Calculus on the TI-83/84

Derivatives

The TI-83/84 has only one derivative function in the math-math submenu.

nDeriv(:Basic numerical first derivative using the symmetric difference quotient
[f(x-δ) - f(x+δ)]/(2δ) :δ is built into the calculator.

The syntax is

nDeriv(*expression*,*variable*,*value*) where

expression :the expression of the function you want to take the derivative of.
variable :the variable to take the derivative with respect to.
value :the value of the variable to evaluate the derivative at.

Example#1

nDeriv(x^3,x,5) will return the derivative of x^3 evaluated at 5. In other words, if $y=x^3$ then $dy/dx = 3x^2$. Which at x=5, $dy/dx = 3(5)^2 = 75$. Try it yourself, press **MATH 8:nDeriv(X ^ 3 , X , 5) ENTER**. The calculator will return "75.000001". Why didn't you get 75 exactly?

Example#2: For f(x)=|x| evaluate f'(0).

0. Since the difference quotient , [f(x+h)-f(x)]/h, is 1 when h>0 and -1 when h<0, f'(x) is undefined at x=0.
1. Try nDeriv(abs(x),x,0) it will return "0". Why?

Thus from the above examples, when evaluating the derivative of a function at a specified value of x, nDeriv is not always accurate.

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

0. By hand, y'=cos(t) , y"=-sin(t) and $-\sin(\pi/3)=-\sqrt{3}/2=-.866025403784$.
1. This can also be done as nDeriv(nDeriv(sin(T),T,X),X,π/3) which returns "-.86602525945".

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
   2nd DRAW 5:Tangent(
3. Enter in the x coordinate of the point.
   type **2 ENTER**
4. The calculator will graph the line tangent to the point entered and print its equation at the bottom of the screen.
   It returns "y=4x+-4".

Example#5: 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
   2nd CALC 6:dy/dx
3. Enter the x coordinate of the point.
   5 ENTER
4. The calculator prints "dy/dx=.0868589".

In the above three examples, dy/dx is stored into the ANS variable for access from the command line.

Newton's Method

Example#6: Apply Newton's method to solve $\sin(x)e^x=3$ to the hundredths with initial guess of $x_1=5$.

1. Bring all non-zero terms to one side.
   $\sin(x)e^x-3=0$
2. Set X to x_1.
   Type **5 STO▶ X ENTER**.
3. Execute Newton's method and store back into x.
   Type **X - (sin X) * e^x X) - 3) ÷ MATH 8:nDeriv(sin ALPHA Y) * e^x ALPHA Y) - 3 , ALPHA Y, X) STO▶ X**.
   The calculator returns "3.549987136".
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.

Definite Integrals

The calculators have only one numerical integration function, fnInt. It's syntax is fnInt(*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.

Example#7: 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 fnInt(x^5-3,x,2,7) by typing **MATH 9:fnInt(X ^ 5 - 3 , X , 2 , 7) ENTER**. It will return "19582.5".

Graphs and Integrals

Example#8: Use the $\int f(x)dx$ function to approximate $\int_1^{2.3}(x^3-4x)dx$.

1. Graph $y=x^3-4x$ in the standard window.
2. Enter the $\int f(x)$ function by typing
   2nd CALC 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 TI-83 will shade in the related regions.
6. The calculator will return "$\int f(x)dx$=-1.833975". This result is now stored is ANS.

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