Regression Analysis

University of Mosul

Collage of Computer Sciences and Mathematics

Statistics & Informatics Dept. / Third Year

Hours: Theoretical (2) , Lab (2), No. of Credits: 3

First Lecture

Regression Analysis Syllabus

First Course Syllabus

First Section: Matrices Review

1. **Topic One:** **Matrix Definition**
2. **Topic Two:** **Some Types of Matrices**
   - ✓ Square Matrix
   - ✓ Diagonal Matrix
   - ✓ Null (Zero) Matrix
   - ✓ Identity Matrix
   - ✓ Scalar Matrix
   - ✓ Symmetric Matrix
   - ✓ Upper Triangular Matrix
   - ✓ Lower Triangular Matrix
3. **Topic Three:** **Transpose Matrix**
   - Properties of Transpose Matrix
4. **Topic Four:** **Vectors**
   - Definition of Vector
5. **Topic Five:** **Some Operations on Matrices**
   - Matrix Addition
   - Matrix Multiplication:
     - • Properties of Matrix Multiplication
     - • Vectors Multiplication
     - - Transpose Pre-Multiplication of Two Vectors
     - - Vector Transpose Multiplication
     - • Multiplying Matrix By Vector and Vector bu Matrix
     - - Vector Pre-Multiplication
     - - Vector Post-Multiplication

- Diagonal Matrix Pre. And Post Multiplication

-Determinants
- Finding the Determination of (2x2) Matrix
- Finding the Determination of (3x3) Matrix
- Finding the Determination using the Co-Factor with Minors for (3x3) and (4x4) and Larger Matrix

-Matrix Inverse
- Properties of Inverse
- Inverse From the Adjoint

6. Matrix Inverse

Features of the inverse
- Finding the inverse using the adjoint matrix
- Finding the inverse using Doolittle method

Second Section: Regression Analysis
1. Some Concepts
- Definition of Regression Analysis
- Uses of Regression Analysis

2. Simple Linear Regression
o Assumptions of Analysis
o Estimation of Regression Parameters by Least Squares Method
o Some Properties of Linear Regression Model
o Estimating the Variance of Regression Coefficient
o Estimating the Variance of the Intercept
o Estimating the Variance for true mean value
o Hypothesis Testing
o Testing the Significance of Regression Coefficient

3. Confidence Limits (Interval-Estimation)
o Confidence Limits for β_1 (C.I for β_1)
o Confidence Limits for β_0 (C.I for β_0
o Confidence Limits for true mean value $\hat{y}_0$ when X=X$_0$

4. (ANOVA) for S.L.R.

- o Equivalence between F-test and t-test
- o Superiority of t-test over F-test
- o R^2 Coefficient of Determination
- o Correlation coefficient between expected values and actual observed values $r_{y\hat{y}}$
- o Relationship of the correlation coefficient r to the estimated regression coefficient $\hat{\beta}_1$
- o Lack of fit Test
- o Maximum R^2
- o Regression Through the Origin (Zero-Intercept)
- o Hypotheses Testing Regarding Regression from the Origin
- o Hypotheses Testing Regarding Correlation Coefficient
- o Estimation Using Maximum Likelihood Estimation (M.L. Method)
- o Matrix Approach to S.L.R.
- o ANOVA table using matrices
- o Variance and covariance using matrices
- o Response mean variance using matrices

5. Assumptions Violation in S.L.R.

- o Test of Overall Assumptions
- o Test whether the relationship between X and Y is linear.
- o Autocorrelation Problem
- o Modify the autocorrelation between errors.
- o Test for Normality

6. Difference Between Regression and Correlation

References used in teaching

Arabic References (Textbook):

الراوي, خاشع محمود, 1987, "المدخل إلى تحليل الأنحدار",جامعة الموصل, العراق.

English Refrences:

1. Jocelyn E. Bolin 2023, "Regression Analysis in R: A Comprehensive View For The Social Sciences [1 ed.]",Chapman & Hall/CRC Statistics In The Social And Behavioral Sciences, CRC Press | Taylor & Francis Group 2023

2. Jeremy Arkes, 2023, "Regression Analysis: A Practical Introduction", [2 ed.], Routledge

3. Daniel P. McGibney 2023, "Applied Linear Regression for Business Analytics with R: A Practical Guide to Data Science with Case Studies" International Series in Operations Research & Management Science.

4. Douglas C. Montgomery; Elizabeth A. Peck; G. Geoffrey Vining 2021, "Introduction to Linear Regression Analysis", [6 ed.], Wiley Series in Probability and Statistics.

5. William Mendenhall, Terry Sincich 2020, "A Second Course in Statistics: Regression Analysis", 8th Edition, Pearson

6. Samprit Chatterjee, Jeffrey S. Simonoff, "Regression Modeling and Data Analysis with Applications in R", [2 ed.], Wiley Series in Probability and Statistics

7. Peter H. Westfall, Andrea L. Arias 2020, "Understanding Regression Analysis", [1 ed.], Routledge