Guide to Using the Ti-nspire
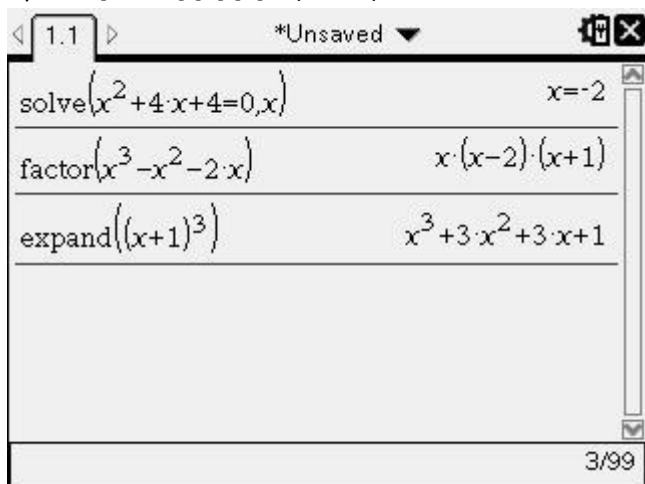
Solve, Factor & Expand

These are the basic functions you will need to know.

Open Calculate (A)

Solve: [Menu] [3] [1] – (equation, variable)|Domain

Factor: [Menu] [3] [2] – (terms)

Expand: [Menu] [3] [3] – (terms)

Matrices

Matrices can be used as an easy way to solve the 'find the values of m for which there is zero or infinitely many solutions' questions. When the equations ax+by=c and dx+ey=f are expressed as a matrix

$\begin{bmatrix} a & b \\ c & d \end{bmatrix} \times \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} c \\ f \end{bmatrix}$,letting the determinant equal to 0 will allow you to solve for m.

E.g. Find the values of m for which there is no solutions or infinitely many solutions for the equations 2x+3y=4 and mx+y=1

Determinant: [Menu] [7] [3] Enter in matrix representing the coefficients, solve for det()=0.
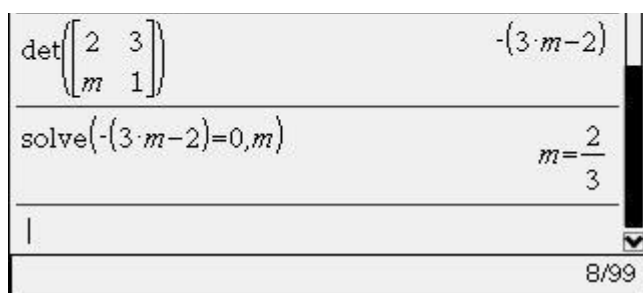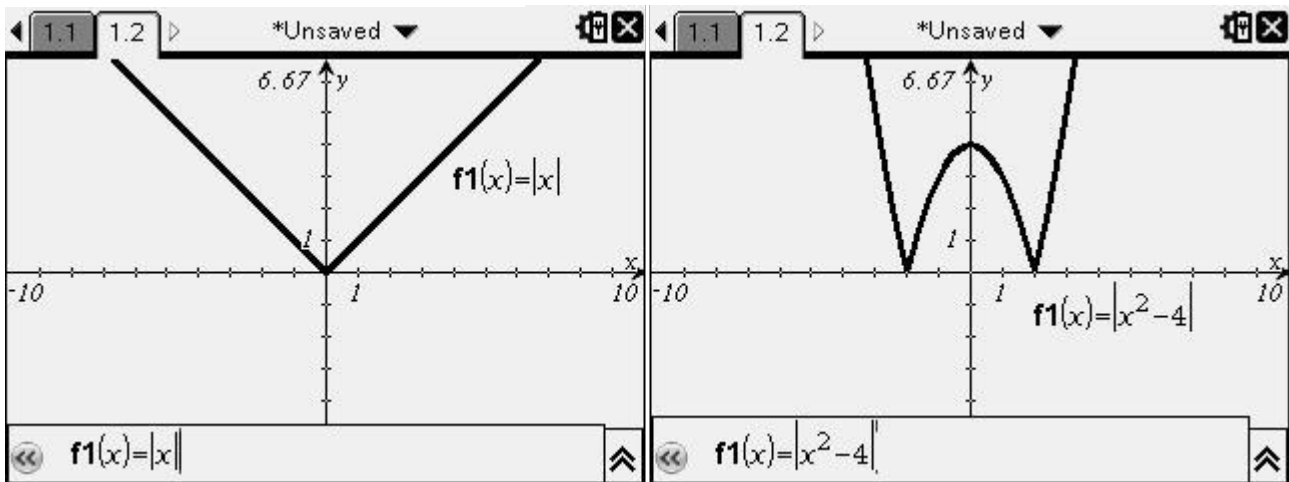

Remember to plug back in to differentiate between the solutions for no solutions and infinitely many solutions.

Modulus Functions

While being written as || on paper, the function for the modulus function is abs() (or absolute function).

i.e. just add in abs(function)
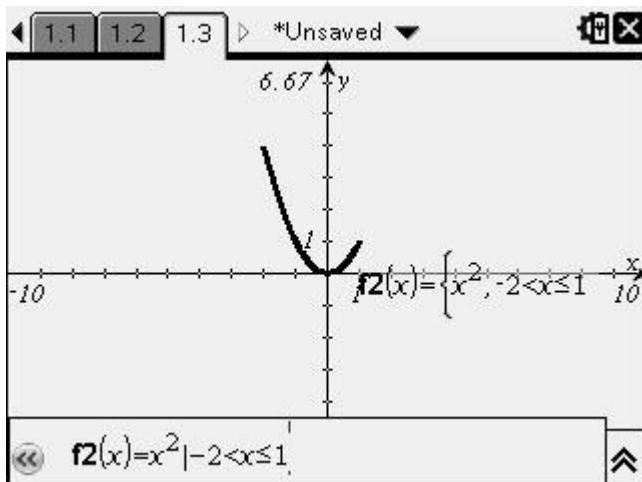
For example $y = |x|$ and $y = |x^2 - 4|$

Defining Domains

While graphing or solving, domains can be defined by the addition of |lowerbound<x<upperbound

The less than or equal to and greater than or equal to signs can be obtained by pressing ctrl + < or >

e.g. Graph $y = x^2$ for $x \in (-2,1]$

Enter $f2(x) = x^2| - 2 < x \le 1$ into the graphs bar
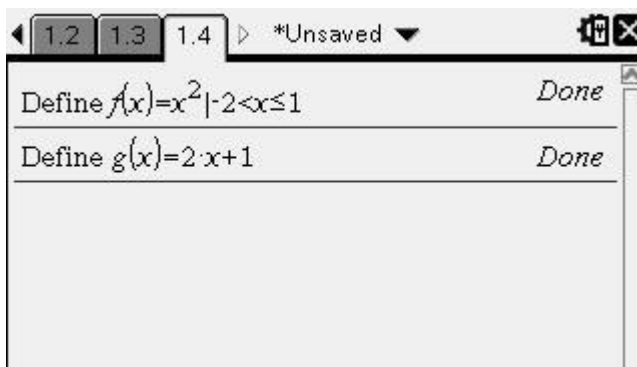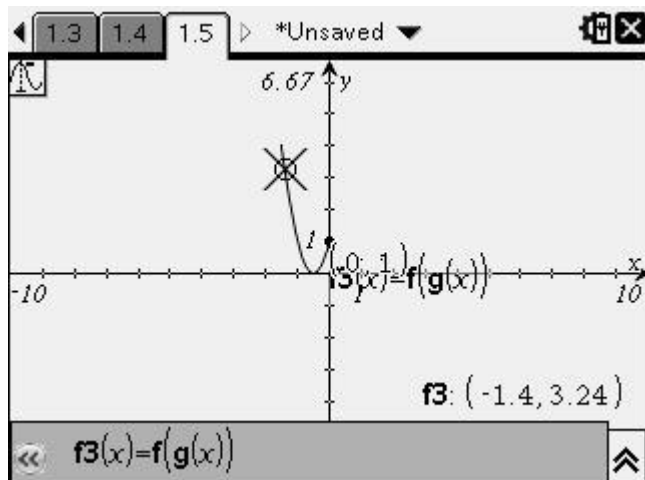

This is particulary useful for fog and gof functions, when a domain is restriced, the resulting function's domain will also be restricted.

E.g. Find the equation of $fog(x)$ when $f(x) = x^2$, $x \in (-2,1]$ and $g(x) = 2x + 1, x \in R$

1. Define the two equations in the Calulate page. [Menu] [1] [1]

2. Open a graph page and type, f(g(x)) into the graph bar

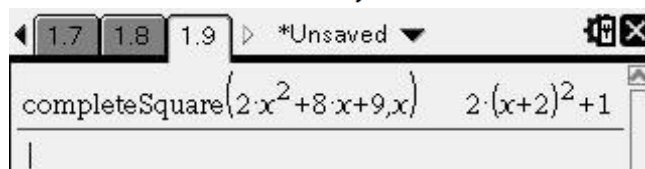The trace feature can be used to find out the range and domain. Trace: [Menu] [5] [1]

Here $fog(x) = (2x + 1)^2$ where the Domain = (-1.5,1] and Range =[0,4)

Completing the Square

The easy way to find the turning point quickly. The Ti-nspire has a built in function for completing the square.

[Menu] [3] [5] - (function,variable)

e.g. Find the turning point of $y = 2x^2 + 8x + 9$

So from that the turning point will be at (-2,1)
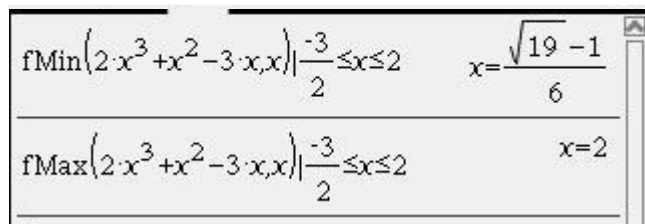

Easy Maximum and Minimums

In the newer version of the Ti-nspire OS, there are functions to find maximum, minimums, tangent lines and normal lines with a couple of clicks, good for multiple choice, otherwise working would need to be shown.

You can do some of these visually on the graphing screen or algebraically in the calculate window.

Maximums: [Menu] [4] [7] – (terms, variable)|domain

Minimums: [Menu] [4] [8] – (terms, variable)|domain

E.g. Find the values of x for which $y = 2x^3 + x^2 - 3x$ has a maxmimum and a minimum for $x \in [-\frac{3}{2}, 2]$

$$fMin\left(2 \cdot x^3 + x^2 - 3 \cdot x, x\right)| \frac{-3}{2} \le x \le 2 \qquad x = \frac{\sqrt{19} - 1}{6}$$

$$fMax\left(2 \cdot x^3 + x^2 - 3 \cdot x, x\right)| \frac{-3}{2} \le x \le 2 \qquad x = 2$$

Tangents at a point: [Menu] [4] [9] – (terms, variable, point)

Normals at a point: [Menu] [4] [A] - (terms, variable, point)

E.g. Find the equation of the tangent and the normal to the curve $y = (x + 2)^2$ when $x = 1$.

$$tangentLine\left((x+2)^2, x, 1\right) \qquad 6 \cdot x + 3$$

$$normalLine\left((x+2)^2, x, 1\right) \qquad \frac{55}{6} - \frac{x}{6}$$
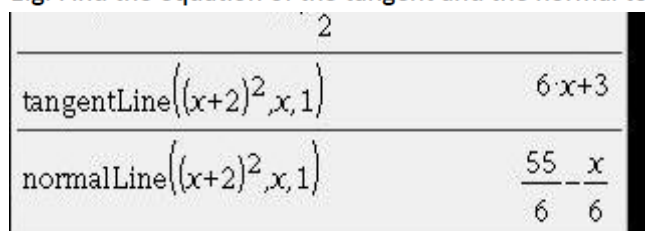
Finding Vertical Asymptotes

Vertical Asymptotes occur when the function is undefined at a given value of x, i.e. when anything is divided by 0. We can manipulate this fact to find vertical asymptotes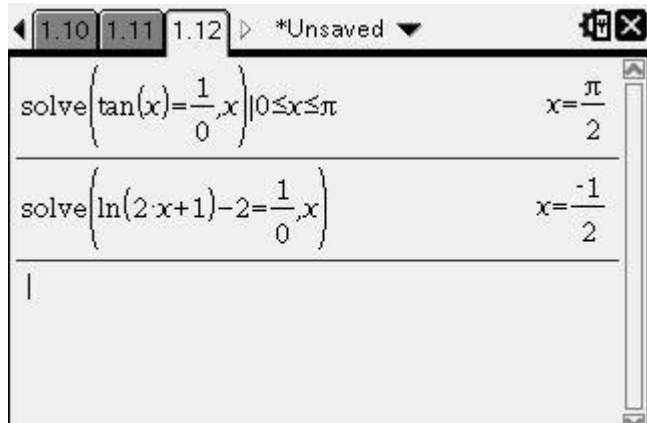 by letting the function equal $\frac{1}{0}$ and solving for x. e.g. Find the vertical asymptotes for $y = \tan(x), x \in [0, \pi]$ and $y = \ln(2x + 1) - 2$

So for $y = \tan(x), x \in [0, \pi]$ there is a vertical asymptote at $x = \frac{\pi}{2}$ and for $y = \ln(2x + 1) - 2$ at $x = \frac{-1}{2}$

Don't forget to find those other non-vertical asymptotes too.

The x-y Function Test

Every now and then you will come across this kind of question in a multiple choice section.

If $f(x) + f(y) = f(xy)$, which of the following is true?

A. $f(x) = x^2$
B. $f(x) = \ln(x)$
C. $f(x) = \frac{1}{x}$
D. $f(x) = x$
E. $f(x) = (x + 2)^2$

You could do it by hand or do it by calculator. The easiest way is to define the functions and solve the condition for x, then test whether the option is true. If true is given, it is true otherwise it is false.
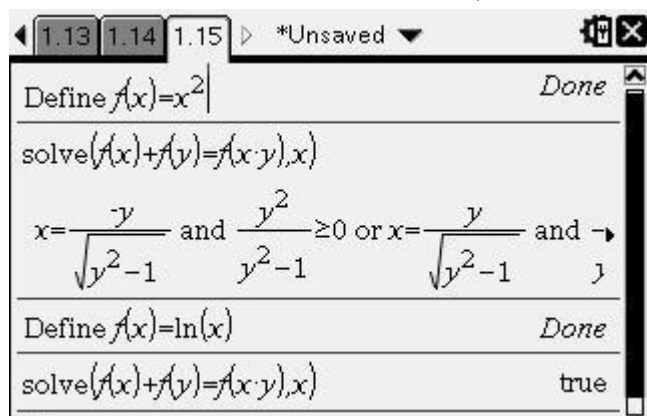
So option B is correct.

The Time Saver for Derivatives

By defining, f(x) and then defining df(x)= the derivative, you won't have to continually type in the derivative keys and function. It also allows you to plug in values easily into f'(x) and f''(x).

Derivative: [Menu] [4] [1]

E.g. Find the derivative of $y = 2x^3 + 3x^2 - 4x + 2 + \frac{1}{x}$

Define f(x), then define df(x)

Define $f(x)=2 \cdot x^3+3 \cdot x^2-4 \cdot x+2+\dfrac{1}{x}$ — Done

Define $df(x)=\dfrac{d}{dx}(f(x))$ — Done

$df(x)$
$$6 \cdot x^2+6 \cdot x-\dfrac{1}{x^2}-4$$

The same thing can be done for the double derivative.

$df(x)$
$$6 \cdot x^2+6 \cdot x-\dfrac{1}{x^2}-4$$

Define $ddf(x)=\dfrac{d}{dx}(df(x))$ — Done

$ddf(x)$
$$12 \cdot x+\dfrac{2}{x^3}+6$$

Just remember to redefine the equations or use a different letter, e.g. g(x) and dg(x)

Solving For Coefficients Using Definitions of Functions

Instead of typing out big long strings of equations and forgetting which one is the antiderivative and which one is the original, defined equations can be used to easily and quickly solve for the coefficients.

E.g. An equation of the form $y = ax^3 + bx^2 + cx + d$ cuts the x-axis at (-2,0) and (2,0). It cuts the y-axis at (0,1) and has a local maximum when $x = -1$. Find the values of a, b, c & d.

1. Define $f(x) = ax^3 + bx^2 + cx + d$ (Make sure you put a multiplication sign between the letters)
2. Define the derivative of the f(x) i.e. df(x)
3. Use solve function and substitute values in, solve for a, b, c & d.

1.1 ▷   *Unsaved ▼

Define $f(x)=a \cdot x^3+b \cdot x^2+c \cdot x+d$ — Done

Define $df(x)=\dfrac{d}{dx}(f(x))$ — Done

$df(x)$
$$3 \cdot a \cdot x^2+2 \cdot b \cdot x+c$$

$\text{solve}(f(-2)=0 \text{ and } f(2)=0 \text{ and } df(-1)=0 \text{ and } f(0)▸$
$$a=\dfrac{1}{2} \text{ and } b=\dfrac{-1}{4} \text{ and } c=-2 \text{ and } d=1$$

4/4

1.1 ▷   *Unsaved ▼

Define $f(x)=a \cdot x^3+b \cdot x^2+c \cdot x+d$ — Done

Define $df(x)=\dfrac{d}{dx}(f(x))$ — Done

$df(x)$
$$3 \cdot a \cdot x^2+2 \cdot b \cdot x+c$$

$◄0 \text{ and } f(2)=0 \text{ and } df(-1)=0 \text{ and } f(0)=1,a,b,c,d)|$
$$a=\dfrac{1}{2} \text{ and } b=\dfrac{-1}{4} \text{ and } c=-2 \text{ and } d=1$$

1/4

So $a = \dfrac{1}{2}, b = \dfrac{-1}{4}, c = -2 \text{ and } d = 1$ and the equation of the curve is $f(x) = \dfrac{1}{2}x^3 - \dfrac{1}{4}x^2 - 2x + 1$

Deriving Using the Right Mode

The derivative of circular functions are different for radians and degrees. Remember to convert degrees to radians and be in radian mode, as the usual derivatives that you learn e.g. $\dfrac{d}{dx}(\sin(x)) = \cos(x)$ are in radians NOT degrees.

RADIAN MODE

DEGREES MODE

$$\frac{d}{dx}(\cos(x)) \qquad -\sin(x)$$

$$\frac{d}{dx}(\sin(x)) \qquad \cos(x)$$

$$\frac{d}{dx}(\tan(x)) \qquad \frac{1}{(\cos(x))^2}$$

⚠ Domain of the result might be larger than the do...

$$\frac{d}{dx}(\cos(x)) \qquad \frac{-\pi\cdot\sin(x)}{180}$$

$$\frac{d}{dx}(\sin(x)) \qquad \frac{\pi\cdot\cos(x)}{180}$$

$$\frac{d}{dx}(\tan(x)) \qquad \frac{\pi}{180\cdot(\cos(x))^2}$$

⚠ Domain of the result might be larger than the do...

Getting Exact Values On the Graph Screen

Now for what you have all been dreaming of. Exact values on the graphing screen. Now the way to do this is a little bit annoying.

1. Open up a graph window

2. Plot a function e.g. $f(x) = \sqrt[3]{x}$

3. Trace the graph using [Menu] [5] [1]

4. Trace right till you hit around 0.9 or 1.2 and click the middle button to plot the point.

5. Press ESC

6. Move the mouse over the x-value and click so that it highlights, then move it slightly to the right and click again. Clear the value and enter in ½.
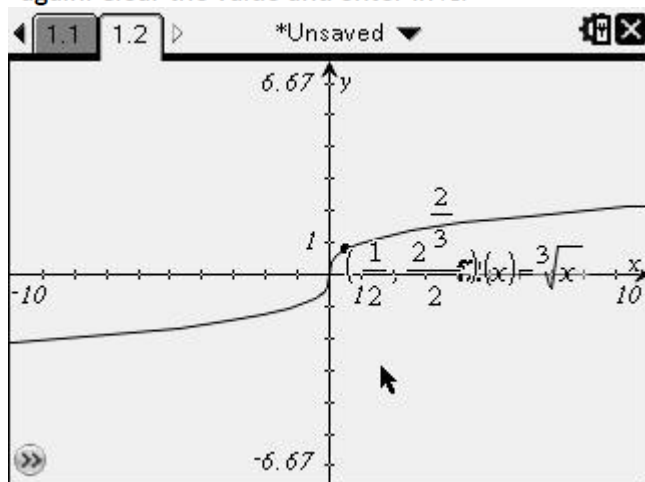
Using tCollect to simplify awkward expressions

Sometimes the calculator won't simplify something the way we want it to. tCollect simplifies expressions that involves trigonometric powers higher than 1 or lower than -1 to linear trigonometric expressions.

$$\text{tCollect}\left((\cos(x))^2\right) \qquad \frac{\cos(2\cdot x)+1}{2}$$

$$\text{tCollect}\left(\left|2\cdot(\sin(2\cdot x))^2+1\right|\right) \qquad 2-\cos(4\cdot x)$$

Streamlined Markov Chains

For questions that require the use of the T transition matrix more than once, the following methods can be used to save time so that the T matrix does not need to be repeatedly inputted or copied down.

1. Define the T matrix as t.
2. Define the initial state matrix as s.
3. Evaluate by substituting t and s in with the appropriate powers.

E.g. For the Transition matrix $T = \begin{bmatrix} 0.6 & 0.85 \\ 0.4 & 0.15 \end{bmatrix}$ and initial state $s = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$, find S_2 and S_3

1.1	1.2	1.3	▶ *Unsaved ▼	咄🗙
Define $t=\begin{bmatrix} 0.6 & 0.85 \\ 0.4 & 0.15 \end{bmatrix}$				*Done*
Define $s=\begin{bmatrix} 1 \\ 0 \end{bmatrix}$				*Done*
$t^2 \cdot s$				$\begin{bmatrix} 0.7 \\ 0.3 \end{bmatrix}$
$t^3 \cdot s$				$\begin{bmatrix} 0.675 \\ 0.325 \end{bmatrix}$
				4/4

Binomial Distributions

For a single value of x e.g. Pr(X=2) = [Menu] [5] [5] [D] (Pdf)
For multiple values of x e.g. Pr(X<2) = [Menu] [5] [5] [E] (Cdf)
e.g. Probability of Success = 0.4, Number of trials =10, i.e. X~Bi(10,0.4)
Find the probability of two successes and less than two successes

1.2	1.3	1.4	▶ *Unsaved ▼	咄🗙
Binomial Pdf				
Num Trials, n:	10			
Prob Success, p:	.4			
X Value:	2			
			OK	Cancel
				0/99

1.2	1.3	1.4	▶ *Unsaved ▼	咄🗙
bin **Binomial Cdf**				2
Num Trials, n:	10			
Prob Success, p:	.4			
Lower Bound:	0			
Upper Bound:	1			
			OK	Cancel
				1/99

1.2	1.3	1.4	▶ *Unsaved ▼	咄🗙
binomPdf$(10,0.4,2)$		0.120932352	
binomCdf$(10,0.4,0,1)$		0.0463574016	

Pr(X=2)=0.1209, Pr(X<2)=0.0464
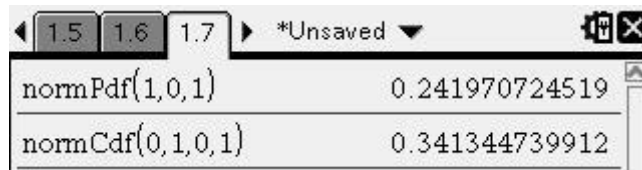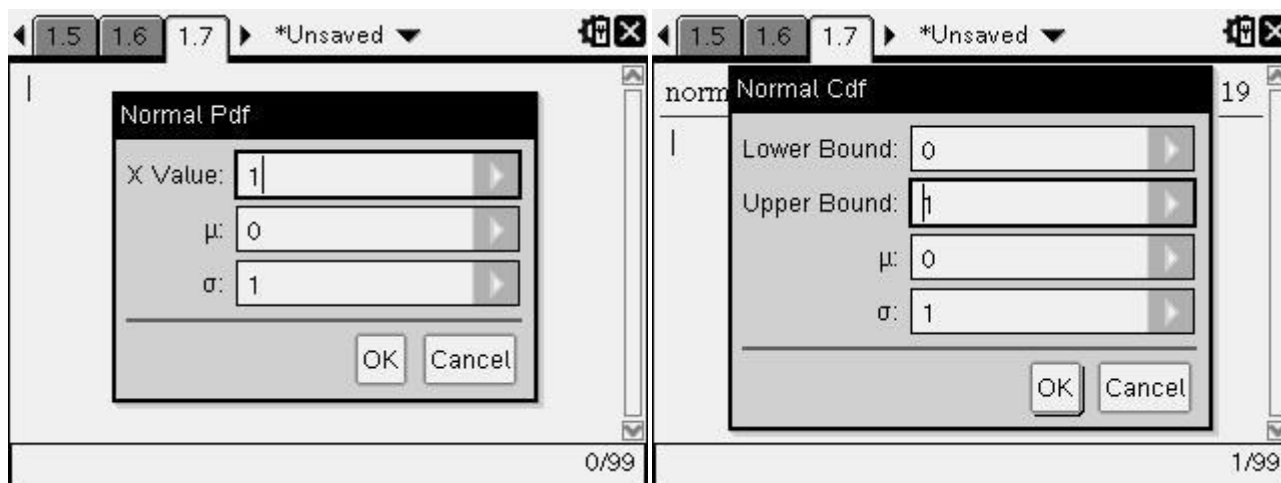
Normal Distributions

The probability will correspond to the area under the Normal distribution curve.
From $-\infty$ (use ctrl + i)(or lowest bound) to value = [Menu] [5] [5] [1] (Pdf)
From lower value to higher value = [Menu] [5] [5] [2] (Cdf)
e.g. The probability of X is given by the Normal Distribution with $\mu = 0, \sigma = 1$ i.e. X~N(0,1)
Find Pr(X<1) and Pr(0<X<1)

Pr(X<1)=0.2420, Pr(0<X<1)=0.3413

Integrals

Using the integral function and solve function for probability distributions. The area under a probability distribution function must equal 1, so if we are given a function multiplied by a k constant, we can antidifferentiate the function and solve for k.

Integral: [Menu] [4] [3]

E.g. If $f(x)$ is given by $f(x) = \begin{cases} kx^2 + 1, & 0 < x < 10 \\ 0, & otherwise \end{cases}$, find the value of k if f(x) is to be a probability density function.
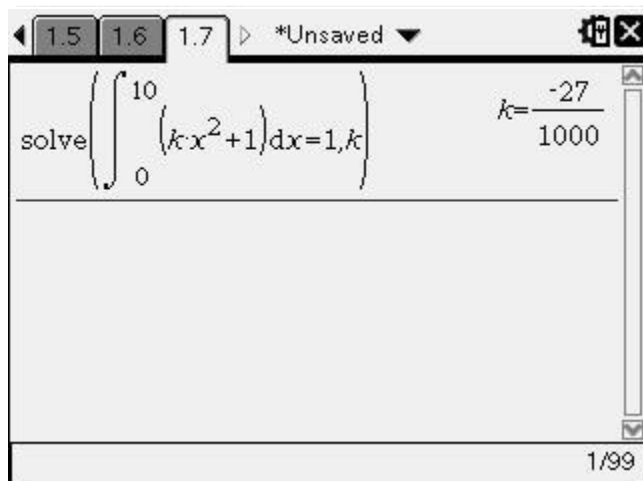
Shortcut Keys

Copy: Ctrl left or right to highlight, [Ctrl] + [c]

Paste: [Ctrl] + [v]

Insert Derivative: [CAPS] + [-]

Insert Integral: [CAPS] + [+]

∞: [Ctrl] + [i]

Using Ti Inspire with Vectors.

Vectors

These way the Ti-nspire handles vectors is to set them up like a 1 X 3 matrix. E.g. The vector 2i+2j+1k would be represented by the matrix $\begin{bmatrix} 2 & 2 & 1 \end{bmatrix}$. You can enter a matrix by pressing [ctrl] + [x], then select the 3 X 3 matrix and enter in the appropriate dimensions.

It's easier to work with the vectors if you define them. E.g. [Menu] [1] [1] a = $\begin{bmatrix} 2 & 2 & 1 \end{bmatrix}$.

The functions that can be applied to the vectors are:

Unit Vector: [Menu] [7] [C] [1] - unitV($\begin{bmatrix} x & y & z \end{bmatrix}$)

Dot Product: [Menu] [7] [C] [3] – dotP($\begin{bmatrix} a & b & c \end{bmatrix}, \begin{bmatrix} x & y & z \end{bmatrix}$)

Magnitude: type "norm()" – norm($\begin{bmatrix} a & b & c \end{bmatrix}$)

E.g. **a=2i+2j+k**, **b=6i+2j-16k**, Find the Unit vector of **a** and **a.b**

E.g. **a** and **b** are perpendicular

Vectors may also be entered as column vectors rather than row vectors. (i.e. one row for i, one row for j and one row for k if needed.) Using columns is preferred.

Try these using your calculator:

Define vectors a = 3i+2j+4k and b=-3i+5j+2k using 2 column vectors.

1. Find a.b

Ans: 9

2. Find a unit vector in the direction of a

Ans: $\sqrt{29}/29(3i + 2j + 4k)$

3. Find the angle between a and b

Since a.b = lal Ibl cos θ then θ = $\cos^{-1}$ [(a.b)/ (lal Ibl)]

Find θ the angle between a and b

Ans: 1.296 radians

Now try this:

If r(m,n) = cos(m)sin(n)i + sin(m)cos(n)j

Define r(m,n) using a 2 by 1 matrix.

1. Evaluate r(π/4,π/3)

Ans: ¼($\sqrt{6}$i+$\sqrt{2}$j)

You may wish to store answers using some other variable if the problem looks like you are going to need these results again.

Don't forget to clear variables a-z using Menu 1-4 if necessary.