Section 4.1: Read lightly. Main concepts are sample space, event, probability. Exercises are 1, 4, 11, 15, 16, 26.

Section 4.2: Read lightly. Main concepts are the complement law, independence, conditional probability, multiplication law. We will emphasize conditional probability more than the text, but will be less concerned with mutually exclusive events and the additive laws. Exercises are 36, 38, 45 plus the following:

1. A family with two children is chosen at random; we are interested in the gender of the children. A sample space for this experiment is \( S = \{MM, MF, FM, FF\} \). Assuming all 4 outcomes are equally likely, answer the following:
   (a) Let \( A \) be the event that there are more male than female children. Compute \( P(A) \).
   (b) Let \( B \) be the event that there are no male children. Compute \( P(B) \).
   (c) Let \( C \) be the event that there is at least one female child. Compute \( P(C) \).
   (d) Describe in words the event \( B^c \).

2. A person is given three glasses of soda labelled A, B, C, and is asked to rank them in order of preference, best first. Let \( X \) be his ranking. A sample space is \( \{ABC, ACB, BAC, BCA, CAB, CBA\} \). Suppose that in fact, each glass contains the same drink, so that the ranking is random.
   (a) What is an appropriate probability distribution?
   (b) What is the probability that A is ranked best?
   (c) What is the probability that A is ranked better than B?
   (d) What is the probability that A is ranked worst?

3. Suppose that a test for tuberculosis has the following properties: If the person tested has tuberculosis, it returns a positive result 99% of the time; if the person tested does not have tuberculosis, it returns a negative result 95% of the time. The test is given to people thought to be at risk for tuberculosis; of this group, 2% actually have the disease.
   (a) What proportion of the tests will return a positive result?
   (b) What proportion of those whose test results are positive actually have tuberculosis?

4. One test for the presence of the HIV virus (the ELISA test) has the following properties: If the person tested is HIV positive, the test will return a positive result with probability .993; if the person is HIV negative, the test will return a negative result with probability .9999. The proportion of people who are HIV positive has been estimated at .000025. Suppose this is true, and suppose that all people are given the ELISA test.
   (a) What proportion of those whose tests are positive are actually HIV positive?
   (b) What proportion of those whose tests are negative are actually HIV negative?
(c) Explain the big difference in the answers to parts (a) and (b).

5. A physician proposes to give a throat culture to detect strep bacteria to every patient who comes to his office. Explain why this may not be a good idea.

- **Section 4.3**: Main concepts are *random variable, probability distribution, discrete, continuous*. We already know the empirical rule and Chebyshev’s rule, so you can ignore these. Exercises are 55, 58, 62.

- **Section 4.4**: Exercises are 85 (a and c), 86 (c and d), 87, 92 and the following.

  1. To save time and money when testing blood samples for the presence of a disease, the following procedure is sometimes used: Blood samples from a number of people are pooled together and the pooled sample is tested. If the pooled sample is negative, then no further testing need be done. If the pooled sample is positive, however, then each of the separate samples must be tested individually. To be specific, suppose that the blood samples of 10 people are pooled together in this procedure, and suppose that the proportion of those who have the disease in the population from which the samples are drawn is .02.

     (a) What is the probability that only one test must be run?
     (b) What is the probability that eleven tests must be run?
     (c) Let \( Y \) be the number of tests that must be run. Use your answers to (a) and (b) to write down the probability distribution of \( Y \).
     (d) Do you think this procedure is more efficient than just testing the 10 samples separately?

  2. Answer the above problem in the case that the population proportion of those who have the disease is .1. Is your answer to part (d) the same?

  3. Answer the above problem in the case that the population proportion of those who have the disease is .3. Is your answer to part (d) the same?

- **Section 4.5**: Read all except the material on normal probability plots on pp. 288–291. *Learning to compute normal probabilities and percentiles will be an essential skill later in the course*. Exercises are 107, 110, 117, 118, 122.