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IN APPLIED RESEARCH

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MATHEMATICS
IN APPLIED RESEARCH

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KOLEJ PENGAJIAN PENGKOMPUTERAN, INFORMATIK, DAN MEDIA, UITM CAWANGAN NEGERI SEMBILAN KAMPUS SEREMBAN
EDISI NOVEMBER 2022

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Sebarang maklumat yang terkandung dalam majalah ini merupakan pengetahuan dan pendapat peribadi penulis artikel. Pembaca dinasihatkan untuk mendapatkan pandangan profesional sebelum mengikuti mana-mana maklumat dalam majalah ini. Pihak universiti, penerbit, dan sidang redaksi tidak akan bertanggungjawab dan menanggung sebarang risiko atas kerugian secara langsung atau tidak langsung atas maklumat yang dipaparkan.

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Majalah ini diterbitkan dua kali setahun

ALUAN KETUA EDITOR

Al-Hamdulillah bersyukur kita ke hadrat Allah swt, dengan penerbitan edisi ketiga makalah Mathematics in Applied Research terbitan Kolej Pengajian Pengkomputeran, Informatik, dan Media UiTM kampus Seremban. Penerbitan ini merupakan satu usaha untuk menonjolkan hasil penyelidikan pelajar bersama pensyarah dalam Projek Tahun Akhir program ijazah sarjana muda di KPPIM Seremban.

Semenjak tahun 2014, mahasiswa tahun akhir KPPIM (sebelumnya dikenali FSKM) Seremban telah menghasilkan banyak penyelidikan yang berpotensi untuk diketengahkan dalam dunia akademik. Akan tetapi tidak banyak yang berjaya diterbitkan dalam jurnal atau pun prosiding konferensi akademik kerana halangan tertentu seperti kualiti penyelidikan dan penulisan ilmiah. Oleh itu, penerbitan makalah ini diharapkan dapat menambahkan lagi ruang bagi penerbitan hasil penyelidikan warga KPPIM Seremban

Disamping itu, pihak KPPIM Seremban mengharapkan makalah ini akan menjadi rujukan dan pemangkin kepada usaha menghasilkan penyelidikan Projek Tahun Akhir yang lebih bermutu tinggi. Makalah ini juga adalah batu asas kepada perkongsian penyelidikan terkini daripada pelajar dan pensyarah KPPIM Seremban.

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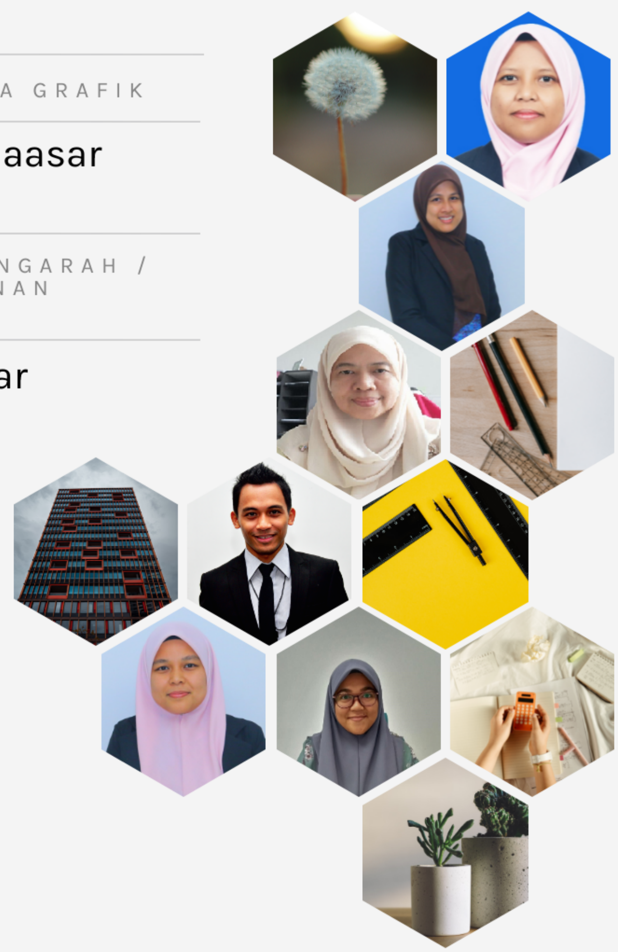
- Profesor Madya Dr. Nur Azlina Abd Aziz
- Dr. Nor Azni Shahari

semoga kecemerlangan perkhidmatan yang ditunjukkan oleh kedua editor-editor ini akan menjadi pendorong kepada editorial board yang seterusnya.

Sekian. Terima kasih.

SIDANG REDAKSI



Thank You!

for being with us,

Dr. Nor Azni Shahari
Editor

MiAR 2021, 2022

Dr. Nur Azlina
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for all the dedications and

Happy Retirement

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Contents

SOLUTION OF FISHER'S EQUATION USING INTEGRAL ITERATIVE METHOD

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1. Introduction

In general, partial differential equations play an important role in various fields of science and engineering. The main problem that researchers focused on is solving the nonlinear part of the differential equation. Fisher's equation is an example of a nonlinear differential equation. Fisher's Equation (FE) is a reaction-diffusion equation in the context of population dynamics. Nowadays it seems in many research areas such as ecology, combustion, Brownian motion and many more. The FE is given as follow (Wazwaz, 2008):

$$\frac{\partial u}{\partial t} = \alpha \frac{\partial^2 u}{\partial x^2} + \beta u(1-u) \tag{1}$$

where $u(x,t)$ is a population density. In this studied, we applied the integral iterative method (IIM) to solve two examples of FE.

2. Integral Iterative method

Consider the general partial different equation of arbitrary order (Hemeda, 2018):

$$\frac{\partial^n u(x,t)}{\partial t^n} = A\left(u, \partial u\right) + B\left(x,t\right), \quad n \in N \tag{2}$$

$$\frac{\partial^n u(x,0)}{\partial t^k} = h_k(x), \quad k = 1,2,3,... \tag{3}$$

where A is a nonlinear function of u, ∂u and B is the source function. In view of integral operators, (2) and (3) is equivalent to the following integral equation:

$$u(x,t) = \sum_{k=0}^{n-1} h_k(x) \frac{t^k}{k!} + I_t^n B + I_t^n A = f + N(u) \tag{4}$$

where $f = \sum_{k=0}^{n-1} h_k(x) \frac{t^k}{k!} + I_t^n B$, $N(u) = I_t^n A$ and I_t^n is n^{th} order (n fold) integral operator. The required solution $u(x,t)$ for (4) can be obtained recurrently by employing the simple recurrence relation:

$$u_0(x,t) = f, \tag{5}$$

$$u_{n+1}(x,t) = u_0(x,t) + N(u_n(x,t)), \quad n = 0,1,2,... \tag{6}$$

where $u(x,t) = \lim_{n\to\infty} u_n(x,t)$.

3. Results and Discussion

Case 1

We applied the IIM to solve the FE in the given form (Matinfar et al., 2010):

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2} + u(1-u) \tag{7}$$

subject to initial condition $u(x,0) = \lambda$, where λ is any constant.

From Table 1, as value of t increase, the absolute error also increases. The absolute error is positively affected by the value of t. The data started to give error at $t = 0.2$. At $t = 0.1$, the exact value and the approximate value is the same which resulting to 0 value of absolute error. It is noted that the error value shows increment when value of t increases because the power series nature is very sensitive to the parameters inherent in the series. When the solution point moves away from the starting point, the accuracy will decline.

Table 1: Absolute error between exact solution, $u(x,t)$ with IIM solution $u_7(x,t)$ for $\lambda = 2$.

t	Exact solution, $u(x,t)$	IIM solution, $u_7(x,t)$	Absolute error $\lvert u(x,t) - u_7(x,t)\rvert$
0.0	2.0	2.0	0.
0.1	1.826212868	1.826212867	1.10^{-5}
0.2	1.693094107	1.693093998	1.09×10^{-7}
0.3	1.588333021	1.588331194	1.827×10^{-6}
0.4	1.504121344	1.504108705	0.000012639
0.5	1.435266598	1.435212769	0.000053829
0.6	1.378180841	1.378010969	0.000169872
0.7	1.330304942	1.329867060	0.000537882
0.8	1.289764208	1.288787878	0.000976330
0.9	1.255153708	1.253201130	0.001952578
1.0	1.225399674	1.221819387	0.003580287

Case 2

We considered the FE in the form (Ağırseven and Öziş, 2010):

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2} + 6u(1-u) \tag{8}$$

with initial condition $u(x,0) = \dfrac{1}{(1+e^x)^2}$.

In view of IIM, we obtained the results as in Table 2. Table 2 show the absolute error between exact solution, $u(x,t)$ with IIM solution $u_4(x,t)$ for short time domain, $t \in [0, 0.5]$. Similar to Case 1, the error value increased when value of t increases.

4. Conclusion

IIM is considered as one of the simple methods to solve FE because this method generates a sequence of approximations. Furthermore, this method is applied for both linear and non-linear problems that contain a large number of variables. However, the accuracy of IIM results only applicable for a small time domain t.

Table 2: Absolute error between exact solution, $u(x,t)$ with IIM solution $u_4(x,t)$.

t	Exact solution, $u(x,t)$	IIM solution, $u_4(x,t)$	Absolute error $\|u(x,t) - u_4(x,t)\|$
0.00	0.25	0.25	0.00
0.05	0.3160424182	0.3160423405	0.0000000777
0.10	0.3874556189	0.3874586984	0.0000030795
0.15	0.4612837053	0.4613541765	0.0000704712
0.20	0.5344466455	0.5349535922	0.0005069467
0.25	0.6041950741	0.6063822018	0.0021871277
0.30	0.6684280243	0.6753607344	0.0069327101
0.35	0.7258235761	0.7436021365	0.0177785604
0.40	0.7758034929	0.8147542028	0.0389507099
0.45	0.8183925900	0.8938314946	0.0754389046
0.50	0.8540381028	0.9861895590	0.1321514562

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