1. Have many different ways can you choose a president, a vice president, a secretary, 3 public relations people, and 5 consultants from a group of 20 people?

2. In a linear programming problem, \(x\) is the number of elephants and \(y\) is the number of penguins. The corner points of the bounded feasible region are (10, 10), (20, 40), and (30, 20). Maximize the revenue \(R = 10x + 5y\), where the revenue is in Euros. What is the maximum revenue and how many elephants and penguins yield the maximum revenue?
3. Circle all true statements.
   a. If \( C = \{-2, -1, 0, 1, 2, 3\} \), then \(-1, 3 \in C\).
   b. If \( A \subseteq B \) and \( B \subseteq A \) for any two sets \( A \) and \( B \), then \( A = B \).
   c. If \( A \cap B = \emptyset \) for any two sets \( A \) and \( B \), then \( A \cup B = U \), where \( U \) is the universal set.
   d. \( (A \cup B)^c = A^c \cup B^c \)
   e. The empty set is a proper subset of all sets.

4. Your music collection consists of 4 different country, 5 different soft rock, and 2 different dance CDs.
   a. How many ways is it possible to place all CDs lined up on a shelf if the same type are grouped together?
   b. If you grab 3 of these CDs, how many ways can you get 2 country or 1 soft rock CDs?

5. If you and 5 of your friends sat down around a circular table, how many different seating arrangements are there?
6. Graph the system of inequalities and label the feasible region $S$.

\[ \begin{align*}
5x + 3y &\leq 60 \\
5x + 6y &\leq 90 \\
x &> 4 \\
y &\geq 0
\end{align*} \]

7. Four couples attend a theater show and are seated in a row of eight seats. How many different seating arrangements are possible if couples are seated together and Susan must sit on one of the ends?

8. What set is represented by the shaded region in the Venn diagram?
9. A clown makes two types of balloon animals: mammals and dinosaurs. A mammal balloon take 25 units of helium and 7 minutes to make, while a dinosaur take 16 units of helium and 16 minutes to make. Each month the clown has 5600 labor minutes and 12800 units of helium available to make balloon animals. If a mammal balloon sells for $2 each and a dinosaur sells for $5 each, how many of each type should the clown make to maximize revenue if at least 160 mammal balloons are needed? Discuss leftovers.
10. Let $A = \{1, 2, g, h\}$, $B = \{1, 3, h, t\}$, $D = \{5, g\}$, and the universal set $U = A \cup B \cup D$.

a. $n(A \cap B) =$

b. $A \cup D =$

c. $n\left[(B \cup D)^c\right] =$

d. True or False $1 \in (A^c \cap D)^c$

e. $A^c \cup B =$

f. List all subsets of set $D$. Circle all subsets that are not proper subsets of $D$.

g. How many subsets does the universal set $U$ have?

h. $A \cap B \cap D =$

11. How many distinguishable ways can the letters of the word *Abracadabra* be permuted?

12. Fully simplify: $4! \cdot P(5, 2) \cdot 0! \cdot C(6, 3) \cdot \frac{P(5, r)}{C(5, r)}$. 
13. There are 4 different green balls, 5 different purple balls, 2 identical yellow balls, and 3 different red balls.

   a. How many different ways can you get a sample of 3 balls from the 14 balls with no restrictions?

   b. How many ways can just the green, purple and red balls be lined up if all balls of the same color must be next to each other? (no yellow balls)

   c. How many different ways can you get a sample of 3 balls from 14 balls with exactly 3 yellow?

   d. How many ways can the 5 purple balls and 3 red balls be placed in a row if a red ball must be on one of the ends?

   e. How many different ways can you get a sample of 3 balls from 14 balls with 1 green, 1 purple and 1 red ball?

   f. If all 14 balls are lined up in a row, how many distinguishable patterns are possible? Leave your answer as a product of integers.

   g. How many different ways can you get a sample of 3 balls from 14 balls with at least 2 purple balls?
h. How many different ways can you get a sample of 3 balls from 14 balls with at least 2 green or exactly 1 red ball?

i. How many different ways can just the 5 purple balls and 3 red balls be placed in a row if the red balls are not next to each other?

j. If all the green and all the purple balls are placed on a circle, how many different patterns are possible?

14. A family has three children.

a. Give an appropriate sample space $S$ based upon gender (let $b$ be the event of a boy and let $g$ be the event of a girl).

b. Describe the event $M$ where the middle child is a boy.

c. Give an example of a sample point of this experiment.

d. How many nonempty subsets does this sample space have?
15. Draw a Venn diagram such that $U = A \cup B$, $A \cap B = \emptyset$, $D \cap A \neq \emptyset$, $D \cap B \neq \emptyset$, $D \cap C = \emptyset$, and $C \subset A$.

16. Given the following set.

$$Q = \{q,u,i,c,k,s,t,e,p\}$$
$$R = \{r,u,m,b,a\}$$
$$T = \{t,a,n,g,o\}$$

such that $U = Q \cup R \cup T$.

a. List all subsets of $Q \cap R \cap T$.

b. $n(R \cup T) =$

c. List all proper subsets of $\{r,u,m\}$

d. $n(\emptyset) =$

e. $n\left(Q^C \cup \left(R \cup T^C\right)^C\right) =$

f. True or False $t \in \left(Q^C \cup T^C\right)^C$

g. True or False $R \subset R$

h. True or False $\{a,b,m,r,u\} = R$

i. True or False $m \in R$

j. True or False $b \notin R^C$

k. True or False $\{T\} \subseteq T$

l. True or False $\{k\} \subset Q$

m. True or False $z \notin T^C$
17. Set up this linear programming problem; do not solve: Alexis plans to invest up to $900,000 in three projects. Project A yields a return of 8.5%, Project B yields a return of 11%, and Project C yields a return of 15% on the investment. Alexis wants to invest at least twice as much in Project B as Project A. Because the investment in Project C is riskier than the other two, Alexis has decided that the investment in Project C should not exceed 22% of the total investment. How much should she invest in each project to maximize the return on her investment?

18. A letter from the word *two* is chosen at random and then a letter from the word *tutu* is chosen at random.

   a. What is the sample space $S$?

   b. List one of the sample points.

   c. How many events does this experiment have?

   d. Describe the event $E$ such that at least one vowel is chosen. The vowels are $a, e, i, o$ and $u$.

   e. Give an example of two mutually exclusive events.

   f. What is the non-proper event of this sample space $S$?

   g. Is this sample space finite or infinite?
19. The following information was collected after asking 146 residents were asked if they liked to read, watch movies, or dance for entertainment.

- 15 liked to only read
- 17 liked to watch movies and dance, but not read
- 48 liked to dance
- 44 liked to read and watch movies
- 20 liked to dance and read
- 75 liked to read or watch movies, but not dance
- 30 liked to watch movies and dance

a. How many residents did not like any of these forms of entertainment?

b. How many residents liked to read or dance but not watch movies?

c. How many residents liked to do all three of these forms of entertainment?

d. How many residents liked to do at least two of these forms of entertainment?