**Basic Questions:**

1. A box contains three marbles — one red, one green, and one blue. Consider an experiment that consists of taking one marble from the box, then replacing it in the box and drawing a second marble from the box. Describe the sample space. Repeat for the case in which the second marble is drawn without first replacing the first marble.

Answer 1. S = {rr, rb, rg, br, bb, bg, gr, gb, gg} when done with replacement and S = {rb, rg, br, bg, gr, gb} when done without replacement, where rb means, for instance, that the first marble is red and the second green.

2. An experiment consists of tossing a coin three times. What is the sample space of this experiment? Which event corresponds to the experiment resulting in more heads than tails?

Answer 2. S = {hhh, hht, hth, htt, thh, tht, tth, ttt}. The event {hhh, hht,hth, thh} corresponds to more heads than tails.

3. A system is composed of four components, each of which is either working or failed. Consider an experiment that consists of observing the status of each component, and let the outcome of the experiment be given by the vector (x1, x2, x3, x4) where xi is equal to 1 if component i is working and is equal to 0 if component i is failed.

(a) How many outcomes are in the sample space of this experiment?

(b) Suppose that the system will work if components 1 and 2 are both working, or if components 3 and 4 are both working. Specify all the outcomes in the event that the system works.

(c) Let E be the event that components 1 and 3 are both failed. How many outcomes are contained in event E?

Answer 3. (a) 24 = 16

  (b) {(1, 1, 0, 0), (1, 1, 0, 1), (1, 1, 1, 0), (1, 1, 1, 1), (0, 0, 1, 1), (0, 1, 1, 1), (1, 0, 1, 1)}

  (c) $2^2$ = 4

4. A group of 5 boys and 10 girls is lined up in random order— that is, each of the 15! permutations is assumed to be equally likely.

(a) What is the probability that the person in the 4th position is a boy?

(b) What about the person in the 12th position?

(c) What is the probability that a particular boy is in the 3rd position?

Answer 4. (a) 1/3 (b) 1/3 (c) 1/15

5. There is a 60 percent chance that the event A will occur. If A does not occur, then there is a 10 percent chance that B will occur.

(a) What is the probability that at least one of the events A or B occurs?

(b) If A is the event that the democratic candidate wins the presidential election in 2012 and B is the event that there is a 6.2 or higher earthquake in Los Angeles sometime in 2013, what would you take as the probability that both A and B occur? What assumption are you making?

**Advanced Questions:**

6. Suppose that an insurance company classifies people into one of three classes — good risks, average risks, and bad risks. Their records indicate that the probabilities that good, average, and bad risk persons will be involved in an accident over a 1-year span are, respectively, 0.05, 0.15, and 0.30. If 20 percent of the population are "good risks," 50 percent are "average risks," and 30 percent are "bad risks," what proportion of people have accidents in a fixed year? If policy holder A had no accidents in 1987, what is the probability that he or she is a good (average) risk?

7. A parallel system functions whenever at least one of its components works. Consider a parallel system of $n$ components, and suppose that each component independently works with probability 1/2. Find the conditional probability that component 1 works, given that the system is functioning.