

**Unit 1 Review** \* STUDY PROBLEM 1B on p.59 for DICE EXAMPLE

Name: **MAX ROCKATANSKY**

\* EXAMPLE 3 p 54 (AND SIMILAR)

Find the mean, median, and mode of each data set.

1. {3, 10, 2, 8, 7, 5, 2, 5}  
 mean: 5.25  
 mode: 2 & 5  
 median: 5

2. {11, 15, 4, 10, 7, 5, 11}  
 mean: 9  
 median: 10  
 mode: 11

Find the expected values.

3. The probability distribution for the number of free throws that Larry makes in a game is given below. Find the expected number of free throws that Larry makes in a game.

6.07

Number of Free Throws Made	5	6	7	8
Probability	.21	.58	.14	.07

*CHANCE*  $1.05 + 3.48 + .98 + .56 = 6.07$

\* OR  $5(.21) + 6(.58) + 7(.14) + 8(.07) = 6.07$

4. The probability distribution for the number of pieces of junk mail May receives is given below. Find the expected number of junk mail letters May receives in a day.

2.05

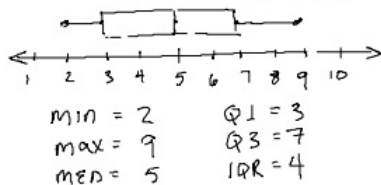
Number of Junk Mail Letters	1	2	3	4
Probability	.15	.70	.10	.05

$.15 + 1.4 + .3 + .2 = 2.05$

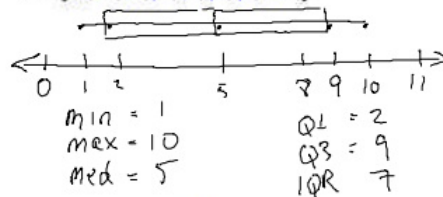
\* OR  $1(.15) + 2(.70) + 3(.10) + 4(.05) = 2.05$

Make a box-and-whisker plot of the data. Tell the value of each point and find the interquartile range.

5. {3, 7, 5, 3, 5, 9, 2, 7}  
 min: 2, med: 5, max: 9



6. {1, 8, 8, 2, 2, 8, 8, 10}  
 min: 1, med: 5, max: 10



#7 ANS: VAR = 13, SD = 3.61

#8 ANS: VAR = 4.67, SD = 2.16

Find the variance and standard deviation. Round to two decimal places.

7. {1, 2, 8, 11, 7, 10, 7, 2}

8. {10, 14, 8, 12, 9, 13}

FORMULAS FOR STANDARD DEVIATION:  $\sigma$

FOR ENTIRE POPULATION

$$\sigma = \sqrt{\frac{\sum (x - \mu)^2}{N}}$$

FOR SAMPLE POPULATION

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}}$$

ADD TOGETHER

SAMPLE DATA SAMPLE MENU

VARIANCE:  $\sigma^2$   
 - SOLVE FOR  $x - \bar{x}$   
 - SOLVE FOR  $(x - \bar{x})^2$   
 - NUMBERS IN ORDER.  
 - SOLVE FOR MEAN  $\bar{x}$   
 - EACH DATA POINT'S  $x$  DIFFERENCE FROM  $\bar{x}$

STANDARD DEVIATION:  $\sigma$

HELPS THOSE IN RESEARCH BECAUSE IT GETS AWAY FROM  $x^2$ -TYPE NUMBERS  
 SOLVE FOR  $\sigma = \sqrt{\sigma^2}$

1. ARRANGE IN ORDER - JUST GOOD HABIT (IF YOU HAVE THE TIME)

11, 12, 12, 13, 14, 14, 14, 14, 15, 15, 65  
13

9. A chemist weighs samples obtained from a production run. The weights of the samples are 13 g, 14 g, 65 g, 11 g, 15 g, 14 g, 14 g, 12 g, 13 g, 15 g, 14 g, and 12 g. Round to 1 decimal place.

STEP 2 a. Find the mean of the data. 17.7

STEP 3 b. Find the standard deviation. 14.3  
SOLVE FOR VARIANCE AND CONVERT OR SOLVE FOR SD DIRECTLY

STEP 4 c. Identify any outliers. 65  
OUTLIER: ANY NUMBER MORE THAN THREE STANDARD DEVIATIONS FROM THE MEAN

STEP 5 d. Describe how any outlier affects the mean and the standard deviation.  
REPEAT STEP 2 w/D THE OUTLIER  
REPEAT STEP 3 w/D THE OUTLIER

STEP 6 STATE YOUR FINDINGS IN A FROM \_\_\_ TO \_\_\_ STATEMENT  
mean increases from 13.4 to 17.7  
SD increases from 1.2 to 14.3

Decide whether the sampling method could result in a biased sample. Explain your reasoning.

BIAS RESULTS FROM IMPROPER SAMPLING AND/OR UNDER/OVER REPRESENTATION OF ANY PART OF OR THE ENTIRE POPULATION

10. A representative of a mall surveys every fifth person walking into an electronics store to ask if they would like there to be a new store that sells audio equipment in the mall.

BIASED. ENTIRE MALL POPULATION IS UNDER REPRESENTED  
ELEC/AUDIO POPULATION IS OVER "

11. A researcher wants to know the average amount of student debt people who are earning degrees expect to have. She surveys 100 randomly-selected students at an expensive medical school.

BIASED: POPULATION OF UNSPECIFIED DEGREES (NON-MED) IS UNDER REPRESENTED  
POPULATION OF MED STUDENTS IS OVER REPRESENTED

Decide whether the results of the survey are likely to be representative of the population. Explain.

12. The manager of a movie theater wants to know what type of movies his customers prefer. He asks every third customer coming out of a comedy movie.

NOT REPRESENTATIVE: THOSE INTERESTED IN FILM TYPES OTHER THAN COMEDY ARE UNDER REPRESENTED

13. The manager of a movie theater wants to know what type of movies his customers prefer. He asks every tenth customer who enters the theater over a period of time when the theater is showing an assortment of movie types.

REPRESENTATIVE: SAMPLE POPULATION INCLUDES ALL FILM TYPES AND WHEN MOVIES ARE SEEN (e.g. DAY/NIGHT/WEEKEND)

STATISTIC - DESCRIBES THE SAMPLE  
 PARAMETER - DESCRIBE THE POPULATION  $\hat{=}$  PROVIDE THE ANSWER

One hundred students out of 2000 at a school have been surveyed. The results are recorded in each problem below. Predict the number of students in the population that would answer similarly.

$$\frac{\text{SAMPLE RESPONSE}}{\text{TOTAL SAMPLE}} = \frac{\text{PREDICTION (X)}}{\text{TOTAL POPULATION}}$$

STEP 1: SUBSTITUTE KNOWN VALUES  
 STEP 2: CROSS PRODUCTS PROPERTY  
 STEP 3: SOLVE FOR X

14. Fifty said they ride the bus to school.

$$\frac{50}{100} = \frac{x}{2,000} \parallel 100,000 = 100x \parallel x = 1,000$$

15. Ten said they had transferred from another school.

$$\frac{10}{100} = \frac{x}{2,000} \parallel 20,000 = 100x \parallel x = 200$$

Tell whether each situation is an experiment or an observational study.

EXPERIMENT: IMPOSE A TREATMENT TO SOMETHING AND RECORD THE RESPONSE  
 OBSERVATIONAL STUDY: OBSERVE AND MEASURE WITHOUT CONTAMINATING OR INFLUENCING THE INDIVIDUAL OR ENVIRONMENT IN ANY WAY

16. A park ranger measures the change in height of all trees of a similar species and age over a month. Half the trees are within a quarter of a mile from a large lake and half are further away.

OBSERVATIONAL STUDY

17. A park ranger plants 10 trees within a quarter of a mile from a large lake and 10 trees of a similar species and age further than half of a mile from the lake. He then measures the growth of all trees over a month.

EXPERIMENT

18. A zoo installs small "caves" in half of the wildcat cages. The cage provides shade and privacy for the animals and are just large enough to hold a wildcat that is lying down. The caretaker at the zoo then compares the sleeping habits of wildcats with "caves" in their cages to the sleeping habits of wildcats without them.

EXPERIMENT

19. A caretaker at a zoo records the sleeping habits of the wildcats at the zoo for a month.

OBSERVATIONAL STUDY

The study described below is a randomized comparative experiment. Describe the treatment, the treatment group, and the control group.

TREATMENT: WHAT IS INTENTIONALLY MADE DIFFERENT

$$RCE = \frac{\text{TREATMENT GROUP (Tx GRP)} - \text{RECEIVES THE Tx}}{\text{CONTROL GROUP} - \text{NOT INFLUENCED BY Tx}}$$

20. A researcher feeds one group of rats high-fat and high-calorie foods like cheesecake, bacon, and pastries. She feeds a second group of rats a normal, nutritious diet. For two weeks, the researcher records how many calories each rat eats daily, as well as how often it goes to its feeding bowl. She compares the data from the one group to the data from the other and finds that the rats that eat the nutritious food get hungry less often and eat a smaller number of calories overall.

Tx GRP: RATS GIVEN JUNK FOOD

Tx: JUNK FOOD (e.g. cheesecake, bacon, pastries)

CONTROL GRP: RATS w/ NORMAL DIET

21. A college professor wants to know if students learn as well in an online class as in person. He decides to offer the same course both online and in a classroom. Students who sign up for the course are told they will be assigned to either class randomly. The professor then gives the same test to both classes and compares the scores.

Tx GRP: STUDENTS IN ONLINE CLASS

Tx: ONLINE CLASS

CONTROL GRP: "IN PERSON" CLASS

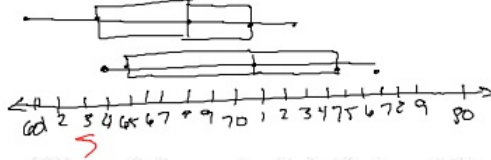
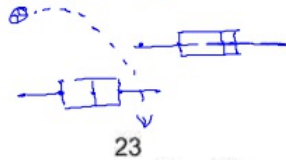
NULL HYPOTHESIS: "NULL" MEANS "ZERO" — STATES THERE IS NO DIFFERENCE BETWEEN THE TWO GROUPS BEING TESTED

22. Mr. Kaplan is supervising an experiment in his science class in order to find out whether adding salt to water causes the water to boil more quickly. Each student in the class records how long it takes his or her beaker of water to boil when placed on a burner. Half of the students do not add salt to the water (control group) and half add a teaspoon of salt to the water (treatment group). The time, in seconds, that it takes each beaker of water to boil is shown in the chart below.

Control	65	78	64	71	75
Treatment	61	70	73	69	64

- a. State the null hypothesis for the experiment.  
THERE IS NO DIFFERENCE IN THE TIME TO BOIL WITH OR WITHOUT SALT

- b. Compare the results for the control group using box and whisker plots. Is there enough information to reject the null?   
 THINK OF IT THIS WAY: IF A BALL COULD FALL BETWEEN THE IQR'S REJECT. e.g.   
 A "LARGE" DIFFERENCE IN THE PLOTS ALLOW YOU TO REJECT THE NULL HYPOTHESIS.



NO: THERE IS SIGNIFICANT OVERLAP IN THE DATA, THE NULL HYPOTHESIS CANNOT BE REJECTED

least 5 mpg. Among 25 cars that were treated with the additive, the average increase in mileage was 4.3 mpg with a standard deviation of 1.6 mpg.

$$z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$$

- a. Find the z-score rounded to the nearest tenth: 2.2

$$z = \frac{5 - 4.3}{\frac{1.6}{5}} = \frac{0.7}{0.32} = 2.18$$

- b. Is there enough evidence to reject the null?   
 YES   
 $2.2 > 1.96 \rightarrow$  REJECT THE NULL

\* IF  $z > 1.96$ , REJECT   
 IF  $z < -1.96$ , ACCEPT

Classify each sample as simple random, systematic, stratified, cluster, convenience, or self-selected.

# 24 ANS: SYSTEMATIC

24. The business manager at a gym calls every 20th member on the complete list of members to find out whether they would use a childcare service during their workouts.

SIMPLE RANDOM = MEMBERS ARE CHOSEN USING A METHOD THAT GIVES EVERYONE AN EQUALLY LIKELY CHANCE OF BEING SELECTED   
 SYSTEMATIC = A PATTERN IS USED (e.g. SELECTING EVERY OTHER PERSON)   
 STRATIFIED = BROKEN INTO GROUPS, THEN RANDOM   
 CLUSTER = BROKEN INTO GROUPS, RANDOM SAMPLE, THEN SURVEY ALL   
 CONVENIENCE = EASILY ACCESSIBLE   
 SELF SELECTED = VOLUNTEERS

\* KNOW DEFINITIONS

Classify each sample as simple random, systematic, stratified, cluster, convenience, or self-selected.

25. A hair salon surveys every customer on a busy Saturday and on a slow Monday about whether the services took longer than the customer expected.   
 POPULATION - EVERYONE THAT GOES TO THE SALON  
 GROUPS - BUSY & SLOW, EACH DAY  
 RANDOM SELECTION - BUSY SAT, SLOW MONDAY SURVEYED - ALL IN SELECTION  
 CLUSTER
26. A college newspaper reporter surveys 50 randomly selected students on campus 4. A  
 SIMPLE RANDOM

27. A first 10 students she meets with on a Monday if they are planning to attend a job fair.  
 CONVENIENCE

28. A news group polls citizens about whether they are in favor of a new school. 58% are in favor, 42% are not, and 3% are not sure.

FAVOR 55% - 61% DO NOT FAVOR 39% - 45%  
 YES: INDICATES THE MAJORITIES PREFERENCE BECAUSE THEY DO NOT OVERLAP

29. Hilary and Michael are running for class president. A poll taken a week before the election shows 47% for Hilary and 53% for Michael. error is ± 4%.

HILARY 43% - 51% MICHAEL 49% - 57%  
 NO: DOES NOT INDICATE MAJORITY PREFERENCE, BECAUSE THE INTERVALS OVERLAP

Scores on a test are normally distributed with a mean of 80 and a standard deviation of 5. Use the table below to find each probability. USE Z TABLE SHEET IF TABLE IS NOT PROVIDED

LOOK AT YOUR CURVE EXAMPLE TO SEE IF THE ANS MAKES SENSE WITH REGARDS TO ANS POSITION IN EACH SD FROM M

30. A randomly selected student scored below 80.  $z = \frac{x-m}{\sigma} = \frac{80-80}{5} = \frac{0}{5} = 0$   
 ANS: .5 PROB  
 Z VALUE CHART SHOWS PROBABILITY - USE POSITIVE SIDE OF CHART = .50

31. A randomly selected student scored above 90.  $z = \frac{x-m}{\sigma} = \frac{90-80}{5} = \frac{10}{5} = 2$   
 ANS: .02 PROB  
 - RED NOTE ABOVE APPLIES  
 - ANS MUST USE THE POSITIVE SIDE BECAUSE IT IS LARGER THAN THE MEAN  
 - HOWEVER, CHECKING THE CURVE SHOWS THAT >90 SHOULD BE A VERY SMALL #  
 USE POSITIVE SIDE OF CHART = .9772 = .98

32. A randomly selected student scored below 75.  $z = \frac{x-m}{\sigma} = \frac{75-80}{5} = \frac{-5}{5} = -1$   
 ANS: .16 PROB  
 USE NEGATIVE SIDE OF CHART = .1587

33. A randomly selected student scored between 75 and 85.  
 ANS: .68 PROB  
 NEGATIVE SIDE OF CHART = .1587 = .16  
 POSITIVE SIDE OF CHART = .8413 = .84  
 $.84 - .16 = .68$

34. The wait times, in minutes, of 10 customers in line at a grocery store are given below. The mean wait time is 7 minutes with a standard deviation of 5. Tell whether the data appear to be normally distributed.

$X = 10$   
 $\mu = 7$   
 $\sigma = 5$

16	15	10	7	5
5	4	3	3	2

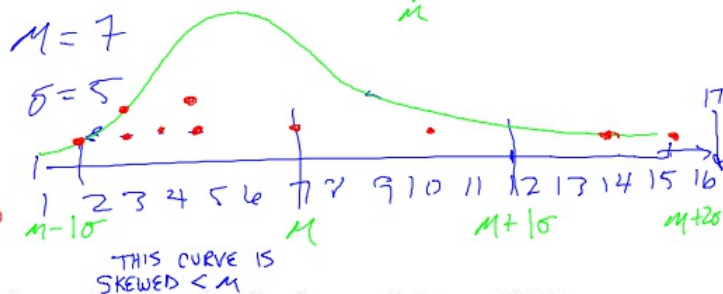
ANS: NOT NORMAL

SIMPLY PUTTING THE NUMBERS IN ORDER AND MARKING THE MEAN GIVES YOU THE IDEA THAT DISTRIBUTION IS

2 3 3 4 5 5 7 10 15 16

NOT NORMAL

- TO VALIDATE YOUR OBSERVATION OF THE NUMBER LINE, APPLY SD TO THE MEAN AND PLOT POINTS
- DETERMINE IF THE POINTS ROT WITHIN THE % RANGE OF EACH SD FROM  $\mu$  FOR A NORMAL CURVE



In each of the problems below, a card will be drawn at random from the four cards shown. Find the expected value for each group of cards. EV = EXPECTED VALUE  $EV = P(A) \times$

35.

4 CHOICES/  
 CHANCES  
 \* PROBABILITY  
 IS ALWAYS  
 = 1.0

6	6
6	2

4 blocks  
 = 1/4 CHANCE  
 = 25%  
 = .25 PER BLOCK

$2(.25) + 6(.25) + 6(.25) + 2(.25)$   
 $.5 + 1.5 + 1.5 + 0.5 = 5$   
 $EV = 5$

36.

1	6
4	1

$1(.25) + 1(.25) + 4(.25) + 6(.25)$   
 $.25 + .25 + 1 + 1.5 = 3$   
 $EV = 3$

37.

1	2
3	4

$1(.25) + 2(.25) + 3(.25) + 4(.25)$   
 $.25 + .5 + .75 + 1 = 2.5$   
 $EV = 2.5$

38. Chelsea has been offered two jobs. Her pay rate at either job will be determined by how well she does on a test. At Company A, she has an 80% chance of getting a pay rate of \$12 and a 20% chance of getting a pay rate of \$15 an hour. At Company B, she has a 60% chance of getting a pay rate of \$10 an hour and a 40% chance of getting a pay rate of \$15 an hour. At which company is she more likely to get a higher pay rate? Explain.

EV A  $12(.80) + 15(.20) = 12.6 = \$12.60$

EV B  $10(.60) + 15(.40) = 12 = \$12.00$

ANS: CHOOSE CO A - PROBABILITY INDICATES AVG POTENTIAL INCOME AT COMPANY A IS \$12.60 - HIGHER THAN \$12.00 AT B

39 - A = 40 w/o TRAFFIC

traffic, but 51 minutes with traffic. Route B takes 38 minutes without traffic, and 55 minutes with traffic. She estimates a 30% chance of encountering traffic on Route A and a 40% chance of encountering traffic on Route B. Which route would you recommend Mallory take? Explain.

EV A  $40(.70) + 51(.30) = 43.3$

EV B  $38(.60) + 55(.40) = 44.8$

CHOOSE ROUTE A - PROBABILITY INDICATES AVG TIME FOR RT A 43.3 min COMPARED TO 44.8 min ON RT B

