

# MATH 442 / OR 442 Final Examination

120 Minutes

## **Rules:**

1. Close book except two sheets of notes (4 sides)
2. Calculator is OK
3. Absolutely no cheating

Name: \_\_\_\_\_ ID: \_\_\_\_\_

1. There are two restaurants in a small town: M and B. A survey shows that 10% of M customers in this week will switch to B restaurant next week, and 30% of B customers will go to M next week.

- (a) (5) If the market share for M restaurant is currently 50% this week, what is the M restaurant's market share next week?
- (b) (5) What is the steady-state market share for these two restaurants?
- (c) (5) What is the mean first passage time from B to M?

2. Nancy wants to sell some special material called "CC" at the price of \$35 per pound at this Sunday Festival. The order price from the manufacturer is \$20 per pound. She can return the unsold material to the manufacturer at \$10 per pound. Suppose the probability distribution for demand is given in the following table.

Demand (pounds)	Probability
10	0.2
15	0.3
20	0.5

- (a) (8) How many pounds of CC should Nancy order? You can use any method.
- (b) (7) If Nancy decides to order 15 pounds, what is her expected profit?

3. Each week, a computer store sells an average of 100 sets of external hard drive. Weekly demand is normally distributed with a standard deviation of 4 sets. The store orders hard drives from a regional distributor. Each order is filled in one week. The cost of placing each order is \$50, and the weekly cost of holding one set of hard drive in inventory is \$4. The per-unit stockout cost is assumed to be \$5. The store is willing to assume that all demand is back-logged.

(a) (7) Determine a good size of order.

(b) (8) Determine a good reorder point.

(Critical point for standard normal distribution:  $z_{0.5} = 0.0$ ,  $z_{0.55} = 0.1$ ,  $z_{0.6} = 0.2$ ,  $z_{0.65} = 0.3$ ,  $z_{0.7} = 0.5$ ,  $z_{0.75} = 0.6$ ,  $z_{0.8} = 0.8$ ,  $z_{0.85} = 1.0$ ,  $z_{0.9} = 1.2$ ,  $z_{0.95} = 1.6$ ,  $z_{0.99} = 2.3$ ,  $z_{0.999} = 3.0$ . If you can not find the exact number, please use the closest number as an approximation.)

4. Assume that an average of 300 packets per second of information arrive to a router and that it takes an average of 0.002 second to process each packet. Assuming exponential interarrival and service times.

- (a) (5) What is the average number of packets waiting for entry into the router?.
- (b) (5) What is the probability that one or more packets are waiting in the queue?
- (c) (5) What is the average waiting time for a packet before entering the router?.
- (d) (5) If the arrival demand is increased by 50%, how will the average waiting time in part (C) be changed?

5. The Holt method (exponential smoothing with trend and without seasonality) is being used to forecast weekly car sales at Fairfax Ford. Currently, the base is estimated to be 40 cars per week, and the trend is estimated to be 5 cars per week. During the current week, 50 cars are sold.

Assume  $\alpha = \beta = 0.4$ . After observing the current week's sales,

(a) (8) Forecast the number of cars to be sold during next week.

(b) (7) Forecast the number of cars to be sold during next next week (the week after next week).

6. Suppose we have 4 observations for the total construction cost of new houses: \$8K for one house, \$25K for 3 houses, \$42K for 5 houses, and \$49K for 7 houses.

- (a) (7) Please give the least squares regression line for the housing construction costs. Let  $y$  be the total construction cost and  $x$  be the number of houses.
- (b) (7) Is the answer in part (a) the best linear model we can have? Why?
- (c) (6) What is  $R^2$ ?