

Harry Potter

AND THE TI-84 PLUS

2.55MP



2011 T³ International Conference
San Antonio, Texas

11:30 A.M. - 1:00 P.M.
Friday, February 25, 2011
Convention Center - 214 B

John LaMaster, National T³ Instructor
Indiana University Purdue University at Fort Wayne
2101 Coliseum Blvd. East
Fort Wayne, IN 46805-1445
lamaster@ipfw.edu
www.ipfw.edu/math/lamaster

Contents

Introducing TI-84 Plus OS Update 2.55MP	1
Compare With TI-84 Plus OS Update 2.53MP	2
How To Check Your OS Version	3
What You Need to Begin	3
How to Archive Your Calculator Memory	3
Method 1 to Upgrade Your TI-84 OS: Let TI-Connect Do It	4
Method 2 to Upgrade Your TI-84 OS: Drag and Drop	4
Method 3 to Upgrade Your TI-84 OS: Get it From Another Upgraded Handheld	5
Update the CatalogHelp APP to version 1.1	5
Update TI-Smartview™ with the New OS	5
Welcome to 2.55MP OS!	6
The Mode Screen Has Two Pages	7
Helpful Tips Related to 2.53MP features	8
More Helpful Tips Related to 2.55MP features	9
Use a Regression Wizard to Model a Nonlinear Relationship for Harry Potter Book Sizes	10
Use $\frac{\square}{\square}$ and Wizard Support for $\frac{\square}{\square}$ While Undertaking Adventures at the Hogshead	11
More Adventures at the Hogshead	12
Use the Δ Tbl Shortcut to Help You Concoct a Potion for Professor Snape	13
Use Stacked Fractions, Scrolling History, and Zoom Features to Investigate Patterns	14
Use the Δ Tbl Shortcut to Help Harry Use the Power of Compound Interest	16
Use \log_{b^x} to Build Conceptual Understanding of the Logarithm	17
Scroll Through the History to Build the Sum of a Sequence	18
An Old Favorite Cleans Up Well: The Quadratic Formula	19
Summary of New Functionality	20
Compatibility with Programs	21
Compatibility with Apps Released Before 2/15/2010	22
<i>Carpe Diem!</i>	22

Join a Google Group on the TI-84 Plus

Want more information? Stay connected at <http://groups.google.com/group/ti84plus/>

Check out other sessions at this conference using the new features of the TI-84 Plus OS:

- *Statistics Functionality Improvements with the Latest TI-84 Operating System* by Gloria Barrett
Friday, Feb. 25, 1:15 PM-2:15 PM Convention Center CC-005 (Right after this session.)
- *Using TI-84 Plus Features – Linear Equations – Show Me the Ways!* by Margo Mankus
Saturday Feb. 26, 2011 8:15 AM- 9:45 AM Convention Center CC-208

TI-84 Plus OS Update 2.55MP

Get release notes by Margo Mankus at
education.ti.com/sites/US/downloads/pdf/84OS_v2dot55MP.pdf



Wizard Support for all menu items in [STAT] CALC:
1-Var Stat, 2-Var Stat, and Regression Equations

1-Var Stats

```
List:L1
FreqList:
Calculate
```

2-Var Stats

```
Xlist:L1
Ylist:L2
FreqList:
Calculate
```

Med-Mod

```
Xlist:L1
Ylist:L2
FreqList:
Store RegEQ:
Calculate
```

LinReg(ax+b)

```
Xlist:L1
Ylist:L2
Freq:
Store
Calc
```

QuadReg

```
Xlist:L1
Ylist:L2
Freq:
Store
Calc
```

CubicReg

```
Xlist:L1
Ylist:L2
Freq:
Store
Calc
```

QuartReg

```
Xlist:L1
Ylist:L2
Freq:
Store
Calc
```

LinReg(a+bx)

```
Xlist:L1
Ylist:L2
Freq:
Store
Calc
```

ExpReg

```
Xlist:L1
Ylist:L2
Freq:
Store
Calc
```

LnReg

```
Xlist:L1
Ylist:L2
Freq:
Store
Calc
```

PowerReg

```
Xlist:L1
Ylist:L2
Freq:
Store
Calc
```

Logistic

```
Xlist:L1
Ylist:L2
FreqList:
Store RegEQ:
Calculate
```

SinReg

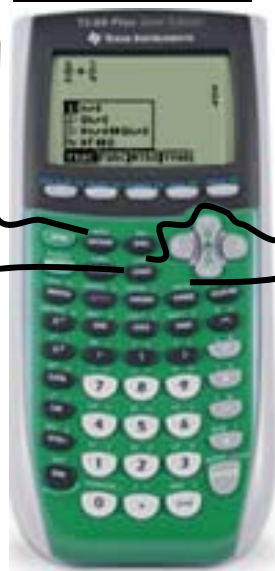
```
Iterations:3
Xlist:L1
Ylist:L2
Period:
Store RegEQ:
Calculate
```

Manual-Fit

```
Store EQ:
Calculate
```

```
NORMAL SCI ENG
FLOAT 0 1 2 3 4 5 6 7 8 9
RADIAN DEGREE
FUNC PAR POL SEQ
CONNECTED DOT
SEQUENTIAL SIMUL
REAL a+bi re^*θi
FULL HORIZ G-T
↓ NEXT ↓
```

```
TRACK+
MATHPRINT CLASSIC
hpd Uned
ANSWERS: AUTO DEC FRAC
GOTO FORMAT GRAPH: NO YES
STAT DIAGNOSTICS: OFF ON
STAT WIZARDS: ON OFF
SET CLOCK 02/21/11 8:58PM
```



Wizard Support for seq(Expr, Var, Start, End, Step) in [LIST] OPS

NAMES MATH

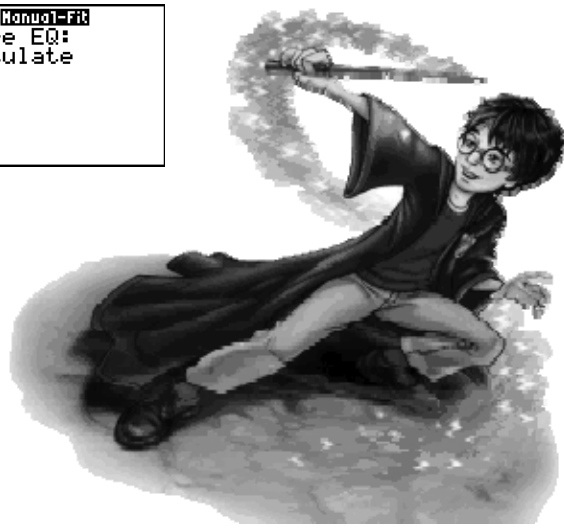
```
1:SortA(
2:SortD(
3:dim(
4:Fill(
5:seq(
6:cumSum(
7:↓List(
```

Expr:
Variable:
start:
end:
step:
Paste

Wizard Support for all menu items in [DISTR] DISTR and [DISTR] DRAW

```
DISTR DRAW
1:normalpdf(
2:normalcdf(
3:invNorm(
4:invT(
5:tPdf(
6:tcdf(
7:X²pdf(
8:X²cdf(
9:Fpdf(
0:Fcdf(
A:binompdf(
B:binomcdf(
C:poissonpdf(
D:poissoncdf(
E:geometpdf(
F:geometcdf(
```

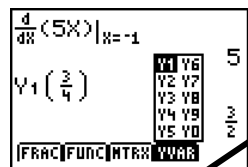
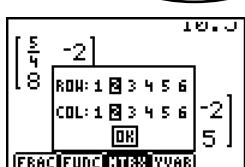
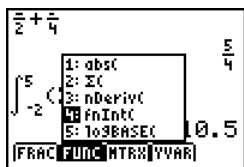
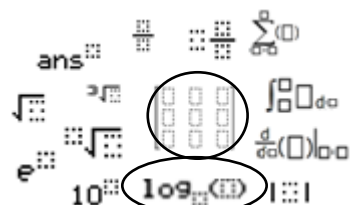
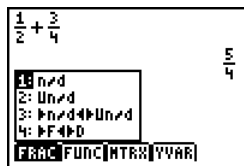
```
DISTR DRAW
1:ShadeNorm(
2:Shade_t(
3:ShadeX²(
4:ShadeF(
```



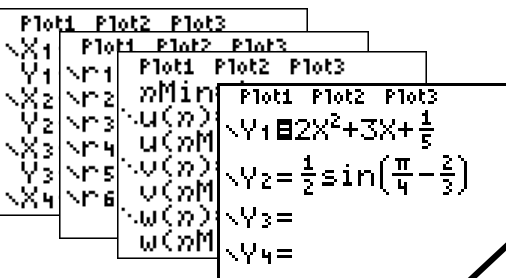
For more on the DISTR menu, attend:
Statistics Functionality Improvements with the Latest TI-84 Operating System
 by Gloria Barrett
 Friday, Feb. 25,
 1:15 PM-2:15 PM
 Convention Center -005
 (Immediately following this session.)

TI-84 Plus OS Update 2.53MP

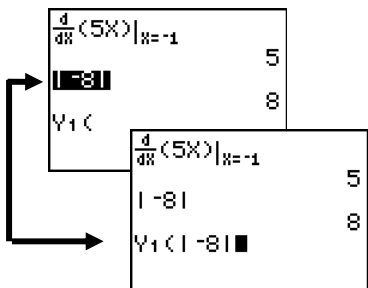
education.ti.com/84



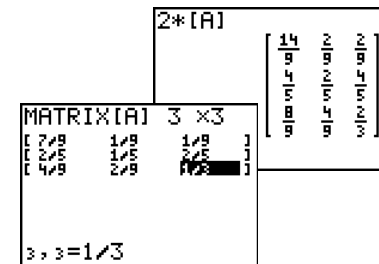
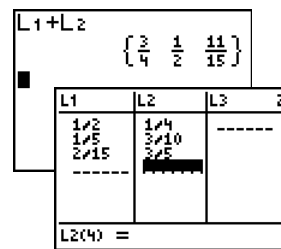
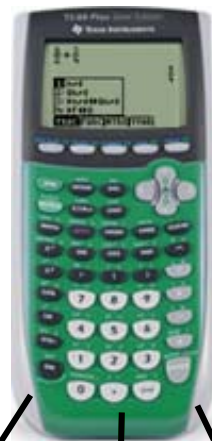
MathPrint Home Screen



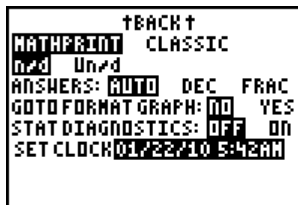
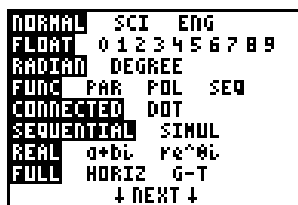
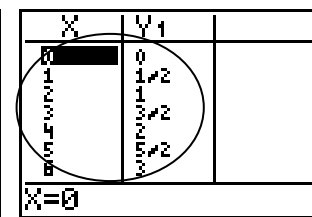
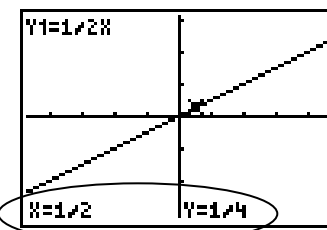
MathPrint Y=



Scrolling History Home Screen MathPrint and Classic

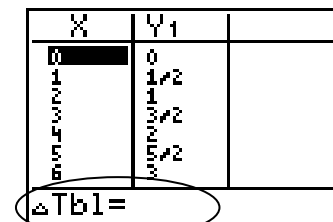
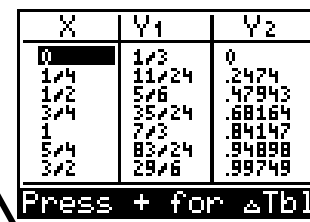


Fraction Support in LIST & MATRIX



Updated Mode Screen

- MATHPRINT to CLASSIC Selection
- Fraction Type Selection n/d U n/d
- ANSWERS: AUTO DEC FRAC
- GOTO FORMAT GRAPH: NO YES
- ON OFF - Stats Diagnostics
- STAT WIZARDS added in 2.55MP



ΔTBL Control from TABLE!

MATH PROB

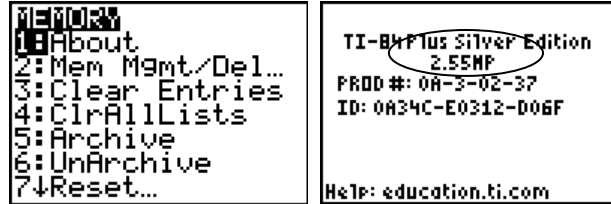
randIntNoRep(startnum,endnum)
Random ordering of integers in a range.

MATH NUM

remainder(dividend, divisor)

How To Check Your OS Version

1. Press **2nd Mem** on your handheld.
2. Select **1:About**.
3. Press **ENTER**.
4. We want TI-84 Plus 2.55MP.



What You Need to Begin

- Computer with Internet access
- The latest version of TI-Connect™ software (v 1.6). Go to <http://education.ti.com/ticonnect/>
- TI Connectivity Cable (included with the TI-84 Plus Silver Edition). Some below are ancient. Available for purchase at <http://education.ti.com/ticonnect/>



Serial for Windows® or Mac® (gray)



Serial for Windows only (black)



USB for Windows® or Mac® (silver)



Standard Mini-A to Mini-B USB Cable for Windows® or Mac®

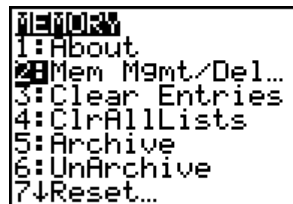
Warning: The cables are, from left to right, in order of oldest to most current. You will need to have TI-Connect™ Version 1.5 or later to use the Mini-A to Mini-B USB Cable. If you plug in the cable before installing the TI Connect™ software, Windows® may assign an incorrect driver for the cable. **INSTALL TI-CONNECT FIRST!!!**

- TI-84 Plus or TI-84Plus Silver Edition handheld with fresh batteries and memory archived. (You wouldn't undergo major surgery without being at the best you can be, would you?)

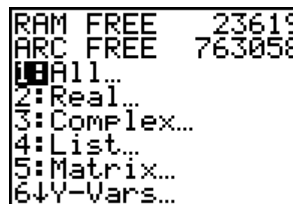
How to Archive Your Calculator Memory

When you upgrade your OS, archived items on the receiving unit are not lost. Move items stored in Random Access Memory (RAM) into the Archived Memory as follows:

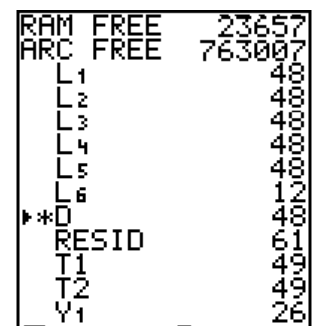
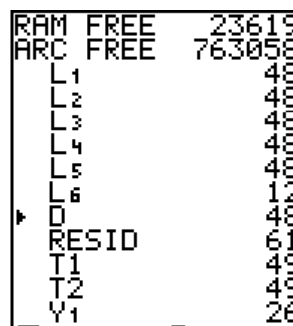
1. Press **2nd Mem** on your handheld.
2. Select **2:Mem Mgmt/Del...**
3. Select **1:All...**
4. Press **ENTER** next to anything that is not marked with a * to move it into archived memory, where it will be safe.



You won't be able to use the item (lists, variables, programs, etc.) while they are archived. It is like a fire proof vault!

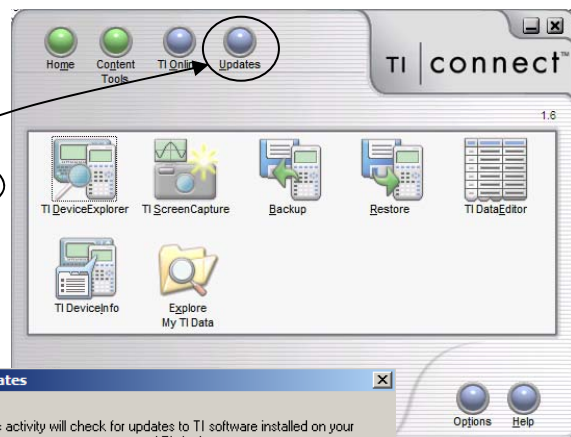


Press **ENTER** again from this screen to unarchive them and move them into RAM.



Method 1 to Upgrade Your TI-84 OS: Let TI-Connect Do It

1. Run your Web browser and visit the TI Home Page <http://education.ti.com>
2. Start the TI Connect™ software (see above) that has already been installed on your machine.
3. Once TI Connect™ software has started, connect your handheld to the computer with the TI Connectivity Cable (See above the four types of cables.)
4. To download Apps you need the latest Operating System (OS) version for your handheld. Once you connect your handheld, click on **Updates** on TI Connect.

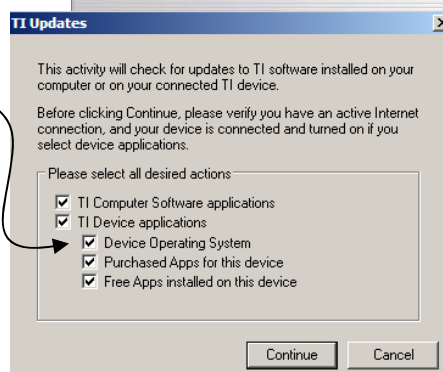


Make sure **Device Operating System** is checked.

If you need a newer OS version,
TI Connect will upload the new OS on your machine.

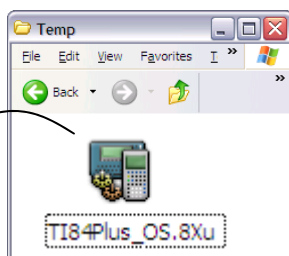
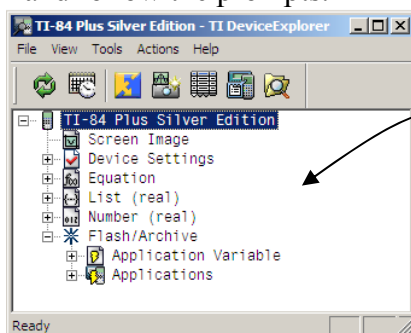
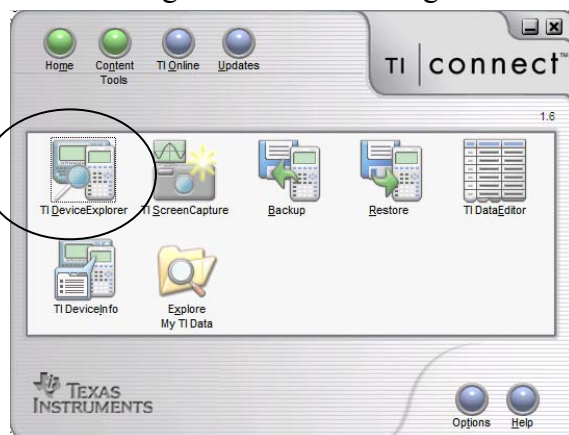


**BE SURE YOUR HANDHELD
HAS FRESH BATTERIES!!!!**



Method 2 to Upgrade Your TI-84 OS: Drag and Drop

- 1-3. Perform the first three steps of Method 1 above.
4. Go to <http://education.ti.com/84> and follow the prompts to get the latest 84 OS. Download it to your computer in a place you'll remember. Don't forget to download the guidebook. It has been updated too. Also download the App *Catalog Help v1.1*.
5. Once you connect your handheld, click on **TI Device Explorer** on TI Connect to open the Device Explorer window.
6. Drag the OS file into the Device Explorer window and follow the prompts.



**BE SURE YOUR HANDHELD
HAS FRESH BATTERIES!!!!**

Method 3 to Upgrade Your TI-84 OS: Get it From Another Upgraded Handheld

1. Make sure the calculators are **firmly** connected by inserting the ends of a unit-to-unit link cable into the appropriate port

2. On the receiving calculator, press 2nd LINK (X, T, θ, n)

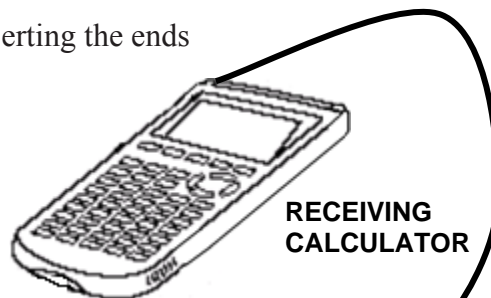
to access the **LINK** menu.

Press RIGHT to highlight the **RECEIVE** menu.

Press ENTER so that the calculator is on **Waiting...**

```
SEND RECEIVE
RECEIVE
```

```
Waiting...
```



(The receiver must be on **Waiting** BEFORE the transfer.)

3. On the sending calculator, press 2nd LINK (X, T, θ, n) to access the **SEND** menu.

Select **G:SendOS**.

```
SEND RECEIVE
A:Y-Vars...
B:String...
C:APPS...
D:AppVars...
E:Group...
F:SendId
G:SendOS
```



Trouble Shooting:

1. If you receive an error, first check that the cables are firmly connected. Push in the cables tightly and then push in again. You don't want any data leaking out into the air!
2. If you still get an error, try it again with another cable. You could have trouble if the Input/Output port of the calculator is damaged.
3. If the receiving calculator does not have fresh batteries, it is unusable until new batteries have been replaced and the process is restarted.

```
Error in Xmit
Quit
```



BE SURE YOUR HANDHELD HAS FRESH BATTERIES!!!!

Update the CatalogHelp APP to Version 1.1

Please also update to Catalog Help v1.1 if you update to 2.53MP. You can use any of the above three methods. There is no functionality update to Catalog Help, but version 1.1 is needed to run on 2.53MP.

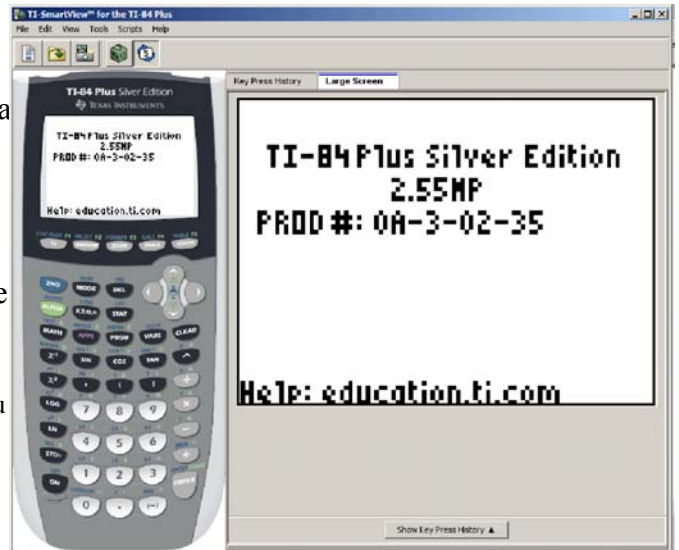
```
APPS:MORE
6: CabriJr
7: CalcSheet
8: Conics
9: CtlgHelp
0: EasyData
: FunSci
↓ Inequalz
```


Update TI-Smartview™ with the New OS

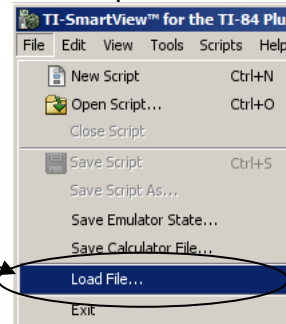
The TI-SmartView™ emulator software gives you a full functioning TI-84 Plus calculator on your computer.

To update TI-84 SmartView™ with the latest OS 2.55MP*, your SmartView software needs to be version 3.1 or higher.

*If you have a version of TI-84 SmartView™ below 3.0, you cannot download the Smartview software update from the TI Web Site. Instead, request your free upgrade by contacting TI Cares at 1-800-TI-CARES. You will need a photocopy of your Product Key.



1. If you haven't yet, go to <http://education.ti.com/84> and follow the prompts to get the latest 84 OS and download it to your computer in a place you'll remember, i.e., the desktop or other folder.
2. Open up TI-Smartview
3. Click on **File**.
4. Click on **Load File...**
5. The Load file dialog box displays.
6. In the Files of type: pull down menu, make sure **All Calculator Files (*.8x?)** is selected.
7. Select the .8xu file you downloaded to your desktop.
8. Select **Open** to start loading the calculator OS to TI-SmartView.
9. If you use the Catalog Help APP, you will also want to load that file as well.

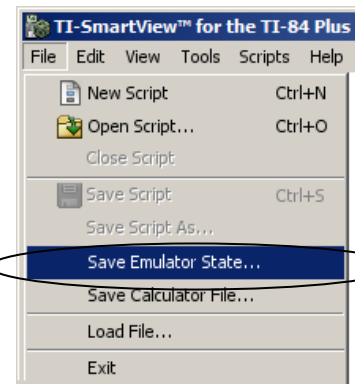
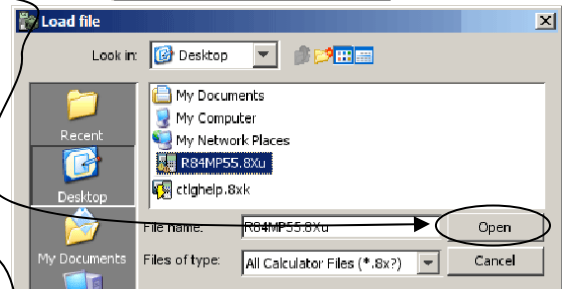


If your computer crashes while SmartView is open, it will revert back to OS v 2.43 when you restart it.



Tip: Click on **File > Save Emulator State** while you have TI-84 OS v 2.55MP running and give it a name, such as *MyState2010-03-07.84state*, and click **Save**. Now if you have a crash while Smartview is running and it reverts back to an earlier OS, you can just reload the Emulator State:

1. Click **File > Load File**.
2. In the dialog box:
 - a. Navigate to the folder that contains the emulator state file.
 - b. Click the emulator state name to highlight it.
 - c. Click **Open**.



Welcome to 2.55MP OS!

Notice the new message to access shortcut menus for access to new features and old favorites when you turn ON your calculator or reset!

Note: Most of the features in the new shortcut menus are available in the **MATH** MATH and **MATH** NUM menus.

PRESS ALPHA F1-F4
TO LOCATE
SHORTCUT MENUS.
DO NOT SHOW AGAIN
2: CONTINUE

The Mode Screen Has Two Pages

Second Screen:

MATHPRINT vs. **CLASSIC** governs only how expressions are displayed.

MathPrint™ mode displays most inputs and outputs the way they are shown

in textbooks, such as $\frac{1}{2} + \frac{3}{4}$ and $\sum_{k=1}^{100} kx^2$.

Classic mode displays expressions and answers as if written on one line, such as $1/2+3/4$ or $\Sigma(KX^2,K,1,100)$.

Note: If you switch between these modes, most entries typed on the home screen will be preserved; however matrix calculations will not be preserved unless you store them. Think of them as images drawn on the screen.

n/d and **U n/d** - selection of fraction output as improper or mixed numbers.

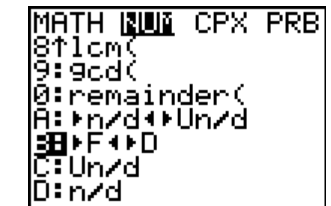
ANSWERS

- **Auto** displays answers in a similar format as the input. For example, if a fraction is entered in an expression, the answer will be in fraction form, if possible.
- **Dec** displays answers as integers or decimal numbers.
- **Frac** displays answers as their fractional approximation, if possible.

The **Answers** mode setting also affects how values in sequences, lists, and tables are displayed.

*If any decimal point appears in the expression, then output is decimal. This is a quick way to force decimal output in **AUTO** mode.*

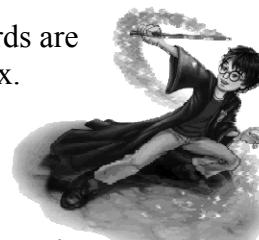
You can also convert values from decimal to fraction or fraction to decimal using the **FRAC** shortcut menu or the **MATH NUM** menu.



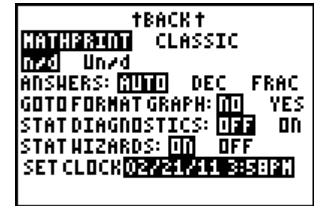
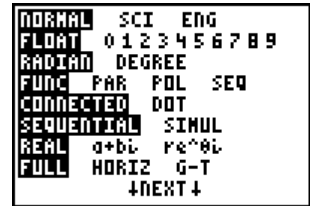
GOTO FORMAT GRAPH: Selecting YES jumps from the MODE screen to the FORMAT screen. This handy shortcut puts the FORMAT screen on the user's radar as a place to check to avoid calculator glitches, as well as helps support teachers who begin an activity making sure all is highlighted on the left on both screens. Pressing MODE will return to MODE from the FORMAT screen.

STAT DIAGNOSTIC ON OFF - Quickly select the existing option of displaying r and r^2 when calculating statistical regressions. This is a shortcut to an existing feature (only found in the catalog under **DiagnosticOn** or **DiagnosticOff**) which is placed here for ease of use.

STAT WIZARDS ON OFF – All of these 2.55MP wizards are registered D.A members or are in the Order of the Phoenix. For that reason, the Default setting is ON.



SET CLOCK was pushed to this screen so room could be made for the **↓NEXT↓** indicator on page 1 of the Mode Screen.

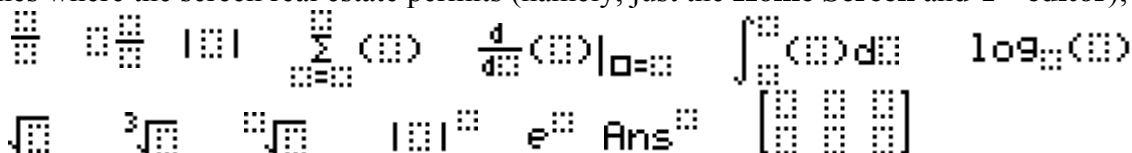


Helpful Tips Related to 2.53MP features



- When using scrolling history to select an item, press **ENTER** to be able to manipulate it. “You must pluck the fruit off the tree before taking a bite.”
- Make these commands your two new friends:
 - 2nd** **▶** takes you to the end of the line;
 - 2nd** **◀** takes you to the beginning of the line.
 These are handy when you may need to scroll horizontally.
- Use **ALPHA** [**F1**] to quickly access the fraction menu. (You can also can press **MATH** , press **▶** to the NUM menu, press **▲** to get **n/d** , etc.)

- In MathPrint™ mode, you get Super-Sized *math templates* of old functions as well as new ones where the screen real estate permits (namely, just the **Home Screen** and **Y= editor**);

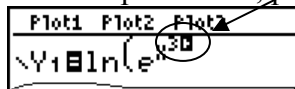


otherwise these are displayed as inline Classic equivalents in tight quarters (namely, the expression on the graph screen, WINDOW, TBLSET, TABLE, List entries, etc.)

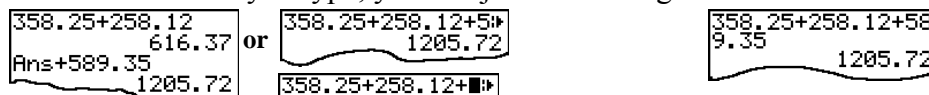
- Using the **n/d** soft key in AUTO or FRAC mode with nondecimal numbers gives you different results than the **÷** hard key.
 - n/d** soft key: **1** **ALPHA** [**F1**] **ENTER** **1** **2** will display $\frac{1}{12}$ as a stacked fraction in template form where the screen real estate permits (namely, just the **Home Screen** and **Y= editor**); otherwise it is displayed as a “thick bar inline fraction”, i.e. as $1\overline{)12}$, in tight quarters (WINDOW, TBLSET, TABLE, List entries, the expression on the graph screen, etc.)

- ÷** hard key: **1** **÷** **1** **2** will display $1\overline{)12}$, the usual “thin bar inline fraction” which gives you the decimal approximation in any mode. $\frac{1}{12} \approx .0833333333$

- Look at the screen as you type!
 In a math template arrows will appear as guideposts to steer you. Follow them.
 For example, if we want $Y_1 = \ln(e^{x^2+1}) + 1$, once you are in the exponent are, press **▶**. You may feel the urge to press **▼** to move down. Resist the urge.



- Because of the unpredictability of the height of the expression on the entry line when using templates in MathPrint™ Mode, entries and answers will not wrap as in Classic Mode; however, if you watch the screen as you type, you can just break longer calculations into smaller ones.



MathPrint™

Classic

You can also scroll horizontally in MathPrint™ Mode with the left and right arrow keys, as long as you make sure the expression is on the entry line.

More practically, if students in your class have a mix of TI-83's and un-enhanced TI-84's, it is likely you will be switching from CLASSIC to MATHPRINT anyway so that no OS user is left behind.

More Helpful Tips Related to 2.55MP features (from release notes by Margo Mankus)



- Notice when you are in **[ALPHA]** LOCK (for example, wherever there are list names). This happens in particular:

- if you are in a Wizard and your cursor sits on a Frequency list
- if in **[2nd]** STAT PLOT at a list name.

If you try to access the top row graphing keys **[Y=]** **[WINDOW]** **[ZOOM]** **[TRACE]** at this point, you will be taken into the shortcut menus. Keep one eye on the cursor and you will be fine.

- If prompted for Y1 through Y0, just press **[ALPHA]** **[TRACE]** to access the shortcut.



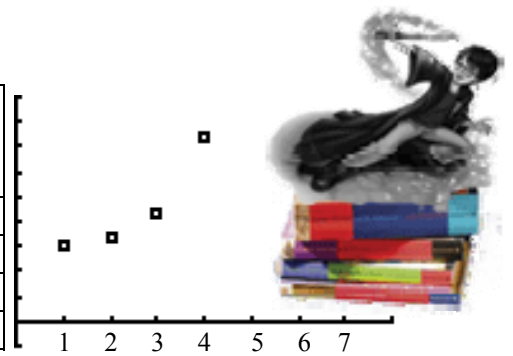
- When asked to do your bidding, notice some hard-working wizards will **Calculate** for you, some wizards will **Paste** the command for you to carry out yourself, and some in the Distribution menu will **Draw**. This means a wizard can call on other wizards as an intermediate step. If you just peruse one wizard after another, you may leave an unintended trail! Tip: when abandoning a wizard, just press **[2nd]** **QUIT** as many times as you needed and you will get to the home screen without disapparation difficulty.
- SinReg needs a value for Period for the calculation depending on the data set. Period is an optional argument. If left blank, the algorithm will calculate a period from the data which may or may not meet your needs. You may need to plot your data and estimate a “good” value for Period from your data to input as the Period argument. See education.ti.com/guides for details.
- If an argument in a wizard is required, you will have to fill in the argument with a legal value. You will not be able to arrow away from a blank required argument.
- Optional arguments are now displayed in wizards. Either leave the input area blank or learn more about how to use the optional arguments in the guidebook at education.ti.com/guides
- In the regression wizards, (STAT CALC menu), the frequency list (FreqList:) is an optional argument. FreqList accepts only list names. (The number 1 is not a legal entry as compared to Freq: in the STAT PLOT setup screens.)
- By request of Uncle Vernon and Aunt Petunia, no wizard functionality assists you if you select a function or command from [CATALOG]. From [CATALOG], the function or command will paste as in earlier versions of the OS.
- If you are using the TI-Nspire™ TI-84 Plus mode keypad, the OS version number is 2.56MP.



Use a Regression Wizard to Model a Nonlinear Relationship for Harry Potter Book Sizes

After the first four Harry Potter books were published, excitement stirred on what might be the size of the fifth book.

Title	Series Number, n	Size, pages, p
<i>Harry Potter and the Sorcerer's Stone</i>	1	309
<i>Harry Potter and the Chamber of Secrets</i>	2	341
<i>Harry Potter and the Prisoner of Azkaban</i>	3	435
<i>Harry Potter and the Goblet of Fire</i>	4	734



What curve could be a possible fit? Use your model to predict the size of the last three books.

- Press **MODE**, press \blacktriangle to move to the second page, and climb up to turn **STAT DIAGNOSTICS** on and set to **CLASSIC** so that equations in the **Y=** Editor will wrap.
- Enter the data in the **STAT** Editor, create a plot, and set up a window.

```

T-BCHT
MATHPRINT CLASSIC
UNIT Un/d
ANSWERS: AUTO DEC FRAC
GOTO FORMAT GRAPH: OFF YES
STAT DIAGNOSTICS: OFF OFF
STAT WIZARDS: OFF
SET CLOCK 02/21/11 11:50PM
    
```

```

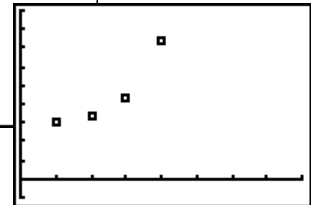
CALC TESTS
1:Edit...
2:ClrList
3:Del
4:
5:
L1 L2 L3 2
1 309 -----
2 341 -----
3 435 -----
4 734 -----
L2(5) =
    
```

```

STAT PLOTS
1:Plot1 Off
2:
3:
4:
Type:
Xlist: L1
Ylist: L2
Mark:
    
```

```

WINDOW
Xmin=0
Xmax=8
Xscl=1
Ymin=0
Ymax=1000
Yscl=100
Xres=1
    
```



- Suppose you wish to model the data with a cubic polynomial. Since there are only four data points, it will pass through each of the four data points. Follow the prompts.

```

CALC TESTS
1:Edit...
2:So EDIT TESTS
3:So 1:1-Var Stats
4:Cl 2:2-Var Stats
5:Se 3:Med-Med
4:LinReg(ax+b)
5:QuadReg
6:CubicReg
7:QuartReg
    
```

```

CubicReg
Xlist:L1
Ylist:L2
FreqList:
Store RegEQ:
Calculate
    
```

```

CubicReg
Xlist:L1
Ylist:L2
FreqList:
Store RegEQ:
Calculate
    
```

```

CubicReg
Xlist:L1
Ylist:L2
FreqList:
Store RegEQ:
Calculate
    
```

- After the equation is displayed on the home screen, press \blacktriangle to see the syntax. Press **Y=**. Compare with the roundoff on the home screen.

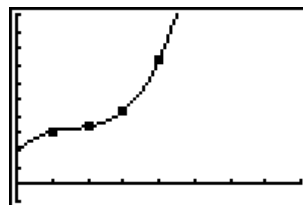
```

CubicReg
y=ax^3+bx^2+cx+d
a=23.83333333
b=-112
c=201.1666667
d=196
R^2=1
    
```

```

Plot2 Plot3
Y1=23.83333333
336X^3+-112.0000
0000002X^2+201.1
6666666671X+195.
99999999997
Y2=
Y3=
    
```

- Press **GRAPH** and then observe a table.



```

TABLE SETUP
TblStart=0
ΔTbl=1
Indent: Auto Ask
Depend: Auto Ask
    
```

X	Y1
0	196
1	309
2	341
3	435
4	734
5	1381
6	2519

Press + for Δ|b|

Compare with a shifted exponential function fit, $y = 306 + 2.68e^{1.27x}$, by Alan Kaminsky, Department of Computer Science, Rochester Institute of Technology, who provides an entertaining analysis at www.cs.rit.edu/~ark/hpbs.shtml.

Extension

The fifth Harry Potter book was actually 870 pages long. Use a wizard to create a quartic model through these five points, store it in Y_2 , and observe the graph. Do you think this is a good model? Discuss.

L1	L2	L3	Z
1	309	-----	
2	341		
3	435		
4	734		
5	870		

Quartic9 Xlist:L1 Ylist:L2 FracList: Store RegEQ:Y2 Calculate

Use n/d and Wizard Support for SEQ While Undertaking Adventures at the Hogshhead

Harry and Hermione get drinks at the Hogshhead.
Harry orders a fire whiskey and water at 60% strength. Assume Harry is poured a 5 oz drink.

Since Harry has his O.W.L.S. exams the next day,
Hermoine continually adds pure water to dilute the drink!
Let $P = H(w)$ be the fractional percentage of fire whiskey in Harry’s drink
if w ounces of **water** are added.

Assume Hermoine has enough talent to build a glass to any height she needs.

a. Fill in some values in the table.
In the last column, report values as fractions. (To better see a pattern, don’t reduce the fractions.)

b. State the domain and range of H .

domain: _____
range: _____

What does your answer mean in the context of Harry’s drink?

c. Plot the points (w, P) in an appropriate viewing window.
Report your window here:

$$\boxed{} \leq w \leq \boxed{}$$

$$\boxed{} \leq H(w) \leq \boxed{}$$

Amt of water added, w (oz)	Amt of fire whiskey (oz)	Amt of total drink (oz)	Fractional percentage of fire whiskey in the mix, P (These fractions need not be simplified.)

- d. Use the n/d soft key instead of the $\frac{\square}{\square}$ hard key. Use a wizard to help you build a sequence to fill your STAT Editor with lots of rows.
- e. Find a formula for H in terms of w . $H(w) =$
Make sure you are in MATHPRINT mode, and insert your formula in the Y= editor.
- f. Discuss what happens to the function as w increases without bound.

More Adventures at the Hogshead

Draco Malfoy is at the Hogshead looking for some liquid courage. He also orders a fire whiskey and water at 60% strength. Assume he also is poured a 5 oz drink.

Draco’s crazy Aunt Bella continually adds pure fire whiskey to strengthen it!

Let $P = D(w)$ be the fractional percentage of fire whiskey in the Draco’s drink if w oz of **fire whiskey** are added.

- a. Fill in some values in the table.
In the last column, report values as fractions. (Again, to better see a pattern, don’t reduce the fractions.)

- b. State the domain and range of D .

domain: _____
range: _____

What does your answer mean in the context of Draco’s drink?

- c. Plot the points (w, P) in an appropriate viewing window.
Report your window here:

$$\boxed{} \leq w \leq \boxed{}$$

$$\boxed{} \leq D(w) \leq \boxed{}$$

Amt of fire whiskey added, w (oz)	Amt of fire whiskey (oz)	Amt of total drink (oz)	Fractional percentage of fire whiskey in the mix, P (These fractions need not be simplified.)

- d. Use a wizard to help you build a sequence to fill your STAT Editor with lots of rows.
e. Find a formula for D in terms of w .

$D(w) =$ _____

Make sure you are in MATHPRINT mode, and insert your formula in the Y= editor.

- f. Discuss what happens to the function as w increases without bound.

Some additional examples which follow highlight the features of 2.55MP that were launched in 2.53 MP.

Use the ΔTbl Shortcut to Help You Concoct a Potion for Professor Snape



Professor Snape appears at the Hogshead.

The Potions Master inquires:

how much whiskey must be added to make the concoction 98.25% strength?

He requires an answer accurate to the nearest 0.1 oz.

1. Press 2nd WINDOW to match the screen shown to the right. Suppose we scroll the table by 10 oz. increments.

X	Y ₂	Y ₃
0	3/5	.98
10	13/15	.98
20	23/25	.98
30	33/35	.98
40	43/45	.98
50	53/55	.98
60	63/65	.98

X	Y ₂	Y ₃
0	3/5	.98
10	13/15	.98
20	23/25	.98
30	33/35	.98
40	43/45	.98
50	53/55	.98
60	63/65	.98

2. Since n/d gives fractions instead of decimals, just modify the formula (either by pressing Y= or sitting your cursor on top of Y_2 in the table and pressing ENTER .)
If any one of the integers is a decimal, all outputs will be displayed as decimal instead of as fractional approximations.
For example, change 3 to 3.0 (or even 3. will work, i.e. $Y_2 = \frac{X+3.0}{X+5}$)

Now scroll to find the number of ounces to the nearest integer.

3. Position your cursor on the input whose output is closest to, but less than 0.9825.
In this case, we highlight 100.

X	Y ₂	Y ₃
70	.97333	
80	.97647	
90	.97895	
100	.98095	
110	.98261	
120	.984	
130	.98519	

X=100

4. Press + . You will get a prompt for ΔTbl . Change ΔTbl to 1. Press ENTER .

X	Y ₂	Y ₃
70	.97333	
80	.97647	
90	.97895	
100	.98095	
110	.98261	
120	.984	
130	.98519	

$\Delta Tbl=10$

X	Y ₂	Y ₃
70	.97333	
80	.97647	
90	.97895	
100	.98095	
110	.98261	
120	.984	
130	.98519	

$\Delta Tbl=1$

5. Your TblStart is now 100 with $\Delta Tbl=1$.
Scroll the table to position the cursor on the input whose output is closest, but less than 0.9825.
In this case, we highlight 109.

X	Y ₂	Y ₃
100	.98095	
101	.98113	
102	.98131	
103	.98148	
104	.98165	
105	.98182	
106	.98198	

X=100

X	Y ₂	Y ₃
105	.98182	
106	.98198	
107	.98214	
108	.9823	
109	.98246	
110	.98261	
111	.98276	

X=109

6. Press + and change ΔTbl to 0.1. Press ENTER .
Adding 109.3 ounces of fire whiskey will make a drink which is 98.25% strength.

X	Y ₂	Y ₃
105	.98182	
106	.98198	
107	.98214	
108	.9823	
109	.98246	
110	.98261	
111	.98276	

$\Delta Tbl=.1$

X	Y ₂	Y ₃
109.3	.98246	
109.1	.98247	
109.2	.98249	
109.3	.9825	
109.4	.98252	
109.5	.98253	
109.6	.98255	

X=109

Try other approaches, such as graphically, analytically, or with a solver, shown below:

1: NUM CPX PRB
2: fMin()
3: fMax()
4: nDeriv()
5: fnInt()
6: summation Σ
7: logBASE()
8: Solver...

Y1	Y6
Y2	Y7
Y3	Y8
Y4	Y9
Y5	Y0

FRAC|FUNC|HFAH|VVAR

Y1	Y6
Y2	Y7
Y3	Y8
Y4	Y9
Y5	Y0

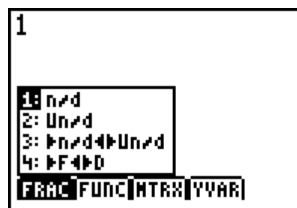
FRAC|FUNC|HFAH|VVAR

Y ₂ -.9825=0
X=100
bound=(-1e99,1...

Y ₂ -.9825=0
X=109.28571428...
bound=(-1e99,1...
left-rt=0

Use Stacked Fractions, Scrolling History, and Zoom Features to Investigate Patterns!

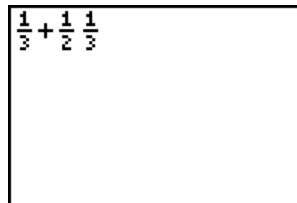
1. Press $\boxed{1}$.
2. Press $\boxed{\text{ALPHA}}$ $\boxed{[F1]}$ to get to the shortcut FRAC menu.



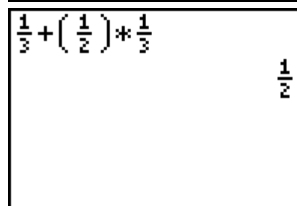
3. Press $\boxed{\text{ENTER}}$ or $\boxed{1}$ to select n/d .



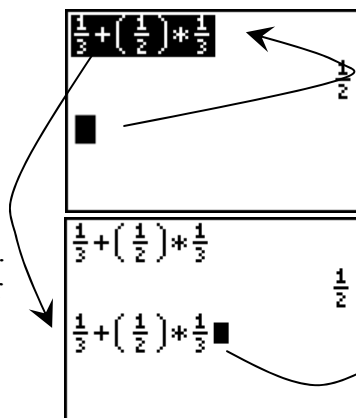
4. Press $\boxed{3}$ $\boxed{\rightarrow}$ $\boxed{+}$ $\boxed{1}$ $\boxed{\text{ALPHA}}$ $\boxed{[F1]}$ $\boxed{\text{ENTER}}$ $\boxed{2}$ $\boxed{\rightarrow}$ $\boxed{1}$ $\boxed{\text{ALPHA}}$ $\boxed{[F1]}$ $\boxed{\text{ENTER}}$ $\boxed{3}$ $\boxed{\rightarrow}$



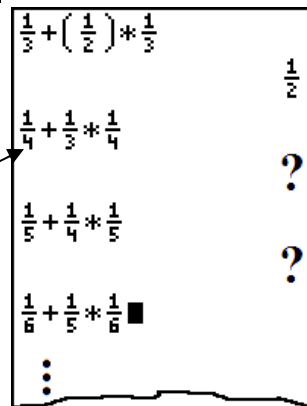
5. Press $\boxed{\text{ENTER}}$ (to say "please").



6. Press the $\boxed{\uparrow}$ key twice to climb up the tree and highlight the expression. Press $\boxed{\text{ENTER}}$ to "pluck the fruit off the tree."



7. Press $\boxed{2nd}$ $\boxed{\leftarrow}$ to go to the beginning of the line. Change the expression to increase each denominator by 1. Press $\boxed{\text{ENTER}}$.



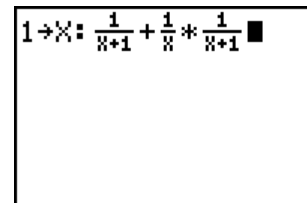
8. Repeat.

Questions:

1. What pattern do you notice? Will it always work?
2. If you entered $\frac{1}{100} + \frac{1}{99} * \frac{1}{100}$ what would you expect? Confirm your guess.

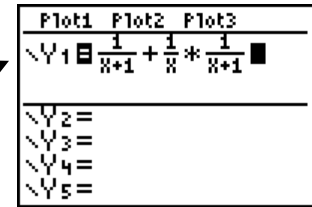
3. Explore $\frac{1}{x+1} + \frac{1}{x} * \frac{1}{x+1}$ on the home screen for values of x of your choice.

Store a number in x : $\boxed{1}$ $\boxed{\text{STO}}$ $\boxed{\rightarrow}$ $\boxed{X,T,\theta,n}$ $\boxed{\text{ALPHA}}$ $\boxed{[:]}$, then "climb the tree" by pressing the $\boxed{\uparrow}$ key twice, press $\boxed{\text{ENTER}}$ to pluck the fruit, and replace numbers with variable expressions.



- Replay, using $\boxed{2nd}$ $\boxed{\leftarrow}$ to go to the beginning of the line and make x any nondecimal value you wish. What do you observe?
- Explore the graph of $y = \frac{1}{x+1} + \frac{1}{x} \cdot \frac{1}{x+1}$

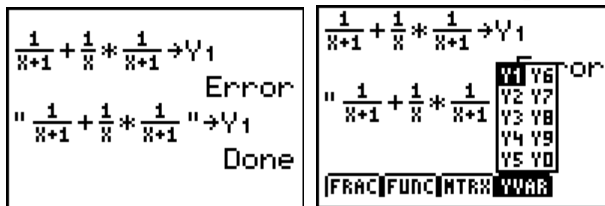
Replay, use the delete key so only you have $\frac{1}{x+1} + \frac{1}{x} \cdot \frac{1}{x+1}$ on the entry line, and press \boxed{ENTER} .



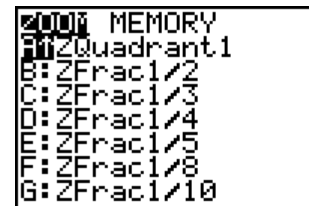
Press $Y=$, position your cursor in $Y1$, and press $\boxed{2nd}$ \boxed{ENTER} to “beam the expression up” into $Y1$.

Alternate Approach:

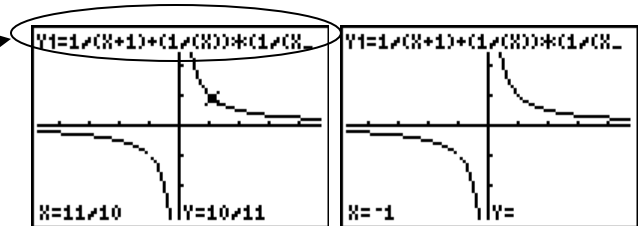
(You can also do this from the home screen but must use quotes. Use \boxed{ALPHA} $\boxed{[F4]}$ \boxed{ENTER} to quickly get $Y1$.)



- Press \boxed{ZOOM} and scroll to see some neat options. Use $\boxed{ZFract1/10}$, press \boxed{TRACE} , and use the left and right arrow keys. Note: $\boxed{ZFract1/10}$ sets the window variables so that you can trace in increments of $\frac{1}{10}$, if possible, and sets ΔX and ΔY to $\frac{1}{10}$.



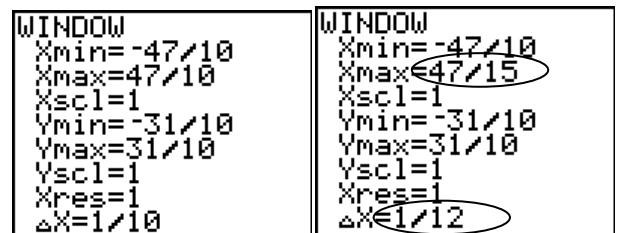
Notice the graph equation is in classic format. (Instead of a stacked fraction, n/d is shown as a thick bar inline fraction.) Compare the graph coordinate values as you trace.



What is happening when $x = -1$?

Press \boxed{GRAPH} to liberate the cursor from the curve and observe the screen coordinates in this window.

- Press \boxed{WINDOW} . Scroll to notice ΔX has now joined the party! $\boxed{ZFract1/10}$ uses thick bar inline fractions for $Xmin$, $Xmax$, $Ymin$, $Ymax$, and ΔX .



Want $\boxed{ZFract1/12}$ instead?

You can make it (or others) yourself. Change ΔX to $1/12$.

(This adjusts $Xmin$ or $Xmax$ since $\Delta x = \frac{Xmax - Xmin}{94}$.) Press \boxed{GRAPH} and \boxed{TRACE} .

Notice it converts coordinates when possible. There is no longer a hole showing at $x = -1$. Why not? Make the adjustment $Xmin = -47/12$ to center the window.

Now press \boxed{GRAPH} and \boxed{TRACE} . Voila! There's the hole.

- Build the motivation to get a common denominator and show $\frac{1}{x+1} + \frac{1}{x} \cdot \frac{1}{x+1}$ is algebraically $\frac{1}{x}$.

Use the ΔTbl Shortcut to Help Harry Use the Power of Compound Interest

Harry invests 200 galleons in Gringotts bank, compounded quarterly at 6 percent APR.

Find how long it takes for it to grow to 475 galleons.

Report your answer correct to the nearest 0.1 year.

Advantages: This is a quick way to find approximate solutions, since you often use the table to help build the graphing window anyway.

It also provides an avenue for multiple perspectives.

Plot1	Plot2	Plot3
$\sqrt{Y_1} = 200 \left(1 + \frac{.06}{4}\right)^{4X}$		
$\sqrt{Y_2} =$		
$\sqrt{Y_3} =$		
$\sqrt{Y_4} =$		
$\sqrt{Y_5} =$		

1. Enter the expression in Y1 and press $\boxed{2nd}$ \boxed{WINDOW} to match the screen shown to the right.

TABLE SETUP	
TblStart=0	
$\Delta Tbl=1$	
Indnt: Auto Ask	
Depnd: Auto Ask	

2. Scroll the table to find when the amount is closest to 475.

X	Y1
0	200
1	212.27
2	225.3
3	239.12
4	253.8
5	269.37
6	285.9

Press + for ΔTbl

3. Position your cursor on the input whose output is closest to 475. In this case, we highlight 14.

X	Y1
11	385.07
12	408.7
13	433.77
14	460.39
15	488.64
16	518.63
17	550.45

X=14

4. Press $\boxed{+}$ and change ΔTbl to 0.1. Press \boxed{ENTER} . It will take about 14.5 years to reach 475 galleons.

X	Y1
11	385.07
12	408.7
13	433.77
14	460.39
15	488.64
16	518.63
17	550.45

$\Delta Tbl=.1$

X	Y1
14	460.39
14.1	463.14
14.2	465.91
14.3	468.69
14.4	471.49
14.5	474.31
14.6	477.14

X=14.5

To approximate the answer to 0.01 years, we need only repeat the last two steps, setting ΔTbl to 0.01.

It will take about 14.52 years to reach 475 galleons.

Support the answer with a graphical and analytical solution, or use the equation solver in the \boxed{MATH} MATH menu.

X	Y1
14	460.39
14.1	463.14
14.2	465.91
14.3	468.69
14.4	471.49
14.5	474.31
14.6	477.14

X=14.5

X	Y1
14	460.39
14.1	463.14
14.2	465.91
14.3	468.69
14.4	471.49
14.5	474.31
14.6	477.14

$\Delta Tbl=.01$

X	Y1
14.48	473.74
14.49	474.03
14.5	474.31
14.51	474.59
14.52	474.87
14.53	475.16
14.54	475.44

X=14.52

Another example: Consider using the table to explore the behavior of $y = \frac{x^2 - 4}{x - 2}$ near $x = 2$.

Use $\log_b x$ to Build Conceptual Understanding of the Logarithm

1. Compare the expressions on the screen to the right.
 Notice the usual order of operations are followed.
 Unveil $\log_2(4)^3 = (\log_2(4))^3 = (\log_2 2^2)^3 = (2)^3 = 8$
 and $\log_2(4^3) = \log_2(2^2)^3 = \log_2(2^6) = 6$

$\log_2(4)^3$	8
$\log_2(4^3)$	6

Explore with a table and a graph.

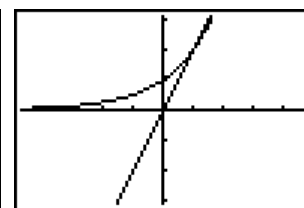
What is simplified form of each?

Plot1	Plot2	Plot3
$Y_1 = \log_2(4)^x$		
$Y_2 = \log_2(4^x)$		
$Y_3 =$		
$Y_4 =$		
$Y_5 =$		

Do they look more familiar now?
 Superimpose graphs of $y = 2^x$ and $y = 2x$ over each.
 Facilitate a class discussion on inverse properties.

X	Y1	Y2
0	1	0
1	2	2
2	4	4
3	8	6
4	16	8
5	32	10
6	64	12

Press + for $\Delta|b|$



2. Consider the function $y = \log_x 10$.

Enter the expression in Y1.

Plot1	Plot2	Plot3
$Y_1 = \log_x(10)$		

Press 2nd WINDOW to match the screen shown to the right,
 where **IndEnt** is set to Ask.

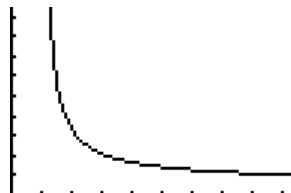
TABLE SETUP		
TblStart=0		
Δ Tbl=1		
Indent: Auto	Ask	
Depend: Auto	Ask	

Explore with a table, where x is a power of 10.

X	Y1	
10	1	
100	1/2	
1000	1/3	
10000	1/4	
1*10	-1	

X=

Explore with a graph after, say, ZoomQuadrant1.



Simplify the function $y = \log_x 10$ so that x is not the logarithmic base.
 Compare tables and graph the result in the same window.

Answer: $y = \frac{1}{\log x}$

3. Perform a similar investigation with the function $y = \log_x e$,
 exploring in a table values of x which are powers of e .
 What is another way to write this function, where x is not the logarithmic base?

Scroll Through the History to Build the Sum of a Sequence

1. Using the scrolling history we can successively build up the series below.

- a. Create these expressions on your home screen. Use **n/d** once.
No need to use the parentheses keys at all.

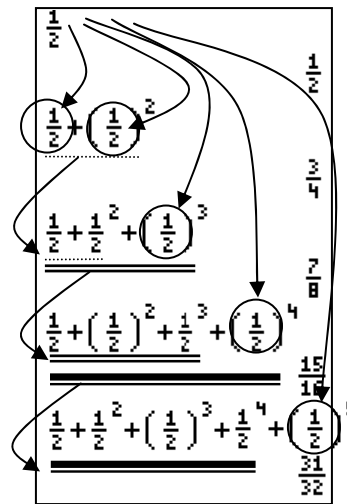
$$\frac{1}{2}$$

$$\frac{1}{2} + \left(\frac{1}{2}\right)^2 =$$

$$\frac{1}{2} + \left(\frac{1}{2}\right)^2 + \left(\frac{1}{2}\right)^3 =$$

$$\frac{1}{2} + \left(\frac{1}{2}\right)^2 + \left(\frac{1}{2}\right)^3 + \left(\frac{1}{2}\right)^4 =$$

$$\frac{1}{2} + \left(\frac{1}{2}\right)^2 + \left(\frac{1}{2}\right)^3 + \left(\frac{1}{2}\right)^4 + \left(\frac{1}{2}\right)^5 =$$



- b. Can you predict the next one?

Now use sigma notation $\sum_{k=1}^n \left(\frac{1}{2}\right)^k$ using the **ALPHA** [F2] shortcut to make four more.

What pattern do you see with the total sums?

- c. Is the sum getting bigger or smaller? Is the number we are adding each time getting bigger or smaller? Is the sum approaching a number? Explain your answer.

2. Pose new questions and make conjectures:

- a. Suppose your first number for finding sums as in the previous problem was $\frac{1}{3}$ instead of $\frac{1}{2}$.

Use the same pattern as the one used above and investigate the sums in the same manner.

- b. Try the same investigation with $\frac{1}{4}$.

- c. What is the pattern if you use $\frac{1}{5}$?

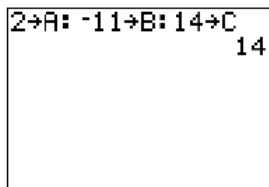
- d. Does a pattern hold for $\frac{2}{5}$?

- e. What happens if you use $\frac{3}{2}$?

An Old Favorite Cleans Up Well: The Quadratic Formula*

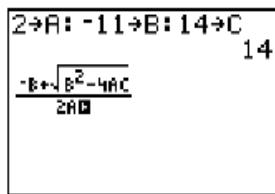
Begin with the equation $2x^2 - 11x + 14 = 0$.

1. Press **2** **[STO]** **[ALPHA]** **A** to store the coefficient of the x^2 term.
2. Press **[ALPHA]** **[:]**. The colon allows you to enter more than one instruction on a line.
3. Press **(-)** **11** **[STO]** **[ALPHA]** **B** to store the coefficient of the X term. Press **[ALPHA]** **[:]** to enter a new instruction on the same line. Press **14** **[STO]** **[ALPHA]** **C** to store the constant.
4. Press **[ENTER]** to store the values to the variables A, B, and C.
5. The last value you stored is shown on the right side of the display. The cursor moves to the next line, ready for your next entry.

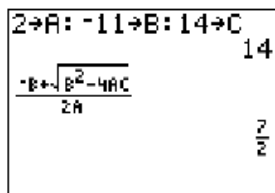


6. Press **[ALPHA]** **[F1]** **1** **[ALPHA]** **B** **[+]** **[2nd]** **[√]** **[ALPHA]** **B** **[x²]** **-** **4** **[ALPHA]** **A** **[ALPHA]** **C** **[*]** **[2]** **[ALPHA]** **A** to enter the expression for one of the solutions for the quadratic formula,

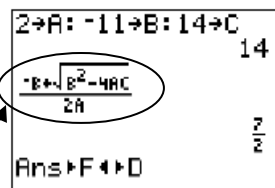
$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$



7. Press **[ENTER]** to find one solution for the equation $2x^2 - 11x + 14 = 0$.
The answer is shown on the right side of the display. The cursor moves to the next line, ready for you to enter the next expression.



8. Convert to a decimal if desired.
9. To find the other solution, press the UP arrow to highlight the expression, press **ENTER**, edit as appropriate, and press **ENTER**.

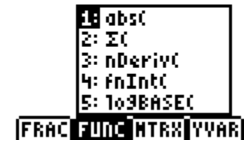
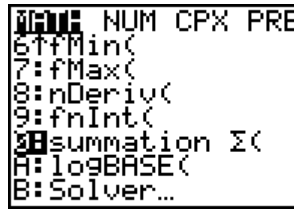


*The above is taken from the updated TI-84 Plus / TI-84 Silver Edition guidebook, available online at <http://education.ti.com/84> for download.

Summary of New Functionality

From the **MATH** MATH menu or **ALPHA** [F2]:

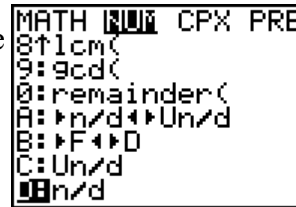
- **Summation** Σ (*expression, start, end*) displays the MathPrint™ summation entry template $\sum_{start}^{end} (expression)$ and returns the sum of elements of *list* from *start* to *end*, where *start* \leq *end*.
- **logBASE**(*value, base*) displays the template $\log_{base}(value)$ and returns $\log_{base} value$.



From the **MATH** NUM menu or **ALPHA** [F1]:

- **remainder**(*dividend, divisor*) reports the remainder as a whole number from a division of two whole numbers where the divisor is not zero.

remainder(125, 2)
1

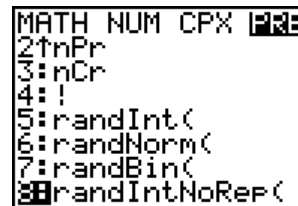


- Converts the results from a fraction to mixed number (**Un/d**) or from a mixed number to a fraction (**n/d**), if applicable.
- Converts an answer from a fraction to a decimal or from a decimal to a fraction.
- **Un/d** displays results as a mixed number, if applicable. $\frac{a}{b}$
The unit, numerator and denominator are limited to three digit integers.
- **n/d** displays results as a simple fraction, if possible. $\frac{a}{b}$
The numerator and denominator are limited to five digit integers.
Complex arithmetic is not supported using **n/d**.

From the **MATH** PRB menu:

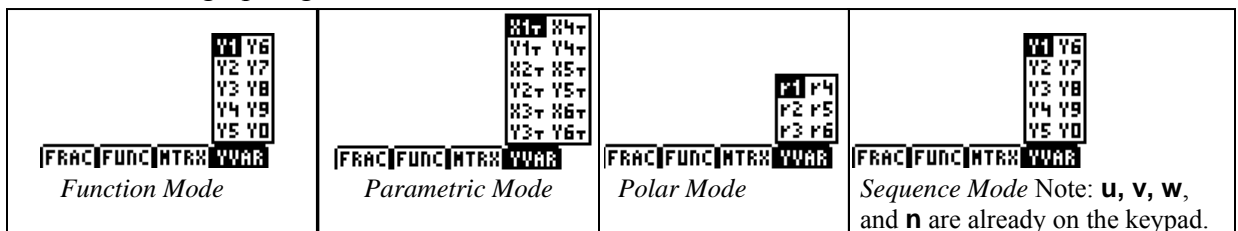
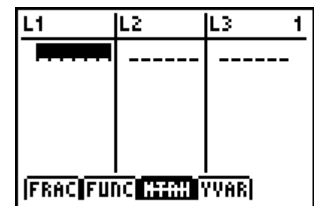
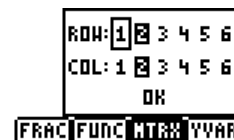
- **RandIntNoRep**(*startnum, endnum*) gives a random reordering of an interval of integers.

randIntNoRep(1, 5)
(1 3 2 5 4)
randIntNoRep(1, 5)
(4 5 1 2 3)
randIntNoRep(1, 5)
(3 2 5 1 4)



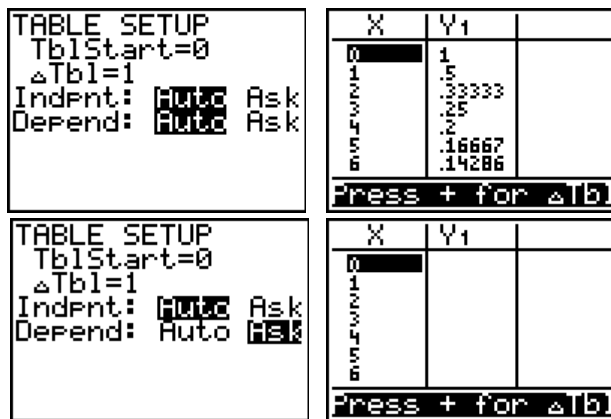
Other Menu Shortcuts:

- **MTRX** Shortcut through **ALPHA** [F3] may be crossed out when it can't fit in one line, i.e., outside of Home Screen or Y= Editor or when in Classic Mode.
- **YVAR** Shortcut through **ALPHA** [F4] is tied to graphing mode.



Shortcuts continued:

- Scroll through the history of calculations on the home screen in MathPrint™ or Classic mode. Quickly recall an input/output by simply highlighting it and pressing enter. (Lists and matrices as output will not paste from the history)
- Use the Δ Tbl Shortcut when IndPnt is set to Auto.



- Jumping to Format screen from second page of Mode screen facilitates classroom housekeeping.
- Stat Diagnostics display controls are easily accessible.



Compatibility with Programs

- Programs created with OS 2.43 and earlier should run correctly but may give unexpected results when you run them using OS 2.53MP or OS 2.55MP. You should test programs created with earlier OS versions to make sure you get the desired results. In particular, some programmers write strings without closing quotation marks or expressions without closing parentheses. Break this habit now to avoid unexpected results.
- Programs can run in Classic or MathPrint™ mode.
- Shortcut menus are available wherever the MATH menu can be accessed.
- MathPrint™ templates are not available for programs. All input and output is in Classic format.
- You can use fractions in programs, but you should test the program to make sure that you get the desired results.
- The spacing of the display may be slightly different in MathPrint™ mode than in Classic mode. (In MathPrint™ Mode, the entire screen prints pixel by pixel. In Classic Mode, the screen prints line by line.) You may notice that programs run slightly slower in MathPrint Mode. If you prefer the spacing in Classic mode, set the mode using a command in your program.
- If a program dumps output to the Home Screen, it is not possible to access it by arrowing up through the scrolling history. (Recall you could not access it with $\boxed{2nd}$ [ENTRY] either.)

Compatibility with Apps Released Before 2/15/2010

APPS developed prior to OS V 2.53MP will still run on the TI-84 Plus family in a classic format entry. For example, Transformation Graphing and Inequality Graphing Y= will be in classic format. The new features of MathPrint (templates and fraction math) will not be enabled since the APPS were developed for previous OS versions.

TI-Navigator will not accept the new MathPrint or fraction entry features as was true for new features that appeared in the 2.43 OS.



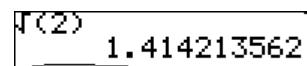
Remember, any version of Catalog Help prior to 1.1 is not compatible with 2.53MP or 2.55MP.

Carpe Deim!

Effective use of technology requires understanding what the machine is doing. Otherwise it is easy to be misled.

This is a finite decimal machine. Always has been. Always will be. It tries to behave, however, as if it is not.

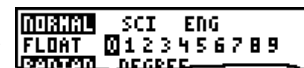
For example, ask *any* programmable device to compute $\sqrt{2}$.



```
√(2)
1.414213562
```

That's a nice approximation, but we know there is a lot more after that, in fact, 1.414213562373095048801688724209698078569671875376948073176679737990732478...

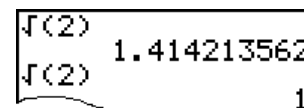
If you change the Mode to "Fixed 0", you may get unexpected results.



```
NORMAL SCI ENG
FLOAT 0 1 2 3 4 5 6 7 8 9
FIXED 0 DEGREE
```

Why did it do this?

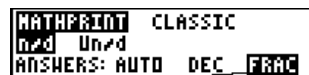
Because you asked it to display it that way. ☺



```
√(2)
1.414213562
√(2)
1
```

Now with TI-84 Plus OS Update 2.53MP and later, the **Frac** command is more powerful than ever, displaying any result as a fraction, if possible, where the numerator and denominator can be up to five digits. Wow!

So, if you change the Mode to "FRAC", and compute some anomalous irrational numbers (and these are not easy to find!), you may get unexpected results.



```
MATHPRINT CLASSIC
Dnd Unnd
ANSWERS: AUTO DEC FRAC
```

Why did it do this?

Because you asked it to display it that way. ☺



```
5√3
70226
8109
```

The fraction command will approximate the output, if possible, as a fraction.

Moral: In a technological age, users must understand what they are asking the machine to do.

If a student chooses to do the above, you have a wonderful teaching moment on your hands.

This is a classic example of "Garbage In-Garbage Out" (GIGO), i.e, when the user blames the machine for not "doing the right thing" when given imperfect input.

They will have to learn this lesson sooner or later, and the sooner the better.

Carpe Diem!