

Practice Problems on Process Analysis

from Chase, Aquilano, Jacobs

Problems: 2, 3, 4, 5, 7 on pp. 3-4 of *this* document.

1. State in your own words what Little's Law means. Think of an example that you have observed where Little's Law applies.
2. On a typical weekday in January, 4,200 customers visit the Ypsilanti Wal-Mart. It is estimated that, on average, there are 350 customers in the store. Assuming that the store is open 14 hours a day, how much time does the average customer spend in the store?
3. In 2006, Shouldice Hospital admitted 14,965 patients. In 2007, a 20% increase in admissions is expected. Currently the hospital has 390 beds. Assume the hospital operates 365 days a year (and, please assume one patient per bed!).
 - a) If the average patient stays in the hospital 8 days, how many beds were empty, on average, in 2006?
 - b) On average, how many beds do you expect to be empty in 2007?
4. The total number and gender mix of employees in a certain company remains constant. Due to turnover, on average the company hires 150 men and 200 women each year. It is estimated that on average a woman stays 50% longer than a man. What proportion of the employees are women?
5. The Internal Revenue Service Department of Tax Regulations writes regulations in accord with laws passed by Congress. On average, the department completes 300 projects per year. The *Wall Street Journal* reports that, as of October 11, 1997, the number of projects currently "on the Department's plate" is 588. Nevertheless, the department head claims that average time to complete a project is under six months. Do you have any reason to disagree? Why or why not?
6. A bank finds that the average number of people waiting in line during lunch hour is 10. On average, during this period 2 people per minute leave the bank after receiving service. On average, how long do bank customers wait in line?
7. At the drive-through counter of a fast-food outlet, an average of 10 cars wait in line. The manager wants to determine if the length of the line impacts potential sales. Her study reveals that, on average, 2 cars per minute try to enter the drive-through area, but 25% of these cars are dismayed by the long line and simply move on without entering the line and placing orders. Assume that no car entering the line

leaves without service. On average, how long does a car spend in the drive-through line?

8. Checking accounts at a local bank carry an average balance of \$3,000. The bank turns over its balance six times a year. On average, how many dollars flow through the bank each month?

- 2 Rockness Recycling refurbishes rundown business students. The process uses a moving belt, which carries each student through the five steps of the process in sequence. The five steps are as follows:

STEP	DESCRIPTION	TIME REQUIRED PER STUDENT
1	Unpack and place on belt	1.0 minute
2	Strip off bad habits	1.5 minutes
3	Scrub and clean mind	0.8 minute
4	Insert modern methods	1.0 minute
5	Polish and pack	1.2 minutes

One faculty member is assigned to each of these steps. Faculty members work a 40-hour week and rotate jobs each week. Mr. Rockness has been working on a contract from General Eclectic, which requires delivery of 2,000 refurbished students per week. A representative of the human resources department has just called complaining that the company hasn't been receiving the agreed-upon number of students. A check of finished goods inventory by Mr. Rockness reveals that there is no stock left. What is going on?

- 3 The bathtub theory of operations management is being promoted as the next breakthrough for global competitiveness. The factory is a bathtub with 50 gallons of capacity. The drain is the outlet to the market and can output three gallons per hour when wide open. The faucet is the raw material input and can let material in at a rate of four gallons per hour. Now, to test your comprehension of the intricacies of operations (assume the bathtub is empty to begin with):
- Draw a diagram of the factory and determine the maximum rate at which the market can be served if all valves are set to maximum. What happens to the system over time?
 - Suppose that instead of a faucet, a five-gallon container is used for filling the bathtub (assume a full container is next to the tub to begin with); it takes two hours to refill the container and return it to the bathtub. What happens to the system over time?
- 4 A local market research firm has just won a contract for several thousand small projects involving data gathering and statistical analysis. In the past the firm has assigned each project to a single member of its highly trained professional staff. This person would both gather and analyze the data. Using this approach an experienced person can complete an average of 10 such projects in an eight-hour day.

The firm's management is thinking of assigning two people to each project in order to allow them to specialize and become more efficient. The process would require the data gatherer to fill out a matrix on the computer, check it, and transmit it to the statistical analysis program for the analyst to complete. Data can be gathered on one project while the analysis is being completed on another, but the analysis must be complete before the statistical analysis program can accept the new data. After some practice, the new process can be completed with a standard time of 20 minutes for the data gathering and 30 minutes for the analysis.

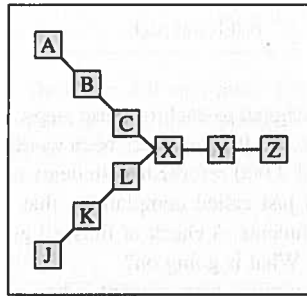
- What is the production (output per hour) for each alternative? What is the productivity (output per labor hour)?
 - How long would it take to complete 1,000 projects with each alternative? What would be the labor content (total number of labor hours) for 1,000 projects for each alternative?
- 5 A processor makes two components, A and B, which are then packaged together as the final product (each product sold contains one A and one B). The processor can do only one component at a time: either it can make As or it can make Bs. There is a setup time when switching from A to B.

Current plans are to make 100 units of component A, then 100 units of component B, then 100 units of component A, then 100 units of component B, and so forth, where the setup and run times for each component are given below.

COMPONENT	SETUP/CHANGEOVER TIME	RUN TIME/UNIT
A	5 minutes	0.2 minute
B	10 minutes	0.1 minute

Assume the packaging of the two components is totally automated and takes only two seconds per unit of the final product. This packaging time is small enough that you can ignore it. What is the average hourly output, in terms of the number of units of packaged product (which includes one component A and one component B)?

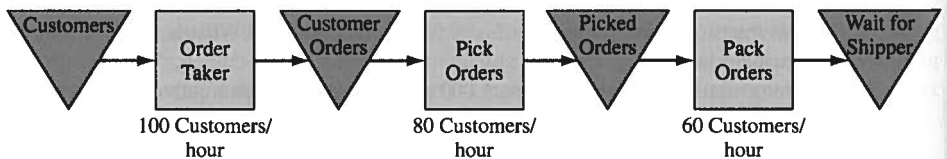
- 6 The following represents a process used to assemble a chair with an upholstered seat. Stations A, B, and C make the seat; stations J, K, and L assemble the chair frame; station X is where the two subassemblies are brought together; and some final tasks are completed in stations Y and Z. One worker is assigned to each of the stations. Generally there is no inventory kept anywhere in the system, although there is room for one unit between each of the stations that might be used for a brief amount of time.



Given the following amount of work in seconds required at each station:

A	38	J	32	X	22
B	34	K	30	Y	18
C	35	L	34	Z	20

- What is the possible daily output of this “process” if 8 hours of processing time is available each day?
 - Given your output rate in part *a*, what is the efficiency of the process?
 - What is the throughput time of the process?
- 7 Wally’s Widget Warehouse takes orders from 7 A.M. to 7 P.M. The manager wants to analyze the process and has provided the process flow diagram shown below. There are three steps required to ship a customer order. The first step is to take the order from a customer. The second step is to pick the order for the customer and then they have to pack the order ready for shipping. Wally promises that every order placed today gets shipped tomorrow. That means that the picking and packing operation must finish all orders before they go home.



Wally wants to figure out the following.

- What is the current maximum output of the process?
- How long will the picking and packing operations have to work if we have a day with the maximum orders?
- What is the maximum number of orders waiting to be picked?
- What is the maximum number of orders waiting to be packed?
- If we double the packing capacity (from 60 to 120 orders per hour), what impact does this have on your answers in parts *b*, *c*, and *d*?