

Probability Worksheet

Math 141

Activity 1: Coffee or Tea?

A survey was given to 100 Math 141 students in 2017. Some results are summarized below:

	Coffee	Tea	total
First-year	7	10	17
Sophomore	25	20	45
Junior	13	12	25
Senior	8	5	13
total	53	47	100

1. What is the probability that a random student prefers *coffee*?
2. What is the probability that a random student is a sophomore?
3. What is the probability that a random student is a *sophomore* and prefers coffee?
4. What is the probability that a random sophomore prefers *coffee*?

Activity 2: Testing for a Rare Disease

Suppose that we have a rapid COVID-19 test that:

- Given a person **does not** have COVID, the test is (correctly) negative 99% of the time.
- Given a person **does** have COVID, the test is (correctly) positive 80% of the time.
- Additionally, the overall prevalence of COVID at the time of the test was 1%.

Research Question: Suppose a person takes this test and receives a positive diagnosis. **Given the positive diagnosis, what is the probability that the person actually has COVID?**

1. Write down the research question as a conditional probability.
2. Define events A (and A^c) and B (and B^c) in this setting.
3. Write out all the given info above in terms of probabilities and events A and B .
4. Answer the research question, starting with Bayes' Rule. You'll also need the Law of Total Probability!

Bonus Question: Bayes' Rule

1. Consider Bayes' Rule. Under what circumstances will $P(A|B) = P(B|A)$?
2. Suppose $P(B|A) = 1$:
 - (a) What does this suggest about A and B ?
 - (b) What is $P(A|B)$ in this case?