Topic : Secant Method - Roots of Equations
Simulation : Graphical Simulation of the Method
Language : Mathmatica 4.1
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Abstract : This simulation shows how the secant method for finding roots of an equation $f[x]$ 0 works.

■ INPUTS: Enter the Following

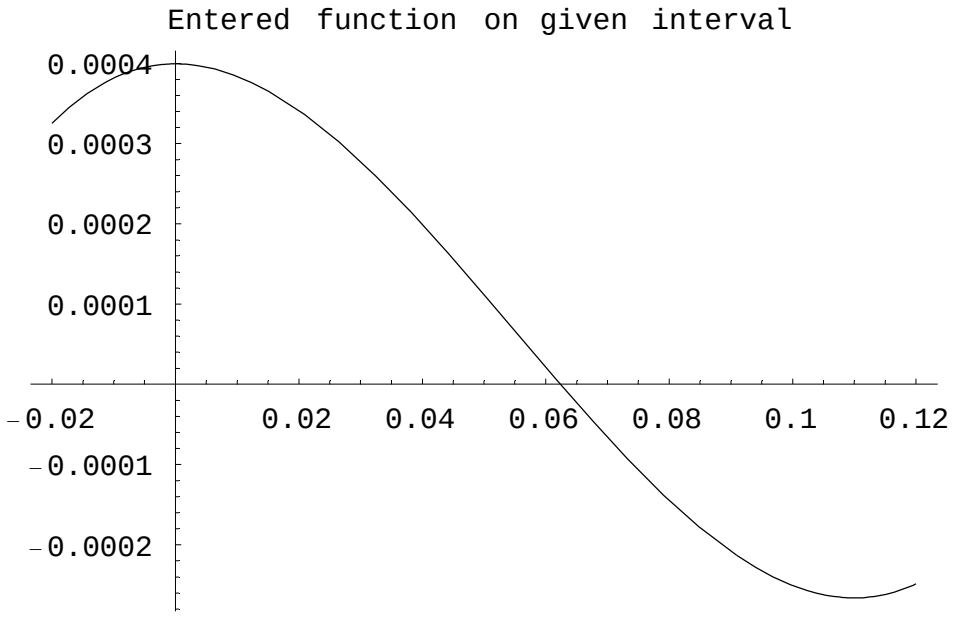
Function in $f[x]$ 0

In[369]:=
```
f[x_] := x^3 - 0.165 * x^2 + 3.993 * 10^-4
```

Range of 'x' you want to see the function

In[370]:=
```
xb = -0.02;
xe = 0.12;
```

In[372]:=
```
curve = Plot[f[x], {x, xb, xe}, PlotLabel →
    "Entered function on given interval", TextStyle → {FontSize → 11}];
```



Lower initial guess

In[373]:=
```
xguess1 = 0.02;
```

Upper initial guess

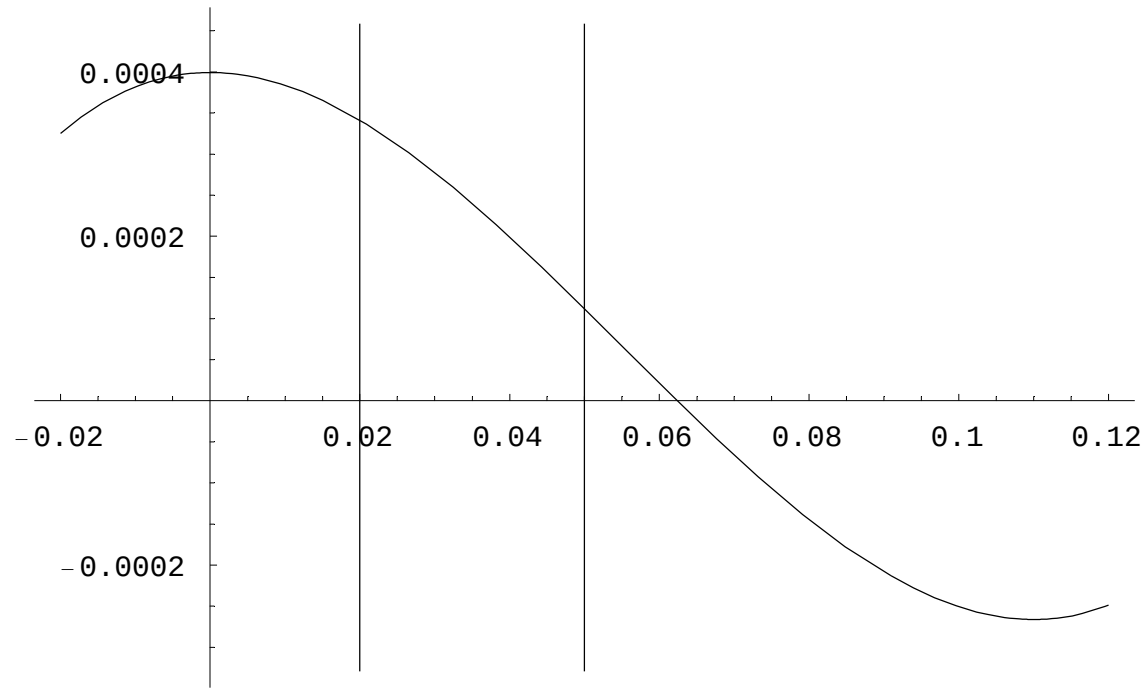
In[374]:=
```
xguess2 = 0.05;
```

■ SOLUTION

In[375]:=
```
maxi = f[xb];
mini = f[xb];
step = (xe - xb) / 10;
Do[ If[f[i] > maxi, maxi = f[i]];
  If[f[i] < mini, mini = f[i]], {i, xb, xe, step}];
tot = maxi - mini;
mini = mini - 0.1 * tot;
maxi = maxi + 0.1 * tot;
```

Check first if the lower and upper guesses bracket the root of the equation

In[382]:=
```
Show[Graphics[Line[{{xguess2, maxi}, {xguess2, mini}}]], curve,
  Graphics[Line[{{xguess1, maxi}, {xguess1, mini}}]], Axes → True, PlotLabel →
   "Entered function on given interval with upper and lower guesses",
  TextStyle → {FontSize → 11}];
```



Iteration 1

Choose two initial guesses of root.

In[383]:=
```
x1' = xguess1;
x0 = xguess2;
```

Estimate of root

In[385]:=
```
x1 = x0 - (f[x0] * (x1' - x0)) / (f[x1'] - f[x0])
```

Out[385]=
```
0.0646144
```

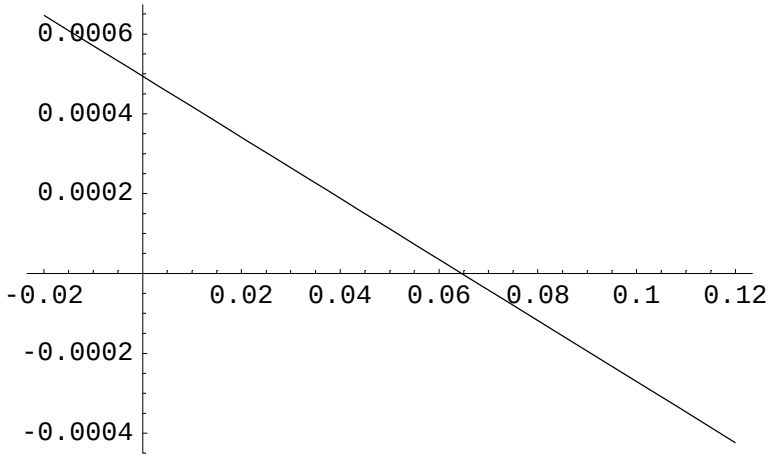
Absolute relative approximate error

In[386]:=
```
ϵa = Abs[(x1 - x0) / x1 * 100]
```

Out[386]=
```
22.6178
```

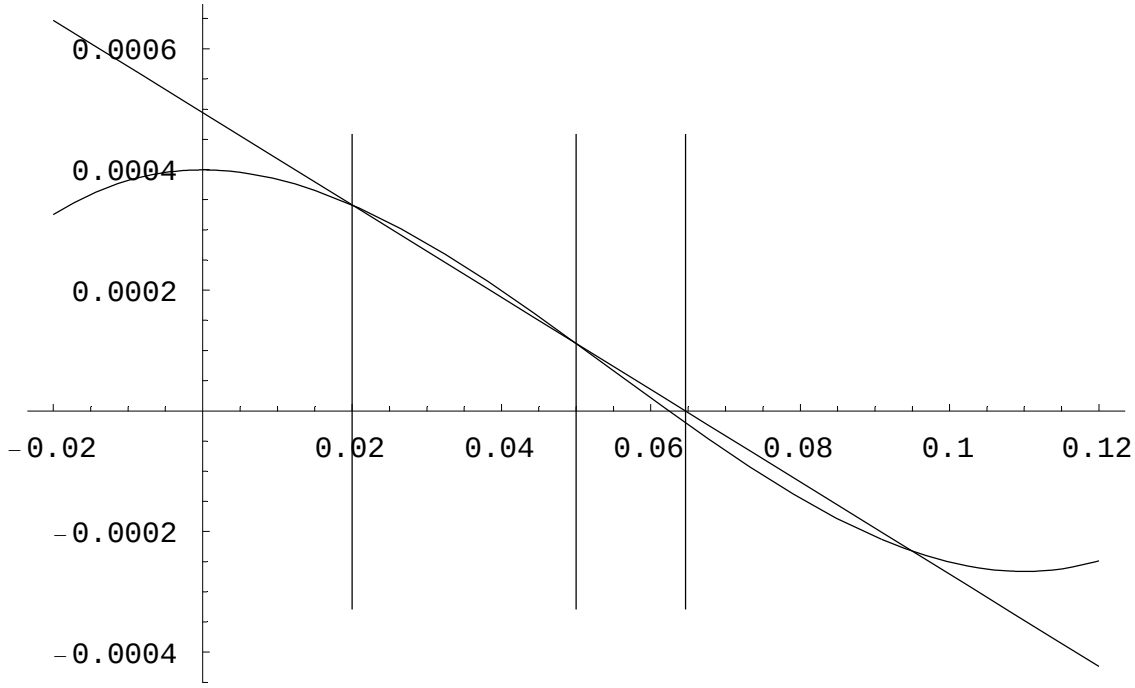
In[387]:=
```
m = (f[x0] - f[x1']) / (x0 - x1');
secantline[x_] = m * x + f[x0] - m * x0;
```

In[389]:=
```
sline = Plot[secantline[x], {x, xb, xe}];
```



In[390]:=
```
Show[Graphics[Line[{{x0, maxi}, {x0, mini}}]],
  Graphics[Line[{{x1, maxi}, {x1, mini}}]], curve,
  Graphics[Line[{{x1', maxi}, {x1', mini}}]], sline, 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



It should be noted that these two guesses do not have to bracket the root. We have called the two initial guesses in the way which we have because that will be the format for subsequent iterations. It does not matter which guess is which. Try switching the two initial guesses to see what happens. One should converge faster than the other.

Iteration 2

Estimate of root

In[391]:=
```
x2 = x1 - (f[x1] * (x0 - x1)) / (f[x0] - f[x1])
```

Out[391]= 0.0624144

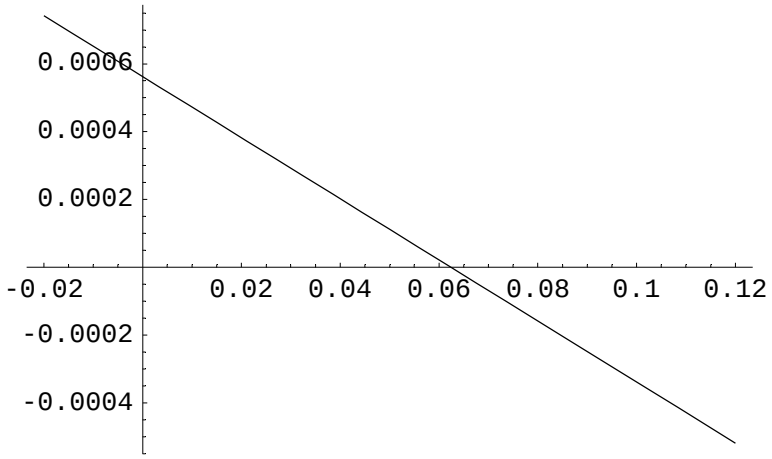
Absolute relative approximate error

In[392]:=
```
ϵa = Abs[(x2 - x1) / x2 * 100]
```

Out[392]= 3.52471

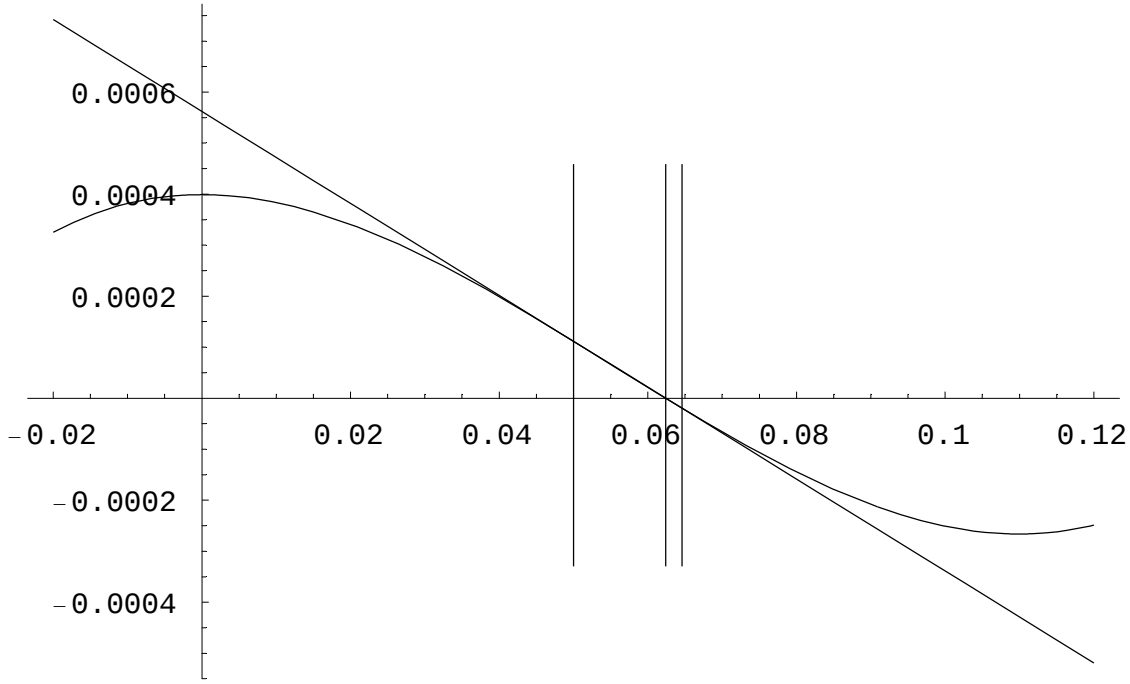
In[393]:=
```
m = (f[x1] - f[x0]) / (x1 - x0);
secantline[x_] = m * x + f[x1] - m * x1;
```

In[395]:=
```
sline = Plot[secantline[x], {x, x_b, x_e}];
```



In[396]:=
```
Show[Graphics[Line[{{x1, maxi}, {x1, mini}}]],
  Graphics[Line[{{x2, maxi}, {x2, mini}}]], curve,
  Graphics[Line[{{x0, maxi}, {x0, mini}}]], sline, 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

Estimate of root

In[397]:=
```
x3 = x2 - (f[x2] * (x1 - x2)) / (f[x1] - f[x2])
```

Out[397]=
```
0.0623774
```

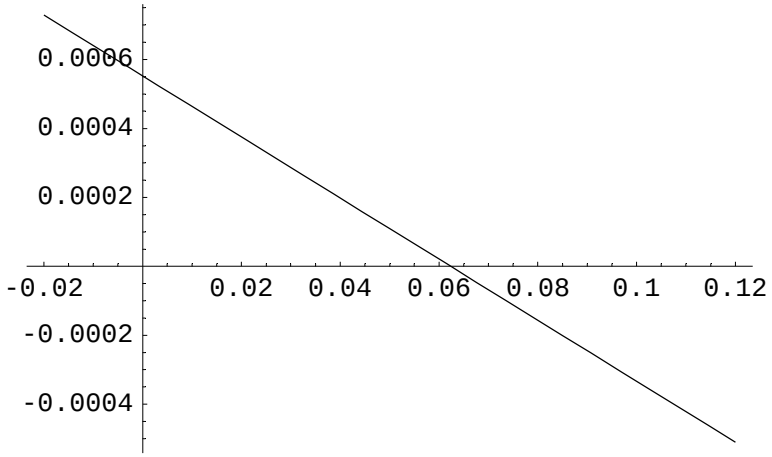
Absolute relative approximate error

In[398]:=
```
ϵa = Abs[(x3 - x2) / x3 * 100]
```

Out[398]=
```
0.0594676
```

In[399]:=
```
m = (f[x2] - f[x1]) / (x2 - x1);
secantline[x_] = m * x + f[x2] - m * x2;
```

In[401]:=
```
sline = Plot[secantline[x], {x, xb, xe}];
```



In[402]:=
```
Show[Graphics[Line[{{x2, maxi}, {x2, mini}}]],
  Graphics[Line[{{x3, maxi}, {x3, mini}}]], curve,
  Graphics[Line[{{x1, maxi}, {x1, mini}}]], sline, 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