# MODELING TUMOR GROWTH IN PRESENCE OF TREATMENT AND IMMUNOLOGICAL RESPONSE

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Abstract. Place abstract here. The abstract summarizes in one paragraph the main question and conclusions draw from your investigation.

## 1. Background/Motivation

Mathematical modeling in biological processes is used to help researchers and doctors understand biological phenomena. Specifically, it enables researchers to understand the complex biological systems and how these respond to signals or perturbations and how the systems evolve with time [**?**].

Mathematical oncology is field of oncology, the study of cancer, that employs math to study cancer and its behavior. In the words of Dr. Rockne and MD Scott, "it [serves] as a bridge between...the biologist, and the practicing clinician (2019)." Some of the most recent and important reasons for math modeling in oncology is to understand and model the characteristics and growth of cancer. Moreover, it seeks also to understand and model the relationship between cancer and the immune system and/or its response to treatment or resistance to it. Lastly, one of the biggest goal is to use this modeling to then develop more personable treatment to individuals facing the plight of cancer.

Tumor growth modeling is a well researched area of mathematical oncology. Its main purpose is to model tumor growth without any intervention as well as growth in response to external factors such as immunological response or treatment. In the absence of any intervention, several models have been made to try to show the growth of a tumor, measured by *tumor burden*[1], as a function of time $t$. The models range from simple ODEs such as linear growth, logistic growth, to more complicated models employing stochastic differential equations and algebraic differential equations.

One of the more popularly used models is called the *Gompertz* model. The model is popular for its sigmoidal shape and approximation

Also reference articles and sources [**?**] that are relevant or that you used when learning and/or thinking about your project.

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*Date*: 4 October 2024.

[1]See the Appendix for a definition.

## 2. Modeling

The primary aspect of the project is the modeling of the chosen phenomenon. If your group's repeated attempts resulted in abject failure, or your group succeeded, detail them in this section. Be sure to account for the various attempted models and why they were not appropriate. Include numerical simulations for each attempted model. Reference figures and plots, like Figure **??**.

## 3. Results

Clearly and succinctly state and describe the conclusions that you can draw from the model you have achieved (or the many failed attempts). Does your model(s) perform well quantitatively or qualitatively?

## 4. Analysis/Conclusions

Discuss the appropriateness of the techniques/methods you employed in modeling. Did your group appropriately model the chosen phenomenon? If not, what different steps could you have taken if you had more time? What did you learn about the techniques/method that were used in the group project? If your model was successful, what additional insight/conclusions could you obtain from it? For instance, if you had a successfully modified SIR model, how might it affect different government policy? If you had a successful model for the spread of inaccurate information on social media, how might it be implemented to help reduce the spread of inaccurate information?

This part should all be done before you get to *page 11.* The bibliography can spill on to page 11, but we won't read text that goes past page 10.

## Appendix

**Definitions.** The following definitions are derived from the National Cancer Institute

- Cancer: TODO
- Tumor: an abnormal growth of cells in the body. A tumor is either *benign* or *malignant*. A benign tumor is a tumor that is not cancer whereas a malignant tumor is a cancerous tumor and has the potential to spread.
- Tumor burden: the size of a tumor or number cancer cells. This is the total amount of cancer found in the body.