

BM5033 Statistical Inference Methods in Bioengineering

Team Projects: Stage 1

1. **Motivation behind this activity:** The primary motivation behind this activity is to give you an experience of translating what we have learned/have been learning in the classroom to a real-world scenario. Having you work in teams of diverse backgrounds will hopefully (fingers crossed) give you an experience of collaboration, mirroring industry and research settings. We have discussed in class that the statistical analyses start even before the experiments are conducted. We will try to bring this into practice. In the first stage of the project, you are expected to use the tools of the trade covered in the class for experimental design. You are expected to analyze the scenario assigned to your group from the perspective of experimental design and come up with how you, as a team, will design the experiment, select the sample size, significance level, and statistical tests once you have the experimental data. After stage 1, I will be providing you with datasets for each of your scenarios for statistical analysis.
 2. **What is expected of you in stage 1:** Analyze the scenario assigned to your group and
 - (a) identify key variables (response, predictor, control, etc.)
 - (b) describe the experimental design and justify your choice
 - (c) determine the sample size using power analysis. You have to give justifications for the input values used in this analysis and/or cite the references, and source materials.
 - (d) specify the statistical tests to be used (e.g., t-test/ANOVA/regression) after the experiments are over, and define the significance level
 3. **What is not expected from this activity:** The project focuses on the techniques learned in the BM5033 course for scenarios assigned to each group. You are supposed to use the tools covered in the course. It is highly likely that this constraint (using only the techniques covered in the course) will render the design and analysis sub-optimal. That is okay. The objective is to use BM5033 course techniques in the best possible way. It is not to come up with the best design and analysis by using anything and everything under the sun.
 4. **Format of the report to be submitted:** The stage-1 report must not be more than 2 A4 pages long with font size 12, single line spacing, and 0.5-inch margins on four sides. It will be better if it is typeset in $\text{\LaTeX}$. Do not miss citing all the resources you have used in stage 1 to obtain preliminary data for power analysis, or background information about your experimental scenario.
 5. **Policy regarding use of LLM:** You can take help from LLMs for analyzing the scenario. However, the report is expected to be written/typed by the group members, and it will be checked (as much as possible) for AI-generated content. An unreasonable amount of AI-generated text will disqualify the team from this project (both stages).
 6. **How and when to submit the report:** The deadline for the submission of the report is Friday 10th October 2025 at 17:00. One of the group members can submit the report by emailing it to me, with group members in CC.
 7. **In case of any doubt, please drop me an email and ask for clarity. Verify. Do not presume. Beware of convenient assumptions.**
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Scenarios

- S1 Type-2 diabetes is known to affect the permeability of the blood-brain barrier. You want to test if type-2 diabetes has an effect on microcirculation in the brain. You have access to resources for measurements of cerebral blood flow using transcranial Doppler and MRI.
- S2 Parkinson's disease is a chronic, progressive neurodegenerative disorder involving gait impairment. You want to assess if the age of the patient affects the forces exerted by the left and right legs of the patient.
- S3 During the COVID-19 pandemic and its aftermath, infrared thermographs became widely used in public places to measure body temperature by scanning facial thermal patterns. In a more traditional setting, the temperature is measured orally using a thermometer. We want to check if both of these measurements give same results.
- S4 Gestational diabetes mellitus, a glucose intolerance during pregnancy, increases risks for both maternal and fetal complications. You want to check if maternal visceral adipose tissue, that can be measured during routine obstetric ultrasound, during early pregnancy can predict the later development of gestational diabetes mellitus?