

Statistics for Data Science

Unit 3 Homework: Probability Theory

August 16, 2016

1. **Gas Station Analytics** At a certain gas station, 40% of customers use regular gas (event R), 35% use mid-grade (event M), and 25% use premium (event P). Of the customers that use regular gas, 30% fill their tanks (Event F). Of the customers that use mid-grade gas, 60% fill their tanks, while of those that use premium, 50% fill their tanks. Assume that each customer is drawn independently from the entire pool of customers.

- (a) What is the probability that the next customer will request regular gas and fill the tank?
- (b) What is the probability that the next customer will fill the tank?
- (c) Given that the next customer fills the tank, what is the conditional probability that they use regular gas?

2. **The Toy Bin**

In a collection of toys, $1/2$ are red, $1/2$ are waterproof, and $1/3$ are cool. $1/4$ are red and waterproof. $1/6$ are red and cool. $1/6$ are waterproof and cool. $1/6$ are neither red, waterproof, nor cool. Each toy has an equal chance of being selected.

- (a) Draw an area diagram to represent these events.
- (b) What is the probability of getting a red, waterproof, cool toy?
- (c) You pull out a toy at random and you observe only the color, noting that it is red. Conditional on just this information, what is the probability that the toy is not cool?
- (d) Given that a randomly selected toy is red or waterproof, what is the probability that it is cool?

3. **On the Overlap of Two Events**

Suppose for events A and B, $P(A) = 1/2$, $P(B) = 2/3$, but we have no more information about the events.

- (a) What are the maximum and minimum possible values for $P(A \cap B)$?
- (b) What are the maximum and minimum possible values for $P(A|B)$?

4. **Can't Please Everyone!** Among Berkeley students who have completed w203, $3/4$ like statistics. Among Berkeley students who have not completed w203, only $1/4$ like statistics. Assume that only 1 out of 100 Berkeley students completes w203. Given that a Berkeley student likes statistics, what is the probability that they have completed w203?