Introduction to simulation modelling

Peter Rowlett

Sheffield Hallam University

p.rowlett@shu.ac.uk

Mathematical Modelling

- Usually describes systems – a collection of components that operate together.
- Models might be deterministic or probabilistic.
  - deterministic: system behaviour is based on parameters;
  - probabilistic: determined, in part, by random events.
- Most real-world systems are probabilistic, but this is difficult to model so we often treat them as deterministic.

Simulation model

- We can explore probabilistic systems by creating a simulation.
- Some reasons to do this include:
  - The system is too complicated to model analytically.
  - It may be difficult to collect data for an empirical model.
  - The system may not yet exist.
  - The system may contain random events that we do not want to oversimplify.
- One approach is *Monte Carlo simulations*.
  1. Construct a model that uses random numbers.
  2. Run this many times.
  3. Statistically analyse the results.
- One advantage is that we can 'try out' the effect of parameter changes in our model.

Exercise: Coin toss

- What is the probability of getting at least 7 heads when a coin is flipped 10 times?
- (Obviously we can do this as a probability calculation; the point here is to practice creating a simulation.)