Basic IT Tools

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Basic IT Tools	2	0	0	2	Class XII	NA

Learning Objectives

The Learning Objectives of this course are as follows:
- To enable students develop IT skills that are a pre-requisite in today's work environment.
- To equip them with basic computing skills that will enhance their employability in general.
- To enable the student to analyse and present information in a meaningful manner.

Learning outcomes

The Learning Outcomes of this course are as follows:
- By studying this course, students will be able to use word-processor to generate documents with appropriate formatting, layout, review and referencing.
- By studying this course, students will be able to manage data in worksheets and workbooks and analyze it using spreadsheet functions and inbuilt formulas.
- By studying this course, students will be able to draw analysis on data using spreadsheets to make decisions.
- By studying this course, students will be able to make meaningful representations of data in the form of charts and pivot tables.
- By studying this course, students will be able to manage data in database tables and use the same for generating queries, forms and reports.

SYLLABUS

Course Contents:

Unit 1: Introduction to Spreadsheets (16 hours)

Spreadsheets: Concept of worksheets and workbooks, creating, opening, closing and saving workbooks, moving, copying, inserting, deleting and renaming worksheets, working with multiple worksheets and multiple workbooks, controlling worksheet views, naming cells using name box, name create and name define; Exchanging data using clipboard, object linking and

embedding; Printing and Protecting worksheets: Adjusting margins, creating headers and footers, setting page breaks, changing orientation, creating portable documents and printing data and formulae; Implementing file level security and protecting data within the worksheet; Understanding absolute, relative and mixed referencing in formulas, referencing cells in other worksheets and workbooks, correcting common formula errors, working with inbuilt function categories like mathematical, statistical, text, lookup, information, logical, database, date and time and basic financial functions.

Unit 2: Data Analysis in Spreadsheets   (16 hours)

Consolidating worksheets and workbooks using formulae and data consolidate command; Choosing a chart type, understanding data points and data series, editing and formatting chart elements, and creating sparkline graphics, Analysing data using pivot tables: Creating, formatting and modifying a pivot table, sorting, filtering and grouping items, creating calculated field and calculated item, creating pivot table charts, producing a report with pivot tables. Introduction to recording and execution of macros.

Unit 3: Word Processing   (12 hours)

Introduction: Creating and saving your document, displaying different views, working with styles and character formatting, working with paragraph formatting techniques using indents, tabs, alignment, spacing, bullets and numbering and creating borders; Page setup and sections: Setting page margins, orientation, headers and footers, end notes and foot notes, creating section breaks and page borders; Working with tables: Creating tables, modifying table layout and design, sorting, inserting graphics in a table, table math, converting text to table and vice versa; Create newspaper columns, indexes and table of contents, Spell check your document using inbuilt and custom dictionaries, checking grammar and style , using thesaurus and finding and replacing text; Create bookmarks, captions and cross referencing, adding hyperlinks, adding sources and compiling and bibliography; Mail merge: Creating and editing your main document and data source, sorting and filtering merged documents and using merge instructions like ask, fill-in and if-then-else; Linking and embedding to keep things together.

Unit 4: Databases   (16 hours)

Introduction to Database Development: Database Terminology, Objects, Creating Tables, working with fields, understanding Data types, Changing table design, Assigning Field Properties, Setting Primary Keys, using field validation and record validation rules, Indexing, working with multiple tables, Relationships & Integrity Rules, Join Properties, Record manipulation, Sorting & Filtering; Select data with queries: Creating Query by design & by wizard (Select, Make Table, Append, Delete, Cross Tab, Update, Parameterized Query, Find Duplicate and Find Unmatched), Creating multi table queries, creating & working with table joins. Using operators & expressions: Creating simple & advance criteria; Working with forms: Creating Basic forms, working with bound, unbound and calculated controls, understanding property sheet, Working with Data on Forms: Changing Layout, creating Sub Forms, creating list box, combo box and option groups; Working with Reports: Creating Basic Reports, Creating Header & Footer, Placing Controls on reports, sorting & grouping, Creating Sub reports.

Essential/recommended readings

- Swinford, E., Dodge, M., Couch, A., Melton, B. A. (2013). Microsoft Office Professional 2013. United States: O'Reilly Media.
- Wang, W. (2018). Office 2019 For Dummies. United States: Wiley. Microsoft Lambert, J. (2019). Microsoft Word 2019 Step by Step. United States: Pearson Education.

Suggestive readings

- Jelen, B. (2013). Excel 2013 Charts and Graphs. United Kingdom: Que.
- Alexander, M., Jelen, B. (2013). Excel 2013 Pivot Table Data Crunching. United Kingdom: Pearson Education.
- Alexander, M., Kusleika, R. (2018). Access 2019 Bible. United Kingdom: Wiley.

Examination scheme and mode:

Evaluation scheme and mode will be as per the guidelines notified by the University of Delhi.

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
IT Skills and Data Analysis - I	2	0	0	2	Class XII	NIL

Learning Objectives

The primary objectives of the course will be to:
- Familiarise the student with the quantitative skills required for representing and interpreting data for the purpose of decision making.
- Equip the student with some fundamental concepts, which play a critical role in understanding and visualizing real world data.
- Enable the student to analyze data and problem situations using relevant IT tools.

Learning Outcomes

By the end of the course students will be able to

- Represent and interpret data in tabular and graphical forms
- Understand and interpret the measures of central tendency and dispersion.
- Use IT tools such as spreadsheets to visualise and analyse data.

PEDAGOGY

Relevant concepts and theory will be introduced which will be supplemented by hands-on activities enabled by the use of spreadsheets. This is a two credit course and will comprise two lecture periods per week. As this is essentially an activity-based course, it will involve two consecutive lecture periods, once in a week.

SYLLABUS
Practical

Unit I : What is Statistics ? (24 hours)

This unit provides an introduction to the fundamentals of datasets, sources of data, frequency distributions and graphical representations of data. The aim is to give students a hands-on experience of initiating data analysis through a spreadsheet.

- Concept of datasets (Variables, Observations)
  Reference 1, Chapter 2
- Different types of variables (Quantitative and Qualitative)
  Reference 1, Chapter 2
- Distinction between primary and secondary sources of data
  Reference 1, Chapter 2
- Basic idea of using questionnaire to collect primary data for analysis
  Reference 2, Chapter 1 [Section 1.6]
- How to construct a questionnaire
  Reference 1, Chapter 1
- Concept of frequency distribution: cumulative and relative frequencies
  Reference 2, Chapter 2
- Introduction to spreadsheet
  Reference 2, Chapter 2
  - Tabular and graphical presentation of data: data tables, frequency curve, histogram,bar graphs, pie charts (through the use of spreadsheets)
  Reference 2, Chapter 2

Unit II: Measures of Central Tendency and Dispersion (36 hours)

The focus of this unit will be to familiarise the student with summary statistics to describe datasets. In particular, two important characteristics of data, viz., central tendency anddispersion, will be used to summarise datasets using a spreadsheet. The concept of the Normal distribution and its characteristics will be discussed to highlight its relevance in modelling real life phenomenon.

- Measures of central tendency: mean, median, mode
  Reference 2, Chapter 3
- Examples of situations where it is appropriate to use the mean, median and mode asa measure of central tendency
  Reference 2, Chapter 3
- Weighted mean
  Reference 2, Chapter 3
- Measures of dispersion: range, variance, standard deviation
  Reference 2, Chapter 3

- Quartiles, deciles and percentiles
  Reference 2, Chapter 3
- Visualize the measures of central tendency and dispersion through frequency curveand histogram
  Reference 2, Chapter 3
  - Skewness and kurtosis
  Reference 2, Chapter 3
- Normal curve and its basic properties : visual representation of population characteristics (height, weight, IQ etc.)
  Reference 2, Chapter 5 [Section 5.6]

References (Readings and Resources)

1. Rowntree, D., Statistics without tears - A primer for non-mathematicians, Allyn and Bacon, 2018.
2. Levin, Rubin, Rastogi and Siddiqui, Statistics for Management, 7th Edn, 2014

Suggested Data Sources

The following data sets are suggested to carry out the activities
1. https://data.worldbank.org/
2. https://www.statista.com/
3. https://data.gov.in/
4. https://censusindia.gov.in/
5. https://www.kaggle.com/
6. http://data.un.org/

Weekly Plan

Weeks I and II: Students learn about the concept of datasets (Variables, Observations) ; Different type of Variables (Quantitative and Qualitative); Distinction between primary and secondary sources of data

Weeks III and IV: Basic idea of using questionnaire and how to construct a it; Concept of frequency distribution - cumulative and relative frequencies; Introduction to spreadsheet

Weeks V and VI: Tabular and graphical presentation of data: data tables, frequency curve, histogram, bar graphs, pie charts. Students to explore various representations on spreadsheet using datasets

Weeks VII and VIII: Introduction of Measures of Central Tendency: Mean, Median, Mode through appropriate examples explaining the use of each one of them in various situations. Understanding the concept of Weighted mean;

Weeks IX and X: Measures of dispersion: Range, Variance, Standard deviation; Visualizingthe measures of central tendency and dispersion through frequency curve and histogram. Understanding Quartiles, deciles and percentiles numerically.

Weeks XI and XII: Representation of population characteristics using the basic propertiesof a Normal Curve, skewness and kurtosis.

Weeks XIII and XIV: Assignments based on Units 1 and 2 using spreadsheets to consolidate the learning of concepts covered.

Examination scheme and mode:
Evaluation scheme and mode will be as per the guidelines notified by the University of Delhi.

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CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibilitycriteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
IT Skills and Data Analysis - II	2	0	0	2	Class XII	IT Skills and Data Analysis - I

Learning Objectives

The primary objectives of the course will be to
- Familiarise the student with the quantitative skills required for corelating the datafor the purpose of decision making.
- Equip the student to visualise functions which play a critical role in understandingand visualizing real world data.
- Enable the student to analyze data and problem situations using relevant IT tools.

Learning Outcomes

By the end of the course students will be able to

- Establish relationships between variables using correlation and regression analysis.
- Visualize functions and differentiate between linear and nonlinear functions.
- Use IT tools such as spreadsheets to visualise and analyse data.

PEDAGOGY

Relevant concepts and theory will be introduced which will be supplemented by hands-on activities enabled by the use of spreadsheets. This is a two credit course and will comprise two lecture periods per week. As this is essentially an activity-based course, it will involve two consecutive lecture periods, once in a week.

SYLLABUS

Unit I: Functions and their graphical representations (16 hours)

This unit introduces the graphical visualisation of functions to understand the relationship between two variables.

- Definition and graphical representation of a function, vertical line test
  Reference 3
- Polynomial functions: linear, quadratic and cubic functions
  Reference 3
- Reciprocal, exponential and logarithmic functions
  Reference 3
- Concept of slope of a function through graphical representation
  Reference 3

Unit II: Relationship between Variables (28 hours)

Students will learn about scatter diagrams and correlation analysis as a means to describe the nature and strength of association between two variables. The concept of regression analysis will be introduced as a method for quantifying the relationship between two variables. Further, multiple linear regression will be discussed for situations where more than one independent variable is needed to estimate the dependent variable. The focus will be mainly on interpreting estimated regression coefficients.

- Scatter diagrams
  Reference 2, Chapter 12
- Correlation analysis : measure and interpretation of correlation coefficient andcoefficient of determination
  Reference 2, Chapter 12
- Hypotheses, model specification and testing
  Reference 2, Chapter 12
- Bi-variate regression analysis: method of least squares, curve of best fit as a modelfor prediction
  Reference 2,
  Chapter 12
- Multiple Linear Regression
  Reference 2,
  Chapter 13

Weeks 12 – 14: Project Presentations and Viva (16 hours)

References (Readings and Resources)

1. Rowntree, D., Statistics without tears - A primer for non-mathematicians, Allyn andBacon, 2018.

2. Levin, Rubin, Rastogi and Siddiqui, Statistics for Management, 7th Edn, 2014
3. Boundless Algebra : https://courses.lumenlearning.com/boundless-algebra/

Suggested Data Sources
The following data sets are suggested to carry out the activities
1. https://data.worldbank.org/
2. https://www.statista.com/
3. https://data.gov.in/
4. https://censusindia.gov.in/
5. https://www.kaggle.com/
6. http://data.un.org/

Weekly Plan

Weeks I and II: Understanding the definition of a function; graphical representation of a function and vertical line test; visualising various kinds of functions (Linear, quadratic andcubic functions)

Weeks III and IV: Reciprocal, exponential and logarithmic functions; Interpretingandvisualising the concept of slope of a function through graphical representations.

Weeks V and VI: Scatter Diagrams; Correlation analysis - measure and interpretationofcorrelation coefficient and coefficient of determination.

Weeks VII to IX: Hypotheses, model specification and testing; Understanding Bi- variateRegression analysis: Method of Least Squares; Curve of best fit as a model forprediction.

Weeks X and XI: Multiple Regression Analysis

Weeks XII to XIV: Project Presentations and Viva

Examination scheme and mode:
Evaluation scheme and mode will be as per the guidelines notified by the University of Delhi.

DOCUMENT PREPARATION & PRESENTATION SOFTWARE

Credit distribution, Eligibility and Prerequisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	**Tutorial**	**Practical/ Practice**		
Document Preparation & Presentation Software	2	0	0	2	Class XII	NIL

Learning Objectives:

- To develop proficiency in the use of document preparation software such as document LaTeX, LibreOffice.
- To make a presentation using LaTeX, LibreOffice.
- To serve as a tool for conveying/communicating one's ideas, views, and observations.

Learning Outcomes

On completion of the course, a student will be able to

- Create a text document using LaTeX using a standard template.
- Incorporate well-formatted mathematical equations, algorithms, figures, tables and references in a document.
- Use Zotero for reference management.
- Format text, including alignment, emphasis and fonts.
- Handle basic aspects of document structure, including sections, subsections, paragraphs, and bulleted and enumerated lists.
- Page set a document including header, footer, and page numbering. Make a presentation.

Practical
Unit 1: Introduction **(4 Hours)**
1. Create a LaTeX/ LibreOffice document having several paragraphs, including comments in LaTeX.
2. Organize content into sections, including preface/abstract. Using the article and book class of LaTeX. Handling errors.

Unit 2: Styling Pages **(6 Hours)**
1. Loading and using packages, setting margins, header and footer, and page orientation.
2. Organizing the document into multiple columns

Unit 3: Formatting Content **(10 Hours)**
1. Formatting text (styles, size, alignment)
2. Adding colours to a block of text/ page
3. Adding ordered and unordered lists
4. Inserting mathematical expressions – subscripts, superscripts, fractions, binomials, aligning equations, operators, Greek and mathematical symbols, and mathematical fonts.

Unit 4: Tables and Figures **(10 Hours)**
1. Create basic tables
2. Adding different types of borders to a table
3. Merging rows and columns
4. Splitting tables across multiple pages.
5. Incorporating figures and subfigures, explore different properties like rotation and scaling.

Unit 5: Algorithms and Equations **(12 hours)**
1. Incorporating algorithms, body typesetting, organizing algorithms across multiple pages.
2. Incorporating equations, indentation, and captioning.

Unit 6: Referencing and Indexing **(6 hours)**
1. Insert captions, labels, and references
2. Incorporate cross-referencing (refer to sections, table, and images)
3. Incorporate a bibliography
4. Create a back index.

Unit 7: Making Presentations **(12 hours)**
1. Create a slideshow
2. Incorporate logo
3. Highlight important points
4. Create a title page
5. Make a table of contents
6. Incorporate special effects in a slideshow.

Exercises:
For the following figures, create LaTex documents using concepts from above:

1.

<div align="center">

Hello World!

Prof. Naveen Kumar

November 15, 2022

</div>

Hello World! Today I am learning LaTeX. LaTeX is a great program for writing math. I can write in line math such as $a^2 + b^2 = c^2$. I can also give equations their own space:

$$\gamma^2 + \theta^2 = \omega^2$$

2.

<div align="center">

Integrals, Sums and Limits

Dr. Neeraj Kumar Sharma

</div>

1 Integrals

Integral $\int_a^b x^2 dx$ inside text.

The same integral on display:

$$\int_a^b x^2 \, dx$$

and multiple integrals:

$$\iint_V \mu(u,v) \, du \, dv$$

$$\iiint_V \mu(u,v,w) \, du \, dv \, dw$$

$$\oint_V f(s) \, ds$$

2 Sums and products

Sum $\sum_{n=1}^{\infty} 2^{-n} = 1$ inside text.
The same sum on display:

$$\sum_{n=1}^{\infty} 2^{-n} = 1$$

Product $\prod_{i=a}^{b} f(i)$ inside text.
The same product on display:

$$\prod_{i=a}^{b} f(i)$$

3 Limits

Limit $\lim_{x \to \infty} f(x)$ inside text.
The same limit on display:

$$\lim_{x \to \infty} f(x)$$

3.

<div align="center">

Equations

Prof. Naveen Kumar[1], Dr. Neeraj Kumar Sharma[2], and Sakeena Shahid[3]

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[1]Department of Computer Science, University of Delhi
[2]Ram Lal Anand College, University of Delhi
[3]SGTB Khalsa College, University of Delhi

<div align="center">

November 15, 2022

</div>

1 Maxwell's Equations

"Maxwell's equations" are named for James Clark Maxwell and are as follow:

$$\vec{\nabla} \cdot \vec{E} = \frac{\rho}{\epsilon_0} \qquad \text{Gauss's Law} \tag{1}$$

$$\vec{\nabla} \cdot \vec{B} = 0 \qquad \text{Gauss's Law for Magnetism} \tag{2}$$

$$\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t} \qquad \text{Faraday's Law of Induction} \tag{3}$$

$$\vec{\nabla} \times \vec{B} = \mu_0 \left(\epsilon_0 \frac{\partial \vec{E}}{\partial t} + \vec{J} \right) \qquad \text{Ampere's Circuital Law} \tag{4}$$

Equations 1, 2, 3, and 4 are some of the most important in Physics.

2 Matrix Equations

$$\begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{pmatrix} \begin{bmatrix} v_1 \\ v_2 \\ \vdots \\ v_n \end{bmatrix} = \begin{matrix} w_1 \\ w_2 \\ \vdots \\ w_n \end{matrix}$$

4.

<div align="center">

List of mathematical functions:

</div>

- Trigonometric functions

  - sine

  - cosine

  - tangent

- Special functions

  - Beta function

  - Gamma function

  - Riemann zeta function

5. Add the following algorithm to the document.

<div align="center">

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</div>

Algorithm 1: Example code

Input: Your Input
Output: Your output
Data: Testing set x

```
1  ∑_{i=1}^{∞} := 0                                      // this is a comment
   /* Now this is an if...else conditional loop           */
2  if Condition 1 then
3  |   Do something                                      // this is another comment
4  |   if sub-Condition then
5  |   |   Do a lot
6  else if Condition 2 then
7  |   Do Otherwise
   |   /* Now this is a for loop                          */
8  |   for sequence do
9  |   |   loop instructions
10 else
11 |   Do the rest
   /* Now this is a While loop                            */
12 while Condition do
13 |   Do something
```

6.

col1	col2	col3
Multiple row	cell2	cell3
	cell5	cell6
	cell8	cell9

7.

Country List		
Country Name or Area Name	ISO ALPHA 2 Code	ISO ALPHA 3
Afghanistan	AF	AFG
Aland Islands	AX	ALA
Albania	AL	ALB
Algeria	DZ	DZA
American Samoa	AS	ASM
Andorra	AD	AND
Angola	AO	AGO

8. Insert four sub-figures as given below, and add captions. Also, refer to these sub-figures in the text.

(a) Subfigure 1 caption

(b) Subfigure 2 caption

(c) Subfigure 3 caption
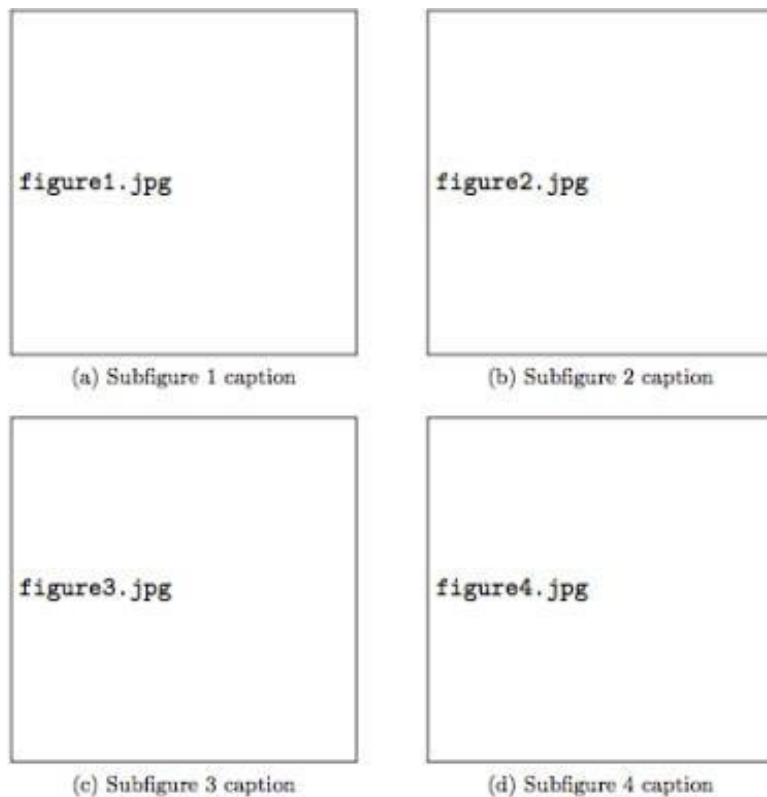
(d) Subfigure 4 caption

Figure 1: This is a figure containing several subfigures.

In the text, you can refer to subfigures of figure 1 as 1a, 1b, 1c and 1d and to the sub-index as (a), (b), (c) and (d).

9. Add a table of contents, a list of figures, and a list of tables in the document as given below.

Contents

List of Tables

List of Figures

10. Add a list of references in the document as given below and cite them in the text.

This document is an example of `natbib` package using in bibliography management. Three items are cited: *The LaTeX Companion* book [2], the Einstein journal paper Einstein [1], and the Donald Knuth's website [3]. The LaTeX related items are [2, 3].

References

[1] A. Einstein. Zur Elektrodynamik bewegter Körper. (German) [On the electrodynamics of moving bodies]. *Annalen der Physik*, 322(10):891–921, 1905. doi: http://dx.doi.org/10.1002/andp.19053221004.

[2] M. Goossens, F. Mittelbach, and A. Samarin. *The LaTeX Companion*. Addison-Wesley, Reading, Massachusetts, 1993.

[3] D. Knuth. Knuth: Computers and typesetting. URL http://www-cs-faculty.stanford.edu/~uno/abcde.html.

Examination scheme and mode:
Evaluation scheme and mode will be as per the guidelines notified by the University of Delhi.

LaTeX TYPESETTING FOR BEGINNERS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
LaTeX Typesetting for Beginners	2	0	0	2	Class XII	NIL

Learning Objectives: The objective of this course is to introduce:
- LaTeX, a high-quality open-source typesetting software that produces professional prints and PDF files for research articles and books in all subjects, and languages.
- Typesetting in Indian languages using LaTeX by transliteration and ITRANS packages.

Learning Outcomes: After completion of the course the learner will be able to:
- Prepare a LaTeX document with title page including contents, references, and index.
- Understand the Indian language transliteration package (ITRANS-processor) for typesetting Sanskrit, Hindi, Punjabi, Malayalam, etc. using LaTeX.

UNIT-I: Getting Started with LaTeX   (24 hours)
Installing and using LaTeX for creating a first LaTeX document; Formatting text and understanding LaTeX commands and environments; Designing pages, Creating a book with chapters and table of contents, Creating and customizing lists, Including images, and creating tables with captions.

UNIT-II: Cross-References, Index, Bibliography and Large Documents   (16 hours)
Setting labels and references, Hyperlinks; Customizing the table of contents, Generating an index, Creating a bibliography; Writing basic math formulas and equations; Developing large documents by splitting the input and creating front/back matter.

UNIT-III: Typesetting in Indian Languages using LaTeX   (20 hours)
Transliteration symbols with illustrative examples of the Indian languages, such as Sanskrit, Hindi (Devanagari), Punjabi, and Malayalam; Creation of the transliterated document for typesetting in Devanagari (for Sanskrit, Hindi, and Marathi), Gurumukhi (for Punjabi), and Rachana (for Malayalam); ITRANS pre-processor package to convert English-encoded text into various Indian language script such as Gujarati, Bengali, Kannada, Tamil, Telugu, etc.

Essential Readings
1. Kottwitz, Stefan (2021). LaTeX Beginner's Guide (2nd ed.). Packet Publishing Ltd.
2. Nambudiripad, K.B.M. (2014). LaTeX for Beginners. Narosa Publishing House, Delhi.
3. https://ctan.org/pkg/devanagari; https://www.ctan.org/pkg/gurmukhi-singh
4. https://ctan.org/tex-archive/language/indian/itrans

Suggested Reading
- Lamport, Leslie (1994). LaTeX: A Document Preparation System, User's Guide and Reference Manual (2nd ed.). Pearson Education. Indian Reprint.

Practical Exercises: Getting started with free open-source software LaTeX for typesetting documents from chapter 1 of the text book [1]: LaTeX Beginner's Guide (2nd ed.) by Stefan Kottwitz for installing and using LaTeX. Learners are required to:

- Design a LaTeX document by choosing title, author, date, address, page dimensions, margins, adjust line spacing, add footnotes, and orientation.
- Create a document with bulleted lists, numbered lists, and definition lists. Furthermore, modify the document with compact and customized versions of such lists, including spacing adjustments and interrupting and resuming.
- Create tables, adding captions to tables, putting text into columns, spanning columns and rows, using LaTeX packages to auto-fit columns.
- Generate a document by customizing the table of contents, lists of figures and tables, producing an index pointing to relevant information for keywords and phrases.
- Typesetting fine-tune math expressions, align and number equations, and use various math symbols from the amsmath package in LaTeX.
- Generate a list of five books related to your field of interest under an automatically generated title 'Bibliography', using thebibliography command in LaTeX. Illustrate how these references are cited in the body of a document.
- Create a LaTeX file to manage large documents consisting of several LaTeX files by splitting the input, including front and back matter and a separate title page.
- Transliterate these six names: Aryabhata, Arthashastra, Bhaskaracharya, Chanakya, Ganita Bharati, and Shankaracharya, and write them in itemize form using Devanagari package in LaTeX. Also use the verbatim environment to display the LaTeX code.
- Typeset ten words of your choice using ITRANS pre-processor package in LaTeX to convert English-encoded text into any one Indian language script.

Teaching Plan (SEC Paper: LaTeX Typesetting for Beginners)

Week 1: Installing and using LaTeX for creating a first LaTeX document. **[1]**: **Chapter 1**.
Week 2: Formatting text and understanding LaTeX commands and environments. [1]: **Chapter 2**.
Week 3: Designing pages, Creating a book with chapters and table of contents. [1]: **Chapter 3**.
Week 4: Creating and customizing lists. [1]: **Chapter 4**.
Week 5: Including images. [1]: **Chapter 5**.
Week 6: Creating tables with captions. [1]: **Chapter 6**.
Week 7: Setting labels and references, Hyperlinks. [1]: **Chapter 7**.
Week 8: Customizing the table of contents, Generating an index, Creating a bibliography. [1]: **Chapter 8**.
Week 9: Writing basic math formulas and equations. [1]: **Chapter 9**.
Week 10: Developing large documents by splitting the input and creating front/back matter. [1]: **Chapter 11**.
Weeks 11, and 12: Transliteration symbols with illustrative examples of the Indian languages, such as Sanskrit, Hindi (Devanagari), Punjabi, and Malayalam. [2]: **Chapter 9**; and **gurmukhi**
Weeks 13, and 14: Creation of transliterated document for typesetting in Devanagari (Sanskrit, Hindi and Marathi), Gurumukhi (Punjabi), and Rachana (Malayalam). [2]: **Chapter 10**; [3]: **Devanagari**, and **Gurmukhi**.
Week 15: ITRANS pre-processor package to convert English-encoded text into various Indian language script such as Gujarati, Bengali, Kannada, Tamil, Telugu, etc. [4]: **Itrans: Indian languages**

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Mathematical Modeling with Excel	2	0	0	2	Class XII pass with Mathematics	NIL

Learning Objectives: The objective of this course is to introduce:
- The importance and significance of assumptions behind a mathematical model.
- The long–term behavior of discrete dynamical systems numerically and graphically.
- Monte Carlo simulations with real-life examples.
- Linear programming, transportation, assignment and traveling salesman problems.

Learning Outcomes: After completion of the course the learner will be able to:
- Understand the purpose and process of mathematical modeling.
- Model different scenarios with linear discrete dynamical systems.
- Formulate and solve LP, transportation and assignment problems using Excel Solver.

UNIT-I: Modeling with Proportionality and Geometric Similarity   (20 hours)
Definition, purpose, process, assumptions, and examples of mathematical modeling; Charts in excel using given data, Modeling with proportionality: Population growth, Radioactive decay, and Free-falling object; Fitting straight lines analytically, Geometric similarity, and Linearizable models.

UNIT-II: Discrete-time Models   (16 hours)
Discrete dynamical system concepts and examples; Long-term behavior and equilibria, Discrete logistic equation, Linear predator-prey model, SIR model of epidemics, SIS model.

UNIT-III: Simulations and Linear Optimization   (24 hours)
Monte Carlo simulation: Flipping a coin, Area under a curve, Car dealership contest, and the birthday problem; Formulation of linear programming, transportation and assignment problems and their solutions using Excel Solver tool; Traveling salesman problem.

Essential Reading
1. Albright, Brian, & Fox, William P. (2020). Mathematical Modeling with Excel (2nd ed.). CRC Press, Taylor & Francis Group.

Suggested Reading
- Giordano, Frank R., Fox, William P., & Horton, Steven B. (2014). A First Course in Mathematical Modeling (5th ed.). CENGAGE Learning India.

Practical Exercises: Practical work to be performed using Excel spreadsheets for the modeling of the following type of problems:

- The data given below measures shoe length (to the nearest quarter of an inch) and height (to the nearest half inch) of ten persons, to determine if there is a relationship between shoe length and height of a person. Graph Height vs. Shoe Length and fit a straight line to the data. How well does this model fit the data?

Shoe Length	9	10	10.5	11	11.5	11.75	12	12.5	12.75	13
Height	62	64	64.5	69	70	73	72	75	74	77

- The table below contains the total length and weight of 10 black bears. Graph weight vs. length, fit different linearizable models to the data, and select the one that best fits the data. Explain.

Length	139	138	139	120.5	149	141	150	166	180	129.5
Weight	110	60	90	60	85	95	85	155	220	105

- The table below contains data on the population of foxes in a forest over a period of several years. Fit a discrete logistic equation to the data. How well does the model fit the data?

n	0	1	2	3	4	5	6	7	8	9	10
a_n	50	85	110	130	175	200	215	221	228	232	234

- Consider a disease such as the common cold where a person is *not* immune once they are 'healed.' Once healed, a person becomes susceptible again. Such a disease could be modeled with an SIS model. Implement your model in an Excel worksheet to describe the spread of the common cold through a population of 1,000 where initially 4 people have the cold and assuming that the cold lasts an average of 2 weeks (use α = 0.00167). What do you observe?
- Random number generation in Excel and then use it to simulate area under a given curve.
- An automobile repair company performs paint-less dent removal from hail damaged cars and trucks. Each vehicle must be processed in both the body assembly shop and the finishing shop. In the body shop it takes 0.5 man-hours to repair a car and 0.5 man-hours to repair a truck. There are 25 body shop man-hours available per day. In the finishing shop it takes 0.4 man-hours to finish a car and 0.6 man-hours to finish a truck. There are 24 finishing man hours available per day. Each car contributes Rs. 20000 to overall profit, and each truck contributes Rs. 22500 to overall profit. Find number of cars & trucks the company can service a day to maximize overall profit, using Solver.

Teaching Plan (SEC Paper: Mathematical Modeling with Excel)

Week 1: Definition, purpose, process, assumptions, and examples of mathematical modeling; [1]:Chapter 1.
Week 2: Charts in excel using given data. [1]: Chapter 2 (Sections 2.1, and 2.2).
Week 3: Modeling with proportionality: Population growth, Radioactive decay, and Free-falling object. [1]: Chapter 2 (Section 2.3).
Weeks 4 and 5: Fitting straight lines analytically, Geometric similarity, and Linearizable models. [1]: Chapter 2 (Sections 2.4 to 2.6).
Weeks 6, and 7: Discrete dynamical system concepts and examples; Long-term behavior and equilibria, Discrete logistic equation. [1]: Chapter 4 (Sections 4.1 to 4.3).
Weeks 8, and 9: Linear predator-prey model, SIR model of epidemics, and SIS model. [1]: Chapter 4 (Sections 4.4, and 4.6).
Weeks 10, and 11: Monte Carlo simulation: Flipping a coin, Area under a curve, Car dealership contest, and the birthday problem. [1]: Chapter 6 (Section 6.2), and Section 6.3 (Example 6.3.2 and Exercise 6.3.4 only).
Weeks 12 to 14: Formulation of linear programming, transportation and assignment problems and their solutions using Excel Solver tool. [1]: Chapter 7 (Sections 7.2 to 7.4).
Week 15: Traveling salesman problem. [1]: Chapter 8 (Section 8.8).

FINANCIAL MODELING WITH EXCEL

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Financial Modeling with Excel	2	0	0	2	Class XII	NIL

Learning Objectives: The objective of this course is to:
- Build financial models using Excel functions to solve some real-life financial problems.
- Acquire practical skills and knowledge that are useful for investment banking.

Learning Outcomes: After completion of the course the learner will be able to:
- Compute present value and future value of a cashflow or annuity.
- Create loans and amortization tables, and find price, yield, and duration of a bond.
- Draw option payoff diagrams and option strategy diagrams.
- Find option price using Black-Scholes, and binomial models.

UNIT-I: Time Value of Money   (28 hours)
Building good financial models, Interest rates, Future value, Present value, Annuity, Perpetuity, Present value of an annuity, Present value of a perpetuity, Present value of non-annuity cash flows; Net present value (NPV), Internal rate of return (IRR), NPV vs IRR; Loans and amortization tables, Interest-only loan, An equal amortization term loan, Mortgage; Effective interest rates, Cost of a mortgage, Continuous compounding and discounting.

UNIT-II: Bond Pricing and Duration   (12 hours)
Characteristics of bonds, Zero-coupon bond, Bond valuation, Yield to maturity, Yield curve and forward rates; Macaulay duration, Modified duration, and convexity.

UNIT-III: Options, Black-Scholes, and Binomial Models   (20 hours)
Call and put options, Option strategies, Put-call parity, Black-Scholes formulae for prices of call and put options; Binomial option pricing model, and two-period binomial model.

Essential Readings
1. Benninga, Simon & Mofkadi, Tal (2018). Principles of Finance with Excel (3rd ed.). Oxford University Press, New York.
2. Sengupta, Chandan (2004). Financial Modeling using Excel and VBA. John Wiley.

Suggested Readings
- Day, Alastair L. (2015). Mastering Financial Mathematics in Microsoft Excel (3rd ed.). Pearson Education Ltd.
- Luenberger, David G. (2014). Investment Science (2nd ed.). Oxford University Press.

Practical Exercises: Review of Excel spreadsheets concepts including functions and graphs from [1]: Part Five Excel Skills. Practical work to be performed using Excel spreadsheets for the modeling of the following type of problems:

1. Calculating future value, present value, and present value of an annuity. Use of Excel functions **FV**, **PV, NPV, and PMT**. [1]: Chapter 2, Exercises 1,3,5, and 7 pages 46-47.
2. Calculating net-present value (NPV) and internal rate of return (IRR). NPV vs IRR. Use of Excel functions **NPV** and **IRR.** [1]: Chapter 3, Exercises 1 to 3 pages 99-100.
3. Creating loan and amortization table. Use of Excel functions **IPMT** and **PPMT**. [1]: Chapter 4, Exercises 1 to 3 pages 132-133.
4. Computing effective annual interest rate (EAIR), using function **IRR**, and **XIRR** (for dates, not evenly spaced). [1]: Chapter 5, Exercises 1, 4, 7, and 9 pages 169-171.
5. Calculating bond price and yield to maturity (YTM) of a bond. Use of Excel functions **PRICE**, **YIELD**, **IRR**, and **XIRR** (for non-periodic cash flows). [2]: Models 2, and 3 pages 276-279.
6. Computing duration, modified duration, and convexity of a bond. Use of Excel functions **DURATION,** and **MDURATION.** [2]: Models 4, and 5 pages 280-284.
7. Computing payoffs of call and put options, and draw profit diagrams in Excel. [1]: Chapter 17, Exercises 1 to 4 pages 572-574.
8. Studying and comparing option strategies: Bear spread, Bull spread, and Butterfly spread, and draw corresponding profit diagrams in Excel. [1]: Chapter 17, Exercises 18, 19, and 21 pages 581-583.
9. Using Black-Scholes formulae to find prices of call and put options. [1]: Chapter 19, Exercises 1 to 4 page 626.
10. Using binomial model to find prices of call and put options, and Excel tree diagram. [1]: Chapter 20, Exercises 3 to 5 page 653.

Teaching Plan (SEC Paper: Financial Modeling with Excel)

Week 1: Excel Skills, Building good financial models.
[1]: Review of Excel basics and functions from Chapters 21 to 23, and Chapter 1(Section 1.4).
Week 2: Interest rates, Future value. [1]: Chapter 2 (Section 2.1).
Weeks 3, and 4: Present value, Annuity, Perpetuity, Present value of an annuity, Present value of a perpetuity, Present value of non-annuity cash flows. [1]: Chapter 2 (Section 2.2).
Week 5: Net present value (NPV), Internal rate of return (IRR), NPV vs IRR.[1]: Chapter 3 (3.1 to 3.3).
Week 6: Loans and amortization tables, Interest-only loan, An equal amortization term loan, Mortgage. [1]: Chapter 4 (Sections 4.2 to 4.5).
Week 7: Effective interest rates, Cost of a mortgage, Continuous compounding and discounting. [1]: Chapter 5 (Sections 5.1, 5.2, and 5.7).
Weeks 8 to 10: Characteristics of bonds, Zero-coupon bond, Bond valuation, Yield, Yield curve and forward rates; Macaulay duration, Modified duration, and convexity. **[2]**: Chapter 10.
Weeks 11 to 13: Call and put options, Option strategies, Put-call parity. [1]: Chapter 17, and Chapter 18 (Section 18.3, and Exercises 4 to 6, page 602).
Week 14: Black-Scholes formulae for prices of call and put options. [1]: Chapter 19 (Section 19.1).
Week 15: Binomial option pricing model, Two-period binomial model. [1]: Chapter 20 (20.1 to 20.3).

NETWORK FLOWS

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Network Flows	2	0	0	2	Class XII	NIL

Learning Objectives: The objective of this course is to:
- Introduce the transportation and assignment problems as network models.
- Learn more about network optimization models and describe the characteristics of various network flow problems.
- Understand the critical path method (CPM) designed to assist in the planning, scheduling, and control of projects.

Learning Outcomes: After completion of the course the learner will be able to:
- Formulate and solve transportation and assignment problems using Excel.
- Understand the network flow problem of types - shortest-path problem, minimum spanning tree problem, maximum flow, and minimum cost flow problems, and their optimum solutions using Excel spreadsheet.
- Apply the critical path method (CPM) of time-cost trade-offs for project management.

UNIT-I: Transportation and Assignment Problems   (20 hours)
Network representation of the transportation and assignment problems, Formulate transportation and assignment problems, and solve using Excel.

UNIT-II: Network Optimization Models   (24 hours)
Terminology of networks; Formulate and use Excel to solve shortest-path, minimum spanning tree, maximum flow, and minimum cost flow problems; Critical path method (CPM) of time-cost trade-offs using Excel spreadsheet.

UNIT-III: Case Studies   (16 hours)
Shipping wood to market, Project pickings, Money in motion, Steps to success.

Essential Reading
1. Hillier, Frederick S., & Lieberman, Gerald J. (2021). Introduction to Operations Research, (11th ed.). McGraw-Hill Education.

Suggested Readings
- Ragsdale, Cliff T. (2022). Spreadsheet Modeling and Decision Analysis: A Practical Introduction to Business Analytics (9th ed.). CENGAGE Learning.
- Taha, Hamdy A. (2017). Operations Research: An Introduction (10th ed.). Pearson Education Limited.

Practical Exercises: Use Excel spreadsheet to solve transportation, and assignment problems, shortest-path problem, maximum flow problem, minimum cost flow problem, and CPM calculations of following type of exercises from the chapters 9 and 10 of [1].

- 9.1-1, 9.3-1, Case 9.1 (Shipping Wood to Market), and Case 9.3 (Project Pickings).
- 10.3-2, 10.3-6, 10.5-3, 10.6-5, 10.8-1, Case 10.1 (Money in motion), and Case 10.3 (Steps to success).

Teaching Plan (SEC Paper: Network Flows)

Weeks 1 to 5: Network representation of the transportation and assignment problems, Formulate transportation and assignment problems, and solve using Excel.
[1]: Chapter 9 (Sections 9.1, and 9.3).
Weeks 6, and 7: Terminology of networks, Formulate and use Excel to solve Shortest-path problem.
[1]: Chapter 10 (Sections 10.2, and 10.3).
Week 8: The minimum spanning tree problem. [1]: Chapter 10 (Section 10.4).
Weeks 9, and 10: Formulate maximum flow, and minimum cost flow problems and solve using Excel.
[1]: Chapter 10 [Sections 10.5, and 10.6 (including special cases fit into the network format of the minimum cost flow problems, pages 388-390)].
Week 11: Critical path method (CPM) of time-cost trade-offs using Excel spreadsheet.
[1]: Chapter 10 (Section 10.8).
Week 12: Shipping wood to market. [1]: Chapter 9 (Case 9.1).
Week 13: Project pickings. [1]: Chapter 9 (**Case 9.3**).
Week 14: Money in motion. [1]: Chapter 10 (Case 10.1).
Week 15: Steps to success. [1]: Chapter 10 (**Case 10.3**).

R-SHINY: POWERFUL WEB APPS FOR EVERYONE

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
R-Shiny: Powerful Web Apps for Everyone	2	0	0	2	Class XII	NIL

Learning Objectives: The objective of this course is to:
- Build interactive web applications for charts, tables, graphs, and maps using R Shiny.
- Create, develop, and deploy Shiny web applications using reactive components.
- Customize the appearance of Shiny web apps using Shiny in R Markdown.

Learning Outcomes: After completion of the course the learner will be able to:
- Understand the fundamentals of Shiny and develop interactive web applications.
- Understand reactive programming concepts and building reactive web applications.
- Learn R Markdown and deploy Shiny apps locally and to the web with flexdashboard.

UNIT-I: Introduction to Shiny and Basic User Interface (UI) components   (20 hours)
What is Shiny? How Shiny works with R; Create Shiny app directory and file, Adding UI controls, and behaviour; Building the UI using the fluidPage(), Input, and Output functions, and deploy Shiny apps locally using server function.

UNIT-II: Reactive Programming in Shiny   (20 hours)
Basic reactivity: The server function and creating reactive outputs using Shiny's render functions, Reactive programming, Reactive graph, and reactive expressions.

UNIT-III: Shiny in R Markdown   (20 hours)
R Markdown: Installation, Basics**,** Shiny with flexdashboard**,** Building Shiny documents by adding the option 'runtime: shiny' to the YAML metadata; Deploy Shiny apps to the web, Embedded Shiny apps, and Shiny widgets.

Essential Readings
1. Wickham, Hadley (2021). Mastering Shiny: Building Interactive Apps, Reports, and Dashboards Powered by R. O'Reilly Media. (https://mastering-shiny.org/)
2. https://shiny.rstudio.com/tutorial/
3. Xie, Yihui, Allaire, J.J, & Grolemund, Garrett (2019). R Markdown: The Definitive Guide. CRC Press, Taylor & Francis Group. (https://bookdown.org/yihui/rmarkdown/)

Suggested Reading
- Granjon, David (2022). Outstanding User Interfaces with Shiny. CRC Press.

Practical Exercises: Practice exercises from first three chapters of Hadley's Mastering Shiny.

Teaching Plan (SEC Paper: R-Shiny: Powerful Web Apps for Everyone)

Weeks 1, and 2: What is Shiny? How Shiny works with R; Create Shiny app directory and file, Adding UI controls, and behaviour. **[1]**: Preface, and Chapter 1.

[2]: Welcome to Shiny: **Lesson1**, and **getting started**

Weeks 3 to 5: Basic UI: Building the UI using the fluidPage(), Input, and Output functions, and deploy Shiny apps locally using server function. [1]: Chapter 2

[2]: Build a UI and control widgets: **Lesson2**, and **Lesson3**

[2]: **User Interface and server function**

Weeks 6 to 8: Basic reactivity: The server function and creating reactive outputs using Shiny's render functions. [1]: Chapter 3 (pages 27-30); [2]: Reactive output: **Lesson4**

[2]: **Reactive Flow**, and **Reactive Elements**

Weeks 9, and 10: Reactive programming, Reactive graph, and reactive expressions.

[1]: Chapter 3 (pages 30-35).

[2]: Reactive expressions: **Lesson6**

Weeks 11, and 12: R Markdown: Installation, Basics, Shiny with flexdashboard.

[3]: Chapter 1, Chapter 2 (p. 5-8, and section 2.8.2, p. 42-45), Chapter 5 (Section 5.3, p. 131-135).

Weeks 13 to 15: Building Shiny documents by adding the option 'runtime: shiny' to the YAML metadata; Deploy Shiny apps to the web, Embedded Shiny apps, and Shiny widgets.

[3]: Chapter 19 (Sections 19.1 to 19.4, pages 283-293); [2]: Share Shiny Apps: **Lesson7**

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	**Tutorial**	**Practical/ Practice**		
Statistics with R	2	0	0	2	Class XII	Basic course in Statistics

Learning Objectives

The Learning Objectives of this course are as follows:
- To enable students to handle data in the R software thereby helping them to understand meaningful statistical analysis performed on the data.
- To enable students to extract data, and perform basic statistical operations entailing data analysis such as – data cleaning, data visualisation, data summarisation, and regression amongst others.

Learning outcomes

The Learning Outcomes of this course are as follows:
- After studying this course, students will be able to extract and Read data into R, manipulate, and analyse it
- After studying this course, students will be able Tto debug, organize, and comment R code
- After studying this course, students will be able to understand the R environment for downloading, installing, and using packages
- After studying this course, students will be able to do basic programming to write own functions
- After studying this course, students will be able to use loops
- After studying this course, students will be able to create standard and customized graphics
- After studying this course, students will be able to perform basic statistical operations and regression.

SYLLABUS

Unit 1: Data Extraction and Spread Sheet Exploration   **(12 hours)**
Extraction of economics and financial data from Prowessiq, RBI, IMF, World bank or an equivalent financial/economic database. The students should be able to save and export the data to 'R-environment' for further analysis.

Unit 2: Basics of R-language   (28 hours)

Overview of the R language: Installing R and R Studio : Using R studio, Scripts, Text editors for R, Graphical User Interfaces (GUIs) for R, Creating and storing R workspaces, installing packages and libraries, Mathematical operations.

Data Types in R – Numeric, Integer, Character, Logical, Complex and missing data. Data Structures in R

- Vectors – Creation, Arithmetic operations of Vectors, Vector Sub setting, Sorting and Sequencing functions.
- Matrix and Arrays – Creation, Arithmetic Operations of matrix, Sub setting, Use of Drop Function.
- Factors – Converting a vector into factor, assigning levels and labels, ordered Factor.

- List – Creating a list, accessing elements from a list, adding a new element and eliminating an existing element form the list, converting list to vectors.
- Data Frames – Creation of Data Frame, adding new columns, rows and removing columns, accessing column using the $ sign, importing a data set (important file formats such as csv, txt and spreadsheet), aggregate function and subsetting of dataframes, tapply function, manipulation using dplyr package (select, filter, arrange, mutate and group by function, pipe operator).

Programming Fundamentals: Logical operators, conditional statements (if, else, else if statements in R), While loops, For loops, repeat loops.

Creating functions in R.

Reading data in R (file formats such as csv, txt, and xlsx), Writing data to external files (file formats such as csv, txt, and xlsx), writing a table to a file, print function.

Unit 3: Basic Statistics and Regression   (20 hours)

Summarizing and exploring data: Descriptive statistics (mean, median, mode, variance, skewness, five-point summary), dealing with missing data in R, Data cleaning (dplyr package, tidyr package and pipe operator), Exploratory Data Analysis; data visualization using inbuilt functions and ggplot2 package (pie chart, bar chart, line chart, histogram, box plot, scatter plot, Normal QQ plot).

Regression analysis using R: Regression vs Correlation, Simple and multiple regression, Ordinary least square, Assumptions of classical normal linear regression model (CNLRM), corrplot package, car package, lmtest package, scatter plot (using plot function and ggplot2 package) to understand the relationship between variables, lm, abline, predict, resid function, interpreting 'summary table' of the regression model, normality of residuals (qqnorm and qqPlot functions), multicollinearity (correlation matrix, corrplot and vif function), autocorrelation (acf plot and Durbin Watson test), heteroscedasticity (graphically, bptest, ncvTest), impact on estimates and inferences in case of violations of assumptions of CNLRM, methods to take care of violations.

Time series data, components of a time series data, additive and multiplicative time series model, ts function, diff function, plot of a time series data, time series data with linear trend; regression analysis using 'lm' function, stationarity in time series (concept only).

Essential/recommended readings

- Gardener, M. (2018), Beginning R: The Statistical Programming Language, Wiley & Sons.
- Sekhar, S.R.M., et al. (2017), Programming with R, Cengage Learning India.
- Wickham, H., et al. (2017), R for Data Science: Import, Tidy, Transform, Visualize, and Model Data, O'Reilly'.
- Field, A., Miles, J and Field (2012), Z. Discovering Statistics using R (Indian Reprint 2022), SAGE
- SimpleR - Using R for Introductory Statistics: John Verzani.
- The R Guide.
- Analysis of Epidemiological Data Using R and Epicalc: Virasakdi Chongsuvivatwong.

- Statistics Using R with Biological Examples: Kim Seefeld and Ernst Linder.
- An Introduction to R: Software for Statistical Modeling & Computing: Petra Kuhnert and Bill Venables.
- Gujarati, D.N. et al (2018), Basic Econometrics, McGraw Hill India, 5th Ed.
- CRAN website: https://cran.r-project.org/
- https://prowessiq.cmie.com,
- https://data.worldbank.org/indicator,
- https://rstudio.com/products/rstudio/download/(Rstudio)
- http://r-statistics.co

Examination scheme and mode:

Evaluation scheme and mode will be as per the guidelines notified by the University of Delhi.