AP Statistics Packet

Summer 2019

Name:_____

AP Statistics

Dear Student,

AP Statistics looks at the ways people analyze information, find relationships between variables, design and carry out experiments, and quantify the reliability of the conclusions they draw. Starting from the basics that virtually every student already knows about Statistics – like mean and median, bar graphs and scatter plots – the students in this class will explore deeply into the less known realms of analysis. There is much to learn, and each class session will require students to work diligently, both during and outside of class.. This summer Math packet addresses the material that you should be comfortable with before the start of AP Statistics. This Math packet serves 2 purposes:

1) it will allow you to remain mathematically fresh during the summer and
2) it will enable you to "hit the ground running" when Statistics begins.

This packet will be due within the first week you come back to school next fall and will be graded, and you will have a test within the first 2 weeks. It would be a mistake to complete this packet immediately upon the completion of this past school year. Take some time off and look towards beginning the packet come mid-summer. It is important that the techniques practiced in this packet are fresh in your mind come the first day of school.

Have a great summer and I look forward to seeing you in the fall!

- Coach Neal

ARE YOU READY FOR AP STATISTICS?

The first unit of AP Statistics begins with the basics of descriptive statistics. Many of these concepts have been covered in previous math and science courses. Over the summer you will review these topics and complete this packet. Writing and reading comprehension are important components to the course. In this packet are three tasks that require you to justify your reasons. Listed below are some Internet sites that contain information about descriptive statistics.

www.mste.uiuc.edu/hill/dstat/dstat.htm
www.chelt.ac.uk/acadres/stats/descript.htm
www.habermas.org/stat2f98.htm

Part I – Background Information

Visit the American Statistical Association
http://www.amstat.org/careers
On the left side of the page, search under each of the following four subtopics.
1) What is Statistics?
2) What Do Statisticians Do?
3) How Do I Become a Statistician?
4) What Industries Employ Statisticians?

Part II – Math Skills Review

1. Write equations of the horizontal and vertical lines that pass through the point (-3, 4). Please label which equation is horizontal and which is vertical.

2. Find the slope and y-intercept of the line. Sketch the line.

a. $y = \frac{2}{3}(2x-4)$ **b.** $\frac{1}{3}y - 6x = 4$

3. Find the slope and write the equation of the line containing the points (6, -2) and (0, 5)

4. Solve and graph each inequality. Graph each.

a. $|4x-6| \le 4$ **b.** $\left|x+\frac{3}{2}\right| > \frac{3}{2}$

c. $-2x+3y > x+9$ **d.** $-y > 3x-1$

5. Plot the data using a scatter plot then decide if the data is linear, exponential, quadratic, or absolute value.

- **a.** (-3, 4) (-2, 3.5) (-1, 3) (0, 2.5) (1, 2) (2, 1.5) (3, 1)
- **b.** (-3, 4) (-2, 3) (-1, 2) (0, 1) (1, 2) (2, 3) (3, 4)
- **c.** (-3, 4) (-2, 2) (-1, 1) (0, ½) (1, ¼) (2, 1/8) (3, 1/16)
- **d.** (-3, 4) (-2, 7/3) (-1, 4/3) (0, 1) (1, 4/3) (2, 7/3) (3, 4)

6. There are 25 students in your English class. To determine the speaking order for presenting oral reports, slips of paper numbered from 1 to 25 are place in a box. Each student draws a number to determine his or her speaking order.

- **a.** What is the probability that the number you draw will be odd?
- **b.** What is the probability that the number you draw will be even?
- **c.** Five oral reports will be given on each day. What is the probability that you will have to give your report on the first day?
- **d.** What is the probability that you will be the last person to give your report?

7. For the function find the requested values.

$f(x) = 3x^2$

f(-3) =

f(0) =

f(2) =

8. Evaluate g[f(-2)] and f[g(3)] for the following function.

f(x) = -x; g(x) = x2 + 5

9. Solve:

a. $2\sqrt{x}+9=21$ **b**. $\sqrt{2x+10}=x+1$ **c**. $2|x-1|=14$

d. $4(x-2)=3^2-x$ **e**. $\frac{1}{3}n+3=n-2$ **f**. $9(2p+1)-3p>4p-6$

g. $\frac{2}{3}y=\frac{8}{13}$ **h**. $x^2-8x+7=0$ **i**. $\frac{m}{12}+\frac{5}{6}=\frac{5}{24}$

10. Write the equation of the line containing the given points:

- **a.** (6, -2) and (0, 5)
- **b**. perpendicular to: $y=2x-1$, contains (2, 7)

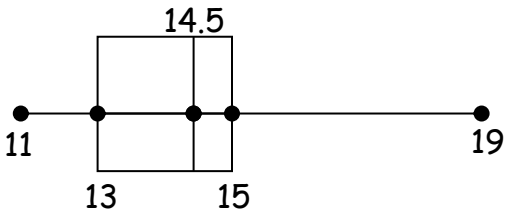
11. On your graph paper, create and sketch a(n):

- **a.** linear function
- **b**. exponential function
- **c**. quadratic function

Part III - Measuring Central Tendency

b. Find the quartiles of the collection in Example a. Then, sketch a box-and-whisker plot of the data

$$\underbrace{11,11,12,13,14,14,14}_{\text{Lower half}},\underbrace{15,15,15,15,17,17,19}_{\text{Upper half}}$$



The **first quartile** is 13 (the median of the lower half)
The **second quartile** is 14.5 (the median)
The **third quartile** is 15 (the median of the upper half).
A **box-and-whisker plot** for the data labels the endpoints of the data and marks the quartiles. It is shown at the right.

The **range** is the difference of the highest and lowest data points. That is, the range is 19-11 = 8.

Exercises

1. Find the mean, median, mode, and range of the following collection of scores on a test.
   32, 72, 81, 95, 98, 58, 77, 75, 83, 97, 45, 89, 93, 57,
   82, 97, 52, 75, 79, 78, 99, 98, 54, 75, 85, 61, 55, 86
2. Find the first, second, and third quartiles of the collection of data in Exercise 1.
3. Construct a box-and-whisker plot of the collection of data in Exercise 1.
4. Complete #1-3 for the following set of data. The weights (in pounds) of eleven children are as follows:
   39, 52,40, 45, 46, 55, 48, 40, 43, 47, 44

Part IV - Organizing Data

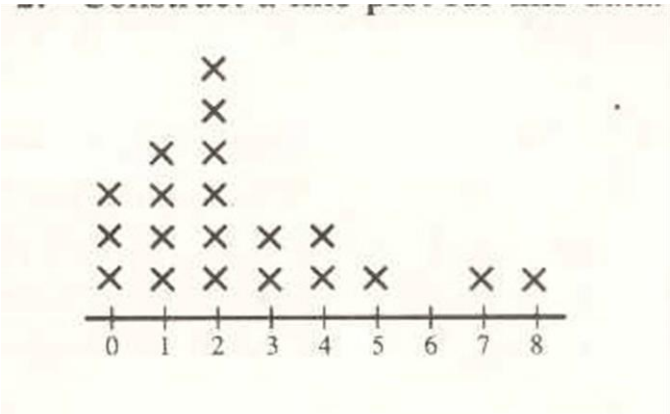
At a car dealership, the number of new cars sold in a week by each salesperson was as follows:

5, 8, 2, 0, 2, 4, 7, 4, 1, 1, 2, 2, 0, 1, 2, 0, 1, 3, 3, 2.

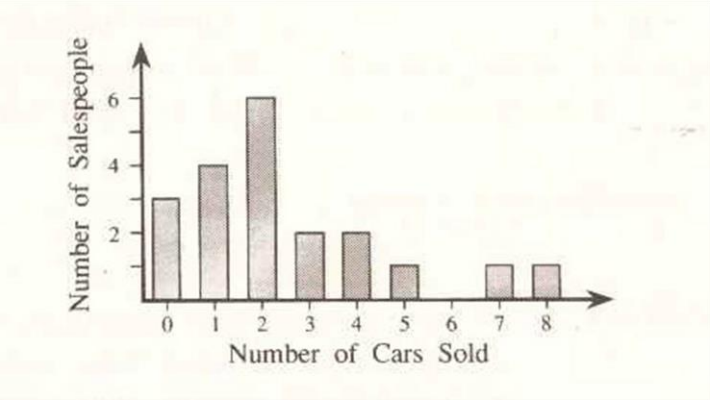
a. Construct a frequency distribution for this data.

Number	Tally	Frequency
8	|	1
7	|	1
6		0
5	|	1
4	||	2
3	||	2
2	|||| |	6
1	||||	4
0	|||	3

b. Construct a line plot for this data



c. Construct a bar graph that shows the number of salespeople who sold 0-8 cars.



Exercises

1. Twenty-eight students in a class were asked how many cars their family owned. The results were as follows:

2, 2, 3, 2, 1, 2, 2, 4, 3, 2, 0, 1, 0, 1, 1, 2, 2, 3, 2, 3, 3, 5, 1, 1, 3, 0, 1, 2

Construct a frequency distribution and a line plot for this data.

2. Each of the members of a recent high school graduating class was asked to name his/her favorite among these subjects: English, foreign language, history, mathematics, science. The results are shown in the table. Construct a bar graph that shows these results.

English	62
Foreign Language	40
History	40
Mathematics	18
Science	33

Part V - Constructing Stem-and-Leaf Plots and Histograms

I. Construct a stem-and-leaf plot for the data

Unordered Data

63, 52, 84, 83,
51, 32, 58, 35,
45, 41, 65, 75,
59, 67, 25, 46

Stem-and-leaf Plot

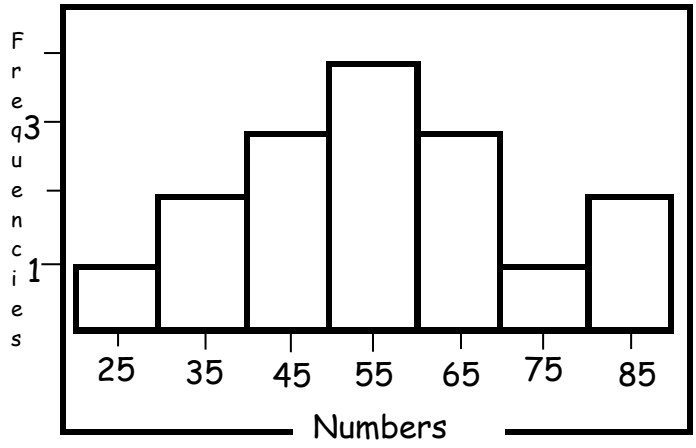
2	5
3	2 5
4	1 5 6
5	1 2 8 9
6	3 5 7
7	5
8	3 4

Leaves should be in increasing order.

A stem-and-leaf plot orders data in increasing or decreasing order.

II. Histograms

1. Construct and label a horizontal number line that is scaled to contain all of the values of the variable of interest.
2. Construct and label a vertical axis so that the greatest frequency can be represented.
3. Construct the bars of equal width that are centered above each value. The heights of the bars represent the frequencies of the values.



Exercises

1. Construct a stem-and-leaf plot for the data
   15, 59, 66, 42, 48, 23, 70, 81, 35, 51, 68, 29, 77, 92,
   85, 16, 37, 59, 61, 76, 40, 25, 86, 11

2. Construct a histogram for the above data.

Task 1: Write two specific survey questions that you would ask voters in the next senatorial election in your state. Choose the type of question and response (yes/no, scale of 1 to 5, numerical responses, etc.) that would be most appropriate for the issues involved. What relationships would be expected when the responses are analyzed?

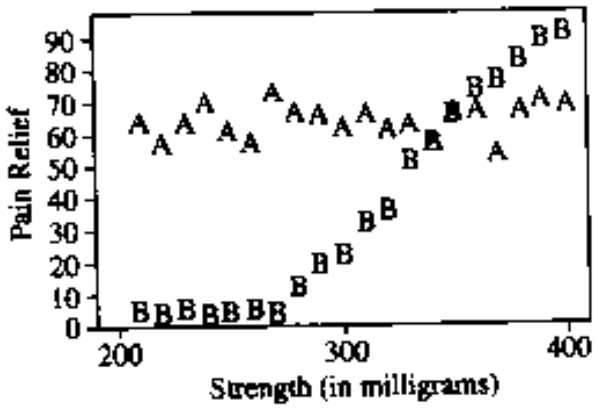
Task 2: Find a set of numbers that will satisfy the following conditions:

- The median of a set of 20 numbers is 24.
- The range is 42.
- To the nearest whole number the mean is 24.
- No more than three numbers are the same.

Show your strategy. Be specific...show your process. Saying guess and check is not a strategy.

Task 3: Two pain relievers, A and B, are being compared for relief of postsurgical pain. Twenty different strengths (doses in milligrams) of each drug were tested. Eight hundred postsurgical patients were randomly divided into 40 different groups. Twenty groups were given drug A. Each group was given a different strength. Similarly, the other twenty groups were given different strengths of drug B. Strengths used ranged from 210 to 400 milligrams. Thirty minutes after receiving the drug, each patient was asked to describe his or her pain relief on a scale of 0 (no decrease in pain) to 100 (pain totally gone).

The strength of the drug given in milligrams and the average pain rating for each group are shown in the scatterplot below. Drug A is indicated with A's and drug B with B's.



(a) Based on the scatterplot, describe the effect of drug A and how it is related to strength in milligrams.
(b) Based on the scatterplot, describe the effect of drug B and how it is related to strength in milligrams.
(c) Which drug would you give and at what strength, if the goal is to get pain relief of at least 50 at the lowest possible strength? Justify your answer based on the scatterplot.

Part VI - Combinations and Permutations

This a review topic from Algebra II that we will use in probability.

An Important Counting Principle The computation of theoretical probabilities is based upon an important counting principle called logical multiplication.

- If a person has 3 different sweatshirts and 2 different pairs of jeans, then there are 3 x 2 = 6 possible outfits.
- If there is a family of 6 children, and assuming both genders are equally likely at birth, how many different gender arrangements are there? For each child, there are 2 possibilities (B or G) and each birth is independent of the others, therefore $2^6 = 64$ possible arrangements.
- How many ways are there of arranging 5 children to stand in a line? For the first space, there are 5 choices, for the next space, 4 choices, and so on until the last space when there is only one choice, the last child. The total number of ways is
  5 x 4 x 3 x 2 x 1 = 5! = 120. To calculate this on a TI83 press 5, go to MATH, scroll right to PROB, then down to #4 !

Permutations have ORDER.

- **In how many ways can we pick a 4 letter word from the word MATH? As explained above, the answer would be 4! = 24 ways.**
- In how many ways can we pick a 7 letter word from the letters ENGLAND? If all the letters were different, there would be 7! ways. However, there are 2 N's and so there would be half as many $\left(\frac{7!}{2!}\right)$ ways. Similarly, there are $\left(\frac{9!}{2!\bullet 2!}\right)$ ways are getting a 9 letter word from the letters JEFFERSON.
- In how many ways can we arrange 4 letters from a total of 6 letters? Using the counting principle, we can see that it would be 6 x 5 x 4 x 3 = $\frac{6!}{2!} = \frac{6!}{(6-4)!}$. In general, the number of different permutations of n items taken r items at a time is denoted by ${}^nP_r = \frac{n!}{(n-r)!}$

Combinations ORDER DOES NOT MATTER

- There is only 1 way to choose 3 letters from C A T because CAT is considered the same choice as TAC. So, there are FEWER ways of arranging items than when order matters.
- For example from the set of 5 elements, {a,b,c,d,e} there are 10 ways of choosing 3 letters:
  {abc} {abd} {abe} {acd} {ace} {ade} {bcd} {bce} {bde} {cde}
- In general, the number of ways that r items can be chosen from n elements is
  ${}^nC_r = \frac{n!}{r!(n-r)!}$

Exercises:

1. If a sandwich shop has 3 different types of meat, 4 types of bread, and 3 different type of cheese. How many types of sandwiches can you create if you must have meat, bread and cheese on each?

2. How many ways can you hang 3 pictures in a row on a wall?

3. How many ways can you visit 5 exclusive shops when you are looking for the perfect present for Mrs. Gustafson?

4. If a person has 4 pairs of shoes and 6 pairs of socks, then how many shoe-sock combos are possible?

5. If there is a family of four, how many different gender arrangements are there?

6. If you are taking a multiple choice test (a, b, c, & d) consisting of 10 questions, then how many different arrangements of answers are there?

Permutations: Order matter; think "president"; key word: arrange

7. How many ways can we pick a 6 letter "word" from the word HOKIES?

8. How many ways can we pick a 10 letter "word" from the word STATISTICS?

9. How many ways can we pick 3 different officers from a club of 20 members?

Combinations: Order doesn't matter; think "committee"; key word: select

10. ${}^{5}C_{3} = \frac{5!}{3!2!} =$ ${}^{7}C_{4} =$ ${}^{10}C_{3} =$

11. How many ways can we select a committee of 3 people from a club of 20 members?

12. How many ways can we pick 4 winners for 8 prizes if each prize is the same?

Part VII – Probability

Probability is the measure of the likelihood that an event will occur. Probability quantifies as a number between 0 and 1, where, loosely speaking, 0 indicates impossibility and 1 indicates certainty. The higher the probability of an event, the more likely it is that the event will occur. A simple example is the tossing of a fair (unbiased) coin. Since the coin is fair, the two outcomes ("heads" and "tails") are both equally probable; the probability of "heads" equals the probability of "tails"; and since no other outcomes are possible, the probability of either "heads" or "tails" is 1/2 (which could also be written as 0.5 or 50%).

1. What is the probability of rolling a 5 on a standard six-sided die?
2. What is the probability of rolling a number greater than 4 on a standard six-sided die?
3. What is the probability of rolling a number less than ten on a standard six-sided die?
4. What is the probability of selecting a queen from a standard 52-card deck?
5. What is the probability of selecting a black seven from a standard 52-card deck?
6. What is the probability of selecting a red spade from a standard 52-card deck?

Independent and Dependent Events. Suppose now we consider the probability of 2 events happening. For example, we might throw 2 dice and consider the probability that both are 6's. We call two events **independent** if the outcome of one of the events doesn't affect the outcome of another. For example, if we throw two dice, the probability of getting a 6 on the second die is the same, no matter what we get with the first one- it's still 1/6. On the other hand, suppose we have a bag containing 2 red and 2 blue balls. If we pick 2 balls out of the bag, the probability that the second is blue depends upon what the color of the first ball picked was. If the first ball was blue, there will be 1 blue and 2 red balls in the bag when we pick the second ball. So the probability of getting a blue is 1/3. However, if the first ball was red, there will be 1 red and 2 blue balls left so the probability the second ball is blue is 2/3. When the probability of one event depends on another, the events are **dependent**.

7. What is the probability of rolling two dice and getting a sum of 10?
8. What is the probability of rolling two dice and getting doubles?
9. What is the probability of rolling a die and flipping a coin and getting a 2 and a tail?
10. What is the probability of rolling a die and flipping a coin and getting an odd number and a head?

You have a bag containing the following colored marbles: 6 blue, 5 red, 8 green, 4 yellow, and 2 black.

11. What is the probability of selecting one blue and one black if the blue marble is replaced after it is selected?
12. What is the probability of selecting one blue and one black if the blue marble is not replaced?
13. What is the probability of selecting two red marbles with replacement?
14. What is the probability of selecting two red marbles without replacement?