Chapter 4 Problem and Solutions - Introduction to Probability

18. To investigate how often families eat at home, Harris Interactive surveyed 496 adults living with children under the age of 18 (*USA Today*, January 3, 2007). The survey results are shown in the following table.

Number of Family Meals Week	Number of Survey Responses
0	11
1	11
2	30
3	36
4	36
5	119
6	114
7 or more	139

For a randomly selected family with children under the age of 18, compute the following.

a. The probability the family eats no meals at home during the week
b. The probability the family eats at least four meals at home during the week
c. The probability the family eats two or fewer meals at home during the week

28. A survey of magazine subscribers showed that 45.8% rented a car during the past 12 months for business reasons, 54% rented a car during the past 12 months for personal reasons, and 30% rented a car during the past 12 months for both business and personal reasons.

a. What is the probability that a subscriber rented a car during the past 12 months for business or personal reasons?
b. What is the probability that a subscriber did not rent a car during the past 12 months for either business or personal reasons?

32. The automobile industry sold 657,000 vehicles in the United States during January 2009 (*The Wall Street Journal*, February 4, 2009). This volume was down 37% from January 2008 as economic conditions continued to decline. The Big Three U.S. automakers— General Motors, Ford, and Chrysler—sold 280,500 vehicles, down 48% from January 2008. A summary of sales by automobile manufacturer and type of vehicle sold is shown in the following table. Data are in thousands of vehicles. The non-U.S. manufacturers are led by Toyota, Honda, and Nissan. The category Light Truck includes pickup, minivan, SUV, and crossover models.

	Type of Vehicle	
Manufacturer	Car	Light Truck
U.S.	87.4	193.1
Non-U.S.	228.5	148.0

a. Develop a joint probability table for these data and use the table to answer the remaining questions.
b. What are the marginal probabilities? What do they tell you about the probabilities associated with the manufacturer and the type of vehicle sold?

c. If a vehicle was manufactured by one of the U.S. automakers, what is the probability that the vehicle was a car? What is the probability that it was a light truck?
d. If a vehicle was not manufactured by one of the U.S. automakers, what is the proba- bility that the vehicle was a car? What is the probability that it was a light truck?
e. If the vehicle was a light truck, what is the probability that it was manufactured by one of the U.S. automakers?
f. What does the probability information tell you about sales?

33. In a survey of MBA students, the following data were obtained on "students' first reason for application to the school in which they matriculated."

Reason for Application

Enrollment Status	School Quality	School Cost or Convenience	Other	Totals
Full Time	421	393	76	890
Part Time	400	593	46	1039
Totals	821	986	122	1929

a. Develop a joint probability table for these data.
b. Use the marginal probabilities of school quality, school cost or convenience, and other to comment on the most important reason for choosing a school.

Chapter 4 Solutions

18. a. $P(\text{no meals}) = \frac{11}{496} = .0222$

b. $P(\text{at least four meals}) = P(4) + P(5) + P(6) + P(7 \text{ or more})$

$$= \frac{36}{496} + \frac{119}{496} + \frac{114}{496} + \frac{139}{496} = .8226$$

c. $P(\text{two or fewer meals}) = P(2) + P(1) + P(0)$

$$= \frac{30}{496} + \frac{11}{496} + \frac{11}{496} = .1048$$

28. Let: B = rented a car for business reasons
P = rented a car for personal reasons

a. $P(B \cup P) = P(B) + P(P) - P(B \cap P)$
$= .54 + .458 - .30 = .698$

b. $P(\text{Neither}) = 1 - .698 = .302$

32. (5^{th} Ed) a. Row and column sums are shown.

	Car	Light Truck	Total
U.S.	87.4	193.1	280.5
Non U.S.	228.5	148.0	376.5
Total	315.9	341.1	657.0

A total of 657.0 thousand vehicles were sold.

Dividing each entry in the table by 657.0 provides the following joint probability table.

	Car	Light Truck	Total
U.S.	.1330	.2939	.4269
Non U.S.	.3478	.2253	.5731
Total	.4808	.5192	1.0000

b. Let U = U. S. manufacturer
N = Non U.S. manufacturer
C = Car
L = Light Truck

Marginal probabilities: $P(U) = .4269$ $P(B) = .5731$
There is a higher probability that the vehicle was not manufactured by a U. S. auto maker. In terms of market share, non U.S. auto makers lead with a 57.3% share of vehicle sales.

Marginal probabilities: $P(C) = .4808$ $P(L) = .5192$
The light truck category which includes pickup, minivans, SUVs and crossover models has a slightly higher probability. But the types of vehicles are fairly even split.

c.

$$P(C|U) = \frac{P(C \cap U)}{P(U)} = \frac{.1330}{.4269} = .3115 \qquad P(L|U) = \frac{P(L \cap U)}{P(U)} = \frac{.2939}{.4269} = .6885$$

If a vehicle was manufactured by one of the U.S. auto makers, there is a higher probability it will be in the light truck category.

d.

$$P(C|N) = \frac{P(C \cap N)}{P(N)} = \frac{.3478}{.5731} = .6069 \qquad P(L|N) = \frac{P(L \cap N)}{P(N)} = \frac{.2253}{.5731} = .3931$$

If a vehicle was not manufactured by one of the U.S. auto makers, there is a higher probability it will be a car.

e.

$$P(U|L) = \frac{P(U \cap L)}{P(L)} = \frac{.2939}{.5192} = .5661$$

If a vehicle was a light truck, there is better than a 50-50 chance that it was manufactured by one of the U.S. auto makers.

f. There is a higher probability, and thus a larger market share for non U.S. auto makers. However, the U. S. auto makers are leaders in sales for the light truck category.

32. (4th Ed) a. Total sample size = 2000

Dividing each entry by 2000 provides the following joint probability table.

	Health Insurance		
Age	Yes	No	Total
18 to 34	.375	.085	.46
35 and over	.475	.065	.54
	.850	.150	1.00

Let A = 18 to 34 age group
B = 35 and over age group
Y = Insurance coverage
N = No insurance coverage

b. $P(A) = .46$
$P(B) = .54$

Of population age 18 and over

46% are ages 18 to 34
54% are ages 35 and over

c. $P(N) = .15$

d. $P(\mathrm{N}|\mathrm{A}) = \dfrac{P(\mathrm{N} \cap \mathrm{A})}{P(\mathrm{A})} = \dfrac{.085}{.46} = .1848$

e. $P(\mathrm{N}|\mathrm{B}) = \dfrac{P(\mathrm{N} \cap \mathrm{B})}{P(\mathrm{B})} = \dfrac{.065}{.54} = .1204$

f. $P(\mathrm{A}|\mathrm{N}) = \dfrac{P(\mathrm{A} \cap \mathrm{N})}{P(\mathrm{N})} = \dfrac{.085}{.150} = .5677$

g. Probability of no health insurance coverage is .15. A higher probability exists for the younger population. Ages 18 to 34: .1848 or approximately 18.5% of the age group. Ages 35 and over: .1204 or approximately 12% of the age group. Of the no insurance group, more are in the 18 to 34 age group: .5677, or approximately 57% are ages 18 to 34.

33. a.

	Reason for Applying			
	Quality	Cost/Convenience	Other	Total
Full Time	.218	.204	.039	.461
Part Time	.208	.307	.024	.539
	.426	.511	.063	1.000

b. It is most likely a student will cite cost or convenience as the first reason - probability = .511. School quality is the first reason cited by the second largest number of students - probability = .426.

c. P(Quality | full time) = .218/.461 = .473

d. P(Quality | part time) = .208/.539 = .386

e. For independence, we must have $P(\mathrm{A})P(\mathrm{B}) = P(\mathrm{A} \cap \mathrm{B})$.

From the table, $P(\mathrm{A} \cap \mathrm{B}) = .218$, $P(\mathrm{A}) = .461$, $P(\mathrm{B}) = .426$

$P(\mathrm{A})P(\mathrm{B}) = (.461)(.426) = .196$

Because $P(\mathrm{A})P(\mathrm{B}) \neq P(\mathrm{A} \cap \mathrm{B})$, the events are not independent.