Re exam - April 2020

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1 Re-exam

This re-exam is composed of two practical exercises and two discussion exercises. Below we present the rules of this exam:

- The exam will be available on April 7th 08:30 am.
- The exam should be hand-in by April 7th 17:30 pm (you get 4 extra hours since you need to use software to produce the results).
- The exam is individual.
- You CAN consult the course material, books and the internet for the any of the questions. However, if there is divergence in concepts (e.g. books or websites that have conflicting information) we will grade based on the course material.
- You should present original solutions and code to all question and all reports will go through **urkund**.
- Submit your all code as an appendix to the report OR present each chunk of code as appropriate.
- Do NOT print screen the output of the command line of R (or any other software) in the report. E.g. if you need a table, create a table.
- All figures and tables must be referenced in the text. Legends and captions must be readable.
- Any concepts or definitions that you present should be appropriately referenced.
- For the open question, it is not allowed to copy and paste text from anywhere. Formulate your answers yourself.

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Examiner: Richard Torkar

Grades: Maximum points: 35

Chalmers:

- Grade 3: $17 - 22$ [50% , 65%[
- Grade 4: $23 - 29$ [65% , 85%[
- Grade 5: $30 - 35$ [85% , 100%]

GU:

- Grade G: $17 - 29$ [50% , 85%[
- Grade VG: $30 - 35$ [85% , 100%]

2 Battery time (14 pts)

J. Doe, was hired by a embedded systems company. The main task of J. Doe is to supervise the acquisition of new components, both software and hardware, making sure that these components attend to the manufacture specifications.

One of the first problems given to J. Doe was to verify the battery time of three suppliers of battery to the product. All three manufactures specify that under standardized temperatures and power consumption settings, the batteries can provide energy for at least 85 hours with a single charge.

To verify this specification, J. Doe planned a control experiment based on the standardized specifications. J. Doe took randomly 5 batteries of each brand and measured the battery time under those specifications. The results are presented in the Table 1 below:

Table 1: Battery Time in hours

	Brand1	Brand2	Brand3
1	100	76	108
2	96	80	100
3	92	75	96
4	96	84	98
5	92	82	100

2.1 Question 1 (10 pts)

Help J. Doe to analyze this result.

Analyse this experiment

- Present an exploratory analysis such as descriptive statistics and plots. Don't forget to discuss them! (2pt)
- Setup your hypotheses (1pt)
- Which type of experiment is this one? How many groups? How many factors? How many levels? (1pt)
- Which statistical test(s) are you using? Why? (1pt)
- Don't forget to check and interpret **all** assumptions of your test! (2pts)
- Interpret the results from your statistical analysis (1pt)
- What are the implications of this for your problem? Which brand would you select to use? (2pts)

Don't forget to:

- Report the confidence level you are using
- Report all the important statistics

2.2 Question 2 (4 pts)

All brand manufactures says that if the battery does not fulfill the specifications they would replace them.

Based on your brand decision, what percentage of replacements would you expect to have?

Tips:

- Select only the data from the brand you selected
- Use a t-distribution and compare the probability of being below 85

3 Battery and product type (10 pts)

After conducting the battery time experiment J. Doe decided to investigate further the difference between Brand 1 and Brand 2 and discover that the both brands have different battery lifes different conditions than the standardized conditions of the previous experiment. To get a sense of how each brand behaves in the actual company products, J. Doe decided to run another experiment.

J. Doe planned another experiment testing 6 different batteries of each brand (12 in total) in three different products. The batteries were randomized to each product. Each product was used in the exact same way using the company automated HIL test suit infrastructure. The collected data is shown in Table 2.

Table 2: Battery Time in hours

	Product1	Product2	Product3	Brand
1	86	79	54	Brand1
2	94	85	58	Brand1
3	82	84	57	Brand3
4	88	89	59	Brand3

Analyse this experiment

- Setup your hypotheses (1pt)
- Which type of experiment is this one? How many groups? How many factors? How many levels? (1pt)
- Which statistical test(s) are you using? Why? (1pt)
- Don't forget to check and interpret **all** assumptions of your test! (2pts)
- What does the interaction term mean? (2 pt)
- Interpret the results from your statistical analysis (1pt)
- What are the implications of this for your problem? Which brand would you select to use? Does this change for each product? (2pts)

Don't forget to:

- Report the confidence level you are using
- Report all the important statistics

4 Validity Threats in Software Engineering Research (8 pts)

Let us imagine that we want to investigate the effect of code comments in relation to the understandability of code, which then leads to fixing a bug. We write one chunk of code with different manipulations of data and insert a bug (group 1). We then create another copy where we write sparse comments about what the code is doing (group 2). We then use the same code again (same in all threee groups!) but write very detailed and exact comments on what the code is doing exactly in every step (group 3). We managed to get 5 participants in each group. Our research question is "do code comments increase the efficiency in finding bugs?" We also time how long it takes for everyone to find the bug. Find 4 validity threats to this study. Use the available literature on categories of validity threats to help you if you need. You do not have to label the threats under categories, only state why it is a threat, and what could possibly be done to lower that threat.

4.1 Sampling techniques (3 pts)

There are different ways of sampling data from a population. What sampling method would use in the example above What are the advantages/disadvantages with different sampling techniques and why did you select the one you did? You should also reflect in your answer on why researchers sometimes don't have that many options when sampling from a population.