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REPOSITORIO: https://github.com/andersonfloress/Trabajos_Est_Computacional

APPLICATION LINK: https://anderson-fls.shinyapps.io/Pruebas_Estadisticas/

HOMEWORK 04

Shiny Application for Statistical Tests

Introduction:

This web application was developed using the R Shiny package to facilitate the execution of classic statistical tests for users without programming experience. Through an intuitive graphical interface, the app allows users to upload Excel files and apply tests for both quantitative and qualitative data, as well as check if the data follow a normal distribution. It is designed for use by students, educators, research professionals, or anyone interested in quickly, structured, and reliably analyzing data.

The application classifies tests into three major groups:

- Quantitative Tests
- Qualitative Tests
- Normality Tests

Each category presents different statistical options that adapt according to the number and type of variables uploaded in the Excel file. Additionally, some tests allow users to manually select which columns to analyze, offering complete flexibility over the data.

Types of Tests and Their Purpose

1. Quantitative Tests

These tests are used when the data to be analyzed is numeric (continuous variables). They are used to evaluate differences between groups or relationships between variables.

Available Tests:

- **T-Test (Student's T-Test):**
Compares the means of two independent groups. It is used when you want to know if there is a statistically significant difference between two conditions or treatments.
 - **Requirements:** 1 column with group names, 1 numeric column with values.
 - **Useful for experiments with 2 conditions.**

- **ANOVA + Tukey:**

An extension of the t-test to compare more than two groups. If the ANOVA test is significant, Tukey's test allows for identifying which groups differ from each other.

- **Requirements:** At least 3 distinct groups.
- **Applicable in studies with multiple treatments or conditions.**

- **Wilcoxon (Mann-Whitney U Test):**

A non-parametric alternative to the t-test, it does not require data to follow a normal distribution. It compares the medians of two groups.

- **Useful when there are doubts about the normality of the data.**

- **Pearson Correlation:**

Measures the strength and direction of a linear relationship between two numeric variables.

- **Requires normality.**
- **Ideal for evaluating quantitative associations.**

- **Spearman Correlation:**

A non-parametric test that evaluates monotonic relationships (not necessarily linear) between two variables. It does not require normality.

- **Recommended when the data is ordinal or has outliers.**

2. Qualitative Tests

Used to analyze categorical variables (e.g., Yes/No responses or groups like "Group A", "Group B").

Available Tests:

- **Chi-Square Test of Independence:**

Evaluates whether there is a relationship between two categorical variables. It is based on a contingency table.

- **Requires two categorical columns.**
- **Common in surveys and frequency analysis.**

- **McNemar:**

Compares binary responses (Yes/No) at two different points for the same subjects (paired data).

- **Ideal for before/after intervention studies.**

- **Cochran's Q:**

Extends McNemar to more than two conditions. It is used to analyze repeated binary responses (more than two columns with 0/1 data).

- **The user can manually select the columns from the app.**
- **Requires strictly binary data (values 0 or 1).**

3. Normality Tests

These tests determine whether a variable follows a normal distribution, which is crucial for applying certain parametric methods (e.g., ANOVA or t-test).

Available Tests:

- **Shapiro-Wilk:**
Highly recommended for small samples. It measures the deviation of the data from a theoretical normal curve.
 - **The user selects a column for analysis.**
- **Kolmogorov-Smirnov (K-S):**
Compares a sample to a normal distribution (by default) or to another sample. The app allows users to:
 - Compare a variable with an estimated normal distribution (automatic).
 - Or compare two user-selected columns.
- **Lilliefors:**
A variant of the Kolmogorov-Smirnov test that automatically adjusts the mean and standard deviation from the data.
 - **Suitable for verifying normality without knowing the exact parameters.**
- **Jarque-Bera:**
A test based on statistical moments: skewness and kurtosis.
 - **Requires the user to select a numeric column.**

Application Features

- **Data Upload:**
The user can upload Excel files with .xlsx or .xls extensions. The app automatically detects whether the data is numeric or categorical and adjusts the available tests accordingly.
- **Dynamic Test Selection:**
Once the type of test (quantitative, qualitative, or normality) is selected, the corresponding tests are enabled in a dropdown menu.
- **Automatic or Manual Column Selection:**
In simple tests (t-test, ANOVA, Pearson, Spearman, etc.), the app assumes the first column corresponds to groups or variable X, and the second to values or variable Y. In more complex tests, the app allows the user to explicitly select columns. This occurs in:

- Cochran's Q Test: Multiple binary columns must be selected.
 - Kolmogorov-Smirnov Test: One or two columns for comparison are selected.
 - Normality Tests: The variable to analyze is selected.
- **Validations and Warnings:**
The system validates that the data is of the appropriate type before executing the test. If the data does not meet the minimum requirements (e.g., fewer than 2 columns, insufficient groups, or non-numeric data where required), a clear message is returned to the user.
 - **Results:**
Results are presented textually in the Results" tab, which displays the object returned by the statistical test, including p-values, statistics, degrees of freedom, etc.
 - **Additional Educational Content:**
A second tab in the interface describes T-tests and ANOVA in simple language with basic examples of use. This section may be expanded in the future to include more explanations.

Technical Requirements

- **Language:** R
- **Libraries Used:** shiny, shinythemes, readxl, ggplot2, dplyr, tidyr, car, DescTools, tseries, nortest
- **Input System:** Excel file (.xlsx or .xls)
- **Output System:** Text results generated by R's native statistical functions and additional packages.

How to Use the App Correctly (Quick Guide)

1. Upload your Excel file from the left panel.
2. Select the type of test: quantitative, qualitative, or normality.
3. Choose the specific test from the dropdown menu that appears.
4. Configure the columns if the test requires it by selecting them manually.
5. Click on Run Test."
6. Check the results in the Results" tab.

Evidence:

The screenshot shows a web browser window with the address bar displaying "anderson-fls.shinyapps.io/Pruebas_Estadisticas/". The page title is "App para Realizar Pruebas Estadísticas". The interface is divided into two main sections: a left sidebar for input and a right main area for results.

Left Sidebar (Input Section):

- Selección el tipo de prueba:** A dropdown menu with "Normalidad" selected.
- Selección la prueba de normalidad:** A dropdown menu with "Lilliefors" selected.
- Cargar archivo Excel:** A "Browse..." button is next to a file named "Lillii_24.xlsx". Below it is an "Upload complete" status bar.
- Selección la columna para analizar:** A dropdown menu with "tiempo1" selected.
- A "Realizar Prueba" button is at the bottom of the sidebar.
- Below the button, it says "Prueba completada correctamente."

Right Main Area (Results Section):

- At the top, there are two tabs: "Resultados" (active) and "Descripción de Pruebas Estadísticas".
- The "Resultados" tab displays the text: "Lilliefors (Kolmogorov-Smirnov) normality test".
- Below this, it shows the data source: "data: columna_valores".
- The final result is: "D = 0.12299, p-value = 0.7839".

The bottom of the image shows a Windows taskbar with the date and time "15:17 21/4/2025" and the location "Mayorm. soleado".