1. Total Probability theorem

Q1. Suppose that an urn contains 8 red balls and 4 white balls. We draw 2 balls from the urn without replacement.
(a) If we assume that at each draw each ball in the urn is equally likely to be chosen, what is the probability that both balls drawn are red?
 (b) Now suppose that the balls have different weights, with each red ball having weight r and each white ball having weight w. Assume that the probability that a given ball in the urn is the next one selected is its weight divided by the sum of the weights of all balls currently in the urn. Now what is the probability that both balls are red?

2. Baeyes' theorem

Q2. An insurance company believes that people can be divided into two classes: those who are accident prone and those who are not. The company's statistics show that an accident-prone person will have an accident at some time within a fixed 1-year period with probability .4, whereas this probability decreases to .2 for a person who is not accident prone. If we assume that 30 percent of the population is accident prone

(a). What is the probability that a new policyholder will have an accident within a year of purchasing a policy?

(b). Suppose that a new policyholder has an accident within a year of purchasing a policy. What is the probability that he or she is accident prone?

Q3. A certain disease has an incidence rate of 2%. If the false negative rate is 10% and the false positive rate is 1%, compute the probability that a person who tests positive actually has the disease.

3: Continuity of Probability

Q4. Consider a bus with infinite seats. The passengers (numbered 1, 2, 3, . . .) are waiting to get on the bus. Much to their dismay, the driver Anant decides to perform the following experiment: At 2 A.M., he asks the passengers numbered 1 to 10 to get on the bus. Then he asks a randomly selected passenger (among the boarded passengers) to get down. Next, at 2:30 A.M., he asks the passengers numbered 11 to 20 to get on the bus and again ask a randomly selected passenger (among the so far boarded passengers) to get down. At 2:45 A.M, he again asks the passengers numbered 21 to 30 to get on the bus and asks a randomly selected passenger to get down. He continues this process till 3AM. Anant wants to know how many passengers are on the bus at 3AM.