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Human Perception of Randomness in Number Generation

Class Project Proposal

IESM315: Design and Analysis of Experiments

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Human Perception of Randomness in Number Generation

Humans often have difficulty generating truly random sequences of numbers. This project aims to explore the concept of randomness by examining whether people can produce random numbers under various conditions and if their background in statistics influences this ability.

Understanding the inherent biases in human-generated randomness can have implications in various fields such as psychology, game design, decision-making, and even security protocols. It will also shed light on the efficacy of human intuition in generating random sequences, and how this intuition might be honed or skewed based on one's educational background.

Objectives

- To understand if people can generate random numbers when asked without any conditions.

- To analyze the distribution of numbers provided when conditions are imposed (e.g., within a certain range, above or below a threshold).

- To determine if a person's background in statistics affects their ability to generate random numbers.

Data Collection

A diverse group of individuals will be selected. They will be categorized based on their statistical background (e.g., No background, Basic knowledge, Expert).

- Each participant will be asked to provide a sequence of numbers (e.g., 10 numbers) in a "random" fashion without any restrictions.

- The same participants will then be asked to provide a sequence of numbers within a certain range (e.g., between 1 and 50).

- Finally, participants will be prompted to generate numbers above or below a certain threshold (e.g., above 70).

Data Analysis

Randomness Tests

- **Runs Test**: Checks the randomness of a sequence. For instance, if participants are giving a sequence of numbers, a run is defined as a series of increasing (or decreasing) numbers. An unusually high or low number of runs can indicate a non-random sequence.
- **Chi-Squared Test**: Compares the observed frequency of numbers to the expected frequency if the numbers were truly random. A significant result indicates that the sequence is probably not random.

Distribution Analysis

- **Kolmogorov-Smirnov Test**: Determines if the sequence of numbers follows a known distribution, like normal or exponential. If a match is found, it suggests that participants might be biased in a systematic way.
- **Kernel Density Estimation**: Non-parametric method will estimate the probability density function of the generated numbers. It will provide a smoothed version of the histogram, revealing any peaks or biases within the chosen numbers.

Group Comparison

- **ANOVA**: Given the three groups (e.g., No background, Basic knowledge, Expert), an ANOVA can test if there are significant differences in their ability to generate random numbers. Post hoc tests will determine which groups differ from each other.
- **T-Tests**: For direct comparisons between two groups, t-tests can be employed. For instance, comparing "No background" vs. "Expert".

**Correlation Analysis*

- **Spearman's Rank Correlation**: This can be used to assess if there's a monotonic relationship between the participants' statistical background (ranked as No background, Basic, Expert) and some measure of randomness (e.g., number of runs).