**BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI**

**WORK INTEGRATED LEARNING PROGRAMMES**

M .Tech (Data Science & Engineering)

**II Semester, 2020-21(MAY 2021)**

**Course Handout(Revised on Jan 2020)**

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| **Course Title** | **Introduction to Statistical Methods** |
| **Course No(s)** | DSECL ZC413 |

**Course Description**

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| This course will cover the statistical techniques which are very important in Data Science. It covers the models related to descriptive statistics, inferential statistics, predictive analytics and applied multivariate analytics. |

**Course Objectives**

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| **CO1** | Understanding the data representation and analysis which is very important in Data Science |
| **CO2** | Understanding the predictive & inferential statistical models used in Data Science |

**Text Books**

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| **No** | **Author(s), Title, Edition, Publishing House** |
| T1 | Probability and Statistics for Engineering and Sciences,8th Edition, Jay L Devore, Cengage Learning |
| T2 | Applied Logistic Regression, Hosmer and Lemeshow,3rd Edition, Wiley |
| T3 | Introduction to Time Series and Forecasting, Second Edition, Peter J Brockwell, Richard ADavis, Springer. |

**Reference Books**

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| **No** | **Author(s), Title, Edition, Publishing House** |
| R1 | Miller and Freund’s Probability and statistics for Engineers, 8th Edition, PHI |
| R2 | Statistics for Business and Economics by Anderson, Sweeney and Wiliams, CENAGE learning |

**Modular Content Structure**

1. Descriptive Statistics
   1. Data Visualisation
   2. Measures of Central Tendency
   3. Measures of Variability
2. Probability
   1. Probability – Introduction and Basics
   2. Conditional probability
   3. Bayes’ theorem
3. Probability Distributions

3.1. Random variables – Discrete & Continuous(single and multiple)

3.2. Probability Distributions

3.2.1. Binomial Distribution

3.2.2. Poisson Distribution

3.2.3. Normal Distribution

1. Testing of Hypothesis
   1. Sampling & Estimation
   2. Type I, Type II errors
   3. Testing of Hypothesis – Mean – one and two mean
   4. Testing of hypothesis – Proportions – one and several Proportions
   5. ANOVA
2. Regression
   1. Covariance
   2. Correlation
   3. Sum of Least Squares
   4. Simple linear regression
   5. Ridge Models &Lasso Model
   6. Assumptions of linear regression
   7. Model validation
   8. Multiple linear regression
   9. Nonlinear regression

5.10. Logistic regression

1. Forecasting Model
   1. Principles of Forecasting
   2. Time series Analysis

6.2.1. Smoothing & decomposition methods

6.2.2. ARIMA Model

6.2.3 Moving Averages

6.2.4 Exponential smoothing

**Learning Outcomes:**

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| **No** | **Learning Outcomes** |
| **LO1** | Clear understanding of the various statistical models to model the data |
| **LO2** | Drawing conclusions from the models selected to understand the data |

**Part B: Course Handout**

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| **Academic Term** | II semester ,2020 – 21 |
| **Course Title** | **Introduction to Statistical Methods** |
| **Course No** | DSECLZ ZC413 |

**Course Contents**

**Contact Session 1: Module 1(**Descriptive Statistics)

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| **Contact Session** | **List of Topic Title** | **Reference** |
| CS - 1 | Descriptive Statistics: Data Visualisation, Measures of Central Tendency, Measures of Variability | T1:Chapter 1 |
| HW | Problems on Descriptive Statistics | T1:Chapter 1 |
| Lab |  |  |

**Contact Session 2: Module 2 - Probability**

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| **Contact Session** | **List of Topic Title** | **Reference** |
| CS - 2 | Probability - Introduction and Basics, Conditional probability, Bayes’ theorem | T1:Chapter 2 |
| HW | Problems on probability | T1:Chapter 2 |
| Lab |  |  |

**Contact Session 3: Module 3 – Probability Distributions**

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| **Contact Session** | **List of Topic Title** | **Reference** |
| CS - 3 | Random Variables – Discrete & Continuous (single variable) | T1:Chapter 3 & 4 |
| HW | Problems on Random Variables | T1:Chapter 3 & 4 |
| Lab |  |  |

**Contact Session 4: Module 3 – Probability Distributions**

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| **Contact Session** | **List of Topic Title** | **Reference** |
| CS - 4 | Random Variables – Discrete & Continuous (Multi variates) | T1:Chapter 3 & 4 |
| HW | Problems on Joint RVs | T1:Chapter 3 & 4 |
| Lab |  |  |

**Contact Session 5: Module 3 – Probability Distributions**

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| **Contact Session** | **List of Topic Title** | **Reference** |
| CS - 5 | Probability Distributions – Binomial, Poisson and Normal Distributions | T1:Chapter 3 & 4 |
| HW | Problems on probability distributions | T1:Chapter 3 & 4 |
| Lab |  |  |

**Contact Session 6: Module 4 – Testing of Hypothesis**

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| **Contact Session** | **List of Topic Title** | **Reference** |
| CS - 6 | Sampling & Estimation | R1 |
| HW | Problems on Interval Estimation | R1 |
| Lab |  |  |

**Contact Session 7: Module 4 – Testing of Hypothesis**

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| **Contact Session** | **List of Topic Title** | **Reference** |
| CS - 7 | Testing of Hypothesis - Type I & II errors, Critical region, t – test, Chi – Square test and F – test(Introduce and discuss these tests) | T1:Chapter 7 ,8,9 & 10 |
| HW | Problems on Testing of Hypothesis | T1:Chapters 7 to 10 |
| Lab |  |  |

**Contact Session 8:**

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| **Contact Session** | **List of Topic Title** | **Reference** |
| CS - 8 | REVISION OF THE TOPICS COVERED |  |
| HW |  |  |
| Lab |  |  |

**MID SEMESTER EXAMINATION**

**Contact Session 9 & 10: Module 4 – Testing of Hypothesis**

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| **Contact Session** | **List of Topic Title** | **Reference** |
| CS – 9 & 10 | Testing of Hypothesis - mean and proportions related models (one mean, two mean, one proportion and Several proportions with small and big samples wherever applicable) | T1:Chapter 7 ,8,9 & 10 |
| HW | Problems on Testing of Hypothesis | T1:Chapters 7 to 10 |
| Lab |  |  |

**Contact Session 11: Module 5 – Regression**

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| **Contact Session** | **List of Topic Title** | **Reference** |
| CS - 11 | Covariance, Correlation, Rank Correlation | T1:Chapter 12 & 13 |
| HW | Problems on correlation and co variance | T1:Chapter 12 & 13 |
| Lab |  |  |

**Contact Session 12: Module 5 – Regression**

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| **Contact Session** | **List of Topic Title** | **Reference** |
| CS - 12 | Simple Linear regression model, Assumption of the model, interpretation of the model | T1:Chapter 12 & 13 |
| HW | Problems on Linear regression | T1:Chapter 12 & 13 |
| Lab |  |  |

**Contact Session 13: Module 5 – Regression**

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| **Contact Session** | **List of Topic Title** | **Reference** |
| CS - 13 | Multiple linear regression model, non – linear regression & Logistic regression( Introducing the model as a continuation of regression models) | T1:Chapter 12 & 13 and T2 |
| HW | Problems on Linear regression | T1:Chapter 12 & 13 |
| Lab |  |  |

**Contact Session 14: Module 6 – Forecasting Models**

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| **Contact Session** | **List of Topic Title** | **Reference** |
| CS - 14 | Principles of Forecasting, Time series models \_ smoothing and decomposition methods, AR,MA,ARIMA Models(Introducing the models only) | T3 |
| HW | Case studies on Time series models |  |
| Lab |  |  |

**Contact Session 15: Module 6 – Forecasting Models**

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| **Contact Session** | **List of Topic Title** | **Reference** |
| CS - 1 | Moving Averages and Exponential smoothing models | T3 |
| HW | Case studies on Time series models |  |
| Lab |  |  |

**Contact Session 16:**

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| **Contact Session** | **List of Topic Title** | **Reference** |
| CS - 16 | **REVISION OF THE SYLLABUS** |  |
| HW |  |  |
| Lab |  |  |