Lesson 2.2 & 2.4(F'11)

Objectives:

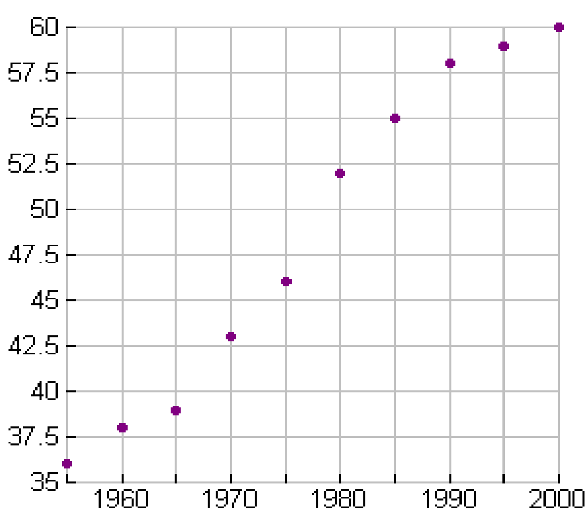
1. To fit lines(exact and approximate) to data points.
2. To use your calculator to find "best fit lines"
3. To find the goodness of fit.(first difference)
4. To solve linear inequalities algebraically and graphically..
5. To solve applications of linear inequalities.

The table below illustrates how the percent of women in the civilian labor force has changed from 1955 to 2000.

Year	1955	1960	1965	1970	1975	1980	1985	1990	1995	2000
%	36	38	39	43	46	52	55	58	59	60

The above table represents points satisfying a **discrete function**(a function with a finite number of inputs) We are going to model the application with the **continuous function**.

Plot these points on a grid to see if they appear to be linear.



In this section we are going to learn how to fit data sets like this to linear models. If we want to find the equation of this line we could pick any two points and write the equation of the line that connects them. If we pick our two points to be (1955, 36) and (2000, 60), our equation is:

Is this line the line that best fits the data? The **best-fit line** is called the **regression line,** and finding this line is called **linear regression.** The process of finding this line by hand is very lengthy, so we are going to use our calculators**.**

STEPS SCATTER PLOTS using the TI-83

I. First you will need to enter the data into lists.

*__Stat Enter__ puts you in the statistics editor. If your lists are not empty, you will need to clear out two of them. Either put the cursor on $\mathbf{L_1}$at the top and hit **Clear, Enter** or put the cursor on each item in the list and hit **Delete**.

Now enter the x values in **List 1** and the y values in **List 2**.

Be sure to hit **Enter** after each item.

II. Turn off any functions in your **Y**= menu. You can do this two ways:

Either put the cursor on each function one at a time and hit **Clear**, or put the cursor on the equal signs of any functions and hit **Enter**.

III. Now we need to turn on a **Stat Plot**. The keystrokes for this are:
2nd **StatPlot#1Enter**. At this point you are in Plot 1. To turn Plot 1 on, put the cursor on the word "on" and hit **Enter**. There are 6 "types" shown. Put the cursor on the first type (which is a scatter plot) and hit **Enter**.
Now cursor down to Xlist: Here you will enter L1. You can type L1 by hitting 2nd1. Now cursor down to Y list: **Enter** L2 here.
IV. To see the scatter plot, enter **Zoom9**. This is the function used to graph statistics pictures.

At this point we analyze the scatter plot to see if the data seem to be linearly related. If so, we can instruct the calculator to find the best - fit (or regression) line.

The remaining steps are for that process:

FINDING THE BEST-FIT LINE using the TI-83

V. To find the best-fit line press **STAT** and move over one to **CALC**. Press #4 for a **LinReg**(ax + b). Press **Enter**. These commands will result in a screen which gives you some information that you can use to write your best fit line. We can also paste this information intoY_1.

Is our line a good fit?

At the same time, you will get a value called r.** The number r is called the correlation coefficient. |r| is always less than 1. In other words, -1 < r < 1. $|r|$ is an indicator of linear correlation. If $|r|$ is close to 1 or 1, there is significant linear correlation. If, on the other hand, $|r|$ is close to 0, there is not significant linear correlation. In our example above, r = .9852680595 which is close to 1. So we definitely have a linear relationship. The number a is the slope of the regression line (or best-fit line), and the number b is the y-intercept. (directions to see the r value are at the end of the lesson)

VI. To graph this line, on our scatter plot.
Turn off or clear all Y = functions. Be sure Plot 1 is on.
Move the cursor to the Y = line you want to use. Press the **VARS** key. Select **#5 Statistics**. Move the right arrow key twice to see the **EQ** menu. Select **EQ #1**. Press **Graph**.

You should now see both the line and the scatter plot.

VII. At this point, you may use this equation to predict future values of the function. Use **2nd Calc; #1[Value].**

Let's predict the percent of women in the work force in 2010.

Rounding- After a model for a data set has been found, it can be rounded for reporting purposes. However, do not use a rounded model in calculations, and do not round answers during the calculation process unless otherwise instructed.

The table below lists the average annual cost in dollars of tuition and fees at private 4year colleges for selected years.

Let 1990 be time zero.

Year	1990	1992	1994	1996	1998	2000	2002
X	0	2	4	6	8	10	12
Tuition	9340	10448	11719	12994	14709	16233	18116

Use your calculator to construct a scatter plot of this data.

Does it appear to be a linear relationship?

If so, find the equation.

Mathematical Model gives the equation and description of the variables with their units of measure.

Modeling Discrete Data with Linear Functions

Continuous Function-real number inputs

Discrete Function-finite number of input values

Applying models

Interpolation-if the value is within the range of the original input value

Extrapolation- if the value is outside the range of the original input value.

Time-for your text

A point on the input axis indicating a time refers to the end of the time period.

2001-means the end of 2001-anything larger is the next year.

If 2001 is time 0 then 2003 is 2, but 2.2,2.4,2.6, etc is 2004.

GOODNESS OF FIT

If output values for a set of data change by the same amount when the input value change by the same amount, then we can find a linear function that models the data.(If the inputs are uniform and the first differences are constant)

EXAMPLE: Without graphing, determine which of the following data sets are exactly linear, approximately linear, or nonlinear.

x	y
1	3
2	6
3	11
4	18
5	27
6	38
7	51

x	y
2	13
5	22
8	31
11	40
14	49

Solving Linear Inequalities

In this section, we will be solving inequalities rather than equations.

LINEAR INEQUALITY (in the variable x) is an inequality that can be written in the form $ax + b > 0$, where a is not zero.
The solution set of an inequality (when it has a solution) is a set of numbers as opposed to just one or two numbers. We can depict this solution set several ways: inequality form, a graph on a number line or in interval notation.
Here is a table comparing two of the three forms.

Interval	Inequality
(a, b)	$a < x < b$
$[a, b]$	$a \le x \le b$
$[a, b)$	$a \le x < b$
$(a, b]$	$a < x \le b$
$[a, \infty)$	$x \ge a$
(a, ∞)	$x > a$
$(-\infty, a)$	$x < a$
$(-\infty, a]$	$x \le a$
$(-\infty, \infty)$	$-\infty < x < \infty$

Example: Write these inequalities using interval notation.

a. $-2 < x \le 5$ b. $x > -2$ c. $x \le -6$

Solving linear inequalities is the same as solving linear equalities when only addition or subtracting is involved.

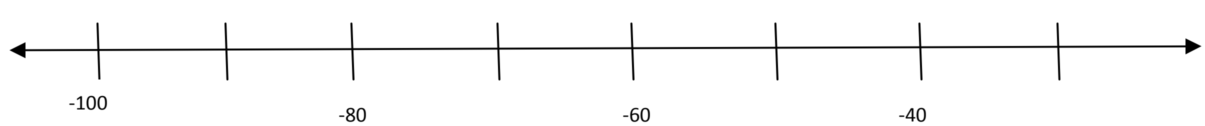
Solving linear inequalities when **multiplying or dividing by a negative number shifts the direction of the inequality**! (steps page 142)

EXAMPLES: Solve each inequality and give your answer in interval notation.

1. $-2x + 1 < 7$

Solve and draw a number line solution.

2. $$\frac{2(x-4)}{3} \geq \frac{3x}{5} - 8$$



Inequalities can be solved on the calculator two ways:

I. The Intersection Method

Steps:
1) Enter Y_1= left side of equation.
2) Enter Y_2= right side of equation.
3) Graph these two equations.
4) Solve $Y_1 < Y_2$ by noting the interval where Y_1 is below Y_2. Or solve $Y_1 > Y_2$ by noting the interval where Y_1 is above Y_2.

EXAMPLE: 1. Solve $-2(x + 3) < 8$

II. X-Intercept Method

Steps:
1) Rewrite the inequality with all nonzero terms on one side of the inequality and combine like terms. The result will be $f(x)>0$, $f(x)<0$, $f(x) \geq 0$, or $f(x) \leq 0$.
2) Graph the nonzero side of this inequality as Y_1.
3) Find the x-intercept of the graph.
4) Use the graph to determine where this inequality is satisfied.

EXAMPLE: 1. Solve $-2(x + 3) < 8$

2. The equation $C = \frac{5}{9}(F - 32)$ gives the relationship between temperature measured in degrees Celsius and degrees Fahrenheit. We know that a temperature at or above 100^0C is "boiling" temperature. Use an inequality to represent the corresponding Fahrenheit temperature.

Double Inequalities

The inequality $-2 < x < 5$ is a double inequality. A double inequality represent two inequalities connected by the word *and* or *or*.

EXAMPLE: 1. Solve $4 < 2x + 2 \leq 10$

2. A Student has taken four exams and has earned grades of 91%, 89%, 90% and 79%. What grade must the student earn on the final test so that his course average is a B (that is, so his average is between 82% and 86%)?

Homework Course Compass for section 2.2 & 2.4 and
page 119 #21 None from 2.4
optional (not collected) as a review for the exam
pages 80 # 1-4, 6, 9, 14-22, , 25,26, 35, 39-42
page 155 #1, 3, 7, 8, 10-13, 14, 20-22, 25, 33,34, 35, 36, 50

**What if I do not get an r value?
Press **2nd 0** to access the catalog.
Press $\mathbf{x^{-1}}$ to jump to the D's.
Use the down arrow to find **DiagnosticOn**. Be sure the arrow is next to it.
Press ENTER twice until you see the word Done on the home screen.
Redo find the linear regression.