A sample space in which each of the outcomes has the same chance of occurring is called a uniform sample space.

The probability of event $E$ is $P(E)$, a number between 0 and 1. It is the ratio of the number of outcomes in event $E$, $n(E)$ to the number of outcomes in the sample space, $n(S)$:

$$P(E) = \frac{n(E)}{n(S)}$$

The union rule for sets can be applied to probability:

$$n(E \cup F) = n(E) + n(F) - n(E \cap F)$$

becomes

$$P(E \cup F) = P(E) + P(F) - P(E \cap F)$$

We can also find the empirical probability of an event by finding the relative frequency of the event.

A probability distribution table has the following properties:

1. Each of the entries is mutually exclusive with all other entries
2. The sum of the probabilities is 1

Events that can’t occur at the same time are called mutually exclusive. Note that the simple events are mutually exclusive.
Example: A letter is chosen at random from the word WOOD. How many outcomes are in the uniform sample space for this experiment?

Example: A bowl has 3 blues and 2 red beads in it. Two beads are chosen at random from the bowl. What is the uniform sample space for this experiment?

Example: Suppose the instructor of a class polled 200 students about the number of hours spent per week studying math during the previous week. The results were 69 students studied two hours or less, 128 students studied 4 or fewer hours, and 30 students studied more than 6 hours. Arrange this information into a probability distribution table.
Example: Consider flipping a fair coin three times. Find the sample space and then following probabilities:

(a) Exactly one head is seen.

(b) Two or more heads are seen.

(c) More than 3 heads are seen.

(d) Find the probability distribution table for the number of heads when a coin is tossed 3 times.
Example: Two fair six-sided dice are rolled and the numbers shown uppermost are noted. Find the following

(a) What is the probability of rolling a sum 2 or a sum of 12?

1~1   2~1   3~1   4~1   5~1   6~1
1~2   2~2   3~2   4~2   5~2   6~2
1~3   2~3   3~3   4~3   5~3   6~3
1~4   2~4   3~4   4~4   5~4   6~4
1~5   2~5   3~5   4~5   5~5   6~5
1~6   2~6   3~6   4~6   5~6   6~6

(b) What is the probability of rolling a sum of 7?

1~1   2~1   3~1   4~1   5~1   6~1
1~2   2~2   3~2   4~2   5~2   6~2
1~3   2~3   3~3   4~3   5~3   6~3
1~4   2~4   3~4   4~4   5~4   6~4
1~5   2~5   3~5   4~5   5~5   6~5
1~6   2~6   3~6   4~6   5~6   6~6

(c) What is the probability that the sum is 7 or at least one 5 is rolled?

1~1   2~1   3~1   4~1   5~1   6~1
1~2   2~2   3~2   4~2   5~2   6~2
1~3   2~3   3~3   4~3   5~3   6~3
1~4   2~4   3~4   4~4   5~4   6~4
1~5   2~5   3~5   4~5   5~5   6~5
1~6   2~6   3~6   4~6   5~6   6~6
Example: A survey gave the following results: 45% of the people surveyed drank diet drinks (D) and 25% drank diet drinks and exercised (D \cap E) and 24% did not exercise and did not drink diet drinks (D^c \cap E^c). Find the probability that:

a) a person does not drink diet drinks (D^c).

b) does not exercise and drinks diet drinks (E^c \cap D).

c) exercises and does not drink diet drinks (E \cap D^c).

Example: Suppose we have a jar with 8 blue and 6 green marbles. Find the probability distribution table for the number of blue marbles in the sample of 2 marbles and find the probability there is at least one blue marble.
A standard deck of 52 cards has 4 suits, each with 13 cards. The suits are spades, ♠, hearts, ♥, clubs, ♦, and diamonds, ♦. The cards in each suit are numbered from Ace, King, Queen, Jack, ten down to 2.

<table>
<thead>
<tr>
<th>♠</th>
<th>♠</th>
<th>♠</th>
<th>♠</th>
<th>♠</th>
<th>♠</th>
<th>♠</th>
<th>♠</th>
<th>♠</th>
<th>♠</th>
<th>♠</th>
<th>♠</th>
<th>♠</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>K</td>
<td>Q</td>
<td>J</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>♥</th>
<th>♥</th>
<th>♥</th>
<th>♥</th>
<th>♥</th>
<th>♥</th>
<th>♥</th>
<th>♥</th>
<th>♥</th>
<th>♥</th>
<th>♥</th>
<th>♥</th>
<th>♥</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>K</td>
<td>Q</td>
<td>J</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>♦</th>
<th>♦</th>
<th>♦</th>
<th>♦</th>
<th>♦</th>
<th>♦</th>
<th>♦</th>
<th>♦</th>
<th>♦</th>
<th>♦</th>
<th>♦</th>
<th>♦</th>
<th>♦</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>K</td>
<td>Q</td>
<td>J</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>♢</th>
<th>♢</th>
<th>♢</th>
<th>♢</th>
<th>♢</th>
<th>♢</th>
<th>♢</th>
<th>♢</th>
<th>♢</th>
<th>♢</th>
<th>♢</th>
<th>♢</th>
<th>♢</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>K</td>
<td>Q</td>
<td>J</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Example: If a single card is drawn from a standard deck of cards, what are the probabilities of

a) a 9 or a 10?

b) a black card or a 3?

Example: You are dealt 3 cards from a standard deck of 52 cards. Find the probability distribution table for the number of spades in your hand of 3 cards.
Example: A student takes a true/false test with 5 questions by guessing (choose answer at random). Write a probability distribution table for the number of correct answers.

Example: There are 72 marbles in a box. There are 18 different colors and 4 marbles of each color. Five marbles are chosen at random from the box. What is the probability of a full house? That is, 3 of one color and 2 of a different color.

Example: A coffee shop finds that 44% of its customers do not order coffee, 16% order only coffee, and 6% order only a muffin. What is the probability that a randomly selected customer will order coffee or a muffin?
Example: A box has 30 transistors and a sample of 5 is chosen for testing to decide if the box is “good” or “bad”. A box is considered “bad” if one or more transistors in the sample are found to be defective. What is the probability that a box that has 4 defective transistors will be considered “good”?

Example: Matthew is studying for a Latin quiz and he learns the meaning of 24 nouns from the list of 30. The Latin quiz has 10 nouns. If a passing grade is 7 or more, what is the probability that Matthew passes this Latin quiz?

Example: A bowl has 3 pennies, 5 nickels and 4 quarters. Four coins are selected at random from the bowl. What is the probability that exactly 3 nickels or exactly one quarter is chosen?