**Lesson3 Combinations**

1. If 5 sprinters compete in race, how many different ways can the medals for first, second, and third place, be awarded?

Does the order of finish for the fastest three matter here?

This is an example of a **permutation** of objects taken at a time.

1. If 5 sprinters compete in a race and the fastest 3 qualify for the relay team, how many different relay teams can be formed?

*Visualize the 5 sprinters below. Since 3 will qualify for the relay team and 2 will not, consider the number of ways of arranging 3 Y’s and 2 N’s.*

Does the order of finish for the fastest three matter here?

This is an example of a **combination** of objects taken at a time.

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| **Combinations**  An *unordered* arrangement of distinct objects is called a *combination*.  The number of combinations of *n* distinct objects taken *r* at a time is |

1. a) How many different committees of 3 people can be formed from 7 people?

b) How many different committees of 3 people can be formed from 7 people if the first person selected serves as the chairperson, the second as the treasurer, and the third as the secretary?

c) If the group of 7 people consists of 3 males and 4 females, how many different committees of 3 people can be formed with 1 male and 2 females?

*Think: you must choose 1 male out of the group of 3 males and 2 females out of the group of 4 females.*

d) If the group of 7 people consists of 3 males and 4 females, how many different committees of 3 people can be formed with **at least** one male on the committee?

1. To play Lotto 6/49, you must choose 6 numbers from 1 to 49. How many ways are there to do this?
2. Solve: = 21
3. A standard deck of 52 playing cards consists of 4 suits (spades, hearts, diamonds, and clubs) of 13 cards each.
4. How many different 5-card hands can be formed?
5. How many different 5-card hands can be formed that consist of all hearts?
6. How many different 5-card hands can be formed that consist of all face cards?
7. How many different 5-card hands can be formed that consist of 3 hearts and 2 spades?
8. How many different 5-card hands can be formed that consist of exactly 3 hearts?
9. How many different 5-card hands can be formed that consist of **at least** 3 hearts?

REMEMBER!

Whenever a few outcomes are possible that fit the criteria, **cases must be considered**. Questions involving the words: **at least, at most, less than, more than**, -- often require cases to determine the solution.

**Applications of Combinations – Poker Hands**

Many games are based on the rules of poker, a game in which five cards are dealt from a shuffled standard deck of 52 cards and different hands are assigned different values. The value of a specific hand is related to the number of ways in which that combination can appear.

For example, there are only four ways to obtain a royal flush. This is the top-rated hand consisting of a 10, jack, queen, king, and ace, all of one suit (i.e., all clubs, all diamonds, all hearts, or all spades).

How many ways are there to obtain the other three highly-rated combinations described below?

**Four of a kind** – four cards of the same rank and one other card

**Full house** – three cards of the same rank and two cards both of another rank (three of a kind, and a pair)

**Two Pairs-** two pairs of cards of distinct ranks and another card

**One Pair-**one pair and three other cards ( no other pair or three of a kind)

**In-class work**

1. Five boys and 5 girls were nominated for a homecoming celebration at a local school. How many ways can a king, a queen, and a court of 2 students be selected from those nominated?
2. A committee consists of 10 people.
3. How many ways can a subcommittee of 3 people be selected from the committee?
4. How many ways can an executive subcommittee consisting of 3 people (chairperson, treasurer, and secretary) be selected from the committee?
5. Why are the answers to parts a and b different?
6. From a deck of 52 cards, how many 5-card hands can be formed in each case?
7. There are only aces and face cards
8. There are only numbered cards (no letters)
9. There are 2 clubs and 3 diamonds
10. There are at least 4 red cards
11. There are exactly 3 fives
12. From a deck of 52 cards, the 12 face cards are removed. From these face cards, 4 are chosen. How many combinations that have at least two red cards are possible?
13. To play in the Super 7 lottery, you must choose 7 numbers from 1 to 47. To play in the Lotto 649 lottery, you must choose 6 numbers from 1 to 49. To win each jackpot, the numbers chosen must match the numbers drawn by the lottery corporation.
14. Without doing any calculations, which do you think is more likely, winning the Super 7 jackpot or winning the Lotto 649 jackpot?
15. How many ways are there to match exactly 4 numbers in each lottery?
16. There are 8 boys and 12 girls in a drama club. How many ways can a committee of 5 be selected in each case?
17. There must be at least 2 boys
18. There must be at least 2 girls
19. There must be more girls than boys