1. Each of the possible five outcomes of a random experiment is equally likely. The sample space is $\{a, b, c, d, e\}$. Let A denote the event $\{a, b\}$, and let B denote the event $\{c, d, e\}$. Determine $P(A \cup B)$. 2.54 easy

   a. 1
   b. 0
   c. $\frac{2}{5}$
   d. $\frac{3}{5}$
   e. $\frac{2}{3}$

$$P(A \cup B) = P(A) + P(B) - P(A \cap B) = \frac{2}{5} + \frac{3}{5} - \frac{0}{5} = 1$$

2. Cooking oil is produced in two main varieties: monounsaturated and polyunsaturated. Two common sources of cooking oil are corn and canola. The following table shows the number of bottles of these oils at a supermarket:

		Type of oil	
		Canola	Corn
Type of Unsaturation	Mono	7	13
	Poly	93	77

   If a bottle of oil chosen at random, what is the probability that it belongs to the monounsaturated corn oil? 2.80 moderate

   a. $\frac{13}{190}$
   b. $\frac{20}{190}$
   c. $\frac{7}{190}$
   d. $\frac{13}{20}$
   e. $\frac{13}{90}$

$$P(mono \cap corn) = \frac{13}{190}$$

3. A batch of 500 containers for frozen orange juice contains 5 that are defective. Two are selected, at random, without replacement from the batch. What is the probability that the second one selected is defective given that the first one was defective? 2-96 difficult

a. $\frac{4}{499}$
b. $\frac{5}{500}\left(\frac{4}{499}\right)$
c. $\frac{5}{500}\left(\frac{495}{499}\right)$
d. $\frac{495}{500}\left(\frac{494}{499}\right)$
e. $2\left(\frac{5}{500}\right)\left(\frac{4}{499}\right)$

$$P\left(2^{nd}\ Def \mid 1^{st}\ Def\right) = \frac{4}{499}$$

4. A credit card contains 16 digits. It also contains the month and year of expiration. Suppose there are 1 million credit card holders with unique card numbers. A hacker randomly selects a 16-digit credit card number. Suppose a hacker has a 25% chance of correctly guessing the year your card expires and randomly selects 1 of the 12 months. What is the probability that the hacker correctly selects the month and year of expiration? **2-134 difficult**

a. 0.0208
b. 0.0833
c. 0.0156
d. 10^{-10}
e. 1.6×10^{-6}

$$P(B) = 0.25\left(\frac{1}{12}\right) = 0.020833$$

5. Suppose that $P(A|B) = 0.5,\ P(A|B') = 0.1$, and $P(B) = 0.7$. Determine $P(B|A)$. **2-143 easy**
   a. 0.921
   b. 0.079
   c. 0.350
   d. 0.380
   e. 0.930

$$\boldsymbol{P(B|A) = \frac{P(A \cap B)}{P(A)}}$$

$$\boldsymbol{P(A|B) = 0.5 = \frac{P(A \cap B)}{P(B)} \ \rightarrow \ P(A \cap B) = P(B)(0.5) = (0.5)(0.7) = 0.35}$$

$$\boldsymbol{P(A|B') = 0.1 = \frac{P(A) - P(A \cap B)}{1 - P(B)} = \frac{P(A) - 0.35}{0.3} \ \rightarrow P(A) = 0.3(0.1) + 0.35 = 0.38}$$

$$\boldsymbol{P(B|A) = \frac{P(A \cap B)}{P(A)} = \frac{0.35}{0.38} = 0.921}$$

6. The probability is 1% that an electrical connector that is kept dry fails during the warranty period of a portable computer. If the connector is ever wet, the probability of a failure during the warranty period is 5%. If 90% of the connectors are kept dry and 10% are wet, what proportion of connectors fail during the warranty period? 2-107 moderate
   a. 0.014
   b. 0.090
   c. 0.046
   d. 0.045
   e. 0.005

$$\boldsymbol{P(F) = P(F|W)P(W) + P(F|\overline{W})P(\overline{W}) = (0.05)(0.1) + (0.01)(0.9) = 0.014}$$

7. The thickness of wood paneling (in inches) that a customer orders is a random variable with the following cumulative distribution function.

$$F(x) = \begin{cases} 0 & x < \frac{1}{8} \\ 0.2 & \frac{1}{8} \le x < \frac{1}{4} \\ 0.9 & \frac{1}{4} \le x < \frac{3}{8} \\ 1 & x \ge \frac{3}{8} \end{cases}$$

Determine $P\left(X \le \frac{1}{18}\right)$ **3-44 easy**

a. 0
b. 0. 1
c. 0.2
d. 0.9
e. 0.7

$$P\left(X \le \frac{1}{18}\right) = 0$$

8. The phone lines to an airline reservation system are occupied 40% of the time. Assume that the events that the lines are occupied on successive calls are independent. Assume that 10 calls are placed to the airline. What is the expected number of calls in which the lines are all occupied? **3-87 easy**

a. 4
b. 6
c. 24
d. 2.4
e. 1.2

$$\mu = np = 10(0.4) = 4$$

9. Astronomers treat the number of stars in a given volume of space as a Poisson random variable. The density in the Milky Way Galaxy in the vicinity of our solar system is one star per 16 cubic light-years. How many cubic light-years of space must be studied so that the probability of one or more stars exceeds 0.95? **3-135 difficult**

   a. 47.9317
   b. 2.9957
   c. 0.0513
   d. 0.8207
   e. 1/16

$$0.95 = P(X \geq 1) = 1 - e^{-\lambda t} \quad \rightarrow \quad e^{-\lambda t} = 0.05 \quad \rightarrow \lambda = -\ln(0.05) = 2.9957$$

$$\mu = \lambda t = 2.9957(16) = 47.9317$$

10. A research study uses 900 men under the age of 55. Suppose that 30% carry a marker on the male chromosome that indicates an increased risk for high blood pressure. If 10 men are selected randomly and tested for the marker, what is the probability that more than 1 has the marker? **(problem 3-123 moderate)**

    a. 0.8522
    b. 0.1478
    c. 0.4567
    d. 0.5433
    e. 0.0276

$$P(X > 1) = 1 - P(X = 1) - P(X = 0)$$
$$= 1 - \frac{C_1^{270} C_9^{630} + C_0^{270} C_{10}^{630}}{C_{10}^{900}} = 0.852167$$

11. A player of a video game is confronted with a series of opponents and has an 70% probability of defeating each one. Success with any opponent is independent of previous encounters. The player continues to play until defeated. What is the probability that a player defeats at least two opponents in a game. 3-108 moderate
    a. 0.49
    b. 0.21
    c. 0.7
    d. 0.79
    e. 0.91

    Let X number of opponents until the player is defeated
    Defeats at least 2, he will defeated in the 3rd or more

$$P(X \geq 3) = 1 - P(X \leq 2) = 1 - P(X = 1) - P(X = 2) = 1 - 0.7^0(0.3) - 0.7^1(0.3) = 0.49$$

12. In a NiCd battery, a fully charged cell is composed of nickelic hydroxide. Nickel is an element that has multiple oxidation states. Assume the following proportions of the state

Nickel Charge	Proportions Found
0	0.15
+2	x
+3	0.33
+4	0.15

Determine the variance of the nickel charge. **3-58 moderate**

a. 1.42
b. 2.33
c. 0.37
d. 0.35
e. 1.19

$$\sigma^2 = \sum x^2 P(X = x) - \left(\sum x P(X = x)\right)^2 = (0 + 1.48 + 2.97 + 2.4 + 6.85) - (0 + 0.74 + 0.99 + 0.6)^2$$
$$= 6.85 - 2.33^3 = 1.4211$$

An article in Technometrics (1977, Vol. 19, p. 425) presented data on the motor fuel octane ratings of several blends of gasoline and the stem and leaf of the data is displayed as:

The decimal points is at the |

Stem	Leaves
84	3
86	7
88	022356789
90	1224667
92	22233
94	24
96	5

Use the above information to answer the next 2 questions

13. Calculate the interquartile range of these data. **6-22 moderate**
    a. 3.75
    b. 88.825
    c. 12.2
    d. 90.2
    e. 7.6

$$Q1 = X_{\left(\frac{27}{4}\right)} = X_{(6.75)} = X_{(6)} + 0.75\left(X_{(7)} - X_{(6)}\right) = X_{(6)} + 0.75\left(X_{(7)} - X_{(6)}\right) = 88.3 + 0.75(88.5 - 88.3) = 88.45$$

$$Q3 = X_{\left(\frac{3(27)}{4}\right)} = X_{(20.25)} = X_{(20)} + 0.25\left(X_{(21)} - X_{(20)}\right) = X_{(6)} + 0.25\left(X_{(21)} - X_{(20)}\right) = 92.2 + 0.75(92.2 - 92.2) = 92.2$$

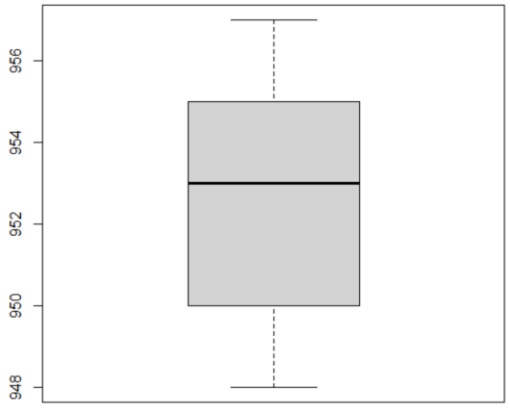
$$IQR = Q3 - Q1 = 92.2 - 88.45 = 3.75$$

14. Calculate the median of these data. **6-22 moderate**
    a. 90.2
    b. 3.75
    c. 88.825
    d. 12.2
    e. 7.6

$$Q2 = X_{\left(\frac{27}{2}\right)} = X_{(13.5)} = \frac{1}{2}\left(X_{(13)} + X_{(14)}\right) = \frac{1}{2}(90.2 + 90.2) = 90.2$$

15. The pH of a solution is measured eight times by one operator using the same instrument. She obtains the following data: 7.15, 7.20, 7.18, 7.19, 7.21, 7.20, 7.16, and 7.18. Calculate the sample mean and sample standard deviation. 6-17 easy
    a. The mean is 7.1838 and the standard deviation is 0.02066
    b. The mean is 7.1750 and the standard deviation is 0.06000
    c. The mean is 7.2000 and the standard deviation is 0.00042
    d. The mean is 7.1750 and the standard deviation is 0.02066
    e. The mean is 7.1838 and the standard deviation is 0.00042

16. The nine measurements that follow are furnace temperatures recorded on successive batches in a semiconductor manufacturing process (units are °F): 953, 950, 948, 955, 951, 949, 957, 954, 955. **6-55 difficult**



Based on the information above, which of the following measurements is/are potential outlier(s).

i. 941
ii. 961
iii. 943

a. (i) only
b. (ii) only
c. (i) and (ii) only
d. (i) and (iii) only
e. (i), (ii) and (iii)

A group of Cola enthusiasts taste-tested Cola. The evaluation was to grade the Cola on a 0-to-100-point scale. The results follow as:

83	84	85	85	85	86	86	87	87	88
88	88	89	89	89	89	89	89	90	90
90	90	90	90	90	91	91	91	91	91
91	91	92	92	92	92	93	94	95	95

Use the above information to answer the next two questions 6-51

17. If the target is to draw frequency distribution with exactly 8 intervals, what is the appropriate class width for constructing frequency table from this data easy
    a. 2
    b. 3
    c. 5
    d. 1
    e. 4

$$C.W = \frac{R}{K} = \frac{95 - 83}{8} = 1.5 \approx 2$$

18. If the target is to draw frequency distribution with exactly 7 intervals, such that the last interval from 95 but less 97, the relative frequency 3rd class is? moderate
    a. 0.125
    b. 0.275
    c. 0.05
    d. 0.225
    e. 0.325

intervals	frequency	Relative frequency
83 but less than 85	2	0.05
85 but less than 87	5	0.125
87 but less than 89	5	0.125
89 but less than 91	13	0.325
91 but less than 93	11	0.275
93 but less than 95	2	0.05
95 but less than 97	2	0.05
Total	40	1