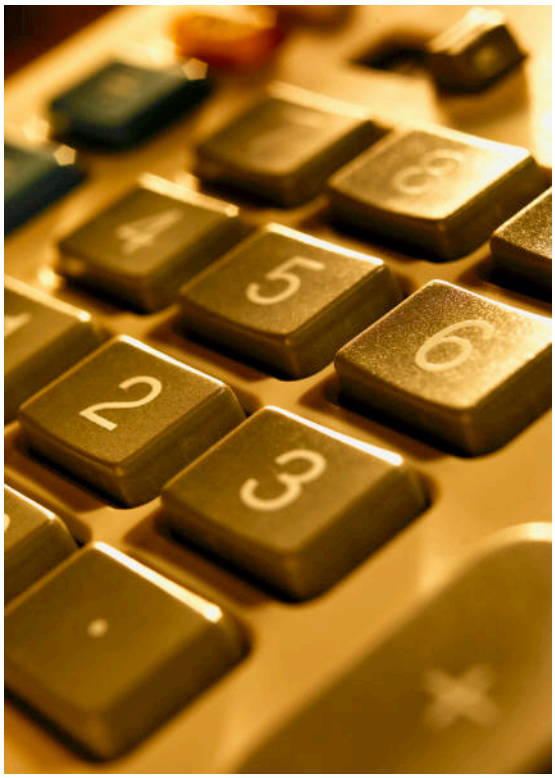


Unit 0

Introduction to the Graphing Calculator

Intermediate Algebra Update 2/06/06

Unit 0 Activity 1: Introduction to Computation on a Graphing Calculator

Why: As technology becomes integrated into all parts of society, many mathematical problems can now be solved using computers and graphing calculators. Learning to use technology to solve mathematical problems is one of our goals in Intermediate Algebra. Using technology effectively is much more than punching buttons on a computer keyboard or calculator. This activity will introduce you to computing on a Texas Instruments (TI) graphing calculator. You will see that learning to use a calculator involves a good understanding of the order of operations. You will have to interpret where to put parenthesis in order to tell the calculator what to do. This involves analysis and forethought on your part.

Learning Objectives:

1) Use the [2nd] and the [ALPHA] keys to access additional calculator functions.
2) Use the MATH menu to work with fractions.
2) Use the calculator to evaluate expressions with hidden or implied parenthesis.

Warm-Up:

Notes: Each button on the calculator has two or more functions. One is printed on the button, the others are in color and in smaller font above the button. These functions can be accessed by first pushing the [2nd] key or the [ALPHA] key, whichever corresponds to the color of the function you want to access.

1. Practice turning the calculator on and off, using the [2nd] key as necessary. Notice that the [2nd] key puts a small arrow in the cursor.

2. This semester we will be working with lists of data. To keep track of the lists, we will name them. Typing a name requires the use of the [ALPHA] key. Practice typing the word "math" by using the [ALPHA] key. Notice that the ALPHA key puts a small A in the cursor. Delete the "h" in "math" by using the left arrow [◁] and [DEL] (On the TI-89 just hit the [←] next to the CLEAR button.) Now erase the rest of the word in one swipe by hitting CLEAR.

Group Exercise:

1) **Working with fractions by using menus**: Find the <u>exact</u> answer to $\frac{2}{3}+\frac{1}{6}$ then follow the instructions on the next page to do this problem on your calculator.

Instructions for working with fractions on the TI-calculators

TI-83	TI-86	TI-89
Type 2 ÷ 3 + 1 ÷ 6 ENTER To convert the approximate decimal answer to an exact fraction, choose the MATH menu by hitting MATH. Within the MATH menu, choose >FRAC (Since this is the first option, it will be highlighted already; choose it by hitting ENTER.)	Type 2 ÷ 3 + 1 ÷ 6 ENTER To convert the approximate decimal answer to an exact fraction, choose the MATH menu by hitting MATH. (MATH is in yellow above the X, so hit 2nd then X.) Within the MATH menu, choose MISC by hitting F5. Hit MORE to scroll through this submenu. Choose >Frac by hitting F1. Then hit ENTER. *See the note on the next page for a short-cut.*	To do fractions on the TI-89, choose the appropriate MODE by hitting MODE and move to the second page of this menu by hitting F2. Use the arrows to scroll down to "Exact/Approx". Use the right arrow to choose AUTO and hit ENTER. Now hit ENTER a second time to return to the home screen. AUTO mode will automatically give fraction answers. Type 2 ÷ 3 + 1 ÷ 6 ENTER To convert to decimal answers, hit the green diamond before ENTER.

A special note to TI-86 users: Since we will be working with fractions quite a bit, you may want to set up the following fraction short-cut on your calculator. You will only need to do this once. Choose CATLG/VARS by hitting 2nd CUSTOM. Choose CATALOG by hitting F1. Choose the CUSTOM menu by hitting F3. Scroll down until the cursor points to >Frac. Then hit any F key to paste the >Frac command into the CUSTOM menu. Now QUIT out of the CUSTOM menu by hitting 2nd EXIT. Now let's add the fractions using this short-cut. Type 2 ÷ 3 + 1 ÷ 6 ENTER. Hit CUSTOM and choose the F key underneath the >Frac and hit ENTER.

2. **Using parenthesis in computation:**
   a) Compute $\left(\frac{2}{3}\right)^4$ by hand and leave your answer in fraction form.

   i.) Check your answer by computing $\left(\frac{2}{3}\right)^4$ with the calculator; use parentheses and convert your answer to fraction form.

   ii.) Now try the same keystrokes <u>without</u> the parenthesis: 2 ÷ 3 ^ 4. Do you get the same answer? Convert your answer to a fraction. How does the calculator interpret the instructions "2 ÷ 3 ^ 4"?

b) Approximate $\sqrt{\pi+1}$ using mental math. Is it more than or less than 2? Why?

i.) Check your estimate by computing $\sqrt{\pi+1}$ with the calculator. Note that this problem has hidden or implied parenthesis inside the square root, i.e. $\sqrt{(\pi+1)}$. The TI-83 and TI-89 will automatically open parenthesis after you hit $\boxed{\sqrt{\ }}$; TI-86 users will have to hit $\boxed{\sqrt{\ }}$ and then $\boxed{(\ }$ before typing $\pi+1$.

ii.) Try to convert this answer to a fraction. What happens? Why can't the calculator convert this answer to a fraction?

c) Approximate $2^{3\pi}$ using mental math. Is your approximation an underestimate or overestimate? How do you know?

i.) Check your estimate by computing $2^{3\pi}$ with the calculator. Note that this problem also has hidden or implied parenthesis, i.e. $2^{(3\pi)}$.

ii.) Try to convert this answer to a fraction. What happens? Why can't the calculator convert this answer to a fraction?

iii.) Now try the same keystrokes <u>without</u> the parenthesis: $2\text{^}3\times\pi$. Do you get the same answer? How does the calculator interpret the instructions "$2\text{^}3\times\pi$"?

d) Compute $\frac{3+5}{2}$ by hand.

i.) Check your answer by computing $\frac{3+5}{2}$ with the calculator. Where are the hidden or implied parenthesis in this expression?

ii.) Now try the same key strokes without parenthesis; enter 3 + 5 ÷ 2. Do you get the same answer? How does the calculator interpret the instructions "3 + 5 ÷ 2"?

e) Compute by hand the value of x^2 when x = -4. Is your answer positive or negative? Why?

i.) Use your calculator to compute the value of x^2 when x = -4. Where are the hidden or implied parenthesis?

ii.) Now try the same keystrokes without parenthesis; enter "- 4 ^ 2". Do you get the same answer? How does the calculator interpret the instructions "- 4 ^ 2"?

Practice: Use your calculator to evaluate the following expressions. Enter the entire expression before hitting ENTER so that you make yourself practice the use of hidden parenthesis. Check your work by 1) working the problem by hand and 2) by comparing with a classmate. In the box with each problem, enter the expression just as you did in the calculator.

1) $\sqrt{b^2 - a^2}$ where $b = 5$ and $a = -4$ Remember: only hit ENTER once to make yourself practice with hidden parenthesis!

2) $\frac{b^2 - 5}{2}$ where $b = -7$ Remember: only hit ENTER once to make yourself practice with hidden parenthesis!

3) $\frac{\sqrt{b^2 - 5}}{2}$ where $b = 3$ Remember: only hit ENTER once!

3) $\sqrt{b^2 - 4ac}$ where $a = 3$, $b = 5$, $c = 2$ Remember: only hit ENTER once!

4) $\frac{\sqrt{b^2 + 2ac}}{2}$ where $a = -2$, $b = -8$, $c = 7$ Remember: only hit ENTER once!

5) $\frac{b + \sqrt{b^2 - 4ac}}{2a}$ where $a = 3$, $b = -5$, $c = 2$ Remember: only hit ENTER once! You can do it!!

6) $25^{\frac{1}{2}}$ $8^{\frac{1}{3}}$ $64^{\frac{1}{4}}$

Intermediate Algebra Update 1/07/05

Unit 0 Activity 2: Introduction to Graphing on a Graphing Calculator

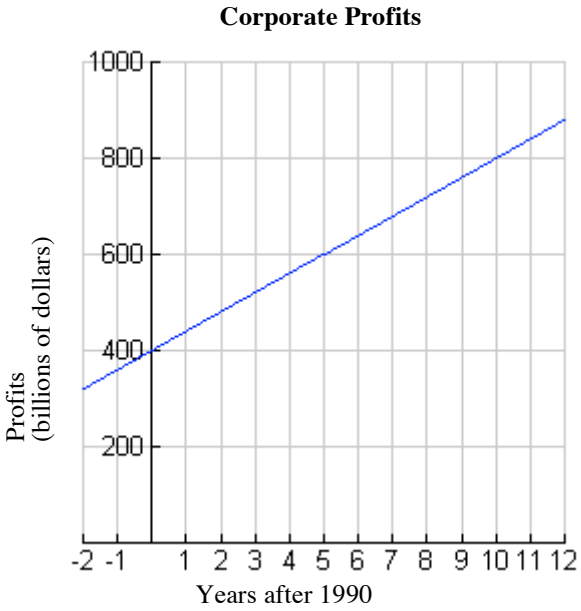
Why: To be mathematically literate in today's society, you need to be able to analyze and interpret graphs. So in Intermediate Algebra we will investigate mathematical ideas by constructing graphs. This activity will introduce you to graphing with a Texas Instruments (TI) graphing calculator. Again you will find the effective use of technology involves a lot of critical thinking.

Learning Objectives:

3) Use the menus of the graphing calculator to generate a graph.
4) Produce a graph with a window that is appropriate to the problem scenario.

Warm-Up:

Corporate profits, in billions of dollars, can be modeled by the equation $y = 400 + 40x$, where x is the years from 1990.
Analyze the graph of this equation to answer the following questions.



1. To generate this graph what is XMIN? _____ XMAX? _____ XSCL? _____

2. What is YMIN? _____YMAX? _____ YSCL? _____

3. What were corporate profits in 1990?

4. When were corporate profits double the 1990 figure?

5. Circle what you would change in the window settings to answer the following questions. Then circle increase or decrease to describe how you would change the setting you circled. You do not need to answer the questions.

a. What year does this model predict corporations will have a profit of a trillion dollars?

XMIN XMAX XSCL YMIN YMAX YSCL

INCREASE DECREASE

b. According to this model, when did corporations break even?

XMIN XMAX XSCL YMIN YMAX YSCL

INCREASE DECREASE

c. When were corporations operating at a loss of 200 billion?

XMIN XMAX XSCL YMIN YMAX YSCL

INCREASE DECREASE

d. What will corporate profits be in the year 2010?

XMIN XMAX XSCL YMIN YMAX YSCL

INCREASE DECREASE

Group Exercise:

1) **Graphing an equation:** Graphing an equation requires two steps: 1) entering the equation and 2) setting an appropriate window to view the graph. Let's learn to graph on the graphing calculator by reproducing the previous graph of corporate profits

STEP 1: Follow the instructions to enter the equation.

TI-83 Plus	TI-86	TI-89
Enter the equation by hitting **Y =** (first blue key in top row) Type-in the equation using X,T,θ,n for the variable *x*.	Enter the equation by hitting Graph Choose y= by hitting F1. Type-in the equation using x-VAR for the variable *x*.	Enter the equation by choosing **Y =** ; hit the green diamond then F1, Type-in the equation.

STEP 2: Follow the instructions to set a window.

TI-83 Plus	TI-86	TI-89
Set a window to view the graph by hitting Window (second blue key in top row). Enter values for XMIN, XMAX, XSCL, etc. Now graph by hitting Graph (last blue key in top row).	Now set a window to view the graph by hitting 2nd F2 (You hit 2nd because WIND is in the top row of the menu.) Set XMIN, XMAX, etc. Now choose Graph by hitting F5.	Now set a window to view the graph by hitting the green diamond and F2 to choose WINDOW. Set XMIN, XMAX, etc. Now choose GRAPH by hitting the green diamond and F3.

Practice:

1) Set your window to "standard" settings (XMIN = -10, XMAX =10, XSCL = 1; YMIN = -10, YMAX = 10, YSCL = 1). Graph the equation $y = \frac{1}{11}x^2 + x - 14$.

a) A "complete" graph of this equation will show a parabola. Change the settings of your window so that you can see the two *x*-intercepts (where the graph crosses the *x*-axis), the *y*-intercept, and the vertex (low point). Record your new settings below.

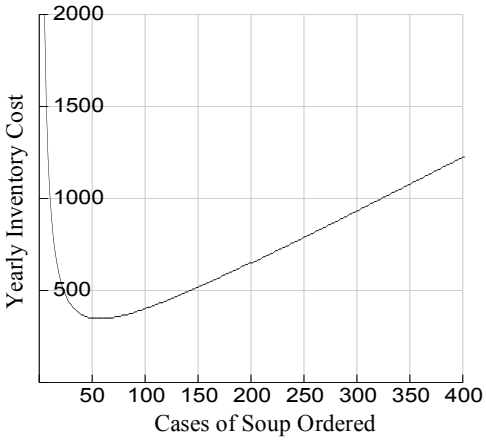
XMIN ____ XMAX _____ XSCL _____ YMIN _____ YMAX _____ YSCL _____

b) Find the exact values of the *x*-intercepts by following the instructions below.

TI-83 Plus	TI-86	TI-89
After graphing the equation, choose **Calc** (2nd, Trace). Choose **#2** (Zero) **Left Bound**? [Use the arrows to move the cursor so the *x*-coordinate is to left of *x*-intercept, press ENTER]; **Right Bound**? [Move the cursor so the *x*-coordinate is to right of *x*-intercept, press ENTER]; **Guess**? [Locate cursor near the *x*-intercept. Press ENTER] Calculator tells you the *x*- and *y*-coordinates of the *x*-intercept.	After graphing the equation, stay in the graph menu, hit More (on Key pad). Choose **Math (F1)** **Root (F1)** **Left Bound?** [Move the cursor so the *x*-coordinate is to left of *x*-intercept, press ENTER]; **Right Bound?** [Move the cursor so the x-coordinate is to right of x-intercept, press ENTER]; **Guess?** [Locate cursor near the *x*-intercept. Press ENTER] Calculator tells you the *x*- and *y*-coordinates of the *x*-intercept.	After graphing the equation, stay in the graph menu, choose Math F5. Choose Zero by pressing #2 Lower Bound? [Move the cursor so the *x*-coordinate is to left of x-intercept, press ENTER]; Upper Bound? [Move the cursor so the x-coordinate is to right of x-intercept, press ENTER]; Calculator tells you the *x*- and *y*-coordinates of the *x*-intercept.

c) Find the exact value of the vertex by using the same instructions as above but this time choose "minimum" (TI-83 or TI-89) or FMIN on the TI-86.

2) A grocery store sells 4,000 cases of canned soup per year. By averaging costs to purchase soup and pay storage costs, the owner has determined that if "c" cases are ordered at a time, the yearly inventory cost in dollars $I = g(c)$ can be modeled by $I = g(c) = \frac{10,000}{c} + 3c$.



a) Reproduce this graph on your calculator.

b) Use your calculator to find the number of cases of soup that should be purchased to minimize inventory costs.

3) A biologist takes several measurements of the amount of contaminant in a lake after a chemical spill and constructs the following model $y = -48.75x + 645$, where x is the number of hours after the spill and y is the concentration of contaminant in milligrams per milliliter.

a) Graph this equation on your calculator. Find a window that makes sense given the context of this problem and that allows you to see the x-intercept and the y-intercept. **Keep a "transcript" of the window settings you use** and **briefly explain your reasoning** as you change settings in order to be able to see the intercepts.

1st settings: XMIN ____ XMAX _____ XSCL _____ YMIN ____ YMAX ____ YSCL _____

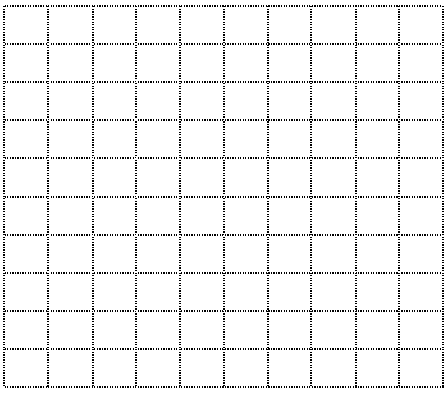
Circle the settings need to change. How will you change the setting? Why?

2nd settings: XMIN ____ XMAX _____ XSCL _____ YMIN ____ YMAX ____ YSCL _____

Circle the settings need to change. How will you change the setting? Why?

Keep a "transcript" of the rest of your settings and your reasoning as you change them on the back of this page.

b) Transcribe your graph into the grid. **Clearly label the axes with a description of the variable and clearly show the scale.**



c) How much contaminant was originally released into the lake? Show this point on your graph.

d) How long does it take the lake to be cleared of contaminant? Show this point on your graph.