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REPOSITORIO: [https://github.com/andersonfloress/Trabajos\\_Est\\_Computacional](https://github.com/andersonfloress/Trabajos_Est_Computacional)

APPLICATION LINK: <https://anderson-fls.shinyapps.io/MiApp/>

## HOMEWORK 03

### Shiny Application Documentation for Interactive Statistical Analysis

#### Introduction:

This Shiny application is designed to perform basic statistical tests and visualize data interactively. It allows users to upload Excel files, select variables for testing, and choose from different types of graphs to visualize the results. The app is ideal for students, researchers, and professionals who need to analyze data quickly and easily.

#### Features:

- **1. Data Upload**

**File Format:** The application accepts Excel files in **.xlsx** format.

**Data Requirements:** Data must be numeric if the entire table is to be pivoted. Otherwise, any data type is accepted. This allows files with a simple structure where each row is an observation and each column a variable.

**Data Pivoting:** If the file contains several numeric columns, the app will automatically pivot them so all columns are treated as values. This makes analysis easier when dealing with multiple numeric variables.

- **2. Statistical Test Selection**

**t-test:** Used to compare the means of two groups (e.g., two treatment groups).

**Requirement:** Exactly two groups must be present in the selected variable.

**ANOVA + Tukey:** Used to compare the means of three or more groups. Useful for detecting significant differences among them.

**Requirement:** At least three groups must be present in the selected variable.

**Tukey Test:** Performed after ANOVA to compare all pairwise group combinations to determine which differ significantly.

- **3. Variable Selection**

**Grouping Variable:** Select the column defining the groups (e.g., "Treatment" with values A, B, C).

**Value Variable:** Select the column containing the numeric values to analyze (e.g., "Results").

- **4. Group Filtering (for ANOVA)**

If your grouping variable contains more than three groups, you can select which ones to include in the ANOVA.

- **5. Graph Types**

**Boxplot:** Displays data distribution per group, including median, quartiles, and outliers.

**Bar Chart with Standard Error:** Shows group means and their standard errors.

**Dot Plot:** Each observation is shown as an individual point, illustrating distribution.

**Violin Plot:** Combines boxplot with data density information.

**Grouped Histograms:** Displays value distributions for each group in separate histograms.

- **6. Running the Test**

Once all options are selected, press the **Run Test**” button to execute the chosen test and view results.

### Usage:

1. Click **Upload Excel File**” and select your data file.
2. If there are multiple numeric columns, the app will pivot them automatically.
3. Select the type of test: **t-test (2 groups)** or **ANOVA (more than 2 groups) + Tukey**.
4. Choose your **Grouping Variable** and **Value Variable**.
5. (Optional) For ANOVA, select specific groups to include.
6. Choose the graph type to visualize the results.
7. Press **Run Test**” to execute the analysis and view the outputs.

### Results:

#### Test Results:

The results of the t-test or ANOVA will be displayed, including the Tukey test if applicable. Statistics like the p-value indicate whether observed differences are statistically significant.

#### Graph:

The selected graph will be displayed below the test results, helping you intuitively understand the data.

### Considerations:

- Ensure that the data matches the test requirements: t-test needs exactly two groups, ANOVA requires at least three.

- If requirements are not met, a warning message will be shown.
- Make sure your data is clean and suitable for the desired analysis.

This app is a valuable tool for exploring and analyzing data interactively, allowing users to extract quick and easy insights from their datasets.

## Usage Examples

### 1. Scientific Experiment Analysis

*Scenario:* A researcher wants to compare the effect of two different treatments on a variable of interest. They can upload the data into the application, select the grouping variable (Treatment A vs. Treatment B) and the value variable (variable of interest), and run a t-test to determine whether there are statistically significant differences between the two groups.

*Visualization:* Use a boxplot or bar chart with standard error to visualize the distribution of values in each group.

### 2. Group Comparison in Social Studies

*Scenario:* A social study aims to compare the means of three different groups on a numerical variable. The user can select ANOVA as the statistical test, choose the grouping and value variables, and run the test. Then, use Tukey's test to identify which pairs of groups differ significantly.

*Visualization:* Use a violin plot or group-wise histograms to visualize the distribution of values in each group.

## Interpretation of Results

### 1. t-test

#### Null and Alternative Hypotheses:

Null Hypothesis (H): The means of the two populations are equal.

Alternative Hypothesis (H): The means of the two populations are different.

#### Interpretation:

- **p-value:**

- $p < 0,05$ : Reject the null hypothesis — significant difference between group means.
- $p \geq 0,05$ : Do not reject the null — insufficient evidence to claim difference.

- **t-value:**

- Large t (positive or negative): Strong evidence against the null.
- t near 0: No significant difference.

- **Possible Cases:**

- **Significant Difference ( $p < 0,05$ ):**

- Positive t: First group mean  $\neq$  second group mean.
- Negative t: First group mean  $\neq$  second group mean.
- **No Significant Difference ( $p \geq 0,05$ ):** Means are considered equal.

## 2. ANOVA + Tukey Test

### Null and Alternative Hypotheses:

Null Hypothesis (H): All group means are equal.

Alternative Hypothesis (H): At least one group mean is different.

### Interpretation:

#### ■ ANOVA p-value:

- $p < 0,05$ : Reject the null — at least one group is different.
- $p \geq 0,05$ : Do not reject the null — no sufficient evidence of difference.

#### ■ Tukey's Test:

- Group pairs with  $p < 0,05$ : Significant difference between those groups.
- Group pairs with  $p \geq 0,05$ : No significant difference.

#### ■ Possible Cases:

- **Significant Differences (ANOVA  $p < 0,05$ ):** Tukey test identifies differing pairs.
- **No Significant Differences (ANOVA  $p \geq 0,05$ ):** No group means differ significantly.

## Application Limitations

### 1. File Formats

*Limitation:* Only Excel files (.xlsx, .xls) are supported. Formats like CSV or JSON are not accepted.

*Future Solution:* Add support for more file formats for greater flexibility.

### 2. Types of Statistical Tests

*Limitation:* Only t-tests and ANOVA with Tukey post-hoc are available. Other tests such as linear regression or multivariate ANOVA are not included.

*Future Solution:* Expand the application to include more statistical methods.

### 3. Data Requirements

*Limitation:* Only numeric data can be analyzed. The app does not support categorical or mixed-type variables.

*Future Solution:* Enable support for categorical or mixed data.

### 4. User Interface

*Limitation:* The interface might be challenging for users without statistical or R experience.

*Future Solution:* Improve the interface to make it more intuitive and user-friendly.

## 5. Scalability

*Limitation:* The app may struggle with very large datasets due to processing constraints.

*Future Solution:* Optimize performance to support large datasets efficiently.

## Evidence:

