**HW #6 exercises on approximation of ODEs**

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**0. Executive Summary**

Use the modified Euler’ method to solve the value of bond today, given the value of bond after 5 years is $1000. To main the accurate to one cent, I used the equals to 0.005, the final result for the bond is 738.036

1. **Statement of Problem**

Given the bond value at Year 5 and using the midpoint rule method to find the value of the bond at time 0, where V(5)=1000, r(t)=0.06+0.03sin(. The result should be accurate to one cent.

The formulas I used are as follows:

1. **Description of The Mathematics**

The midpoint rule method is as follows:

This method can be used to solve the ODE problem for

We also know from the problem that

Here k(t)=5-t , r(t)=0.06+0.03sin( and V(5)=1000.

Since the midpoint method is calculate ,, so I take to make V(0)=1000 and calculate V(5) in the , which is the initial value of the bond at time 0.

so the formula becomes -(0.06+0.03sin(

then can used the midpoint rule method to solve it.

1. **Description of the Algorithm**

N=T/

Y=1000

For n= 0 to N -1

T1=(n+1/2)\*

T2=n\*

Y=Y+))

Next N

Next n

1. **Result**

**I choose the**  form the 0.5 to 0.001,and get the results as follows:

|  |  |
| --- | --- |
|  | Bond value |
| =0.5 | 736.3554 |
| =0.25 | 737.6618 |
| =0.1 | 737.9800 |
| =0.05 | 738.0228 |
| =0.01 | 738.0362 |
| =0.005 | 738.0366 |
| =0.001 | 738.0367 |
| =0.0001 | 738.0367 |

**From the above results, we can see that when the**  is less than 0.01, the value will not change under the two decimals. So the result which is accurate to cent is 738.036

1. **Conclusion**

**Via using the midpoint rule method and take the**  , we can get the bond value at time 0 is 738.036, which was under the accuracy of cent.

I used the language of VBA to solve the problem the code is as follows:

1. **Code Listing**

Sub Euler()

Dim n As Double

Dim delatat As Double

Dim v As Double

Dim t1 As Double

Dim t2 As Double

v = 1000

t = 5

deltat = 0.0001

n = t / deltat

For i = 0 To n - 1

t1 = (i + 1 / 2) \* deltat

t2 = i \* deltat

v = v + deltat \* F(t1, v + deltat / 2 \* F(t2, v))

Next i

Worksheets("sheet1").Range("a1").Value = v

End Sub

Function F(t As Double, y As Double) As Double

Pi = 3.1415926

F = t - (0.06 + 0.03 \* Sin(Pi \* (5 - t))) \* y

'F = y

End Function