



Submit

 LOGIN

 REGISTER

[Home](#)
[Academic Journals](#)
[Books & Monographs](#)
[Conferences](#)
[Language Service](#)
[News & Announcements](#)
[About](#)

Home / Journals / CMES / Vol.135, No.2, 2023 / 10.32604/cmcs.2022.023694

Computer Modeling in  
Engineering & Sciences

Submit a Paper



Propose a Special Issue



Open Access

ARTICLE

## A Detailed Mathematical Analysis of the Vaccination Model for COVID-19

Abeer S. Alnahdi<sup>1,\*</sup>, Mdi B. Jeelani<sup>1</sup>,  
Hanan A. Wahash<sup>2</sup>, Mansour A.

Abdulwasaa<sup>3,4</sup>

1 Department of Mathematics and  
Statistics, Imam Mohammad Ibn Saud  
Islamic University (IMSIU), Riyadh,  
Saudi Arabia

2 Department of Mathematics, Dr.  
Babasaheb Ambedkar Marathwada  
University, Aurangabad, India

3 Department of Statistics, Taiz  
University, Taiz, Yemen

4 Department of Statistics, Dr.  
Babasaheb Ambedkar Marathwada  
University, Aurangabad, India

\* Corresponding Author: Abeer S.  
Alnahdi. Email:

[asalahdi@imamu.edu.sa](mailto:asalahdi@imamu.edu.sa)

(This article belongs to the Special  
Issue: [Advanced Numerical Methods  
for Fractional Differential Equations](#))

*Computer Modeling in Engineering &  
Sciences* **2023**, 135(2), 1315-1343.

[https://doi.org/10.32604/  
cmcs.2022.023694](https://doi.org/10.32604/cmcs.2022.023694)

**Received** 09 May 2022; **Accepted** 30  
June 2022; **Issue published** 27  
October 2022



Downloads



Citation Tools

956



573



Download



### Table of Content

- > Abstract
- > Introduction
- > Statistical Analysis
- > Auxiliary Results
- > Model Derivation in ABC Operator
- > Existence Criteria
- > Numerical Results
- > Simulations Results
- > Conclusion
- > References

### Related articles

AdaBoosting Neural Network for  
Short-Term Wind Speed

Forecasting Based on Seasonal  
Characteristics Analysis and Lag  
Space Estimation

Haijian Shao, Xing Deng

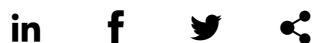
Exploring Urban Population  
Forecasting and Spatial  
Distribution Modeling with Artificial  
Intelligence Technology

Yan Zou, Shaoliang Zhang, Yanhai...

A Self-Organizing Memory Neural  
Network for Aerosol Concentration  
Prediction

Qiang Liu, Yanyun Zou, Xiaodong...

Wind Power Forecasting Methods

 View Full Text Download PDF

## Abstract

This study aims to structure and evaluate a new COVID-19 model which predicts vaccination effect in the Kingdom of Saudi Arabia (KSA) under Atangana-Baleanu-Caputo (ABC) fractional derivatives. On the statistical aspect, we analyze the collected statistical data of fully vaccinated people from June 01, 2021, to February 15, 2022. Then we apply the Eviews program to find the best model for predicting the vaccination against this pandemic, based on daily series data from February 16, 2022, to April 15, 2022. The results of data analysis show that the appropriate model is autoregressive integrated moving average ARIMA (1, 1, 2), and hence, a forecast about the evolution of the COVID-19 vaccination in 60 days is presented. The theoretical aspect provides equilibrium points, reproduction number, and biologically feasible region of the proposed model. Also, we obtain the existence and uniqueness results by using the Picard-Lindel method and the iterative scheme with the Laplace transform. On the numerical aspect, we apply the generalized scheme of the Adams-Bashforth technique in order to simulate the fractional model. Moreover, numerical simulations are performed dependent on real data of COVID-19 in KSA to show the plots of the effects of the fractional-order operator with the anticipation that the suggested model approximation will be better than that of

Based on Deep Learning: A Survey

Xing Deng, Haijian Shao, Chunlong...

Validating the Correct Wearing of Protection Mask by Taking a Selfie: Design of a Mobile Application "CheckYourMask" to Limit the Spread of COVID-19

Karim Hammoudi, Adnane Cabani,...

the established traditional model. Finally, the concerned numerical simulations are compared with the exact real available data given in the statistical aspect.

---

## Keywords

COVID-19; Eviews program; forecasting; ABC fractional derivative; Picard-Lindel method; Adams-Bashforth technique

---

## Cite This Article

### APA Style

Alnahdi, A.S., Jeelani, M.B., Wahash, H.A., Abdulwasaa, M.A. (2023). A detailed mathematical analysis of the vaccination model for COVID-19. *Computer Modeling in Engineering & Sciences*, 135(2), 1315-1343. <https://doi.org/10.32604/cmes.2022.023694>

### Vancouver Style

Alnahdi AS, Jeelani MB, Wahash HA, Abdulwasaa MA. A detailed mathematical analysis of the vaccination model for COVID-19. *Comput Model Eng Sci*. 2023;135(2):1315-1343 <https://doi.org/10.32604/cmes.2022.023694>

### IEEE Style

A.S. Alnahdi, M.B. Jeelani, H.A. Wahash, and M.A. Abdulwasaa "A Detailed Mathematical Analysis of the Vaccination Model for COVID-19," *Comput. Model. Eng. Sci.*, vol. 135, no. 2, pp. 1315-1343. 2023. <https://doi.org/10.32604/cmes.2022.023694>

[BibTex](#) [EndNote](#) [RIS](#)



This work is licensed under a Creative Commons Attribution 4.0 International License, which permits unrestricted use,

distribution, and reproduction in any medium, provided the original work is properly cited.

### We recommend

Analysis and Dynamics of Illicit Drug Use Described by Fractional Derivative with Mittag-Leffler Kernel  
Berat Karaagac et al., CMC-Computers, Materials & Continua, 2020

Analysis and Dynamics of Fractional Order Mathematical Model of COVID-19 in Nigeria Using Atangana-Baleanu Operator  
Olumuyiwa Peter et al., CMC-Computers, Materials & Continua, 2020

Fractional Order Modeling of Predicting COVID-19 with Isolation and Vaccination Strategies in Morocco  
Lakhlifa Sadek et al., CMES-Computer Modeling in Engineering & Sciences, 2023

An Unsteady Oscillatory Flow of Generalized Casson Fluid with Heat and Mass Transfer: A Comparative Fractional Model  
Anis ur Rehman et al., CMC-Computers, Materials & Continua, 2020

New Configurations of the Fuzzy Fractional Differential Boussinesq Model with Application in Ocean Engineering and Their Analysis in Statistical Theory  
Yu-Ming Chu et al., CMES-Computer Modeling in Engineering & Sciences, 2023

