Equitable Equations: *Introduction to probability*

$S = \{ (H,1)(H,2)\ldots (H,6)$
$(T,1)(T,2)\ldots (T,6)\}$

Problem 1

A probability experiment consists of flipping a coin and then rolling a standard 6-sided die.

(a) Identify the sample space. $S = \{H1, H2, H3, H4, H5, H6, T1, T2, T3, T4, T5, T6\}$

(b) Write the event, "the coin is a tail and the die roll isn't a 5" as a set. $E = \{T1, T2, T3, T4, T6\}$

(c) What is the probability of the event in part (b)? Assume all outcomes are equally likely. $\frac{5}{12} = 42\%$
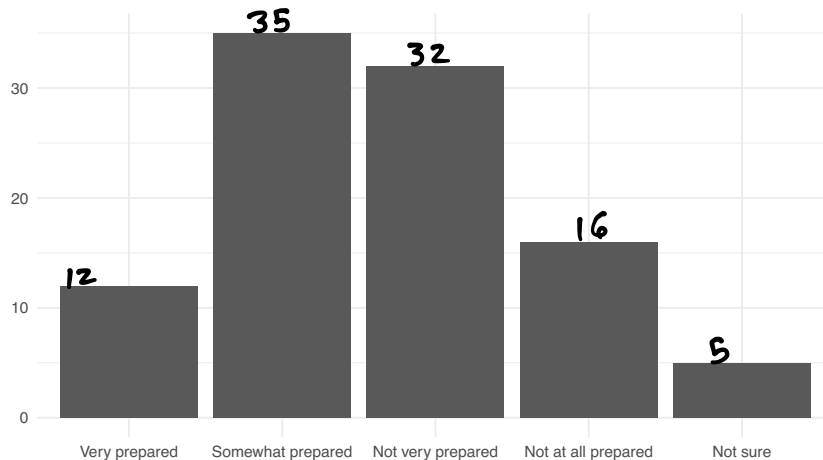
$P(E) = \frac{|E|}{|S|}$

(d) What is the probability that the coin is a head and the die roll is odd?

$E = \{H1, H3, H5\} = \frac{3}{12} = 25\%$

Problem 2

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

One hundred students are selected at random at the beginning of finals week and asked how prepared they feel. The results are summarized in the following bar chart.

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

compliment

(a) What is the probability that the next person surveyed says they are somewhat prepared? $\frac{35}{100} = 35\%$

(b) What is the probability that the next person surveyed does *not* say they are somewhat prepared? $\frac{65}{100} = 65\%$

(c) Is this an example of empirical probability, classical probability, or subjective probability?

Classical probability
empirical – next person – not equally likely

Problem 3

Classify each of the following as examples of empirical, classical, or subjective probability.

(a) According to a company's records, the probability that one of their cars will need a new muffler in its first 8 years is 10%. empirical, based on previous observations
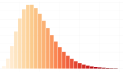
(b) The coach of a basketball team says they have a 50% chance of winning the championship. empirical – subjective
↓
Coach's opinion

(c) A passcode consists of 4 digits from 0 to 9. The probability of guessing the code correctly on the first try is $1/10^4 = 0.0001$.

Classical probability
↳ all equally likely

Equitable Equations: *The addition rule*

Problem 1

Are the following events disjoint or not? Briefly justify your choice.

    A: Randomly select a college professor who has exactly 20 years experience

    B: Randomly select a college professor who is exactly 50 years old

there is an outcome where...

No, it is possible to be 50 years old and have 20 years experiance.

Problem 2

Are the following events disjoint or not? Briefly justify your choice.

    A: Randomly select a student whose birthday is in May

    B: Randomly select a student whose birthday is in June

Yes, these are disjoint. It is impossible to have a birthday in 2 seperate months

Problem 3

The following problem is adapted from *OpenIntro Statistics*, Fourth Edition, by David Diez, Mine Çetinkaya-Rundel, and Christopher Barr. Pay what you want or download for free at `https://www.openintro.org/book/os/`

A Pew Research poll asked 1,306 Americans "From what you've read and heard, is there solid evidence that the average temperature on earth has been getting warmer over the past few decades, or not?". The table below shows the distribution of responses by party and ideology, where the counts have been replaced with relative frequencies.

		Response			
		Earth is warming	Not warming	Don't Know Refuse	Total
Party and Ideology	Conservative Republican	0.11	0.20	0.02	0.33
	Mod/Lib Republican	0.06	0.06	0.01	0.13
	Mod/Cons Democrat	0.25	0.07	0.02	0.34
	Liberal Democrat	0.18	0.01	0.01	0.20
	Total	0.60	0.34	0.06	1.00

Suppose a random person is selected from this sample.

(a) What is the probability that the person is a liberal democrat who believes that the earth is not warming? 2%

(b) What is the probability that the person is a republican (conservative, moderate, or liberal)? 46%

(c) What is the probability that the person is either a conservative republican OR believes the earth is warming (or both)?

$$0.33 + 0.60 - 0.11 = 82\%$$

Problem 4

A statistics class has 30 students. Of these, 8 are data science majors and 12 are sophomores. Of the sophomores, 3 are data science majors. Find the probability that a randomly-selected student is a data science major or a sophomore.

$$\frac{8}{30} + \frac{12}{30} - \frac{3}{30} = \frac{17}{30} = 57\%$$