According to the Standards:

Instructional programs from preK-grade 12 should enable students to:

- Recognize and use connections among mathematical ideas
- Make and investigate mathematical conjectures

In grades 9-12 students should

1. Students should develop an increased capacity to link mathematical ideas and a deeper understanding of how more than one approach to the same problem can lead to equivalent results.

Calculus Scope and Sequence: Applications of Derivatives **Keywords:** Mean Value Theorem, MVT **Description:** This activity will illustrate The Mean Value Theorem

Mean Value Theorem: If f, is a function continuous over a closed interval [a,b], differentiable on the open interval (a,b) then there is a number c in the interval (a,b) such that $f'(c) = \frac{f(b) - f(a)}{b - a}$.

(Alternately stated: If f, is a function continuous over a closed interval [a,b], differentiable on the open interval (a,b) then there is a number c in the interval (a,b) such that the tangent line at x=c, is parallel to the secant line connecting x=a and x=b)

Determine whether the hypotheses of the MVT hold for the following and if so, find a value of c satisfying the conclusions of the theorem:

$$f(x) = 1 - 4x - x^2$$
, [-5,0]

Since it's a polynomial function, it will be continuous and differentiable everywhere. So what remains is to find the value of c.

- 1. Go to the Y= screen and input the function into y1
- 2. Graph in the standard window (Zoom 6)
- 3. Find the equation of the secant line through the interval given
- 4. Find the value of c
- 5. Find the equation of the tangent line
- 6. Sketch both lines on the graph for visual confirmation



Slope of Secant line:

| F1+ F2+ F3+ F4+ F5 | F1+ F2+ F3+ F4+ F5 |
|---|-------------------------------------|
| ToolsA13ebra(Calc Other Pr3m10 Clean Up | ToolsA13ebraCa1cOtherPr9mIOClean Up |
| | |
| | $= \frac{91(0) - 91(-5)}{05} $ 1 |
| (y1(0)-y1(-5))/(05) | (y1(0)-y1(-5))/(05) |
| Main Rad Auto Func 0/30 | MAIN RAD AUTO FUNC 1/30 |

Equation of Secant line:



First we need to get the derivative of y1 and store it in y3

- Go to HOME •
- Go to F3-Calc-#1
 - Derivative syntax: (function, variable)

| F1+ F2+ F3+ F4+ F5 Tools Algebra Cole Other Providicition UP 1: 20 differentiate 2: 3 integrate | F1+ F2+ F3+ F4+ F5 ToolsAllsebraCalcOtherPr9mIOClean UP |
|--|--|
| 3:11m1t(4:∑(sum 5:T(product 6:fMin(■ <u>91(0)</u> 7:fMax(8.Barclen(| $= \frac{g1(0) - g1(-5)}{0 - 5}$ = $\frac{d}{dy}(g1(x))$ $-2 \cdot x - 4$ |
| SOLVE (TYPE OR USE ++++ CENTER) OR CESCI | a(y1(x),x) Main Rad Auto Func 2/30 |

To Store in y3:

- Go to Y=
- Go to y3(x)
 Press 2nd-Ans-ENTER

| F1+ F2+ (3 8) 8) - F3+ 8) | F1+ F2+ F3 F4 F5+ F6+ 50 |
|--------------------------------|--|
| ToolsZoom: 8) / 80 (9) 8) - 80 | ToolsZoomEdit / AllStyle 8005 |
| -PLOTS | -PLOTS ✓u1=1 - 4·x - x ² |
| √y2=1·(x − 0) − y1(0) | $\sqrt{92=1} \cdot (x - 0) - 91(0)$ |
| 93- | *g3= 2·× = 4 |
| 94= | 94=∎ |
| 95= | ∪5= |
| <u>96</u> = <u>17</u> = | 90- 96- |
| Y3(X)=ans(1) | U4(X)= |
| MAIN RAD AUTO FUNC | Main Rad Auto Func |

Finding a value of *c*:

- Go to HOME
- Use F2-Algebra-#2 Solve
 - Solve arguments: (function=solution, variable)



The Equation of the tangent line:



(note: be sure to shut off the derivative function using F4)

The graph:



What you see is a picture of where the instantaneous rate of change (the derivative) is equal to the average rage of change over the interval given.