Topic : Newton Raphson Method - Roots of Equations
Simulation : Graphical Simulation of the Method
Language : Mathmatica 4.1
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Abstract : This simulation illustrates the Newton-Raphson method of finding the root of an equation $f[x]$ 0.

■ INPUTS: Enter the Following

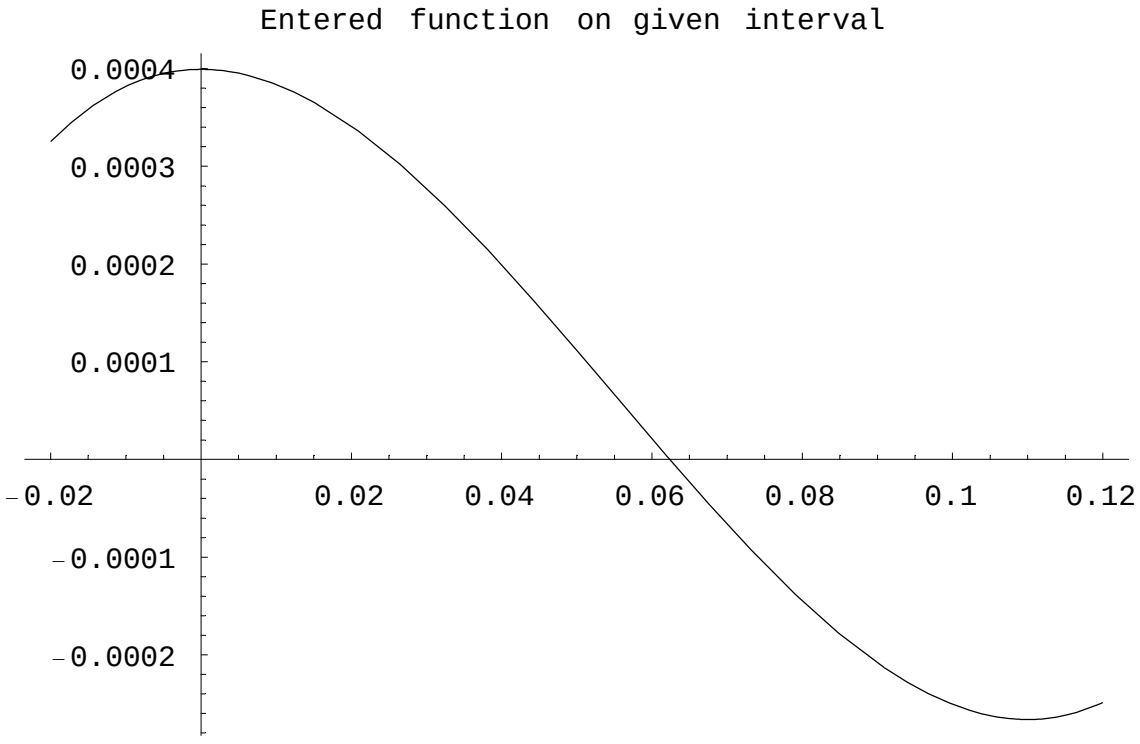
Function in $f[x]$ 0

In[403]:=
```
f[x_] := x^3 - 0.165 * x^2 + 3.993 * 10^-4
```

Range of 'x' you want to see the function

In[404]:=
```
xbegin = -0.02;
xend = 0.12;
```

In[406]:=
```
curve = Plot[f[x], {x, xbegin, xend}, PlotLabel →
    "Entered function on given interval", TextStyle → {FontSize → 11}];
```



Initial guess

In[407]:=
```
x0 = 0.05;
```

Because this method uses a line tangent to the function at the initial guess, we must calculate the derivative of the function to find the slope of the line at this point. Here we will define the derivative of the function $f(x)$ as $g(x)$.

In[408]:=
```
g[x_] := f'[x]
```

In[409]:=
```
maxi = f[x_begin];
mini = f[x_begin];
step = (x_end - x_begin) / 10;
Do[ If[f[i] > maxi, maxi = f[i]];
  If[f[i] < mini, mini = f[i]], {i, x_begin, x_end, step}];
tot = maxi - mini;
mini = mini - 0.1 * tot;
maxi = maxi + 0.1 * tot;
```

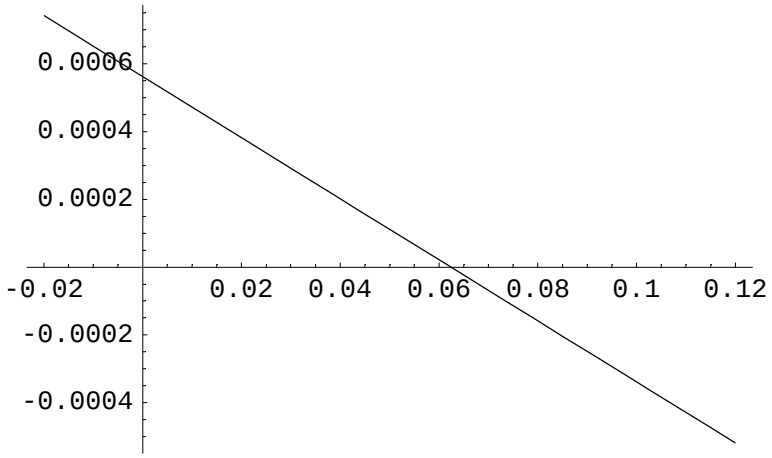
Iteration 1

In[416]:=
```
x1 = x0 - f[x0] / g[x0]
```
Out[416]=
```
0.0624222
```

In[417]:=
```
ϵ_a = Abs[(x1 - x0) / x1 * 100]
```
Out[417]=
```
19.9003
```

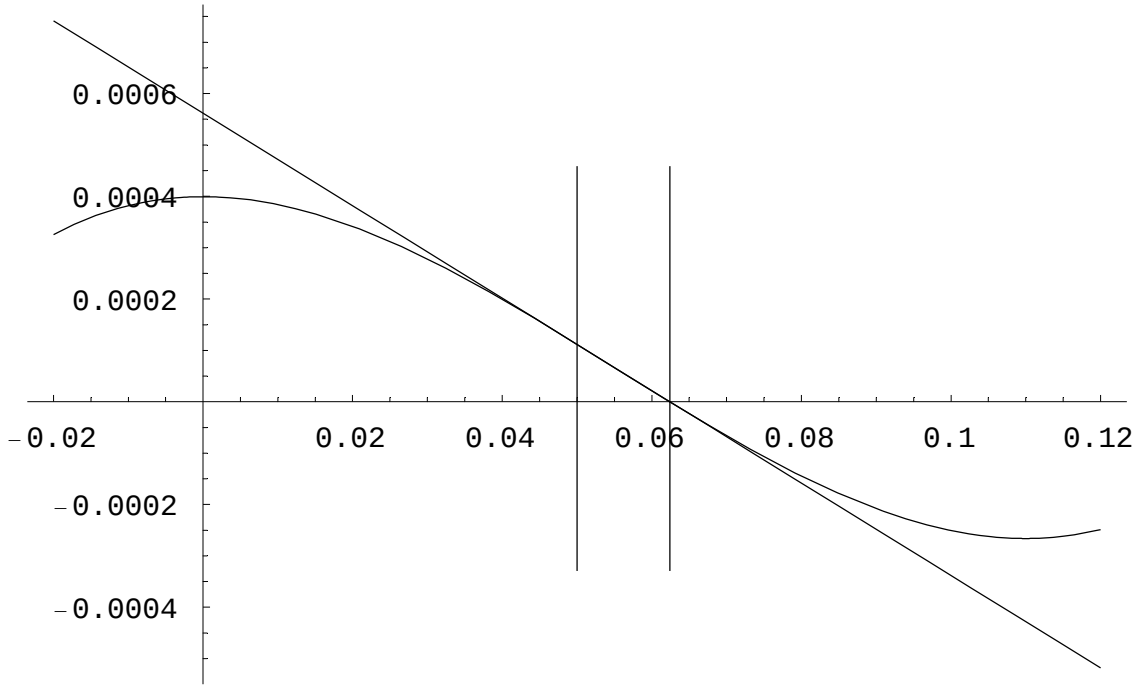
In[418]:=
```
tanline[x_] := f[x0] + ((0 - f[x0]) / (x1 - x0)) * (x - x0)
```

In[419]:=
```
tline = Plot[tanline[x], {x, x_begin, x_end}];
```



In[420]:=
```
Show[Graphics[Line[{{x0, maxi}, {x0, mini}}]], curve,
  Graphics[Line[{{x1, maxi}, {x1, mini}}]], tline, Axes → True,
  PlotLabel → "Entered function on given interval with upper and
     lower guesses and estimated root", TextStyle → {FontSize → 11}];
```

unction on given interval with upper and lower guesses and estimated



Iteration 2

In[421]:=
```
x2 = x1 - f[x1] / g[x1]
```

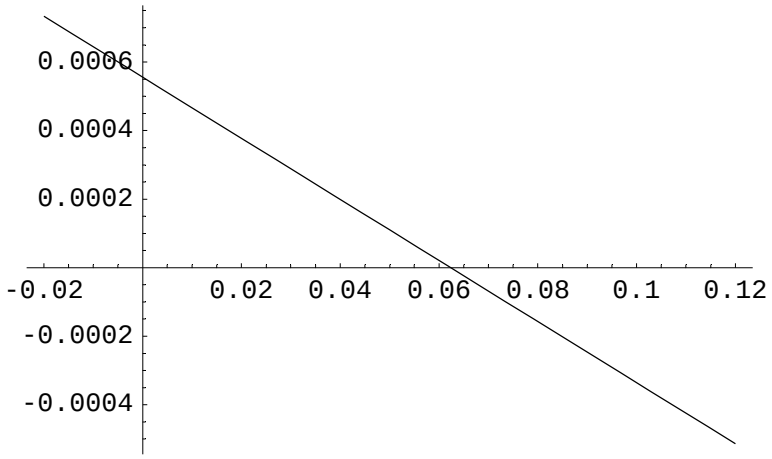
Out[421]= 0.0623776

In[422]:=
```
ϵa = Abs[(x2 - x1) / x2 * 100]
```

Out[422]= 0.0715733

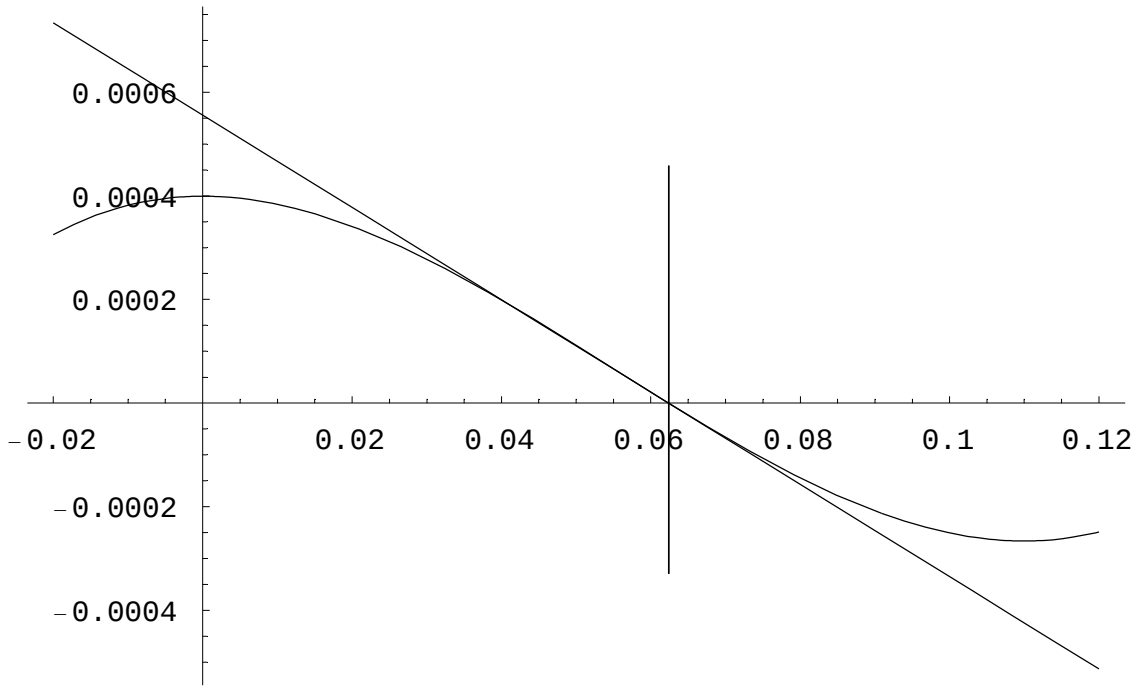
In[423]:=
```
tanline[x_] := f[x1] + ((0 - f[x1]) / (x2 - x1)) * (x - x1)
```

In[424]:=
```
tline = Plot[tanline[x], {x, x_begin, x_end}];
```



In[425]:=
```
Show[Graphics[Line[{{x1, maxi}, {x1, mini}}]], curve,
  Graphics[Line[{{x2, maxi}, {x2, mini}}]], tline, Axes → True,
  PlotLabel → "Entered function on given interval with upper and
     lower guesses and estimated root", TextStyle → {FontSize → 11}];
```

unction on given interval with upper and lower guesses and estimated



Iteration 3

In[426]:=
```
x3 = x2 - f[x2] / g[x2]
```

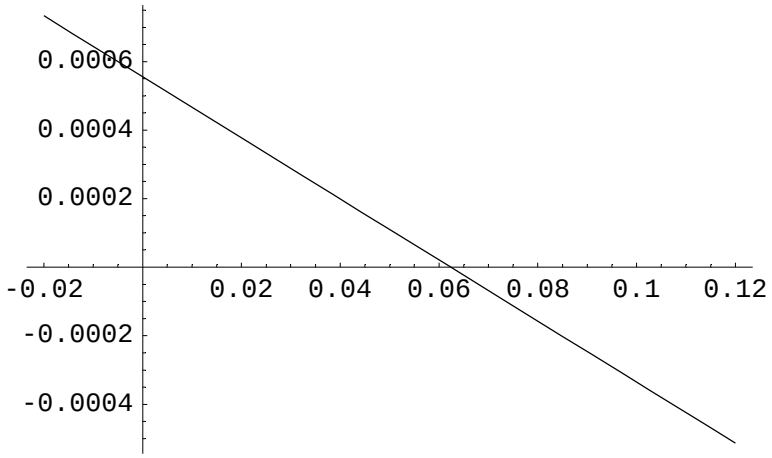
Out[426]=
```
0.0623776
```

In[427]:=
```
ϵa = Abs[(x3 - x2) / x3 * 100]
```

Out[427]=
$$7.96806 \times 10^{-6}$$

In[428]:=
```
tanline[x_] := f[x2] + ((0 - f[x2]) / (x3 - x2)) * (x - x2)
```

In[429]:=
```
tline = Plot[tanline[x], {x, xbegin, xend}];
```



In[430]:=
```
Show[Graphics[Line[{{x3, maxi}, {x3, mini}}]], curve,
  Graphics[Line[{{x2, maxi}, {x2, mini}}]], tline, Axes → True,
  PlotLabel → "Entered function on given interval with upper and
     lower guesses and estimated root", TextStyle → {FontSize → 11}];
```

nction on given interval with upper and lower guesses and estimated