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COMBINING SIMULATION AND INTEGER PROGRAMMING IP TECHNIQUES TO ACHIEVE REALISTIC OPTIMALITY

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ABSTRACT

In recent years, call centers have been considered as an integral part of the modern businesses. High performance of call centers, therefore, is crucial to ensure high level of customer satisfaction in today's competitive market. In order to achieve that high performance, managers of call centers face a very difficult set of challenges. They need to achieve low operating costs and high service quality. The proposed framework combines statistical, simulation, and integer programming (IP) techniques in achieving realistic optimality. The framework begins by developing stochastic statistical data models for call center operations parameters which are divided into service demand (arrival volumes) and service quality (service times, abandonment volumes, and patience time) parameters. These data models are then used to run a simulation model that is used to determine the minimum staffing levels in daily, hour periods. Finally, these staffing levels are considered as input to an IP model that optimally allocates the service agents to the different operating shifts of the working day.

1 BACKGROUND AND MOTIVATION

All modern businesses in today's competitive market include customers' satisfaction at the top of their list of priorities. Service businesses are interested in providing information and assistance, smoothly and efficiency to existing and prospective customers. During the last two decades, the reduced costs of telecommunications and information technology motivated the decision makers to consolidate information and service delivery functions to their running businesses, through call centres and their contemporary successors, contact centres. Those centres include a large number of resources allocated to provide prevalent means for modern businesses to communicate with their customers.

2 OBJECTIVES

The objective of the current research work is to develop a framework to enhance the call center performance through obtaining realistic optimal staffing and scheduling decisions. In order to achieve that, the special features characterizing the call center system should be considered. The imminent challenge of this research is that call center systems are normally rather complex, and most of their operational parameters exhibit highly stochastic nature and require some form of optimization such as in terms workforce management decisions. Traditional analytic queuing models and optimization methods, in contrast, only apply if the systems are sufficiently simple and simplified assumptions are usually made.

This research project hypothesizes that using a combination of discrete simulation and static optimization should result more beneficially when developing the proposed performance enhancement framework.

The first step in the proposed framework is to develop appropriate stochastic models for the various operational parameters. These include; arrival counts, service times and the two closely related parameters of abandonment rates and patience times. The next step is to build a simulation model which can capture the main characteristics of the call center dynamics based on the previously developed stochastic models for the various input parameters. The simulation model is in turn used to determine the minimal staffing levels in each daily one-hour period. Finally, after an appropriate staffing level has been determined for each period, this time-varying staffing pattern is fed into an integer linear programming model for further selection from all feasible shifts covering the staffing requirements, thus enabling optimization by achieving the minimal cost.

Computationally efficient staffing and scheduling optimization algorithms are usually very efficient in solving very large problems with complex constraints to achieve optimality or near-optimality in short period's time. However, the computational efficiency is not the sole objective in solving the staffing and scheduling problems in call centers.

A more important objective which needs to be considered is how realistic the obtained optimal solutions are. The extent to which the optimal solutions obtained by different optimization algorithms if they are realistic depends mainly on the quality of inputs used in running these algorithms. In the staffing and scheduling problems context, the staff levels and schedules depend on two sets of parameters, the service demand (arrival volumes) and service quality (service times, abandonment volumes, and patience time) parameters. These parameters exhibit considerable level of uncertainty. Traditionally, the optimization models, quoted in a number of literatures, simply use simple averages to represent these parameters. This may result in a probable optimal solution which could be totally unrealistic.

Therefore, the objective of the research is to develop a framework which is capable of enhancing the call center performance through obtaining realistic optimal staffing and scheduling decisions.

The development of the proposed framework is based on combining statistical modeling, discrete simulation, and Integer Programming IP techniques **TO OBTAIN OPTIMAL RESOURCES UTILISATION**, in three consecutive steps:

I. Develop stochastic data models for call center dynamics parameters. This requires extensive study and analysis to develop valid realistic data models to avoid the shortcomings due to neglecting the call centers highly stochastic nature.

II. Develop a valid discrete-event-simulation model of the call center dynamics that mimics its stochastic operations through using the developed stochastic data models. This valid model is used in evaluating the current service levels to determine the enhancement goals. Afterwards, the simulation model will be run several times to determine the optimal staff levels in each daily period in an iterative manner.

III. Develop an integer programming model which can optimally allocate the service agents, determined in step II, to the different operating shifts of the working day.