



2019– 2020

Bishop Kelley High School

Summer Math Program

Course: Statistics (Honors and AP)

NAME: _____

DIRECTIONS:

- Show all work in the packet or on loose-leaf paper, which you will turn in with the packet.
- Put final answer on the answer sheet.
- This material will be collected, graded, and points awarded at the discretion of each teacher on the first day of the math class.
- Graphing calculators are required for the course. I recommend the TI 83 or TI 84.
- An additional resource for help with this packet is <http://www.khanacademy.org>. It provides videos of about 10 minutes in length on hundreds of different math topics.

Math Teachers will be available in C-1 the following dates/times if you need help.

Date	Time
<i>Wednesday, July 24th</i>	<i>8-9:30am</i>
<i>Monday, July 29th</i>	<i>8-9:30am</i>
<i>Tuesday, July 30th</i>	<i>8-9:30am</i>

VOCABULARY

STATISTICS - The science of collecting, organizing, and interpreting data for the purpose of drawing conclusions.

DATA - Numbers with context. (15 is not data/A 15 lb baby is data)

INDIVIDUALS - People, animals, objects from which data is collected.

VARIABLE - Any characteristic of an individual.

CATEGORICAL VARIABLE - Places an individual into one of several groups or categories.(i.e. - hair color, favorite food ...)

QUANTITATIVE VARIABLE - Takes numerical values for which arithmetic operations such as adding and averaging make sense.(i.e. - height, weight, IQ ...)

*Note that all quantitative data is numeric, but not all numeric data is quantitative. (Phone numbers, addresses, Social Security Numbers ...)

EXPLORATORY DATA ANALYSIS - Describing the main features of a data set

1. Who are the individuals?
2. How many individuals are there?
3. What variable(s) have been collected?
4. What are the units of these variables?
5. Why/by whom has the data been collected?

DISTRIBUTION - Tells what values a variable may take on and the frequencies with which they occur.

PERCENTILE - A measure of position within a data set. Indicates what percentage of values in a data set are at or below a particular member of the set.

Vocabulary

The **mean**, or average, of n numbers is the sum of the numbers divided by n . The mean is denoted by \bar{x} and is represented by

$$\frac{x_1 + x_2 + \cdots + x_n}{n}$$

The **median** of n numbers is the middle numbers when the numbers are written in order. (If n is even, the median is the mean of the two middle numbers.) The **mode** of n numbers is the number or numbers that occur most frequently. There may be one mode, no mode, or more than one mode. The **range** is the difference between the greatest and least data values. The **standard deviation** describes the typical difference (or deviation) between the mean and a data value, and is represented by

$$\sigma = \sqrt{\frac{(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + \cdots + (x_n - \bar{x})^2}{n}}$$

Test Scores

32, 72, 81, 95, 98, 58, 77, 75, 83, 97, 45, 89, 93, 57, 82, 97, 52, 75

Find the mean, median, and mode of the data set listed above.

Solution

To find the mean, divide the sum of the scores by the number of scores.

Mean:

$$\begin{aligned}\bar{x} &= \frac{32 + 72 + 81 + 95 + 98 + 58 + 77 + 75 + 83 + 97 + 45 + 89 + 93 + 57 + 82 + 97 + 52 + 75}{18} \\ &= \frac{1358}{18} \approx 75.4\end{aligned}$$

To find the median, order the 18 numbers first. Because there is an even number of scores, the median is the average of the two middle scores.

32, 45, 52, 57, 58, 72, 75, 75, 77, 81, 82, 83, 89, 93, 95, 97, 97, 98

$$\text{Median} = \frac{77 + 81}{2} = 79$$

There are two modes, 75 and 97, because these numbers occur most frequently.

Example 2: Finding Measures of Dispersion

Find the range and the standard deviation of the test scores from Example 1.

Solution

To find the range, subtract the lowest score from the highest score.

$$\text{Range} = 98 - 32 = 66$$

To find the standard deviation, substitute the scores and the mean of 75.4 from Example 1 into the formula:

$$\sigma = \sqrt{\frac{(32 - 75.4)^2 + (45 - 75.4)^2 + (52 - 75.4)^2 + \cdots + (98 - 75.4)^2}{18}}$$

$$\approx \sqrt{\frac{6466}{18}} \approx \sqrt{359} \approx 18.9$$

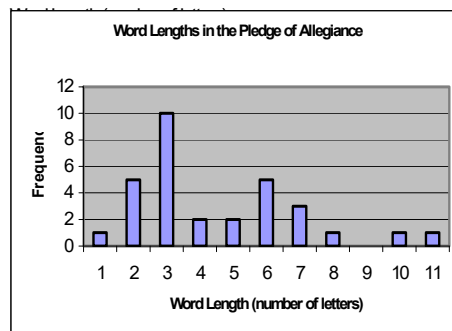
Exercises:

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

1. 15, 11, 19, 15, 14, 14, 13, 17, 11, 12, 17, 15, 14, 15
2. 79, 78, 99, 98, 54, 75, 85, 61, 55, 86, 74
3. 10, 15, 12, 20, 25, 22, 28, 24, 22, 26
4. 100, 150, 100, 120, 130, 125, 135, 140, 145

Find the range and standard deviation of the data set.

5. 47, 18, 65, 28, 43, 18
6. 35.8, 29.4, 32.1, 24.9, 30.5, 20.3
7. **Reading Levels** *The Pledge of Allegiance* contains 31 words. The bar graph below shows the number of words of different lengths in the pledge. Find the mean word length of the set of 31 words.



Walking Shoes An important feature of walking shoes is their weight. The chart below shows the weight of the top-10 rated men’s walking shoes:

Ranking	Weight	Ranking	Weight
1	24 oz	6	28 oz
2	22 oz	7	22 oz
3	26 oz	8	28 oz
4	28 oz	9	22 oz
5	24 oz	10	28 oz

8. Find the mean of the ten weights.
9. Find the median of the ten weights.
10. Find the mode of the ten weights.
11. Find the range of the ten weights.
12. Find the standard deviation of the ten weights.

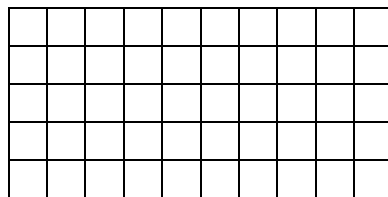
World Series The World Series is a best-of-seven playoff between the National League champion and the American League champion. The table shows the number of games played in each World Series for 1981 through 1998.

Year	1981	1982	1983	1984	1985	1986	1987	1988	1989
Games	6	7	5	5	7	7	7	5	4

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998
Games	4	7	6	6	0	6	6	7	4

For Exercises 13-15, go to <http://www.wikihow.com/Make-a-Box-Plot> or do an internet search for “making a boxplot”

13. Find the median of the number of games played.
14. Find the lower (25th percentile) and upper (75th percentile) quartiles of the number of games played.
15. Construct a box-and-whisker plot of the number of games played.



Vocabulary

A **combination** is a selection of r objects from a group of n objects where the order is not important.

Combinations of n Objects Taken r at a Time

The number of combinations of r objects taken from a group of n distinct objects is denoted by ${}_n C_r$ and is given by:

$${}_n C_r = \frac{n!}{(n-r)!r!}$$

Example 8: Finding Combinations

A committee of five people is to be chosen from a group of 20 people, 12 of which are men and 8 are women.

- If the order in which the people are chosen is not important, how many different five-people committees are possible?
- How many different ways can 3 men and 2 women be chosen for the committee?

Solution

- The number of ways to choose 5 people from a group of 20 is:

$${}_{20}C_5 = \frac{20!}{15!5!} = \frac{20 \cdot 19 \cdot 18 \cdot 17 \cdot 16 \cdot 15 \cdot 14 \cdot 13 \cdot 12 \cdot 11 \cdot 10 \cdot 9 \cdot 8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}{15 \cdot 14 \cdot 13 \cdot 12 \cdot 11 \cdot 10 \cdot 9 \cdot 8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1} = 15,504$$

- Because you need to choose 3 of the 12 men and 2 of the 8 women, the number of possible committees is:

$${}_{12}C_3 \cdot {}_8C_2 = \frac{12!}{9!3!} \cdot \frac{8!}{6!2!} = 6,160$$

Exercises:

16. An ice cream shop has a choice of 10 toppings. In how many ways can you choose 3 different toppings for your ice cream?
17. Out of a group of 30 people, how many different committees of 6 people can be chosen?

Exercises: (Probability) (You might try consulting <http://stattrek.com/>, or do a 'search' if you need some help)

Rolling Dice You have an equally likely chance of rolling any value on each of two dice. Find the probability of the given event.

18. rolling a sum of either 7 or 9
19. rolling a sum greater than 5
20. rolling a 6 on exactly one die
21. rolling doubles

Genetics Common parakeets have genes that can produce four feather colors: green (BBCC, BBCc, BbCC, or BbCc), blue (BBcc, or Bbcc), yellow (bbCC or bbCc), or white (bbcc). Complete the Punnett square below to find the possible feather colors of the offspring of two green parents (both with BcCc feather genes).

	BC	Bc	bC	bc
BC				
Bc				
bC				
bc				

Find the probability of the given event.

22. green feathers
23. not blue feathers

24. yellow or white feathers

25. yellow feathers

Test Scores Thirty-five students in an AP Statistics class took a test: 9 received A's, 18 received B's, and 8 received C's. Find the probability of the given event.

26. If a student from the class is chosen at random, what is the probability that the student did not receive a C?
27. If the teacher randomly chooses 3 test papers, what is the probability that the teacher chose tests with grades A, B, and C in that order?
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Additional Probability Exercises:

28. A fair coin is thrown in the air four times. If the coin lands with the head up on the first three tosses, what is the probability that the coin will land with the head up on the fourth toss?
1. 0
 2. $1/16$
 3. $1/8$
 4. $1/2$
29. How many different three-member teams can be formed from six students?
1. 20
 2. 120
 3. 216
 4. 720
30. How many different 6-letter arrangements can be formed using the letters in the word ABSENT, if each letter is used only once?
1. 6
 2. 36
 3. 720
 4. 46,656
31. If $P(E)$ is the probability that an event will occur, which of the following must be false?

1. $P(E)=1$
2. $P(E)=1/2$
3. $P(E)=1/3$
4. $P(E)= - 1$

32. From a group of 8 people, how many teams of 4 can be chosen?

1. 32
2. 70
3. 500
4. 1680

33. A standard deck of 52 cards is shuffled. What is the probability of choosing the 5 of diamonds?

1. $1/5$
2. $1/13$
3. $5/52$
4. $1/52$

34. A die is rolled. What is the probability that the number rolled is greater than 2 and even?

1. $1/2$
2. $1/3$
3. $2/3$
4. $5/6$

35. A pair of dice is rolled. A possible event is rolling a multiple of 5. What is the probability of the complement of this event?

1. $2/36$
2. $12/36$
3. $29/36$
4. $32/36$

36. Your state issues license plates consisting of letters and numbers. There are 26 letters and the letters may be repeated. There are 10 digits and the digits may be repeated. How many possible license plates can be issued with two letters followed by three numbers?

1. 25000
2. 67600
3. 250000
4. 676000

37. How many elements are in the sample space of rolling one die?

1. 6
2. 12
3. 24
4. 36

38. Two cards are drawn at random from a standard deck of 52 cards, without replacement. What is the probability of drawing a 7 and a king in that order?

1. $\frac{4}{51}$
2. $\frac{4}{52}$
3. $\frac{4}{256}$
4. $\frac{4}{663}$

39. A movie theater sells 3 sizes of popcorn (small, medium, and large) with 3 choices of toppings (no butter, butter, extra butter). How many possible ways can a bag of popcorn be purchased?

1. 1
2. 3
3. 9
4. 27

40. Which of the following sampling methods would provide a simple random sample of 50 college students?

- a. • Survey the first 50 students to enter the math building in the morning?
- b. • Obtain a list of alphabetized student names, and then select every 5th student on the list until there are 50 students selected.
- c. • Place the name of each student in a hat and then draw 50 names.

Use the criteria for simple random sampling to justify your answer.

Vocabulary

In [statistics](#), a **simple random sample** is a subset of [individuals](#) (a [sample](#)) chosen from a larger set (a [population](#)). Each individual is chosen [randomly](#) and entirely by chance, such that each individual has the same [probability](#) of being chosen at any stage during the sampling process, and each subset of k individuals has the same probability of being chosen for the sample as any other subset of k individuals. (Yates, Daniel S.; David S. Moore, Daren S. Starnes (2008). *The Practice of Statistics, 3rd Ed.*. [Freeman](#). ISBN 978-0-7167-7309-2.). This process and technique is known as **simple random sampling**.

You need to be able to use your **graphing calculator** with its statistics package to enter data, calculate simple statistics such as the mean, median or linear regression equation, and produce a boxplot, scatterplot and histogram BEFORE the first day of class. Consult your manual if you are not already familiar with how to use your calculator. **A TI-83-84 series calculator is required(every day) for this course!**

STAT Button use: Enter the following data into List 1.

1. Select the STAT menu.
2. Choose "Edit."
3. Enter the following data: 510 510 510 543 454 438 459 459 498 466 448 403 498 466
498 433 454 454 498 419 415 454 407 498 443 448 498 433
459 459 419

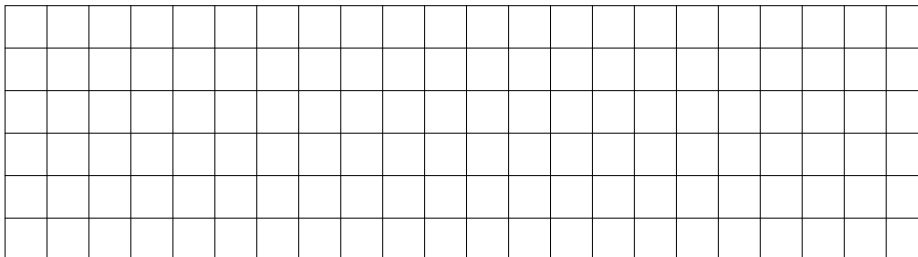
Entry sequence: Stat → Calc → 1VarStats → L1

Record the following (Refer to the manual to see which symbol is which statistic)

41. Mean 42. Standard deviation(s) 43. n 44. Min 45. Q1
46. Median 47. Q3 48. Max

Using the Statistics Plot: Select **StatPlot** (2nd Y=). Hit Enter to select Plot 1. Toggle cursor to "On," by hitting Enter. Select the fourth plot (a box plot with outliers) by hitting Enter. Your data should be in List 1, so xlist should read "L1." Select "Zoom" (3rd button, top row). Choose option 9 (ZoomStat).

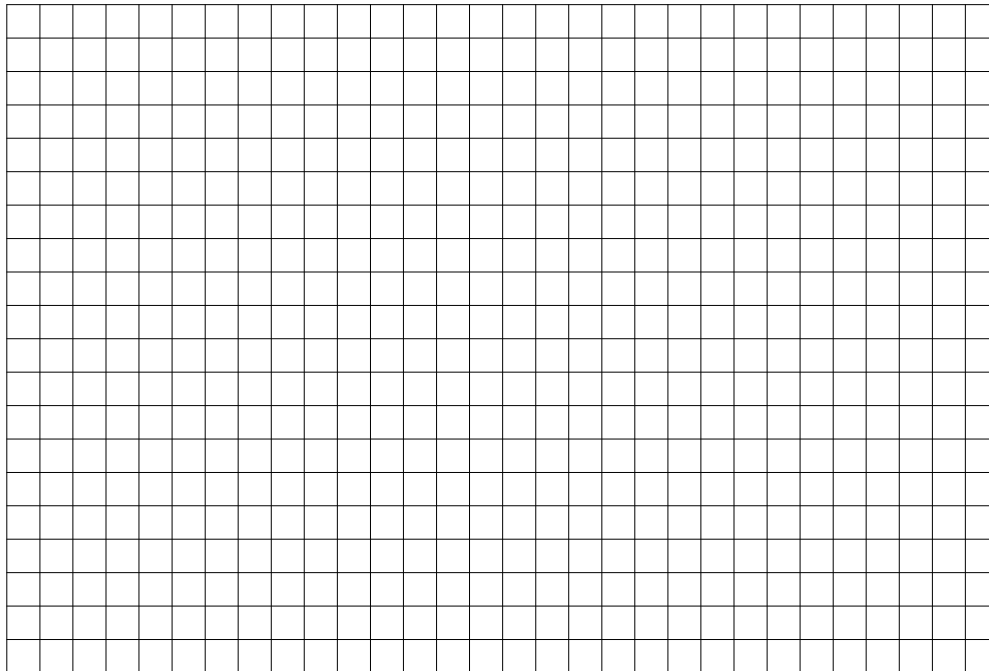
49. Reproduce the box plot in scale here. Use trace to find the end of the whisker and the ends of the box and the middle line on the box. Label your axis and scale. Choose a scale appropriate for the space provided.



50. **Practice with regression:** If you are camping in the woods, can you tell what the temperature is by how quickly the crickets chirp? Examine the data below:

<u>Temperature (°C)</u>	<u>Chirps/min</u>
18	110
19	110
20	130
21	135
23	154
24	158
26	179
29	201
31	210
32	230

Enter this data into L2 and L3. Plot a scatterplot (the first choice in the plots, 2nd Y= again). Reproduce the scatterplot with labeled axes, scale and a title. Choose a scale appropriate for the space provided. Remember to change the *x*-and *y*-lists to L2 and L3!



- Now find the line of best fit using these commands: Stat → Calc → 8 → L2, L3. Record the equation of the line.
- At 27°, what would you expect the number of chirps/minute to be (don't forget context— units)?

For Statistics, you cannot forget how to use simple Algebra, so the next set of problems is simply Algebra review.

51. $x = \frac{a-b}{c}$ Solve for b .

52. $z = \frac{x-\mu}{\sigma}$ Solve for x .

53. $z = \frac{x-\mu}{\sigma}$ Solve for σ .

54. $z = \frac{x-\mu}{\sigma}$ Solve for μ .

55. Let $z^* \frac{\sigma}{\sqrt{n}} \leq m$, and suppose $z^* = 1.96, \sigma = 43, m = 5$. Solve the inequality for n (to the nearest whole number).

56. Let $t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$, and suppose

$\bar{x}_1 = 5.000, \bar{x}_2 = -0.273, s_1 = 8.743, s_2 = 5.901, n_1 = 10, n_2 = 11$ Solve for t .

A study asked 120 people whether they wear glasses and whether they are over age 40.

Use the table for #57-59

Wears Glasses?

Age	Yes	No
Under 40	18	52
Over 40	15	35

57. What is the probability that a randomly selected person wears glasses?

58. What is the probability that a randomly selected person is over 40 AND does not wear glasses?

59. Given that a person is over the age of 40, what is the probability that he or she wears glasses?

	Mean	Median	Mode
1.			
2.			
3.			
4.			

5. Range _____ Standard deviation _____

6. Range _____ Standard deviation _____

7. Mean word length _____

8. Mean _____ 9. Median _____ 10. Mode _____

11. Range _____ 12. Standard Deviation _____

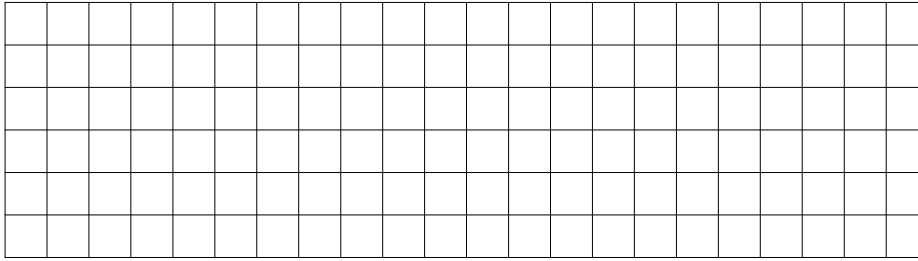
13. Median _____ 14. Lower quartile _____ Upper quartile _____

15.

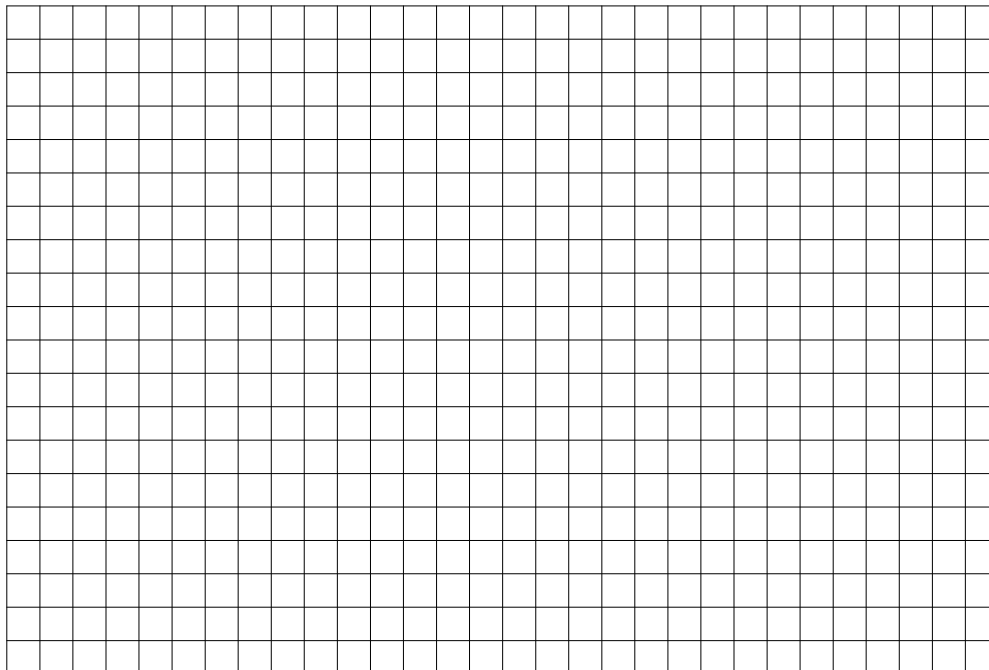
16.	17.	18.	19.
20.	21.	22.	23.
24.	25.	26.	27.

28.	29.	30.	31.	32.
33.	34.	35.	36.	37.
38.	39.	40.	41.	42.
43.	44.	45.	46.	47.
48.				

49.



50.



a. **Line of Best Fit** _____

b. _____

51.	52.	53.
54.	55.	56.
57.	58.	59.

