9A: EXPERIMENTAL PROBABILITY

In the field of probability theory we use mathematics to describe the chance or likelihood of an event happening.

An impossible event is one in which there is a 0% chance of the event happening.

A certain event is one in which there is a 100% chance of this happening.

Example:

Take a bag of 15 blue marbles and 15 red marbles.

There is 100% chance that the color you pull from the bag is either blue or red.

There is a 0% chance that the color marble you pull is Magenta.

Can you think of any examples? Discuss with your partner and be ready to share!
PROBABILITY: 0-1

We assign a number to every event which lies between 0 and 1. 0 indicates our impossible outcome (0%) and 1 indicates our certain outcome (100%).

Most often probability is shown as a decimal. Outcomes are shown as a fraction.

Key Terms:
- The number of trials is the total number of times the experiment is repeated.
- The outcomes are the different results possible for one trial of the experiment.
- The frequency of a particular outcome is the number of times that this outcome is observed.
- The relative frequency of an outcome is the frequency of that outcome expressed as a fraction or percentage of the total number of trials.

Experimental Probability = Relative Frequency

EXAMPLE 1

when a small plastic cone was tossed into the air 270 times it fell on its side 157 times and on its base 113 times.

How many trials were there?
There were 270 trials (the total of the two outcomes)

What are the two possible outcomes?
Landing on it’s side, landing on it’s base

What are the frequencies of the two outcomes respectively?
Side = 157, Base = 113

What is the relative frequency of both outcomes respectively?
THE NOTATION:

The last question we could phrase as “The probability that the cone will land on its base is \( \frac{113}{270} \).”

We can use notation as well: \( P(\text{base}) = \frac{113}{270} \approx .4185 \) respectively.

Capital P is used for probability and within the parentheses is a possible outcome.

You try:

What is \( P(\text{side}) \) for the problem on slide 4?

Answer: \( \frac{157}{270} = .5815 \) respectively.

Note: we use respectively because the outcomes are based on prior trials.

COIN TOSSING EXPERIMENT

- Suppose we have 1 coin. What are our possible outcomes? If we tossed the coin, what would the probability be for one of those possible outcomes to occur?

- Suppose we have 2 coins. What would are possible outcomes be? If we tossed the coins, what would the probability be for one of those possible outcomes to occur? Note that order matters!

We will do a different coin toss as a warmup in class. Bring some change on Tuesday!
ESTIMATING PROBABILITIES FROM DATA

Stats can be used to calculate probabilities in many situations. Check out this example

1) The table shows the number of short-term visitors coming to Australia in the period April – June 2011, and the main reason for their visit.
   a) Find the probability that a person who visited in June was on holiday.
   b) Find the probability that a person coming to Australia arrived in May.
   c) Lars arrived in Australia in April, May, or June 2011. He came to visit his brother. What is the probability that he arrived in April?

<table>
<thead>
<tr>
<th>Main reason for journey</th>
<th>April 2011</th>
<th>May 2011</th>
<th>June 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convention/conference</td>
<td>8300</td>
<td>14800</td>
<td>8800</td>
</tr>
<tr>
<td>Business</td>
<td>27200</td>
<td>33900</td>
<td>32000</td>
</tr>
<tr>
<td>Visiting friends/relatives</td>
<td>77500</td>
<td>52700</td>
<td>59900</td>
</tr>
<tr>
<td>Holiday</td>
<td>159300</td>
<td>119300</td>
<td>156500</td>
</tr>
<tr>
<td>Employment</td>
<td>6200</td>
<td>6300</td>
<td>5500</td>
</tr>
<tr>
<td>Education</td>
<td>9800</td>
<td>7900</td>
<td>12500</td>
</tr>
<tr>
<td>Other</td>
<td>35200</td>
<td>28000</td>
<td>33200</td>
</tr>
<tr>
<td>Total</td>
<td>321500</td>
<td>260900</td>
<td>308300</td>
</tr>
</tbody>
</table>

a) \( \frac{260,900}{690,700} \approx 0.3829 \)
9B: UNIVERSAL SET

The universal set, denoted as \( U \), is the set of all possible outcomes. This is sometimes referred to as the sample space. For continuity, we will refer to \( U \) as the sample space.

How to represent a sample space you ask? Here are a few ways.

1) Listing outcomes: We use set notation to show the possible outcomes.

Rolling a die: There are 6 possible outcomes,

\[ \therefore \text{ sample space } = \{1, 2, 3, 4, 5, 6\} \]

\( \therefore \) is used to say “therefore” in mathematical terms.

2) 2-dimensional grids:

When rolling a pair of dice, a 2 dimensional grid illustrates the possible outcomes.

Each of the following cross sections represents an outcome. When you roll the dice you can have these outcomes:

\( \{11, 12, 13, 14, 15, 16, 21, 22, 23, 24, 25, 26, 31, 32, 33, 34, 35, 36, 41, 42, 43, 44, 45, 46, 51, 52, 53, 54, 55, 56, 61, 62, 63, 64, 65, 66\} \)

11 represents a 1 rolled and a 1 rolled.

This is useful for 2 events occurring at the same time with multiple outcomes for each.
3) **Tree diagrams:**

Each branch of the tree diagram gives a different outcome. This is good for multiple events. Let’s use 3 coins (a 2-d grid would not be helpful with 3 coins).

On Your own, try this! Create a tree diagram that illustrates when you draw 2 marbles from a bag containing green, red, blue and white marbles.
HOMEWORK

9A.1
#1-3  \underline{write it down!}

9A.2
#1,2

9B.1
#1ac,2 ,3