Parameter estimation and uncertainty quantification for a mathematical model of breast cancer

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Breast cancer is the most commonly diagnosed cancer in women and the second leading cause of cancer death for women worldwide. Mathematical modeling is a powerful tool that helps us understand complex phenomena of biological systems. A mathematical model was previously constructed, using an ODE (ordinary differential equation) system, to study the tumor growth in breast cancer [1]. The parameter values were estimated using experimental data published in scientific literature. However, parameter estimation of dynamical systems is often associated with parameter uncertainty, and the analysis of parameter uncertainty is important as it determines how reliable the model outputs are. In this study, the mathematical model proposed in [1] is revisited. Uncertainty quantification is carried out using the Markov chain Monte Carlo method, and the effect of parameter uncertainty on the dynamics of the model is addressed.

[1] Hsiu-Chuan Wei, Mathematical modeling of tumor growth: the MCF-7 breast cancer cell line, Mathematical Biosciences and Engineering, 16(6), 2019, 6515-6535, DOI: 10.3934/mbe.2019325.