**Chapter 7: Unit A – Fundamentals of Probability**

**Fundamental Probability**

**Probability** is the extent to which an event is likely to occur, measured by the ratio of the favorable cases to the whole number of cases possible.

Example: Tossing a Coin

When a coin is tossed, there are two possible outcomes:

* heads (H) or
* tails (T)

We say that the probability of the coin landing **H** is ½.

And the probability of the coin landing **T** is ½.

### Example: Throwing Dice

When a single [die](https://www.mathsisfun.com/geometry/fair-dice.html) is thrown, there are six possible outcomes: **1, 2, 3, 4, 5, 6**.

The probability of any one of them is 1/6.

**Outcomes** are the most basic possible results of observations or experiments.

An **event** consists of one or more outcomes that share a property of interest.

Expressing Probability

The probability of an event, expressed as P(event), is always between 0 and 1 (inclusive). A probability of 0 means the event is impossible and a probability of 1 mean the event is certain.

**Types of Probabilities**

Theoretical Probability is based on a model in which all outcomes are equally likely. It is determined by dividing the number of ways an event can occur by total number of possible outcomes.

$$P\left(A\right)= \frac{number of ways A can occur}{total number of outcomes}$$

Empirical probability (relative frequency method) is based on observations or experiments. It is the relative frequency of the event of interest.

Subjective probability is an estimate based on experience or intuition.

Example 1

If you draw one card from a standard deck, what is the probability that it is a spade?

1. There are 52 possible outcomes.
2. The event of interest is spade, and there are 13 spades in the standard deck.
3. $P\left(spade\right)= \frac{13}{52}= \frac{1}{4}=25\% $

Example 2

You select a person at random from this class. What is the probability that the person has a birthday in July? Assume 365 days in a year.

1. How many possible outcomes are there?
2. How many possible days represent event of interest?
3. $P\left(July\right)= $

Example 3

What is the probability that a family with three children has 2 boys and one girl?

1. There are 2 possible outcomes for each birth: boy (B) or girl (G). For a family with 3 children, the total number of possible outcomes (birth orders) is 2x2x2 = 8. The 8 possible outcomes are the birth orders BBB, BBG, BGB, BGG, GBB, GBG, GGB, and GGG.
2. Of these 8 possible outcomes, three have 2 boys and 1 girl: BBG, BGB, and GBB.
3. $P\left(2 boys\right)= \frac{3}{8} ≈ 0.375 ≈37.5\%$

Example 4

Geological records indicate that a river has crested above a particular high flood level 4 times in the past 2000 years. What is the empirical probability that the river will crest above this flood level this year?

 $\frac{numbers of time has occurred}{time span}= \frac{4}{2000}=0.002$

**Probability of an Event Not Occurring**

0 < P < 1

P(A) + P(not A) = 1

P(not A) = 1 – P(A)

Stating the Odds

The odds for an event A are

$$odds for event A= \frac{P(A)}{P(not A)}$$

The odds against an event A are

$$odds against event A= \frac{P(not A)}{P(A)}$$

Homework: # 21-41 odd.

 P2. # 45,46, 47-59 odds