

# ME 794 – Project Proposal

**Topic:** Statistical Analysis of Parameters Impacting Performance in Visual Acuity Tests

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**Problem Description & Motivation:**

Visual acuity tests measure the ability of individuals to distinguish details of items placed at a distance. It is usually measured using a Snellen chart, which contains letters or symbols of varying sizes that a person must read correctly from a specific distance (usually 20 feet). The results of a visual acuity tests are typically expressed as a fraction (e.g., 6/9 or 20/20), with the numerator representing the distance at which the test is conducted, and the denominator representing the smallest size of letters or symbols that the person can correctly identify.

When considering the performance of a visual acuity test, the variables that could potentially impact the test are (but not limited to) as follows:

- Distance between the person and chart
- Size and font of the letters/symbols on the chart
- Type of chart (e.g., Snellen chart, Landolt ring chart, etc)
- Type of testing (e.g., near vision or at a distance)
- Type of visual aids the person is allowed to use during the test if any
- Lighting conditions

The primary motivation to design an experiment for this problem stems from the relevance and intrigue to gain a deeper understanding of how variation of several factors can impact sensory perception in humans. Let us not even stray too far from home – more than half of the students at IIT (including everyone in our group) use spectacles and other visual aids of varying powers. Thus, it felt very appropriate and relevant to conduct a statistical analysis regarding the same. We hope to use the learnings from the course in the design of an accurate statistical experiment to help us develop an understanding of this problem.

**Objectives & Challenges:**

The goal of this project is to apply statistical analysis concepts to effectively design an experiment for various control groups, analyse how several variables can potentially impact the results, and use the findings to verify our hypotheses. Some specific objectives we aim to achieve as part of this project are as follows:

- Designing an experiment using Snellen charts and/or other visual testing methods to collect data regarding visual acuity and measure the impact of the above listed factors on performance of individuals in the test
- Use the collected data and further refine & process it, if necessary, to verify a null and/or alternate hypothesis
- Model and analyse the data to observe any trends/patterns that are exhibited within particular individuals or control groups with certain similarities
- Analyse other parameters, out of our control, that introduce variability to the results of the experiment
- Present all the above facets of the statistical analysis in a report/presentation as required

The challenges in this project may include:

1. Recruitment of an optimal number of participants across a varied range of visual powers
2. Control of internal & external factors that may affect performance in a visual acuity test, such as prior knowledge or biased participants
3. Ensuring the repeatability of the experiment
4. Formulating a quick test to act as an approximate proxy for intelligence

### **Tentative Timeline:**

Week 0 – 3: Designing the experiment

Week 4: Collecting data on visual acuity, lighting, contrast, age, gender, and underlying medical conditions

Week 5-7: Assess the relationship between visual acuity and other parameters using statistical methods

Week 8: Summarizing the experiment, results and conclusions in a report

### **Project Deliverables & Outcomes:**

- A detailed report (pdf)
- An excel spreadsheet with all the raw data collected in week 4 along with a record of all the analysis performed
- A presentation highlighting the relevant aspects of the project (ppt)

By conducting this study, we expect to gain a deeper understanding of the various parameters that impact visual acuity. This understanding will lead to process improvements in the way visual acuity is measured, and will provide a more comprehensive assessment of a person's visual function.

references: (for internal use to generate the motivation, hypothesis)

<https://www.ceenta.com/news-blog/are-people-who-wear-glasses-smarter-than-people-who-dont>

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<https://www.theguardian.com/science/2018/may/30/glasses-smarter-study-intelligence-bad-eyesight-link-health-benefits>

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<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7356996/>

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