UNIVERSITI TEKNOLOGI MARA

TECHNICAL REPORT

MATHEMATICAL MODELLING OF BRAIN TUMOUR GROWTH

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ABSTRACT

Tumour is a disease that has been a biological study since 60 years ago. A lot of tumour growth curves have been developed and most of the successful models are as an extension of the classical Verhulst equation. This project is done to describe and compare two of those models, which are Logistic and Gompertz. The comparison is then made to see the best model in modelling tumour growth. In this project, such models are reviewed, solved and investigated their interests of properties. Besides, a report on limitations and assumptions of the models are also made. In order to see the behaviour of the models, a few curves are constructed to see the similarities and differences. As results, Gompertz model has given a better accuracy in modeling tumour growth due to its realistic properties, compare to the Logistic model.

1 INTRODUCTION

1.1 Research Backgroud

There is nothing new about tumour. It has been a biological study for more than 60 years ago since it has became the major cause of death worldwide. The World Health Organization (WHO) estimated that there were 7.6 million deaths due to cancer in 2008 and this number is likely to rise to 13.1 million deaths by the year 2030 in Malaysia. While in the US, it is the second leading cause of death and also ranked among the top killers worldwide.A numerous approaches of battling against cancer has been used including biological experiments and theoretical approaches. Nevertheless, scientists often refer to the theoretical approach of Mathematical model as it can interpret the biological process which may lead to the experimental observations.

Mathematical modeling is a powerful tool to test hypotheses, confirm experiments, and simulate the dynamics of complex systems (Enderling & Chaplain, 2014). As for the oncology field, it is an aid for the oncologists to express the cancer diseases and also the treatment decisions. This is because such model (which was derived from balance equation) uses parameters i.e. cell population rate, carrying capacity and time to resemble the tumour's progression in humans. According to Boltz (2015), mathematical model also provides useful clues about the effect of surgery on metastasis and may help to predict the risk of cancer spread. Clearly the study of tumour growth and the development of anti-cancer therapies are most worthwhile pursuits, having significant potential to enhance quality of life and increase life-expectancy, which may, in turn, yield considerable economic and social benefits (Araujo & McElwain, 2004).

There is already a lot of successful quantitative modelling that have been applied to the cancer biology. Some of the models are statistical model, mechanistic model, and exponential-linear model. We are now going to see how differential equation can be used to measure tumour growth using population model. In their journal, (Araujo & McElwain, 2004) has stated the goal