Chapters #1, #2 and #3

1. Research on the viscosity characteristics of rubber-modified asphalts yielded the following experimental observations on stabilized viscosity in centipoise (cP) for specimens of a certain grade of asphalt with 18% rubber added.

   2781 2900 3013 2856 2888 2905

   (a) Determine the sample range.
   (b) Calculate the sample mean and sample median.
   (c) Obtain the sample variance and the corresponding standard deviation.

2. Fission occurs when the nucleus of an atom captures a subatomic particle called a neutron and splits into two lighter nuclei. This causes energy to be released. At the same time other neutrons are emitted, two or three on average. If at least one of these neutrons is captured by another fissionable nucleus, then a chain reaction is possible.

   (a) Consider a reaction in which three neutrons are emitted initially. Number these electrons 1, 2 and 3, and assume their interactions can be tracked individually. Let *c* denote that a given neutron is captured by another nucleus; let *n* denote that the neutron is not captured by another nucleus. Construct an event tree diagram showing the possible outcomes for the three electrons from the initial emission.

   (b) List the sample points.

   (c) List the sample points that constitute each of the following events:
   A_1: a chain reaction is possible.
   A_2: all three neutrons are captured.
   A_3: a chain reaction is not possible.

   (d) Answer the following questions:
   Are A_1 and A_2 mutually exclusive?
   Are A_1 and A_3 mutually exclusive?
   Are A_2 and A_3 mutually exclusive?
   Are A_1, A_2 and A_3 mutually exclusive?

3. The configuration of a particular computer terminal consists of a baud-rate setting, a duplex setting, and a parity setting. There are 11 possible baud-rate settings, 2 parity settings (even or odd), and 2 duplex settings (half or full).

   (a) How many configurations are possible for this terminal?

   (b) In how many of these configurations, is the parity even and the duplex full.

   (c) A line surge occurs that causes these settings to change at random. What is the probability that the resulting configuration will have even parity and be full duplex?

4. A computer system uses passwords that consist of five upper case letters followed by one digit.

   (a) How many passwords are possible if each upper case letter and digit can be used only once?

   (b) How many passwords are possible if any upper case letter and digit can be repeated?

   (c) How many passwords consist of three A's and two B's, and end in an even digit.

   (d) If the user forgets his or her password but remembers that it has the characteristics described above in part (c), what is the probability that the user will guess the password correctly on the first attempt?

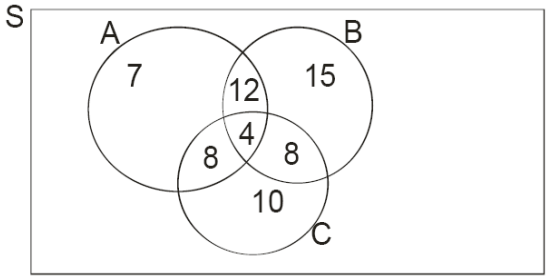
5. A jail warden has 9 keys that open 9 distinct cells, but only carries 3 of those keys with him at any given time. Only one key will open a given cell. If 30% of the cells are unlocked during exercise time (assume a random selection), what is the probability that the warden can get into a specific (designated) cell during exercise time?

   (a) 0.31
   (b) 0.42
   (c) 0.53
   (d) 0.68
   (e) none of the above

6. A company has a fleet of half-ton and one-ton trucks. The likelihood that a truck will require warranty repairs is 0.30 for the half-ton trucks, and 0.40 for the one-ton trucks. If one quarter of the trucks in the fleet are half-ton trucks, what is the probability that a truck requiring repairs is in fact a one-ton truck?

   (a) 0.30
   (b) 0.70
   (c) 0.75
   (d) 0.85
   (e) none of the above

7. A car dealer's stock consists of cars with power steering (A), compact cars (B) and cars with automatic transmissions (C); see the diagram below.



   A random car was vandalized. What is the probability that the damaged car has power steering or an automatic transmission given that it is compact?

   (a) 0.05
   (b) 0.10
   (c) 0.35
   (d) 0.62
   (e) none of the above

8. Based on a conducted study, one out of 14 people at the U of C ride a motorbike and 21% of those are engineers. Two out of 11 people ride a bicycle and 8% of those are engineers. 25% of the people walk to school and 10% of those are engineers. All other persons use cars and 7% of those are engineers. If a person is chosen at random and if he/she happens to be an engineer, find the probability that the person rides a motorbike.

   (a) 0.08
   (b) 0.17
   (c) 0.42
   (d) 0.63
   (e) none of the above

9. If X is a discrete random variable with probability function $f(x) = k(x+2k)$; for $x = 0, 1, 2, 3, 4, 5$. What is the probability of $(2 < X < 4)$?

   (a) 0.60
   (b) 0.20
   (c) 0.33
   (d) 0.92
   (e) none of the above

10. The length of time required by students to complete a one-hour exam is a random variable T with a probability density function given by:

$$f(t) = \begin{cases} \frac{3}{2}t^2 + t & , \ 0 \le t \le 1 \\ 0 & , \ \text{elsewhere} \end{cases}$$

    What is the probability that a student will finish in more than 45 minutes?

    (a) 0.49
    (b) 0.59
    (c) 0.19
    (d) 0.51
    (e) none of the above