**1.** **Probability Overview**

The study of probability is concerned with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Even though we cannot be certain, or guaranteed, a given result will happen, we can often calculate the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of it occurring.

Experiment: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Outcomes: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Sample Space (*S*): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Event (*E*): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Probability can be written in one of three formats:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Since probability is calculating \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, it always falls somewhere between:

Probability of \_\_\_\_\_ or \_\_\_\_\_% (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ event, will \_\_\_\_\_\_\_\_\_\_\_\_ happen)

and

Probability of \_\_\_\_\_ or \_\_\_\_\_% (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_event, will \_\_\_\_\_\_\_\_\_\_\_\_\_ happen)

Probability can NEVER be \_\_\_\_\_\_\_\_\_\_\_\_\_ and it can NEVER be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**2.** **Basic Probability (simple fraction)**

If all outcomes in a Sample (*S*) are equally likely to happen and the Event (*E*) is an event we want to see happen, then we can calculate the mathematical (theoretical) probability.

**Mathematical or Theoretical probability of an event is:**

**EXAMPLE:** Give the probability that the spinner shown would land on the color grey.

Circle

Description automatically generated

*P*(grey) =

**EXAMPLE:** A bag contains 8 red marbles, 4 blue marbles, and 1 green marble. What is the probability that a randomly selected marble is not blue?

*P*(even) =

**EXAMPLE:** Two fair 6-sided dice are rolled What is the probability that the sum of the two numbers is 8?

*P*(sum 8) =

**EXAMPLE:** The spinner to the right is spun twice in succession to determine a two-digit number. The first spin gives the first digit and the second spin gives the second digit. Give each of the following.

(Write as a simplified fraction.)

1. the sample space (*S*)
2. the probability of an odd number
3. the probability of a number with no repeated digits
4. the probability of a number greater than 60
5. the probability of a composite numberChart, pie chart

   Description automatically generated
6. the sample space (*S*) is all possible 2-digit numbers created by 2 spins on the spinner:

{ }

1. *P*(odd) =
2. *P*(no repeated digits) =
3. *P*(number greater than 60) =
4. NOTE: A **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** number is only divisible by 1 and itself.

A **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** number is a number that is not prime; that is, divides by numbers other than 1 and itself.

*P*(composite number) =

**Law of Large numbers:**

If an experiment is repeated more and more times, the proportion of favorable events (events we want to see happen) will tend to come closer and closer to the actual mathematical (theoretical) probability of that event.

An experiment must be performed a very large number of times for the experimental (empirical) probability to come closer to the mathematical (theoretical) probability.

If an Event (*E*) occurs when an **experiment** is performed, then we can calculate the experimental (or empirical) probability after collecting the results and counting.

**Experimental or Empirical probability of an event:**

**EXAMPLE:** Of the last 60 people who went to the cash register at a department store, 12 had blond hair, 19 had black hair, 22 had brown hair, and 7 had red hair. Determine the empirical probability that the next person to come to the cash register has blond hair.

**EXAMPLE:** A pair of dice is rolled 50 times and the sum of the dots on the faces is noted.

Compute the empirical probability that the sum rolled is greater than 9.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Outcome (sum of dots) | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Frequency | 15 | 1 | 4 | 4 | 0 | 4 | 12 | 4 | 4 | 2 | 0 |

**EXAMPLE:** A school has 820 male students and 903 female students. If a student from that school is selected at random, what is the probability that the student will be female?

*P*(female) =

**EXAMPLE:** The table shows the number of college students who prefer a given pizza topping.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Toppings | freshman | sophomore | junior | senior |
| cheese | 13 | 11 | 26 | 27 |
| meat | 19 | 27 | 11 | 13 |
| veggie | 11 | 13 | 19 | 27 |

1. Determine the empirical probability that a student prefers veggie toppings. (Round 3 places)

Total amount of veggie lovers =

Total amount of students (sample space *S*) =

*P*(veggie) =

**EXAMPLE:** The table shows the number of college students who prefer a given pizza topping.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Toppings | freshman | sophomore | junior | senior |
| cheese | 13 | 11 | 26 | 27 |
| meat | 19 | 27 | 11 | 13 |
| veggie | 11 | 13 | 19 | 27 |

1. Determine the empirical probability that a student prefers meat toppings. (Round 3 places)

Total amount of meat lovers =

Total amount of students (sample space *S*) =

*P*(meat) =

**EXAMPLE:** The table shows the number of college students who prefer a given pizza topping.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Toppings | freshman | sophomore | junior | senior |
| cheese | 13 | 11 | 26 | 27 |
| meat | 19 | 27 | 11 | 13 |
| veggie | 11 | 13 | 19 | 27 |

1. Determine the empirical probability that a freshman prefers cheese toppings. (Round 3 places)

Total amount of freshman cheese lovers =

Total amount of freshmen (sample space *S*) =

*P*(meat) =

**3. Odds**

While probability compares favorable outcomes to the total outcomes,

* **Odds compares favorable outcomes to unfavorable outcomes** (or vice-versa).

Odds are commonly quoted in horse racing, lotteries, and most gambling situations.

* Odds in favor of an event *E* =

or alternatively, odds in favor of *E* =

* Odds against an event *E* =

or alternatively, odds against *E* =

**EXAMPLE:** The given jar contains yellow (Y), blue (B) and red (R) balls. Anne randomly chooses a single ball from the can shown. Find the odds against the event yellow (Y).

Shape, circle

Description automatically generated

Odds against yellow (Y) =

also written as \_\_\_\_ to \_\_\_\_

**EXAMPLE:** What are the odds in favor of spinning an A on this spinner?

A picture containing text, clock

Description automatically generated

Odds in favor of A =

also written as \_\_\_\_ : \_\_\_\_

**EXAMPLE:** If it has been determined that the probability of an earthquake occurring on a certain day in a certain area is 0.05, what are the odds against an earthquake.

Complement principle: A probability and its complement MUST always add up to \_\_\_\_\_.

Given: *P*(earthquake) = 0.05, so *P*(**not** earthquake) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_

Odds **against** earthquake =

also written as \_\_\_\_\_\_ to \_\_\_\_\_\_