Stochastic Modeling and Management of an Emergency Call Center

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AKADEMISK AVHANDLING

För avläggande av teknologie licentiatexamen vid fakulteten för Naturvetenskap, Teknik och Medier vid Mittuniversitetet, Campus Sundsvall, som offentligen kommer att försvaras i sal L 111, onsdagen den 13 juni 2018, kl 13.00.

Opponent är prof. Panagiotis Papapetrou, Stockholm University
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Abstract
A key task of managing an inbound call center is in estimating its performance and consequently plan its capacity, which can be considered a complex task since several system variables are stochastic. These issues are highly crucial for certain time-sensitive services, such as emergency call services. Waiting times affect the service quality of call centers in general, but various customers may place different waiting time expectancies depending on the need. Call center managers struggle to find the relationship between these expectations to their strategical, tactical and operational issues. They are assisted by queueing models that approximate the outcome. Simple setups use analytical approximations while a network of multi-skilled agents serving several customer classes is dependent on computer simulations. Regardless of simple or complex setups, models assume that the system components are homogenous, that the components have some parametric distribution, and that they remain the same regardless of the setup. Human resource and marketing research show that such status quo assumptions are not highly reliable. As an example, customer experience is often affected by the skill of the agent, and agents themselves are affected by their workload and duties, which inter alia affect their efficiency. This thesis aim to assist the Swedish emergency call center with a strategical issue, which require detection of some causalities in the set of system components. The overall aim is to design a simulation model, but such model requires a lot of detailed system knowledge, which itself adds to the knowledge gap in the research field. Findings that contribute to the scientific knowledge body include the burst model that addresses some of the non-stationarity of call arrivals, since some rapid rate increments derives from a latent emergency event. Other contributions are the introduction of stochastic agent behavior, which increases the uncertainty in queueing models; and the service time relationship to geographical distance. The latter may involve general evidence on how area-specific understanding and cultural differences affect the quality of service. This is important for organizations that consider off-shoring or outsourcing their call center service. These findings,
along with several undiscovered and unknown influencers, are needed in order to design a reliable simulation model. However, the proposed model in this study cannot be rejected, in terms of waiting time replication. This robust model allowed traffic routing strategies to be evaluated and also assisted managers of the emergency call center into a strategical shift in the late 2015.

**Keywords:** Call Center Management, Burst Modeling, Stochastic Resources, Skills-Based Routing, Discrete-Event-Simulation