

# Bayes class 3

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0 Who are you? Name, surname, student number:

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## 1 Simulation

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By now you should be familiar with the basic concepts of stochastic simulation via pseudo random number generators. If not, read up on the fascinating history of both pseudo and physical random number generation.

What random number generation algorithm is used by statistical programs like R, SAS, etc.? What is the random number generation algorithm used in Excel called and what are its drawbacks?

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Can you write down the theorem that helps us simulate from a general univariate distribution, given the pseudo uniform numbers generated by the above algorithms?

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## 2 The art of the simulation study

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In this class we are going to look at how statistical modelling procedures are compared objectively, given a specific problem that these procedures are meant to address.

## 3 The steps of the simulation study

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### 3.1 What to simulate?

The first step of a simulation study is to decide on what will be simulated. Usually this revolves around comparing a new approach to one or more existing approaches for a problem. It is almost always the same team that developed the new approach that end up doing the simulation study, usually with the goal of showing that their new approach has favourable properties. Where do the existing approaches come from?

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### 3.2 Details, sample sizes, and parameter values

Once it is established which approaches will be compared then there are often still tons of small details to decide upon. These might include sample sizes, model complexity, and especially parameter values. Can you think of a good way to choose parameter values for a simulation study?

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### 3.3 Simulating samples

This is where the coding starts. For each scenario, a number of samples are simulated given the chosen parameter values and stored.

### 3.4 Pretending to forget

Before any modelling takes place, it is critical that the chosen properties and parameter values are put aside as if they are completely unknown. **Each sample must be viewed as if it was the only sample ever collected and you have no idea how it came to be.** Why is this step important?

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### 3.5 Applying the models

For a single given sample, each model is applied, and the results recorded. At this stage the results can only be checked for sanity – did the models run and do the results make any sense.

### 3.6 Oh yes, I just remembered the parameter values

Once the models are done fitting, we can compare the fits to the true parameter values that we chose at the start. We should at least try to be objective here.

The results should include fit statistics of many kinds. Can you give some examples of fit statistics that are used in simulation studies? Remember to ask those around you for more examples.

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### 3.7 Comparing approaches

The final step is to summarise the statistics across many samples, per approach. This enables us to compare approaches, which was the goal all along.

## 4 Examples

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When called upon, please explain a simulation study that you read about to the class. This could be a formal study in an academic journal, or perhaps something illustrative on a blog post. You may use up to 3 minutes and up to 1 slide.