

ODE Analysis of Cancer Pathways

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1 Introduction

- Could start with the conventional cancer is bad paragraph.
- Or, could just start with a paragraph about cancer treatments and how there is a lack of knowledge about the dynamics of the pathways that these treatments might try to target. This could be too strong of a statement though, so we'd have to smooth it a bit
- This leads to potentially ineffective treatments, or at least treatments that are not as effective as they could be.
- Large databases exist that provide a wealth of information about numerous carcinogenic biochemical pathways.
- Using this information, mathematical models of the pathways can be constructed.
- Accurate math models of these pathways could be analyzed in order to find the processes in the pathway that the tumour growth is the most dependent on.
- This could lead to more effective treatments by targeting the critical processes in cancerous pathways
- Not sure if this should go here, but mention that modelling the entire pathway usually unrealistic, need to build simple models based upon the “key” interactions.
- Although our report doesn't really focus on this, perhaps mention the “toolbox” of equations or whatever that we were talking about earlier
- Of course, give the outline of the report.

2 The basal cell carcinoma pathway

- This is really the hard part
- Start with the total pathway and justify focusing on a small subset of the total pathway
- Describe the biological processes that are going on with each interaction that we are choosing to model. This should be brief, but detailed enough to give non-biologists like ourselves a decent feel for what is going on.
- I think that's it...

3 Model

- Turn the description from the previous section into the mathematical equations, explaining why we chose the terms we did.
- Describe the reduction in the number of parameters by assuming species conservation, etc.
- Quantify rate of cancer development and the total amount of cancer at time t .
- Explain our assumption that drugs reduce rate constants, show how drugs would change governing equations

3.1 Results

- Probably the shortest section...
- Show figure of SSH, SMO, cancer evolution
- Drug efficacy figure
- Explain how these were produced, namely, numerical integration of the governing dynamical equations.

4 Discussion and Conclusions

- The typical discussion, you know
- Found that targeting different steps in the pathway can lead to significant reductions in the growth of the tumour.
- These are promising results, but must be taken with a grain of salt
- Graph slightly misleading – the amount of drug (x -axis) is really the rescaled amount of drug that is needed to completely stop that particular complex from forming or whatever. These dimensional values could be different by orders of magnitude
- Furthermore, might not be able to target a particular process without causing severe (or a possibly fatal amount of) strain on the patient
- Regardless, model shows there exists an ideal targeting strategy
- Really need a model which incorporates both the dynamics of the biochemical pathway plus an optimization problem for the well-being of the patient
- Of course, also need realistic, yet simple, mathematical models that capture the essence of the biological processes that occur along the pathway
- Toolbox of equations would allow one to easily extend a model or to build a model of new pathways
- A rigorous analysis of accurate mathematical models could potentially lead to revolutionary new treatments that are both highly effective and allow the patient to live with a relatively high quality of life.