Calculus on the TI-89/TI-92

Derivatives

In the F3:Calc(ulus) menu there are 2 derivative functions ***d*** and **nDeriv**.

The basic syntax for both is

function(*expression*,*variable*) where

- *function* :one of the 2 functions above.
- *expression* :the expression of the function you want to take the derivative of.
- *variable* :the variable to take the derivative with respect to.

The ***d*** can also has a 3rd parameter for performing higher derivatives. Beyond this the 2 functions are the same.

Since ***d*** has a better 3rd parameter and is a 2nd function on the keyboard, we'll usually use it.

Example#1

nDeriv(x^3,x) or *d*(x^3,x) will return the derivative of x^3, $3x^2$. Try it yourself, either type **F3:Calc ENTER x ^ 3 , x) ENTER** or **2nd *d* x ^ 3 , x) ENTER** The calculator will return "$3x^2$".

Example#2: For $f(x)=e^{4x-3}$ evaluate f'(5).

0. $f'(x)=4e^{4x-3}$ and $f'(5)=4e^{17}$
1. Type

   TI-89 | **2nd *d* ♦ e^x 4 x - 3) , x) | x = 5 ENTER**.

   TI-92 | **2nd *d* 2nd e^x 4 x - 3) , x) 2nd | x = 5 ENTER**.
2. It will return "$4\cdot e^{17}$".

Example#3: For y=sin(t), find y".

0. By hand, y'=cos(t) and y"=-sin(t).
1. *d*(sin(t),t,2) returns "-sin(t)".

Graphs and Derivatives

Example#4: Graph the line tangent to $y=x^2$ at x=2 on the calculator.

0. It can be shown by hand that for x=2, y=4 and that y=4x-4 is tangent to the curve $y=x^2$ at the point (2,4).
1. Graph $y=x^2$ in a window containing the point (2,4), i.e. [-10,10]by[-10,10].
2. Enter the tangent line function by typing

   TI-92 | **F5:Math A:Tangent**.
3. Move the cursor as close to the point (2,4) as you can get and enter the point, or type in the value of x press ENTER.

   TI-92 | Type **2 ENTER**.
4. The calculator will graph the line tangent to the point entered and print equation of the tangent line at the bottom of the screen.

   The calculator will return "y=4.x-4.".

Example#5: Get the slope of the line tangent to $y=e^x$ at x=1.

1. Graph $y1=e^x$ in a standard window.
2. Enter the *d*y/*d*x function by typing

   F5:Math 6:Derivatives 1:*dy/dx*.
3. Type in 1 for x and enter the point.

   Type **1 ENTER**.
4. The calculator print "dy/dx=2.7182818" at the bottom of the screen.

Example#6: Use the dy/dx function to approximate y' at x=5 where y=Log(x).

1. Graph y=Log(x) in the standard window.
2. Enter the dy/dx function by typing

   F5:Math 6:Derivatives 1:*dy/dx*.
3. Type in 5 for x and enter the point.

   Type **5 ENTER** to go directly to the point.
4. The calculator prints "dy/dx=.0868589".

Example#7: Using the calculator to approximate the inflection point of $y=x^3+2x^2-3x+5$.

1. Graph $y=x^3+2x^2-3x+5$ in the standard window.
2. Enter the inflection point function by typing

   F5:Math 8:Inflection.
3. Enter the left(lower) and right(upper) bounds.

   Press **(cursor left)** until the cursor is to the left of the I.P. and press **ENTER**.

   Press **(cursor right)** until the cursor is to the right of the I.P. and press **ENTER**.
4. The calculator returns "x=-.6666667 y=7.5925926" as the I.P.

Newton's Method

Example#8: Apply Newton's method to solve $\sin(x)e^{x}=3$ to the hundredths with initial guess of $x_0=5$.

1. Bring all non-zero terms to one side.

   $\sin(x)e^{x}-3=0$

2. Set x to x_0 and y1 to the non-zero side of the equation.

   Type

   TI-89 | **F4:Other 1:Define y 1 (x) = 2nd sin x) ♦ e^x x) ENTER** to store y1.

   TI-92 | **F4:Other 1:Define y 1 (x) = 2nd sin x) 2nd e^x x) ENTER** to store y1.

   Type **5 STO► x ENTER** to store x.

3. Execute Newton's method and store back into x.

   Type **x - y 1 (x) ÷ 2nd *d* y 1 (x), x) STO► x ♦ ENTER**.

   The calculator returns "3.57992283293".

4. Press **♦ ENTER** repeatedly to reexecute the last command without having to retype it until desired accuracy is achieved.

   In this case, after pressing **ENTER** 4 times the results all round to 3.14 .

   Press **ENTER** a couple of more times and the number stops changing.

Note: We use y1 solely to save typing. Sometimes, it's easier to find y' by hand and not use y1. You can also use the function editor, y=, to enter and delete y1.

Definite Integrals

The calculators have only one numerical integration function, nInt. It's syntax is

nInt(*expression*,*variable*,*lower limit*,*upper limit*) ,where

expression :the expression of the function you want to take the integral of.
variable :the variable to integrate with respect to.
lower limit :the lower limit of integration, a.
upper limit :the lower limit of integration, b.

The TI-89 and TI-92 also has one symbolic integration function, ∫. It's syntax is

∫(*expression*,*variable*,*constant*) ,where

expression :the expression of the function you want to take the integral of.
variable :the variable to integrate with respect to.
constant :the constant of integration.

or for definite integrals

∫(*expression*,*variable*,*lower limit*,*upper limit*) ,where

expression :the expression of the function you want to take the integral of.
variable :the variable to integrate with respect to.
lower limit :the lower limit of integration, a.
upper limit :the lower limit of integration, b.

The main differences between nint and ∫ are that nint will only return an approximation for a definite integral, while ∫ will try to return the exact value for a definite integral. Plus, ∫ can do indefinite integrals. Since ∫ can do anything nInt can do, we'll emphasize ∫.

Example#9: Evaluate $\int_2^7 (x^5-3)\,dx$.

0. By hand, $\int_2^7 (x^5-3)\,dx = [\ x^6/6 - 3x\ ]_2^7 = 7^6/6 - 3*7 - (\ 2^6/6 - 3*2\ ) = 19582.5$.
1. Enter ∫(x^5-3,x,2,7) by typing **2nd ∫ x ^ 5 - 3 , x , 2 , 7) ENTER**. It will return "39165/2" or of you hit ♦ before ENTER, it will return "19582.5".

Example#10: Find the integral from 0 to 1 of $e(-x^2)$ with respect to x.

0. We can't do this one exactly by hand since this function doesn't have an anti-derivative. At least, there's not one that doesn't involve an infinite series.
1. Enter ∫(e^(-x²),x,0,1). It will return ".746824132812". Since the calculator doesn't know the anti-derivative, it automatically found a numerical approximation.

Example#11: Find the indefinite integral of 7cos(x) with respect to x.

0. By hand, $\int [7\cos(x)]\,dx = 7\sin(x) + C$
1. Enter ∫(7cos(x),x). It will return "7sin(x)". But, there is no "+C"
2. To get the "+C+, type ∫(7cos(x),x,C). It will return "7sin(x)+C".

Example#12: Find the 2nd antiderivative of 12x with respect to x.

0. By hand, $\int[12x]dx = 6x^2 + C_1$, and $\int[6x^2 + C_1]dx = 2x^3 + C_1x + C_2$.
1. Enter ∫(∫(12x,x,a),x,b). It will return "$2x^3$ + ax + b". Note, the calculator doesn't like using c1 or c2.

Graphs and Integrals

Example#13: Use the ∫f(x)dx function to approximate $\int_1^{2.3}(x^3-4x)dx$.

1. Graph $y=x^3-4x$ in the in a standard window.
2. Enter the ∫f(x)dx function by typing
   F5:Math 7:∫f(x)dx
3. Enter the lower limit of integration.
   Type **1 ENTER**
4. Enter the upper limit of integration.
   Type **2.3 ENTER**
5. The calculator will shade in the related regions.
6. Both calculators will return "∫f(x)dx=-1.833975".

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