Model & Simulation of Call Centre

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***Abstract* – A practical spreadsheet-based scheduling method is developed to determine the optimal allocation of service agents to candidate tour types and start times in an inbound call center. Call centers are becoming an essential component for the majority of organizations in the fast expanding information and communications era. Managing call centers is a complicated issue because there has been a large investment in call center infrastructure, resources, and business impact. The instance examined in this paper models a typical call center setting using real-time discrete event simulation. The main objectives behind modeling were to identify and optimize the Average Waiting time of the callers. A structured method for dynamic modeling of real-world situations, understanding behavior, and analyzing and improving the performance of both current and future systems is provided by simulation.**

Keyword – Call center, Modeling, Simulation, Discrete Event Simulation (DES), Dynamic Modeling, Spreadsheet-based scheduling, Inbound Call Center.

I. Introduction

Companies now understand how customers' value service is to attracting new clients and keeping existing ones. Call centers have evolved into the primary method of customer service delivery over time. To achieve a high level of customer satisfaction and to keep costs down, a call center must reach its ideal amount of staffing, their timetable, and their expertise. To determine Average Waiting time of the callers, call centers use analytical models. These models work best when a call center is just getting started and there aren't many measurements yet. However, the use of simulation will produce more accurate results as additional data are available. Simulation allows for the elimination of analytical model assumptions as well as the incorporation of call center activity that is more complicated. In this paper, we look at how some of these variables, such as handle time distribution and call-to-agent allocation criteria, a traffic modeling technique typically used in contact center scheduling to determine delays and forecast caller wait times, is being used for simulation.

II. Related Work

In an inbound call center, a manager typically uses historical call data sets to forecast the future call volumes. Based on the call volume forecast, one can make staffing decisions. An inaccurate forecast inevitably leads to inaccurate staffing decisions (see Steckley, Henderson, & Mehrotra, 2010). There is extensive literature on different forecasting methods applied to call centers. Andrews and Cunningham (1995) used the Autoregressive Integrated Moving Average (ARIMA) method to forecast the inbound call volume of the L. L. Bean's call center. Taylor (2012) adjusted the traditional Holt-Winters exponential smoothing method to the Poisson count model with gamma-distributed arrival rate, and took both intraweek and intraday patterns into account in his model. Taylor (2008) compared the accuracy of a few forecasting models for a British retail bank call center. He concluded that for forecasting

horizons up to two or three days ahead, seasonal ARIMA and Holt-Winters model are more accurate, while for longer lead times, simple historical average is more accurate. Shen and Huang (2008) used the Singular Value Decomposition (SVD) method to reduce the dimension of square-root-transformed call center data. Then they applied time series and regression analysis techniques to make distributional forecasts. Besides the forecasts, they also developed a method to dynamically update the forecasts when early realizations of the day are given. The doubly stochastic model built by Jongbloed and Koole (2001) addresses the issue of high variability in call arrival volume. This model was then further developed in Avramidis, Deslauriers, and L'Ecuyer (2004), where three variants of doubly stochastic model were analyzed and compared. Ibrahim and L'Ecuyer (2013) added the correlation between different call types into a model with additive seasonality, interday correlation and intraday correlation. A multiplicative way to model the intraweek and intraday pattern was used by Gans, Shen, Zhou, Korolev, McCord, and Ristock (2009).

III. Call Center Terminology

A. Call Centre Components

A call center is a centralized office that is used to receive and transmit a lot of phone-based inquiries. A business runs a call center to handle inbound consumer requests for product assistance or information. Additionally, calls are placed for telemarketing, clients, product services, and debt collection. A call center is a facility that handles emails, faxes, live chats, and other correspondence in addition to calls. The parts of a typical call center are shown in Figure 1. Customers who call into the center are said to be making inbound calls. The call may be stopped if all trunk lines are busy; otherwise, an Interactive Voice Response (IVR) unit will answer the call first. IVR is a technique that enables a computer to communicate with people by using keypad and voice inputs. The IVR may allow customers to finish the service interaction. If not, an Automatic Call Distributor receives the calls from the IVR (ACD). An ACD is a specialized switch created to direct each call to a specific agent; in the absence of a qualified agent, the call is queued. Customer in line may leave without obtaining service. In a multi-skill call center, we identify different call types and separate agents according to their skill set. The subset of call types that an agent is capable of handling is referred to as the skill group. Specialist refers to an agent who handles a single type of call, whereas cross-trained refers to an agent who handles multiple types of calls. Agent-to-call and call-to-agent assignments are managed in real time by rules (coded in the ACD) known as skill-based routing (SBR), also known as simply routing.

B. Call Center Metrics

Only those Contact Center indicators that have an impact on personnel size are shown below, even though there are many of them. Blockage: This metric shows what proportion of consumers won't be able to access the center at a given moment because there aren't enough network facilities in place. The majority of centers gauge obstruction based on the time of day or instances of "all trunks busy" conditions. Abandon Rate: The proportion of calls that are dropped while awaiting a response. Abandon rate is a metric that is often used in relation to web-chat engagements rather than email because email does not leave the "queue" once it has been received. Average Speed of Answer (SOA): Average time (often measured in seconds) it takes for the service desk to answer a call. In terms of measuring the quality of customer service, this is one of the most crucial indicators. Time Service Factor is another name for the SOA percentile value (TSF). 80/20 TSF denotes

that the average SOA for consumers is under 20 seconds. Service Level: The percentage of calls that are returned in a specific amount of time. Agent Utilization: The ratio of an agent's actual time spent working with customers to their available or idle time is known as agent occupancy. It is computed by dividing workload hours by staff hours. Staff Shrinkage: The period of time staff members are not accessible to answer calls because of meetings, vacations, breaks, etc. Average Call Handle Time: The amount of time it typically takes an agent to handle a call. Expense per Call: This is often the cost associated with staffing each call. However, some contact centers might also charge for things like power, other rent, and the cost of communication infrastructure.

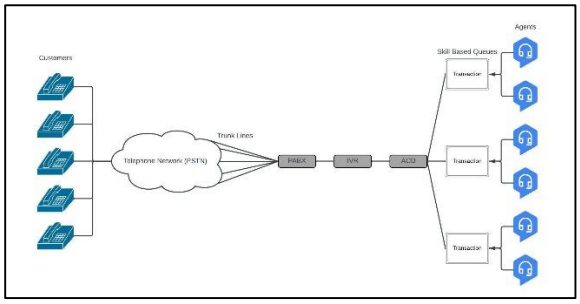


Figure 1. Call Center Terminology

IV. Limitations

The cumulative distribution function is used to describe the probability distribution of random variables. It can be used to describe the probability for a discrete, continuous or mixed variable. It is obtained by summing up the probability density function and getting the cumulative probability for a random variable.

The probability distribution that used in the model was cumulative distribution function (CDF), we used this to simulate and compute the average waiting time and total time of the caller from call center agent. The simulation time is 4 hours, half of the total time of the call center agent shift. The model was limited to inbound call only.

V. Call Center Simulation Modelling (Framework)

The design and arrangement of model inputs presents the major difficulty for call center simulation modeling. Our methodology for call center simulation model definition and essential inputs is shown in Figure 2 below. Figure 2 shows how call center simulation models use a variety of inputs from various data sources. As with any simulation designs, choices must be taken regarding the level of information to include in the model.

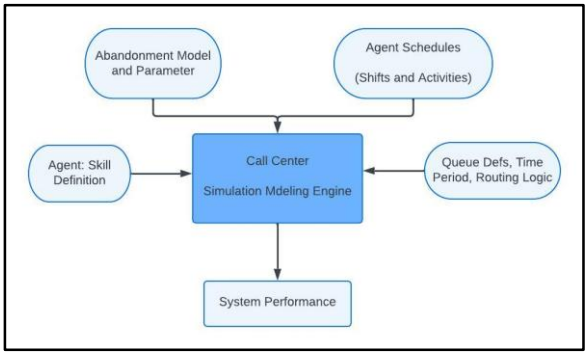


Figure 2: Call Center Simulation Modeling Framework

VI. Call Center Simulation Modelling (Excel Result)

The Call Arrival and Call Duration of call center simulation modeling using data from Telus Company are shown in the graph of model inputs. The call arrival in Figure 3 demonstrates that there are more callers every 4 minutes, and the call duration reveals that calls always last for 3 minutes.

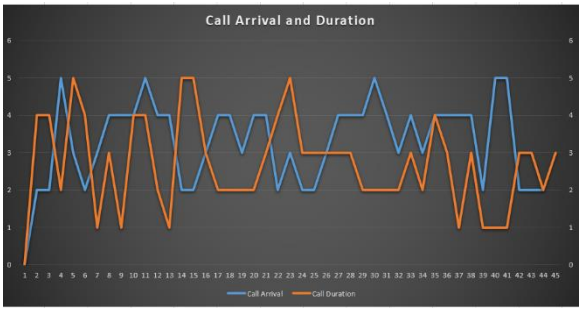


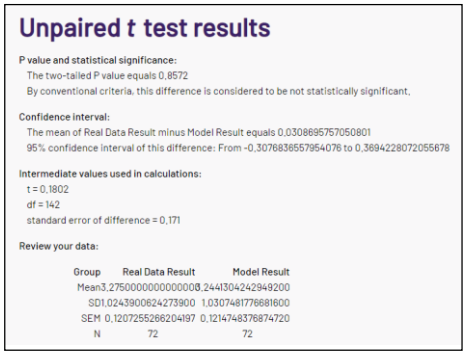
Figure 3. Graph of Call Arrival and Call Duration.

VII. Validation

A t-test is a type of inferential statistic used to determine if there is a significant difference between the means of two groups, which may be related in certain features. The t-test is one of many tests used for the purpose of hypothesis testing in statistics. Calculating a t-test requires three key data values.

The p-value is a number, calculated from a statistical test, that describes how likely you are to have found a particular set of observations if the null hypothesis were true. P-values are used in hypothesis testing to help decide whether to reject the null hypothesis. The smaller the p-value, the more likely you are to reject the null hypothesis.

Based on the Figure 4. the entity Caller Arrival Time have P-value of 0.8572 based on the T-test Results (from https://www.graphpad.com/quickcalcs/ttest1/?format=SD).



Unpaired t test results

P value and statistical significance:
The two-tailed P value equals 0.8572
By conventional criteria, this difference is considered to be not statistically significant.

Confidence interval:
The mean of Real Data Result minus Model Result equals 0.0308695757050801
95% confidence interval of this difference: From -0.3076836557954076 to 0.3694228072055678

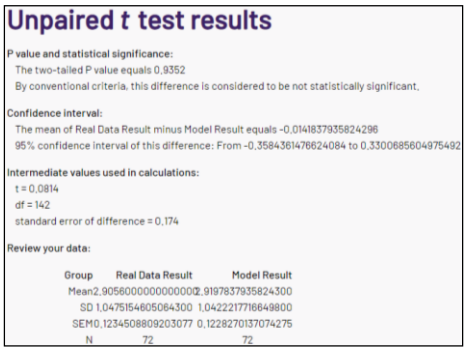
Intermediate values used in calculations:
t = 0.1802
df = 142
standard error of difference = 0.171

Review your data:

Group	Real Data Result	Model Result
Mean	3.275000000000008	3.244130424294920
SD	1.024390062427390	1.030748177668160
SEM	0.120725526620419	0.121474837687472
N	72	72

Figure 4. T-test and P-value of Caller Arrival Time.

Based on the Figure 5. the entity Call Duration Time have P-value of 0.9352 based on the T-test Results (from https://www.graphpad.com/quickcalcs/ttest1/?format=SD).



Unpaired t test results

P value and statistical significance:
The two-tailed P value equals 0.9352
By conventional criteria, this difference is considered to be not statistically significant.

Confidence interval:
The mean of Real Data Result minus Model Result equals -0.0141837935824296
95% confidence interval of this difference: From -0.3584361476624084 to 0.3300685604975492

Intermediate values used in calculations:
t = 0.0814
df = 142
standard error of difference = 0.174

Review your data:

Group	Real Data Result	Model Result
Mean	2.905600000000000	2.919783793582430
SD	1.047515460508430	1.042221771664980
SEM	0.123450880920307	0.122827013707427
N	72	72

Figure 5. T-test and P-value of Call Duration Time

VIII. Scope in Future

The future scope contains yet is not limited to:

- These methods can be applied to other call center companies, such as VIX Global, Concentrix, and Teleperformance, etc., however, it is currently only applicable to Telus International Philippines, Inc.
- The data can be used of Telus International Philippines, Inc. to identify and optimize the Average Waiting time of the callers and Average Total Time.

IX. Conclusion

This paper describes the benefits of simulation as a tool for predicting call center performance. It conducted a number of simulation studies using the simulation tool to test how sensitive the performance of the call center was to various factors, such as knowing the average caller wait time and average total time. Additionally, we may demonstrate how using call allocation algorithms helps call centers operate better.

While the Telus Company data allowed us to get detailed information, the true potential of simulation can only be achieved when real measurements are combined with the what-if capability to determine the number of agents, their abilities, and their schedule.

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