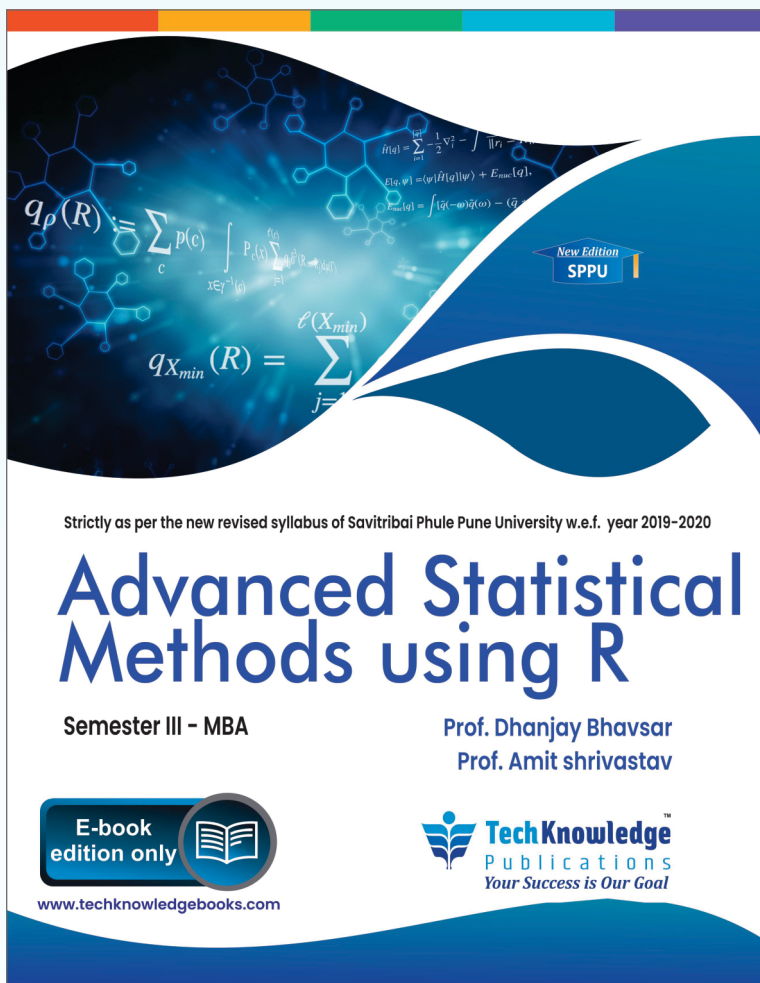


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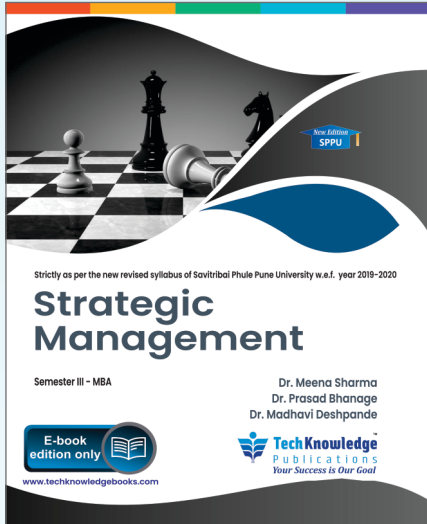


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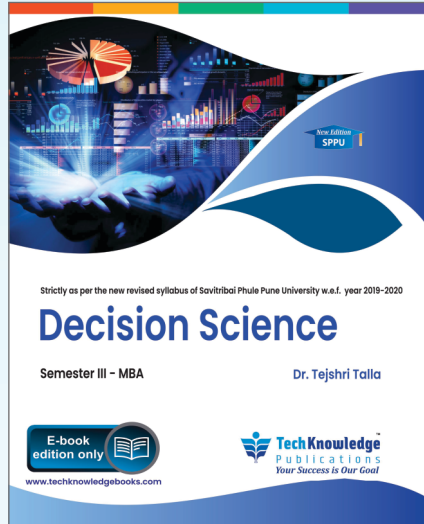
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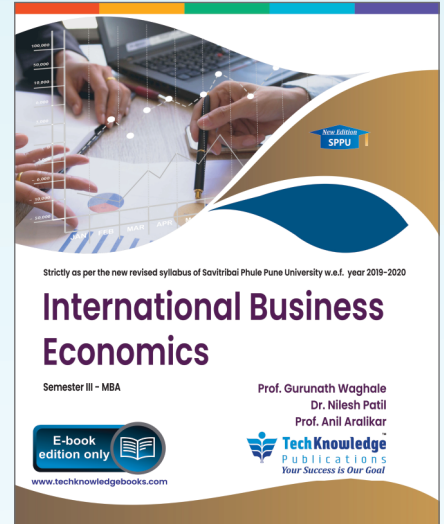
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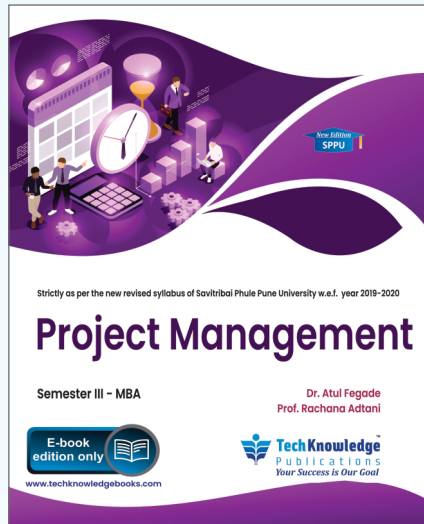
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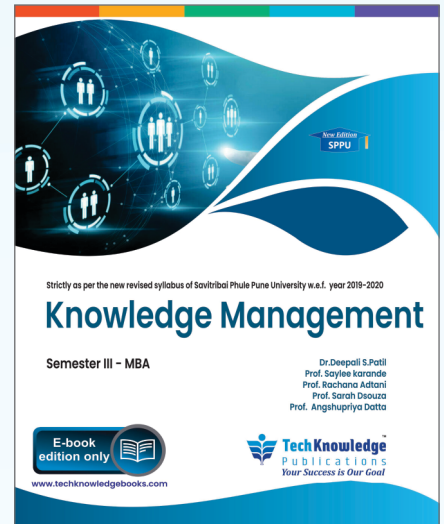
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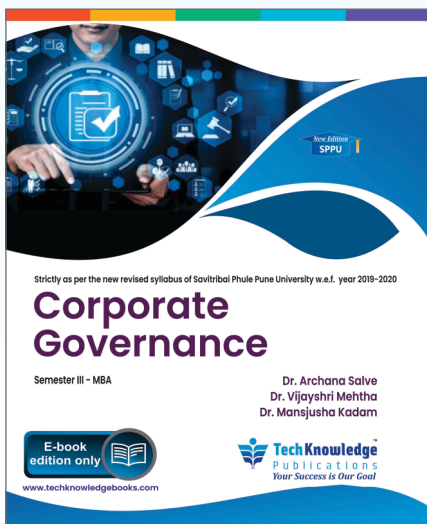
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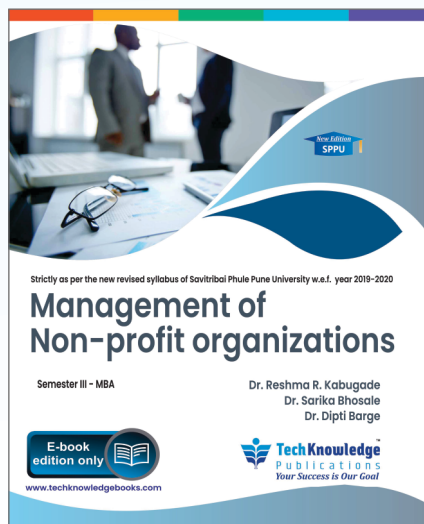
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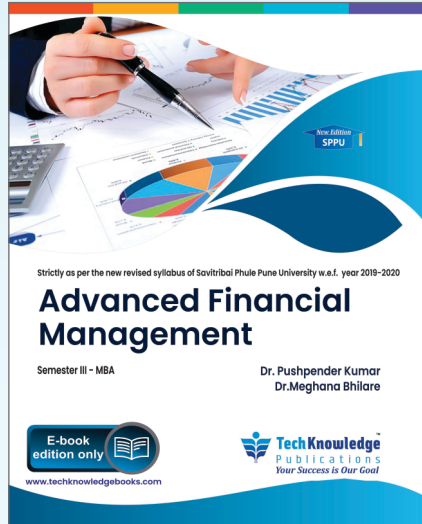
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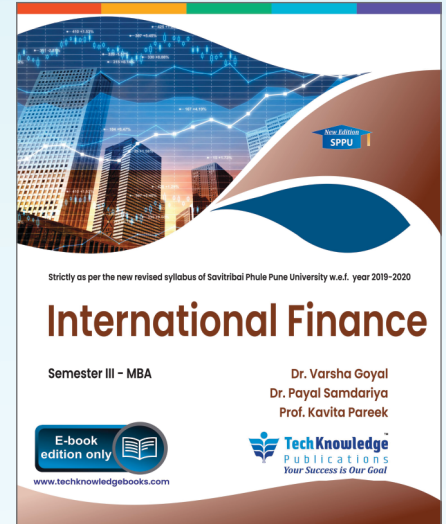
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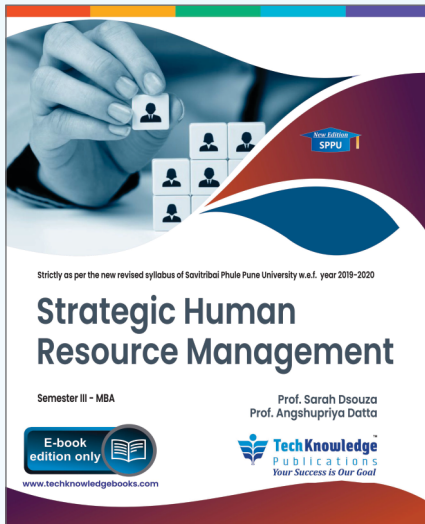
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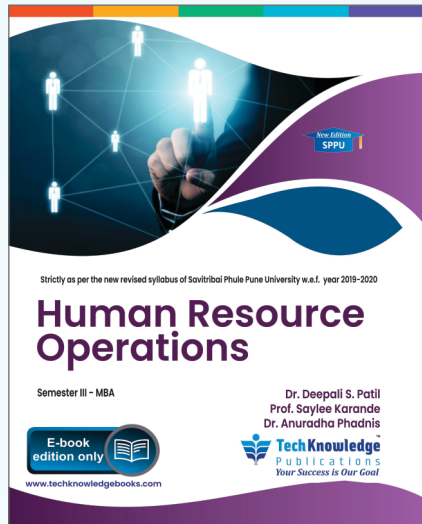
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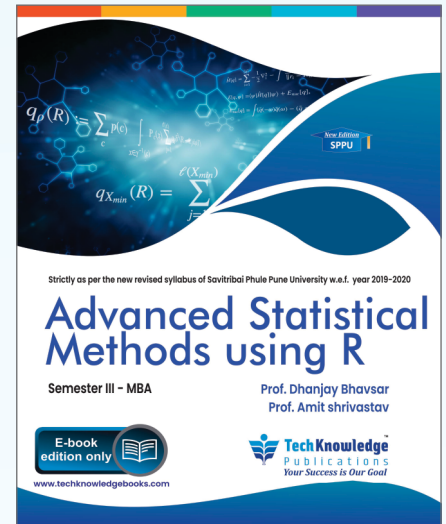
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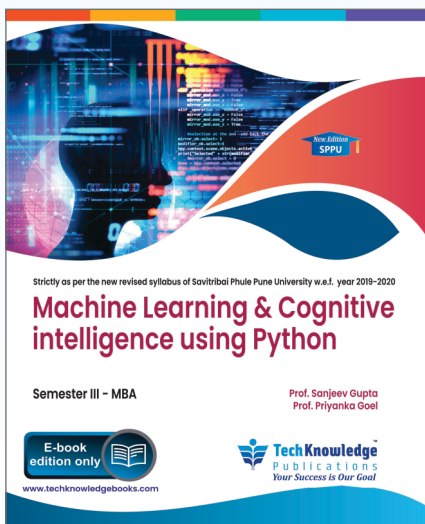
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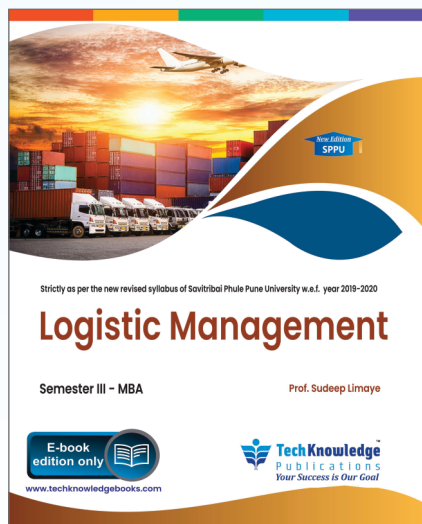
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# Advanced Statistical Methods Using R

(Code : SC–BA-03)

Semester III – Master of Business Administration (MBA)

(Savitribai Phule Pune University)

**Strictly as per the New Revised Syllabus (Rev. 2019) of Savitribai Phule Pune University w.e.f. academic year 2020-21 (As per Choice Based Credit System)**

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## **Advanced Statistical Methods Using R**

**Mr. Dhananjay Narayan Bhavsar, Mr. Amit Shrivastava**

Semester III – Master of Business Administration (MBA) (SPPU)

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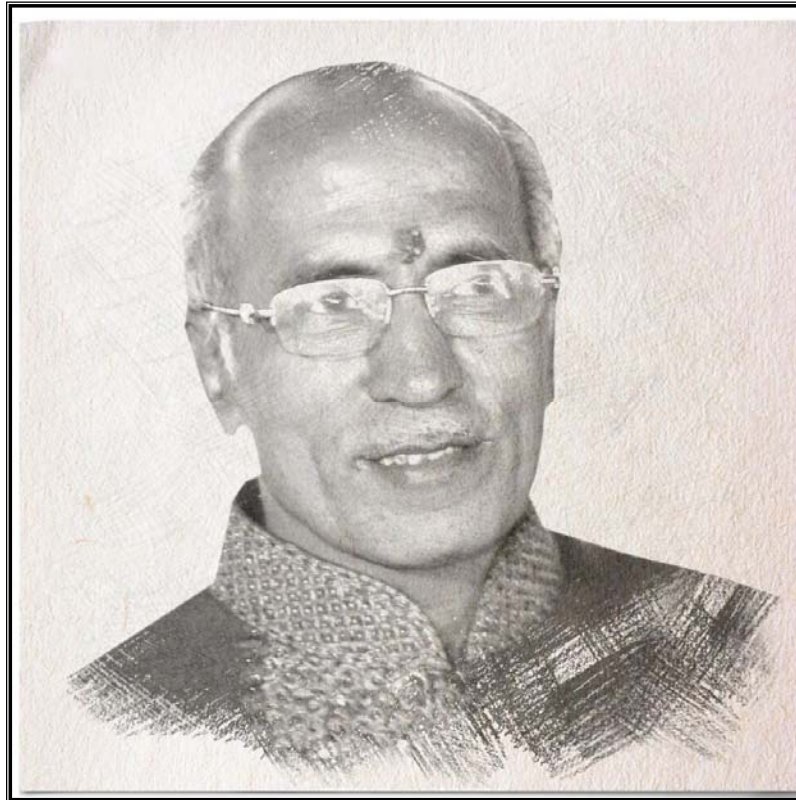
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*We dedicate this Publication soulfully and wholeheartedly,  
in loving memory of our beloved founder director,  
Late Shri. Pradeepji Lalchandji Lunawat,  
who will always be an inspiration, a positive force and strong support  
behind us.*



*“My work is my prayer to God”*

*- Lt. Shri. Pradeepji L. Lunawat*

*Soulful Tribute and Gratitude for all Your  
Sacrifices, Hardwork and 40 years of Strong Vision...*

## **Preface**

Dear Students,

We are extremely happy to present the book of “**Advanced Statistical Methods Using R**” for you. We have divided the subject into small chapters so that the topics can be arranged and understood properly. The topics within the chapters have been arranged in a proper sequence to ensure smooth flow of the subject.

We present this book in the loving memory of **Late. Shri. Pradeepji Lunawat**, our source of inspiration and a strong foundation of “**TechKnowledge Publications**”. He will always be remembered in our hearts and motivate us to achieve our new milestone.

We are thankful to Seema P. Lunawat, Vaishali Nisargand and Dr. Deepali Patil for the encouragement and support that they have extended. We are also thankful to the staff members of TechKnowledge Publications and others for their efforts to make this book as good as it is. We have made every possible efforts to eliminate all the errors in this book. However if you find any, please let us know, because that will help us to improve the book quality further.

We are thankful to my family members and friends for their patience and encouragement.

**- Authors**

□□□



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#### **Assistant Professor**

BSc. (Physics), MCM, MCA, MBA (HR), Ph D(pursuing )

An Assistant Professor having 12 years of teaching experience in various Management Institutes affiliated to S.P. Pune University. His areas of interest include Web technology & Data Analysis. He has published 7 research papers in International and National Conferences & got Best Paper Presentation award in 2009 MAMI conference. He feels that, IT and Modern Management education have a Problem of mass obsolescence as today's knowledge becomes obsolete the next day. We need to gear up to face those challenges and overcome them with effective global solution knowledge.



**Mr. Dhananjay Narayan Bhavsar**

### **Mr. Amit Shrivastava**

#### **Assistant Professor**

M.Phil (Computer Science) MCA, Ph D(pursuing )

An Assistant Professor, in Dr. D.Y. Patil Institute of Management & Research Pimpri- Pune, from last 11 years. He has completed MCA from RGTU, Bhopal and also completed M.Phil in computer Science from Alagappa University, Karaikudi. He has participated in Smart India Hackathon 2019 as well as in Aviskar SPPU Pune as a mentor. currently he is pursuing PhD from Bharti Vidyapeeth in Computer Application.



**Mr. Amit Shrivastava**



## Syllabus

<b>Semester III</b>		<b>304 – Advanced Statistical Methods using R</b>
3 Credits	LTP: 2:1:1	Subject Core (SC) Course – Business Analytics

**Course Outcomes: On successful completion of the course the learner will be able to**

CO#	COGNITIVE ABILITIES	COURSE OUTCOMES
CO 304BA .1	Remembering	RECALL all basic statistical concepts and associated values, formulae.
CO 304BA .2	Understanding	EXPLAIN the statistical tools and DESCRIBE their applications in multiple business domains and scenarios
CO 304BA .3	Applying	APPLY time series analysis in prediction of various trends.
CO 304BA .4	Analysing	DISCRIMINATE between various types of probability and probability distributions.
CO 304BA .5	Evaluating	FORMULATE and TEST hypothesis using tools of R.
CO 304BA .6	Creating	COMBINE various tools and functions of R programming language and use them in live analytical projects in multiple business domains and scenarios

1. **Statistics with R** : Computing basic statistics, Business Hypothesis Testing concepts, Basics of statistical modeling, Logistic Regression, Comparing means of two samples, Testing a correlation for significance, Testing a proportion, t test, z Test, F test, Basics of Analysis of variance (ANOVA), One way ANOVA, ANOVA with interaction effects, Two way ANOVA, Summarizing Data, Data Mining Basics, Cross tabulation. Case studies in different domains- using R. **(7+2)**
  
2. **Linear Regression** : Concept of Linear regression, Dependency of variables, Ordinary Least Sum of Squares Model, Multiple Linear Regression, Obtaining the Best fit line, Assumptions and Evaluation, Outliers and Influential Observations, Multi-collinearity, Case studies in different domains- using R. Dimension Reduction Techniques – Concept of latent dimensions, need for dimension reduction, Principal Components Analysis, Factor Analysis. Case studies in different domains- using R. **(7+2)**
  
3. **Probability** : Definition, Types of Probability, Mutually Exclusive events, Independent Events, Marginal Probability, Conditional Probability, Bayes Theorem. Probability Distributions – Continuous, Normal, Central Limit theorem, Discrete distribution, Poison distribution, Binomial distribution. **(7+2)**
  
4. **Predictive Modeling** : (a) Multiple Linear Regression: Concept of Multiple Linear regression, Step wise Regression, Dummy Regression, Case studies in different domains- using R (b) Logistic regression: Concept of Logistic Regression, odds and probabilities, Log likelihood ratio test, Pseudo R square, ROC plot, Classification table, Logistic regression & classification problems, Case studies in different domains using R (c) Linear Discriminant Analysis: Discriminant Function, Linear Discriminant Analysis, Case studies in different domains- using R **(7+2)**

5. **Time Series** : Time Series objects in R, Trends and Seasonality Variation, Decomposition of Time Series, autocorrelation function (ACF) and partial autocorrelation (PACF) plots, Exponential Smoothing, holt's Winter Method, Autoregressive Moving Average Models (ARMA), Autoregressive Integrated Moving Average Models (ARIMA), Case studies in different domains- using R.

(7+2)

□□□



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# Unit 1

## Statistics with R

### Syllabus

Computing basic statistics, Business Hypothesis Testing concepts, Basics of statistical modeling, Logistic Regression, Comparing means of two samples, Testing a correlation for significance, Testing a proportion, t test, z Test, F test, Basics of Analysis of variance (ANOVA), One way ANOVA, ANOVA with interaction effects, Two way ANOVA, Summarizing Data, Data Mining Basics, Cross tabulation. Case studies in different domains- using R.

# Unit 2

## Linear Regression

### Syllabus

Concept of Linear regression, Dependency of variables, Ordinary Least Sum of Squares Model, Multiple Linear Regression, Obtaining the Best fit line, Assumptions and Evaluation, Outliers and Influential Observations, Multi-collinearity, Case studies in different domains- using R. Dimension Reduction Techniques – Concept of latent dimensions, need for dimension reduction, Principal Components Analysis, Factor Analysis. Case studies in different domains- using R.



# Unit 3

## Probability



### Syllabus

Definition, Types of Probability, Mutually Exclusive events, Independent Events, Marginal Probability, Conditional Probability, Bayes Theorem. Probability Distributions – Continuous, Normal, Central Limit theorem, Discrete distribution, Poisson distribution, Binomial distribution.

# Unit 4

## Predictive Modeling



### Syllabus

**Multiple Linear Regression:** Concept of Multiple Linear regression, Step wise Regression, Dummy Regression, Case studies in different domains- using R  
**Logistic regression:** Concept of Logistic Regression, odds and probabilities, Log likelihood ratio test, Pseudo R square, ROC plot, Classification table, Logistic regression & classification problems, Case studies in different domains using R  
**Linear Discriminant Analysis:** Discriminant Function, Linear Discriminant Analysis, Case studies in different domains- using R

# Unit 5

## Time Series



### Syllabus

Time Series objects in R, Trends and Seasonality Variation, Decomposition of Time Series, autocorrelation function (ACF) and partial autocorrelation (PACF) plots, Exponential Smoothing, holt's Winter Method, Autoregressive Moving Average Models (ARMA), Autoregressive Integrated Moving Average Models (ARIMA), Case studies in different domains- using R.