

UNIVERSITI TEKNOLOGI MARA

TECHNICAL REPORT

ANALYZING, PREDICTING AND CONTROLLING  
THE EBOLA DISEASE BY USING SEIR MODEL

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Report submitted in partial fulfillment of the requirement  
for the degree of  
Bachelor of Science (Hons.) Mathematics  
Center of Mathematics Studies  
Faculty of Computer and Mathematical Sciences

JANUARY 2018

## ACKNOWLEDGEMENTS

IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL

Our first appreciation are means of how extremely blessed we are to Allah S.W.T for giving us such opportunity and ability to finish this project on time. From him we owed all that we have and all that we are. We also would love to present our genuine thanks to our supervisor Madam Zati Iwani bt Abdul Manaf for consulting us the expertise, precious thoughts, and constructive advises upon completing this project. Her willingness to give her time generously has been specially valued.

Then, our thankful to Madam Khairiyah Hulaini bt Wan Ramli as the final year project (FYP) coordinator for the never ending guidance and assisting us upon finishing the project's requirement. Our grateful thanks are also extended to, Dr Norzieha bt Mustapha as the lecturer and also as our project panel. Thank you for giving us such enthusiastic encouragement and useful critics which gives us the chance in correcting our mistakes.

Finally, we also wish to thank our family and friends as an inspiration and also to who influenced us directly or indirectly. We feel that the words are not enough to express our feelings and how deeply grateful we are.

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## ABSTRACT

Ebola virus remarks as one of the most lethal pathogens for humans which lead to loss of many lives. In this project, a mathematical model of Susceptible-Exposed-Infectious-Recovered (*SEIR*) models are presented. The West Africa Ebola Virus Disease (EBV) is described as having the latest major outbreak by playing with the mathematical model and numerical simulations. Discussion and study of the EBV along with *SEIR* models properties, validity of the models and gathering information is done to enable in analyzing more about EBV. With the help of maple software, verifying and validating is done through numerical simulations. More detailed case study of the real cases is discussed and investigation of vaccination role to control and predict the virus in the population is put into action. Therefore, investigation on the strategies in order to predict and halt the spread of Ebola virus with the application of correct measures in controlling it optimally by the model of *SEIR* so that the number of infected individual can be reduced. This is set as the goal of our study.

# 1 INTRODUCTION

## 1.1 Research Background

### 1.1.1 *Ebola Virus*

Ebola is a virus which was found in the state of Congo around year 1976 along side a river named Ebola. It was recently being identified in a number of African countries such as Liberia, Sierra Leona and Guinea. Apart from that, the virus was also detected in West Africa. As a deadly virus for human and with most cases happening in Liberia, based on study showed by Lewnard et al. (2014), the WHO reported that there were 4656 Ebola virus cases as of 8 October 2014. The virus signs and symptoms are normally onset from two or three weeks after contracting the virus with a sore throat, headaches, fever and muscular pain. Then, vomiting, diarrhea and rash usually follow along with internal and external bleeding. The virus destroys the body's organs and immune system as it spreads through the body and by a direct contact with blood of the person who is already affected by the virus. Besides that, the virus is indirectly transmit through the exposure of contaminated environment or object with infected secretions. According to Rachah & Torres (2015), the virus may be fatal in 50% to 90% of infections with an average of 10 days. There is a development of a range of drug therapies and blood immunological although yet no prove of authorized treatment to kill the infection.

### 1.1.2 *Mathematical Modeling of Ebola*

First and foremost, by considering an *ODEs* system of *SIR* model to depict the outbreak which is nothing else than an epidemic *SIR* model, that is a model based on the division of the population into three groups: the Susceptible, the Infected, and the Recovered. Normally, in predominant cases of infection diseases, an exposed time are exist after infective transmission from susceptible to potentially infective members. Subsequently, the exposed class *E*, which is an extra compartment is introduced into the system and the basic properties of *SIR* model is come to render understandable by the utilizing the *S,E,I* and *R* group. From the identified data that