Project Proposal: Optimising Call Centre Operations

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1 Introduction

This research project focuses on optimising call center operations by developing a skill-based routing system designed to minimize customer waiting times, server idle times, and overtime service costs. The project aims to address the critical issue of efficiently managing call congestion by allocating agents, with varying skill levels, to incoming calls in a manner that minimizes wait times and improves overall service efficiency. The key goal is to develop a mathematical model that simulates and optimises agent allocation strategies based on real-world data.

2 Background

Skill-based routing (SBR) has become a crucial method in optimising call centre operations, allowing efficient allocation of agents based on their skill sets to minimize customer waiting times and server idle times. Several studies have demonstrated the effectiveness of SBR in improving operational efficiency [2]. Roubos and Bhulai [3] explored the use of Approximate Dynamic Programming (ADP) techniques for dynamic routing in multi-skill call centers. Their work highlights how scalable and near-optimal routing policies can improve decision-making in real time, offering a solution to high-dimensional routing challenges in large-scale call centers. Similarly, Wallace and Whitt [4] proposed a staffing algorithm that showed even minimal agent cross-training can significantly reduce staffing requirements while maintaining high service levels, underscoring the efficiency of resource pooling. Additionally, research on multi-class queue scheduling [1] delves into optimal scheduling for different call types in heavy traffic scenarios, providing insights into handling peak loads in call centers. Lastly, the importance of flexible architectures was demonstrated in studies that introduced adaptive routing frameworks, where agents with different skills are allocated efficiently based on the call type, further optimising overall system performance.

3 Problem Statement

The goal of this project is to optimise agent allocation in a call center system by minimizing customer waiting costs, server idle costs, and overtime service costs. The system will include:

- Two queues (R1 and R2) with different arrival rates.
- A Poisson process distribution for call arrivals.
- Exponentially distributed inter-arrival times and service times.
- Two agents, one of whom can serve both queues, while the other can only serve one.

The aim is to model this system mathematically, simulate it, and then analyze its performance using real-world call center data. By removing these assumptions and adding more complexity, we will be analyzing more complicated (dynamic) systems.

4 Methods

The system will be modeled using a Markov Decision Process (MDP). The assumptions are:

- Call arrivals follow an exponential process.
- Services are exponentially distributed.
- A finite number of total customers N, distributed between two queues, with $N1$ and $N2$ representing customers in the first and second queues respectively.
- The condition $N1 + N2 + 2 \leq N$ must hold.
- At time $t = 0$, there are no customers in the system.
- At time $t = T$, no new customers are accepted, but service can continue past T.
- The Bellman equation will be used to solve the system by backward reasoning, where the system state at $t = T$ will only depend on customer departures.

After modeling the system mathematically, the next step will involve simulating it to evaluate its performance. Simulation will allow us to test different customer allocation strategies, understand the effects on waiting times and service costs, and improve decision-making. After this, we will be using a dataset to see how our model fits [3].

References

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