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

**Introduction**

Most sciences today use mathematical and computer simulation models to study and describe certain real-world processes that would otherwise be very difficult or even impossible to analyse (Kennedy), (Fojo). These models play a very significant role in health policymaking and estimating the impact of interventions in situations where empirical studies may be time-consuming, costly and impractical (Stout). They incorporate assumptions relax the complexity of the real-world process under study (Vanni). Developing a model calls for a trade-off between computational cost and accuracy. Having developed the model, it is imperative to know as the next task, how well the model represents that complex reality one intends to describe. Simple models require less computation time but poorly describes the real-world process, whereas complex models represent the process well but are computationally expensive.

A crucial aspect of model development and implementation is checking that the model outputs are consistent with empirical data. An important step toward ascertaining this consistency is the process of calibration (Vanni). Calibration improve the credibility and validity of the subsequent predictions made and inferences drawn from the model (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). It can also be used to describe the process of adjusting the input parameter values of a model to identify which set of the parameter values gives a good fit to data. Calibration is also commonly used in the case where model parameters are not observable or available. In this case, calibration is used to estimate the unobservable or unavailable input parameters (Elske). The two main components are parameter-search strategy and goodness of fit (GOF) measure

Several methods have been used for model calibration and the number of studies that apply these calibration methods is proliferating in many research fields (Vanni). (Stout) broke the model calibration process into seven stages which were later discussed in detail by (Vanni). (Karnon) went through the seven stages of the calibration process using an early breast cancer model and produced a practical guidance on a more applicable calibration process. (Vanni), in their review article further examined different methods of calibration and reviewed some examples from health economic decision models. The model calibration methods applied in most studies can be categorized into two, which are optimal calibration methods and Bayesian calibration methods.

Because there are many model calibration methods and little consensus on which one performs better, this study compares some model calibration methods using a simple Susceptible-Infected-Recovered (SIR) model. The methods to be compared are as follows: Bayesian Maximum Likelihood estimation (BMLE), Rejection Approximate Bayesian Computation (Rejection ABC), Sequential Approximate Bayesian Computation (Sequential ABC).

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