AP Statistics – Linear Transformations Notes Name KEY

1. In algebra, we used the slope-intercept form for a line. What is the slope intercept form? $y=mx+b$

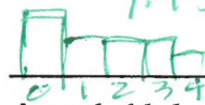
2. A linear transformation changes the original variable x into the new variable x_{new} given by an equation of the form: $x_{new} = a + bx$. Do you see why this is called a <u>linear</u> transformation? Yes! :)

3. The data on the number of children in a household for the 10 households in a neighborhood is:

2, 3, 0, 2, 1, 0, 3, 0, 1, and 4. Put this data in List 1.

Find the mean number of children per household, $\bar{x}$. 1.6 Find the standard deviation, s. (1.4298→) 1.43

(round-off to two decimal places)

Draw a histogram (or boxplot) of the data and describe the shape of the distribution.  right skew

a. Suppose we wish to summarize the number of people in a household. Each of the households has two adults so we can simply add the value 2 to each number in the list. 4, 5, 2, 4, 3, 2, 5, 2, 3, 6.

Find the mean and standard deviation of this new set of observations and compare them to the original observations. 3.6, 1.43 How did the mean change? add 2

How did the standard deviation change? it did not change

Did the shape of the distribution change? No

b. Summarize how adding the same constant to each observation affects the mean and standard deviations. Knowing how each measure is computed, does this make sense?

adding a constant to each observation increases the mean by that constant; it does not affect the standard deviation. it makes sense because the mean shifts up by 2 in this case, but the spread stays the same.

c. Suppose each child receives a weekly allowance of \$3. The total allowance in a household can be obtained by multiplying every number in the original list by 3. 6, 9, 0, 6, 3, 0, 9, 0, 3, and 12

Find the mean and the standard deviation of this new set of observations. 4.8, 4.29. How did the mean change? Multiplied by 3 How did the standard deviation change? Multiplied by 3 Did the shape of the distribution change? (it spread out more)) but NO... (still right skewed)

d. Summarize how multiplying each observation by the same constant affects the mean and standard deviation of the observations. Knowing how each measure is computed, does this make sense?

multiplying ~~by~~ each observation by the same constant ~~results in a mean~~ multiplies the mean by that constant and the standard deviation by that (positive) constant. this does make sense!

4. <u>What is the algebraic effect of such transformations on the shape, center, and spread of a distribution?</u>

- Linear transformations do *not change the shape* of the distribution! ($b>0$) (otherwise, it flips the skew)
- Multiplying each observation by a positive number b multiplies both measures of center (mean and median) <u>and</u> measures of spread (IQR, standard deviation) by b.
- Adding the same number a (positive, negative, or zero) to each observation adds a to the measures of center and to quartiles but does <u>not</u> change the measures of spread.

5. Let's change the units of measurement in the following example from Celsius to Fahrenheit. $F = \frac{9}{5}C + 32$

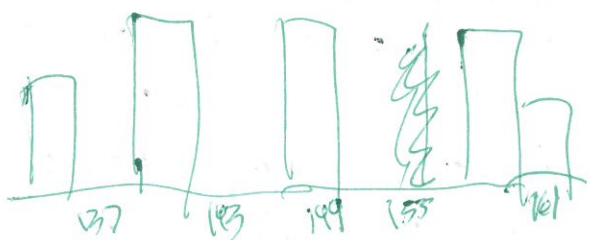
Put the following Celsius temperature readings in list 1, L1: 56, 60, 60, 65, 65, 70, 70, 72.

Draw a histogram of the data. Draw a boxplot of the data. Describe the shape. Roughly symmetrical

Find the mean temperature, in Celsius, $\bar{x}$. 64.75 Find the standard deviation, s. 5.726

Now without changing each individual temperature into Fahrenheit, can you tell me the mean, standard deviation, and shape of the temperature in Fahrenheit? 148.55, 10.31, roughly symmetrical

Check your results by creating a List 2. Go on top of the list name and type $\frac{9}{5}(L1)+32$



6. **Totally off this topic:** If a distribution is symmetric then the mean and median are equal. This is a **true** statement. Consider the converse: If a distribution has a mean equal to the median, then it is symmetric. Do you think this statement is true? NO

Consider the following data: 3, 3, 3, 3, 5, 6, 6, 6, and 10. Find the mean 5 median 5 and look at the shape of the distribution. Right skew So, is the converse true? NO!