1.18 Is a football jersey number a quantitative or a categorical variable? Support your answer with a detailed explanation.

Solution:

A football jersey number is a categorical variable. It is attribute information that can identify something about the position played by a player [for example; 60's & 70's are numbers for lineman and they are not eligible to catch passes, other number groups have similar restrictions], but does not give any measurable information about that player.

1.33 Identify each of the following as examples of (1) attribute (qualitative) or (2) numerical (quantitative) variables:

a. The breaking strength of a given type of string

b. The hair color of children auditioning for the musical *Annie*

c. The number of stop signs in towns of fewer than 500 people

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d. Whether or not a faucet is defective

e. The number of questions answered correctly on a standardized test

f. The length of time required to answer a telephone call at a certain real estate office

Solution:

a. numerical	b. attribute	c. numerical
d. attribute	e. numerical	f. numerical

2.21 [EX02-021] Shown below are the heights (in inches) of the basketball players who were the first-round picks by National Basketball Association professional teams for 2009.

82	86	76	77	75	72	75	81	78	74
77	77	81	81	82	80	76	72	74	74
73	82	80	84	74	81	80	77	74	78

Source: http://www.mynbadraft.com/

a. Construct a dotplot of the heights of these players.

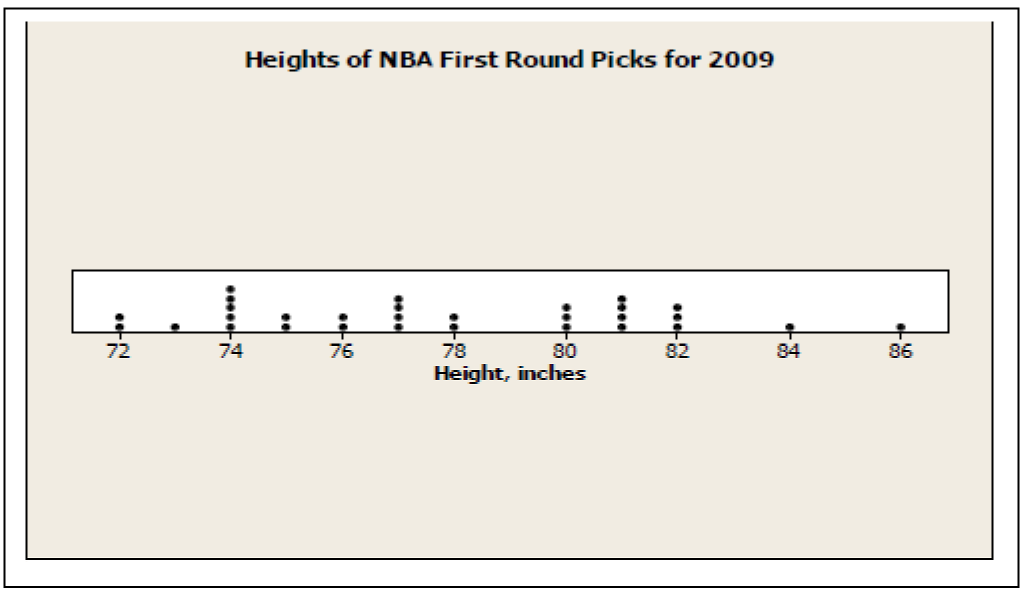
b. Use the dotplot to uncover the shortest and the tallest players.

c. What is the most common height and how many players share that height?

d. What feature of the dotplot illustrates the most common height?

Solution:

a.



b. 72, 86

c. 74, 5

d. tallest column of dots

2.99 Consider the sample 6, 8, 7, 5, 3, 7. Find the following:

a. Range

b. Variance s^2, using formula (2.5)

c. Standard deviation, s

Solution:

a. range = H - L = 8 - 3 = <u>5</u>

b. 1st: find mean, $\overline{x} = \sum x/n = 36/6 = 6$

	x	$x - \overline{x}$	$(x - \overline{x})^2$
	3	-3	9
	5	-1	1
	6	0	0
	7	1	1
	7	1	1
	8	2	4
$\sum$	36	0	16

$s^2 = \sum(x-\overline{x})^2/(n-1)$

$= 16/5 = \underline{3.2}$

c. $s = \sqrt{s^2} = \sqrt{3.2} = 1.789 = \underline{1.8}$

3.45 [EX03-045] Sports drinks are very popular in today's culture around the world. The following table lists 10 different products you can buy in England and the values for three variables: cost per serving (in pence), energy per serving (in kilocalories), and carbohydrates per serving (in grams).

Sports Drink	Cost	Energy	Carbs
Lucozade Sport RTD 330ml pouch/can	72	92	21.1
Lucozade Sport RTD 500ml bot.	79	140	32
Lucozade Sport RTD 650ml sports bot.	119	182	41.6
POWERade 500ml bot.	119	120	30
Gatorade Sports 750ml	89	188	45
Science in Sport Go Electrolyte (500ml)	99	160	40
High Five Isotonic electrolyte (750ml)	99	220	55
Isostar powder (per litre) 5l tub	126	320	77
Isostar RTD 500ml bot.	99	150	35
Maxim Electrolyte (per litre) 2kg bag	66	296	75

Note: Cost is in pence (p), 0.01 of a British pound, worth $0.0187 on March 28, 2005

Source: http://www.simplyrunning.net

a. Draw a scatter diagram using x = carbs/serving and y = energy/serving.

b. Does there appear to be a linear relationship?

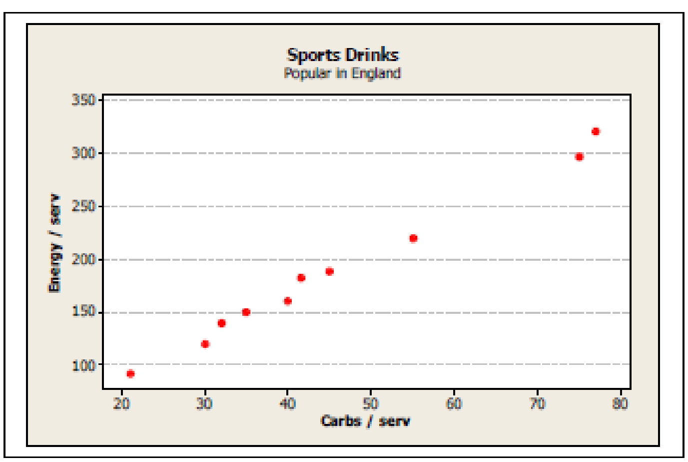
c. Calculate the linear correlation coefficient, r.

d. What does this value of correlation seem to be telling us? Explain.

e. Repeat parts a through d using x = cost/serving and y = energy/serving. (Retain these solutions to use in Exercise 3.59, p. 157.)

Solution:

a.



b. Yes, a straight line relationship appears. As carb/serving increase, so does the energy/serving.

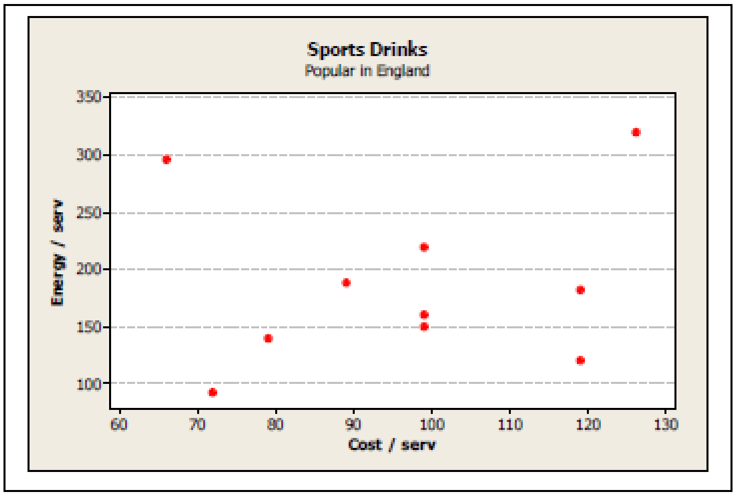
c. Summations from extensions tables: $n = 10$, $\sum x = 451.7$, $\sum y = 1868$, $\sum x^2 = 23528.8$, $\sum xy = 96642.4$, $\sum y^2 = 397448$

$SS(x) = \sum x^2 - ((\sum x)^2/n) = 23528.8 - (451.7^2/10) = 3125.511$
$SS(y) = \sum y^2 - ((\sum y)^2/n) = 397448 - (1868^2/10) = 48505.6$
$SS(xy) = \sum xy - ((\sum x \cdot \sum y)/n) = 96642.4 - (451.7 \cdot 1868/10) = 12264.84$

$r = SS(xy)/\sqrt{SS(x) \cdot SS(y)} = 12264.84/\sqrt{3125.511 \cdot 48505.6}$
$= \underline{0.996}$

d. There is a strong, almost perfect, positive correlation between the carbs/serving and the energy/serving for sports drinks.

e.



Appears to have no linear relationship between the cost/serving of a sports drink and the energy/serving.

Summations from extensions tables: $n = 10$, $\sum x = 967$, $\sum y = 1868$, $\sum x^2 = 97303$, $\sum xy = 182680$, $\sum y^2 = 397448$

$SS(x) = \sum x^2 - ((\sum x)^2/n) = 97303 - (967^2/10) = 3794.1$
$SS(y) = \sum y^2 - ((\sum y)^2/n) = 397448 - (1868^2/10) = 48505.6$
$SS(xy) = \sum xy - ((\sum x \cdot \sum y)/n) = 182680 - (967 \cdot 1868/10) = 2044.4$

$r = SS(xy)/\sqrt{SS(x) \cdot SS(y)} = 2044.4/\sqrt{3794.1 \cdot 48505.6}$
$= 0.1507 = \underline{0.15}$

There is little or no correlation between the cost/serving of a sports drink and the energy/serving.

3.59 [EX03-045] What is the relationship between carbohydrates consumed and energy released in a sports drink? Let's use the sports drink data listed in Exercise 3.45 on page 144 to investigate the relationship.

a. In Exercise 3.45 a scatter diagram was drawn using x = carbs/serving and y = energy/serving. Review the scatter diagram (if you did not draw it before, do so now), and describe why you believe there is or is not a linear relationship.

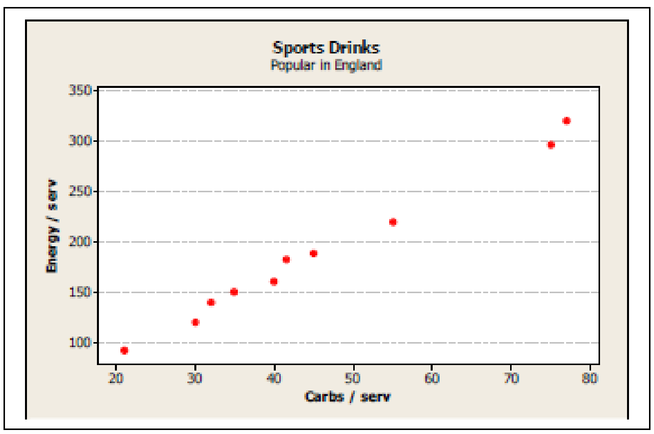
b. Find the equation for the line of best fit.

c. Using the equation found in part b, estimate the amount of energy that one can expect to gain from consuming 40 grams of carbohydrates.

d. Using the equation found in part b, estimate the amount of energy that one can expect to gain from consuming 65 grams of carbohydrates.

Solution:

a.



A linear relationship appears between carbs/serving and energy/serving for the sports drinks in the sample. The ordered pairs follow very closely to a straight line.

b. Summations from extensions tables: $n = 10$, $\sum x = 451.7$, $\sum y = 1868$, $\sum x^2 = 23528.8$, $\sum xy = 96642.4$

$SS(x) = \sum x^2 - ((\sum x)^2/n) = 23528.8 - (451.7^2/10) = 3125.511$
$SS(xy) = \sum xy - ((\sum x \cdot \sum y)/n) = 96642.4 - (451.7 \cdot 1868/10) = 12264.84$

$b_1 = SS(xy)/SS(x) = 12264.84/3125.511 = 3.924$

$b_0 = [\sum y - b_1 \cdot \sum x]/n = [1868 - (3.924 \cdot 451.7)]/10 = 9.553$

$$\hat{y} = 9.55 + 3.924x$$

c. $\hat{y} = 9.55 + 3.924(40) = 166.51$

d. $\hat{y} = 9.55 + 3.924(65) = 264.61$

4.130 $P(\text{R}) = 0.5$, $P(\text{S}) = 0.3$, and events R and S are independent.

a. Find $P(\text{R and S})$.

b. Find $P(\text{R or S})$.

c. Find $P(\overline{\text{S}})$.

d. Find $P(\text{R}|\text{S})$.

e. Find $P(\text{S}|\text{R})$.

f. Are events R and S mutually exclusive? Explain.

Solution:

a. $P(\text{R and S}) = P(\text{R}) \cdot P(\text{S}) = 0.5 \cdot 0.3 = \underline{0.15}$

b. $P(\text{R or S}) = P(\text{R}) + P(\text{S}) - P(\text{R and S}) = 0.50 + 0.30 - 0.15 = \underline{0.65}$

c. $P(\overline{\text{S}}) = 1 - P(\text{S}) = 1 - 0.3 = \underline{0.7}$

d. $P(\text{R}|\text{S}) = P(\text{R and S})/P(\text{S}) = 0.15/0.30 = \underline{0.5}$

e. $P(\text{S}|\text{R}) = P(\text{S and R})/P(\text{R}) = 0.15/0.50 = \underline{0.3}$

f. No. Independent events can intersect, therefore R and S are not mutually exclusive events.

4.142 A coin is flipped three times.

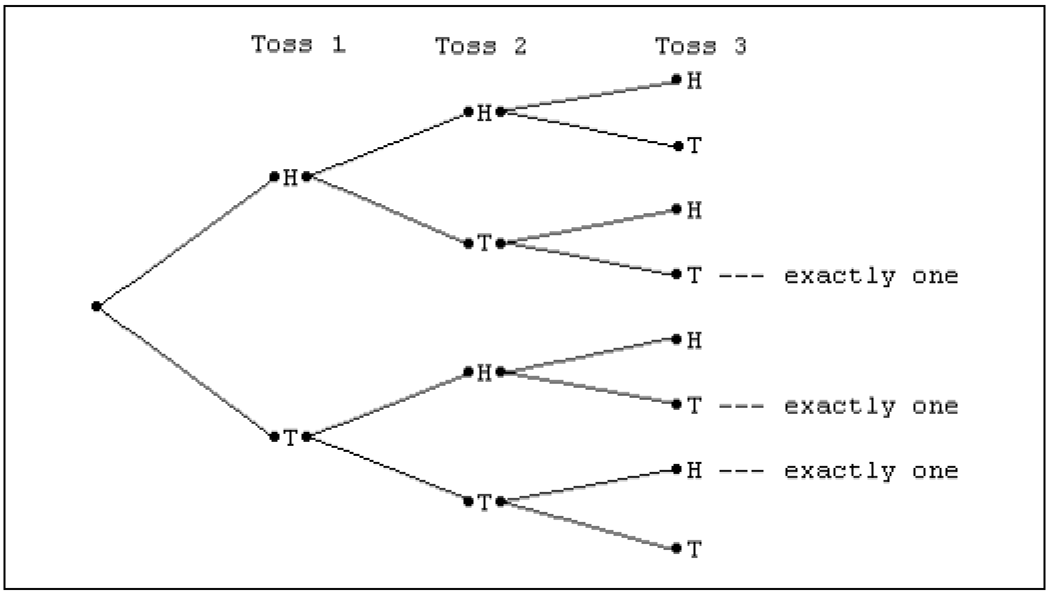
a. Draw a tree diagram that represents all possible outcomes.

b. Identify all branches that represent the event "exactly one head occurred."

c. Find the probability of "exactly one head occurred."

Solution:

a. & b.



c. P(exactly one head occurred) = 3(1/2 · 1/2 · 1/2) = 3/8 = 0.375

5.22 a. Form the probability distribution table for $P(x) = \frac{x}{6}$, for $x = 1, 2, 3$.

b. Find the extensions $xP(x)$ and $x^2P(x)$ for each x.

c. Find $\Sigma[xP(x)]$ and $\Sigma[x^2P(x)]$.

d. Find the mean for $P(x) = \frac{x}{6}$, for $x = 1, 2, 3$.

e. Find the variance for $P(x) = \frac{x}{6}$, for $x = 1, 2, 3$.

f. Find the standard deviation for $P(x) = \frac{x}{6}$, for $x = 1, 2, 3$.

Solution:

a.	x	P(x)	b) xP(x)	$x^2P(x)$
	1	1/6	1/6	1/6
	2	2/6	4/6	8/6
	3	3/6	9/6	27/6
	Σ	6/6 = 1.0 ck	c) 14/6 = 2.33	36/6 = 6.0

d. $\mu = \Sigma[xP(x)] = 2.33$

e. $\sigma^2 = \Sigma[x^2P(x)] - \{\Sigma[xP(x)]\}^2 = 6.0 - \{2.3333\}^2 = 0.55556$

f. $\sigma = \sqrt{\sigma^2} = \sqrt{0.55556} = 0.745$

5.79 According to United Mileage Plus Visa (November 22, 2004), 41% of passengers say they "put on the earphones" to avoid being bothered by their seatmates during flights. To show how important, or not important, the earphones are to people, consider the variable x to be the number of people in a sample of 12 who say they "put on the earphones" to avoid their seatmates. Assume the 41% is true for the whole population of airline travelers and that a random sample is selected.

a. Is x a binomial random variable? Justify your answer.

b. Find the probability that $x = 4$ or 5.

c. Find the mean and standard deviation of x.

Solution:

a. x might be approximated by using a binomial random variable. There are only two possible outcomes for each trial of the experiment, there are n = 12 repeated trials. But are the trials independent? [This might depend on whether you are traveling alone or with someone.] Probably not, but the binomial distribution might be a reasonable estimator. x is the count of people and can take on values from zero to 12.

b. P(x=4 or x=5) = P(x=4)+P(x=5) $= \left[\frac{12!}{4!(12-4)!}(0.41)^4(1-0.41)^{12-4} + \frac{12!}{5!(12-5)!}(0.41)^5(1-0.41)^{12-5}\right]$

$= [(0.2054 + 0.2284)] = 0.4338$

c. $\mu = np = 12 \cdot 0.41 = 4.92$

$\sigma = \sqrt{npq} = \sqrt{12 \cdot 0.41 \cdot 0.59} = 1.70376 = 1.7$