

# Chapter 3

## Probability

# 3.1

## Basic Concepts of Probability and Counting

# Definitions:

- Probability – the \_\_\_\_\_ of \_\_\_\_\_
- Probability Experiment – an \_\_\_\_\_ through which \_\_\_\_\_ are obtained
  - EX:
- Sample space – the set of \_\_\_\_\_  
\_\_\_\_\_
- EX:

○ Event – \_\_\_\_\_ of the \_\_\_\_\_

○ EX:

○ Simple event – event that consists of a

\_\_\_\_\_

○ EX:

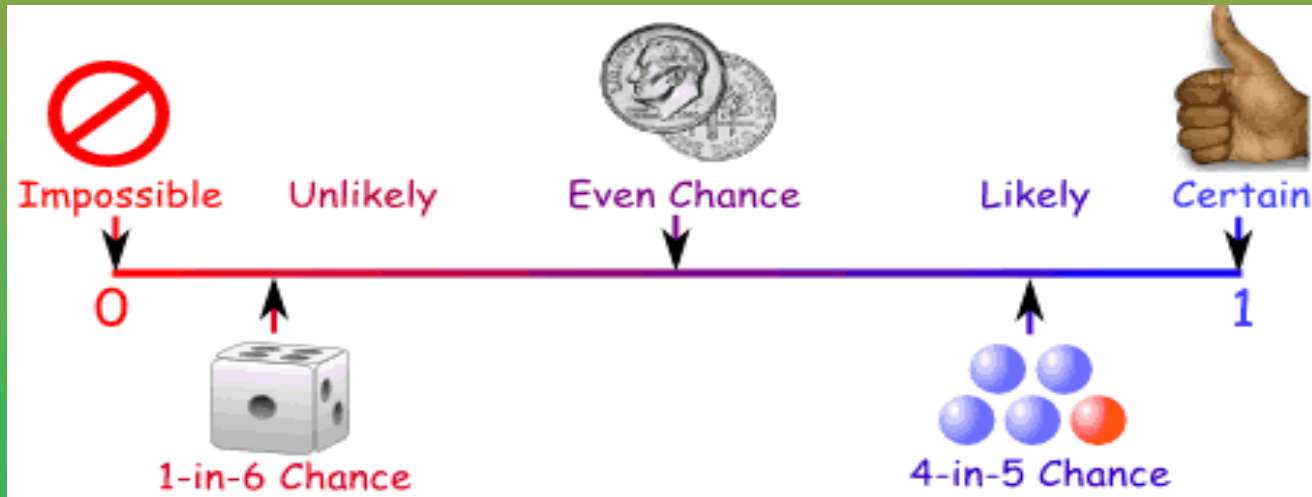
○ Outcome – \_\_\_\_\_ of a \_\_\_\_\_

\_\_\_\_\_

○ EX:

# Express Probabilities:

- As a \_\_\_\_\_ or \_\_\_\_\_  
\_\_\_\_\_ or as a \_\_\_\_\_.
- 0 – cannot occur
- 1 – certain to occur



# Unusual Events

- An event that has a \_\_\_\_\_ of occurring
  - Approximately \_\_\_\_\_

# Rounding Probabilities

- When a probability is not an \_\_\_\_\_  
\_\_\_\_\_ or a \_\_\_\_\_  
– round it to \_\_\_\_\_

EX: Determine the number of outcomes and then decide if the event is simple or not.

- You roll a 6 sided die. Event A: rolling at least a 4.
  
- You ask a student her age on her last birthday. Event B: the student's age is 20.



# Fundamental Counting Principle

- The \_\_\_\_\_ that events can occur in sequence is found by \_\_\_\_\_ the \_\_\_\_\_ by the \_\_\_\_\_
  - Practical to use when there are several outcomes
  - EX:

# EX: Determine the number of outcomes.

- Tossing a coin and then rolling a 6 sided die
  
- Recording a response to a survey (Yes, No, Not Sure) and the geographic location of the respondent (Northeast, South, Midwest, West)

# EX: Use the FCP.

- How many license plates can you make when a license plate consists of:
  - Six (out of 26) letters, each of which can be repeated
  - Six (out of 26) letters, each of which cannot be repeated
  - Six (out of 26) letters, each of which can be repeated, but the first letter cannot be A,B,C, or D

# Types of Probability

○ 1) \_\_\_\_\_ Probability:

○ Used when each outcome in a sample space is  
\_\_\_\_\_ to occur

○  $P(A) =$

○ EX:

# EX:

- You select a card from a standard deck of playing cards. Find the probability of each:
  - Event A: Selecting the nine of clubs
  - Event B: Selecting a heart
  - Event C: Selecting a diamond, heart, club, or spade

- 2) \_\_\_\_\_ Probability:
- Based on \_\_\_\_\_ obtained from \_\_\_\_\_
- Use \_\_\_\_\_ to find the probability of the \_\_\_\_\_
- $P(A) =$

- EX: Survey results on favorite sport:

Football – 75    Basketball – 40    Baseball – 21

You could use the \_\_\_\_\_ to find the probability that the \_\_\_\_\_ likes football the best.

EX:

- An insurance company determines that in every 100 claims, 4 are fraudulent. What is the probability that the next claim the company processes is fraudulent?

# EX:

- A company is conducting a phone survey of randomly selected individuals to determine the ages of social networking site users. The results are shown in the frequency distribution. What is the probability that the next user surveyed is 23-35 years old?

<b>Ages</b>	<b>Frequency</b>
18-22	156
23-35	312
36-49	254
50-65	195
65 and over	58



# Law of Large Numbers

- As an experiment is \_\_\_\_\_, the \_\_\_\_\_ of an even gets closer to the \_\_\_\_\_ of the event.
- EX: Tossing a coin

○ 3) \_\_\_\_\_ Probability

○ Probability resulting from \_\_\_\_\_  
\_\_\_\_\_

○ EX: A doctor \_\_\_\_\_ that a patient has a 90% chance of a full recovery after surgery based on the patient's health history

# Complementary Events

- Complement – all \_\_\_\_\_ in which the event does not occur
- The \_\_\_\_\_ of an \_\_\_\_\_ and its \_\_\_\_\_ is \_\_\_\_\_.
  
- EX: Event – rolling at least a 5  
Compliment –

## 3.2

# Conditional Probability and the Multiplication Rule

# Conditional Probability

- Sometimes it is necessary to \_\_\_\_\_  
\_\_\_\_\_ of the \_\_\_\_\_  
event to \_\_\_\_\_.
- “Without replacement”
- Notation:

EX:

- Two cards are selected from a standard deck of playing cards. Find the probability that the second card is a queen, given that the first card is a king (Assume that the king is not replaced).

○ Independent events – the occurrence of one event  
\_\_\_\_\_the probability of the  
other

○ EX:

○ Dependent events – the occurrence of one event  
\_\_\_\_\_the probability of the other

○ EX:

# EX:

- Determine whether the events are independent or dependent:
- Smoking a pack of cigarettes per day and developing a lung disease.
- Tossing a coin and getting a head, then tossing the coin again and getting a tail.



# Multiplication Rule

- $P(A \text{ and } B) = P(A) \cdot P(B|A)$
- Meaning: To find the probability of \_\_\_\_\_  
\_\_\_\_\_ and \_\_\_\_\_  
\_\_\_\_\_, **the probability of A by the probability of B, but be sure to adjust the probability of B if necessary.**

# EX:

- Two cards are selected, without replacing the first card, from a standard deck of playing cards. Find the probability of selecting:
  - a king and then selecting a queen.
  - Two hearts
- A coin is tossed and a die is rolled. Find the probability of tossing a head and then rolling a 6.

# EX:

- The probability that an ACL reconstructive surgery is successful is 0.95.
  - Find the probability that three ACL surgeries are successful.
  
- Find the probability that none of the three surgeries are successful.
  
  
  
  
  
  
  
  
  
  
- Find the probability that at least one of the three surgeries is successful.

# EX:

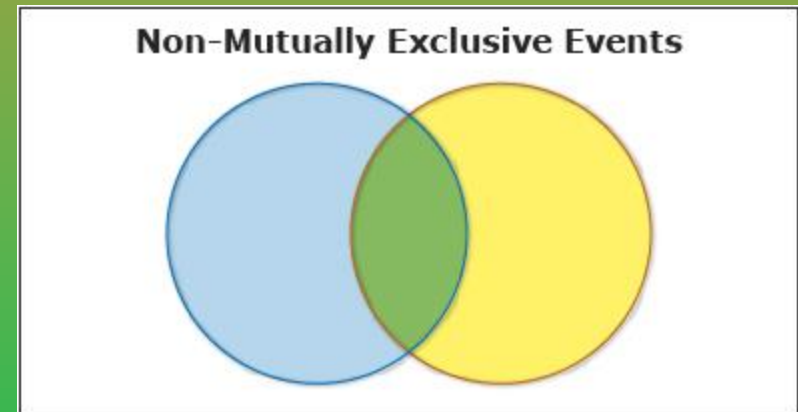
- In a jury selection pool, 65% of the people are female. Of these 65%, one out of four works in a health field.
  - Find the probability that a randomly selected person from a jury pool is female and works in a health field. Is this event unusual?
  
- Find the probability that a randomly selected person from the jury pool is female and does not work in a health field? Is this event unusual?

# 3.3

## Addition Rule

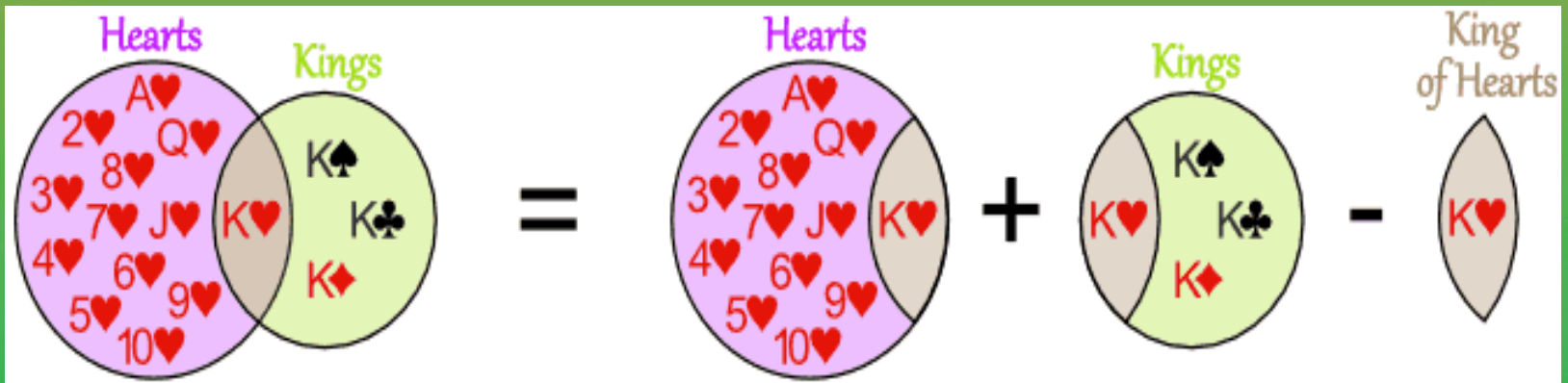
# Mutually Exclusive Events

- Events that \_\_\_\_\_ at the same time
  - \_\_\_\_\_
- $P(A \text{ or } B)$
- EX: <http://www.mathsisfun.com/data/probability-events-mutually-exclusive.html>



# Addition Rule

- $P(A \text{ or } B) =$  Probability that \_\_\_\_\_ A occurs or B occurs
- $P(A \text{ or } B) =$
- Meaning: \_\_\_\_\_ individual probabilities of \_\_\_\_\_ but \_\_\_\_\_ the probability that they \_\_\_\_\_



EX:

- You select a card from a standard deck. Find the probability that the card is a 4 or an ace.
  
- You roll a die. Find the probability of rolling a number less than 3 or rolling an odd number.



EX:

- A die is rolled. Find the probability of rolling a 6 or an odd number.
  
- A card is selected from a standard deck. Find the probability that the card is a face card or a heart.

## 3.4 Additional Topics in Probability and Counting

# Permutation

- An \_\_\_\_\_ of objects.
- The number of \_\_\_\_\_ that \_\_\_\_\_ can be arranged \_\_\_\_\_ is \_\_\_\_\_.
- \_\_\_\_\_ :

EX:

- The women's hockey teams that qualified for the Olympics are Canada, Finland, Russia, Sweden, Switzerland, and the United States. How many different final standings are possible?

# Permutations in a Group of Objects

- Choosing \_\_\_\_\_ in a \_\_\_\_\_ and putting them in \_\_\_\_\_:
- Permutation of \_\_\_\_\_ taken \_\_\_\_\_

EX:

- Find the number of ways of forming four-digit codes in which no digit is repeated.
  
  
  
  
  
  
  
  
  
  
- Forty-three race cars started the Daytona 500. How many ways can the cars finish first, second, or third?

# Permutations in Groups of Objects – in which some Objects are the Same

- EX: Grouping the letters AAAABBC
- All orders are \_\_\_\_\_
- EX: Switching the \_\_\_\_\_ produces the \_\_\_\_\_.

○ To find the number of \_\_\_\_\_  
of \_\_\_\_\_, where  
\_\_\_\_\_ :



EX:

- A building contractor is planning to develop a subdivision. The subdivision is to consist of 6 one-story houses, 4 two-story houses, and 2 split-level houses. In how many distinguishable ways can the houses be arranged?

EX:

- The contractor wants to plant 6 oak trees, 9 maple trees, and 5 poplar trees along the subdivision street. In how many distinguishable ways can the trees be planted?

# Combinations

- Ordering objects in which \_\_\_\_\_.
- EX:



EX:

- A state's department of transportation plans to develop a new section of interstate highway and receives 16 bids for the project. The state plans to hire four of the bidding companies. How many different combinations of four companies can be selected from the 16 bidding companies?

EX:

- The manager of an accounting department wants to form a three-person committee from the 20 employees in the department. In how many ways can the manager form this committee?

# EX: Probabilities and Counting Principles

- A student advisory board consists of 17 members. Three members serve as the board's chair, secretary, and webmaster. Each member is equally likely to serve in any of the positions. What is the probability of selecting at random the three members who currently hold the three positions?

EX:

- Find the probability of being dealt 5 diamonds from a standard deck of 52 playing cards.