B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19
DEPARTMENT OF INFORMATION SCIENCE & ENGINEERING
Autonomous Institute affiliated to VTU

Master of Technology

in

COMPUTER NETWORK ENGINEERING

Scheme and Syllabus 2024-2026

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19
DEPARTMENT OF INFORMATION SCIENCE & ENGINEERING
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VISION OF INSTITUTE:

Promoting Prosperity of mankind by augmenting human resource capital through Quality Technical Education & Training

MISSION OF INSTITUTE:

Accomplish excellence in the field of Technical Education through Education, Research and Service needs of society.

VISION OF DEPARTMENT:

Promote Quality Human Resource Capital by inculcating in every student the art of Creativity and Productivity in the field of Information Technology.

MISSION OF DEPARTMENT:

- Offer High Quality Graduate, Post Graduate programs in the field of Information Technology to prepare students for higher studies and professional career in industry.
- Provide Teaching and Research Environment for Quality education in the field of Information Technology.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19
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Program Educational Objectives (PEO)	
PEO1	Excel in their professional career in computer network engineering and allied disciples
PEO2	Achieve Proficiency in Industry or Academia and Research & Development
PEO3	Exhibit professionalism, team work and adapt to the latest technologies through continuous learning

Sl. No.	**Program Out Come**
PO1	Demonstrate the ability to independently conduct research and development work to address practical engineering problems.
PO2	Develop and deliver comprehensive technical presentations that effectively convey complex information to diverse audiences.
PO3	Exhibit mastery in the specialized study area, surpassing the requirements of a relevant bachelor's program.
PO4	Analyze engineering problems critically and apply appropriate techniques, skills, and modern tools to develop innovative solutions.
PO5	Collaborate effectively in teams while also functioning independently, recognizing opportunities for career advancement and research.
PO6	Cultivate a proactive approach to continuous learning and professional development in response to evolving technological landscapes.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Autonomous Institute affiliated to VTU

M.Tech. Computer Networking Engineering

I SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical/Seminar	Tutorial/ Skill Development	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1	PCC	MCS101	Artificial Intelligence	03	00	00	03	50	50	100	3
2	PCC	MCS102	Data Science and Management	03	00	00	03	50	50	100	3
3	PCC	MCS103	Data Structures & Algorithms for Problem Solving	03	00	00	03	50	50	100	3
4	PCC	MCS104B	Cloud Computing	03	00	00	03	50	50	100	3
5	IPCC	MCS105C	Cryptography and Network security	02	02	00	03	50	50	100	4
6	PCCL	MCSL106	Algorithms & AI Laboratory	00	02	00	03	50	50	100	2
7	NCMC	MRMI107	Research Methodology and IPR (**Online**)	Online courses (online.vtu.ac.in)							PP
				14	**04**	**00**	**18**	**300**	**300**	**600**	**18**

Note: **PCC**: Professional Core Courses. **IPCC**-Integrated Professional Core Courses, **PCC(PB):** Professional Core Courses (Project Based), **PCCL**-Professional Core Course lab, **NCMC**- Non Credit Mandatory Course, ,**L-**Lecture**, P-**Practical**, T/SDA-**Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students) **MRMI107**- Research Methodology and IPR (**Online**) for the students who have **not studied** this course in the Undergraduate level. This course is not counted for vertical progression, students have to qualify for the award of the master's degree.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19
DEPARTMENT OF INFORMATION SCIENCE & ENGINEERING

Autonomous Institute affiliated to VTU

I SEMESTER

Credits	3[L-P-T: 3-0-0]	Course Code	MCS101
Course Name	Artificial Intelligence & ML	Total No. of Lecture Hours	40
CIE Marks	50	SEE Marks	50

Unit 1:

Introduction: What is AI? The Foundations of Artificial Intelligence.

Problem-Solving: Problem-Solving Agents, Search algorithms, Uninformed search strategies, Informed (Heuristic) search strategies. 8 hrs.

Unit 2:

Knowledge, reasoning and planning: Knowledge-based agents, Logic, Propositional logic: A very simple logic, Propositional theorem proving, Syntax and semantics of First-order logic, Using First- order logic, Propositional vs First-order inference. 8 hrs.

Unit 3:

Uncertain knowledge and reasoning: Acting under uncertainty, Basic Probability Notation, Inference using full joint distribution, Independence, Baye's rule and its use, Naïve Bayes models, Representing knowledge in an uncertain domain, The semantics of Bayesian networks. 8 hrs.

Unit 4:

Machine learning: Forms of learning, Supervised learning, Learning decision trees, Model selection and optimization, Linear regression and classification. 8 hrs.

Unit 5:

Natural Language Processing: Language models, Grammar, Parsing, Augmented grammars, Complications of real natural language, Natural language tasks. 8 hrs.

The Ethics of AI, The Future of AI.

Text Book:

1 Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig, 4th Edition (2021).

References:

1 "Pattern Recognition and Machine Learning" by Christopher M. Bishop Edition: 4th Edition (2020)

2 "Artificial Intelligence: Foundations of Computational Agents" by David L. Poole and Alan K. Mackworth Edition: 3rd Edition (2021).

Course Outcomes (COs):				
On Completion of the course, the students will be able to		**PO1**	**PO2**	**PO3**
CO1:	Understand the foundational concepts of artificial intelligence, types, ethics and key problem-solving techniques.			**3**
CO2:	Apply knowledge representation and reasoning techniques to solve complex problems in AI systems.			**3**
CO3:	Implement machine learning algorithms and evaluate their performance in real-world applications.	**2**		
CO4:	Explore the principles and applications of natural language processing to enhance human-computer interaction.			**3**

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19
DEPARTMENT OF INFORMATION SCIENCE & ENGINEERING

Autonomous Institute affiliated to VTU

I SEMESTER

Credits	3[L-P-T: 3-0-0]	Course Code	MCS105
Course Name	Data Science and Management	Total No. of Lecture Hours	40
CIE Marks	50	SEE Marks	50

Unit 1:
Introduction to Data Science: The Data Science Process: Roles in a data science project, Stages of a data science project, Setting expectations. Starting with Rand data: Starting with R, working with data from files, Working with relational databases. Exploring data: Using Summary Statistics to spot problems, Spotting problems with graphics and visualization. 8 hrs.

Unit-2:
Managing data: Cleaning data, Data transformations, Sampling for modeling and validation. Choosing and evaluating models: Mapping problems to machine learning tasks, evaluating models, Local interpretable model-agnostic explanations (LIME) for explaining model predictions. 8 hrs.

Unit-3:
Modeling Methods: Supervised methods Linear Regression, Logistic Regression. Unsupervised methods: Cluster Analysis, Association rules. Exploring Advanced Methods: Bagging and random forest, generalized additive models, Kernel methods to increase data separation. 8 hrs.

Unit-4:
Documentation, Deployment and Presentation: Predicting buzz, Using R markdown to produce milestone documentation, using comments and version control for running documentation, Deploying models, Producing Effective Presentations. 8 hrs.

Unit-5:
Text Mining and Sentiment analysis: The tidy text format, Sentiment analysis with Tidy data: The sentiments datasets, Comparing the three sentiment dictionaries, Most common positive and negative words, Word clouds, Looking at units beyond just words, Analyzing word and document frequency. 8 hrs.

Text Book:

1. Zumel, N., Mount, J., & Porzak, J., "Practical data science with R", 2nd edition. Shelter Island, NY: Manning, 2019.
2. Julia Silge and David Robinson. "Text Mining with R: A Tidy Approach", 1st. edition. O'Reilly Media, Inc., 2017

References:

1. Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 2017.

Course Outcomes (COs):				
On Completion of the course, the students will be able to		**PO 1**	**PO 2**	**PO 3**
CO1:	Apply the concepts of modeling methods			**3**
CO2:	Analyze and formulate relationships of data			**3**
CO3:	Implement various models on different datasets using R	**3**		

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19
DEPARTMENT OF INFORMATION SCIENCE & ENGINEERING

Autonomous Institute affiliated to VTU

I SEMESTER

Credits	3[L-P-T: 3-0-0]	Course Code	MCS103
Course Name	Data Structures & Algorithms for Problem Solving	Total No. of Lecture Hours	40
CIE Marks	50	SEE Marks	50

Unit 1: 8 hrs.

Search Trees: Two Models of Search Trees. General Properties and Transformations. Height of a Search Tree. Basic Find, Insert, and Delete. Returning from Leaf to Root. Dealing with Non unique Keys. Queries for the Keys in an Interval. Building Optimal Search Trees. Converting Trees into Lists. Removing a Tree.

Unit 2: 8 hrs.

Balanced Search Trees: Height-Balanced Trees. Weight-Balanced Trees. (a, b)- and B-Trees. Red-Black Trees and Trees of Almost Optimal Height. Top-Down Rebalancing for Red-Black Trees.

Unit 3: 8 hrs.

Heaps: Balanced Search Trees as Heaps. Array-Based Heaps. Heap-Ordered Trees and Half Ordered Trees. Leftist Heaps. Skew Heaps. Binomial Heaps. Changing Keys in Heaps. Fibonacci Heaps. Heaps of Optimal Complexity.

Unit 4: 8 hrs.

Graph Algorithms: Bellman - Ford Algorithm; Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs. Flow networks and Ford-Fulkerson method. Maximum bipartite matching.

Unit 5: 8 hrs.

String-Matching Algorithms: Naïve string Matching. Rabin - Karp Algorithm. String matching with Finite Automata. Knuth-Morris-Pratt Algorithm. Boyer – Moore Algorithms.

Text Books:

1. Advanced Data Structures, Peter Brass, Cambridge University Press, 2008.
2. Kenneth A. Berman. Algorithms. Cengage Learning. 2002.
3. T. H Cormen, C E Leiserson, R L Rivest and C Stein. Introduction to Algorithms. PHI, 3rd Edition, 2010

Reference Books:

1. Data Structures and Algorithm Analysis in C++, Mark Allen Weiss, 4 th Edition, 2014, Pearson.
2. Data structures with Java, Ford and Topp, Pearson Education.

I SEMESTER

3. Ellis Horowitz, Sartaj Sahni, S.Rajasekharan. Fundamentals of Computer Algorithms. Uni- versities press. 2nd Edition, 2007
4. Data structures and Algorithms in Java, M.T.Goodrich, R.Tomassia, 3rd edition, Wiley India Edition.

Course Outcomes (COs):				
On Completion of the course, the students will be able to		**PO1**	**PO2**	**PO3**
CO1	Analyze fundamental data structures and algorithms to solve complex computational problems effectively			**3**
CO2	Apply various searching algorithm to optimize algorithm performance.			**3**
CO3	Design and analyze advanced tree and graph algorithms, including balanced search trees and graph traversal methods, to address real-world applications	**3**		

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19
DEPARTMENT OF INFORMATION SCIENCE & ENGINEERING

Autonomous Institute affiliated to VTU

I SEMESTER

Credits	3[L-P-T: 3-0-0]	Course Code	MCS104B
Course Name	Cloud Computing	Total No of Lecture Hours	40
CIE Marks	50	SEE Marks	50

Unit 1: 8 hrs.

Cloud Computing Architectural Framework: Cloud Benefits, Business scenarios, Cloud Computing Evolution, cloud vocabulary, Essential Characteristics of Cloud Computing, Cloud deployment models, Cloud Service Models, Multi-Tenancy, Approaches to create a barrier between the Tenants, cloud computing vendors, Cloud Computing threats, Cloud Reference Model, The Cloud Cube Model, Security for Cloud Computing, How Security Gets Integrated.

Unit 2: 8 hrs.

Compliance and Audit: Cloud customer responsibilities, Compliance and Audit Security Recommendations. Portability and Interoperability: Changing provider's reasons, Changing provider's expectations, Recommendations all cloud solutions, IaaS Cloud Solutions, PaaS Cloud Solutions, SaaS Cloud.

Unit 3: 8 hrs.

Traditional Security, Business Continuity, Disaster Recovery, Risk of insider abuse, Security baseline, Customers actions, Contract, Documentation, Recovery Time Objectives (RTOs), Customers responsibility, Vendor Security Process (VSP).

Unit 4: 8 hrs.

Data Center Operations: Data Center Operations, Security challenge, Implement Five Principal Characteristics of Cloud Computing, Data center Security Recommendations. Encryption and Key Management: Encryption for Confidentiality and Integrity, Encrypting data at rest, Key Management Lifecycle, Cloud Encryption Standards, Recommendations.

Unit 5: 8 hrs.

Identity and Access Management: Identity and Access Management in the cloud, Identity and Access Management functions, Identity and Access Management (IAM) Model, Identity Federation, Identity Provisioning Recommendations, Authentication for SaaS and Paas customers, Authentication for IaaS customers, Introducing Identity Services, Enterprise Architecture with IDaaS , IDaaS Security .

Text Books:

1. Cloud Security and Privacy, An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, Oreilly Media Education, 2009.
2. Securing the Cloud, Cloud Computer Security Techniques and Tactics, Vic (J.R.) Winkler, Syngress 2011.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

DEPARTMENT OF INFORMATION SCIENCE & ENGINEERING

Autonomous Institute affiliated to VTU

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Course Outcomes (COs):				
At the end of the course the student will be able to :		**PO1**	**PO2**	**PO3**
CO1:	Analyze industry security standards, certificates, regulatory mandates, audit policies, and compliance requirements.			**3**
CO2:	Demonstrate the growth of Cloud computing, architecture and different modules of implementation.			**3**
CO3:	Access the security implementation flow, actions and responsibilities of stake holders.			**3**

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

DEPARTMENT OF INFORMATION SCIENCE & ENGINEERING

Autonomous Institute affiliated to VTU

I SEMESTER

Credits	4[L-P-T:2-2-0]	Course Code	MCS105C
Course Name	Cryptography and Network Security	Total No of Lecture Hours	40
CIE Marks	50 Marks	SEE Marks	50 Marks

Unit 1:

Introduction to Cryptography, Basics of Cryptography, History and importance, Symmetric asymmetric cryptography, Classical Cryptosystems, Substitution ciphers, Transposition ciphers, Modern Cryptography, Block ciphers (AES, DES), Stream ciphers. 8 hrs.

Unit 2:

Public Key Cryptography, RSA Algorithm, Key generation, Encryption and decryption, Key Management, Public key infrastructure (PKI), Digital certificates, Elliptic Curve Cryptography (ECC), Basics and applications. 8 hrs.

Unit 3:

Cryptographic Hash Functions, Hash Functions, Properties and applications, SHA family of hash functions, Message Authentication Codes (MACs), HMAC and its applications, Digital Signatures Concepts and algorithms, Verification and applications. 8 hrs.

Unit 4:

Network Security Protocols, Secure Socket Layer (SSL)/Transport Layer Security (TLS), Architecture An operation, Internet Protocol Security (IPsec), Modes of operation, Security associations Virtual Private Networks (VPNs), Concepts and implementations. 8 hrs.

Unit 5:

Security Threats and Countermeasures, Network Security Threats, Types of attacks (DoS, DDoS,phishing), Malware and its impact, Intrusion Detection Systems (IDS), Types and methodologies Firewalls and Security Policies, Types of firewalls, Designing security policies. 8 hrs.

Text Books:

1. William Stallings, "Cryptography and Network Security: Principles and Practice," Pearson Education.
2. Behrouz A. Forouzan, "Cryptography and Network Security," McGraw-Hill.

Reference Books:

1. Charles P. Pfleeger, "Security in Computing," Prentice Hall.
2. Bruce Schneier, "Secrets and Lies: Digital Security in a Networked World," Wiley.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU-19

DEPARTMENT OF INFORMATION SCIENCE & ENGINEERING

Autonomous Institute affiliated to VTU

I SEMESTER

Course Outcomes (COs):				
At the end of the course the student will be able to:		**PO1**	**PO2**	**PO3**
CO1:	To apply various technics of cryptography, including symmetric and asymmetric encryption, in securing data over transmission.			**2**
CO2:	To analyze and evaluate various network security protocols, such as SSL/TLS and IPsec, to understand their roles in maintaining data confidentiality and integrity.			**3**
CO3:	To implement cryptographic techniques, including hashing and digital signatures, to ensure data authenticity and integrity in software applications.			**3**
CO4:	To identify & analysis common security threats and vulnerabilities in network systems and propose effective countermeasures to mitigate these risks.			**2**
CO5:	To assess real-world security solutions and practices, critically evaluating their effectiveness in addressing contemporary cybersecurity challenges.			**3**

B.M.S. COLLEGE OF ENGINEERING, BENGALURU
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Autonomous Institute affiliated to VTU

I SEMESTER

Credits	2[L-P-T: 0-2-0]	Course Code	MCSL106
Course Name	Algorithms & AI Lab	Total No. of Lecture Hours	-
CIE Marks	50	SEE Marks	50

List of Experiments:

1. Implement Naive Bayes models and Bayesian networks. (Demonstrate the diagnosis of heart patients using standard heart disease data set etc)

2. Implement a simple linear regression algorithm to predict a continuous target variable based on a given dataset.

3. Develop a program to implement a Support Vector Machine for binary classification. Use a sample dataset and visualize the decision boundary.

4. Write a program to demonstrate the ID3 decision tree algorithm using an appropriate dataset for classification.

5. Implement a KNN algorithm for regression tasks instead of classification. Use a small dataset, and predict continuous values based on the average of the nearest neighbors.

6. Implement the k-Nearest Neighbor algorithm to classify the Iris dataset, printing both correct and incorrect predictions.

7. Develop a program to implement the non-parametric Locally Weighted Regression algorithm, fitting data points and visualizing results.

8. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test it with suitable datasets.

9. Implement a Q-learning algorithm to navigate a simple grid environment, defining the reward structure and analyzing agent performance.

10. Write a python program
a. to perform tokenization by word and sentence using nltk.
b. to eliminate stop words using nltk.
c. to perform stemming using nltk.
d. to perform Parts of Speech tagging using nltk.

Note: Instructions to Students to be followed in each lab:

1. Each student should bring the observation book for each lab and write the programs and output completed in the previous week and get it evaluated by the faculty in charge.
2. In the observation book, students should
   a) Handwrite the Program/scenarios with topology and procedure
   b) Paste the printout of the Output or Handwrite the Output (Output should be written for all the cases).
3. Hard copy (PDF file) of all the experiments and programs along with the output needs to be submitted before the lab test.
4. Each Student should practice the extra exercise given in each lab.

B.M.S. COLLEGE OF ENGINEERING, BENGALURU
DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Autonomous Institute affiliated to VTU

I SEMESTER

Credits	PP	Course Code	MRMI107
Course Name	**Research Methodology and IPR**	**Total No. of Lecture Hours**	-
CIE Marks	-	**SEE Marks**	-

Unit 1:

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India. Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration

Unit-2

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed. Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

Unit-3

Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale. Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

Unit-4

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. Chi-square @#@#@ Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests.

Unit-5

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets,

I SEMESTER

Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing.

Text Books:

1 Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg, New Age International, 4th Edition, 2018.
2 Research Methodology a step-by-step guide for beginners.RanjitKumar, SAGE Publications, 3rd Edition, 2011.

References:

1 Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.

2 Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009.

Web links:

1. https://www.youtube.com/watch?v=A7oioOJ4g0Y&list=PLVf5enqoJ-yVQ2RXUl6mCfLPf3J_JUfoc

Course Outcomes (Cos):				
On Completion of the course, the students will be able to		**PO1**	**PO2**	**PO3**
CO1:	Identify and Conduct research independently in suitable research field.			**3**
CO2:	Choose research designs, sampling designs, measurement and scaling techniques and also different methods data collection.			**3**
CO3:	Explore the Precautions in interpreting the data and drawing inferences.			**3**