

PROBLEMS

1. Determine the utilization and the efficiency for each of these situations:
 - a. A loan processing operation that processes an average of 7 loans per day. The operation has a design capacity of 10 loans per day and an effective capacity of 8 loans per day.
 - b. A furnace repair team that services an average of four furnaces a day if the design capacity is six furnaces a day and the effective capacity is five furnaces a day.
 - c. Would you say that systems that have higher efficiency ratios than other systems will always have higher utilization ratios than those other systems? Explain.
2. In a job shop, effective capacity is only 50 percent of design capacity, and actual output is 80 percent of effective output. What design capacity would be needed to achieve an actual output of eight jobs per week?
3. A producer of pottery is considering the addition of a new plant to absorb the backlog of demand that now exists. The primary location being considered will have fixed costs of \$9,200 per month and variable costs of 70 cents per unit produced. Each item is sold to retailers at a price that averages 90 cents.
 - a. What volume per month is required in order to break even?
 - b. What profit would be realized on a monthly volume of 61,000 units? 87,000 units?
 - c. What volume is needed to obtain a profit of \$16,000 per month?
 - d. What volume is needed to provide a revenue of \$23,000 per month?
 - e. Plot the total cost and total revenue lines.
4. A small firm intends to increase the capacity of a bottleneck operation by adding a new machine. Two alternatives, A and B, have been identified, and the associated costs and revenues have been estimated. Annual fixed costs would be \$40,000 for A and \$30,000 for B; variable costs per unit would be \$10 for A and \$11 for B; and revenue per unit would be \$15.
 - a. Determine each alternative's break-even point in units.
 - b. At what volume of output would the two alternatives yield the same profit?
 - c. If expected annual demand is 12,000 units, which alternative would yield the higher profit?
5. A producer of felt-tip pens has received a forecast of demand of 30,000 pens for the coming month from its marketing department. Fixed costs of \$25,000 per month are allocated to the felt-tip operation, and variable costs are 37 cents per pen.
 - a. Find the break-even quantity if pens sell for \$1 each.
 - b. At what price must pens be sold to obtain a monthly profit of \$15,000, assuming that estimated demand materializes?
6. A real estate agent is considering changing her cell phone plan. There are three plans to choose from, all of which involve a monthly service charge of \$20. Plan A has a cost of \$.45 a minute for daytime calls and \$.20 a minute for evening calls. Plan B has a charge of \$.55 a minute for daytime calls and \$.15 a minute for evening calls. Plan C has a flat rate of \$80 with 200 minutes of calls allowed per month and a charge of \$.40 per minute beyond that, day or evening.
 - a. Determine the total charge under each plan for this case: 120 minutes of day calls and 40 minutes of evening calls in a month.
 - b. Prepare a graph that shows total monthly cost for each plan versus daytime call minutes.
 - c. If the agent will use the service for daytime calls, over what range of call minutes will each plan be optimal?
 - d. Suppose that the agent expects both daytime and evening calls. At what point (i.e., percentage of call minutes for daytime calls) would she be indifferent between plans A and B?
7. A firm plans to begin production of a new small appliance. The manager must decide whether to purchase the motors for the appliance from a vendor at \$7 each or to produce them in-house. Either of two processes could be used for in-house production; one would have an annual fixed cost of \$160,000 and a variable cost of \$5 per unit, and the other would have an annual fixed cost of \$190,000 and a variable cost of \$4 per unit. Determine the range of annual volume for which each of the alternatives would be best.
8. A manager is trying to decide whether to purchase a certain part or to have it produced internally. Internal production could use either of two processes. One would entail a variable cost of \$17 per unit and an annual fixed cost of \$200,000; the other would entail a variable cost of \$14 per unit and an annual fixed cost of \$240,000. Three vendors are willing to provide the part. Vendor A has a price of \$20 per unit for any volume up to 30,000 units. Vendor B has a price of \$22 per unit for demand of 1,000 units or less, and \$18 per unit for larger quantities. Vendor C offers a price of \$21 per unit for the first 1,000 units, and \$19 per unit for additional units.

- a. If the manager anticipates an annual volume of 10,000 units, which alternative would be best from a cost standpoint? For 20,000 units, which alternative would be best?
 - b. Determine the range for which each alternative is best. Are there any alternatives that are never best? Which?
9. A company manufactures a product using two machine cells. Each cell has a design capacity of 250 units per day and an effective capacity of 230 units per day. At present, actual output averages 200 units per cell, but the manager estimates that productivity improvements soon will increase output to 225 units per day. Annual demand is currently 50,000 units. It is forecasted that within two years, annual demand will triple. How many cells should the company plan to produce to satisfy predicted demand under these conditions? Assume 240 workdays per year.
10. A company must decide which type of machine to buy, and how many units of that type, given the following information:

Type	Cost
1	\$10,000
2	14,000

Product demand and processing times for the equipment are:

Product	Annual Demand	PROCESSING TIME PER UNIT (minutes)	
		1	2
001	12,000	4	6
002	10,000	9	9
003	18,000	5	3

- a. How many machines of each type would be required to handle demand if the machines will operate 8 hours a day, 250 days a year, and what annual capacity cushion in processing time would result for each?
 - b. With high certainty of annual demand, which type of machine would be chosen if that was an important consideration? With low certainty, which type of machine would be chosen?
 - c. If purchasing and operating costs are taken into account, which type of machine would minimize total costs, given your answer for part *a*? Operating costs are \$6/hr for type 1 and \$5/hr for type 2.
11. A manager must decide which type of machine to buy, A, B, or C. Machine costs are as follows:

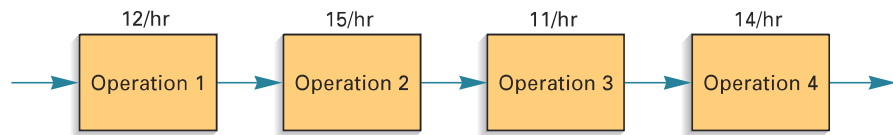
Machine	Cost
A	\$40,000
B	\$30,000
C	\$80,000

Product forecasts and processing times on the machines are as follows:

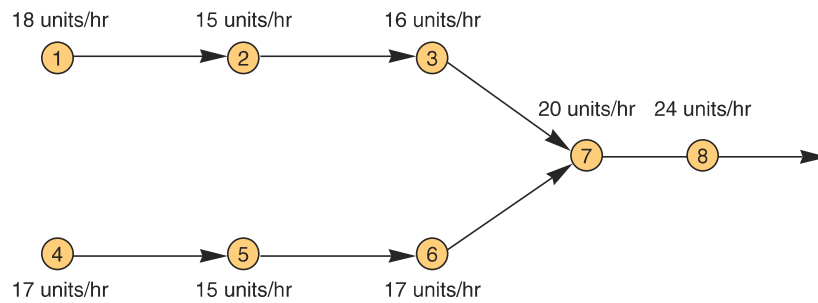
Product	Annual Demand	PROCESSING TIME PER UNIT (minutes)		
		A	B	C
1	16,000	3	4	2
2	12,000	4	4	3
3	6,000	5	6	4
4	30,000	2	2	1

- a. Assume that only purchasing costs are being considered. Which machine would have the lowest total cost, and how many of that machine would be needed? Machines operate 10 hours a day, 250 days a year.
- b. Consider this additional information: The machines differ in terms of hourly operating costs: The A machines have an hourly operating cost of \$10 each, B machines have an hourly operating cost of \$11 each, and C machines have an hourly operating cost of \$12 each. Which alternative would be selected, and how many machines, in order to minimize total cost while satisfying capacity processing requirements?

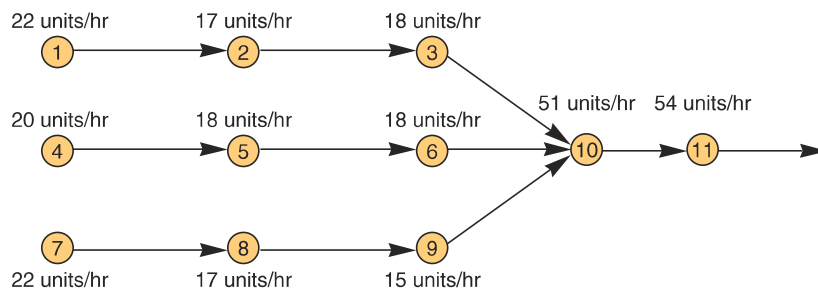
12. A manager must decide how many machines of a certain type to purchase. Each machine can process 100 customers per day. One machine will result in a fixed cost of \$2,000 per day, while two machines will result in a fixed cost of \$3,800 per day. Variable costs will be \$20 per customer, and revenue will be \$45 per customer.
 - a. Determine the break-even point for each range.
 - b. If estimated demand is 90 to 120 customers per day, how many machines should be purchased?
13. The manager of a car wash must decide whether to have one or two wash lines. One line will mean a fixed cost of \$6,000 a month, and two lines will mean a fixed cost of \$10,500 a month. Each line would be able to process 15 cars an hour. Variable costs will be \$3 per car, and revenue will be \$5.95 per car. The manager projects an average demand of between 14 and 18 cars an hour. Would you recommend one or two lines? The car wash is open 300 hours a month.
14. The following diagram shows a four-step process that begins with Operation 1 and ends with Operation 4. The rates shown in each box represent the effective capacity of that operation.
 - a. Determine the capacity of this process.
 - b. Which action would yield the greatest increase in process capacity: (1) increase the capacity of Operation 1 by 15 percent; (2) increase the capacity of Operation 2 by 10 percent; or (3) increase the capacity of Operation 3 by 10 percent?



15. Given the following diagram,
 - a. What is the capacity of this system?
 - b. If the capacity of one operation could be increased in order to increase the output of the system, which operation should it be, and what amount of increase?



16. Find the capacity of this system:



17. The following diagram describes a service process where customers go through either of two parallel three-step processes and then merge into a single line for two final steps. Capacities of each step are shown on the diagram.
 - a. What is the current capacity of the entire system?
 - b. If you could increase the capacity of only one operation through process improvement efforts, which operation would you select, how much additional capacity would you strive for, and what would the resulting capacity of the process be?