CONTEST PROBLEM 8

IIE/RA Contest Problems

Eighth Annual Contest: SM Travel

SM Travel is in the process of consolidating our current small travel offices into two new locations that will handle all requests by phone. With the recent reduction in business travel and the general condition of the travel industry, we find it necessary to reduce our operating cost. Our current plan is to locate the first office in the U.S. and the second at a yet-to-be-determined overseas site. The U.S. site would handle all calls between 7 AM and 7 PM EST, with the overseas site handling calls from 7 PM to 7 AM EST.

SM Travel has employed several consultants to collect data and develop a design for the proposed consolidation. Although we've received sufficient information to proceed with the implementation of the design, we question the actual operating cost of the new system. The two major costs are associated with employees and phone lines, but the uncertainty of the operating cost compels us to request recommendations. We ask you to evaluate the current design and propose a configuration that will result in (approximately) minimizing operating cost while still achieving the desired customer-service levels.

It's obvious that we could intentionally overstaff the systems as a way of always meeting the projected customer demand, but it is understood that a design that always meets demand may result in a very expensive system with reduced profitability. We'd like to be able to size this system so that we meet or exceed customer requirements while keeping our investment and operating costs at an approximate minimum. We explored several options to resolve this problem and have concluded that computer simulation may well provide the technology necessary to size this system properly. With this in mind, we'll describe the operating policies and general design of the proposed system, as well as include data where available.

The proposed system can best be described as a call center that is specifically designed for callers to make travel reservations. There are two basic types of customers who will use this system—regular and cardholders. Cardholder customers travel extensively and hold one of our two card types—silver or gold. To become a cardholder, a customer must have established a consistent use of the services offered by SM Travel. Those with the highest level of usage become gold cardholders. The cardholder customers call into the system on a different number and are given preferential treatment.

Extensive data have been collected and analyzed on the projected caller patterns for the consolidated system. The following table summarizes the data. The caller rates are expressed in calls per hour.

Time Period	Regular Arrival Rates	Cardholder Arrival Rates
7 AM – 8 AM	87	89
8 AM – 9 AM	165	243
9 AM – 10 AM	236	221
10 AM – 11 AM	323	180
11 AM – Noon	277	301
Noon – 1 PM	440	490
1 PM – 2 PM	269	394
2 PM – 3 PM	342	347
3 PM – 4 PM	175	240
4 PM – 5 PM	273	269
5 PM – 6 PM	115	145
6 PM – 7 PM	56	69

Both the silver and gold cardholders dial into the same number (different from the regular customers). Analysis indicates that 68% of the cardholder calls are silver cardholders, with the remaining being gold cardholders. The new system will have a limited number of trunk lines available. If a line is not available, the customer will receive a busy signal. The system will automatically record the number of times that customers receive busy signals. One of the goals of this new system is to distinguish between regular and cardholder customers and provide better service to the cardholders because they generate more income.

One of our previous consultants developed a method that attempts to minimize the number of busy signals for cardholders. When the system becomes congested (most of the lines are in use), the remaining lines will be made available only to cardholder callers. Because cardholders call in on a different number, the phone system can be programmed to detect whether an incoming call is from a cardholder or regular customer. If an incoming call is on the regular customer line and the system is congested, that caller will automatically be greeted with a busy signal. For example, if there are 50 lines, we may reserve the last five lines for cardholders. Thus if 45 lines were in use, a regular customer would receive a busy signal, where a cardholder would be given one of the remaining available lines. This would result in fewer busy signals for cardholders, but more busy signals for regular customers.

Although we plan to implement this procedure, we're unsure of the number of lines to reserve for cardholder calls. Your report should include a recommendation on the number of lines that should be held in reserve. If a regular customer acquires a trunk line and there is an operator available, the operator will immediately answer the call. If no operators are available, the customer will be placed in a queue and an automated system will provide an estimate of their wait time (this takes an average of 8 seconds). At this point, some customers will decide to abandon the call and try again later (hopefully). Data reveal that the regular customer wait-time tolerance can be estimated using a uniform distribution (minimum value of 12 minutes, maximum value of 30 minutes). If the wait-time estimate is greater than the customer tolerance time, that customer will abandon the call. The wait-time tolerance for cardholders is uniform with a minimum value of 8 minutes and maximum value of 17 minutes. Although we have good data on

the wait-time tolerance, we do not have an accurate method to estimate the wait time. Your report should include a recommendation for estimating the expected wait times by customer type. Analysis also indicates that some customers who decide to wait will later abandon the calls if the wait becomes excessive. Although this does occur, it's not considered to be a significant element in this new system.

Upon acquiring a trunk line, each cardholder is asked to enter the member number. Once the number is entered, the system identifies the card type as silver or gold. The estimated wait time is not given until this transaction has been completed. This transaction takes between 7 and 16 seconds.

Calling customers generally fall into three categories: requesting information about a potential trip, making reservations for a trip, or changing reservations. The percentages are 16% for information, 76% for reservations, and 8% for changes. These percentages apply to both regular and cardholder customers.

The new system separates operators into three different pools: regular, silver, and gold. A gold cardholder caller is given priority over all other callers and goes to the front of the queue (behind any other waiting gold callers). The first available operator from any of the pools will take the gold call. If several operators are available, preference is given to the gold pool, followed by the silver pool, and then the regular pool. The gold-card operators are only available for gold-card customers.

A silver-card caller is given priority over regular customers, but not gold-card customers. A silver-card caller is placed in the queue behind any gold-card callers, but in front of any regular callers. The first available operator from the silver or regular pools will take the silver call (only if there are no waiting gold-card callers). If several operators are available, preference is given to the silver pool, followed by the regular pool.

Regular callers are placed in the queue behind the gold- and silver-card callers. Regular customers can be served only by regular operators.

There is also a difference in the skill level between the operator pools, with the gold-card operators being the most skilled. Our estimates of service times assume a regular operator is available. A silver-card operator can reduce the service time by 5% and a gold-card operator by 12%. Operators are generally not immediately available for other callers when customer service has been completed. The customer exits the system and the trunk line becomes immediately available, but the operator is required to perform a certain amount of after-call work. This includes any work required to secure the reservations, e-mail the customer, or update the customer database. The amount of time required varies by call type. The data for service and after-call work durations are given in the following table by call type. All data assume a regular operator. The values given for service times are for a triangular distribution and the values for after-call work are for a uniform distribution. All times are in minutes.

Call Type	Service	After Call Work
Information	1.2 , 2.05 , 3.75	0.05 , 0.10
Reservations	2.25 , 2.95 , 8.6	0.5 , 0.8
Changes	1.2, 1.9 , 5.8	0.4 , 0.6

Although a wide variety of operator staffing is possible, we have simplified the staffing patterns for your analysis. You can assume that all operators will work a full eight-hour shift. Thus, there are five possible patterns: 7 AM to 3 PM, 8 AM to 4 PM, 9 AM to 5 PM, 10 AM to 6 PM, and 11 AM to 7 PM. The current staffing plan calls for part-time, roving operators to provide relief and lunch breaks for the full-time staff. It is not necessary for you to include these roving operators in your model. Note that although there are only five staffing patterns, there are three operator pools, for a total of 15 possible staffing levels.

We have further simplified the analysis by assuming that the system starts empty at 7 AM and that all calls waiting in queue at 7 PM are automatically transferred to the overseas location.

Based on our experience with our customers, we have established several minimum customer-performance levels, which our new system must meet or exceed. These are as follows:

- 98% of all gold-card customers should have a wait or queue time of 90 seconds or less.
- 95% of all silver-card customers should have a wait or queue time of 3 minutes or less.
- 85% of all regular customers should have a wait or queue time of 15 minutes or less.
- No more than 2% of cardholder customers should receive a busy signal.
- No more than 20% of regular customers should receive a busy signal.

SM Travel requests that you evaluate the current design and propose a configuration that will result in approximately minimal operating cost while still achieving the above-mentioned customer-performance levels.

You should base your evaluation on the following costs:

- Regular operator, $16 per hour
- Silver-card operator, $20 per hour
- Gold-card operator, $23 per hour
- Additional trunk lines, $170 per day per trunk line beyond 50

The above-mentioned operator costs include base salary, benefits, and overhead. We have already signed an agreement for trunk lines, which provides 50 lines at a fixed cost. Additional lines can be added in blocks of five for the cost stated above.

Your report should include a recommendation for the most cost-effective system configuration. This should include the number of trunk lines, the number of operators by type and shift pattern, the number of cardholder reserve lines, and a recommendation for estimating the expected wait times by customer type. You should also include the operating cost expressed in dollars per day for your recommended configuration.

We are currently proceeding with the construction of the first facility. Since there are several groups competing for this contract, we have decided that we will not provide additional information during the analysis period. However, you are encouraged to make additional reasonable, documented assumptions. We look forward to receiving your report and reviewing your proposed solution.