`EstIT_HLM` Function README

The `EstIT_HLM` function is a versatile tool designed to perform a Harmonic Linear Modeling (HLM) analysis on a set of scores. This function combines a harmonic model with a linear model to estimate the intraindividual trajectory of scores over sessions, providing both model predictions and diagnostic plots. `EstIT_HLM` was inspired in the 4 logistic parameters syntax by Gomes & Blesa (apud Araújo e Blesa, 2024).

Table of Contents

Function Overview

The `EstIT_HLM` function performs a combined harmonic and linear regression analysis on a vector of scores. It estimates model parameters, computes residuals, generates diagnostic plots (such as Residuals vs. Fitted Values and Q-Q plots), and provides the R^2 values for the role model. This approach is particularly useful in contexts where data exhibits both periodic (harmonic) and linear trends.

Syntax

```
scores <- c(6,6,8,8,7)
EstIT_HLM(scores)
```

Arguments

- **`scores`**: A numeric vector of scores representing measurements taken over different sessions. These scores are used to fit both the harmonic and linear models.

Details

The function performs the following steps:

1. **Define Error Function for Harmonic Model**: An internal function, `harmonic_model_error`, computes the sum of squared residuals between observed scores and the harmonic model's predictions. This error function is minimized during parameter optimization.

2. **Initialize Parameters**: Initial guesses for the model parameters (frequency, linear trend, intercept, sine, and cosine coefficients) are set, with default values such as:
    - `freq` = 1 (frequency of the harmonic component),
    - `f` = 0 (linear trend),
    - `a` = mean of the scores (intercept),
    - `b` = 1 (sine coefficient),
    - `c` = 1 (cosine coefficient).
3. **Optimize Harmonic Model Parameters**: The `optim` function is used to find the parameter values that minimize the error function. The optimized parameters (`best_freq`, `best_f`, `best_a`, `best_b`, `best_c`) are extracted for the harmonic model.
4. **Fit Harmonic and Linear Models**:
    - The harmonic model is fitted with the optimized parameters.
    - A simple linear regression model is fitted using the `lm` function.
5. **Calculate R^2 Values**: R^2 values are computed for the harmonic, linear, and combined models to assess model fit.
6. **Combine Models**: A weighted combination of the harmonic and linear model predictions is computed based on their R^2 values.
7. **Plot Generation**:
    - **Residuals vs. Fitted Values Plot**: Assesses the distribution of residuals.
    - **Q-Q Plot**: Checks the normality of residuals.
    - **Prediction Plot**: Shows observed scores versus the combined model's predictions.
8. **Statistical Tests**:
    - A Shapiro-Wilk test is performed to check the normality of the residuals.
9. **Trend Analysis**: The slope of the linear model is used to determine if the trend is increasing or decreasing.
10. **Output Results**: The function prints the model's results, including R^2 values, parameter estimates, and diagnostic plots.

Return Values

The function returns a list containing:

- **`R2`**: R^2 value for the combined harmonic-linear model.
- **`optimized_frequency`**: The optimized frequency for the harmonic component.
- **`adjusted_data`**: A data frame with observed scores, session numbers, predicted scores from both models, and residuals.
- **`prediction_plot`**: A `ggplot` object of the combined model's predictions.
- **`qq_plot`**: A Q-Q plot `ggplot` object to assess the normality of residuals.
- **`residuals_plot`**: A `ggplot` object showing residuals vs. fitted values.
- **`harmonic_parameters`**: A list with the optimized parameters (`intercept`, `sine_coef`, `cosine_coef`, `linear_trend`, `frequency`) for the harmonic model.
- **`linear_parameters`**: A list with the parameters (`intercept`, `slope_coef`) for the linear model.

Examples

```
R
```

```
Copiar código
# Example usage of the EstIT_HLM function

# Sample score data
scores <- c(6,6,8,8,7)

# Running the harmonic linear model estimation
model_results <- EstIT_HLM(scores)

# Accessing results
print(model_results)  # Prints role model's parameters
print(model_results$R2)  # Prints model's  R²
print(model_results$harmonic_parameters)  # Prints optimized harmonic
model parameters
print(model_results$harmonic_parameters)  # Prints optimized harmonic
model parameters
print(model_results$linear_parameters) # Prints linar model parameters


# Plotting diagnostic plots
print(model_results$prediction_plot)
print(model_results$qq_plot)
print(model_results$residuals_plot)
```

Dependencies

This function requires the `ggplot2` package for plotting:

```
install.packages("ggplot2")
```

Make sure the package is installed and loaded into the R session with `library(ggplot2)`.

Notes

- Ensure that the `scores` vector is appropriately preprocessed (e.g., no missing values) before using this function.
- The function assumes that scores are measured over equidistant sessions.

References

Araújo, J. de, & Blesa, H. (2024). Avaliando a trajetória do processo psicológico do indivíduo por meio de modelos. I Congrsso Brasileiro de Psicometria e Análise de Dados, Porto Alegre. https://www.researchgate.net/publication/381741254_Avaliando_a_trajetoria_do_processo_psicologico_do_individuo_por_meio_de_modelos