Section1

General Introduction

The Purpose of statistics: Statistics has many uses, but perhaps its most important purpose is to help us make decisions about issues that involve uncertainty.

Definition of Statistics:

1. Numerical Facts
   1. Average price for one-bedroom apartment at the city of Rocklin is $895.
   2. 80% of Sierra students graduate in 2 years.

2. **C O D A** **C**ollection, **O**rganization, **D**escription, **A**nalysis, and interpretation of data.

Collection: **D**ata **S**ampling

Organization: **F**requency Table (Bar-chart, Pie-chart),
Histogram, **F**requency **P**olygon, **O**give **C**urve

Description: **M**ean, **M**ode, **M**edian,
Range, **V**ariance, **S**tandard **D**eviation,
Quartiles, **P**ercentiles, **B**ox Plot

Analysis: **C**orrelation and **R**egression, **E**stimation,
Test of **H**ypothesis, Analysis of **V**ariance

Types of Statistics:

Descriptive: **C**ollection, **O**rganization, **D**escription

Inferential: **A**nalysis and interpretation of data

What is the statistics all about?

1. It is about how we test if a new drug is effective in treating cancer.
2. It is about opinion polls, pre-election polls, and exit polls.
3. It is about sports, where we rank players and teams primarily through their statistics.
4. It is about the market research and the effectiveness of advertising
5. It is about how agricultural inspectors ensure the safety of the food supply.

Population versus Sample:

Population: Entire elements or subjects under study that share one or more **common characteristic** such as age, gender, major or race. (Keyword all/every), All college students, All Sierra College students, All male Sierra College Students who are taking statistics and majoring in business. Two Elements: **T**ime and **P**lace

Sample: A portion of population. **Census**: The collection of data from every element in a population.

Parameter vs. statistic:

Parameter: A numerical description of a population characteristic.
Statistic: A numerical description of a sample characteristic.

Hint: Use Greek Alphabet for parameter μ = avg. σ (sigma) = st. dev χ^2 = Chi-squared
and lower-case English for statistic….. $\overline{X}$, s, r

Extra Practice: Answer questions A from page 1 of practice problem part 1

Types of Data

Qualitative: Consists of attributes, labels, or nonnumerical entries.
Examples: pass / fail, democrat/republican/independent, yes/no, grades (A,B,C,D,F)
Quantitative: Numerical measurements or counts.

2 Types of Quantitative Data

1. **D**iscrete (Countable): number of accidents in Rocklin each day, number of emergency call to 911 center each day, number of students that will pass Abe stat class

2. **C**ontinuous (Measurable): Speed, weight, time, capacity, length, volume, area

Extra Practice: Answer questions B from page 1 of practice problem part 1

Types of Sampling: R_S_S_C_C

1. **R**andom: Every member of population has equal chance to be selected.
How? Every member will be assigned a different number, and we select random numbers by a computer or a table and match those with the members' numbers.

2. Systematic: We select some starting point and then select every kth (such as every 20^{th}) member in the population.
How? Every 10^{th} customer or client will be selected to be asked questions.

3. Stratified: **Subdivide** the population into at least two different subgroups (strata) sharing the same characteristics (such as gender or age bracket), then we draw a sample from each stratum.
How? a) divide the police officers in Sacramento into male and female group
b) select a random sample of each and collect data regarding the years in service.

4. Cluster: Divide the population into sections (or clusters), and then randomly select some of those clusters, then choose all the members from those selected clusters.
How? To see the customer feedback to a new menu
a) divide Sacramento in different zones,
b) randomly select some of those zones
c) collect data from **all** fast-food branches in those selected zones.

5.**C**onvinence: Use the results are readily available.
How? A math instructor asks some of his students if they use student solution manual to do their homework.

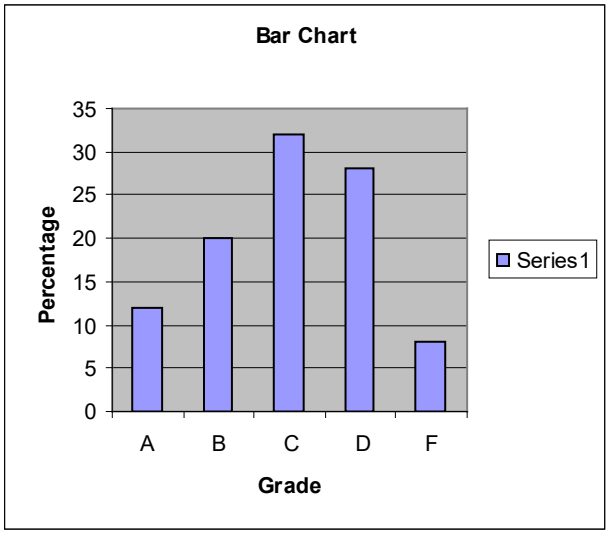
Extra Practice: Answer questions C from page 1 of practice problem part 1

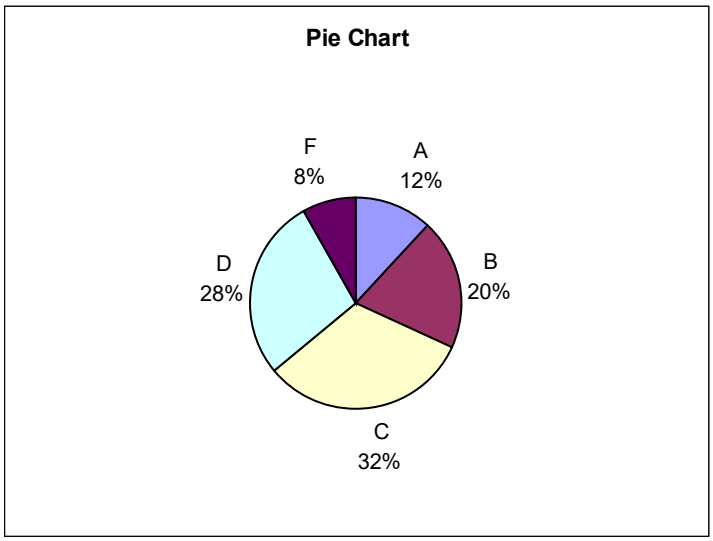
Qualitative Data

Example 1.

Grade	$f =$ Students	Rel. freq % $\frac{f}{n}\times 100$	Angles 360° (Rel. freq)
A	6	$(6/50)\times 100 = 12$	$.12\times 360 = 43.2^\circ$
B	10	$(10/50)\times 100 = 20$	$.20\times 360 = 72^\circ$
C	16	$(16/50)\times 100 = 32$	$.32\times 360 = 115.2^\circ$
D	14	$(14/50)\times 100 = 28$	$.28\times 360 = 100.8^\circ$
F	4	$(4/50)\times 100 = 8$ +	$.8\times 360 = 28.8^\circ$ +
	$n = \sum f = 50$	100?	360° ?

Using Excel to graph the followings





Practice 1:

Complete the table and draw the bar chart and the pie chart. (You can use Microsoft Excel to do the graphs)

Grade	$f =$ Students	Rel. freq % $\frac{f}{n}\times 100$	Angles 360° (Rel. freq)
A	22		
B	26		
C	20		
D	8		
F	4	+	+
	$n = \sum f =$	100?	360° ?

Descriptive Statistics

A) Measure of Central Tendency (**M**ean, **M**edian, **M**ode)

Mean (μ , $\bar{x}$) $x = data$ $\sum = Sum$ N or n = Number of data points

Data: 5, 6, 3 , 9, 7 $\bar{x} = \frac{\sum x}{n} = \frac{5+6+3+9+7}{5} = \frac{30}{5} = 6$

Median: The middle data point in a ranked (largest to smallest or smallest to largest) data, **or**
The median cuts the ranked data in half **one half below** it and **one half above** it.

Example1: Suppose the median score for the first test was 73, it simply means half the class got below 73 and the other half above it. Examples for odd and even numbered of data.

2, 5, 11, 16, 8, 9, 3, 7, 5 Ranked 2, 3, 5, 5, **7**, 8, 9, 11, 16, **Median** = **7**

2, 3, 5, 5, **7**, 8, 9, 11, 16, 4 Ranked 2, 3, 4, 5, **5**, **7**, 8, 9, 11, 16, **Median** = $(5+7)/2 = 6$

Hint: If there are extreme values in data set (too large or too low with respect of the rest of data) then median is a better than mean to identify the measure of central tendency.

Mode: The data value(s) with the highest occurrence, bimodal, multimodal

2, **8**, 11, 7, **8**, 13 **Mode** = 8

3, **12**, 5, 14, 9, **12**, **7**, 16, **7** **Bimodal** = 7, 12

11, **15**, 7, **2**, 6, 16, **15**, 3, **2**, **11**, 19, 5, 4 **Multimodal** = 2, 11, 15

B) Measure of Positions (**Q**uartiles, **B**oxplot, **Z**-score)

Quartiles: Breaking the **ranked data** in 3 quartiles (**Q1, Q2, Q3**)

Data: _____25%_____**Q1**_____ 25%_____**Q2**_____25%_____**Q3**_____25%_____

How to find quartiles? 3 steps
Rank the data, Find **Q2** = Median, Find the new medians **Q1, Q3** on either side of Q2.

Example 1: **Odd** number of data 2, 5, 11, 16, 8, 9, 3, 7, 5, 4, 13

Ranked Data: 2, 3, ,**4**, 5, 5, **7**, 8, 9, **11**, 13, 16,
Q1 Q2 Q3

Example 2: **Even** number of data 2, 3, 5, 5, 7, 8, 9, 11, 16, 4

Ranked Data 2, 3, **4**, 5, 5, 7, 8, **9**, 11, 16, **Q2 = Median** = $(5+7)/2 = 6$
Q1 **Q2** = 6 **Q3**

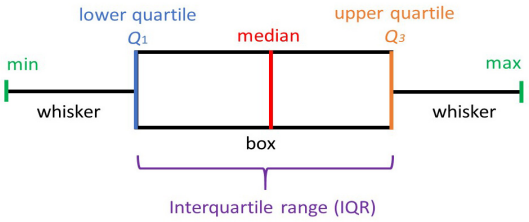
Mean/Median/Mode Calculator **Quartiles calculator**

Extra Practice: Answer questions A through G from page 3 of practice problem part 1

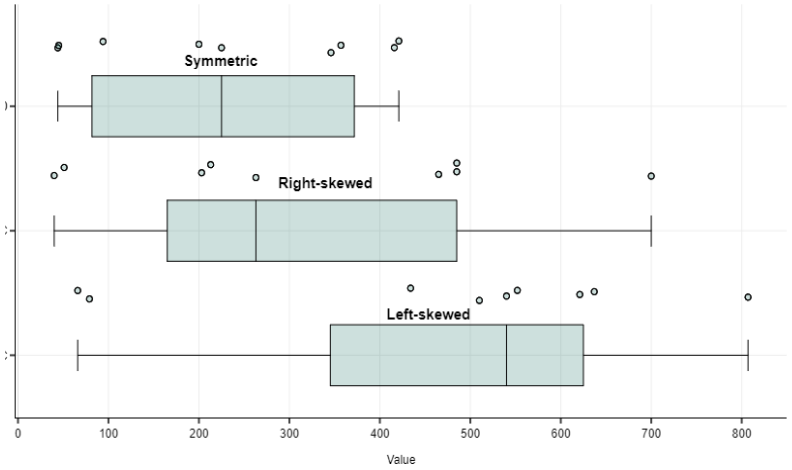
Boxplot: is mainly used for ungrouped data to show how the data are distributed by showing **center**, **spread**, and **skewness**. **Center** is the **Q2**, **Spread** is how wide the box is, **Skewness** explains the distribution of the data by using the longer tail to describe the **Skewness** (for example if the longer tail is on the right, it is called skewed to the right)

To construct a boxplot
1. Find the 5-**number summery** of the data that are **Min, Q1, Q2, Q3, Max**
2. Plot these points on a **scaled** number line.
3. Construct a box by using Q1, Q2, Q3

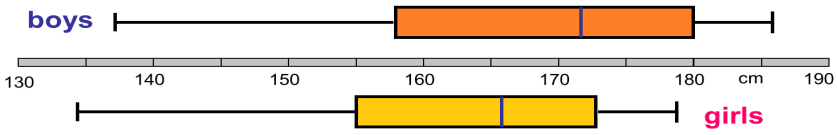
Quartiles calculator ***Boxplot graph maker***



There are many possibilities of where the box in boxplot may be located.



boxplot of student's heights:



which are true and why?

1. the girls are taller on average
2. the boys are taller on average
3. the girls show less spread in height
4. the boys show less spread in height
5. the shortest person is a girl
6. the tallest person is a boy
7. both data sets are skewed to the left
8. half the boys are over 172 cm tall
9. half the girls are under 165cm tall

TI-83/84 *Inputting data in **L1** (stat → Option 1 → enter)*

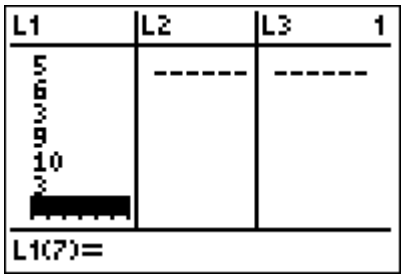
then *stat → calc → Option 1 → enter → 2n d → 1 → enter*

Extra Practice**: Answer questions on columns **A-G** on **page 3** of practice problem **part 1

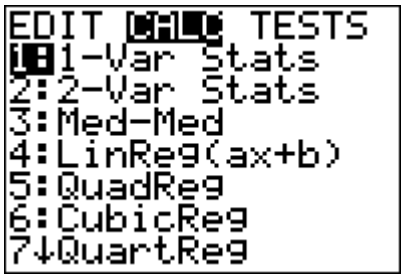
TI-83/84

Find the mean, median, Q1, Q3 and standard deviation for 5, 6, 3 , 9, 10, 3, and also draw the Box_Plot.

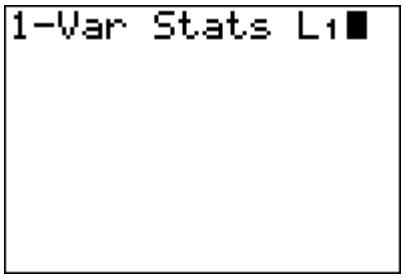
*Inputting data in **L1** (stat → Option 1 → enter)*



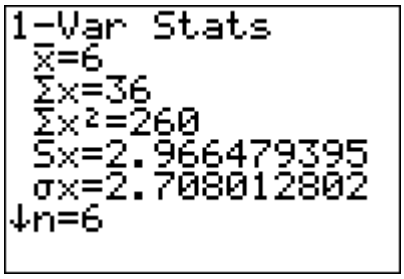
stat → calc → Option 1 → enter



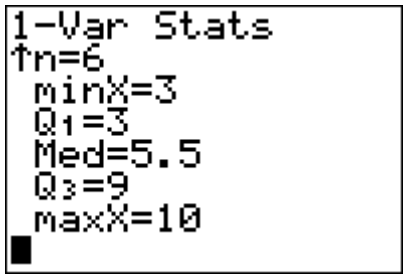
2n d → 1



Results

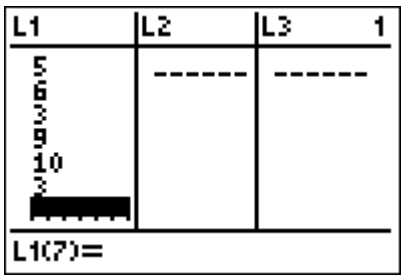


Use down arrow for more Results

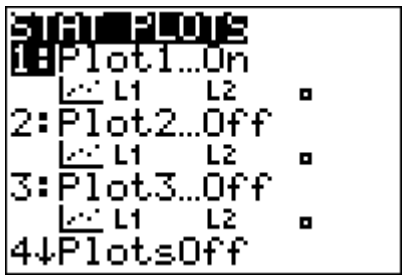


Doing the Box Plot by TI

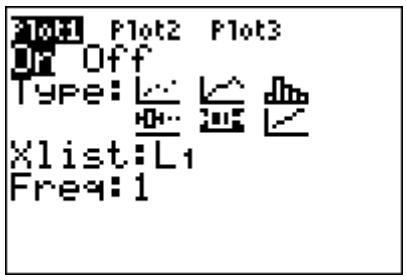
Inputting data in L1



2nd STAT Plots

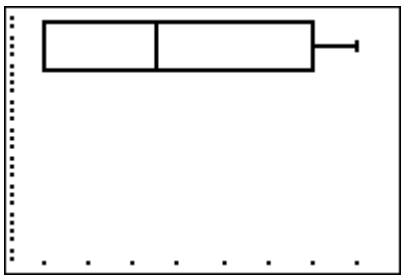


Choose the fifth option



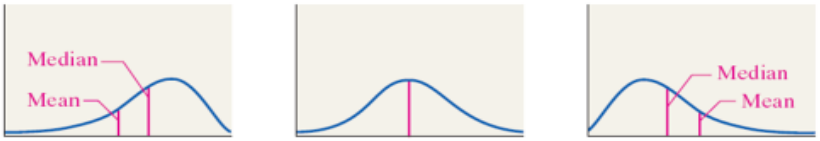
Press ZOOM 9

Result



Relation Between the Mean, Median, and Distribution Shape

Distribution Shape	Mean versus Median
Skewed left	Mean substantially smaller than median
Symmetric	Mean roughly equal to median
Skewed right	Mean substantially larger than median

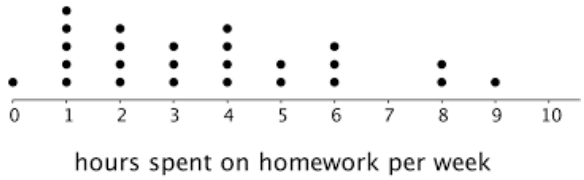


(a) Skewed Left
Mean < Median

Mean = Median
(b) Symmetric
Mean = Median

(c) Skewed Right
Mean > Median

A dot chart or *dot plot* is a statistical chart consisting of data points plotted on a fairly simple scale, typically using filled in circles.



The dot-plot above shows how many students spending how many hours in homework.

The dot-plot above shows number of preferred snacks.

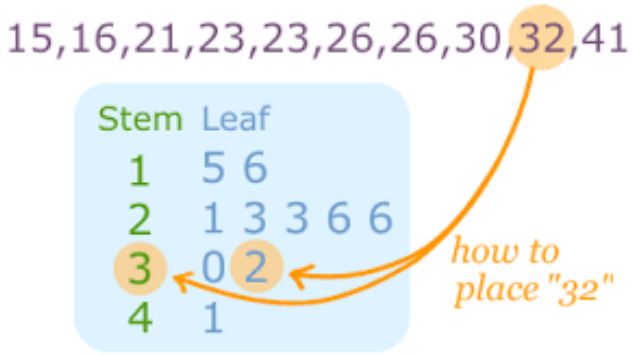
Construction of a Stem-and-Leaf Plot

Step 1: The stem of a data value will consist of the digits to the left of the right-most digit. The leaf of a data value will be the rightmost digit.

Step 2: Write the stems in a vertical column in increasing order. Draw a vertical line to the right of the stems.

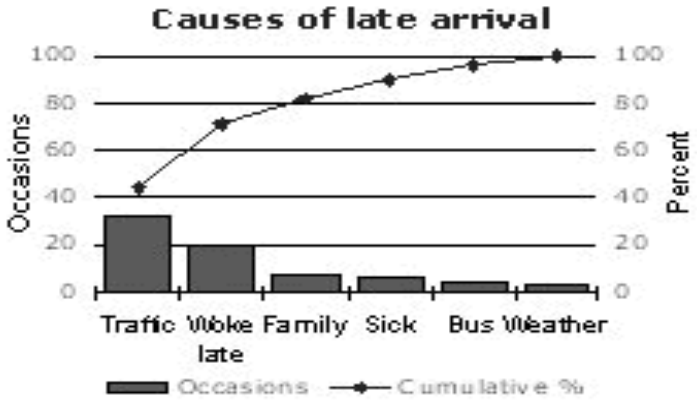
Step 3: Write each leaf corresponding to the stems to the right of the vertical line.

Step 4: Within each stem, rearrange the leaves in ascending order, title the plot, and provide a legend to indicate what the values represent.



Class A Leaves	Stems	Class B Leaves
8 0	6	0 0
5 0	7	0 1 3 3 5 6 7
6 4	8	4 5 6
6 4 4 2 1 0	9	1 2
0 0	10	

The above stem and leaves plot is used to show the difference in scores between the two classes.



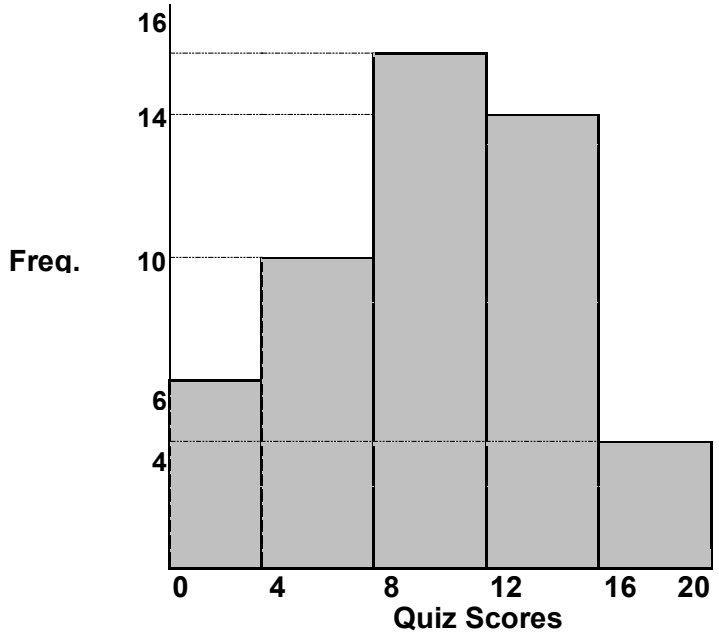
Pareto Chart: It shows which factors are the major and minor causes for arriving late.

Grouped Data (Freq. Table)

The table below shows the quiz scores of 50 students that are given in group.

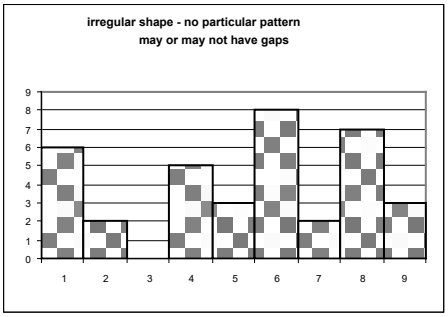
Quiz Score	Freq (f) = Students			
0 – 4	6			
4 - 8	10			
8 – 12	16			
12 – 16	14			
16 – 20	4			

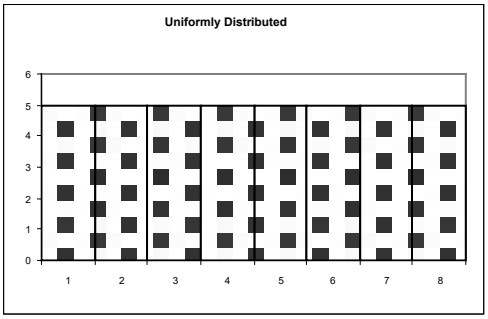
Use the quiz scores on x-axis, frequency on the Y-axis to draw blocks for a shape that is called **Histogram**

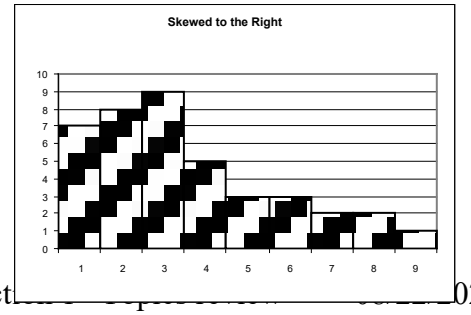


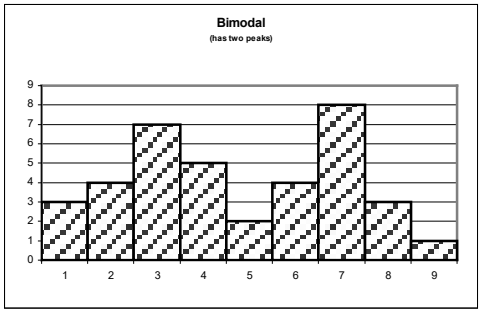
Histogram looks close to a Centered or bell-shaped distribution.

Different possible shapes of Histogram









Finding **Mean** for grouped data.

Steps in finding the mean and standard deviation from a frequency table.

1) You need a table with 4 columns the first two columns from the left always will be given.
2) You need to create have three columns as m, $f \times m$
3) The third column is called midpoint = m and to find it to find the average of the two numbers from first column
4) The fourth column $f \times m$ is the product of frequency of each row and its midpoint.
5) You need to get the summation of the 2nd, and 4th column.
6) You need these summations and plug them into the mean formula given below, look at the arrows as how where each summation goes.

Mean: $\bar{X} = \dfrac{\sum f \times m}{n} =$ Sample Standard deviation:

Column 1	**Column 2**	**Column 3**	**Column 4**
Quiz Scores	**Frequency (f)= Students**	m = **midpoint**	$f \times m$
0 – 4 4 - 8 8 – 12 12 – 16 16 – 20	6 10 16 14 4	$(0+4)/2 = 2$ $(4+8)/2 = 6$ $(8+12)/2 = 10$ $(12+16)/2 = 14$ $(16+20)/2 = 18$	$6 \times 2 = 12$ $10 \times 6 = 60$ $16 \times 10 = 160$ $14 \times 14 = 196$ $4 \times 18 = 72$
	$\sum f = n = 50$		$\sum f \times m = 500$

Mean: $\bar{X} = \dfrac{\sum f \times m}{n} \quad \dfrac{500}{50} = 10$

Calculator to find mean from frequency table

Practice 1: Find the mean

Quiz Scores	**Frequency (f)= Students**	m	$f \times m$
0 – 10 10 - 20 20 – 30 30 – 40	8 12 14 6	25	180
	$\sum f = n =$		$\sum f \times m =$ **780**

Mean: $\bar{X} = \dfrac{\sum f \times m}{n} =$ _____ = 19.5

Extra Practice**: Answer questions **A, B, C, D** on **pages 5, 6** from practice problem **part 1

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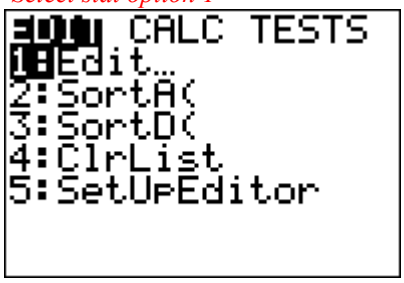
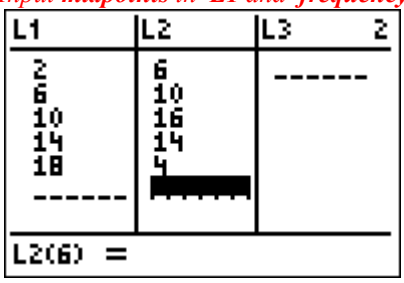
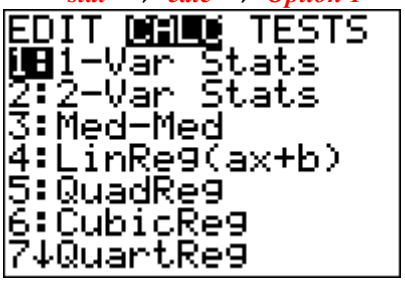
Select stat option 1



*Input **midpoints** in **L1** and **frequency** in **L2***

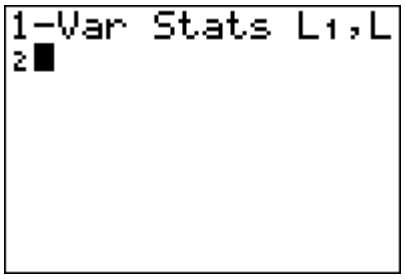


stat → calc → Option 1

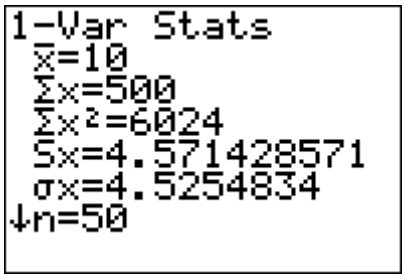


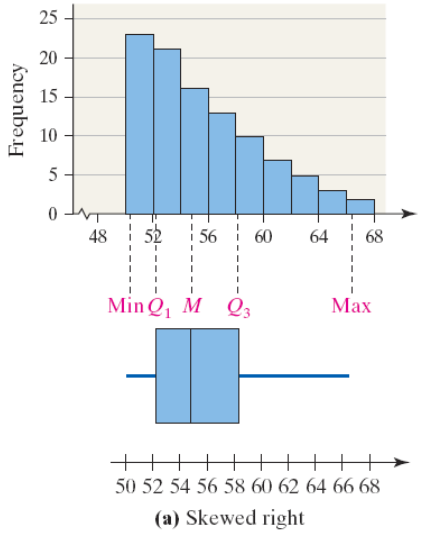
2^{nd} 1 , 2^{nd} 2

Press enter

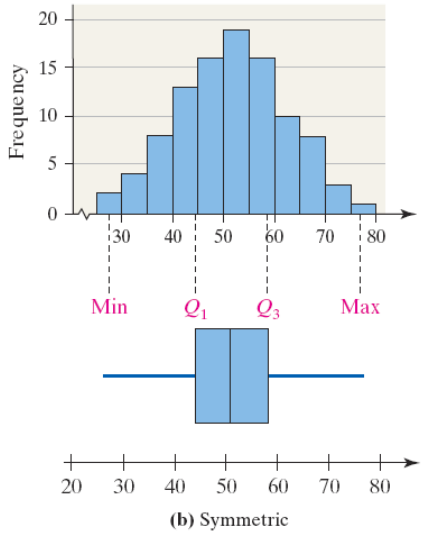


Results

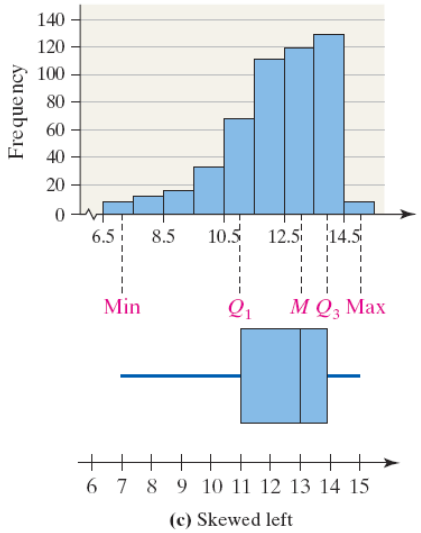




(a) Skewed right



(b) Symmetric



(c) Skewed left