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Milne's Spreadsheet Calculator Using VBA with Excel Programming for solving Ordinary Differential Equations

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ABSTRACT

In this paper we have shown a calculator for solving differential equations that is developed in Microsoft Excel. We have selected Milne's method. We have built a VBA program for Milne's method for solving ODE numerically. In this program, computer accepts input form and sufficient information to solve the ODE via Milne's method. On the other hand, they are needed to input the interval for independent variable, initial value for dependent variable, step size 'h' in this program.The computational procedures were translated into Visual Basic for Application.

Keywords: Milne's Method, Ordinary Differential Equations.,VBA Programme.

I. INTRODUCTION

Numerical solution of ordinary differential equation with integer order has been developed by long time and has been a standard topic in numerical and computational Mathematics. These solutions can be divided into the exact solution method and the numerical method. The exact solution of the nonlinear ODEs is difficult hence it is necessary to develop a tool in order to solve the ODEs easily. Most of the Numerical methods used for solving ordinary differential equations are based on approximation.

VBA stands for Visual Basic for Applications an event driven programming language from Microsoft that is now predominantly used with Microsoft office applications such as MS-Excel, MS-Word and MS-Access. It helps techies to build customized applications and solutions to enhance the capabilities of those applications. The advantage of this facility is that we NEED NOT have visual basic installed on our PC but installing office will implicitly help us to achieve the purpose. Visual Basic for Application (VBA) is the scripting language used to create all macros in this application. The macros were written either from scratch or by editing pre-recorded macros.

Tay, et, al (2009b) solved systems of nonlinear equations using spread sheet. Kek and Tay (2009c) developed Newton's divided interpolation solver in spread sheet. Lagrange interpolating solver in spread sheet was developed by Tay et, al(2010) whereas bivariate approximation spread sheet calculator was developed by Tay

et, al(2014). All the interpolation solvers and spread sheet calculators were developed without applying VBA programming. The spread sheet calculator for the numerical differentiations is developed by Tay et, al (2013a,2013b,2014).

In this paper we are using Milne-Simpson method with VBA programming for solving ordinary differential equations. Here we are comparing the result with output values by VBA programming with numerical solutions of a given function.

Milne-Simpson Method

Details of method can be found in many textbooks for ex.[5,10]. The essences of the method given below.We have discussed many methods for obtaining the solutions of Ordinary Differential Equationswith initial condition. All of them use information only from the computed point (x_i, y_i) to compute the next point (x_{i+1}, y_{i+1}).These all are called single step methods. They do not make use of the information available at the earlier steps, y_{i-1}, y_{i-2}etc. , even when they are available.

Milne-Simpsons method is multistep method since this method use information points from more than one previous points to compute the next point. It is also called Predictor-Corrector method. Milne's formula used as a predictor and Simpson's formula as a corrector. These are based fundamental theorem of calculus.

$$y(x_{i+1}) = y(x_j) + \int_{xi}^{xi+1} f(x,y)\,dx$$

Ex:Given equation y'(x)= 2y/x with y(1)=2. Estimate y(2) using Milne- Simpsons Predictor Corrector Method .

⇨ Mines formula at i=3 is

$$y^p_4 = y_0 + (4h/3)(2f_1 - f_2 + 2f_3)$$

Simpson's Fomula at i=3 is

$$y^c_4 = y_2 + h/3(f_2 + 4f_3 + f^p_4)$$

where fi=f(xi,yi)

Using RK4,

$y_1=y(1.25)=3.13$, $y_2= y(1.5)= 4.50$, $y_3= y(1.75)= 6.13$

$f_1=5.01$, $f_2= 6$, $f_3= 7.01$

eq.(1) $Y^p_4=8.01$

$f^p_4 =8.01$

eq.(2) $y^c_4 =4.5+0.25/3(6+4*7.0+8.01)=8$

$f_4 =2*8/2=8$

$y^c_4 =4.5+0.25/3(6.00+4*7.07+8)= 8$

$y^c_4 =8$

In this section, first frame shows excel spreadsheet for Milne-Simpson method in which a button for Milne-Simpson Method and relevant information are inserted.

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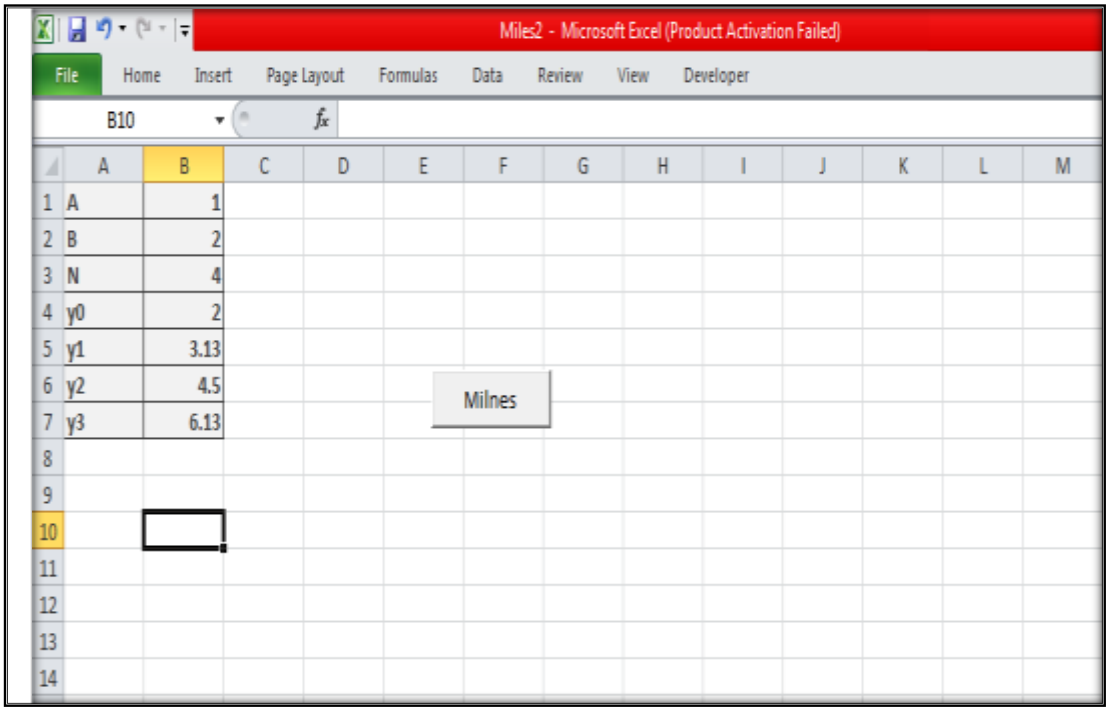
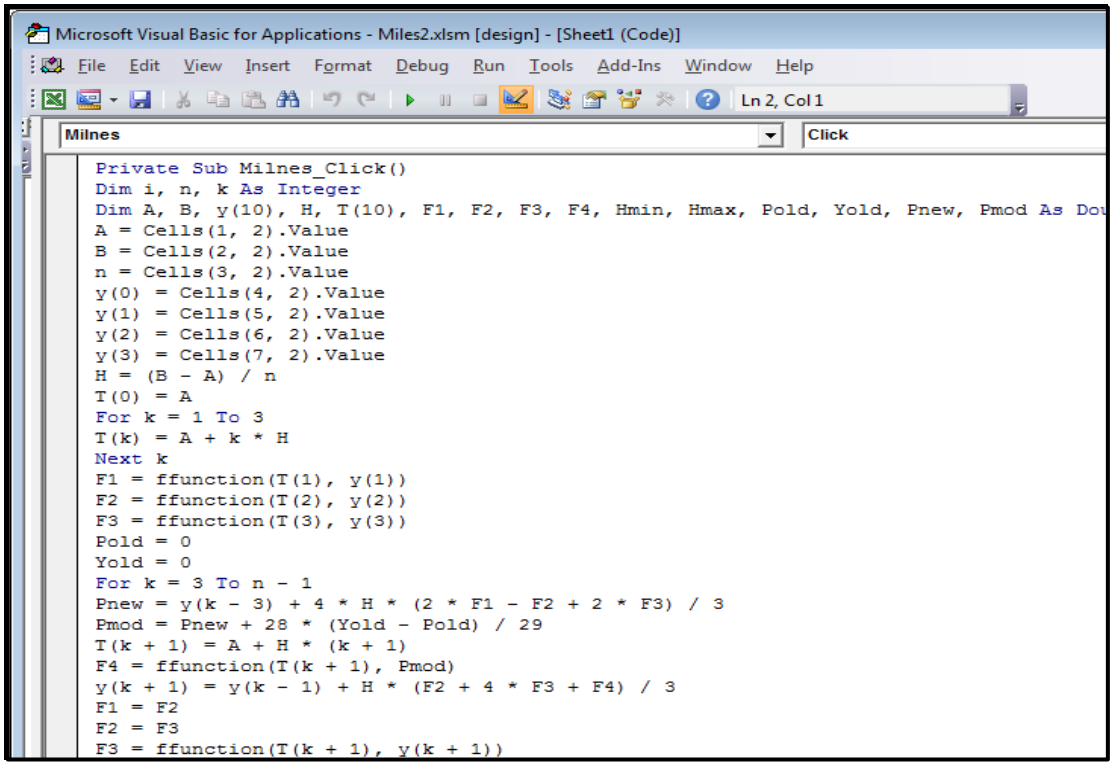
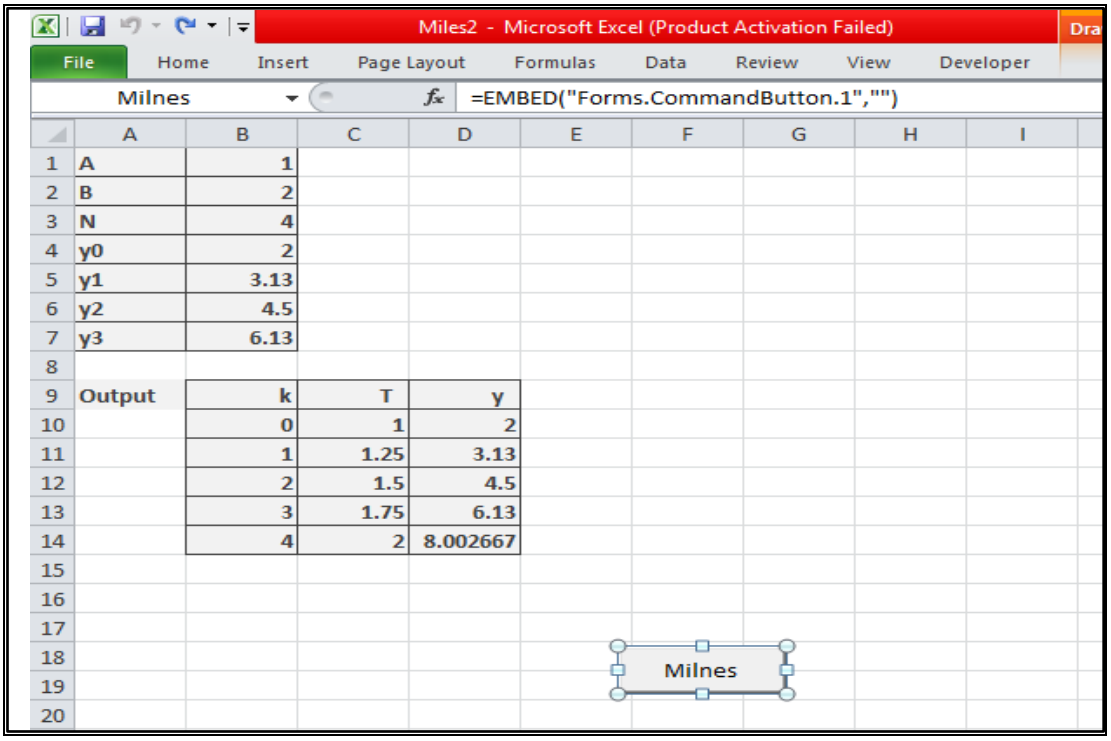


In the second frame, we have shown a program code for Milne-Simpson Method.



In the third frame, we get output by providing the relevant information such as initial values and step length.



	A	B	C	D	E	F	G	H	I
1	A	1							
2	B	2							
3	N	4							
4	y0	2							
5	y1	3.13							
6	y2	4.5							
7	y3	6.13							
8									
9	Output	k	T	y					
10		0	1	2					
11		1	1.25	3.13					
12		2	1.5	4.5					
13		3	1.75	6.13					
14		4	2	8.002667					
15									
16									
17									
18									
19									
20									

The table shows comparison between actual calculated value and output of the program.

Actual calculated Value	Output of the Program
8	**8.002667**

IV. CONCLUSION

In this paper, we have discussed Milne-Simpson Method for solving Ordinary Differential Equations was developed by VBA programming with Excel. Since users need only relevant information to compute the full solution of the ODEs efficiently, it is very user friendly and time consuming. In this paper we have compared the actual value with output in the third frame of the program designed, which are very close to each other's.

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