1. Let A = {m, a, t, h, e}, B = {m, a, t, i, c, s} and U = {a, b, c, ..., x, y, z}. Which of the following sets is $(A \cup B) \cap (A \cap B)'$? a. $\varnothing$ b. {m, a, t} c. {h, e, m, a, t, i, c, s}

   d. {b, d, f, g, j, k, l, n, o, p, q, r, u, v, w, x, y, z} e. {h, e, i, c, s}

2. Let A and B denote subsets of a universal set U with n(U) = 30. Suppose $n(A \cap B') = 10$, $n(A' \cap B) = 9$ and $n(A \cap B) = 6$. What is $n(A' \cup B')$? a. 24 b. 5 c. 25 d. 16 e. 15

3. How many different 4-letter words (possibly nonsense words) can be formed from the letters of the word DIFFERENT if no letter can be repeated?

a. 9^4 b. 7^4 c. P(7,4) d. P(9,4) e. $\binom{7}{4}$

4. The Jones family, consisting of Mom, Dad, Brad, Bob, Bill and Biff, need to line up for a family picture. However, Bill and Biff are mad at each other and refuse to stand next to each other. Given this, in how many ways can they line up?

a. 6! – 5! b. $2 \cdot 5!$ c. $2 \cdot \binom{6}{5}$ d. $6! - 2 \cdot 5!$ e. $6! - \frac{1}{2} \cdot 5!$

5. How many different poker hands are there consisting of two kings, two queens and one card from a third denomination?

a. $\binom{4}{2}\binom{4}{2}(52)$ b. $\binom{4}{2}\binom{4}{2}(44)$ c. $2^2 \cdot 44$ d. $\binom{13}{2}\binom{4}{2}\binom{4}{2}(44)$ e. $\binom{8}{4}(11)\binom{4}{1}$

6. Jack has six different rare coins, and he wants to give some of them as a gift to Jill. He is willing to part with any or all of the coins, but he wants to give her at least one. In how many ways can he choose the coins that he will give her?

a. 63 b. 64 c. 36 d. 6 e. 57

7. In a certain month (of 30 days) it rains 10 days, snows 10 days and is clear 10 days. In how many ways can such weather be distributed over the month?

a. $\frac{1}{10!}\frac{30!}{(3!)^{10}}$ b. $\frac{1!}{3!}\frac{30!}{(10!)^3}$ c. $\frac{30!}{(3!)^{10}}$ d. $\frac{30!}{(10!)^3}$ e. $\binom{30}{10}^3$

8. An urn contains 4 red marbles and 6 blue ones. Moe, Larry and Curly each pick a marble at random, without replacement. What is the probability that all three wind up with the same color marble?

a. $\frac{1}{4}$ b. $\frac{1}{3}$ c. $\frac{1}{10}$ d. $\frac{2}{3}$ e. $\frac{1}{5}$

9. A light bulb company has 3 factories. Factory I makes 10% of the light bulbs, of which 20% are defective. Factory II makes 50% of the light bulbs, of which 30% are defective. Factory III makes 40% of the light bulbs, of which 10% are defective. A customer buys a bulb and finds it to be defective. What is the probability that it came from Factory I?

a. $\frac{1}{10}$ b. $\frac{21}{100}$ c. $\frac{2}{21}$ d. $\frac{1}{50}$ e. $\frac{3}{5}$

10. 100 married couples form a club. The 200 names are entered into a hat and 10 are selected at random to be the club's officers. What is the probability that no 2 of the 10 are married to each other?

a. $\frac{\binom{100}{10}\binom{10}{2}}{\binom{200}{10}}$ b. $\frac{\binom{100}{10} \cdot 2^{10}}{\binom{200}{10}}$ c. $\frac{990}{200}$ d. $\binom{990}{200}\binom{8}{10}$ e. $\frac{P(100, 10)}{P(200, 10)}$

11. Fred has 5 pairs of socks in a drawer, from which he selects 2 socks at random. What is the probability that the socks match?

a. $\frac{1}{8}$ b. $\frac{1}{10}$ c. $\frac{1}{9}$ d. $\frac{1}{11}$ e. $\frac{2}{5}$

12. Mary plays the following game. She first rolls a 6-sided die and observes the number that appears. She then flips a coin that number of times and observes how many heads come up. What is the probability that she will wind up getting exactly 6 heads?

a. $\frac{6}{64}$ b. $\frac{1}{64}$ c. $\frac{1}{36}$ d. $\frac{1}{6}$ e. $\frac{1}{384}$

13. Find the area under the standard normal curve between $z = \frac{-1}{4}$ and $z = \frac{1}{4}$.

a. 0.25 b. 0.1974 c. 0. 5 d. .5987 e. .4013

14. Doug rolls a pair of 4-sided dice (each of which has sides labelled 1, 2, 3, 4). If the two numbers that appear are the same, he wins \$8. If they are different he must pay \$2. What are his expected winnings from playing the game once?

a. –\$0.50 b. \$0.00 c. –\$1.00 d. \$0.50 e. \$1.00

15. A 6-sided die is rolled until 3 fives appear. What is the probability that the third five appears on the fifth roll? a. $\binom{4}{2}\left(\frac{1}{6}\right)^3\left(\frac{5}{6}\right)^2$ b. $\binom{1}{5}\binom{4}{2}\left(\frac{1}{6}\right)^2\left(\frac{5}{6}\right)^2$ c. $\binom{5}{3}\left(\frac{1}{6}\right)^3\left(\frac{5}{6}\right)^2$

d. $\binom{1}{3}\binom{5}{3}\left(\frac{1}{6}\right)^3\left(\frac{5}{6}\right)^2$ e. $\binom{1}{3}\binom{4}{2}\left(\frac{1}{6}\right)^2\left(\frac{5}{6}\right)^2$

16. In a study of newborn elephants it is found that the birth weights are normally distributed with a mean of 50 lbs. and a standard deviation of 5 lbs. Find the approximate percentage of elephants with weight between 47 and 52 lbs. (Use the attached table.)

a. 66% b. 10% c. 27% d. 38% e. 50%

17. A baseball player has a probability of $\frac{1}{3}$ that he will get a hit on any given at-bat. If he is at-bat 18 times, estimate the probability that he will get between 5 and 10 hits, inclusive. (Use the normal approximation to the binomial distribution, and the attached table.)

a. .6687 b. .7612 c. .9938 d. .9987 e. .5

18. Let L be the line which is parallel to the line $2x + 3y = 4$ and passes through the point (2,1). Which of the following is the equation of L?

a. $2x - 3y = 1$ b. $2x + 3y = 8$ c. $3x - 2y = 4$ d. $3x + 2y = 8$ e. $2x + 3y = 7$

19. The matrix $\begin{bmatrix} 3 & 2 & 1 \\ 2 & 2 & 4 \\ 0 & 2 & 2 \end{bmatrix}$ is pivoted about the circled entry. Find the entry in the first row and third column of the resulting matrix. a. –1 b. –2 c. –3 d. 0 e. 1

20. When the following system of equations is solved, what is the value of y?

$$\begin{cases} x + 2y = 2 \\ 2x + 5y + 2z = 9 \\ 2x + 4y + 2z = 8 \end{cases}$$

a. 3 b. 5 c. 0 d. –1 e. 1

21. One of the following matrix products can be performed and one cannot. For the one that can be performed, find the entry in the second row and third column.

$$\begin{bmatrix} 1 & 2 & -1 \\ 2 & 1 & 2 \\ 3 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 2 & 3 & 4 \\ 0 & -1 & 1 & 2 \\ 3 & 1 & 1 & -1 \end{bmatrix} \quad \text{or} \quad \begin{bmatrix} 1 & 2 & 3 & 4 \\ 0 & -1 & 1 & 2 \\ 3 & 1 & 1 & -1 \end{bmatrix} \begin{bmatrix} 1 & 2 & -1 \\ 2 & 1 & 2 \\ 3 & 0 & 1 \end{bmatrix}$$

a. 9 b. 7 c. −3 d. 0 e. 11

22. Let $A = \begin{bmatrix} 3 & -2 \\ -5 & 4 \end{bmatrix}$ and let A^{-1} be its inverse. The entry in the second row and first column of A^{-1} is

a. 5 b. $\frac{5}{2}$ c. −1 d. $\frac{-5}{2}$ e. The matrix has no inverse

23. The inverse of the matrix $A = \begin{bmatrix} 4 & -2 & 3 \\ 8 & -3 & 5 \\ 7 & -2 & 4 \end{bmatrix}$ is $A^{-1} = \begin{bmatrix} -2 & 2 & -1 \\ 3 & -5 & 4 \\ 5 & -6 & 4 \end{bmatrix}$.

Consider the system of equations $\begin{cases} 4x - 2y + 3z = a \\ 8x - 3y + 5z = b \\ 7x - 2y + 4z = c \end{cases}$ where a, b and c are some fixed numbers. If this system is solved, the value of y is

a. b b. 8a − 3b + 5c c. 3a − 5b + 4c d. 2 e. 2a − 5b −6c

24. Consider the system of equations $\begin{cases} x + y + 2z = 2 \\ 2x + 2y + 5z = 3 \end{cases}$

Which of the following is the general solution?

a. x = 2 − y
y = any number
z = − 1

b. x = 2 − y − z
y = any number
z = any number

c. x = 2 − 2z
y = − 1
z = any number

d. x = 3
y = 1
z = −1

e. x = 4 − y
y = any number
z = − 1

25. Consider the system of inequalities

$$\begin{aligned} x + 2y &\geq 5 \\ 3x - y &\geq 1 \\ x \geq 0,\ y &\geq 0. \end{aligned}$$

The vertices of the feasible set are

a. (1,2) and (5,0) b. (0,0), $\left(\frac{1}{3},0\right)$, (1,2) and $\left(0,\frac{5}{2}\right)$

c. $\left(0,\frac{5}{2}\right)$ and (1,2) d. $\left(\frac{1}{3},0\right)$, (1,2) and (5,0) e. (0,−1), $\left(\frac{1}{3},0\right)$ and (5,0)

26. Maximize the function 6x + 3y subject to the constraints

$$\begin{aligned} 2x + 3y &\leq 7 \\ 3x + 2y &\leq 8 \\ x \geq 0,\ y &\geq 0. \end{aligned}$$

The maximum value obtained is a. 7 b. 15 c. 16 d. 21 e. 12

27. Set up the following linear programming problem:
A company makes two kinds of bicycles: Standard and Deluxe. A Standard bicycle requires $75 of material and 6 man-hours of labor and sells for $200. A Deluxe bicycle requires $100 of material and 10 man-hours of labor and sells for $300. The company has available $5000 of material and 300 man-hours of labor each day. How many of each type of bicycle should they produce each day in order to maximize revenue? (Let x = # Standard bicycles and y = # Deluxe bicycles.)

a. Maximize $5000x + 300y$
subject to
$75x + 6y \le 200$
$100x + 10y \le 300$
$x \ge 0$
$y \ge 0$

b. Maximize $75x + 100y$
subject to
$200x + 300y \le 5000$
$6x + 10y \le 300$
$x \ge 0$
$y \ge 0$

c. Maximize $200x + 300y$
subject to
$75x + 6y \le 5000$
$100x + 10y \le 300$
$x \ge 0$

d. Maximize $200x + 300y$
subject to
$75x + 100y \le 5000$
$6x + 10y \le 300$
$y \ge 0$

e. Maximize $200x + 300y$
subject to
$75x + 100y \le 5000$
$6x + 10y \le 300$
$x \ge 0$
$y \ge 0$

28. Set up the following linear programming problem: Mahogany Farms makes three kinds of Christmas Gift packages, El Cheapo, Yummy and Porker's Delight. Each package of El Cheapo contains one sausage, two slices of cheese and three crackers, and sells for $5. Each package of Yummy contains two sausages, four slices of cheese and ten crackers, and sells for $12. Each package of Porker's Delight contains five sausages, ten slices of cheese and twenty-five crackers, and sells for $28. They are obligated to have exactly 1000 packages in stock, all together. How many of each type of package should they produce in order to maximize (potential) revenue if they have on hand 2000 sausages, 3000 slices of cheese and 5000 crackers? (Let x = # El Cheapo's, y = # Yummies)

a. Maximize $28{,}000 - 23x - 16y$
subject to:
$x + 2y \le 2000$
$2x + 4y \le 3000$
$3x + 10y \le 5000$
$x + y \le 1000$
$x \ge 0$
$y \ge 0$

b. Maximize $28{,}000 - 23x - 16y$
subject to:
$4x + 3y \ge 3000$
$8x + 6y \ge 7000$
$22x + 15y \ge 20{,}000$
$x + y \le 1000$
$x \ge 0$
$y \ge 0$

c. Maximize $28{,}000 - 23x - 16y$
$12y$
subject to:
$2x + y \ge 1000$
$8x + 6y \ge 7000$
$20x + 15y \ge 20{,}000$
$20{,}000$
$x + y \le 1000$
$y \le 1000$
$x \ge 0$
$y \ge 0$

d. Maximize $28{,}000 - 23x - 16y$
subject to:
$2x + 3y \le 2000$
$4x + 10y \le 3000$
$10x + 25y \le 5000$
$x + y \le 1000$
$x \ge 0$
$y \ge 0$

e. Maximize $5x +$
subject toP
$2x + y \ge 1000$
$8x + 6y \ge 7000$
$20x + 15y \ge$
$x +$
$x \ge 0$
$Y \ge -$