

Math 1313
Definition of Probability

Two Approaches to Probability

In this lesson, you will learn the vocabulary, definition, notation and properties of probability.

Example 1: Suppose an experiment consists of flipping a fair coin and observing whether it lands on heads or tails.

What is an appropriate sample space for this experiment?

What do you think the likelihood is that the coin will land on heads? on tails?
Why?

Notation:

We can verify this in the following manner: Suppose we repeat the experiment over and over again, recording the results after every flip of the coin. In the table below, we record the number of heads observed, m , when we flip the coin n times. Then we compute the relative frequency of heads, that is, we divide m by n .

Number of tosses, n	Number of heads, m	Relative frequency of heads, m/n
10	4	.4000
100	56	.5600
1000	509	.5090
2500	1223	.4892
10000	5016	.5016
15000	7488	.4992
25000	12476	.49904
50000	25007	.50014

Notice that as the number of trials gets larger, the relative frequency of heads gets closer and closer to $\frac{1}{2}$. This is the same value we theorized the probability would be in example 1, but, in this experiment, we do not rely on the assumption that the outcomes are equally likely.

Definition: Empirical Probability

Definitions and Properties

We will work mostly with finite sample spaces.

Suppose $S = \{s_1, s_2, s_3, \dots, s_n\}$

Definition: Simple (elementary) Event

Definition: Probability Distribution

Definition: Probability Function

Example 2: A Probability Distribution Table

Simple Event	Probability
$\{s_1\}$	$P(s_1)$
$\{s_2\}$	$P(s_2)$
$\{s_3\}$	$P(s_3)$
\cdot	\cdot
\cdot	\cdot
\cdot	\cdot
$\{s_n\}$	$P(s_n)$

Properties of Probabilities of Simple Events

-
-
-

Definition: Uniform Sample Space

Probability of an Event in a Uniform Sample Space:

Examples 3 - 4

Let's look at one of our familiar examples.

Example 3: Suppose an experiment consists of tossing a fair die and observing the number that falls on the uppermost side. Find the probability distribution for this experiment.

Example 4: A survey was conducted by a consumer magazine and the following results were observed:

Rating	Number of Respondents
Very Safe	285
Somewhat Safe	915
Not Too Safe	225
Not Safe at All	30
Don't Know	45

Construct a probability distribution table using these data

Using a Probability Distribution and Example 5

We can use our probability distribution tables to answer questions about the experiment.

Finding the Probability of an Event E

Example 5: Suppose you toss a pair of fair dice and observe the sum of the numbers on the uppermost faces of the dice.

Construct a probability distribution for this experiment

Calculate the probability that the two dice show the same number

Calculate the probability that the sum of the numbers on the two dice is 7

Calculate the probability that the sum of the numbers on the two dice is more than 8.

Example 6 and 7

Example 6: A ball is selected at random from an urn containing 12 red balls, 8 white balls and 6 blue balls. What is the probability that the ball selected is white?

Example 7: A card is drawn at random from a well-shuffled deck of 52 playing cards. What is the probability that the card drawn was

a jack?

a black card?

a diamond?

Example 8

Example 8: Given the following probability distribution, find each:

Outcome	Probability
A	.05
B	.12
C	.15
D	.43
E	.22
F	.03

the probability of A or B

the probability of B, C or D

the probability that A does not occur

By now, you should be able to construct a probability distribution from a set of data or a familiar situation and you should be able to answer some questions based on your probability distribution.