Marks

This is a closed book exam. No notes are permitted.

1. Assume that the cost of making 20 books is $2,300, the cost of making 50 books is $3,050, and the cost equation is linear. The books are sold for $60 each.

2. (a) Find the marginal cost of production.
3. (b) Find a linear cost function that will represent the total cost of making \( x \) books.
2. (c) What is the fixed cost?
2. (d) Find a profit function that will represent the profit if \( x \) books are made and sold.
2. (e) Find the break-even point.

2. Assume the book value, \( V \), in dollars, of a boat \( t \) years after January 1, 2002 is given by the linear equation \( V = 50,000 - 4,000t \). The expected useful life of the boat is 7 years.

3. (a) Sketch the graph of this linear equation.
2. (b) What is the annual deduction for depreciation?
2. (c) Find the salvage value of the boat (defined to be its value after its expected life).
3. (d) Find when the book value of the boat will be $27,000.

3. Let \( A = \begin{bmatrix} 1 & 8 \\ 3 & 40 \end{bmatrix} \) and \( B = \begin{bmatrix} 2 & k \\ 0 & -5 \end{bmatrix} \). Find

8. (a) \( A + B \)  (b) \( A - 6B \)  (c) \( AB \)  (d) \( A^{-1} \)
3. (e) \( \begin{bmatrix} x \\ y \end{bmatrix} \) if \( A \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 32 \\ 48 \end{bmatrix} \).

6. A pizza parlor offers six toppings on its pizza. Find how many different pizzas are possible that use no more than two toppings.

6. Airlines find that each passenger who reserves a seat fails to show up with probability 0.08 independently of other passengers. As a result, an airline always sells 14 tickets for its 12 seat plane. Find the probability of a given flight having more passengers show up than there are seats available, resulting in overbooking requiring at least one passenger to be bumped from the flight.

6. Last September, Boston had 11 days with rain, 19 days without rain, 5 days with wind gusts above 30 mph, and 16 days without rain and without wind gusts above 30 mph. Find how many days had a rainstorm (meaning both rain and wind gusts above 30 mph) Draw and label a Venn diagram that numerically represents this data.

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7. A manufacturing company has plants in Michigan, Texas and Utah. The plant in Michigan costs $520 per hour to operate and produces 20 chairs, 2 desks and 5 sofas per hour. The plant in Texas costs $360 per hour to operate and produces 10 chairs, 1 desk and 2 sofas per hour. The plant in Utah costs $400 per hour to operate and produces 15 chairs, 1 desk and 4 sofas per hour. The company wants to fill an order for 475 chairs, 40 desks and 120 sofas.

10 (a) Find how many hours each plant should be operated to fill the order at the minimum cost. What is the minimum cost?

7 (b) The company is thinking of bidding on a contract to fill an order for 5 extra chairs. Use marginal analysis to find the change in the minimum cost. What is the marginal cost associated with extra chairs? For what range of number of chairs ordered will this marginal cost be applicable?

7 (c) Find how many hours each plant should be operated to fill the original order exactly. What would the cost be in this case?

5  8. An absent-minded person picks 2 different socks at random from a drawer that contains 4 black and 6 white socks. Find the probability that the socks match.

6  9. A shipment of 10 engines, including 4 that are defective, is sent to a plane factory. The receiving department at the plane factory selects 3 at random for testing, without replacement, and will accept the whole shipment if none of the sample of 3 are found to be defective. Find the probability that the shipment containing 4 defective engines will be accepted.

10. A polygraph test indicates a person is a spy 80% of the time when the person actually is a spy. The polygraph test indicates a person is a spy 2% of the time when the person is not a spy. One person out of 500 in a federal agency actually is a spy. The government plans to test people in the agency using the polygraph test to try to identify the spy.

3 (a) Find the probability that a person selected at random both actually is a spy and has a polygraph test indicating the person is a spy.

5 (b) Find the probability that a person selected at random is a spy, given that the test has indicated the person is a spy.

3 (c) If the government uses this test to screen its employees, what is the expected value for the number of people who are not spies who will have a polygraph test indicating they are a spy when 500 employees are screened?

4  11. A company with 14 workers is going to choose a committee of five, consisting of a chairperson, a secretary, and three other members. In how many ways can this committee be chosen?