**Calibrating Models to Data: A comparison of Methods**

**Introduction**

Most sciences today use mathematical and computer simulation models to approximate the real-world processes under study (Kennedy), (Fojo), (Vanni). For example, models play a significant role in health policymaking by estimating the impact of interventions in situations where empirical studies may be time-consuming, costly and impractical (Stout). Developing a model calls for a trade-off between computational cost and accuracy; simple models require little computation time but can be a poor description of the real-world process, whereas complex models allow for a more accurate description of the process at the cost of increased computational cost. After model development, it is imperative to know how well the model represents reality. Model calibration, or fitting the model to data, increases the confidence that the model provides a realistic approximation to the real-world process (Vanni), (Stout).

Calibration is the process of comparing model outputs with empirical data to identify the model parameter values that achieve a good fit to data (Menzies), (Vanni). Calibration improves the credibility and validity of the subsequent predictions made and inferences drawn from the model (Stout). It is also commonly used in the case where model parameters are not observable or available, to estimate such input parameters (Elske). The main components of calibration are summary statistics, parameter-search strategy, goodness-of-fit (GOF) measure and acceptance criteria. Model calibration involves running the model many times. This becomes a problem with complex models for which model run-times are very long. For example, a recent model in …. 45year model runtime example Dengue (Hladish). Several methods have been used for model calibration including more efficient ones and the number of studies that apply these calibration methods is proliferating in many research fields (Vanni). The model calibration methods applied in most studies are divided into two categories, optimisation methods and sampling methods (Menzies). (Hazelbag), in their study conducted on calibration of Individual-based models to epidemiological data recommended that sampling algorithms are used to obtain valid estimates of parameter uncertainty correlation between parameters. We focus on the sampling methods.

Existing literature compare the performance of alternative algorithms for calibrating the same model but does not allow us to draw general conclusions ( (Dahabreh), (Minter) ). (Hazelbag) highlight the need for simulation-based studies that compare the performance, strengths and limitations of different model calibration methods. Because there are many model calibration methods with little or no consensus on their performance, we perform a simulation-based study to compare the performance of model calibration methods using a simple stochastic Susceptible-Infected-Recovered (SIR) model. The methods to be compared are Rejection Approximate Bayesian Computation (Rejection ABC), Sequential Approximate Bayesian Computation (Sequential ABC), … Tom’s method… and Bayesian Maximum Likelihood estimation (BMLE).

Outline to be completed when thesis is fully written…….