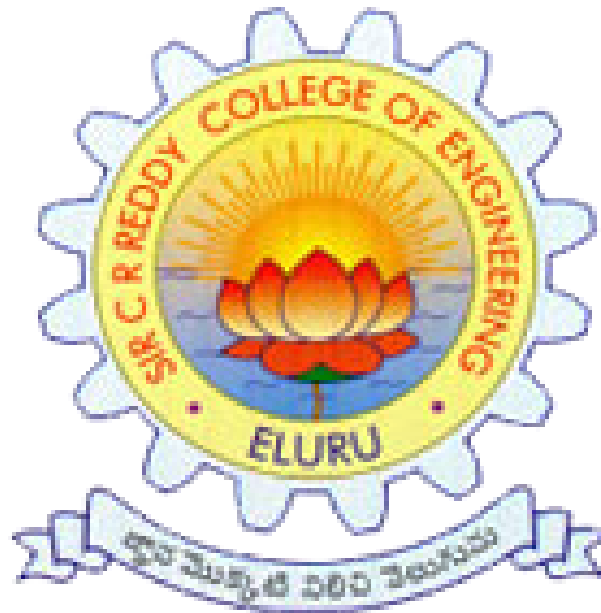


**SIR C.R.REDDY COLLEGE OF ENGINEERING, ELURU**  
**DEPARTMENT OF INFORMATION TECHNOLOGY**  
**COURSE HANDOUT**



**SUBJECT: STATISTICS WITH R**

**CLASS: II/IV B.Tech. II SEMESTER, A.Y.2022-23**

**INSTRUCTOR: SRI P RAMAIAH CHOWDARY**

## Course Handout Index

| S. No | Description                           |
|-------|---------------------------------------|
| 1     | College Vision & Mission              |
| 2     | Department Vision & Mission           |
| 3     | Program Educational Objectives (PEOs) |
| 4     | Program Outcomes (POs)                |
| 5     | Program Specific Outcomes (PSOs)      |
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### **College Vision & Mission**

**Vision:** To emerge as a premier institution in the field of technical education and research in the state and as a home for holistic development of the students and contribute to the advancement of society and the region.

**Mission:** To provide high quality technical education through a creative balance of academic and industry oriented learning; to create an inspiring environment of scholarship and research; to instill high levels of academic and professional discipline; and to establish standards that inculcate ethical and moral values that contribute to growth in career and development of society in general.

### **Department Vision & Mission**

**Vision:** To be a premier department in the region in the field of Information Technology through academic excellence and research that enable graduates to meet the challenges of industry and society.

**Mission:** To Provide dynamic teaching-learning environment to make the students industry ready and advancement in career; to inculcate professional and leadership quality for better employability and entrepreneurship; to make high quality professional with moral and ethical values suitable for industry and society.

### **Program Educational Objectives (PEOs)**

**PEO1:** Solve real world problems through effective professional skills in Information Technology industry and academic research.

**PEO2:** Analyze and develop applications in Information Technology domain and adapt to changing technology trends with continuous learning.

**PEO3:** Practice the profession in society with ethical and moral values.

### **Program Outcomes (POs)**

**PO1: Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO2: Problem Analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.

**PO3: Design/Development of Solutions:** Design solutions for complex engineering problems and system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, society, and environmental considerations.

**PO4: Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO5: Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**PO6: The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7: Environment and Sustainability:** Understand the impact of the professional engineering solutions in society and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9: Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.

**PO10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**PO11: Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

**PO12: Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**Program Specific Outcomes (PSOs)**

**PSO1: Design Skill:** Design and develop software's in the area of relevance under realistic constraints.

**PSO2: New Technology:** Adapt new and fast emerging technologies in the field of Information Technology.

# JNTUK Academic Calendar

Website: [www.jntuk.edu.in](http://www.jntuk.edu.in)  
Email: [dap@jntuk.edu.in](mailto:dap@jntuk.edu.in)



Phone: 0884-2300991

**Directorate of Academic Planning**  
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA  
KAKINADA-533003, Andhra Pradesh, INDIA  
(Established by AP Government Act No. 30 of 2008)

Lr. No. DAP/RAC/II Year /B. Tech/2022

Date 02.11.2022

**Dr. KVSG Murali Krishna,**  
*M.E., Ph.D.,*  
**Director, Academics & Planning**  
**JNTUK, Kakinada**

To  
All the Principals of Affiliated Colleges,  
JNTUK, Kakinada.

**Revised Academic Calendar for II Year - B. Tech for the AY 2022-23**  
**(2021-22 Admitted Batch)**

| I SEMESTER  |                   |            |       |
|---|-------------------|------------|-------|
| Description   | From              | To         | Weeks |
| <b>Community Service Project</b>  | <b>22.08.2022</b> | 03.09.2022 | 2W    |
| I Unit of Instruction   | 05.09.2022        | 29.10.2022 | 8W    |
| I Mid Examinations  | 24.10.2022        | 29.10.2022 |       |
| II Unit of Instructions   | 31.10.2022        | 24.12.2022 | 8W    |
| II Mid Examinations   | 19.12.2022        | 24.12.2022 |       |
| Community Service Project for Lateral Entry Students,<br>Preparation & Practicals | 26.12.2022        | 14.01.2022 | 3W    |
| End Examinations  | 18.01.2023        | 28.01.2023 | 2W    |
| Commencement of II Semester Class Work  | <b>28.01.2023</b> |            |       |
| II SEMESTER   |                   |            |       |
| I Unit of Instructions  | <b>30.01.2023</b> | 25.03.2023 | 8W    |
| I Mid Examinations  | 20.03.2023        | 25.03.2023 |       |
| II Unit of Instructions   | 27.03.2023        | 20.05.2023 | 8W    |
| II Mid Examinations   | 15.05.2023        | 20.05.2023 |       |
| Preparation & Practicals  | 22.05.2023        | 27.05.2023 | 1W    |
| End Examinations  | 29.05.2023        | 10.06.2023 | 2W    |

\* As per the APSICHE Guidelines Out of the Total 180 hours of Community Service Project leading to 4 Credits, two weeks will be offline and remaining project work can be done during the II-I semester weekends and holidays.

*KVSG*  
2/11/22

**Director,**  
**Academics & Planning, JNTUK**  
**Academic Planning**  
**JNTUK Kakinada**

Copy to the Secretary to the Hon'ble Vice Chancellor, JNTUK  
Copy to Rector, JNTUK  
Copy to Registrar, JNTUK  
Copy to Director Academic Audit, JNTUK  
Copy to Director of Evaluation, JNTUK

## Course Description

In this course, you will learn to analyse and visualize data in R and create reproducible data analysis reports, demonstrate a conceptual understanding of the unified nature of statistical inference, perform frequent and Bayesian statistical inference and modelling to understand natural phenomena and make data-based decisions, communicate statistical results correctly, effectively, and in context without relying on statistical jargon, critique data-based claims and evaluated data-based decisions, and wrangle and visualize data with R packages for data analysis.

You will produce a portfolio of data analysis projects from the Specialization that demonstrates mastery of statistical data analysis from exploratory analysis to inference to modelling, suitable for applying for statistical analysis or data scientist positions.

## Course Objectives

After taking the course, students will be able to

- Use R for statistical programming, computation, graphics, and modeling,
- Write functions and use R in an efficient way,
- Fit some basic types of statistical models
- Use R in their own research,
- expand their knowledge of R on their own

## Course Outcomes

At the end of this course, students will be able to:

| CO Number | COs   | Level |
|-----------|---|-------|
| CO1       | Understand the R programming basic concepts required for statistics.                | L2    |
| CO2       | Apply basic Math and statistics in R programming                                    | L3    |
| CO3       | Sketch visualizations/graphics in R Programming.                                    | L3    |
| CO4       | Analyze the R programming constructs/models required to perform certain statistics. | L4    |

|             |               |          |           |            |          |
|-------------|---------------|----------|-----------|------------|----------|
| Remembering | Understanding | Applying | Analyzing | Evaluating | Creating |
| L1          | L2            | L3       | L4        | L5         | L6       |

|                          |   |   |   |   |
|--------------------------|---|---|---|---|
| II Year – II Semester    | L | T | P | C |
|                          | 2 | 0 | 2 | 3 |
| <b>STATISTICS WITH R</b> |   |   |   |   |

### Syllabus

**UNIT-I:** Introduction, How to run R, R Sessions and Functions, Basic Math, Variables, Data Types, Vectors, Conclusion, Advanced Data Structures, Data Frames, Lists, Matrices, Arrays, Classes.

**UNIT-II:** R Programming Structures, Control Statements, Loops, - Looping Over Nonvector Sets,- IfElse, Arithmetic and Boolean Operators and values, Default Values for Argument, Return Values, Deciding Whether to explicitly call return- Returning Complex Objects, Functions are Objective, No Pointers in R, Recursion, A Quicksort Implementation-Extended Extended Example: A Binary Search Tree.

**UNIT-III:** Doing Math and Simulation in R, Math Function, Extended Example Calculating ProbabilityCumulative Sums and Products-Minima and Maxima- Calculus, Functions Fir Statistical Distribution, Sorting, Linear Algebra Operation on Vectors and Matrices, Extended Example: Vector cross Product- Extended Example: Finding Stationary Distribution of Markov Chains, Set Operation, Input /output, Accessing the Keyboard and Monitor, Reading and writer Files,

**UNIT-IV:** Graphics, Creating Graphs, The Workhorse of R Base Graphics, the plot() Function – Customizing Graphs, Saving Graphs to Files. Probability Distributions, Normal Distribution-Binomial Distribution- Poisson Distributions Other Distribution, Basic Statistics, Correlation and Covariance, T-Tests,-ANOVA

**UNIT-V:** Linear Models, Simple Linear Regression, -Multiple Regression Generalized Linear Models, Logistic Regression, - Poisson Regression- other Generalized Linear Models-Survival Analysis, Nonlinear Models, Splines- Decision- Random Forests,

**TEXT BOOKS:** 1) The Art of R Programming, Norman Matloff, Cengage Learning 2) R for Everyone, Lander, Pearson

**REFERENCE BOOKS:** 1) R Cookbook, PaulTeetor, Oreilly. 2) R in Action,Rob Kabacoff, Manning



## Lesson Plan

| S. No | Unit | Topic  | Teaching Aids | CO  |
|-------|------|--|---------------|-----|
| 1.    | I    | <b>Introduction</b>                                  | BB            | CO1 |
| 2.    |      | How to run R   | BB            | CO1 |
| 3.    |      | R Sessions and Functions                             | BB            | CO1 |
| 4.    |      | Basic Math.  | BB            | CO1 |
| 5.    |      | Variables  | BB            | CO1 |
| 6.    |      | Data Types   | PPT           | CO1 |
| 7.    |      | Vectors  | PPT           | CO1 |
| 8.    |      | Advanced Data Structures                             | PPT           | CO1 |
| 9.    |      | Data Frames  | BB/PPT        | CO1 |
| 10.   |      | Lists  | BB            | CO1 |
| 11.   |      | Matrices   | BB/PPT        | CO1 |
| 12.   |      | Arrays   | BB            | CO1 |
| 13.   |      | Classes  | BB/PPT        | CO1 |
| 14.   | II   | R Programming Structures,                            | BB            | CO1 |
| 15.   |      | Control Statements                                   | BB/PPT        | CO1 |
| 16.   |      | Loops  | BB/PPT        | CO1 |
| 17.   |      | Looping Over Non-vector Sets,- IfElse                | BB/PPT        | CO1 |
| 18.   |      | Arithmetic and Boolean Operators and values          | BB            | CO1 |
| 19.   |      | Default Values for Argument                          | BB            | CO1 |
| 20.   |      | Return Values  | BB            | CO1 |
| 21.   |      | Deciding Whether to explicitly call return           | BB/PPT        | CO1 |
| 22.   |      | Returning Complex Objects,                           | BB            | CO1 |
| 23.   |      | Functions are Objective                              | BB/PPT        | CO1 |
| 24.   |      | No Pointers in R, Recursion                          | BB            | CO1 |
| 25.   |      | A Quicksort Implementation-Extended                  | BB            | CO1 |
| 26.   |      | Extended Example: A Binary Search Tree               | BB/PPT        | CO1 |
| 27.   | III  | Doing Math and Simulation in R                       | BB/PPT        | CO2 |
| 28.   |      | Math Function, Extended Example                      | BB            | CO2 |
| 29.   |      | Calculating Probability Cumulative Sums and Products | BB/PPT        | CO2 |

|     |    |  |        |     |
|-----|----|--|--------|-----|
| 30. |    | Minima and Maxima  | BB     | CO2 |
| 31. |    | Calculus,  | BB/PPT | CO2 |
| 32. |    | Functions For Statistical Distribution,                            | BB/PPT | CO2 |
| 33. |    | Sorting  | BB     | CO2 |
| 34. |    | Linear Algebra Operation on Vectors and Matrices                   | BB     | CO2 |
| 35. |    | Extended Example: Vector cross Product-                            | BB     | CO2 |
| 36. |    | Extended Example: Finding Stationary Distribution of Markov Chains | BB/PPT | CO2 |
| 37. |    | Set Operation,   | BB     | CO2 |
| 38. |    | Input /output  | BB     | CO2 |
| 39. |    | Accessing the Keyboard and Monitor                                 | BB/PPT | CO2 |
| 40. |    | Reading and writer Files   | BB     | CO2 |
| 41. | IV | Graphics, Creating Graphs,   | BB     | CO3 |
| 42. |    | The Workhorse of R Base Graphics                                   | BB/PPT | CO3 |
| 43. |    | the plot() Function  | BB     | CO3 |
| 44. |    | Customizing Graphs   | BB/PPT | CO3 |
| 45. |    | Saving Graphs to Files   | BB     | CO3 |
| 46. |    | Probability Distributions  | BB     | CO3 |
| 47. |    | Normal Distribution  | BB     | CO3 |
| 48. |    | Binomial Distribution  | BB     | CO3 |
| 49. |    | Poisson Distributions  | BB/PPT | CO3 |
| 50. |    | Other Distribution   | BB     | CO3 |
| 51. |    | Basic Statistics   | BB/PPT | CO3 |
| 52. |    | Correlation and Covariance   | BB     | CO3 |
| 53. |    | T-Tests,-ANOVA   | BB     | CO3 |
| 54. | V  | Linear Models  | BB/PPT | CO4 |
| 55. |    | Simple Linear Regression   | BB     | CO4 |
| 56. |    | Multiple Regression Generalized                                    | BB/PPT | CO4 |
| 57. |    | Logistic Regression  | BB     | CO4 |
| 58. |    | Poisson Regression   | BB/PPT | CO4 |
| 59. |    | other Generalized Linear Models                                    | BB     | CO4 |
| 60. |    | Survival Analysis  | BB/PPT | CO4 |

|     |  |                  |        |     |
|-----|--|------------------|--------|-----|
| 61. |  | Nonlinear Models | BB/PPT | CO4 |
| 62. |  | Splines          | BB     | CO4 |
| 63. |  | Decision         | BB/PPT | CO4 |
| 64. |  | Random Forests   | BB     | CO4 |

### **Evaluation Pattern**

The assessment of the student's performance in each course will be as per the details given:

| S. No | Components   | Internal | External | Total |
|-------|--|----------|----------|-------|
| 1     | Theory   | 30       | 70       | 100   |
| 2     | Engineering Graphics/Design/Drawing  | 30       | 70       | 100   |
| 3     | Practical  | 15       | 35       | 50    |
| 4     | Mini Project/Internship/Industrial Training/ Skill Development programmes/Research Project | -        | 50       | 50    |
| 5     | Project Work   | 60       | 140      | 200   |

Continuous Internal Theory Evaluation:

- a) For theory subjects, during a semester, there shall be two mid-term examinations. Each mid-term examination consists of (i) one online objective examination (20 multiple choice questions) for 10 marks for a duration of 20 minutes (ii) one descriptive examination (3 full questions for 5 marks each) for 15 marks for a duration of 90 minutes and (iii) one assignment for marks. All the internal exams shall be conducted as per university norms from first 50% of the syllabi.
- b) In the similar lines, the second online, descriptive examinations assignment shall be conducted on the rest of the 50% syllabus.
- c) Internal marks can be calculated with 80% weightage for better of the two mids and 20% Weightage for other mid exam.

Example: Mid-1 marks = Marks secured in (online examination-1+descriptive examination-1 +one assignment-1)

Mid-2 marks = Marks secured in (online examination-2+descriptive examination-2 +one assignment-2)

Final internal Marks = (Best of (Mid-1/Mid-2) marks x 0.8 + Least of (Mid-1/Mid-2) marks x 0.2)

**Timetable**

**SIR CRREDDY COLLEGE OF ENGINEERING, ELURU  
DEPARTMENT OF INFORMATION TECHNOLOGY**

**II/IV B.Tech IT – II SEMESTER A.Y 2022-2023**

**TIME TABLE  
A-SECTION**

**With effect from : 30-01-2023 Class Teacher:Sri.Y.SivaKoteswaraRao/P.Ramaiahchowdary LH- 45**

|            | 1                    | 2                 | 3                    | 4                    |   | 5                  | 6                    | 7                    | 8                   |
|------------|----------------------|-------------------|----------------------|----------------------|---|--------------------|----------------------|----------------------|---------------------|
| <b>DAY</b> | 09:00<br>To<br>09:50 | 09:50 To<br>10:40 | 11:00<br>To<br>11:50 | 11:50<br>To<br>12:40 |   | 1:40<br>To<br>2:30 | 02:30<br>To<br>03:20 | 03:20<br>To<br>04:10 | 04:10<br>To<br>5:00 |
| <b>MON</b> | SRP LAB              |                   | AT&CD                | PSE(T)               | L | UML LAB            |                      |                      | AT&CD(M)            |
| <b>TUE</b> | JAVA                 | PSE               | MEFA                 | SRP(T)               | U | FOSS LAB           |                      |                      | MEFA(M)             |
| <b>WED</b> | AT&CD                | SOC LAB           |                      |                      | N | SRP                | MEFA                 | JAVA(T)              | SRP(M)              |
| <b>THU</b> | MEFA                 | SRP               | AT&CD<br>(T)         | JAVA                 | C | JAVA LAB           |                      |                      | PSE(M)              |
| <b>FRI</b> | PSE                  | AT&CD             | MEFA(T)              | JAVA                 | H | PSE                | SRP                  | Counseling           | JAVA(M)             |
| <b>SAT</b> | MEFA                 | AT&CD             | JAVA                 | PSE                  |   | AT&CD<br>(R)       | JAVA<br>(R)          | PSE/SRP<br>(R)       | MEFA<br>(R)         |

\*T – Tutorial

\*R- Remedial Class

\*M- Make Up Class

**STAFF:**

Statistics with R R2022121

Principles of Software Engineering R2022122

Automata Theory and Compiler Design R2022123

Java Programming R2022054

Managerial Economics and financial Accountancy R2022055

UML Lab R2022124

FOSS Lab R2022125

Java Programming Lab R2022126

Skill oriented Course R2022128

:Sri. P.Ramaiah chowdary

: Dr. G.Chamundeswari

: Sri. Ch. Yallamanda

: Dr. K.Satyanarayana

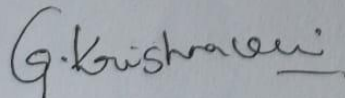
:Sri.Y.Siva Koteswara Rao

:Dr.G.Chamundeswari/Sri.P.RamaiahChowdary

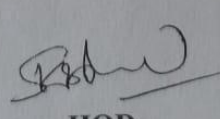
: Sri. E.B.K.Manash / Sri. G.Vihari

:Dr. K.Satyanarayana /Sri. P.Rajendra Kumar

:Sri.S.Uma Sheshagiri Rao/Sri.P.RamaiahChowdary

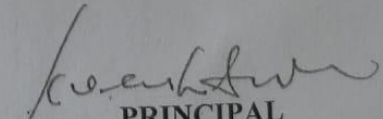


**Dept. Time Table Incharge**



**HOD,**

**HEAD OF DEPARTMENT  
Information Technology  
Sir C.R.R. College of Engg.  
ELURU-534 007.**



**PRINCIPAL**

**Principal  
Sir C.R.R.College of Engineering  
ELURU - 534 007**

**SIR CRREDDY COLLEGE OF ENGINEERING, ELURU**  
**DEPARTMENT OF INFORMATION TECHNOLOGY**

**II/IV B.Tech IT – II SEMESTER A.Y 2022-2023**

**TIME TABLE**  
**B-SECTION**

**With effect from :30-01-2023 Class Teacher: Dr. G.Chamundeswari/Ch.Yallamanda LH- 46**

|            | 1                    | 2                    | 3                    | 4                    |                       | 5                  | 6                    | 7                    | 8                   |
|------------|----------------------|----------------------|----------------------|----------------------|-----------------------|--------------------|----------------------|----------------------|---------------------|
| <b>DAY</b> | 09:00<br>To<br>09:50 | 09:50<br>To<br>10:40 | 11:00<br>To<br>11:50 | 11:50<br>To<br>12:40 |                       | 1:40<br>To<br>2:30 | 02:30<br>To<br>03:20 | 03:20<br>To<br>04:10 | 04:10<br>To<br>5:00 |
| <b>MON</b> | PSE                  | JAVA LAB             |                      |                      | L<br>U<br>N<br>C<br>H | AT&CD              | MEFA(T)              | Counseling           | AT&CD(M)            |
| <b>TUE</b> | SRP                  | AT&CD                | JAVA                 | PSE                  |                       | MEFA               | <b>SRP</b>           | JAVA(T)              | MEFA(M)             |
| <b>WED</b> | JAVA                 | MEFA                 | PSE                  | AT&CD                |                       | FOSS LAB           |                      |                      | SRP(M)              |
| <b>THU</b> | AT&CD                | UML LAB              |                      |                      |                       | PSE                | MEFA                 | SRP(T)               | PSE(M)              |
| <b>FRI</b> | MEFA                 | JAVA                 | SRP                  | AT&CD(T)             |                       | SOC LAB            |                      |                      | JAVA(M)             |
| <b>SAT</b> | JAVA                 | PSE(T)               | SRP LAB              |                      |                       | AT&CD<br>(R)       | JAVA<br>(R)          | PSE/SRP<br>(R)       | MEFA<br>(R)         |

\*T – Tutorial

\*R- Remedial Class

\*M- Make Up Class

**STAFF:**

Statistics with R R2022121

: Sri. P.Ramaiah Chowdary

Principles of Software Engineering R2022122

: Dr. G. Chamundeswari

Automata Theory and Compiler Design R2022123

: Sri. Ch. Yallamanda

Java Programming R2022054

: Dr. K.Satyanarayana

Managerial Economics and financial Accountancy R2022055

: Sri. Y.Siva Koteswara Rao

UML Lab R2022124

:Dr.G.Chamundeswari/Sri.S.Uma Sheshagiri Rao

FOSS Lab R2022125

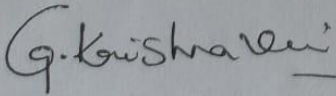
:Sri. G.Vihari /Sri. E.B.K.Manash

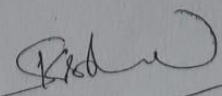
Java Programming Lab R2022126

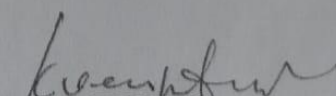
: Dr. K.Satyanarayana /Sri. P.Rajendra Kumar

Skill oriented Course R2022128

: Sri. S.Uma Sheshagiri Rao / Sri.V.Gopinath

  
**Dept. Time Table Incharge**

  
**HOD,**  
**HEAD OF THE DEPARTMENT**  
**Information Technology**  
**Sir C.R.R. College of Engineering**  
**ELURU - 534 007**

  
**PRINCIPAL**  
**Principal**  
**Sir C.R.R.College of Engineering**  
**ELURU - 534 007**

**Google Class room link:**

<https://classroom.google.com/c/NTk1ODk4NDExODYy?cjc=2lenqeo>

class code: **2lenqeo**

**Unit-wise questions**

**UNIT – 1**  
**Introduction to R**

1. Describe the features of R.
2. Can you list the applications of R?
3. What are the merits and demerits of R programming language?
4. How do you install and run R?
5. Discuss R sessions and functions.
6. Explain data types in R.
7. Discuss the data structures in R with examples.
8. Discuss object-oriented systems (classes) in R with suitable examples.
9. Explain the concept of user-defined function with an example.
10. What are vectors? Elaborate with the help of R program.
11. What do you understand from vector arithmetic? Explain with an example.
12. Explain matrix function in R with an example.
13. Explain array function in R with an example.
14. Discuss the differences between built-in function and user-defined function.
15. Write R code to create two different data frames with some common information, and then merge those two data frames.
16. Discuss about the operations on vectors?
17. Describe the concept of lists with suitable examples.
18. Explain about apply() family in R.
19. Explain the following with suitable examples.
  - a) apply()
  - b) sapply()
  - c) lapply()
  - d) tapply()

**UNIT – 2**  
**R Programming Structures**

1. Explain R programming structures.
2. Discuss control structures in R with suitable examples.
3. Discuss the concepts of operators in R.
4. How do use default value for an argument? Elaborate with an example.
5. Discuss the importance of return with an example.
6. Discuss complex objects in R.
7. Describe the concept of “No pointers in R”.
8. Write an R program to find a factorial of a given number using recursion.
9. Explain quick sort algorithm with a suitable example.
10. Write R script to implement quick sort algorithm.
11. Discuss binary search tree (BST) with suitable example.
12. Write R code to implement binary search tree (BST).
13. Write an R program to check whether the given number is a prime or not.
14. Write an R program to print a multiplication table for the given number.
15. Write code in R to print the sum of n natural numbers.
16. Discuss reserved words in R.
17. Write a program to print the factorial of a given number (use loops).
18. What is the difference between break and next? Explain with an example.
19. Explain switch statement with an example.
20. Write an R program to print the Fibonacci series.

**UNIT – 3**  
**Math and Simulation in R**

1. Discuss Math and Simulation in R.
2. Discuss various math functions in R.
3. How do you calculate probability? Explain with an example.
4. Write a short note on the following with suitable example.
  - a. Cumulative sum
  - b. Cumulative product
  - c. Maxima
  - d. Minima
5. How do you perform calculus functions in R?



6. Explain about the functions for statistical distribution.
7. Discuss sorting with suitable examples.
8. Write short note on the following with suitable examples.
  - a. `sort()`
  - b. `order()`
  - c. `rank()`
9. Describe linear algebra operations on vectors and matrices.
10. Discuss vector cross product with an example.
11. Elaborate the concept of finding stationary distribution of Markov chains with an example.
12. Discuss set operations in R.
13. How do you access the keyboard and monitor in R?
14. Briefly discuss input and output operations in R.
15. Write a brief note on `readLine()` function.
16. How do you read and write files in R?

**UNIT – 4**  
**Graphics in R**  
**(You should write R script)**

1. Write short notes on graphics in R.
2. What are the primary styles of graphics? Discuss at least three primary styles.
3. Discuss the workhorse of R base graphics.
4. Explain graphical parameters in R.
5. Explain about `plot()` function with example.
6. Draw a pie chart for the given data.
7. Draw a bar plot for the given data.
8. Draw a histogram for the given data.
9. Draw a scatter plot for the given data.
10. Write the difference between high-level and low-level graphics functions.
11. Discuss strip chart with some example.
12. Discuss saving graphs to files.
13. How do you create a polygon in R?
14. How do you draw multiple curves on the same plot?
15. Discuss box-plot with an example.
16. Draw a bar plot and use legend function.



**Basic Statistics and Probability Distributions**  
**(You should write R code after solving problem)**

1. Descriptive statistics vs. inferential statistics.
2. Briefly discuss basic statistics.
3. What is probability? Discuss probability distributions.
4. Discuss measures of central tendency.
5. Discuss measures of dispersion.
6. Calculate mean, median and mode for the given data.
7. Calculate Range, Interquartile range, variance, standard deviation for the given data.
8. Calculate coefficient of variation for the given data.
9. Discuss covariance with an example.
10. Explain correlation with an example.
11. Calculate covariance for the given data.
12. Calculate correlation for the given data.
13. Calculate correlation coefficient for the given data (use Karl Pearson's method).
14. Discuss ANOVA with an example.
15. One-way ANOVA problem.
16. Two-way ANOVA problem.
17. Discuss t-test.
18. t-test problem.
19. z-test problem
20. Binomial distribution problems.
21. Poisson distribution problems.
22. Normal distribution problems.

**Unit-5**  
**Linear Models and Non-linear Models**

**(You should write R code)**

1. Write short notes on linear models.
2. Discuss non-linear models.
3. Discuss linear regression.
4. Discuss multiple regressions.
5. Explain generalized linear models.

6. Write R script and discuss logistic regression.
7. Write R script and discuss poisson regression.
8. What is survival analysis?
9. Explain decision trees.
10. Write short notes on random forest.
11. Explain splines.
12. Fit straight line for the given data.
13. Fit parabola for the given data.
14. Fit exponential function for the given data.