AP Statistics
Summer Assignment

Purpose: The purpose for the summer assignment is to cover some elementary statistics concepts, as well as some algebraic concepts that will be useful for the course. To make this assignment the most useful for you, begin working on it about a week or two before the due date.

Date Due: Monday, August 14, 2017 – this is <u>BEFORE</u> school starts!

Scoring the Assignment:

The summer assignment will be worth 80 points. Furthermore, there will be a quiz covering this material, as well as other material learned in the first few days of class, within the first week of school.

Methods for submitting the assignment:

1. Turn in a hard copy to the main office (Do this no earlier than August 11) to be picked up by Mr. Stephens. Ask the secretary to place your assignment in my mailbox.

OR

2. Scan a copy and e-mail it to Mr. Stephens at andrew.stephens@copley-fairlawn.org from your Google apps account (more info below).

    **Late summer assignments will be assessed a serious penalty for each day it is late. (25% off for each weekday it is late)

Completing the assignment:

1. Read through the packet. Not only is it the source of the questions, but also some important information for answering those questions.
2. Respond to all numbered questions on notebook paper.
3. Number each problem, as numbered in the question packet. (i.e. R-1, 1-2, etc.)
4. Put a circle, or box, around any final answers.
5. Show all necessary work, and clearly identify the answers on a sheet(s) separate from the question packet. When asked to respond with an explanation, use complete sentences and make your responses coherent.
6. Staple all answer/work sheets together, and in order, then attach a cover sheet with your name and the title "AP Statistics Summer Assignment" on it.
7. Work on the assignment individually. If you have trouble understanding a problem, you may consult a classmate or Mr. Stephens. Contact Mr. Stephens via e-mail only.
8. You may use any calculator on the assignment as you deem necessary.

Before school starts:

1. Purchase a Texas Instruments graphing calculator – if you do not have one already. The following models are acceptable: TI – 89, TI – 83, TI – 84, TI-*n*spire
2. Join the AP Statistics Google Classroom. Access Google Classroom at classroom.google.com. Use your school email account and the join code **fdb37j**.
3. Join the AP Statistics Remind text service. Text **@ k236gg** to **81010**. I will use this service to remind of upcoming due dates and changes to homework.

Review of Important Algebra Topics

Properties of Logarithms

$\log_b(mn) = \log_b m + \log_b n$ $\log_b(m \div n) = \log_b m - \log_b n$ $\log_b(m^n) = n\log_b m$

PRACTICE. Use properties of logarithms to simplify or solve each as directed.

R-1. Expand using properties of logarithms. $\log_3(2x^4y^2)$

R-2. Condense into a single logarithmic expression. $\ln 3x - 2\ln y$

R-3. Solve for x in the following equation. $4e^x - 2 = 10$
Approximate to three decimal places.

R-4. Solve for x in the following equation. $2 + 3\ln(x - 3) = 26$
Approximate to three decimal places.

Summation Notation

- **Basic Definition:**

$$\sum_{i=1}^{n} x_i = x_1 + x_2 + x_3 + ... + x_n$$

*Read: "The sum from i equals 1 to n, of x sub i "

*Means: Add up (find the sum) of all the x's, starting with the first one and continuing until the n^{th} one.

*Note: The expression that is being summed can be more complicated.

- **Example.** $\sum_{i=1}^{n} x_i y_i = x_1y_1 + x_2y_2 + x_3y_3 + ... + x_ny_n$

PRACTICE. Expand, condense, or find the sum as indicated.

R-5. Expand the summation using the definition of summations. $\sum_{i=1}^{5} (x_i - 2)^2$

R-6. Condense, or rewrite, as a sum using summation notation. $\frac{x_1 - y_1}{2} + \frac{x_2 - y_2}{2} + \frac{x_3 - y_3}{2} + ... + \frac{x_{10} - y_{10}}{2}$

Use $x_1 = 2$, $x_2 = -3$, $x_3 = 5$, $x_4 = 7$, $y_1 = 1$, $y_2 = -2$, $y_3 = -6$, $y_4 = 0$, $f_1 = 12$, $f_2 = 18$, $f_3 = 15$, and $f_4 = 7$ to evaluate the following sums. Show your work.

R-7. $\sum_{i=1}^{4} x_i^2$

R-8. $\left(\sum_{i=1}^{4} x_i\right)^2$ *This is different than #7.

R-9. $\sum_{i=1}^{4} (x_i - y_i)$

R-10. $\sum_{i=1}^{4} x_i f_i$

R-11. $\left(\sum_{i=1}^{4} x_i\right)\left(\sum_{i=1}^{4} f_i\right)$

R-12. Is it true that $\sum_{i=1}^{4} x_i f_i = \left(\sum_{i=1}^{4} x_i\right)\left(\sum_{i=1}^{4} f_i\right)$? Explain.

Graphing and Linear Transformations

*Linear Transformations are probably new

R-13. Graph the set of ordered pairs on a set of axes in your answer document.

x	1	2	4	5	8
y	15	45	405	1215	32,805

R-14. Keep *x* the same, but evaluate the natural log of each *y*. Copy and complete the table shown below in your answer document. Then construct a graph.

x	1	2	4	5	8
ln *y*					

R-15. The equation that yields the table in #R-13 is $\boldsymbol{y = 5(3)^x}$. Take the natural log of both sides of this equation. Then simplify the right–hand side of the equation, using properties of logarithms. The result should be that **ln *y*** equals a linear expression involving ***x***.

R-16. What is the slope and *y*–intercept of the expression on the right–hand side of the equation in R-15?

R-17. Graph the line with the slope and *y* – intercept indicated in R-16 on the graph used for R-14.

R-18. Graph the set of ordered pairs on the axes provided on the answer document.

x	1	2	4	5	8
y	0.5	2.83	16	27.95	90.51

R-19. Evaluate *both* the natural log of each *x* and each *y*. Copy and complete the table shown below in your answer document. Then construct a graph.

ln *x*					
ln *y*					

R-20. The equation that yields the table in #18 is $\boldsymbol{y = 0.5(x)^{2.5}}$. Take the natural log of both sides of this equation. Then simplify the right–hand side of the equation, using properties of logarithms. The result should be that **ln *y*** equals a linear expression involving **ln *x***, which acts like *x* would.

R-21. What is the slope and *y*–intercept of the expression on the right–hand side of the equation in R-20, where slope is the coefficient of **ln *x*** instead of *x* (as it usually is)?

R-22. Graph the line with the slope and *y*–intercept indicated in R-21 on the graph used for R-19.

Introduction to Statistics

Some of the following terms have been defined for you, but you must find definitions for the others. The definitions provided come from *The Practice of Statistics*, 2nd Edition by Daniel Yates, David Moore, and Daren Starnes.

Fundamental Statistical Concepts

Individuals – objects described by a set of data. Individuals may be people, but they may also be animals or things.

Variable – any characteristic of an individual. A variable can take different values for different individuals.

Categorical (or Qualitative) Variable – ____

____

____

Quantitative Variable – ____

____

____

Distribution (of a variable) – indicates what values the variable takes and how often it takes those values. A distribution is usually shown using a table.

PRACTICE. The following exercises can be found in *The Practice of Statistics*, 2nd Edition by Daniel Yates, David Moore, and Daren Starnes. They have been renumbered for this assignment.

1-1. **Fuel – Efficient Cars** Here is a small part of a data set that describes the fuel economy (in miles per gallon) of 1998 model motor vehicles:

Make and Model	Vehicle Type	Transmission Type	Number of Cylinders	City MPG	Highway MPG
…					
BMW 318I	Subcompact	Automatic	4	22	31
BMW 318I	Subcompact	Manual	4	23	32
Buick Century	Midsize	Automatic	6	20	29
Chevrolet Blazer	Four-wheel drive				
…					

(a) What are the individuals in this data set?

(b) For each individual what variables are given? Which of these variables are categorical and which are quantitative?

1-2. **Medical Study Variables** Data from a medical study contain values of many variables for each of the people who were subjects of the study. Which of the following variables are categorical and which are quantitative?

(a) Gender (female or male)

(b) Age (years)

(c) Race (Asian, black, white, or other)

(d) Smoker (yes or no)

(e) Systolic blood pressure (millimeters of mercury)

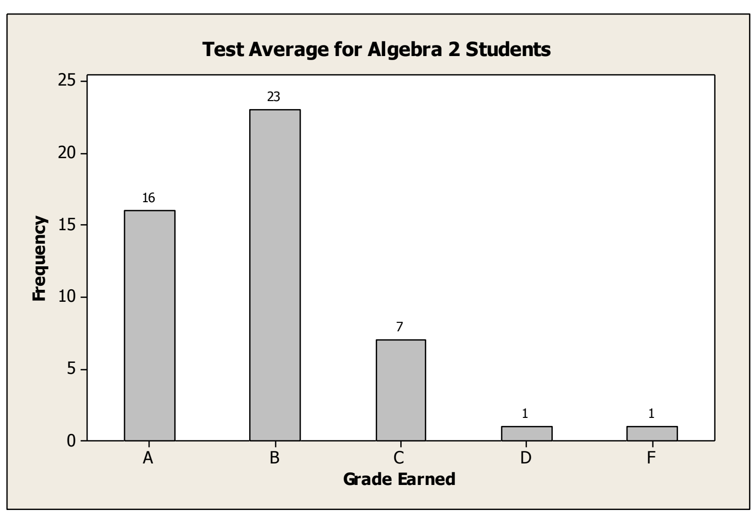
(f) Level of calcium in the blood (micrograms per milliliter)

1-3. Popular magazines often rank cities in terms of how desirable it is to live and work in each city. Describe five variables that you would measure for each city if you were designing such a study. Give reasons for each of your choices.

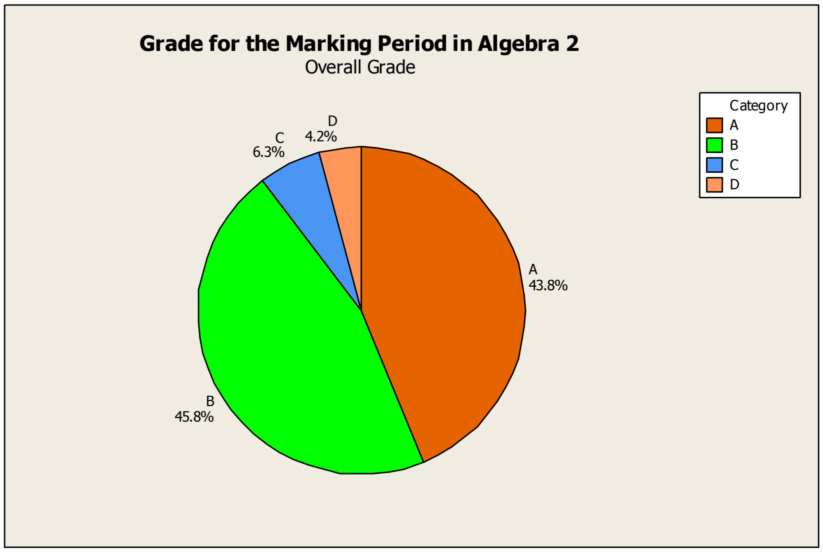
Displaying Distributions with Graphs

Graphs of Categorical Variables:

- **Bar Graph** – compares counts in different categories of a categorical variable. This is done by drawing vertical (or horizontal) bars of the same width.
  - How to construct a bar graph:
    - Label your axes and title your graph. Draw a set of axes. Label the horizontal axis with the categories and the vertical axis with the counts, include units if necessary.
    - Scale your axes. Use the counts in each category to help you scale the vertical axis. Write the category names at equally spaced intervals beneath the horizontal axis.
    - Draw a vertical bar above each category name to a height that corresponds to the count in that category. Leave a space between the bars in a bar graph.
  - **Example.** See the graph to the right.
  - A bar graph that displays the categories in descending order of their counts (frequency) is called a **Pareto Chart**.

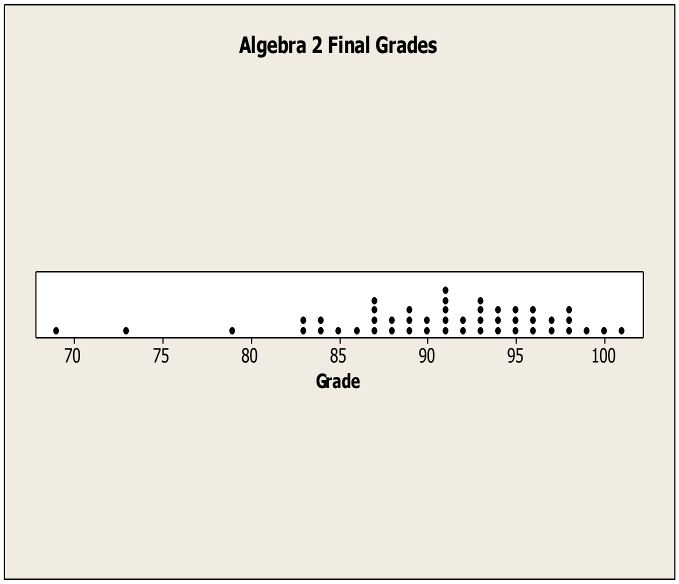


- **Pie Chart** – shows what part of a whole each group of a categorical variable forms.
  - How to construct a pie chart:
    - Use a computer program, like Excel or Minitab. They are difficult to draw by hand since there are many additional tools needed, like a compass and a protractor.
  - **Example.**



Graphs of Quantitative Variables:

- **Dotplot** – shows the frequency of individual (usually integer) values of a quantitative variable.
  - How to construct a dotplot:
    - Label a horizontal axis and title your graph.
    - Scale the axis based on the values of the variable. Do not skip any values that have a frequency of zero. You want to see that gap in the data.
    - Mark a dot above the number on the horizontal axis corresponding to each data value.



- **Stemplot (or Stem-and-Leaf Plot)** – shows the frequency in groups (classes) of values of a quantitative variable. The groups are typically groups of 10, like 0–9, 10–19, 20–29, and so on.

    - How to construct a stemplot:

        - Separate each observation into a stem consisting of all but the rightmost digit and a leaf, the final digit. For example, the observation 32 has a stem of 3 and a leaf of 2. Or the observation 115 has a stem of 11 and a leaf of 5. Or the observation 7 has a stem of 0 and a leaf of 7.

        - Write the stems vertically in increasing order from top to bottom, and draw a vertical line to the right of the stems. Include stems that are skipped to show gaps in the data. Go through the data, writing each leaf to the right of its stem and spacing the leaves equally.

        - Write the stems again, and rearrange the leaves in increasing order out from the stem (this can be done at the same time as the previous step).

        - Title your graph and add a key describing what the stems and leaves represent.

    - **Example.** The data for the final grade in Algebra 2 is shown below.

Final Algebra 2 Grades

```
 6 | 9                                            7 | 2 = 72
 7 | 29
 8 | 223446666777889
 9 | 000111111222224444555567777789
10 | 1
```

    - Split-stem stemplot – stems are split into equal size classes. For instance, there could be two stems for each class of 10: 10 – 14 and 15 – 19 would each have a stem of one, but only leaves 0 to 4 would be placed on the first stem of one. Then leaves of 5 to 9 would be placed on the second stem of one. Split-stems should be used if the data does not have a high range in values.

Final Algebra 2 Grades

```
 6 | 9                                            7 | 2 = 72
 7 | 2
 7 | 9
 8 | 22344
 8 | 6666777889
 9 | 0001111112222224444
 9 | 555567777789
10 | 1
```

- **Time Plots** – plots each observation of a variable against the time at which it was measured.

  - How to construct a time plot:

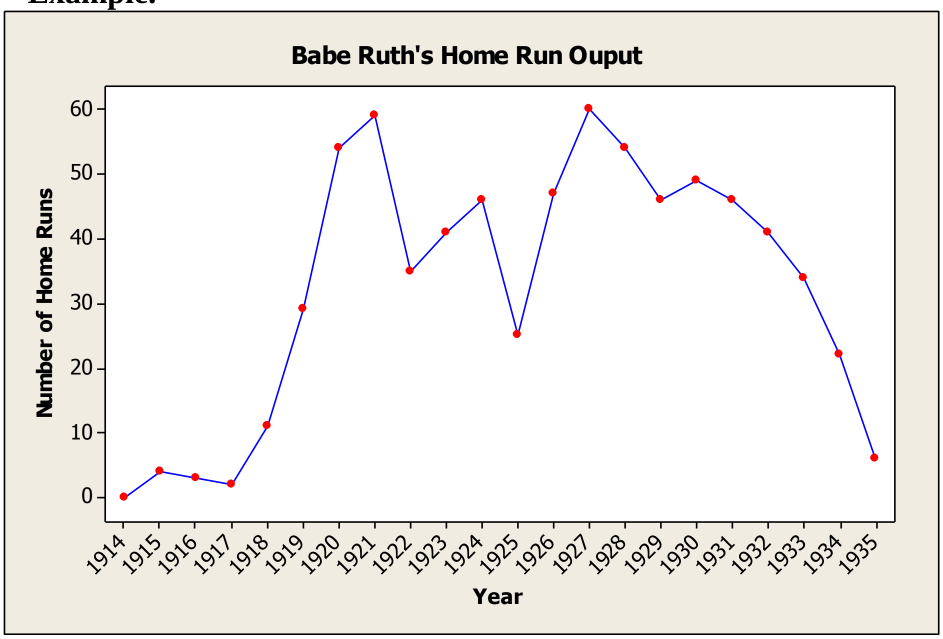
    - Label your axes and title your graph. Draw a set of axes. Label the horizontal axis with the time interval and the vertical axis with the variable amounts, include units if necessary.

    - Scale your axes. Use the values of the variable to help you scale the vertical axis. Write the time periods at equally spaced intervals beneath the horizontal axis.

    - Plot a point with ordered pair (time, variable value) for each observation. Using line segments, connect the points in sequential order.

  - Change over time called **seasonal variation** can be observed from a time plot.

  - **Example.**



PRACTICE. The following exercises can be found in *The Practice of Statistics,* 2nd Edition by Yates, Moore, and Starnes. They have been renumbered for this assignment.

2-1. **Olympic Gold** Athletes like Cathy Freeman, Rulon Gardner, Ian Thorpe, Marion Jones, and Jenny Thompson captured public attention by winning gold medals in the 2000 Summer Olympic Games in Sydney, Australia. The table below displays the total number of gold medals won by several countries in the 2000 Summer Olympics.

Country	Gold medals	Country	Gold medals
Sri Lanka	0	Netherlands	12
Qatar	0	India	0
Vietnam	0	Georgia	0
Great Britain	28	Kyrgyzstan	0
Norway	10	Costa Rica	0
Romania	26	Brazil	0
Switzerland	9	Uzbekistan	1
Armenia	0	Thailand	1
Kuwait	0	Denmark	2
Bahamas	1	Latvia	1
Kenya	2	Czech Republic	2
Trinidad and Tobago	0	Hungary	8
Greece	13	Sweden	4
Mozambique	1	Uruguay	0
Kazakhstan	3	United States	39

(a) Make a **dotplot** to display these data. Describe the distribution of number of gold medals won.

(b) Make a **bar graph** using the countries that had at least one gold medal.

2-2. **Are You Driving a Gas Guzzler?** The following table shows the highway gas mileage for 32 model year 2000 midsize cars.

Model	MPG	Model	MPG
Acura 3.5RL	24	Lexus GS300	24
Audi A6 Quattro	24	Lexus LS400	25
BMW 740I Sport M	21	Lincoln-Mercury LS	25
Buick Regal	29	Lincoln-Mercury Sable	28
Cadillac Catera	24	Mazda 626	28
Cadillac Eldorado	28	Mercedes-Benz E320	30
Chevrolet Lumina	30	Mercedes-Benz E430	24
Chrysler Cirrus	28	Mitsubishi Diamante	25
Dodge Stratus	28	Mitsubishi Gallant	28
Honda Accord	29	Nissan Maxima	28
Honda Sonata	28	Oldsmobile Intrigue	28
Infiniti I30	28	Saab 9-3	26
Infiniti Q45	23	Saturn LS	32
Jaguar Vanden Plas	24	Toyota Camry	30
Jaguar S/C	21	Volkswagon Passat	29
Jaguar X200	26	Volvo S70	27

(a) Make the **dotplot** of these data.

(b) Describe the shape, center, and spread of the distribution of gas mileages.

2-3. **DRP Test Scores** There are many ways to measure the reading ability of children. One frequently used test is the Degree of Reading Power (DRP). In a research study on third-grade students, the DRP was administered to 44 students. Their scores were:

40	26	39	14	42	18	25	43	46	27	19
47	19	26	35	34	15	44	40	38	31	46
52	25	35	35	33	29	34	41	49	28	52
47	35	48	22	33	41	51	27	14	54	45

(a) Display these data with a **stemplot**.
(b) Display these data with a **split-stem stemplot.**
(c) Comment on the shape, center, and spread of these data. Which graph shows these characteristics best?

2-4. **Cancer Deaths** Here are the data on the rate of deaths from cancer (deaths per 100,000 people) in the United States over the 50-year period from 1945 to 1995:

Year:	1945	1950	1955	1960	1965	1970	1975	1980	1985	1990	1995
Deaths:	134.0	139.8	146.5	149.2	153.5	162.8	169.7	183.9	193.3	203.2	204.7

(a) Construct a **time plot** for these data. Describe what you see in a few sentences.
(b) Do these data suggest that we have made no progress in treating cancer? Explain.

Frequency Distributions and Histograms

Constructing a Frequency Distribution

- Use the following example as an illustration of how to construct a frequency distribution.
  - **Example**

High Temperature in November & December

Temperature	**Frequency**	**Cumulative Frequency**	**Relative Frequency**
25 – 29	9	9	9/61 = 14.8%
30 – 34	17	26	17/61 = 27.9%
35 – 39	13	39	13/61 = 21.3%
40 – 44	8	47	8/61 = 13.1%
45 – 49	5	52	5/61 = 8.2%
50 – 54	6	58	6/61 = 9.8%
55 – 59	2	60	2/61 = 3.3%
60 – 64	1	61	1/61 = 1.6%

  - Column 1 contains **Classes**, which are intervals of values that every data value would fall. (Ideally, a frequency distribution has at least 5 classes)
    - **Class Limits** are the lowest and highest values in a class.
    - **Class Width** is difference between successive lower class limits. (In the example, the class width is 5)
    - **Class Marks (midpoints)** are the values exactly halfway through a class, found by finding the average of the class limits.

- Classes may sometimes be only a single value
- This column *must* be in all frequency distributions.

- Column 2 contains **frequencies**, which are the counts of how many data fall in that particular class.

- Column 3 contains **cumulative frequencies**, which are the counts of how many data fall in that particular class, or any class below that.

- Column 4 contains **relative frequencies**, which are the percentages (or ratios) of the amount of data in that one particular class.

- Depending on the situation, maybe all or only one of columns 2 – 4 would be needed in a frequency distribution.

- Sometimes a column for class mark is included, as well.

<u>Constructing a Histogram</u>

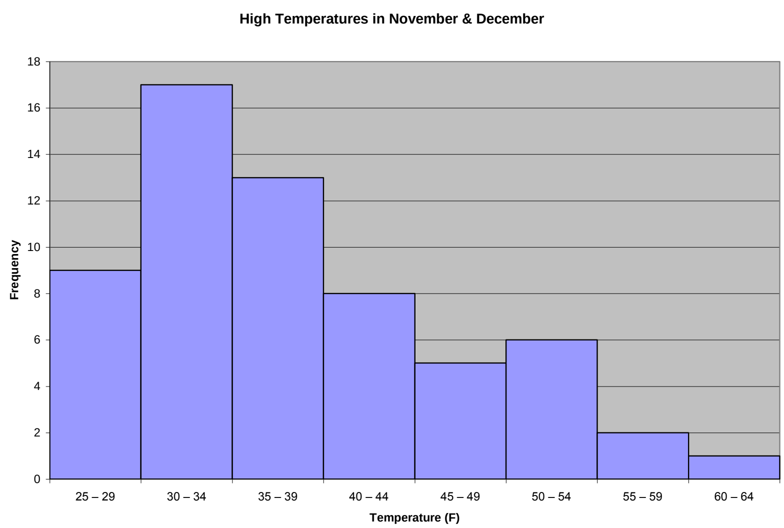
- Create Frequency Distribution.

- Label a horizontal axis with class limits, or with class marks.

- Label *y* – axis with a scale to include all possible frequencies.

- Draw bars for each class to the frequency for that class. The bars for successive classes should touch. There should be NO GAPS*.
  * Unless a class has a frequency of zero.

- **<u>Example</u>**



- **<u>Distribution Shapes for Quantitative Observations</u>**

  - **Symmetric –**

    In general, the frequencies of the classes are low at either end of the distribution and higher in the middle. Furthermore, the classes with the higher frequencies are in the middle of the distribution, with the highest being in the absolute middle.

  - **Skewed Left –**

    In general, the frequencies are low on the left end of the distribution (classes with lower data values numerically) and gradually increase throughout the distribution with the highest frequency being on the right side of the distribution (but not necessarily the very last class)

  - **Skewed Right –**

    In general, the frequencies are low on the right end of the distribution (classes with higher data values numerically) and gradually increase throughout the distribution with the highest frequency being on the left side of the distribution (but not necessarily the very first class)

  - **Bimodal –**

    In general, there are two peaks in the distribution separated by a few classes, and neither peak is in the middle of the distribution.

  - **Uniform –**

    In general, the classes have roughly the same frequencies (a purely uniform distribution would have classes with exactly the same frequencies).

- **Ogive** – a graph based on the cumulative frequencies of a frequency distribution.

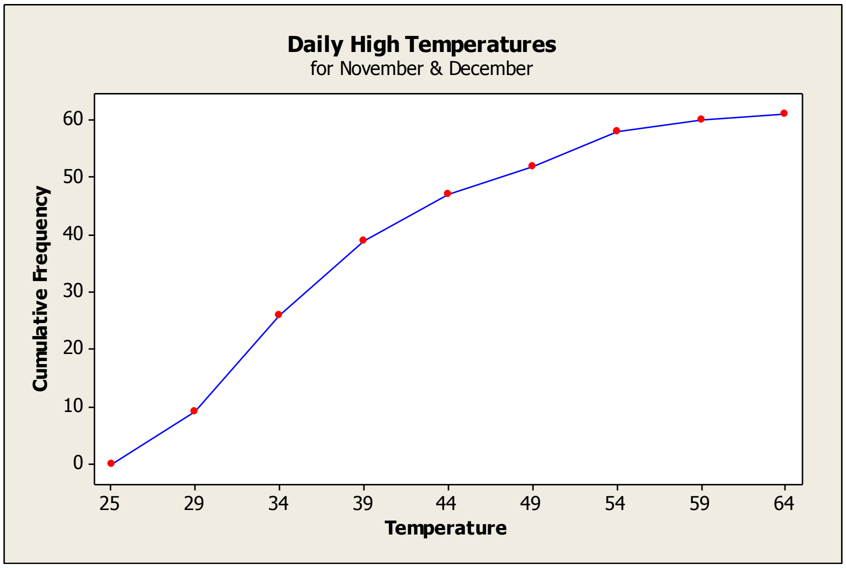
  - How to construct an ogive:

    - Label your axes and title your graph. Draw a set of axes. Label the horizontal axis with the class limits of the classes and the vertical axis with the cumulative frequency.

    - Plot a point at a frequency (or relative frequency) of zero for the *first* class limit – this indicates that by this value there are no data values yet. Place a point at the cumulative frequency (or relative frequency) for the first class at the upper class limit for this class. Continue placing points for the cumulative frequencies of a class above the upper class limit for that class.

    - Connect the points plotted with line segments. Give your graph a title.

- **Example of an ogive**



- **<u>Percentiles</u>**

  - The *p*th percentile of a distribution is the value such that *p* percent of the observations fall at or below it.

  - To find a percentile from a relative frequency ogive given a value: (1) find the value on the horizontal axis, (2) trace that value to the graph, (3) from that point on the graph see what percentile that it corresponds to on the vertical axis.

  - If the ogive is not *relative* frequency, after you trace back to the vertical axis take that frequency and divide by the total number of observations to obtain the percentile rank.

PRACTICE. The following exercises can be found in *The Practice of Statistics,* 2nd Edition by Yates, Moore, and Starnes. They have been renumbered for this assignment.

3-1. **Where Do Older Folks Live?** The following table gives the percentage of residents aged 65 or older in each of the 50 states.

State	Percent	State	Percent	State	Percent
Alabama	13.1	Louisiana	11.5	Ohio	13.4
Alaska	5.5	Maine	14.1	Oklahoma	13.4
Arizona	13.2	Maryland	11.5	Oregon	13.2
Arkansas	14.3	Massachusetts	14.0	Pennsylvania	15.9
California	11.1	Michigan	12.5	Rhode Island	15.6
Colorado	10.1	Minnesota	12.3	South Carolina	12.2
Connecticut	14.3	Mississippi	12.2	South Dakota	14.3
Delaware	13.0	Missouri	13.7	Tennessee	12.5
Florida	18.3	Montana	13.3	Texas	10.1
Georgia	9.9	Nebraska	13.8	Utah	8.8
Hawaii	13.3	Nevada	11.5	Vermont	12.3
Idaho	11.3	New Hampshire	12.0	Virginia	11.3
Illinois	12.4	New Jersey	13.6	Washington	11.5
Indiana	12.5	New Mexico	11.4	West Virginia	15.2
Iowa	15.1	New York	13.3	Wisconsin	13.2
Kansas	13.5	North Carolina	12.5	Wyoming	11.5
Kentucky	12.5	North Dakota	14.4		

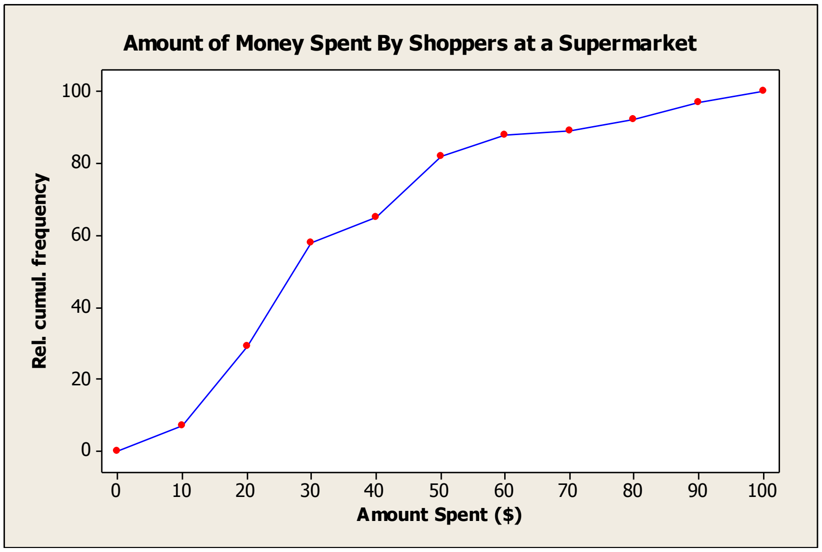
(a) Construct a **frequency distribution** of these data. Record your class intervals, frequencies, and cumulative frequencies. Use 5.0 as the first lower class limit, and a class width of 2.0.
(b) Construct a **histogram**.
(c) Identify the distribution shape of the data, then comment on distribution of people aged 65 and over in the states. Do there appear to be any potential outliers?
(d) Construct a **relative cumulative frequency graph (ogive)** for these data.
(e) Use the ogive to answer the following questions:
- In what percentage of states was the percentage of "65 and older" less than 15%?
- What is the 40th percentile of this distribution, and what does it tell us?
- What percentile is associated with Ohio?

3-2. **Chest out, Soldier!** In 1846, a published paper provided chest measurements (in inches) of 5738 Scottish militiamen. The following table displays the data in summary form.

Chest Size	Count	Chest Size	Count
33	3	41	934
34	18	42	658
35	81	43	370
36	185	44	92
37	420	45	50
38	749	46	21
39	1073	47	4
40	1079	48	1

(a) Create a histogram of these data.
(b) Describe the shape, center, and spread of the chest measurements distribution. Why might this information be useful?

3-3. The graph below shows the amount spent by shoppers at supermarket.



(a) Estimate the center of this distribution.
(b) At what percentile would the shopper who spent $17.00 fall?
(c) Draw the **histogram** that corresponds to this ogive.

Describing Distributions with Numbers

Measures of Center – describe the center of the data set (summarize the data with a "typical number")

- **Mean** – arithmetic average, found by finding the sum of the observations, and dividing by the number of observations. Symbolized with $\bar{x}$ (read: "*x*-bar"). Expressed by the following formula:

$$\bar{x} = \frac{1}{n}\sum x$$

******When finding the mean use the symbol, $\bar{x}$, show the formula, substitute into the formula, and show the final answer.

- **Median** – the value such that half of the observations are smaller, and the other half are larger. To find the median:
    - Arrange all observations in order of size, from smallest to largest.
    - If the number of observations n is odd, then the median M (or $\tilde{x}$) is the center observation in the ordered list.
    - If the number of observations n is even, then the median M (or $\tilde{x}$) is the mean of the two center observations in the ordered list.

- **Resistant Measures** – values used to describe a data set that will be affected very little by extreme values. The median is a resistant measure, since the actual values are not used to determine its value. The mean is not, since an extreme value would change its value very much.

- **Comparing mean and median** – For the following distributions shapes, a summary of how mean and median compare is given.

    - **Symmetric** – For a roughly symmetric distribution, the mean and median will be approximately equal.
    - **Skewed Right** – For a skewed right distribution, the mean will be larger than the median.
    - **Skewed Left** – For a skewed left distribution, the mean will be smaller than the median.

<u>Measures of Variation</u> – a value that describes how different the data values are from each other, or how different they tend to be from a measure of center (particularly the mean).

- **Range** – the simplest (and least useful) value to determine the spread of a data set. The range is calculated by finding the difference between the highest and lowest values of a data set.

<u>Measures of Relative Standing</u> – a value that gives an indication of where in the ordered data that a particular value would be found.

- **Percentile** – see previous notes.

- **Median** – see previous notes.

- **Quartiles** – the values that split the data set into four equal sized parts, like the median splits the data set into two equal sized parts.

    - **First Quartile, Q_1 (Lower Quartile)** – value such that 25% of the data values are smaller than it, and 75% are larger.
    - **Second Quartile (Median)** – value such that half of the data values are smaller than it, and half are larger.
    - **Third Quartile, Q_3 (Upper Quartile)** – value such that 75% of the data values are smaller than it, and 25% are larger.
    - **Inter-Quartile Range, IQR** – is found by finding the difference between Q_3 and Q_1
    - **Five-number Summary** – synopsis of the data set consisting of the minimum value, Q_1, median, Q_3, and the maximum value.

- **Checking for Outliers using the IQR:**

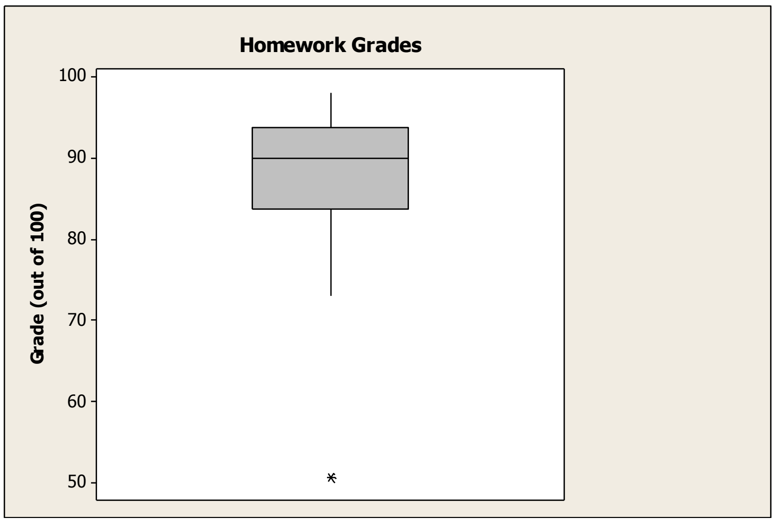
    - After finding the IQR, subtract 1.5*IQR from Q_1. Any data value less than the result would be considered an outlier.
    - After finding the IQR, add 1.5*IQR to Q_3. Any data value greater than this result would be considered an outlier.

- **Boxplots (or Box-and-Whisker Plot)**

    - Graphical display of the five-number summary. When constructed with the outliers indicated, it is known as a ***modified boxplot.***

- How to construct a modified boxplot:
    - Find the five-number summary, IQR, and outliers.
    - Draw a vertical scale that would include all data values.
    - Plot the five number summary *next* to the scale with regular points. If there any outliers indicate them with an asterisk, then plot the last data value that would not be considered an outlier.
    - Draw a box from Q_1 to Q_3, with those points being at the center of their respective sides of the box.
    - Draw a line in the box, through the median.
    - Connect a line segment from the lower quartile to the minimum (or last value not considered an outlier), and one from the upper quartile to the maximum (or last value not considered an outlier).

Example.



<u>PRACTICE</u>. The following exercises can be found in *The Practice of Statistics,* 2nd Edition by Yates, Moore, and Starnes. They have been renumbered for this assignment.

4-1. Joey's first 14 quiz grades in the marking period were

86	84	91	75	78	80	74	87	76	96	82	90	98	93

(a) Use the formula to calculate the mean quiz grade.
(b) Suppose Joey has an unexcused absence for the fifteenth quiz and he receives a score of zero. Determine his final quiz average. What property of the mean does this situation illustrate? Write a sentence about the effect of the zero on Joey's quiz average that mentions this property.
(c) What kind of plot would best show Joey's distribution of grades? Assume an 8-point scale (A: 93 to 100, B: 85 to 92, etc.). Make an appropriate plot, and be prepared to justify your choice.

4-2. Suppose a major league baseball team's mean yearly salary for a player is \$1.2 million, and that the team has 25 players on its active roster. What is the team's annual payroll for players? If you knew only the median salary, would you be able to answer the question? Why or why not?

4-3. Last year a small accounting firm paid each of its five clerks $22,000, two junior accountants $50,000 each, and the firm's owner $270,000. What is the mean salary paid at this firm? How many employees earn less than the mean? What is the median salary? Write a sentence to describe how an unethical recruiter could use statistics to mislead prospective employees.

4-4. **U.S. Incomes** The distribution of individual incomes in the United States is strongly skewed right. In 1997, the mean and median incomes of the top 1% of Americans were $330,000 and $675,000. Which of these numbers is the mean and which is the median? Explain your reasoning.

4-5. **SSHA Scores** Here are the scores on the Survey of Study Habits and Attitudes (SSHA) for 18 first-year college women:

154	109	137	115	152	140	154	178	101	103	126	126	137	165	165	129	200	148

and for 20 first-year college men:

108	140	114	91	180	115	126	92	169	146	109	132	75	88	113	151	70	115	187	104

(a) Find the **5 – number summary** for each set of data.
(b) Find the **Inter-quartile range** for each set of data. Use the IQR to identify any outliers.
(c) Make side-by-side boxplots to compare the distributions.
(d) Write a paragraph comparing the SSHA scores for men and women.

4-6. **How Old are Presidents?** Consider the outputs given below (MINITAB output and histogram) for this question.

(a) Compare the mean and the median. Does the graph provided support your comparison?
(b) Construct a modified boxplot of these data.

```
          Total
Variable  Count     Mean  SE Mean  TrMean
C9           44   54.636    0.940  54.550

Minimum      Q1  Median      Q3  Maximum
42.000   51.000  54.500 57.750   69.000
```