Possible Empirical Student Projects for IEOR 8100, Spring 2012

A major opportunity for student research projects is the call center data and hospital data which Dr. Galit Yom-Tov has access to through her work at the Technion with Professor Avishai Mandelbaum. Students have relatively easy access to the call center data, as can be explained by Galit or Song-Hee Kim (TA for the associated IEOR 4615 course, where the use of the data will be discussed. The students in IEOR 4615 will be working with the call center data. Students in IEOR 8100 are encouraged to attend portions of that course.) But other data may be available as well.

Here are three specific empirical projects to consider. You should discuss with the instructors about these and other empirical projects you might want to consider.

A. <u>Service Time Analysis</u>

In this project we suggest to investigate empirical data of service times in call centers. For example, learning curves of agents service time were investigated at [1] using this data. But there are many aspects that were not investigated yet. For example, here are some questions: Can we find evidence to well known stress effects [2] on service time in this data? Can we see dependence between service times and time of day (end of shift versus beginning of shift)? Or the proportion of time that this agent has been busy during the last hour? Are there dependencies between the queue length and length of the call? The impact might be due to the workload, because the queue length might not directlybe observable by the agents. Are there dependencies between calls?

<u>References</u>:

1. Service Times in Call Centers: Agent Heterogeneity and Learning with some Operational Consequences, by Noah Gans, Nan Liu, Avishai Mandelbaum, Haipeng Shen, Han Ye.
2. Sullivan, S. E. and Baghat, R. S. (1992). Organizational Stress, Job Satisfaction, and Job Performance: Where Do We Go from Here? Journal of Management 18 353-375

B. Estimating Unobservable Queues

In many systems, the data on the number of people waiting in queue is unobservable. For example, in hospitals, queues are virtual, in the sense that the people waiting in queue to be transferred for the next ward, are being served while "waiting in queue" at the previous ward. In addition, the information on the number of people in queue, is not kept. (We have such info for transfer from the ED to the internal wards.) Nevertheless, the question of how many people are actually in queue and how long they are waiting is very important when trying to find bottlenecks in the network. Therefore, in this project, we would like you to estimate these unobservable queues.

The analysis we suggest is in the spirit of QIE and related queue inference problems.

References:

1. Larson, R. 1990. The queue inference engine: Deducing queue statistics from transactional data Management Science 36: 586-601.
2. Bertimas, D. and L. Servi. 1992. Deducing queueing from transactional data: The queue inference engine, revisited. Operations Research 40: 217-228.
3. Dimitrijevic, D. 1996. Inferring most likely queue length from transactional data. Operations Research Letters 19: 191-199

C. Designing Effective Interactive Voice Response (IVR) Systems:

From [1]: "Call centers play an increasingly growing part in today's business world and global economy. Indeed, they serve as the primary customer-contact channel, for companies in many different industries. Employing millions of agents across the globe, call centers are highly labor-intensive operations, with the cost of staff members who handle phone calls (also known as "agents", or CSRs – Customer Service Representatives) typically comprising 60%-80% of the overall operating budget. In order to reduce these operational costs, it is important to

identify means for reducing agents' workload – self-service of customers is one way, and IVR (Interactive Voice Response) is one of the main self-service channel.

IVR systems, if properly designed, can increase customer satisfaction and loyalty, cut staffing costs and increase revenue by extending business hours and market reach. Poorly designed IVR systems, on the other hand, will cause the opposite effect and lead to dissatisfied customers, increased call volume and even increased agent turnover, as customers take out their frustrations on the agents.

Analysis of IVR transactions may shed light on the IVR service quality and efficiency. For example, are customers satisfied with the IVR service or do they opt out for agent assistance, or perhaps, leave the IVR without getting any relevant information? Are all IVR capabilities in fact being used? “

In this project you will get customer flow data within the IVR system, and try to define methods to reveal routes in which customers are more likely to abandon the IVR without being served, or routes in which the customer reached a “dead-end”. As a first stage, you will use returns and “abandonments”(= sort stays) as a quality measure that indicates such problems.

References:

1. Nitzan Uviler research proposal (Technion 2011)
2. Aspect Communications Corporation. Why Your Customers Hate Your IVR Systems. White paper, 2003. Available at: http://www.apaccustomerservices.com/uploadedFiles/knowledge/White_Papers/2338- A_Aspect_IVR_wp.pdf
3. Behzad B. Tezcan T. Robust Design and Control of IVR Systems in Call Centers. Submitted July 2010.
4. Commarford P.M., Lewis J.R., Smither J.A. and Gentzler M.D. A Comparison of Broad Versus Deep Auditory Menu Structures. Human Factors, 50(1), 77-89, 2008.

5. Delorey E. Correlating IVR Performance and Customer Satisfaction. 2003. Available at: http://www.easyivr.com/tech-ivr-applications_108.htm
6. Schumacher R.M., Hardzinski M.L. and Schwartz A.L. Increasing the Usability of Interactive Voice Response Systems: Research and Guidelines for Phone-Based Interfaces. Human Factors, 37(2), 251-264, 1995.
7. Srinivasan R., Talim J. and Wang J. Performance Analysis of a Call Center with Interactive Voice Response Units. Top, 12(1), 91-110, 2004.
8. Suhm B., Bers J., McCarthy D., Freeman B., Getty D., Godfrey K. and Peterson P. A Comparative Study of Speech in the Call Center: Natural Language Call Routing vs. Touch-Tone Menus. Proceedings of the SIGCHI conference on Human Factors in Computing Systems, 2002