IE375 Fall 2020 Exercise Set V

1) Question from your textbook, 7th Edition, p. 509 – Problem 10 (6th Edition, p. 436 – Problem 10)

10. Seven jobs are to be processed through a single machine. The processing times and due dates are given here.

Job	1	2	3	4	5	6	7
Processing time	3	6	8	4	2	1	7
Due date	4	8	12	15	11	25	21

Determine the sequence of the jobs in order to minimize

a. Mean flow time.
b. Number of tardy jobs.
c. Maximum lateness.
d. What is the makespan for any sequence?

2) Question from your textbook, 7th Edition, p. 517 – Problem 12 (6th Edition, p. 444 – Problem 12)

12. Suppose that 12 jobs must be processed through six machines. If the jobs may be processed in any order, how many different possible schedules are there? If you were to run a computer program that could evaluate 100 schedules every second, how much time would the program require to evaluate all feasible schedules?

17. Peter Minn is planning to go to the Department of Motor Vehicles to have his driver's license renewed. His friend, Patricia, who is accompanying him, is applying for a new license. In both cases there are five steps that are required: (A) having a picture taken, (B) signing a signature verification form, (C) passing a written test, (D) passing an eye test, and (E) passing a driving test.

For renewals the steps are performed in the order A, B, C, D, and E with average times required, respectively, of 0.2, 0.1, 0.3, 0.2, and 0.6 hour. In the case of new applications, the steps are performed in the sequence D, B, C, E, and A, with average times required of 0.3, 0.2, 0.7, 1.1, and 0.2 hour, respectively. Peter and Pat go on a day when the department is essentially empty. How should they plan their schedule in order to minimize the time required for both to complete all five steps?

3) Question from your textbook, 7th Edition, p. 518 – Problem 17 (6th Edition, p. 445 – Problem 17)) 4) Question from your textbook, 7th Edition, p. 522 – Problem 21 (6th Edition, p. 449 – Problem 21)

13. Two law students, John and Marsha, are planning an all-nighter to prepare for their law boards the following day. Between them they have one set of materials in the following five subjects: contracts, torts, civil law, corporate law, and patents. Based on their previous experience, they estimate that they will need the following amount of time (in hours) with each set of materials:

	Contracts	Torts	Civil	Corporate	Patents
John	1.2	2.2	0.7	0.5	1.5
Marsha	1.8	0.8	3.1	1.1	2.3

They agree that Marsha will get the opportunity to see each set of notes before John. Assume that they start their studying at 8:00 P.M. Determine the exact times that each will begin and end studying each subject in order to minimize the total time required for both to complete studying all five subjects.

21. Solve Problem 13 assuming that the times required by John and Marsha are exponentially distributed random variables with expected times given in Problem 13.

5) Question from your text-book, 7th Edition, p. 528 – Problem 25 (6th Edition, p. 455 – Problem 25)

25. A critical resource in a manufacturing operation experiences a very high traffic intensity during the shop's busiest periods. During these periods the arrival rate is approximately 57 jobs per hour. Job processing times are approximately exponentially distributed with mean 1 minute.

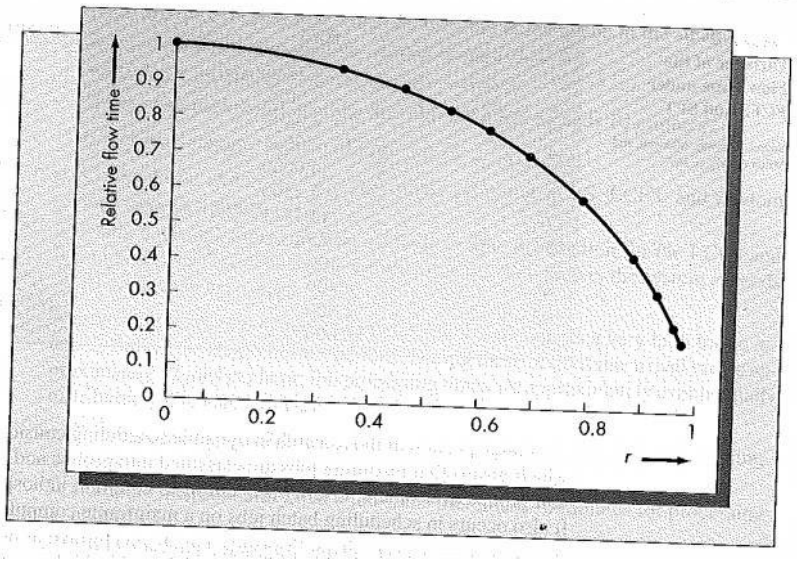
a. Compute the expected flow time in the system assuming an FCFS processing discipline, and the expected flow time under SPT using Figure 8–13.

b. Compute the probability that a job waits more than 30 minutes for processing under FCFS.

c. Using a normal approximation, estimate the probability that a job waits more than 30 minutes for processing under LCFS.

FIGURE 8–13
Relative flow times: SPT versus FCFS

Source: Adapted from tabled results in Conway, Maxwell, and Miller (1967), p. 184.



6) Question from your textbook, 7th Edition, p. 539 – Problem 41 (6th Edition, p. 468 – Problem 41)

41. Five Hong Kong tailors—Simon, Pat, Choon, Paul, and Wu—must complete alterations on a suit for the duke and a dress for the duchess as quickly as possible. On the dress, Choon must first spend 45 minutes cutting the fabric, then Pat will spend 75 minutes sewing the bodice, Simon will need 30 minutes stitching the sleeves, Paul 2 hours lacing the hem, and finally Wu will need 80 minutes for finishing touches. As far as the suit is concerned, Pat begins with shortening the sleeves, which requires 100 minutes. He is followed by Paul, who sews in the lining in 1.75 hours; Wu, who spends 90 minutes sewing on the buttons and narrowing the lapels; and finally Choon, who presses and cleans the suit in 30 minutes.

Determine precisely when each tailor should be performing each task in order to minimize the total time required to complete the dress and the suit. Assume that the tailors start working at 9 A.M. and take no breaks. Draw the Gantt chart indicating your solution.

7) Question from your textbook, 7th Edition, p. 541 – Problem 10 (6th Edition, p. 470 – Problem 45)

45. Develop a template that computes several measures of performance for first-come, first-served job sequencing. Allow for up to 20 jobs so that column 1 holds the numbers 1, 2, . . . , 20. Column 2 should be the processing times to be inputted by the user, and column 3 the due dates also inputted by the user. Column 4 should be the tardiness and column 5 the flow time. Develop the logic to compute the mean flow time, the average tardiness, and the number of tardy jobs. (When computing the average of a column, be sure that your spreadsheet does not treat blanks as zeros.)

a. Use your template to find the mean flow time, average tardiness, and number of tardy jobs for Problem 7 (Section 8.6), assuming FCFS sequencing.

b. Find the mean flow time, average tardiness, and number of tardy jobs for Problem 8, assuming FCFS sequencing.

c. Find the mean flow time, average tardiness, and number of tardy jobs assuming FCFS sequencing for the following 20-job problem:

Job	Processing Time	Due Date	Job	Processing Time	Due Date
1	10	34	11	17	140
2	24	38	12	8	120
3	16	60	13	23	110
4	8	52	14	25	160
5	14	25	15	40	180
6	19	95	16	19	140
7	26	92	17	6	130
8	24	61	18	23	190
9	4	42	19	25	220
10	12	170	20	14	110

8) Question from your textbook, 7th Edition, p. 508-509 – Problems 7 & 8 (6th Edition, p. 435-436 – Problems 7 & 8)

7. On May 1, a lazy MBA student suddenly realizes that he has done nothing on seven different homework assignments and projects that are due in various courses. He estimates the time required to complete each project (in days) and also notes their due dates:

Project	1	2	3	4	5	6	7
Time (days)	4	8	10	4	3	7	14
Due date	4/20	5/17	5/28	5/28	5/12	5/7	5/15

Because projects 1, 3, and 5 are from the same class, he decides to do those in the sequence that they are due. Furthermore, project 7 requires results from projects 2 and 3, so 7 must be done after 2 and 3 are completed. Determine the sequence in which he should do the projects in order to minimize the maximum lateness.

8. Eight jobs are to be processed through a single machine. The processing times and due dates are given here.

Job	1	2	3	4	5	6	7	8
Processing time	2	3	2	1	4	3	2	2
Due date	5	4	13	6	12	10	15	19

Furthermore, assume that the following precedence relationships must be satisfied:

$$2 \rightarrow 6 \rightarrow 3.$$

$$1 \rightarrow 4 \rightarrow 7 \rightarrow 8.$$

Determine the sequence in which these jobs should be done in order to minimize the maximum lateness subject to the precedence restrictions.