1. (2.49) Find the errors in each of the following statements:

   (a) The probabilities that an automobile salesperson will sell 0, 1, 2, or 3 cars on any given day in February are, respectively, 0.19, 0.38, 0.29, and 0.15.

   - Error: $P(\Omega) \nleq 1; 0.19 + 0.38 + 0.29 + 0.15 = 1.01$

   (b) The probability that it will rain tomorrow is 0.40, and the probability that it will not rain tomorrow is 0.52.

   - Error: $P(A) + P(A^{'}) \neq 1; 0.40 + 0.52 = 0.92$

   (c) The probabilities that a printer will make 0, 1, 2, 3, or 4 or more mistakes in setting a document are, respectively, 0.19, 0.34, -0.25, 0.43, and 0.29.

   - Error: $P(E) \ngeq 0; -0.25 < 0$

   (d) On a single draw from a deck of playing cards, the probability of selecting a heart is 1/4, the probability of selecting a black card is 1/2, and the probability of selecting both a heart and a black card is 1/8.

   - Error: $P(\blacksquare) \cap P(\heartsuit) = \emptyset$; $P(E \in \mathcal{F}) = 0 \neq \frac{1}{8}$

2. (2.53) The probability that an American industry will locate in Shanghai, China, is 0.7, the probability that it will locate in Beijing, China, is 0.4, and the probability that it will locate in either Shanghai or Beijing or both is 0.8. What is the probability that the industry will locate

$$: P(S) = 0.7, \quad P(C) = 0.4, \quad P(S \cup C) = 0.8$$

   (a) in both cities?

   - $P(S \cap C) = 0.7 + 0.4 - 0.8 = 0.3$

   (b) in neither city?

   - $P(S^{'} \cap C^{'}) = 1 - 0.8 = 0.2$

3. (2.54) From past experience, a stockbroker believes that under present economic conditions a customer will invest in tax-free bonds with a probability of 0.6, will invest in mutual funds with a probability of 0.3, and will invest in both tax-free bonds and mutual funds with a probability of 0.15. At this time, find the probability that a customer will invest

$$: P(T) = 0.6, \quad P(M) = 0.3, \quad P(T \cap M) = 0.15$$

   (a) in either tax-free bonds or mutual funds;

   - $P(T \cup M) = 0.6 + 0.3 - 0.15 = 0.75$

   (b) in neither tax-free bonds nor mutual funds.

   - $P(T' \cap M') = 1 - 0.75 = 0.25$

4. (2.55) If each coded item in a catalog begins with 3 distinct letters followed by 4 distinct nonzero digits, find the probability of randomly selecting one of these coded items with the first letter a vowel and the last digit even.

$$N = {}_{26}P_3 \cdot {}_9P_4 = \frac{26!}{(26-3)!} \cdot \frac{9!}{(9-4)!} = 47\,174\,400$$
$$n = 5 \cdot {}_{25}P_2 \cdot 4 \cdot {}_8P_3 = 4\,032\,000$$
$$P\left(\frac{n}{N}\right) = 0.085$$

5. (2.61) In a high school graduating class of 100 students, 54 studied mathematics, 69 studied history, and 35 studied both mathematics and history. If one of these students is selected at random, find the probability that

$$P(M) = 0.54, \quad P(H) = 0.69, \quad P(M \cap H) = 0.35$$

   (a) the student took mathematics or history;

   - $P(M \cup H) = 0.54 + 0.69 - 0.35 = 0.88$

   (b) the student did not take either of these subjects;

   - $P(M' \cap H') = 1 - 0.88 = 0.12$

   (c) the student took history but not mathematics.

   - $P(H \cap M') = P(H) - P(H \cap M) = 0.69 - 0.35 = 0.34$

6. (2.66) Factory workers are constantly encouraged to practice zero tolerance when it comes to accidents in factories. Accidents can occur because the working environment or conditions themselves are unsafe. On the other hand, accidents can occur due to carelessness or so-called human error. In addition, the worker's shift, 7:00 A.M.–3:00 P.M. (day shift), 3:00 P.M.–11:00 P.M. (evening shift), or 11:00 P.M.–7:00 A.M. (graveyard shift), may be a factor. During the last year, 300 accidents have occurred. The percentages of the accidents for the condition combination are as follows:

Shift	Unsafe Conditions	Human Error
Day	5%	32%
Evening	6%	25%
Graveyard	2%	30%

If an accident report is selected randomly from the 300 reports,

(a) what is the probability that the accident occurred on the graveyard shift?

- $P(G) = 0.3 + 0.02 = 0.32$

(b) what is the probability that the accident occurred due to human error?

- $P(H) = 0.32 + 0.25 + 0.3 = 0.87$

(c) what is the probability that the accident occurred due to unsafe conditions?

- $P(U) = 0.05 + 0.06 + 0.02 = 0.13$

(d) what is the probability that the accident occurred on either the evening or the graveyard shift?

- $P(E \cup G) = P(D') = 1 - (0.05 + 0.32) = 0.63$

7. (2.69) It is common in many industrial areas to use a filling machine to fill boxes full of product. This occurs in the food industry as well as other areas in which the product is used in the home, for example, detergent. These machines are not perfect, and indeed they may A, fill to specification, B, underfill, and C, overfill. Generally, the practice of underfilling is that which one hopes to avoid. Let $P(B) = 0.001$ while $P(A) = 0.990$

   (a) Give $P(C)$.

   - $P(C) = P((A \cup B)') = 1 - (0.99 + 0.001) = 0.009$

   (b) What is the probability that the machine does not underfill?

   - $P(B') = 1 - 0.001 = 0.999$

   (c) What is the probability that the machine either overfills or underfills?

   - $P(A') = 1 - 0.99 = 0.01$

8. (2.76) In an experiment to study the relationship of hypertension and smoking habits, the following data are collected for 180 individuals:

	Nonsmokers A	Moderate B	Heavy C
H	21	36	30
H'	48	26	19

   where H and H' in the table stand for Hypertension and Non-hypertension, respectively. If one of these individuals is selected at random, find the probability that the person is

$$P(H) = \frac{87}{180}, \quad P(H') = \frac{93}{180}$$

   (a) experiencing hypertension, given that the person is a heavy smoker;

   - $P(H \mid C) = \dfrac{P(H \cap C)}{P(C)} = \dfrac{30}{49}$

   (b) a nonsmoker, given that the person is experiencing no hypertension.

   - $P(A \mid H') = \dfrac{P(A \cap H')}{P(H')} = \dfrac{48}{93}$

9. (2.80) The probability that an automobile being filled with gasoline also needs an oil change is 0.25; the probability that it needs a new oil filter is 0.40; and the probability that both the oil and the filter need changing is 0.14.

$$P(O) = 0.25, \quad P(F) = 0.40, \quad P(O \cap F) = 0.14$$

   (a) If the oil has to be changed, what is the probability that a new oil filter is needed?

   - $P(F \mid O) = \dfrac{0.14}{0.25} = 0.56$

   (b) If a new oil filter is needed, what is the probability that the oil has to be changed?

   - $P(O \mid F) = \dfrac{0.14}{0.40} = 0.$

10. (2.126) During bad economic times, industrial workers are dismissed and are often replaced by machines. The history of 100 workers whose loss of employment is attributable to technological advances is reviewed. For each of these individuals, it is determined if he or she was given an alternative job within the same company, found a job with another company in the same field, found a job in a new field, or has been unemployed for 1 year. In addition, the union status of each worker is recorded. The following table summarizes the results.

	U Union	U' Non-union
S Same Company	40	15
C New Company (same field)	13	10
F New Field	4	11
N Unemployed	2	5

$$P(U) = 59$$

   (a) If the selected worker found a job with a new company in the same field, what is the probability that the worker is a union member?

   - $P(U \mid C) = \dfrac{13}{13 + 10} = 0.5652$

   (b) If the worker is a union member, what is the probability that the worker has been unemployed for a year?

   - $P(N \mid U) = \dfrac{2}{59} = 0.034$