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Differential Equations

Article Review

I chose to read the article titled “Simple ODE Models of Tumor Growth and Anti-Angiogenic or Radiation Treatment” and written by R. K. Sachs, a mathematics professor at the University of California, Berkeley. The article is trying to discover whether there is an ordinary differential equation or a set of ordinary differential equations which can properly model the affect that certain treatments have on the growth of tumor cells. The two types of treatment that the mathematical models were focusing on were anti-angiogenic and radiation treatment. The tumors that were observed in the treatment and decay process were relatively large, about 1 mm3 in diameter, and could be directly observed. In modeling the affect that treatment has on the size of tumors and their growth rate, scientists are able to see the effectiveness of the treatments and can also discover ways in which their processes may be enhanced.

The final conclusion in the article stated that there are many factors which can cause cells to deteriorate and die, so it cannot be assumed that any one treatment is the sole reason for a tumor’s growth to decelerate. However, there are trends that have been observed over various experiments that suggest that certain treatments can actually cause the growth rate of tumors to slow.

There are three distinct differential equations which the article focused on to model cell growth rates. These three ODE models form the basic structure of the article and provide the flow of information that is presented in the article. An ordinary differential equation called the generalized logistic model can be used to display the deceleration of tumors as they get larger; it can also help scientists determine what the limiting cell number is for a tumor. This ODE incorporates the idea of growth deceleration as the basis for its formulation. Another equation mentioned in the article is actually a set of two ODE’s which are used to compare two different cell populations. For example, the two populations could be tumor cells and endothelial cells; these are the two groups talked about in the article as their relationship is of interest to cancer researchers today. The other ODE discussed in length in the article is called the linear-quadratic, or LQ, model. This model focuses on the effects of irreparable damage and damage susceptible to disrepair that occurs in cells when undergoing radiation treatment. The article overall was very eye-opening and helped me to better understand how mathematics can be applied to biologically scientific equations.

Previously Unknown Terms:

1. Angiogenesis: the start of blood-vessel growth, usually in association with a certain

organ, tissue, or tumor

1. Stochastic: relating to a process which involves a randomly determined sequence of observations, where each observation is considered as a sample of one element from a probability distribution
2. Endothelial Cell: a cell that is part of a tissue that covers a surface or lines a cavity, specifically the heart, blood vessels, lymphatics, and serious cavities
3. Carcinogenesis: the development of a cancer
4. Apoptosis: a genetically regulated process that leads to the death of cells and is triggered by either the presence or absence of certain stimuli

\*All definitions were found on www.dictionary.com