

## Chapter 5 Elementary Probability Theory

### Section 5.1 What is Probability?

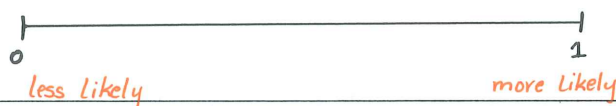
Objective: In this lesson you learned how to work with probabilities and the law of large numbers and apply them to real-life situations.

#### Important Vocabulary

Probability	Relative Frequency	Equally Likely Outcomes	Law of Large Numbers
Event	Simple Event	Sample Space	Complement of an Event

#### I. Probability

**Probability** is: A numerical measure between 0 and 1 that describes the likelihood that an event will occur.



$P(A)$ , read "P of A," denotes the **probability of event A**.

- $P(A) = 1$ ; Event A is certain to occur
- $P(A) = 0$ ; Event A is certain not to occur

#### Focus Points:

- Assign probabilities to events
- Explain how the law of large numbers relates to relative frequencies
- Apply basic rules of probability in everyday life

#### Probability Assignments

1. A probability based on intuition incorporates past experience, judgement, or opinion to estimate the likelihood of an event.

2. A probability based on relative frequency uses the formula

$$P(A) = \text{relative frequency} = \frac{f}{n}$$

3. A probability based on equally likely outcomes uses the formula

$$P(A) = \frac{\# \text{ of favorable outcomes}}{\text{total } \# \text{ of outcomes}}$$

A **statistical experiment** or: statistical observation can be thought of as any random activity that results in a definite outcome.

An **event** is a: collection of one or more outcomes of a statistical experiment

A **simple event** is: one particular outcome of an experiment

**Sample space** - the set of ALL simple events

The **sum** of all probabilities = 1

The **complement of event A**: is the chance that event A does not occur.  
NOTATION  $\rightarrow A^c$

1.  $P(A) + P(A^c) = 1$

2.  $P(\text{Event A does not occur}) = P(A^c) = 1 - P(A)$

Some Important Facts About Probability

1. A statistical experiment is any random activity that results in a definite outcome. A simple event is one outcome of the experiment. The sample space is the set of all simple events.

2.  $P(A)$  = Probability of Event A.

3. Probability is between 0 and 1.  
- can be written as a fraction, decimal, or percent.

4. The sum of all probabilities of a sample space is 1.

5. Probabilities can be assigned using intuition, relative frequency, or equally likely outcomes.

6. The complement of event A is  $A^c$

7.  $P(A) + P(A^c) = 1$ .

## II. Interpreting Probabilities

What does the probability of an event tell us?

- The likelihood that Event  $A$  will occur.
- The probability of event  $A$  applies only in the context of conditions surrounding the sample space.
- If we know  $P(A)$  then we can easily compute  $P(A^c)$ .

Focus Points:

- Explain the relationship between statistics and probability

## Section 5.1 Examples – What is Probability?

( 1 ) Assign a probability to the indicated event on the basis of the information provided. Indicate the technique you used: intuition, relative frequency, or the formula for equally likely outcomes.

- a. A random sample of 500 students at Hudson College were surveyed and it was determined that 375 wear glasses or contact lenses. Estimate the probability that a Hudson College student selected at random wears corrective lenses.

$$P(\text{student needs corrective lenses}) = \frac{375}{500} = 0.75$$

- b. The Friends of the Library hosts a fundraising barbecue. George is on the cleanup committee. There are four members on this committee, and they draw lots to see who will clean the grills. Assuming that each member is equally likely to be drawn, what is the probability that George will be assigned the grill-cleaning job?

$$P(\text{George}) = \frac{1}{4}$$

- c. Joanna photographs whales for Sea Life Adventure Films. On her next expedition, she is to film blue whales feeding. Based on her knowledge of the habit of blue whales, she is almost certain she will be successful. What specific number do you suppose she estimates for the probability of success?

$$0.90 < P(\text{Success}) < 1$$

( 2 ) Professor Gutierrez is making up a final exam for a course in literature of the southwest. He wants the last three questions to be of the true-false type. To guarantee that the answers do not follow his favorite pattern, he lists all possible true-false combinations for three questions on slips of paper and then picks one at random from a hat.

- a. Finish listing the outcomes in the given sample space.

TTT	FTT	TFT	FFT
TTF	FTF	TFF	FFF

- b. What is the probability that all three items will be false? Use the formula

$$P(\text{all F}) = \frac{\text{No. of favorable outcomes}}{\text{Total No. of outcomes}}$$

$$P(\text{ALL F}) = \frac{1}{8}$$

- c. What is the probability that exactly two items will be true?

$$P(\text{Two T}) = \frac{3}{8}$$

( 3 ) A veterinarian tells you that if you breed two cream-colored guinea pigs, the probability that an offspring will be pure white is 0.25. What is the probability that an offspring will not be pure white?

a.  $P(\text{pure white}) + P(\text{not pure white}) = \underline{1}$

b.  $P(\text{not pure white}) = \underline{0.75}$