On the Statistical Analysis of Computer Performance Test Data

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Abstract

In the context of computer systems, non-functional performance testing tools report externally observed metrics, such as success rates, response times, and throughput rates. However, these metrics may not always provide sufficient information for informed decisions regarding an application's readiness for field deployment, and post hoc analysis of augmented data is often necessary to assess the risks of deployment. Notwithstanding problems regarding the post hoc analyses, the required augmented data may not be available, aligned or suitable for the required analyses.

To address this, conducting performance tests as experimental studies with careful and deliberate designs forming a systematic approach with a defined test plan and analysis method should provide more confidence in any inferences that inform decisions about an application's fitness for field deployment or the reasons for its unsuitability.

By aligning test-system interactions with field expectations, designing test plans, creating and using test data, and collecting physical resource metrics, it is possible to regress offered and successful loads onto resource usage, estimate unit costs, identify bottlenecks and suspected outside interference, and be able to determine changes in unit costs and performance over time.

Rather than relying solely on response time averages, using field expectations to determine milestone loads, and reporting response time estimates with confidence intervals at these milestones, a more accurate assessment of a system's fitness for field deployment can be determined.

This report demonstrates that a more formal and carefully constructed approach to analysing performance and resource metrics from real systems can support more informed decisions and highlight possible issues.

Chapter 1

Introduction

The activity of non-functional testing of computer systems has not changed much with the state-of-the-art more or less as summarised by Vokolos and Weyuker (Vokolos and Weyuker, 1998; Weyuker and Vokolos, 2000). However, what informs the activity of performance testing has seen considerable change in the last couple of decades, and while this study is not concerned with the specific test-system[1] and its configuration, it has become a common feature of some popular performance testing software to include some analysis of the system-under-test, and in turn come to define what the requirements of this analysis are. From the point of view of computer system performance testing, the terminology used in this report is aligned to the common understanding and definitions of the terms as defined in, for example, Jiang and Hassan (2015). Specifically in this work the test-system is configured for performance testing and stress testing, and does not involve performance modelling, but should rather be viewed as performance analysis as it considers the resource data from the components of the system-under-test and the performance data from the test-system, including how they relate to each other. The purpose of the analysis is to inform decisions regarding the preparedness of software, its configuration, or changes in either for field deployment, possible risks that could arise due to the deployment, whether capacity is adequately provisioned for field operation, the ability of the system to recover from outages, and the ability of the system to survive certain failures without impacting users.

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[1]A *test-system* or TS is the collection of software components that interact with an instance of the application system or systems in a test environment, which are in turn referred to as the *system-under-test* or SUT

1.1 Background

There are many choices of test-system, but the primary test-system considered here is Orkhestra (Donaldson *et al.*, 2022a) which models actors (agents in the test-system) using non-deterministic input/output finite state machines, a scheme popular for modelling actors in data communication protocol and protocol stack testing. Examples are the extended finite-state machines (or EFSMs) in the form of input-output FSMs (or I/O FSM) described in Yao *et al.* (1993) or Petrenko *et al.* (1996). The I/O FSM is explicitly the modelling scheme of the formal description technique Estelle (Budkowski and Dembinski, 1987), and implemented in the Protocol Engineering Workbench (Wheeler and Kritzinger, 1992) (although Estelle has been withdrawn as an ISO Formal Description Technique). The I/O FSM model is explicitly and syntactically represented in Orkhestra as it provides, as it does in Estelle, syntactic structures useful for measurement. Figure 1.1 shows the test-system and its driving touch points with the system-under-test[2]. In the Orkhestra I/O FSM models, each I/O FSM abstracts state sufficiently for the control, measurement of functions and their outcomes at an appropriate level for a single actor interacting with the system-under-test. For example, that a user has made a choice amongst several available and requested the purchase of a travel ticket, and is awaiting a response. The choice of business function to execute (purchase a ticket) is a *transition* that is randomly chosen among the available business functions to perform, weighted in the ratio of ticket purchases to other functions, and the *state* of this particular actor is that it is waiting a response to a ticket purchase request, with possible outcomes that determine a possible state exit transition that represents a successful purchase, a business/account reason for failing to purchase a ticket, a time-out waiting a response, or a technical fault.

These I/O FSM models, while simple, can be quite large and are built from various sources, including specifications, inspection of source code, analysis of trace and audit data from the field, analysis of Google Analytics (Cutroni, 2010), Adobe Analytics, and discussions with development teams. Generally a state of interest would represent waiting for a response from the system-under-test or waiting for a timer to expire (or both). think-times and idle-times are implemented using timers, with the state exit transition being signalled by the expiration of the timer. The actual times used in the timers are either constants or are drawn on each occasion using pseudo random number generators for the appropriate distributions, or a sum of constants and random distributions, with both the distribution(s) and their parameters being made available as parameters of the I/O FSM model. This

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[2]*Driving* in the sense of delivering the offered load, and causing activity in the system-under-test, as opposed to the system-under-test reacting to the offered load and, as a result, interacting with the test-system.
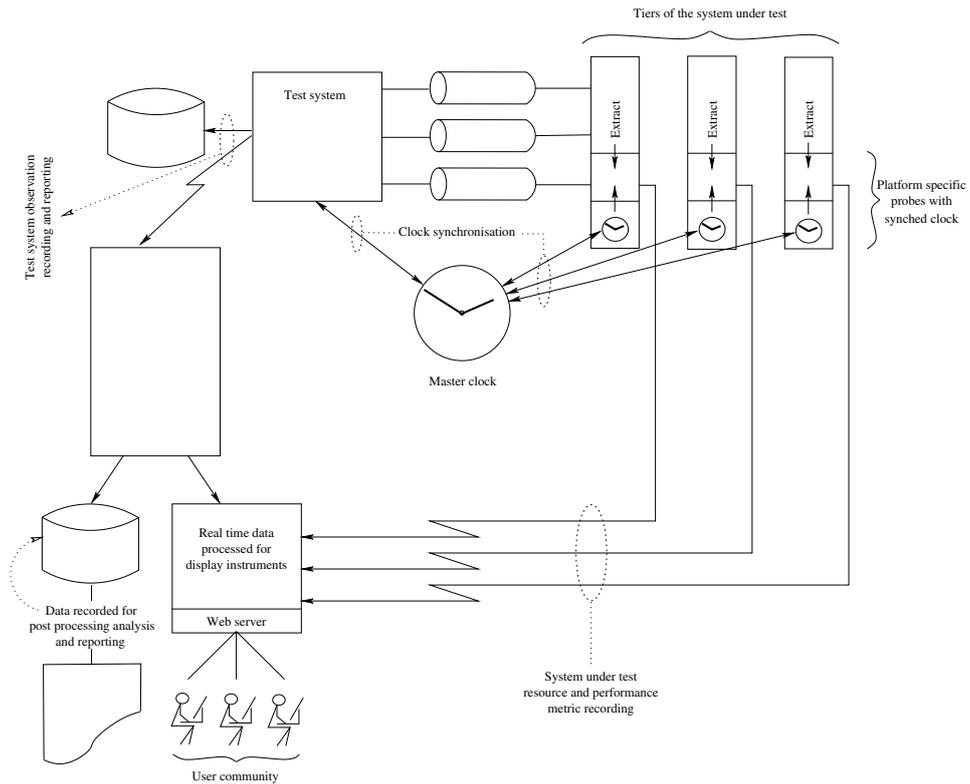
Figure 1.1: Test-system configuration in relation to components of the system-under-test from the perspective of driving the system-under-test. The figure shows the test-system, top-left, orchestrating interaction with the system-under-test, top-right, through the three channels shown, top-centre. The tiers of the system-under-test, shown top-right, include instrumentation which extracts resource usage metrics from the hosting platforms, formulates them as time-series data with synchronised clocks and records these time-series data centrally, shown bottom left. A synchronised clock is also used to formulate time-series data from the test-system and also records these times-series data centrally.

means that the distributions and their parameters can be set by the analysis of customer behaviour as is evident from traces and audit logs from the application in the field by determining estimates of the distributions by kernel density estimation, and then modelling them using various standard continuous distributions, and also means that the model parameters can be revised from time-to-time as customer behaviour changes. Where this is not possible, some reasonable exponential distribution is chosen (often offset, and sometimes truncated).

Not all test-systems impose an explicit I/O FSM model, but it is useful to have a light-weight and efficient overall control or coordination of the tests in order to implement a careful and deliberate design, maintaining a high-level abstract state (the state of interest) separate from the detailed state required to drive meaningful interactions with the system-under-test. The test is conducted under a specific configuration of weights and by the instantiation of concurrent and independent simulations of the I/O FSM models. The number of instances of the I/O FSM models controls the load on the system. At this top level, the simulation of an I/O FSMs provides timing, control and abstract state of a single entity interacting with the system-under-test. The actual state, the concrete or detailed state is maintained in a *control program* which typically is a script that contains application domain detail for successfully and meaningfully interacting with the system-under-test, and which is also responsible for signalling the I/O FSM being simulated in order to advance by providing an input. This control program behaviour is thus responding to the system-under-test, but is also responding to the simulated I/O FSM by, for example, taking direction as output signals from the I/O FSM. Timing, time-measurement, and high-level or abstract states, transitions amongst states, etc. are the responsibility of Orkhestra for driving the simulation of multiple concurrent independent instances of the I/O FSM models. This separation of layers is depicted in Figure 1.2.

On face value, these I/O FSMs are in fact finite state Markov chains (for example, Kleinrock, 1975) as the set of states that can be transitioned to next depends only the current state. However, the sojourn times and the transition between states are not all random. While the simulation of the I/O FSM may draw a sojourn time for a state, which could be a pseudo random variate from a number of distributions, the events (inputs) from the control programs mainly reflect the state of the data of the system-under-test, and the data communications mechanisms used to interact with the system-under-test. Even so, there is some utility in viewing the model as a Markov chain, as for example, aggregating all the paths of the actual flows through the system-under-test from the particular test may prove difficult, but we can determine this from the cycle time through the idle state (a special state representing the period of time that an instance of the I/O FSM is not interacting with the system-under-test), and the rate at which instances leave

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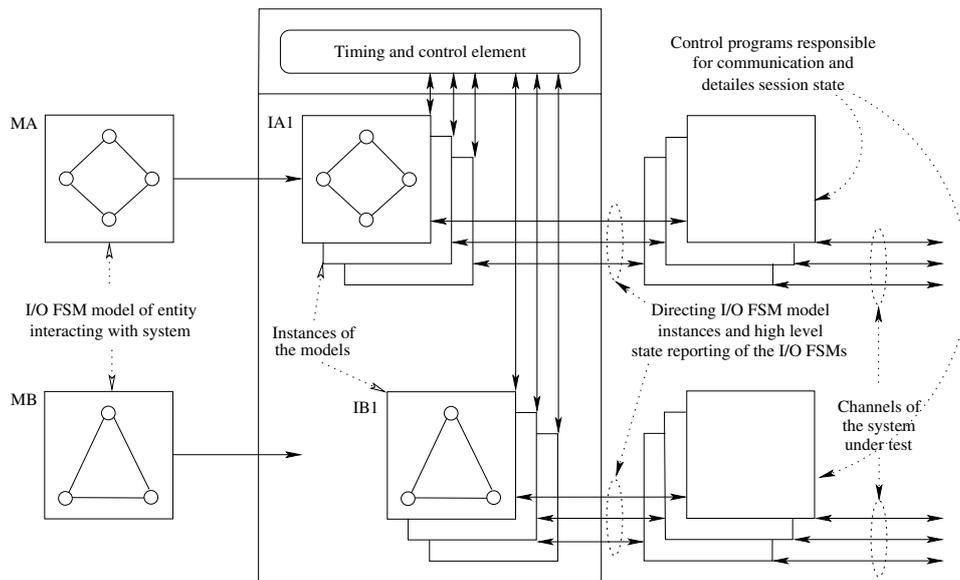
Figure 1.2: Layers of a test-system showing abstract and detailed states from the viewpoint of driving the system-under-test. The figure shows two I/O FSM model definitions on the left-hand-side. In the centre of the figure, these two models are instantiated a number of times and simulated under the control of the timing and control elements of the test-system. The simulation of the instantiations of the I/O FSM models result in signals being passed between the timing and control elements of the test-system as well as tailored components that interact with the system-under-test through its channels, shown on the right-hand-side. The system-under-test is off to the right of the figure and not shown.

this state in order to start interacting with the system-under-test, which can be directly estimated from Little's Law (Little, 1961).

Figure 1.3 illustrates the types of outcomes a chosen business activity or flow might encounter. The figure shows a single business activity flow through the states of an I/O FSM, and indicates that, once selected, it may turn out that the data in hand do not support the execution of the activity. In this case the activity is ignored (transition labelled `IGNORE`) and the flow returns to make another choice. The sojourn time in a state that takes an `IGNORE` exit transition is not representative of the performance of the system-under-test, and these function-outcome (or state-transition) pairs are not taken into account when analysing the performance of the system. However, if their proportions over all transitions exiting the respective states are significant, then this may indicate an issue with the suitability of the test data to support the current test. Should any state in the flow receive an application error, technical error or fault response, depicted in the figure by an `ERROR` transition, then the flow of the business activity is curtailed and flow returns to choose the next business function. In practice, the `ERROR` transitions do not go directly to a state to make another choice amongst the business functions, but rather directs the flow through a general failure state so that the failure rate and the proportion of failures can be measured. If a chosen business flow completes without an error, the `PASS` transition is taken. Again, the flow is directed through a state so that pass rate and the proportion of successes can be measured.

A specific I/O FSM may be quite complicated and difficult to view as a graph. Figure 1.4 depicts a relatively simple real application in which the graph can be graphically interpreted. However, the application considered in this report is significantly larger and graphic depiction of the flows through the system are too cumbersome to be useful.

The paths that form loops through an initial or home node generally depict different business functions; self loops depict iteration of an activity within a business function; and returning loops before the final state of a business function depict visitors not completing or *bailing out* of a business activity. Not shown, but in these graphs the edges are weighted to depict the relative frequency of occurrence, and these weights are used in the model to inform the corresponding business function weights, and bailouts at each stage, and the iteration within each business function (which might be driven by the data in the system-under-test, and hence deterministic, or by weighted random choices with weights determined by the corresponding edge weights).

The weights amongst various choices, implemented as non-deterministic inputs to drive the I/O FSM out of a state into a randomly chosen state representing an actors choice, are also determined by the analysis of field data, and where this is not available, by marketing assumptions or analysis
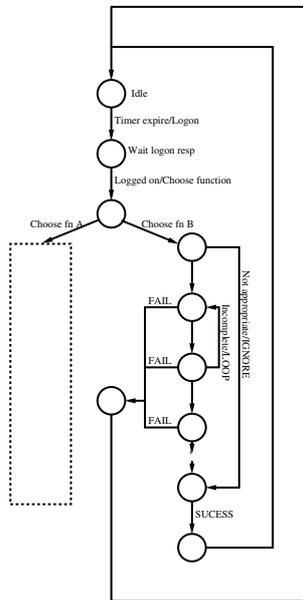
Figure 1.3: Illustrative example of an I/O FSM portion showing function success, ignore and failure bail-out arcs forming cycles. The dotted rectangle in the figure depicts other business functions which may be chosen, but whose detail is not shown. The details of the business function on the right-hand-side are illustrative of flows through the I/O FSM, and depict successful attempts at a business function by emerging at the bottom, and unsuccessful attempts at a business function, indicated by failures within the flow.
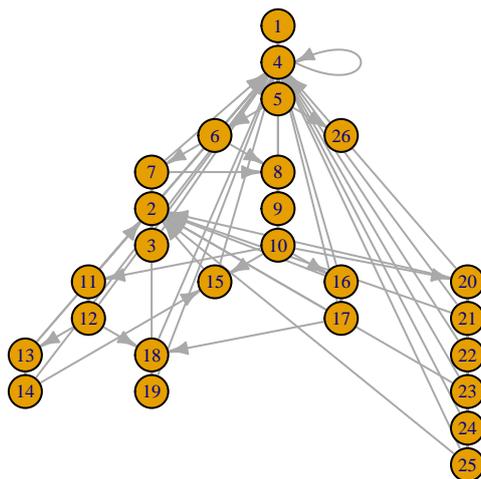
Figure 1.4: Example of graph of an I/O FSM for a real yet relatively simple application.

of the popularity of a feature. These weights are also exposed as parameters to the I/O FSM model and hence can be revised or changed depending on changes in customer behaviour, either over time or because of certain events (for example, to model the impact of campaigns, system outages, etc.).

While the bailouts and their extent are clear from an inspection of the of the Google or Adobe analytics, they are undesirable as they represent attempts at performing a function (using resources), but not completing a transaction (not producing any benefit), and likely resulting in some frustration. These problems are addressed separately, with better labelling of available functions and better customer experience in using the functions. In practice, the tests have minimal bailout and reducing the time spent in a function from a Coxian-like behaviour to more of an Erlang-like behaviour. Hence, if a function starts, it is expected to complete with its intended outcome and any other outcome is treated as a failure, and reported as such. This assumption significantly reduces the number of transitions in the model.

There are also non-driving interactions which originate from the system-under-test, and which in the field, would be requests to third-parties involved in the fulfilment of requests made to the application system. In most cases, these third-parties cannot participate in the tests to an appropriate level and should not be considered part of the system-under-test. In these cases, these third-parties are simulated with components that are also considered components of the test-system, but not integrated into the driving component of the test-system since they are not required to be synchronised with the driving system components and act independently of any other component of the test-system. These simulations typically involve processing requests from the system-under-test, and respond in a well-behaved manner with configured response time distributions modelled on information provided or observations of the third-parties from the field.

1.2   Test execution

Execution of a test results in the test-system yielding performance data and the monitors of the system-under-test yielding resource utilisation data. Focus is on physical resource usage such as physical CPU usage and network bandwidth usage. For the tests considered here, the stream of performance metrics from the test-system and the streams of resource usage metrics (one per server/appliance in the landscape being monitored) are synchronised with a master clock as depicted in Figure 1.1 (whether or not the individual server/appliance clocks are already synchronised). A test progresses by incrementally and in a synchronised manner (relative to the same master clock) increasing the number of independent actors all behaving in a manner dictated by a model of one of the I/O FSMs. The effect of this is to

periodically increase the offered load on the system, with the throughput and successful load being measured and recorded in synchronised intervals by the test-system (including the outcome of each function). The interval of time that the offered load is held constant is referred to here as the *load interval* or *step load interval*. In an ideal world and by careful arrangement of the application data of the system-under-test and planning the exclusive use of the system-under-test, the outcomes expected would be 100% successful. If this is the case and there were no material and erratic non-test-system usage or influence on the servers and appliances of the system-under-test, then a regression of the individual server and appliance resource usage onto the successful load would yield, as regression coefficients, some measure of the background activity of the servers and appliances that is independent of the successful load together with some estimate of a confidence interval (using the corresponding fitted models intercept estimates and standard errors), and some measure of the resource cost per *average* business function (using the estimated coefficients of the successful load of corresponding fitted models and their standard errors).

If a test is executed as a performance test (as opposed to a load or stress test), then a primary objective is to determine the response times and whether the throughput rate can achieve a certain level. The best response times and best throughput rates do not in general coincide at the same successful load, and hence certain objectives of specified throughput rates need to be known in advance. The expectation of the peak load on a software system in the field is not necessarily constant over time, and often there is a throughput rate that the system is expected to be able to support in the short term in order to be deployed into the field, and there is a throughput rate that is anticipated to be supported within the budget cycle of the capacity provisioned. The first required throughput rate level (referred to here as the first milestone) is the throughput rate that the system-under-test is required to demonstrate with acceptable response times and successful outcomes in order to support a decision to deploy (together with other functional and non-functional requirements). The second milestone, should the first be reasonably surpassed then becomes a further objective of the test, and is used to determine whether the longer term capacity provisioned is sufficient or would need to be adjusted in the near future. This milestone is aligned to the budget cycle and the capacity determined to be required within the current cycle. Hence, failure to achieve milestone one with acceptable response times and acceptable success rates would be considered a failure of the performance test.

Figure 1.5 shows a graph of the number of instances of an actor from a real test (the number of instances of an actor is directly proportional to the offered load), and Figure 1.6 shows a graph of the corresponding throughput achieved in terms of number of customers completing a session with the

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system per second. For this test, Figure 1.6 shows that the first milestone was not quite met and that the behaviour of the system became quite erratic as the offered load increased further. This is often an indication of saturation of a component in the application landscape.
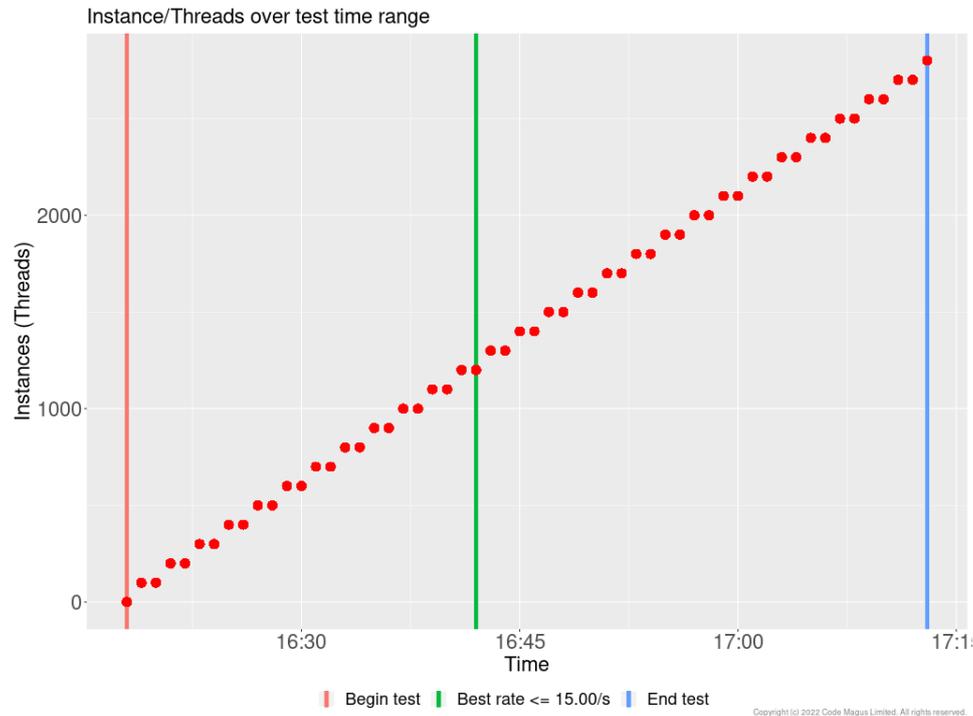
Figure 1.5: Offered load represented by number of actors or instances of the I/O FSM model interacting with the system-under-test. The number of instances is the number of independent I/O FSM models being simulated by the test-system. In a test plan, the increments in the number of independent I/O FSM models being simulated occur at precisely timed boundaries (typically every 120 seconds). During these load intervals where the number of instances being simulated is held constant, these instances correspond to the offered load against the system-under-test for the load interval duration.

1.3 Software tooling

Orkhestra is not the only possible tool that could be used as the test-system, but aside from its implementation of the I/O FSM as system models, familiarity with the software and readily available scripted systems for used as the system-under-test, and the availability of the data from these tests, make it a good choice. Other popular performance testing software tools are Jmeter (Erinle, 2017; Halili, 2008), Load Runner (Khan and Amjad, 2016; OpenText LoadRunner professional, 2024), K6 (Kravchenko *et al.*, 2023), and Neoload (Tricentis neoload for enterprise performance testing, 2024),
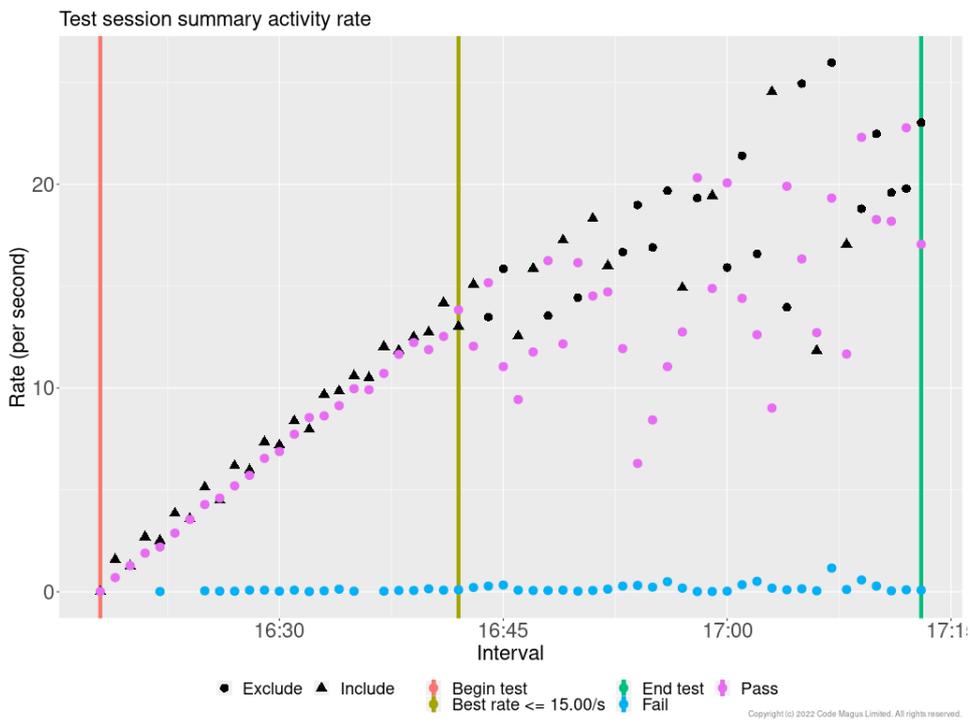
Figure 1.6: Successful load and breakdown into functionally completed and functional failures. Corresponding to the offered load, and rate at which instances exit the idle state, which under a steady state is governed by the number of instances and the mean sojourn time in the idle state, the rate at which business functions are successfully completed is expected to match the arrival rate in each load interval for which the system-under-test is in a state of control. The figure shows that this is reasonably the case in this example up to the point where the customer arrival rate reaches approximately 15 customer arrivals per second.

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amongst others, and for which there are a number of comparisons in the literature (Kravchenko *et al.*, 2023; Saharan *et al.*, 2018; Thakur and Bansal, 2015; and Chandrasekhar and Chandran, 2021). All performance testing tools will report on response times, and most will allow arbitrary function calls within their respective scripting environments in order to maintain response time metrics by outcome (i.e, that the function/request invoked succeeded as expected or had some other, unacceptable, outcome).

While some software performance testing tools include the ability to consume data provided by agents, these typically only cater for one or a few platform types. One candidate with widespread coverage, which is fairly ubiquitous is DynaTrace's OneAgent (OneAgent, 2024). However, the resolution and timing of the resource data collection needs to be tightly synchronised with the timing and metric collection from the test-system as these will form the respective response and predictor values of the observations to which linear models will be fitted. Again, familiarity with the source code, and these synchronisation and timing requirements, the probes used to sample the resource data across many platforms and deliver the data in a common format are as follows: `cmlxsnmp` (Donaldson *et al.*, 2009a) samples performance data from servers and appliances supporting SNMP performance MIBs (Mauro and Schmidt, 2005), and uses Net-SNMP (Burger), `cmlxaicp` (Donaldson *et al.*, 2009b) samples AIX performance data using the `PerfStat` API (Perfstat API programming — ibm.com), `cmlxwinp` (Donaldson *et al.*, 2009c) samples Windows performance data using the Microsoft PDH function (Karl-Bridge-Microsoft), `cmlxsolp` (Donaldson *et al.*, 2009d) samples Solaris data using `libkstat` API (Kstat - man pages section 3: Extended Library Functions, Volume 2 — docs.oracle.com), `cmlxlinp` (Donaldson *et al.*, 2020) samples Linux performance data using the `proc` file-system (The /proc Filesystem —The Linux Kernel documentation — docs.kernel.org), `cmlxrmfp` (Donaldson *et al.*, 2022b) samples MVS RMF performance data using the `ERBSMFI` interface to RMF (Obtaining Monitor II SMF record data directly (ERBSMFI) — ibm.com), and `cmlxdynp` (Donaldson *et al.*, 2024a) samples DynaTrace collected data using the DynaTrace REST API (Dynatrace API — docs.dynatrace.com).

Chapter 2

Methods

From the viewpoint of the customer organisation, and not withstanding the issues of preparing, conducting, and reporting on tests, the problem is one of logistics. The window in which a decision is required as to whether a deployment into the field is acceptable or not is very narrow. Hence in a short period of time, a report needs to be produced which informs this decision, and thus a pipeline of an efficient data-preparation-analysis-reporting process is required. In addition, reports should be both consistent in style, coverage, and analysis across multiple tests (whether they be of the same application or multiple applications), and in which pertinent facts are are as succinctly presented as possible.

Large and complex systems-under-test (for example the application considered here) could span landscapes of many servers and appliances of different platform types and application stacks, and with functions supported by different clusters of these servers[1]. The system considered here comprises of over 360 servers and appliances making up approx 120 clusters. With both the test-system and the instrumented servers and appliances of the system-under-test producing data for the duration of a test session, the analysis is required to process a significant amount of data within a short period of time to produce meaningful reports.

For this project, the analysis is arranged into a pipeline, which includes phases of preparation of the data, analysis and reporting, running aspects in parallel where possible as well as caching the prepared data for faster downstream access. It is not uncommon for a test session to generate from 50 million to 100 million observations from both the test-system and the system-under-test. The pipeline scripts are all written in R (R Core Team,

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[1]The term *cluster* refers loosely to a group of servers processing requests off the same queue or end-point in a loosely coupled manner, mostly without sharing resources except the network interconnect.

2024) with the reporting produced using R Markdown (Xie *et al.*, 2018).

Except for a few cases, most clusters have at least two servers with an average of about three servers, and a maximum of about 15 servers. The test environment has been provisioned at considerable expense, but always shares infrastructure to support elements in the field. Consequently, the periods that the environment is available for performance testing are limited, and in great demand. This is one reason why concurrent testing needs to be considered in the available time, but there are more practical reasons too. In the field, the applications coexist in the landscape to support real customers going about their business, and even though these application systems support disparate functions, they use components that are common and shared. To gain confidence that the field workload will be supported at required levels it would be better to demonstrate the applications operating together as part of a test. However in order to be able to resolve the impact of certain functions and applications on the infrastructure or on each other some degree of control and orchestration of the testing activity is required.

Even when there is control, a more robust analysis of the performance and resource metric data is warranted as there are effects that go unnoticed in the test environment or inadvertently or purposefully overlooked, allowing flawed applications and changes to be deployed into the field. This is not necessarily because the analysis is flawed, it might simply be that the presentation of the results do not make the risks clear, or do not report on the specific portion of the range of the test that is meaningful, or that validly report on metrics that have little to do with the stability or risks of current technology. One example of misused metrics for stability is concurrency. In the systems considered by Vokolos and Weyuker (Vokolos and Weyuker, 1998), depending on the nature of the system, concurrency could either mean the number of users on whose behalf the system is actively completing requests for, or could mean the number of users on whose behalf the system is holding resources for and who *could* ask the system to do something (number of logged on user). More recently, a *logged* on user has very few or no resources held by the system with even the context in a flow not being held in the system (pseudo conversational systems have very low concurrency in the former sense, yet attain very high transactional throughput rates). Therefore, the number of individuals *able* to interact can be made arbitrarily large without demanding much resources being allocated to executing functions of the system. Unfortunately, the misunderstood terminology is common and enshrined in service level agreements, and thus there are occasions where the supposed measure of quality does not actually say anything about quality or performance or availability.

Another example is that business is interested in volumes (because that is directly proportional to revenue) whereas engineers are (or should be)

interested in peak rates and behaviour under extremes. When engineers ask what the system should be capable of, the answer comes back as the expected volumes per time period (for example per month), since there are orders of magnitude in the differences between the active periods and less active periods of a day, it is simple to choose a denominator to demonstrate the *volumes*. Doing so leads to a false security about the system-under-test. To resolve this, where it has not been possible to extract the peaks rates, logs of systems of similar customer behaviour or driven in a similar user pattern are analysed, with a view of determining their peak periods, and the proportion of this to the volume over the entire period (for example, peak half hour volume as a proportion of the total volume for the month). With agreement, this proportion is applied to the volumes provided for the system in question. If consensus is reached on the method and agreement on the implied peak, this is then used to establish *the first milestone rate.*

Here we want to take a more engineering centric view of the performance of the system, whilst maintaining a dialogue with the consumers of the reports and the owners of the system. In doing so, we need to raise risks that are real, and report on the performance at ranges of throughput rates without being too far out of the ranges of loads that will be expected in the field, but at least somewhat above the margin of error in the formal or informal peak rates communicated, observed, or derived.

The tests considered are for a customer of considerable maturity, so it would be relatively easy to engage the relevant team, in both changing the behaviour in the preparation, execution, analysis, and reporting.

2.1   Linear regression

The bread and butter analysis tool used in this project is the simple linear regression or SLR (see, for example, Neter *et al.*, 1996). Consequently, the statistical models of interest are

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\begin{aligned}
y_i &= \beta_0 + \beta_1 x_i + \epsilon_i \\
\text{and } y_i &= \beta_1 x_i + \epsilon_i \\
\text{where } x_i &\quad \text{are the predictor variable values} \\
y_i &\quad \text{are the response variable values} \\
\epsilon_i &\quad \text{are the errors, and } \epsilon_i \stackrel{\text{iid}}{\sim} N(0, \sigma^2) \ .
\end{aligned}
$$

The underlying physical process dictates which linear model is appropriate. Where this process dictates that a direct proportional relationship holds between the predictor variable and the response variable applies, then a linear model through the origin is appropriate. In those situations in which the response variable may depend on more than just the observed predictor

variables then a linear model with an intercept term is more appropriate. The assumptions, which should be checked, is that this interference is captured, and that in both cases, the error terms are normal, independent with zero mean and constant variance.

By the desirable properties of the system-under-test at hand, and with a careful and deliberate design and execution plan, certain assumptions are expected to hold. The analysis needs to assess these assumptions and to report where these have failed, including reporting any remedial actions taken in order to address any simple linear regression diagnostics. It is not appropriate to take a remedial action such as the removal of an observation without reporting this, and getting assurance that exclusion is a genuine out-of-control state of the system-under-test, and that the assignable cause is not considered a system-under-test issue.

The model assumptions align with desirable properties of the system-under-test, and hence the respective hypothesis of the SLR diagnostics are included in the inferences about the behaviour of the system-under-test. Testing the hypotheses is based on the fitted model in terms of the estimated parameters $\widehat{\beta}_0$, $\widehat{\beta}_1$, the residuals $r_i = y_i - \widehat{\beta}_0 - \widehat{\beta}_1 x_i$ (for $i = 1, \ldots, n$), and the standard errors of the fitted parameters $\text{SE}(\widehat{\beta}_0)$, and $\text{SE}(\widehat{\beta}_1)$. This study does not seek to find an appropriate model to fit to the data, instead the model is expected if the system-under-test has the required properties. Thus, provided sufficient clean observations are collected from an experiment, and any unsuitable observations can be attributed to causes outside of the system-under-test, then testing the model assumptions is a test of the nature of the system-under-test. These SLR model assumptions are:

1. *Linearity:* A linear relationship is expected to exist between the predictor variable and the response variable. The purpose is not to look for a model that fits the data, it is expected by the nature of the system-under-test that a linear model exists for some of the cost metrics (represented by Y) of some subsets of the infrastructure (the *Clusters*) and the successful load on the system-under-test (represented by X). Thus a diagnostic test on the linearity assumption is a test of a desirable property of the system-under-test.

2. *Independence:* The design of the test, and the nature of the test plan, should ensure that the observations are independent. In some situations the metrics available for a resource of interest are smoothed values over long periods (relative to a step load interval). For example, the CPU usage resource for a particular platform may only be available as 5 minute average values, or they may only be available as exponentially smoothed values. In these cases, a careful design and test plan can mitigate the nature of these metrics, either by ensuring the applied load at particular step values exceeds these intervals, or that the metrics

are allowed to settle at each load and only the settled values taken as observations. For the current report it is assumed that the test plan has step/load lengths of suitable duration and that the tests are properly carried out according to this plan. The independence of the observations ensures that the error terms are not correlated.

3. *Homoscedasticity:* The variance of the errors should be consistent across the values of the predictor values. From a diagnostic viewpoint the residuals r_i (for $i = 1, \ldots, n$) should be scattered evenly about zero. Further, the design of the test (length of intervals at particular loads, size of jumps in offered load between intervals, etc.) should be such that the residuals are not expected to be excessive since the predictors are averaged over reasonably long intervals (by design) to allow the process to settle at each load level. Even so, the customer arrival process to the system-under-test is approximately Poisson with rate parameter λ, Pois(λ), and hence with variance λ, thus the arrival error is expected to increase with increasing load levels. This claim about the arrival process is based on the fact that the process is governed by a large number of customers in the system, each with idle-time (time waiting to interact with the system) independently exponentially distributed with the same parameter. However, these errors are mitigated by regressing the resource usage onto the average customer arrival rate for each load interval, and not the total number of available customers at each load level.

4. *Normality of Errors:* The model assumes the errors are independent and identically distributed $N(\mu, \sigma^2)$. This assumption is important in this project as we are not only fitting a model to describe the relationship among the predictor and response variables, but that the coefficients have a physical interpretation, and that in some cases the estimates are required to be not too far from their expected values according to the design of the experiment and setup of the environment of the system-under-test. To test these hypotheses, inferences about the coefficients are used, these inferences are based on t-tests, which assume an underlying normal population. The assessment of this assumption will also be defeated if the execution of the experiment results in too few usable observations.

Where these assumptions are met, even if reasonably approximately, control charts (see, for example, Montgomery, 2020) can be used to track the estimates of the parameters over repeated executions of the tests to ensure that the system-under-test has not moved to an out-of-control state. Possible control charts for consideration are the X-bar chart to monitor the parameter estimates over time, and S-bar charts to monitor the standard errors of the estimates over time.

The linear model is fitted by minimising the least-squares of the residuals or

error terms

$$\min_{\beta_0,\beta_1} \sum_{i=1}^{n} r_i^2 \;=\; \min_{\beta_0,\beta_1} \sum_{i=1}^{n} \left(y_i - (\beta_0 + \beta_1 x_i)\right)^2.$$

Minimising $\sum_{i=1}^{n} r_i^2$ minimises the sum of the squares of vertical separation of the fitted regression line and the responses. It can be shown that the least squares values or estimates $\widehat{\beta}_0$ and $\widehat{\beta}_1$ for the parameters β_0 and β_1 satisfies

$$
\begin{aligned}
\widehat{\beta}_1 &= \frac{\sum_{i=1}^{n}(x_i-\overline{x})(y_i-\overline{y})}{\sum_{i=1}^{n}(x_i-\overline{x})^2} \\[2ex]
&= \frac{\left(\sum_{i=1}^{n} x_i y_i\right) - n\overline{x}\,\overline{y}}{\left(\sum_{i=1}^{n} x_i^2\right) - n\overline{x}^2} \quad && \text{by expanding the numerator and denominator expressions} \\[2ex]
\text{and } \widehat{\beta}_0 &= \overline{y} - \widehat{\beta}_1 \overline{x} \\[1ex]
\text{where } \overline{x} &= \frac{1}{n}\sum_{i=1}^{n} x_i && \text{the sample mean of the } x_i \\
\text{and } \overline{y} &= \frac{1}{n}\sum_{i=1}^{n} y_i && \text{the sample mean of the } y_i \\
\text{the short hands } S_{xx} &= \sum_{i=1}^{n}(x_i-\overline{x})^2 \\
S_{yy} &= \sum_{i=1}^{n}(y_i-\overline{y})^2 \\
S_{xy} &= \sum_{i=1}^{n}(x_i-\overline{x})(y_i-\overline{y}) \quad && \text{are used.}
\end{aligned}
$$

The slope of the regression line represents the unit increase of the response for a unit increase of the predictor, and hence when regressing resource usage onto load, in terms of customer arrivals per second, represents an estimate of the unit cost of a single customer arrival per second.

Ordinarily, the intercept term is deemed to have no intrinsic value citing, among other reasons, that predicting the response at zero is outside of the context of the problem at hand, or that the range of predictors excludes zero and that predicting outside this range is problematic. This is not the case with the problems considered here, and it is indeed the fact that observations where the predictor value is at or near zero are collected and that this makes sense in the current context. For example, the resource usage at zero load (number of customer in the system is zero) represents the usage of the servers that is independent of the test load. Ideally, this is not interference from another load on the same system-under-test (depending on how that is

controlled, this would invalidate the current test), but rather the resource usage attributed to the overhead processing of the system, or it may represent resource usage of other applications co-hosted on the infrastructure and in which case, if this load is not smoothly controlled (i.e. held constant through the time frame of the current test), would end up invalidating the test.

If the error terms ϵ_i for $i = 1, \ldots, n$ are to be normally distributed independently and identically $N(0, \sigma^2)$ or equivalently, the y_i values are normally distributed for each level of the predictor, then the least squares estimates of the parameters are also normally distributed, with the respective sampling distributions estimated using the standard errors.

$$
\begin{aligned}
\text{If } s \ &= \ \sqrt{\frac{S_{yy}}{n-2}} \qquad \text{is the standard error of the regression} \\
\text{then } \text{SE}(\widehat{\beta}_0) \ &= \ s\sqrt{\frac{1}{n} + \frac{\overline{x}}{S_{xx}}} \\
\text{and } \text{SE}(\widehat{\beta}_1) \ &= \ \frac{s}{\sqrt{S_{xx}}}.
\end{aligned}
$$

For certain clusters, claims are made about the load being balanced across the members of the cluster. By fitting linear models regressing the cluster load onto the observations of the resource usage levels on each of the cluster members, inference on respective β_1 parameters can be used to determine if there is a significant deviation from a balanced load. For example, if it is claimed that load balancing should exist for the members of a cluster, and that the expected metric value for the cluster is the sum of the metric measures of each of the members, then under the null hypothesis, H_0, that the load is balanced across the cluster members, we have that

$$
\begin{aligned}
H_0 : \beta_1 &= k \quad \text{where } k \text{ is the number of members in the cluster} \\
\text{versus } H_1 : \beta_1 &\neq k
\end{aligned}
$$

and that hypothesis H_0 holds true for each member of the cluster. A test for H_0 can be determined from the test statistic

$$
\begin{aligned}
t^* \ &= \ \frac{\widehat{\beta}_1 - k}{\text{SE}(\widehat{\beta}_1)} \\
\text{which under } H_0, \quad t^* \ &\sim \ t_{n-2} \qquad \text{if the normality assumption holds.}
\end{aligned}
$$

Thus to test whether or not to reject H_0, the two-sided test can be performed on each of the k t^*-test statistics against the corresponding significance levels of the t_{n-2} distribution. The null hypothesis, H_0, is rejected if $|t^*| > t_{n-2,\alpha/2}$, the critical point on the t_{n-2} distribution at the significance level α.

There is an expectation that the overhead of a server, in terms of CPU resources consumed, as a percentage of the provisioned resources should not exceed some reasonably low percent, such as 5% or 10%, denoted by l (for limit). Under the normality assumption, inferences on β_0 may be useful in determining whether or not the background resource usage significantly exceeds this value (at the server or cluster level). If a model is fitted, regressing the cluster CPU resource usage onto the customer arrival rate, then for the null hypothesis that the background load does not exceed the expected limit, we have

$$H_0 : \beta_0 \leq l \text{ versus } H_1 : \beta_0 > l$$

A test of the hypothesis can be determined from the test statistic

$$t^* \quad = \quad \frac{\widehat{\beta}_0 - l}{\text{SE}(\widehat{\beta}_0)}$$

Under $H_0 : \beta_0 = l$, test statistic $t^* \sim t_{n-2}$. Thus a one sided test establishes that there is evidence to reject H_0 at the given α level of significance if $t^* > t_{n-2,\alpha}$, the critical point on the t_{n-2} distribution at significance level α.

When performing an SLR in this report, in addition to tabulating the intercept and slope estimates, with their respective standard errors, t-statistics, and corresponding p-values, the coefficients of determination or R^2 values and the F-statistics with their respective degrees of freedom, and p-values are also included.

$$
\begin{aligned}
R^2 \quad &= \quad 1 - \frac{\sum\limits_{i=1}^{n}(y_i - \widehat{y}_i)^2 / n}{\sum\limits_{i=1}^{n}(y_i - \overline{y})^2} \\
&= \quad 1 - \frac{\text{SSE}}{\text{SST}} \\
\text{where} \quad \text{SSE} \quad &= \quad \sum\limits_{i=1}^{n}(y_i - \widehat{y}_i)^2 \qquad \text{is the residual sum of squares} \\
\text{SST} \quad &= \quad \sum\limits_{i=1}^{n}(y_i - \overline{y})^2 \qquad \text{is the total sum of squares} \\
\text{and} \quad \text{SSR} \quad &= \quad \sum\limits_{i=1}^{n}(\widehat{y}_i - \overline{y})^2 \qquad \text{is the regression sum of squares} \\
F^* \quad &= \quad \frac{\frac{\text{SSR}}{1}}{\frac{\text{SSE}}{n-1}}
\end{aligned}
$$

Under the null-hypothesis $H_0 : \beta_1 = 0$, $F^* \sim F_{1,n-2}$. The null-hypothesis asserts that there is no linear relationship between the predictor and the response variable. The R^2 value is a measure of the proportion of the variance

in the response variable that is explained by the predictor variable under the fitted model.

In practice, and for the sequel, the linear models are fitted using the R function `lm`. This is for both regressions through the origin and for those for which an intercept parameter should be estimated. The regression models are then used to predict the respective resource usage at each of the milestones. This is done at various levels of aggregation, but if any of these predictions, at either milestone, exceeds the capacity provisioned for the respective resource, then attention is drawn to this in the reporting. Further, if at the first milestone the estimated resource used exceeds the capacity provisioned, then the test is not considered a success.

2.1.1 Assessment of assumptions

To test whether the errors are reasonably $\epsilon_i \overset{\text{iid}}{\sim} N(0, \sigma^2)$, $i = 1, \ldots, n$, where σ^2 is not known (but common across the errors), that is, $H_0 : \epsilon_i \sim N(0, \sigma^2)$, the set of residuals, r_i, of the fitted model estimates and the predictors, are tested using the Shapiro-Wilk test of normality (Shapiro and Wilk, 1965), also Ugarte *et al.* (2015). The Shapiro-Wilk test statistic is computed from the uncorrected sample variance, and the square of the weighted sum of the distances between the most extreme pair of order statistics of the sample to the least extreme pair of order statistics of the sample. In practice, and in the sequel, the test statistics W and corresponding p-values are computed using the R function `shapiro.test` on the standardised residuals.

If $r_{(1)} \leq r_{(1)} \leq \cdots \leq r_{(n)}$ are the order statistics of the residuals,

$$
\begin{aligned}
\text{and } S_u^2 &= \frac{1}{n} \sum_{i=1}^{n} (r_i - \bar{r})^2, \text{ the uncorrected sample variance} \\
\text{where } \bar{r} &= \frac{1}{n} \sum_{i=1}^{n} r_i \text{ is the sample mean of the residuals} \\
\text{then if } b &= \sum_{i=1}^{\lfloor \frac{n}{2} \rfloor} a_{n-i+1} \left(r_{(n-i+1)} - r_{(i)} \right) \\
\text{where } a_i &= \text{ are the weights} \\
\text{then } W &= \frac{b^2}{nS_u^2} \text{ is the test statistic}
\end{aligned}
$$

The weights a_i, $i = n - \lfloor \frac{n}{2} \rfloor + 1, \ldots, n$, and the critical value K for W are tabulated in Shapiro and Wilk (1965) such that the critical region under $H_0 : \epsilon_i \sim N(0, \sigma^2)$ is given by $P(W \leq K) = \alpha$ for the significance level α. The Shapiro-Wilk test is known to be conservative, resulting in reduced Type I Errors, that is, a lower chance of incorrectly rejecting the null-hypothesis, H_0 : the residuals are normally distributed. However, the Shapiro-Wilk test

is useful for testing for normality when the sample size is small, which is the case for the present analysis (Ugarte *et al.*, 2015).

2.2   Local regression

It is common practice to provide point estimates of response times that are the sample averages of the response times of the individual function calls, typically constrained to the range over which the load is at least what is expected in the field, but not significantly over this. This tends to under-estimate the response times for the portion of the load that matters to users (at peak loads or loads at the first milestone level). By dividing the sum of all response times by function call by the number of calls to that function, we at least get a weighted response time. The danger is that response time degradation is not linear when resource capacity becomes exhausted, still leading to an under-estimate as the milestone is reached. It would be better to report the response times at the milestone as this would reflect the performance in the field at the milestone rate, and an expectation that at lower rates, an improved response times will be observed. Generally, the response times versus customer arrival rate graphs show some form of capacity saturation process at play, with an ever increasing decay of response times as the load increases. Thus, generally, if in the field the first milestone is not exceeded, then the response times at the first milestone are worst-case response times. In general it is difficult to determine the saturation model at play, and hence local regressions are considered instead, and then for each function the response times at the first milestone load are predicted together with their corresponding standard error.

Even if it were practical or possible to model response times with suitable saturation models, the number of models required would make this task infeasible. This is due to the large number and variety of configurations of clusters that make up the landscape that host the system-under-test. Instead, local regressions models are fitted to the response time observations, regressing the observed response times onto the customer arrival rates. Then, provided the test exceeded its first milestone in a manner determined to have high-quality observations, and which are not considered outliers with respect to the offered load to successful load relationship, the fitted local regression model is used to estimate the response times at the first milestone. These local regression models are fitted to all function metrics with good outcomes, and includes standard errors of the estimates. Even if the behaviour of the function at the interval that is considered to have achieved the first milestone is itself an interval of relatively poor quality, an estimate is still possible as the local regression smooths over the observations on either side of the poor quality observation. Although computationally intensive, here we are only looking for an estimate of the y values corresponding to one x value, and

the local regression has the advantage of capturing complex patterns in the relationship between the predictor and the response variable.

$$y_i = g(x_i) + \epsilon_i$$

The local regression (see, for example, Cleveland *et al.*, 1992) fits the model at the point of interest, say x_m, by estimating the function $g(x)$ by $\widehat{g}(x)$ by fitting a quadratic locally weighted least squares using the weights $w_i(x_m)$ for the observations (x_i, y_i) where

$$
\begin{aligned}
w_i(x_m) &= T(\Delta_i(x_m), \Delta_{(q)}(x_m)) \text{ where } T \text{ is the tricube weight} \\
& \text{function:} \\
T(u, t) &= \begin{cases} (1 - (u/t)^3)^3 & \text{for } 0 \leq u < t \\ 0 & \text{for } u \geq t \end{cases} \\
\text{and} \quad \Delta_i(x_m) &= |x_m - x_i| \\
\Delta_{(q)}(x_m) &= \text{the distances ordered from smallest to largest} \\
q &= \lfloor \alpha n \rfloor \\
\text{and} \quad 0 < \alpha \leq 1 & \text{where } \alpha \text{ is the proportion of the predictors in the} \\
& \text{neighbourhood of the predictor for which an} \\
& \text{and estimate is required.}
\end{aligned}
$$

The locally weighted regression is fitted by minimising the weighted sums of squares:

$$
\begin{aligned}
L_W &= \sum_{i=1}^{n} w_i(x_m)(y_i - \mathbf{x}_i^T \boldsymbol{\beta})^2 \\
\text{where } \mathbf{x}_i^T &= \begin{bmatrix} 1 & x_i & x_i^2 \end{bmatrix} \\
\text{and } \boldsymbol{\beta}^T &= \begin{bmatrix} \beta_0 & \beta_1 & \beta_2 \end{bmatrix}
\end{aligned}
$$

The local regression estimate at x_m is

$$\widehat{g}(x_m) = \widehat{\beta}_0 + \widehat{\beta}_1 \cdot x_m + \widehat{\beta}_2 \cdot x_m^2$$

A standard error of the estimate can be determined from the weighted sums of squares of the residuals and the number of observations, n:

$$\text{SE}(\widehat{g}(x_m)) = \sqrt{\frac{1}{n-2} \sum_{i=1}^{n} w_i(x_m)(y_i - \widehat{y}_i)^2}$$

In practice though, and in the sequel the local regression models are fitted using the `loess` function in R. This function returns the degrees of freedom

as well as a model object from which estimates can be returned using the `predict` function. In the sequel, the default for the degree parameter (`degree = 2`) for polynomial fitting, and the default for the `span` (α value) of 0.75 are used. See also Hastie *et al.* (2009) and James *et al.* (2021).

2.3   Non-parametric bootstrap testing

Ideally, more complete information about the distributions underlying the response times at the first milestone and resource usage regression coefficients would be useful when determining whether the corresponding values from the current test are significantly different to those determined from prior tests. For the data at hand, and the lack of specific parametric distribution details, tests such as the *t*-test are not feasible as the *t*-test requires the determination of a pooled sample variance for which the underlying individual values are not available. Instead, non-parametric bootstrap tests are performed to determine test statistics from the empirical distributions and estimate *p*-values, thus comparing the current estimates against estimates from prior tests. The empirical distribution of a sample $\mathbf{x} = \{x_1, x_2 \ldots, x_n\}$ is the function $\widehat{F}$ computed as follows

$$\widehat{F}(x) \;\;=\;\; \tfrac{1}{n} \sum_{i=1}^{n} I(x \le x_i) \quad \text{the proportion of the sample values less than}$$
$$\text{or equal to } x.$$

The bootstrap estimates a test statistic by repeatedly resampling from the supplied sample (that is, sampling with replacement), computing a test statistic on each of the resamples. If the assumptions hold, the statistics of the resampled values provide an estimate of the variability within the population. See, for example, James *et al.* (2021) or Ugarte *et al.* (2015).

The bootstrap method is relatively simple and applies to many test statistics, such as the mean, median, quantiles, the variance, and confidence intervals. A *p*-value estimate is possible by comparing the computed statistic on the given sample to the computed statistics to the bootstrap samples.

There are few assumptions for the bootstrap, and these can reasonably be assumed to hold in the present case:

1. The given sample is representative of the population. For the current task, it may be the case that estimates from prior tests that are deemed to be failures are removed from the sample. If this means removing those response times and resource usage estimates that are considered to be excessive, then this should reduce the variance among the remaining estimates, making the the confidence intervals narrower. If this pruning

process is diligently followed, then Type I Errors would be elevated. In any case, as stated before, removal should be accompanied by an assignable cause, and an acknowledgement that the system-under-test was deemed to be in an out-of-control state.

2. Larger samples are preferred, and lead to more accurate bootstrap results. However, the bootstrap still works with small sample sizes. Over time, repeated executions of the test with the system-under-test in control will build up a larger sample that can be taken into the bootstrap.

3. It is assumed that the samples are independent. This is certainly the case, as the respective samples are generated from independent repetitions of the entire performance testing experiment.

If T is the statistic of interest, then the bootstrap proceeds as follows for the given sample $\mathbf{x} = \{x_1, x_2 \ldots, x_n\}$, and where B is the number of times the given sample is resampled:

1. Compute the test statistic for the given sample: $\widehat{\theta} = T(\mathbf{x})$.
2. For $i = 1, \ldots, B$, resample $\mathbf{x}$ (sample with replacement), $\mathbf{x}^* = \{x_1^*, x_2^*, \ldots, x_n^*\}$ (called the bootstrap sample or resample), and compute $\widehat{\theta}_i^* = T(\mathbf{x}^*)$. The values $\widehat{\theta}_i^*$ are the bootstrap estimates.
3. The bootstrap estimate for θ is then $\overline{\widehat{\theta^*}} = \frac{1}{B} \sum_{i=1}^{B} \widehat{\theta}_i^*$.

A confidence interval can be determined from the quantiles of the bootstrap estimates or from a z-score and the sample variance of the bootstrap samples if $\widehat{\theta}$ is assumed to be approximately normal. To test the null-hypothesis that a give point is drawn from the same underlying population as the sample $\mathbf{x}$, the test proceeds by checking whether the point is outside of the confidence interval, in which case evidence at the prescribed α level of significance results in the rejection of the null-hypothesis. An estimated p-value can also be determined by assessing the proportion of the $\widehat{\theta}_i^*$ at least as extreme as $\widehat{\theta}$.

For the purposes of this analysis, the test statistic is the absolute value of the distance between the point being tested, y, and the mean of a sample $\mathbf{x}$, with the number of bootstrap samples in each test set to $B = 1000$

$$T(\mathbf{x}, y) = |\overline{\mathbf{x}} - y|$$

And the p-value is computed as follows in R:

```
bootstrap.test<-function(x,p,B=1000,side="both") {
  x<-na.omit(x);
  if (length(x)<4 | is.na(p)) return(1);
  bootstrap.means<-numeric(B);
```

```
  for (i in 1:B) {
    bootstrap.sample<-sample(x,replace = TRUE);
    bootstrap.means[i]<-mean(bootstrap.sample);
  }
  test.statistic<-abs(p-mean(x));
  p_value = mean(abs(bootstrap.means - mean(x)) >= test.statistic);
  if (side=="upper" & (p<mean(x))) {
    return(0.5);
  } else if (side=="lower" & (p>mean(x))) {
    return(0.5);
  }
  return(p_value);
}
```

It is not always possible to establish acceptable ranges within which estimates are deemed to be acceptable. Response time estimates, for example, are often required to be sub-second, but this is not always possible due to the amount of work required of some functions. In addition, there are certain functions whose response times are required to be only a few milliseconds. The amount of work a specific function performs, and hence its response time, may vary significantly from call to call. It is not always possible to get reasonable response time requirements, yet excessive response times are required to be high-lighted so they can be investigated, and an assignable cause determined. Over time, prior tests establish a precedent for both performance estimates as well as levels of resource usage on each of the clusters. The bootstrap p-values allows significance testing to determine possible departures from previous tests. However, not all significant results are materially different. Aside from Type I Errors, a change in response times that does not result in a meaningful increase in absolute values, for example, from 250 milliseconds to 300 milliseconds, is not considered material.

2.4 Random number generation

There are several places where random numbers from various distributions are required to be drawn. These random numbers are drawn from underlying uniform $(0, 1)$ pseudo-random numbers using a mixed linear congruential generator supplying a long sequence of integers:

$$
\begin{aligned}
Y_{n+1} &= (aY_n + b) \mod M \text{ where } a, b, M \in \mathbb{N} \\
\text{such that } M &\in \mathbb{N}, \text{ is the modulus} \\
a &\in \{0, \ldots, M-1\}, \text{ is the multiplier} \\
b &\in \{0, \ldots, M-1\}, \text{ is the increment} \\
Y_0 &\in \{0, \ldots, M-1\}, \text{ is the seed.}
\end{aligned}
$$

The value of the seed, $Y_0 \in \mathbb{N}_0$, for the generation process is often set to a fixed value so that the generated sequence is repeatable. There are conditions under which the values chosen for a, b, and M results in a sequence of length M of non-repeating integers, and in which the values of the sequence appear to be statistically uncorrelated, and evenly distributed in the range $\{0, \ldots, M-1\}$, and by omitting 0 results in the sequence $X_n = Y_n \div M \in (0, 1)$ to appear to be statistically indistinguishable from random numbers drawn a uniform $(0, 1)$, or $U(0, 1)$, distribution. The necessary and sufficient conditions on a, b, and M for this maximal sequence of M integers are (see, for example, Morgan, 2018; or Ripley, 2009):

1. The $\gcd(b, M) = 1$
2. $a - 1$ is a multiple of every prime divisor of M
3. $a - 1$ is a multiple of 4 if M is a multiple of 4.

For the current implementation, the largest value of M suggested in Knuth (2014) is used, that is $M = 2^{64} = 18446744073709551616$ which only has prime factors of 2, and with $a = 6364136223846793005$ and $b = 1442695040888963407$. The prime factors of b are 7, 13, 23, 127, 827, and 6562904431, hence the $\gcd(b, M) = 1$. Since $a - 1$ is even, it is a multiple of 2 which is the only prime factor of M. And since the prime factors of $a - 1$ are 2, 2, 89, 236429, and 75611651471, it is the case that $a - 1$ is a multiple of 4, and as all the prime factors of M are 2, it is also a multiple of 4. Hence the conditions for a maximum cycle for the mixed linear congruential generator are met with the chosen values of a, b, and M. In addition, since the word size of the arithmetic chosen is 64-bits, $M - 1$ is the largest value that can be represented, and hence by allowing the arithmetic to overflow the 64-bits, there is no need to take the remainder after dividing my M to form the modulus:

```
/*
 * Constants:
 */

#define LCG_MULTIPLIER  6364136223846793005L
#define LCG_INCREMENT   1442695040888963407L

/*
 * Globals:
 */

static uint64_t lcg_value;

/*
 * Exported functions:
 */
```

```
void lcg_seed(uint64_t seed)
   {
   lcg_value  = seed;
   } /* lcg_seed */

uint64_t lcg_next(void)
   {
   lcg_value = lcg_value*LCG_MULTIPLIER+LCG_INCREMENT;

   return lcg_value;
   } /* lcg_next */
```

Tests of non-uniformity of a sequence pseudo-random $U(0,1)$ values include the frequency test, the serial test and the Kolmogorov-Smirnov tests. These tests are straightforward to accomplish in R (R Core Team, 2024) using the `randtoolbox` package (Chalabi *et al.*, 2009) functions `freq.test` and `serial.test`, and the bundled `stats` package `ks.test` function. A good pseudo random number generator of $U(0,1)$ values is expected to demonstrate the statistical properties of:

1. *Uniformity* across the interval $(0,1)$; and
2. *Independence* by showing that the generated numbers are not correlated with each other.

In addition, the following non-statistical properties are desirable:

1. *Replication*: It should be possible to replicate the sequence. This is possible by seeding the underlying linear congruential generator with the same value for Y_0;
2. *Cycle length*: It should be able to generate very long sequences of numbers before the numbers start to repeat. The values of a, b, and M with M as large as possible for the word size of the computer, and their specific values satisfying the three conditions ensure that the sequence length before repeating is $M = 2^{64}$;
3. *Speed*: Computing values should be fast. For the linear congruential generator, a new value requires only a single 64-bit integer multiplication and addition, a conversion to floating point and three floating point divisions (the division of the values in the $\{Y_n\}$ sequence are divided by 2^{32} in two divisions on order not cause problems on some 64-bit processors as the value of M exceeds what can be stored in a 64-bit register). Clearly a claim to speed is justified; and
4. *Memory usage*: The generator should not require much storage. For the generation of the k-th value of the sequence $\{X_n\} \in U(0,1)$ only the last integer value Y_{k-1} is required to be stored.

For the first statistical property, there are a number of tests which can be applied:

1. A *Frequency Test* performs a chi-squared test to determine whether a sequence of N numbers in $(0, 1)$ can be taken as $U(0, 1)$ (N should be at least 100). The test is performed by partitioning the interval $(0, 1)$ into k intervals of length $1/k$, and then counting the number of values in the sequence in each of the intervals, N_r. The chi-squared test can be then be performed on the counts in each interval as the expected number of values in each interval should be $E_r = N/k$. The test statistic $T = \sum\limits_{r=0}^{k-1} (N_r - E_r)^2 \div E_r$, and under that null-hypothesis, H_0, that the sequence of numbers is drawn from a $U(0, 1)$ distribution is such that $T \sim \chi^2_{k-1}$ (chi-squared with $k - 1$ degrees of freedom).

2. A *Serial Test* which also accomplishes a test of the independence of successive pairs of the values of the sequence. For this test, the square $(0, 1) \times (0, 1)$ is partitioned into k^2 sub-squares of equal area. Then for each sub-square, the number of pairs of numbers in the sequence N_{ij} in that sub-square are counted. For this test, the number expected in each sub-square is $E_{ij} = N/k^2$, and a test statistic can again be determined by $T = \sum\limits_{i=0}^{k-1} \sum\limits_{j=0}^{k-1} (N_{ij} - E_{ij})^2 \div E_{ij}$. Under the null-hypothesis, H_0, that the sequence is a sample drawn from $U(0, 1)$, it is expected that $T \sim \chi^2_{k^2-1}$.

3. A *Kolmogorov-Smirnov Test* is a non-parametric test which compares the empirical cumulative distribution of the values in the sequence to the hypothesised distribution. The empirical cumulative distribution function for a sequence of N values, $\{x_n\}$, is defined as $F(x) = \frac{1}{N} \sum\limits_{i=1}^{N} I_{x_i \leq x}$ (the proportion of values in the sequence $\{x_n\}$ less than or equal to x). The test statistic D is the maximum vertical distance between the empirical cumulative distribution function and the cumulative distribution function of the hypothesised distribution. In this case $F_{U(0,1)}(x) = x$.

The results of these three tests from a generated sample of size $n = 1000000$ are shown in Table 2.1. The table shows that in each case, for the test performed, there is no evidence to doubt that the sequence was drawn from the $U(0, 1)$ distribution at the $\alpha = 0.05$ level of significance. For the frequency test, the default of $k = 16$ intervals was used, and for the serial test, the default of $k^2 = 64$ sub-squares was used.

Table 2.1: Tests of uniformity of a sequence of size $n = 1000000$. The table shows that for the individual tests performed, there is no evidence to suggest that the null-hypothesis, H_0, that the sequence of numbers were drawn from a $U(0,1)$ distribution should be rejected at a significance level of $\alpha = 0.05$.

Test name	Statistic	p-value
Frequency test	11.403	0.72
Serial test	71.543	0.21
Kolmogorov-Smirnov test	0.009	0.35

A sample from a good $U(0,1)$ pseudo random number generator should not only be pairwise independent, but there should be independence between all lags of in the sequence of numbers. The sample autocorrelation, $r_X(k)$, provides an estimate of the autocorrelation function (`acf` in R) and determines the estimated correlations between samples at k lags in the sample (values in the sample every k steps apart), and is given by the approximation for a large sample size n of the random variable X as follows (see, for example, Chatfield and Xing, 2019):

$$r_X(k) \approx \frac{\sum\limits_{i=1}^{n-k} (X_i - \overline{X})(X_{i+k} - \overline{X})}{\sum\limits_{i=1}^{n} (X_i - \overline{X})^2}.$$

Under the null-hypothesis, H_0, that the sample values are independent, the distribution of autocorrelation values across the lags is such that $r_X(k)$ values are approximately $N(0, 1/n)$. Thus, if the sequence is a random sample, then approximately $100(1-\alpha)\%$ of the values should lie between $\pm z_{\alpha/2} \cdot 1/\sqrt{n}$ (as a result of the sampling distribution of $N(0, 1/n)$).

$$\begin{aligned} \text{SE}(r_X(k)) &\approx \frac{1}{\sqrt{n}} \\ \text{with confidence limits} &= \pm z_{\alpha/2} \cdot \text{SE}(r_X(k)) \end{aligned}$$

Figure 2.1 shows that there is no significant correlation between the values in the sequence for lags of $k = 1, \ldots, 30$. There is therefor no reason to doubt the independence of the sample values. This together with the tests of uniformity, suggest that the pseudo random number generator for the values X_n is a good generator of values that can be considered to be drawn from a $U(0,1)$ distribution.

There are other methods for testing the statistical properties of pseudo random number generators of samples purported to be from a $U(0,1)$ distribution, but these are not applied here. Brown *et al.* (2018) describes
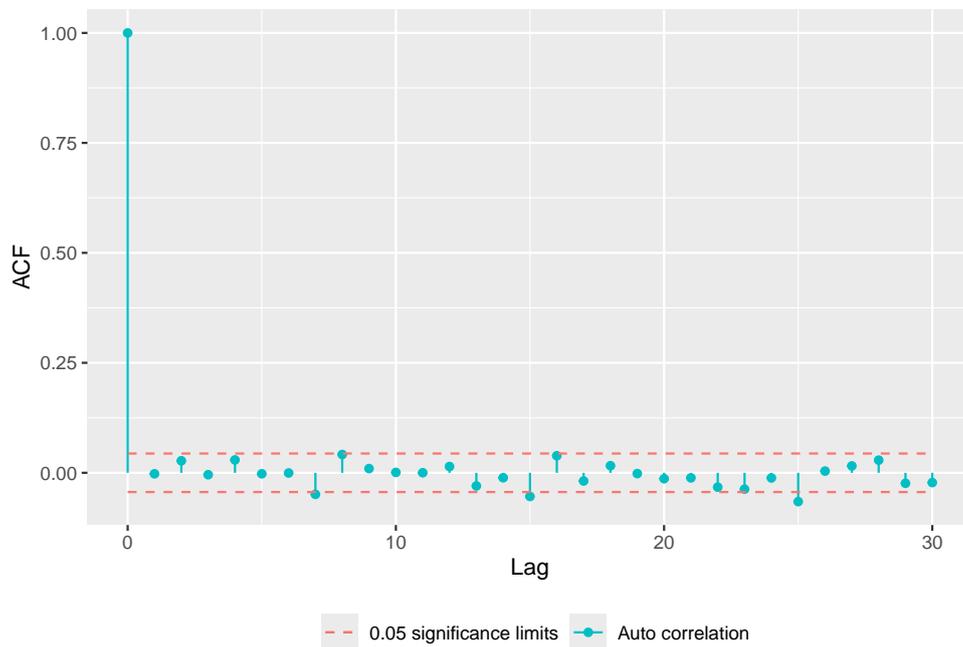
Figure 2.1: The autocorrelation function for the first 2000 values produced by the pseudo random number generator based on the mixed linear congruential generator. The graph shows that auto correlation values for lags from 0 to 30, and that not an unreasonable number of points lie outside of the 0.05 significance limits (and only the expected value at lag 0 significantly outside of the significance limits), hence there is no evidence to suggest that the values are not statistically independent. There is also no obvious pattern to the correlations across the lags considered.

a battery of tests which can be run selectively using the tool `dieharder`, but these tests are being applied to samples of pseudo random numbers generated by the tool, yet what is required here are tests against the samples of random numbers produced by the implementation of the pseudo $U(0,1)$ random number generator based upon a specific mixed linear congruential generator.

For the simulation of various processes in the performance testing, pseudo random number generators from other continuous distributions are required. These random numbers are typically drawn to simulate idle-times, think-times, various response-times, and weighted random choices. For these, an acceptably behaved $U(0,1)$ generator, such as the one based on the mixed linear congruential generator described here, is used as the underlying random process based on the fact that the sequence $\{X_t\} \overset{\text{iid}}{\sim} U(0,1)$ (that is independent and identically distributed values from the $U(0,1)$ distribution). To simulate from a continuous distributions D for which the cumulative distribution function F_D is invertible, pseudo random numbers can be obtained from a good uniform $(0,1)$ distribution pseudo number generator using the inversion method (for example, Morgan, 2018):

$$\text{If } x \sim U(0,1) \text{ then } y = F_D^{-1}(x) \implies y \sim D.$$

In order to simulate samples from a uniform (a, b) distribution with cumulative probability distribution function

$$
\begin{aligned}
F(y) &= \begin{cases} 0 & \text{if } y < a \\ \frac{y-a}{b-a} & \text{if } a \leq y \leq b \\ 1 & \text{if } y > b \end{cases} \\
\text{hence } F^{-1}(x) &= x(b-a) + a \text{ for } x \in (0,1) \\
\text{and hence } x \sim U(0,1) &\implies F^{-1}(x) \sim U(a,b).
\end{aligned}
$$

In order to simulate samples from the exponential distribution with rate parameter λ, or $\text{Exp}(\lambda)$, and cumulative distribution function

$$
\begin{aligned}
F(y) &= \begin{cases} 0 & \text{if } y \leq 0 \\ 1 - e^{-\lambda y} & \text{if } y > 0 \end{cases} \\
\text{hence } F^{-1}(x) &= \frac{1}{\lambda} \ln x \text{ for } x \in (0,1) \\
\text{and hence } x \sim U(0,1) &\implies F^{-1}(x) \sim \text{Exp}(\lambda).
\end{aligned}
$$

Also required, are simulations from normal distributions, $N(\mu, \sigma^2)$. To generate a random value $x \sim N(\mu, \sigma^2)$, and value $y \sim N(0,1)$ from the standard normal can be generated, then re-centred and scaled. That is, if $x \sim N(0,1)$, then $(x + \mu) \times \sigma \sim N(\mu, \sigma^2)$. Thus it suffices to generate values

from the standard normal, $N(0, 1)$. The *Polar Marsaglia* method (see, for example, Morgan, 2018) employs hints of the rejection method and draws two independent $U(-1, 1)$ random values to produce two independent $N(0, 1)$ values. Thus employing a good pseudo random number generator for $U(0, 1)$ values using the Polar Marsaglia method to produce two independent $N(0, 1)$ values, it is possible to generate independent pseudo random numbers from the $N(\mu, \sigma^2)$ distribution. The two standard normal values are produced by drawing independent $U(-1, 1)$ values V_1 and V_2. This provides a point uniformly distributed in the 2×2 square in the XY plane centred on the origin. Next, points outside the unit circle are rejected and another pair of independent $U(-1, 1)$ values are drawn for V_1 and V_2. This continues until the point (V_1, V_2) is inside the unit circle centred on the origin. That is, until $W = V_1^2 + V_2^2 \leq 1$. The values N_1 and N_2 are then independently distributed $N(0, 1)$, where

$$
\begin{aligned}
N_1 &= V_1 \sqrt{\frac{-2 \ln W}{W}} \\
\text{and } N_2 &= V_2 \sqrt{\frac{-2 \ln W}{W}}
\end{aligned}
$$

from which two independent $N(\mu, \sigma^2)$ values may be obtained as described above. The underlying implementation in C is modified from Press *et al.* (2007) by integrating the mixed linear congruential generator described here.

Functions to generate pseudo random variables for the $U(a, b)$, $N(\mu, \sigma^2)$, and $\text{Exp}(\lambda)$ have been implemented in a drop in expression evaluation engine employed in Orkhestra and certain ad-hoc simulations. In the implementation, these functions have been given their familiar names found in R: `runif`, `rnorm`, and `rexp` (Donaldson *et al.*, 2024b).

2.4.1 Modelling third-parties

Figure 4.5 on page 60 depicts an arrangement of servers in their respective clusters and includes interaction with third-party service providers. Often, these third-parties do not provide test environments suitable for performance testing to the extent required to determine suitability of the system-under-test in the field. In these cases, it is often possible to substitute the third-party in the test landscape by simulating its functionality. Undesirable side effects can occur if the simulation excludes a realistic response time profile. For example, Figure 2.2 shows a series of flows from the customer's viewpoint that ultimately result in the orchestration of requests to a third-party service provider through the components of the system-under-test, through to the components of the third-party provider, and then all the way back to the customer. If the response times were not modelled realistically, and allowed to be too short or instantaneous, then response times seen by the customer request would be unrealistically quick and would give an underestimate

of what would be experienced in the field, possibly giving a false sense of security about the acceptability of the application's suitability for deployment into the field. In addition, the resources used in the system-under-test for pending responses from the third-party would also be less than what would be experienced in the field. The relationship between the expected resources for pending responses is typically linear in the response times according to Little's Law $N = \lambda W$, where λ is the mean request rate, W is the mean third-party response time, and N, the expected number of waiting requests, and is proportional to the resources such as memory held on behalf the pending response (Little, 1961). If the response times are too long then it is possible that the test fails to meet its first milestone objective due to the resource usage becoming saturated. Further, if in the field, responses are not returned in a strictly first-come-first-completed order, then this should not be the case when simulating the third-party service provider.

When simulating the third-party service provider, certain features are transparent to the system-under-test, and the requests can be split according to their transparent features. For example, a parameter for a function against a third-party might ask whether a proposed request to a function is valid without completing the request, and a subsequent call to that function without another parameter value might ask the third-party provider to complete the request. In such cases of apparent features, the response time distributions for different features would be treated separately for each feature. This might result in the straightforward estimation of the parameters for an appropriate distribution for each of the function and feature sets by analysing the performance of the third-party requests in the field. However, the features are not always transparent, and in those situations where the features are opaque or only known by the third-party provider an appropriate model of the distribution of response times might best be described as a finite mixture model.
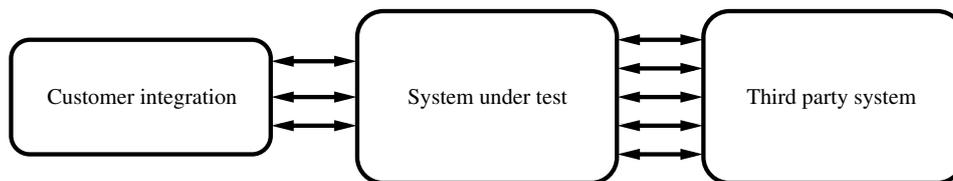
Figure 2.2: Depiction of functions invoked by customer integration against the system-under-test and resulting in various orchestrated function calls to a third-party provider. For the test execution, the customer integration role is played by the test-system and where the third-party is not suitably setup for a test, the third-party is replaced by a simulation.

From sampled response time data collected from the field, it might be obvious that a standard distribution does not provide an adequate fit, and non-

parametric density estimation may be required. *Kernel Density Estimation* (KDE) is a method that provides a non-parametric estimate of a distribution from a sample by using well-behaved density kernels to estimate the density at various points using a weighting of points from the sample using the kernel density function to give higher weight to points closer to the desired value (see, for example, Silverman, 2018).

$$
\begin{array}{rcl}
\text{Let} \quad \widehat{f}(x) & = & \text{the estimated density function for the supplied sample} \\
n & = & \text{the sample size} \\
x_i & = & \text{the sample values for } i = 1, \ldots, n \\
h & = & \text{the bandwidth specifying the neighbourhood in the sample} \\
& & \text{around the points of estimation} \\
K(x) & = & \text{a symmetric probability density function with mean 0} \\
\text{then} \quad \widehat{f}(x) & = & \frac{1}{nh} \sum_{i=1}^{n} K\left(\frac{x-x_i}{h}\right) \text{ is the smoothed or estimated probability} \\
& & \text{density of the sample}
\end{array}
$$

The degree of smoothing is controlled by the bandwidth, h, with small values tending to overfit the sample, and larger values tending to mask out certain features in the data. The choice of kernel, K, among the suitable density functions is less serious as empirical studies have demonstrated. The R function `density` computes kernel density estimates. By default, this function uses a method of Silverman to determine the bandwidth (called the *normal reference distribution*), and with the $N(0,1)$ Gaussian kernel function:

$$
K(x) \quad = \quad \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}x^2}
$$

The R function `density` computes the non-parametric KDE from a given sample, and returns a structure that includes the evaluation of the density at a number of points (the number can be defaulted or requested in the function call). In the sequel, the default bandwidth determination method is used along with the default Gaussian kernel.

As it relates to the current study, there are a number of reasons why the estimated density determined by the KDE is not ideal in practice. The simulations required might require values to be drawn from the distribution at a high rate (depending the test execution requirements). In general, one would need to resort to either a *table lookup method* using the estimated values or to the *rejection method* in order to draw samples from the kernel density estimated distribution described by the KDE function $\widehat{f}(x)$ (see, for example, Morgan, 2018). However, the former would require tables of the appropriate sizes, and the latter would require knowledge of the peak density

value in order to establish a suitable rectangular or triangular envelope. As in the current case, shown in Figure 2.3, a rectangular envelope would have an area significantly larger than 1 (the area under the density curve), resulting in a high rejection rate. This inefficiency can be reduced or avoided if the kernel density estimated distribution closely resembles a standard distribution or a mixture of standard distributions (at least ones for which simulating the drawing of random values is relatively efficient). Nevertheless, the non-parametric KDE determined density function is still useful as it allows for the identification of a possible proposed standard distribution or mixture of distributions by visualising the density function. Identifying a standard distribution, would then allow the sample to be used for the parameter estimates of that distribution. And if a finite mixture model is identified for the distribution, then the kernel density estimated distribution can be used to define a function that captures the errors between the finite mixture model distribution and the kernel density estimated distribution. As this error function is a function of the mixing proportion and the respective distributions in the mixture, it can be used as an objective function to search the space of mixing proportions and parameters in order to minimise the errors.
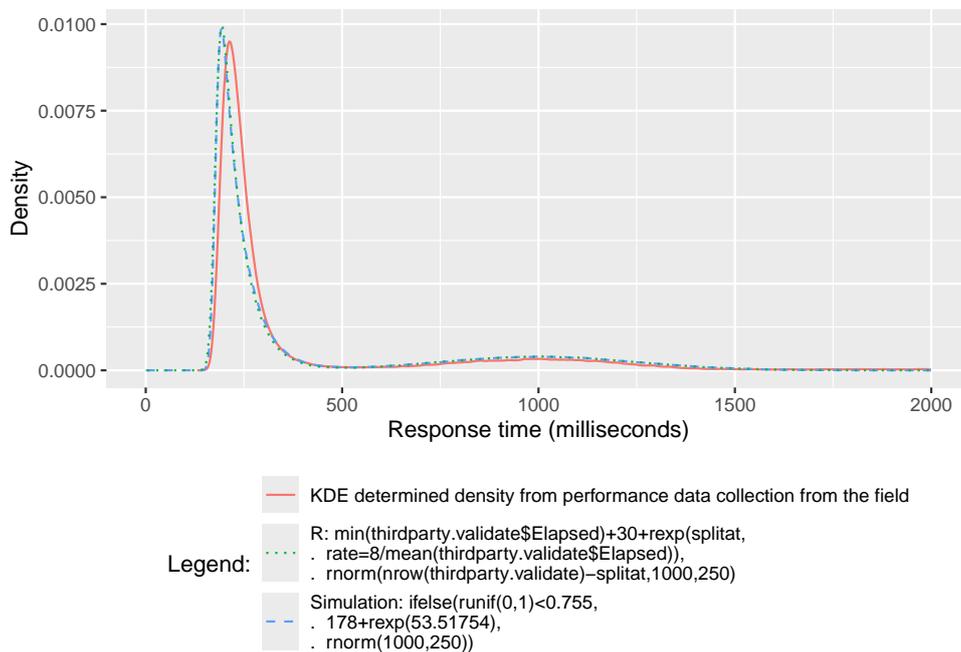
Figure 2.3: Response time density for a particular function. The figure shows a multimodal kernel density estimation from response time data collected from the field overlaid with a simulations of the density using a finite mixture model of an exponential and a normal distribution. The simulated finite mixture densities are produced from R and the third-party simulation and show no material differences.

Figure 2.3 shows the KDE density of the response time data collected from the field. Although not a major element to the distribution, the distribution appears to be comprised of the mixture of an exponential and normal distributions, with the bulk of the density in the exponential distribution. In addition to the KDE density from the field data, the figure also shows two other densities. These are both drawn from a mixture of the exponential and normal distributions with parameters and weights estimated from the KDE distribution. These parameters are shown Table 2.2. It is clear from the figure that the normal density is centred around 1000 milliseconds, and the exponential density is offset by 178 milliseconds (possibly representing the physical minimum response time).

Table 2.2: Mixing proportion and parameters of the finite mixture model component distributions.

Parameter	Description
m	Mixture proportion
λ	Rate parameter for exponential component
μ	Mean of normal component
σ^2	Variance of normal component

For the current example, it is possible to determine estimates of the parameters of the respective distributions and the mixing proportion by inspection and a little experimentation (this is how the finite mixture model in Figure 2.3 was determined), but these parameters and mixing proportion could also be estimated by performing an optimisation minimising the errors between the estimated KDE density and the densities of the proposed mixture model. For the current problem, this has shown to be sensitive to the initial estimate, and also slow to converge. However, if the initial estimates of the parameters are close to the correct values, then the method has shown to be robust in determining mixture proportion from various initial estimates of the mixing proportion. The following R code sets up the optimisation and solves it by using the `optim` function (Byrd *et al.*, 1995).

```r
# Produce a kernel density estimation from the extracted
# data points that are considered valid and that relate
# to a single function and fixed set of visible features.
# The data are also shifted so that the exponential
# distribution support, and hence the finite mixture model
# support is the interval [0,infinity):
data.density<-density(data,n=100000);
fdensity<-function(x,m,lambda,mu,sigma) {
  return(m*dexp(x,rate=lambda)+(1-m)*dnorm(x,mu,sigma));
}
```

```r
# The objective function computes the sum-of-squares
# of the distance between the points of the kernel
# based empirical density and the proposed mixture
# density with respect to the current values of the
# parameters and the mixing proportion:
objfn<-function(params) {
  print(params);
  # Extract parameters
  m<-params[1]
  lambda <- params[2]
  mu <- params[3]
  sigma <- params[4]

  sumsq<-0;
  for (i in 1:length(data.density$x)) {
    sumsq<-sumsq+
      (data.density$y[i]-
        fdensity(data.density$x[i],m,lambda,mu,sigma))^2;
  }
  print(sumsq);
  return(sumsq);
}


## Establish bounds for the mixing proportion
## and the respective distribution parameters:
lower_bounds<-c(0.2,0,0,0);
upper_bounds<-c(0.8,2000,2000,1000);

## Best guess at the initial parameter values:
params<-c(1/2,50,800,250);

## Find the parameters of the mixture model that
## approx minimises the sum-of-squares of
## vertical distances between the kernel density
## points the proposed mixture distribution:
mixed.fit<-optim(par = params,
      fn = objfn,
      method=  "L-BFGS-B",
      lower = lower_bounds,
      upper = upper_bounds);
```

Modelling third-parties is desirable even if the third-party has the ability to participate in the tests to the required levels of activity. It is not possible to
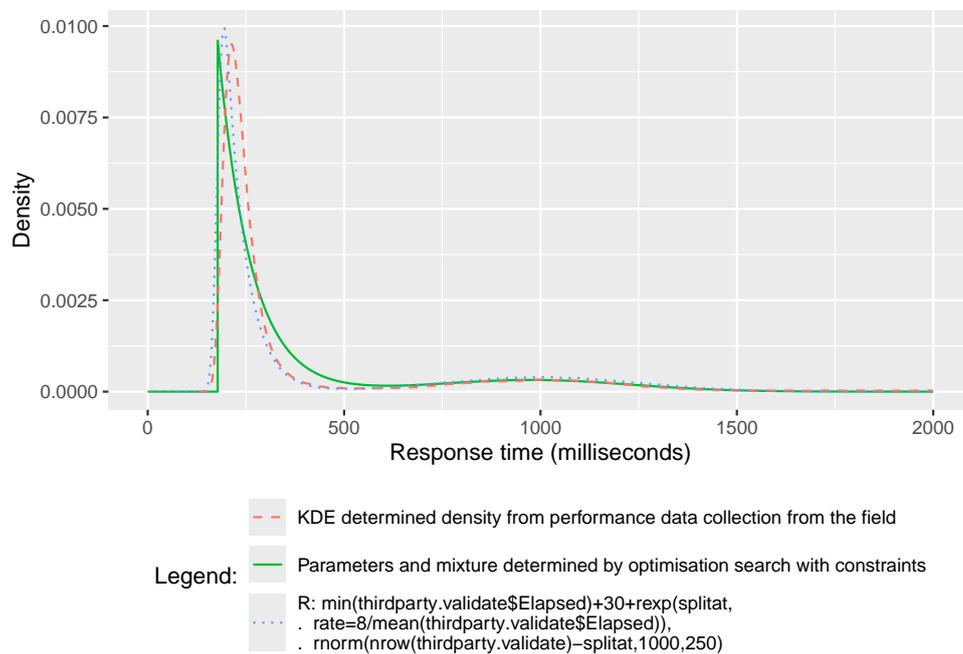
Figure 2.4: Response time density for a particular function. The figure shows a multimodal kernel density estimation from response time data collected from the field, and in this case, overlaid with optimisation sought parameters of simulations of the finite mixture model densities. The simulated finite mixture densities are produced from R and the third-party simulation and show no material differences.

collect all the changed features of the third-party that might be in play for a test session, and the performance of the third-party from test to test may not reflect the stable behaviour observed in the field. If the third-party is replaced by a simulation and considered part of the test-system, then a greater degree of control will result with a stable performance from test session to test session. This means that a significant change in the performance of a function must be caused by a change in the system-under-test. This allows the tests to both proceed in the cases where the third-party cannot, and to be able to localise problems, should they arise, to the system-under-test.

Ideally, the bandwidth, h, should not be left Silverman's normal reference distribution as it may be the case that important features are smoothed. Additionally, the somewhat naive choice of candidate densities in the finite mixture model, and the method of optimisation used to determine the mixture proportion and model parameters can be improved upon (see Section 5.1.4).

2.4.2   Ordering test data

The order in which test data is consumed by the test-system in driving the system-under-test can have, in some cases, important consequences for the success of the performance tests. For example, if identities (such as accounts or user-ids) are processed in a sequential order, then two unnatural and undesirable effects are possible. In the first instance, the false sharing of sequential read-only data of the system-under-test may result in an efficiency unlikely to be observed in the field; and in the second instance, the false sharing of sequential update data of the system-under-test may result in a degradation of performance unlikely to be observed in the field. False sharing refers to the unintended fetching of data because it resides in the same block or page of the data intended to be fetched. In the read-only case, the unintended fetch of the data does not require a physical read. And in the update scenario, a lock might be applied to the block or page containing the unintended data due to an update to the intended data, causing a possible delay to a subsequent update of the unintended data fetched.

To avoid these problems, and to better simulate the data access patterns observed in the field, the data driving independent activities is shuffled before being consumed by the test-system, and hence before being past to the system-under-test. This shuffling is accomplished using the sequence of pseudo random integers from the mixed linear congruential generator, and assigns a pseudo random number to each record in the test data, then sorts the test data on this pseudo random number. Once sorted, the data is saved after removing the pseudo random number.

2.5 Treatment of outliers

With a controlled offered load, and an arrangement of the data so that outcomes are successful, the system-under-test is expected to have a high rate of successful outcomes and that the successful load is linear in the offered load. Where the results of a test demonstrate that this is not the case, an investigation is triggered to determine the underlying cause, or to find an assignable cause. This situation is often apparent during a test, especially if the successful load started out being linear in the offered load (the tests start with low offered loads, and incrementally increase the offered load). Generally, two types of observations are apparent:

1. If response times start to increase, but not to the extent that time-outs are triggered, then the success rate will remain the same, but it will become apparent that the throughput is not climbing linearly with the offered load. An assignable cause needs to be determined. Typically, this is the result of some components capacity being exhausted, but could be because of the offered load, or because of an agent external to the test using resources. If it can be determined that this is due to the test, and if the rate expected of the offered load is less than the required milestone, then the test is considered a failure. If it can be determined that this drop in expected throughput is due to an external agent, then it may be possible to address the cause during the test and letting the test continue (an external agent might, for example, take an unexpected backup, or initiate some activity on a system that shares resources).

2. The failure rates starts to increase. If the failure rate increases without degraded throughput, then, again, it might be an indication of an outside agent interfering with the test, or it may be that the application itself has started to fault, that a patch of bad data (despite careful attempts to prepare the data) has been stumbled upon. Again, an assignable cause needs to be found.

It is not always the case that faults or throughput degradation are detected during the test, but assignable causes are always required, and these need to be addressed (there are very few cases where this is not the case, and where no assignable cause is found and/or addressed, a risk is raised). Hence it is the expectation that the throughput of the system is linear in the offered load, throughout a range of loads that include the required milestones expected in the field. Therefore, the system's background and unit activity resource costs can be estimated by a linear regression of the observed resources consumed onto the successful load.

Hence, by the preparation and conduct of the tests, there are two classes of outliers, external interference in the test, and anomalous behaviour of the

system-under-test. Both require assignable causes and investigation, and provided all anomalous behaviour can be assigned to a cause that can be rectified, outliers should be removed from the analysis in order to determine expected resource consumption (in some cases outliers due to anomalous behaviour are accepted and allowed to progress into the field, but in these cases a risk should be raised and no estimates or confident estimates of resource usage should be offered).

The method of removing outliers has so far been to remove intervals of data for which the failure rate exceeds the expected failure rate due to the state of the application data of the system-under-test.

2.6 Treatment of missing data

Test-system data is unlikely to go missing as the performance metrics are recorded directly to disk and a check is made prior to test execution to ensure sufficient capacity is available. Metrics recorded from the components of the system-under-test depend on network capacity in order to record these centrally. Thus the lack of capacity, including capacity depleted as a result of the test, could result in data loss. This can partly be remedied by the manner in which the metrics are sampled and communicated. Each time a metric is sampled, the number of samples, the cumulative sum of samples, and the cumulative sum-of-squares of the samples (to that point) are collected. Thus if in a step interval (generally set to 120 seconds), if a packet is lost, an estimated sample mean value for the interval can be recovered. The purpose of including the sum-of-squares is to be able to include the sample variance. All samples that arrive in the same step interval are used to determine the sample mean and sample variance for that interval. If all metrics are lost in the interval, then the interval is dropped from consideration in the analysis. The metric loss should be noted as a possible indication of capacity saturation.

2.7 Visualising information

Previously, the visualisation of resource usage data, has been to produce a graph for every machine and cluster for the resource type. This produces a large number of graphics which take up many pages of a report. Paging through the graphics looking for patterns is tedious, time-consuming, subjective and error prone. By converting all resources of the same type to the same scale, for example, CPU resource usage to percent of capacity provisioned and network bandwidth used to bits per second or to megabits per second, allows visual comparisons across clusters by comparing their respective graphs. In Tufte (1990), the idea of *small multiples* is to use these

consistent scales to portray the information in a grid structure. This packs more information onto a single page, and the resulting denser information makes pattern determination more efficient.

In addition to rendering resource usage graphics across the execution of a test, by using consistent scales across tests allows for efficient comparisons across tests. This applies both to resource usage as well as performance.

2.8   Multiple hypothesis tests

The multiple hypothesis tests performed on the test results, including multiple hypothesis tests where the tests are clearly dependent, is a possible cause for concern. However, while it is possible to adjust the significance level for these tests, the cost of Type I Errors (false positives) is considerably less expensive than allowing a change to be deployed to the field with unsatisfactory behaviour or performance, justifying erring on the side of caution.

There are occasions where additional post hoc tests are used to confirm an observation or hypothesis. From an experiment design viewpoint, these may appear to be switched outcomes, but this can be mitigated against by adding any post hoc analysis to the pipeline for inclusion in future tests. Over time, it should become obvious whether the result obtained in the current test was spurious or not. And if it is felt that it is critical to understand this for the current test, the same post hoc test could be applied to the data from previous tests. The test process is repeatable, and the test data remains available for further analysis and augmented tests.

Chapter 3

Data

3.1   Data sourcing

Each test generates two streams of data. The first set of data are produced by the test-system, which measures sojourn times and rates through model state-transition pairs. These metrics then give time-series response times for each function by function outcome as well as interval rates for each function by function outcome. The second set of data are gathered from the system-under-test by instrumenting each component in the test landscape. By default, the types of metrics gathered relate to physical resource usage such as CPU usage, network bandwidth usage, memory usage and I/O rates and response times. Typically, there is other instrumentation in place that monitors the application stack. This application instrumentation is viewed as part of the system-under-test as it is or will be in place when the application is deployed into the field.

Metrics from the test-system and from the components in the landscape, are time-stamped using a common clock and reported centrally.

Figure 3.1 shows the classical portrayal of the test-system and system-under-test, together with the points at which the time-series performance and resource data is generated, indicating that these time-series are time-stamped with a common clock. In order to make sense of the resource usage time-series data, and to be able to analyse this data in a platform independent manner, these time-series data are preprocessed in a platform dependent manner in order to present the usage of the respective resources in a common and platform independent manner for down-stream processing in the pipeline.

The interval metrics produced by the test-system (labelled *Time-series performance data* in Figure 3.1) include records produced for each function
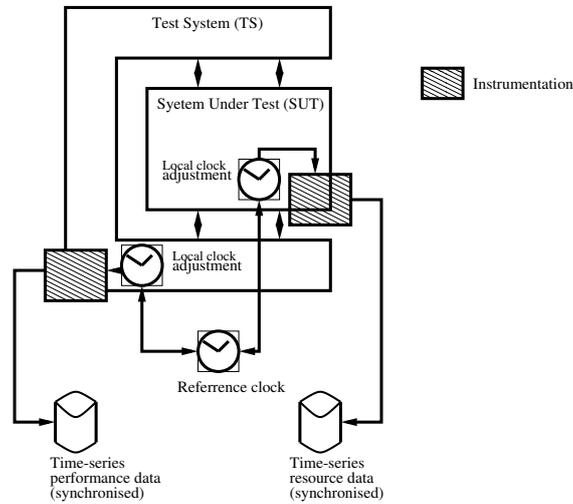
Figure 3.1: Typical portrayal of a test-system and system-under-test augmented with test-tool instrumentation for performance metrics and platform probes for collection resource usage metrics

call at intervals suitable for aggregation to form a summary of the performance for each load level during the test. Records are produced at times t_i for each function call and outcome separately, but in a manner that continually accumulates the measurements from the start of the test. Each record contains the following details:

$$
\begin{aligned}
t_i^{(k)} &= \text{the time that the record is produced;} \\
d_i^{(k)} &= \text{duration of the sampling interval;} \\
C_i^{(k)} &= \text{the number of customers available for interacting} \\
&\quad \text{with the system-under-test;} \\
L_i^{(k)} &= \text{a label for the } k\text{-th function and its outcome;} \\
D_i^{(k)} &= \text{a description of the } k\text{-th function and its outcome;} \\
n_i^{(k)} &= \text{the cumulative number of calls to the function} \\
&\quad \text{at the specific point in the flow;} \\
\sum_{j=0}^{i} x_i^{(k)} &= \text{the cumulative sum of the metric values since} \\
&\quad \text{the test started;} \\
\sum_{j=0}^{i} (x_i^{(k)})^2 &= \text{the cumulative sum of the squares of the metric} \\
&\quad \text{values since the test started; and} \\
&\quad \text{the superscript } (k) \text{ indicates a record for each} \\
&\quad \text{function call and outcome.}
\end{aligned}
$$

From this recorded data, and depending on the time spent at each load level, the metrics are aggregated so that a summary description of the specific

function and outcome is computed for the load interval. This is accomplished by first producing sampling interval records as follows for each function call and outcome, k, by subtracting the corresponding values of each immediately previous record for k, and hence produces additional fields per record as follows:

$$
\begin{aligned}
\Delta t_i^{(k)} &= t_i^{(k)} - t_{i-1}^{(k)} && \text{interval between recorded samples;} \\
\Delta n_i^{(k)} &= n_i^{(k)} - n_{i-1}^{(k)} && \text{the number of calls within the recording interval;} \\
X_i^{(k)} &= \sum_{j=0}^{i} x_i^{(k)} - \sum_{j=0}^{i-1} x_i^{(k)} && \text{the sum of sampled values in the recording interval;} \\
S_i^{(k)} &= \sum_{j=0}^{i} \left(x_i^{(k)} \right)^2 - \sum_{j=0}^{i-1} \left(x_i^{(k)} \right)^2 && \text{the sum of the squares of the values in recording interval;} \\
m_i^{(k)} &= \frac{X_i^{(k)}}{\Delta n_i^{(k)}} && \text{sample mean for the recording interval; and} \\
s_i^{2(k)} &= \frac{S_i^{(k)}}{\Delta n_i^{(k)}} - (m_i^{(k)})^2 && \text{sample variance for the recording interval.}
\end{aligned}
$$

By design, the recording intervals, $\Delta t_i^{(k)}$, are all the same and also by design the load interval (the interval over which the offered load is held constant) is a multiple of this recording interval length. This is to establish metrics summarising the performance for each load interval, the respective samples taken in the load interval are summed up, giving a similar set of data, but this time describing intervals for which the records detail each function and its outcome for each of the load intervals. That is, in the above, the interval of interest need not be made up of two adjacent recordings, that is, indices $i-1$ and i, and instead $i-1$ may be replaced by any earlier record index.

The time-series data capturing the resource usage of the system-under-test shown in Figure 3.1 (labelled *time-series resource data*) are structured in a similar manner to the performance metrics when presented for analysis. That is, they are aggregated measurements so as to report in synchronised time-intervals matching the load intervals. In this case, the labelling in the observations indicates from which server the metrics are drawn, and for the specific item being measured in each observation.

3.2 Obfuscating commercially sensitive data

Unless stated otherwise, the data used in this report is not synthetic, and comes from a real system-under-test. The customer that provided this data required that elements such as names of functions, servers and clusters be obfuscated due to commercial sensitivity.

Permission to use the data in an obfuscated manner was provided on the 14th of February, 2023. The method of obfuscation agreed was to replace elements with a hash of the words after adding a secret key. Then to form the replacement of the word, the hashed words were sorted and sequenced with the replacement word essentially being the sequence number within the random hash of the original word. This provided a one-way hash to replace the elements names by replacing each of the words in the names with a unique, yet unpredictable word. The secret key remains in the customer's domain, and will be deleted once the last set of data is obfuscated. The key needs to be constant for the exercise so that the mapping of the names to their obfuscated values is consistent throughout. Figure 3.2 shows a high-level process that uses the mapped names to produce the obfuscated data, consistent in that sense that referential integrity amongst datasets remains intact.
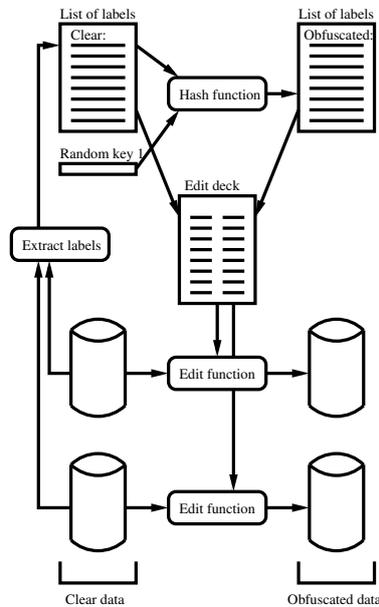
Figure 3.2: Data obfuscation process. The figure depicts the process of collecting all words or labels from the system-under-test resource usage time-series datasets, the test-system performance time-series dataset, and the landscape data of the system-under-test. These words are individually hashed with a secret key (using a secure hash algorithm). The hash values are then sorted and assigned sequential numbers to produce new labels used to replace to replace the original words or labels. These words together with the original words or labels are then used to create an edit deck which is applied to the respective time-series datasets and the landscape description. The result is a consistent sets of time-series datasets with meaningless labels, that cannot be reversed to disclose their original values.

Chapter 4

Results

Overwhelmingly, the expectation of the resource usage of these system in terms of CPU usage and network bandwidth usage is expected to be linear in the successful load of the system-under-test, and that this expectation carries into the field. Deviations from this should be highlighted and an assignable cause determined. It may be an exception that some resource usage against a successful load is superlinear is accepted based on an algorithm used, but not by much, perhaps $n \log n$. All other deviations, including sublinear are causes for concern.

Linear regressions have been the bread-and-butter of the analysis to date, but only in a direct one-for-one simple linear regression manner. Interaction and high-order terms can be added to the regressions to detect non-linear resource costs and interference of one test on another. This of course only works if the interfering test is known about, and is constructed in a manner that can provide detail of the successful load by interval.

It it is not possible to redo the analysis as the deadlines are often quite tight, so within eight to ten hours of a test, a report needs to be available to inform decisions. Therefore, the set of tests are not executed in an exploratory manner, but as part of a pipeline of predetermined tests seeking anomalies to highlight. The wording of the anomaly needs to be carefully selected so as not to imply that fault has indeed been detected.

Certain throughput rates are expected to be achieved and exceeded. These rates or milestones could be determined by marketing or an analysis of the peak usage of a system in the field (or a similar system in the field). Confusion arises in terms of what the milestone rates should be as business view a transaction as the financial transaction or the act of establishing something tangible from a business viewpoint, for example, the setting up of an account or the purchase of an item. However, technically, there are potentially dozens

of *transactions* as technical interactions which are orchestrated in order to accomplish the business transaction. Since the stipulated rates (from marketing, business or field analysis) is in terms of the business sense of a transaction, that is the sense used here. For those applications where a customer generally accomplishes a single business transaction per visit to the system, the term *customer arrival rate* is used instead, aligns with the business perception of a transaction, and avoids confusion with a technical interaction view as a transaction. The notion of function response times are still required as these are the individual units that need to be checked to make sure they perform adequately and/or as expected. The time a customer spends in the system on a particular visit will be the sum of all the particular function calls to accomplish the specific business transaction, plus the think-times of the customer interacting with the device being used (for example, mobile phone, browser, point of sale device, or ATM).

4.1 Hypotheses and required stable system behaviour

As with the previously mentioned testing tools, the responses times and throughput rates of the customer arrivals and the response times and throughput rates of the individual functions executed from the test-system on behalf of the customer activity is reported on. Depending on the system-under-test, a customer arrival may represent a person approaching an ATM to initiate a transaction, a point of sale swiping or tapping a card at a point of sale machine to initiate a payment, a person loading a web page to load a single page application, or a person opening an application on their mobile phone. The individual functions are then the orchestrated calls to the system-under-test in order to accomplish the specific business function(s) required. As described earlier, the metrics of these interactions are specific to the outcome of the customer session and the individual function calls. For example, a customer session is unsuccessful if any function call within one of the business activities invoked fails to respond in the expected manner (time-out, invalid request, server fault, etc.). The performance metrics and reporting are thus specific to the particular outcome, and the ratio of expected (good) outcomes to total request yields a success rate per function call point (that is, the location of the call within a flow).

From the data generated from the test-system and the prepared data generated from the platforms the following desired properties of a well-behaved system are assessed and reported on:

4.1.1 First milestone reached in a stable manner

The customer arrival rate needs to exceed the first milestone in order to be successful. But this milestone needs to be reached with successful sessions, and in a manner that the successful load is equal to the offered load. There is no direct measure of offered load, but this can be determined from the number of instantiations of concurrent and independent simulations of the I/O FSM models (often referred to as the *instances* within the toolset and the reporting). The rate at which a single instance exits the idle state to interact with the system-under-test has a fixed mean (a parameter set by the test configuration) and is the applied load on the system-under-test of a single instance. Since the instances are identical and independent simulations of the same I/O FSM configuration, the applied load on the system-under-test is the sum of the individual applied loads due to all the instances. Thus, the applied load is directly proportional to the number of instances being simulated. This suggests that a linear regression of the successful load onto the number of instances could be used to determine a departure of the successful load from the applied load. The first milestone is considered to have been successfully reached if the rate is stable as it traverses the milestone value. As it is not possible to completely control the environment, it may be that some outside interference impacts some of the step load intervals, reducing the success rate or impacting the performance. The determination of whether the first milestone has been reached is accomplished by removing observations deemed to be of a poor quality, then fitting a linear model on the remaining observations provided there are a sufficient number of observations. In the linear regression there is an observation for each interval. All intervals removed are reported on so that an assignable cause (see, for example, Montgomery, 2020) can be determined. If an assignable cause is found for the out-of-control system-under-test, and if this cause is determined to be unrelated to the system-under-test, then this would not be cause to fail the test. For the present analysis, this success rate is required to be at least 98 percent. If there are insufficient remaining intervals after removing the poor quality observations, then the test is deemed to be a failure. Otherwise, for the remaining observations, a simple linear regression is performed. An analysis is then carried out on the resulting model in order to determine if there are any points with a high-influence. The R function `influence.measures` computes a few quantities for leave-one-out tests of high influence, including DFFITS (DFFITS_i) and Cook's distance (D_i) (Ugarte *et al.*, 2015; or Neter *et al.*, 1996):

$$
\begin{aligned}
D_i &= \frac{(\widehat{\mathbf{Y}}_{(i)} - \widehat{\mathbf{Y}})^T (\widehat{\mathbf{Y}}_{(i)} - \widehat{\mathbf{Y}})}{p\widehat{\sigma}^s} \\
&= \frac{r_i^2}{p} \left(\frac{h_{ii}}{1 - h_{ii}} \right) \\
\text{DFFITS}_i &= \frac{\widehat{Y}_i - \widehat{Y}_{i(i)}}{\widehat{\sigma}_{(i)} \sqrt{h_{ii}}}
\end{aligned}
$$

where p is the number of predictors (in this case $p = 1$), r_i is the standardised residual of the i-th observation, h_{ii} the corresponding diagonal entry of the hat-matrix, $\widehat{\sigma}$ is the sample standard deviation, and where the subscript in brackets indicates the corresponding calculation with the i-th observation removed.

Figure 4.1 shows models fitted to the successful load versus offered load (in terms of number of instances of simulating the I/O FSM), from which it is clear that the second model provides a better estimate of the number of instances required to achieve the first milestone (indicated by the cross-hairs). And hence that the test achieved this milestone. That the second milestone is not shown on the graph is in an indication that the second milestone was not reached.

Figure 4.2 shows quantile-quantile plot of the standardised residuals of the model fitted without poor quality observations and without high influence observations. The figure shows that departure from normality is not too severe, and in particular, there are more points than would be expected clustered around zero in the sample, and with a slight left skew. However, the deviation is not uncommon for such a small sample size. A Shapiro-Wilk normality test produces a W-statistic $= 0.94$ which is not significant at the $\alpha = 0.05$ level (p-value $= 0.44$, and hence, provides no evidence to reject the null-hypothesis H_0 : the sample was drawn from a normal population. However, Figure 4.3, which shows a scatter plot the standardised residuals versus the number of instances of the I/O FSM models being simulated at each load level, appears to favour negative residuals, monotonically increasing until approximately 500 instances being simulated, at which point there does not appear to be an obvious pattern to the residuals. Regardless, the predictions of interest are all within the range of the predictor values, and the R^2 coefficient of determination suggests an almost perfectly fitted model.

Table 4.1 shows the estimated coefficients from the models fitted to all the successful load versus offered load observations, the coefficient estimate after removing the poor quality observations, and then the same after removing the observations considered to have a high influence. The coefficient is the multiplication factor used to determine the offered load in terms of customer arrivals per second. The estimates show a 27.74% improvement in the coefficient from the first to the third dataset, with almost 100% of the model explaining the variance in the data according to the R^2 value.
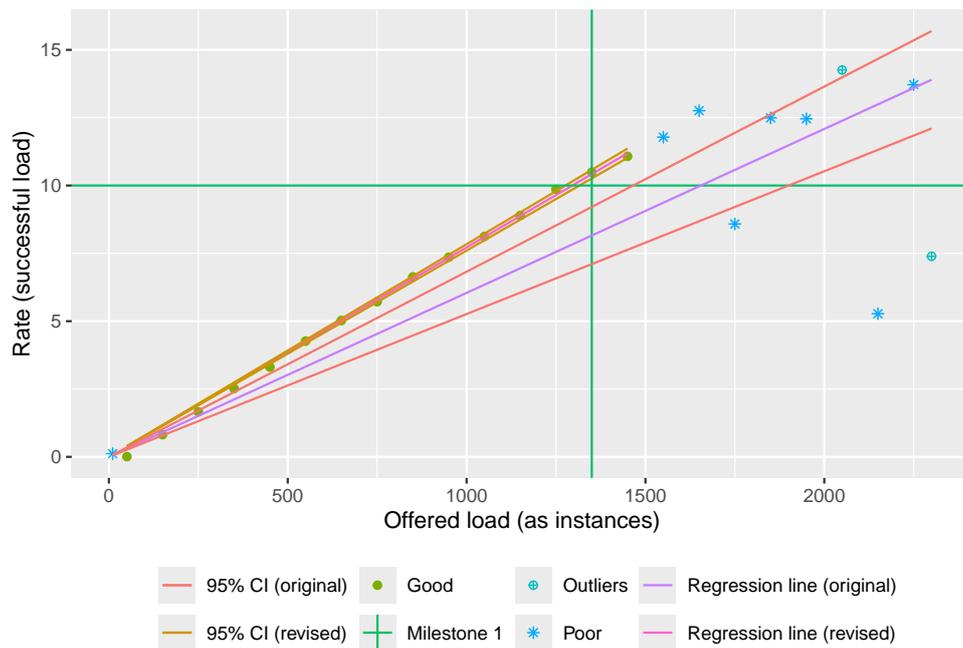
Figure 4.1: Fitted model with all observations included and fitted model after removing the poor quality observations and observations deemed to have a high-influence. The graphic shows that the regression line for model fitted with all the observations has a shallower slope compared to the regression line for the model fitted after removing poor quality and high influence observations. The result with all observations included is to project the offered load that achieves the first milestone at significantly higher values, and with a much wider 95% confidence interval, whereas the removal of these observations provides for a prediction for the first milestone at a much lower offered load and with a much narrower 95% confidence interval. The graphic also indicates that the first milestone was achieved.
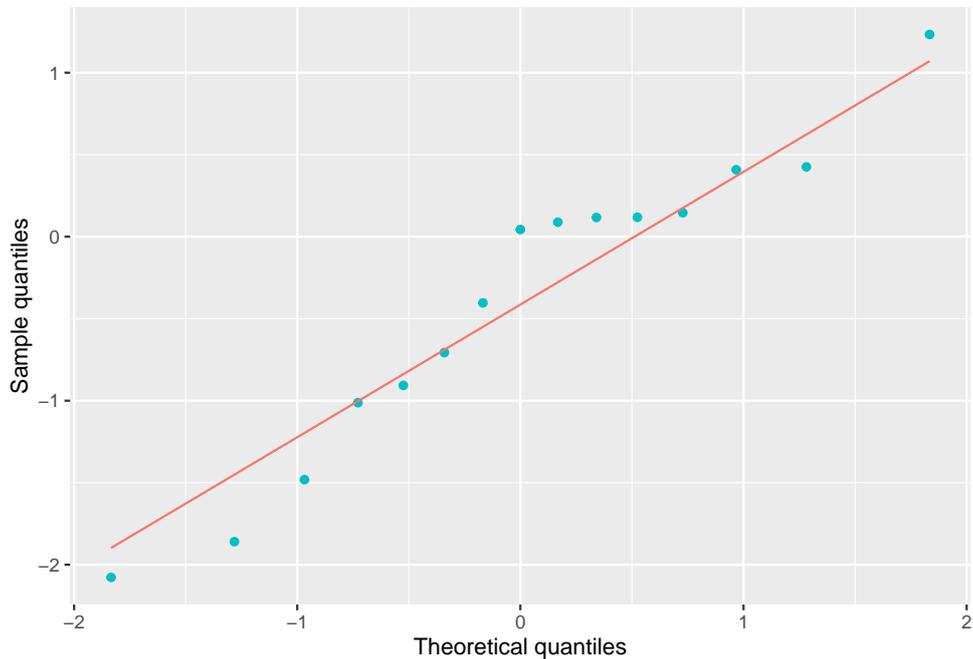
Figure 4.2: Quantile-quantile plot of standardised residuals of the fitted model when excluding poor quality observations and excluding high-influence observations. The deviation from normality is not severe considering the small sample size.

Table 4.1: Coefficient estimates relating successful load to offered load in terms of number of independent I/O FSMs being simulated. The first row shows the F-statistic and R^2 coefficient of determination for the model fitted with all observations. The second shows the results after removing the poor quality observations. The third row shows the results after removing the poor quality observations and those observations from the second set of results that are deemed to have a high influence.

Dataset	Estimate	StdErr	R2	F-stat	df1	df2	p-value
All obs	0.0060	0.0004	0.91	255	1	24	0
w/o poor obs	0.0064	0.0005	0.92	182	1	16	0
w/o hi-infl obs	0.0077	0.0001	1.00	19852	1	14	0

Further analysis in the pipeline is continued with poor observation points and the high-influence points removed. In addition, as mentioned, the removed observations require an assignable cause, and in order to assist with this, the pipeline notes the removed observations so that they can be investigated.

4.2 Performance results

The prime objective of the performance tests is to report on the capability of the system-under-test in terms of the functions initiated by the users (in
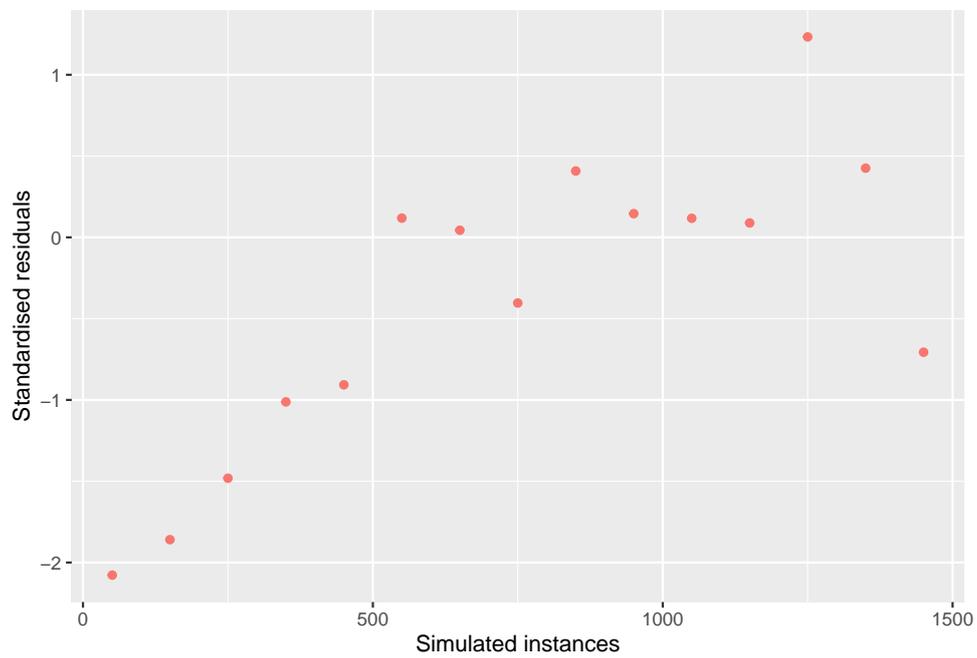
Figure 4.3: Scatter plot of standardised residuals versus number of simulated instances of I/O FSM model. The figure shows that error structure appears to depart from heteroscedasticity as it shows mostly negative standardised residuals monotonically increasing up to about 500 instances of the model, from which point there appears to be no obvious pattern in the residuals.

the test setting, this is the test-system). At the very least, the tool used as the test-system would report on the throughput rates achieved (typically as requests of individual functions per second), and the mean response times (in seconds or milliseconds). In addition, it is often the case that quantiles are included. For the test-system considered here, quantiles are not catered for as the number of function calls, the rate at which functions are called, the various load conditions under which functions are called, make it prohibitive to collect the required amount of data. Instead, each sample summarises the activity since the last sample in terms of the length of the sampling period, the number of events in the sample, the sum of the response times, and the sum of the squares of the response times. This sampling is performed for each function qualified by its position within a business flow, and separately recorded for each outcome of a function call (for example, whether the call was successful or resulted in a unsatisfactory response due to data, responded with a system fault, or failed to respond at all). The context of a function call (that is, as part of a particular flow, and its position in that flow) is a necessary qualifier as individual function call points of the same function may place different demands on the system-under-test. For example, a function that lists accounts may be called to list all accounts in order to render an overview of held accounts and is not the same as a function that lists accounts suitable for ad-hoc purchase transactions. The accumulated samples are reported at relatively short intervals so that the test-system is capable of online rendering the progress of a test in real-time. For this purpose, these intervals are set at 15 seconds, and in addition to being dashboard and graphically reported as the test progresses, recorded for processing by, for example, the pipeline used in this study. For the analysis and inline with the test plan, these shorter recording intervals are aggregated in a straightforward manner to provide the same detail over the larger load intervals of time (as long as these larger intervals are multiples of the smaller recording intervals). For the current report, these larger intervals are set at 120 seconds.

The problem with citing interval averages as point estimates of response times for function calls is that they put too much weight on the lower rates, and use very little information for rates above the milestone, unless the system-under-test is seriously out of control and that too many outliers are taken into account in the regression. Instead, a more practical approach to provide a point estimate at the milestone may be to use a local polynomial regression using `loess` (R Core Team, 2024). Although it is possible to determine an estimate of the performance from the recorded data for each individual load interval present, in some cases the load interval of interest may not be in the data for a particular function call. If some of the recording intervals are missing from the load interval of interest then it is still possible to provide an estimate of throughput, and of response times, although with larger sample variances and standard errors. But if the entire load interval

is missing for a particular function call, then it is still possible to estimate response time, and confidence interval, using the fitted local regression.

Table 4.2 shows a few of the estimated function response times and their throughput rates at the load interval of interest (that is the earliest interval for which the customer arrival rate objective was met). The table includes two estimates of the response times for this first milestone, and includes standard errors for each method. The table shows those functions with the highest response times, and in decreasing order of response time as estimated by the local regression at the customer arrival rate of the first milestone. Table A.2 shows the complete results. For the complete table, 91% of the local regression estimates are higher than the corresponding interval sample estimates, and for those functions for which the standard error of the sample mean is defined, 90% of the standard errors of the local regression are larger than the corresponding standard errors of the mean (21 functions have too few observations in the first milestone interval to calculate a standard error).

Table 4.2: Estimated response times and throughput rates at the interval that achieved the first milestone of the customer arrival rate. The table shows only the first 18 items, arranged in descending order on their local regression estimated response times at the first milestone. Local regression estimates at the first milestone rate as well as sample estimates for the interval that first achieved the first milestone in the test are included. The local regression estimates tend to be higher than the interval sample estimates. The local regression standard error of the estimate also tends to be larger than the standard error of the sample interval.

Test Number	Basename	Local Regression Predict	Local Regression StdErr	Local Regression 95CILo	Local Regression 95CIHi	Samp Size	Samp Mean Resp	Samp Var Resp	SEM	Rate
1	W1218_W1232_0	11.8	0.713	10.3	13.3	1301	10.2	0.308	0.015	10.842
1	W1237_W444_W611_0	11.7	0.733	10.1	13.2	8	9.9	0.113	0.119	0.067
1	W999_W1649_CA_W...	11.6	0.522	10.5	12.7	4	10.3	0.099	0.158	
1	W999_W1649_CA_W...	11.5	0.642	10.1	12.9	3	10.3	0.374	0.353	0.025
1	W1822_W2434_W69...	11.4	0.599	10.2	12.7	84	10.2	0.354	0.065	0.700
1	W1822_W2434_W69...	11.3	0.554	10.2	12.5	282	10.1	0.292	0.032	2.350
1	W1822_W2434_W696_0	11.3	0.569	10.1	12.5	281	10.1	0.288	0.032	2.342
1	W1237_W444_W1662_0	11.3	0.541	10.1	12.4	71	10.1	0.256	0.060	0.592
1	W1822_W2434_W69...	11.2	0.505	10.1	12.3	76	10.0	0.269	0.059	0.633
1	W999_W1649_CA_W...	10.4	0.448	9.4	11.4	4	9.7	0.094	0.154	0.033
1	W1237_W444_W166...	3.8	0.173	3.4	4.1	65	3.4	5.809	0.299	0.542
1	W999_W1649_CA_W...	3.7	0.247	3.2	4.2	3	3.0	0.002	0.029	0.025
1	W999_W1649_CA_W...	3.7	0.258	3.1	4.2	1	3.3			0.008
1	W999_W1649_CA_W...	3.7	0.378	2.8	4.5	5	3.1	0.011	0.046	0.042
1	W1237_W444_W611...	2.7	0.178	2.4	3.1	6	2.4	0.039	0.081	0.050
1	W1237_W444_W611...	2.1	0.124	1.8	2.3	5	2.3	1.780	0.597	0.042
1	W1237_W444_W166...	1.9	0.088	1.7	2.1	70	1.7	0.196	0.053	0.583
1	W1218_W1232_13_...	1.8	0.088	1.7	2.0	1277	1.6	0.544	0.021	10.642

Figure 4.4 shows the performance of a sample function. The full test report shows graphs of each function. The graph on the left shows the per load interval sample mean response times for the function with the error bars indicating the 95% confidence interval based on the standard error of the respective sample means. This graph shows the typical pattern of response time decay as the customer arrival rate increases, with response times at lower throughput rates less than those of the first milestone showing a slow decay, and response times at the higher throughput rates greater than those of the first milestone. A benefit of the local regression is that estimates at the first milestone rate are possible even if the interval at the first milestone cannot produce a standard error or is missing entirely. Including the information from either side of the milestone interval suggests why the local regression estimates tend to be higher than the sample estimates of the milestone intervals, and also why the standard errors for the local regression tend to be larger than the standard errors of the interval sample means.
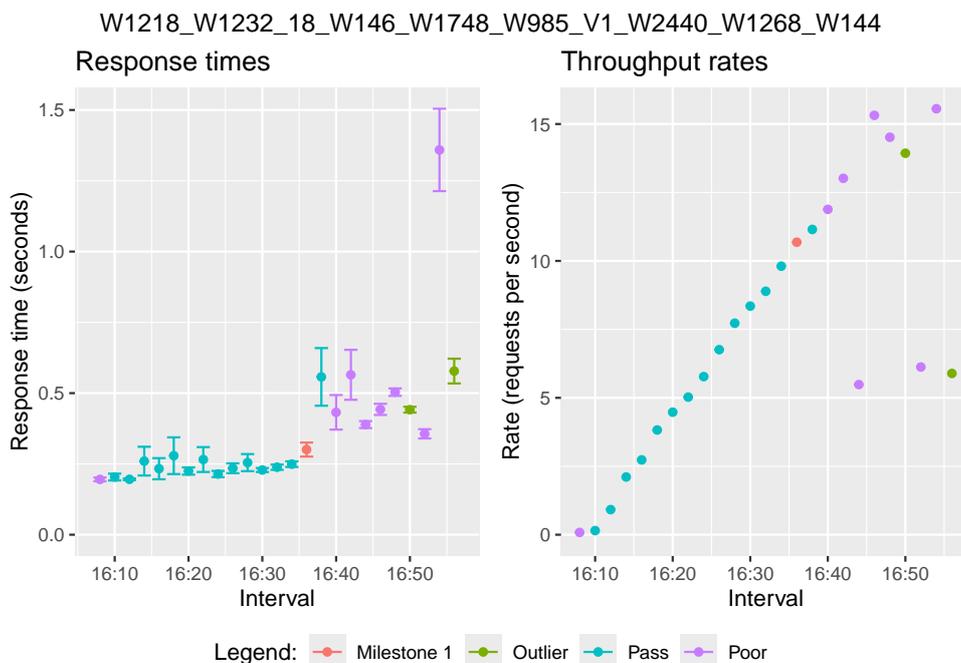
Figure 4.4: Sample performance graphs showing the response times and throughput for a sample function which exhibits a typical decay of response times as the customer arrival rate increases. The graph on the left shows the response times per load interval, and the graph on the right shows the function call rate (in this case the function call rate happens to match the customer arrival rate).

In the absence of any precedent for the response time of a particular function it is customary in this particular domain to state that a response time of one second is required. Typically, any stated response time requirement is a reference to the mean response time. It is a simple matter to select the entries

in Table A.2 for which the local regression model predicts a mean response time for the load interval that exceeds one second, or for which the sample mean response time of the load interval exceeds one second. For the current test, this would amount to 59 (using the local regression model estimates) or 48 (using the sample means) out of the 368 entries being marked for investigation. Instead, where past test results are available, and where the performance of these functions have been accepted (even if greater than one second), then this precedence can be used to determine whether or not the function in the present test has an acceptable performance.

4.2.1   Resource usage of system-under-test

The nature of the computer systems considered here is that, overwhelmingly, the level of usage of certain physical resources is expected to be linear in the successful load. This is the case for CPU usage and network bandwidth usage. However, it is often not the individual servers or appliances whose resource usage is expected to be linear with the successful load, but rather the aggregate resource usage of the cluster. For example, where a pair of servers in a cluster are operating in an Active-Passive manner, all (or most) of the load will be directed to one of the servers, the Active server. Further, it may be the case that under normal operating conditions the roles of the Active and Passive servers are switched. Something similar occurs frequently in the tests we consider here, in that a new pod or address-space (depending on the server type) may be started up during the test. The expectation is still that the sum of the resource usage across the members of the cluster is expected to be linear in the successful load. The analysis seeks to determine the resource costs per customer arrival per second, as well as the level of resource usage that is independent of the arrival rate (due to background or other activity not attributed to the test workload). To assist with this analysis, the landscape data (description of the servers and appliances supporting the system-under-test) has been augmented to include the functional groups to which the servers belong, as well the network fabric to which the servers are attached. This allows the cost per customer arrival per second to be determined per cluster for CPU usage and network bandwidth usage, and for network bandwidth usage to be determined per network fabric. Table A.1 shows this augmented server landscape for the current application. In general, the landscape of a system-under-test is an arrangement of interconnected servers in clusters where the purpose of each cluster is to service functions in a specific functional area (for example, a set authentication functions). Figure 4.5 shows a representation of such a landscape where each cluster has a distribution component fronting it in order to direct requests to individual servers in order to effect redundancy and/or load-balancing.
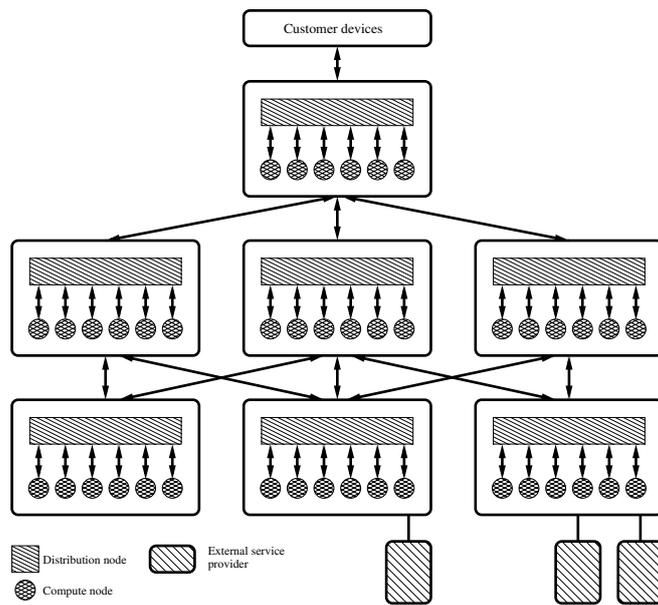
Figure 4.5: Depiction of a server landscape arranged into clusters. Typically, customer interactions arrive at a central cluster in the landscape of the system-under-test, with requests fanning out across the landscape depending on the functions requested. Each cluster hosts a set of related functions, and is fronted with a distribution component responsible for load balancing and redundancy within the cluster. Also shown are third-party components delivering services. The third-party components are not typically considered part of the system-under-test, and ideally should be simulated as part of the test-system.

4.2.1.1 CPU cost per customer arrival per second

The *Capacity* column shown in Table A.1 is the contribution to the server or appliance to the capacity provisioned by that server in the units of the metric that the server CPU usage is measured in. As a result, CPU usage is portrayed in the reporting in a consistently scaled manner across servers and appliances of different types, including their combined cluster CPU usage.

In this analysis, the CPU usage reported is not the cost per request on the cluster or server, but rather the cost per customer arrival per second on the cluster or server. That is, it is the cost to support the combined rate that the simulated I/O FSMs exit their idle states and the effect of the consequent workload on the components of the system-under-test. By regressing the percent CPU used of a cluster (which could be just one server) using SLR onto the customer arrival rate, the cost per arrival per second of percent CPU usage is estimated by the slope of the regression line. In addition, the percent CPU overhead or the percent CPU usage not attributed to the test workload is estimated by the intercept of the regression line. Thus expectations of overhead can be checked as well as projected CPU usage at the first and second milestones. An assumption is made on the nature of the system-under-test, that provided that assumption holds, it is safe to project outside of the range of the predictors (an assumption that the linear relationship holds).

Using a common unit across all servers and their clusters for CPU simplifies the comparison of CPU resource usage across the clusters. In general, it is not the absolute value of resource usage that is of interest to the testing exercise, but rather whether what has been provisioned is sufficient or excessive. Consequently it makes sense to measure CPU resource usage as a proportion or percent of what has been provisioned. Figure 4.6 shows graphs of CPU percent usage for each server within their respective clusters. It is clear from the figure which servers approach their capacity as the test progresses. Figure 4.7 shows the same data, but from the viewpoint of cluster percent usage of provisioned CPU.

Figure 4.6: Proof sheet comparing CPU resource usage for each server in the clusters. The figure shows the percent of provisioned CPU resource capacity used for each server across the time intervals of the test. The vertical lines in each graphic mark the intervals which are either considered to be poor quality observations or observations with a high-influence. The figure shows visually the servers that are reasonably balanced within the clusters, those that are not balanced at all, and those which are partially balanced, or balanced but have different levels of background loads. Also clear from the graphics is those clusters which have servers which are not significantly involved in the test.

Figure 4.7: Proof sheet comparing CPU usage across the clusters. The graphics show the percent of CPU resource capacity provisioned for each cluster over the intervals of the test. The vertical lines in each graphic mark the intervals which are either considered to be poor quality observations or observations with a high-influence. From the figure, it is clear which clusters are closer to exhausting their CPU capacity provisioned, and which clusters are not materially impacted by the test.

For each cluster, by regressing the CPU percent used of the cluster onto the successful load, estimates of the cluster overhead usage and the cost of a customer arrival per second can be determined.

Table A.3 shows the regression estimates for each of the clusters. Here the fitted linear models regress the CPU resource usage for each cluster onto the successful load (of customer arrivals). The entries of interest are those where the F-statistic indicates an overall good fit (that is, where the F-statistic is significant on the F distribution with the indicated degrees of freedom (alternatively, the t-statistic of the slope coefficient), and that the estimated slope coefficient is positive. A subset of the table is shown in Table 4.3. Shown are those clusters where the CPU estimated at the second milestone exceeds the provisioned capacity as well as those clusters where the estimated background load on the cluster is deemed to be excessive (greater than 10% of the provisioned CPU resource).

Figure 4.8 shows a scatter plot of the standardised residuals of the fitted regression lines predicting the level of CPU resource usage from the customer arrival rate. The scatter plots are faded out for those clusters for which the estimated slope is not significantly greater than zero at the $\alpha = 0.05$ level. The colours of the points for each scatter plot show which of the Shapiro-Wilk tests on the standardised residuals are significant, suggesting evidence against the hypothesis of normality of the error terms in the respective linear models. Together, these features indicate which of the clusters meaningfully consume CPU resources as participants in the test. That is, the scatter plots indicate which of the servers meaningfully participate in the tests.
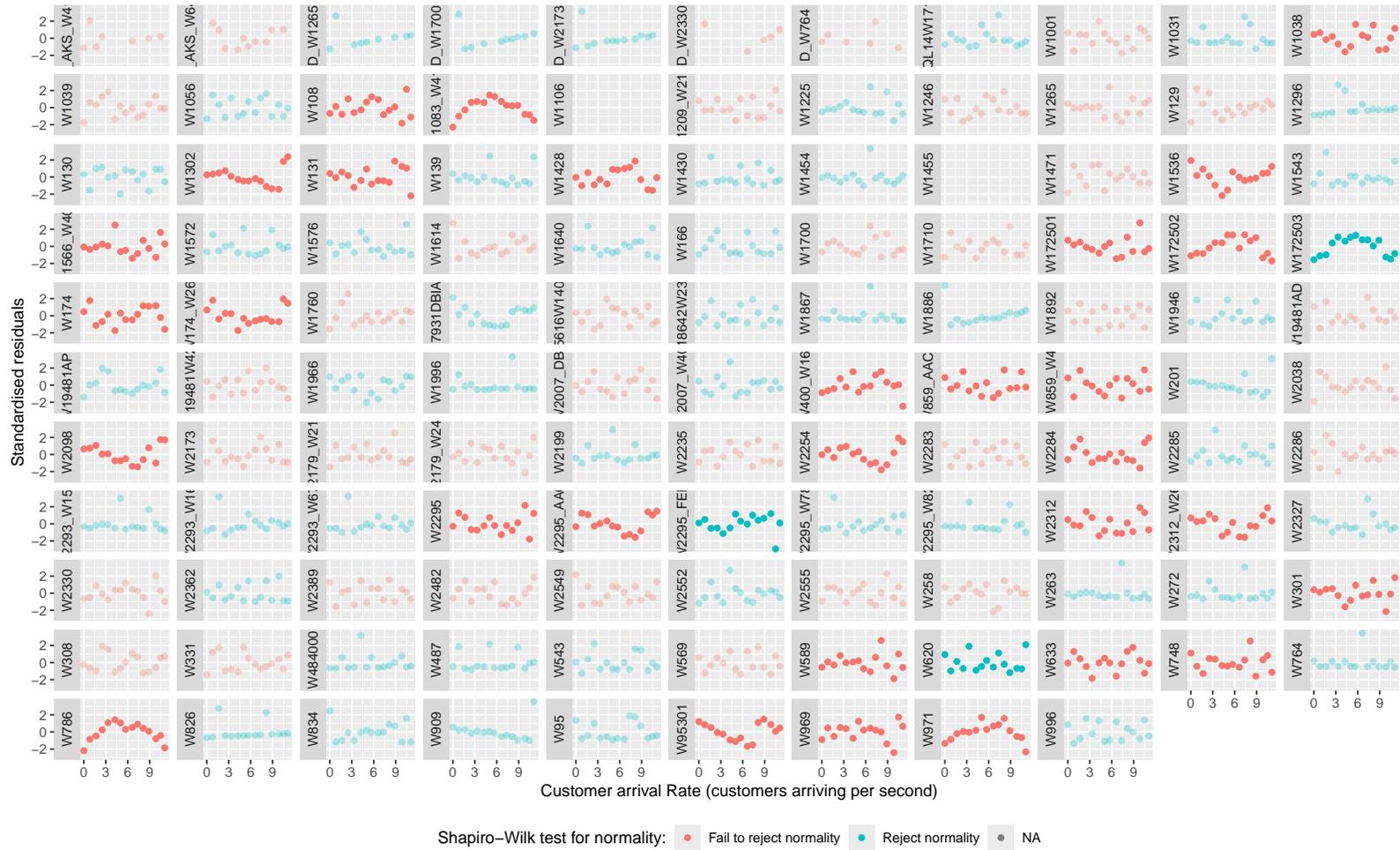
Figure 4.8: Scatter plots of standardised residuals for the models regressing CPU resource usage onto the customer arrival rate. The figure shows diagnostic scatter plots for each cluster in the landscape. The faded images indicate those clusters which have been determined to not have significantly participated in the tests in the sense that there is no positive linear relationship between the customer arrival rate and the level of CPU resource usage. The colouring of the points indicates whether or not there is sufficient evidence for the Shapiro-Wilk test to reject the normality assumption of the standardised residuals.

Figure 4.9 shows plots of regression lines of the fitted models for each of the clusters together with 95% confidence bands. As with figure 4.8, the shading indicates those clusters where the estimated slope (the increase in percentage of CPU provisioned for a unit increase in the customer arrival rate) is non-negative and significantly greater than zero at the $\alpha = 0.05$ level. The colour of the regression and confidence bands indicates the outcome of the Shapiro-Wilk test in the standardised residuals. It is clear from both Figure 4.8 and 4.9 that for some of the clusters for which the Shapiro-Wilk test failed to reject the normality assumption, that there is a pattern amongst the levels of the standardised residuals as the customer arrival rate increases, but that the 95% confidence bands for these are very narrow. It may be that the observed patterns are an artefact of these narrow bands.
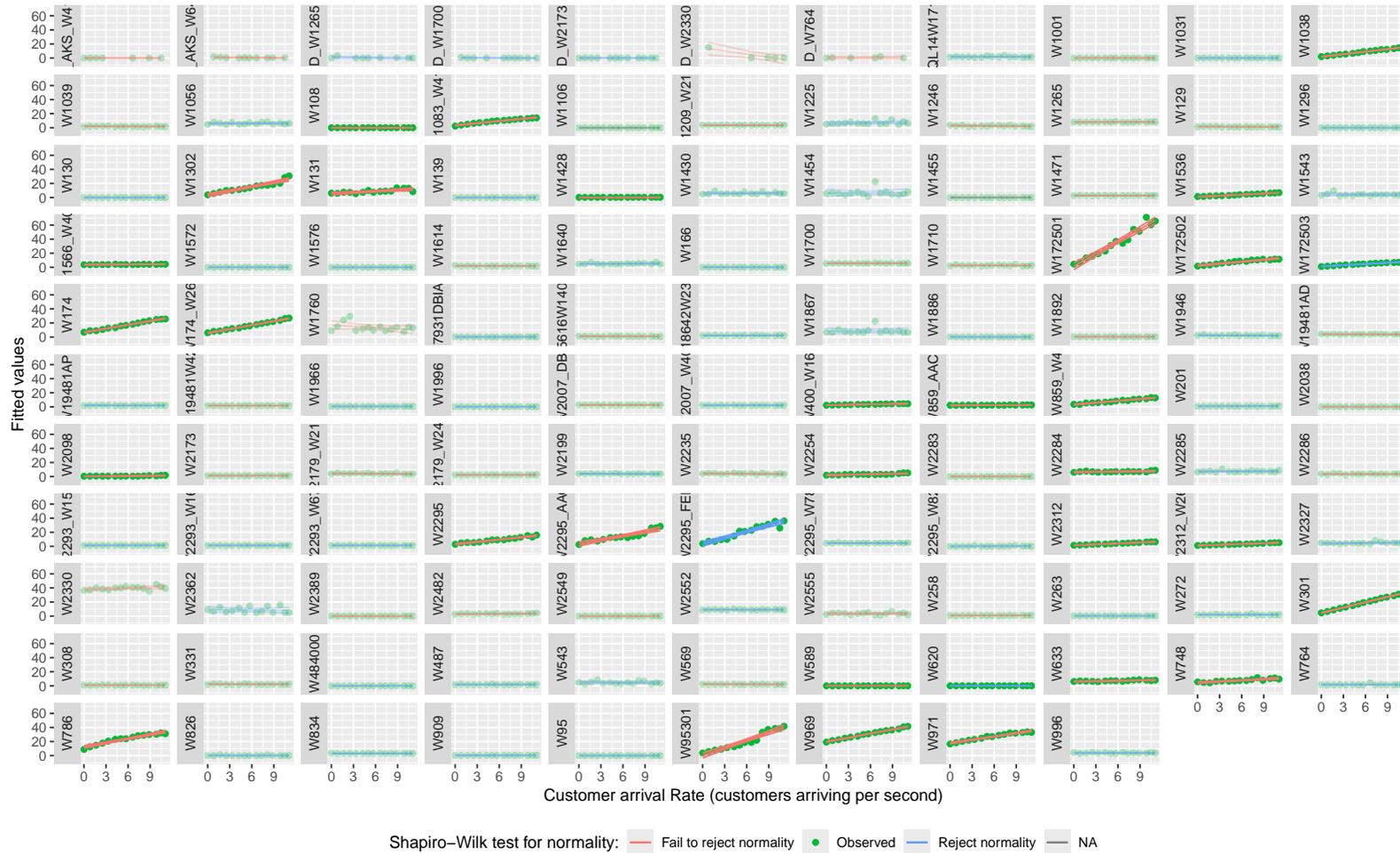
Figure 4.9: CPU resource usage regression lines with 95% confidence bands. The figure shows regression lines for all clusters on the same scale. The faded images indicate those clusters which have been determined to not have significantly participated in the tests in the sense that there is no positive linear relationship between the customer arrival rate and the level of CPU resource usage. The colouring of the points indicates whether or not there is sufficient evidence for the Shapiro-Wilk test to reject the normality assumption of the error terms. Hence, visual identification of those clusters which are the heaviest users of the respective provisioned resource capacity is straightforward.

Table 4.3: Results of linear models regressing cluster CPU resource usage onto successful load where the estimated capacity is likely to exceed the capacity provisioned at the second milestone or where the estimated background CPU resource usage exceeds 10 percent of the capacity provisioned for the respective cluster.

Test Number	Cluster	Intercept Est	Intercept Std.Err	Intercept t-val	Intercept p-val	Slope Est	Slope Std.Err	Slope t-val	Slope p-val	R2	F-stat	df1	df2	p-value	MS1Est	MS2Est
1	D_W2330	14.4	3.08	4.67	0.018	-1.49	0.372	-4.0	0.028	0.84	16.0	1	3	0.028	-0.46	-15.3
1	W172501	1.5	2.30	0.66	0.523	5.87	0.344	17.1	0.000	0.96	290.9	1	13	0.000	60.18	118.9
1	W1760	16.9	2.87	5.88	0.000	-0.56	0.429	-1.3	0.216	0.12	1.7	1	13	0.216	11.29	5.7
1	W2330	37.8	1.12	33.81	0.000	0.32	0.167	1.9	0.077	0.22	3.7	1	13	0.077	41.02	44.2
1	W786	12.3	0.91	13.51	0.000	1.97	0.136	14.5	0.000	0.94	210.9	1	13	0.000	31.96	51.7
1	W969	19.6	0.23	83.14	0.000	1.96	0.035	55.7	0.000	1.00	3104.9	1	13	0.000	39.20	58.8
1	W971	17.8	0.51	35.20	0.000	1.57	0.076	20.8	0.000	0.97	431.4	1	13	0.000	33.50	49.2

4.2.1.2 CPU load balancing within clusters

In most cases it is the expectation that the requests processed by the members in a cluster is done in such a way that the load is balanced across the members. This load-balancing typically appears as balanced request traffic across the individual servers or balanced CPU usage across the servers. If it is required that a cluster is CPU load balanced across its members, then the hypothesis that this is the case can be tested. In a similar manner of testing multicollinearity amongst candidate predictors for multiple linear regression (for example, Ugarte *et al.*, 2015), imbalance amongst the members of a cluster can be tested by regressing the percent CPU usage values of the cluster separately onto each of the corresponding percent CPU usage values of the servers. Because both sets of figures represent the percentage used of provisioned CPU capacity (that is the values for the servers and the values for the clusters), the expected coefficient of the percentage used of CPU capacity provisioned is expected to be one when the balance hypothesis holds. The regression provides a test that the coefficient is indeed one. Further, the expected value of the intercept term under the balanced hypothesis is expected to be zero. The t^*-value from from `lm()` is suitable for testing this hypothesis, i.e. $H_0 : \beta_0 = 0$, but the t^*-value for the slope estimate and the corresponding p-value needs to be computed with respect to the null-hypothesis $H_0 : \beta_1 = 1$ (see, for example, James *et al.*, 2021):

$$t^* \quad = \quad \frac{\widehat{\beta_1} - 1}{\text{SE}(\widehat{\beta_1})}$$

Table 4.4 shows the results for three of the clusters shown in Figure 4.6 (clusters `W969`, `W971`, and `W1302`). In accord with the figure, the results show the coefficients (the slopes) for servers `W13021`, `W13023`, `W9696`, `W9698`, `W97101`, and `W97103` are significantly different from one at the $\alpha = 0.01$ level, and hence an indication of an imbalance of load amongst the servers of the respective clusters. Additionally, the table shows that the intercepts for servers `W9691`, `W9694`, `W9696`, `W9697`, `W9698`, `W97101`, and `W97102` are significantly different from zero at the $\alpha = 0.001$ level. This departure from zero of the intercept may be an indication of outside influence on the test and is an example of an item flagged for investigation. Table A.4 shows the results for the servers across all clusters.

Table 4.4: Balance test results in terms of CPU resource consumption for clusters `W969`, `W971`, and `W1302`. The table shows that for these clusters, loads on servers `W13021`, `W13023`, `W9696`, `W9698`, `W97101`, and `W97103` are significantly out of balance at the $\alpha = 0.01$ level.

Test Number	Cluster	Server	Servers	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=1 t-value	Slope=1 p-value	R2	F-stat	df1	df2	p-value
1	W1302	W13021	5	4.387	1.09	4.008	0.001	0.76	0.065	-3.72	0.003	0.91	134	1	13	0
1	W1302	W13022	5	-0.073	1.27	-0.057	0.955	0.86	0.065	-2.20	0.046	0.93	172	1	13	0
1	W1302	W13023	5	1.819	1.44	1.267	0.227	0.73	0.070	-3.84	0.002	0.89	107	1	13	0
1	W1302	W13024	5	-1.937	2.43	-0.796	0.440	1.45	0.194	2.30	0.038	0.81	56	1	13	0
1	W1302	W13025	5	0.888	0.90	0.990	0.340	1.04	0.059	0.61	0.555	0.96	310	1	13	0
1	W969	W9691	10	13.417	0.44	30.675	0.000	0.97	0.023	-1.45	0.170	0.99	1819	1	13	0
1	W969	W96910	10	-1.329	1.31	-1.011	0.330	1.02	0.041	0.40	0.693	0.98	623	1	13	0
1	W969	W9692	10	1.166	1.19	0.983	0.344	0.96	0.037	-1.15	0.270	0.98	656	1	13	0
1	W969	W9693	10	-2.848	1.53	-1.862	0.085	1.01	0.045	0.29	0.778	0.97	503	1	13	0
1	W969	W9694	10	13.279	0.36	37.170	0.000	0.98	0.019	-1.06	0.309	0.99	2765	1	13	0
1	W969	W9695	10	0.644	1.11	0.582	0.570	0.99	0.035	-0.38	0.711	0.98	781	1	13	0
1	W969	W9696	10	15.075	0.60	25.132	0.000	0.85	0.030	-5.14	0.000	0.98	814	1	13	0
1	W969	W9697	10	-12.046	1.34	-9.007	0.000	0.99	0.030	-0.37	0.718	0.99	1052	1	13	0
1	W969	W9698	10	-19.430	1.75	-11.083	0.000	1.23	0.042	5.34	0.000	0.98	836	1	13	0
1	W969	W9699	10	-8.527	2.30	-3.706	0.003	0.92	0.053	-1.60	0.134	0.96	300	1	13	0
1	W971	W97101	3	5.324	0.42	12.516	0.000	0.45	0.009	-63.66	0.000	0.99	2710	1	13	0
1	W971	W97102	3	0.884	1.15	0.770	0.455	0.98	0.043	-0.48	0.641	0.98	531	1	13	0
1	W971	W97103	3	-45.031	6.91	-6.516	0.000	5.80	0.557	8.62	0.000	0.89	109	1	13	0

4.2.1.3 Network bandwidth usage cost per customer arrival per second

In a similar manner to how the CPU usage is resolved between background usage and usage attributed to the load the test-system puts on the components of the system-under-test, it is possible to estimate the costs in terms of network bandwidth usage per server, or cluster or network fabric component by regressing the respective network resource usage onto the customer arrival rate. For each server, there is a metric for network bandwidth usage for data sent by the server of the system-under-test, and a metric for network bandwidth usage for data received by the server of the system-under-test. Loopback traffic should be treated differently as this traffic does not impact on the provisioned network fabric. The resource usage metrics of the system-under-test are included in the resource usage data. If it were further possible to include resource usage of third-party infrastructure, or to simulate the behaviour of third-parties, then including the resource usage components of these systems as part of the system-under-test would result in a closed system in the sense that any data sent by a component of the system-under-test would be received by a component of the system-under-test. As a result the sum of all the data sent would be expected to be the same as the sum of all data received. Hence when determining network fabric impact, it may be better to consider only one of these metrics.

Unlike the CPU resource costs, which have been converted to percentages of provisioned CPU capacity used, the network metrics have all been converted to absolute units of bits per second, and then to megabits per second for convenience of reporting. As with CPU usage, there is an expectation that the aggregated bandwidth used by a cluster of the system-under-test is linear in the customer-arrival-rate. And for the same reason as before, that is, in an Active-Passive configuration, this is not necessarily the case for individual servers, but in an Active-Active configuration, there is usually an expectation that the load is balanced across the members of a cluster (whether that is for the individual metric for data sent or for the individual metric for the data received).
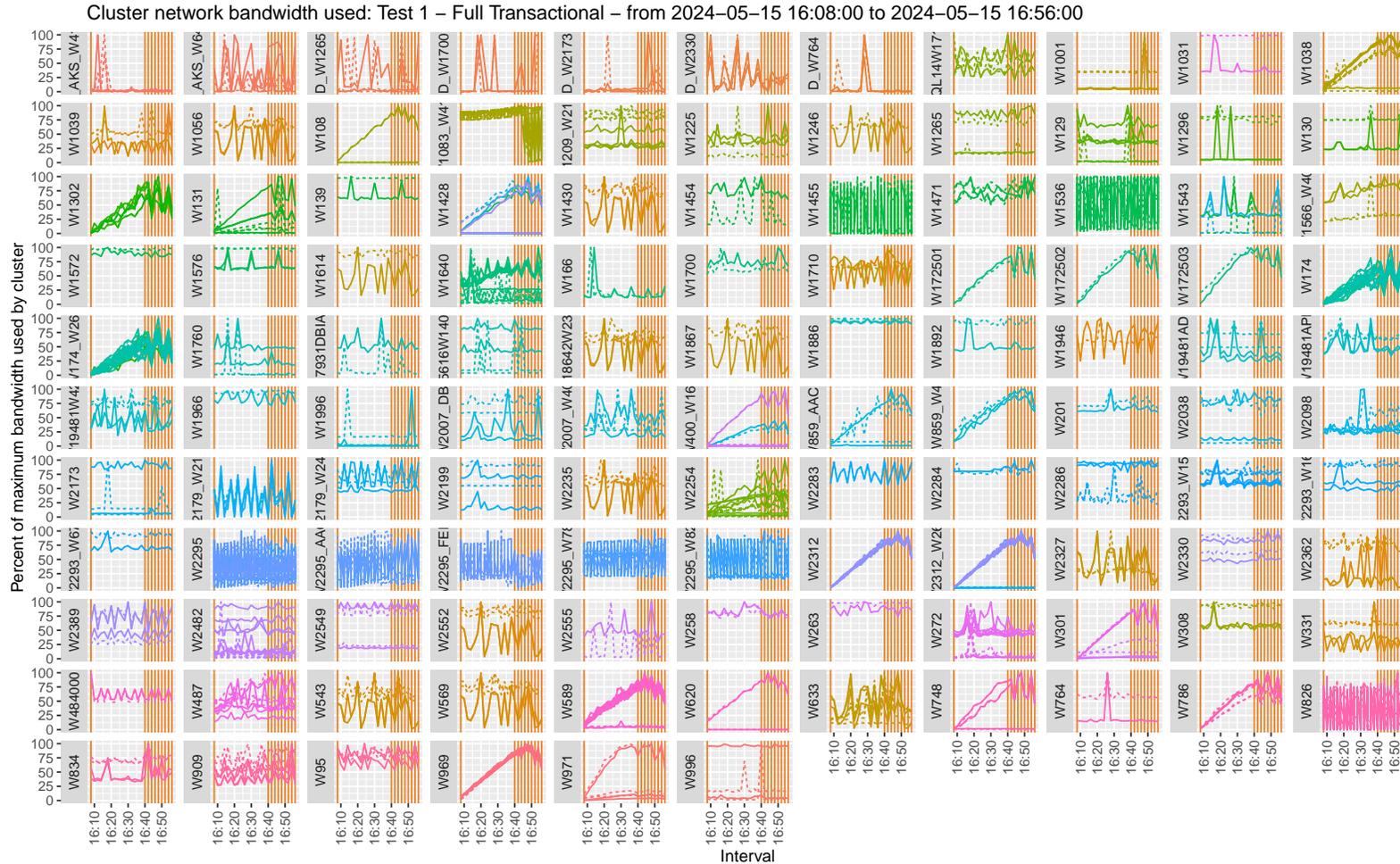
Figure 4.10: Proof sheet showing server network bandwidth usage as a percent of the maximum server bandwidth usage for the cluster. Horizontal patterns, whether shown with high variance across the times of the test or not, are an indication of a lack of dependence on the offered load, and hence that these clusters are not significantly involved in the test. Cluster `W859_AAC` shows a pattern where the data received has a smooth pattern, but the data sent has a higher variance, and should be investigated. It is clear from the figure that clusters such as `W2312` and `W1302` are load-balanced, but that clusters `W971` and `W131` are not. Cluster `W971` appears to be an Active-Passive cluster.

Figure 4.11: Proof sheet showing cluster network bandwidth usage as a percent of the maximum cluster bandwidth usage. The figure shows the cluster view (without the details of the individual servers) of the network bandwidth usage for sending and receiving data over the time intervals of the test. As before, it is clear from the graphics which clusters do not significantly participate in the tests, and which cluster do. Cluster `W859_AAC` shows a similar disconnect between the data received and data sent by the cluster.

Figure 4.12 shows a scatter plot of the standardised residuals of the fitted regression line predicting the level of network bandwidth resource usage (for both sending and receiving data) from the customer arrival rate. The scatter plots are faded out for those cluster network resources for which the estimated slope is not significantly greater than zero at the $\alpha = 0.05$ level. The colours of the points for each scatter plot show which of the Shapiro-Wilk tests on the standardised residuals for the respective metrics are significant, suggesting evidence against the hypothesis of normality of the error terms in the respective linear models. Together, these features indicate which of the clusters meaningfully consume network bandwidth resources as participants in the test. That is, the scatter plots indicate which of the servers meaningfully participate in the tests in terms of network bandwidth consumption.
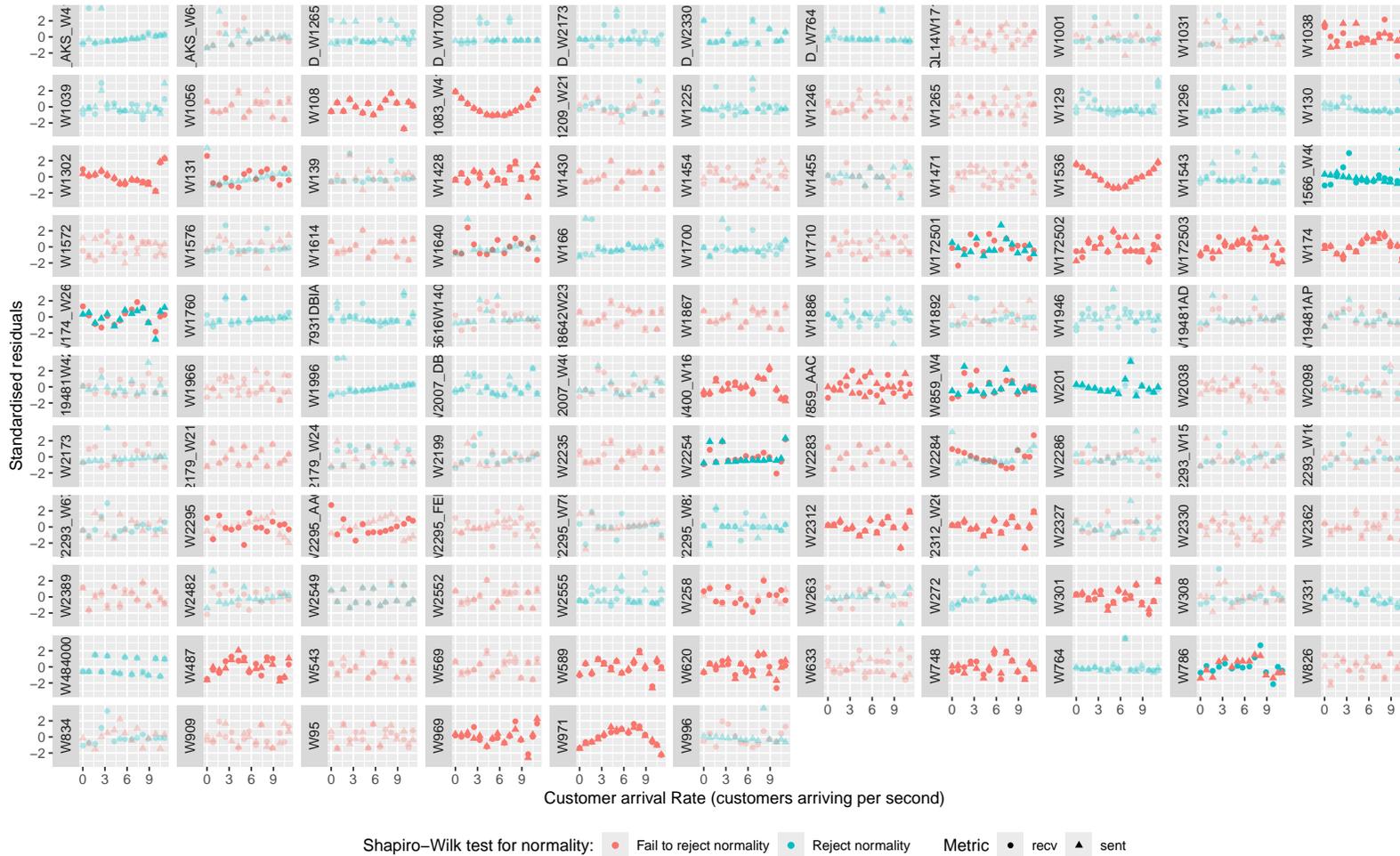
Figure 4.12: Scatter plots of standardised residuals for the models regressing network bandwidth resource usage onto the customer arrival rate. The figure shows diagnostic scatter plots for each cluster in the landscape, where each graph shows a scatter plot for the data sent and the data received by the cluster. The faded dots indicate those network cluster metrics which have been determined to not have significantly participated in the tests in the sense that there is no positive linear relationship between the customer arrival rate and the level of network bandwidth resource usage for the particular metric. The colouring of the points indicates whether or not there is sufficient evidence for the Shapiro-Wilk test to reject the normality assumption of the standardised residuals.

Figure 4.13 shows plots of regression lines of the fitted models for each of the clusters, and within each cluster, the metric for data sent by the cluster and the metric for data received by the cluster, together with 95% confidence bands. As with figure 4.12, the shading indicates those clusters where the estimated slope (the increase in network bandwidth usage metrics for a unit increase in the customer arrival rate) is non-negative and significantly greater than zero at the $\alpha = 0.05$ level. The colour of the regression and confidence bands indicates the outcome of the Shapiro-Wilk test on the standardised residuals. As with the CPU resource usage, it is clear from both Figure 4.12 and 4.13 that for some of the clusters for which the Shapiro-Wilk test failed to reject the normality assumption, that there is a pattern amongst the levels of the standardised residuals as the customer arrival rate increases, but that the 95% confidence bands for these are very narrow. It may be that the observed patterns are an artefact of these narrow bands. Cluster `W1083_W418` (second row, fourth plot from the left in both figures) shows standardised residuals for both sending and receiving are reasonably matched, but not randomly scattered about zero. The same cluster shows a similar pattern in the standardised residuals for CPU resource usage, as shown in Figure 4.8. This cluster shows a high background load on the network, but not correspondingly high CPU resource usage for background load. The behaviour of the application on cluster `W1083_W418` should be investigated.
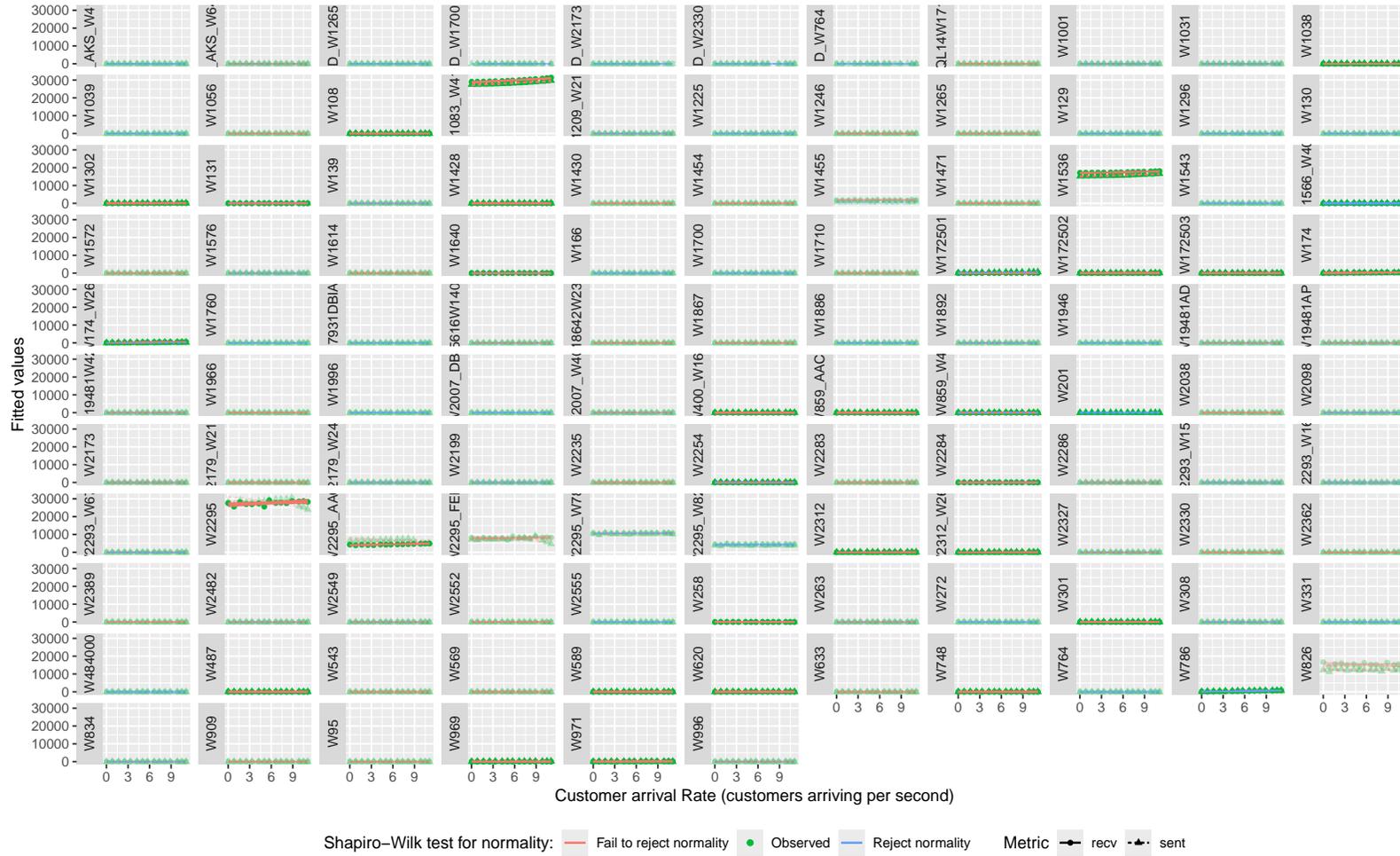
Figure 4.13: Network resource usage regression lines with 95% confidence bands. The figure shows regression lines for all clusters on the same scale. The faded images indicate those clusters which have been determined to not have significantly participated in the tests in the sense that there is no positive linear relationship between the customer arrival rate and the level of network bandwidth resource usage. The colouring of the points indicates whether or not there is sufficient evidence for the Shapiro-Wilk test to reject the normality assumption of the error terms. Hence, visual identification of those clusters which are the heaviest users of the respective provisioned resource capacity is straightforward.

4.2.1.4   Network load balancing within clusters

For those clusters for which the load is expected to be balanced over the member servers, just as there is an expectation that the CPU usage reflects this balance, so too should the network bandwidth usage reflect this balance. The consistent unit of measure adopted here for CPU resource usage is the respective percentage of provisioned resource usage for clusters and their individual server members. However, for network resource usage, this measure is their absolute network bandwidth usage. Hence, for a balanced load across a cluster of k servers, the expected load for the cluster is expected to be k times the bandwidth usage of a member server. For each cluster, this should apply separately to the network bandwidth used to send data to the cluster and for data received by the cluster.

Similar to the case of determining load balancing using CPU usage, the null hypothesis that a specific server shows load balancing is that the estimated coefficient for β_1 when regressing the cluster usage onto an individual server is not significantly different from k, that is $H_0 : \beta_1 = k$, and that this is the case for all servers in the cluster. The test statistic is then computed as

$$t^* \quad = \frac{\widehat{\beta_1} - k}{\mathrm{SE}(\widehat{\beta_1})}$$

under the null hypothesis, $H_0 : \beta_1 = k$, $t^* \sim t_{n-1}$ (if the regression assumptions hold).

Table 4.5 shows the results for three of the clusters shown in Figure 4.10 (clusters `W969`, `W971`, and `W1302`). In accord with the figure, the results show the coefficients (the slopes) for servers `W13021`, `W13021`, `W13024`, `W9694`, `W97101`, `W97101`, `W97102`, `W97102`, `W97103`, and `W97103` are significantly out of balance at the $\alpha = 0.01$ level, and hence an indication of an imbalance of load amongst the servers of the respective clusters. An exception is server `W9694` where this appears to be spurious as the estimate is only slightly over 10. Additionally, the table shows that the intercepts for servers `W13021`, `W13021`, `W9691`, `W97101`, and `W97102` are significantly different from zero at the $\alpha = 0.01$ level. This departure from zero of the intercept may be an indication of outside influence on the test and is an example of an item flagged for investigation. Table A.6 shows the results for the servers across all clusters.

Table 4.5: Balance test results in terms of network resource consumption for clusters W969, W971, and W1302. The table shows that for these clusters, the network resource usage on servers W13021, W13021, W13024, W9694, W97101, W97101, W97102, W97102, W97103, and W97103 are significantly out of balance at the $\alpha = 0.01$ level. However, for server W9694 this appears to be a false positive as the slope estimate is only slightly over 10 (at 10.4).

Test Number	Cluster	Server	Servers	metric	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=k t-value	Slope=k p-value	R2	F-stat	df1	df2	p-value
1	W1302	W13021	5	recv	23.172	4.53	5.11	0.000	3.5	0.242	-6.217	0.000	0.94	208	1	13	0
1	W1302	W13021	5	sent	9.325	2.01	4.65	0.000	3.6	0.281	-5.123	0.000	0.93	160	1	13	0
1	W1302	W13022	5	recv	-3.490	7.43	-0.47	0.646	4.4	0.369	-1.744	0.105	0.92	139	1	13	0
1	W1302	W13022	5	sent	-1.655	2.66	-0.62	0.544	4.3	0.331	-2.084	0.057	0.93	170	1	13	0
1	W1302	W13023	5	recv	3.839	6.39	0.60	0.559	4.2	0.334	-2.253	0.042	0.93	162	1	13	0
1	W1302	W13023	5	sent	1.291	2.25	0.57	0.575	4.2	0.295	-2.677	0.019	0.94	204	1	13	0
1	W1302	W13024	5	sent	-5.140	4.55	-1.13	0.279	8.0	0.969	3.074	0.009	0.84	68	1	13	0
1	W1302	W13024	5	recv	-16.499	13.44	-1.23	0.241	8.3	1.128	2.912	0.012	0.81	54	1	13	0
1	W1302	W13025	5	sent	1.786	1.43	1.25	0.234	5.0	0.223	-0.149	0.884	0.97	494	1	13	0
1	W1302	W13025	5	recv	7.193	3.77	1.91	0.079	4.7	0.226	-1.209	0.248	0.97	438	1	13	0
1	W969	W9691	10	sent	2.160	0.75	2.88	0.013	9.9	0.076	-1.350	0.200	1.00	16769	1	13	0
1	W969	W9691	10	recv	0.917	0.22	4.12	0.001	9.5	0.184	-2.862	0.013	0.99	2663	1	13	0
1	W969	W96910	10	sent	0.779	1.06	0.74	0.474	9.9	0.106	-0.939	0.365	1.00	8677	1	13	0
1	W969	W96910	10	recv	0.211	0.15	1.36	0.197	9.8	0.125	-1.695	0.114	1.00	6122	1	13	0
1	W969	W9692	10	sent	0.485	1.03	0.47	0.646	9.9	0.104	-0.575	0.575	1.00	9137	1	13	0
1	W969	W9692	10	recv	-0.150	0.23	-0.64	0.531	10.1	0.189	0.491	0.631	0.99	2855	1	13	0
1	W969	W9693	10	recv	0.047	0.25	0.19	0.855	9.8	0.202	-0.874	0.398	0.99	2369	1	13	0
1	W969	W9693	10	sent	-0.090	1.00	-0.09	0.929	9.9	0.100	-0.810	0.433	1.00	9845	1	13	0
1	W969	W9694	10	recv	-0.327	0.13	-2.46	0.028	10.4	0.110	4.072	0.001	1.00	9015	1	13	0
1	W969	W9694	10	sent	-1.055	0.99	-1.07	0.304	10.1	0.100	1.387	0.189	1.00	10297	1	13	0
1	W969	W9695	10	sent	-0.680	1.69	-0.40	0.694	10.0	0.169	-0.078	0.939	1.00	3482	1	13	0
1	W969	W9695	10	recv	-0.337	0.22	-1.50	0.156	10.1	0.180	0.636	0.536	1.00	3172	1	13	0
1	W969	W9696	10	recv	0.175	0.10	1.67	0.119	9.8	0.085	-2.122	0.054	1.00	13507	1	13	0
1	W969	W9696	10	sent	-0.391	0.83	-0.47	0.644	10.0	0.083	-0.319	0.755	1.00	14492	1	13	0
1	W969	W9697	10	recv	0.087	0.25	0.35	0.730	9.5	0.191	-2.820	0.014	0.99	2462	1	13	0
1	W969	W9697	10	sent	-0.144	1.19	-0.12	0.905	9.9	0.119	-0.988	0.341	1.00	6954	1	13	0
1	W969	W9698	10	recv	-0.632	0.27	-2.31	0.038	10.7	0.227	2.957	0.011	0.99	2210	1	13	0
1	W969	W9698	10	sent	-0.921	1.50	-0.61	0.551	10.2	0.153	1.030	0.322	1.00	4418	1	13	0
1	W969	W9699	10	sent	1.823	2.31	0.79	0.445	10.0	0.237	-0.070	0.945	0.99	1775	1	13	0
1	W969	W9699	10	recv	0.397	0.35	1.14	0.276	10.0	0.292	-0.064	0.950	0.99	1172	1	13	0
1	W971	W97101	3	recv	-1.501	0.88	-1.71	0.110	1.1	0.009	-217.293	0.000	1.00	17961	1	13	0
1	W971	W97101	3	sent	1.774	0.19	9.54	0.000	1.2	0.009	-194.933	0.000	1.00	16350	1	13	0
1	W971	W97102	3	recv	16.644	5.17	3.22	0.007	9.9	0.511	13.577	0.000	0.97	378	1	13	0
1	W971	W97102	3	sent	-2.706	1.00	-2.71	0.018	8.1	0.289	17.674	0.000	0.98	786	1	13	0
1	W971	W97103	3	recv	6.215	6.19	1.00	0.334	32.5	1.830	16.119	0.000	0.96	315	1	13	0
1	W971	W97103	3	sent	-16.914	6.24	-2.71	0.018	20.4	3.059	5.690	0.000	0.77	44	1	13	0

4.3 Comparisons across tests

The analysis of each test session processed in the pipeline results in summary resource usage and performance data being recorded. The pipeline is thus able to pick up results from previous tests and present comparisons to these tests. The comparisons are useful as it is not always obvious with just the test in hand what the expected response times, background resource usage, or load determined resource usage should be. At least the history establishes a precedent.

4.3.1 Performance

Table 4.6 shows those functions for which the bootstrap test shows a significant increase in the response times at the first milestone as estimated by the local regression. The test of significance is carried out as a one-sided test at the $\alpha = 0.05$ level. Compared to Table 4.2, Table 4.6 shows that some of the poor performing items have not been determined to be significantly worse than they have been in previous tests. Statistically significant improvements in response times could also be tabulated, if required, by reversing the side of the bootstrap tests. Comparisons are made with prior tests with the same configuration as the current test, in this case *Full Transactional.*

Table 4.6: Degraded estimated response times (and throughput rates) at the interval that achieved the first milestone of the customer arrival rate. The table shows only the first 18 items, arranged in descending order on their local regression estimated response times at the first milestone, and for which the bootstrap test p-value indicates that the response times are significantly greater than the corresponding response times from previous tests at the $\alpha = 0.05$ level.

Test Number	Basename	Local Regression Predict	Local Regression 95CILo	Local Regression 95CIHi	Samp Size	Samp Mean Resp	Samp Var Resp	SEM	Rate	Bootstrap p-value
1	W1218_W1232_0	11.8	10.33	13.3	1301	10.20	0.308	0.015	10.842	0.000
1	W1237_W444_W611_0	11.7	10.15	13.2	8	9.88	0.113	0.119	0.067	0.003
1	W999_W1649_CA_W...	11.6	10.45	12.7	4	10.26	0.099	0.158		0.000
1	W999_W1649_CA_W...	11.5	10.11	12.9	3	10.33	0.374	0.353	0.025	0.000
1	W1822_W2434_W69...	11.4	10.19	12.7	84	10.18	0.354	0.065	0.700	0.000
1	W1822_W2434_W69...	11.3	10.17	12.5	282	10.15	0.292	0.032	2.350	0.003
1	W1822_W2434_W696_0	11.3	10.11	12.5	281	10.11	0.288	0.032	2.342	0.000
1	W1237_W444_W1662_0	11.3	10.14	12.4	71	10.06	0.256	0.060	0.592	0.008
1	W999_W1649_CA_W...	1.5	0.73	2.3	5	1.75	2.128	0.652	0.042	0.004
1	W999_W1649_CA_W...	1.5	1.21	1.8	3	1.61	0.278	0.304	0.025	0.000
1	W1237_W444_W611...	1.4	1.04	1.8	5	1.41	0.214	0.207	0.042	0.028
1	W1822_W2434_W69...	1.4	1.08	1.7	558	1.05	0.142	0.016	4.650	0.000
1	W1822_W2434_W69...	1.4	1.04	1.7	548	1.04	0.156	0.017	4.567	0.001
1	W1822_W2434_W69...	1.4	1.05	1.7	169	1.07	0.169	0.032	1.408	0.000
1	W1822_W2434_W69...	1.4	1.09	1.6	153	1.07	0.196	0.036	1.275	0.003
1	W1237_W444_W166...	1.3	1.12	1.5	65	1.13	0.194	0.055	0.542	0.027
1	W999_W1649_CA_W...	1.2	0.78	1.6	1	0.78			0.008	0.000
1	W999_W1649_CA_W...	1.2	0.57	1.7	4	0.40	0.067	0.129		0.000

4.3.2 Resource usage

Figures 4.14, 4.15, 4.16, 4.17, 4.18, and 4.19 show proof sheets comparing resource usage estimates across recent tests. One of these recent tests was executed under a different test configuration to the present test. For the present test, the configuration of interest in the proof sheets is called *Full Transactional*. In the figures, the faded images indicate that for the current test, a non-parametric bootstrap test did not find evidence of a statistically significant increase of the estimate at the $\alpha = 0.05$ level. Although the respective figures show the latest estimates for at most 9 of the latest test executions, the non-parameter bootstrap tests include estimates for up to the last 29 test executions.

Figure 4.14 compares the CPU resource cost estimates for each of the clusters in terms of percent CPU usage required to support a single customer arrival per second. It is clear from the figure that for most clusters the CPU resource cost per customer arrival per second has been steady over time, but for cluster `W172501` there has been a steady increase in the CPU cost of a customer arrival per second across the tests. This cluster is explored further later.

Figure 4.15 compares estimates of background CPU over recent tests across the clusters. From the figure it is clear that for the most part the background CPU usage has mostly been quite stable (indicating a good control of the test environment). The exceptions are clusters `W2330` which has shown a steady increase over recent tests, and `W969` which shows a possible pattern of an even more recent upturn in the background CPU load.

Figure 4.16 compares the estimated network bandwidth usage for data sent by each cluster to support a customer arrival rate of one customer per second for recent tests. The figure shows that while there has been some variation in network bandwidth usage (for clusters sending data) in recent tests for a few of the clusters, for the current test the bandwidth usage appears reasonably consistent and stable.

Figure 4.17 compares the estimates for the network bandwidth used by the clusters for sending data as part of the background load (traffic not considered to be dependent on the test load). The figure shows that the estimates for the background loads for a few of the clusters have varied over recent tests, and that clusters `W1083_W418` and `W2295` have fared better in the past and suggests that the clusters could be better controlled while participating in the tests.

Figure 4.18 compares estimates of the slope from regressing successful load onto network bandwidth used for receiving data for each each of the clusters. The figure shows that while there has been some variation in network bandwidth usage (for clusters receiving data) in recent tests for a few of

the clusters, for the current test the bandwidth usage appears reasonably consistent and stable.

Figure 4.19 compares estimates for the network bandwidth used by the clusters to receive data as part of the background load (traffic not considered to have to be dependent on the test load). The figure shows that the estimates for the background loads for a few of the clusters have varied over recent tests, and that of these clusters `W1083_W418` and `W2295` have fared better in the past and suggests that the clusters could be better controlled while participating in the tests.
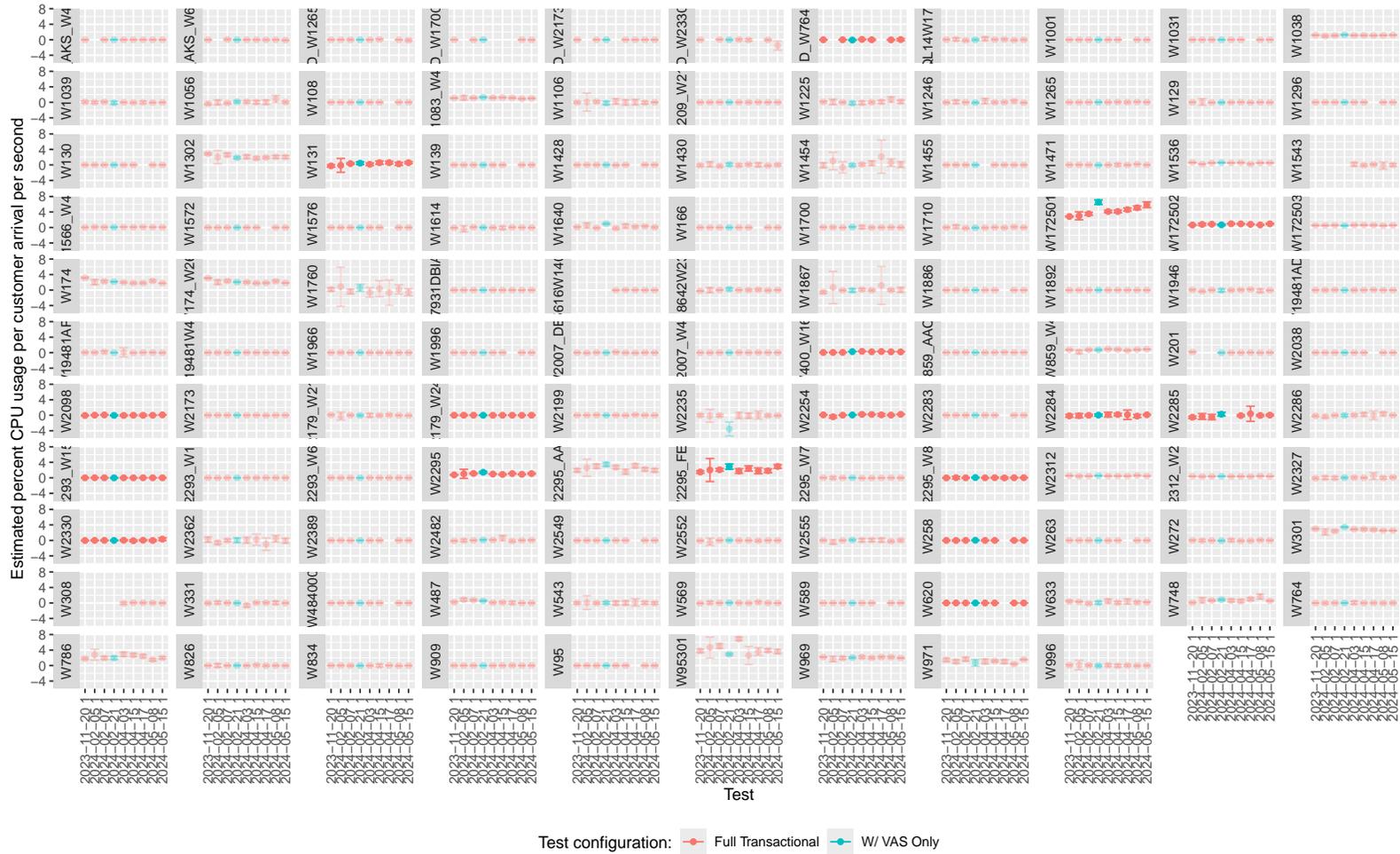
Figure 4.14: Cross test estimates of the slope from regressing successful load onto CPU resource usage for each of the clusters. From the graphic it is clear that for most clusters the CPU resource cost per customer arrival per second has been steady over time, but for cluster W172501 there has been a steady increase in the CPU cost of a customer arrival per second across the tests.
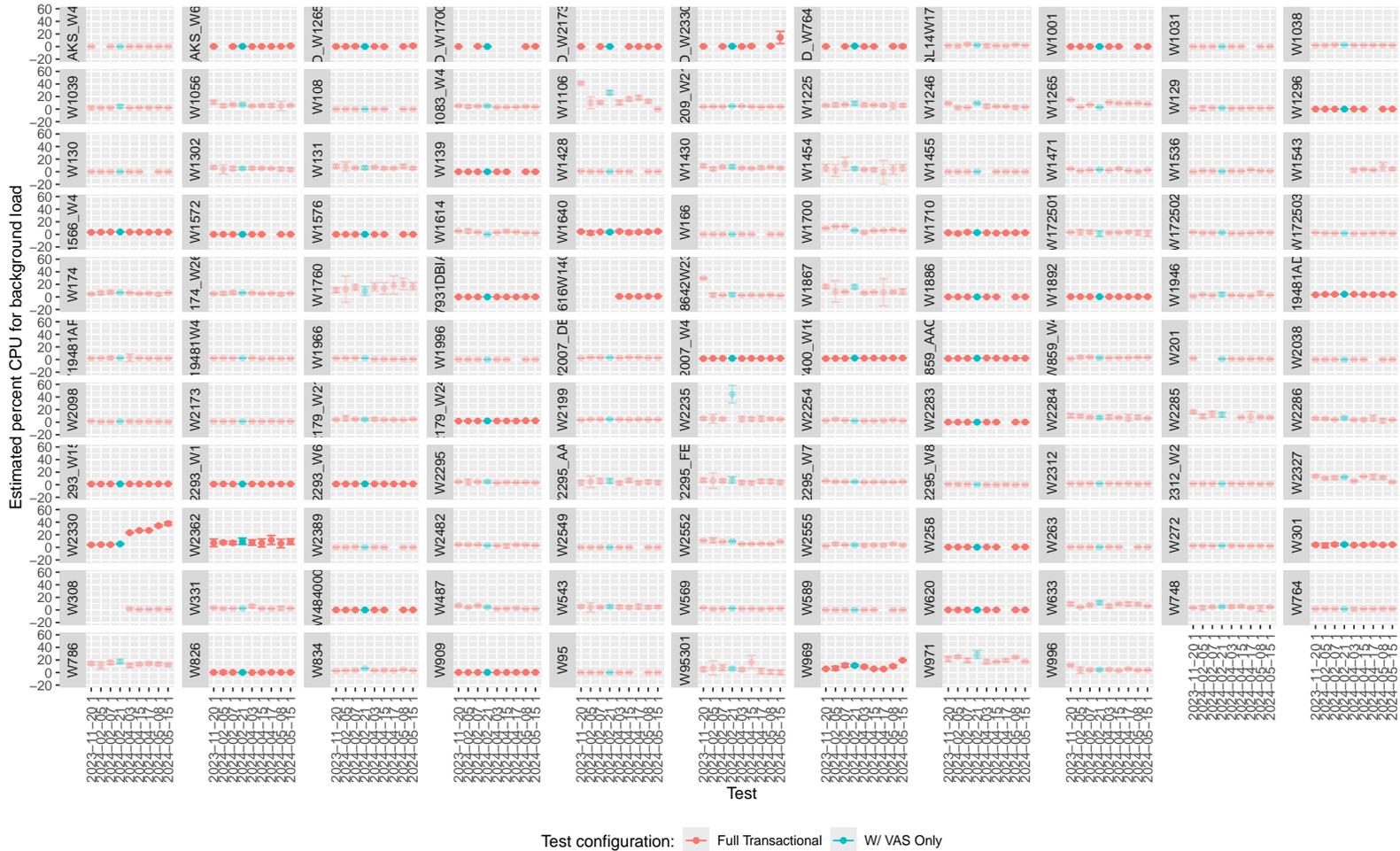
Figure 4.15: Cross test estimates for the percent CPU usage consumed by the background load, that is, the CPU usage which is independent of the test load for each of the clusters. The graphic shows that across the tests, the cluster background loads have mostly been quite stable (indicating a good control of the test environment). The exceptions are clusters W2330 which has shown a steady increase over recent tests, and W969 which shows a possible pattern of an even more recent upturn in the background CPU load.

Figure 4.16: Cross test estimates of the slope from regressing successful load onto network bandwidth used for sending data for each each of the clusters. The graphic shows that while there has been some variation in network bandwidth usage (for clusters sending data) in recent tests for a few of the clusters, for the current test the bandwidth usage appears reasonably consistent and stable.

Figure 4.17: Cross test estimates for the network bandwidth used by the clusters to send data as part of the background load (traffic not considered to have resulted as a result of the test load). The graphic shows that the estimates for the background loads for a few of the clusters have varied over recent tests, and that of these clusters `W1083_W418` and `W2295` have fared better in the past and suggests that the clusters could be better controlled while participating in the tests.

Figure 4.18: Cross test estimates of the slope from regressing successful load onto network bandwidth used for receiving data for each each of the clusters. The graphic shows that while there has been some variation in network bandwidth usage (for clusters receiving data) in recent tests for a few of the clusters, for the current test the bandwidth usage appears reasonably consistent and stable.
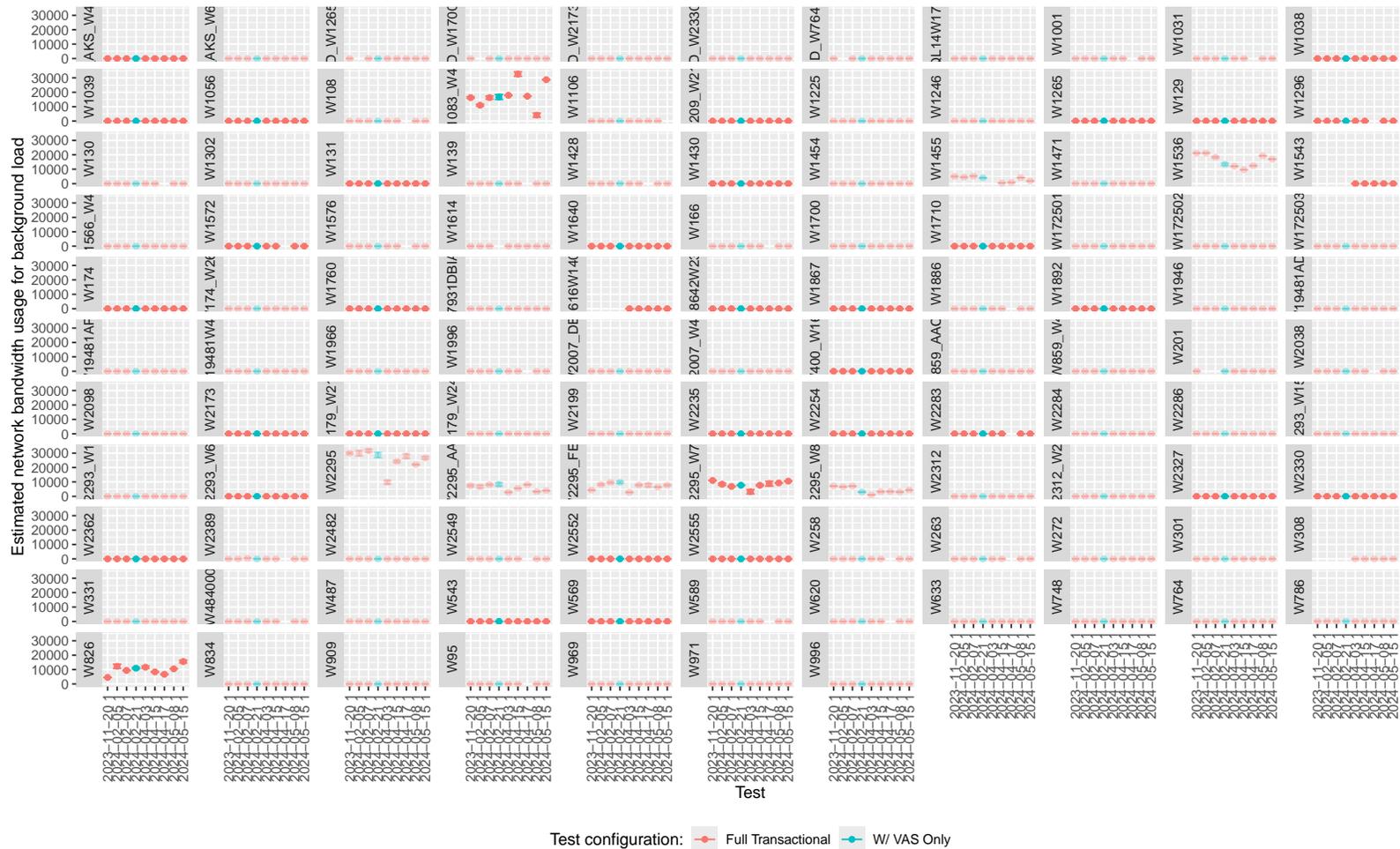
Figure 4.19: Cross test estimates for the network bandwidth used by the clusters to receive data as part of the background load (traffic not considered to have resulted as a result of the test load). The graphic shows that the estimates for the background loads for a few of the clusters have varied over recent tests, and that of these clusters `W1083_W418` and `W2295` have fared better in the past and suggests that the clusters could be better controlled while participating in the tests.

4.4   Observations

While the current test achieved its first milestone of 10 customer arrivals per second, it did not achieve its second milestone of 20 customer arrivals per second. Its is clear from Table 4.3 that the estimated CPU capacity for cluster `W172501` that the second milestone may not be feasible as the estimated required CPU to process a customer arrival rate of 20 customer per second exceeds the CPU capacity provisioned (even if the capacity were sufficient, there may be other causes preventing the second milestone from being achieved).

There is only one server in cluster `W172501`. Figure 4.6 and Figure 4.7 show several clusters with a resource usage pattern consistent with saturation as the test approaches the poor quality observations and the observations demonstrating outliers in the offered-load successful-load regression. While it is possible any of these clusters are responsible for the test not achieving its second milestone, suspicion should first fall on the cluster with the largest percent of used provisioned resources, that is, cluster `W172501` (some clusters are allowed to use more than 100% of their provisioned capacity should the additional resource be available).

Figure 4.10 and Figure 4.11 show similar pictures in terms of network bandwidth usage. Cluster `W172501` hosts a database. In the absence of any interference, a good proxy of the request load of a database server is the network traffic received by the hosting cluster. Figures 4.10 and 4.11 show that the data received by the cluster and the data sent by the cluster both increased smoothly with increasing load placed on the system-under-test.

Figure 4.14 shows that the cluster `W172501` may not always have been a problem, In the figure, for the prior tests conducted with the same configuration as present test, it is clear that the CPU cost per customer arrival per second has been increasing over recent tests. To test that this is not an artefact of the system-under-test, but rather an issue localised to the database server, a post hoc test using the network bandwidth data (as proxies of the query requests and query responses) is used. Regressing the respective network bandwidth usage metrics onto the CPU usage shows that there is no evidence of a linear relationship between the network resource usage estimated and the corresponding CPU usage estimates required to support a customer arrival per second.

Comparison of network and CPU resource usage

Legend: ● recv ● sent
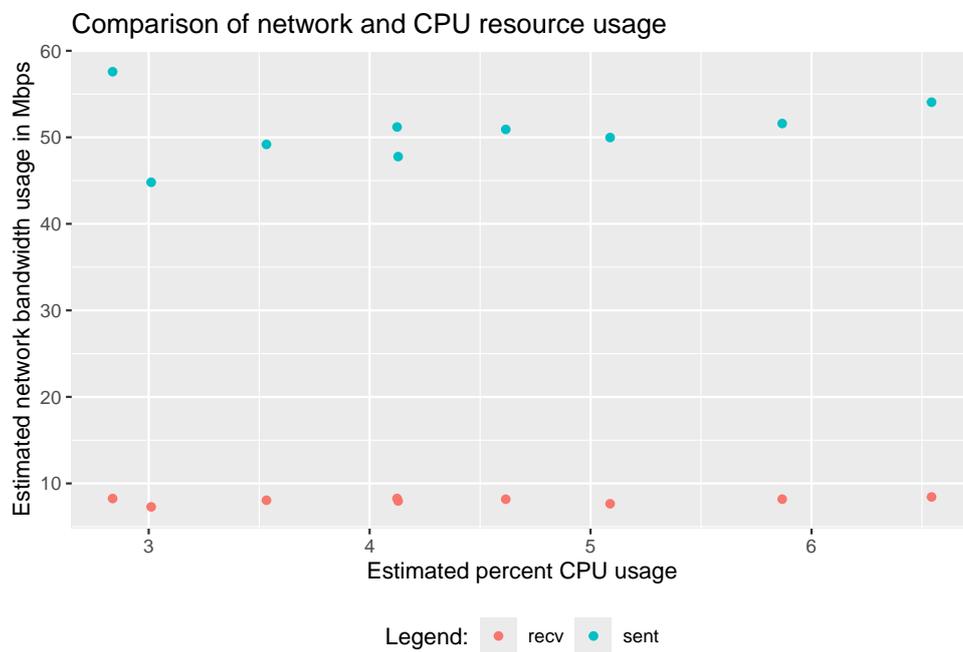
Figure 4.20: Scatter plot showing the estimated network bandwidth resource usage versus the estimated CPU resource usage over recent tests. The resource usage levels are those required to support a customer arrival per second for cluster `W172501`.

Table 4.7: Summary of fitting linear model regressing estimated CPU resource usage per customer arrival per second onto estimated network resource usage for data sent by cluster `W172501` and separately onto estimated network resource usage for data received by cluster `W172501`. The observations are taken from corresponding resource estimates across recent tests. The table shows that the p-value for the F-statistic, alternatively, the p-value for the t-statistic, for the slope parameter is not significant at the $\alpha = 0.05$ level, and hence there is no reason to doubt the slope is different from zero.

ClusterMetric	Int Est	Int Std Err	Int t value	Int p-value	Slope Est	Slope Std Err	Slope t value	Slope p-value	R2	F-Stat	df1	df2	p-value
W172501sent	0.84	6.5	0.13	0.90	0.07	0.13	0.55	0.60	0.042	0.31	1	7	0.60
W172501recv	-7.31	9.7	-0.75	0.48	1.46	1.21	1.21	0.27	0.172	1.46	1	7	0.27

Figure 4.20 shows a scatter plot of the cluster `W172501` estimated CPU and network resource usage values over recent tests. The figure shows that there is no evidence of increased database request activity corresponding to the estimated increase in CPU resource usage. Table 4.7 shows the results of regressing the estimated CPU resource usage required to support a customer arrival per second onto the estimated network resource usage required to support a customer arrival per second for cluster `W172501` across the tests. The p-values for both the F-statistic and the t-statistic show that there is no evidence to suggest that the coefficient of the network bandwidth usage is significantly different from zero at the $\alpha = 0.05$ level. And hence that the null hypothesis $H_0 : \beta_1 = 0$ is not rejected.

Thus there is evidence that the increase in CPU usage is not as a result of an increase in the database requests, but rather a localised increase in the CPU costs of the queries over time. Such changes are consistent with increasing amounts of access activity as table data grows. This is possibly an indication some cleanup is required, or an access strategy should be reviewed (for example, consider adding an additional index). Any remedial action should take into account the sizes of the tables in the field, keeping the test environment aligned with the field behaviour and content as much as possible.

Figure 4.15 shows that there has been no corresponding increase in the overhead or load independent CPU resource usage on the cluster.

By contrast, Figure 4.15 does show that the estimated background load on cluster `W2330` has been steadily increasing over recent tests. Although less clear, and less severe, so has the estimate of the background load for clusters `W1760` and `W969`. The value for cluster `W2330` is particularly poor with an estimated CPU usage of 37.8% of the provisioned CPU resources being used for background processing (see Table 4.3).

For cluster `W95301`, Figure 4.6 shows an initial balance of the CPU usage between the members of the cluster, but approximately halfway through the test, there is a jump in the CPU for one of the servers. This may be an indication of external influence impacting the test, or that one of the members of the cluster started having problems. However, if this is because of problems, it did not impact the test as the quality of observations did not drop at this point.

The graph for cluster `W969` in Figure 4.6 shows a pattern of CPU resource usage of that rises consistently with the test load, but with different background loads among the members of the cluster.

Some of the clusters shown in Figure 4.6 show a pattern of CPU resource usage consistent with an imbalanced load across the servers. An obvious example is cluster `W971`. This is also clear from Figure 4.10 showing the corresponding

imbalances of network resource usage. For the network resource usage, Table 4.5 shows the results of testing each server's network resource usage as a proportion of the cluster's network resource usage. For cluster `W971`, the table shows the proportion of the total is significantly different from the expected proportion of the total for each of the cluster members.

4.5 Pipeline observations

Many of the statistical tests are carried out in the pipeline, including testing for significance, and thresholds for milestone projections, proportions for quality observations, as well as determination and removal of outliers. Dropping observations and observed significance tests, results in notes being generated by the pipeline, which in turn should be included in the reporting. Ultimately, all tests should be accommodated in the pipeline to ensure a rigorous and repeatable process. The following observations are un-edited notes produced by the pipeline for the current test.

4.5.1 Test 1 - Full Transactional - from 2024-05-15 16:08:00 to 2024-05-15 16:56:00

1. For the second milestone, the estimated network bandwidth usage for cluster `W1083_W418` is 32821.627 Mbps and exceeds capacity provisioned.
2. For the second milestone, the estimated network bandwidth usage for cluster `W1083_W418` is 31190.364 Mbps and exceeds capacity provisioned.
3. For the second milestone, the estimated network bandwidth usage for cluster `W1536` is 18699.419 Mbps and exceeds capacity provisioned.
4. For the second milestone, the estimated network bandwidth usage for cluster `W1536` is 17497.328 Mbps and exceeds capacity provisioned.
5. For the second milestone, the estimated network bandwidth usage for cluster `W2295` is 30020.338 Mbps and exceeds capacity provisioned.
6. For the first milestone, the estimated network bandwidth usage for cluster `W1083_W418` is 30782.043 Mbps and exceeds capacity provisioned.
7. For the first milestone, the estimated network bandwidth usage for cluster `W1083_W418` is 29208.137 Mbps and exceeds capacity provisioned.
8. For the first milestone, the estimated network bandwidth usage for cluster `W1536` is 17838.074 Mbps and exceeds capacity provisioned.
9. For the first milestone, the estimated network bandwidth usage for cluster `W1536` is 16282.539 Mbps and exceeds capacity provisioned.
10. For the first milestone, the estimated network bandwidth usage for cluster `W2295` is 28353.872 Mbps and exceeds capacity provisioned.
11. In test 1, for some of the clusters, there does not appear to be any evidence at the $\alpha = 0.050000$ level of significance to suggest that

the network usage is positively correlected with the successful load. This appears to be the case for the following clusters: : `D_AKS_W415`, `D_AKS_W415`, `D_AKS_W647`, `D_AKS_W647`, `D_W1265`, `D_W1265`, `D_W1700`, `D_W1700`, `D_W2173`, `D_W2173`, `D_W2330`, `D_W2330`, `D_W764`, `D_W764`, `SQL14W1719`, `SQL14W1719`, `W1001`, `W1001`, `W1031`, `W1031`, `W1039`, `W1039`, `W1056`, `W1056`, `W1209_W2181`, `W1209_W2181`, `W1225`, `W1225`, `W1246`, `W1246`, `W1265`, `W1265`, `W129`, `W129`, `W1296`, `W1296`, `W130`, `W130`, `W131`, `W139`, `W139`, `W1430`, `W1430`, `W1454`, `W1454`, `W1455`, `W1455`, `W1471`, `W1471`, `W1543`, `W1543`, `W1572`, `W1572`, `W1576`, `W1576`, `W1614`, `W1614`, `W1640`, `W166`, `W166`, `W1700`, `W1700`, `W1710`, `W1710`, `W1760`, `W1760`, `W17931DBIAPP`, `W17931DBIAPP`, `W185616W1400401`, `W185616W1400401`, `W18642W2324`, `W18642W2324`, `W1867`, `W1867`, `W1886`, `W1886`, `W1892`, `W1892`, `W1946`, `W1946`, `W19481ADB`, `W19481ADB`, `W19481APP`, `W19481APP`, `W19481W429`, `W19481W429`, `W1966`, `W1966`, `W1996`, `W1996`, `W2007_DB2`, `W2007_DB2`, `W2007_W400`, `W2007_W400`, `W201`, `W2038`, `W2038`, `W2098`, `W2098`, `W2173`, `W2173`, `W2179_W2190`, `W2179_W2190`, `W2179_W2415`, `W2179_W2415`, `W2199`, `W2199`, `W2235`, `W2235`, `W2283`, `W2283`, `W2284`, `W2286`, `W2286`, `W2293_W1519`, `W2293_W1519`, `W2293_W164`, `W2293_W164`, `W2293_W672`, `W2293_W672`, `W2295`, `W2295_AAC`, `W2295_FED`, `W2295_FED`, `W2295_W789`, `W2295_W789`, `W2295_W822`, `W2295_W822`, `W2327`, `W2327`, `W2330`, `W2330`, `W2362`, `W2362`, `W2389`, `W2389`, `W2482`, `W2482`, `W2549`, `W2549`, `W2552`, `W2552`, `W2555`, `W2555`, `W258`, `W263`, `W263`, `W272`, `W272`, `W308`, `W308`, `W331`, `W331`, `W484000`, `W484000`, `W543`, `W543`, `W569`, `W569`, `W633`, `W633`, `W764`, `W764`, `W826`, `W826`, `W834`, `W834`, `W909`, `W909`, `W95`, `W95`, `W996` and `W996`.

12. For the second milestone, the estimated percent of provisioned CPU usage for cluster `W172501` is 118.858 percent and exceeds capacity provisioned.

13. Due to a lack of unique observations in test 1, a linear model could not successfully be created for the following clusters: `W1106` and `W1455`.

14. The observation correspnding to interval 2024-05-15 16:56:00 is considered a high-inlfluence observation, and omitted from the regression. This observation should be invesgigated to make sure that the cause is external to the test.

15. The observation correspnding to interval 2024-05-15 16:50:00 is considered a high-inlfluence observation, and omitted from the regression. This observation should be invesgigated to make sure that the cause is external to the test.

16. The observation corresponding to the interval 2024-05-15 16:54:00 is considered a poor quality observation because the observation success rate of 97.33% is less than the required observation success rate of 98.00%. The observation is omitted from the analysis, but should be investigated for an assignable cause outside of the system-under-test.

17. The observation corresponding to the interval 2024-05-15 16:52:00 is

considered a poor quality observation because the observation success rate of 17.85% is less than the required observation success rate of 98.00%. The observation is omitted from the analysis, but should be investigated for an assignable cause outside of the system-under-test.

18. The observation corresponding to the interval 2024-05-15 16:48:00 is considered a poor quality observation because the observation success rate of 97.66% is less than the required observation success rate of 98.00%. The observation is omitted from the analysis, but should be investigated for an assignable cause outside of the system-under-test.

19. The observation corresponding to the interval 2024-05-15 16:46:00 is considered a poor quality observation because the observation success rate of 94.26% is less than the required observation success rate of 98.00%. The observation is omitted from the analysis, but should be investigated for an assignable cause outside of the system-under-test.

20. The observation corresponding to the interval 2024-05-15 16:44:00 is considered a poor quality observation because the observation success rate of 86.80% is less than the required observation success rate of 98.00%. The observation is omitted from the analysis, but should be investigated for an assignable cause outside of the system-under-test.

21. The observation corresponding to the interval 2024-05-15 16:42:00 is considered a poor quality observation because the observation success rate of 97.84% is less than the required observation success rate of 98.00%. The observation is omitted from the analysis, but should be investigated for an assignable cause outside of the system-under-test.

22. The observation corresponding to the interval 2024-05-15 16:40:00 is considered a poor quality observation because the observation success rate of 97.67% is less than the required observation success rate of 98.00%. The observation is omitted from the analysis, but should be investigated for an assignable cause outside of the system-under-test.

23. The observation corresponding to the interval 2024-05-15 16:08:00 is considered a poor quality observation because the observation success rate of 85.71% is less than the required observation success rate of 98.00%. The observation is omitted from the analysis, but should be investigated for an assignable cause outside of the system-under-test.

Chapter 5

Conclusion

A strict, careful and deliberate design that instils confidence in the causal linkage between the activities driven by the test-system, the responses to various functions of the system-under-test, and the levels of usage of resources connected to test-system activity, leads to enhanced assessments of capacity requirements, the tracking of performance, and the tracking of resource usage over repeated tests. These tests are conducted with labelled configurations, and are viewed as experimental studies of the preparedness of the system-under-test for field deployment. Instead of just a pass or fail outcome of the system-under-test based on the levels of nominal throughput rates and response times, by conducting the tests in the manner described here with load levels, performance and resource usage time-series data globally synchronised, a deeper layer of desirable properties can be assessed and estimated with demonstrably narrow confidence intervals. If the test data is as clean as possible, with a high expectation of business function level success (for example, in a load interval the business activity flow success rate is expected to be at least 98%), then variations of this can be attributed to undesirable behaviour of the system-under-test (rather than noise raised by the test-system, the test-data, or the environment in general). By using controlled increments to the offered load throughout the test plan (or experiment), that is, by incrementing the offered load by constant amounts precisely on the boundaries of fixed length duration load intervals, the expectation is that the system-under-test responds in a correspondingly controlled and steady manner, for the portion of the experiment that the provision of resources of system-under-test is expected to support.

In the absence of specific response time objectives, tests of the mean response time at the first milestone can be assessed against a default requirement (typically subsecond). However, the nature of the design of the experiment, the test plan (the length of load intervals and the increment of offered load

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applied to each interval), the weights for the choices amongst the possible business activities or functions, and the timings of the I/O FSMs as they are directed by the test-system (for example, timings for user think-times, time-out times and idle-times) makes for a repeatable test under the same external configuration (typically a repeat of the test is as a result of a change to the system-under-test, for example, to remedy a fault, to optimise some code, or to add a new feature or business function), which means that the historical test response times can be used to test response times against acceptable precedents and to report on significant variations to these.

The nature of the applications that make up the system-under-test is such that the resource level usage is expected to be strictly linear in the load level (in terms of customer arrivals per second). This offers an interpretation of the linear model coefficients for the intercept term and the slope term. In general, by cluster or server, there is an expectation that the level of resource usage required to support load independent functions makes up a relatively small percent of the available resources. For the present test, the respective estimates of the intercept parameters of the linear models are estimates of the resource usage required to support the background load (arranging zero offered load in the test plan ensures the level is not outside the range of predictors). And for the historic tests, the use of the non-parametric bootstrap test, a confidence interval or p-value allows for the detection of possible significant changes to the background load. Similarly for the cost per customer arrival per second for each cluster in terms of CPU resource usage or network bandwidth resource usage. With the non-parametric bootstrap test, the historic data provides tests on the means of the unit costs per customer arrival per second in terms of the resources of interest. Tests on the present response times based on the historic performance are conducted in a similar manner.

By arranging the analysis in a pipeline, the statistical tests are fixed as well as their respective significance levels. Thus calls regarding anomalies are immune to influence without making changes and rerunning the analysis. And for those situations where a post hoc test or analysis is conducted, there is an opportunity to integrate the test back into the pipeline, hence to test whether the results are spurious or not by the outcomes of future tests. In this way, the set of tests and their significance levels can be tuned to the requirements, and once agreed, continue without fear or favour.

The tuning also requires monitoring the field. Over time, the relative frequency amongst the business functions will change. Periodic assessment of the behaviour in the field needs to be carried out, and where materially different, corresponding changes to the weights in the test-system configuration need to be made. The same is true of the behaviour of the third-parties. These too need to be monitored for material performance changes, and where

materially different, the corresponding simulated response time distributions need to be adjusted.

Of course, the process is not specific to the system-under-test used here, and applies generally, although in this particular case, due to the sourcing of the performance and the resource usage data, the pipeline code is Orkhestra specific. For the few examples considered, and for the pipeline in its draft form, acceptance appears to be within reach. Although more effort is required in this area, it is assumed, but needs to be tested, that there is some comfort and trust in both the familiarity of the reporting style across tests, that the tests take the history into account, and that the reporting analysis is consistently thorough.

There are some shortcomings with the test-system and with the analysis as it stands. These will need to be considered as part of ongoing improvements to both.

5.1 Future work

There are various areas in which improvements are possible. These include the nature of the test planning, and expanding the systems-under-test; retrofitting tests back into the analysis pipeline, and including a summary report similar to the results section in this report, as a per test session distributable report, including a call on whether the tests in the session should be considered a failure; and improvements to the modelling; and improved simulation of third-parties.

5.1.1 Concurrent and conflicting tests

There are concurrent tests within this closed space which would benefit from this approach in that the effort would better inform the customer as to the readiness of the system, application, or change to be deployed into the field. However, there are other teams performing tests and competing for the same time-slots. A further aim should be to facilitate this extended concurrent use. This requires specifying a minimal burden of cooperation in order to share the available slots, and to ensure the end-to-end testing is more aligned to the coexistence expected in the field.

There have been a number of requests from engineering and management teams that the tests executed should be against the loads of an active system. This is natural as it is what is expected in the field, and it is well known within the landscape of these systems that certain components are shared across many systems (for example, security access, security roles, outbound notifications to customers, and sensitive transaction authentication platforms). However, problems arise at various levels:

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1. There is the problem of participating in the session in an uncoordinated manner. If a particular test's requirements are not robust, then nothing is lost by a party attempting to run a test while another testing is being run. The problem arises with the unknown predictors that the uncoordinated test puts on the system, causing problems interpreting the response time and resource data.

2. Even when the second test (the test being run against a background load) is conducted in a coordinated manner, the analysis of the second (and possibly subsequent tests) needs to performed in a manner that takes into account the possible impact and interaction with the first test. Figure 5.1 shows the throughput indicating the successful load against an increasing offered load. The first part of the test, before the throughput reaches a peak, was executed without any other (known) load, whereas from the peak onwards, the offered load was held constant, and a second test was run through another channel against the same system. In this case, a linear regression of the CPU resource usage onto the successful load would not resolve the correct coefficient estimates of the successful load, resulting in a smaller estimated coefficient value, and hence would under estimate the cost in terms of CPU resources or over estimate the ability of the provided capacity.

3. Not all tests that run concurrently are known. There have been examples where a ramp test was executed concurrently with another ramp test. If both test loads increase linearly, and the time interval of the one test was a subset of the other, then a similar regression analysis of the test in the subset interval would not look too out of the ordinary, but the coefficient of the load in this case would over estimate the cost of a customer interaction.

To control for the under-estimation in the first case, and the over-estimation in the second case, it is necessary to perform one analysis which combines the successful load summary as a time-series as multiple predictors in the same linear model.

5.1.2 Distribution of response times

Reporting the estimated mean and standard error of the response times at the first milestone alone is unsatisfactory. It is common amongst other tools to report percentiles, specifically around 90 or 95 percent. If this number is low enough, then this gives confidence to the general response times per function. However it is impractical to collect response time values for every call to an instance of a function by its outcome. The number of function calls directed by Orkhestra make it impractical to record the individual values. It may be the case that the other tools are dealing with less complicated
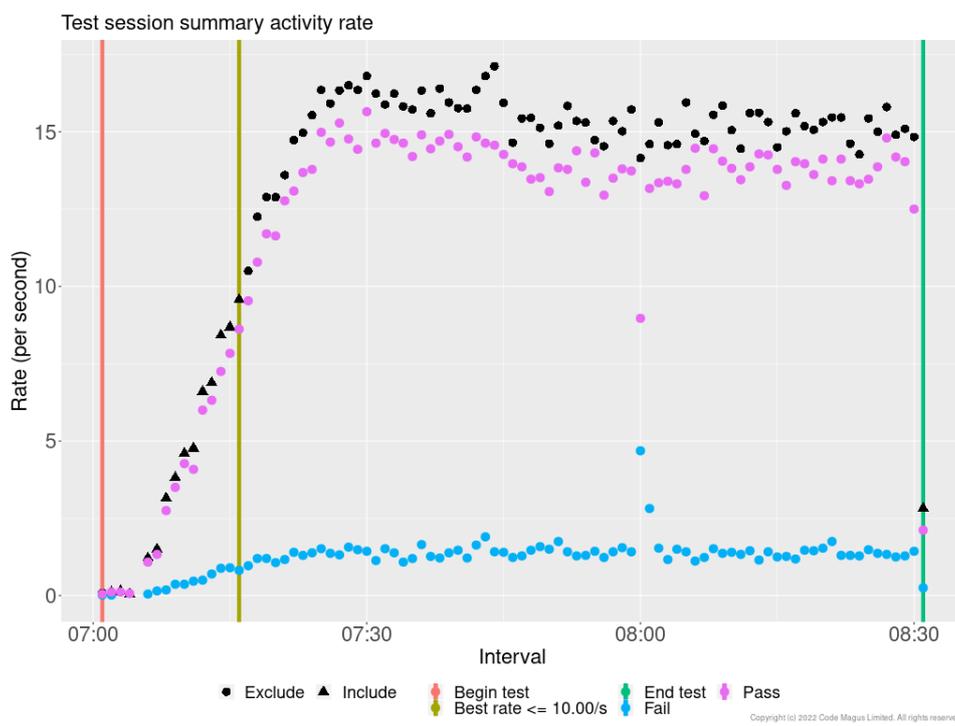
Figure 5.1: Throughput showing one ramp test and then using the test load at a steady offered load a background when running a second ramp test.

systems or aggregating their records into larger groups. One thought was to consider fitting the data to a Pearson distribution with four moments, but in experiments, regenerating the data from these distributions looked nothing like the original distribution. The problem is not as straightforward as originally hoped.

5.1.3   Lack of analysis and coordination

In many cases there is no analysis of the impact of a test, just the outcome that some throughput was achieved or not achieved. This is not adequate as without understanding the resource requirements in the test environment, it would be difficult to estimate the impact on the resources in the field, bearing in mind that the capacity of the test environment may not be the same as the capacity in the field, and that in the field the capacity is shared amongst many competing applications. If ad-hoc tests have a minimum requirement to provide details of throughput achieved within specified intervals of time, then an analysis would be possible.

The solution to this part of the problem now has both a technical and an educational or persuasion component. For the technical component, the solution is the same as above, but the other aspect is a little more difficult as it involves the persuasion of another party to structure tests in a possibly slightly different way, and to establish an obligation to provide throughput information. From an effort point of view, on the other party, this is minimal but may be difficult to sell. However, the customer is common between the parties and an appeal to the customer may be required to encourage a change. In any case, the benefits should be significant, as with minimal effort the impact on tests by other parties on the infrastructure will become apparent at a level of detail where this was not previously the case.

5.1.4   Modelling distributions

The third-party response time distribution modelling described in Section 2.4.1 can be improved on in a number of ways, but these have come to light too late to implement as part of this project (as it is not possible to regenerate the earlier test data used in this project).

1. It may be better to trim the third-party time-series response data down to the intervals in which the current application in the field is most active. If the variability of the third-party response times in the field changes significantly over the course of time, then only the subset of the third-party response times when they are at their worst should be considered, or the subset of the third-party response time data that corresponds to the application in the field when the arrival rate is closest to the first milestone rate.

2. The distributions and their finite mixtures considered for simulating the third-party behaviour could be chosen to better match the field data.

3. Improved methods of parameter space searching for optimal mixing proportions and distribution parameter estimates could be applied.

A recent observation of Tukey g-and-h distributions (Hoaglin *et al.*, 1985), shown in Yan and Genton (2019), appear, at least visually, to be a better match of the component of finite mixture distribution in Section 2.4.1 modelled by the exponential distribution. The Tukey g-and-h distribution models skewness and heaviness of tails using the parameters g and h. This is achieved by a monotonic transformation of the standard normal. Thus drawing pseudo random numbers from the Tukey g-and-h is not much more expensive than drawing standard normal pseudo random numbers. The $g \in \mathbb{R}$ parameter controls skewness, and the $h \in \mathbb{R}$, $h \geq 0$, parameter controls heaviness of the tails. The transformation function, $T(z; g, h)$, on a standard normal is a Tukey g-and-h random variable:

$$
\begin{aligned}
\text{For} \quad T(Z; g, h) &= \frac{e^{gZ} - 1}{g} e^{hZ^2/2} \\
\text{then if } Z \sim N(0, 1), \quad T(Z; g, h) &\sim \text{Tukey}_{g,h}
\end{aligned}
$$

Additionally, location ($A \in \mathbb{R}$), and scale ($B \in \mathbb{R}$, $B > 0$) may be adjusted as

$$
Y = A + B \cdot T(Z; g, h)
$$

Since the Gaussian is a member of the Tukey g-and-h family of distributions (as $g \to 0$ and $h = 0$, $T(Z; g, 0) \to Z$, the identity function), and hence replacing the exponential distribution by a Tukey g-and-h distribution renders the required distribution in Section 2.4.1 as a finite mixture of Tukey g-and-h distributions, each with their own location and scale. As described by Zhan *et al.* (2024), function `QLMDe` from the R package `QuantileGH` (Zhan, 2024) fits the respective Tukey g-and-h component distributions by estimating their parameters, including their location and scale, as well as estimating the component mixing proportions. This is accomplished using quantile least Mahalanobis distances. For details, see Zhan *et al.* (2025).

The resultant cumulative probability distribution of the Tukey g-and-h finite mixture model with location and scale parameters is

$$
\begin{aligned}
P(T_{\boldsymbol{\theta}} \leq t) &= \sum_{i=1}^{k} w_i P(T_{A_i, B_i, g_i, h_i} \leq t), \text{ (for the present case, } k = 2) \\
\text{where } \boldsymbol{\theta} &= (A_1, \ldots, A_k, B_1, \ldots, B_k, g_1, \ldots, g_k, h_1, \ldots, h_k)
\end{aligned}
$$

From the transformation function

```
tukey_gh_transform <- function(z, g, h) {
  y <- (exp(g * z) - 1) / g * exp(h * z^2 / 2)
  return(y)
}
```

the required response times can be simulated from the standard normal as follows (where `thirdparty.validate.GH` is the object returned from the function `QLMDe`):

```
ifelse(runif(1)<thirdparty.validate.GH@w[1],
       thirdparty.validate.GH@pars[1,1]+
         thirdparty.validate.GH@pars[1,2]*
         tukey_gh_transform(rnorm(1),
                            thirdparty.validate.GH@pars[1,3],
                            thirdparty.validate.GH@pars[1,4]),
       thirdparty.validate.GH@pars[2,1]+
         thirdparty.validate.GH@pars[2,2]*
         tukey_gh_transform(rnorm(1),
                            thirdparty.validate.GH@pars[2,3],
                            thirdparty.validate.GH@pars[2,4]))
```

Table 5.1 shows the estimated parameters and their mixing proportions for the resultant finite mixture model (the function `QLMDe` also produces confidence intervals on the population parameters). For the second component, the location and scale estimates are similar to those determined in Section 2.4.1. Figure 5.2 shows kernel density estimates of the data collected from the third-party in the field, together with a sample of the same size drawn from the fitted finite mixture model. The figure shows that the two smoothed densities are almost indistinguishable.

Table 5.1: Tukey *g*-and-*h* finite mixture model component parameters and mixing proportions (weights).

Component	A	B	g	h	Weight
1	229	38	0.60	0.045	0.81
2	1009	230	0.23	0.090	0.19

It has not been possible to rerun the experiments with a better model of response times. Up to now, the model used is more than adequate, but there is plenty of opportunity to revise the models used by the test-system going forward as the behaviour of third-parties in the field need to be monitored for significant changes. It should also be apparent that the kernel density estimation is also a finite mixture model of systematically adjusted K
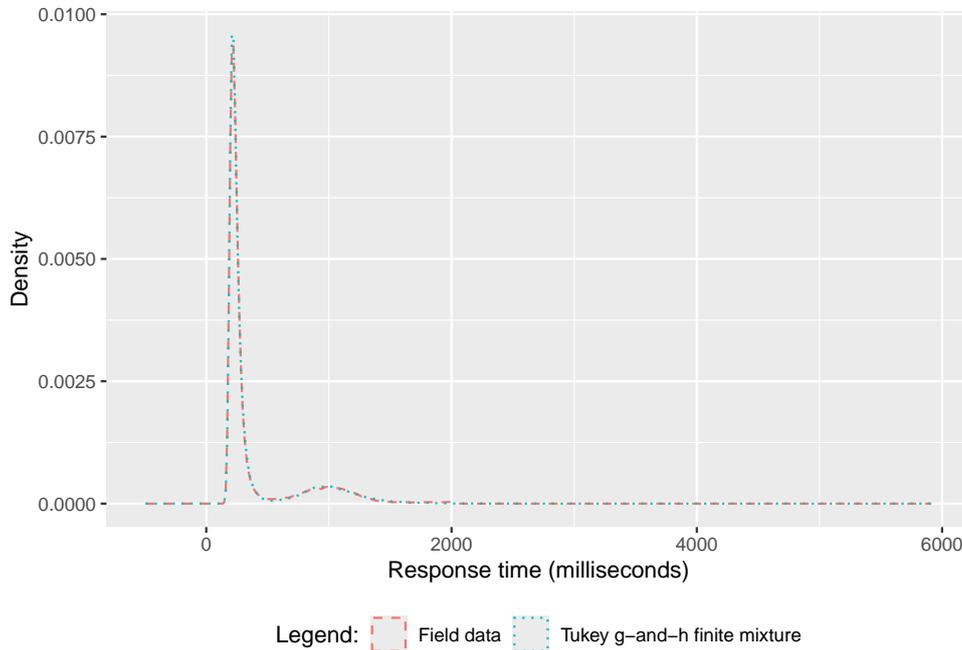
Figure 5.2: Smoothed densities comparing samples collected from the third-party in the field and samples generated from the *g*-and-*h* finite mixture model.

densities, albeit a mixture of a large number of densities (the sample size, n). There may be features in the distribution that should not be smoothed over. Thus, going forward, it may be better to experiment with the bandwidth parameter, h, to determine if this is the case, as opposed to accepting the default normal reference distribution determined value.

5.1.5 Deployment of the pipeline

In carrying out this project, effectively post hoc analyses were carried out on the existing data being generated. Where the methods appeared to lead to some insight, this was then carried out on older datasets. This in turn showed up some weaknesses in the pipeline where certain conditions were not met causing the pipeline to fail. For example, discovering that no observations can be considered to be of a high quality. In which case the performance test should fail, but the process should still produce a report indicating that this is the case. In some cases, in order to include historical data, the pipeline was allowed to process and produce data reduced to some stage without complete analysis, and then this resultant data was used to augment the analysis in this study. As it stands the pipeline report is too unwieldy and can be from 600 to 2000 pages long. Going forward, a summary report generator needs to be added to the pipeline that picks up the summary data and notes and produces a succinct report from that. The summary report would then more

closely resemble the test specific content contained in this project report.

The cumbersome reporting system in place may have found some acceptance, or perhaps there is some comfort in the familiarity of that reporting. The idea is to augment the existing reporting once the summary reporting has been completed and the analysis in this report incorporated back into the pipeline, and that, over time, allows the new reporting to gain acceptance. Based on the work done in this project, the turnaround time for making a report available after a test is significantly shorter than the current reporting. This and the more compact representation could be drivers to accepting the newer reporting.

Appendix A

Additional tables

Although lengthy the full tables have proved to be a useful reference for historical tests when investigating changes in behaviour of the system-under-test, the influence of test-data, or the environment.

Table A.1: Servers of the system-under-test participating in the test session including the units in which the CPU resource is measured and the capacity provisioned.

Server	Cluster	OSType	Capacity	NWF
D_AKS_W41...	D_AKS_W415	DynLinux	64	NWF2
D_AKS_W41...	D_AKS_W415	DynLinux	64	NWF2
D_AKS_W41...	D_AKS_W415	DynLinux	64	NWF2
D_AKS_W64...	D_AKS_W647	DynLinux	4	NWF2
D_AKS_W64...	D_AKS_W647	DynLinux	4	NWF2
D_AKS_W64...	D_AKS_W647	DynLinux	4	NWF2
D_W12651	D_W1265	DynLinux	4	NWF2
D_W12652	D_W1265	DynLinux	4	NWF2
D_W17001	D_W1700	DynLinux	16	NWF2
D_W17002	D_W1700	DynLinux	16	NWF2
D_W21731	D_W2173	DynLinux	8	NWF2
D_W21732	D_W2173	DynLinux	8	NWF2
D_W23301	D_W2330	DynLinux	4	NWF2
D_W23302	D_W2330	DynLinux	4	NWF2
D_W7641	D_W764	DynLinux	4	NWF2
D_W7642	D_W764	DynLinux	4	NWF2
DP_W2324_...	DP_W2324_GW_W749	LinuxSNMP	NA	NWF2
DP_W2324_...	DP_W2324_GW_W749	LinuxSNMP	NA	NWF2
DP_W2324_...	DP_W2324_GW_W749	LinuxSNMP	NA	NWF2
DP_W2324_...	DP_W2324_GW_W749	LinuxSNMP	NA	NWF2
DP_W2324_...	DP_W2324_W1250_W749	LinuxSNMP	NA	NWF2

Server	Cluster	OSType	Capacity	NWF
DP_W2324_...	DP_W2324_W1250_W749	LinuxSNMP	NA	NWF2
DP_W2324_...	DP_W2324_W1250_W749	LinuxSNMP	NA	NWF2
DP_W2324_...	DP_W2324_W1250_W749	LinuxSNMP	NA	NWF2
DP_W2324_...	DP_W2324_W1250_W749	LinuxSNMP	NA	NWF2
DP_W2324_...	DP_W2324_W1250_W554	LinuxSNMP	NA	NWF2
DP_W2324_...	DP_W2324_W1250_W554	LinuxSNMP	NA	NWF2
DP_W2324_...	DP_W2324_W1250_W160	LinuxSNMP	NA	NWF2
DP_W2324_...	DP_W2324_W1250_W160	LinuxSNMP	NA	NWF2
S_105W1039	W1039	Windows	1	NWF7
S_105W1056	W1056	Windows	1	NWF7
S_105W1430	W1430	Windows	1	NWF7
S_105W1710	W1710	Windows	1	NWF7
S_105W186...	W18642W2324	Windows	1	NWF7
S_105W1946	W1946	Windows	1	NWF7
S_105W2235	W2235	Windows	1	NWF7
S_105W2362	W2362	Windows	1	NWF7
S_105W2552	W2552	Windows	1	NWF7
S_105W331	W331	Windows	1	NWF7
S_105W543	W543	Windows	1	NWF7
S_105W569	W569	Windows	1	NWF7
S_W1335	W569	Windows	1	NWF8
S_W1439	W2552	Windows	1	NWF8
S_W1537	W1430	Windows	1	NWF8
S_W1673	W2235	Windows	1	NWF8
S_W1677	W1056	Windows	1	NWF8
S_W246	W331	Windows	1	NWF8
S_W249	W2362	Windows	1	NWF8
S_W2498	W543	Windows	1	NWF8
S_W466	W1039	Windows	1	NWF8
S_W9281W1...	W2327	Windows	1	NWF7
S_W9281W1...	W1106	Windows	1	NWF7
S_W9281W1...	W1246	Windows	1	NWF7
S_W9281W1...	W633	Windows	1	NWF7
S_W9281W2...	W1614	Windows	1	NWF7
S_W9281W2...	W2285	Windows	1	NWF7
S_W9281W5...	W633	Windows	1	NWF7
S_W9281W5...	W1867	Windows	1	NWF7
S_W9282W1...	W2327	Windows	1	NWF8
S_W9282W1...	W1106	Windows	1	NWF8
S_W9282W1...	W1246	Windows	1	NWF8
S_W9282W1...	W18642W2324	Windows	1	NWF8
S_W9282W1...	W633	Windows	1	NWF8

Server	Cluster	OSType	Capacity	NWF
S_W9282W2...	W1614	Windows	1	NWF8
S_W965	W1710	Windows	1	NWF8
W10011	W1001	AIX	30	NWF2
W10012	W1001	AIX	50	NWF2
W1005	W1005	AIX	NA	NWF7
W103801	W1038	Windows	1	NWF1
W103802	W1038	Windows	1	NWF1
W103803	W1038	Windows	1	NWF1
W103804	W1038	Windows	1	NWF1
W103805	W1038	Windows	1	NWF1
W103806	W1038	Windows	1	NWF1
W108301	W1083_W418	LinuxSNMP	100	NWF9
W108302	W1083_W418	LinuxSNMP	100	NWF9
W108303	W1083_W418	LinuxSNMP	100	NWF9
W108304	W1083_W418	LinuxSNMP	100	NWF9
W108305	W1083_W418	LinuxSNMP	100	NWF9
W10991	W1566_W400	Linux	200	NWF3
W10992	W1566_W400	Linux	200	NWF3
W11203	W308	Windows	1	NWF9
W11204	W308	Windows	1	NWF9
W11871	W108	AIX	100	NWF2
W11872	W108	AIX	50	NWF2
W12091	W1209_W2181	Linux	200	NWF3
W12092	W1209_W2181	Linux	200	NWF3
W12093	W1209_W2181	Linux	200	NWF3
W12094	W1209_W2181	Linux	200	NWF3
W122501	W1225	Windows	1	NWF2
W122502	W1225	Windows	1	NWF2
W125914W1...	SQL14W1719	Windows	1	NWF2
W125914W1...	SQL14W1719	Windows	1	NWF2
W12651	W1265	Linux	400	NWF1
W12652	W1265	Linux	400	NWF1
W128402	W2254	Windows	1	NWF1
W128403	W2254	Windows	1	NWF1
W128404	W2254	Windows	1	NWF1
W128405	W2254	Windows	1	NWF1
W128406	W2254	Windows	1	NWF1
W128407	W2254	Windows	1	NWF1
W128408	W2254	Windows	1	NWF1
W12901	W129	Windows	1	NWF6
W12902	W129	Windows	1	NWF6
W12903	W129	Windows	1	NWF6

Server	Cluster	OSType	Capacity	NWF
W12904	W129	Windows	1	NWF6
W12961	W1296	AIX	40	NWF2
W12962	W1296	AIX	40	NWF2
W1301	W130	AIX	120	NWF4
W1302	W130	AIX	90	NWF4
W13021	W174_W266	Windows	1	NWF2
W13021	W1302	Windows	1	NWF2
W13022	W174_W266	Windows	1	NWF2
W13022	W1302	Windows	1	NWF2
W13023	W174_W266	Windows	1	NWF2
W13023	W1302	Windows	1	NWF2
W13024	W1302	Windows	1	NWF2
W13024	W174_W266	Windows	1	NWF2
W13025	W174_W266	Windows	1	NWF2
W13025	W1302	Windows	1	NWF2
W13101	W131	Windows	1	NWF1
W13102	W131	Windows	1	NWF1
W13103	W131	Windows	1	NWF1
W13104	W131	Windows	1	NWF1
W131401	W1543	Windows	1	NWF1
W13161	W1316	Linux	2000	NWF9
W13162	W1316	Linux	1300	NWF9
W13163	W1316	Linux	NA	NWF9
W137501	W301	Linux	200	NWF1
W137502	W301	Linux	200	NWF1
W137503	W301	Linux	200	NWF1
W137504	W301	Linux	200	NWF1
W139	W139	AIX	50	NWF2
W145401	W1454	Windows	1	NWF1
W145505	W1455	LinuxSNMP	100	NWF2
W14711	W1471	Linux	900	NWF9
W14712	W1471	Linux	1300	NWF9
W153601	W1536	LinuxSNMP	100	NWF9
W153602	W1536	LinuxSNMP	100	NWF9
W153603	W1536	LinuxSNMP	100	NWF9
W1572	W1572	AIX	50	NWF2
W15761	W1576	AIX	42	NWF2
W15762	W1576	AIX	80	NWF2
W16111	W1611	Linux	NA	NWF6
W16112	W1611	Linux	NA	NWF6
W16113	W1611	Linux	NA	NWF6
W16251	W1428	AIX	200	NWF2

Server	Cluster	OSType	Capacity	NWF
W16252	W1428	AIX	50	NWF2
W16401	W1640	Windows	1	NWF1
W164010	W1640	Windows	1	NWF1
W16402	W1640	Windows	1	NWF1
W16403	W1640	Windows	1	NWF1
W16404	W1640	Windows	1	NWF1
W16405	W1640	Windows	1	NWF1
W16406	W1640	Windows	1	NWF1
W16407	W1640	Windows	1	NWF1
W16408	W1640	Windows	1	NWF1
W16409	W1640	Windows	1	NWF1
W166	W166	AIX	167	NWF2
W17002	W1700	Linux	1600	NWF1
W172501	W172501	Linux	2000	NWF2
W172502	W172502	Linux	2000	NWF2
W172503	W172503	Linux	2000	NWF2
W17401	W174_W266	Windows	1	NWF2
W17401	W174	Windows	1	NWF2
W17402	W174	Windows	1	NWF2
W17402	W174_W266	Windows	1	NWF2
W17403	W174_W266	Windows	1	NWF2
W17403	W174	Windows	1	NWF2
W17404	W174	Windows	1	NWF2
W17404	W174_W266	Windows	1	NWF2
W17405	W174_W266	Windows	1	NWF2
W17405	W174	Windows	1	NWF2
W17406	W174_W266	Windows	1	NWF2
W17406	W174	Windows	1	NWF2
W17407	W174_W266	Windows	1	NWF2
W17407	W174	Windows	1	NWF2
W17408	W174_W266	Windows	1	NWF2
W17408	W174	Windows	1	NWF2
W17409	W174_W266	Windows	1	NWF2
W17409	W174	Windows	1	NWF2
W17410	W174_W266	Windows	1	NWF2
W17410	W174	Windows	1	NWF2
W17411	W174	Windows	1	NWF2
W17411	W174_W266	Windows	1	NWF2
W17412	W174	Windows	1	NWF2
W17412	W174_W266	Windows	1	NWF2
W17413	W174_W266	Windows	1	NWF2
W17413	W174	Windows	1	NWF2

Server	Cluster	OSType	Capacity	NWF
W17414	W174	Windows	1	NWF2
W17414	W174_W266	Windows	1	NWF2
W17415	W174_W266	Windows	1	NWF2
W17415	W174	Windows	1	NWF2
W174622	W185616W1400401	Windows	1	NWF6
W174623	W185616W1400401	Windows	1	NWF6
W176003	W1760	Windows	1	NWF6
W176004	W1760	Windows	1	NWF6
W17931DBI...	W17931DBIAPP		100	NWF1
W188302	NA	NA	NA	NWF9
W18861	W1886	AIX	20	NWF2
W18862	W1886	AIX	20	NWF2
W189201	W1892	Linux	600	NWF2
W19481ADB1	W19481ADB	Linux	200	NWF3
W19481ADB2	W19481ADB	Linux	200	NWF3
W19481APP1	W19481APP	Linux	400	NWF3
W19481APP2	W19481APP	Linux	400	NWF3
W19481W42...	W19481W429	Linux	200	NWF3
W19481W42...	W19481W429	Linux	200	NWF3
W19661	W1966	Linux	200	NWF3
W19961	W1996	AIX	100	NWF2
W19962	W1996	AIX	84	NWF2
W20071	W2007_W859_W400_DB2	Linux	400	NWF3
W20072	W2007_W859_W400_DB2	Linux	400	NWF3
W20073	W2007_W400	Linux	400	NWF3
W20074	W2007_W400	Linux	400	NWF3
W20075	W2007_DB2	Linux	400	NWF3
W20076	W2007_DB2	Linux	400	NWF3
W20077	W2007_W859_AACFED_DB2	Linux	400	NWF3
W20078	W2007_W859_AACFED_DB2	Linux	400	NWF3
W20079	W2007_W400_W1603_W313	Linux	400	NWF3
W20105	W201	Linux	800	NWF2
W20381	W2038	AIX	500	NWF2
W20382	W2038	AIX	30	NWF2
W203901	W1543	Windows	1	NWF1
W20981	W2098	Windows	1	NWF2
W20981	W2312_W266	Windows	1	NWF2
W20982	W2098	Windows	1	NWF2
W20982	W2312_W266	Windows	1	NWF2
W20983	W2312_W266	Windows	1	NWF2
W20983	W2098	Windows	1	NWF2
W21271	W1428	AIX	200	NWF2

Server	Cluster	OSType	Capacity	NWF
W21272	W1428	AIX	50	NWF2
W21731	W2173	Linux	800	NWF1
W21732	W2173	Linux	800	NWF1
W21791	W2179_W2415	Linux	400	NWF3
W21792	W2179_W2415	Linux	200	NWF3
W21793	W2179_W2190	Linux	200	NWF3
W21794	W2179_W2190	Linux	200	NWF3
W21991	W2199	Linux	200	NWF3
W21992	W2199	Linux	200	NWF3
W2283	W2283	AIX	100	NWF2
W22841	W2284	Linux	400	NWF2
W228601	W2286	Windows	1	NWF2
W228602	W2286	Windows	1	NWF2
W22932	W2293_W672	Linux	500	NWF3
W22933	W2293_W164	Linux	500	NWF3
W22934	W2293_W164	Linux	500	NWF3
W22935	W2293_W1519	Linux	500	NWF3
W22937	W2293_W1519	Linux	500	NWF3
W22938	W2293_W1519	Linux	500	NWF3
W22939	W2293_W1519	Linux	500	NWF3
W229501	W2295_W822	LinuxSNMP	100	NWF2
W229501	W2295	LinuxSNMP	100	NWF2
W229502	W2295	LinuxSNMP	100	NWF2
W229502	W2295_W822	LinuxSNMP	100	NWF2
W229503	W2295	LinuxSNMP	100	NWF2
W229503	W2295_W789	LinuxSNMP	100	NWF2
W229504	W2295	LinuxSNMP	100	NWF2
W229504	W2295_W789	LinuxSNMP	100	NWF2
W229505	W2295_W789	LinuxSNMP	100	NWF2
W229505	W2295	LinuxSNMP	100	NWF2
W229506	W2295	LinuxSNMP	100	NWF2
W229506	W2295_AAC	LinuxSNMP	100	NWF2
W229507	W2295_AAC	LinuxSNMP	100	NWF2
W229507	W2295	LinuxSNMP	100	NWF2
W229509	W2295	LinuxSNMP	100	NWF2
W229509	W2295_FED	LinuxSNMP	100	NWF2
W229510	W2295_FED	LinuxSNMP	100	NWF2
W229510	W2295	LinuxSNMP	100	NWF2
W231201	W2312	Windows	1	NWF2
W231201	W2312_W266	Windows	1	NWF2
W231202	W2312	Windows	1	NWF2
W231202	W2312_W266	Windows	1	NWF2

Server	Cluster	OSType	Capacity	NWF
W231203	W2312_W266	Windows	1	NWF2
W231203	W2312	Windows	1	NWF2
W231204	W2312	Windows	1	NWF2
W231204	W2312_W266	Windows	1	NWF2
W231205	W2312	Windows	1	NWF2
W231205	W2312_W266	Windows	1	NWF2
W231206	W2312_W266	Windows	1	NWF2
W231206	W2312	Windows	1	NWF2
W231207	W2312	Windows	1	NWF2
W231207	W2312_W266	Windows	1	NWF2
W231208	W2312	Windows	1	NWF2
W231208	W2312_W266	Windows	1	NWF2
W231209	W2312	Windows	1	NWF2
W231209	W2312_W266	Windows	1	NWF2
W23301	W2330	Linux	400	NWF1
W23302	W2330	Linux	400	NWF1
W23891	W2389	AIX	800	NWF2
W23892	W2389	AIX	670	NWF2
W24461	W1428	AIX	200	NWF2
W24462	W1428	AIX	50	NWF2
W248201	W2482	Windows	1	NWF2
W248202	W2482	Windows	1	NWF2
W248203	W2482	Windows	1	NWF2
W248204	W2482	Windows	1	NWF2
W248205	W2482	Windows	1	NWF2
W248206	W2482	Windows	1	NWF2
W248207	W2482	Windows	1	NWF2
W248208	W2482	Windows	1	NWF2
W25491	W2549	AIX	100	NWF2
W25492	W2549	AIX	100	NWF2
W25531	NA	NA	NA	NWF5
W255501	W2555	Windows	1	NWF2
W256510	W2007_W400_W1603_W313	Linux	400	NWF3
W256511	W2007_W400_W1603_W313	Linux	400	NWF3
W256512	W2007_W400_W1603_W313	Linux	400	NWF3
W256513	W2007_W400_W1603_W313	Linux	400	NWF3
W25702	W301	Linux	2400	NWF2
W25703	W301	Linux	2400	NWF2
W258	W258	AIX	80	NWF2
W263	W263	AIX	10	NWF2
W27201	W272	Windows	1	NWF9
W27202	W272	Windows	1	NWF9

Server	Cluster	OSType	Capacity	NWF
W27203	W272	Windows	1	NWF9
W27204	W272	Windows	1	NWF9
W27205	W272	Windows	1	NWF9
W27206	W272	Windows	1	NWF9
W27207	W272	Windows	1	NWF9
W27208	W272	Windows	1	NWF9
W3010	W301	Linux	2500	NWF2
W3011	W301	Linux	2500	NWF2
W3071	W1031	AIX	100	NWF2
W34301	NA	NA	NA	NWF9
W34302	NA	NA	NA	NWF9
W34303	NA	NA	NA	NWF9
W39201	W392	Linux	NA	NWF6
W39202	W392	Linux	NA	NWF6
W41701	NA	NA	NA	NWF9
W41702	NA	NA	NA	NWF9
W41703	NA	NA	NA	NWF9
W47401	W474		NA	NWF9
W47402	W474		NA	NWF9
W47403	W474		NA	NWF9
W47404	W474		NA	NWF9
W48701	W487	Linux	700	NWF2
W48702	W487	Linux	800	NWF2
W48703	W487	Linux	800	NWF2
W48704	W487	Linux	800	NWF2
W48707	W487	Linux	800	NWF2
W5301	NA	NA	NA	NWF9
W5302	NA	NA	NA	NWF9
W5891	W589	AIX	600	NWF2
W58910	W589	AIX	400	NWF2
W58911	W589	AIX	400	NWF2
W58912	W589	AIX	600	NWF2
W58913	W589	AIX	400	NWF2
W58914	W589	AIX	600	NWF2
W5892	W589	AIX	600	NWF2
W5893	W589	AIX	600	NWF2
W5894	W589	AIX	342	NWF2
W5895	W589	AIX	200	NWF2
W5896	W589	AIX	200	NWF2
W5897	W589	AIX	600	NWF2
W5898	W589	AIX	342	NWF2
W5899	W589	AIX	400	NWF2

Server	Cluster	OSType	Capacity	NWF
W598	W484000	AIX	100	NWF2
W6201	W620	AIX	100	NWF2
W6202	W620	AIX	29	NWF2
W6640W116...	W95301	MVS	300	NWF3
W6640W116...	W95301	MVS	300	NWF3
W74801	W748	Windows	1	NWF1
W74802	W748	Windows	1	NWF1
W74803	W748	Windows	1	NWF1
W7642	W764	Linux	400	NWF1
W78601	W786	Linux	800	NWF2
W78602	W786	Linux	800	NWF2
W78603	W786	Linux	800	NWF2
W78605	W786	Linux	800	NWF2
W81201	NA	NA	NA	NWF2
W81202	NA	NA	NA	NWF2
W82601	W826	LinuxSNMP	100	NWF2
W82602	W826	LinuxSNMP	100	NWF2
W8341	W834	Linux	200	NWF3
W8342	W834	Linux	200	NWF3
W90902	W909	Linux	400	NWF2
W90903	W909	Linux	800	NWF2
W90904	W909	Linux	800	NWF2
W90905	W909	Linux	400	NWF2
W951	W95	AIX	100	NWF2
W952	W95	AIX	100	NWF2
W9691	W969	Windows	1	NWF2
W96910	W969	Windows	1	NWF2
W9692	W969	Windows	1	NWF2
W9693	W969	Windows	1	NWF2
W9694	W969	Windows	1	NWF2
W9695	W969	Windows	1	NWF2
W9696	W969	Windows	1	NWF2
W9697	W969	Windows	1	NWF2
W9698	W969	Windows	1	NWF2
W9699	W969	Windows	1	NWF2
W97101	W971	Linux	700	NWF2
W97102	W971	Linux	700	NWF2
W97103	W971	Linux	1000	NWF2
W99601	W996	Windows	1	NWF2
W99602	W996	Windows	1	NWF2

Table A.2: Estimated response times and throughput at interval that achieved the first milestone of the customer arrival rate. For convenience, the table is arranged in descending order to the local regression estimated response times at this first milestone. In the absence of percentiles, the local regression estimated response times should be the performance metrics of greatest interest, with the worst performing functions presented first.

Test Number	Basename	Local Regression Predict	Local Regression 95CILo	Local Regression 95CIHi	Samp Size	Samp Mean Resp	Samp Var Resp	SEM	Rate
1	W1218_W1232_0	11.814	10.327	13.302	1301	10.202	0.308	0.015	10.842
1	W1237_W444_W611_0	11.696	10.146	13.245	8	9.875	0.113	0.119	0.067
1	W999_W1649_CA_W...	11.585	10.453	12.718	4	10.258	0.099	0.158	
1	W999_W1649_CA_W...	11.486	10.105	12.866	3	10.333	0.374	0.353	0.025
1	W1822_W2434_W69...	11.447	10.192	12.701	84	10.182	0.354	0.065	0.700
1	W1822_W2434_W69...	11.332	10.173	12.491	282	10.147	0.292	0.032	2.350
1	W1822_W2434_W696_0	11.302	10.107	12.498	281	10.109	0.288	0.032	2.342
1	W1237_W444_W1662_0	11.273	10.136	12.411	71	10.063	0.256	0.060	0.592
1	W1822_W2434_W69...	11.205	10.149	12.262	76	9.995	0.269	0.059	0.633
1	W999_W1649_CA_W...	10.367	9.358	11.376	4	9.736	0.094	0.154	0.033
1	W1237_W444_W166...	3.770	3.406	4.134	65	3.415	5.809	0.299	0.542
1	W999_W1649_CA_W...	3.701	3.164	4.238	3	2.970	0.002	0.029	0.025
1	W999_W1649_CA_W...	3.679	3.117	4.240	1	3.349			0.008
1	W999_W1649_CA_W...	3.667	2.797	4.537	5	3.070	0.011	0.046	0.042
1	W1237_W444_W611...	2.738	2.357	3.119	6	2.391	0.039	0.081	0.050
1	W1237_W444_W611...	2.058	1.793	2.324	5	2.345	1.780	0.597	0.042
1	W1237_W444_W166...	1.932	1.747	2.118	70	1.726	0.196	0.053	0.583
1	W1218_W1232_13_...	1.849	1.665	2.033	1277	1.632	0.544	0.021	10.642
1	W999_W1649_CA_W...	1.504	0.729	2.280	5	1.748	2.128	0.652	0.042
1	W999_W1649_CA_W...	1.502	1.209	1.795	3	1.613	0.278	0.304	0.025
1	W1855_W2226_2_W...	1.475	1.139	1.812	4	2.026	1.555	0.623	0.033

Test Number	Basename	Local Regression Predict	Local Regression 95CILo	Local Regression 95CIHi	Samp Size	Samp Mean Resp	Samp Var Resp	SEM	Rate
1	W1218_W1232_4_W...	1.440	1.327	1.552	1311	1.349	0.076	0.008	10.925
1	W1237_W444_W611...	1.409	1.042	1.777	5	1.412	0.214	0.207	0.042
1	W1822_W2434_W69...	1.403	1.173	1.634	279	1.202	0.155	0.024	2.325
1	W1822_W2434_W69...	1.384	1.127	1.642	85	1.132	0.050	0.024	0.708
1	W999_W1649_CA_W...	1.379	1.048	1.710	1	1.119			0.008
1	W1822_W2434_W69...	1.378	1.140	1.616	270	1.183	0.162	0.024	2.250
1	W1822_W2434_W69...	1.375	1.076	1.674	558	1.052	0.142	0.016	4.650
1	W1822_W2434_W69...	1.366	1.115	1.617	77	1.167	0.067	0.029	0.642
1	W1822_W2434_W69...	1.365	1.044	1.686	548	1.039	0.156	0.017	4.567
1	W1237_W444_W611...	1.357	1.130	1.584	5	1.073	0.014	0.053	0.042
1	W1822_W2434_W69...	1.355	1.055	1.655	169	1.070	0.169	0.032	1.408
1	W1237_W444_W166...	1.355	1.137	1.572	69	1.183	0.298	0.066	0.575
1	W1822_W2434_W69...	1.352	1.086	1.617	153	1.070	0.196	0.036	1.275
1	W1237_W444_W611...	1.343	1.024	1.663	5	1.230	0.111	0.149	0.042
1	W1237_W444_W611...	1.342	-1.778	4.461	5	0.854	0.023	0.068	0.042
1	W1237_W444_W166...	1.329	1.124	1.533	65	1.126	0.194	0.055	0.542
1	W1822_12_W1425_...	1.328	1.166	1.491	141	1.206	0.193	0.037	1.175
1	W718_W1945_6_W1...	1.321	1.159	1.483	54	1.181	0.142	0.051	0.450
1	W718_6_W1425_W1...	1.308	1.144	1.472	197	1.173	0.208	0.032	1.642
1	W1237_W444_W166...	1.297	1.088	1.506	66	1.148	0.112	0.041	0.550
1	W1237_W444_W611...	1.281	-1.946	4.508	5	0.523	0.142	0.169	0.042
1	W1218_W1232_33_...	1.266	1.114	1.417	1272	1.137	0.317	0.016	10.600
1	W1770_W2226_2_W...	1.258	0.957	1.558	3	1.741	2.311	0.878	0.025
1	W1822_W1945_12_...	1.249	1.091	1.407	44	1.185	0.309	0.084	0.367
1	W187_W161_W2226...	1.223	0.955	1.490	10	1.265	1.003	0.317	0.083
1	W999_W1649_CA_W...	1.178	0.778	1.578	1	0.780			0.008

Test Number	Basename	Local Regression Predict	Local Regression 95CILo	Local Regression 95CIHi	Samp Size	Samp Mean Resp	Samp Var Resp	SEM	Rate
1	W999_W1649_CA_W...	1.153	0.573	1.733	4	0.399	0.067	0.129	
1	W999_W1649_CA_W...	1.147	0.909	1.385	4	0.989	0.053	0.116	
1	W999_W1649_CA_W...	1.147	0.689	1.604	4	0.565	0.006	0.038	
1	W999_W1649_CA_W...	1.137	0.894	1.380	3	0.879	0.006	0.043	0.025
1	W999_W1649_CA_W...	1.113	0.824	1.402	4	0.991	0.048	0.109	0.033
1	W1237_W444_W611...	1.108	0.900	1.316	7	0.899	0.004	0.024	0.058
1	W1218_W1232_26_...	1.059	0.909	1.208	1280	0.928	0.120	0.010	10.667
1	W1237_W444_W611...	1.036	0.719	1.353	11	0.754	0.006	0.023	0.092
1	W1237_W444_W166...	1.024	0.814	1.234	139	0.810	0.088	0.025	1.158
1	W999_W1649_CA_W...	1.015	0.552	1.479	4	0.823	0.655	0.405	
1	W999_W1649_CA_W...	1.012	0.534	1.490	9	0.756	0.005	0.022	0.075
1	W1218_W1232_10_...	1.011	−3.423	5.445	1284	1.121	0.288	0.015	10.700
1	W1218_W1232_6_W...	0.965	0.837	1.093	1296	0.894	0.048	0.006	10.800
1	W1822_10_W146_W...	0.935	0.808	1.061	141	0.754	0.060	0.021	1.175
1	W1822_W2434_W69...	0.931	0.742	1.119	274	0.744	0.018	0.008	2.283
1	W1822_W2434_W69...	0.918	0.757	1.080	277	0.773	0.076	0.017	2.308
1	W1822_W2434_W69...	0.913	0.730	1.096	275	0.662	0.042	0.012	2.292
1	W1822_W2434_W69...	0.910	0.695	1.124	83	0.830	0.157	0.044	0.692
1	W999_W1649_CA_W...	0.909	0.065	1.753	4	0.239	0.001	0.015	0.033
1	W1822_W2434_W69...	0.908	0.757	1.059	76	0.763	0.046	0.025	0.633
1	W999_W1649_CA_W...	0.907	0.610	1.204	4	0.617	0.006	0.038	0.033
1	W1822_W2434_W69...	0.907	0.750	1.064	77	0.674	0.023	0.017	0.642
1	W1770_W2226_5_W...	0.903	0.683	1.122	3	0.555	0.017	0.075	0.025
1	W1822_W2434_W69...	0.896	0.730	1.061	277	0.676	0.036	0.011	2.308
1	W1822_3_W1425_W...	0.886	0.772	1.000	141	1.059	−10.757		1.175
1	W1822_W1945_10_...	0.878	0.750	1.005	41	0.724	0.034	0.029	0.342

Test Number	Basename	Local Regression Predict	Local Regression 95CILo	Local Regression 95CIHi	Samp Size	Samp Mean Resp	Samp Var Resp	SEM	Rate
1	W999_W1649_CA_W...	0.870	0.600	1.141	6	0.723	0.003	0.021	0.050
1	W1822_W2434_W69...	0.854	0.717	0.991	281	0.651	0.028	0.010	2.342
1	W1822_W2434_W69...	0.850	0.748	0.952	282	0.810	6.640	0.153	2.350
1	W1770_W2226_4_W...	0.849	0.586	1.112	3	0.556	0.019	0.081	0.025
1	W1822_W2434_W69...	0.846	0.676	1.016	83	0.675	0.047	0.024	0.692
1	W1822_11_W146_W...	0.839	0.697	0.981	142	0.684	0.093	0.026	1.183
1	W1822_W1945_11_...	0.823	0.664	0.983	42	0.636	0.023	0.023	0.350
1	W1237_W444_W611...	0.819	0.455	1.182	5	0.249	0.001	0.013	0.042
1	W999_W1649_CA_W...	0.816	-1.483	3.115	3	1.130	1.161	0.622	0.025
1	W1822_W2434_W69...	0.811	0.688	0.935	78	0.682	0.038	0.022	0.650
1	W1822_W1945_3_W...	0.790	0.671	0.909	41	0.702	0.258	0.079	0.342
1	W1822_W2434_W69...	0.787	0.674	0.901	83	0.638	0.026	0.018	0.692
1	W718_5_W146_W17...	0.786	0.643	0.930	198	0.601	0.031	0.012	1.650
1	W718_W1945_5_W1...	0.779	0.632	0.927	54	0.604	0.028	0.023	0.450
1	W1218_W1232_8_W...	0.742	0.622	0.861	1290	0.585	0.075	0.008	10.750
1	W718_4_W146_W17...	0.727	0.603	0.850	195	0.559	0.030	0.012	1.625
1	W718_W1945_4_W1...	0.721	0.593	0.849	54	0.559	0.030	0.024	0.450
1	W1218_W1232_30_...	0.707	0.570	0.845	1283	0.583	-1.087		10.692
1	W1855_W2226_7_W...	0.701	0.271	1.131	4	0.473	0.004	0.030	0.033
1	W999_W1649_CA_W...	0.700	0.441	0.960	4	0.512	0.021	0.072	0.033
1	W999_W1649_CA_W...	0.685	0.549	0.820	3	0.661	0.020	0.082	0.025
1	W1822_W1945_2_W...	0.681	0.515	0.846	42	0.391	0.038	0.030	0.350
1	W999_W1649_CA_W...	0.673	0.216	1.131	3	0.243	0.000	0.003	0.025
1	W1855_W2226_5_W...	0.666	0.443	0.889	4	0.509	0.013	0.057	0.033
1	W999_W1649_CA_W...	0.646	0.254	1.039	3	0.347	0.002	0.029	0.025
1	W1218_W1232_31_...	0.643	0.495	0.790	1277	0.436	0.036	0.005	10.642

Test Number	Basename	Local Regression Predict	Local Regression 95CILo	Local Regression 95CIHi	Samp Size	Samp Mean Resp	Samp Var Resp	SEM	Rate
1	W1822_21_W1425_...	0.628	0.521	0.734	143	0.507	0.027	0.014	1.192
1	W187_W161_W2226...	0.624	0.445	0.803	10	0.514	0.028	0.053	0.083
1	W1822_W2434_W69...	0.624	-1.513	2.761	283	0.621	0.118	0.020	2.358
1	W1218_W1232_7_W...	0.621	0.477	0.765	1294	0.450	0.165	0.011	10.783
1	W1822_W2434_W69...	0.619	0.447	0.791	85	0.918	-23.121		0.708
1	W999_W1649_CA_W...	0.615	0.304	0.926	3	0.187	0.000	0.012	0.025
1	W1822_W1945_21_...	0.614	0.511	0.717	45	0.531	0.024	0.023	0.375
1	W999_W1649_CA_W...	0.604	0.317	0.892	4	0.377	0.004	0.031	
1	W999_W1649_CA_W...	0.595	0.330	0.860	4	0.452	0.015	0.061	0.033
1	W999_W1649_CA_W...	0.593	-11.697	12.884	3	0.841	0.730	0.493	0.025
1	W1822_W2434_W69...	0.581	0.395	0.768	76	0.296	0.007	0.010	0.633
1	W187_W161_W2226...	0.565	0.463	0.666	10	0.430	0.008	0.028	0.083
1	W999_W1649_CA_W...	0.564	0.049	1.079	4	0.206	0.003	0.029	0.033
1	W1218_W1232_15_...	0.564	0.252	0.876	1275	0.249	0.091	0.008	10.625
1	W718_W1945_16_W...	0.564	0.431	0.696	53	1.070	28.531	0.734	0.442
1	W1822_W2434_W69...	0.542	0.397	0.688	280	0.515	-7.238		2.333
1	W1822_2_W1425_W...	0.541	0.065	1.018	141	0.439	0.179	0.036	1.175
1	W1237_W444_W611...	0.538	0.320	0.755	5	0.342	0.001	0.016	0.042
1	W1218_W1232_18_...	0.536	0.359	0.713	1282	0.301	0.203	0.013	10.683
1	W999_W1649_CA_W...	0.534	0.257	0.812	1	0.262			0.008
1	W1822_W2434_W69...	0.529	0.361	0.697	77	0.339	0.002	0.005	0.642
1	W1822_W2434_W69...	0.527	0.381	0.672	272	0.517	-7.320		2.267
1	W1822_W2434_W69...	0.522	0.363	0.680	279	0.295	0.015	0.007	2.325
1	W999_W1649_CA_W...	0.521	0.290	0.751	4	0.358	0.000	0.011	0.033
1	W1822_W2434_W69...	0.520	0.354	0.687	273	0.292	0.007	0.005	2.275
1	W1237_W444_W611...	0.520	0.357	0.684	8	0.350	0.002	0.015	0.067

Test Number	Basename	Local Regression Predict	Local Regression 95CILo	Local Regression 95CIHi	Samp Size	Samp Mean Resp	Samp Var Resp	SEM	Rate
1	W999_W1649_CA_W...	0.516	0.324	0.709	4	0.336	0.001	0.018	
1	W999_W1649_CA_W...	0.516	0.315	0.718	1	0.310			0.008
1	W1822_W2434_W69...	0.515	0.344	0.686	85	0.291	0.008	0.009	0.708
1	W1218_W1232_32_...	0.503	0.375	0.631	1275	0.356	0.027	0.005	10.625
1	W999_W1649_CA_W...	0.500	0.127	0.873	1	0.135			0.008
1	W1822_W2434_W69...	0.497	0.375	0.620	279	0.493	5.029	0.134	2.325
1	W999_W1649_CA_W...	0.494	0.304	0.684	5	0.613	0.445	0.298	0.042
1	W999_W1649_CA_W...	0.492	0.283	0.701	5	0.361	0.002	0.021	0.042
1	W999_W1649_CA_W...	0.491	0.187	0.796	3	0.229	0.001	0.018	0.025
1	W1237_W444_W166...	0.490	0.347	0.634	61	0.340	0.001	0.004	0.508
1	W718_W1945_3_W1...	0.487	0.362	0.612	54	0.277	0.003	0.008	0.450
1	W1822_W2434_W69...	0.482	0.355	0.608	280	0.295	0.013	0.007	2.333
1	W635_W1276_2_W1...	0.474	0.341	0.606	1241	0.309	0.079	0.008	10.342
1	W999_W1649_CA_W...	0.470	-0.097	1.038	4	0.141	0.000	0.010	
1	W1822_W2434_W69...	0.470	0.364	0.576	281	0.343	0.003	0.003	2.342
1	W999_W1649_CA_W...	0.469	-0.068	1.006	4	0.268	0.004	0.030	0.033
1	W1237_W444_W166...	0.468	0.376	0.560	70	0.376	0.034	0.022	0.583
1	W718_3_W1425_W1...	0.465	0.352	0.578	195	0.286	0.009	0.007	1.625
1	W1822_W2434_W69...	0.460	0.326	0.593	83	0.306	0.029	0.019	0.692
1	W1822_W2434_W69...	0.459	0.329	0.589	276	0.300	0.036	0.011	2.300
1	W1822_W2434_W69...	0.457	0.354	0.561	79	0.347	0.003	0.006	0.658
1	W1822_W2434_W69...	0.453	0.328	0.578	79	0.288	0.010	0.011	0.658
1	W1237_W444_W611...	0.450	0.196	0.704	5	0.201	0.001	0.011	0.042
1	W1822_W2434_W69...	0.450	0.339	0.561	83	0.353	0.003	0.006	0.692
1	W1218_W1232_27_...	0.444	0.280	0.607	1280	0.291	0.027	0.005	10.667
1	W999_W1649_CA_W...	0.442	0.200	0.684	1	0.184			0.008

Test Number	Basename	Local Regression Predict	Local Regression 95CILo	Local Regression 95CIHi	Samp Size	Samp Mean Resp	Samp Var Resp	SEM	Rate
1	W1237_W444_W166...	0.442	0.332	0.552	70	0.311	0.001	0.004	0.583
1	W1822_6_W1425_W...	0.440	0.350	0.530	141	0.347	0.019	0.012	1.175
1	W1822_W1945_22_...	0.440	0.357	0.522	45	0.365	0.063	0.037	0.375
1	W1237_W444_W166...	0.437	0.332	0.543	70	0.318	0.027	0.020	0.583
1	W999_W1649_CA_W...	0.437	0.202	0.673	1	0.198			0.008
1	W1822_W1945_20_...	0.437	0.318	0.556	44	0.264	0.002	0.007	0.367
1	W999_W1649_CA_W...	0.435	0.242	0.629	4	0.242	0.002	0.023	
1	W1237_W444_W166...	0.433	0.332	0.534	70	0.314	0.002	0.005	0.583
1	W1822_20_W1425_...	0.431	0.332	0.530	143	0.285	0.006	0.007	1.192
1	W718_16_W1425_W...	0.430	0.343	0.518	195	0.343	0.003	0.004	1.625
1	W1822_W2434_W69...	0.429	0.290	0.567	83	0.338	0.055	0.026	0.692
1	W1822_9_W1425_W...	0.428	0.334	0.522	140	0.282	0.013	0.010	1.167
1	W999_W1649_CA_W...	0.424	0.183	0.665	4	0.212	0.002	0.023	
1	W1822_22_W1425_...	0.423	0.331	0.516	143	0.341	0.002	0.004	1.192
1	W1237_W444_W611...	0.423	0.164	0.682	5	0.140	0.000	0.008	0.042
1	W1822_W2434_W69...	0.423	0.257	0.589	85	0.243	0.002	0.005	0.708
1	W1822_W2434_W69...	0.423	0.258	0.588	76	0.239	0.002	0.005	0.633
1	W1822_W2434_W69...	0.421	0.263	0.579	274	0.235	0.002	0.002	2.283
1	W1822_W1945_6_W...	0.421	0.329	0.514	41	0.332	0.001	0.006	0.342
1	W999_W1649_CA_W...	0.419	0.111	0.726	3	0.133	0.000	0.008	0.025
1	W1822_7_W1425_W...	0.418	0.326	0.511	140	0.564	12.189	0.295	1.167
1	W1822_W2434_W69...	0.418	-1.527	2.362	84	0.385	0.033	0.020	0.700
1	W1237_W444_W611...	0.416	0.303	0.530	7	0.330	0.003	0.019	0.058
1	W1822_W1945_9_W...	0.413	0.319	0.507	41	0.263	0.002	0.007	0.342
1	W718_14_W1425_W...	0.413	0.316	0.509	196	0.287	0.008	0.006	1.633
1	W1822_W2434_W69...	0.411	-0.120	0.943	278	0.319	0.040	0.012	2.317

Test Number	Basename	Local Regression Predict	Local Regression 95CILo	Local Regression 95CIHi	Samp Size	Samp Mean Resp	Samp Var Resp	SEM	Rate
1	W1218_W1232_9_W...	0.410	0.280	0.540	1288	0.270	0.026	0.004	10.733
1	W1822_W2434_W69...	0.409	0.259	0.559	280	0.239	0.002	0.002	2.333
1	W999_W1649_CA_W...	0.409	0.107	0.711	3	0.135	0.000	0.010	0.025
1	W1822_W2434_W69...	0.404	-0.012	0.820	79	0.275	0.264	0.058	0.658
1	W999_W1649_CA_W...	0.403	0.166	0.641	5	0.217	0.002	0.020	0.042
1	W1218_W1232_29_...	0.398	0.267	0.528	1281	0.250	0.005	0.002	10.675
1	W1822_W2434_W69...	0.396	0.257	0.536	280	0.510	-14.564		2.333
1	W999_W1649_CA_W...	0.396	0.171	0.620	1	0.181			0.008
1	W999_W1649_CA_W...	0.395	0.106	0.685	3	0.146	0.000	0.008	0.025
1	W999_W1649_CA_W...	0.395	0.140	0.650	3	0.174	0.000	0.010	0.025
1	W999_W1649_CA_W...	0.395	0.069	0.720	3	0.142	0.001	0.013	0.025
1	W1237_W444_W611...	0.394	0.152	0.636	5	0.204	0.006	0.034	0.042
1	W1822_W2434_W69...	0.392	0.221	0.563	85	0.211	0.001	0.004	0.708
1	W1237_W444_W611...	0.390	0.160	0.620	5	0.149	0.001	0.014	0.042
1	W1237_W444_W166...	0.387	0.238	0.537	63	0.229	0.001	0.005	0.525
1	W1822_W2434_W69...	0.386	0.261	0.510	277	0.269	0.056	0.014	2.308
1	W1822_W2434_W69...	0.382	0.226	0.539	76	0.211	0.002	0.005	0.633
1	W1237_W444_W166...	0.382	0.218	0.545	62	0.201	0.001	0.005	0.517
1	W999_W1649_CA_W...	0.381	0.147	0.615	4	0.217	0.001	0.015	0.033
1	W718_W1945_14_W...	0.381	0.278	0.483	53	0.292	0.010	0.014	0.442
1	W1822_W2434_W69...	0.378	0.222	0.534	280	0.208	0.002	0.002	2.333
1	W1822_W2434_W69...	0.377	0.222	0.533	273	0.205	0.002	0.003	2.275
1	W1822_W2434_W69...	0.377	0.049	0.705	276	0.286	0.334	0.035	2.300
1	W999_W1649_CA_W...	0.377	0.146	0.608	1	0.115			0.008
1	W1237_W444_W611...	0.377	0.260	0.494	8	0.304	0.004	0.023	0.067
1	W999_W1649_CA_W...	0.375	0.122	0.629	1	0.126			0.008

Test Number	Basename	Local Regression Predict	Local Regression 95CILo	Local Regression 95CIHi	Samp Size	Samp Mean Resp	Samp Var Resp	SEM	Rate
1	W1237_W444_W611...	0.374	0.153	0.595	5	0.143	0.001	0.011	0.042
1	W1822_W2434_W69...	0.374	0.260	0.487	282	0.262	0.012	0.007	2.350
1	W999_W1649_CA_W...	0.372	0.039	0.705	5	0.167	0.000	0.008	0.042
1	W1822_W2434_W69...	0.372	0.216	0.527	76	0.197	0.001	0.004	0.633
1	W999_W1649_CA_W...	0.370	0.158	0.583	4	0.138	0.001	0.014	
1	W999_W1649_CA_W...	0.370	0.127	0.613	1	0.125			0.008
1	W785_W2344_2_W2...	0.368	-0.126	0.863	2	0.290	0.000	0.012	0.017
1	W1822_W2434_W69...	0.366	0.251	0.481	83	0.253	0.003	0.006	0.692
1	W1218_W1232_28_...	0.366	0.239	0.492	1280	0.216	0.002	0.001	10.667
1	W1237_W444_W611...	0.365	0.251	0.480	7	0.280	0.006	0.030	0.058
1	W1218_W1232_22_...	0.364	0.227	0.501	1279	0.198	0.003	0.002	10.658
1	W1822_W2434_W69...	0.362	0.248	0.477	79	0.257	0.005	0.008	0.658
1	W1822_W2434_W69...	0.362	0.220	0.504	280	0.195	0.001	0.002	2.333
1	W1822_W2434_W69...	0.360	0.209	0.511	87	0.205	0.003	0.006	0.725
1	W1822_W2434_W69...	0.359	0.042	0.677	281	0.239	0.032	0.011	2.342
1	W1218_W1232_5_W...	0.357	0.279	0.435	2606	0.255	0.049	0.004	21.717
1	W1855_W2226_3_W...	0.356	0.182	0.530	4	0.176	0.000	0.009	0.033
1	W1822_W2434_W69...	0.356	0.213	0.498	272	0.200	0.002	0.003	2.267
1	W718_11_W1425_W...	0.352	0.251	0.453	199	0.236	0.014	0.008	1.658
1	W999_W1649_CA_W...	0.352	0.106	0.598	5	0.165	0.002	0.020	0.042
1	W999_W1649_CA_W...	0.351	0.140	0.563	1	0.131			0.008
1	W999_W1649_CA_W...	0.351	0.146	0.555	5	0.239	0.002	0.021	0.042
1	W999_W1649_CA_W...	0.350	0.144	0.557	3	0.324	0.001	0.014	0.025
1	W999_W1649_CA_W...	0.349	0.126	0.573	3	0.171	0.004	0.037	0.025
1	W1822_W2434_W69...	0.349	0.210	0.487	280	0.331	-7.001		2.333
1	W1237_W444_W611...	0.346	0.100	0.592	5	0.130	0.000	0.010	0.042

Test Number	Basename	Local Regression Predict	Local Regression 95CILo	Local Regression 95CIHi	Samp Size	Samp Mean Resp	Samp Var Resp	SEM	Rate
1	W999_W1649_CA_W...	0.345	0.123	0.567	5	0.207	0.002	0.021	0.042
1	W1822_W2434_W69...	0.343	0.176	0.510	77	0.163	0.002	0.004	0.642
1	W999_W1649_CA_W...	0.343	0.204	0.482	3	0.288	0.002	0.028	0.025
1	W1822_18_W1425_...	0.343	0.260	0.425	145	0.254	0.025	0.013	1.208
1	W1218_W1232_17_...	0.343	0.214	0.472	1278	0.193	0.003	0.001	10.650
1	W1822_W1945_7_W...	0.343	0.259	0.427	41	0.319	0.141	0.059	0.342
1	W999_W1649_CA_W...	0.342	0.093	0.591	4	0.148	0.001	0.015	0.033
1	W999_W1649_CA_W...	0.341	0.073	0.608	5	0.190	0.004	0.028	0.042
1	W1218_W1232_24_...	0.340	0.212	0.469	1274	0.199	0.003	0.002	10.617
1	W1822_W2434_W69...	0.338	0.221	0.454	279	0.217	0.011	0.006	2.325
1	W1822_W2434_W69...	0.337	-0.127	0.802	83	0.269	0.204	0.050	0.692
1	W1822_W2434_W69...	0.336	0.178	0.494	273	0.160	0.002	0.003	2.275
1	W999_W1649_CA_W...	0.336	0.100	0.572	3	0.137	0.000	0.007	0.025
1	W718_2_W1425_W1...	0.336	-0.304	0.975	196	0.225	0.051	0.016	1.633
1	W1770_W2226_3_W...	0.335	0.124	0.546	3	0.171	0.000	0.005	0.025
1	W718_W1945_11_W...	0.335	0.233	0.437	54	0.231	0.001	0.004	0.450
1	W1237_W444_W611...	0.334	0.135	0.534	5	0.137	0.000	0.009	0.042
1	W1218_W1232_16_...	0.334	0.200	0.469	1277	0.182	0.002	0.001	10.642
1	W1237_W444_W166...	0.334	0.236	0.432	70	0.209	0.001	0.005	0.583
1	W1822_W2434_W69...	0.333	0.175	0.490	86	0.164	0.002	0.005	0.717
1	W1822_W2434_W69...	0.332	0.175	0.488	77	0.149	0.001	0.003	0.642
1	W1822_W2434_W69...	0.332	0.170	0.493	85	0.164	0.002	0.005	0.708
1	W1237_W444_W611...	0.332	0.202	0.461	7	0.244	0.007	0.031	0.058
1	W1822_W2434_W69...	0.331	0.179	0.484	87	0.162	0.002	0.005	0.725
1	W1822_W2434_W69...	0.331	-3.943	4.605	281	0.423	0.076	0.016	2.342
1	W1822_W1945_18_...	0.331	0.232	0.430	44	0.230	0.001	0.006	0.367

Test Number	Basename	Local Regression Predict	Local Regression 95CILo	Local Regression 95CIHi	Samp Size	Samp Mean Resp	Samp Var Resp	SEM	Rate
1	W1218_W1232_25_...	0.331	0.207	0.455	1278	0.175	0.003	0.002	10.650
1	W1218_W1232_14_...	0.331	0.194	0.468	1275	0.169	0.002	0.001	10.625
1	W1237_W444_W611...	0.330	0.129	0.531	5	0.147	0.001	0.010	0.042
1	W1218_W1232_21_...	0.330	0.194	0.465	1280	0.176	0.003	0.002	10.667
1	W1822_W2434_W69...	0.329	0.219	0.440	83	0.216	0.003	0.006	0.692
1	W1218_W1232_20_...	0.329	0.197	0.462	1282	0.175	0.003	0.002	10.683
1	W1822_W2434_W69...	0.329	0.218	0.439	282	0.212	0.002	0.003	2.350
1	W1822_W2434_W69...	0.328	0.176	0.480	76	0.157	0.001	0.004	0.633
1	W1218_W1232_19_...	0.328	0.194	0.461	1283	0.175	0.003	0.001	10.692
1	W1822_W2434_W69...	0.326	0.210	0.443	79	0.208	0.001	0.004	0.658
1	W1822_W2434_W69...	0.326	0.173	0.478	76	0.152	0.001	0.004	0.633
1	W1237_W444_W166...	0.325	0.165	0.485	62	0.167	0.049	0.028	0.517
1	W1237_W444_W166...	0.324	0.185	0.463	64	0.189	0.001	0.005	0.533
1	W1822_W2434_W69...	0.323	0.180	0.467	279	0.166	0.011	0.006	2.325
1	W1237_W444_W166...	0.322	0.177	0.467	65	0.158	0.002	0.005	0.542
1	W1822_W2434_W69...	0.322	0.184	0.461	271	0.153	0.002	0.002	2.258
1	W1822_W2434_W69...	0.322	0.174	0.470	273	0.165	0.013	0.007	2.275
1	W1822_W2434_W69...	0.320	0.175	0.465	271	0.171	0.013	0.007	2.258
1	W718_W1945_13_W...	0.320	0.211	0.430	54	0.205	0.002	0.006	0.450
1	W1822_W2434_W69...	0.320	0.167	0.473	76	0.159	0.001	0.004	0.633
1	W1822_W2434_W69...	0.320	0.172	0.468	86	0.198	0.130	0.039	0.717
1	W1822_W2434_W69...	0.320	0.173	0.466	280	0.163	0.038	0.012	2.333
1	W1822_4_W1425_W...	0.318	0.217	0.418	140	0.217	0.021	0.012	1.167
1	W1218_W1232_23_...	0.313	0.174	0.451	1279	0.165	0.002	0.001	10.658
1	W999_W1649_CA_W...	0.312	0.126	0.497	1	0.119			0.008
1	W1822_W2434_W69...	0.311	0.170	0.452	279	0.150	0.001	0.002	2.325

Test Number	Basename	Local Regression Predict	Local Regression 95CILo	Local Regression 95CIHi	Samp Size	Samp Mean Resp	Samp Var Resp	SEM	Rate
1	W1822_W2434_W69...	0.306	0.163	0.449	273	0.165	0.048	0.013	2.275
1	W718_W1945_8_W1...	0.306	0.200	0.412	54	0.223	0.053	0.031	0.450
1	W1822_W2434_W69...	0.304	0.155	0.454	85	0.153	0.002	0.004	0.708
1	W718_13_W1425_W...	0.304	0.216	0.393	197	0.202	0.002	0.003	1.642
1	W1822_W1945_4_W...	0.300	0.211	0.389	41	0.201	0.003	0.009	0.342
1	W1218_W1232_12_...	0.299	0.174	0.423	1283	0.153	0.002	0.001	10.692
1	W1237_W444_W166...	0.299	0.160	0.437	62	0.154	0.001	0.004	0.517
1	W1822_19_W1425_...	0.298	0.211	0.385	145	0.207	0.002	0.004	1.208
1	W1237_W444_W166...	0.297	0.161	0.434	62	0.145	0.001	0.004	0.517
1	W718_8_W1425_W1...	0.297	0.204	0.390	197	0.189	0.002	0.003	1.642
1	W718_W1945_12_W...	0.295	0.192	0.398	54	0.157	0.002	0.005	0.450
1	W1822_W1945_19_...	0.289	0.203	0.375	44	0.209	0.002	0.006	0.367
1	W999_W1649_CA_W...	0.287	0.051	0.524	5	0.148	0.000	0.002	0.042
1	W1237_W444_W166...	0.287	0.156	0.417	64	0.152	0.001	0.004	0.533
1	W999_W1649_CA_W...	0.287	0.051	0.522	5	0.152	0.001	0.012	0.042
1	W1822_W1945_16_...	0.286	0.206	0.366	44	0.264	0.252	0.076	0.367
1	W718_W1945_2_W1...	0.286	-1.307	1.879	56	0.305	0.217	0.062	0.467
1	W1822_W2434_W69...	0.285	0.179	0.392	281	0.165	0.002	0.003	2.342
1	W718_W1945_7_W1...	0.285	0.172	0.399	54	0.162	0.002	0.005	0.450
1	W1822_W2434_W69...	0.285	-8.845	9.415	77	0.701	0.291	0.061	0.642
1	W1822_16_W1425_...	0.280	0.201	0.360	142	0.194	0.002	0.004	1.183
1	W1822_W2434_W69...	0.280	0.165	0.395	279	0.177	0.062	0.015	2.325
1	W1822_W2434_W69...	0.279	0.171	0.387	79	0.159	0.001	0.004	0.658
1	W1822_W2434_W69...	0.277	0.159	0.396	83	0.168	0.003	0.006	0.692
1	W1822_W2434_W69...	0.277	0.163	0.391	275	0.164	0.049	0.013	2.292
1	W999_W1649_CA_W...	0.276	0.160	0.393	3	0.228	0.000	0.013	0.025

Test Number	Basename	Local Regression Predict	Local Regression 95CILo	Local Regression 95CIHi	Samp Size	Samp Mean Resp	Samp Var Resp	SEM	Rate
1	W999_W1649_CA_W...	0.276	0.045	0.507	5	0.150	0.001	0.010	0.042
1	W1237_W444_W166...	0.275	0.148	0.403	63	0.145	0.001	0.003	0.525
1	W1822_W2434_W69...	0.274	0.172	0.376	79	0.150	0.001	0.004	0.658
1	W1822_W1945_14_...	0.273	0.165	0.381	44	0.158	0.003	0.009	0.367
1	W187_W161_W2226...	0.271	0.154	0.387	10	0.205	0.006	0.025	0.083
1	W1237_W444_W611...	0.266	0.114	0.418	7	0.147	0.002	0.018	0.058
1	W718_7_W1425_W1...	0.264	0.169	0.358	197	0.173	0.057	0.017	1.642
1	W1237_W444_W166...	0.263	0.162	0.363	70	0.162	0.002	0.005	0.583
1	W718_W1945_15_W...	0.262	0.154	0.371	53	0.148	0.002	0.005	0.442
1	W718_10_W1425_W...	0.261	0.168	0.354	198	0.151	0.002	0.003	1.650
1	W1822_5_W1425_W...	0.260	0.170	0.350	140	0.156	0.002	0.004	1.167
1	W1822_W2434_W69...	0.259	0.154	0.363	281	0.153	0.002	0.002	2.342
1	W1822_W1945_13_...	0.253	0.166	0.340	44	0.162	0.004	0.009	0.367
1	W1822_13_W1425_...	0.250	0.169	0.332	141	0.160	0.002	0.003	1.175
1	W718_15_W1425_W...	0.250	0.159	0.342	196	0.166	0.059	0.017	1.633
1	W1822_W2434_W69...	0.249	0.146	0.351	83	0.152	0.002	0.004	0.692
1	W718_9_W1425_W1...	0.248	0.160	0.336	198	0.162	0.060	0.017	1.650
1	W718_12_W1425_W...	0.248	0.158	0.337	199	0.160	0.016	0.009	1.658
1	W1822_17_W1425_...	0.246	0.167	0.325	144	0.173	0.022	0.012	1.200
1	W718_W1945_10_W...	0.244	0.154	0.334	54	0.161	0.002	0.006	0.450
1	W1237_W444_W611...	0.242	0.109	0.376	7	0.163	0.003	0.021	0.058
1	W1822_W1945_17_...	0.241	0.165	0.318	44	0.160	0.002	0.007	0.367
1	W1822_14_W1425_...	0.241	0.163	0.319	142	0.161	0.002	0.004	1.183
1	W1822_W1945_15_...	0.241	0.152	0.329	44	0.146	0.001	0.006	0.367
1	W1822_8_W1425_W...	0.238	0.150	0.326	140	0.147	0.002	0.003	1.167
1	W1822_W1945_8_W...	0.236	0.151	0.322	41	0.137	0.001	0.005	0.342

Test Number	Basename	Local Regression Predict	Local Regression 95CILo	Local Regression 95CIHi	Samp Size	Samp Mean Resp	Samp Var Resp	SEM	Rate
1	W718_W1945_9_W1...	0.236	0.145	0.326	54	0.153	0.001	0.005	0.450
1	W1822_15_W1425_...	0.235	0.162	0.308	142	0.152	0.002	0.004	1.183
1	W999_W1649_CA_W...	0.235	0.094	0.376	3	0.182	0.000	0.004	0.025
1	W1822_W1945_5_W...	0.231	0.134	0.328	41	0.148	0.002	0.007	0.342
1	W1218_W1232_3_W...	0.197	0.135	0.258	1314	0.162	0.031	0.005	10.950
1	W1237_W444_W166...	0.190	-5.753	6.134	70	0.372	0.031	0.021	0.583
1	W999_W1649_CA_W...	0.184	0.066	0.302	3	0.141	0.000	0.012	0.025
1	W999_W1649_CA_W...	0.177	-0.011	0.364	3	0.144	0.001	0.020	0.025
1	W1218_W1232_1_*W803*	0.043	0.042	0.045	1301	0.045	0.002	0.001	10.842
1	W785_W2344_1_W1...	0.022	0.019	0.025	2	0.016	0.000	0.002	0.017
1	W718_1_*W803*	0.022	0.020	0.024	196	0.022	0.000	0.001	1.633
1	W1822_1_*W803*	0.022	0.020	0.023	139	0.021	0.000	0.001	1.158
1	W1822_W2434_W69...	0.022	0.021	0.022	282	0.021	0.000	0.001	2.350
1	W1822_W2434_W69...	0.021	0.020	0.023	76	0.020	0.000	0.001	0.633
1	W718_W1945_1_*W803*	0.021	0.018	0.024	56	0.022	0.000	0.002	0.467
1	W1822_W1945_1_*W803*	0.021	0.019	0.024	41	0.021	0.000	0.001	0.342
1	W1822_W2434_W69...	0.021	0.020	0.022	84	0.022	0.000	0.001	0.700
1	W1822_W2434_W69...	0.021	0.020	0.022	282	0.021	0.000	0.001	2.350
1	W1855_W2226_1_W...	0.021	0.018	0.024	3	0.023	0.000	0.002	0.025
1	W1237_W444_W166...	0.021	0.019	0.022	71	0.022	0.000	0.001	0.592
1	W187_W161_W2226...	0.021	0.017	0.024	10	0.017	0.000	0.001	0.083
1	W1770_W2226_1_W...	0.019	0.015	0.023	3	0.020	0.000	0.001	0.025
1	W785_W2344_3_W1...	0.011	0.007	0.016	2	0.008	0.000	0.001	0.017
1	W1855_W2226_6_W...	0.011	0.009	0.013	4	0.012	0.000	0.004	0.033
1	W1855_W2226_4_W...	0.009	0.008	0.011	4	0.013	0.000	0.004	0.033
1	W785_W2344_4_W1...	0.009	0.007	0.010	2	0.007	0.000	0.000	0.017

Test Number	Basename	Local Regression Predict	Local Regression 95CILo	Local Regression 95CIHi	Samp Size	Samp Mean Resp	Samp Var Resp	SEM	Rate
1	W1770_W2226_0	0.006	0.003	0.010	3	0.010	0.000	0.009	0.025
1	W1822_W1945_0	0.003	0.002	0.004	41	0.004	0.000	0.001	0.342
1	W1822_0	0.003	0.002	0.004	139	0.003	0.000	0.001	1.158
1	W187_W161_W2226_0	0.003	0.001	0.005	10	0.001	0.000	0.000	0.083
1	W635_W1276_0	0.003	0.002	0.004	1241	0.003	0.000	0.000	10.342
1	W718_0	0.003	0.002	0.004	196	0.003	0.000	0.000	1.633
1	W1855_W2226_0	0.003	-0.002	0.007	3	0.002	0.000	0.001	0.025
1	W718_W1945_0	0.003	0.002	0.004	56	0.003	0.000	0.001	0.467
1	W785_W2344_0	0.002	0.000	0.003	2	0.002	0.000	0.000	0.017

Table A.3: Results of linear models regressing cluster CPU resource usage onto successful load. For convenience, and depending on the audience, this table could be arranged descending on the regression line intercept term or the regression line slope term. As arranged here, the table is arranged descending on the regression line slope term, and hence is arranged descending on the clusters using the largest percentage of provisioned CPU resources per customer arrival per second. As expected, cluster W172501 consumes the largest proportion of its provisioned CPU resources per customer arrival per second.

Test Number	Cluster	Intercept Est	Intercept Std.Err	Intercept t-val	Intercept p-val	Slope Est	Slope Std.Err	Slope t-val	Slope p-val	R2	F-stat	df1	df2	p-value	MS1Est	MS2Est
1	W172501	1.509	2.299	0.66	0.523	5.867	0.344	17.056	0.000	0.957	2.9e+02	1	13	0.000	60.184	118.858
1	W95301	0.189	1.686	0.11	0.913	3.623	0.252	14.362	0.000	0.941	2.1e+02	1	13	0.000	36.423	72.657
1	W2295_FED	3.514	1.515	2.32	0.037	2.920	0.227	12.879	0.000	0.927	1.7e+02	1	13	0.000	32.715	61.916
1	W301	4.420	0.133	33.24	0.000	2.541	0.020	127.702	0.000	0.999	1.6e+04	1	13	0.000	29.827	55.234
1	W1302	3.306	1.162	2.85	0.014	2.036	0.174	11.709	0.000	0.913	1.4e+02	1	13	0.000	23.666	44.027
1	W786	12.253	0.907	13.51	0.000	1.971	0.136	14.522	0.000	0.942	2.1e+02	1	13	0.000	31.963	51.673
1	W969	19.572	0.235	83.14	0.000	1.963	0.035	55.722	0.000	0.996	3.1e+03	1	13	0.000	39.201	58.830
1	W2295_AAC	3.318	1.386	2.39	0.032	1.938	0.207	9.341	0.000	0.870	8.7e+01	1	13	0.000	22.697	42.077
1	W174_W266	5.715	0.265	21.59	0.000	1.860	0.040	46.948	0.000	0.994	2.2e+03	1	13	0.000	24.315	42.915
1	W174	6.576	0.290	22.71	0.000	1.797	0.043	41.479	0.000	0.993	1.7e+03	1	13	0.000	24.547	42.518
1	W971	17.792	0.506	35.20	0.000	1.571	0.076	20.770	0.000	0.971	4.3e+02	1	13	0.000	33.503	49.214
1	W1038	1.855	0.138	13.41	0.000	1.202	0.021	58.058	0.000	0.996	3.4e+03	1	13	0.000	13.874	25.893
1	W2295	3.094	0.406	7.63	0.000	1.083	0.061	17.854	0.000	0.961	3.2e+02	1	13	0.000	13.927	24.761
1	W1083_W418	3.404	0.271	12.55	0.000	1.020	0.041	25.131	0.000	0.980	6.3e+02	1	13	0.000	13.601	23.798
1	W172502	2.382	0.422	5.65	0.000	0.934	0.063	14.808	0.000	0.944	2.2e+02	1	13	0.000	11.722	21.062
1	W2007_W859_W400_DB2	3.183	0.246	12.91	0.000	0.877	0.037	23.767	0.000	0.978	5.6e+02	1	13	0.000	11.948	20.713
1	W172503	1.266	0.100	12.61	0.000	0.578	0.015	38.482	0.000	0.991	1.5e+03	1	13	0.000	7.046	12.826
1	W131	5.610	0.895	6.26	0.000	0.566	0.134	4.223	0.001	0.578	1.8e+01	1	13	0.001	11.268	16.926
1	W748	4.555	0.546	8.35	0.000	0.553	0.082	6.767	0.000	0.779	4.6e+01	1	13	0.000	10.082	15.608
1	W1536	1.111	0.090	12.38	0.000	0.512	0.013	38.104	0.000	0.991	1.5e+03	1	13	0.000	6.227	11.343
1	W2312	1.398	0.080	17.55	0.000	0.454	0.012	38.132	0.000	0.991	1.5e+03	1	13	0.000	5.941	10.484
1	W2312_W266	1.109	0.078	14.19	0.000	0.364	0.012	31.156	0.000	0.987	9.7e+02	1	13	0.000	4.754	8.398
1	W2330	37.806	1.118	33.81	0.000	0.321	0.167	1.920	0.077	0.221	3.7e+00	1	13	0.077	41.019	44.233
1	W2254	1.891	0.275	6.87	0.000	0.231	0.041	5.614	0.000	0.708	3.2e+01	1	13	0.000	4.202	6.513
1	W2007_W400_W1603_W313	2.346	0.045	52.70	0.000	0.198	0.007	29.769	0.000	0.986	8.9e+02	1	13	0.000	4.329	6.311
1	W633	6.167	0.274	22.50	0.000	0.178	0.041	4.344	0.001	0.592	1.9e+01	1	13	0.001	7.949	9.730
1	W1225	6.042	1.218	4.96	0.000	0.169	0.182	0.928	0.370	0.062	8.6e-01	1	13	0.370	7.733	9.423
1	W2284	6.372	0.360	17.71	0.000	0.121	0.054	2.240	0.043	0.278	5.0e+00	1	13	0.043	7.577	8.783
1	W2327	4.158	0.613	6.78	0.000	0.097	0.092	1.061	0.308	0.080	1.1e+00	1	13	0.308	5.131	6.104
1	W2098	0.244	0.157	1.56	0.142	0.095	0.023	4.045	0.001	0.557	1.6e+01	1	13	0.001	1.192	2.139
1	W1454	6.185	2.438	2.54	0.025	0.091	0.365	0.249	0.807	0.005	6.2e-02	1	13	0.807	7.094	8.002
1	W2482	2.860	0.255	11.22	0.000	0.056	0.038	1.471	0.165	0.143	2.2e+00	1	13	0.165	3.420	3.981
1	W1566_W400	3.680	0.096	38.18	0.000	0.053	0.014	3.697	0.003	0.513	1.4e+01	1	13	0.003	4.214	4.747
1	W1867	8.416	2.053	4.10	0.001	0.053	0.307	0.173	0.866	0.002	3.0e-02	1	13	0.866	8.947	9.477
1	W1640	4.837	0.530	9.13	0.000	0.051	0.079	0.638	0.534	0.030	4.1e-01	1	13	0.534	5.343	5.849
1	W2007_W859_AACFED_DB2	2.098	0.063	33.08	0.000	0.048	0.009	5.087	0.000	0.666	2.6e+01	1	13	0.000	2.580	3.063
1	D_W764	0.386	0.587	0.66	0.547	0.045	0.097	0.467	0.665	0.052	2.2e-01	1	4	0.665	0.839	1.292
1	W2285	7.384	0.588	12.55	0.000	0.031	0.088	0.356	0.728	0.010	1.3e-01	1	13	0.728	7.697	8.010
1	W1056	6.100	0.667	9.15	0.000	0.030	0.100	0.303	0.767	0.007	9.2e-02	1	13	0.767	6.402	6.705

Test Number	Cluster	Intercept Est	Intercept Std.Err	Intercept t-val	Intercept p-val	Slope Est	Slope Std.Err	Slope t-val	Slope p-val	R2	F-stat	df1	df2	p-value	MS1Est	MS2Est
1	W1430	5.889	0.746	7.90	0.000	0.029	0.112	0.262	0.798	0.005	6.8e-02	1	13	0.798	6.181	6.473
1	W2295_W822	0.100	0.230	0.44	0.670	0.027	0.034	0.793	0.442	0.046	6.3e-01	1	13	0.442	0.373	0.646
1	W1265	8.091	0.155	52.19	0.000	0.023	0.023	1.005	0.333	0.072	1.0e+00	1	13	0.333	8.324	8.557
1	W201	0.725	0.066	10.94	0.000	0.016	0.010	1.640	0.125	0.171	2.7e+00	1	13	0.125	0.887	1.050
1	W18642W2324	2.046	0.167	12.25	0.000	0.016	0.025	0.622	0.545	0.029	3.9e-01	1	13	0.545	2.202	2.357
1	W258	0.738	0.075	9.88	0.000	0.014	0.011	1.279	0.223	0.112	1.6e+00	1	13	0.223	0.881	1.023
1	W1428	0.233	0.003	66.53	0.000	0.011	0.001	21.356	0.000	0.972	4.6e+02	1	13	0.000	0.345	0.457
1	W2179_W2415	2.191	0.050	43.92	0.000	0.010	0.007	1.406	0.183	0.132	2.0e+00	1	13	0.183	2.296	2.401
1	W487	1.659	0.179	9.27	0.000	0.008	0.027	0.313	0.759	0.007	9.8e-02	1	13	0.759	1.743	1.827
1	W2007_W400	1.935	0.101	19.09	0.000	0.008	0.015	0.533	0.603	0.021	2.8e-01	1	13	0.603	2.015	2.096
1	W764	1.512	0.420	3.60	0.003	0.007	0.063	0.116	0.909	0.001	1.3e-02	1	13	0.909	1.585	1.658
1	W1700	5.694	0.113	50.20	0.000	0.006	0.017	0.365	0.721	0.010	1.3e-01	1	13	0.721	5.756	5.818
1	W909	0.268	0.019	14.36	0.000	0.006	0.003	2.095	0.056	0.252	4.4e+00	1	13	0.056	0.326	0.385
1	W2293_W1519	1.264	0.032	39.93	0.000	0.004	0.005	0.941	0.364	0.064	8.9e-01	1	13	0.364	1.309	1.353
1	W2286	3.470	0.314	11.06	0.000	0.003	0.047	0.070	0.945	0.000	5.0e-03	1	13	0.945	3.503	3.536
1	W272	1.789	0.240	7.45	0.000	0.003	0.036	0.090	0.930	0.001	8.0e-03	1	13	0.930	1.821	1.853
1	W2555	3.410	0.756	4.51	0.001	0.003	0.113	0.027	0.979	0.000	1.0e-03	1	13	0.979	3.440	3.470
1	W17931DBIAPP	0.161	0.066	2.44	0.030	0.002	0.010	0.181	0.859	0.003	3.3e-02	1	13	0.859	0.179	0.197
1	W263	0.287	0.015	19.20	0.000	0.002	0.002	0.740	0.472	0.040	5.5e-01	1	13	0.472	0.304	0.320
1	W620	0.059	0.001	42.29	0.000	0.001	0.000	5.056	0.000	0.663	2.6e+01	1	13	0.000	0.070	0.080
1	W108	0.026	0.001	19.96	0.000	0.001	0.000	4.634	0.000	0.623	2.1e+01	1	13	0.000	0.035	0.043
1	SQL14W1719	1.649	0.392	4.20	0.001	0.001	0.059	0.013	0.990	0.000	0.0e+00	1	13	0.990	1.657	1.665
1	W589	0.007	0.000	37.56	0.000	0.001	0.000	27.717	0.000	0.983	7.7e+02	1	13	0.000	0.015	0.023
1	W130	0.019	0.001	22.74	0.000	0.000	0.000	0.850	0.411	0.053	7.2e-01	1	13	0.411	0.020	0.022
1	W1001	0.020	0.001	34.82	0.000	0.000	0.000	0.781	0.449	0.045	6.1e-01	1	13	0.449	0.020	0.021
1	W1576	0.009	0.000	31.71	0.000	0.000	0.000	0.865	0.403	0.054	7.5e-01	1	13	0.403	0.010	0.010
1	W139	0.010	0.000	28.68	0.000	0.000	0.000	0.672	0.514	0.034	4.5e-01	1	13	0.514	0.011	0.011
1	W2038	0.059	0.001	56.10	0.000	0.000	0.000	0.105	0.918	0.001	1.1e-02	1	13	0.918	0.059	0.059
1	W2549	0.024	0.000	64.08	0.000	0.000	0.000	0.076	0.941	0.000	6.0e-03	1	13	0.941	0.024	0.024
1	W1031	0.012	0.000	40.45	0.000	0.000	0.000	0.002	0.999	0.000	0.0e+00	1	13	0.999	0.012	0.012
1	W1106	0.000	0.000	NaN	NaN	0.000	0.000	NaN	NaN	NaN	NaN	1	13	NaN	0.000	0.000
1	W1455	0.000	0.000	NaN	NaN	0.000	0.000	NaN	NaN	NaN	NaN	1	13	NaN	0.000	0.000
1	W95	0.020	0.000	67.79	0.000	0.000	0.000	-0.560	0.585	0.024	3.1e-01	1	13	0.585	0.019	0.019
1	W484000	0.014	0.002	7.29	0.000	0.000	0.000	-0.306	0.764	0.007	9.4e-02	1	13	0.764	0.013	0.012
1	W166	0.105	0.011	9.92	0.000	0.000	0.002	-0.164	0.872	0.002	2.7e-02	1	13	0.872	0.102	0.099
1	W2283	0.032	0.002	15.77	0.000	0.000	0.000	-0.867	0.402	0.055	7.5e-01	1	13	0.402	0.029	0.027
1	W1572	0.048	0.002	27.11	0.000	0.000	0.000	-1.243	0.236	0.106	1.5e+00	1	13	0.236	0.045	0.041
1	W2173	1.177	0.017	67.79	0.000	0.000	0.003	-0.140	0.890	0.002	2.0e-02	1	13	0.890	1.173	1.170
1	W2389	0.036	0.003	12.53	0.000	0.000	0.000	-1.021	0.326	0.074	1.0e+00	1	13	0.326	0.032	0.027
1	D_AKS_W415	0.009	0.005	2.02	0.099	-0.001	0.001	-1.079	0.330	0.189	1.2e+00	1	5	0.330	0.001	-0.007
1	W1996	0.109	0.045	2.46	0.029	-0.001	0.007	-0.212	0.835	0.003	4.5e-02	1	13	0.835	0.095	0.081
1	W1296	0.089	0.011	7.80	0.000	-0.001	0.002	-0.834	0.419	0.051	6.9e-01	1	13	0.419	0.075	0.060
1	W308	0.910	0.124	7.36	0.000	-0.002	0.019	-0.093	0.927	0.001	9.0e-03	1	13	0.927	0.893	0.876
1	W834	3.050	0.064	47.49	0.000	-0.002	0.010	-0.190	0.853	0.003	3.6e-02	1	13	0.853	3.032	3.014
1	W1209_W2181	3.569	0.043	83.49	0.000	-0.003	0.006	-0.400	0.695	0.012	1.6e-01	1	13	0.695	3.543	3.518
1	W19481W429	1.555	0.028	54.80	0.000	-0.003	0.004	-0.655	0.524	0.032	4.3e-01	1	13	0.524	1.528	1.500
1	W1710	2.539	0.335	7.58	0.000	-0.003	0.050	-0.058	0.955	0.000	3.0e-03	1	13	0.955	2.510	2.481
1	W1892	0.414	0.019	21.59	0.000	-0.003	0.003	-1.040	0.317	0.077	1.1e+00	1	13	0.317	0.384	0.354

Test Number	Cluster	Intercept Est	Intercept Std.Err	Intercept t-val	Intercept p-val	Slope Est	Slope Std.Err	Slope t-val	Slope p-val	R2	F-stat	df1	df2	p-value	MS1Est	MS2Est
1	W2293_W672	1.238	0.041	30.29	0.000	-0.004	0.006	-0.611	0.551	0.028	3.7e-01	1	13	0.551	1.201	1.164
1	W1966	0.567	0.024	23.89	0.000	-0.004	0.004	-1.072	0.303	0.081	1.1e+00	1	13	0.303	0.529	0.491
1	W996	3.766	0.311	12.11	0.000	-0.005	0.047	-0.103	0.919	0.001	1.1e-02	1	13	0.919	3.718	3.670
1	W2293_W164	1.245	0.046	27.34	0.000	-0.005	0.007	-0.777	0.451	0.044	6.0e-01	1	13	0.451	1.192	1.139
1	W2007_DB2	2.512	0.035	72.62	0.000	-0.006	0.005	-1.172	0.262	0.096	1.4e+00	1	13	0.262	2.451	2.391
1	D_W2173	0.066	0.034	1.97	0.077	-0.007	0.005	-1.271	0.233	0.139	1.6e+00	1	10	0.233	-0.001	-0.069
1	W2295_W789	4.661	0.162	28.77	0.000	-0.007	0.024	-0.286	0.779	0.006	8.2e-02	1	13	0.779	4.592	4.522
1	W1471	2.711	0.095	28.51	0.000	-0.007	0.014	-0.499	0.626	0.019	2.5e-01	1	13	0.626	2.640	2.569
1	W1543	4.301	1.011	4.26	0.001	-0.008	0.151	-0.050	0.961	0.000	3.0e-03	1	13	0.961	4.226	4.150
1	W2552	9.199	0.221	41.69	0.000	-0.009	0.033	-0.268	0.793	0.005	7.2e-02	1	13	0.793	9.111	9.022
1	W1886	0.185	0.036	5.13	0.000	-0.010	0.005	-1.857	0.086	0.210	3.4e+00	1	13	0.086	0.085	-0.015
1	W19481APP	1.899	0.095	19.95	0.000	-0.012	0.014	-0.877	0.396	0.056	7.7e-01	1	13	0.396	1.774	1.649
1	W331	2.220	0.218	10.19	0.000	-0.016	0.033	-0.487	0.634	0.018	2.4e-01	1	13	0.634	2.062	1.903
1	W185616W1400401	1.010	0.133	7.62	0.000	-0.016	0.020	-0.812	0.432	0.048	6.6e-01	1	13	0.432	0.849	0.688
1	W826	0.269	0.225	1.19	0.255	-0.017	0.034	-0.516	0.614	0.020	2.7e-01	1	13	0.614	0.094	-0.080
1	W19481ADB	3.951	0.113	34.96	0.000	-0.020	0.017	-1.158	0.268	0.093	1.3e+00	1	13	0.268	3.756	3.560
1	W2199	3.995	0.124	32.19	0.000	-0.021	0.019	-1.156	0.269	0.093	1.3e+00	1	13	0.269	3.780	3.566
1	W569	2.168	0.094	23.02	0.000	-0.023	0.014	-1.664	0.120	0.176	2.8e+00	1	13	0.120	1.934	1.699
1	W1614	1.908	0.132	14.46	0.000	-0.024	0.020	-1.227	0.242	0.104	1.5e+00	1	13	0.242	1.665	1.423
1	W1039	1.948	0.176	11.05	0.000	-0.026	0.026	-0.973	0.348	0.068	9.5e-01	1	13	0.348	1.691	1.434
1	W543	4.756	0.898	5.30	0.000	-0.034	0.134	-0.250	0.806	0.005	6.3e-02	1	13	0.806	4.420	4.084
1	D_W1700	0.322	0.146	2.21	0.058	-0.037	0.021	-1.765	0.116	0.280	3.1e+00	1	8	0.116	-0.045	-0.413
1	W129	1.476	0.120	12.32	0.000	-0.039	0.018	-2.156	0.050	0.263	4.7e+00	1	13	0.050	1.089	0.703
1	W1946	2.547	0.258	9.89	0.000	-0.059	0.039	-1.525	0.151	0.152	2.3e+00	1	13	0.151	1.959	1.371
1	W2179_W2190	4.428	0.287	15.41	0.000	-0.064	0.043	-1.483	0.162	0.145	2.2e+00	1	13	0.162	3.790	3.153
1	W1246	2.971	0.343	8.65	0.000	-0.070	0.051	-1.360	0.197	0.125	1.9e+00	1	13	0.197	2.272	1.573
1	W2235	4.407	0.347	12.71	0.000	-0.075	0.052	-1.438	0.174	0.137	2.1e+00	1	13	0.174	3.661	2.915
1	W2362	9.159	2.073	4.42	0.001	-0.085	0.310	-0.273	0.789	0.006	7.4e-02	1	13	0.789	8.314	7.468
1	D_AKS_W647	1.034	0.293	3.53	0.008	-0.099	0.047	-2.087	0.070	0.353	4.4e+00	1	8	0.070	0.048	-0.938
1	D_W1265	1.159	0.606	1.91	0.097	-0.122	0.090	-1.361	0.216	0.209	1.9e+00	1	7	0.216	-0.062	-1.283
1	W1760	16.876	2.868	5.88	0.000	-0.559	0.429	-1.302	0.216	0.115	1.7e+00	1	13	0.216	11.288	5.701
1	D_W2330	14.401	3.081	4.67	0.018	-1.486	0.372	-3.998	0.028	0.842	1.6e+01	1	3	0.028	-0.459	-15.320

Table A.4: Balance test results for clusters in terms of CPU resource consumption. For convenience, the table is arranged in increasing order of the p-value of the significance test on the null-hypothesis, $H_0 : \beta_1 = 1$, in an effort to present the cluster members furthest from being balanced first.

Test Number	Cluster	Server	Servers	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=1 t-value	Slope=1 p-value	R2	F-stat	df1	df2	p-value
1	W1246	S_W9282W15...	2	0.000	0.000	-6.191	0.000	0.500	0.000	-2.9e+16	0.000	1.000	8.3e+32	1	13	0.000
1	W1614	S_W9282W22...	2	0.000	0.000	-8.712	0.000	0.500	0.000	-2.0e+16	0.000	1.000	3.9e+32	1	13	0.000
1	W1886	W18861	2	0.036	0.002	19.163	0.000	0.497	0.008	-6.4e+01	0.000	0.997	4.0e+03	1	13	0.000
1	W1996	W19961	2	0.005	0.000	12.651	0.000	0.542	0.002	-2.5e+02	0.000	1.000	8.7e+04	1	13	0.000
1	W2007_W400...	W256510	5	1.382	0.054	25.641	0.000	0.315	0.008	-8.9e+01	0.000	0.992	1.7e+03	1	13	0.000
1	W2098	W20981	3	0.351	0.023	14.950	0.000	0.325	0.012	-5.4e+01	0.000	0.981	6.9e+02	1	13	0.000
1	W2389	W23891	2	0.003	0.000	13.507	0.000	0.584	0.004	-1.0e+02	0.000	0.999	2.0e+04	1	13	0.000
1	W301	W137501	8	1.515	0.141	10.742	0.000	0.093	0.001	-1.4e+03	0.000	0.999	1.9e+04	1	13	0.000
1	W301	W137502	8	1.994	0.060	33.216	0.000	0.097	0.000	-3.0e+03	0.000	1.000	1.0e+05	1	13	0.000
1	W301	W137503	8	1.915	0.076	25.080	0.000	0.098	0.000	-2.3e+03	0.000	1.000	6.3e+04	1	13	0.000
1	W301	W137504	8	0.364	0.061	6.009	0.000	0.091	0.000	-3.4e+03	0.000	1.000	1.1e+05	1	13	0.000
1	W301	W3010	8	-6.555	0.231	-28.336	0.000	2.952	0.025	7.7e+01	0.000	0.999	1.4e+04	1	13	0.000
1	W971	W97101	3	5.324	0.425	12.516	0.000	0.450	0.009	-6.4e+01	0.000	0.995	2.7e+03	1	13	0.000
1	W2362	S_105W2362	2	2.253	0.148	15.249	0.000	0.505	0.010	-5.0e+01	0.000	0.995	2.6e+03	1	13	0.000
1	W909	W90903	4	0.199	0.004	49.181	0.000	0.372	0.014	-4.6e+01	0.000	0.983	7.4e+02	1	13	0.000
1	W543	S_105W543	2	1.070	0.087	12.311	0.000	0.506	0.011	-4.4e+01	0.000	0.994	2.0e+03	1	13	0.000
1	W301	W3011	8	-7.985	0.456	-17.504	0.000	3.258	0.052	4.3e+01	0.000	0.997	3.9e+03	1	13	0.000
1	W2254	W128406	7	2.230	0.149	14.926	0.000	0.182	0.021	-4.0e+01	0.000	0.857	7.8e+01	1	13	0.000
1	W620	W6202	2	-0.005	0.005	-0.923	0.373	0.267	0.020	-3.7e+01	0.000	0.934	1.9e+02	1	13	0.000
1	W1265	W12652	2	1.436	0.167	8.603	0.000	0.529	0.013	-3.6e+01	0.000	0.992	1.7e+03	1	13	0.000
1	W2295	W229509	9	3.054	0.510	5.986	0.000	0.288	0.020	-3.5e+01	0.000	0.940	2.0e+02	1	13	0.000
1	W2038	W20382	2	0.055	0.001	40.530	0.000	0.078	0.028	-3.2e+01	0.000	0.367	7.5e+00	1	13	0.017
1	W301	W25703	8	0.256	0.506	0.506	0.621	4.536	0.111	3.2e+01	0.000	0.992	1.7e+03	1	13	0.000
1	W2007_W400...	W20079	5	1.004	0.078	12.831	0.000	0.510	0.016	-3.2e+01	0.000	0.988	1.1e+03	1	13	0.000
1	W2482	W248203	8	2.526	0.157	16.073	0.000	0.150	0.031	-2.8e+01	0.000	0.651	2.4e+01	1	13	0.000
1	W1430	S_105W1430	2	2.588	0.150	17.225	0.000	0.484	0.019	-2.6e+01	0.000	0.979	6.2e+02	1	13	0.000
1	W1428	W21271	6	0.070	0.011	6.618	0.000	0.473	0.022	-2.4e+01	0.000	0.973	4.7e+02	1	13	0.000
1	W272	W27204	8	1.394	0.101	13.833	0.000	0.190	0.034	-2.4e+01	0.000	0.703	3.1e+01	1	13	0.000
1	SQL14W1719	W125914W17...	2	0.416	0.065	6.446	0.000	0.500	0.023	-2.2e+01	0.000	0.974	4.9e+02	1	13	0.000
1	W131	W13101	4	5.970	0.360	16.578	0.000	0.326	0.031	-2.2e+01	0.000	0.894	1.1e+02	1	13	0.000
1	W2330	W23302	2	10.540	1.542	6.835	0.000	0.472	0.025	-2.1e+01	0.000	0.965	3.6e+02	1	13	0.000
1	W1471	W14712	2	0.641	0.078	8.200	0.000	0.588	0.023	-1.8e+01	0.000	0.981	6.8e+02	1	13	0.000
1	W1640	W16401	10	3.978	0.523	7.606	0.000	0.121	0.049	-1.8e+01	0.000	0.315	6.0e+00	1	13	0.030
1	W2327	S_W9282W10...	2	1.970	0.179	11.017	0.000	0.491	0.029	-1.7e+01	0.000	0.955	2.8e+02	1	13	0.000
1	D_W1700	D_W17001	2	-0.004	0.002	-2.007	0.080	0.771	0.006	-3.7e+01	0.000	0.999	1.6e+04	1	8	0.000
1	W1038	W103803	6	0.462	0.165	2.804	0.015	0.774	0.014	-1.6e+01	0.000	0.996	3.1e+03	1	13	0.000
1	W487	W48701	5	-0.016	0.130	-0.126	0.901	0.459	0.034	-1.6e+01	0.000	0.933	1.8e+02	1	13	0.000
1	W272	W27203	8	1.286	0.112	11.487	0.000	0.270	0.047	-1.6e+01	0.000	0.719	3.3e+01	1	13	0.000
1	D_W1265	D_W12652	2	0.029	0.015	1.976	0.089	0.636	0.009	-4.2e+01	0.000	0.999	5.4e+03	1	7	0.000
1	W2295	W229506	9	3.950	0.751	5.261	0.000	0.364	0.043	-1.5e+01	0.000	0.848	7.3e+01	1	13	0.000
1	W2293_W1519	W22937	4	0.927	0.087	10.675	0.000	0.230	0.055	-1.4e+01	0.000	0.576	1.8e+01	1	13	0.001
1	D_W2173	D_W21731	2	0.003	0.001	2.328	0.042	0.745	0.014	-1.9e+01	0.000	0.997	3.0e+03	1	10	0.000

Test Number	Cluster	Server	Servers	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=1 t-value	Slope=1 p-value	R2	F-stat	df1	df2	p-value
1	W95301	W6640W1166...	2	3.510	0.459	7.649	0.000	0.784	0.017	-1.3e+01	0.000	0.994	2.2e+03	1	13	0.000
1	W1640	W16402	10	4.621	0.299	15.459	0.000	0.167	0.064	-1.3e+01	0.000	0.340	6.7e+00	1	13	0.022
1	W272	W27208	8	1.622	0.190	8.524	0.000	0.090	0.073	-1.3e+01	0.000	0.106	1.5e+00	1	13	0.237
1	W2295	W229510	9	1.791	1.005	1.783	0.098	0.400	0.049	-1.2e+01	0.000	0.839	6.8e+01	1	13	0.000
1	W2007_W859...	W20078	2	0.922	0.111	8.310	0.000	0.534	0.040	-1.2e+01	0.000	0.931	1.7e+02	1	13	0.000
1	W2293_W164	W22934	2	0.648	0.049	13.152	0.000	0.503	0.043	-1.2e+01	0.000	0.912	1.4e+02	1	13	0.000
1	D_W1700	D_W17002	2	0.008	0.004	2.111	0.068	1.418	0.021	2.0e+01	0.000	0.998	4.6e+03	1	8	0.000
1	W1038	W103802	6	0.049	0.188	0.262	0.798	0.826	0.016	-1.1e+01	0.000	0.995	2.6e+03	1	13	0.000
1	W174	W17411	15	3.601	1.020	3.531	0.004	0.582	0.041	-1.0e+01	0.000	0.940	2.0e+02	1	13	0.000
1	W19481ADB	W19481ADB1	2	1.223	0.174	7.019	0.000	0.601	0.040	-1.0e+01	0.000	0.946	2.3e+02	1	13	0.000
1	W18642W2324	S_W9282W18...	2	1.006	0.112	9.020	0.000	0.512	0.049	-1.0e+01	0.000	0.894	1.1e+02	1	13	0.000
1	W589	W5894	14	0.000	0.001	0.092	0.928	0.559	0.045	-9.9e+00	0.000	0.923	1.6e+02	1	13	0.000
1	W1760	W176004	2	6.389	1.023	6.247	0.000	0.476	0.054	-9.7e+00	0.000	0.856	7.7e+01	1	13	0.000
1	W589	W5898	14	0.002	0.000	3.992	0.002	0.726	0.029	-9.5e+00	0.000	0.980	6.4e+02	1	13	0.000
1	W1056	S_105W1056	2	2.712	0.423	6.405	0.000	0.486	0.055	-9.4e+00	0.000	0.857	7.8e+01	1	13	0.000
1	W174_W266	W17411	20	2.662	1.072	2.484	0.027	0.601	0.043	-9.3e+00	0.000	0.938	2.0e+02	1	13	0.000
1	W1536	W153601	3	0.940	0.104	9.058	0.000	0.793	0.023	-9.0e+00	0.000	0.989	1.2e+03	1	13	0.000
1	W1640	W16403	10	4.047	0.575	7.042	0.000	0.190	0.092	-8.8e+00	0.000	0.248	4.3e+00	1	13	0.059
1	W2389	W23892	2	-0.032	0.006	-5.136	0.000	5.880	0.555	8.8e+00	0.000	0.896	1.1e+02	1	13	0.000
1	W130	W1301	2	0.005	0.001	4.321	0.001	0.589	0.047	-8.7e+00	0.000	0.923	1.6e+02	1	13	0.000
1	W971	W97103	3	-45.031	6.911	-6.516	0.000	5.799	0.557	8.6e+00	0.000	0.893	1.1e+02	1	13	0.000
1	W2235	S_105W2235	2	1.353	0.291	4.655	0.000	0.523	0.056	-8.5e+00	0.000	0.870	8.7e+01	1	13	0.000
1	W2199	W21992	2	2.075	0.186	11.161	0.000	0.536	0.055	-8.4e+00	0.000	0.880	9.5e+01	1	13	0.000
1	W589	W58910	14	0.002	0.000	6.843	0.000	0.815	0.022	-8.4e+00	0.000	0.991	1.4e+03	1	13	0.000
1	W589	W5891	14	-0.001	0.000	-2.824	0.014	1.453	0.054	8.3e+00	0.000	0.982	7.2e+02	1	13	0.000
1	W1640	W16409	10	3.300	0.526	6.270	0.000	0.318	0.085	-8.0e+00	0.000	0.517	1.4e+01	1	13	0.003
1	W2552	S_W1439	2	4.794	0.620	7.738	0.000	0.476	0.067	-7.8e+00	0.000	0.793	5.0e+01	1	13	0.000
1	W2295_W822	W229502	2	0.073	0.042	1.734	0.107	0.591	0.054	-7.5e+00	0.000	0.901	1.2e+02	1	13	0.000
1	D_W2173	D_W21732	2	-0.005	0.003	-1.962	0.078	1.490	0.055	8.9e+00	0.000	0.987	7.3e+02	1	10	0.000
1	W1038	W103805	6	0.493	0.324	1.522	0.152	0.793	0.028	-7.4e+00	0.000	0.984	8.1e+02	1	13	0.000
1	W1710	S_105W1710	2	1.208	0.240	5.037	0.000	0.445	0.075	-7.4e+00	0.000	0.729	3.5e+01	1	13	0.000
1	W748	W74802	3	1.423	0.343	4.152	0.001	0.724	0.037	-7.4e+00	0.000	0.967	3.8e+02	1	13	0.000
1	W174_W266	W17412	20	2.622	0.681	3.847	0.002	0.753	0.034	-7.3e+00	0.000	0.974	4.9e+02	1	13	0.000
1	W1038	W103804	6	0.118	0.276	0.428	0.676	0.828	0.024	-7.2e+00	0.000	0.989	1.2e+03	1	13	0.000
1	W487	W48703	5	0.592	0.093	6.332	0.000	0.635	0.051	-7.2e+00	0.000	0.922	1.5e+02	1	13	0.000
1	W1209_W2181	W12091	4	1.645	0.311	5.292	0.000	0.464	0.075	-7.1e+00	0.000	0.744	3.8e+01	1	13	0.000
1	W1640	W16408	10	3.739	0.589	6.348	0.000	0.266	0.104	-7.1e+00	0.000	0.334	6.5e+00	1	13	0.024
1	D_W1265	D_W12651	2	-0.096	0.057	-1.681	0.137	2.292	0.114	1.1e+01	0.000	0.983	4.0e+02	1	7	0.000
1	W748	W74801	3	1.448	0.726	1.994	0.068	0.565	0.062	-7.0e+00	0.000	0.864	8.2e+01	1	13	0.000
1	W95301	W6640W1166...	2	-5.450	1.077	-5.058	0.000	1.344	0.049	7.0e+00	0.000	0.983	7.4e+02	1	13	0.000
1	W174	W17412	15	3.661	0.803	4.559	0.001	0.723	0.040	-6.9e+00	0.000	0.962	3.3e+02	1	13	0.000
1	W633	S_W9281W19...	3	4.259	0.596	7.151	0.000	0.421	0.084	-6.9e+00	0.000	0.661	2.5e+01	1	13	0.000
1	W2549	W25491	2	0.006	0.003	2.025	0.064	0.453	0.080	-6.8e+00	0.000	0.709	3.2e+01	1	13	0.000
1	W2295_W789	W229504	3	2.358	0.316	7.464	0.000	0.515	0.071	-6.8e+00	0.000	0.800	5.2e+01	1	13	0.000
1	W2254	W128404	7	1.541	0.579	2.659	0.020	0.312	0.102	-6.8e+00	0.000	0.421	9.5e+00	1	13	0.009
1	W272	W27207	8	1.927	0.304	6.334	0.000	-0.068	0.158	-6.7e+00	0.000	0.014	1.9e-01	1	13	0.674
1	W2312_W266	W231207	12	0.725	0.197	3.684	0.003	0.676	0.048	-6.7e+00	0.000	0.938	2.0e+02	1	13	0.000
1	W2312_W266	W231204	12	0.067	0.204	0.327	0.749	0.711	0.043	-6.7e+00	0.000	0.954	2.7e+02	1	13	0.000

Test Number	Cluster	Server	Servers	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=1 t-value	Slope=1 p-value	R2	F-stat	df1	df2	p-value
1	W1566_W400	W10991	2	1.124	0.235	4.790	0.000	0.652	0.053	-6.5e+00	0.000	0.920	1.5e+02	1	13	0.000
1	W2312_W266	W231201	12	0.339	0.242	1.397	0.186	0.664	0.052	-6.5e+00	0.000	0.927	1.6e+02	1	13	0.000
1	W129	W12902	4	0.661	0.114	5.820	0.000	0.465	0.083	-6.4e+00	0.000	0.705	3.1e+01	1	13	0.000
1	W2295_AAC	W229506	2	3.752	0.767	4.890	0.000	0.725	0.044	-6.3e+00	0.000	0.955	2.8e+02	1	13	0.000
1	W1640	W164010	10	4.787	0.835	5.729	0.000	0.065	0.151	-6.2e+00	0.000	0.014	1.8e-01	1	13	0.674
1	W1039	S_105W1039	2	1.054	0.256	4.113	0.001	0.334	0.110	-6.1e+00	0.000	0.415	9.2e+00	1	13	0.009
1	W129	W12903	4	0.959	0.141	6.794	0.000	0.277	0.119	-6.1e+00	0.000	0.293	5.4e+00	1	13	0.037
1	W129	W12901	4	1.194	0.236	5.068	0.000	0.045	0.164	-5.8e+00	0.000	0.006	7.4e-02	1	13	0.790
1	W1543	W203901	2	2.196	0.514	4.275	0.001	0.464	0.093	-5.8e+00	0.000	0.658	2.5e+01	1	13	0.000
1	W308	W11203	2	0.584	0.116	5.028	0.000	0.343	0.114	-5.8e+00	0.000	0.410	9.0e+00	1	13	0.010
1	W487	W48704	5	0.825	0.079	10.386	0.000	0.673	0.057	-5.8e+00	0.000	0.915	1.4e+02	1	13	0.000
1	W1640	W16405	10	5.437	0.838	6.487	0.000	-0.074	0.189	-5.7e+00	0.000	0.012	1.5e-01	1	13	0.701
1	W2312_W266	W231208	12	0.408	0.104	3.925	0.002	0.838	0.028	-5.7e+00	0.000	0.985	8.7e+02	1	13	0.000
1	W1209_W2181	W12093	4	2.093	0.340	6.164	0.000	0.433	0.100	-5.7e+00	0.000	0.588	1.9e+01	1	13	0.001
1	W1001	W10011	2	0.008	0.002	3.792	0.002	0.515	0.087	-5.5e+00	0.000	0.727	3.5e+01	1	13	0.000
1	W1640	W16406	10	4.046	0.656	6.171	0.000	0.243	0.137	-5.5e+00	0.000	0.196	3.2e+00	1	13	0.098
1	W569	S_105W569	2	1.016	0.194	5.237	0.000	0.490	0.092	-5.5e+00	0.000	0.685	2.8e+01	1	13	0.000
1	W834	W8341	2	1.168	0.250	4.671	0.000	0.581	0.077	-5.4e+00	0.000	0.812	5.6e+01	1	13	0.000
1	W129	W12904	4	0.699	0.147	4.764	0.000	0.425	0.106	-5.4e+00	0.000	0.553	1.6e+01	1	13	0.001
1	W174_W266	W13021	20	7.218	1.075	6.715	0.000	0.655	0.064	-5.4e+00	0.000	0.889	1.0e+02	1	13	0.000
1	W2482	W248202	8	1.584	0.406	3.903	0.002	0.430	0.106	-5.4e+00	0.000	0.557	1.6e+01	1	13	0.001
1	W969	W9698	10	-19.430	1.753	-11.083	0.000	1.227	0.042	5.3e+00	0.000	0.985	8.4e+02	1	13	0.000
1	W174	W17409	15	4.707	1.423	3.307	0.006	0.640	0.068	-5.3e+00	0.000	0.873	9.0e+01	1	13	0.000
1	W2179_W2415	W21792	2	1.157	0.465	2.487	0.027	0.310	0.132	-5.2e+00	0.000	0.299	5.5e+00	1	13	0.035
1	W2173	W21731	2	0.345	0.136	2.545	0.024	0.539	0.088	-5.2e+00	0.000	0.742	3.7e+01	1	13	0.000
1	W969	W9696	10	15.075	0.600	25.132	0.000	0.847	0.030	-5.1e+00	0.000	0.984	8.1e+02	1	13	0.000
1	W331	S_W246	2	1.123	0.229	4.900	0.000	0.477	0.103	-5.1e+00	0.000	0.621	2.1e+01	1	13	0.000
1	W1640	W16404	10	5.150	0.942	5.468	0.000	-0.005	0.200	-5.0e+00	0.000	0.000	1.0e-03	1	13	0.979
1	W1225	W122502	2	2.578	0.703	3.666	0.003	0.582	0.084	-5.0e+00	0.000	0.788	4.8e+01	1	13	0.000
1	W2254	W128407	7	3.466	0.455	7.618	0.000	-0.159	0.234	-4.9e+00	0.000	0.034	4.6e-01	1	13	0.508
1	W1576	W15761	2	0.003	0.001	2.120	0.054	0.504	0.100	-4.9e+00	0.000	0.659	2.5e+01	1	13	0.000
1	W1039	S_W466	2	1.425	0.220	6.481	0.000	0.275	0.149	-4.9e+00	0.000	0.208	3.4e+00	1	13	0.088
1	W1536	W153603	3	-1.028	0.208	-4.952	0.000	1.230	0.048	4.8e+00	0.000	0.981	6.7e+02	1	13	0.000
1	W308	W11204	2	0.640	0.141	4.548	0.001	0.297	0.147	-4.8e+00	0.000	0.238	4.1e+00	1	13	0.065
1	W1296	W12961	2	0.048	0.009	5.381	0.000	0.460	0.115	-4.7e+00	0.000	0.554	1.6e+01	1	13	0.001
1	W826	W82601	2	0.001	0.013	0.083	0.935	0.885	0.025	-4.7e+00	0.000	0.990	1.3e+03	1	13	0.000
1	W589	W58911	14	0.003	0.001	4.100	0.001	0.707	0.063	-4.7e+00	0.000	0.908	1.3e+02	1	13	0.000
1	W2482	W248206	8	2.384	0.547	4.357	0.001	0.244	0.163	-4.6e+00	0.000	0.147	2.2e+00	1	13	0.158
1	W996	W99601	2	-0.706	0.346	-2.039	0.062	0.737	0.057	-4.6e+00	0.000	0.928	1.7e+02	1	13	0.000
1	W2312_W266	W231205	12	0.031	0.261	0.119	0.907	0.738	0.057	-4.6e+00	0.000	0.928	1.7e+02	1	13	0.000
1	W633	S_W9281W51...	3	5.610	1.350	4.156	0.001	0.205	0.173	-4.6e+00	0.001	0.097	1.4e+00	1	13	0.258
1	W174_W266	W13023	20	5.598	1.792	3.123	0.008	0.597	0.088	-4.6e+00	0.001	0.780	4.6e+01	1	13	0.000
1	W2295_FED	W229509	2	2.926	1.150	2.545	0.024	0.798	0.046	-4.4e+00	0.001	0.959	3.1e+02	1	13	0.000
1	W2293_W1519	W22938	4	0.898	0.160	5.598	0.000	0.357	0.145	-4.4e+00	0.001	0.316	6.0e+00	1	13	0.029
1	W174_W266	W17409	20	4.100	1.701	2.411	0.031	0.645	0.081	-4.4e+00	0.001	0.831	6.4e+01	1	13	0.000
1	W95	W951	2	0.010	0.003	3.871	0.002	0.466	0.123	-4.4e+00	0.001	0.527	1.4e+01	1	13	0.002
1	W2007_DB2	W20075	2	1.234	0.287	4.305	0.001	0.503	0.116	-4.3e+00	0.001	0.592	1.9e+01	1	13	0.001
1	W131	W13102	4	0.195	2.286	0.085	0.933	0.481	0.124	-4.2e+00	0.001	0.536	1.5e+01	1	13	0.002

Test Number	Cluster	Server	Servers	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=1 t-value	Slope=1 p-value	R2	F-stat	df1	df2	p-value
1	W786	W78602	4	-1.466	1.375	-1.067	0.306	0.820	0.043	-4.1e+00	0.001	0.965	3.6e+02	1	13	0.000
1	W1038	W103801	6	0.115	0.175	0.657	0.522	0.930	0.017	-4.1e+00	0.001	0.996	3.0e+03	1	13	0.000
1	W2254	W128408	7	3.609	0.632	5.708	0.000	-0.202	0.293	-4.1e+00	0.001	0.035	4.7e-01	1	13	0.503
1	W2295	W229507	9	0.131	1.294	0.101	0.921	0.649	0.086	-4.1e+00	0.001	0.815	5.7e+01	1	13	0.000
1	W2312_W266	W231209	12	0.331	0.183	1.811	0.093	0.808	0.047	-4.0e+00	0.001	0.957	2.9e+02	1	13	0.000
1	W2007_W400	W20074	2	1.032	0.193	5.343	0.000	0.555	0.112	-4.0e+00	0.002	0.656	2.5e+01	1	13	0.000
1	W2482	W248201	8	1.829	0.543	3.369	0.005	0.391	0.154	-4.0e+00	0.002	0.333	6.5e+00	1	13	0.024
1	W2312_W266	W231202	12	-0.099	0.227	-0.437	0.669	0.801	0.052	-3.9e+00	0.002	0.949	2.4e+02	1	13	0.000
1	W2482	W248204	8	3.682	0.867	4.247	0.001	-0.179	0.305	-3.9e+00	0.002	0.026	3.4e-01	1	13	0.568
1	W19481W429	W19481W429...	2	0.919	0.113	8.161	0.000	0.589	0.107	-3.9e+00	0.002	0.701	3.0e+01	1	13	0.000
1	W1302	W13023	5	1.819	1.435	1.267	0.227	0.729	0.070	-3.8e+00	0.002	0.892	1.1e+02	1	13	0.000
1	W272	W27202	8	1.619	0.457	3.544	0.004	0.102	0.237	-3.8e+00	0.002	0.014	1.8e-01	1	13	0.675
1	W2312_W266	W231203	12	-0.235	0.238	-0.987	0.342	0.803	0.053	-3.7e+00	0.002	0.947	2.3e+02	1	13	0.000
1	W1302	W13021	5	4.387	1.095	4.008	0.001	0.757	0.065	-3.7e+00	0.003	0.912	1.3e+02	1	13	0.000
1	W174_W266	W13022	20	3.518	1.420	2.478	0.028	0.732	0.073	-3.7e+00	0.003	0.885	1.0e+02	1	13	0.000
1	W786	W78605	4	-1.631	0.873	-1.869	0.084	1.139	0.038	3.7e+00	0.003	0.986	8.9e+02	1	13	0.000
1	W2312	W231206	9	-0.665	0.171	-3.892	0.002	1.142	0.040	3.6e+00	0.003	0.985	8.3e+02	1	13	0.000
1	W95	W952	2	0.011	0.003	3.913	0.002	0.456	0.156	-3.5e+00	0.004	0.397	8.6e+00	1	13	0.012
1	W272	W27206	8	1.614	0.448	3.605	0.003	0.116	0.257	-3.4e+00	0.004	0.015	2.0e-01	1	13	0.661
1	W174	W17401	15	6.071	1.475	4.115	0.001	0.707	0.086	-3.4e+00	0.005	0.840	6.8e+01	1	13	0.000
1	W108	W11872	2	0.016	0.005	3.536	0.004	0.489	0.150	-3.4e+00	0.005	0.451	1.1e+01	1	13	0.006
1	W1209_W2181	W12094	4	3.343	0.898	3.723	0.003	0.065	0.275	-3.4e+00	0.005	0.004	5.5e-02	1	13	0.817
1	W1296	W12962	2	0.040	0.016	2.529	0.025	0.443	0.166	-3.4e+00	0.005	0.353	7.1e+00	1	13	0.020
1	W589	W58913	14	0.002	0.001	3.232	0.007	0.844	0.047	-3.3e+00	0.006	0.961	3.2e+02	1	13	0.000
1	W2254	W128405	7	2.996	0.863	3.471	0.004	0.075	0.285	-3.2e+00	0.006	0.005	6.9e-02	1	13	0.797
1	W174_W266	W17401	20	5.151	1.489	3.461	0.004	0.735	0.086	-3.1e+00	0.009	0.848	7.3e+01	1	13	0.000
1	W272	W27205	8	1.656	0.396	4.183	0.001	0.116	0.288	-3.1e+00	0.009	0.012	1.6e-01	1	13	0.695
1	W2295_W789	W229503	3	1.198	0.663	1.806	0.094	0.632	0.122	-3.0e+00	0.010	0.673	2.7e+01	1	13	0.000
1	D_AKS_W415	D_AKS_W415...	3	-0.001	0.001	-1.355	0.233	1.379	0.094	4.0e+00	0.010	0.977	2.1e+02	1	5	0.000
1	W2007_DB2	W20076	2	1.222	0.412	2.965	0.011	0.505	0.166	-3.0e+00	0.010	0.417	9.3e+00	1	13	0.009
1	W826	W82602	2	0.003	0.016	0.218	0.831	1.117	0.039	3.0e+00	0.011	0.984	8.0e+02	1	13	0.000
1	W1428	W24461	6	-0.053	0.022	-2.426	0.031	1.227	0.077	3.0e+00	0.011	0.952	2.6e+02	1	13	0.000
1	W331	S_105W331	2	1.145	0.409	2.799	0.015	0.458	0.185	-2.9e+00	0.012	0.320	6.1e+00	1	13	0.028
1	D_AKS_W415	D_AKS_W415...	3	0.001	0.001	1.102	0.320	0.740	0.068	-3.8e+00	0.013	0.959	1.2e+02	1	5	0.000
1	W2312	W231207	9	0.903	0.217	4.158	0.001	0.847	0.053	-2.9e+00	0.013	0.951	2.5e+02	1	13	0.000
1	D_W764	D_W7642	2	0.094	0.064	1.460	0.218	0.768	0.055	-4.2e+00	0.014	0.980	1.9e+02	1	4	0.000
1	W2179_W2190	W21794	2	1.704	0.382	4.458	0.001	0.690	0.109	-2.8e+00	0.014	0.754	4.0e+01	1	13	0.000
1	W1543	W131401	2	2.548	0.950	2.682	0.019	0.420	0.205	-2.8e+00	0.014	0.244	4.2e+00	1	13	0.061
1	W185616W140040	W174623	2	0.197	0.138	1.428	0.177	0.661	0.122	-2.8e+00	0.015	0.694	3.0e+01	1	13	0.000
1	W1710	S_W965	2	1.852	0.539	3.438	0.004	0.321	0.245	-2.8e+00	0.016	0.116	1.7e+00	1	13	0.214
1	W2293_W1519	W22939	4	1.032	0.294	3.511	0.004	0.242	0.275	-2.8e+00	0.016	0.056	7.7e-01	1	13	0.396
1	W2179_W2415	W21791	2	1.213	0.209	5.791	0.000	0.644	0.130	-2.8e+00	0.017	0.655	2.5e+01	1	13	0.000
1	W2549	W25492	2	0.021	0.002	9.851	0.000	0.363	0.233	-2.7e+00	0.017	0.157	2.4e+00	1	13	0.144
1	W2295_W789	W229505	3	3.217	1.000	3.216	0.007	0.346	0.246	-2.7e+00	0.020	0.132	2.0e+00	1	13	0.183
1	D_AKS_W647	D_AKS_W647...	3	0.089	0.055	1.603	0.148	0.800	0.069	-2.9e+00	0.020	0.944	1.3e+02	1	8	0.000
1	W633	S_W9282W19...	3	2.809	0.990	2.837	0.014	0.633	0.142	-2.6e+00	0.022	0.605	2.0e+01	1	13	0.001
1	W2312	W231201	9	0.472	0.329	1.433	0.175	0.819	0.070	-2.6e+00	0.023	0.912	1.4e+02	1	13	0.000
1	W2482	W248205	8	2.098	0.681	3.080	0.009	0.387	0.240	-2.6e+00	0.024	0.167	2.6e+00	1	13	0.130

Test Number	Cluster	Server	Servers	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=1 t-value	Slope=1 p-value	R2	F-stat	df1	df2	p-value
1	W2482	W248207	8	2.128	0.649	3.277	0.006	0.396	0.240	-2.5e+00	0.026	0.174	2.7e+00	1	13	0.122
1	W589	W5897	14	0.002	0.001	1.949	0.073	0.760	0.095	-2.5e+00	0.026	0.830	6.3e+01	1	13	0.000
1	W569	S_W1335	2	1.085	0.417	2.599	0.022	0.477	0.208	-2.5e+00	0.026	0.287	5.2e+00	1	13	0.039
1	W2007_W400	W20073	2	0.665	0.383	1.735	0.106	0.584	0.169	-2.5e+00	0.029	0.479	1.2e+01	1	13	0.004
1	W2482	W248208	8	2.545	0.770	3.304	0.006	0.262	0.312	-2.4e+00	0.034	0.051	7.0e-01	1	13	0.417
1	W2312	W231204	9	0.088	0.227	0.386	0.705	0.889	0.048	-2.3e+00	0.037	0.964	3.4e+02	1	13	0.000
1	W2312_W266	W231206	12	-0.544	0.157	-3.473	0.004	0.916	0.036	-2.3e+00	0.037	0.980	6.3e+02	1	13	0.000
1	W1302	W13024	5	-1.937	2.432	-0.796	0.440	1.446	0.194	2.3e+00	0.038	0.811	5.6e+01	1	13	0.000
1	W185616W14004	W174622	2	0.408	0.112	3.641	0.003	0.684	0.139	-2.3e+00	0.041	0.650	2.4e+01	1	13	0.000
1	W272	W27201	8	1.219	0.506	2.409	0.032	0.346	0.290	-2.3e+00	0.042	0.099	1.4e+00	1	13	0.253
1	W2295	W229505	9	-19.080	10.999	-1.735	0.106	6.994	2.703	2.2e+00	0.045	0.340	6.7e+00	1	13	0.023
1	W2293_W1519	W22935	4	0.709	0.378	1.874	0.084	0.410	0.267	-2.2e+00	0.045	0.154	2.4e+00	1	13	0.148
1	W1302	W13022	5	-0.073	1.267	-0.057	0.955	0.856	0.065	-2.2e+00	0.046	0.930	1.7e+02	1	13	0.000
1	W131	W13103	4	8.265	1.976	4.183	0.001	0.125	0.399	-2.2e+00	0.047	0.008	9.9e-02	1	13	0.758
1	W2007_W400...	W256513	5	6.296	2.278	2.764	0.016	-1.326	1.069	-2.2e+00	0.049	0.106	1.5e+00	1	13	0.237
1	W174	W17414	15	1.882	1.052	1.790	0.097	1.162	0.076	2.1e+00	0.052	0.948	2.4e+02	1	13	0.000
1	W2552	S_105W2552	2	5.508	2.584	2.132	0.053	0.398	0.282	-2.1e+00	0.053	0.133	2.0e+00	1	13	0.182
1	W108	W11871	2	0.007	0.003	1.980	0.069	0.776	0.105	-2.1e+00	0.054	0.806	5.4e+01	1	13	0.000
1	W19481W429	W19481W429...	2	0.238	0.347	0.686	0.505	0.643	0.171	-2.1e+00	0.057	0.520	1.4e+01	1	13	0.002
1	W2254	W128402	7	1.231	0.702	1.755	0.103	0.596	0.202	-2.0e+00	0.067	0.401	8.7e+00	1	13	0.011
1	W174_W266	W17414	20	1.090	1.338	0.815	0.430	1.184	0.096	1.9e+00	0.077	0.921	1.5e+02	1	13	0.000
1	W1640	W16407	10	3.557	1.166	3.051	0.009	0.422	0.306	-1.9e+00	0.081	0.128	1.9e+00	1	13	0.191
1	W2173	W21732	2	0.692	0.174	3.966	0.002	0.595	0.215	-1.9e+00	0.082	0.371	7.7e+00	1	13	0.016
1	W19481APP	W19481APP1	2	0.340	0.132	2.564	0.024	0.858	0.076	-1.9e+00	0.083	0.908	1.3e+02	1	13	0.000
1	W1760	W176003	2	9.543	4.483	2.129	0.053	0.344	0.350	-1.9e+00	0.084	0.069	9.6e-01	1	13	0.344
1	W1209_W2181	W12092	4	0.876	0.428	2.047	0.061	0.773	0.124	-1.8e+00	0.090	0.751	3.9e+01	1	13	0.000
1	W2330	W23301	2	44.547	12.481	3.569	0.003	-0.277	0.705	-1.8e+00	0.093	0.012	1.5e-01	1	13	0.700
1	W2179_W2190	W21793	2	0.541	0.678	0.798	0.439	0.748	0.143	-1.8e+00	0.101	0.679	2.8e+01	1	13	0.000
1	W1265	W12651	2	-2.204	3.874	-0.569	0.579	2.885	1.072	1.8e+00	0.102	0.358	7.2e+00	1	13	0.018
1	W174	W17413	15	3.100	3.099	1.000	0.335	0.732	0.155	-1.7e+00	0.107	0.631	2.2e+01	1	13	0.000
1	W620	W6201	2	0.050	0.004	11.884	0.000	1.861	0.503	1.7e+00	0.111	0.513	1.4e+01	1	13	0.003
1	W2295_AAC	W229507	2	-3.193	2.180	-1.465	0.167	1.246	0.144	1.7e+00	0.112	0.851	7.4e+01	1	13	0.000
1	W174_W266	W13025	20	4.104	0.879	4.669	0.000	0.902	0.058	-1.7e+00	0.113	0.950	2.5e+02	1	13	0.000
1	W1056	S_W1677	2	4.130	1.846	2.236	0.043	0.411	0.348	-1.7e+00	0.114	0.097	1.4e+00	1	13	0.259
1	W2098	W20983	3	0.884	0.356	2.479	0.028	-0.210	0.720	-1.7e+00	0.117	0.006	8.5e-02	1	13	0.776
1	W487	W48702	5	1.289	0.393	3.276	0.006	0.395	0.362	-1.7e+00	0.118	0.084	1.2e+00	1	13	0.295
1	W2254	W128403	7	1.986	0.493	4.027	0.001	0.623	0.227	-1.7e+00	0.120	0.367	7.5e+00	1	13	0.017
1	W2007_W400...	W256512	5	6.500	2.847	2.283	0.040	-1.775	1.670	-1.7e+00	0.120	0.080	1.1e+00	1	13	0.307
1	W909	W90905	4	-0.010	0.083	-0.119	0.907	0.695	0.186	-1.6e+00	0.124	0.519	1.4e+01	1	13	0.002
1	W174_W266	W17413	20	2.864	3.469	0.825	0.424	0.718	0.174	-1.6e+00	0.128	0.568	1.7e+01	1	13	0.001
1	W748	W74803	3	6.608	1.524	4.336	0.001	0.328	0.417	-1.6e+00	0.131	0.045	6.2e-01	1	13	0.446
1	W969	W9699	10	-8.527	2.301	-3.706	0.003	0.916	0.053	-1.6e+00	0.134	0.959	3.0e+02	1	13	0.000
1	W589	W5893	14	0.000	0.001	0.370	0.717	1.077	0.049	1.6e+00	0.140	0.974	4.8e+02	1	13	0.000
1	D_W764	D_W7641	2	-0.102	0.128	-0.795	0.471	1.297	0.165	1.8e+00	0.146	0.939	6.2e+01	1	4	0.001
1	W2312_W266	W20981	12	2.176	0.298	7.301	0.000	0.761	0.158	-1.5e+00	0.153	0.642	2.3e+01	1	13	0.000
1	W909	W90902	4	0.314	0.271	1.160	0.267	-0.033	0.684	-1.5e+00	0.155	0.000	2.0e-03	1	13	0.962
1	D_AKS_W647	D_AKS_W647...	3	0.063	0.060	1.051	0.324	0.878	0.080	-1.5e+00	0.165	0.938	1.2e+02	1	8	0.000
1	W2295_FED	W229510	2	-1.235	2.038	-0.606	0.555	1.143	0.098	1.5e+00	0.170	0.912	1.3e+02	1	13	0.000

Test Number	Cluster	Server	Servers	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=1 t-value	Slope=1 p-value	R2	F-stat	df1	df2	p-value
1	W969	W9691	10	13.417	0.437	30.675	0.000	0.967	0.023	-1.5e+00	0.170	0.993	1.8e+03	1	13	0.000
1	W1083_W418	W108304	5	-0.214	0.122	-1.752	0.103	1.018	0.012	1.4e+00	0.175	0.998	6.8e+03	1	13	0.000
1	W2007_W859...	W20071	2	-0.532	0.350	-1.521	0.152	0.949	0.036	-1.4e+00	0.177	0.982	7.0e+02	1	13	0.000
1	W2286	W228601	2	0.463	0.321	1.443	0.173	0.872	0.091	-1.4e+00	0.182	0.876	9.2e+01	1	13	0.000
1	W2312	W231208	9	0.525	0.115	4.552	0.001	1.044	0.032	1.4e+00	0.190	0.988	1.1e+03	1	13	0.000
1	W1225	W122501	2	2.458	1.453	1.692	0.114	0.710	0.214	-1.4e+00	0.199	0.458	1.1e+01	1	13	0.006
1	W1430	S_W1537	2	7.381	4.661	1.583	0.137	-0.268	0.939	-1.4e+00	0.200	0.006	8.1e-02	1	13	0.780
1	W2286	W228602	2	0.410	0.330	1.243	0.236	0.878	0.093	-1.3e+00	0.211	0.874	9.0e+01	1	13	0.000
1	W131	W13104	4	7.585	2.199	3.450	0.004	0.319	0.528	-1.3e+00	0.219	0.027	3.7e-01	1	13	0.556
1	W2312_W266	W20983	12	3.931	1.010	3.891	0.002	-1.586	2.041	-1.3e+00	0.227	0.044	6.0e-01	1	13	0.451
1	W2295	W229503	9	21.472	14.227	1.509	0.155	-2.249	2.619	-1.2e+00	0.237	0.054	7.4e-01	1	13	0.406
1	W2312	W231205	9	0.046	0.308	0.151	0.883	0.922	0.067	-1.2e+00	0.264	0.936	1.9e+02	1	13	0.000
1	W969	W9692	10	1.166	1.187	0.983	0.344	0.957	0.037	-1.2e+00	0.270	0.981	6.6e+02	1	13	0.000
1	W174	W17407	15	3.397	1.847	1.839	0.089	0.873	0.110	-1.1e+00	0.272	0.828	6.2e+01	1	13	0.000
1	W834	W8342	2	0.930	0.655	1.419	0.179	0.739	0.229	-1.1e+00	0.275	0.444	1.0e+01	1	13	0.007
1	W909	W90904	4	0.348	0.230	1.512	0.154	-0.227	1.113	-1.1e+00	0.290	0.003	4.2e-02	1	13	0.842
1	W2235	S_W1673	2	2.114	1.008	2.098	0.056	0.637	0.339	-1.1e+00	0.303	0.214	3.5e+00	1	13	0.083
1	W130	W1302	2	0.012	0.005	2.393	0.033	0.579	0.396	-1.1e+00	0.307	0.142	2.1e+00	1	13	0.167
1	W2327	S_W9281W10...	2	3.518	2.514	1.400	0.185	0.311	0.648	-1.1e+00	0.307	0.017	2.3e-01	1	13	0.639
1	W487	W48707	5	1.396	0.567	2.463	0.028	0.344	0.619	-1.1e+00	0.308	0.023	3.1e-01	1	13	0.588
1	W2293_W164	W22933	2	0.526	0.580	0.908	0.380	0.529	0.445	-1.1e+00	0.309	0.098	1.4e+00	1	13	0.256
1	W969	W9694	10	13.279	0.357	37.170	0.000	0.980	0.019	-1.1e+00	0.309	0.995	2.8e+03	1	13	0.000
1	W1996	W19962	2	0.204	0.111	1.842	0.088	-9.120	9.635	-1.1e+00	0.313	0.064	9.0e-01	1	13	0.361
1	W1083_W418	W108303	5	0.105	0.113	0.926	0.371	0.988	0.011	-1.0e+00	0.314	0.998	7.5e+03	1	13	0.000
1	W18642W2324	S_105W1864...	2	0.903	0.813	1.111	0.287	0.597	0.392	-1.0e+00	0.322	0.152	2.3e+00	1	13	0.152
1	W174_W266	W13024	20	2.293	2.530	0.906	0.381	1.204	0.202	1.0e+00	0.330	0.733	3.6e+01	1	13	0.000
1	W174_W266	W17402	20	-4.247	2.363	-1.797	0.096	1.125	0.124	1.0e+00	0.332	0.864	8.2e+01	1	13	0.000
1	W19481ADB	W19481ADB2	2	-0.546	1.073	-0.508	0.620	1.318	0.322	9.9e-01	0.342	0.563	1.7e+01	1	13	0.001
1	W2295	W229504	9	13.499	8.830	1.529	0.150	-0.959	1.997	-9.8e-01	0.344	0.017	2.3e-01	1	13	0.639
1	W2295	W229501	9	8.455	1.202	7.036	0.000	4.119	3.281	9.5e-01	0.359	0.108	1.6e+00	1	13	0.231
1	W1083_W418	W108301	5	0.055	0.174	0.317	0.756	0.984	0.017	-9.2e-01	0.373	0.996	3.2e+03	1	13	0.000
1	W2098	W20982	3	0.690	0.542	1.271	0.226	0.174	0.951	-8.7e-01	0.400	0.003	3.3e-02	1	13	0.858
1	W1471	W14711	2	2.183	1.273	1.715	0.110	0.316	0.823	-8.3e-01	0.421	0.011	1.5e-01	1	13	0.708
1	W589	W58912	14	0.002	0.000	7.392	0.000	0.982	0.022	-8.3e-01	0.421	0.994	2.1e+03	1	13	0.000
1	W2199	W21991	2	0.709	1.488	0.476	0.642	0.721	0.339	-8.2e-01	0.425	0.258	4.5e+00	1	13	0.053
1	W174_W266	W17415	20	0.259	1.039	0.249	0.807	1.050	0.063	7.9e-01	0.443	0.955	2.8e+02	1	13	0.000
1	W1576	W15762	2	0.003	0.001	2.586	0.023	0.886	0.145	-7.9e-01	0.445	0.742	3.7e+01	1	13	0.000
1	W174	W17404	15	0.940	2.424	0.388	0.705	0.899	0.129	-7.8e-01	0.450	0.788	4.8e+01	1	13	0.000
1	W589	W58914	14	0.002	0.000	3.723	0.003	1.032	0.041	7.8e-01	0.451	0.979	6.2e+02	1	13	0.000
1	W174_W266	W17407	20	2.110	1.678	1.257	0.231	0.924	0.100	-7.5e-01	0.465	0.867	8.5e+01	1	13	0.000
1	W174	W17410	15	2.472	1.448	1.707	0.111	0.937	0.087	-7.2e-01	0.484	0.899	1.2e+02	1	13	0.000
1	W996	W99602	2	2.143	0.221	9.717	0.000	1.102	0.145	7.1e-01	0.492	0.817	5.8e+01	1	13	0.000
1	W174	W17415	15	1.109	0.710	1.562	0.142	1.027	0.043	6.3e-01	0.540	0.978	5.7e+02	1	13	0.000
1	W19481APP	W19481APP2	2	0.020	0.180	0.113	0.912	0.941	0.094	-6.3e-01	0.540	0.886	1.0e+02	1	13	0.000
1	W1302	W13025	5	0.888	0.897	0.990	0.340	1.036	0.059	6.1e-01	0.555	0.960	3.1e+02	1	13	0.000
1	W1566_W400	W10992	2	-0.073	0.797	-0.091	0.929	1.134	0.222	6.0e-01	0.558	0.667	2.6e+01	1	13	0.000
1	SQL14W1719	W125914W17...	2	1.246	0.738	1.690	0.115	0.490	0.854	-6.0e-01	0.561	0.025	3.3e-01	1	13	0.576
1	W1428	W16252	6	0.247	0.049	5.013	0.000	2.293	2.230	5.8e-01	0.572	0.075	1.1e+00	1	13	0.323

Test Number	Cluster	Server	Servers	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=1 t-value	Slope=1 p-value	R2	F-stat	df1	df2	p-value
1	W1001	W10012	2	0.004	0.003	1.275	0.225	0.901	0.172	-5.8e-01	0.574	0.678	2.7e+01	1	13	0.000
1	W1886	W18862	2	0.152	0.173	0.877	0.396	-0.342	2.420	-5.6e-01	0.589	0.002	2.0e-02	1	13	0.890
1	W1536	W153602	3	-0.146	0.192	-0.762	0.460	1.024	0.043	5.5e-01	0.589	0.977	5.6e+02	1	13	0.000
1	D_AKS_W647	D_AKS_W647...	3	0.071	0.150	0.471	0.650	0.881	0.222	-5.4e-01	0.607	0.663	1.6e+01	1	8	0.004
1	W589	W5892	14	0.000	0.001	0.086	0.933	0.976	0.045	-5.3e-01	0.608	0.973	4.7e+02	1	13	0.000
1	W786	W78601	4	3.064	0.750	4.083	0.001	1.018	0.035	5.2e-01	0.612	0.985	8.3e+02	1	13	0.000
1	W1428	W21272	6	0.285	0.038	7.450	0.000	0.389	1.267	-4.8e-01	0.638	0.007	9.4e-02	1	13	0.764
1	W971	W97102	3	0.884	1.148	0.770	0.455	0.980	0.043	-4.8e-01	0.641	0.976	5.3e+02	1	13	0.000
1	W174_W266	W17404	20	-0.293	2.397	-0.122	0.905	0.941	0.128	-4.6e-01	0.650	0.806	5.4e+01	1	13	0.000
1	W174	W17402	15	-2.593	2.604	-0.996	0.338	1.062	0.137	4.5e-01	0.658	0.823	6.0e+01	1	13	0.000
1	W174	W17405	15	2.549	2.972	0.858	0.407	1.093	0.214	4.3e-01	0.671	0.667	2.6e+01	1	13	0.000
1	W969	W96910	10	-1.329	1.315	-1.011	0.330	1.016	0.041	4.0e-01	0.693	0.980	6.2e+02	1	13	0.000
1	W174	W17406	15	-0.118	2.632	-0.045	0.965	0.945	0.139	-3.9e-01	0.702	0.779	4.6e+01	1	13	0.000
1	W2295	W229502	9	9.155	1.155	7.923	0.000	0.426	1.497	-3.8e-01	0.708	0.006	8.1e-02	1	13	0.781
1	W969	W9695	10	0.644	1.106	0.582	0.570	0.987	0.035	-3.8e-01	0.711	0.984	7.8e+02	1	13	0.000
1	W969	W9697	10	-12.046	1.337	-9.007	0.000	0.989	0.030	-3.7e-01	0.718	0.988	1.1e+03	1	13	0.000
1	W2007_W400...	W256511	5	0.141	3.487	0.041	0.968	1.614	1.684	3.6e-01	0.721	0.066	9.2e-01	1	13	0.355
1	W174_W266	W17403	20	-0.151	1.768	-0.085	0.933	1.038	0.104	3.6e-01	0.724	0.884	9.9e+01	1	13	0.000
1	W1428	W16251	6	-0.044	0.028	-1.586	0.137	1.030	0.083	3.6e-01	0.726	0.922	1.5e+02	1	13	0.000
1	W174_W266	W17410	20	1.503	1.517	0.991	0.340	0.968	0.091	-3.5e-01	0.729	0.896	1.1e+02	1	13	0.000
1	W1428	W24462	6	0.262	0.039	6.696	0.000	1.618	1.766	3.5e-01	0.732	0.061	8.4e-01	1	13	0.376
1	W2007_W859...	W20072	2	0.902	0.321	2.810	0.015	1.014	0.041	3.5e-01	0.735	0.979	6.1e+02	1	13	0.000
1	W2038	W20381	2	-0.004	0.008	-0.441	0.667	1.048	0.139	3.4e-01	0.736	0.815	5.7e+01	1	13	0.000
1	D_AKS_W415	D_AKS_W415...	3	0.000	0.001	0.054	0.959	0.973	0.078	-3.4e-01	0.747	0.969	1.6e+02	1	5	0.000
1	W174_W266	W17405	20	2.254	3.344	0.674	0.512	1.077	0.241	3.2e-01	0.754	0.606	2.0e+01	1	13	0.001
1	W969	W9693	10	-2.848	1.529	-1.862	0.085	1.013	0.045	2.9e-01	0.778	0.975	5.0e+02	1	13	0.000
1	W1083_W418	W108302	5	0.178	0.230	0.774	0.453	0.993	0.023	-2.9e-01	0.779	0.993	1.8e+03	1	13	0.000
1	W1038	W103806	6	8.523	3.498	2.437	0.030	0.179	2.914	-2.8e-01	0.783	0.000	4.0e-03	1	13	0.952
1	W2007_W859...	W20077	2	0.595	0.917	0.649	0.527	0.877	0.452	-2.7e-01	0.790	0.225	3.8e+00	1	13	0.074
1	W543	S_W2498	2	1.478	3.714	0.398	0.697	1.388	1.657	2.3e-01	0.819	0.051	7.0e-01	1	13	0.418
1	W174_W266	W17406	20	-0.974	2.841	-0.343	0.737	0.965	0.151	-2.3e-01	0.821	0.760	4.1e+01	1	13	0.000
1	W2312	W231209	9	0.419	0.203	2.068	0.059	1.010	0.053	2.0e-01	0.848	0.966	3.7e+02	1	13	0.000
1	W2362	S_W249	2	2.365	8.865	0.267	0.794	1.366	1.904	1.9e-01	0.851	0.038	5.1e-01	1	13	0.486
1	W589	W5895	14	0.002	0.009	0.239	0.815	0.896	0.850	-1.2e-01	0.905	0.079	1.1e+00	1	13	0.311
1	W2312_W266	W20982	12	2.819	1.566	1.800	0.095	0.672	2.745	-1.2e-01	0.907	0.005	6.0e-02	1	13	0.811
1	W786	W78603	4	2.148	0.685	3.134	0.008	0.996	0.030	-1.2e-01	0.907	0.988	1.1e+03	1	13	0.000
1	W589	W5899	14	0.000	0.001	0.500	0.625	1.005	0.049	1.1e-01	0.916	0.970	4.3e+02	1	13	0.000
1	W2312	W231202	9	-0.096	0.286	-0.336	0.742	0.995	0.065	-7.7e-02	0.939	0.947	2.3e+02	1	13	0.000
1	W301	W25702	8	20.024	22.530	0.889	0.390	-6.813	141.335	-5.5e-02	0.957	0.000	2.0e-03	1	13	0.962
1	W2295_W822	W229501	2	0.057	0.107	0.532	0.604	0.988	0.291	-4.2e-02	0.967	0.470	1.2e+01	1	13	0.005
1	W1083_W418	W108305	5	0.039	0.161	0.244	0.811	0.999	0.016	-3.9e-02	0.969	0.997	3.8e+03	1	13	0.000
1	W589	W5896	14	0.000	0.009	-0.045	0.965	1.022	0.807	2.8e-02	0.978	0.110	1.6e+00	1	13	0.228
1	W2312	W231203	9	-0.264	0.303	-0.872	0.399	0.998	0.067	-2.7e-02	0.979	0.945	2.2e+02	1	13	0.000
1	W174	W17403	15	0.940	1.745	0.538	0.599	1.001	0.103	5.0e-03	0.996	0.879	9.4e+01	1	13	0.000

Table A.5: Results of linear models regressing cluster network resource usage onto successful load. For convenience, and depending on the audience, this table could also be arranged descending on the regression line intercept term or the regression line slope term. As arranged here, the table is arranged descending on the regression line slope term, and hence is arranged descending on the clusters using the largest absolute network bandwidth resources per customer arrival per second.

Test Number	Cluster	Metric	Intercept Est	Intercept Std.Err	Intercept t-val	Intercept p-val	Slope Est	Slope Std.Err	Slope t-val	Slope p-val	R2	F-stat	df1	df2	p-value	MS1Est	MS2Est
1	W1083_W418	recv	2.9e+04	95.809	300.00	0.000	203.958	14.336	14.227	0.000	0.940	2.0e+02	1	13	0.000	30782.043	32821.627
1	W1083_W418	sent	2.7e+04	93.341	291.68	0.000	198.223	13.967	14.193	0.000	0.939	2.0e+02	1	13	0.000	29208.137	31190.364
1	W2295	recv	2.7e+04	439.968	60.66	0.000	166.647	65.832	2.531	0.025	0.330	6.4e+00	1	13	0.025	28353.872	30020.338
1	W1536	sent	1.5e+04	61.419	245.33	0.000	121.479	9.190	13.218	0.000	0.931	1.7e+02	1	13	0.000	16282.539	17497.328
1	W1536	recv	1.7e+04	44.533	381.22	0.000	86.134	6.663	12.926	0.000	0.928	1.7e+02	1	13	0.000	17838.074	18699.419
1	W2295_AAC	recv	4.0e+03	62.371	63.91	0.000	75.695	9.332	8.111	0.000	0.835	6.6e+01	1	13	0.000	4742.718	5499.666
1	W2295_FED	recv	7.7e+03	241.863	32.01	0.000	67.982	36.190	1.878	0.083	0.213	3.5e+00	1	13	0.083	8421.933	9101.752
1	W786	recv	6.7e+01	7.453	8.97	0.000	60.913	1.115	54.622	0.000	0.996	3.0e+03	1	13	0.000	675.979	1285.110
1	W786	sent	9.2e+01	8.884	10.37	0.000	59.885	1.329	45.050	0.000	0.994	2.0e+03	1	13	0.000	690.954	1289.800
1	W172501	sent	5.8e+01	10.437	5.58	0.000	51.596	1.562	33.038	0.000	0.988	1.1e+03	1	13	0.000	574.192	1090.153
1	W174_W266	recv	5.0e+01	4.241	11.72	0.000	46.598	0.635	73.424	0.000	0.998	5.4e+03	1	13	0.000	515.694	981.675
1	W174	recv	4.1e+01	5.821	6.96	0.000	35.066	0.871	40.260	0.000	0.992	1.6e+03	1	13	0.000	391.196	741.851
1	W2295_W789	recv	1.1e+04	108.010	97.71	0.000	18.723	16.161	1.159	0.267	0.094	1.3e+00	1	13	0.267	10741.141	10928.372
1	W174_W266	sent	1.7e+01	1.137	14.77	0.000	18.560	0.170	109.051	0.000	0.999	1.2e+04	1	13	0.000	202.403	388.006
1	W174	sent	1.4e+01	1.660	8.27	0.000	13.976	0.248	56.263	0.000	0.996	3.2e+03	1	13	0.000	153.485	293.240
1	W969	sent	1.4e+01	0.802	16.88	0.000	13.063	0.120	108.842	0.000	0.999	1.2e+04	1	13	0.000	144.173	274.805
1	W971	recv	3.3e+01	4.949	6.74	0.000	12.837	0.741	17.334	0.000	0.959	3.0e+02	1	13	0.000	161.724	290.090
1	W2295_W789	sent	1.0e+04	87.141	118.67	0.000	12.631	13.039	0.969	0.350	0.067	9.4e-01	1	13	0.350	10466.996	10593.301
1	W1302	recv	9.2e+00	4.769	1.92	0.077	11.533	0.714	16.163	0.000	0.953	2.6e+02	1	13	0.000	124.498	239.824
1	W172501	recv	7.8e+00	1.509	5.15	0.000	8.182	0.226	36.233	0.000	0.990	1.3e+03	1	13	0.000	89.582	171.399
1	W172502	recv	7.4e+00	1.224	6.01	0.000	7.101	0.183	38.762	0.000	0.991	1.5e+03	1	13	0.000	78.373	149.382
1	W2312_W266	recv	4.5e+00	0.336	13.47	0.000	5.568	0.050	110.629	0.000	0.999	1.2e+04	1	13	0.000	60.206	115.882
1	W2312	recv	4.5e+00	0.334	13.45	0.000	5.567	0.050	111.274	0.000	0.999	1.2e+04	1	13	0.000	60.164	115.833
1	W1038	sent	8.9e+00	1.157	7.69	0.000	5.171	0.173	29.861	0.000	0.986	8.9e+02	1	13	0.000	60.609	112.317
1	W2295_W822	sent	3.9e+03	75.636	51.85	0.000	4.645	11.317	0.410	0.688	0.013	1.7e-01	1	13	0.688	3968.532	4014.978
1	W1302	sent	3.1e+00	1.911	1.61	0.132	4.585	0.286	16.036	0.000	0.952	2.6e+02	1	13	0.000	48.918	94.766
1	W2295_W822	recv	4.4e+03	96.861	45.48	0.000	4.247	14.493	0.293	0.774	0.007	8.6e-02	1	13	0.774	4448.080	4490.548
1	W172502	sent	6.8e+00	0.717	9.45	0.000	4.159	0.107	38.784	0.000	0.991	1.5e+03	1	13	0.000	48.358	89.946
1	W1455	recv	1.8e+03	68.492	26.40	0.000	4.150	10.248	0.405	0.692	0.012	1.6e-01	1	13	0.692	1849.803	1891.308
1	W2312_W266	sent	3.3e+00	0.222	14.72	0.000	3.603	0.033	108.381	0.000	0.999	1.2e+04	1	13	0.000	39.303	75.334
1	W2312	sent	3.2e+00	0.219	14.61	0.000	3.601	0.033	109.999	0.000	0.999	1.2e+04	1	13	0.000	39.204	75.212
1	W1428	recv	4.7e+00	0.363	12.84	0.000	2.850	0.054	52.479	0.000	0.995	2.8e+03	1	13	0.000	33.154	61.650
1	W971	sent	1.1e+01	1.163	9.29	0.000	2.316	0.174	13.304	0.000	0.932	1.8e+02	1	13	0.000	33.968	57.128
1	W748	sent	1.7e+00	0.147	11.42	0.000	2.223	0.022	100.733	0.000	0.999	1.0e+04	1	13	0.000	23.911	46.139
1	W589	sent	6.2e+00	0.413	14.91	0.000	2.203	0.062	35.627	0.000	0.990	1.3e+03	1	13	0.000	28.188	50.215
1	W172503	recv	2.7e+00	0.417	6.51	0.000	2.163	0.062	34.690	0.000	0.989	1.2e+03	1	13	0.000	24.343	45.972
1	W1428	sent	1.1e+01	0.369	29.43	0.000	2.059	0.055	37.281	0.000	0.991	1.4e+03	1	13	0.000	31.446	52.032
1	W1455	sent	7.4e+02	26.955	27.55	0.000	1.797	4.033	0.446	0.663	0.015	2.0e-01	1	13	0.663	760.583	778.555
1	W301	recv	1.5e+00	0.094	15.76	0.000	1.729	0.014	123.515	0.000	0.999	1.5e+04	1	13	0.000	18.760	36.046
1	W969	recv	2.7e+00	0.140	19.15	0.000	1.487	0.021	70.919	0.000	0.997	5.0e+03	1	13	0.000	17.554	32.423

Test Number	Cluster	Metric	Intercept Est	Intercept Std.Err	Intercept t-val	Intercept p-val	Slope Est	Slope Std.Err	Slope t-val	Slope p-val	R2	F-stat	df1	df2	p-value	MS1Est	MS2Est
1	W301	sent	2.5e+00	0.063	38.97	0.000	1.422	0.009	150.716	0.000	0.999	2.3e+04	1	13	0.000	16.680	30.902
1	W620	sent	5.9e+00	0.239	24.55	0.000	1.412	0.036	39.558	0.000	0.992	1.6e+03	1	13	0.000	19.978	34.098
1	W620	recv	4.9e+00	0.228	21.25	0.000	1.367	0.034	40.001	0.000	0.992	1.6e+03	1	13	0.000	18.519	32.186
1	W108	sent	2.0e+00	0.218	9.16	0.000	1.271	0.033	38.923	0.000	0.991	1.5e+03	1	13	0.000	14.714	27.429
1	W108	recv	1.9e+00	0.218	8.55	0.000	1.265	0.033	38.844	0.000	0.991	1.5e+03	1	13	0.000	14.506	27.152
1	W589	recv	3.4e+00	0.278	12.32	0.000	1.120	0.042	26.896	0.000	0.982	7.2e+02	1	13	0.000	14.634	25.839
1	W1038	recv	2.2e+00	0.118	18.61	0.000	1.107	0.018	62.626	0.000	0.997	3.9e+03	1	13	0.000	13.263	24.329
1	W826	sent	1.2e+04	290.262	42.25	0.000	1.023	43.432	0.024	0.982	0.000	1.0e-03	1	13	0.982	12273.602	12283.833
1	W2007_W400_W1603_W319	sent	1.0e+00	0.088	11.44	0.000	0.780	0.013	59.458	0.000	0.996	3.5e+03	1	13	0.000	8.805	16.607
1	W2007_W400_W1603_W319	recv	1.7e+00	0.103	16.42	0.000	0.735	0.015	47.674	0.000	0.994	2.3e+03	1	13	0.000	9.044	16.397
1	W172503	sent	3.0e+00	0.293	10.14	0.000	0.707	0.044	16.100	0.000	0.952	2.6e+02	1	13	0.000	10.046	17.115
1	W2254	sent	4.2e+00	1.316	3.21	0.007	0.525	0.197	2.666	0.019	0.353	7.1e+00	1	13	0.019	9.477	14.726
1	W2179_W2190	recv	1.6e+01	8.328	1.92	0.077	0.341	1.246	0.274	0.788	0.006	7.5e-02	1	13	0.788	19.391	22.805
1	W748	recv	3.4e-01	0.024	14.47	0.000	0.307	0.004	87.223	0.000	0.998	7.6e+03	1	13	0.000	3.409	6.478
1	W2254	recv	2.1e+00	0.037	57.83	0.000	0.301	0.005	54.990	0.000	0.996	3.0e+03	1	13	0.000	5.118	8.124
1	W131	recv	6.2e-01	0.031	20.28	0.000	0.277	0.005	60.258	0.000	0.996	3.6e+03	1	13	0.000	3.395	6.167
1	W487	sent	1.1e+01	0.284	37.37	0.000	0.182	0.042	4.288	0.001	0.586	1.8e+01	1	13	0.001	12.415	14.234
1	W487	recv	5.2e+00	0.430	12.17	0.000	0.157	0.064	2.445	0.029	0.315	6.0e+00	1	13	0.029	6.801	8.373
1	W1640	recv	2.1e+00	0.151	13.84	0.000	0.108	0.023	4.795	0.000	0.639	2.3e+01	1	13	0.000	3.166	4.247
1	W2007_W859_AACFED	recv	1.6e-01	0.011	14.32	0.000	0.108	0.002	65.173	0.000	0.997	4.2e+03	1	13	0.000	1.239	2.320
1	W2007_W859_AACFED	sent	3.6e-01	0.155	2.32	0.037	0.102	0.023	4.414	0.001	0.600	1.9e+01	1	13	0.001	1.382	2.405
1	W129	sent	6.7e-01	0.958	0.70	0.496	0.094	0.143	0.656	0.523	0.032	4.3e-01	1	13	0.523	1.611	2.551
1	W2007_W859_W400_DB2	sent	4.7e-01	0.017	28.29	0.000	0.071	0.002	28.476	0.000	0.984	8.1e+02	1	13	0.000	1.178	1.885
1	W131	sent	2.8e+00	1.152	2.44	0.030	0.064	0.172	0.374	0.715	0.011	1.4e-01	1	13	0.715	3.457	4.102
1	W2007_W859_W400_DB2	recv	1.6e-01	0.012	13.96	0.000	0.061	0.002	34.710	0.000	0.989	1.2e+03	1	13	0.000	0.772	1.380
1	W2284	recv	9.7e+00	0.108	89.64	0.000	0.059	0.016	3.630	0.003	0.503	1.3e+01	1	13	0.003	10.249	10.834
1	W1543	sent	3.6e-01	0.630	0.57	0.581	0.055	0.094	0.580	0.572	0.025	3.4e-01	1	13	0.572	0.903	1.449
1	W633	sent	3.4e-01	0.137	2.45	0.029	0.037	0.021	1.788	0.097	0.197	3.2e+00	1	13	0.097	0.705	1.072
1	W1566_W400	sent	3.6e-01	0.081	4.44	0.001	0.030	0.012	2.507	0.026	0.326	6.3e+00	1	13	0.026	0.661	0.963
1	W2362	recv	2.4e-01	0.178	1.33	0.207	0.028	0.027	1.069	0.305	0.081	1.1e+00	1	13	0.305	0.520	0.804
1	W633	recv	3.8e-01	0.147	2.62	0.021	0.025	0.022	1.151	0.270	0.093	1.3e+00	1	13	0.270	0.637	0.891
1	W17931DBIAPP	sent	6.5e-02	0.172	0.38	0.711	0.025	0.026	0.958	0.356	0.066	9.2e-01	1	13	0.356	0.511	0.557
1	W201	recv	1.6e+00	0.126	12.67	0.000	0.023	0.019	1.215	0.246	0.102	1.5e+00	1	13	0.246	1.830	2.059
1	W996	sent	4.3e-01	0.165	2.63	0.021	0.017	0.025	0.672	0.514	0.034	4.5e-01	1	13	0.514	0.600	0.766
1	W201	sent	9.4e-01	0.050	18.82	0.000	0.017	0.007	2.218	0.045	0.275	4.9e+00	1	13	0.045	1.105	1.270
1	W2038	recv	1.6e+00	0.076	21.41	0.000	0.016	0.011	1.436	0.175	0.137	2.1e+00	1	13	0.175	1.789	1.953
1	W2007_W400	sent	4.0e-01	0.082	4.84	0.000	0.016	0.012	1.281	0.223	0.112	1.6e+00	1	13	0.223	0.557	0.715
1	W2555	sent	2.4e-01	0.231	1.05	0.312	0.016	0.035	0.453	0.658	0.016	2.0e-01	1	13	0.658	0.400	0.556
1	W2038	sent	6.0e+00	0.384	15.56	0.000	0.014	0.057	0.244	0.811	0.005	6.0e-02	1	13	0.811	6.109	6.249
1	W2327	recv	2.4e-01	0.105	2.34	0.036	0.012	0.016	0.784	0.447	0.045	6.1e-01	1	13	0.447	0.368	0.491
1	W1454	sent	6.0e-02	0.045	1.34	0.203	0.012	0.007	1.716	0.110	0.185	2.9e+00	1	13	0.110	0.176	0.292
1	W258	sent	8.8e-01	0.044	19.78	0.000	0.011	0.007	1.701	0.113	0.182	2.9e+00	1	13	0.113	0.991	1.104
1	W1056	recv	2.0e-01	0.089	2.27	0.041	0.008	0.013	0.574	0.576	0.025	3.3e-01	1	13	0.576	0.279	0.356
1	W1430	recv	2.0e-01	0.089	2.28	0.040	0.008	0.013	0.575	0.575	0.025	3.3e-01	1	13	0.575	0.278	0.354
1	W569	recv	2.1e-01	0.089	2.36	0.035	0.008	0.013	0.567	0.580	0.024	3.2e-01	1	13	0.580	0.286	0.361
1	W2235	recv	2.1e-01	0.091	2.29	0.039	0.008	0.014	0.554	0.589	0.023	3.1e-01	1	13	0.589	0.283	0.358
1	W2552	recv	2.1e-01	0.089	2.39	0.032	0.007	0.013	0.564	0.582	0.024	3.2e-01	1	13	0.582	0.288	0.363
1	W18642W2324	recv	2.2e-01	0.088	2.51	0.026	0.007	0.013	0.553	0.589	0.023	3.1e-01	1	13	0.589	0.293	0.366

Test Number	Cluster	Metric	Intercept Est	Intercept Std.Err	Intercept t-val	Intercept p-val	Slope Est	Slope Std.Err	Slope t-val	Slope p-val	R2	F-stat	df1	df2	p-value	MS1Est	MS2Est
1	W258	recv	3.8e-01	0.016	24.66	0.000	0.007	0.002	2.852	0.014	0.385	8.1e+00	1	13	0.014	0.450	0.516
1	W2327	sent	2.0e-01	0.037	5.31	0.000	0.006	0.006	1.156	0.268	0.093	1.3e+00	1	13	0.268	0.264	0.329
1	W543	recv	2.4e-01	0.094	2.50	0.027	0.006	0.014	0.426	0.677	0.014	1.8e-01	1	13	0.677	0.296	0.356
1	W1566_W400	recv	1.5e-01	0.009	17.56	0.000	0.005	0.001	3.734	0.003	0.517	1.4e+01	1	13	0.003	0.197	0.245
1	W1614	recv	1.5e-01	0.047	3.17	0.007	0.005	0.007	0.666	0.517	0.033	4.4e-01	1	13	0.517	0.197	0.245
1	W1246	recv	1.8e-01	0.053	3.37	0.005	0.005	0.008	0.570	0.579	0.024	3.2e-01	1	13	0.579	0.224	0.269
1	W484000	sent	4.1e-01	0.046	8.75	0.000	0.005	0.007	0.650	0.527	0.031	4.2e-01	1	13	0.527	0.451	0.496
1	W1867	recv	9.8e-02	0.045	2.17	0.049	0.004	0.007	0.618	0.547	0.029	3.8e-01	1	13	0.547	0.140	0.181
1	W1225	sent	2.7e-01	0.061	4.51	0.001	0.003	0.009	0.299	0.769	0.007	9.0e-02	1	13	0.769	0.300	0.328
1	W1209_W2181	sent	7.1e-01	0.011	67.41	0.000	0.003	0.002	1.639	0.125	0.171	2.7e+00	1	13	0.125	0.740	0.766
1	W1209_W2181	recv	2.2e-01	0.018	12.62	0.000	0.003	0.003	0.965	0.352	0.067	9.3e-01	1	13	0.352	0.247	0.272
1	W2007_DB2	recv	5.1e-02	0.015	3.47	0.004	0.002	0.002	1.111	0.287	0.087	1.2e+00	1	13	0.287	0.075	0.100
1	W2098	sent	7.4e-02	0.008	9.25	0.000	0.002	0.001	2.007	0.066	0.237	4.0e+00	1	13	0.066	0.098	0.123
1	W764	sent	2.9e-01	0.029	10.19	0.000	0.002	0.004	0.540	0.598	0.022	2.9e-01	1	13	0.598	0.314	0.337
1	W2007_DB2	sent	3.5e-01	0.010	35.31	0.000	0.002	0.002	1.384	0.190	0.128	1.9e+00	1	13	0.190	0.375	0.396
1	W2179_W2415	sent	3.7e-01	0.019	19.75	0.000	0.001	0.003	0.486	0.635	0.018	2.4e-01	1	13	0.635	0.381	0.394
1	W484000	recv	1.8e-01	0.014	12.93	0.000	0.001	0.002	0.577	0.574	0.025	3.3e-01	1	13	0.574	0.196	0.208
1	W2293_W1519	sent	5.9e-01	0.007	87.29	0.000	0.001	0.001	1.155	0.269	0.093	1.3e+00	1	13	0.269	0.604	0.616
1	W1246	sent	1.4e-01	0.009	14.93	0.000	0.001	0.001	0.763	0.459	0.043	5.8e-01	1	13	0.459	0.152	0.163
1	W1430	sent	1.5e-01	0.010	15.32	0.000	0.001	0.001	0.742	0.471	0.041	5.5e-01	1	13	0.471	0.157	0.168
1	W909	sent	2.4e-01	0.009	28.55	0.000	0.001	0.001	0.812	0.431	0.048	6.6e-01	1	13	0.431	0.256	0.266
1	W909	recv	4.5e-02	0.004	10.08	0.000	0.001	0.001	1.495	0.159	0.147	2.2e+00	1	13	0.159	0.055	0.065
1	W1614	sent	1.6e-01	0.005	32.09	0.000	0.001	0.001	1.364	0.196	0.125	1.9e+00	1	13	0.196	0.165	0.175
1	W1056	sent	1.5e-01	0.010	15.06	0.000	0.001	0.001	0.651	0.526	0.032	4.2e-01	1	13	0.526	0.160	0.170
1	W2552	sent	2.5e-01	0.010	25.09	0.000	0.001	0.001	0.613	0.551	0.028	3.8e-01	1	13	0.551	0.259	0.268
1	W764	recv	3.3e-02	0.020	1.64	0.125	0.001	0.003	0.292	0.775	0.007	8.6e-02	1	13	0.775	0.042	0.051
1	W130	sent	1.4e-01	0.003	46.73	0.000	0.001	0.000	1.805	0.094	0.200	3.3e+00	1	13	0.094	0.146	0.154
1	SQL14W1719	sent	8.5e-02	0.010	8.94	0.000	0.001	0.001	0.526	0.608	0.021	2.8e-01	1	13	0.608	0.093	0.100
1	W2482	recv	4.0e-01	0.009	45.98	0.000	0.001	0.001	0.559	0.586	0.023	3.1e-01	1	13	0.586	0.410	0.418
1	W2098	recv	3.5e-02	0.006	5.90	0.000	0.001	0.001	0.806	0.435	0.048	6.5e-01	1	13	0.435	0.042	0.049
1	W1867	sent	6.4e-02	0.005	12.04	0.000	0.001	0.001	0.871	0.400	0.055	7.6e-01	1	13	0.400	0.071	0.078
1	W18642W2324	sent	1.6e-01	0.009	18.06	0.000	0.001	0.001	0.506	0.621	0.019	2.6e-01	1	13	0.621	0.171	0.178
1	W130	recv	3.0e-02	0.005	5.57	0.000	0.001	0.001	0.840	0.416	0.051	7.0e-01	1	13	0.416	0.037	0.044
1	W569	sent	1.8e-01	0.010	16.99	0.000	0.001	0.002	0.340	0.739	0.009	1.2e-01	1	13	0.739	0.181	0.187
1	W331	recv	8.0e-03	0.002	4.24	0.001	0.000	0.000	1.301	0.216	0.115	1.7e+00	1	13	0.216	0.012	0.016
1	W2293_W672	sent	1.5e-01	0.003	52.64	0.000	0.000	0.000	0.850	0.411	0.053	7.2e-01	1	13	0.411	0.159	0.163
1	W95	recv	6.7e-02	0.005	14.48	0.000	0.000	0.001	0.528	0.607	0.021	2.8e-01	1	13	0.607	0.071	0.075
1	W17931DBIAPP	recv	2.6e-02	0.004	6.65	0.000	0.000	0.001	0.501	0.625	0.019	2.5e-01	1	13	0.625	0.029	0.032
1	W2286	sent	2.1e-01	0.049	4.23	0.001	0.000	0.007	0.038	0.970	0.000	1.0e-03	1	13	0.970	0.209	0.212
1	W331	sent	3.2e-02	0.002	20.05	0.000	0.000	0.000	1.056	0.310	0.079	1.1e+00	1	13	0.310	0.034	0.037
1	W95	sent	3.0e-01	0.013	23.07	0.000	0.000	0.002	0.126	0.902	0.001	1.6e-02	1	13	0.902	0.305	0.307
1	W996	recv	8.0e-01	0.009	85.92	0.000	0.000	0.001	0.141	0.890	0.002	2.0e-02	1	13	0.890	0.806	0.808
1	W2362	sent	1.6e-01	0.010	16.77	0.000	0.000	0.001	0.130	0.899	0.001	1.7e-02	1	13	0.899	0.165	0.167
1	W1966	sent	1.1e-01	0.002	62.74	0.000	0.000	0.000	0.514	0.616	0.020	2.7e-01	1	13	0.616	0.109	0.110
1	W263	recv	2.2e-02	0.001	22.21	0.000	0.000	0.000	0.706	0.493	0.037	5.0e-01	1	13	0.493	0.023	0.024
1	W2293_W164	sent	2.9e-01	0.004	72.71	0.000	0.000	0.001	0.174	0.864	0.002	3.0e-02	1	13	0.864	0.290	0.291
1	W2007_W400	recv	7.2e-02	0.013	5.47	0.000	0.000	0.002	0.031	0.976	0.000	1.0e-03	1	13	0.976	0.073	0.073
1	D_W2330	recv	2.0e-03	0.001	1.57	0.143	0.000	0.000	0.220	0.830	0.004	4.8e-02	1	12	0.830	0.003	0.003

Test Number	Cluster	Metric	Intercept Est	Intercept Std.Err	Intercept t-val	Intercept p-val	Slope Est	Slope Std.Err	Slope t-val	Slope p-val	R2	F-stat	df1	df2	p-value	MS1Est	MS2Est
1	D_W764	recv	0.0e+00	0.001	0.21	0.839	0.000	0.000	0.503	0.624	0.021	2.5e-01	1	12	0.624	0.001	0.001
1	D_W2330	sent	2.0e-03	0.001	1.77	0.101	0.000	0.000	0.191	0.852	0.003	3.6e-02	1	12	0.852	0.003	0.003
1	W2555	recv	3.4e-02	0.004	8.95	0.000	0.000	0.001	0.060	0.953	0.000	4.0e-03	1	13	0.953	0.035	0.035
1	D_W2173	sent	6.0e-03	0.011	0.50	0.626	0.000	0.002	0.017	0.987	0.000	0.0e+00	1	11	0.987	0.006	0.006
1	W543	sent	1.6e-01	0.011	14.29	0.000	0.000	0.002	0.014	0.989	0.000	0.0e+00	1	13	0.989	0.164	0.165
1	W1710	sent	3.7e-02	0.001	47.62	0.000	0.000	0.000	0.196	0.847	0.003	3.9e-02	1	13	0.847	0.037	0.037
1	W1031	sent	5.7e-02	0.000	325.33	0.000	0.000	0.000	0.775	0.452	0.044	6.0e-01	1	13	0.452	0.058	0.058
1	W1454	recv	3.1e-02	0.002	15.20	0.000	0.000	0.000	0.053	0.958	0.000	3.0e-03	1	13	0.958	0.031	0.031
1	D_W1265	recv	1.0e-03	0.000	1.47	0.165	0.000	0.000	0.123	0.904	0.001	1.5e-02	1	13	0.904	0.001	0.001
1	D_W2173	recv	0.0e+00	0.000	2.47	0.028	0.000	0.000	-0.148	0.885	0.002	2.2e-02	1	13	0.885	0.000	0.000
1	D_W764	sent	1.0e-03	0.001	0.68	0.509	0.000	0.000	-0.022	0.983	0.000	0.0e+00	1	11	0.983	0.001	0.001
1	W1576	sent	9.2e-02	0.000	484.85	0.000	0.000	0.000	-0.362	0.723	0.010	1.3e-01	1	13	0.723	0.092	0.092
1	D_W1700	sent	1.1e-02	0.014	0.81	0.433	0.000	0.002	-0.006	0.996	0.000	0.0e+00	1	12	0.996	0.011	0.011
1	W1001	sent	9.6e-02	0.000	347.24	0.000	0.000	0.000	-0.383	0.708	0.011	1.5e-01	1	13	0.708	0.096	0.096
1	W139	recv	4.0e-03	0.000	11.18	0.000	0.000	0.000	-0.348	0.734	0.009	1.2e-01	1	13	0.734	0.004	0.004
1	W1576	recv	8.0e-03	0.001	13.00	0.000	0.000	0.000	-0.250	0.806	0.005	6.2e-02	1	13	0.806	0.008	0.008
1	W1966	recv	1.7e-02	0.001	18.38	0.000	0.000	0.000	-0.204	0.841	0.003	4.2e-02	1	13	0.841	0.017	0.016
1	W1001	recv	1.0e-02	0.001	14.26	0.000	0.000	0.000	-0.282	0.782	0.006	8.0e-02	1	13	0.782	0.009	0.009
1	W139	sent	4.0e-02	0.000	241.70	0.000	0.000	0.000	-1.250	0.233	0.107	1.6e+00	1	13	0.233	0.040	0.039
1	W1946	recv	5.0e-03	0.001	4.66	0.000	0.000	0.000	-0.206	0.840	0.003	4.2e-02	1	13	0.840	0.004	0.004
1	W1039	sent	3.4e-02	0.002	17.64	0.000	0.000	0.000	-0.120	0.906	0.001	1.4e-02	1	13	0.906	0.034	0.033
1	W1946	sent	1.7e-02	0.002	10.80	0.000	0.000	0.000	-0.212	0.835	0.003	4.5e-02	1	13	0.835	0.016	0.016
1	W1710	recv	1.1e-02	0.001	12.16	0.000	0.000	0.000	-0.467	0.648	0.017	2.2e-01	1	13	0.648	0.010	0.010
1	W308	sent	4.1e-02	0.000	95.90	0.000	0.000	0.000	-1.024	0.325	0.075	1.0e+00	1	13	0.325	0.040	0.039
1	W19481APP	recv	7.2e-02	0.010	7.01	0.000	0.000	0.002	-0.051	0.960	0.000	3.0e-03	1	13	0.960	0.072	0.071
1	W1886	recv	6.9e-02	0.001	69.21	0.000	0.000	0.000	-0.549	0.593	0.023	3.0e-01	1	13	0.593	0.068	0.067
1	W263	sent	7.2e-02	0.001	121.56	0.000	0.000	0.000	-1.071	0.304	0.081	1.1e+00	1	13	0.304	0.071	0.071
1	W834	sent	2.6e-01	0.004	63.41	0.000	0.000	0.001	-0.167	0.870	0.002	2.8e-02	1	13	0.870	0.254	0.253
1	W1572	recv	5.1e-01	0.001	38.84	0.000	0.000	0.000	-0.621	0.545	0.029	3.9e-01	1	13	0.545	0.050	0.048
1	W1892	sent	7.2e-02	0.002	46.76	0.000	0.000	0.000	-0.784	0.447	0.045	6.1e-01	1	13	0.447	0.070	0.068
1	W1892	recv	1.3e-02	0.002	6.55	0.000	0.000	0.000	-0.800	0.438	0.047	6.4e-01	1	13	0.438	0.011	0.008
1	W1543	recv	1.0e-01	0.022	4.69	0.000	0.000	0.003	-0.071	0.945	0.000	5.0e-03	1	13	0.945	0.103	0.100
1	W1039	recv	1.2e-02	0.002	5.95	0.000	0.000	0.000	-0.829	0.422	0.050	6.9e-01	1	13	0.422	0.009	0.007
1	W2284	sent	1.1e-01	0.004	30.21	0.000	0.000	0.001	-0.446	0.663	0.015	2.0e-01	1	13	0.663	0.111	0.108
1	W1031	recv	9.0e-03	0.002	5.41	0.000	0.000	0.000	-1.110	0.287	0.087	1.2e+00	1	13	0.287	0.006	0.003
1	W1886	sent	3.6e-01	0.002	205.68	0.000	0.000	0.000	-1.147	0.272	0.092	1.3e+00	1	13	0.272	0.361	0.358
1	D_AKS_W647	recv	1.3e-02	0.006	2.28	0.040	0.000	0.001	-0.352	0.730	0.009	1.2e-01	1	13	0.730	0.010	0.007
1	W2179_W2415	recv	1.1e-01	0.011	9.93	0.000	0.000	0.002	-0.199	0.845	0.003	4.0e-02	1	13	0.845	0.108	0.105
1	SQL14W1719	recv	4.7e-02	0.003	15.23	0.000	0.000	0.000	-0.783	0.448	0.045	6.1e-01	1	13	0.448	0.044	0.040
1	W2199	sent	3.4e-01	0.004	84.11	0.000	0.000	0.001	-0.634	0.537	0.030	4.0e-01	1	13	0.537	0.339	0.335
1	W1572	sent	4.4e-01	0.004	113.89	0.000	0.000	0.001	-0.751	0.466	0.042	5.6e-01	1	13	0.466	0.437	0.432
1	W129	recv	5.1e-01	0.017	29.61	0.000	0.000	0.003	-0.177	0.862	0.002	3.1e-02	1	13	0.862	0.506	0.501
1	W308	recv	6.5e-02	0.006	11.63	0.000	-0.001	0.001	-0.611	0.552	0.028	3.7e-01	1	13	0.552	0.060	0.055
1	W2235	sent	1.7e-01	0.011	15.73	0.000	-0.001	0.002	-0.357	0.727	0.010	1.3e-01	1	13	0.727	0.162	0.157
1	W19481W429	sent	2.6e-01	0.012	21.76	0.000	-0.001	0.002	-0.342	0.738	0.009	1.2e-01	1	13	0.738	0.251	0.245
1	W1225	recv	6.3e-02	0.004	14.71	0.000	-0.001	0.001	-0.950	0.359	0.065	9.0e-01	1	13	0.359	0.057	0.051
1	W2293_W672	recv	9.2e-02	0.006	16.46	0.000	-0.001	0.001	-0.780	0.449	0.045	6.1e-01	1	13	0.449	0.086	0.079
1	D_W1700	recv	1.3e-02	0.010	1.36	0.200	-0.001	0.001	-0.481	0.640	0.021	2.3e-01	1	11	0.640	0.006	-0.001

Test Number	Cluster	Metric	Intercept Est	Intercept Std.Err	Intercept t-val	Intercept p-val	Slope Est	Slope Std.Err	Slope t-val	Slope p-val	R2	F-stat	df1	df2	p-value	MS1Est	MS2Est
1	W19481W429	recv	5.6e-02	0.008	6.81	0.000	-0.001	0.001	-0.700	0.497	0.036	4.9e-01	1	13	0.497	0.047	0.039
1	D_W1265	sent	1.3e-02	0.008	1.74	0.106	-0.001	0.001	-0.755	0.464	0.042	5.7e-01	1	13	0.464	0.005	-0.004
1	W2293_W164	recv	9.7e-02	0.005	19.83	0.000	-0.001	0.001	-1.243	0.236	0.106	1.5e+00	1	13	0.236	0.088	0.079
1	W2173	recv	9.3e-01	0.025	36.92	0.000	-0.001	0.004	-0.308	0.763	0.007	9.5e-02	1	13	0.763	0.914	0.903
1	W2286	recv	3.6e-01	0.004	83.68	0.000	-0.001	0.001	-1.889	0.081	0.215	3.6e+00	1	13	0.081	0.352	0.340
1	W2199	recv	9.9e-02	0.008	11.83	0.000	-0.001	0.001	-1.167	0.264	0.095	1.4e+00	1	13	0.264	0.085	0.070
1	W19481ADB	sent	3.4e-01	0.012	29.53	0.000	-0.001	0.002	-0.842	0.415	0.052	7.1e-01	1	13	0.415	0.330	0.316
1	W1296	sent	4.3e-01	0.010	42.85	0.000	-0.002	0.002	-1.005	0.333	0.072	1.0e+00	1	13	0.333	0.420	0.405
1	W272	recv	3.8e-01	0.028	13.22	0.000	-0.002	0.004	-0.365	0.721	0.010	1.3e-01	1	13	0.721	0.360	0.344
1	W834	recv	8.7e-02	0.009	9.26	0.000	-0.002	0.001	-1.135	0.277	0.090	1.3e+00	1	13	0.277	0.071	0.055
1	W19481ADB	recv	5.4e-02	0.009	5.80	0.000	-0.002	0.001	-1.277	0.224	0.112	1.6e+00	1	13	0.224	0.036	0.018
1	W19481APP	sent	3.3e-01	0.018	18.66	0.000	-0.002	0.003	-0.743	0.471	0.041	5.5e-01	1	13	0.471	0.312	0.292
1	D_AKS_W647	sent	2.8e-02	0.012	2.42	0.031	-0.002	0.002	-1.189	0.256	0.098	1.4e+00	1	13	0.256	0.007	-0.013
1	D_AKS_W415	sent	2.1e-02	0.011	1.88	0.083	-0.002	0.002	-1.271	0.226	0.111	1.6e+00	1	13	0.226	0.000	-0.021
1	W2293_W1519	recv	2.2e-01	0.019	12.11	0.000	-0.002	0.003	-0.810	0.433	0.048	6.6e-01	1	13	0.433	0.202	0.179
1	D_AKS_W415	recv	2.5e-02	0.012	2.11	0.055	-0.003	0.002	-1.512	0.154	0.150	2.3e+00	1	13	0.154	-0.002	-0.029
1	W1760	recv	1.4e-01	0.014	9.53	0.000	-0.003	0.002	-1.426	0.177	0.135	2.0e+00	1	13	0.177	0.107	0.076
1	W2549	recv	1.3e+00	0.026	50.89	0.000	-0.004	0.004	-0.909	0.380	0.060	8.3e-01	1	13	0.380	1.298	1.263
1	W1265	recv	5.8e+00	0.139	41.89	0.000	-0.004	0.021	-0.196	0.848	0.003	3.8e-02	1	13	0.848	5.775	5.734
1	W2179_W2190	sent	1.6e+00	0.443	3.66	0.003	-0.005	0.066	-0.077	0.940	0.000	6.0e-03	1	13	0.940	1.568	1.517
1	W185616W1400401	recv	8.5e-01	0.027	31.12	0.000	-0.006	0.004	-1.359	0.197	0.124	1.8e+00	1	13	0.197	0.799	0.743
1	W1296	recv	3.9e-01	0.245	1.61	0.131	-0.011	0.037	-0.304	0.766	0.007	9.3e-02	1	13	0.766	0.283	0.171
1	W2549	sent	1.9e+00	0.087	21.84	0.000	-0.012	0.013	-0.903	0.383	0.059	8.1e-01	1	13	0.383	1.774	1.657
1	W2283	sent	2.8e+00	0.228	12.25	0.000	-0.036	0.034	-1.049	0.313	0.078	1.1e+00	1	13	0.313	2.435	2.077
1	W1471	sent	3.8e+00	0.092	41.44	0.000	-0.037	0.014	-2.701	0.018	0.359	7.3e+00	1	13	0.018	3.443	3.071
1	W2482	sent	1.1e+00	0.213	5.20	0.000	-0.044	0.032	-1.370	0.194	0.126	1.9e+00	1	13	0.194	0.672	0.235
1	W1265	sent	7.5e+00	0.383	19.68	0.000	-0.045	0.057	-0.786	0.446	0.045	6.2e-01	1	13	0.446	7.097	6.646
1	W2283	recv	4.0e+00	0.336	11.90	0.000	-0.053	0.050	-1.047	0.314	0.078	1.1e+00	1	13	0.314	3.470	2.943
1	W2330	recv	1.5e+01	0.238	62.44	0.000	-0.055	0.036	-1.560	0.143	0.158	2.4e+00	1	13	0.143	14.280	13.726
1	W1700	recv	9.8e+00	0.484	20.27	0.000	-0.060	0.072	-0.828	0.423	0.050	6.9e-01	1	13	0.423	9.214	8.614
1	W2173	sent	1.7e+00	0.623	2.81	0.015	-0.066	0.093	-0.708	0.492	0.037	5.0e-01	1	13	0.492	1.090	0.431
1	W185616W1400401	sent	2.3e+00	1.036	2.22	0.045	-0.094	0.155	-0.606	0.555	0.027	3.7e-01	1	13	0.555	1.358	0.418
1	W2330	sent	1.6e+01	0.238	66.36	0.000	-0.094	0.036	-2.650	0.020	0.351	7.0e+00	1	13	0.020	14.870	13.925
1	W1760	sent	1.3e+00	0.796	1.64	0.124	-0.100	0.119	-0.836	0.418	0.051	7.0e-01	1	13	0.418	0.312	-0.683
1	W2389	recv	1.2e+01	1.155	10.72	0.000	-0.119	0.173	-0.688	0.503	0.035	4.7e-01	1	13	0.503	11.192	10.002
1	W272	sent	3.0e+00	1.321	2.29	0.040	-0.125	0.198	-0.634	0.537	0.030	4.0e-01	1	13	0.537	1.769	0.515
1	W1700	sent	1.0e+01	0.794	12.74	0.000	-0.133	0.119	-1.120	0.283	0.088	1.3e+00	1	13	0.283	8.787	7.456
1	W2389	sent	1.7e+01	1.157	14.58	0.000	-0.148	0.173	-0.852	0.410	0.053	7.3e-01	1	13	0.410	15.393	13.917
1	W166	recv	3.1e+00	1.123	2.80	0.015	-0.158	0.168	-0.941	0.364	0.064	8.9e-01	1	13	0.364	1.567	-0.014
1	W1996	sent	3.8e+00	1.154	3.28	0.006	-0.202	0.173	-1.172	0.262	0.096	1.4e+00	1	13	0.262	1.762	-0.262
1	W1996	recv	3.5e+00	1.249	2.82	0.015	-0.288	0.187	-1.540	0.148	0.154	2.4e+00	1	13	0.148	0.639	-2.238
1	W166	sent	4.3e+00	1.219	3.56	0.003	-0.295	0.182	-1.617	0.130	0.167	2.6e+00	1	13	0.130	1.391	-1.558
1	W1471	recv	4.0e+01	1.359	29.52	0.000	-0.460	0.203	-2.261	0.042	0.282	5.1e+00	1	13	0.042	35.509	30.912
1	W1640	sent	1.5e+01	6.012	2.50	0.027	-0.733	0.900	-0.815	0.430	0.049	6.7e-01	1	13	0.430	7.671	0.337
1	W826	recv	1.6e+04	420.872	36.99	0.000	-51.826	62.975	-0.823	0.425	0.050	6.8e-01	1	13	0.425	15050.218	14531.954
1	W2295_FED	sent	7.6e+03	518.196	14.75	0.000	-69.441	77.537	-0.896	0.387	0.058	8.0e-01	1	13	0.387	6948.106	6253.700
1	W2295_AAC	sent	7.2e+03	452.535	15.98	0.000	-112.700	67.713	-1.664	0.120	0.176	2.8e+00	1	13	0.120	6106.531	4979.533

| 1 | W2295 | sent | 2.9e+04 | 942.115 | 30.93 | 0.000 | -164.865 | 140.968 | -1.170 | 0.263 | 0.095 | 1.4e+00 | 1 | 13 | 0.263 | 27490.164 25841.512 |

Table A.6: Balance test results for clusters in terms of network bandwidth resource consumption. For convenience, the table is arranged in increasing order of the p-value of the significance test on the null-hypothesis, $H_0 : \beta_1 = k$ (where k is the number of members in the cluster), in an effort to present the cluster members furthest from being balanced first.

Test Number	Cluster	Server	Servers	metric	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=k t-value	Slope=k p-value	R2	F-stat	df1	df2	p-value
1	D_W1700	D_W17001	2	sent	0.000	0.0e+00	3.695	0.004	0.994	0.006	-1.6e+02	0.000	1.000	2.5e+04	1	10	0.000
1	D_W1700	D_W17002	2	sent	0.000	0.0e+00	2.953	0.014	0.995	0.007	-1.5e+02	0.000	1.000	2.2e+04	1	10	0.000
1	D_W2173	D_W21731	2	sent	0.000	0.0e+00	1.722	0.116	1.000	0.001	-1.3e+03	0.000	1.000	1.6e+06	1	10	0.000
1	W108	W11871	2	recv	0.035	0.0e+00	72.531	0.000	1.000	0.000	-2.1e+04	0.000	1.000	4.4e+08	1	13	0.000
1	W108	W11871	2	sent	0.095	0.0e+00	191.910	0.000	1.000	0.000	-2.1e+04	0.000	1.000	4.3e+08	1	13	0.000
1	W1246	S_W9282W15...	2	recv	0.000	0.0e+00	-5.327	0.000	1.000	0.000	-2.7e+16	0.000	1.000	7.1e+32	1	13	0.000
1	W1246	S_W9282W15...	2	sent	0.000	0.0e+00	0.000	1.000	1.000	0.000	-7.8e+16	0.000	1.000	6.0e+33	1	13	0.000
1	W129	W12902	4	sent	0.405	3.1e-02	13.079	0.000	0.986	0.015	-2.0e+02	0.000	0.997	4.1e+03	1	13	0.000
1	W131	W13102	4	recv	0.232	2.7e-02	8.616	0.000	1.725	0.021	-1.1e+02	0.000	0.998	6.7e+03	1	13	0.000
1	W1536	W153601	3	sent	15143.014	6.2e+02	24.426	0.000	0.211	0.210	-1.3e+01	0.000	0.023	1.0e+00	1	43	0.321
1	W1536	W153601	3	recv	17455.910	8.6e+01	202.755	0.000	0.007	0.040	-7.5e+01	0.000	0.001	3.4e-02	1	43	0.855
1	W1536	W153602	3	recv	17443.494	9.3e+01	187.127	0.000	0.018	0.056	-5.3e+01	0.000	0.002	1.0e-01	1	43	0.751
1	W1536	W153603	3	sent	15735.282	1.2e+02	126.219	0.000	0.015	0.060	-5.0e+01	0.000	0.002	6.5e-02	1	43	0.800
1	W1536	W153603	3	recv	17308.612	3.2e+02	53.885	0.000	0.062	0.122	-2.4e+01	0.000	0.006	2.6e-01	1	43	0.616
1	W1614	S_W9282W22...	2	recv	0.000	0.0e+00	9.556	0.000	1.000	0.000	-9.7e+16	0.000	1.000	9.3e+33	1	13	0.000
1	W1614	S_W9282W22...	2	sent	0.000	0.0e+00	0.000	1.000	1.000	0.000	-6.9e+16	0.000	1.000	4.7e+33	1	13	0.000
1	W19481ADB	W19481ADB1	2	sent	0.131	1.0e-03	114.020	0.000	1.004	0.006	-1.8e+02	0.000	1.000	3.3e+04	1	13	0.000
1	W1996	W19961	2	recv	0.034	0.0e+00	145.075	0.000	1.000	0.000	-1.3e+04	0.000	1.000	1.8e+08	1	13	0.000
1	W1996	W19961	2	sent	0.225	2.0e-03	94.337	0.000	1.000	0.001	-1.4e+03	0.000	1.000	1.9e+06	1	13	0.000
1	W2007_DB2	W20076	2	sent	0.155	3.0e-03	54.348	0.000	0.997	0.013	-7.5e+01	0.000	0.998	5.5e+03	1	13	0.000
1	W2007_W400...W256510	5	sent	0.296	4.7e-02	6.323	0.000	1.389	0.011	-3.4e+02	0.000	0.999	1.7e+04	1	13	0.000
1	W2007_W400...W256510	5	recv	-0.209	5.0e-02	-4.167	0.001	1.478	0.012	-3.0e+02	0.000	0.999	1.6e+04	1	13	0.000
1	W2007_W859...W20078	2	recv	0.022	5.0e-03	4.490	0.001	0.994	0.006	-1.7e+02	0.000	1.000	2.9e+04	1	13	0.000
1	W2007_W859...W20078	2	sent	0.153	1.0e-03	130.467	0.000	1.000	0.001	-7.8e+02	0.000	1.000	6.0e+05	1	13	0.000
1	W2038	W20381	2	sent	0.260	6.1e-02	4.235	0.001	1.025	0.011	-9.1e+01	0.000	0.999	9.1e+03	1	13	0.000
1	W2173	W21731	2	sent	0.248	5.0e-03	50.950	0.000	1.000	0.003	-3.4e+02	0.000	1.000	1.1e+05	1	13	0.000
1	W2173	W21731	2	recv	0.046	1.5e-02	3.094	0.009	1.015	0.017	-5.7e+01	0.000	0.996	3.5e+03	1	13	0.000
1	W2295	W229501	9	sent	28163.943	6.7e+02	41.856	0.000	0.022	0.395	-2.3e+01	0.000	0.000	3.0e-03	1	28	0.955
1	W2295	W229502	9	recv	27608.855	3.4e+02	81.138	0.000	0.020	0.181	-5.0e+01	0.000	0.000	1.2e-02	1	28	0.913
1	W2295	W229504	9	recv	27611.868	3.7e+02	75.017	0.000	0.016	0.174	-5.2e+01	0.000	0.000	8.0e-03	1	28	0.929
1	W2295	W229504	9	sent	28238.024	7.5e+02	37.902	0.000	-0.027	0.426	-2.1e+01	0.000	0.000	4.0e-03	1	28	0.950
1	W2295	W229505	9	recv	27148.857	7.5e+02	36.151	0.000	0.330	0.488	-1.8e+01	0.000	0.016	4.6e-01	1	28	0.505
1	W2295	W229506	9	sent	27772.582	3.6e+02	77.724	0.000	0.421	0.230	-3.7e+01	0.000	0.072	3.3e+00	1	43	0.075
1	W2295	W229506	9	recv	27557.706	2.4e+02	114.615	0.000	0.126	0.285	-3.1e+01	0.000	0.005	2.0e-01	1	43	0.660
1	W2295	W229507	9	sent	28352.617	7.1e+02	39.738	0.000	-0.088	0.349	-2.6e+01	0.000	0.002	6.3e-02	1	28	0.804
1	W2295	W229507	9	recv	27356.293	5.7e+02	48.139	0.000	0.230	0.435	-2.0e+01	0.000	0.010	2.8e-01	1	28	0.601
1	W2295	W229509	9	sent	27140.577	5.1e+02	53.215	0.000	0.715	0.295	-2.8e+01	0.000	0.120	5.9e+00	1	43	0.020
1	W2295	W229509	9	recv	27496.923	2.7e+02	101.345	0.000	0.088	0.138	-6.5e+01	0.000	0.009	4.1e-01	1	43	0.527
1	W2295	W229510	9	recv	27428.770	3.5e+02	79.095	0.000	0.196	0.288	-3.1e+01	0.000	0.011	4.6e-01	1	43	0.501
1	W2295_AAC	W229506	2	sent	6348.748	1.8e+02	35.685	0.000	0.239	0.115	-1.5e+01	0.000	0.092	4.3e+00	1	43	0.043
1	W2295_AAC	W229506	2	recv	4381.892	6.8e+01	64.015	0.000	0.056	0.081	-2.4e+01	0.000	0.011	4.8e-01	1	43	0.492
1	W2295_FED	W229509	2	recv	8052.907	1.4e+02	58.546	0.000	0.048	0.070	-2.8e+01	0.000	0.011	4.7e-01	1	43	0.498

Test Number	Cluster	Server	Servers	metric	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=k t-value	Slope=k p-value	R2	F-stat	df1	df2	p-value
1	W2295_W789	W229503	3	sent	10105.972	2.6e+02	39.090	0.000	0.177	0.148	-1.9e+01	0.000	0.049	1.4e+00	1	28	0.242
1	W2295_W789	W229504	3	recv	10656.420	7.8e+01	137.179	0.000	0.003	0.037	-8.1e+01	0.000	0.000	5.0e-03	1	28	0.946
1	W2295_W789	W229504	3	sent	10406.440	6.8e+01	153.339	0.000	0.004	0.039	-7.7e+01	0.000	0.000	1.2e-02	1	28	0.915
1	W2295_W789	W229505	3	recv	10565.459	1.6e+02	66.583	0.000	0.064	0.103	-2.8e+01	0.000	0.014	3.9e-01	1	28	0.539
1	W2295_W822	W229501	2	sent	3933.401	5.2e+01	76.215	0.000	0.010	0.030	-6.6e+01	0.000	0.004	1.2e-01	1	28	0.732
1	W2295_W822	W229502	2	recv	4420.786	6.1e+01	71.893	0.000	0.006	0.033	-6.1e+01	0.000	0.001	3.2e-02	1	28	0.860
1	W2482	W248206	8	sent	0.714	5.5e-02	12.999	0.000	0.956	0.128	-5.5e+01	0.000	0.811	5.6e+01	1	13	0.000
1	W272	W27202	8	sent	1.264	1.2e-01	10.681	0.000	2.098	0.092	-6.4e+01	0.000	0.975	5.1e+02	1	13	0.000
1	W301	W3010	8	sent	1.069	4.7e-02	22.822	0.000	2.355	0.010	-5.5e+02	0.000	1.000	5.2e+04	1	13	0.000
1	W301	W3010	8	recv	0.320	4.7e-02	6.849	0.000	2.068	0.008	-7.7e+02	0.000	1.000	7.2e+04	1	13	0.000
1	W301	W3011	8	recv	0.274	5.3e-02	5.188	0.000	2.035	0.009	-7.0e+02	0.000	1.000	5.7e+04	1	13	0.000
1	W301	W3011	8	sent	1.166	5.0e-02	23.210	0.000	2.410	0.011	-4.9e+02	0.000	1.000	4.5e+04	1	13	0.000
1	W620	W6202	2	recv	0.033	1.0e-03	33.906	0.000	1.000	0.000	-1.4e+04	0.000	1.000	1.9e+08	1	13	0.000
1	W620	W6202	2	sent	0.094	1.0e-03	83.141	0.000	1.000	0.000	-1.3e+04	0.000	1.000	1.7e+08	1	13	0.000
1	W826	W82601	2	recv	15191.984	1.7e+02	88.305	0.000	0.047	0.080	-2.4e+01	0.000	0.006	3.5e-01	1	58	0.557
1	W826	W82601	2	sent	12223.578	1.2e+02	98.798	0.000	0.032	0.071	-2.8e+01	0.000	0.003	2.0e-01	1	58	0.654
1	W826	W82602	2	recv	15163.259	2.1e+02	72.974	0.000	0.051	0.084	-2.3e+01	0.000	0.006	3.7e-01	1	58	0.545
1	W826	W82602	2	sent	12228.769	1.1e+02	106.702	0.000	0.025	0.055	-3.6e+01	0.000	0.003	2.0e-01	1	58	0.654
1	W971	W97101	3	recv	-1.501	8.8e-01	-1.714	0.110	1.144	0.009	-2.2e+02	0.000	0.999	1.8e+04	1	13	0.000
1	W971	W97101	3	sent	1.774	1.9e-01	9.544	0.000	1.188	0.009	-1.9e+02	0.000	0.999	1.6e+04	1	13	0.000
1	W996	W99601	2	sent	0.041	6.0e-03	6.323	0.000	0.994	0.011	-9.1e+01	0.000	0.998	8.1e+03	1	13	0.000
1	W2295_FED	W229510	2	recv	8022.225	1.8e+02	45.605	0.000	0.100	0.146	-1.3e+01	0.000	0.011	4.7e-01	1	43	0.496
1	W301	W25703	8	recv	-0.422	2.1e-01	-2.037	0.062	41.647	0.653	5.2e+01	0.000	0.997	4.1e+03	1	13	0.000
1	D_W1700	D_W17002	2	recv	0.000	0.0e+00	3.355	0.008	0.990	0.007	-1.4e+02	0.000	0.999	1.8e+04	1	9	0.000
1	W1428	W21271	6	recv	0.698	5.9e-01	1.174	0.262	2.633	0.070	-4.8e+01	0.000	0.991	1.4e+03	1	13	0.000
1	W1428	W21271	6	sent	2.499	6.1e-01	4.069	0.001	2.536	0.073	-4.7e+01	0.000	0.989	1.2e+03	1	13	0.000
1	W2295_AAC	W229507	2	recv	4307.867	1.6e+02	26.656	0.000	0.090	0.124	-1.5e+01	0.000	0.018	5.3e-01	1	28	0.474
1	W1536	W153602	3	sent	15594.507	1.4e+02	107.997	0.000	0.302	0.232	-1.2e+01	0.000	0.038	1.7e+00	1	43	0.200
1	D_W1700	D_W17001	2	recv	0.000	0.0e+00	3.031	0.014	0.991	0.011	-9.0e+01	0.000	0.999	7.8e+03	1	9	0.000
1	W2007_W400...	W20079	5	recv	0.709	1.0e-01	7.019	0.000	3.047	0.056	-3.5e+01	0.000	0.996	2.9e+03	1	13	0.000
1	W1428	W24461	6	sent	0.020	6.2e-01	0.033	0.974	3.204	0.084	-3.3e+01	0.000	0.991	1.5e+03	1	13	0.000
1	W1265	W12652	2	recv	1.144	1.6e-01	7.102	0.000	0.967	0.033	-3.1e+01	0.000	0.985	9.4e+02	1	13	0.000
1	D_W1265	D_W12652	2	recv	0.000	0.0e+00	2.345	0.044	0.999	0.015	-6.7e+01	0.000	0.998	4.5e+03	1	9	0.000
1	W1428	W16251	6	recv	-0.544	7.3e-01	-0.749	0.467	3.172	0.097	-2.9e+01	0.000	0.988	1.1e+03	1	13	0.000
1	W1428	W24461	6	recv	0.897	7.1e-01	1.267	0.227	3.162	0.100	-2.8e+01	0.000	0.987	1.0e+03	1	13	0.000
1	D_AKS_W415	D_AKS_W415...	3	recv	0.002	1.0e-03	3.219	0.012	1.002	0.024	-8.3e+01	0.000	0.995	1.8e+03	1	8	0.000
1	W2295_FED	W229509	2	sent	6674.421	2.7e+02	24.286	0.000	0.387	0.159	-1.0e+01	0.000	0.121	5.9e+00	1	43	0.019
1	W1428	W16251	6	sent	-0.915	7.3e-01	-1.250	0.233	3.290	0.098	-2.8e+01	0.000	0.989	1.1e+03	1	13	0.000
1	W130	W1302	2	sent	0.069	3.0e-03	26.990	0.000	1.030	0.035	-2.7e+01	0.000	0.985	8.4e+02	1	13	0.000
1	W131	W13103	4	sent	2.136	3.0e-01	7.069	0.000	0.857	0.118	-2.7e+01	0.000	0.803	5.3e+01	1	13	0.000
1	W301	W25703	8	sent	0.663	1.1e-01	5.824	0.000	6.285	0.065	-2.7e+01	0.000	0.999	9.5e+03	1	13	0.000
1	W1209_W2181	W12093	4	recv	0.166	7.0e-03	24.096	0.000	1.232	0.110	-2.5e+01	0.000	0.906	1.3e+02	1	13	0.000
1	W2295_AAC	W229507	2	sent	6705.516	3.6e+02	18.700	0.000	-0.065	0.175	-1.2e+01	0.000	0.005	1.4e-01	1	28	0.713
1	W748	W74801	3	sent	-0.283	4.7e-01	-0.603	0.557	1.760	0.050	-2.5e+01	0.000	0.990	1.2e+03	1	13	0.000
1	W2179_W2415	W21791	2	sent	0.150	8.0e-03	18.435	0.000	1.071	0.038	-2.4e+01	0.000	0.984	7.8e+02	1	13	0.000
1	W272	W27204	8	sent	1.190	1.7e-01	7.228	0.000	3.225	0.197	-2.4e+01	0.000	0.954	2.7e+02	1	13	0.000
1	W2199	W21991	2	sent	0.124	9.0e-03	14.337	0.000	1.019	0.041	-2.4e+01	0.000	0.979	6.2e+02	1	13	0.000
1	W2179_W2415	W21791	2	recv	0.038	3.0e-03	13.965	0.000	1.084	0.039	-2.3e+01	0.000	0.983	7.7e+02	1	13	0.000

Test Number	Cluster	Server	Servers	metric	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=k t-value	Slope=k p-value	R2	F-stat	df1	df2	p-value
1	W748	W74801	3	recv	-0.010	7.1e-02	-0.147	0.885	1.771	0.053	-2.3e+01	0.000	0.988	1.1e+03	1	13	0.000
1	W2482	W248206	8	recv	0.395	8.0e-03	49.509	0.000	0.567	0.323	-2.3e+01	0.000	0.191	3.1e+01	1	13	0.103
1	W2007_W400	W20073	2	sent	0.155	1.5e-02	10.660	0.000	1.065	0.042	-2.2e+01	0.000	0.981	6.5e+02	1	13	0.000
1	W1225	W122502	2	sent	0.057	1.0e-02	5.830	0.000	1.085	0.041	-2.2e+01	0.000	0.982	7.1e+02	1	13	0.000
1	W2312_W266	W231201	12	sent	1.118	5.4e-01	2.058	0.060	8.175	0.171	-2.2e+01	0.000	0.994	2.3e+03	1	13	0.000
1	W2482	W248207	8	recv	0.400	8.0e-03	49.544	0.000	0.380	0.345	-2.2e+01	0.000	0.085	1.2e+00	1	13	0.292
1	W2549	W25491	2	sent	0.582	7.5e-02	7.768	0.000	0.864	0.052	-2.2e+01	0.000	0.956	2.8e+02	1	13	0.000
1	W2549	W25491	2	recv	0.356	5.6e-02	6.323	0.000	0.879	0.052	-2.2e+01	0.000	0.957	2.9e+02	1	13	0.000
1	W2007_W400...	W20079	5	sent	1.132	1.1e-01	10.135	0.000	3.534	0.073	-2.0e+01	0.000	0.994	2.3e+03	1	13	0.000
1	W1038	W103805	6	recv	0.302	1.0e-01	2.970	0.011	4.910	0.055	-2.0e+01	0.000	0.998	8.0e+03	1	13	0.000
1	W2254	W128403	7	sent	5.415	6.6e-01	8.183	0.000	1.305	0.288	-2.0e+01	0.000	0.613	2.1e+01	1	13	0.001
1	W2098	W20981	3	recv	0.023	2.0e-03	11.818	0.000	1.012	0.101	-2.0e+01	0.000	0.886	1.0e+02	1	13	0.000
1	W2389	W23891	2	sent	0.153	3.8e-01	0.408	0.690	1.368	0.032	-2.0e+01	0.000	0.993	1.8e+03	1	13	0.000
1	W1566_W400	W10991	2	sent	0.233	1.6e-02	14.714	0.000	1.062	0.048	-2.0e+01	0.000	0.974	4.9e+02	1	13	0.000
1	W2312_W266	W231202	12	recv	0.465	6.8e-01	0.685	0.505	9.106	0.152	-1.9e+01	0.000	0.996	3.6e+03	1	13	0.000
1	W2254	W128404	7	recv	1.400	2.4e-01	5.828	0.000	2.564	0.235	-1.9e+01	0.000	0.902	1.2e+02	1	13	0.000
1	W487	W48703	5	sent	7.523	6.2e-01	12.185	0.000	1.330	0.197	-1.9e+01	0.000	0.779	4.6e+01	1	13	0.000
1	W1083_W418	W108302	5	sent	1437.348	1.4e+03	1.044	0.305	10.187	0.521	1.0e+01	0.000	0.932	3.8e+02	1	28	0.000
1	W2098	W20981	3	sent	0.055	4.0e-03	12.583	0.000	0.946	0.112	-1.8e+01	0.000	0.846	7.1e+01	1	13	0.000
1	W2312_W266	W231209	12	sent	-0.287	5.4e-01	-0.536	0.601	8.840	0.174	-1.8e+01	0.000	0.995	2.6e+03	1	13	0.000
1	W971	W97102	3	sent	-2.706	1.0e+00	-2.711	0.018	8.114	0.289	1.8e+01	0.000	0.984	7.9e+02	1	13	0.000
1	W2482	W248201	8	recv	0.352	2.8e-02	12.790	0.000	0.827	0.411	-1.7e+01	0.000	0.238	4.1e+00	1	13	0.065
1	W2312_W266	W231206	12	recv	0.359	7.9e-01	0.454	0.657	9.000	0.175	-1.7e+01	0.000	0.995	2.7e+03	1	13	0.000
1	W1038	W103803	6	recv	0.214	1.1e-01	1.994	0.068	4.994	0.059	-1.7e+01	0.000	0.998	7.2e+03	1	13	0.000
1	W2312_W266	W231202	12	sent	0.003	4.9e-01	0.007	0.995	9.173	0.166	-1.7e+01	0.000	0.996	3.0e+03	1	13	0.000
1	W633	S_W9281W19...	3	sent	0.036	1.8e-02	2.059	0.060	1.990	0.060	-1.7e+01	0.000	0.988	1.1e+03	1	13	0.000
1	W2327	S_W9282W10...	2	sent	0.100	8.0e-03	12.085	0.000	1.048	0.057	-1.7e+01	0.000	0.963	3.4e+02	1	13	0.000
1	W2312_W266	W231209	12	recv	-0.503	9.3e-01	-0.542	0.597	8.788	0.196	-1.6e+01	0.000	0.994	2.0e+03	1	13	0.000
1	W2312_W266	W231207	12	recv	0.445	5.5e-01	0.803	0.436	8.957	0.187	-1.6e+01	0.000	0.994	2.3e+03	1	13	0.000
1	W1083_W418	W108305	5	sent	26416.960	1.4e+03	19.496	0.000	0.674	0.468	-9.2e+00	0.000	0.069	2.1e+00	1	28	0.161
1	W971	W97103	3	recv	6.215	6.2e+00	1.004	0.334	32.493	1.830	1.6e+01	0.000	0.960	3.2e+02	1	13	0.000
1	W1038	W103802	6	recv	0.103	1.1e-01	0.944	0.362	5.058	0.060	-1.6e+01	0.000	0.998	7.2e+03	1	13	0.000
1	W2312_W266	W231208	12	sent	0.634	7.1e-01	0.895	0.387	8.490	0.228	-1.5e+01	0.000	0.991	1.4e+03	1	13	0.000
1	W2312_W266	W231207	12	recv	0.210	8.7e-01	0.241	0.813	9.065	0.193	-1.5e+01	0.000	0.994	2.2e+03	1	13	0.000
1	W633	S_W9282W19...	3	sent	0.114	1.6e-02	6.954	0.000	2.024	0.064	-1.5e+01	0.000	0.987	9.9e+02	1	13	0.000
1	W2312_W266	W231201	12	recv	1.515	1.1e+00	1.318	0.210	8.344	0.241	-1.5e+01	0.000	0.989	1.2e+03	1	13	0.000
1	W2038	W20381	2	recv	0.224	1.0e-01	2.212	0.046	0.999	0.068	-1.5e+01	0.000	0.944	2.2e+02	1	13	0.000
1	W1083_W418	W108301	5	sent	26215.943	1.4e+03	18.492	0.000	0.741	0.488	-8.7e+00	0.000	0.076	2.3e+00	1	28	0.140
1	W1886	W18862	2	sent	0.157	1.2e-02	13.582	0.000	1.108	0.062	-1.4e+01	0.000	0.960	3.1e+02	1	13	0.000
1	W2312_W266	W231205	12	recv	0.904	9.7e-01	0.931	0.369	8.950	0.216	-1.4e+01	0.000	0.993	1.7e+03	1	13	0.000
1	W2389	W23891	2	recv	1.408	3.3e-01	4.307	0.001	1.392	0.043	-1.4e+01	0.000	0.988	1.0e+03	1	13	0.000
1	W2293_W1519	W22939	4	sent	0.475	3.6e-02	13.374	0.000	0.799	0.229	-1.4e+01	0.000	0.485	1.2e+01	1	13	0.004
1	W2295	W229510	9	sent	28165.401	1.2e+03	23.952	0.000	0.033	1.216	-7.4e+00	0.000	0.000	1.0e-03	1	43	0.979
1	W2482	W248203	8	recv	0.364	3.6e-02	10.133	0.000	0.642	0.534	-1.4e+01	0.000	0.100	1.4e+00	1	13	0.250
1	W129	W12902	4	recv	0.339	4.4e-02	7.622	0.000	0.875	0.228	-1.4e+01	0.000	0.531	1.5e+01	1	13	0.002
1	W971	W97102	3	recv	16.644	5.2e+00	3.220	0.007	9.937	0.511	1.4e+01	0.000	0.967	3.8e+02	1	13	0.000
1	W909	W90905	4	sent	0.195	1.7e-02	11.131	0.000	0.785	0.238	-1.3e+01	0.000	0.455	1.1e+01	1	13	0.006
1	W272	W27203	8	sent	0.641	1.4e-01	4.593	0.001	4.905	0.230	-1.3e+01	0.000	0.972	4.6e+02	1	13	0.000

Test Number	Cluster	Server	Servers	metric	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=k t-value	Slope=k p-value	R2	F-stat	df1	df2	p-value
1	W1038	W103801	6	recv	0.535	1.3e-01	4.042	0.001	4.996	0.075	-1.3e+01	0.000	0.997	4.5e+03	1	13	0.000
1	W2312_W266	W231204	12	sent	-0.223	5.6e-01	-0.395	0.700	9.377	0.195	-1.3e+01	0.000	0.994	2.3e+03	1	13	0.000
1	W2293_W164	W22933	2	recv	0.038	4.0e-03	10.032	0.000	1.035	0.072	-1.3e+01	0.000	0.941	2.1e+02	1	13	0.000
1	W487	W48702	5	recv	3.541	4.6e-01	7.708	0.000	1.561	0.264	-1.3e+01	0.000	0.729	3.5e+01	1	13	0.000
1	W2312_W266	W231206	12	sent	-0.492	5.6e-01	-0.876	0.397	9.482	0.194	-1.3e+01	0.000	0.995	2.4e+03	1	13	0.000
1	W2286	W228601	2	recv	0.192	1.4e-02	13.361	0.000	0.946	0.082	-1.3e+01	0.000	0.910	1.3e+02	1	13	0.000
1	W130	W1302	2	recv	0.015	2.0e-03	9.953	0.000	1.033	0.077	-1.3e+01	0.000	0.933	1.8e+02	1	13	0.000
1	W331	S_105W331	2	sent	0.014	1.0e-03	12.083	0.000	1.126	0.070	-1.3e+01	0.000	0.953	2.6e+02	1	13	0.000
1	W2312_W266	W231208	12	recv	0.755	1.2e+00	0.618	0.547	8.701	0.263	-1.3e+01	0.000	0.988	1.1e+03	1	13	0.000
1	W2312_W266	W231203	12	sent	0.099	7.0e-01	0.142	0.889	9.039	0.236	-1.3e+01	0.000	0.991	1.5e+03	1	13	0.000
1	W2362	S_105W2362	2	recv	0.077	2.6e-02	2.908	0.012	1.172	0.067	-1.2e+01	0.000	0.960	3.5e+02	1	13	0.000
1	W1083_W418	W108303	5	sent	25849.442	1.5e+03	16.919	0.000	0.870	0.528	-7.8e+00	0.000	0.088	2.7e+00	1	28	0.110
1	W2254	W128403	7	recv	1.938	2.3e-01	8.317	0.000	2.998	0.328	-1.2e+01	0.000	0.865	8.3e+01	1	13	0.000
1	W2312_W266	W231205	12	sent	0.575	6.7e-01	0.854	0.409	9.157	0.234	-1.2e+01	0.000	0.992	1.5e+03	1	13	0.000
1	W1083_W418	W108304	5	sent	25810.568	1.5e+03	16.823	0.000	0.885	0.531	-7.7e+00	0.000	0.090	2.8e+00	1	28	0.107
1	W2254	W128402	7	sent	6.266	1.1e+00	5.811	0.000	0.713	0.539	-1.2e+01	0.000	0.119	1.8e+00	1	13	0.209
1	W1038	W103804	6	recv	0.053	1.6e-01	0.335	0.743	5.002	0.086	-1.2e+01	0.000	0.996	3.4e+03	1	13	0.000
1	W2254	W128404	7	sent	4.819	1.3e+00	3.676	0.003	1.139	0.517	-1.1e+01	0.000	0.272	4.9e+00	1	13	0.046
1	W2007_DB2	W20076	2	recv	0.016	4.0e-03	3.529	0.004	1.058	0.084	-1.1e+01	0.000	0.925	1.6e+02	1	13	0.000
1	W2312_W266	W231204	12	recv	-0.375	1.1e+00	-0.343	0.737	9.265	0.244	-1.1e+01	0.000	0.991	1.5e+03	1	13	0.000
1	W2482	W248203	8	sent	0.708	1.6e-01	4.377	0.001	0.824	0.643	-1.1e+01	0.000	0.112	1.6e+00	1	13	0.223
1	D_W2173	D_W21732	2	sent	0.000	0.0e+00	5.257	0.001	0.895	0.059	-1.9e+01	0.000	0.966	2.3e+02	1	8	0.000
1	W2295_W789	W229503	3	recv	9143.554	6.4e+02	14.182	0.000	0.747	0.317	-7.1e+00	0.000	0.166	5.6e+00	1	28	0.026
1	W2482	W248208	8	recv	0.397	1.3e-02	30.519	0.000	0.599	0.727	-1.0e+01	0.000	0.050	6.8e-01	1	13	0.425
1	D_AKS_W647	D_AKS_W647...	3	sent	0.003	3.0e-03	1.015	0.332	1.519	0.139	-1.1e+01	0.000	0.915	1.2e+02	1	11	0.000
1	W1038	W103805	6	sent	3.753	1.3e+00	2.957	0.011	4.609	0.150	-9.3e+00	0.000	0.986	9.5e+02	1	13	0.000
1	W748	W74802	3	recv	0.163	8.4e-02	1.946	0.074	2.222	0.084	-9.2e+00	0.000	0.982	6.9e+02	1	13	0.000
1	W909	W90904	4	sent	0.201	2.6e-02	7.672	0.000	0.704	0.359	-9.2e+00	0.000	0.229	3.9e+00	1	13	0.071
1	W748	W74802	3	sent	1.001	5.6e-01	1.775	0.099	2.246	0.082	-9.2e+00	0.000	0.983	7.5e+02	1	13	0.000
1	W2312_W266	W231203	12	recv	-0.468	1.4e+00	-0.340	0.740	9.203	0.305	-9.2e+00	0.000	0.986	9.1e+02	1	13	0.000
1	W487	W48703	5	recv	3.564	6.9e-01	5.176	0.000	1.501	0.389	-9.0e+00	0.000	0.534	1.5e+01	1	13	0.002
1	W2295_W789	W229505	3	sent	9304.471	7.5e+02	12.416	0.000	0.995	0.389	-6.2e+00	0.000	0.073	2.2e+00	1	28	0.150
1	W589	W58912	14	sent	1.885	5.6e-01	3.334	0.005	11.105	0.339	-8.5e+00	0.000	0.988	1.1e+03	1	13	0.000
1	W1038	W103803	6	sent	3.669	1.4e+00	2.667	0.019	4.644	0.163	-8.3e+00	0.000	0.984	8.1e+02	1	13	0.000
1	W1710	S_105W1710	2	sent	0.020	3.0e-03	7.770	0.000	0.887	0.135	-8.2e+00	0.000	0.768	4.3e+01	1	13	0.000
1	W272	W27206	8	recv	0.286	4.6e-02	6.274	0.000	1.475	0.801	-8.1e+00	0.000	0.207	3.4e+00	1	13	0.089
1	W786	W78602	4	sent	-23.100	9.9e+00	-2.329	0.037	3.448	0.068	-8.1e+00	0.000	0.995	2.6e+03	1	13	0.000
1	W589	W58912	14	sent	1.032	3.5e-01	2.915	0.012	10.924	0.402	-7.7e+00	0.000	0.983	7.4e+02	1	13	0.000
1	W1039	S_W466	2	recv	0.004	1.0e-03	5.114	0.000	1.107	0.119	-7.5e+00	0.000	0.869	8.7e+01	1	13	0.000
1	D_W764	D_W7642	2	recv	0.000	0.0e+00	0.578	0.579	1.604	0.038	-1.0e+01	0.000	0.996	1.8e+03	1	8	0.000
1	W174_W266	W17411	20	sent	16.125	6.4e+00	2.532	0.025	14.576	0.748	-7.2e+00	0.000	0.967	3.8e+02	1	13	0.000
1	D_W764	D_W7641	2	recv	0.000	0.0e+00	-0.570	0.579	2.604	0.081	7.5e+00	0.000	0.989	1.0e+03	1	12	0.000
1	SQL14W1719	W125914W17...	2	sent	0.026	6.0e-03	4.007	0.001	1.175	0.116	-7.1e+00	0.000	0.887	1.0e+02	1	13	0.000
1	W1543	W131401	2	sent	0.232	1.7e-01	1.325	0.208	0.953	0.148	-7.1e+00	0.000	0.761	4.1e+01	1	13	0.000
1	W131	W13101	4	recv	-0.076	4.0e-02	-1.909	0.079	4.505	0.072	7.0e+00	0.000	0.997	3.9e+03	1	13	0.000
1	D_AKS_W415	D_AKS_W415...	3	sent	0.001	1.0e-03	0.893	0.391	2.294	0.092	-7.7e+00	0.000	0.983	6.3e+02	1	11	0.000
1	W2293_W1519	W22938	4	sent	0.468	6.8e-02	6.845	0.000	0.861	0.448	-7.0e+00	0.000	0.221	3.7e+00	1	13	0.077
1	W589	W5892	14	sent	-0.120	6.7e-01	-0.179	0.861	11.411	0.375	-6.9e+00	0.000	0.986	9.2e+02	1	13	0.000

Test Number	Cluster	Server	Servers	metric	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=k t-value	Slope=k p-value	R2	F-stat	df1	df2	p-value
1	W1225	W122501	2	recv	0.030	4.0e-03	8.254	0.000	1.091	0.132	-6.9e+00	0.000	0.840	6.8e+01	1	13	0.000
1	W2389	W23892	2	sent	0.659	9.6e-01	0.686	0.505	3.475	0.215	6.9e+00	0.000	0.953	2.6e+02	1	13	0.000
1	W1265	W12652	2	sent	1.635	9.2e-01	1.770	0.100	0.949	0.154	-6.8e+00	0.000	0.745	3.8e+01	1	13	0.000
1	W174	W17411	15	sent	13.247	5.1e+00	2.622	0.021	10.972	0.593	-6.8e+00	0.000	0.963	3.4e+02	1	13	0.000
1	W174	W17408	15	recv	38.154	1.0e+01	3.636	0.003	11.532	0.513	-6.8e+00	0.000	0.975	5.1e+02	1	13	0.000
1	W2293_W164	W22934	2	sent	0.145	2.1e-02	6.845	0.000	1.006	0.147	-6.7e+00	0.000	0.782	4.7e+01	1	13	0.000
1	W1640	W16409	10	sent	4.137	2.2e+00	1.842	0.088	4.335	0.843	-6.7e+00	0.000	0.670	2.6e+01	1	13	0.000
1	W589	W5891	14	sent	-0.402	6.0e-01	-0.673	0.513	11.739	0.340	-6.6e+00	0.000	0.989	1.2e+03	1	13	0.000
1	W2295	W229503	9	sent	27351.844	2.9e+03	9.416	0.000	0.487	1.662	-5.1e+00	0.000	0.003	8.6e-02	1	28	0.772
1	W2482	W248204	8	recv	0.561	1.3e-01	4.347	0.001	-1.797	1.507	-6.5e+00	0.000	0.099	1.4e+00	1	13	0.254
1	W2482	W248205	8	recv	0.426	2.3e-02	18.845	0.000	-1.232	1.442	-6.4e+00	0.000	0.053	7.3e-01	1	13	0.409
1	W589	W58911	14	sent	2.041	8.0e-01	2.551	0.024	10.950	0.478	-6.4e+00	0.000	0.976	5.3e+02	1	13	0.000
1	W589	W5893	14	sent	-0.565	6.4e-01	-0.877	0.396	11.702	0.363	-6.3e+00	0.000	0.988	1.0e+03	1	13	0.000
1	W1640	W16403	10	recv	3.187	1.4e+00	2.237	0.043	5.944	0.644	-6.3e+00	0.000	0.868	8.5e+01	1	13	0.000
1	W2482	W248202	8	recv	0.384	1.4e-01	2.676	0.019	0.205	1.240	-6.3e+00	0.000	0.002	2.7e-02	1	13	0.871
1	W1302	W13021	5	recv	23.172	4.5e+00	5.112	0.000	3.494	0.242	-6.2e+00	0.000	0.941	2.1e+02	1	13	0.000
1	W331	S_105W331	2	recv	0.005	1.0e-03	5.189	0.000	1.079	0.151	-6.1e+00	0.000	0.796	5.1e+01	1	13	0.000
1	W95	W951	2	sent	0.054	1.1e-02	4.803	0.000	1.572	0.070	-6.1e+00	0.000	0.975	5.0e+02	1	13	0.000
1	W2295_W822	W229502	2	sent	478.462	5.0e+02	0.957	0.347	6.668	0.960	4.9e+00	0.000	0.633	4.8e+01	1	28	0.000
1	W1710	S_105W1710	2	recv	0.008	1.0e-03	6.034	0.000	0.553	0.240	-6.0e+00	0.000	0.291	5.3e+00	1	13	0.038
1	W174	W17409	15	recv	66.063	2.6e+01	2.533	0.025	8.577	1.080	-5.9e+00	0.000	0.829	6.3e+01	1	13	0.000
1	W174_W266	W17408	20	recv	48.778	1.7e+01	2.935	0.012	15.198	0.813	-5.9e+00	0.000	0.964	3.5e+02	1	13	0.000
1	W272	W27208	8	recv	0.199	3.3e-02	5.988	0.000	3.754	0.720	-5.9e+00	0.000	0.677	2.7e+01	1	13	0.000
1	W1710	S_W965	2	recv	0.008	1.0e-03	5.321	0.000	0.527	0.253	-5.8e+00	0.000	0.250	4.3e+00	1	13	0.058
1	W174_W266	W17411	20	recv	36.277	2.0e+01	1.807	0.094	14.711	0.920	-5.8e+00	0.000	0.952	2.6e+02	1	13	0.000
1	W174_W266	W17409	20	recv	88.025	3.7e+01	2.369	0.034	11.182	1.538	-5.7e+00	0.000	0.803	5.3e+01	1	13	0.000
1	W174	W17408	15	sent	14.189	4.1e+00	3.450	0.004	11.968	0.531	-5.7e+00	0.000	0.975	5.1e+02	1	13	0.000
1	W971	W97103	3	sent	-16.914	6.2e+00	-2.712	0.018	20.407	3.059	5.7e+00	0.000	0.774	4.4e+01	1	13	0.000
1	W589	W5892	14	recv	0.429	3.8e-01	1.139	0.275	11.565	0.428	-5.7e+00	0.000	0.983	7.3e+02	1	13	0.000
1	W1471	W14712	2	sent	2.500	3.6e-01	7.006	0.000	0.711	0.228	-5.6e+00	0.000	0.427	9.7e+00	1	13	0.008
1	W1640	W16408	10	sent	4.288	2.3e+00	1.875	0.083	4.779	0.961	-5.4e+00	0.000	0.656	2.5e+01	1	13	0.000
1	D_AKS_W647	D_AKS_W647...	3	recv	0.002	2.0e-03	0.748	0.472	1.441	0.256	-6.1e+00	0.000	0.761	3.2e+01	1	10	0.000
1	W1640	W16401	10	recv	1.479	3.4e-01	4.323	0.001	4.085	1.102	-5.4e+00	0.000	0.514	1.4e+01	1	13	0.003
1	W1209_W2181	W12094	4	sent	0.428	7.4e-02	5.800	0.000	1.733	0.424	-5.4e+00	0.000	0.563	1.7e+01	1	13	0.001
1	W272	W27202	8	recv	0.186	4.4e-02	4.228	0.001	3.542	0.843	-5.3e+00	0.000	0.576	1.7e+01	1	13	0.001
1	W2295	W229503	9	recv	23611.512	3.3e+03	7.251	0.000	1.984	1.601	-4.4e+00	0.000	0.052	1.5e+00	1	28	0.226
1	W589	W58911	14	recv	1.124	4.5e-01	2.526	0.025	11.250	0.525	-5.2e+00	0.000	0.972	4.6e+02	1	13	0.000
1	W174	W17411	15	recv	31.013	1.7e+01	1.855	0.086	11.039	0.766	-5.2e+00	0.000	0.941	2.1e+02	1	13	0.000
1	W174_W266	W17408	20	sent	18.021	6.3e+00	2.860	0.013	15.802	0.813	-5.2e+00	0.000	0.967	3.8e+02	1	13	0.000
1	W1083_W418	W108302	5	recv	24963.258	2.1e+03	11.746	0.000	1.758	0.754	-4.3e+00	0.000	0.163	5.4e+00	1	28	0.027
1	W1302	W13021	5	recv	9.325	2.0e+00	4.649	0.000	3.558	0.281	-5.1e+00	0.000	0.925	1.6e+02	1	13	0.000
1	D_W2173	D_W21731	2	recv	0.000	0.0e+00	1.774	0.104	1.048	0.175	-5.4e+00	0.000	0.764	3.6e+01	1	11	0.000
1	W1640	W16408	10	recv	0.806	1.7e-01	4.602	0.000	6.875	0.618	-5.1e+00	0.000	0.905	1.2e+02	1	13	0.000
1	D_AKS_W647	D_AKS_W647...	3	recv	0.001	3.0e-03	0.394	0.702	1.429	0.281	-5.6e+00	0.000	0.721	2.6e+01	1	10	0.000
1	W95	W951	2	recv	0.000	2.0e-03	0.149	0.883	1.789	0.042	-5.0e+00	0.000	0.993	1.8e+03	1	13	0.000
1	D_AKS_W415	D_AKS_W415...	3	sent	0.001	0.0e+00	1.911	0.085	3.342	0.062	5.6e+00	0.000	0.997	2.9e+03	1	10	0.000
1	W589	W5891	14	recv	-0.127	4.5e-01	-0.285	0.780	11.597	0.484	-5.0e+00	0.000	0.978	5.8e+02	1	13	0.000
1	W2389	W23892	2	recv	-2.092	1.1e+00	-1.974	0.070	3.204	0.243	5.0e+00	0.000	0.930	1.7e+02	1	13	0.000

Test Number	Cluster	Server	Servers	metric	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=k t-value	Slope=k p-value	R2	F-stat	df1	df2	p-value
1	W1576	W15762	2	sent	0.054	1.1e-02	4.945	0.000	0.819	0.240	-4.9e+00	0.000	0.473	1.2e+01	1	13	0.005
1	W185616W14004	W174622	2	recv	0.552	6.4e-02	8.578	0.000	0.928	0.218	-4.9e+00	0.000	0.582	1.8e+01	1	13	0.001
1	W487	W48701	5	sent	8.332	1.7e+00	4.796	0.000	1.406	0.734	-4.9e+00	0.000	0.220	3.7e+00	1	13	0.078
1	W1640	W16402	10	sent	10.898	3.4e+00	3.200	0.007	-0.149	2.081	-4.9e+00	0.000	0.000	5.0e-03	1	13	0.944
1	W909	W90905	4	recv	0.023	7.0e-03	3.095	0.009	1.796	0.453	-4.9e+00	0.000	0.547	1.6e+01	1	13	0.002
1	W2312	W231201	9	sent	1.045	5.4e-01	1.930	0.076	8.170	0.171	-4.9e+00	0.000	0.994	2.3e+03	1	13	0.000
1	W996	W99602	2	recv	0.765	9.0e-03	86.945	0.000	0.995	0.207	-4.9e+00	0.000	0.640	2.3e+01	1	13	0.000
1	W174_W266	W17412	20	sent	23.580	7.4e+00	3.182	0.007	15.343	0.968	-4.9e+00	0.000	0.951	2.5e+02	1	13	0.000
1	W174_W266	W13021	20	recv	118.488	2.6e+01	4.529	0.001	13.294	1.398	-4.8e+00	0.000	0.874	9.0e+01	1	13	0.000
1	W543	S_105W543	2	sent	0.046	1.3e-02	3.517	0.004	1.324	0.142	-4.7e+00	0.000	0.870	8.7e+01	1	13	0.000
1	W174	W17409	15	sent	23.610	1.1e+01	2.200	0.046	9.290	1.206	-4.7e+00	0.000	0.820	5.9e+01	1	13	0.000
1	W185616W14004	W174622	2	sent	0.998	4.1e-01	2.440	0.030	0.925	0.229	-4.7e+00	0.000	0.556	1.6e+01	1	13	0.001
1	W2007_W400	W20073	2	recv	0.000	7.0e-03	0.067	0.947	1.409	0.127	-4.6e+00	0.000	0.904	1.2e+02	1	13	0.000
1	W308	W11203	2	sent	0.021	4.0e-03	4.754	0.000	0.961	0.224	-4.6e+00	0.000	0.587	1.8e+01	1	13	0.001
1	W1640	W16405	10	sent	5.311	2.4e+00	2.248	0.043	4.901	1.104	-4.6e+00	0.000	0.603	2.0e+01	1	13	0.001
1	W174_W266	W17409	20	sent	31.546	1.5e+01	2.072	0.059	12.122	1.712	-4.6e+00	0.000	0.794	5.0e+01	1	13	0.000
1	W1471	W14711	2	sent	2.330	6.2e-01	3.772	0.002	0.620	0.300	-4.6e+00	0.000	0.247	4.3e+00	1	13	0.059
1	W1039	S_105W1039	2	sent	0.015	3.0e-03	4.342	0.001	1.089	0.198	-4.6e+00	0.000	0.699	3.0e+01	1	13	0.000
1	W786	W78605	4	sent	18.054	1.2e+01	1.514	0.154	4.533	0.116	4.6e+00	0.001	0.992	1.5e+03	1	13	0.000
1	W786	W78601	4	sent	35.131	1.0e+01	3.399	0.005	4.463	0.103	4.6e+00	0.001	0.993	1.9e+03	1	13	0.000
1	W834	W8341	2	recv	0.009	2.0e-03	4.538	0.001	1.777	0.050	-4.4e+00	0.001	0.990	1.2e+03	1	13	0.000
1	W1209_W2181	W12093	4	sent	0.411	1.0e-01	4.071	0.001	1.665	0.527	-4.4e+00	0.001	0.435	1.0e+01	1	13	0.008
1	SQL14W1719	W125914W17...	2	recv	0.020	7.0e-03	2.761	0.016	0.907	0.247	-4.4e+00	0.001	0.510	1.4e+01	1	13	0.003
1	W2295_W822	W229501	2	recv	3813.547	1.9e+02	20.579	0.000	0.944	0.280	-3.8e+00	0.001	0.288	1.1e+01	1	28	0.002
1	W2330	W23302	2	sent	3.511	1.5e+00	2.373	0.034	1.299	0.163	-4.3e+00	0.001	0.830	6.3e+01	1	13	0.000
1	W174_W266	W13021	20	sent	46.657	1.1e+01	4.386	0.001	13.596	1.493	-4.3e+00	0.001	0.864	8.3e+01	1	13	0.000
1	D_W1265	D_W12652	2	sent	0.004	4.0e-03	1.091	0.301	0.888	0.243	-4.6e+00	0.001	0.573	1.3e+01	1	10	0.004
1	W1640	W16409	10	recv	0.770	2.4e-01	3.255	0.006	6.654	0.796	-4.2e+00	0.001	0.843	7.0e+01	1	13	0.000
1	W589	W5899	14	recv	-0.341	5.5e-01	-0.615	0.549	11.530	0.587	-4.1e+00	0.001	0.967	3.9e+02	1	13	0.000
1	W174	W17412	15	sent	19.479	6.6e+00	2.958	0.011	11.453	0.860	-4.1e+00	0.001	0.932	1.8e+02	1	13	0.000
1	W909	W90904	4	recv	0.022	8.0e-03	2.944	0.011	1.929	0.502	-4.1e+00	0.001	0.531	1.5e+01	1	13	0.002
1	W1209_W2181	W12091	4	sent	0.341	9.7e-02	3.526	0.004	1.982	0.493	-4.1e+00	0.001	0.554	1.6e+01	1	13	0.001
1	W969	W9694	10	recv	-0.327	1.3e-01	-2.465	0.028	10.448	0.110	4.1e+00	0.001	0.999	9.0e+03	1	13	0.000
1	W1760	W176003	2	sent	0.366	3.1e-01	1.185	0.257	0.960	0.256	-4.1e+00	0.001	0.521	1.4e+01	1	13	0.002
1	W1576	W15761	2	sent	0.057	1.4e-02	3.995	0.002	0.768	0.307	-4.0e+00	0.001	0.324	6.2e+00	1	13	0.027
1	W589	W5897	14	sent	2.376	1.4e+00	1.690	0.115	10.682	0.836	-4.0e+00	0.002	0.926	1.6e+02	1	13	0.000
1	W19481ADB	W19481ADB1	2	recv	0.007	4.0e-03	1.575	0.139	1.431	0.144	-4.0e+00	0.002	0.884	9.9e+01	1	13	0.000
1	W1296	W12961	2	sent	0.213	5.1e-02	4.168	0.001	1.032	0.245	-3.9e+00	0.002	0.576	1.8e+01	1	13	0.001
1	W1056	S_105W1056	2	sent	0.031	9.0e-03	3.518	0.004	1.568	0.110	-3.9e+00	0.002	0.939	2.0e+02	1	13	0.000
1	W589	W58910	14	sent	0.934	6.5e-01	1.445	0.172	12.385	0.413	-3.9e+00	0.002	0.986	9.0e+02	1	13	0.000
1	W272	W27201	8	recv	0.242	6.4e-02	3.799	0.002	2.699	1.358	-3.9e+00	0.002	0.233	3.9e+00	1	13	0.068
1	W589	W5897	14	recv	1.751	8.3e-01	2.098	0.056	10.247	0.962	-3.9e+00	0.002	0.897	1.1e+02	1	13	0.000
1	W1296	W12961	2	recv	0.174	1.0e-01	1.690	0.115	0.936	0.274	-3.9e+00	0.002	0.473	1.2e+01	1	13	0.005
1	W1760	W176004	2	recv	0.039	2.3e-02	1.707	0.112	0.979	0.264	-3.9e+00	0.002	0.515	1.9e+01	1	13	0.003
1	W174_W266	W17401	20	sent	43.127	8.6e+00	5.014	0.000	15.041	1.285	-3.9e+00	0.002	0.913	1.4e+02	1	13	0.000
1	W589	W58910	14	recv	0.471	4.0e-01	1.184	0.258	12.176	0.478	-3.8e+00	0.002	0.980	6.5e+02	1	13	0.000
1	W1296	W12962	2	recv	0.178	1.0e-01	1.711	0.111	0.934	0.280	-3.8e+00	0.002	0.462	1.1e+01	1	13	0.005
1	W1471	W14711	2	recv	14.267	4.8e+00	2.962	0.011	1.120	0.231	-3.8e+00	0.002	0.644	2.3e+01	1	13	0.000

Test Number	Cluster	Server	Servers	metric	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=k t-value	Slope=k p-value	R2	F-stat	df1	df2	p-value
1	W272	W27206	8	sent	2.561	1.2e+00	2.223	0.045	-0.631	2.278	-3.8e+00	0.002	0.006	7.7e-02	1	13	0.786
1	W174	W17414	15	sent	14.826	5.0e+00	2.945	0.011	18.903	1.034	3.8e+00	0.002	0.963	3.3e+02	1	13	0.000
1	W131	W13102	4	sent	2.711	1.3e+00	2.063	0.060	0.387	0.963	-3.8e+00	0.002	0.012	1.6e-01	1	13	0.695
1	W131	W13103	4	recv	-0.322	1.2e-01	-2.583	0.023	4.829	0.223	3.7e+00	0.003	0.973	4.7e+02	1	13	0.000
1	W19481W429	W19481W429...	2	sent	0.092	2.4e-02	3.920	0.002	1.299	0.189	-3.7e+00	0.003	0.785	4.7e+01	1	13	0.000
1	W589	W5894	14	sent	-0.143	9.8e-01	-0.146	0.886	11.885	0.570	-3.7e+00	0.003	0.971	4.3e+02	1	13	0.000
1	W18642W2324	S_W9282W18...	2	sent	0.044	1.6e-02	2.748	0.017	1.359	0.174	-3.7e+00	0.003	0.824	6.1e+01	1	13	0.000
1	W589	W5893	14	recv	-1.001	5.4e-01	-1.849	0.087	11.941	0.562	-3.7e+00	0.003	0.972	4.5e+02	1	13	0.000
1	W2549	W25492	2	sent	2.424	3.8e-01	6.403	0.000	-1.552	0.972	-3.7e+00	0.003	0.164	2.5e+00	1	13	0.134
1	SQL14W1719	W125914W17...	2	recv	0.030	5.0e-03	5.631	0.000	0.884	0.309	-3.6e+00	0.003	0.387	8.2e+00	1	13	0.013
1	W19481APP	W19481APP1	2	recv	0.068	2.1e-02	3.183	0.007	1.538	0.129	-3.6e+00	0.003	0.917	1.4e+02	1	13	0.000
1	W129	W12901	4	recv	0.344	6.9e-02	5.013	0.000	1.610	0.669	-3.6e+00	0.003	0.308	5.8e+00	1	13	0.032
1	W174	W17401	15	sent	34.009	7.1e+00	4.806	0.000	11.240	1.057	-3.6e+00	0.004	0.897	1.1e+02	1	13	0.000
1	W272	W27203	8	recv	0.146	3.9e-02	3.733	0.003	4.963	0.862	-3.5e+00	0.004	0.718	3.3e+01	1	13	0.000
1	W1760	W176003	2	recv	0.084	1.2e-02	6.846	0.000	0.977	0.292	-3.5e+00	0.004	0.464	1.1e+01	1	13	0.005
1	W1760	W176004	2	sent	0.404	3.4e-01	1.207	0.249	0.953	0.300	-3.5e+00	0.004	0.436	1.0e+01	1	13	0.007
1	W589	W58913	14	sent	0.920	9.6e-01	0.962	0.354	11.965	0.591	-3.4e+00	0.004	0.969	4.1e+02	1	13	0.000
1	W2235	S_105W2235	2	sent	0.035	1.4e-02	2.549	0.024	1.470	0.154	-3.4e+00	0.004	0.875	9.1e+01	1	13	0.000
1	W129	W12903	4	recv	0.370	8.5e-02	4.338	0.001	1.287	0.790	-3.4e+00	0.004	0.169	2.7e+00	1	13	0.127
1	W1001	W10011	2	sent	0.042	1.3e-02	3.234	0.007	1.093	0.267	-3.4e+00	0.005	0.564	1.7e+01	1	13	0.001
1	W95	W952	2	recv	0.001	2.0e-03	0.537	0.600	2.223	0.065	3.4e+00	0.005	0.989	1.2e+03	1	13	0.000
1	W19481W429	W19481W429...	2	recv	0.020	6.0e-03	3.264	0.006	1.221	0.229	-3.4e+00	0.005	0.686	2.8e+01	1	13	0.000
1	W589	W58914	14	sent	0.970	9.1e-01	1.068	0.305	12.099	0.568	-3.3e+00	0.005	0.972	4.5e+02	1	13	0.000
1	W185616W14004W174623	2	sent	0.927	5.4e-01	1.728	0.108	0.890	0.333	-3.3e+00	0.005	0.355	7.2e+00	1	13	0.019
1	W1038	W103801	6	sent	6.180	4.0e+00	1.530	0.150	4.380	0.487	-3.3e+00	0.005	0.862	8.1e+01	1	13	0.000
1	W1640	W16406	10	sent	2.640	1.8e+00	1.492	0.160	6.927	0.929	-3.3e+00	0.006	0.811	5.6e+01	1	13	0.000
1	W834	W8342	2	sent	0.091	2.9e-02	3.183	0.007	1.267	0.222	-3.3e+00	0.006	0.716	3.3e+01	1	13	0.000
1	W2549	W25492	2	recv	1.640	2.3e-01	6.976	0.000	-1.455	1.047	-3.3e+00	0.006	0.129	1.9e+00	1	13	0.188
1	D_AKS_W647	D_AKS_W647...	3	sent	0.008	4.0e-03	1.895	0.095	7.202	1.127	3.7e+00	0.006	0.836	4.1e+01	1	8	0.000
1	W569	S_W1335	2	sent	0.056	1.5e-02	3.828	0.002	1.441	0.171	-3.3e+00	0.006	0.846	7.1e+01	1	13	0.000
1	W1038	W103802	6	sent	3.851	4.3e+00	0.898	0.386	4.397	0.491	-3.3e+00	0.006	0.861	8.0e+01	1	13	0.000
1	W2179_W2190	W21794	2	sent	0.234	9.5e-02	2.464	0.028	1.672	0.100	-3.3e+00	0.006	0.955	2.8e+02	1	13	0.000
1	W589	W5898	14	recv	0.852	4.6e-01	1.860	0.086	12.152	0.569	-3.2e+00	0.006	0.972	4.6e+02	1	13	0.000
1	W185616W14004W174623	2	recv	0.353	1.9e-01	1.895	0.081	0.885	0.350	-3.2e+00	0.007	0.330	6.4e+00	1	13	0.025
1	W1640	W164010	10	sent	3.272	2.2e+00	1.474	0.164	6.335	1.150	-3.2e+00	0.007	0.700	3.0e+01	1	13	0.000
1	W487	W48701	5	recv	4.246	1.1e+00	3.781	0.002	1.760	1.025	-3.2e+00	0.008	0.185	2.9e+00	1	13	0.110
1	W2293_W1519	W22937	4	sent	0.414	1.3e-01	3.256	0.006	1.264	0.868	-3.2e+00	0.008	0.140	2.1e+00	1	13	0.169
1	W1001	W10012	2	sent	0.044	1.3e-02	3.314	0.006	1.099	0.286	-3.2e+00	0.008	0.533	1.5e+01	1	13	0.002
1	W174_W266	W17401	20	recv	116.998	2.3e+01	4.988	0.000	15.466	1.445	-3.1e+00	0.008	0.898	1.1e+02	1	13	0.000
1	W786	W78603	4	sent	-6.257	1.4e+01	-0.435	0.671	3.660	0.108	-3.1e+00	0.008	0.989	1.1e+03	1	13	0.000
1	W2254	W128402	7	recv	1.605	5.3e-01	3.014	0.010	4.129	0.928	-3.1e+00	0.009	0.604	2.0e+01	1	13	0.001
1	W308	W11204	2	sent	0.021	7.0e-03	3.015	0.010	0.941	0.343	-3.1e+00	0.009	0.367	7.5e+00	1	13	0.017
1	W2293_W1519	W22938	4	recv	0.048	1.6e-02	2.929	0.012	3.069	0.302	-3.1e+00	0.009	0.888	1.0e+02	1	13	0.000
1	W1302	W13024	5	sent	-5.140	4.6e+00	-1.129	0.279	7.978	0.969	3.1e+00	0.009	0.839	6.8e+01	1	13	0.000
1	W1640	W16404	10	sent	2.973	2.0e+00	1.520	0.152	6.802	1.042	-3.1e+00	0.009	0.766	4.3e+01	1	13	0.000
1	W1296	W12962	2	sent	0.199	6.9e-02	2.888	0.013	1.040	0.313	-3.1e+00	0.009	0.459	1.1e+01	1	13	0.006
1	W2295	W229501	9	recv	24752.261	1.1e+03	22.873	0.000	4.422	1.637	-2.8e+00	0.009	0.207	7.3e+00	1	28	0.012
1	D_W1265	D_W12651	2	sent	0.007	4.0e-03	1.753	0.105	0.847	0.375	-3.1e+00	0.010	0.298	5.1e+00	1	12	0.043

Test Number	Cluster	Server	Servers	metric	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=k t-value	Slope=k p-value	R2	F-stat	df1	df2	p-value
1	W1640	W16403	10	recv	0.925	3.8e-01	2.461	0.029	6.183	1.279	-3.0e+00	0.011	0.643	2.3e+01	1	13	0.000
1	W2330	W23302	2	recv	2.014	2.0e+00	1.022	0.325	1.360	0.214	-3.0e+00	0.011	0.756	4.0e+01	1	13	0.000
1	W174_W266	W17414	20	sent	19.281	8.0e+00	2.420	0.031	24.859	1.637	3.0e+00	0.011	0.947	2.3e+02	1	13	0.000
1	W969	W9698	10	recv	-0.632	2.7e-01	-2.305	0.038	10.671	0.227	3.0e+00	0.011	0.994	2.2e+03	1	13	0.000
1	W1302	W13024	5	recv	-16.499	1.3e+01	-1.228	0.241	8.284	1.128	2.9e+00	0.012	0.806	5.4e+01	1	13	0.000
1	W174	W17401	15	recv	92.627	2.0e+01	4.741	0.000	11.526	1.203	-2.9e+00	0.013	0.876	9.2e+01	1	13	0.000
1	W2552	S_105W2552	2	recv	0.006	3.0e-03	1.881	0.083	1.938	0.021	-2.9e+00	0.013	0.998	8.2e+03	1	13	0.000
1	W969	W9691	10	recv	0.917	2.2e-01	4.123	0.001	9.475	0.184	-2.9e+00	0.013	0.995	2.7e+03	1	13	0.000
1	W969	W9697	10	recv	0.087	2.5e-01	0.353	0.730	9.462	0.191	-2.8e+00	0.014	0.995	2.5e+03	1	13	0.000
1	W834	W8342	2	recv	-0.009	3.0e-03	-2.894	0.013	2.221	0.079	2.8e+00	0.015	0.984	7.9e+02	1	13	0.000
1	W1640	W16402	10	recv	2.811	6.2e-01	4.538	0.001	-0.687	3.856	-2.8e+00	0.016	0.002	3.2e-02	1	13	0.861
1	W589	W5898	14	sent	1.553	7.7e-01	2.023	0.064	12.590	0.514	-2.7e+00	0.017	0.979	6.0e+02	1	13	0.000
1	W2312	W231201	9	recv	1.481	1.1e+00	1.288	0.220	8.343	0.241	-2.7e+00	0.017	0.989	1.2e+03	1	13	0.000
1	W2295_FED	W229510	2	sent	6881.133	6.3e+02	10.899	0.000	0.388	0.653	-2.5e+00	0.018	0.008	3.5e-01	1	43	0.555
1	W174_W266	W17412	20	recv	34.115	2.7e+01	1.255	0.231	16.266	1.375	-2.7e+00	0.018	0.915	1.4e+02	1	13	0.000
1	W272	W27207	8	sent	-1.509	1.0e+00	-1.448	0.171	23.865	5.847	2.7e+00	0.018	0.562	1.7e+01	1	13	0.001
1	W2362	S_105W2362	2	recv	0.016	8.0e-03	1.980	0.069	1.737	0.097	-2.7e+00	0.018	0.961	3.2e+02	1	13	0.000
1	W996	W99601	2	recv	0.047	2.8e-01	0.165	0.871	0.991	0.372	-2.7e+00	0.018	0.353	7.1e+00	1	13	0.019
1	W589	W5896	14	recv	-3.293	4.5e+00	-0.725	0.481	177.167	60.247	2.7e+00	0.018	0.399	8.6e+00	1	13	0.011
1	W1710	S_W965	2	recv	0.027	1.0e-02	2.802	0.015	0.549	0.540	-2.7e+00	0.019	0.074	1.0e+00	1	13	0.328
1	W1302	W13023	5	sent	1.291	2.2e+00	0.574	0.575	4.211	0.295	-2.7e+00	0.019	0.940	2.0e+02	1	13	0.000
1	W2254	W128405	7	recv	-2.664	5.0e-01	-5.361	0.000	8.767	0.663	2.7e+00	0.019	0.931	1.7e+02	1	13	0.000
1	W174_W266	W13022	20	sent	-1.155	8.2e+00	-0.141	0.890	17.289	1.020	-2.6e+00	0.020	0.957	2.9e+02	1	13	0.000
1	W1640	W16404	10	recv	0.806	3.3e-01	2.481	0.028	6.935	1.162	-2.6e+00	0.020	0.733	3.6e+01	1	13	0.000
1	W174_W266	W17404	20	recv	-24.725	2.0e+01	-1.213	0.247	23.331	1.265	2.6e+00	0.021	0.963	3.4e+02	1	13	0.000
1	W1209_W2181	W12092	4	recv	0.440	1.5e-01	3.014	0.010	1.719	0.869	-2.6e+00	0.021	0.231	3.9e+00	1	13	0.070
1	W589	W5894	14	recv	0.170	7.1e-01	0.239	0.815	11.886	0.813	-2.6e+00	0.022	0.943	2.1e+02	1	13	0.000
1	W2482	W248201	8	sent	1.952	7.8e-01	2.512	0.026	-9.684	6.814	-2.6e+00	0.022	0.134	2.0e+00	1	13	0.179
1	W2098	W20982	3	sent	0.065	2.3e-02	2.806	0.015	0.844	0.833	-2.6e+00	0.022	0.073	1.0e+00	1	13	0.330
1	W1640	W164010	10	recv	0.500	2.1e-01	2.354	0.035	8.038	0.760	-2.6e+00	0.023	0.896	1.1e+02	1	13	0.000
1	W95	W952	2	sent	-0.053	2.6e-02	-2.022	0.064	2.461	0.179	2.6e+00	0.023	0.935	1.9e+02	1	13	0.000
1	W543	S_105W543	2	recv	0.024	2.5e-02	0.983	0.344	1.651	0.137	-2.5e+00	0.024	0.918	1.5e+02	1	13	0.000
1	W1471	W14712	2	recv	17.874	5.5e+00	3.254	0.006	1.170	0.326	-2.5e+00	0.024	0.498	1.3e+01	1	13	0.003
1	W633	S_W9282W19...	3	recv	-0.023	2.6e-02	-0.877	0.397	2.713	0.113	-2.5e+00	0.025	0.978	5.7e+02	1	13	0.000
1	W2254	W128406	7	recv	-2.550	5.0e-01	-5.142	0.000	8.687	0.667	2.5e+00	0.025	0.929	1.7e+02	1	13	0.000
1	W1543	W131401	2	recv	0.026	1.3e-02	1.972	0.070	1.442	0.223	-2.5e+00	0.027	0.762	4.2e+01	1	13	0.000
1	W174	W17415	15	recv	2.614	1.4e+01	0.186	0.855	13.288	0.698	-2.5e+00	0.029	0.965	3.6e+02	1	13	0.000
1	W2312	W231206	9	sent	-0.563	5.6e-01	-1.005	0.333	9.475	0.194	2.4e+00	0.029	0.995	2.4e+03	1	13	0.000
1	W174	W17412	15	recv	31.266	2.3e+01	1.334	0.205	12.098	1.186	-2.4e+00	0.029	0.889	1.0e+02	1	13	0.000
1	W1038	W103804	6	sent	1.312	4.8e+00	0.275	0.788	4.669	0.548	-2.4e+00	0.030	0.848	7.3e+01	1	13	0.000
1	W2552	S_W1439	2	recv	-0.006	4.0e-03	-1.577	0.139	2.058	0.024	2.4e+00	0.031	0.998	7.3e+03	1	13	0.000
1	W2482	W248205	8	sent	1.256	3.3e-01	3.858	0.002	-9.278	7.155	-2.4e+00	0.031	0.115	1.7e+00	1	13	0.217
1	W174_W266	W13024	20	sent	-8.974	2.1e+01	-0.435	0.671	30.565	4.386	2.4e+00	0.032	0.789	4.9e+01	1	13	0.000
1	W1265	W12651	2	recv	6.178	6.8e-01	9.032	0.000	0.836	0.495	-2.4e+00	0.035	0.180	2.9e+00	1	13	0.115
1	W589	W5899	14	sent	-0.278	8.4e-01	-0.332	0.745	12.774	0.521	-2.4e+00	0.035	0.979	6.0e+02	1	13	0.000
1	W174	W17404	15	recv	-14.875	1.7e+01	-0.859	0.406	17.516	1.075	2.3e+00	0.036	0.953	2.7e+02	1	13	0.000
1	W174_W266	W13023	20	sent	16.493	1.3e+01	1.261	0.230	16.011	1.715	-2.3e+00	0.037	0.870	8.7e+01	1	13	0.000
1	W487	W48704	5	sent	9.094	3.5e+00	2.565	0.024	1.181	1.644	-2.3e+00	0.037	0.038	5.2e-01	1	13	0.485

Test Number	Cluster	Server	Servers	metric	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=k t-value	Slope=k p-value	R2	F-stat	df1	df2	p-value
1	W1430	S_W1537	2	sent	0.019	7.0e-03	2.521	0.026	1.774	0.097	-2.3e+00	0.037	0.962	3.3e+02	1	13	0.000
1	W1566_W400	W10991	2	recv	0.039	1.6e-02	2.478	0.028	1.588	0.179	-2.3e+00	0.039	0.858	7.8e+01	1	13	0.000
1	W589	W5896	14	sent	-31.657	2.1e+01	-1.506	0.156	260.221	108.117	2.3e+00	0.040	0.308	5.8e+00	1	13	0.032
1	W2312	W231208	9	sent	0.560	7.0e-01	0.796	0.440	8.484	0.227	-2.3e+00	0.041	0.991	1.4e+03	1	13	0.000
1	W589	W58913	14	sent	0.525	6.5e-01	0.810	0.433	12.218	0.787	-2.3e+00	0.041	0.949	9.4e+00	1	13	0.000
1	W1543	W203901	2	sent	0.493	3.2e-01	1.540	0.148	0.835	0.516	-2.3e+00	0.042	0.168	2.6e+00	1	13	0.129
1	W1302	W13023	5	recv	3.839	6.4e+00	0.600	0.559	4.248	0.334	-2.3e+00	0.042	0.926	1.6e+02	1	13	0.000
1	W174_W266	W17415	20	recv	3.100	2.3e+01	0.136	0.894	17.447	1.137	-2.3e+00	0.043	0.948	2.4e+02	1	13	0.000
1	W1640	W16407	10	recv	0.484	2.8e-01	1.738	0.106	7.837	0.966	-2.2e+00	0.043	0.835	6.6e+01	1	13	0.000
1	W19481W429	W19481W429...	2	recv	0.017	9.0e-03	2.005	0.066	1.302	0.313	-2.2e+00	0.044	0.571	1.7e+01	1	13	0.001
1	W2007_W859...W20072		2	recv	0.136	5.6e-02	2.428	0.030	1.725	0.124	-2.2e+00	0.045	0.937	1.9e+02	1	13	0.000
1	W131	W13101	4	sent	2.604	1.2e+00	2.262	0.041	0.835	1.429	-2.2e+00	0.045	0.026	3.4e-01	1	13	0.569
1	W2312_W266	W20981	12	sent	9.904	6.8e+00	1.448	0.171	396.947	175.629	2.2e+00	0.047	0.282	5.1e+00	1	13	0.042
1	W1039	S_W466	2	sent	0.014	6.0e-03	2.256	0.042	1.172	0.382	-2.1e+00	0.050	0.420	9.4e+00	1	13	0.009
1	W487	W48704	5	recv	5.019	2.0e+00	2.488	0.027	1.025	1.849	-2.1e+00	0.051	0.023	3.1e-01	1	13	0.589
1	D_W764	D_W7642	2	sent	0.000	0.0e+00	-0.377	0.714	1.718	0.127	-2.2e+00	0.051	0.948	1.8e+02	1	10	0.000
1	W174_W266	W13023	20	recv	43.357	3.3e+01	1.297	0.217	16.259	1.744	-2.1e+00	0.051	0.870	8.7e+01	1	13	0.000
1	W2179_W2190	W21794	2	recv	1.759	1.7e+00	1.025	0.324	1.716	0.133	-2.1e+00	0.053	0.927	1.7e+02	1	13	0.000
1	W174_W266	W13022	20	recv	1.085	2.4e+01	0.045	0.965	17.463	1.194	-2.1e+00	0.053	0.943	2.1e+02	1	13	0.000
1	W969	W9696	10	recv	0.175	1.0e-01	1.670	0.119	9.821	0.085	-2.1e+00	0.054	0.999	1.4e+04	1	13	0.000
1	W2038	W20382	2	sent	0.969	2.0e+00	0.477	0.641	12.694	5.063	2.1e+00	0.055	0.326	6.3e+00	1	13	0.026
1	W174	W17414	15	recv	53.948	1.4e+01	3.851	0.002	17.289	1.093	2.1e+00	0.056	0.951	2.5e+02	1	13	0.000
1	W1302	W13022	5	recv	-1.655	2.7e+00	-0.622	0.544	4.311	0.331	-2.1e+00	0.057	0.929	1.7e+02	1	13	0.000
1	W589	W58914	14	recv	0.181	4.8e-01	0.380	0.710	12.790	0.585	-2.1e+00	0.059	0.973	4.8e+02	1	13	0.000
1	W1056	S_W1677	2	recv	0.002	2.0e-03	0.992	0.339	1.973	0.013	-2.1e+00	0.060	0.999	2.2e+04	1	13	0.000
1	W2293_W1519	W22935	4	recv	0.479	2.3e-01	2.116	0.054	0.829	1.557	-2.0e+00	0.063	0.021	2.8e-01	1	13	0.603
1	W633	S_W9281W51...	3	recv	0.123	2.7e-02	4.575	0.001	3.367	0.182	-2.0e+00	0.065	0.963	3.4e+02	1	13	0.000
1	W834	W8341	2	sent	0.082	3.9e-02	2.084	0.057	1.377	0.312	-2.0e+00	0.067	0.599	1.9e+01	1	13	0.001
1	W2007_W859...W20072		2	recv	0.069	2.9e-02	2.403	0.032	1.791	0.105	-2.0e+00	0.069	0.957	2.9e+02	1	13	0.000
1	W19481APP	W19481APP1	2	recv	0.012	8.0e-03	1.408	0.183	1.599	0.208	-1.9e+00	0.076	0.820	5.9e+01	1	13	0.000
1	W2286	W228601	2	sent	0.009	1.4e-02	0.657	0.522	1.782	0.114	-1.9e+00	0.078	0.949	2.4e+02	1	13	0.000
1	W174_W266	W13024	20	recv	-21.573	6.6e+01	-0.328	0.748	30.539	5.513	1.9e+00	0.078	0.702	3.1e+01	1	13	0.000
1	W2293_W164	W22933	2	sent	0.141	7.6e-02	1.846	0.088	1.021	0.522	-1.9e+00	0.083	0.227	3.8e+00	1	13	0.072
1	W2312	W231204	9	sent	-0.293	5.7e-01	-0.512	0.617	9.370	0.198	1.9e+00	0.084	0.994	2.3e+03	1	13	0.000
1	W1083_W418	W108305	5	recv	19427.577	2.7e+03	7.286	0.000	3.438	0.874	0.085	0.356	1.5e+01	1	28	0.001	
1	W1640	W16406	10	recv	0.403	2.2e-01	1.856	0.086	8.532	0.791	-1.9e+00	0.086	0.899	1.2e+02	1	13	0.000
1	W2254	W128407	7	sent	10.357	2.1e+00	5.023	0.000	-56.915	34.782	-1.8e+00	0.089	0.171	2.7e+00	1	13	0.126
1	W1056	S_105W1056	2	recv	-0.002	2.0e-03	-0.838	0.417	2.025	0.014	1.8e+00	0.090	0.999	2.1e+04	1	13	0.000
1	W633	S_W9281W19...	3	recv	-0.017	4.2e-02	-0.402	0.694	2.664	0.184	-1.8e+00	0.091	0.942	2.1e+02	1	13	0.000
1	W633	S_W9281W51...	3	sent	-0.763	6.0e-01	-1.265	0.228	17.097	7.819	1.8e+00	0.095	0.269	4.8e+00	1	13	0.048
1	W1543	W203901	2	recv	0.028	1.5e-02	1.893	0.081	1.524	0.265	-1.8e+00	0.095	0.718	3.3e+01	1	13	0.000
1	D_W2330	D_W23302	2	recv	0.000	0.0e+00	0.196	0.848	1.745	0.142	-1.8e+00	0.101	0.932	1.5e+02	1	11	0.000
1	W1576	W15762	2	recv	0.001	0.0e+00	1.899	0.080	1.795	0.117	-1.8e+00	0.102	0.948	2.4e+02	1	13	0.000
1	W2286	W228602	2	recv	0.282	1.7e-01	1.704	0.112	0.412	0.905	-1.8e+00	0.103	0.016	2.1e-01	1	13	0.657
1	W1428	W24462	6	sent	-141.863	9.4e+01	-1.514	0.154	996.407	567.315	1.7e+00	0.104	0.192	3.1e+00	1	13	0.103
1	W1302	W13022	5	recv	-3.490	7.4e+00	-0.470	0.646	4.357	0.369	-1.7e+00	0.105	0.915	1.4e+02	1	13	0.000
1	W589	W5895	14	sent	-5.032	1.2e+01	-0.411	0.687	119.122	60.539	1.7e+00	0.106	0.229	3.9e+00	1	13	0.071
1	W174_W266	W17414	20	recv	69.655	2.1e+01	3.395	0.005	22.779	1.601	1.7e+00	0.106	0.940	2.0e+02	1	13	0.000

Test Number	Cluster	Server	Servers	metric	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=k t-value	Slope=k p-value	R2	F-stat	df1	df2	p-value
1	W2330	W23301	2	recv	6.549	1.6e+00	4.166	0.001	1.496	0.295	-1.7e+00	0.111	0.664	2.6e+01	1	13	0.000
1	W2098	W20982	3	recv	0.025	1.2e-02	2.073	0.059	1.243	1.028	-1.7e+00	0.111	0.101	1.5e+00	1	13	0.248
1	W969	W96910	10	recv	0.211	1.5e-01	1.361	0.197	9.788	0.125	-1.7e+00	0.114	0.998	6.1e+03	1	13	0.000
1	W1083_W418	W108301	5	recv	18997.432	2.7e+03	6.966	0.000	3.582	0.895	-1.6e+00	0.124	0.364	1.6e+01	1	28	0.000
1	W1640	W16401	10	sent	10.645	4.9e+00	2.191	0.047	0.275	5.994	-1.6e+00	0.129	0.000	2.0e-03	1	13	0.964
1	W272	W27208	8	sent	2.154	1.1e+00	1.933	0.075	0.783	4.477	-1.6e+00	0.131	0.002	3.1e-02	1	13	0.864
1	W1209_W2181	W12092	4	recv	-0.084	8.5e-02	-0.984	0.343	6.973	1.856	1.6e+00	0.133	0.521	1.4e+01	1	13	0.002
1	W2007_W400...W256513		5	sent	8.134	1.9e+00	4.339	0.001	-117.004	76.352	-1.6e+00	0.134	0.153	2.3e+00	1	13	0.149
1	W1428	W24462	6	recv	-33.124	3.4e+01	-0.969	0.350	1159.328	730.660	1.6e+00	0.138	0.162	2.5e+00	1	13	0.137
1	W174_W266	W17406	20	recv	-4.067	4.3e+01	-0.095	0.926	16.777	2.042	-1.6e+00	0.139	0.838	6.7e+01	1	13	0.000
1	W19481APP	W19481APP2	2	recv	0.016	8.0e-03	1.932	0.075	1.650	0.226	-1.5e+00	0.146	0.804	5.3e+01	1	13	0.000
1	W308	W11204	2	recv	0.004	3.0e-03	1.290	0.220	1.851	0.096	-1.5e+00	0.147	0.966	3.7e+02	1	13	0.000
1	D_W2330	D_W23301	2	sent	0.000	0.0e+00	1.292	0.223	1.715	0.183	-1.6e+00	0.147	0.889	8.8e+01	1	11	0.000
1	W272	W27204	8	recv	0.118	7.0e-02	1.688	0.115	5.619	1.555	-1.5e+00	0.150	0.501	1.3e+01	1	13	0.003
1	W174	W17406	15	recv	-5.261	2.9e+01	-0.182	0.859	12.905	1.377	-1.5e+00	0.152	0.871	8.8e+01	1	13	0.000
1	W2482	W248204	8	sent	1.377	9.2e-01	1.504	0.157	-4.839	8.485	-1.5e+00	0.154	0.024	3.3e-01	1	13	0.578
1	W1428	W21272	6	sent	256.041	1.6e+02	1.649	0.123	-1510.770	1005.003	-1.5e+00	0.155	0.148	2.3e+00	1	13	0.157
1	W331	S_W246	2	recv	0.004	3.0e-03	1.406	0.183	1.261	0.498	-1.5e+00	0.161	0.331	6.4e+00	1	13	0.025
1	W1265	W12651	2	recv	6.911	2.1e+00	3.290	0.006	-1.138	2.136	-1.5e+00	0.166	0.021	2.8e-01	1	13	0.603
1	W2179_W2415	W21792	2	recv	-0.069	6.3e-02	-1.083	0.298	4.119	1.458	1.5e+00	0.170	0.381	8.0e+00	1	13	0.014
1	W174	W17403	15	sent	-1.094	7.9e+00	-0.139	0.891	16.776	1.248	1.4e+00	0.178	0.933	1.8e+02	1	13	0.000
1	W786	W78602	4	recv	-2.286	3.3e+00	-0.702	0.495	4.039	0.028	1.4e+00	0.184	0.999	2.1e+04	1	13	0.000
1	W174_W266	W17407	20	recv	26.516	3.1e+01	0.866	0.402	17.692	1.654	-1.4e+00	0.186	0.898	1.1e+02	1	13	0.000
1	W969	W9694	10	sent	-1.055	9.9e-01	-1.070	0.304	10.139	0.100	1.4e+00	0.189	0.999	1.0e+04	1	13	0.000
1	W1430	S_W1537	2	recv	0.006	5.0e-03	1.389	0.188	1.957	0.031	-1.4e+00	0.189	0.997	4.0e+03	1	13	0.000
1	W1225	W122501	2	sent	-0.005	1.1e-01	-0.048	0.962	3.935	1.417	1.4e+00	0.195	0.372	7.7e+00	1	13	0.016
1	W129	W12904	4	recv	0.287	1.5e-01	1.939	0.075	2.096	1.399	-1.4e+00	0.197	0.147	2.2e+00	1	13	0.158
1	W174	W17403	15	recv	9.894	2.1e+01	0.475	0.642	16.829	1.352	1.4e+00	0.199	0.923	1.5e+02	1	13	0.000
1	W969	W9691	10	sent	2.160	7.5e-01	2.877	0.013	9.897	0.076	1.4e+00	0.200	0.999	1.7e+04	1	13	0.000
1	W19481W429	W19481W429...	2	sent	0.054	4.4e-02	1.214	0.246	1.541	0.342	-1.3e+00	0.202	0.610	2.0e+01	1	13	0.001
1	W174_W266	W17403	20	sent	-2.620	1.1e+01	-0.249	0.807	22.233	1.669	1.3e+00	0.204	0.932	1.8e+02	1	13	0.000
1	W1428	W16252	6	recv	80.657	4.5e+01	1.794	0.096	-1260.833	947.975	-1.3e+00	0.204	0.120	1.8e+00	1	13	0.206
1	W174_W266	W17403	20	recv	9.311	2.7e+01	0.345	0.736	22.340	1.754	1.3e+00	0.205	0.926	1.6e+02	1	13	0.000
1	W1428	W16252	6	sent	190.773	1.3e+02	1.503	0.157	-1063.082	802.626	-1.3e+00	0.206	0.119	1.8e+00	1	13	0.208
1	W487	W48702	5	sent	3.371	2.4e+00	1.404	0.184	3.614	1.047	-1.3e+00	0.209	0.478	1.2e+01	1	13	0.004
1	W272	W27201	8	sent	1.772	1.0e+00	1.714	0.110	2.736	3.979	-1.3e+00	0.209	0.035	4.7e-01	1	13	0.504
1	W174	W17407	15	recv	24.232	2.5e+01	0.982	0.344	13.244	1.333	-1.3e+00	0.210	0.884	9.9e+01	1	13	0.000
1	W131	W13104	4	recv	4.365	1.8e+00	2.446	0.029	-68.913	56.450	-1.3e+00	0.219	0.103	1.5e+00	1	13	0.244
1	W2312_W266	W20981	12	recv	26.329	9.1e+00	2.880	0.013	629.663	479.469	1.3e+00	0.220	0.117	1.7e+00	1	13	0.212
1	W301	W25702	8	recv	-15.172	1.9e+01	-0.805	0.435	90.631	64.162	1.3e+00	0.220	0.133	2.0e+00	1	13	0.181
1	W2362	S_W249	2	recv	0.028	1.2e-01	0.247	0.809	2.976	0.762	1.3e+00	0.223	0.540	1.5e+01	1	13	0.002
1	W174_W266	W13025	20	recv	52.748	2.2e+01	2.393	0.032	18.332	1.319	-1.3e+00	0.228	0.937	1.9e+02	1	13	0.000
1	W2098	W20983	3	sent	0.068	4.5e-02	1.504	0.156	0.770	1.764	-1.3e+00	0.228	0.014	1.9e-01	1	13	0.670
1	W129	W12901	4	sent	2.326	1.4e+00	1.723	0.109	-9.633	10.834	-1.3e+00	0.230	0.057	7.9e-01	1	13	0.390
1	W1209_W2181	W12094	4	recv	-0.010	5.7e-02	-0.176	0.863	5.606	1.283	1.3e+00	0.233	0.595	1.9e+01	1	13	0.001
1	W1428	W21272	6	recv	84.449	5.2e+01	1.624	0.128	-1382.944	1130.749	-1.2e+00	0.241	0.103	1.5e+00	1	13	0.243
1	W2179_W2415	W21792	2	sent	-0.276	2.6e-01	-1.056	0.310	3.944	1.583	1.2e+00	0.241	0.323	6.2e+00	1	13	0.027
1	W1302	W13025	5	recv	7.193	3.8e+00	1.907	0.079	4.727	0.226	-1.2e+00	0.248	0.971	4.4e+02	1	13	0.000

Test Number	Cluster	Server	Servers	metric	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=k t-value	Slope=k p-value	R2	F-stat	df1	df2	p-value
1	W1640	W16407	10	sent	3.512	1.0e+00	3.352	0.005	9.147	0.723	-1.2e+00	0.259	0.925	1.6e+02	1	13	0.000
1	W1001	W10012	2	recv	0.002	0.0e+00	3.943	0.002	1.866	0.114	-1.2e+00	0.260	0.954	2.7e+02	1	13	0.000
1	W272	W27205	8	recv	0.013	3.1e-02	0.415	0.685	8.900	0.776	1.2e+00	0.267	0.910	1.3e+02	1	13	0.000
1	W2235	S_W1673	2	recv	0.004	2.0e-03	2.403	0.032	1.988	0.010	-1.2e+00	0.271	1.000	3.8e+04	1	13	0.000
1	W2312	W231208	9	recv	0.720	1.2e+00	0.591	0.565	8.700	0.262	-1.1e+00	0.273	0.988	1.1e+03	1	13	0.000
1	W1209_W2181	W12091	4	recv	0.015	1.2e-01	0.128	0.900	2.469	1.342	-1.1e+00	0.274	0.207	3.4e+00	1	13	0.089
1	W1640	W16405	10	recv	0.257	4.3e-01	0.604	0.556	8.370	1.437	-1.1e+00	0.277	0.723	3.4e+01	1	13	0.000
1	W1996	W19962	2	recv	37.573	3.2e+01	1.185	0.257	-1061.080	941.929	-1.1e+00	0.279	0.089	1.3e+00	1	13	0.280
1	W174_W266	W17415	20	sent	-0.581	7.9e+00	-0.074	0.942	18.811	1.070	-1.1e+00	0.287	0.960	3.1e+02	1	13	0.000
1	W1225	W122502	2	recv	0.014	1.9e-02	0.769	0.455	1.386	0.561	-1.1e+00	0.294	0.320	6.1e+00	1	13	0.028
1	W2312	W231209	9	recv	-0.537	9.3e-01	-0.581	0.571	8.787	0.196	-1.1e+00	0.295	0.994	2.0e+03	1	13	0.000
1	W909	W90902	4	recv	0.005	4.0e-03	1.270	0.226	4.443	0.410	1.1e+00	0.300	0.900	1.2e+02	1	13	0.000
1	W174	W17415	15	sent	-0.118	4.9e+00	-0.024	0.981	14.280	0.667	-1.1e+00	0.300	0.972	4.6e+02	1	13	0.000
1	W2098	W20983	3	recv	0.023	1.8e-02	1.287	0.221	1.362	1.520	-1.1e+00	0.301	0.058	8.0e-01	1	13	0.387
1	W2312	W231204	9	recv	-0.408	1.1e+00	-0.373	0.715	9.263	0.245	1.1e+00	0.302	0.991	1.4e+03	1	13	0.000
1	W2552	S_105W2552	2	sent	0.004	1.6e-02	0.240	0.814	1.872	0.120	-1.1e+00	0.308	0.949	2.4e+02	1	13	0.000
1	W2007_W859...W20077	2	recv	0.972	2.4e-01	4.018	0.001	-10.990	12.343	-1.1e+00	0.312	0.057	7.9e-01	1	13	0.389
1	W1083_W418	W108304	5	recv	17654.056	2.8e+03	6.346	0.000	4.058	0.921	-1.0e+00	0.315	0.410	1.9e+01	1	28	0.000
1	W1083_W418	W108303	5	recv	17581.651	2.8e+03	6.325	0.000	4.072	0.917	-1.0e+00	0.320	0.413	2.0e+01	1	28	0.000
1	W969	W9698	10	sent	-0.921	1.5e+00	-0.612	0.551	10.157	0.153	1.0e+00	0.322	0.997	4.4e+03	1	13	0.000
1	W786	W78603	4	recv	-0.039	4.8e+00	-0.008	0.994	3.958	0.041	-1.0e+00	0.330	0.999	9.3e+03	1	13	0.000
1	W2199	W21991	2	recv	-0.047	6.0e-03	-7.520	0.000	1.913	0.086	-1.0e+00	0.333	0.974	4.9e+02	1	13	0.000
1	W2312	W231202	9	recv	-0.068	4.9e-01	-0.141	0.890	9.167	0.166	1.0e+00	0.333	0.996	3.1e+03	1	13	0.000
1	W2235	S_105W2235	2	recv	-0.004	2.0e-03	-2.247	0.043	2.010	0.010	1.0e+00	0.333	1.000	3.7e+04	1	13	0.000
1	W2295	W229505	9	sent	19080.930	8.4e+03	2.281	0.030	4.736	4.343	-9.8e-01	0.335	0.041	1.2e+00	1	28	0.285
1	W969	W9697	10	sent	-0.144	1.2e+00	-0.121	0.905	9.883	0.119	-9.9e-01	0.341	0.998	7.0e+03	1	13	0.000
1	W1566_W400	W10992	2	recv	0.017	2.1e-02	0.819	0.428	1.770	0.235	-9.8e-01	0.344	0.814	5.7e+01	1	13	0.000
1	D_W2173	D_W21732	2	recv	0.000	0.0e+00	1.226	0.251	1.286	0.717	-1.0e+00	0.345	0.263	3.2e+00	1	9	0.107
1	W2312	W231209	9	sent	-0.360	5.3e-01	-0.675	0.512	8.834	0.173	-9.5e-01	0.357	0.995	2.6e+03	1	13	0.000
1	W18642W2324	S_105W1864...	2	sent	0.039	2.6e-02	1.501	0.157	1.685	0.332	-9.5e-01	0.360	0.664	2.6e+01	1	13	0.000
1	W129	W12903	4	sent	2.252	1.7e+00	1.300	0.216	-8.076	12.840	-9.4e-01	0.364	0.030	4.0e-01	1	13	0.540
1	W969	W96910	10	recv	0.779	1.1e+00	0.737	0.474	9.900	0.106	-8.9e-01	0.365	0.999	8.7e+03	1	13	0.000
1	W589	W5895	14	recv	6.942	2.0e+00	3.495	0.004	31.677	18.891	9.4e-01	0.366	0.178	2.8e+00	1	13	0.117
1	W569	S_W1335	2	recv	0.004	3.0e-03	1.632	0.127	1.984	0.017	-9.4e-01	0.367	0.999	1.3e+04	1	13	0.000
1	D_AKS_W647	D_AKS_W647...	3	recv	-0.002	7.0e-03	-0.345	0.737	2.458	0.576	-9.4e-01	0.369	0.646	1.8e+01	1	10	0.002
1	W1430	S_105W1430	2	recv	-0.005	5.0e-03	-1.004	0.334	2.031	0.033	9.2e-01	0.373	0.996	3.7e+03	1	13	0.000
1	W2007_W400	W20074	2	sent	-0.112	2.8e-01	-0.405	0.692	3.428	1.556	9.2e-01	0.375	0.272	4.9e+00	1	13	0.046
1	W487	W48707	5	recv	4.178	1.3e+00	3.284	0.006	3.183	2.037	9.2e-01	0.389	0.158	2.4e+00	1	13	0.142
1	W2007_W400...W256512	5	recv	6.949	1.9e+00	3.605	0.003	-74.296	89.180	-8.9e-01	0.390	0.051	6.9e-01	1	13	0.420
1	W2179_W2190	W21793	2	sent	-0.087	1.5e-01	-0.585	0.569	2.153	0.172	8.9e-01	0.391	0.923	1.6e+02	1	13	0.000
1	W2038	W20382	2	recv	1.498	2.6e-01	5.804	0.000	0.990	1.139	-8.9e-01	0.392	0.055	7.6e-01	1	13	0.400
1	W969	W9693	10	recv	0.047	2.5e-01	0.187	0.855	9.824	0.202	-8.7e-01	0.398	0.995	2.4e+03	1	13	0.000
1	W2007_W400...W256511	5	recv	6.712	1.7e+00	3.846	0.002	-56.648	71.845	-8.6e-01	0.406	0.046	6.2e-01	1	13	0.445
1	W108	W11872	2	recv	-36.753	5.4e+01	-0.684	0.506	1305.177	1530.235	8.5e-01	0.410	0.053	7.3e-01	1	13	0.409
1	W2293_W1519	W22939	4	recv	-0.020	1.7e-02	-1.171	0.263	4.258	0.306	8.5e-01	0.413	0.937	1.9e+02	1	13	0.000
1	W2330	W23301	2	sent	4.792	2.3e+00	2.055	0.061	1.686	0.375	-8.4e-01	0.417	0.609	2.0e+01	1	13	0.001
1	W174_W266	W17407	20	sent	7.423	1.1e+01	0.696	0.499	18.728	1.526	-8.3e-01	0.420	0.921	1.5e+02	1	13	0.000
1	W2482	W248207	8	sent	0.265	2.8e-01	0.938	0.365	12.708	5.661	8.3e-01	0.421	0.279	5.0e+00	1	13	0.043

Test Number	Cluster	Server	Servers	metric	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=k t-value	Slope=k p-value	R2	F-stat	df1	df2	p-value
1	D_W1265	D_W12651	2	recv	0.001	0.0e+00	2.171	0.051	-3.544	6.777	-8.2e-01	0.429	0.022	2.7e-01	1	12	0.611
1	W2312_W266	W20982	12	recv	52.781	2.1e+01	2.507	0.026	-1458.960	1812.135	-8.1e-01	0.432	0.047	6.5e-01	1	13	0.435
1	W969	W9693	10	sent	-0.090	1.0e+00	-0.090	0.929	9.919	0.100	-8.1e-01	0.433	0.999	9.8e+03	1	13	0.000
1	W174_W266	W17406	20	sent	-7.501	1.6e+01	-0.468	0.648	18.344	2.051	-8.1e-01	0.434	0.860	8.0e+01	1	13	0.000
1	W174	W17407	15		7.516	9.0e+00	0.833	0.420	13.964	1.291	-8.0e-01	0.437	0.900	1.2e+02	1	13	0.000
1	W1056	S_W1677	2	sent	-0.011	1.8e-02	-0.605	0.556	2.181	0.230	7.9e-01	0.445	0.874	9.0e+01	1	13	0.000
1	D_W2330	D_W23302	2	sent	0.000	0.0e+00	0.155	0.880	1.814	0.235	-7.9e-01	0.445	0.844	5.9e+01	1	11	0.000
1	W174_W266	W17413	20	sent	14.489	2.7e+01	0.529	0.606	16.935	3.893	-7.9e-01	0.445	0.593	1.9e+01	1	13	0.001
1	W2482	W248208	8	sent	0.749	3.4e-01	2.205	0.046	2.445	7.056	-7.9e-01	0.445	0.009	1.2e-01	1	13	0.735
1	W569	S_105W569	2	sent	0.013	2.8e-02	0.464	0.651	1.769	0.298	-7.8e-01	0.452	0.731	3.5e+01	1	13	0.000
1	W2254	W128406	7	sent	0.936	2.1e+00	0.440	0.667	5.631	1.817	-7.5e-01	0.465	0.425	9.6e+00	1	13	0.008
1	W2254	W128408	7	sent	2.865	4.6e+00	0.619	0.547	32.566	33.991	7.5e-01	0.465	0.066	9.2e-01	1	13	0.356
1	W1039	S_105W1039	2	recv	0.003	3.0e-03	1.095	0.293	1.548	0.609	-7.4e-01	0.471	0.332	6.5e+00	1	13	0.024
1	W2362	S_W249	2	recv	-0.003	1.2e-02	-0.222	0.828	2.108	0.146	7.4e-01	0.474	0.941	2.1e+02	1	13	0.000
1	W174	W17402	15	recv	1.242	4.2e+01	0.030	0.977	13.421	2.156	-7.3e-01	0.477	0.749	3.9e+01	1	13	0.000
1	W1886	W18862	2	recv	0.002	3.0e-03	0.742	0.471	1.933	0.092	-7.3e-01	0.478	0.971	4.4e+02	1	13	0.000
1	W1886	W18861	2	recv	-0.121	1.8e-02	-0.682	0.507	2.729	1.002	7.3e-01	0.480	0.363	7.4e+00	1	13	0.017
1	W174_W266	W17402	20	recv	-5.838	5.4e+01	-0.109	0.915	18.022	2.741	-7.2e-01	0.483	0.769	4.3e+01	1	13	0.000
1	W620	W6201	2	sent	-51.762	9.1e+01	-0.569	0.579	696.128	964.484	7.2e-01	0.484	0.039	5.2e-01	1	13	0.483
1	W2312_W266	W20983	12	sent	57.625	3.1e+01	1.863	0.085	-1836.768	2633.405	-7.0e-01	0.495	0.036	4.9e-01	1	13	0.498
1	W569	S_105W569	2	recv	-0.004	3.0e-03	-1.411	0.182	2.012	0.018	7.0e-01	0.498	0.999	1.3e+04	1	13	0.000
1	W2312	W231202	9	recv	0.430	6.8e-01	0.636	0.536	9.105	0.151	6.9e-01	0.501	0.996	3.6e+03	1	13	0.000
1	W174	W17402	15	sent	-4.636	1.5e+01	-0.302	0.767	13.653	1.951	-6.9e-01	0.502	0.790	4.9e+01	1	13	0.000
1	W174	W17406	15	sent	-6.155	1.1e+01	-0.563	0.583	14.036	1.399	-6.9e-01	0.503	0.886	1.0e+02	1	13	0.000
1	W331	S_W246	2	sent	-0.009	1.5e-02	-0.646	0.529	2.595	0.884	6.7e-01	0.512	0.399	8.6e+00	1	13	0.012
1	W2327	S_W9282W10...	2	recv	0.003	7.0e-03	0.427	0.676	1.975	0.037	-6.7e-01	0.513	0.996	2.9e+03	1	13	0.000
1	W19481ADB	W19481ADB2	2	sent	-1.091	1.7e+00	-0.625	0.543	10.841	13.255	6.7e-01	0.516	0.049	6.7e-01	1	13	0.428
1	W174_W266	W17402	20	sent	-9.469	1.9e+01	-0.497	0.628	18.393	2.426	-6.6e-01	0.519	0.816	5.7e+01	1	13	0.000
1	W2312	W231203	9	recv	-0.501	1.4e+00	-0.363	0.722	9.202	0.306	6.6e-01	0.521	0.986	9.1e+02	1	13	0.000
1	W996	W99602	2	sent	0.622	2.7e-01	2.275	0.041	-2.461	6.831	-6.5e-01	0.525	0.010	1.3e-01	1	13	0.724
1	W2312	W231205	9	sent	0.503	6.7e-01	0.747	0.468	9.151	0.234	6.5e-01	0.529	0.992	1.5e+03	1	13	0.000
1	D_AKS_W415	D_AKS_W415...	3	sent	-0.003	3.0e-03	-0.827	0.428	3.247	0.381	6.5e-01	0.531	0.879	7.3e+01	1	10	0.000
1	W2552	S_W1439	2	sent	0.023	1.5e-02	1.498	0.158	1.919	0.127	-6.4e-01	0.534	0.946	2.3e+02	1	13	0.000
1	D_AKS_W415	D_AKS_W415...	3	recv	0.012	1.0e-02	1.235	0.243	-1.373	6.827	-6.4e-01	0.535	0.004	4.0e-02	1	11	0.844
1	W969	W9695	10	recv	-0.337	2.2e-01	-1.505	0.156	10.180	0.180	-6.4e-01	0.536	0.996	3.2e+03	1	13	0.000
1	W2295	W229502	9	sent	16932.945	1.1e+04	1.610	0.119	21.643	20.205	6.3e-01	0.537	0.039	1.1e+00	1	28	0.293
1	W2173	W21732	2	recv	0.645	2.5e-01	2.596	0.022	4.658	4.213	6.3e-01	0.539	0.086	1.2e+00	1	13	0.289
1	W174	W17413	15	sent	8.725	1.9e+01	0.449	0.661	13.261	2.763	-6.3e-01	0.540	0.639	2.3e+01	1	13	0.000
1	W129	W12904	4	sent	2.070	2.4e+00	0.874	0.398	-5.827	15.643	-6.3e-01	0.541	0.011	1.4e-01	1	13	0.716
1	W2007_W400...	W256513	5	sent	10.900	9.4e+00	1.162	0.266	-28.795	53.807	-6.3e-01	0.541	0.022	2.9e-01	1	13	0.602
1	W18642W2324	S_W9282W18...	2	recv	-0.005	4.0e-03	-1.253	0.232	1.985	0.025	-6.2e-01	0.545	0.998	6.5e+03	1	13	0.000
1	W1566_W400	W10992	2	sent	-0.178	3.6e-01	-0.499	0.626	2.837	1.417	5.9e-01	0.565	0.236	4.0e+00	1	13	0.067
1	W174_W266	W17410	20	sent	-2.150	1.2e+01	-0.180	0.860	21.059	1.806	5.9e-01	0.568	0.913	1.4e+02	1	13	0.000
1	W130	W1301	2	recv	0.011	1.6e-02	0.686	0.505	1.422	0.991	5.7e-01	0.570	0.137	2.1e+00	1	13	0.175
1	W969	W9692	10	sent	0.485	1.0e+00	0.470	0.646	9.940	0.104	-5.7e-01	0.575	0.999	9.1e+03	1	13	0.000
1	W2293_W1519	W22935	4	recv	0.011	1.0e-02	1.109	0.287	3.891	0.196	-5.6e-01	0.587	0.968	4.0e+02	1	13	0.000
1	W174_W266	W13025	20	sent	16.544	9.1e+00	1.817	0.092	19.213	1.420	-5.5e-01	0.589	0.934	1.8e+02	1	13	0.000
1	W174	W17410	15	sent	-0.076	9.6e+00	-0.008	0.994	15.779	1.450	5.4e-01	0.600	0.901	1.2e+02	1	13	0.000

Test Number	Cluster	Server	Servers	metric	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=k t-value	Slope=k p-value	R2	F-stat	df1	df2	p-value
1	W272	W27205	8	sent	0.148	1.6e+00	0.091	0.929	12.682	8.737	5.4e-01	0.601	0.139	2.1e+00	1	13	0.170
1	W1430	S_105W1430	2	sent	-0.007	1.0e-02	-0.684	0.506	2.071	0.135	5.3e-01	0.606	0.948	2.4e+02	1	13	0.000
1	W1886	W18861	2	recv	0.002	3.0e-03	0.506	0.621	1.951	0.094	-5.2e-01	0.613	0.971	4.3e+02	1	13	0.000
1	W969	W9692	10	recv	-0.150	2.3e-01	-0.643	0.531	10.093	0.189	4.9e-01	0.631	0.995	2.9e+03	1	13	0.000
1	W786	W78605	4	recv	-0.276	5.4e+00	-0.052	0.960	3.978	0.046	-4.9e-01	0.634	0.998	7.6e+03	1	13	0.000
1	W174_W266	W17413	20	recv	33.428	7.9e+01	0.422	0.680	17.773	4.600	-4.8e-01	0.636	0.534	1.5e+01	1	13	0.002
1	W2293_W164	W22934	2	recv	0.032	4.2e-02	0.759	0.462	1.504	1.048	-4.7e-01	0.644	0.137	2.1e+00	1	13	0.175
1	W1001	W10011	2	recv	-0.001	1.0e-03	-1.486	0.161	1.943	0.124	-4.6e-01	0.652	0.950	2.4e+02	1	13	0.000
1	W301	W25702	8	sent	-13.149	3.3e+01	-0.395	0.699	22.464	31.479	4.6e-01	0.653	0.038	5.1e-01	1	13	0.488
1	W2007_DB2	W20075	2	recv	0.035	1.8e-02	1.978	0.070	1.611	0.887	-4.4e-01	0.668	0.203	3.3e+00	1	13	0.092
1	W2007_DB2	W20075	2	sent	0.441	8.8e-01	0.501	0.625	-0.483	5.699	-4.4e-01	0.670	0.001	7.0e-03	1	13	0.934
1	W174_W266	W17404	20	sent	-7.100	9.3e+00	-0.765	0.458	20.559	1.323	4.2e-01	0.679	0.949	2.4e+02	1	13	0.000
1	W174	W17404	15	sent	-3.936	7.6e+00	-0.517	0.614	15.428	1.084	4.0e-01	0.699	0.940	2.0e+02	1	13	0.000
1	W2235	S_W1673	2	sent	0.020	2.2e-02	0.906	0.381	1.889	0.291	-3.8e-01	0.708	0.764	4.2e+01	1	13	0.000
1	W2254	W128405	7	sent	0.778	2.8e+00	0.279	0.784	6.046	2.523	-3.8e-01	0.712	0.306	5.7e+00	1	13	0.032
1	W130	W1301	2	sent	-0.053	1.5e-01	-0.366	0.720	2.759	2.052	3.7e-01	0.717	0.122	1.8e+00	1	13	0.202
1	W786	W78601	4	sent	4.343	2.8e+00	1.576	0.139	4.009	0.024	3.6e-01	0.728	1.000	2.8e+04	1	13	0.000
1	W2312	W231207	9	recv	0.175	8.7e-01	0.202	0.843	9.064	0.192	3.3e-01	0.746	0.994	2.2e+03	1	13	0.000
1	W969	W9696	10	sent	-0.391	8.3e-01	-0.473	0.644	9.974	0.083	-3.2e-01	0.755	0.999	1.4e+04	1	13	0.000
1	W2293_W1519	W22937	4	recv	0.006	1.4e-02	0.408	0.690	3.920	0.256	-3.1e-01	0.759	0.948	2.3e+02	1	13	0.000
1	W543	S_W2498	2	sent	0.024	2.9e-02	0.826	0.424	1.881	0.386	-3.1e-01	0.762	0.646	2.4e+01	1	13	0.000
1	W18642W2324	S_105W1864...	2	recv	0.006	4.0e-03	1.569	0.141	2.007	0.025	2.9e-01	0.775	0.998	6.4e+03	1	13	0.000
1	W174	W17405	15	recv	60.339	2.4e+01	2.470	0.028	15.158	1.781	2.9e-01	0.776	0.854	7.6e+01	1	13	0.000
1	D_W764	D_W7641	2	sent	0.000	0.0e+00	0.936	0.374	2.057	0.199	2.9e-01	0.781	0.922	1.1e+02	1	9	0.000
1	W174	W17413	15	recv	16.875	5.6e+01	0.301	0.769	14.092	3.258	-2.8e-01	0.785	0.590	1.9e+01	1	13	0.001
1	W2482	W248202	8	recv	-0.286	7.8e-01	-0.364	0.721	6.741	4.572	-2.7e-01	0.787	0.143	2.3e+00	1	13	0.164
1	W131	W13104	4	sent	5.185	8.2e+00	0.632	0.538	-36.892	150.614	-2.7e-01	0.790	0.005	6.0e-02	1	13	0.810
1	SQL14W1719	W125914W17...	2	sent	0.024	2.0e-02	1.175	0.261	1.848	0.563	-2.7e-01	0.792	0.453	1.1e+01	1	13	0.006
1	W2312	W231207	9	sent	0.372	5.5e-01	0.676	0.511	8.952	0.186	-2.6e-01	0.798	0.994	2.3e+03	1	13	0.000
1	W19481APP	W19481APP2	2	sent	-0.002	4.0e-02	-0.057	0.955	2.066	0.255	2.6e-01	0.800	0.835	6.6e+01	1	13	0.000
1	W2007_W400	W20074	2	recv	0.028	8.0e-03	3.501	0.004	2.084	0.337	2.5e-01	0.806	0.747	3.8e+01	1	13	0.000
1	W2312	W231205	9	recv	0.870	9.7e-01	0.895	0.387	8.948	0.216	-2.4e-01	0.815	0.992	1.7e+03	1	13	0.000
1	W174	W17405	15	sent	19.077	1.0e+01	1.877	0.083	15.429	1.804	2.4e-01	0.816	0.849	7.3e+01	1	13	0.000
1	W272	W27207	8	recv	0.019	5.1e-02	0.367	0.720	8.280	1.208	2.3e-01	0.821	0.783	4.7e+01	1	13	0.000
1	W2179_W2190	W21793	2	recv	1.238	2.0e+00	0.607	0.554	1.962	0.179	-2.1e-01	0.836	0.902	1.2e+02	1	13	0.000
1	W748	W74803	3	sent	4.995	4.4e+01	0.114	0.911	103.832	481.810	2.1e-01	0.837	0.004	4.6e-02	1	13	0.833
1	W2199	W21992	2	recv	0.054	2.0e-03	28.411	0.000	1.981	0.093	-2.0e-01	0.841	0.972	4.6e+02	1	13	0.000
1	W2007_W859...	W20071	2	recv	-0.025	3.9e-02	-0.634	0.537	2.027	0.137	2.0e-01	0.849	0.944	2.2e+02	1	13	0.000
1	W1038	W103806	6	recv	5.497	8.7e+00	0.631	0.539	13.259	37.877	1.9e-01	0.851	0.009	1.2e-01	1	13	0.732
1	W2007_W400...	W256511	5	sent	6.576	8.3e+00	0.790	0.444	-3.908	47.633	-1.9e-01	0.855	0.001	7.0e-03	1	13	0.936
1	W1038	W103806	6	sent	41.218	2.3e+01	1.784	0.098	-11.501	94.100	-1.9e-01	0.855	0.001	1.5e-02	1	13	0.905
1	W2327	S_W9281W10...	2	recv	0.000	7.0e-03	-0.014	0.989	2.007	0.038	1.8e-01	0.861	0.995	2.8e+03	1	13	0.000
1	W909	W90903	4	sent	0.003	1.7e-01	0.020	0.985	4.564	3.205	1.8e-01	0.863	0.135	2.0e+00	1	13	0.178
1	W2312_W266	W20982	12	sent	26.494	1.7e+01	1.515	0.154	-96.194	628.366	-1.7e-01	0.866	0.002	2.3e-02	1	13	0.881
1	D_W2330	D_W23301	2	recv	0.000	0.0e+00	1.061	0.312	1.969	0.185	-1.7e-01	0.870	0.912	1.1e+02	1	11	0.000
1	W19481ADB	W19481ADB2	2	recv	0.009	6.0e-03	1.493	0.159	1.949	0.316	-1.6e-01	0.873	0.745	3.8e+01	1	13	0.000
1	W620	W6201	2	recv	18.154	3.5e+01	0.519	0.613	-166.355	1060.247	-1.6e-01	0.876	0.002	2.5e-02	1	13	0.878
1	W1302	W13025	5	sent	1.786	1.4e+00	1.247	0.234	4.967	0.223	-1.5e-01	0.884	0.974	4.9e+02	1	13	0.000

Test Number	Cluster	Server	Servers	metric	Intercept Est	Intercept StdErr	Intercept t-value	Intercept p-value	Slope Est	Slope StdErr	Slope=k t-value	Slope=k p-value	R2	F-stat	df1	df2	p-value
1	W2312	W231203	9	sent	0.029	7.0e-01	0.041	0.968	9.033	0.238	1.4e-01	0.893	0.991	1.4e+03	1	13	0.000
1	W909	W90903	4	recv	0.011	5.0e-03	2.318	0.037	3.938	0.450	-1.4e-01	0.893	0.855	7.7e+01	1	13	0.000
1	W2254	W128408	7	recv	1.720	7.3e+00	0.236	0.817	13.044	45.046	1.3e-01	0.895	0.006	8.4e-02	1	13	0.777
1	W1576	W15761	2	recv	0.000	1.0e-03	-0.011	0.991	1.983	0.144	-1.2e-01	0.908	0.936	1.9e+02	1	13	0.000
1	W543	S_W2498	2	recv	0.031	3.0e-02	1.010	0.331	1.976	0.205	-1.2e-01	0.908	0.877	9.3e+01	1	13	0.000
1	W2007_W859...W20077		2	sent	-0.399	9.2e+00	-0.044	0.966	8.745	59.657	1.1e-01	0.912	0.002	2.1e-02	1	13	0.886
1	W1996	W19962	2	sent	-0.337	2.4e+01	-0.014	0.989	13.172	106.479	1.0e-01	0.918	0.001	1.5e-02	1	13	0.903
1	W2007_W400...W256512		5	sent	10.898	5.6e+01	0.194	0.849	-29.754	333.828	-1.0e-01	0.919	0.001	8.0e-03	1	13	0.930
1	W2312_W266	W20983	12	sent	26.979	3.3e+01	0.811	0.432	-121.324	1291.049	-1.0e-01	0.919	0.001	9.0e-03	1	13	0.927
1	W2254	W128407	7	recv	3.846	6.1e+00	0.633	0.538	-0.198	80.530	-8.9e-02	0.930	0.000	0.0e+00	1	13	0.998
1	W2199	W21992	2	sent	0.103	2.4e-01	0.435	0.671	1.847	1.849	-8.3e-02	0.935	0.071	1.0e+00	1	13	0.336
1	D_AKS_W415	D_AKS_W415...	3	recv	0.005	1.3e-02	0.420	0.683	3.489	6.034	8.1e-02	0.937	0.030	3.3e-01	1	11	0.575
1	W969	W9695	10	sent	-0.680	1.7e+00	-0.402	0.694	9.987	0.169	-7.8e-02	0.939	0.996	3.5e+03	1	13	0.000
1	W108	W11872	2	sent	-1.843	1.5e+02	-0.012	0.990	117.494	1589.424	7.3e-02	0.943	0.000	5.0e-03	1	13	0.942
1	W174_W266	W17405	20	recv	81.069	3.6e+01	2.275	0.040	20.189	2.597	7.3e-02	0.943	0.823	6.0e+01	1	13	0.000
1	W748	W74803	3	recv	1.837	2.1e+00	0.880	0.395	7.034	56.437	7.1e-02	0.944	0.001	1.6e-02	1	13	0.903
1	W2327	S_W9281W10...	2	sent	0.013	1.4e-01	0.094	0.927	2.090	1.285	7.0e-02	0.945	0.169	2.6e+00	1	13	0.128
1	W969	W9699	10	sent	1.823	2.3e+00	0.788	0.445	9.983	0.237	-7.0e-02	0.945	0.993	1.8e+03	1	13	0.000
1	W969	W9699	10	recv	0.397	3.5e-01	1.137	0.276	9.981	0.292	-6.4e-02	0.950	0.989	1.2e+03	1	13	0.000
1	W308	W11203	2	recv	0.000	4.0e-03	0.138	0.892	2.007	0.114	-6.1e-02	0.952	0.960	3.1e+02	1	13	0.000
1	D_AKS_W647	D_AKS_W647...	3	recv	0.008	3.0e-03	2.794	0.017	2.942	1.443	-4.0e-02	0.969	0.274	4.2e+00	1	11	0.066
1	W2173	W21732	2	sent	1.081	6.4e+00	0.169	0.869	1.175	25.869	-3.2e-02	0.975	0.000	2.0e-03	1	13	0.964
1	W909	W90902	4	sent	0.043	9.8e-02	0.439	0.668	3.942	1.843	-3.2e-02	0.975	0.260	4.6e+00	1	13	0.052
1	W174_W266	W17405	20	sent	25.937	1.5e+01	1.748	0.104	20.069	2.634	2.6e-02	0.979	0.817	5.8e+01	1	13	0.000
1	W174	W17410	15	recv	4.122	2.4e+01	0.172	0.866	14.971	1.364	-2.1e-02	0.983	0.903	1.2e+02	1	13	0.000
1	W2286	W228602	2	sent	0.015	1.5e-02	0.967	0.351	2.002	0.146	1.4e-02	0.989	0.935	1.9e+02	1	13	0.000
1	W174_W266	W17410	20	recv	-0.693	2.9e+01	-0.024	0.981	20.022	1.646	1.3e-02	0.990	0.919	1.5e+02	1	13	0.000
1	W487	W48707	5	sent	2.838	2.6e+00	1.092	0.295	5.011	1.478	7.0e-03	0.994	0.469	1.1e+01	1	13	0.005
1	W2312	W231206	9	recv	0.326	7.9e-01	0.410	0.688	8.999	0.175	-7.0e-03	0.995	0.995	2.6e+03	1	13	0.000
1	W2007_W859...W20071		2	sent	-0.017	7.9e-02	-0.219	0.830	1.999	0.171	-5.0e-03	0.996	0.913	1.4e+02	1	13	0.000

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