

Answer all questions by marking the scantron. Write your name both on the scantron and on the exam. **Write the handwritten number on the exam form on your scantron!!!** You may write on the exam as well. Good Luck!

Consider the following PERT problem:

| Act. | Pred. | a | m | b | T | ES | EF | LS | LF | Slack | σ^2 |
|------|-------|----|----|----|---|----|----|----|----|-------|------------|
| A | D,I | 6 | 12 | 12 | | | | | | | |
| B | F,I | 2 | 8 | 8 | | | | | | | |
| C | B,H | 5 | 12 | 13 | | | | | | | |
| D | – | 10 | 11 | 12 | | | | | | | |
| E | B,H | 12 | 13 | 20 | | | | | | | |
| F | A,D,J | 8 | 8 | 14 | | | | | | | |
| G | C,E,J | 10 | 12 | 14 | | | | | | | |
| H | F,J | 12 | 15 | 18 | | | | | | | |
| I | – | 5 | 7 | 15 | | | | | | | |
| J | A,D,I | 4 | 5 | 12 | | | | | | | |

- Find the expected duration of the project.
 - 78
 - 81
 - 85
 - 89
 - none of the above
- What is the standard deviation of the duration of the project?
 - 2.33
 - 2.67
 - 2.85
 - 3.03
 - none of the above
- How many activities are in the critical path?
 - 5
 - 6
 - 7
 - 8
 - none of the above
- Which activity should be assigned the least experienced team?
 - A
 - B
 - C
 - more than one activity are tied for selection
 - none of the above
- If you consider three standard deviations above the mean as “safe”, what duration should you commit yourself for the completion of the project?
 - 86
 - 90
 - 94
 - 97
 - none of the above

32000 students at Cal State Fullerton are eligible to register for the Fall semester over a 10 day period. The system is open 16 hours each day. Assume that students register at the same rate each hour. Only 80% of the students are expected to register during the period. There are two computers working in parallel with a common waiting line. When a student connects to the system he/she may need to wait until a computer becomes available. When a computer becomes available, the first student in line can log in to

register. Registering takes about 20 seconds. Assume Poisson arrival and exponential service time.

6. How many students are connected to the system?
a. 0.83 b. 0.92 c. 1.01 d. 1.11 e. none of the above
7. How long (in seconds) does it take for an average student from the time they dial in until they are done?
a. 24.92 b. 24.20 c. 23.56 d. 23.00 e. none of the above
8. How many students are actually in the process of registering (and not waiting to log in)?
a. 0.72 b. 0.78 c. 0.83 d. 0.89 e. none of the above
9. What is the probability that a student has to wait in order to log in?
a. 0.22 b. 0.25 c. 0.27 d. 0.19 e. none of the above

Now assume that one computer is down and only one is providing service.

10. How many students are connected to the system?
a. 8.0 b. 3.5 c. 2.6 d. 5.0 e. none of the above
11. How long (in seconds) does it take for an average student from the time they dial in until they are done?
a. 72 b. 90 c. 120 d. 180 e. none of the above
12. How many students are actually in the process of registering (and not waiting to log in)?
a. 0.72 b. 0.78 c. 0.83 d. 0.89 e. none of the above
13. What is the probability that a student has to wait in order to log in?
a. 0.72 b. 0.78 c. 0.83 d. 0.89 e. none of the above

When calling for service, you may need to wait for the operator to direct your call and then may need to wait on hold again until the counselor can talk to you. There is one operator and one counselor. There are 18 people calling for service per hour (assume Poisson arrivals), directing your call takes about 1 minute and is exponentially distributed and getting service from the counselor takes exactly two minutes.

14. How many minutes, on the average, it takes from the time a customer calls until he finished getting service?
a. 5.2 b. 4.9 c. 6.4 d. 6.9 e. None of the above
15. How many customers, on the average, are in the system?
a. 2.2 b. 1.5 c. 1.6 d. 1.9 e. None of the above
16. How many customers, on the average, are waiting on hold?
a. 1.2 b. 1.0 c. 0.6 d. 0.7 e. None of the above

Now assume that there are two operators rather than one.

17. How many minutes, on the average, it takes from the time a customer calls until he finished getting service?
 - a. 6.0
 - b. 6.5
 - c. 4.5
 - d. 4.8
 - e. None of the above
18. How many customers, on the average, are in the system?
 - a. 1.4
 - b. 2.1
 - c. 1.8
 - d. 1.5
 - e. None of the above
19. How many customers, on the average, are waiting on hold?
 - a. 0.5
 - b. 0.6
 - c. 0.9
 - d. 1.1
 - e. None of the above

Customers arrive at the checkout counter at a rate of 10 per hour. You consider hiring one of two cashiers. John can serve customers at an average time of 4 minutes with a standard deviation of 7.2 minutes. George can serve customers at an average time of 5 minutes with a standard deviation of 1.2 minutes. John is paid \$12 per hour and George is paid \$10 per hour. Every minute a customer waits in line costs you \$0.12 in good will cost.

20. How many minutes, on the average, does a customer wait for service if John is hired?
 - a. 17.0
 - b. 18.5
 - c. 23.0
 - d. 19.2
 - e. None of the above
21. How many minutes, on the average, does a customer wait for service if George is hired?
 - a. 12.4
 - b. 13.2
 - c. 14.1
 - d. 15.6
 - e. None of the above
22. How many customers, on the average, are waiting for service if John is hired?
 - a. 2.8
 - b. 3.2
 - c. 3.6
 - d. 4.0
 - e. None of the above
23. How many customers, on the average, are waiting for service if George is hired?
 - a. 1.8
 - b. 2.0
 - c. 2.2
 - d. 2.4
 - e. None of the above
24. What is your cost per hour (including good will cost) if John is hired?
 - a. \$37.15
 - b. \$31.86
 - c. \$39.85
 - d. \$32.94
 - e. None of the above
25. What is your cost per hour (including good will cost) if George is hired?
 - a. \$37.15
 - b. \$31.86
 - c. \$39.85
 - d. \$32.94
 - e. None of the above

In a production process the first machine produces 700 items per day (12 hours) and the second machine uses 400 items per day (also 12 hours). Holding cost is \$0.12 per hour and set up cost is \$20.

26. What is the daily inventory cost?
 - a. \$69.28
 - b. \$87.64
 - c. \$90.71
 - d. \$99.37
 - e. none of the above
27. What should be the quantity produced on the first machine before stopping it?
 - a. 161
 - b. 220
 - c. 183
 - d. 289
 - e. none of the above
28. How many hours should the first machine run before stopping it?
 - a. 3.78
 - b. 5.77
 - c. 2.76
 - d. 3.65
 - e. none of the above

29. How many hours should the first machine be idle before restarting it?
a. 1.51 b. 2.07 c. 1.15 d. 1.83 e. none of the above

30. What is the inventory cost per item?
a. \$0.14 b. \$0.18 c. \$0.22 d. \$0.25 e. none of the above

Daily sales of cars in your dealership are 4 cars with a standard deviation of 3 cars. You are open 250 days a year. Your annual holding cost is \$1600 per car and the ordering cost is \$600. When you place an order it takes 5 days for the order to arrive. Also, you would like to have a safety factor of 2. (For all the answers below round to the nearest integer.)

31. What should be the order quantity?
a. 32 b. 27 c. 30 d. 34 e. none of the above

32. What is the annual inventory cost (with no buffer)?
a. \$43,818 b. \$47,329 c. \$50,596 d. \$53,666 e. none of the above

33. What is the re-order point?
a. 26 b. 30 c. 33 d. 37 e. none of the above

34. What is your extra annual cost for the safety stock?
a. \$21,466 b. \$23,466 c. \$25,466 d. \$27,466 e. none of the above

35. What is your total annual cost for the inventory and the safety stock?
a. \$68,795 b. \$72,063 c. \$75,132 d. \$65,284 e. none of the above