AP Statistics: True or False?

1.

A bunch of people review a movie from 1-star to 5-stars as shown in the table to the right. The mean and median score is calculated. Two more people then add their scores, one grading it as a 1-star and the other as a 5-star. Both of these statements are correct.

I. The shape of the distribution does not change.

II. Both the mean and median do not change.

Stars	1	2	3	4	5
People	5	4	8	2	1

Solution

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II. Both the mean and median do not change.

Stars	1	2	3	4	5
People	5	4	8	2	1

I is correct as the both distributions will be skewed right.
II is incorrect. The median (middle score) of the original data is 3 and adding one to the 1-star and 5-star data doesn't change that.
But the mean of the original data is $\frac{5+8+24+8+5}{20} = 2.5.$
Adding 2 pieces of data whose average is 3 will increase the mean.
False

AP Statistics: True or False?

2.

Gloria and Howard are two senior golfers who are married to each other.
The table below shows how they did in a recent round of golf as well the
average and standard deviation for other married senior golfers in their gender.

Both statements below are correct.

I. Gloria scored better (lower) than Howard relative to their gender categories.

II. A sample of married senior women scores as well as their husband's scores are collected with the idea of showing that married senior men score better than their wife (raw score). To test that theory, a 2-sample t-test is used.

	Score	$\bar{x}$	s
Gloria	86	89.5	2.2
Howard	81	84.3	2.7

Solution

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	Score	$\bar{x}$	s
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Howard	81	84.3	2.7

$z_G = \dfrac{86-89.5}{2.2} = -1.6 \qquad z_H = \dfrac{81-84.3}{2.7} = -1.2$

I. Since Gloria's standardized score is lower than Howard's, she scored better.

II. Since there is a relationship between the man and woman, each couple's scores is subtracted making it a matched pairs one-sample test.

False

AP Statistics: True or False?

3.

During the COVID-19 outbreak, shoppers at a market were allowed a maximum of 3 cleaning/disinfecting products during a store visit. The number of such products brought by shoppers during a day are summarized in the table below. Someone purchasing 3 products was within 1 standard deviation of the mean.

products bought	0	1	2	3
percent buying	15%	10%	35%	40%

Solution

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products bought	0	1	2	3
percent buying	15%	10%	35%	40%

$$\bar{x} = 0.15(0) + 0.10(1) + 0.35(2) + 0.40(3) = 2.0$$

$$s = \sqrt{0.15(0-2)^2 + 0.1(1-2)^2 + 0.35(2-2)^2 + 0.4(3-2)^2}$$

$$s = \sqrt{0.60 + 0.1 + 0 + 0.4} = \sqrt{1.1} = 1.05$$

$2 + 1.05 = 3.05$ so 3 is within 1 sd of the mean

True

AP Statistics: True or False?

4.

The 5-number summary of a data set is 7, 20, 21, 28, and 33.

It can be determined that the mean of the data is less than 21 and there is at least one outlier.

Solution

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The 5-number summary of a data set is 7, 20, 21, 28, and 33.
It can be determined that the mean of the data is less than 21 and there is at least one outlier.

The IQR is Q3 – Q1 = $28-20=8$.

$28+1.5(8)=40$ so no outliers on the high end

$20-1.5(8)=8$ so at least one outlier on the low end

This means that the data is skewed left and the mean will be less than the median.

True

AP Statistics: True or False?

5.

A tropical storm is expected to drop a lot of rain on an island in the Bahamas. There are many rain gauges on the island but obviously not everywhere. The 95% confidence interval for the amount of rain the island will get is $[5.5 \text{ to } 9.5]$ inches. This can be interpreted as being 95% sure that the average amount of rain throughout the island is between 5.5 and 9.5 inches. The following interpretations are both correct as well.

I. The probability that the average amount of rain throughout the island is between 5.5 to 9.5 inches is 95%.

II. If the procedure of checking rain gauges were done repeatedly, 95% of the resulting confidence intervals would contain the true population mean.

Solution

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I. The probability that the average amount of rain throughout the island is between 5.5 to 9.5 inches is 95%.

II. If the procedure of checking rain gauges were done repeatedly, 95% of the resulting confidence intervals would contain the true population mean.

I is false. The average amount of rain on the island is either between 5.5 and 9.5 inches or not.

II is true. A confidence interval interpretation is about procedure. You take a sample of gauges and compute the confidence interval. Do it with other samples. 95% of them will catch the true mean. So you are reasonable sure that the given CI contains the true average amount of rain throughout the island.

False

AP Statistics: True or False?

6.

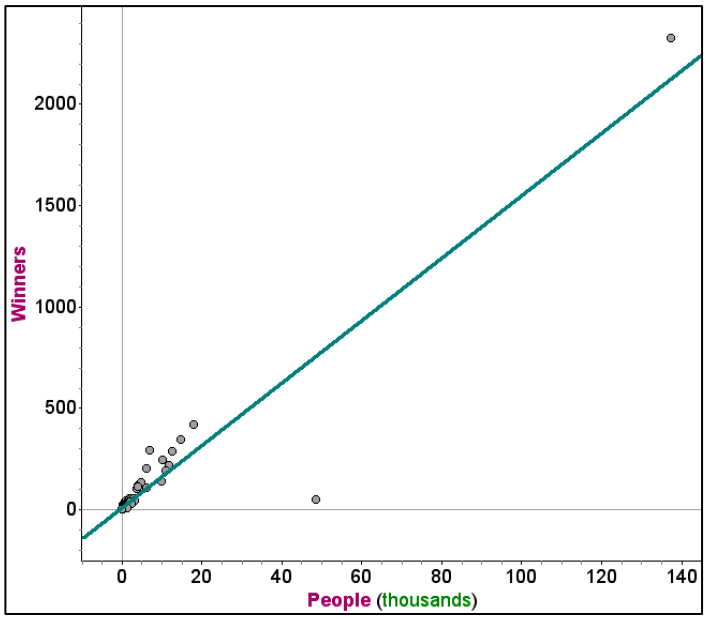
A survey was conducted in a state. People who play the lottery regularly were asked whether they had ever won a jackpot of over $500 (winners). A scatterplot is shown with each dot representing a city within the state, examining the city's population in thousands versus the number of winners. The equation of the least square regression line is

$\widehat{\text{Winners}} = 0.0154 \cdot \text{People} + 13, \; r^2 = 0.88$

The following statements are both correct:

I. As a good rule of thumb, for every 1000 people playing the lottery in the state, about 15 of them win over $500.

II. There is one outlier.



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The following statements are both correct:

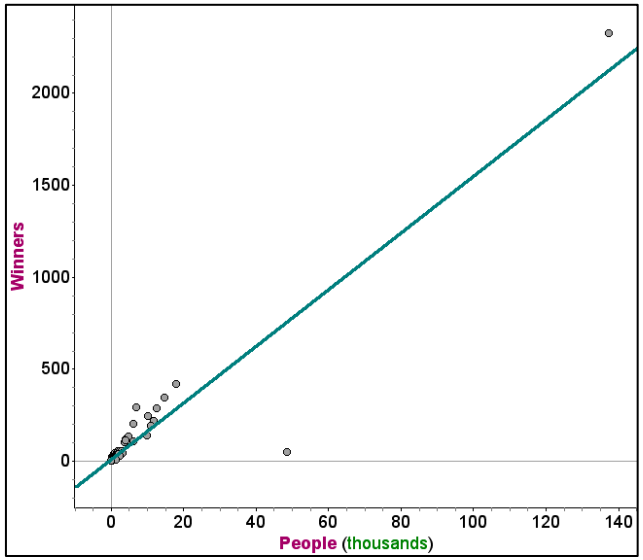
I. As a good rule of thumb, for every 1000 people playing the lottery in the state, about 15 of them win over \$500.

II. There is one outlier.

I. With $r^2 = 0.88, r = 0.94$ which is a strong positive association. The slope of the line is 0.0154 which is about 15 out of 1000.

II. The point at about $(50000,100)$ is an outlier as it corresponds to 2 people out of 1000 as winners. The point at the top right is not an outlier as it is close to the regression line.

True



AP Statistics: True or False?

7.

On June 1, a used car dealer increases the price of every vehicle on his lot by 5% and then takes $100 off the new price. If the mean, median, and standard deviation of the car prices were taken on May 31 and then again on June 1, all will have increased by 5% and then lowered by $100.

Solution

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The mean and median will be changed as stated. But the standard deviation will only be increased by 5% as the lowering of the price by $100 doesn't change the spread.

False

AP Statistics: True or False?

8.

Diane pays $1 to play a game. She rolls two 10-sided dice, each containing the digits 0 – 9. If both come up a 7, she wins $10. If one of them is a 7, she wins $5. Otherwise she wins nothing. Diane can be expected to break even by playing this game.

Solution

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There are $10(10) = 100$ possibilities.

The only way she can win \$10 is to roll 77.

To get one 7, there are 18 combinations: 07, 17, 27, 37, 47, 57, 67, 87, 97, 70,71, 72, 73, 74, 75, 76, 78, 79.

$\mu_x = 10\left(\frac{1}{100}\right) + 5\left(\frac{18}{100}\right) + 0\left(\frac{81}{100}\right) = 1$. She can be expected to win \$1 every time she plays but the cost of the game is \$1 so she breaks even.

True

AP Statistics: True or False?

9.

A car wash establishment has determined over time that the average amount of time that it takes a car to go through the process of driving up, paying, washing, and drying is 12 minutes, 15 seconds with a standard deviation of 2 minutes, 5 seconds. Because of a $5 off promotion, they believe that on average, it will take a car at least 5 minutes longer to go through the car wash. Using a random sample of cars, the appropriate hypothesis test is used with a result of $p = 0.024$.

The hypothesis test is a one-sample z-test, the hypotheses are $\begin{cases} H_0 : \mu = 17.5 \\ H_a : \mu > 17.5 \end{cases}$

and the conclusion is that there is evidence that it takes at least 5 minutes longer to get through the car wash with the promotion.

Solution

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This is a z-test as the population standard deviation is known. The parameter of interest is μ, the average amount of time to get through the car wash, which is believed to be greater than $12.25 + 5 = 17.25$. Since $p \le 0.05$, we reject H_0 and accept H_a.

True (Note that this falls short of saying the reason for the longer amount of time is the promotion itself. There could be other reasons why it takes longer such as fewer workers.)

AP Statistics: True or False?

10.

A restaurant has on the menu a cold soup served in the husk of a melon. The price of the soup is related to the size of the husk which is offered in a variety of sizes. When examining the data points in the form $\left(x:\text{diameter of the melon}, y:\text{price of the soup}\right)$, a statistician performed a transformation $\left(x,y\right)\Rightarrow\left(\log x,\log y\right)$. Statistics software yields the linear equation $y=a+bx$ where $a=-0.871$, $b=2.54,$ and $r^2=0.944$. The price P of the soup with diameter d is approximately given by $P=\dfrac{2.54^d}{10^{0.871}}$.

Solution

10. A restaurant has on the menu a cold soup served in the husk of a melon. The price of the soup is related to the size of the husk which is offered in a variety of sizes. When examining the data points in the form $(x: \text{diameter of the melon}, y: \text{price of the soup})$, a statistician performed a transformation $(x, y) \Rightarrow (\log x, \log y)$. Statistics software yields the linear equation $y = a + bx$ where $a = -0.871$, $b = 2.54$, and $r^2 = 0.944$. The price P of the soup with diameter d is approximately given by $P = \dfrac{2.54^d}{10^{0.871}}$.

The $y = a + bx$ regression performed on $(\log x, \log y)$ is the product of a power regression on (x, y) with $y = a \cdot x^b$ so $P = 10^{-0.871} \cdot d^{2.54}$ or $P = \dfrac{d^{2.54}}{10^{0.871}}$.

False

AP Statistics: True or False?

11.

An Internet Service Provider gets frequent calls for support. The company wants to make a claim about the average wait on hold waiting to talk to a representative. It takes a sample of n callers, determines the average length of time on hold, and then creates a confidence interval. Both of these statements are correct:

I. Using $n = 100$ with 90% confidence will narrow the confidence interval from the one created with $n = 50$ and 95% confidence.

II. Whether the waiting times on hold are normally distributed does not affect the validity of the calculations in I.

Solution

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II. Whether the waiting times on hold are normally distributed does not affect the validity of the calculations in I.

The greater the confidence, the wider the interval. If we want a narrower, interval, we lower the confidence. A larger sample will make $\frac{s}{\sqrt{n}}$ smaller further narrowing the interval. The Central-Limit Theorem states that $n = 40$ is sufficient for these calculations, even if the population is not normally distributed.
True

AP Statistics: True or False?

12.

A survey was taken as to the TV regular viewing habits of men who watch indoor sports and outdoor sports as shown in the table below.

	Football	Baseball	Golf
Basketball	40	32	14
Hockey	16	20	17
Indoor soccer	2	4	5

The percentage of people who watch basketball or football is about the same $(\text{within } 1\%)$ of the percentage of football watchers who also watch basketball.

Solution

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Hockey	16	20	17
Indoor soccer	2	4	5

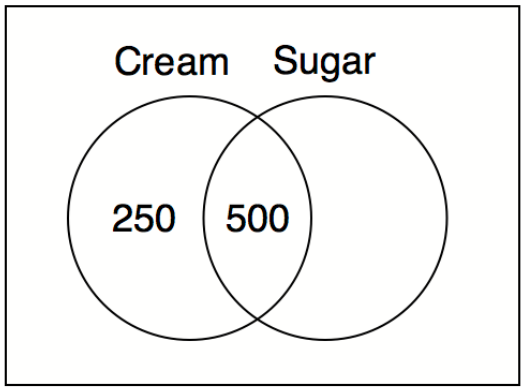
The percentage of people who watch basketball or football is about the same $(\text{within } 1\%)$ of the percentage of football watchers who also watch basketball.

There are 150 men total in the survey. The number of men who watch basketball or football is $40+16+2+32+14=104$.
The percentage is $104/150=69.3\%$.
There are $40+16+2=58$ football watchers and 40 also watch basketball. The percentage is $40/58=69.0\%$.
True

AP Statistics: True or False?

13.

The managers of a restaurant believe that drinking coffee with cream and drinking it with sugar are independent events. In examining the drinking habits of 1200 coffee drinking customers in a week, the number of people using each can be partially summarized by the Venn diagram below. If 300 coffee drinkers use sugar only, the managers would be correct in their theory.



Solution

13.

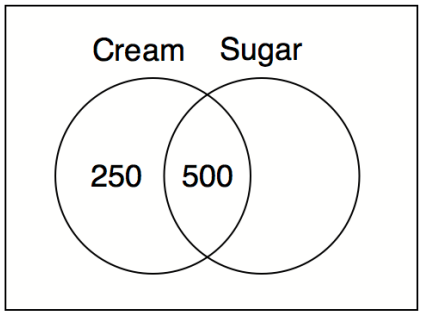
The managers of a restaurant believe that drinking coffee with cream and drinking it with sugar are independent events. In examining the drinking habits of 1200 coffee drinking customers in a week, the number of people using each can be partially summarized by the Venn diagram below. If 300 coffee drinkers use sugar only, the managers would be correct in their theory.

To be independent, $P(\text{cream}) \cdot P(\text{sugar}) = P(\text{both})$

$$\left(\frac{750}{1200}\right)\left(\frac{300+500}{1200}\right) = \left(\frac{5}{8}\right)\left(\frac{2}{3}\right) = \frac{5}{12} = \frac{500}{1200}$$

or independence: $P(\text{sugar} \mid \text{cream}) = P(\text{sugar}) \Rightarrow \frac{500}{750} = \frac{800}{1200}$

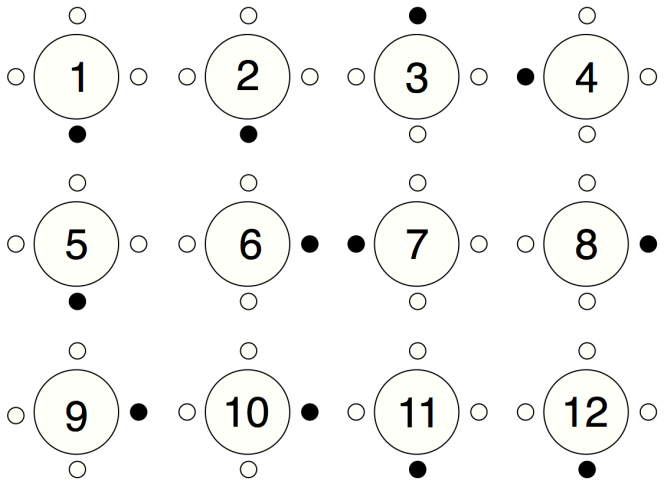
True



AP Statistics: True or False?

14.

At a teacher meeting, there are 4 teachers seated at 12 tables. A sampling of teacher opinion about the meeting is taken with the teachers chosen by the sample indicated in black. This is most likely an example of multistage sampling and it eliminates bias in choosing the teachers.

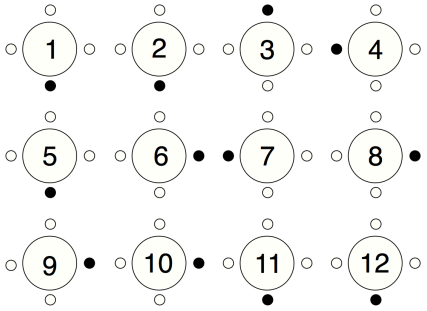


Solution

14. False (it could possibly be a simple random sample but the chance of choosing every table exactly once is remote.)

At a teacher meeting, there are 4 teachers seated at 12 tables. A sampling of teacher opinion about the meeting is taken with the teachers chosen by the sample indicated in black. This is most likely an example of multistage sampling and it eliminates bias in choosing the teachers.

Multistage would choose several tables and ask several or all the teachers from those tables. For instance, it might choose tables 4, 7, 8 and 11 and randomly choose 3 teachers from each. This is most likely a stratified sample with one person chosen randomly from each table. It doesn't eliminate bias because once a teacher from a table is chosen, then no other teacher from that table can be chosen.



AP Statistics: True or False?

15.

A convenience store has a soft-drink machine that with the press of a button is suppose to fill a cup with 12 ounces of the soda of choice. There have been complaints that it does not completely fill the cup. The store manager is uncertain whether the machine is actually broke. The appropriate hypotheses are $\begin{cases} H_0 : \mu = 12 \\ H_a : \mu < 12 \end{cases}$ and the cost of making a Type II error is the time and money it takes attempting to fix a machine that is not broke.

Solution

A convenience store has a soft-drink machine that with the press of a button is suppose to fill a cup with 12 ounces of the soda of choice. There have been complaints that it does not completely fill the cup. The store manager is uncertain whether the machine is actually broke. The appropriate hypotheses are $\begin{cases} H_0 : \mu = 12 \\ H_a : \mu < 12 \end{cases}$ and the cost of making a Type II error is the time and money it takes attempting to fix a machine that is not broke.

The hypotheses are correct. If the complaint was that the cup was not properly filling the cup, then it could be over or under-filling and $H_a : \mu \neq 12$. A Type I error is rejecting the null hypothesis when it is true. A Type I error decides that the machine is under filling the cup correctly when in fact it working OK. The cost of making a Type I error is the time and money it takes attempting to fix a machine that is not broke. A Type II accepts a false null hypothesis. It decides that the machine is filling the cups properly when it isn't. The error described is a type I error.

15. False

AP Statistics: True or False?

16.

The chance that a randomly selected person will provide a suitable matching kidney for a transplant is 20%. The expected number of failures before a matching kidney is found is 4 and the chances that a matching kidney will be found within the first 3 donors is close to 50%.

Solution

16. The chance that a randomly selected person will provide a suitable matching kidney for a transplant is 20%. The expected number of failures before a matching kidney is found is 4 and the chances that a matching kidney will be found within the first 3 donors is close to 50%.

This is a geometric probability question as we are waiting for a success.

The expected number of trials until a success is $\frac{1}{0.20} = 5$ so 4 failures are expected before success. For success within the first 3 donors, the probability is $0.2 + 0.8(0.2) + 0.8^2(0.2) = 0.488 \approx 50\%$.

True

AP Statistics: True or False?

17.

A summer camp has a policy that during the last activity period of the day starting at 4:00 PM, campers may be involved in activities or choose to read quietly. It was felt that too many were not active so the director insituted a "Pepsi break" at 4 PM. After institution of that policy, the average daily difference in percentage of campers who change from reading to active was 14% and the appropriate hypothesis test found this to be statistically significant. The following statement is correct:

A two-proportion z-test found that the Pepsi break was responsible for more campers being active than reading during the last period of the day.

Solution

17.

A summer camp has a policy that during the last activity period of the day starting at 4:00 PM, campers may be involved in activities or choose to read quietly. It was felt that too many were not active so the director insituted a "Pepsi break" at 4 PM. After institution of that policy, the average daily difference in percentage of campers who change from reading to active was 14% and the appropriate hypothesis test found this to be statistically significant. The following statement is correct:

A two-proportion *z*-test found that the Pepsi break was responsible for more campers being active than reading during the last period of the day.

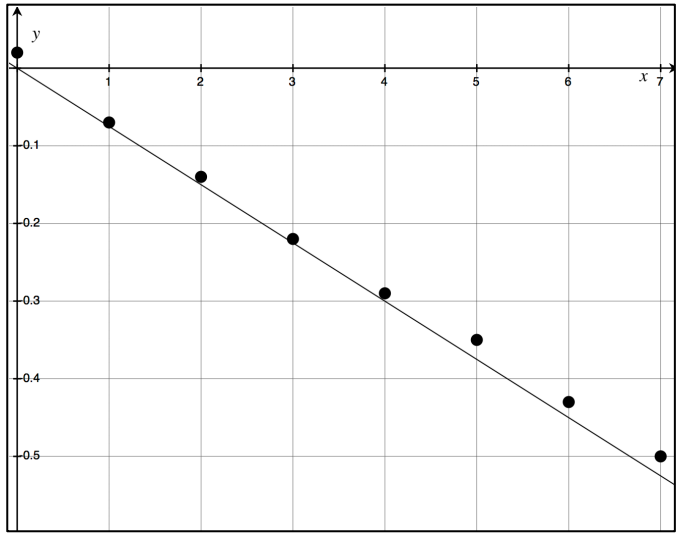
The choice of test is correct. On a sample of days, you calculate the percentage of campers who are active and then do so after the Pepsi break policty is initiated. However, the statement is wrong when saying that it was the Pepsi break that was responsible for the change in percentage. There could have been other factors such as weather or illness.

False

AP Statistics: True or False?

18.

Given 2 data sets x and y, the graph of x vs. $\log y$ is shown in the graph below. The equation of the least-squares regression line for this graph is $y = -0.071x$. The regression equation linking the original data sets x and y could be $y = -0.85^x$.



Solution

18.

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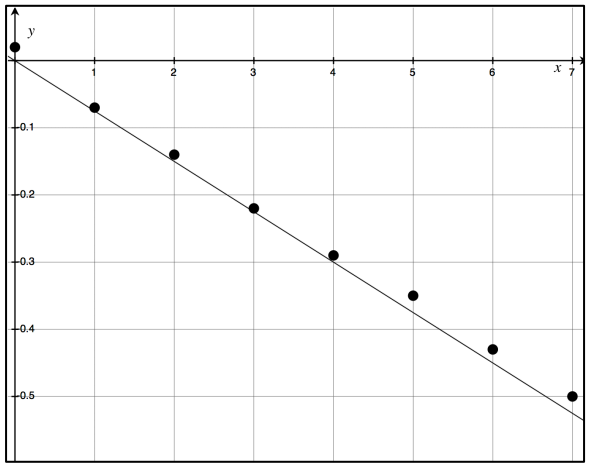
Since the graph of x vs. $\log y$ is quite linear, then the graph of x vs. y must be exponential. The equation is $y = 10^{-0.071x}$ which is approximately $y = 0.85^x$.

False



AP Statistics: True or False?

19.

In a simple random sample from a large condo, 64 of 91 said they were happy with their Comcast Digital Cable service while 38 of 62 said they were happy with their AT&T Fiber Optic service. The following two statements are correct:

I. A 95% confidence interval estimate for the difference between Comcast and AT&T user in this condo who are happy with their service is 0.09 ± 0.153.

II. Based on the CI, a greater percentage of people are happy with Comcast than those who are happy with AT&T.

Solution

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II. Based on the CI, a greater percentage of people are happy with Comcast than those who are happy with AT&T.

$$n_C = 91, p_C = \frac{64}{91} = 0.703 \qquad n_A = 62, p_A = \frac{38}{62} = 0.613$$

$$\sigma = \sqrt{\frac{(0.703)(0.297)}{91} + \frac{(0.613)(0.387)}{62}} = 0.078$$

$$0.703 - 0.613 \pm 1.96(0.078) = 0.09 \pm 0.153$$

Doing on the calculator as a two-proportion z-interval: $[-0.06, 0.24]$

Since the 95% CI contains negative numbers, it is possible that a greater percent of people are happy with AT&T than Comcast.

False

AP Statistics: True or False?

20.

On a commercial jet, all luggage is placed in a metal container weighing 250 lbs. The container is filled with a set number of large and small suitcases whose average weight and standard deviation is given in the table below.

Suitcase	Number in container	Average weight (lbs)	Standard Deviation (lbs)
Large	30	25	7
Small	50	15	4

The average weight of the filled containers is 1750 lbs.

The standard deviation of the filled containers is 410 lbs.

Solution

On a commercial jet, all luggage is placed in a metal container weighing 250 lbs. The container is filled with a set number of large and small suitcases whose average weight and standard deviation is given in the table below.

Suitcase	Number in container	Average weight (lbs)	Standard Deviation (lbs)
Large	30	25	7
Small	50	15	4

The average weight of the filled containers is 1750 lbs.
The standard deviation of the filled containers is 410 lbs.

$$\mu = 30(25) + 50(15) + 250 = 1750 \text{ lbs}$$

$$\sigma = \sqrt{30(7^2) + 50(4^2)} = \sqrt{2270} \approx 47.6 \text{lbs}$$

20. False (To calculate the standard deviation, you must find the variance of the large and small suitcases, add them, then take the square root. Since the container has no variance, it is not included in the calculation.)

AP Statistics: True or False?

21.

Angelo is a very controversial radio talk-show host.
It is felt that people either really like him or can't stand him.
To test this, he does an online poll. He asks his listeners to
visit the radio station's website and participate in the poll and
rate Angelo in terms of how much they like him on a scale to
1 to 5. The hypothesis test that should be used is a two-sided *t*-test
but the results will most likely be flawed because of undercoverage.

Solution

21.

Angelo is a very controversial radio talk-show host.
It is felt that people either really like him or can't stand him.
To test this, he does an online poll. He asks his listeners to
visit the radio station's website and participate in the poll and
rate Angelo in terms of how much they like him on a scale to
1 to 5. The hypothesis test that should be used is a two-sided *t*-test
but the results will most likely be flawed because of undercoverage.

Since it is believed that Angelo doesn't have many listeners who are ambivalent about him, the test would be two-sided: $\begin{cases} H_0 : \mu = 2.5 \\ H_a : \mu \neq 2.5 \end{cases}$

A *t*-test is appropriate because the population standard deviation
is unknown. Since people who can't stand Angelo are most likely
not listening, the poll will most likely be biased towards people who
like him a lot. This is voluntary response which usually results
in undercoverage.

True

AP Statistics: True or False?

22.

A large study is done with parents and children as to whether they were forced to eat everything on their plate at dinner. Parents are asked 2 questions:

1. Did your parents make you eat everything on your plate?
2. Do you make your kids eat everything on your plate?

Children are asked 2 questions:

1. Do your parents make you eat everything on your plate?
2. Will you make your kids eat everything on your plate?

The results are summarized in the table to the right.

		Parents	
		Yes	No
Kids	Yes	22%	7%
	No	11%	60%

Both statements are true:

I. If a parent is chosen who was forced to eat everything, it is more likely that her kids will do the same.

II. If a child is chosen who isn't forced to eat everything, it is more likely that her parents didn't do so as well.

Solution

22.

A large study is done with parents and children as to whether they were forced to eat everything on their plate at dinner. Parents are asked 2 questions:

1. Did your parents make you eat everything on your plate?
2. Do you make your kids eat everything on your plate?

Children are asked 2 questions:

1. Do your parents make you eat everything on your plate?
2. Will you make your kids eat everything on your plate?

The results are summarized in the table to the right.

		Parents: Yes	Parents: No
Kids	Yes	22%	7%
	No	11%	60%

Both statements are true:

I. If a parent is chosen who was forced to eat everything, it is more likely that her kids will do the same.

II. If a child is chosen who isn't forced to eat everything, it is more likely that her parents didn't do so as well.

$$P\left(\text{Kids yes}\middle|\text{Parents yes}\right)=\frac{22\%}{22\%+11\%}\approx 67\%$$

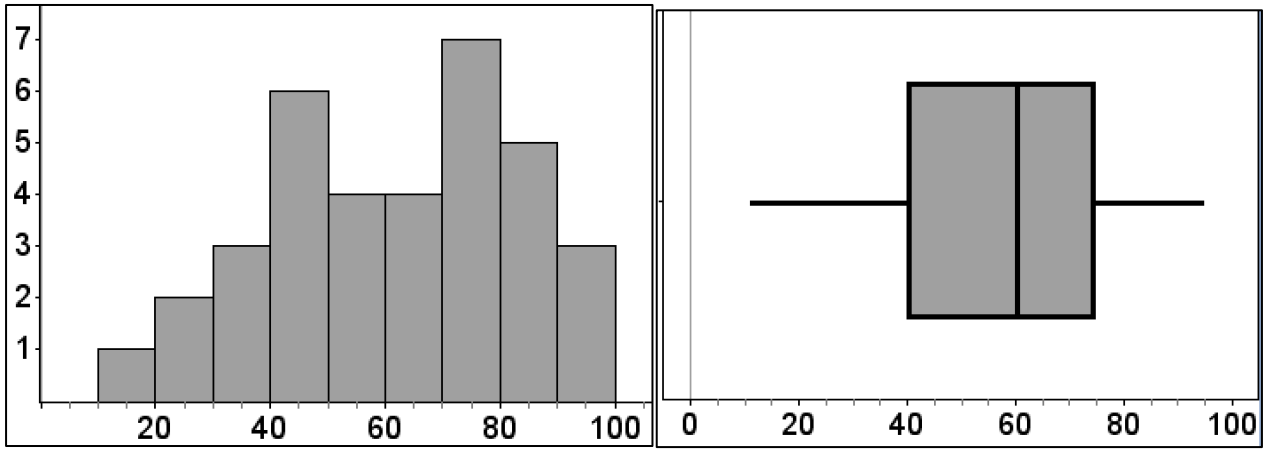
$$P\left(\text{Parents no}\middle|\text{Kids no}\right)=\frac{60\%}{11\%+60\%}\approx 85\%$$

True

AP Statistics: True or False?

23.

The histogram and boxplot below could represent the same data set.



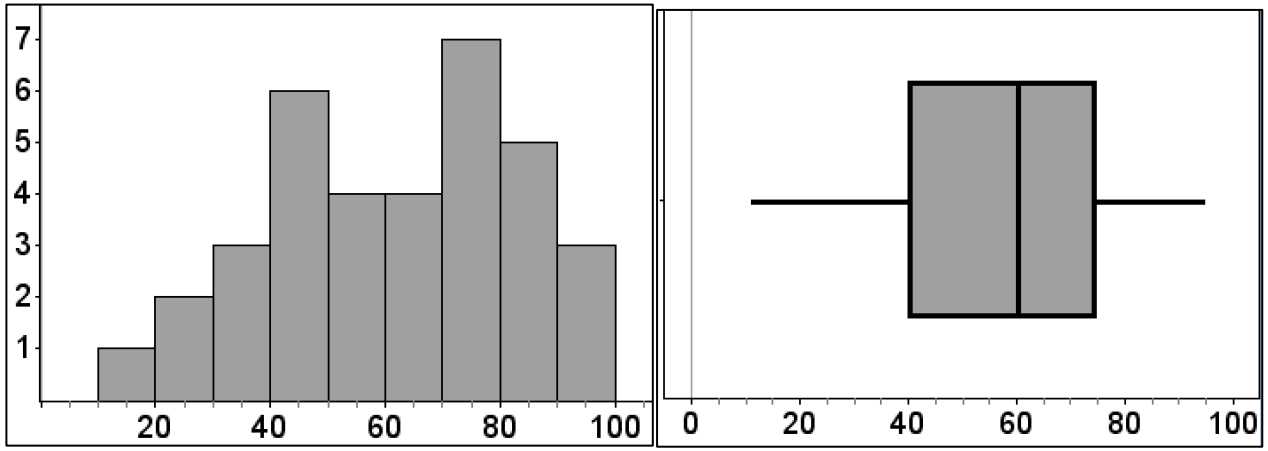
Solution

23.

The histogram and boxplot below could represent the same data set.

Counting the heights of the histogram bars, there are 35 pieces of data so the median is in the bar where the 18th piece of data is which is between 50 and 60. The median in the boxplot is 60. The data in the histogram tails to the left so that the data is skewed left which is borne out by the boxplot. The hisogram puts the minimum between 10 and 20 and the maximum between 90 and 100 which is consistent with the boxplot. There is nothing in either that says that they do not come from the same data.

True.



AP Statistics: True or False?

24.

A car company claims that its new electric vehicle can travel 200 miles on an electric charge. A consumer's research company believes this figure is too high and does a study. It makes 30 trips with the same car and finds that the average number of miles that the car can travel is on a charge is 193 with a standard deviation of 13.9. Their conclusion of the research is:

The test statistic value of -2.758 with degrees of freedom 29 is sufficient evidence to reject the car company's claim and that this electric vehicle gets less than the advertised 200 miles on a charge.

Based on this description, the conclusion is valid.

Solution

24.

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The test statistic value of -2.758 with degrees of freedom 29 is sufficient evidence to reject the car company's claim and that this electric vehicle gets less than the advertised 200 miles on a charge.

Based on this description, the conclusion is valid.

If $\mu =$ the mileage that this type of car gets on a single charge,

$\begin{cases} H_0 : \mu = 200 \\ H_a : \mu < 200 \end{cases}$ This is a one-sample t-test with $\bar{x} = 193, n = 30, s = 13.9$

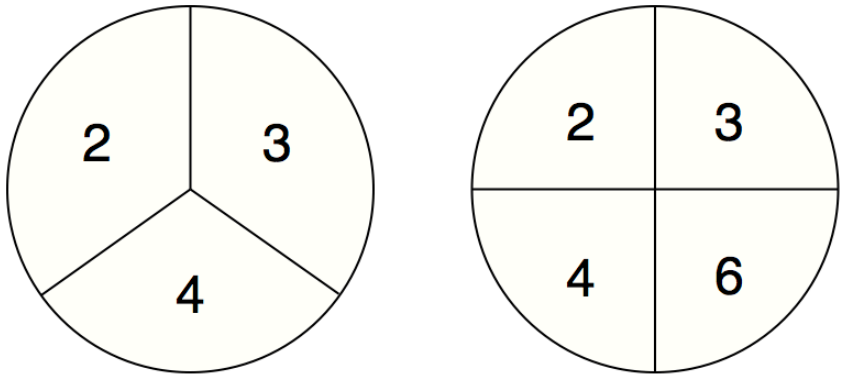
$n = 30$ meets the conditions of a t-test. The degrees of freedom is $n - 1 = 14$ and from the calculator, $t = -2.758$ and $p = 0.005$. We reject H_0 and accept H_a. However, the fact that the same car was used over and over introduces bias and invalidates the test.

False

AP Statistics: True or False?

25.

John pays $1 to play a game of chance. He spins both spinners below, with the numbers on each spinner having the same probability of coming out. If he gets 2 odd numbers, he wins $4. If he gets 2 even numbers, he wins nothing. Otherwise, he wins $1.50. John can expect to make money playing this game if he plays it many times.



Solution

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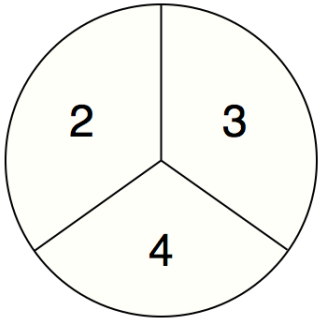
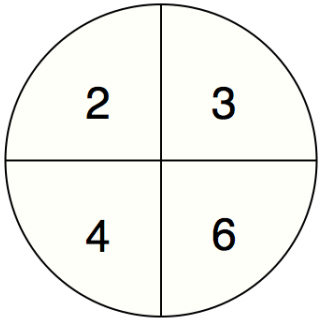
25.

$$P(OO)=\frac{1}{3}\left(\frac{1}{4}\right)=\frac{1}{12} \quad P(EE)=\frac{2}{3}\left(\frac{3}{4}\right)=\frac{1}{2} \quad \text{So } P(\text{OE or EO})=1-\frac{1}{12}-\frac{1}{2}=\frac{5}{12}$$

$$\mu=4\left(\frac{1}{12}\right)+0\left(\frac{1}{2}\right)+1.5\left(\frac{5}{12}\right)=\frac{11.5}{12}=0.958$$

Since the game costs \$1.00, he can expect to lose $1-0.958=4.2$ cents on each play

False