CS 70 Discrete Mathematics and Probability Theory
Fall 2017 Satish Rao and Kannan Ramchandran

DISCUSSION 08B

1 Disease Diagnosis

You have a high fever and go to the doctor to identify the cause. 1% of the people have Ebola, 10% of the people have the flu, and 89% have neither. Assume that no person has both. Suppose that 100% of the Ebola people have a high fever, 30% of the flu people have a high fever, and 2% of the people who have neither, have a high fever. Is it more likely that you have Ebola, the flu, or neither?

2 Let's Talk Probability

(a) When is $\mathbb{P}(A \cup B) = \mathbb{P}(A) + \mathbb{P}(B)$ true? What is the general rule that always holds?

(b) When is $\mathbb{P}(A \cap B) = \mathbb{P}(A)\mathbb{P}(B)$ true? What is the general rule that always holds?

(c) If A and B are disjoint, are they independent?

(d) On the space of a fair roll of a six-sided die, find three events, each of which is independent of the intersection of the other two, such that they are not mutually independent.

(e) If we roll 2 dice, what is the probability that the first roll is a 3? What is the probability that the first roll is a 3 if we know that the sum of the dice is 6?

3 Simple Dice Roll

A die is rolled four times. What is the probability that we obtain exactly one 6?

4 Maybe Lossy Maybe Not

Let us say that Alice would like to send a message to Bob, over some channel. Alice has a message of length 4 and sends 5 packets.

(a) Packets are dropped with probability p. What is probability that Bob can successfully reconstruct Alice's message?

(b) Again, packets can be dropped with probability p. The channel may additionally corrupt 1 packet. Alice realizes this and sends 3 additional packets. What is the probability that Bob receives enough packets to successfully reconstruct Alice's message?

(c) Again, packets can be dropped with probability p. This time, packets may be corrupted with probability q. Consider the original scenario where Alice sends 5 packets for a message of length 4. What is probability that Bob can successfully reconstruct Alice's message?