Matlab-2
Mean Value Theorem

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MEAN VALUE THEOREM

Experiment 2 (18-07-2016)

Aim:

Graphically demonstrate the Mean Value Theorem for the function $f(x) = x^2 + 2x - 1$, [0, 1].

Plotting tangent and secant lines:

Plotting Tangent and Secant Lines: Secant Line: The secant line to the curve y = f(x) at the point P(a,f(a)) through the nearby distinct point Q(x,f(x)) is the line through P with slope

$$m_{sec} = f(x)-f(a)/ b-a.$$

Two points of intersection make it easy to find the slope.

Tangent Line: The tangent line to the curve y = f(x) at the point P(a,f(a)) is the limiting case of secant line as $x \to a$. The slope of tangent line thus is given by

$m_{tan} = \lim_{x\to a} (f(x)-f(a))/ (b-a)$.

One point of intersection makes it hard to find the slope.

New commands:

syms var1 var2: Creates symbolic variables var1 var2

var = sym('var'): Creates the symbolic variable var result = input(prompt) Request user input by displaying the prompt string on the screen. The input is stored in the variable result.

disp(X): Displays the contents of X without printing the variable name

diff(F,var): Differentiates F with respect to the variable var

subs(s,old,new): Returns a copy of symbolic expression s replacing all occurrences of old with new, and then evaluating s

S = solve(eq) Solves the equation eqn for the default variable determined by symvar

S = num2str(A) Converts a numeric array into a string representation

S = strcat(s1,s2) Horizontally concatenates strings in arrays

S. ezplot(fun,[xmin, xmax]): Plots fun(x) over the domain: xmin < x < xmax

The code:

```
clc;

syms x c;

f = input('Enter the function: '); I = input('Enter the interval [a,b]: ');

df = diff(f,x);

dfc = subs(df,x,c);

rhs = (subs(f,x,I(2))−subs(f,x,I(1)))/(I(2)−I(1));

c = double(solve(dfc−rhs));

index = find(c > I(1)& c < I(2));

c = c(index);

for i = 1:numel(c)

 disp(['The value of c is: ', num2str(c(i))])

 fc = double(subs(f,c(i))); m = double(subs(df,c(i)));

 b = double(subs(f,c(i)) − subs(df,c(i))*c(i));

 tangent = m*x + b;

disp('Tangent Line is: ');

 disp(vpa(tangent,4));

figure h = ezplot(tangent);

 set(h,'Color','black','LineWidth',1.5);

 hold on;

 h = ezplot(f,[I(1) I(2)]);

 set(h,'Color','red','LineWidth',1.5);

 plot([I(1) I(2)],[double(subs(f,I(1))) double(subs(f,I(2)))],'−−g','LineWidth',1.5);

plot(c(i),fc,'o','MarkerEdgeColor','blue','MarkerFaceColor','blue');

 str = strcat('(',num2str(c(i)),',',num2str(fc),')');

 hold off;

 legend('Function','Tangent Line','Secant Line',str,'Location','Best');

 title('Demonstration of Mean Value Theorem');

 end
```

Input:

Enter the function: x^2+2*x-1

Enter the interval [a,b]: [0,1]

Output:

The value of c is: 0.5

Tangent Line is:

3.0*x - 1.25

Graph: