Review of: "Analysis of the Spread of Covid-19 via Atangana-Baleanu Fractional Derivatives"

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Review Report

 Analysis of the Spread of Covid-19 via AtanganaBaleanu Fractional Derivatives

1. Comments and Queries

1.1 Grammar, Typographical Errors, and Punctuation

Upon reviewing the document, several grammatical errors, typos, and punctuation issues were observed:

• Typographical Errors: – "Statictics" should be "Statistics" in the references section. – "Avalilable" should be "Available" in the references.

– "Statictics,cited" should be "Statistics, cited" with appropriate spacing.

– "World Health Organization.coronavirus." should have a space after the period: "World Health Organization. Coronavirus."

– "Fredj" should be capitalized consistently in reference to the author's name.

– "Fredj and Cherif" should be correctly cited with consistent capitalization and correct punctuation.

• Punctuation Issues:

– Commas and periods are often misused, especially around references and in complex sentences.

– Missing or misplaced commas, particularly in lists and around subordinate clauses, e.g., "By considering these seven compartments, our model aims to provide..." requires a comma for clarity.

1 – Some sentences are run-on and could be split for better readability.

• Grammar Errors:

– Subject-verb agreement issues, such as "The simulation results provide valuable insights into the behavior of the infected population and the potential outcomes..." could be more concise.

– Consistency in tenses throughout the document is sometimes lacking. For example, the text shifts between past and present tense inconsistently.

1.2 Novelty and Originality of the Work

The work presents a novel approach by applying Atangana-Baleanu fractional derivatives to model the spread of Covid-19. This approach, while innovative, builds on existing fractional calculus methods used in epidemiology. The uniqueness lies in the specific application of Atangana-Baleanu derivatives, which are known for their nonlocal and nonsingular kernel properties, providing a potentially more accurate modeling of the disease's dynamics compared to traditional methods.

However, the work does heavily rely on the foundation laid by previous research. The novelty is more in the application of an established mathematical tool to a specific problem rather than in introducing a completely new concept or theory. ***One of the most important questions is, what is the justification for the replacement of the first-order derivative by the Atangana-Baleanu derivative of fractional order γ?***

1.3 Comparison with Existing Research

The research compares itself with existing models, such as the classical SIR model, and other fractional derivative approaches like Riemann-Liouville and Caputo derivatives. The authors argue that the Atangana-Baleanu derivative offers advantages due to its ability to capture nonlocal interactions better. This is a valid point, but the paper could benefit from a more thorough comparison with recent models that have applied other fractional derivatives in similar contexts. Moreover, the model could be compared with more contemporary models dealing with real-time data during the Covid-19 pandemic to assess its relative accuracy and predictive power.

1.4 Weaknesses in the Work

• Model Limitations:

The model assumes certain parameters that may not fully capture the stochastic nature of real-world disease spread, such as mutation rates of the virus, varying public health interventions, and behavioral responses.

• Lack of Data Integration:

The model is not tested with diverse datasets across different regions or under different pandemic conditions, which limits the generalizability of the findings.

• Numerical Simulation Details:

While numerical simulations are provided, the paper could offer more insight into the sensitivity analysis of different parameters. The implications of parameter changes, especially the fractional order and quarantine rate, could be more deeply explored.

• Theoretical Over Practical:

The paper is highly theoretical and may lack practical guidance on how to implement the findings in realworld public health strategies. More practical examples or case studies could enhance the paper's impact.

1.5 Validity and Correctness of Conclusions:

The conclusions drawn are generally supported by the mathematical analysis and simulations presented in the paper. However, the scope of the conclusions could be expanded to discuss the potential limitations of the model in real-world scenarios. The stability analysis and the findings regarding equilibrium points are sound, but their real-world implications need to be discussed in more depth.

1.6 Publication Worthiness:

The work is certainly of interest to the mathematical and epidemiological modeling communities. It offers a novel application of fractional calculus, which could justify its publication in a specialized journal focusing on mathematical biology or applied mathematics. However, before publication, it is recommended that the authors address the grammatical and typographical issues, provide a deeper comparison with existing models, and possibly include more practical implications or applications of their findings.

1.7 Literature Review:

While the paper references existing models and fractional derivatives, a dedicated literature review section that critically examines previous studies on Covid-19 modeling using fractional derivatives would strengthen the work. This section should discuss related works in more depth and highlight how this paper builds on or diverges from them.

1.8 Methodology:

A more detailed explanation of the methodology used to develop the model could be beneficial. This should include the rationale behind choosing the Atangana-Baleanu fractional derivative over other types, the assumptions made in the model, and the step-by-step process of the mathematical derivations.

1.9 Data Sources and Calibration:

While the paper provides numerical simulations, there is no clear section that discusses the data sources in detail, how parameters were calibrated, and any preprocessing done on the data. Including this would clarify how the model was validated against real-world data.

1.10 Discussion:

Although some analysis is present, a dedicated discussion section that interprets the results in the context of public health, model limitations, and potential real-world applications is missing. This section should also address how the model's findings can inform policy or future research. It is strange to read in the conclusion section that the obtained graphical results clearly indicated that decreasing the fractional order and quarantine rate leads to a decrease in the infection population. How a declining quarantine rate can lead to a decrease in the infection population? Clarify it!

1.11 Sensitivity Analysis:

The paper mentions the impact of varying parameters like the fractional order and quarantine rate, but a formal sensitivity analysis that quantifies how changes in these parameters affect the model's outcomes would be valuable. This is crucial for understanding the robustness of the model.

1.12 Future Work:

There is no section that outlines possible extensions of this work or other areas of research that could build on these findings. Discussing future research directions would add value to the study by showing how it fits into a larger research agenda.

1.13 Ethical Considerations:

Given that the work deals with public health and pandemic modeling, it could benefit from a brief section on ethical considerations, especially regarding the use of data and the implications of the findings. Including these sections or expanding on them would enhance the completeness and academic rigor of the paper.

1.14 Conclusion:

In summary, while the work is novel in its application and provides valid and rigorous mathematical findings, it would benefit from further refinement, especially in terms of clarity, comparison with existing research, and practical applicability. Addressing these aspects would make it a stronger candidate for publication and increase its impact in the field.