

Graphics calculator instructions

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In this course it is assumed that you have a **graphics calculator**. If you learn how to operate your calculator successfully, you should experience little difficulty with future arithmetic calculations.

There are many different brands (and types) of calculators. Different calculators do not have exactly the same keys. It is therefore important that you have an instruction booklet for your calculator, and use it whenever you need to.

However, to help get you started, we have included here some basic instructions for the **Texas Instruments TI-83** and the **Casio fx-9860G** calculators. Note that instructions given may need to be modified slightly for other models.

GETTING STARTED

Texas Instruments TI-83

The screen which appears when the calculator is turned on is the **home screen**. This is where most basic calculations are performed.

You can return to this screen from any menu by pressing $\boxed{2\text{nd}}$ $\boxed{\text{MODE}}$.

When you are on this screen you can type in an expression and evaluate it using the $\boxed{\text{ENTER}}$ key.

Casio fx-9860g

Press $\boxed{\text{MENU}}$ to access the Main Menu, and select **RUN·MAT**.

This is where most of the basic calculations are performed.

When you are on this screen you can type in an expression and evaluate it using the $\boxed{\text{EXE}}$ key.

A

BASIC CALCULATIONS

Most modern calculators have the rules for **Order of Operations** built into them. This order is sometimes referred to as BEDMAS.

This section explains how to enter different types of numbers such as negative numbers and fractions, and how to perform calculations using grouping symbols (brackets), powers, and square roots. It also explains how to round off using your calculator.

NEGATIVE NUMBERS

To enter negative numbers we use the **sign change** key. On both the **TI-83** and **Casio** this looks like $\boxed{(-)}$.

Simply press the sign change key and then type in the number.

For example, to enter -7 , press $\boxed{(-)}$ 7.

FRACTIONS

On most scientific calculators and also the **Casio** graphics calculator there is a special key for entering fractions. No such key exists for the **TI-83**, so we use a different method.

Texas Instruments TI-83

To enter common fractions, we enter the fraction as a division.

For example, we enter $\frac{3}{4}$ by typing $3 \div 4$. If the fraction is part of a larger calculation, it is generally wise to place this division in brackets, i.e., $(3 \div 4)$.

To enter mixed numbers, either convert the mixed number to an improper fraction and enter as a common fraction *or* enter the fraction as a sum.

For example, we can enter $2\frac{3}{4}$ as $(11 \div 4)$ *or* $(2 + 3 \div 4)$.

Casio fx-9860g

To enter fractions we use the **fraction** key $\boxed{a/b/c}$.

For example, we enter $\frac{3}{4}$ by typing $3 \boxed{a/b/c} 4$ and $2\frac{3}{4}$ by typing $2 \boxed{a/b/c} 3 \boxed{a/b/c} 4$. Press $\boxed{\text{SHIFT}} \boxed{a/b/c}$ ($a\frac{b}{c} \leftrightarrow \frac{d}{c}$) to convert between mixed numbers and improper fractions.

SIMPLIFYING FRACTIONS & RATIOS

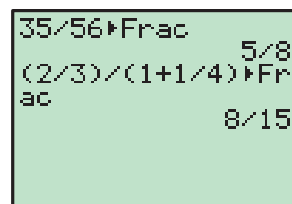
Graphics calculators can *sometimes* be used to express fractions and ratios in simplest form.

Texas Instruments TI-83

To express the fraction $\frac{35}{56}$ in simplest form, press $35 \div 56$ $\boxed{\text{MATH}} 1 \boxed{\text{ENTER}}$. The result is $\frac{5}{8}$.

To express the ratio $\frac{2}{3} : 1\frac{1}{4}$ in simplest form, press $(2 \div 3) \div (1 + 1 \div 4)$ $\boxed{\text{MATH}} 1 \boxed{\text{ENTER}}$.

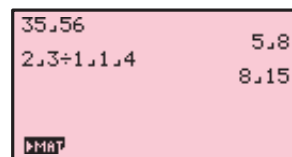
The ratio is 8 : 15.



Casio fx-9860g

To express the fraction $\frac{35}{56}$ in simplest form, press $35 \boxed{a/b/c} 56$ $\boxed{\text{EXE}}$. The result is $\frac{5}{8}$.

To express the ratio $\frac{2}{3} : 1\frac{1}{4}$ in simplest form, press $2 \boxed{a/b/c} 3 \div 1 \boxed{a/b/c} 1 \boxed{a/b/c} 4 \boxed{\text{EXE}}$. The ratio is 8 : 15.



ENTERING TIMES

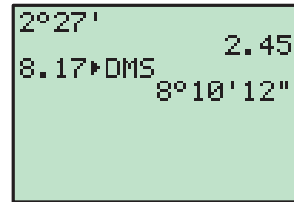
In questions involving time, it is often necessary to be able to express time in terms of hours, minutes and seconds.

Texas Instruments TI-83

To enter 2 hours 27 minutes, press 2 $\boxed{2\text{nd}}$ $\boxed{\text{MATRX}}$ $\boxed{2}$:'. This is equivalent to 2.45 hours.

To express 8.17 hours in terms of hours, minutes and seconds, press 8.17 $\boxed{2\text{nd}}$ $\boxed{\text{MATRX}}$ $\boxed{4}$:►DMS $\boxed{\text{ENTER}}$.

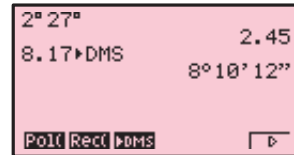
This is equivalent to 8 hours, 10 minutes and 12 seconds.

**Casio fx-9860g**

To enter 2 hours 27 minutes, press 2 $\boxed{\text{OPTN}}$ $\boxed{\text{F6}}$ $\boxed{\text{F5}}$ (ANGL) $\boxed{\text{F4}}$ (°) 27 $\boxed{\text{F4}}$ (°) $\boxed{\text{EXE}}$. This is equivalent to 2.45 hours.

To express 8.17 hours in terms of hours, minutes and seconds, press 8.17 $\boxed{\text{OPTN}}$ $\boxed{\text{F6}}$ $\boxed{\text{F5}}$ (ANGL) $\boxed{\text{F6}}$ $\boxed{\text{F3}}$ (►DMS) $\boxed{\text{EXE}}$.

This is equivalent to 8 hours, 10 minutes and 12 seconds.

**B****BASIC FUNCTIONS****GROUPING SYMBOLS (BRACKETS)**

Both the **TI-83** and **Casio** have bracket keys that look like $\boxed{[}$ and $\boxed{]}$.

Brackets are regularly used in mathematics to indicate an expression which needs to be evaluated before other operations are carried out.

For example, to enter $2 \times (4 + 1)$ we type 2 $\boxed{\times}$ $\boxed{[}$ 4 $\boxed{+}$ 1 $\boxed{]}$.

We also use brackets to make sure the calculator understands the expression we are typing in.

For example, to enter $\frac{2}{4+1}$ we type 2 $\boxed{\div}$ $\boxed{[}$ 4 $\boxed{+}$ 1 $\boxed{]}$. If we typed 2 $\boxed{\div}$ 4 $\boxed{+}$ 1 the calculator would think we meant $\frac{2}{4} + 1$.

In general, it is a good idea to place brackets around any complicated expressions which need to be evaluated separately.

POWER KEYS

Both the **TI-83** and **Casio** also have power keys that look like $\boxed{\wedge}$. We type the base first, press the power key, then enter the index or exponent.

For example, to enter 25^3 we type 25 $\boxed{\wedge}$ 3 .

Note that there are special keys which allow us to quickly evaluate squares.

Numbers can be squared on both **TI-83** and **Casio** using the special key $\boxed{x^2}$.

For example, to enter 25^2 we type 25 $\boxed{x^2}$.

SQUARE ROOTS

To enter square roots on either calculator we need to use a secondary function (see the **Secondary Function and Alpha Keys**).

Texas Instruments TI-83

The **TI-83** uses a secondary function key **2nd**.

To enter $\sqrt{36}$ we press **2nd** **x²** 36 **)**.

The end bracket is used to tell the calculator we have finished entering terms under the square root sign.

Casio fx-9860g

The Casio uses a shift key **SHIFT** to get to its second functions.

To enter $\sqrt{36}$ we press **SHIFT** **x²** 36.

If there is a more complicated expression under the square root sign you should enter it in brackets.

For example, to enter $\sqrt{18 \div 2}$ we press **SHIFT** **x²** **(** 18 **÷** 2 **)**.

ROUNDING OFF

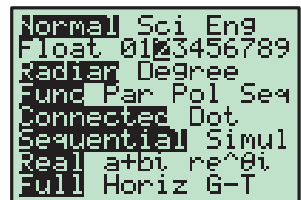
You can use your calculator to round off answers to a fixed number of decimal places.

Texas Instruments TI-83

To round to 2 decimal places, press **MODE** then **▼** to scroll down to Float.

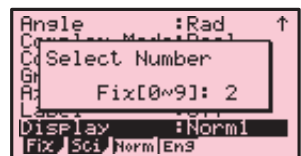
Use the **▶** button to move the cursor over the 2 and press **ENTER**. Press **2nd** **MODE** to return to the home screen.

If you want to unfix the number of decimal places, press **MODE** **▼** **ENTER** to highlight Float.



Casio fx-9860g

To round to 2 decimal places, select **RUN·MAT** from the Main Menu, and press **SHIFT** **MENU** to enter the setup screen. Scroll down to Display, and press **F1** (**Fix**). Press 2 **EXE** to select the number of decimal places. Press **EXIT** to return to the home screen.



To unfix the number of decimal places, press **SHIFT** **MENU** to return to the setup screen, scroll down to Display, and press **F3** (**Norm**).

INVERSE TRIGONOMETRIC FUNCTIONS

To enter inverse trigonometric functions, you will need to use a secondary function (see the **Secondary Function and Alpha Keys**).

Texas Instruments TI-83

The inverse trigonometric functions \sin^{-1} , \cos^{-1} and \tan^{-1} are the secondary functions of **SIN**, **COS** and **TAN** respectively. They are accessed by using the secondary function key **2nd**.

For example, if $\cos x = \frac{3}{5}$, then $x = \cos^{-1}\left(\frac{3}{5}\right)$.

To calculate this, press **2nd** **COS** **3** **÷** **5** **)** **ENTER**.

Casio fx-9860g

The inverse trigonometric functions \sin^{-1} , \cos^{-1} and \tan^{-1} are the secondary functions of **sin**, **cos** and **tan** respectively. They are accessed by using the secondary function key **SHIFT**.

For example, if $\cos x = \frac{3}{5}$, then $x = \cos^{-1}\left(\frac{3}{5}\right)$.

To calculate this, press **SHIFT** **cos** **(** **3** **÷** **5** **)** **EXE**.

SCIENTIFIC NOTATION

If a number is too large or too small to be displayed neatly on the screen, it will be expressed in scientific notation, that is, in the form $a \times 10^k$ where $1 \leq a \leq 10$ and k is an integer.

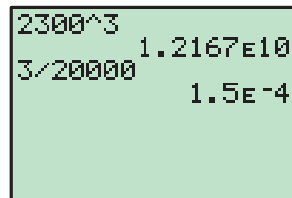
Texas Instruments TI-83

To evaluate 2300^3 , press **2300** **^** **3** **ENTER**. The answer displayed is **1.2167E10**, which means 1.2167×10^{10} .

To evaluate $\frac{3}{20000}$, press **3** **÷** **20000** **ENTER**. The answer displayed is **1.5E-4**, which means 1.5×10^{-4} .

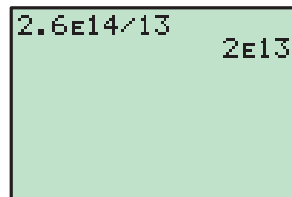
You can enter values in scientific notation using the EE function, which is accessed by pressing **2nd** **,**.

For example, to evaluate $\frac{2.6 \times 10^{14}}{13}$, press **2.6** **2nd** **,** **14** **÷** **13** **ENTER**. The answer is 2×10^{13} .



```

2300^3      1.2167E10
3/20000    1.5E-4
  
```

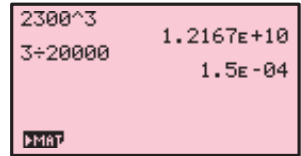


```

2.6E14/13  2E13
  
```

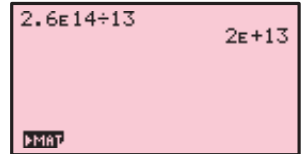
Casio fx-9860g

To evaluate 2300^3 , press 2300 $\boxed{\wedge}$ 3 $\boxed{\text{EXE}}$. The answer displayed is 1.2167E+10, which means 1.2167×10^{10} .



To evaluate $\frac{3}{20000}$, press 3 $\boxed{\div}$ 20000 $\boxed{\text{EXE}}$. The answer displayed is 1.5E-04, which means 1.5×10^{-4} .

You can enter values in scientific notation using the $\boxed{\text{EXP}}$ key. For example, to evaluate $\frac{2.6 \times 10^{14}}{13}$, press 2.6 $\boxed{\text{EXP}}$ 14 $\boxed{\div}$ 13 $\boxed{\text{EXE}}$. The answer is 2×10^{13} .



C SECONDARY FUNCTION AND ALPHA KEYS

Texas Instruments TI-83

The **secondary function** of each key is displayed in yellow above the key. It is accessed by pressing the $\boxed{2\text{nd}}$ key, followed by the key corresponding to the desired secondary function. For example, to calculate $\sqrt{36}$, press $\boxed{2\text{nd}}$ $\boxed{x^2}$ 36 $\boxed{)}$ $\boxed{\text{ENTER}}$.

The **alpha function** of each key is displayed in green above the key. It is accessed by pressing the $\boxed{\text{ALPHA}}$ key followed by the key corresponding to the desired letter. The main purpose of the alpha keys is to store values into memory which can be recalled later. Refer to the **Memory** section.

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The **shift function** of each key is displayed in yellow above the key. It is accessed by pressing the $\boxed{\text{SHIFT}}$ key followed by the key corresponding to the desired shift function.

For example, to calculate $\sqrt{36}$, press $\boxed{\text{SHIFT}}$ $\boxed{x^2}$ 36 $\boxed{\text{EXE}}$.

The **alpha function** of each key is displayed in red above the key. It is accessed by pressing the $\boxed{\text{ALPHA}}$ key followed by the key corresponding to the desired letter. The main purpose of the alpha keys is to store values which can be recalled later.

D MEMORY

Utilising the memory features of your calculator allows you to recall calculations you have performed previously. This not only saves time, but also enables you to maintain accuracy in your calculations.

SPECIFIC STORAGE TO MEMORY

Values can be stored into the variable letters A, B, ..., Z using either calculator. Storing a value in memory is useful if you need that value multiple times.

Texas Instruments TI-83

Suppose we wish to store the number 15.4829 for use in a number of calculations. Type in the number then press **STO▶**

ALPHA **MATH** (A) **ENTER**.

We can now add 10 to this value by pressing **ALPHA** **MATH**

+ 10 **ENTER**, or cube this value by pressing **ALPHA** **MATH**

^ 3 **ENTER**.

15.4829→A	15.4829
A+10	25.4829
A^3	3711.563767

Casio fx-9860g

Suppose we wish to store the number 15.4829 for use in a number of calculations. Type in the number then press **→** **ALPHA**

X,θ,T (A) **EXE**.

We can now add 10 to this value by pressing **ALPHA** **X,θ,T** **+**

10 **EXE**, or cube this value by pressing **ALPHA** **X,θ,T** **^** 3

EXE.

15.4829→A	15.4829
A+10	25.4829
A^3	3711.563767
▶MATH	

ANS VARIABLE

Texas Instruments TI-83

The variable **Ans** holds the most recent evaluated expression, and can be used in calculations by pressing **2nd** **(-)**.

For example, suppose you evaluate 3×4 , and then wish to subtract this from 17. This can be done by pressing 17 **-**

2nd **(-)** **ENTER**.

If you start an expression with an operator such as **+**, **-**, etc, the previous answer **Ans** is automatically inserted ahead of the operator. For example, the previous answer can be halved simply by pressing **÷** 2 **ENTER**.

If you wish to view the answer in fractional form, press **MATH**

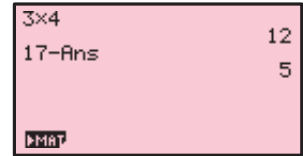
1 **ENTER**.

3*4	12
17-Ans	5

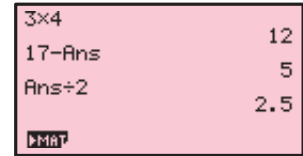
17-Ans	12
	5
Ans/2	2.5
Ans▶Frac	5/2

Casio fx-9860g

The variable **Ans** holds the most recent evaluated expression, and can be used in calculations by pressing **SHIFT** **(-)**. For example, suppose you evaluate 3×4 , and then wish to subtract this from 17. This can be done by pressing 17 **-** **SHIFT** **(-)** **EXE**.



If you start an expression with an operator such as **+**, **-**, etc, the previous answer Ans is automatically inserted ahead of the operator. For example, the previous answer can be halved simply by pressing **÷** 2 **EXE**.



If you wish to view the answer in fractional form, press **F↔D**.

RECALLING PREVIOUS EXPRESSIONS

Texas Instruments TI-83

The **ENTRY** function recalls previously evaluated expressions, and is used by pressing **2nd** **ENTER**.

This function is useful if you wish to repeat a calculation with a minor change, or if you have made an error in typing.

Suppose you have evaluated $100 + \sqrt{132}$. If you now want to evaluate $100 + \sqrt{142}$, instead of retyping the command, it can be recalled by pressing **2nd** **ENTER**.

The change can then be made by moving the cursor over the 3 and changing it to a 4, then pressing **ENTER**.

If you have made an error in your original calculation, and intended to calculate $1500 + \sqrt{132}$, again you can recall the previous command by pressing **2nd** **ENTER**.

Move the cursor to the first 0.

You can insert the digit 5, rather than overwriting the 0, by pressing **2nd** **DEL** 5 **ENTER**.

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Pressing the left cursor key allows you to edit the most recently evaluated expression, and is useful if you wish to repeat a calculation with a minor change, or if you have made an error in typing.

Suppose you have evaluated $100 + \sqrt{132}$.

If you now want to evaluate $100 + \sqrt{142}$, instead of retyping the command, it can be recalled by pressing the left cursor key.

Move the cursor between the 3 and the 2, then press **DEL** 4 to remove the 3 and change it to a 4. Press **EXE** to re-evaluate the expression.

E

LISTS

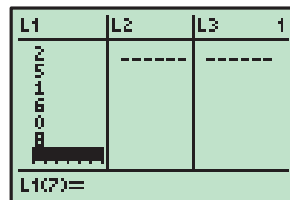
Lists are used for a number of purposes on the calculator. They enable us to enter sets of numbers, and we use them to generate number sequences using algebraic rules.

CREATING A LIST

Texas Instruments TI-83

Press **STAT** 1 to take you to the **list editor** screen.

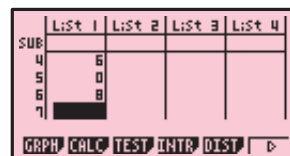
To enter the data {2, 5, 1, 6, 0, 8} into **List1**, start by moving the cursor to the first entry of **L1**. Press 2 **ENTER** 5 **ENTER** and so on until all the data is entered.



Casio fx-9860g

Selecting **STAT** from the Main Menu takes you to the **list editor** screen.

To enter the data {2, 5, 1, 6, 0, 8} into **List 1**, start by moving the cursor to the first entry of **List 1**. Press 2 **EXE** 5 **EXE** and so on until all the data is entered.



DELETING LIST DATA

Texas Instruments TI-83

Pressing **STAT** 1 takes you to the **list editor** screen.

Move the cursor to the heading of the list you want to delete then press **CLEAR** **ENTER** .

Casio fx-9860g

Selecting **STAT** from the Main Menu takes you to the **list editor** screen.

Move the cursor to anywhere on the list you wish to delete, then press **F6** (\triangleright) **F4** (**DEL-A**) **F1** (**Yes**).

REFERENCING LISTS

Texas Instruments TI-83

Lists can be referenced by using the secondary functions of the keypad numbers 1–6.

For example, suppose you want to add 2 to each element of **List1** and display the results in **List2**. To do this, move the cursor to the heading of **L2** and press **2nd** 1 **+** 2 **ENTER** .

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Lists can be referenced using the List function, which is accessed by pressing **[SHIFT]** **1**.

For example, if you want to add 2 to each element of **List 1** and display the results in **List 2**, move the cursor to the heading of **List 2** and press **[SHIFT]** **1** (**List**) **1** **[+]** **2** **[EXE]**.

Casio models without the List function can do this by pressing **[OPTN]** **[F1]** (**LIST**) **[F1]** (**List**) **1** **[+]** **2** **[EXE]**.

NUMBER SEQUENCES

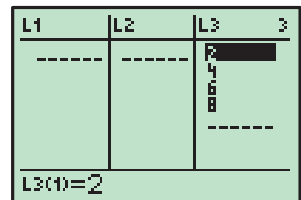
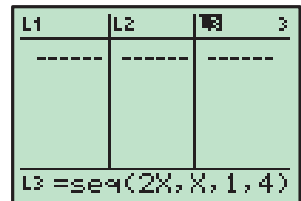
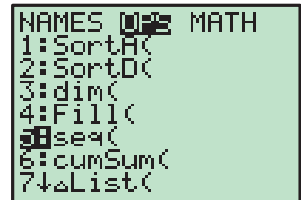
Texas Instruments TI-83

You can create a sequence of numbers defined by a certain rule using the *seq* command.

This command is accessed by pressing **[2nd]** **[STAT]** **[▶]** to enter the **OPS** section of the List menu, then selecting **5:seq**.

For example, to store the sequence of even numbers from 2 to 8 in **List3**, move the cursor to the heading of **L3**, then press **[2nd]** **[STAT]** **[▶]** **5** to enter the *seq* command, followed by **2** **[X,T,θ,n]** **[,]** **[X,T,θ,n]** **[,]** **1** **[,]** **4** **)** **[ENTER]**.

This evaluates $2x$ for every value of x from 1 to 4.



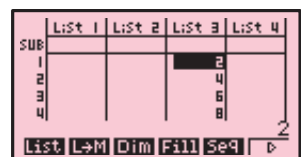
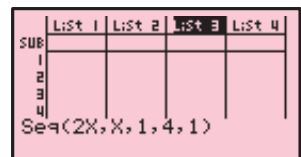
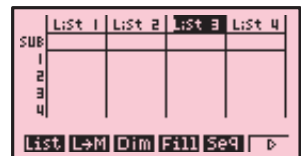
Casio fx-9860g

You can create a sequence of numbers defined by a certain rule using the *seq* command.

This command is accessed by pressing **[OPTN]** **[F1]** (**LIST**) **[F5]** (**Seq**).

For example, to store the sequence of even numbers from 2 to 8 in **List 3**, move the cursor to the heading of **List 3**, then press **[OPTN]** **[F1]** **[F5]** to enter a sequence, followed by **2** **[X,θ,T]** **[,]** **[X,θ,T]** **[,]** **1** **[,]** **4** **[,]** **1** **)** **[EXE]**.

This evaluates $2x$ for every value of x from 1 to 4 with an increment of 1.



F

STATISTICAL GRAPHS

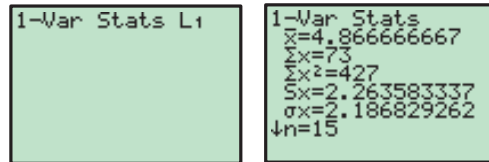
STATISTICS

Your graphics calculator is a useful tool for analysing data and creating statistical graphs.

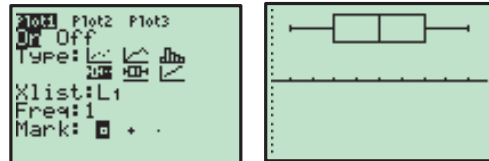
In this section we will produce descriptive statistics and graphs for the data set 5 2 3 3 6 4 5 3 7 5 7 1 8 9 5.

Texas Instruments TI-83

Enter the data set into **List1** using the instructions on page 18. To obtain descriptive statistics of the data set, press **STAT** **▸** **1:1-Var Stats** **▸** **2nd** **1 (L1)** **ENTER**.



To obtain a boxplot of the data, press **2nd** **Y=** (STAT PLOT) **1** and set up **Statplot1** as shown. Press **ZOOM** **9:ZoomStat** to graph the boxplot with an appropriate window.

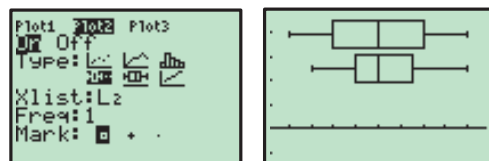
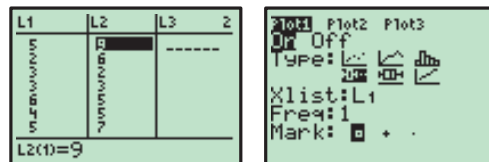


To obtain a vertical bar chart of the data, press **2nd** **Y=** **1**, and change the type of graph to a vertical bar chart as shown. Press **ZOOM** **9:ZoomStat** to draw the bar chart. Press **WINDOW** and set the **Xscl** to 1, then **GRAPH** to redraw the bar chart.



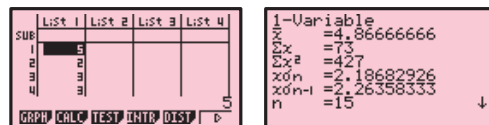
We will now enter a second set of data, and compare it to the first.

Enter the data set 9 6 2 3 5 5 7 5 6 7 6 3 4 4 5 8 4 into **List2**, press **2nd** **Y=** **1**, and change the type of graph back to a boxplot as shown. Move the cursor to the top of the screen and select **Plot2**. Set up **Statplot2** in the same manner, except set the **XList** to **L2**. Press **ZOOM** **9:ZoomStat** to draw the side-by-side boxplots.

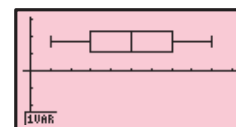
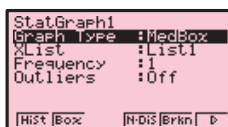


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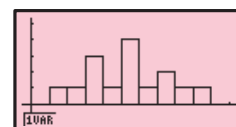
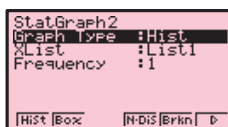
Enter the data into **List 1** using the instructions on page 18. To obtain the descriptive statistics, press **F6** (**▷**) until the **GRPH** icon is in the bottom left corner of the screen, then press **F2** (CALC) **F1** (1VAR).



To obtain a boxplot of the data, press **EXIT** **EXIT** **F1** (**GRPH**) **F6** (**SET**), and set up **StatGraph 1** as shown. Press **EXIT** **F1** (**GPH1**) to draw the boxplot.

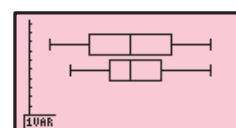
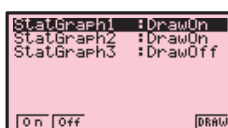
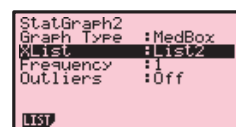
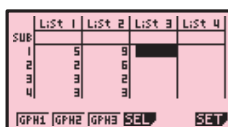


To obtain a vertical bar chart of the data, press **EXIT** **F6** (**SET**) **F2** (**GPH 2**), and set up **StatGraph 2** as shown. Press **EXIT** **F2** (**GPH 2**) to draw the bar chart (set Start to 0, and Width to 1).



We will now enter a second set of data, and compare it to the first.

Enter the data set 9 6 2 3 5 5 7 5 6 7 6 3 4 4 5 8 4 into **List 2**, then press **F6** (**SET**) **F2** (**GPH2**) and set up **StatGraph 2** to draw a boxplot of this data set as shown. Press **EXIT** **F4** (**SEL**), and turn on both **StatGraph 1** and **StatGraph 2**. Press **F6** (**DRAW**) to draw the side-by-side boxplots.

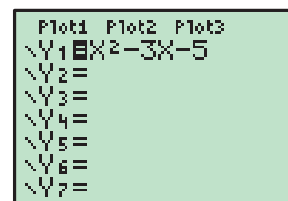


G WORKING WITH FUNCTIONS

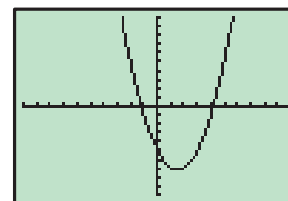
GRAPHING FUNCTIONS

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Pressing **Y=** selects the **Y=** editor, where you can store functions to graph. Delete any unwanted functions by scrolling down to the function and pressing **CLEAR**.



To graph the function $y = x^2 - 3x - 5$, move the cursor to **Y1**, and press **X,T,θ,n** **x²** **-** **3** **X,T,θ,n** **-** **5** **ENTER**. This stores the function into **Y1**. Press **GRAPH** to draw a graph of the function.



To view a table of values for the function, press **2nd** **GRAPH** (**TABLE**). The starting point and interval of the table values can be adjusted by pressing **2nd** **WINDOW** (**TBLSET**).

X	Y1
-3	13
-2	5
-1	-1
0	-5
1	-7
2	-5
3	1

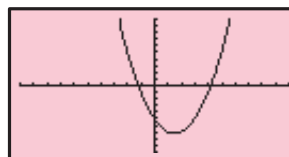
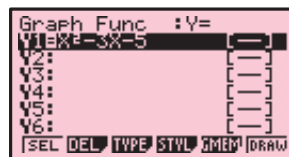
X = -3

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Selecting **GRAPH** from the Main Menu takes you to the Graph Function screen, where you can store functions to graph. Delete any unwanted functions by scrolling down to the function and pressing **[DEL]** **[F1]** (**Yes**).

To graph the function $y = x^2 - 3x - 5$, move the cursor to **Y1** and press **[X,θ,T]** **[x²]** **[−]** **3** **[X,θ,T]** **[−]** **5** **[EXE]**. This stores the function into **Y1**. Press **[F6]** (**DRAW**) to draw a graph of the function.

To view a table of values for the function, press **[MENU]** and select **TABLE**. The function is stored in **Y1**, but not selected. Press **[F1]** (**SEL**) to select the function, and **[F6]** (**TABL**) to view the table. You can adjust the table settings by pressing **[EXIT]** and then **[F5]** (**SET**) from the Table Function screen.



X	Y1
-3	13
-2	5
-1	-1
0	-5

-3

FORM DEL ROW EDIT G-COM G-PLT

FINDING POINTS OF INTERSECTION

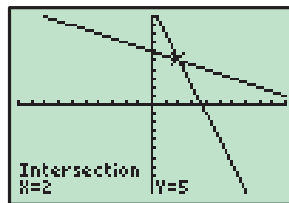
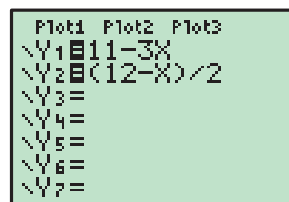
It is often useful to find the points of intersection of two graphs, for instance, when you are trying to solve simultaneous equations.

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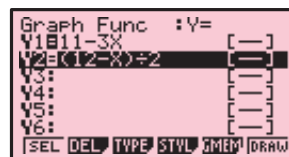
We can solve $y = 11 - 3x$ and $y = \frac{12 - x}{2}$ simultaneously by finding the point of intersection of these two lines. Press **[Y=]**, then store $11 - 3x$ into **Y1** and $\frac{12 - x}{2}$ into **Y2**. Press **[GRAPH]** to draw a graph of the functions.

To find their point of intersection, press **[2nd]** **[TRACE]** (**CALC**) **5**, which selects **5:intersect**. Press **[ENTER]** twice to specify the functions **Y1** and **Y2** as the functions you want to find the intersection of, then use the arrow keys to move the cursor close to the point of intersection and press **[ENTER]** once more.

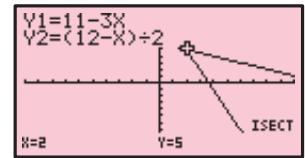
The solution $x = 2$, $y = 5$ is given.

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We can solve $y = 11 - 3x$ and $y = \frac{12 - x}{2}$ simultaneously by finding the point of intersection of these two lines. Select **GRAPH** from the Main Menu, then store $11 - 3x$ into **Y1** and $\frac{12 - x}{2}$ into **Y2**. Press **[F6]** (**DRAW**) to draw a graph of the functions.



To find their point of intersection, press **F5** (**G-Solv**) **F5** (**ISCT**). The solution $x = 2, y = 5$ is given.



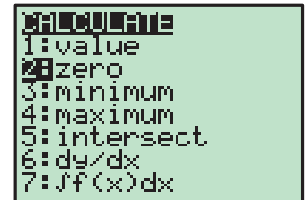
Note: If there is more than one point of intersection, the remaining points of intersection can be found by pressing **▶**.

SOLVING $f(x) = 0$

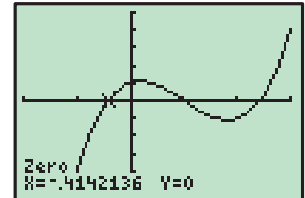
In the special case when you wish to solve an equation of the form $f(x) = 0$, this can be done by graphing $y = f(x)$ and then finding when this graph cuts the x -axis.

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To solve $x^3 - 3x^2 + x + 1 = 0$, press **Y=** and store $x^3 - 3x^2 + x + 1$ into **Y1**. Press **GRAPH** to draw the graph.



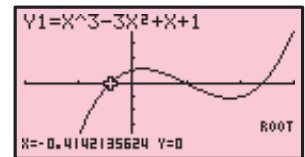
To find where this function first cuts the x -axis, press **2nd** **TRACE** (**CALC**) **2**, which selects **2:zero**. Move the cursor to the left of the first zero and press **ENTER**, then move the cursor to the right of the first zero and press **ENTER**. Finally, move the cursor close to the first zero and press **ENTER** once more. The solution $x \approx -0.414$ is given.



Repeat this process to find the remaining solutions $x = 1$ and $x \approx 2.41$.

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To solve $x^3 - 3x^2 + x + 1 = 0$, select **GRAPH** from the Main Menu and store $x^3 - 3x^2 + x + 1$ into **Y1**. Press **F6** (**DRAW**) to draw the graph.



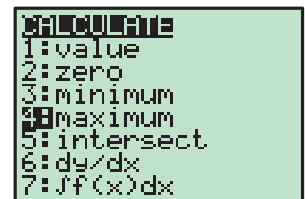
To find where this function cuts the x -axis, press **F5** (**G-Solv**) **F1** (**ROOT**). The first solution $x \approx -0.414$ is given.

Press **▶** to find the remaining solutions $x = 1$ and $x \approx 2.41$.

TURNING POINTS

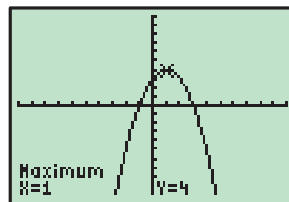
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To find the turning point (vertex) of $y = -x^2 + 2x + 3$, press **Y=** and store $-x^2 + 2x + 3$ into **Y1**. Press **GRAPH** to draw the graph.



From the graph, it is clear that the vertex is a maximum, so press **2nd** **TRACE** (**CALC**) **4** to select **4:maximum**.

Move the cursor to the left of the vertex and press **ENTER**, then move the cursor to the right of the vertex and press **ENTER**. Finally, move the cursor close to the vertex and press **ENTER** once more. The vertex is (1, 4).

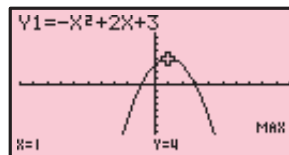


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To find the turning point (vertex) of $y = -x^2 + 2x + 3$, select **GRAPH** from the Main Menu and store $-x^2 + 2x + 3$ into **Y1**. Press **F6** (**DRAW**) to draw the graph.

From the graph, it is clear that the vertex is a maximum, so to find the vertex press **F5** (**G-Solv**) **F2** (**MAX**).

The vertex is (1, 4).



ADJUSTING THE VIEWING WINDOW

When graphing functions it is important that you are able to view all the important features of the graph. As a general rule it is best to start with a large viewing window to make sure all the features of the graph are visible. You can then make the window smaller if necessary.

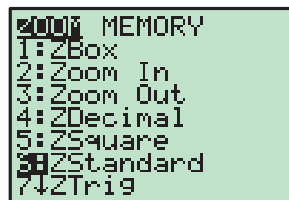
Texas Instruments TI-83

Some useful commands for adjusting the viewing window include:

ZOOM 0:ZoomFit : This command scales the y -axis to fit the minimum and maximum values of the displayed graph within the current x -axis range.

ZOOM 6:ZStandard : This command returns the viewing window to the default setting of $-10 \leq x \leq 10$, $-10 \leq y \leq 10$.

If neither of these commands are helpful, the viewing window can be adjusted manually by pressing **WINDOW** and setting the minimum and maximum values for the x and y axes.



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The viewing window can be adjusted by pressing **SHIFT** **F3** (**V-Window**). You can manually set the minimum and maximum values of the x and y axes, or press **F3** (**STD**) to obtain the standard viewing window $-10 \leq x \leq 10$, $-10 \leq y \leq 10$.

