Regression & ANOVA in Base R

Ekiti R Users Group Training

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What You Will Learn

1. **Simple Linear Regression**
   - One predictor $\rightarrow$ one outcome
2. **Multiple Linear Regression**
   - Several predictors $\rightarrow$ one outcome
3. **One-Way ANOVA**
   - Compare means across 3+ groups
4. **Two-Way ANOVA**
   - Study two factors & their interaction

Simple Linear Regression

Concept:
Models the relationship between a dependent variable (Y) and one predictor (X).

$$Y = \beta_0 + \beta_1 X + \epsilon$$

Assumptions:
- Linearity
- Normality of residuals
- Constant variance (homoscedasticity)

Example:
Predicting **exam score (Y)** from **study hours (X)**.

Multiple Linear Regression

Relationship between outcome (Y) and **two or more predictors**.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_p X_p + \epsilon$$

Assumptions:

- Linearity
- Independence of observations
- No multicollinearity
- Normality & homoscedasticity

Example:

Predicting **exam score (Y)** using **study hours (X1)** and **sleep hours (X2)**.

One-Way ANOVA

Concept:
Compares the **means of 3+ groups** based on a single factor.

$$Y_{ij} = \mu + \tau_i + \epsilon_{ij}$$

Assumptions:
- Independent groups
- Normal distribution
- Equal variances

Example:
Compare **exam scores** across **departments** (CS, Biosciences, Engineering).

Two-Way ANOVA

Examines effects of **two categorical factors** + their interaction on Y.

$$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \epsilon_{ijk}$$

Assumptions:

- Same as one-way ANOVA
- Additivity (unless interaction exists)

Example:

Impact of **Department (CS, Bio, Eng.)** and **Gender (M/F)** on **exam scores**.

Quick Recap

- **Simple Regression** $\rightarrow$ 1 predictor
- **Multiple Regression** $\rightarrow$ Many predictors
- **One-Way ANOVA** $\rightarrow$ One factor, 3+ groups (2 group is t-test)
- **Two-Way ANOVA** $\rightarrow$ Two factors, possible interaction

Next: Hands-on with **Base R**

Resources

- Download the slides (PDF)
- Download the sample dataset (Excel)
- Download the R script used in the training
- Download steps to installing R and Rstudio

Stay Connected

- **Download R:** https://cran.r-project.org
- **Download RStudio:** https://posit.co/download/rstudio/
- **Join our community on Telegram:** Click here to join
- **Meetup Page:** Ekiti R Users Group

Stay updated with resources, upcoming trainings, and networking with other R enthusiasts.

Appreciation