EEE933 - Design and Analysis of Experiments

Case Study 01

This version was compiled on April 24, 2018

Experiment: erformance of a new software version.

The experiment

The **current** version of a software used for simulating certain electromagnetic characteristics of a patch antenna is known, based on extensive past experience, to have a mean simulation time of $\mu = 55s$ seconds and a variance $\sigma^2 = 100s^2$.

A **new** version of this software is developed, and we wish to investigate whether it results in *performance gains* (i.e., smaller mean runtime and/or smaller variance) in relation to the current standard. To investigate this particular question, 16 simulations are executed, and their times are recorded as (`CS01_data.csv`, available on https://git.io/vpGxG):

```
#   [1] 45.05054 55.44200 61.09109 37.08012 56.50387 57.04239 49.47682
#   [8] 49.67358 49.54884 47.26974 50.15965 46.51129 48.06622 53.95121
```

Activities

For the test on the mean runtime. For this test, assume a desired significance level $\alpha = 0.01$. The teams must perform the following activities:

- Define the statistical hypotheses to be tested (null/alternative).
- Discuss and define the other experimental parameters of the test (smallest effect of practical relevance, desired power, *etc.*). This is specific for each team, but must be determined based on discussions, related to the topic of the experiment.
- Test the hypotheses and decide for rejecting (or not) the null hypothesis.
- Calculate the confidence interval on the mean runtime.
- Validate and discuss the assumptions of the test.
- Discuss the power of the test (if needed), and the adequacy of the available sample size for this particular test.

For the test on the standard deviation. For this test, assume a desired significance level $\alpha = 0.05$. The teams must perform the following activities:

- Define the statistical hypotheses to be tested (null/alternative).
- Test the hypotheses and decide for rejecting (or not) the null hypothesis.
- Calculate the confidence interval on the variance of the runtime.
- Validate and discuss the assumptions of the test.

After performing the activities related to each test individually, the team must:

- Draw conclusions and provide recommendations regarding the adoption (or not) of the new software version.
- Discuss possible ways to improve this experiment.

Report

Each team must prepare a short report detailing the experiment and the analysis performed. The report will be evaluated according to the following criteria:

- Use of the predefined format (see below);
- Reproducibility of the analyses;
- Technical quality;
- Logical structure;
- Correct use of language (grammar, orthography, *etc.*);

The report must **necessarily** be prepared using R Markdown, and must contain the full code needed to reproduce the analysis performed by the team, embedded in the form of *code blocks*. Each team must deliver the following files:

- The report file, compiled in **.pdf** .
- The original (source) of the report, in **.Rmd**.

the **.Rmd** file must be able to be recompiled, if needed (tip: save your **.Rmd** file using UTF-8 encoding, to prevent compilation problems in other operational systems.

Report templates are available on https://git.io/vHk0F, and an example of report structure can be consulted on https://git.io/vHk0j.

Important: Please include in the report the roles of each team member (Coordinator, Recorder, Checker and, for 4-member teams, Monitor)

Important: Reports can be prepared in either Portuguese or English.

Deadline

The report files (pdf + rmd) must be compressed into a single file and uploaded to the activity **Case Study 01** on Moodle, until **Monday, April 30th 2018, 11:59p.m.**. After that deadline the system will be closed.

Important: Only ONE submission is required for each team.

Important: Reports will NOT be received by e-mail or in printed form.