9. A builder has located a piece of property that she would like to buy and eventually build on. The land is currently zoned for four homes per acre, but she is planning to request new zoning. What she builds depends on approval of zoning requests and your analysis of this problem to advise her. With her input and your help, the decision process has been reduced to the following costs, alternatives, and probabilities:

   Cost of land: $2 million

   Probability of rezoning: .60

   If the land is rezoned, there will be additional costs for new roads, lighting, and so on, of $1 million.

   If the land is rezoned, the contractor must decide whether to build a shopping center or 1,500 apartments that the tentative plan shows would be possible. If she builds a shopping center, there is a 70 percent chance that she can sell the shopping center to a large department store chain for $4 million over her construction cost, which excludes the land; and there is a 30 percent chance that she can sell it to an insurance company for $5 million over her construction cost (also excluding the land). If, instead of the shopping center, she decides to build the 1,500 apartments, she places probabilities on the profits as follows: There is a 60 percent chance that she can sell the apartments to a real estate investment corporation for $3,000 each over her construction cost; there is a 40 percent chance that she can get only $2,000 each over her construction cost. (Both exclude the land cost.)

   If the land is not rezoned, she will comply with the existing zoning restrictions and simply build 600 homes, on which she expects to make $4,000 over the construction cost on each one (excluding the cost of land).

   Draw a decision tree of the problem and determine the best solution and the expected net profit.

LO5–4

10. Owners of a local restaurant are concerned about their ability to provide quality service as they continue to grow and attract more customers. They have collected data from Friday and Saturday nights, their busiest times of the week. During these time periods, about 75 customers arrive per hour for service. Given the number of tables and chairs, and the typical time it takes to serve a customer, the owners estimate they can serve, on average, about 100 customers per hour. During these nights, are they in the *zone of service,* the *critical zone,* or the *zone of nonservice*? (Answer in Appendix D)
11. Owners of the restaurant in the prior problem anticipate that in one year their demand will double as long as they can provide good service to their customers. How much will they have to increase their service capacity to stay out of the critical zone?

Case: Shouldice Hospital—A Cut Above

"Shouldice Hospital, the house that hernias built, is a converted country estate which gives the hospital 'a country club' appeal."

A quote from *American Medical News*

Shouldice Hospital in Canada is widely known for one thing—hernia repair! In fact, that is the only operation it performs, and it performs a great many of them. Over the past two decades this small 90-bed hospital has averaged 7,000 operations annually. Last year, it had a record year and performed nearly 7,500 operations. Patients' ties to Shouldice do not end when they leave the hospital. Every year, the gala Hernia Reunion dinner (with complimentary hernia inspection) draws in over 1,000 former patients, some of whom have been attending the event for over 30 years.

A number of notable features in Shouldice's service delivery system contribute to its success: (1) Shouldice accepts only patients with uncomplicated external hernias, and uses a superior technique developed for this type of hernia by Dr. Shouldice during World War II. (2) Patients are subject to early ambulation, which promotes healing. (Patients literally walk off the operating table and engage in light exercise throughout their stay, which lasts only three days.) (3) Its country club atmosphere, gregarious nursing staff, and built-in socializing make a surprisingly pleasant experience out of an inherently unpleasant medical problem. Regular times are set aside for tea, cookies, and socializing. All patients are paired up with a roommate with a similar background and interests.

The Production System

The medical facilities at Shouldice consist of five operating rooms, a patient recovery room, a laboratory, and six examination rooms. Shouldice performs, on average, 150 operations per week, with patients generally staying at the hospital for three days. Although operations are performed only five days a week, the remainder of the hospital is in operation continuously to attend to recovering patients.

An operation at Shouldice Hospital is performed by one of the 12 full-time surgeons, and assisted by one of seven part-time assistant surgeons. Surgeons generally take about one hour to prepare for and perform each hernia operation, and they operate on four patients per day. The surgeons' day ends at 4 P.M., although they can expect to be on call every 14th night and every 10th weekend.

The Shouldice Experience

Each patient undergoes a screening exam prior to setting a date for his or her operation. Patients in the Toronto area are encouraged to walk in for the diagnosis. Examinations are done between 9 A.M. and 3:30 P.M. Monday through Friday, and between 10 A.M. and 2 P.M. on Saturday. Out-of-town patients are mailed a medical information questionnaire (also available over the Internet), which is used for the diagnosis. A small percentage of the patients who are overweight or otherwise represent an undue medical risk are refused treatment. The remaining patients receive confirmation cards with the scheduled dates for their operations. A patient's folder is transferred to the reception desk once an arrival date is confirmed.

Patients arrive at the clinic between 1 and 3 P.M. the day before their surgery. After a short wait, they receive a brief preoperative examination. They are then sent to an admissions clerk to complete any necessary paperwork. Patients are next directed to one of the two nurses' stations for blood and urine tests and then are shown to their rooms. They spend the remaining time before orientation getting settled and acquainting themselves with their roommates.

Orientation begins at 5 P.M., followed by dinner in the common dining room. Later in the evening, at 9 P.M., patients gather in the lounge area for tea and cookies. Here, new patients can talk with patients who have already had their surgery. Bedtime is between 9:30 and 10 P.M.

On the day of the operation, patients with early operations are awakened at 5:30 A.M. for preoperative sedation. The first operations begin at 7:30 A.M. Shortly before an operation starts, the patient is administered a local anesthetic, leaving him or her alert and fully aware of the proceedings. At the conclusion of the operation, the patient is invited to walk from the operating table to a nearby wheelchair, which is waiting to return the patient to his or her room. After a brief period of rest, the patient is encouraged to get up and start exercising. By 9 P.M. that day, he or she is in the lounge having cookies and tea and talking with new, incoming patients.

The skin clips holding the incision together are loosened, and some even removed, the next day. The remainder are removed the following morning just before the patient is discharged.

When Shouldice Hospital started, the average hospital stay for hernia surgery was three weeks. Today, many institutions push "same day surgery" for a variety of reasons. Shouldice Hospital firmly believes that this is not in the best interests of patients and is committed to its three-day process. Shouldice's postoperative rehabilitation program is designed to enable the patient to resume normal activities with minimal interruption and discomfort. Shouldice patients frequently return to work in a few days; the average total time off is eight days.

"It is interesting to note that approximately 1 out of every 100 Shouldice patients is a medical doctor."

Future Plans

The management of Shouldice is thinking of expanding the hospital's capacity to serve considerable unsatisfied demand. To this effect, the vice president is seriously considering two options. The first involves adding one more day of operations (Saturday) to the existing five-day schedule, which would increase capacity by 20 percent. The second option is to add another floor of rooms to the hospital, increasing the number of beds by 50 percent. This would require more aggressive scheduling of the operating rooms.

The administrator of the hospital, however, is concerned about maintaining control over the quality of the service delivered. He thinks the facility is already getting very good utilization. The doctors and the staff are happy with their jobs, and the patients are satisfied with the service. According to him, further expansion of capacity might make it hard to maintain the same kind of working relationships and attitudes.

Questions

Exhibit 5.7 is a room-occupancy table for the existing system. Each row in the table follows the patients who checked in on a given day. The columns indicate the number of patients in the hospital on a given day. For example, the first row of the table shows that 30 people checked in on Monday and were in the hospital for Monday, Tuesday, and Wednesday. By summing the columns of the table for Wednesday, we see that there are 90 patients staying in the hospital that day.

1. How well is the hospital currently utilizing its beds?
2. Develop a similar table to show the effects of adding operations on Saturday. (Assume that 30 operations

exhibit 5.7 Operations with 90 Beds (30 patients per day)

	Beds Required						
Check-in Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Monday	30	30	30				
Tuesday		30	30	30			
Wednesday			30	30	30		
Thursday				30	30	30	
Friday							
Saturday							
Sunday	30	30					30
Total	60	90	90	90	60	30	30

would still be performed each day.) How would this affect the utilization of the bed capacity? Is this capacity sufficient for the additional patients?

3. Now look at the effect of increasing the number of beds by 50 percent. How many operations could the hospital perform per day before running out of bed capacity? (Assume operations are performed five days per week, with the same number performed on each day.) How well would the new resources be utilized relative to the current operation? Could the hospital really perform this many operations? Why? (*Hint:* Look at the capacity of the 12 surgeons and the five operating rooms.)
4. Although financial data are sketchy, an estimate from a construction company indicates that adding bed capacity would cost about $100,000 per bed. In addition, the rate charged for the hernia surgery varies between about $900 and $2,000 (U.S. dollars), with an average rate of $1,300 per operation. The surgeons are paid a flat $600 per operation. Due to all the uncertainties in government health care legislation, Shouldice would like to justify any expansion within a five-year time period.

Practice Exam

In each of the following, name the term defined or answer the question. Answers are listed at the bottom.

1. The level of capacity for which a process was designed and at which it operates at minimum cost.
2. A facility has a maximum capacity of 4,000 units per day using overtime and skipping the daily maintenance routine. At 3,500 units per day, the facility operates at a level where average cost per unit is minimized. Currently, the process is scheduled to operate at a level of 3,000 units per day. What is the capacity utilization rate?
3. The concept that relates to gaining efficiency through the full utilization of dedicated resources, such as people and equipment.
4. A facility that limits its production to a single product or a set of very similar products.
5. When multiple (usually similar) products can be produced in a facility less expensively than a single product.
6. The ability to serve more customers than expected.
7. In considering a capacity expansion, we have two alternatives. The first alternative is expected to cost $1,000,000 and has an expected profit of $500,000 over the next three years. The second alternative has an expected cost of $800,000 and an expected profit of $450,000 over the next three years. Which alternative should we select, and what is the expected value of the expansion? Assume a 10 percent interest rate.
8. In a service process such as the checkout counter in a discount store, what is a good target percent for capacity utilization?

Answers to Practice Exam 1. Best operating level 2. 85.7 percent 3. Economies of scale 4. Focused factory 5. Economies of scope 6. Capacity cushion 7. Alternative 1: Present value = 500,000 × (.909 + .826 + .751) − 1,000,000 = $243,000; Alternative 2: Present value = 450,000 × (.909 + .826 + .751) − 800,000 = $318,700; Alternative 2 is best. 8. 70 percent.