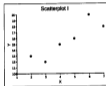


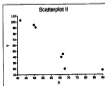
Question 1 For each scatterplot in (a), (b) and (c) below, select the correct form (linear or non-linear), strength of the association (weak or strong), direction (positive, negative or neither), and the best approximate value for the correlation r .

(a) [3 points]



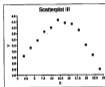
- form: linear non-linear
 strength: weak strong
 direction: positive negative neither
 value of r : -1.0 -0.7 -0.1
 0 0.7 1.0

(b) [3 points]



- form: linear non-linear
 strength: weak strong
 direction: positive negative neither
 value of r : -1.0 -0.7 -0.1
 0 0.7 1.0

(c) [3 points]

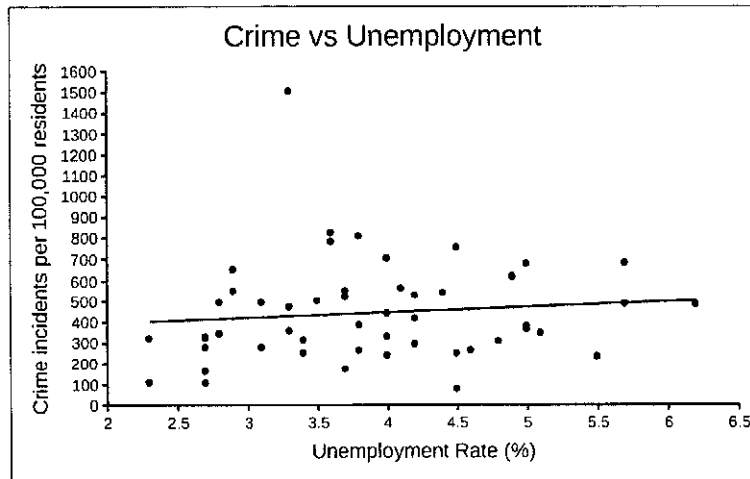


- form: linear non-linear
 strength: weak strong
 direction: positive negative neither
 value of r : -1.0 -0.7 -0.5
 0 0.7 1.0

(d) [1 point] A scatterplot contains only two data points: (1,10) and (10,1). What must be the value of r ?

$r = -1$. Both data points lie on a line, and y decreases with x .

Question 2 The following scatterplot shows crime and unemployment rates for fifty US states:



Letting x denote the unemployment rate and y the crime incidents per 100,000 residents, the least squares regression line shown has equation

$$y = 25.6x + 344.0$$

(a)[3 points] Based on the least squares model, what is the approximate change in crime rate corresponding to a two percent increase in unemployment rate?

As x increases by 2, y increases by $(25.6)(2) = \boxed{51.2}$
 (incidents per 100,000 residents.)

(b)[3 points] Based on the least squares model, what unemployment rate corresponds to a crime rate of 450 incidents per 100,000 residents?

When $y = 450$ what is x ? $450 = 25.6x + 344.0$
 $25.6x = 450 - 344$
 $x = \frac{450 - 344}{25.6} = \boxed{4.1\%}$

(c)[2 points] The square of the correlation in this case is $r^2 = 0.01$. A national newspaper claims that, based on the least squares model, crime increases with unemployment. Is this a fair statement?

No. $r^2 = 0.01$ says that only 1% of the variation in y is explained by the linear relationship between y and x .

(d)[2 points] If the data point corresponding to 1500 on the y -axis is removed from the scatterplot would you expect r to increase or decrease? Explain briefly.

Increase, since the data would then follow a stronger linear relationship.

Question 3 This question deals with the roulette wheel discussed in class and also in your homework. A roulette wheel has 38 slots: 18 red, 18 black, and 2 green slots numbered 0 and 00. On any spin of the roulette wheel the marble is equally likely to land in any of the 38 slots. Round all answers below to two decimals.

- (a)[3 points] On two successive spins of the wheel, what is the probability of first landing on red, and on the second spin landing on black or green?

$$\begin{aligned}
 & P(\text{first red, second black or green}) \\
 &= P(\text{first red}) P(\text{second black or green}) \quad \text{by independence.} \\
 &= \left(\frac{18}{38}\right) \left(\frac{20}{38}\right) \\
 &\doteq \boxed{0.25}
 \end{aligned}$$

- (b)[3 points] On two successive spins of the wheel, what is the probability of landing on green at least once?

$$\begin{aligned}
 & P(\text{green at least once}) \\
 &= 1 - P(\text{not green both times}) \\
 &= 1 - \left(\frac{36}{38}\right) \left(\frac{36}{38}\right) \quad \text{by independence} \\
 &\doteq \boxed{0.10}
 \end{aligned}$$

- (c)[4 points] Suppose landing on red or black pays you \$2, landing on the green 0 pays you \$12, and landing on the green 00 pays you \$20. What is the expected payout for this game (ignore what it costs you to play the game— assume it costs you nothing).

Let $X = \text{payout}$

$$\begin{aligned}
 E(X) &= (2) P(\text{red or black}) + (12) P(\text{green } 0) + (20) P(\text{green } 00) \\
 &= (2) \left(\frac{36}{38}\right) + (12) \left(\frac{1}{38}\right) + (20) \left(\frac{1}{38}\right) \\
 &= \boxed{\$2.74}
 \end{aligned}$$

Question 4 If a coin is flipped 10,000 times, the number of times heads comes up is approximately normally distributed with mean $\mu = 5000$ and standard deviation $\sigma = 50$.

(a)[2 points] If a coin is flipped 10,000 times what is the probability of getting fewer than 5075 heads?

Let $X = \# \text{ heads}$.

$$z\text{-score for } X = 5075 : z = \frac{5075 - 5000}{50} = 1.5$$

$$\therefore P(X < 5075) = P(Z < 1.5) = \frac{93.32}{100} = \boxed{0.9332}$$

(b)[4 points] Suppose two people each flip a coin 10,000 times. Find the probability that at least one of the sequences of 10,000 coin flips results in 5075 or more heads.

$P(\text{at least one results in 5075 or more heads})$

$$= 1 - P(\text{both result in fewer than 5075 heads})$$

$$= 1 - (0.9332)(0.9332) \text{ by independence, using (a)}$$

$$= \boxed{0.1291}$$

(c)[4 points] If a coin is flipped 10,000 times, the probability of getting fewer than n heads is 0.92. What is n ?

$$P(X \leq n) = 0.92$$

$$z\text{-score for } X = n \text{ is } \frac{n - 5000}{50}$$

z -score corresponding to 92nd percentile is 1.4

$$\therefore \frac{n - 5000}{50} = 1.4,$$

$$n - 5000 = 70, \text{ so } n = 5000 + 70 = \boxed{5070}$$

Question 5

- (a)[5 points] Consider the following game: draw a card from a standard 52 card deck. If the card is a king, you receive \$10, if it is a red queen you pay \$12. If any other card comes up you don't pay or receive anything. What amount of money do you expect to win or lose in this game?

Let $X =$ amount won.

$$\begin{aligned} E(X) &= (10)P(\text{King}) + (-12)P(\text{red queen}) + (0)P(\text{not King or red queen}) \\ &= (10)\left(\frac{4}{52}\right) + (-12)\left(\frac{2}{52}\right) \\ &= \boxed{\$0.31} \end{aligned}$$

- (b)[5 points] We wish to modify the game in part (a) so that the expected amount won or lost is zero. If you still must pay \$12 when you draw a red queen, what must be the amount received if you draw a king?

Let $C =$ amount received if King is drawn.

Then we want $E(X) = 0$, so

$$0 = (C)\left(\frac{4}{52}\right) + (-12)\left(\frac{2}{52}\right)$$

$$0 = \frac{4C}{52} - \frac{24}{52}$$

$$0 = \frac{4C - 24}{52}$$

$$\therefore 4C - 24 = 0$$

$$4C = 24$$

$$\boxed{C = \$6}$$