

104 points possible

1. Use the data for the sample represented in the following table to answer parts (a) through (e).

(1 point, 1 minute)

- (a) What is the probability that a randomly selected person from this sample will have visited movie theaters more than 10 times in 2014?

$$\frac{24}{519} = 0.0462$$

Age Group (in years)	Visits to Movie Theaters in 2014				Total
	0	1 to 5	6 to 10	> 10	
< 15	57	32	20	2	111
15 to < 18	50	83	40	2	175
18 to < 30	14	26	49	14	103
30 to < 50	11	38	13	5	67
50+	39	21	2	1	63
Total	171	200	124	24	519

(3 points, 3 minutes)

- (b) What is the probability that a person randomly selected from this sample will have be 15 to < 18 years old given that the person visited movie theaters 1 to 5 times in 2014?

$$P(15 \text{ to } < 18 | 1 \text{ to } 5 \text{ visits}) = \frac{P(15 \text{ to } < 18 \text{ and } 1 \text{ to } 5 \text{ visits})}{P(1 \text{ to } 5 \text{ visits})}$$

$$= \frac{83/519}{200/519} = \frac{83}{200} = 0.415$$

(3 points, 3 minutes)

- (c) What is the probability that a person randomly selected from this sample will not be a person that is 50+ years old who also visited movie theaters 0 times in 2014?

$$P(50+ \text{ and } 0 \text{ visits}) = 39/519$$

$$P(\text{Not } 50+ \text{ and } 0 \text{ visits}) = 1 - \frac{39}{519} = \frac{480}{519} = 0.925$$

(3 points, 3 minutes)

- (d) What is the probability that a person randomly selected from this sample will have visited movie theater > 10 times in 2014 or be in the "18 to < 30" age group?

$$P(> 10 \text{ visits OR } 18 \text{ to } < 30) = P(< 10) + P(18 \text{ to } < 30) - P(\text{both})$$

$$= \left(\frac{24}{519}\right) + \left(\frac{103}{519}\right) - \left(\frac{14}{519}\right) = \frac{113}{519} = 0.218$$

(3 points, 3 minutes)

- (e) What is the probability that a person randomly selected from this sample will have "11 to 20" social media contacts per day or be in the "20 to < 30" age group?

(5 points; 5 minutes)

2. If birth weights of all babies in the USA have a bell-shaped distribution with a mean of 7.13 pounds and a standard deviation of 1.08 pounds, approximately what percent of the babies born last year had birth weights between 4.97 pounds and 9.29 pounds? To get any points for this problem, you must show how you got your answer!

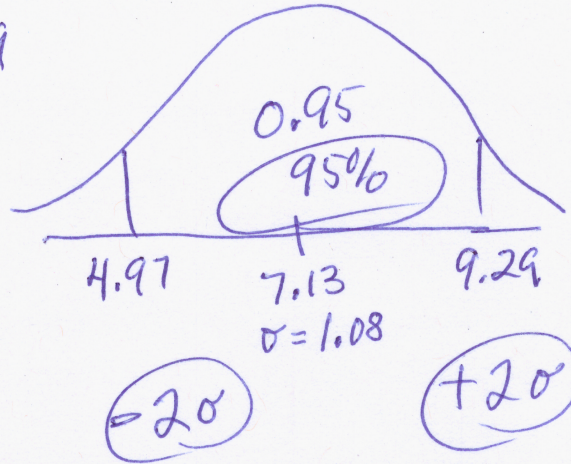
Answer:

95%

$$\begin{array}{r} 7.13 \\ - 4.97 \\ \hline 2.16 \end{array}$$

$$\begin{array}{r} 2.16 \\ \div 1.08 \\ \hline = 2 \end{array}$$

$$\begin{array}{r} 9.29 \\ - 7.13 \\ \hline 2.16 \\ \div 1.08 \\ \hline = 2 \end{array}$$



(10 points; 8 minutes)

3. Complete the columns in the "Frequency Distribution" table using the data values given below, and answer the two questions below the table.

Frequency Distribution						
Class Limits Lower Upper	Tally	Frequency	Relative Frequency	Cumulative Frequency	Cumulative Relative Frequency	
10 50		4	4/10	4	4/10	
60 100		3	3/10	7	7/10	
110 150		3	3/10	10	10/10	

N=10

Data:	11	109	110	50	77
	34	102	33	78	145

Class Midpoint	Class Boundary
30	
80	55
130	105

$$\begin{aligned} 50 + 60 &= \frac{110}{2} \\ 100 + 110 &= \frac{210}{2} \end{aligned}$$

Class Width
50

What is the frequency for Class #2 ?

3

What is the upper limit for Class #1 ?

50

(5 points; 5 minutes)

4. For each of the underlined segments in the situations below, select the appropriate term from the list provided and write it in the blank next to the description or situation. Choose the term that is best connected to the underlined text in the description or situation.

Terms:	1. randomization	5. placebo	9. parameter
	2. replication	6. block	10. statistic
	3. confounding	7. experimental unit	11. population
	4. blinding	8. treatment	

(a.) An experiment is done to estimate the average of the responses of all autistic children to large doses of vitamins. The study involved 600 autistic children in each of 5 age groups. In each age group, 200 children were given a pill with no vitamins, 200 a pill with the standard dose, and 200 a pill with a large dose. The children stayed in their family homes, and each family believed their child was receiving the "large dose". Cameras in each home recorded the behavior of each child which was scored on a "20 point scale" for "severity of autism". Conclusions were based on the difference between the average score of the large dose group and the average score of the standard dose group. The study could not control for the possible effects of unique factors in each household that may also affect autism.

Block

(b.) An experiment is done to estimate the average of the responses of all autistic children to large doses of vitamins. The study involved 600 autistic children in each of 5 age groups. In each age group, 200 children were given a pill with no vitamins, 200 a pill with the standard dose, and 200 a pill with a large dose. The children stayed in their family homes, and each family believed their child was receiving the "large dose". Cameras in each home recorded the behavior of each child which was scored on a "20 point scale" for "severity of autism". Conclusions were based on the difference between the average score of the large dose group and the average score of the standard dose group. The study could not control for the possible effects of unique factors in each household that may also affect autism.

Experimental Units

(c.) An experiment is done to estimate the average of the responses of all autistic children to large doses of vitamins. The study involved 600 autistic children in each of 5 age groups. In each age group, 200 children were given a pill with no vitamins, 200 a pill with the standard dose, and 200 a pill with a large dose. The children stayed in their family homes, and each family believed their child was receiving the "large dose". Cameras in each home recorded the behavior of each child which was scored on a "20 point scale" for "severity of autism". Conclusions were based on the difference between the average score of the large dose group and the average score of the standard dose group. The study could not control for the possible effects of unique factors in each household that may also affect autism.

Placebo

(d.) An experiment is done to estimate the average of the responses of all autistic children to large doses of vitamins. The study involved 600 autistic children in each of 5 age groups. In each age group, 200 children were given a pill with no vitamins, 200 a pill with the standard dose, and 200 a pill with a large dose. The children stayed in their family homes, and each family believed their child was receiving the "large dose". Cameras in each home recorded the behavior of each child which was scored on a "20 point scale" for "severity of autism". Conclusions were based on the difference between the average score of the large dose group and the average score of the standard dose group. The study could not control for the possible effects of unique factors in each household that may also affect autism.

Statistic

(4 points; 4 minutes)

5. In the United States, 9.3% of all people have some form of diabetes (a condition in which blood sugar levels are not well-controlled). If a random sample of 30 Americans is selected, what is the probability that exactly 3 of them will have some form of diabetes?

Fixed Number of Trials: $30 = n$
 $\begin{cases} P(\text{diabetic}) = P(s) = 0.093 \\ P(\text{not diabetic}) = P(f) = 1 - P(s) = 0.907 \end{cases}$
 these stay the same for all trials
 Random sample \Rightarrow independent
 $X =$ Number of successes
Binomial

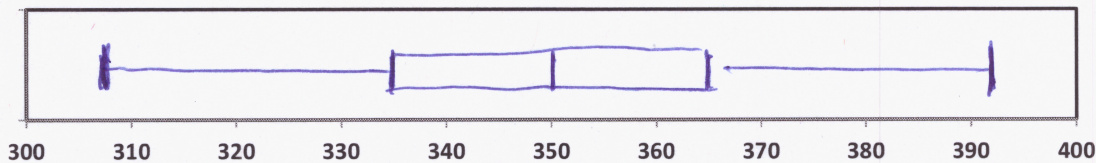
$$P(X=3) = {}_{30}C_3 (0.093)^3 (0.907)^{27}$$

$$= (4060)(0.0008044)(0.07168)$$

$$= 0.2341$$

(5 points and 4 points; 8 minutes)

6. (a) For the set of 37 values shown below in sorted order, prepare a Boxplot inside the rectangle and above the number line.



min	309	314	318	321	324	327	329	331	333	335	P_{25}
	337	339	340	342	344	345	347	348	350	352	
	353	355	356	358	360	361	363	365	367	369	
	371	373	376	379	382	386	391				Max

P_{25} location: $(\frac{25}{100})(37) = 9.25 \uparrow 10$
 P_{50} : $(\frac{50}{100})(37) = 18.5 \uparrow 19$
 P_{75} : $(\frac{75}{100})(37) = 27.75 \uparrow 28$

- (b) For the set of 37 values shown above in sorted order, what percentile is represented by the value 365?

27 values are less than 365

$$R = \left[\frac{\# \text{ of values} < x}{\text{Total } \# \text{ of values}} \right] \cdot 100$$

$$= \left(\frac{27}{37} \right) 100 = 72.97$$

$$365 = P_K \quad (R=?)$$

$$365 = P_{72.97}$$

$$= P_{73}$$

(8 points; 10 minutes)

7. Answer parts (a), (b), and (c).

Use the columns in the table in any way you wish to use them.

(a) Is this distribution "proper" (circle "YES" or "NO")?

YES

NO

Why?

Because the probabilities $[P(x)]$ add up to 1.

x	P(x)	$x \cdot P(x)$	$P(x) \cdot (x - \mu)^2$		
19	0.1	1.9	44.1		
29	0.2	5.8	24.2		
41	0.3	12.3	0.3		
50	0.4	20.0	40.0		

$$\sum P(x) = 1$$

$$\sum = 40 = \mu$$

$$\sum = 108.6 = \sigma^2$$

$$\sqrt{\sigma^2} = \sqrt{108.6} = 10.42 = \sigma$$

(b) Write the formulas for the mean, the variance, and the standard deviation of a discrete probability distribution.

$$\mu = \sum x \cdot P(x)$$

$$\sigma^2 = \sum (x - \mu)^2 \cdot P(x)$$

$$\sigma = \sqrt{\sum (x - \mu)^2 \cdot P(x)}$$

(c) Write the values for the mean, the variance, and the standard deviation of this discrete probability distribution. The work above must show how you determined these values. If you used an advance calculator, describe what you did.

$$\mu = 40$$

$$\sigma^2 = 108.6$$

$$\sigma = 10.42$$

(4 points and 2 points; 5 minutes)

8. You have four aces: the spade (S), the heart (H), the diamond (D), and the club (C). Two of the cards will be picked without replacement. List the sample space for this procedure.

SH	HS	DS	CS
SD	HP	DH	CH
SC	HC	DC	CD

12 events in the sample space

If the two cards are picked at random in the procedure (without replacement), what is the probability that the Club will not be picked?

$$\frac{6}{12}$$

6 events do not have "C" in them
12 events in sample space

(4 points; 4 minutes)

9. At the local thrift store, there are three dishwashers, four stoves, and five refrigerators and eight microwaves. How many different ways are there to pick a combination of one dishwasher, one stove, one refrigerator, and one microwave.

3 DW 4 ST 5 RF 8 MW

$$\frac{3}{DW} \cdot \frac{4}{ST} \cdot \frac{5}{RF} \cdot \frac{8}{MW} = 480$$

(3 points and 2 points; 5 minutes)

10. A person has four dogs: a terrier (T), a collie (C), a boxer (B), and a dachshund (D). The person prepares a web page to show the dogs, one at a time. In how many different sequences could the dogs be shown? Example: {DCTB}.

$$\underline{4} \cdot \underline{3} \cdot \underline{2} \cdot \underline{1} = 4! = 24 \quad \text{OR} \quad 4P_4 = 24$$

What is the probability that the dachshund will be the last dog in the sequence on the web page?

If "D" is last, $\frac{3 \cdot 2 \cdot 1}{3 \cdot 2 \cdot 1 \cdot 1} = 6$ must happen. outcomes have "D" last.

$$\frac{6}{24} = 0.25$$

All are equally likely to be last.
There are four dogs, so $P(D \text{ last}) = \frac{1}{4} = 0.25$

(5 points; 6 minutes)

11. A factory produces 16-ounce bottles of iced tea. The manager is considering buying a new bottle-filling machine that would fill the bottles twice as fast. But, the manager wants to estimate the standard deviation of the of the amounts (ounces) of tea that all future bottles will contain. The current machine has a standard deviation of 0.082 ounces. The manager visits another factory that uses the new machine and carefully measures the amounts of tea in a random sample of 60 bottles. The standard deviation of the 60 values is 0.086 ounces.

Use the information in the "story" to answer the following:

- (a) What is the population of interest to the manager of the iced tea bottling factory?

The amounts of tea that all future bottles will contain. The only way to (know) the true σ is to have all the values.

- (b) The manager is interested in the value of what population parameter?

The standard deviation (σ) of the amounts of tea in all future bottles

- (c) The manager determined the value of what statistic?

The standard deviation (s) of the amounts of tea in a ~~sa~~ random sample of 60 bottles at another factory that uses the new machine.

- (d) What was the value of the statistic that the manager determined?

0.082 ounces

- (e) Did the manager use a sample or a census to determine the value of the statistic?

$N=60$ sample. A census of all future bottles (amount of tea in each bottle) would mean every bottle would have to be measured into the future.

(14 points; 8 minutes)

12. Use the data below to determine the value of each statistic. Write an expression for each statistic or describe how it is calculated in principle (do NOT describe how to use the calculator to determine the result).

Data
56
57
60
56
60
52
58
59
55

4 values
 $\begin{bmatrix} 52 \\ 55 \\ 56 \\ 56 \end{bmatrix} 2x$
 median $\rightarrow 57$
 4 values
 $\begin{bmatrix} 58 \\ 59 \\ 60 \\ 60 \end{bmatrix} 2x$

	Expression or Description	Value of statistic
median	The value in the middle when data are in sorted order.	(57)
variance	$\frac{\sum (x - \bar{x})^2}{n-1}$	$6.75 = (2.598)^2$ done in calc.
mode	The value that occurs most often	(56) and (60) each occur 2 times
range	$\begin{matrix} \text{Max} & - & \text{Min} \\ 60 & & 52 \end{matrix}$	$(8) = 60 - 52$
mean	$\frac{\sum x}{n}$	(57)
midrange	$\frac{\text{min} + \text{max}}{2}$	$(56) = \frac{52+60}{2}$
standard deviation	$\sqrt{\frac{\sum (x - \bar{x})^2}{n-1}}$	2.598

(6 points; 5 minutes)

13. In the United States, 9.3% of all people have some form of diabetes (a condition in which blood sugar levels are not well-controlled). If a random sample of 500 Americans is selected, would it be unusual to find that 60 of them have some form of diabetes? America currently has more than 300 million people. (Show your work.)

→ Z-score needed

$$\mu = np = 500(0.093) = 46.5$$
$$\sigma = \sqrt{npq} = \sqrt{500(0.093)(0.907)} = 6.49$$
$$Z = \frac{X - \mu}{\sigma} \quad X = 60$$
$$\mu = (?)$$
$$\sigma = (?)$$
$$Z = \frac{60 - 46.5}{6.49} = 2.08$$

(4 points; 4 minutes)

Because $|Z| > 2$, 60 would be unusual.

14. In a bag of 100 batteries, 18 are bad and 82 are good. What is the probability that a random sample of four of the batteries (without replacement) will include at least one bad battery?

$$P(\text{At least one bad}) = 1 - P(\text{all good})$$
$$= 1 - P(\text{good and good and good and good})$$
$$= 1 - \left(\frac{82}{100}\right)\left(\frac{81}{99}\right)\left(\frac{80}{98}\right)\left(\frac{79}{97}\right) = \cancel{1 - 0.0000689}$$
$$= 1 - 0.446 = 0.554$$

(6 points; 8 minutes for problems 15 and 16 together)

15. Circle the best answer for each situation.

A random sample of 3,420 people is selected from the millions of low-income Californians that used "Medi-Cal" in the last 10 years. Each person is asked if they know that their estate must repay the costs when they die. Those surveyed must answer, by law.

Simple Random	Systemmatic
Stratified Random	Cluster
Convenience	Census

At a factory that makes toasters, a computer sets a random time during each hour of production. When a horn sounds at each random time, the next toaster that comes of the line will be checked for 24 different aspects of its quality.

Simple Random	Systemmatic
Stratified Random	Cluster
Convenience	Census

A printed survey is sent to 10,000 homes selected at random from all homes in the state. All residents in the 10,000 homes are asked about their level of education. Most often the survey is thrown away and not answered.

Simple Random	Systemmatic
Stratified Random	Cluster
Convenience	Census

without the last sentence, "cluster" would be correct.

16. Circle the best answer for each situation.

The Department of Corrections (Prisons) selects a group of 800 prisoners released in 2010 and follows their lives for the next 30 years to find out what types of decisions decrease the percent that return to prison at a later time.

observational retrospective	observational cross-sectional
observational prospective	experiment

The Department of Corrections randomly selects 5000 prisoners in 2013 and conducts a detailed examination of their lives before they went to prison, to learn about factors that may lead to criminal behavior and imprisonment.

observational retrospective	observational cross-sectional
observational prospective	experiment

The Department of Corrections releases 10 groups of 40 prisoners. In each group, the prisoners are as much alike as possible (age, gender, criminal record, ethnicity, religion, etc.). In each group, half go into the army and the other half does not, so the effect of army service on post-release life can be evaluated.

observational retrospective	observational cross-sectional
observational prospective	experiment