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A SIMULATION AND ANALYSIS OF BANK TELLER MANNING

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ABSTRACT

This paper presents an application study to find cost effective bank teller management policies for providing high quality service levels at reasonable costs in a modern banking system. Two models are developed. The first is a spreadsheet model to calculate desired teller manning levels from mathematical queuing models, and the second is a simulation model for testing new management policies. Manning heuristics are tested and found to provide the desired level of services.

1 INTRODUCTION

In the highly competitive banking business, customers now demand many custom fit products from interest paying checking accounts and free traveler's checks to "no annual fee" VISA cards. The local branch bank has become a financial center for a wide variety of these services. Deregulation in the banking industry has led to numerous mergers and stiff competition for the existing customer base. Bank management at one major metropolitan bank found that in the new market after deregulation they were the fourth largest bank in a larger market, rather than the largest in their previous smaller market. Increasing the productivity of banking operations has become a major issue in bank management, and tellers and lobby services have been identified as two of five major areas for productivity improvement at regional banks. This fact has highlighted the need for establishing staffing levels based on standards of customer service (Pihl and Wambay 1990).

Customers demand higher levels of service and now have numerous choices in how to get service. In spite of the availability of automated service, many customers still prefer to use human teller services, but long waits for service are perceived as a major source of customer dissatisfaction. Customers demand, and the banks have attempted to provide, quick service whether in the bank's lobby or in the outside drive through facility. Providing the demanded service while holding teller manning costs to a competitive level has become one of the prime tasks for bank managers.

Careful application of queuing theory can alleviate the actual time spent in line and how long it seems the customer has spent in line (Wayne and DiSotto 1994). In addition, work design leading to simplification of teller procedures and the development of staffing levels and work schedules based on customer requirements have been effective in reducing manpower costs. The use of microcomputer-based scheduling and staffing decision support systems are very useful tools for this purpose (McDonell and Klipsch 1988). A banking institution in the New Orleans area requested assistance in building a banking teller management model. Teller personnel have many tasks to accomplish during the business day besides direct contact with the banking customer. Management's task is to have enough teller stations open to provide quick service while ensuring productive work time is not wasted by having idle tellers. This bank, like many consolidated companies today, has ten branch locations with varying capacities in both the lobby and the drive through facility. The consistent factor among the branches was the bank's desired policy to provide service to 95% of the customers within three minutes.

While many banks have used operations research models (Cheng 1990), the majority of the simulation models studied were for asset management or for management training (Krut 1990, Thompson 1994). Our paper deals with a two step modeling process which begins with a spreadsheet-based queuing theory model for determining ideal staffing levels, followed by a simulation model that illustrates the expected results of management policies under a variety of conditions.

2 THE MANNING MODEL

The bank's central management wanted a benchmark manning model to give to each branch manager. This model was to demonstrate the ideal teller staffing required to deal with actual customer arrivals and to begin service within three minutes 95% of the time. Since the bank was not yet prepared to forecast customer arrival patterns, this model was an after-the-fact look at how service should have been provided. Any large deviations would indicate possible problems and motivate further studies to find solutions.

The bank's data collection system provided the average number of customer/teller transactions for each time period of the day, grouped into fifteen minutes intervals. This data was usually averaged for all days of the week and month to provide a "bank standard" for transactions per customer and time per transaction. The bank's standards did not provide a breakdown by day of the week or day of the month. This local data collection model mirrored that provided by banking industry publications which compiled "national standard" data on the mean number of separate transactions each customer makes, both in the lobby and the drive through, and the mean length of time required for each transaction. The objective of the bank's data model was to permit comparison of local performance to national standards.

Our first step was to build a mathematical model to compute the number of teller Full Time Equivalents (FTE's) needed in each time interval to provide service within three minutes 95% of the time. Since this is a discontinuous mathematical function (one teller is needed until the customer queue grows beyond the teller's capacity, then another teller is added), a spreadsheet model was created to provide the manning calculations. The spreadsheet is essentially a "look-up" model that searches the authors' hand-calculated queuing model data for both bank standards and national standards (see Table 1). The model translates the actual number of bank transactions from the past week into required manning (FTE's) in both the lobby and the drive through facility.

The spreadsheet manning model provided a starting point for management. The actual number of FTE's utilized by a branch manager for the day could be quickly compared to the model's calculated requirements. In the future, data collected from the processing system will be used to forecast customer transactions for each fifteen minute time interval by day of the week and day of the month. The forecast will be used in the manning model to provide a suggested teller manning. While this mathematical average model was a good starting point, both the researchers and the bank management realized that we needed a more sophisticated model that could simulate actual conditions and permit analyses of the entire system under some new bank policies. Specific policies included the length of the waiting line at which new teller would be added to the system, and the period for which a teller would continue at the counter after assignment.

3 THE SIMULATION MODEL

The objective of the simulation model was to provide a simple method for testing new bank teller manning policies and to illustrate what may be expected under the policy. It was desirable to have the simulation model read an easily generated report on the number of transactions for each fifteen minute time interval during the work day from the bank's existing information system, and then simulate the affects of different policies on the banking system. Since the institution consisted of ten branch facilities, all with slightly different configurations, the main office branch was chosen for the prototype model.

Table 1: Lobby Teller Manning

Time	Monday			Tuesday		
		BK	NA		BK	NA
Periods	TRAN	FTE's		TRAN	FTE's	
8:00-8:15	2	1	1	2	1	1
8:15-8:30	5	2	1	2	1	1
8:30-8:45	3	1	1	2	1	1
8:45-9.00	7	2	2	2	1	1
9:00-9:15	19	4	3	16	3	3
9:15-9:30	17	4	3	16	3	3
9:30-9:45	10	3	2	16	3	3
9:45-10:00	19	4	3	16	3	3
10:00-10:15	15	3	2	14	3	2
10:15-10:30	17	4	3	14	3	2
10:30-10:45	17	4	3	14	3	2
10:45-11:00	23	4	3	14	3	2
11:00-11:15	18	4	3	14	3	2
11:15-11:30	15	3	2	14	3	2
11:30-11:45	20	4	3	14	3	2
11:45-12:00	23	4	3	14	3	2
12:00-12:15	17	4	3	18	4	3

(BK) *Bank rate = 3.0 min/ customer, 2.0 min/ transaction; an average of 1.5 transactions/ customer.*
(NA) *National standard = 1.65 min/ customer,1.5 min/ transaction; an average of 1.1 transactions/ customer.*
(FTE's) *Full Time Equivalents*

The information system of the bank we were modeling was primarily oriented toward data collection. While reports were readily available on the number of transactions, any analyses were accomplished through spreadsheets on personal computers. For that reason and for the convenience of transportability, a simulation language was selected that could be installed on a microcomputer. The SLAM II (Pritsker 1986) was the language selected, but the Windows-based SLAMSYSTEM (1994) version 4.5 with its CASE-like modeling capabilities provided the modeling system. A network simulation of the bank's branch facility was created by selecting network icons (arrival generators, queues, etc.) with a mouse, "dragging" them to the proper location in the "Network Builder" window, and then connecting the icons by banking activities. The network simulated one infinite queue for the lobby customers and four infinite driveway queues for the drive through facility. When completed, the SLAMSYSTEM translated the graphical network into FORTRAN coded routines to operate the simulations.

By writing FORTRAN code subroutines, the authors created management policies that dictated when tellers opened and closed their windows to customers. Tellers who were not open to customers were assumed to be working at other bank tasks. The typical manning at this branch, with a maximum of six lobby tellers and three drive through tellers, was used as the basis for model resources.

The simulation is driven by actual transaction data recorded and reported by the bank's information system. The bank's daily transaction data is "imported" into the spreadsheet manning model. This model calculates suggested manning for each fifteen minute interval and writes both the number of transactions and the suggested manning levels to an ASCII file. The simulation model reads the number of transactions from the ASCII file and generates a Poisson arrival pattern sufficient to make the needed transactions. The time required for each transaction is drawn from a normal distribution with mean and standard deviation equal to the "standard" used (bank or national average). The number of tellers serving customers is based on the calculated manning levels. The conditions of each fifteen minute interval are simulated for 150 minutes (the equivalent of ten runs), and statistics are reported on the average time in the queue and total time in the system. Preliminary validation was performed by comparing mathematical model data to the simulation model, but the actual validation through observation of the real system behavior is pending.

The simulation model showed that manning levels calculated from queuing theory models are not always adequate in a stochastic system. The two tellers calculated to be adequate 95% of the time under average conditions provided the desired level of service only 68% of the time in the simulation model. This occurs in the model, and real life, when random arrivals cluster together.

4 THE MODEL APPLICATIONS

Since the objective of the modeling project was to provide a computer laboratory for testing new polices, the first experiment involved testing a manning heuristic. The heuristic suggested to management requires all (scheduled) bank tellers to begin their day by performing alterative tasks (those other than customer to teller tasks). All teller personnel are assigned a priority for opening their windows (actually, the teller in closest proximity to the customer queue, teller one, would open first; the adjacent teller would open next, and so forth to the end of the window line.) As the first customer enters the queue, teller one opens for business. In the lobby, the heuristic requires the next teller to open for business when the queue contains at least two customers. When a teller other than teller one finishes service with a customer, they check the length of the lobby queue. If there is only one customer is in the queue, the teller closes the window and goes back to their alternative tasks.

In the drive through facility where the pattern of service demanded is slightly different from the lobby, the heuristic is slightly different. Since there are four queues which can be serviced by any of the drive through tellers, the rule states that the second teller will only open when the sum of cars waiting in all the queues is more than two. Thus, the teller would open if a third car entered the queue.

Analysis of the 40 reports produced by this simulation (every 15 minute interval from 8:00 AM to 6:00 PM closing) for the walk-in and drive through facilities showed the manning heuristics produced the desired level of service in most cases. Again, the authors reiterate that the model has not been completely validated by observations of the heuristic's use in the real system.

The second application of the model is to illustrate to managers the effectiveness of their fixed level or heuristic manning policies. By entering the number of transactions from the transaction file, and the actual manning decisions of the branch managers into the ASCII file, the model displays a simulation of the system's expected performance under these conditions. Management policies that provide level manning through most of the day but permit teller manning to drop during lunch hours have not produced the desired service levels in the simulation model.

5 DISCUSSION

Our efforts to this point have produced two working models. The spreadsheet manning model provides a quick calculation of the approximate number of full time tellers required to provide the desired service levels. This provides a benchmark for top management and the branch managers to use when evaluating the performance of their branch banks. The prototype simulation model now provides a laboratory for testing new policies at the main branch and for illustrating the need to carefully consider service levels when setting teller manning.

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