



**RAMAIAH
UNIVERSITY**
OF APPLIED SCIENCES

**Programme Specifications
Of
B.Sc. (Hons) in Data Science and Analytics
2024 onwards**

**School of Social Sciences
Department of Data Sciences and Analytics**


Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru - 560054


Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru - 560054


Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

University's Vision, Mission and Objectives

The M. S. Ramaiah University of Applied Sciences (MSRUAS) will focus on student-centric professional education and motivates its staff and students to contribute significantly to the growth of technology, science, economy and society through their imaginative, creative and innovative pursuits. Hence, the University has articulated the following vision and objectives.

Vision

MSRUAS aspires to be the premier university of choice in Asia for student centric professional education and services with a strong focus on applied research whilst maintaining the highest academic and ethical standards in a creative and innovative environment

Mission

Our purpose is the creation and dissemination of knowledge. We are committed to creativity, innovation and excellence in our teaching and research. We value integrity, quality and teamwork in all our endeavors. We inspire critical thinking, personal development and a passion for lifelong learning. We serve the technical, scientific and economic needs of our Society.

Objectives

1. To disseminate knowledge and skills through instructions, teaching, training, seminars, workshops and symposia in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to equip students and scholars to meet the needs of industries, business and society
2. To generate knowledge through research in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to meet the challenges that arise in industry, business and society
3. To promote health, human well-being and provide holistic healthcare
4. To provide technical and scientific solutions to real life problems posed by industry, business and society in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences
5. To instill the spirit of entrepreneurship in our youth to help create more career opportunities in the society by incubating and nurturing technology product ideas and supporting technology backed business
6. To identify and nurture leadership skills in students and help in the development of our future leaders to enrich the society we live in To develop partnership with universities, industries, businesses, research establishments, NGOs, international organizations, governmental organizations in India and abroad to enrich the experiences of faculties and students through research and developmental programmes.

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

Faculty	Social Sciences
Department	Data Sciences and Analytics
Programme Code	415
Programme Name	B.Sc. (Hons) in Data Science and Analytics
Dean of the Faculty	
Head of the Department	

- 1. Title of the Award:** B.Sc. (Hons) in Data Science and Analytics
- 2. Mode of Study:** Full-Time
- 3. Awarding Institution /Body:** M. S. Ramaiah University of Applied Sciences, Bengaluru
- 4. Joint Award:** Not Applicable
- 5. Teaching Institution:** School of Social Sciences, M. S. Ramaiah University of Applied Sciences, Bengaluru
- 6. Date of Programme Specifications:** July 2022
- 7. Date of Programme Approval by the Academic Council of MSRUAS:** 14-July-2022
- 8. Next Review Semester Date:** June 2026
- 9. Programme Approving Regulating Body and Date of Approval:**
Academic Council of MSRUAS, 14-July-2020
- 10. Programme Accredited Body and Date of Accreditation:** Not Applicable
- 11. Grade Awarded by the Accreditation Body:** Not Applicable
- 12. Programme Accreditation Validity:** Not Applicable
- 13. Programme Benchmark:** Not Applicable
- 14. Rationale for the Programme**

B.Sc. (Hons.) in Data Science and Analytics is an undergraduate honours degree programme designed to create motivated, energetic, thinking, and creative graduates. The programme aspires to prepare students for roles as economists, financial analysts, bank and commerce professions, trade markets experts and professionals like economic chief consultants, financial examiners, statistician, operations research analysts, credit analysts and so on.

The curriculum is outcome-based, and it imbibes required theoretical concepts and practical skills in the domain. Students develop application-oriented learning skills, critical, analytical thinking, and problem-solving abilities for a smooth transition from academic to the real-life work environment by undergoing this programme.


Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru - 560054


Director
School of Social Sciences & School of Law,
M S Ramaiah University of Applied Sciences
Bengaluru - 560054


Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Approved by the Academic Council at meeting held on 14th July 2023

15. Programme Mission

B.Sc. (Hons.) in Data Science and Analytics is an undergraduate programme designed to create motivated, energetic, thinking and creative graduates. The programme aspires to prepare students for roles as economists, financial analysts, banking and commerce professions, trade markets experts and professionals like economic chief consultants, financial examiners, statisticians, operations research analysts, credit analysts, etc.

16. Graduate Attributes (GAs)

- GA-1. Data Science and Analytics knowledge:** Ability to apply knowledge of mathematics, science fundamentals to solve complex problems in Data Science.
- GA-2. Problem Analysis:** Ability to analyze Data Science problems, interpret data and arrive at meaningful conclusions involving mathematical inferences
- GA-3. Design and Development of Solutions:** Ability to design an Data Sciences and Data Analytics system, component, or process to meet desired needs considering public health and safety, and the cultural, societal, and environmental considerations
- GA-4. Conduct Investigations of Complex Problems:** Ability to understand and solve complex Data Science problems by conducting experimental investigations
- GA-5. Modern Tool Usage:** Ability to apply appropriate tools and techniques and understand utilization of resources appropriately to complex economic activities
- GA-6. Environment and Sustainability:** Ability to develop sustainable solutions and understand their effect on society and environment
- GA-7. Ethics:** Ability to apply ethical principles to economic practices and professional responsibilities
- GA-8. Communication:** Ability to make effective oral presentations and communicate technical ideas to a broad audience using written and oral means
- GA-9. Life-long learning:** Ability to adapt to the changes and advancements in technology and engage in independent and life-long learning

17. Programme Outcomes (POs)

B.Sc. (Hons) Data Science and Analytics graduates will be able to:

- PO-1.** Apply the knowledge of Data Sciences and Data Analytics to the solution of complex societal problems.
- PO-2.** Identify problems by closely examining the situations around them and think holistically about the phenomena and generate viable solutions to these problems. Exhibit the skill of critical

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Page 4 of 158

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru - 560054
Director
School of Social Sciences & Commerce
M S Ramaiah University of Applied Sciences
Bengaluru - 560054
Dean - Academics
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

thinking and understand scientific texts and place scientific statements and themes in contexts and evaluate them in terms of generic conventions.

- PO-3.** Demonstrate ability to accommodate the views of others and present their own opinions and complex ideas, in written or oral form, in a clear and concise manner in group settings. Exhibit thoughts and ideas effectively in writing and orally; communicate with others using appropriate media, build effective interactive and presenting skills to meet global competencies.
- PO-4.** Infer scientific literature, build a sense of enquiry and be able to formulate, test, analyze, interpret, and establish hypothesis and research questions; and to identify and consult relevant sources to find answers.
- PO-5.** Create new conceptual, theoretical, methodological innovations that integrate and transcend beyond discipline-specific approaches to address a common problem.
- PO-6.** Perform independently and collaboratively as a part of a team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
- PO-7.** Demonstrate empathetic social concern and equity centered national development and act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
- PO-8.** Analyze the impact of the scientific solutions in societal and environmental contexts for sustainable development.
- PO-9.** Demonstrate attitudes of being a life-long learner who passionately pursues self-determined goals in the broadest context of socio-technological changes.

18. Programme Goal

The programme goal is to produce graduates with critical, analytical and problem-solving skills, and ability to think independently, to pursue a career in Data Science and Analytics and allied areas.

19. Programme Educational Objectives (PEOs)

The objectives of the B.Sc. (Hons) (Data Science and Analytics) programme are to:

- PEO-1.** Create a community of informed purveyors of knowledge geared towards academic excellence and increase the knowledge base and skill sets aimed at enhancing their professional competence.
- PEO-2.** Promote innovation and research by instilling a sense of independent and critical thinking with sensitivity to social needs.
- PEO-3.** Inculcate strong human values and social, interpersonal and leadership skills required for professional success in evolving global professional environments

20. Programme Specific Outcomes (PSOs)

At the end of the B.Sc. (Hons) in Data Science and Analytics programme, the graduate will be able to:

Think
Associate Professor HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

Approved by the Academic Council at meeting held on 14th July 2023

Director
School of Social Sciences & School of Data Science
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

Rangarath R.V.
Dean - Academics
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

- PSO-1.** Apply the knowledge of Data Science and Analytics to develop innovative and inclusive understanding to real-world issues.
- PSO-2.** Acquire the skills necessary to think critically and communicate effectively about Data Sciences and Analytics and allied domains.
- PSO-3.** Demonstrate the understanding of life-long learning and leadership qualities through professional development and strive for the betterment of organization, environment, and society.

21. Programme Structure:

Semester 1							
Sl. No.	Code	Course Title	Theor y (h/W/S)	Tutoria ls (h/W/S)	Practic al (h/W/S)	Total Credi ts	Max. Mar ks
1	SSF101A	Compulsory Foundation Course 1 (CFC 1)	4			4	100
2	SSF102A	Compulsory Foundation Course 2 (CFC 2)	4			4	100
3	DSC101A	Maths for Data Science	5			5	100
4	DSC102A	Programming in R	4		2	5	100
5	TSM101A	Ability Enhancement Course 1	3			3	100
Total			20		2	21	500
Total number of contact hours per week			22				

Semester 2							
Sl. No.	Code	Course Title	Theor y (h/W/ S)	Tutoria ls (h/W/S)	Practic al (h/W/S)	Total Credit s	Max. Mark s
1	SSF103A	Compulsory Foundation Course 3 (CFC 3)	4			4	100
2	SSF104A	Compulsory Foundation Course 4 (CFC 4)	4			4	100
3	DSC104A	Inferential Statistics	5			5	100
4	DSC106A	Programming in Python	4		2	5	100
5	DSC101A	Open Elective	3			3	100
6	TSM101A	Ability Enhancement Course 1					100

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

Approved by the Academic Council at meeting held on 14th July 2023

Page 6 of 158
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Bangalore - 560 054

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

Total	20	-	6	23	600
Total number of contact hours per week	26				

Semester 3							
SL No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	DSC105A	Regression Techniques and Time series Analysis	4		2	5	100
2	DSC202A	Data base Management Systems	4		2	5	100
3	DSC203A	Data Pre-processing	4		2	5	100
4	DSO201A	Open Elective	3			3	100
5	DSU201A	Ability Enhancement Course 1	3			3	100
Total			18	-	6	21	500
Total number of contact hours per week			24				

Semester 4							
SL No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	DSC201B	Multivariate Analysis	4		2	5	100
2	DSC205A	Data Warehousing & Mining (CC)	4		2	5	100
3	DSC206B	Artificial Intelligence (CC)	5			5	100
4	DSO202A	Open Elective	3			3	100
5	DSU202A	Skill Enhancement Course – 2 (SEC-2)	2			2	100
6	BAU201A	Entrepreneurial mindset and action	3			3	100
Total			21		4	23	600
Total number of contact hours per week			25				

Note: Students must choose one DSE out of three DSEs.

Associate Professor and HOD
 Department of Data Sciences and Analytics
 School of Social Sciences
 M S Ramaiah University of Applied Sciences
 Bengaluru - 560054

Rangayuth R.V.
 Dean - Academics
 M.S. Ramaiah University of Applied Sciences
 Bengaluru - 560054

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Page 7 of 158

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 Bengaluru - 560054

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	DSC301A	Machine Learning (CC)	4		2	5	100
2	DSC204B	Operation Research & Optimisation Techniques (CC)	4		2	5	100
3	DSE301A	Advanced Time Series and forecasting (DSE) (Track 1)	3		2	4	100
4	DSE303A	Advanced Statistics (DSE) (Track 2)	4				
5	DSC103A	Data Visualization	4		2	5	100
6	CSM301A	Cyber Security	3			3	100
7	DSO301A	Open Elective	3			3	100
Total			21/22		8/6	25	600
Total number of contact hours per week			29/28				

Note: Students must choose three DSE out of four DSEs

Semester 6							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	DSC303A	Dissertation/Project (CC)	12			6	100
2	DSE303A	Deep Learning (DSE) (Track 1)	3		2	4	100
3	DSE304A	Supply-Chain Management (DSE) (Track 2)	4				
4	DSC302A	Big Data	4		2	5	100
5	DSO301A	Open Elective	3			3	100
Total			10/11		16/14	18	400
Total number of contact hours per week			26/25				

Students who successfully complete six semesters (three academic years) will be awarded the **B.Sc. in Data Science and Analytics** degree. Students may opt to exit after completing three years. Alternatively, students may choose to extend their studies into a four-year program. Continuation into the fourth year is subject to meeting the following minimum eligibility requirements:

- Students must achieve a minimum of **75% aggregate marks or an equivalent 7.5 CGPA** in the B.Sc. Data Science and Analytics program after completing 3rd year.

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

- Students who want to continue to four years of study and have a **CGPA of less than 7.5 at the end of the 6th semester**, will have to undertake the **courses for 12 credits and project for 8 credits in the 4th year**, and will be awarded the **B.Sc. (Honours)** degree.
- Students who want to continue to four years of study, and achieved a **CGPA of 7.5 or above at the end of the 3rd year**, and will undertake :
 - A **research project/dissertation of a minimum of 20 credits in the 4th year** under the guidance of an academic or industry mentor, will be awarded the **B.Sc. (Honours with Research)** degree.
 - Students under this category may undertake the **courses for 12 credits and project for 8 credits in the 4th year** but will be awarded **B.Sc. (Honours)** degree.

Semester 7							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	DSE401A	Cloud Computing (DSE)	3		2	4	100
2	DSE403A	Natural Language Processing (DSE)			2		100
3	DSE404A	Applied Econometrics (DSE)	3		2	4	100
4	DSE405A	Health Care Analytics	3		2	4	100
5	DSO401A	Open Elective	3			3	100
Total			12		6	15	500
Total number of contact hours per week			18				

Semester 8							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	DSI401A	Research Project			40	20	400
Total						20	400
Total number of contact hours per week			40				

Open Elective Courses

A number of Open Elective Courses from the School of Social Sciences are offered as mentioned in the University's website. Students can choose the Open Electives on their own choice.

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 School of Social Sciences
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22 Innovation Courses in Lieu of Open Elective Courses

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Semester 8 (BSc (hons) DSA)							
Sl. No.	Code	Course Title	Theory (h/W/S)	Tutorials (h/W/S)	Practical (h/W/S)	Total Credits	Max. Marks
1	DSE303A	Deep Learning	3 4		2	4	100
2	DSE304A	Supply-Chain Management (DSE)					100
3	DSE501A	Introduction to GIS	3		2	4	100
4	DSE503A	Business Analytics	3		2	4	100
4	DSI402A	Group Project	0		16	8	100
Total			10/9		20/22	20	400
Total number of contact hours per week			30/31				

Ramya R.V.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

23.Course Delivery: As per the Timetable

24.Teaching and Learning Methods

1. Face to Face Lectures using Audio-Visuals
2. Workshops, Group Discussions, Debates, Presentations
3. Demonstrations
4. Guest Lectures
5. Laboratory work/Field work/Workshop
6. Industry Visit
7. Seminars
8. Group Exercises
9. Project Work
10. Project
11. Exhibitions
12. Technical Festival

25.Assessment and Grading

25.1. Components of Grading

There shall be **two components** of grading in the assessment of each course:

Component 1, Continuous Evaluation (CE): This component involves multiple subcomponents (SC1, SC2, etc.) of learning assessment. The assessment of the subcomponents of CE is conducted during the semester at regular intervals. This subcomponent represents the formative assessment of students' learning.

Component 2, Semester-end Examination (SEE):

This component represents the summative assessment carried out in the form an examination conducted at the end of the semester.

Marks obtained CE and SEE components have a weightage of 60:40 (CE: 60% and SEE: 40%) in determining the final marks obtained by a student in a Course.

The complete details of Grading are given in the Academic Regulations.

25.2. Continuous Evaluation Policies

Continuous evaluation depends on the type of the course as discussed below:

25.2.1 Theory Courses

For Theory Courses Only		
Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: CE (60% Weightage)	Component 2: SEE (40% Weightage)
Subcomponent	Terms Tests	Assignments

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Associate Professor and HOD
Department of Data Science and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

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Dean - Academics
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

Type ☐			
CO-1			
CO-2			
CO-3			
CO-4			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.			

- CE components should have a mix of term tests, quiz and assignments
- Two Tests (15 each), Two Assignments (20 marks). (One written and another to be MCQs)
- Course leaders to declare the assessment components before the commencement of the session and get approval from HoD and Dean

25.2.2 Laboratory Course

For a laboratory course, the scheme for determining the CE marks is as under:

For Laboratory Courses Only			
Focus of COs on each Component or Subcomponent of Evaluation			
	Component 1: CE (60% Weightage)		Component 2: SEE (40% Weightage)
Subcomponent Type ☐	Conduct of Experiments	Laboratory Report + Viva	Laboratory SEE
CO-1			
CO-2			
CO-3			
CO-4			
The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document			

The subcomponents can be of any of the following types:

- Laboratory / Clinical Work Record
- Experiments
- Computer Simulations
- Creative Submission
- Virtual Labs
- Viva / Oral Exam
- Lab Manual Report
- Any other (e.g. combinations)

Course leaders to declare the assessment components before the commencement of the session and get approval from HoD and Dean

Th.S.
Associate Professor and HoD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

Ramya R.V.
Dean - Academics
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

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Page 11 of 158

25.2.3 Course Having a Combination of Theory and Laboratory

For a course that contains the combination of theory and laboratory sessions, the scheme for determining the CE marks is as under:

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ►	SC1	SC2	SC3	
Subcomponent Type ►	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ►	20	20	20	
CO				

The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.

- CE components should have a mix of term tests, quiz and assignments
- In case of courses where laboratory is combined with theory, laboratory components to be assessed in both CE and SEE
- Course leaders to declare the assessment components before the commencement of the session and get approval from HoD and Dean

25.2.4 Ability Enhancement courses

For AECC Only		
Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: CE (50% Weightage)	Component 2: SEE (50% Weightage)
Subcomponent Type □	Terms Tests or Assignments	
CO-1		
CO-2		
CO-3		
CO-4		

The details of number of tests and assignments to be conducted are presented in the Academic Regulations and Programme Specifications Document.

- Course leaders to declare the assessment components before the commencement of the session and get approval from HoD and Dean

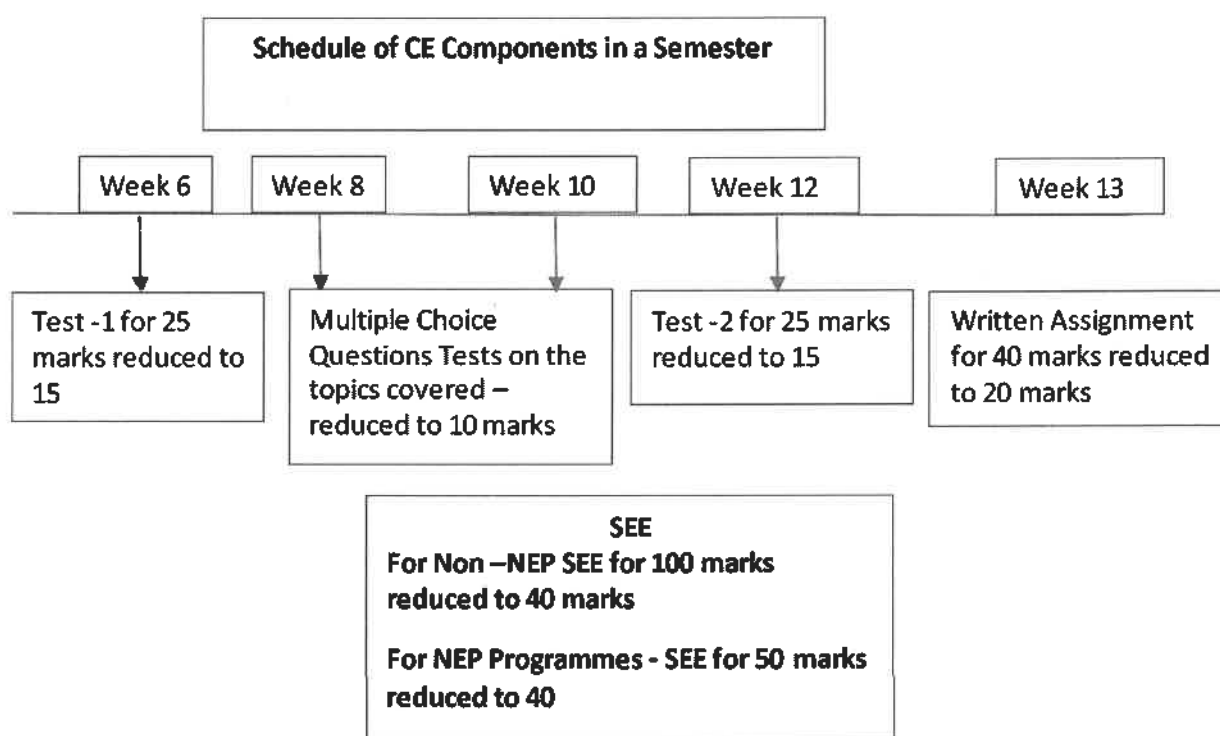
[Signature]
Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

[Signature]
Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560054

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Page 12 of 158

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028



26.Minor Programme

NA

27.Student Support for Learning

1. Course Notes
2. Reference Books in the Library
3. Magazines and Journals

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Page 13 of 158

4. Internet Facility
5. Computing Facility
6. Laboratory Facility
7. Workshop Facility
8. Staff Support
9. Lounges for Discussions

28. Any other support that enhances their learning. Quality Control Measures

1. Review of Course Notes
2. Review of Question Papers and Assignment Questions
3. Student Feedback
4. Moderation of Assessed Work
5. Opportunities for students to see their assessed work
6. Review by external examiners and external examiners reports
7. Staff Student Consultative Committee meetings
8. Student exit feedback
9. Subject Assessment Board (SAB)
10. Programme Assessment Board (PAB)


Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054


Rangarath K.V.
Data Academics
HOD

29. Programme Map (Course-PO-PSO Map)

Se m .	Course Title	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
1	Compulsory Foundation Course 1 (CFC 1)	3		2			1				3	1	2
1	Compulsory Foundation Course 2 (CFC 2)	3		2				1		1	3	1	2
1	Maths for Data Science	3		2			1				3	1	2
1	Programming in R	3	2						1		3	2	1
1	Ability Enhancement Course I			2		3			2	1	2	3	1
2	Compulsory Foundation Course 3 (CFC 3)	3		2			1				3	1	2
2	Compulsory Foundation Course 4 (CFC 4)	3	2							1	3	2	1
2	Inferential Statistics	3		2			2				2	3	1
2	Programming in Python					3	2			2	2	3	1
2	Generic Elective 1	3		2			1				3	1	2
2	Skill Enhancement Course 1			1		2			3		3	2	1
3	Regression Techniques and Time series Analysis	2		3			1				2	3	1
3	Data base Management Systems			3	2			1			2	3	1
3	Data Pre-processing	3		2			1				3	1	2
3	Generic Elective 2		3	2			1				3	2	1
3	Ability Enhancement Course 1	3		2			1				3	1	2
4	Multivariate Analysis	2					1		3		3	2	1
4	Data Warehousing & Mining (CC)		3	2						1	3	1	2
4	Artificial Intelligence (CC)	3		2			1				3	1	2
4	Generic Elective-3		3	1			2				3	2	1
4	Skill Enhancement Course – 2 (SEC-2)			3				1	2		2	3	1
4	Entrepreneurial mindset and action				3		2			1	2	3	1
5	Machine Learning (CC)				3	3			2		3	1	2
5	Operation Research & Optimization Techniques ion Techniques(CC)	3		2			2				2	3	1
5	Advanced Time Series and forecasting (DSE) (Track -1)		3	1			2				3	2	1
5	Advanced Statistics (DSE) (Track 2)		3				1	2		2	3	1	
5	Data Visualization				3	3			2		3	1	2
5	Cyber Security	2	3							1	3	2	1
5	Open Elective	3		2			1				3	1	2
6	Dissertation/Project (CC)	3	2							1	3	2	1
6	Deep Learning (DSE) (Track 1)		3	1			2				3	2	1
6	Supply-Chain Management (DSE) (Track 2)				3	2			2	2	3	1	
6	Big Data	2		3		3	3		2		2	3	1
6	Open Elective					3	2			2	2	3	1
7	Cloud Computing (DSE)	3		2			1				3	1	2
7	Natural Language Processing (DSE)			1		2			3		3	2	1
7	Applied Econometrics (DSE)	3		2			1				3	1	2
7	Health Care Analytics (DSE)				3	3			2		3	1	2
7	Open Elective	3		2			1				3	1	2
8	Research Project	3		2			1				3	1	2

Approved by the Academic Council at meeting held on 14th July 2023

Page 15 of 158


 Associate Professor in
 Department of Data Sciences and Analytics
 School of Social Sciences
 M S Ramaiah University of Applied Sciences
 Bengaluru – 560054


 Director
 M.S. Ramaiah University of Applied Sciences
 Bangalore - 560054
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 M S Ramaiah University of Applied Sciences
 Bengaluru – 560054

30.Co-curricular Activities

Students are encouraged to take part in co-curricular activities like seminars, conferences, symposia, paper writing, attending industry exhibitions, project competitions and related activities for enhancing their knowledge and networking.

31.Cultural and Literary Activities

Annual cultural festivals are held to showcase the creative talents in students. They are involved in planning and organizing the activities.

32.Sports and Athletics

Students are encouraged to take part in sports and athletic events regularly. Annual sports meet will be held to demonstrate sportsmanship and competitive spirit.





**RAMAIAH
UNIVERSITY**
OF APPLIED SCIENCES

Course Specifications

B.Sc. (Hons) in Data Science and Analytics

Programme Code: 415

**School of Social Sciences
Batch 2024-2028**

A handwritten signature in blue ink, likely belonging to the Associate Professor and HOD.

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

A handwritten signature in blue ink, likely belonging to the Director.

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

A handwritten signature in blue ink, likely belonging to Ramya R.V.

SEMESTER 1

Course Specifications: Maths for Data Science

Course Title	Maths for Data Science
Course Code	DSC101A
Course Type	Core Course
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

The objective of this course is to introduce to the concept of vector, graphical representation of vector operation, matrix operations, eigen value and eigen vectors, finding solution for linear equations. Finally, they will be introduced with calculus covering intuition for limit, continuity and calculating first and second order derivative.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	5:0:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Understand the concept of vectors, theory of matrices and tools for solving system of linear equations

CO-2. Impart knowledge on Eigen values and Eigen vectors.

CO-3. Understand the basic concepts of vector spaces and their properties.

CO-4. Apply the concepts of Limit, Continuity and Derivative.

4. Course Contents

Unit 1: Vectors and Matrices

Concept of vector, vector operations, graphical representation of vector operation. Introduction to Matrices and Determinants, Properties of Determinant, Cramer's rule, inverse of a matrix, rank of a matrix, hermitian and unitary matrices, eigen values and eigen vectors.

Unit 2: System of Linear Equations

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Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

Concept of linear relation in linear equation, solution of linear equations, solving system of linear equations, Gaussian elimination method, Echelon and Row-reduced Echelon Form of a matrix, Linear Transformation, linear dependence and independence.

Unit 3: Vector Space

Vector space, linear combination of vectors, linear span, basis and dimension. Linear transformations-null space, Row and Column Space. Inner Product Spaces, examples of inner product spaces, cauchy-schwarz's inequality, orthogonality, orthogonal sets.

Unit 4: Calculus

Concept of Tangent and Secant Line, Calculating slope, positive and negative slope, calculating limit of function, Continuous Function. Calculating derivative and equation of a tangent line, derivative of trigonometric functions.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3	2	2	1	3	1	2	3	2	3	1	2
CO-2	3	2	2	1	3	1	2	3	2	3	1	2
CO-3	3	2	2	2	3	1	2	2	2	3	1	2
CO-4	3	2	2	3	3	1	2	1	1	3	1	2

3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		50
1. Solving Numerical Problems	50	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		20
1. Case Study Presentation	15	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	5	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		5
Total Duration in Hours		75

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

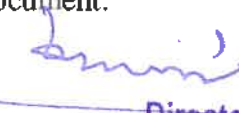
The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ▶	20	20	20	
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.


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The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9.Course Resources

Essential Reading

- i. Gilbert Strang ,Introduction to linear algebra, 5/e, Wellesley-Cambridge Press, 2016.
- ii. Seymour Lipchutz,Marc Lipson,Linear Algebra,Schaum's Outline,4/e,McGraw-Hill Education, 2008
- iii. Peter V. O'Neil, Advanced Engineering Mathematics, 7/e, Cengage, 2012.
- iv. B. S. Grewal, Higher Engineering Mathematics,44/e, Khanna Publishers, 1965.
- v. Michael. D. Greenberg, Advanced Engineering Mathematics, 2/e, Pearson,2002.

10.Course Organization

Course Code	DSC101A		
Course Title	Maths for Data Science		
Course Leader's Name	As per Timetable		
Course Leader's Contact Details	Phone:		
	E-mail:		
Course Specifications Approval Date			
Next Course Specifications Review Date			



Course Specifications: CFC Math (CFC 1)

Course Title	CFC Math (CFC 1)
Course Code	SSF101A
Course Type	Compulsory Foundation Course
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

This course provides a comprehensive introduction to essential mathematical concepts, laying the groundwork for advanced applications. Topics include set theory, logic, and their role in mathematical reasoning. Students will determine the domain and range of functions, perform operations on matrices and determinants, and analyze the intuition behind calculus. The course also explores the principles of permutations and combinations, equipping students with problem-solving techniques applicable across various disciplines. Practical exercises and real-world examples ensure a deep understanding of these foundational concepts.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Understand the basic concepts like set theory and logic

CO-2. Determine the domain and range of various functions

CO-3. Perform operations on matrices and determinants

CO-4. Analyze the intuition behind calculus and apply the concepts of permutations and combinations


Associate Professor
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School of Social Sciences
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Bengaluru – 560054


Director
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4. Course Contents

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Unit 1: Logic:

Propositions and truth values; Tautologies and Contradictions; Deduction and Induction; Different proof techniques.

Unit 2: Set Theory:

Definition of a set and discussion of related concepts; Set types; Complement of a set; Operations on sets; Nested sets; Cartesian product; Concept of Euclidean Space.

Unit 3: Relations and Functions:

Definitions; Concepts of 'range', 'domain' and 'mapping'; Relations; Types of Relations; Explicit and implicit functions; Types of functions - polynomial, Exponential, logarithmic, power etc.

Unit 4: Matrices and Determinants:

Concept of a matrix; Types of matrices; Operations on matrices; Transpose of a matrix; Symmetric and skew-symmetric matrices; Concept of Determinants; Adjoint and inverse of a matrix; Cramer's rule.

Unit 5: Introduction to Differential Calculus:

Discussion of concepts of limits and continuity, derivative, partial derivative, total differential and integral; Derivative of basic functions; Chain rule; Applications of differential and integral calculus to the study of functions: slope and curvature of functions, distinction between concave and convex functions; maxima and minima.

Unit 6: Permutations and Combinations:

Introduction to factorial notation; Permutations and Combinations: Concepts and Applications.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3	2	1	1	1	1	2	2	1	3	2	2
CO-2	3	3	2	1	1	2	2	2	1	3	3	2
CO-3	3	2	2	2	2	2	2	3	1	3	2	2
CO-4	3	3	2	3	3	3	2	3	1	3	3	3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

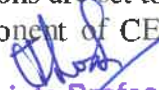
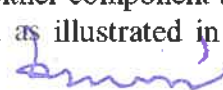
Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		25
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		30
1. Solving Numerical Problems	30	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		05
1. Case Study Presentation	00	
2. Guest Lecture	05	
3. Industry / Field Visit	00	
4. Brain Storming Hospital Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		60

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

 Associate Professor and HOD Department of Data Sciences and Analytics School of Social Sciences M S Ramaiah University of Applied Sciences Bengaluru	 Director School of Social Sciences & School of Law M S Ramaiah University of Applied Sciences Bengaluru - 560054
Focus of COs on each Component or Subcomponent of M S Ramaiah University of Applied Sciences	

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ►	SC1	SC2	SC3	
Subcomponent Type ►	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ►	20	20	20	
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving Cos

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

References

1. Mathematics NCERT Class XI & XII

2. Harcourt Mathematics 11: Functions/Relations
3. Calculus, H. Anton, I. Birens, S. Davis. John Wiley and Sons Inc., 2002
4. Schaum's Outline of Calculus, F. Ayres, E. Mendelson
5. An Introduction to Determinants and Matrices, Frank Bowman

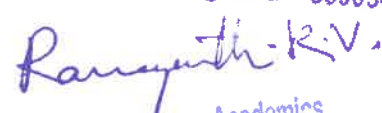
10. Course Organization

Course Code	SSF101A	
Course Title	CFC Math (CFC 1)	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	Phone:	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		




Associate Professor and HOD
 Department of Data Sciences and Analytics
 School of Social Sciences
 M S Ramaiah University of Applied Sciences
 Bengaluru - 560054


Director
 School of Social Sciences & School of Law
 M S Ramaiah University of Applied Sciences
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Dean - Academics
 M.S. Ramaiah University of Applied Sciences
 Bengaluru

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Course Specifications: CFC Statistics

Course Title	CFC Statistics (CFC 2)
Course Code	SSF102A
Course Type	Compulsory Foundation Course
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

This course offers a foundational understanding of statistics and probability, focusing on data analysis and interpretation. Students will learn to collect, organize, and present data effectively using textual, tabular, and diagrammatic methods, including various charts and graphs. The course covers measures of central tendency (mean, median, mode) and dispersion (range, quartile deviation, mean deviation, standard deviation) to analyze data variability. Additionally, students will create frequency distributions and visualize them through histograms, polygons, and ogives. Fundamental probability concepts, including rules, mutually exclusive and independent events, and conditional probability, are introduced and applied to real-world scenarios.

2. Course Size and Credits:

Number of Credits	04
Credit Structure(Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- CO-1.** Collect, organize, and present data effectively using textual, tabular, and diagrammatic methods, including distinct types of charts and graphs.
- CO-2.** Understand and calculate different measures of central tendency, such as arithmetic mean, median, and mode, and determine appropriate measures based on data characteristics.
- CO-3.** Proficient in calculating measures of dispersion, including range, quartile deviation, mean deviation, and standard deviation, and interpreting their significance in analyzing data variability.
- CO-4.** Able to create frequency distributions for both discrete and continuous variables and visualize them using relevant diagrammatic representations, such as histograms, frequency polygons, and ogives. Will grasp the foundational concepts of probability,

including key terminology, mutually exclusive and independent events, basic probability rules, and conditional probability, and apply these concepts to practical scenarios.

4. Course Contents

Unit 1: Introduction

Statistics as a Subject; Importance, Limitations and Misuse of Statistics; Descriptive and Inferential Statistics; Qualitative and Quantitative data; Types of variables -ordinal/nominal/ratio/interval; Descriptive vs. Inferential Statistic

Unit 2: Collection, Organization and Presentation of Data:

Primary and Secondary Data; Methods of Collection; Scrutiny of Data; Presentation of Data: Textual and Tabular Presentations; Diagrammatic Representation of Data: Line Diagrams, Ratio Chart, Bar Diagrams, Pie Charts and Divided-Bar Diagrams.

Unit 3: Frequency Distributions:

Variables and Attributes; Frequency Distribution of an Attribute; Discrete and Continuous Variables; Frequency Distributions of Discrete and Continuous Variables; Diagrammatic Representation of a Frequency Distribution: Case of an Attribute, Case of a Discrete Variable: Column Diagram, Frequency Polygon and Step Diagram, Case of a Continuous Variable: Histogram and Ogive, Frequency Polygon.

Unit 4: Measures of Central Tendency:

Definition and Utility; Characteristics of Average; Different Measures of Average: Arithmetic Mean, Median, Mode; Partitioned Values: Quartile, Percentile and Deciles; Geometric and Harmonic Mean; Choice of a Suitable Measure of Central Tendency.

Unit 5: Measures of Dispersion:

Meaning and Objective of Dispersion; Characteristics of a Good Measure of dispersion; Different measures of dispersion – Range, Quartile deviation, Mean deviation, Mean Absolute Deviation, Standard Deviation; Comparison of the Different Measures of Dispersion; Measures of Relative Dispersion: Coefficient of Variation; Moments; Skewness; Kurtosis.

Unit 5: Basics of Probability:

Probability as a Concept; Some Important Terminology (random experiment, sample space, etc.); Mutually Exclusive Events and Independent Events; Basic Probability Rules; Addition and Multiplication Theorem of Probability; Applications; Conditional Probability: Basic formula and Applications; Bayes' Theorem: Statement, Application

 Associate Professor and HOD Department of Data Sciences and Analytics School of Social Sciences M S Ramaiah University of Applied Sciences Bengaluru - 560054										 Director School of Social Sciences & School of Law M S Ramaiah University of Applied Sciences Bengaluru - 560054		
5. Course Map (CO-PO-PSO Map)												
Programme Outcomes (POs)										Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3		2			1				3	1	2

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

CO-2	3		2			1				3	1	2
CO-3	3		2			1				3	1	2
CO-4	3		2			1				3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		60

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ►	SC1	SC2	SC3	
Subcomponent Type ►	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ►	20	20	20	
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

Associate Professor and HOD
Department of Data Sciences and Analytics

Essential Reading

1. Statistics for Business and Economics" by David R. Anderson, Dennis J. Sweeney and Thomas A. Williams

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2. Introduction to Probability" by Dimitri P. Bertsekas and John N. Tsitsiklis
3. Statistics" by Robert S. Witte and John S. Witte
4. Think Stats" by Allen B. Downey

10.Course Organization

Course Code	SSF102A	
Course Title	CFC Statistics (CFC 2)	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	Phone:	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		



Course Specifications: Programing in R

Course Title	Programing in R
Course Code	DSC102A
Course Type	Core Course
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

The goal of the course is to give the students an introduction to programming through R and teach them how to conduct data analysis through R. After this course, the students will be familiar with basic components of programming such as loops, conditions and functions, and have a working knowledge data wrangling and visualization using the tidyverse ecosystem.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:0:1
Total Hours of Interaction	90
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- CO-1. Comprehend R environment and learn fundamental concepts
- CO-2. Learn to work with data structures and operators
- CO-3. Use R to read files and apply suitable functions for data manipulation
- CO-4. Carry out exploratory data analysis, present data in suitable visual forms and draw insights

Unit 1: R preliminaries

Introduction to R and R Studio, Working directories, Variables, Atomic data types, Default arguments, Packages in R, Basics of R Markdown

Unit 2: Data Structures

Operators in R, Vectors, Matrices, Lists, Dataframes, Dimensionality of data, indexing data structures, String operations using stringr package, Working with data structures, Functions, Conditions, Loops

Unit 3: Handling data

Working with internal datasets, importing datasets, Delimited files - reading and writing delimited files, Data handling – Using Tidyverse, dplyr packages.

Unit 4: Data Visualization

Bar plot, Pie chart, Scatter Plots, Box Plots, Histograms, Density plots, Visualization using ggplot package in R

Unit 5: Exploring data in R

Descriptive measures – Univariate and Bivariate data – Frequency distributions, Measures of Central Tendency, Variability, Skewness and Kurtosis, Correlation, Summary functions, Using Summarytools package, Aggregating and Group Processing functions – aggregate and apply functions

Debugging in R, Basics of Regular Expressions, Basic discussion on web scrapping

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3	2		2					3	3		2
CO-2	3	2		2				1	2	3		
CO-3	3	2		3					2	3	2	
CO-4	3	3	2	3	2	2		3	2	3	2	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	00
Numeracy		
1. Solving Numerical Problems	00	00
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	30	

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

3.Engineering Workshop / Course/Workshop /Kitchen	00	30
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		10
1. Case Study Presentation	05	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming HospitalSessions	00	
5. Group Discussions	05	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		05
Total Duration in Hours		90

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (50% Weightage)			Component 2: SEE (50% Weightage)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ▶	20	20	20	
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following

Approved by the Academic Council at meeting held on 14th July 2023

Page 35 of 158

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

References:

Venables W.N., Smith D.M. et al. (2022), An Introduction to R. CRAN
 Wickham, H. & Golemund, G. (2018). R for Data Science. O'Reilly
 Peng R.D. (2022), R Programming for Data Science. Leanpub

Required software

R: <http://www.r-project.org/>

RStudio (additional libraries required): <http://www.rstudio.com/>

10. Course Organization

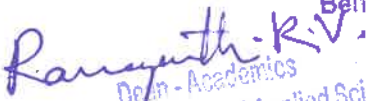
Course Code	DSC102A	
Course Title	Programing in R	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	Phone:	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		



SEMESTER 2


Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054


Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054


Dean - Academics
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Course Specifications: Introduction to Computer Science

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Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

Course Title	Introduction to Computer Science 101
Course Code	SSF103A
Course Type	Compulsory Foundation Course
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course summary:

This comprehensive course explores computer science in a structured progression. Beginning with the foundational elements, students learn about the history and societal impact of computing, followed by an in-depth understanding of number systems. The course advances in hardware components, operating systems, web development, and computer networks, providing both theoretical knowledge and practical skills. Additionally, the course introduces key concepts in algorithms and ethical considerations in computing, equipping students for diverse roles in the field.

2. Course size and credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes:

- 1: Understanding Computer Science Fundamentals.
- 2: Proficiency in Web Development and understanding algorithms.
- 3: Understanding computer hardware and command-line operations.
- 4: Understanding the different fields in Computer Science and AI tools.

4. Course Content:

Module 1: Fundamentals of Computer Science and Number Systems

Introduction to Computer Science and historical overview of computing, Binary and hexadecimal number systems, binary arithmetic, and floating-point representation, Decimal to binary conversion and binary logic, Overview of computer hardware components: CPUs, memory types (RAM, ROM), and storage devices (HDDs, SSDs), Introduction to operating systems: Types (Windows, Linux, macOS), command-line vs. graphical interfaces, and file systems

Module 2: Web Development with HTML and CSS

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

Basics of HTML: Structure, syntax, tags, elements, and attributes, Introduction to CSS: Styling, selectors, cascading, specificity, and advanced layout techniques (Flexbox, CSS Grid), Responsive design: Media queries and adapting websites for different devices, Hands-on practice: Building static web pages with HTML and CSS, Enhancing user experience: CSS transitions, animations, and usability best practices.

Module 3: Algorithms and Problem-Solving

Introduction to algorithms: Basic concepts and algorithm analysis, searching algorithms: Linear search and binary search, sorting algorithms: Bubble sort, quicksort, and their complexities, Problem-solving techniques: Connecting algorithms with real-world scenarios, Interactive sessions

Module 4: Computer Networks and Command-Line Operations

Introduction to computer networks: Topologies, protocols, and OSI model, Network layers: IPv4, IPv6, TCP, UDP, and application-layer protocols (HTTP, FTP), Command-line operations: Basic commands, file system navigation, and scripting tasks

Module 5: Advanced Topics and Ethical Considerations

Subfields of computer science: Software engineering, data science, databases, Latest technologies: Edge computing, quantum computing, bioinformatics, cybersecurity, Ethical considerations in computing: Privacy, security, AI ethics, responsible AI practices, Project work: web development applications (Personal Portfolio webpage designing).

5. CO-PO mapping:

	Programme Outcomes (POs)								Programme Specific Outcomes ((PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3	2	2							1	3	2
CO-2	3	2	2	2						1	3	2
CO-3	2										2	1
CO-4	3	3	3	3	2	3	2	2	2	3	3	3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		5
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	

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Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560054

Director
School of Social Sciences & School of Law
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560054

Page 39 of 158

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

3. Demonstration on a Computer	30	
Numeracy		5
1. Solving Numerical Problems		
Practical Work		5
1. Course Laboratory	5	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		5
1. Case Study Presentation	5	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		60

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ►	SC1	SC2	SC3	
Subcomponent Type ►	Midterm exam	Assignment -1	Assignment-2	
Maximum Marks ►	20	20	20	40 Marks
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

Book:

Computer Science Principles: The Foundational Concepts of Computer Science

Online Reading materials:

[https://openstax.org/books/introduction-computer-science/pages/4-introduction\(Complete Notes\)](https://openstax.org/books/introduction-computer-science/pages/4-introduction(Complete Notes))

- Computer basics: <https://edu.gcfglobal.org/en/computerbasics/>
- Code playing grounds: W3Schools, codepen.io
- binary-numbers-in-computers <https://www.programiz.com/blog/working-of-binary-numbers-in-computers/>
- Operatingsystems <https://www.mygreatlearning.com/blog/what-is-operating-system>
- Link for different Tools to explore in the field of Psychology:

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Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

https://docs.google.com/document/d/1EJpJw37FGzwG7MCWWisXNddHg_vBHrjewCyQ93amj1k/edit?tab=t.0

- Subfields of Computer Science: https://en.wikipedia.org/wiki/Category:Subfields_of_computer_science
- Latest technologies:
- <https://www.mygreatlearning.com/blog/latest-technologies-in-computer-science/#Data-Science>
- <https://www.programiz.com/blog/psychoinformatics>

10.Course Organization

Course Code	SFF103A	
Course Title	Introduction to Computer Science	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	Phone:	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		


Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054


Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560054
Course Specifications: Introduction to Data Science

Course Title	Introduction to Data Science
Course Code	SSF104A

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

Course Type	Compulsory Foundation Course
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

The course aims to introduce fundamentals of data science and provide insights on domain-specific applications.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- CO-1.** Understand data science fundamentals and their applications in social sciences.
- CO-2.** Learn methods for collecting and sampling quantitative and qualitative data.
- CO-3.** Analyze human behavior and systems using social network analysis techniques.
- CO-4.** Learn agent-based models and explore domain specific applications.

4. Course Contents

Unit 1: Fundamentals of data science

Evolution of data science, Types of data - Structured, unstructured, and semi-structured, Key concepts in data science – variables and measurements, Data formats- CSV, JSON, XML, databases, Big data and its characteristics, Role of data in decision making, Ethics and data privacy considerations, Data science in social sciences, AI paradigms- overview of machine learning and deep learning, Ethical and social implications of AI, Emerging trends in data science.

Unit 2: Data Collection Techniques

Data sources – primary and secondary, Quantitative, and qualitative data and their characteristics, Methods of data collection- surveys, interviews, experiments, observations, Sampling- Concept of Population, Sample, Target Population, Sampling Frame, Sampling Unit and Sample Size, Sampling techniques –

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

Probability and Non-Probability Sampling.

Unit 3: Social Network Analysis

Social Network Analysis and its significance, Role of SNA in understanding human behavior, interactions, and systems, Concepts in SNA – nodes, edges, network structure, degree centrality, clusters and communities, Types of networks – undirected, directed, weighted, Overview of the methods of SNA – Graph theory, Clustering and Community Detection, Network Visualization.

Unit 4: Agent-Based Modelling

Agent Based Models (ABM) as a computational approach, Key concepts of ABM – agents, environment, rules of interaction, Components of ABM, Steps of building ABM, Tools for ABM – NetLogo, Python Libraries, AnyLogic, Demonstration of building an ABM, Emerging trends in ABM, ABM in social science applications – social network formation and cultural evolutions, ABM in Market Dynamics and Consumer behaviour, Resource allocation.

Unit 5: Domain-specific Applications

Data Science Use Cases in select sub-disciplines of sociology, economics, and policy - Macroeconomic forecasting and prediction, Stock market prediction, Trade and market analysis, Demand Forecasting, Economic Inequality Studies, Supply Chain optimization, Urban Sociology, Designing the Data analytics workflow for the use-cases.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3	1	1	1	1	1	1	1	3	3	1	2
CO-2	3	2	2	2	1	1	2	2	3	3	1	2
CO-3	3	2	2	2	1	1	2	2	3	3	1	2
CO-4	3	2	2	2	1	1	2	2	3	3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		25

Approved by the Academic Council at meeting held on 14th July 2023

Page 45 of 158

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

Demonstrations		
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		15
1. Case Study Presentation	15	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	05	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		05
Total Duration in Hours		60

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of
Subcomponent ►	SC1	SC2	SC3	

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

				total marks) 100
Subcomponent Type ▶	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ▶	20	20	20	
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	Class Seminars
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	Class Seminars
11.	Presentation Skills	Class Seminars
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	Class Seminars

9. Course Resources

1. Cady, Field. The Data Science Handbook: Advice and Insights from 25 Amazing Data Scientists. Wiley, 2017.
2. Leavy, Patricia. Research Design: Quantitative, Qualitative, Mixed Methods, Arts-Based, and Community-Based Approaches. 1st ed., Guilford Press, 2017.
3. Scott, John. Social Network Analysis: A Handbook. 4th ed., SAGE Publications, 2017.

Associate Professor
Department of Data Science
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

10. Course Organization

Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

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Page 47 of 158

Programme Structure and Course Details of B.Sc. In Data Science 2024-2028

Course Code	SSF104A	
Course Title	Introduction to Data Science	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	Phone:	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		



Course Specifications: Inferential Statistics

Course Title	Inferential Statistics
Course Code	DSC104A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

Introduce the basic elements of statistical methods in the estimation of population parameters. The subject helps students to familiarize themselves with various methods of hypothesis testing and their properties. Applications in business will be emphasized by using practical examples to illustrate the principles and methods.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	5:0:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1: Identify and analyze critical features of data sets on real-life business situations

CO-2: Understand and apply statistical reasoning to the concept of parameter estimation on mean, proportion, and variance

CO-3: Acquire techniques to calculate problems on point and interval estimation

CO-4: Solve concepts on Testing of Hypotheses both on large and small samples and Hypothesize advanced statistical techniques for modeling by exploring practical situations

[Signature]
Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

Course Contents

[Signature]
Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

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[Signature]
Dean, Academic
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 1: Sampling Distributions

Population and random samples; The Central Limit Theorem; Sampling distributions related to sample means, sample proportions, and sample variances.

Unit 2: Useful Distributions in Statistical Inference

Definitions and properties of normal, t, F, and chi-square distributions; Familiarization with the relationships between these distributions and the use of corresponding tables.

Unit 3: Estimation of Parameters

Concepts of point estimator, unbiasedness and efficiency; Concepts of confidence interval; Point and interval estimates of a mean and the difference between two means, proportion and the difference between two proportions, variance and the ratio of two variances; Sample size determination; Illustrative examples of their applications in business.

Unit 4: Test of Hypotheses

Statistical hypotheses and their tests; Type I and type II errors; One sided and two-sided tests; Tests of significance; Levels of significance; Test statistics; Critical regions; p-values; Tests for an assumed mean, the difference between two means, an assumed proportion, the difference between two proportions, an assumed variance, and the ratio of two variances; Illustrations of their applications in business; The use of chi-square tests for goodness of fit and independence; Contingency tables; Illustrative examples of their applications in business.

Unit 5: Nonparametric Tests

Nonparametric tests: the sign test, the signed-rank test, the rank-sum test, the Kolmogorov-Smirnov test, and then the run-test

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	2		3		3	3		2		2	3	1
CO-2	2		3		3	3		2		2	3	1
CO-3	2		3		3	3		2		2	3	1
CO-4	2		3		3	3		2		2	3	1

3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution

6. Course Teaching and Learning Methods

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2023-2027

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		60
Demonstrations		
1. Demonstration using Videos	00	00
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		
1. Solving Numerical Problems	15	15
Practical Work		
1. Course Laboratory	00	00
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop /Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	00
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		75


 Associate Professor
 Department of Data Science
 School of Social Sciences
 M S Ramaiah University of Applied Sciences
 Bengaluru - 560054


 Director
 School of Social Sciences & School of Law
 M S Ramaiah University of Applied Sciences
 Bengaluru - 560054


 Dean - Academics
 M S Ramaiah University of Applied Sciences
 Bengaluru

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7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ►	SC1	SC2	SC3	
Subcomponent Type ►	Midterm exam	Assignment -1	Assignment-2	
Maximum Marks ►	20	20	20	40 Marks
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

1. Dunlop, Tamhane, Statistics, and Data Analysis: From Elementary to Intermediate, 1st edition,

Pearson, 2000

2. William M.K. Trochim, Research Methods Knowledge Base
3. Sprint hall, R. C. Basic Statistical Analysis. Publisher: Allyn and Bacon
4. Howell D. C. (2007), Statistical Methods for Psychology (6th Ed.). Publisher: Thomson/Wadsworth.

10. Course Organization

Course Code	DSC104A	
Course Title	Inferential Statistics	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	Phone:	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		




Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054


Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054


Deputy Academic
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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Course Specifications: Programming in Python

Course Title	Programming in Python
Course Code	DSC106A
Course Type	Core Course
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

The objective of the course is to familiarize the students about the various concepts in data types, variable, Control Flow. Writing functions, basic concepts of Data Structure. Students will learn to code in Jupyter Notebook. They will learn to work on Numpy and Pandas packages.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:0:2
Total Hours of Interaction	90
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1: Understand Python fundamentals, including its syntax, variables, data types, operators, and basic string operations, and effectively use Jupyter Notebook as a development environment.

CO-2: Apply Python data structures such as lists, tuples, sets, and dictionaries to organize and manage data efficiently.

CO-3: Develop functional programs using Python's control structures and perform numerical operations using NumPy for single-dimensional and multi-dimensional arrays.

CO-4: Perform data manipulation, analysis, and visualization using Pandas, including data indexing, slicing, grouping, aggregation, and merging techniques to address real-life scenarios.

4. Course Contents

Unit 1: The Basics of Python:

Introduction to Python, IDE: Installing Anaconda, Jupyter Notebook , Python Character set, Variables, Data Types, Typecasting, Operators, Arithmetic Operation, Python Tokens, String Operation

Unit 2: Python Data Structure:

List, Tuple, Sets, Dictionary

Unit 3: Python Control Structure and Functions:

Decision Making, Loops and Iterations, Functions-Def, Lambda, Map, Filter, Reduce

Unit 4: Python Packages NumPy:

Introduction to Numpy, Basics of Numpy., Operation of on 1D array and multi-dimensional array, Creating Numpy arrays, Mathematical operations on NumPy arrays

Unit 5: Pandas:

Introduction to pandas, Basics of pandas, Rows and columns, Indexing, Slicing, Operation on data frames, Group by and aggregate functions, Merging and pivot table

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1			1		2			3		3	2	1
CO-2			1		2			3		3	2	1
CO-3			1		2			3		3	2	1
CO-4			1		2			3		3	2	1

3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		0
Demonstration using Videos		
2. Demonstration using Physical Models / Systems		
Demonstration on a Computer		
Practical Work		
Solving Numerical Problems		
Course Laboratory		
Computer Laboratory		


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3. Engineering Workshop / Course/Workshop /Kitchen		
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	10
4. Brain Storming Sessions	10	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		
Total Duration in Hours		90

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40 % Weightage of total 100 marks)
Subcomponent ►	SC1	SC2	SC3	
Subcomponent Type ►	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ►	20	20	20	
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2023-2027

3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

Essential Reading

1. Python for Data Analysis Data Wrangling with Pandas, NumPy, and IPython by **Wes McKinney (O'Reilly Publication)**
2. Practical Time Series Analysis: Prediction with Statistics and Machine Learning by **Aileen Nielsen (O'Reilly Publication)**
3. Python for Data Analysis Data Wrangling with Pandas, NumPy, and IPython by **Wes McKinney (O'Reilly Publication)**
4. Recommended Links: <https://www.w3schools.com/python/>

10. Course Organization

Course Code	DSC106A	
Course Title	Programming in Python	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	Phone:	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		


Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054


Director
School of Social Sciences & School of Law
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Course Specifications: Advanced Excel

Course Title	Advanced Excel
Course Code	DSU102A
Course Type	Skill Enhancement Course
Department	Data Sciences & Analytics
Faculty	School of Social Sciences

1. Course Summary

MS Excel is an essential tool in today's globalized world, widely used for data analysis, financial modeling, statistical calculations, and data visualization in both academic and professional environments. This course aims to equip participants with advanced skills to perform complex arithmetic, financial, and statistical operations. Emphasis will be placed on mastering tools such as Pivot Tables, What-If Analysis, and data management techniques. Participants will also learn to audit and analyze data, utilize Excel's data tools, and gain hands-on experience in creating and managing macros to automate tasks. By the end of the course, participants will be well-prepared to derive meaningful insights from data, enhancing their employability and enabling more informed research and business decisions.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	0:0:2
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Data Sciences & Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulation/ Programme Specifications
Attendance Requirement	As per the Academic Regulations/ Programme Specifications

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Master Excel for Data Management and Analysis

CO-2. Design and Implement Data Visualizations

CO-3. Automate and Optimize Excel Processes

CO-4. Transform and Cleanse Data Using Advanced Excel Tools

4. Course Contents

Unit 1 - Data Entry and Workbook Management

Workbook, worksheet, and cell concepts. Data types, handling mixed data types. Creating, opening, saving, and managing workbooks. Working with multiple worksheets and workbooks. Basic data cleaning

and handling missing values. Naming cells, Fill/Series/Custom lists, data entry, and editing. Formatting data, headers, footers, and page setup for printing. Basic date/time handling and manipulation. Working with structured tables and ranges

Unit 2 - Data Analysis with Excel Functions and Tools

Excel built-in formulas and libraries. Financial, statistical, string, and logical functions. Using array formulas and dynamic arrays. Regression analysis and correlation. Working with PowerPivot for data modeling. Cell referencing: Absolute, relative, and mixed. Filtering, conditional formatting, and applying advanced filters. Advanced Excel functions: HLOOKUP, VLOOKUP, INDEX/MATCH, and array formulas. What-If Analysis and Goal Seek

Unit 3 - Data Visualization and Automation

Creating charts and interactive visualizations. Customizing charts for presentation. Dynamic charts and interactive reports. Working with Power BI integration. Recording and managing macros for automation. Advanced VBA for automating complex tasks. Data validation and using form controls for inputs

Unit 4 - Power Query for Data Transformation

Introduction to Power Query for data transformation. Data loading and cleaning from multiple sources. Advanced data wrangling (e.g., unstructured data, nested data). Merging and appending data. Power Query integration with databases and APIs. Data validation and quality control in Power Query

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3	1	1	1		1	1	1	1	3	1	2
CO-2	3	2	2	2	1	1	2	2	2	3	1	2
CO-3	3	2	2	2	1	1	2	2	2	3	1	2
CO-4	3	2	2	2	1	1	2	2	2	3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		00
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2023-2027

Practical Work		50
1. Course Laboratory	00	
2. Computer Laboratory	50	
3. Engineering Workshop / Course / Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		05
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	05	
6. Discussing Possible Innovations	00	
Laboratory Examination		05
Total Duration in Hours		60

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the **BSc. (H) Data Sciences & Analytics**. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1 and SC2), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
Subcomponent ▶	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
	SC1	SC2	SC3	
Subcomponent Type ▶	Lab exam	Assignment -1	Project	40 marks
Maximum Marks ▶	20	20	20	
CO-1				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations / Programme Specifications document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

Approved by the Academic Council at meeting held on 14th July 2023

Page 61 of 158

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures and laboratory instructions
2.	Understanding	Laboratory instruction
3.	Critical Skills	Laboratory work
4.	Analytical Skills	Laboratory work
5.	Problem Solving Skills	Laboratory work
6.	Practical Skills	Laboratory work
7.	Group Work	Laboratory work
8.	Self-Learning	Laboratory work
9.	Written Communication Skills	Laboratory work
10.	Verbal Communication Skills	Laboratory Viva
11.	Presentation Skills	Laboratory report
12.	Behavioral Skills	---
13.	Information Management	Laboratory report
14.	Personal Management	Effective management of learning, time management, achieving the learning outcomes
15.	Leadership Skills	Laboratory instruction
16.	Ability Enhancement	Laboratory work
17.	Skill/Vocational Enhancement	Laboratory work, Laboratory report

9. Course Resources

a. Essential Reading

1. "Excel 2019 Bible" by John Walkenbach
2. "Microsoft Excel Data Analysis and Business Modeling" by Wayne Winston
3. "Excel Power Pivot and Power Query for Dummies" by Michael Alexander and John Walkenbach

b. Recommended Reading

1. "Power Query for Power BI and Excel" by Chris Webb
2. "The Big Book of Dashboards: Visualizing Your Data for Better Business Decisions" by Steve Wexler, Jeffrey Shaffer, and Andy Cotgreave

c. Magazines and Journals

1. Harvard Business Review (HBR)
2. Journal of Data Science and Analytics
3. Analytics Magazine

d. Websites

1. <https://www.microsoft.com/en-us/microsoft-365/excel>
2. <https://community.powerbi.com/>
3. <https://stackoverflow.com/questions/tagged/excel>
4. <https://www.datacamp.com/courses/tech:excel>

e. Other Electronic Resources

1. ExcellsFun YouTube Channel
2. <https://www.linkedin.com/learning/>
3. <https://www.excel-dashboard-templates.com/>

10. Course Organization

Course Code	DSU102A	
Course Title	Advanced Excel	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	Phone:	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		




Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bangalore - 560054


Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bangalore - 560054


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Bangalore - 560 054

SEMESTER 3

Course Specifications: Regression Techniques and Time Series Analysis

Course Title	Regression Techniques and Time Series Analysis
Course Code	DSC105A
Course Type	Core Theory
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

The benefit of simplicity, parsimony and interpretability offered by regression models (and their close generalizations) should make them a first tool of choice for any practical problem. Regression models are the workhorse of data science. They are the most well-described, practical, and theoretically understood models in statistics. This course intends to help students understand the basic premises of regression techniques thereby equipping them to apply the course content to basic and advanced problems later.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	5:0:0
Total Hours of Interaction	90
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1: Understand the concept of a simple linear regression model and properties of model parameters;

CO-2: Understand the development of modern statistical models and the relationships of these models;

CO-3: Apply various linear models to address research questions and fit into different data Structure;

CO-4: Help the students learn basic analysis of time series data; learn basic concepts in time series regression; learn forecasting based on baseline model, auto-regressive and moving average process; visualization, and analysis of time series data.

[Signature]
Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

4. Course Contents

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Approved by the Academic Council at meeting held on 14th July 2023

Page 65 of 158

Unit 1: The Nature of Regression Analysis: Historical Origin of the Term Regression; The Modern Interpretation of Regression; Statistical versus Deterministic Relationships; Regression versus Causation; Regression versus Correlation

Unit 2: Two-Variable Regression Analysis: Some Basic Ideas: The Concept of Population Regression Function (PRF); The Meaning of the Term Linear; Stochastic Specification of PRF; The Significance of the Stochastic Disturbance Term; The Sample Regression Function (SRF).

Unit 3: Two-Variable Regression Model: The Problem of Estimation: The Method of Ordinary Least Squares; The Classical Linear Regression Model; Properties of Least-Squares Estimators; The Gauss–Markov Theorem

Unit 4: Classical Normal Linear Regression Model (CNLRM): The Normality Assumption for UI; Properties of OLS Estimators under the Normality Assumption

Unit 5: Two-Variable Regression: Interval Estimation and Hypothesis Testing: Interval Estimation: Some Basic Ideas; Confidence Intervals for Regression; Hypothesis Testing

Unit 6: Time-series (TS) analysis: Forecasting, Components of TS, Baseline model and Moving Average and Auto-regressive Model in TS, Measure of Forecast Accuracy

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3	2				1				3	2	3
CO-2	3	3		2		2				3	2	3
CO-3	3	3	3		2		2		1	3	2	3
CO-4	2		3	3		3			2	3	2	3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		50
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2023-2027

Numeracy		05
1. Solving Numerical Problems	45	
Practical Work		30
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop /Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		05
1. Case Study Presentation	10	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		90

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component(CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ►	SC1	SC2	SC3	
Subcomponent Type ►	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ►	20	20	20	
CO				

The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

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Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

Essential Reading

1. Kenney and Keeping. Mathematical Statistics. Part 1 & Part II, Chapman and Hall.
2. Croxton, Cowden and Klein. Applied Statistics, Prentice Hall.
3. Hogg and Craig. Introduction to Mathematical Statistics, Prentice Hall.
4. Goon, Gupta and Dasgupta. Fundamentals of Statistics, The World Press.
5. N G Das, Statistical Methods, McGraw Hill Education

10. Course Organization

Course Code	DSC105A	
Course Title	Regression Techniques and Time Series Analysis	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	Phone:	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		



Course Specifications: Data Pre-processing

Course Title	Data Pre-processing
Course Code	DSC203A
Course Type	Core Course
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

The Data Pre-processing course covers essential techniques for preparing and analyzing data. It includes data cleaning, transformation, and handling missing values using tools like Pandas. It explores data visualization with Matplotlib and Seaborn, covering various plots, outlier detection, and data handling. The course also covers univariate, bivariate, and multivariate analysis, focusing on statistical insights and relationships. Finally, it introduces linear regression (SLR & MLR), covering model building, multicollinearity, and performance evaluation for predictive analytics.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:0:1
Total Hours of Interaction	90
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO1: Explain the importance of data pre-processing in data science and apply essential steps such as data cleaning, transformation, and preparation to create analysis-ready datasets.

CO2: Demonstrate proficiency in using Python libraries like Pandas, Matplotlib, and Seaborn to pre-process and visualize datasets, supporting data-driven insights.

CO3: Conduct univariate, bivariate, and multivariate analyses to understand relationships in data and derive meaningful interpretations for data-driven decision-making.

CO4: Apply data pre-processing techniques such as handling missing values, outlier detection, feature scaling, and encoding in supervised learning contexts, specifically in linear regression models.

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences

4. Course Contents

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Director
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560054

Page 69 of 158

Unit 1: Overview of Data Pre-processing

Introduction to Data Pre-processing, Importance of data pre-processing in data science, Common Steps in Data Pre-processing, Tools and Techniques used for Data Pre-processing Data Pre-processing workflow, Pandas: Pandas Basics, Rows and columns, Describing Data, Indexing and Slicing
Pandas: Operations on Dataframes, Groupby and Aggregate Functions, Merging Dataframes

Unit 2: Data Visualization: Matplotlib

Introduction to Matplotlib, The necessity of Data Visualization, Facts and Dimensions
Bar Graph, Scatter Plot, Line Graph and Histogram, Box Plot, Sub Plots, Choosing Plot Types, Data Handling and Cleaning
, Sanity Checks, Outlier Analysis with Box Plots, Histograms

Unit 3: Data Visualization: Sea Born

Introduction to Sea Born, Distribution Plots, Styling Options, Pie Chart and Bar Chart, Scatter Plots, Pair Plots, Revisiting Bar Graphs and Box Plots, Heat Maps, Line Charts, Stacked Bar charts

Unit 4: Data Cleaning and Data Transformation

Introduction, Data Types, Fixing the Rows and Columns, Impute/Remove Missing Values
Handling Outliers, Standardising Values, Fixing Invalid Values and Filter Data

Unit 5: Univariate, Bivariate and Multivariate Analysis:

Introduction to Univariate Analysis, Categorical Unordered Univariate Analysis, Categorical ordered Univariate Analysis
Statistics on Numerical Features, Introduction to Bivariate Analysis, Numeric-Numeric Analysis
Correlation vs Causation, Numerical-Categorical Analysis, Categorical-Categorical Analysis, Multivariate Analysis

Unit 6: Simple Linear Regression and Multiple Linear Regression

Introduction, Assumption of SLR, Hypothesis Testing in Linear Regression, Building a Linear Model
Residual Analysis and Prediction, Moving from SLR to MLR, Multicollinearity, Dealing with Categorical Variables
Model Assessment and Comparison, Feature Selection, SLR and MLR with Python

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)	Programme Specific Outcomes
--	--------------------------	-----------------------------

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2023-2027

										(PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1			1		2			3		3	2	1
CO-2			1		2			3		3	2	1
CO-3			1		2			3		3	2	1
CO-4			1		2			3		3	2	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		15
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	15	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	00	
2. Computer Laboratory	30	
3. Engineering Workshop / Course/Workshop /Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		15
1. Case Study Presentation	05	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	10	
6. Discussing Possible Innovations	00	
Term Tests		00
Laboratory Examination/Written Examination		00

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

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Presentations	
Total Duration in Hours	90

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Midterm exam	Assignment -1	Assignment-2	
Maximum Marks ▶	20	20	20	40 Marks
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

1. Python for Data Analysis (Data Wrangling with Pandas, NumPy, and Ipython) by Wes McKinney (O'Reilly Publication)
2. <https://www.python.org/>
3. Python Cookbook by David Beazley and Brian K. Jones
4. <https://numpy.org/>
5. <https://pandas.pydata.org/>
6. <https://scikit-learn.org/stable/>
7. <https://matplotlib.org/>

10. Course Organization

Course Code	DSC203A
Course Title	Data Pre-processing
Course Leader's Name	As per Timetable
Course Leader's Contact Details	Phone:
	E-mail:
Course Specifications Approval Date	
Next Course Specifications Review Date	


Associate Professor and HOD
 Department of Data Sciences and Analytics
 School of Social Sciences
 M S Ramaiah University of Applied Sciences
 Bengaluru – 560054


Director
 School of Social Sciences & School of Law
 M S Ramaiah University of Applied Sciences
 Bengaluru – 560054

Approved by the Academic Council at meeting held on 14th July 2023

Page 73 of 158


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Course Specifications: Database Management Systems

Course Title	Database Management Systems
Course Code	DSC202A
Course Type	Core Course
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

This course is intended to provide a thorough knowledge of the principles, design, programming, and applications of database systems. The concepts of databases along with the challenges of effective design of database systems are taught. Data modeling, schemas, normalization, and query languages are covered in detail. The physical organization of databases, indexing structures, and transaction processing are covered. Multidimensional data modeling and OLAP concepts are introduced. Database administration, management, and interfacing are covered. Students are trained to design, implement and interface databases for data-centric software applications.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:0:1
Total Hours of Interaction	90
Number of Weeks in a Semester	15
Department Responsible	Data sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- Understand the core concepts, design methodologies, and applications of database systems, including data modeling, querying, and storage principles.
- Utilize database principles to analyze schemas, normalize data structures, and optimize relational databases.
- Construct and execute efficient queries using query languages to address practical database scenarios.
- Design and develop effective database systems and integrate them with applications to address real-world challenges

4. Course Contents

Unit 1 : Introduction to Database Systems:

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2023-2027

Purpose of database systems, characteristics of database approaches, history of database applications, classification of DBMS, database users, architectures for DBMS, recent database applications, data models, schemas, data independence, database design, and implementation process.

Unit 2 Entity-Relationship Model:

E-R diagrams, entities, attributes, relationships, roles and constraints, Enhanced Entity-Relationship (EER) diagrams, subclasses and super classes, specialization, and generalization.

Unit 3 - Relational Data models: Relational schema, relational model constraints, keys, relational database design, relational algebra, relational calculus.

Unit- 4 Query Languages:

SQL- data definition and data types, query formulation, constraints in SQL, basic queries in SQL, complex queries in SQL, QBE, query processing, database programming - techniques and issues, embedded SQL, using JDBC, database stored procedures.

Unit-5 : Normalization for Relational Databases:

Functional dependency, normal forms, decomposition of a schema, multivalued dependencies, join dependencies, dependency preservation, inclusion dependencies.

Unit- 6: File Organization and Storage:

Basic file structure, RAID technology, hashing techniques, indexing structures, types of single-level ordered indexes, multi-level indexes, B+ trees.

Unit -7: Transaction Processing:

Transaction processing systems, transaction states, ACID properties, characterizing schedules, recoverability, and serializability of schedules, concurrency control, locking techniques, timestamp ordering, database recovery techniques, shadow pages, ARIES recovery algorithm, database security, and authorization.

Unit-8: Multidimensional Data Modeling:

Logical multidimensional data model, cubes, dimensions, measures, OLAP servers, ROLAP- fact and dimension tables, star and snowflake schemas.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3	2	2						2		3	2
CO-2	3	3	3		2				2	2	3	3
CO-3	3	3	3		2						3	3
CO-4	3	3	3	2	3	2			3	2	3	3

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Department of Social Sciences
School of Social Sciences
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560054

3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate

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Page 75 of 158

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Contribution

6.Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		30
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	30	
Numeracy		
1. Solving Numerical Problems		
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop /Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		90

7.Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ▶	20	20	20	
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

Associate Professor and HOD
Department of Data Sciences and Analytics
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Bangalore - 560054

Online Materials: GeeksforGeeks, Java I point etc.

Medium publications link for Mastering SQL Roadmap , materials, SQL projects :
<https://estheranagu.medium.com/clear-roadmap-to-mastering-sql-in-2024-db633eac4c88>

Guide to Database Schema Design: <https://www.integrate.io/blog/complete-guide-to-database-schema-design-guide/>

Approved by the Academic Council at meeting held on 14th July 2023

Page 77 of 158

Database Designing Use Case Scenarios: <https://www.geeksforgeeks.org/how-to-design-a-database-for-booking-and-reservation-systems/>

ER-Modelling: <https://vertabelo.com/blog/er-diagram-for-a-university-database/>

Code platforms: SQL50 Leet code, W3schools – MySQL, SQL zoo

10. Course Organization

Course Code	DSC202A	
Course Title	Database Management Systems	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	Phone:	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		



SEMESTER 4


Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054


School of Soc.
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Course Specifications: Multivariate Analysis

Course Title	Multivariate Analysis
Course Code	DSC201B
Course Type	Core Theory + Practical
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

Multivariate Analysis is a statistical technique used to analyze relationships among multiple variables simultaneously. This course delves into advanced statistical methods, exploring how various variables interact and influence each other within a dataset. Students will learn techniques such as multivariate regression, factor analysis, and multivariate analysis of variance

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:0:1
Total Hours of Interaction	90
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- CO-1** . Learn to develop an in-depth understanding of the Multivariate models, methods and techniques
- CO-2.** Demonstrate the knowledge and skill of multivariate normal distributions, related probability distributions and their applications
- CO-3.** Examine the relationships between dependent and independent variables of multivariate models, estimate the parameters and fit a model.
- CO-4.** Perform, handle and manipulate the analysis of logistic regression.

4. Course Contents

Unit 1: Introduction to Multivariate Data Analysis

Understanding of multivariate data and their diagrammatic representation. Exploratory multivariate data analysis, mean vector, covariance and correlation matrix, graphical representation of means, variances, co-

variances, correlations of linear transforms, ANOVA model

Unit 2: Multivariate Normal Distribution

Introduction to multivariate distribution, probability density function and moment generating function of multivariate normal distribution, singular normal distributions, distribution of linear and quadratic form of normal variables, marginal and conditional distributions. Random sampling from multivariate normal distributions. Goodness of fit of multivariate normal distribution.

Unit 3: Multivariate Linear Model and Analysis of Variance and Covariance

Maximum likelihood estimation of parameters, tests of linear hypothesis, distribution of partial and multiple correlation coefficients and regression coefficients. Multivariate linear regression multivariate analysis of variance of one- and two-way classification data (only Likelihood Ratio test)

Unit 4: Logistic Regression

Regression with a binary dependent variable, representation of the binary dependent variable, estimating the logistic regression model, assessing the goodness of fit of the estimation model, testing for significance of the coefficients, interpreting the coefficients.

Unit 5: Other Multivariate Analysis techniques

Worked out examples on LDA, PCA, MDS, ANOVA 1 way, ANOVA 2 way, MANOVA

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3	2			3	1				3	3	3
CO-2	3	3	2			2				3	3	3
CO-3	3	3	3	3			2			3	3	3
CO-4	3	2	3						2	3	3	3

3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate

Contribution

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		15
1. Solving Numerical Problems	15	
Practical Work		30
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop /Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		90

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: CE (60% Weightage of total 100	Component

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2023-2027

	marks)			2: SEE (40% Weightage of total 100 marks)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ▶	20	20	20	
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

1. Hardy W.K. and Simor L., Applied Multivariate Statistical Analysis, 4 th Edition, Springer-Verlag, 2015.
2. Joseph F. Hair, Jr., William C. Black, Barry J. Babin, Rolph E. Anderson and Ronald L. Tatham, Multivariate Data Analysis, 7 th Edition, Pearson Education India, 2014.
3. Rao, C. R. and Rao, M. M., Multivariate Statistics and Probability, Elsevier & Academic Press, 2014.
4. Basic Econometrics by Damodar N. Gujarati and Dawn C. Porter

10. Course Organization

Course Code	DSC201B		
Course Title	Multivariate Analysis		
Course Leader's Name	As per Timetable		
Course Leader's Contact Details	Phone:		
	E-mail:		
Course Specifications Approval Date			
Next Course Specifications Review Date			



Course Specifications: Data Warehousing and Mining

Course Title	Data Warehousing and Mining
Course Code	DSC205A
Course Type	Core Course
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

The course provides a comprehensive understanding of storing, managing, and analyzing large volumes of data efficiently. Students learn the principles of data warehousing architecture, focusing on designing and building data warehouses. The course delves into advanced techniques for data mining, covering algorithms for pattern recognition, clustering, and predictive modeling. Students gain hands-on experience in using tools like SQL Server, Oracle, and data mining software.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:0:1
Total Hours of Interaction	90
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

1. Understand the core principles and structure of data warehousing, with an emphasis on modeling and design.
2. Effectively implement and optimize modern data storage solutions, particularly using cloud-based architectures and SQL techniques.
3. Master the techniques for managing data flow and transformation within cloud environments, including integration with external sources.
4. Showcase proficiency in advanced platform features and apply analytical techniques for effective decision-making and problem-solving.

4. Course Contents

(Signature)
Associate Professor and Head
Department of Data Sciences and Analytics
School of Social Sciences
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560054

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(Signature)
Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560054

(Signature)
Director
School of Social Sciences & School of Law
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560054

Module 1: Foundations of Data Warehousing and Snowflake Basics

Basics of Data Warehousing, Data Warehouse Architecture, Differences between Data Warehousing and Traditional Databases, Dimensional Modeling: Concepts of Facts and Dimensions, Types of Facts and Dimensions, Steps Involved in Building a Data Warehouse, Star Schema vs. Snowflake Schema, Snowflake Architecture, Virtual Warehouse, Creating a Free Trial Account and Overview of Snowflake Web Interface (Snowsight), Data Loading and Transformation: Fast and Bulk Data Loading, Loading Data from Local File System into Snowflake

Module 2: Intermediate Snowflake Features and Integration

Stages in Snowflake: Purpose and Practice, External Stages and Internal Stages, Integration with AWS S3 Storage, Loading and Processing Semi-Structured Data, External Tables, Snowpipe: Purpose and Practice, Caching in Snowflake, Micro Partitions and Data Clustering, Time Travel: Purpose and Practice, Fail Safe, Zero-Copy Cloning, Types of Tables, Role-Based Access Control

Module 3: Designing Data Marts and Advanced Data Management

Slowly Changing Dimensions, Designing Data Marts: Understanding Business Requirements, Identifying and Designing Data Marts for Specific Business Functions, Optimizing Data Warehouse, Modern Data Warehouse, Views in Snowflake: Standard Views and Materialized Views, Dynamic Data Masking, Data Sharing, Tasks and Streams, Data Unloading, Data Sampling, Stored Procedures, User-Defined Functions (UDFs)

Module 4: OLAP Systems and Data Mining Basics

Resource Monitors, Integration of Snowflake with Power BI, Online Transaction Processing (OLAP), OLAP Architecture, Types of OLAP Systems: MOLAP, ROLAP, HOLAP, Data Mining: Introduction, Types of Data: Structured, Unstructured, Semi-Structured

Module 5: Data Mining Techniques and Exploratory Analysis

Data Quality: Importance and Challenges, Methods to Improve Data Quality, Data Preprocessing: Cleaning, Transformation, Reduction, Similarity Measures in Data Mining, Summary Statistics and Data Distributions, Exploratory Data Analysis (EDA) Using WEKA Tools, Challenges in Data Mining: Scalability, Dimensionality, Noise, Addressing Challenges Through Preprocessing Techniques in WEKA, Overview of the CRISP-DM Process Model: Understanding Business Objectives, Data Understanding and Data Preparation, Modeling and Evaluation: Building and Evaluating a Basic Model in WEKA, Revision and Practice Tests

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3	2	2		2	2				1	3	2
CO-2	3	2	2	2	2	2	3			1	3	3
CO-3	3	3	3		3	3	3			2	3	3
CO-4	3	3	3	3	3	3	2	2	2	3	3	3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		30
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	30	
Numeracy		
1. Solving Numerical Problems		
Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		90

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ▶	SC1	SC2	SC3	

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560 054

Ramya R.V.

Dezn - Academics
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560 054

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Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2023-2027

Subcomponent Type ▶	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ▶	20	20	20	
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester. Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources**Books Recommended:**

1. Pang – ningTan , Steinbach & Kumar, "Introduction to Data Mining", Pearson Edu, 2019.
2. Jaiwei Han, Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers

Reference Books:

1. Margaret H. Dunham, "Data Mining: Introductory and Advanced topics", Pearson Edu., 2009.
2. Anahory& Murray, "Data Warehousing in the Real World", Pearson Edu., 2009.
3. Data Mining: Practical Machine Learning Tools and Techniques (Morgan Kaufmann Series in Data Management Systems) 4th Edition by Ian H. Witten (Author), Eibe Frank (Author), Mark A. Hall (Author), Christopher J. Pal (Author)

Must read:

<https://www.1keydata.com/datawarehousing/datawarehouse.html>

Snowflake Documentation: (base resource)

<https://docs.snowflake.com/en/guides>

10. Course Organization

Course Code	DSC205A		
Course Title	Data Warehousing and Mining		
Course Leader's Name	As per Timetable		
Course Leader's Contact Details	Phone:		
	E-mail:		
Course Specifications Approval Date			
Next Course Specifications Review Date			



Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

Rangayuth R.V.
Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560054

Course Specifications: Artificial Intelligence

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2023-2027

Course Title	Artificial Intelligence
Course Code	DSC206B
Course Type	Core Course
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

This course provides students with a comprehensive understanding of the foundational concepts, methods, and applications of Artificial Intelligence (AI), focusing on problem-solving, reasoning, decision-making under uncertainty, and specialized topics such as computer vision and natural language processing. The course aims to equip students with theoretical knowledge and practical skills to develop intelligent systems capable of rational decision-making and knowledge representation.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	5:0:0
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

The students should be able to:

CO1: Demonstrate knowledge of the history, foundations, and principles of Artificial Intelligence, including agents, environments, and rationality concepts.

CO2: Apply search strategies and adversarial game techniques to solve complex problem-solving tasks in various deterministic and nondeterministic environments.

CO3: Develop reasoning and planning models using propositional and first-order logic, knowledge representation, and automated planning methods.

CO4: Analyze uncertainty in decision-making and implement probabilistic reasoning models, Bayesian networks, and basic applications of computer vision and natural language processing.

4. Course Contents

Unit I: Introduction to Artificial Intelligence (Week 1)

Foundations of Artificial Intelligence, History of Artificial Intelligence, Risks and Benefits of AI, Agents

and Environments, Concept of Rationality, Nature of Environments, Structure and Types of Agents

Unit II: Problem-Solving (Week 2-4)

- **Problem-Solving by Searching:** Introduction to Problem-Solving Agents, Example Problems, Search Algorithms: Uninformed and Informed (Heuristic) Search Strategies, Heuristic Functions, Search in Complex Environments: Local Search and Optimization Problems, Local Search in Continuous Spaces, Search with Nondeterministic Actions, Search in Partially Observable Environments, Online Search Agents and Unknown Environments

Adversarial Search and Games: Introduction to Game Theory, Optimal Decisions in Games, Heuristic Alpha-Beta Tree Search, Monte Carlo Tree Search, Limitations of Game Search Algorithms

Unit III: Knowledge, Reasoning, and Planning (Week 5-9)

- **Logical Agents:** Knowledge-Based Agents, Propositional Logic: Syntax, Semantics, and Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic, First-Order Logic: Representation, Syntax, and Semantics, Knowledge Engineering in First-Order Logic
- **Knowledge Representation:** Categories and Objects, Events, Mental Objects, and Modal Logic, Reasoning Systems for Categories, Reasoning with Default Information
- **Automated Planning:** Classical Planning and Its Algorithms, Heuristics for Planning, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Time, Schedules, and Resources, Analysis of Planning Approaches

Unit IV: Uncertain Knowledge and Reasoning (Week 10-12)

- **Quantifying Uncertainty:** Acting under Uncertainty, Probability Notation and Bayes' Rule, Naïve Bayes Models
- **Probabilistic Reasoning:** Bayesian Networks: Components, Exact and Approximate Inference, Causal Networks
- **Probabilistic Reasoning over Time:** Temporal Models and Inference, Hidden Markov Models
- **Making Simple Decisions:** Utility Theory and Utility Functions, Multi-Attribute Utility Functions, Decision Networks and Value of Information
- **Multiagent Decision Making:** Properties of Multiagent Environments, Non-Cooperative and Cooperative Game Theory, Making Collective Decisions

Unit V: Introduction to Computer Vision and Natural Language Processing (Week 13-14)

- **Computer Vision:** Image Classification, Edge Detection, Applications of Computer Vision, Overview of Convolutional Neural Networks (CNN)
- **Natural Language Processing (NLP):** Introduction to Language Models, Word Embedding Techniques, Applications of NLP-Based Systems.

5. Course Map (CO-PO-PSO Map)

Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3

Approved by the Academic Council at meeting held on 14th July 2023

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2023-2027

CO-1	3		2			1				3	1	2
CO-2	3		2			1				3	1	2
CO-3	3		2			1				3	1	2
CO-4	3		2			1				3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		35
Demonstrations		10
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	10	
Numeracy		05
1. Solving Numerical Problems	05	
Practical Work		00
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		25
1. Case Study Presentation	10	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	15	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		75

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ▶	20	20	20	
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester. Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

• Books:

- "Artificial Intelligence: A Modern Approach" by Stuart Russell and Peter Norvig.
- "Deep Learning" by Ian Goodfellow et al.
- "Reinforcement Learning: An Introduction" by Sutton and Barto.

• Online Resources:

- Coursera: AI for Everyone (by Andrew Ng).
- Kaggle datasets for practical assignments.
- Blogs/documentation on libraries like TensorFlow, PyTorch, OpenCV, Hugging Face.

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Department of Data Sciences and Analytics
School of Social Sciences
M.S. Ramaiah University of Applied Sciences

Approved by the Academic Council at meeting held on 14th July 2023

10.Course Organization

Course Code	DSC206B		
Course Title	Artificial Intelligence		
Course Leader's Name	As per Timetable		
Course Leader's Contact Details	Phone:		
	E-mail:		
Course Specifications Approval Date			
Next Course Specifications Review Date			



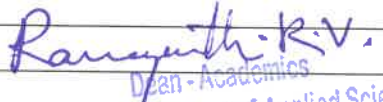
SEMESTER 5


Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences


Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

Course Specifications: Machine Learning

Course Title	Machine Learning
Course Code	DSC301A
Course Type	Core Course
Department	Data Sciences and Analytics


Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560 054

Faculty

School of Social Sciences

1. Course Summary

This course covers a comprehensive journey through the world of Machine Learning. In the first unit, students delve into the foundations of ML, understanding its connection to Data Science, exploring its historical development, types, applications, and the challenges it poses. They gain proficiency in essential tools and data preprocessing techniques. Moving on to the second unit, the focus shifts to supervised learning, encompassing Linear Regression, Logistic Regression, Decision Trees, Random Forest, Support Vector Machines, k-nearest neighbors, and Ensemble methods. The third unit explores unsupervised learning with an emphasis on clustering algorithms and dimensionality reduction. In unit four, students delve into probabilistic and stochastic models, covering probability basics, Bayes' Theorem, Naïve Bayes, and Bayesian networks. Finally, the fifth unit guides students in fine-tuning their models, emphasizing model selection, hyperparameter training, and practical hands-on experience with tools like NumPy, Pandas, Matplotlib, Seaborn, and Scikit-learn. Throughout the course, students develop a strong foundation in Machine Learning, equipping them with the skills to tackle real-world problems in data analysis and prediction.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:0:1
Total Hours of Interaction	90
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO1. Understand machine learning concepts and range of problems that can be handled by machine learning, data-preprocessing

CO2. Understanding the theoretical concepts of Regressor and classifier along with hands-on activities using state-of-art algorithms from sklearn, evaluation of model performance

CO3. Apply ML algorithms under Supervised and Unsupervised learning

CO4. Apply the machine learning concepts in real life problems.

4. Course Contents

Unit 1: Introduction to ML:

Explain the intersection of ML with Data Science, History of machine learning, Introduction, Types of machine learning, Applications of Machine Learning, Perspectives and issues in machine learning, Tools in machine learning, basic types of data in machine learning, Data-preprocessing: Dealing with missing data, Feature scaling, Dealing categorical variables, Model evaluation: Confusion Matrix, Precision, Recall, F1-score, Bias-Variance,

Overfitting and Underfitting, ROC, AUC.

Unit 2: Supervised Learning:

Linear Regression: Introduction to linear regression, mathematical intuition of linear regression, Cost function, Gradient Descent, Stochastics, Batch and Mini-batch Gradient Descent, estimating the coefficients, Accessing the accuracy of the coefficient estimates, Accessing the accuracy of the regression model, Multiple linear regression, Logistic Regression: Introduction to Logistic Regression and Logistic Classification, Activation and cost function, understanding of different ML algorithms used for solving regression and classification problems, Regularization, ridged(L2) and Lasso(L1) Regularizes

Basic decision tree learning (ID3) algorithm, Entropy, Gini impurity, Information Gain, Math's intuition of decision Tree, pre and post pruning, Hypothesis space search in decision tree learning algorithm, Random Forest, Support Vector Machine algorithm and the math intuition for support vectors, k-nearest neighbor, Ensemble method: Bagging and Boosting, AdaBoost, XGBoost algorithms.

Unit 3: Unsupervised Learning:

Intuition of clustering, type of data in clustering analysis, k-means, density-based clustering method (DBSCAN), Performance analysis of clustering algorithms. Dimensionality reduction while retaining information, Principal Component Analysis, Visualization of high-dimensional data, Applications in image recognition, finance, Anomaly Detection.

Unit 4: Probabilistic and Stochastic Models:

Basics of probability, Overview of probabilistic models in machine learning, Bayes' Theorem: Concept and significance, Maximum Likelihood Estimation (MLE) in Bayesian Learning, Naïve Bayes Classifier: Understanding conditional independence assumption, Naïve

Bayes algorithm, Applications of Naïve Bayes in text classification and spam filtering, Basics of Bayesian networks, Representing and reasoning with Bayesian networks(optional)

Unit 5: Fine-Tuning your model:

Model Selection and Hyperparameter Training, Cross Validation, Grid Search, Randomized Search, Pipelines, Data Leakage Hands On: NumPy, Pandas, Matplotlib, Seaborn, Sklearn packages/modules for preprocessing, Regression and Classification models, Model selection, model accuracy, Normalization, Standardization, model evaluation etc.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3	2	1	3	1	2	1	1	2	3	2	1
CO-2	3	2	1	2	2	2	1	1	1	3	2	1
CO-3	3	1	1	2	3	2	1	1	1	3	2	1
CO-4	3	2	1	2	2	2	1	1	1	3	2	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in Hours	Total Duration in Hours
Associate Professor and HOD		

Approved by the Academic Council at meeting held on 14th July 2023

Page 97 of 169

M.S. Ramaiah University of Applied Sciences

Bengaluru - 560054

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2023-2027

Face to Face Lectures		30
Demonstrations		
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	00	
2. Computer Laboratory	30	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		20
1. Case Study Presentation	10	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	10	
5. Group Discussions	10	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		10
Total Duration in Hours		90

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment is presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ►	SC1	SC2	SC3	
Subcomponent Type ►	Midterm exam	Assignment -1	Assignment-2	40 Marks

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2023-2027

Maximum Marks ▶	20	20	20	
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester. Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

1. "Introduction to Machine Learning" by Alpaydin, Introduction to Machine Learning
2. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurelien Geron
3. "The Hundred-Page Machine Learning Book" by Burkov
4. "Machine Learning Yearning" by Ng, <https://info.deeplearning.ai/machine-learning-yearning-book>

10. Course Organization

Course Code	DSC301A		
Course Title	Machine Learning		
Course Leader's Name	As per Timetable		
Course Leader's Contact Details	Phone:		
	E-mail:		
Course Specifications Approval Date			
Next Course Specifications Review Date			

Associate Professor and HOD
Department of Data Sciences and Analytics
M S Ramaiah University of Applied Sciences
Bengaluru-560054

H. R. V.
Ramaiah Academics
M.S. Ramaiah University of Applied Sciences
Bengaluru

Approved by the Academic Council at meeting held on 14th July 2023



Course Specifications: Operations Research and Optimization Techniques

Course Title	Operation Research and Optimization Techniques
Course Code	DSC204B
Course Type	Core Course
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

The course aims at building capabilities in students for analyzing different situations and applying optimization techniques in the industrial/ business scenario involving limited resources and finding the optimal solution within constraints. The student will be able to understand and apply the various decision models to arrive at optimal solutions. Students will develop skills in formulating and solving real-world problems using techniques such as linear programming, transportation models, network models, queuing theory, among other key operations research techniques.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:0:1
Total Hours of Interaction	90
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO1: Recognize the relevance of operations research in real-life contexts for better decision making.

CO2: Formulate and solve the business problem as a linear programming problem.

CO3: Apply transportation models to optimize costs.

CO4: Assess the decision-making environment and apply decision models based on game and queueing theory to arrive at optimal solutions.

4. Course Contents

Unit 1: Introduction to Operations Research

Evolution of Operations Research (OR), Definition & Characteristics of OR, Phases of OR, Methodology of OR, Models used in OR, Limitations of OR, Applications of OR

Unit 2: Linear Programming Problem (LPP)

Formulation, Corner point theorem, Graphical method (for two variables), Solution approaches - Simplex method and Big M method (algorithms), Concept of degeneracy, Two Phase Simplex Method, Concept of Duality, writing Dual of given LPP, Use cases, Hands-on exposure of solution techniques using open-source software.

Rangayathi K.V.
Dean, Academics

M.S. Ramaiah University of Applied Sciences
Bangalore - 560054

Unit 3: Transportation models

Use cases, Formulating the transportation problem, Finding an initial basic feasible solution using methods: North West Corner (NWC), Least Cost Method (LCM), Vogels Approximation (VAM), (balanced & unbalanced transportation problems), Test for Optimality test- UV method or the Modified Distribution (MODI) method, Concept of degeneracy in Transportation Model, Use cases, Hands-on exposure of solution techniques using open source software.

Unit 4: Queueing Models

Queueing systems and their characteristics, Kendall's notation, Queueing models –M/M/1 and M/M/C, Use cases in Service Industry, Hands-on exposure of solution techniques using open source software.

Unit 5: Game Theory

Introduction, Optimal solution of Two-Person Zero-Sum Games, Solution method of Pure Strategy (Minimax - Maximin principle), Principle of Dominance, Use cases

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3	1	1	1		1	1	1	1	3	1	2
CO-2	3	2	2	2	1	1	2	2	2	3	1	2
CO-3	3	2	2	2	1	1	2	2	2	3	1	2
CO-4	3	2	2	2	1	1	2	2	2	3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		25
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		20
1. Solving Numerical Problems	20	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	30	

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2023-2027

3. Engineering Workshop / Course/Workshop / Kitchen	00	30
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		10
1. Case Study Presentation	05	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	05	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		05
Total Duration in Hours		90

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ▶	20	20	20	
CO				

The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester. Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment

Approved by the Academic Council at meeting held on 14th July 2023

Page 103 of

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2023-2027

4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	Class Seminars
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	Class Seminars
11.	Presentation Skills	Class Seminars
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	Class Seminars

9. Course Resources

Essential Readings:

- Hillier, F. S., Lieberman, G. J., Basu, P., & Gopalan, N. (2017). Introduction to operations research (10th ed.). New Delhi: McGraw Hill Education.
- Vohra, N. D. (2017). Quantitative techniques in management (5th ed.). New Delhi: McGraw Hill Education.

Supplementary References:

- Taha, H. A. (2016). Operations research: An introduction (10th ed.). Pearson.
- Rardin, R. L. (2017). Optimization in operations research (2nd ed.). Pearson.
- Ravindran, A., Phillips, D. T., & Solberg, J. J. (2007). Operations research: Principles and practice (2nd ed.). Wiley.
- Gupta, P. K., & Hira, D. S. (2020). Operations Research (10th ed.). S. Chand & Co. Ltd.
- Pai, P. P. (2021). Operations Research - Principles and Practices (2nd ed.). Oxford Higher Education.
- Sharma, J. K. (2020). Operations Research: Theory and Applications (5th ed.). Trinity University Press.
- Taylor, B. W. (2017). Introduction to Management Science (12th ed.). Pearson Publications.

10. Course Organization

Course Code	DSC204B	
Course Title	Operations Research and Optimization Techniques	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	Phone:	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		



Course Specifications: Advanced Statistics

Course Title	Advanced Statistics
Course Code	DSE303A
Course Type	Discipline specific elective
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

Associate Professor and HOD

Department of Data Sciences and Analytics

Approved by the Academic Council at meeting held on 14th July 2023

University of Applied Sciences

Bangalore - 560054

1. Course Summary

Director

School of Social Sciences & School of Law
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Page 105 of

Statistical methods used in practice are based on a foundation of statistical theory. One branch of this theory uses the tools of probability to establish important distributional results that are used throughout statistics. Another major branch of statistical theory is statistical inference. It deals with issues such as how do we define a "good" estimator or hypothesis test, how do we recognize one and how do we construct one? This course is concerned with the fundamental theory of random variables and statistical inference.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

On completion of this course, the student will be able to:

CO1: Define some basic concepts and notations in Advance statistics

CO2: Discuss quantitative and qualitative approaches in Advance statistics

CO3: Solve different types of problems involving the concepts of Advance statistics

CO4: Analyze and Evaluate the problems involving the concepts of statistical inferences.

4. Course Contents

UNIT I

Introduction to Statistics:

Introduction: Statistics, Frequency distribution

Measures of central tendency: Mean, Median, Mode- Data Science examples

Measures of dispersion: Dispersion, Range, standard deviation, Data Science problems

Correlation: Definition, Karl Pearson's coefficient of correlation, Multiple correlation - Data Science examples

UNIT II

Probability Theory:

Sample space, discrete probability, independent events, Bayes theorem. Random variables and distribution functions. Independent random variables, Probability inequalities (Tchebyshef, Markov, Jensen). Modes of convergence, weak and strong laws of large numbers, Central Limit theorems (i.i.d. case).

UNIT III

Concepts of Statistical Distribution:

Probability mass function, Cumulative distribution function, Moments, Expectation and Variance, Moment Generating function, Characteristic function. Binomial, Poisson and Geometric distributions, Probability density function, Cumulative distribution function, Expectation and Variance, Uniform, Normal, Exponential and Weibull distributions, Joint distribution and joint density functions, Conditional distribution and density function.

UNIT IV

Sampling Techniques and Sampling Distribution:

Basic concepts of sampling from a finite population; sampling versus complete enumeration; simple random sampling; sample size determination; stratified random sampling; systematic sampling; cluster sampling and multi – stage sampling (all sampling schemes without proof of expressions). Sampling distributions, standard errors and asymptotic distributions.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PSO-1	PSO-2	PSO-3
CO-1	3	0	0	0	0	0	0	0	0	3	1	1
CO-2	0	3	0	0	0	0	2	2	0	2	3	1
CO-3	0	0	3	0	0	3	0	0	3	3	2	2
CO-4	0	0	3	3	0	0	0	0	0	3	2	3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		10
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	05	10
Numeracy		
1. Solving Numerical Problems	10	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	05	

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2023-2027

3. Engineering Workshop / Course/Workshop / Kitchen	05	10
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		10
1. Case Study Presentation	00	
2. Guest Lecture	05	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	05	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		60

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ▶	20	20	20	
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester. Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2023-2027

2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

Text books:

1. "Fundamentals of Statistics, Vol. 1", Goon, A.M., Gupta, M.K. & Dasgupta B, World Press, 2016.
2. "An Introduction to Probability Theory and Mathematical Statistics", Rohatgi, V.K. & Saleh, Wiley Series, 2nd Edition.

References Books:

1. "Probability and Statistical Inference", R.V. Hogg, A. Craig, 6th .Ed.Pearson Education. 2006
2. "Mathematical Statistics with Applications", I. Miller, M. Miller, Pearson Education. 2006

10.Course Organization

Course Code	DSE303A	
Course Title	Advanced Statistics	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	Phone:	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		

◆


Associate Professor and HOD
 Department of Data Sciences and Analytics
 School of Social Sciences
 M S Ramaiah University of Applied Sciences


Dean - Academics
 M S Ramaiah University of Applied Sciences
 Bangalore - 560054


School of Social Sciences & School of Law
 M S Ramaiah University of Applied Sciences
 Bengaluru - 560054

Approved by the Academic Council at meeting held on 14th July 2023

Course Specifications: Advanced Time Series and forecasting

Course Title	Advanced Time Series and Forecasting
Course Code	DSE301A
Course Type	Discipline specific elective
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

This "Time Series and Forecasting" course covers a comprehensive spectrum of time series analysis and Bayesian learning. Students start by understanding univariate and seasonal time series models, including AR, MA, ARMA, ARIMA, and SARIMA, as well as their selection and forecasting. Advanced topics encompass multivariate analysis, cointegration, Granger causality, and time series clustering. The course then delves into Bayesian learning principles, exploring Bayes' theorem, model selection, parameter estimation, and its application in regression and classification problems. By the end of the course, students will have the knowledge and skills to analyze time series data and employ Bayesian approaches in various data analysis tasks.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

On completion of this course, the student will be able to:

CO1: Understand the fundamental concepts of time series analysis, including autoregressive (AR) models, moving average (MA) models, ARMA models, ARIMA models, and seasonal time series models.

CO2: Develop the skills to select appropriate time series models and estimate their parameters using diagnostic checking and model evaluation techniques and gain proficiency in forecasting future values and making predictions using time series models, specifically SARIMA models.

CO3: Explore advanced topics in time series analysis, such as multivariate time series analysis, vector autoregression (VAR) models, cointegration, error correction models, Granger causality tests, time series clustering, and classification.

CO4: Understand the Bayesian learning framework, including Bayes theorem, hypothesis testing, maximum likelihood estimation, and Bayesian model selection and comparison.

4. Course Contents

Unit 1: Brief introduction on time series, Autoregressive (AR) models, Moving average (MA) models, Autoregressive moving average (ARMA) models, Autoregressive integrated moving average (ARIMA) models, Model selection and parameter estimation, Diagnostic checking and model evaluation

Unit 2: Seasonal decomposition of time series, Seasonal autoregressive integrated moving average (SARIMA) models, Seasonal and non-seasonal differencing, Seasonal ARIMA (SARIMA) model selection, Forecasting with SARIMA models

Unit 3: Multivariate time series analysis, Vector autoregression (VAR) models, Co-integration and error correction models, Granger causality tests, Time series clustering and classification, ARCH and GARCH process, Introduction to index numbers.

Unit 4: Bayes theorem, Maximum likelihood and least-squared error hypotheses, differences between Bayesian and frequentist approaches, Advantages and challenges of Bayesian learning, Bayesian estimation: Maximum a posteriori (MAP) estimation, Bayesian parameter estimation using conjugate priors, Bayesian formulation of linear regression, Bayesian formulation of classification problems, Naive Bayes classifier, Bayesian logistic regression.

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Dean - Academics, M S Ramaiah University of Applied Sciences, Bengaluru - 560054

Programme Outcomes (POs)

Programme Specific Outcomes

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2023-2027

										(PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3	3	2		2	1				3	3	3
CO-2	3	3	3	2	2	2				3	3	3
CO-3	3	2	3	2	2		2			3	3	3
CO-4	3	2	3	2		3	2		1	3	3	3
CO-5	3	2		3	3					3	3	3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		45
Demonstrations		0
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		35
1. Solving Numerical Problems	35	
Practical Work		40
1. Course Laboratory	10	
2. Computer Laboratory	30	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00

Total Duration in Hours	75
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7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ▶	20	20	20	
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester. Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--

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15.	Leadership Skills	--
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9. course Organization

Reference Books:

- "Time Series Analysis: With Applications in R" by Jonathan D. Cryer and Kung-Sik Chan
- "Analysis of Time Series Structure: SSA and Related Techniques" by Wolfgang Karl Härdle and Holger Dette
- "An Introduction to Time Series Analysis and Forecasting" by Douglas C. Montgomery and Cheryl L. Jennings
- "Time Series Econometrics" by Walter Enders
- <https://www.bayesrulesbook.com/>

10. Course Resources

Course Code	DSE301A		
Course Title	Advanced Time Series and forecasting		
Course Leader's Name	As per Timetable		
Course Leader's Contact Details	Phone:		
	E-mail:		
Course Specifications Approval Date			
Next Course Specifications Review Date			



Course Specifications: Data Visualization

Course Title	Data Visualization
Course Code	DSC103A
Course Type	Core Theory and Practical
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

This course introduces students to the principles and practices of data visualization with a focus on using Microsoft Power BI. Students will learn to transform raw data into meaningful insights through interactive dashboards and reports. The course covers key concepts of data visualization, design best practices, and Power BI tools for creating effective visual representations of data.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:0:1
Total Hours of Interaction	90
Number of Weeks in a Semester	15
Department Responsible	Data Science and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- CO-1. Understand the principles of data visualization and its importance in decision-making.
- CO-2. Gain proficiency in Microsoft Power BI for data transformation, modeling, and visualization.
- CO-3. Learn to design and build interactive dashboards and reports and apply best practices for storytelling with data.
- CO-4. Develop the ability to analyze real-world datasets and present actionable insights.

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Department of Data Sciences and Analytics

Unit 1: Introduction to Data Visualization and Power BI

4. Course Contents

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- Importance and evolution of data visualization in the digital age.
- Overview of key visualization tools and platforms.
- Introduction to Microsoft Power BI: interface and components.

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4. Connecting to data sources: files, databases, and online services.
5. Overview of Power BI service vs. Power BI desktop.
6. Understanding the visualization pipeline: Data to Insights.

Unit 2: Data Preparation and Transformation in Power BI

1. Importing datasets from various sources: Excel, SQL, APIs, and more.
2. Data cleaning and transformation using Power Query Editor.
3. Managing relationships between tables: star schema vs. snowflake schema.
4. Creating calculated columns and custom tables.
5. Using data profiling tools for quality checks.
6. Dealing with common data issues: null values, duplicates, and outliers.

Unit 3: Building Visualizations in Power BI

1. Overview of basic visualization types: bar charts, line charts, pie charts, etc.
2. Creating maps: geographical and heat maps.
3. Using slicers, filters, and drill-through for interactivity.
4. Incorporating custom visuals and third-party libraries.
5. Implementing tooltips and conditional formatting for deeper insights.
6. Combining visuals into reports: managing layouts and themes.

Unit 4: Advanced Analytics and DAX in Power BI

1. Introduction to DAX (Data Analysis Expressions) and its syntax.
2. Creating measures for dynamic calculations (e.g., averages, rankings).
3. Time intelligence functions for trend analysis.
4. Building hierarchies and drill-down capabilities.
5. Using AI-driven tools like Q&A and key influencers.
6. Forecasting, clustering, and using advanced analytical features.

Unit 5: Designing Dashboards for Effective Storytelling

1. Principles of effective dashboard design: layout, color, and typography.
2. Aligning dashboards with audience needs: executive vs. operational.
3. Creating responsive dashboards for web and mobile.
4. Publishing dashboards on Power BI Service and sharing reports.
5. Ensuring data security: managing roles and permissions.
6. Enhancing user experience with bookmarks and custom navigation.

Unit 6: Real-World Applications and Capstone Project

1. Case studies: Power BI in different industries (finance, healthcare, retail, etc.).
2. Analyzing and visualizing publicly available datasets.
3. Best practices for collaborative work in Power BI.
4. Developing an end-to-end project: from raw data to actionable insights.
5. Group presentations: storytelling and communication of findings.
6. Receiving feedback and refining dashboards for maximum impact.

5. Course Map (CO-PO-PSO Map)

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2023-2027

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3	2							2	3		2
CO-2	3			2		3				3	2	2
CO-3	3		3	3		3				3	2	
CO-4	3	3	3		3		2		3	2	3	2

3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	40
Numeracy		
1. Solving Numerical Problems		30
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	30	
3. Engineering Workshop / Course/Workshop /Kitchen	00	20
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	20	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Hospital Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination,		00

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Department
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M S Ramai

Sciences and Analytics
Social Sciences
University of Applied Sciences
Bengaluru - 560054

Dean - Academics
M.S. Ramiah University of Applied Sciences
Bangalore - 560054

Approved by the Academic Council at meeting held on 14th July 2023 Page 117 of 117

Presentations	
Total Duration in Hours	90

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component(CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks) 100 Marks
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Midterm exam	Assignment -1	Assignment-2	
Maximum Marks ▶	20	20	20	
CO-1				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

Designing Data Visualizations: Representing Informational Relationships Book by Julie Steele and Noah Iliinsky

Technical Requirements:

1. System requirements are listed hereunder Tableau Desktop and Tableau Prep: <https://www.tableau.com/products/techspecs>

2. The latest version of Tableau Desktop, as well as Tableau Prep, should be downloaded and installed from here: <https://www.tableau.com/tft/activation>

10. Course Organization

Course Code	DSC103A	
Course Title	Data Visualization	
Course Leader's Name	As per Timetable	
Course Leader's Contact Details	Phone:	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		

Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences

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Director
School of Social Sciences & School of Law
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Bengaluru - 560054

SEMESTER 6

Course Specifications: Deep Learning

Course Title	Deep Learning
Course Code	DSE303A
Course Type	Discipline Specific Elective
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

This course provides a comprehensive introduction to deep learning, covering the fundamentals of Artificial Neural Networks (ANNs), optimization techniques, Convolutional Neural Networks (CNNs), and Generative Adversarial Networks (GANs). It also covers the practical aspects e.g., data-preprocessing, choice of regularizer etc. to train deep neural network. Through hands-on activities and real-world case studies, students will develop a strong understanding of deep learning concepts and applications.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
Total Hours of Interaction	45+30
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

On completion of this course, the student will be able to:

CO-1: To introduce the foundations of Artificial Neural Networks

CO-2: To acquire the knowledge on Deep Learning Concepts and architectures

CO-3: To learn various types of Optimization techniques, practical implementation of Deep Neural Networks

CO-4: To gain understanding on Convolutional Neural Network and it's application

4. Course Contents

UNIT-1: Artificial Neural Network

Overview of Deep Learning Vs classical ML, Historical milestones, Introduction to Artificial Neural

Networks, Perceptron. Multi-layer Perceptron; Computational Graph to calculate derivative, Concept of vectorization for efficient training of network; Basic architectures of ANN, Activation functions, Supervised Learning Networks, Training of Neural Network: Forward and Back-propagation.
Hands-on: Lab activities and problem-solving on the concepts.

UNIT-II: Optimizer, Regularizer and Best practices to Train DL models

Best practices to deal with the dataset to train a network, weight initialization, bias-variance trade-off, Vanishing and Exploding gradient problem, different regularization techniques: L1, L2, dropout regularization, hyperparameter tuning, batch normalization, and gradient checking; Optimization algorithms: Gradient Descent, mini-batch gradient descent, gradient descent with Momentum, RMSprop, and Adam Optimizer.

Hands-on: Lab activities and case studies on the concepts.

UNIT – III: Convolutional Neural Network

Introduction to CNN, Intuition of convolution operation, Edge detection, Convolution and pooling layers in a CNN, padding and stride, Case studies through some classic networks e.g., LeNet-5, AlexNet; Transfer learning through LeNet-5, AlexNet networks, Advanced CNN architectures: Residual Block and ResNet, knowledge of CNNs to computer vision: object detection and semantic segmentation using self-driving car datasets.

Hands-on: Lab activities and case studies on the concepts

UNIT – IV: Generative Adversarial Networks

Autoencoders; Variational Autoencoders (VAEs); Understanding Generative Adversarial Networks (GANs) and their components, Training GANs for image synthesis, Applications of GANs in image-to-image translation.

Hands-on: Lab activities and case studies on the concepts

TEXT BOOKS:

1. Deep Learning: An MIT Press Book By Ian Goodfellow and Yoshua Bengio and Aaron Courville
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, 2016.
3. Andrew Ng "Deep Learning Specialization" Course materials
2. Neural Networks and Learning Machines, Simon Haykin, 3rd Edition, Pearson Prentice Hall.

Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PSO-1	PSO-2	PSO-3
CO-1	2	2	3	1	2	3	3	2	3	2	3	3
CO-2	1	1	2	1	1	2	2	1	2	1	2	2
CO-3	2	1	3	1	2	3	2	2	3	1	3	3
CO-4	1	2	2	2	2	1	1	1	2	1	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

5. Course Teaching and Learning Methods

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2024-2028

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		25
Demonstrations		10
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		05
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	00	00
2. Computer Laboratory	25	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Projects	5	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	02	
5. Group Discussions	02	
6. Discussing Possible Innovations	01	
Term Tests, Laboratory Examination/Written Examination, Presentations		05
Total Duration in Hours		75

6. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. (Hons) Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Midterm	Assignment-1	Assignment-2	

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Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2024-2028

	exam			40 Marks
Maximum Marks ▶	20	20	20	
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

7. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures, Hands-on
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment, Hands-on
4.	Analytical Skills	Assignment, Hands-on
5.	Problem Solving Skills	Assignment, Examination, Hands-on
6.	Practical Skills	Assignment, solving real-life problems through project
7.	Group Work	Through project and peer-learning
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

8. Reference Books

Suggested Reading:

1. Deep Learning: An MIT Press Book By Ian Goodfellow and Yoshua Bengio and Aaron Courville
2. Ian Goodfellow, YoshuaBengio and Aaron Courville, "Deep Learning", MIT Press, 2016.
3. Andrew Ng "Deep Learning Specialization" Course materials
4. Neural Networks and Learning Machines, Simon Haykin, 3rd Edition, Pearson Prentice Hall.

9. Course Resources

Course Code	DSE303A
Course Title	Deep Learning
Course Leader's Name	As per Timetable

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2024-2028

Course Leader's Contact Details	Phone:	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		



Associate Professor and HOD
Department of Data Sciences and Analytics
Faculty of Social Sciences
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Rangayuth R.V.
Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

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Course Specifications: Supply Chain Management

Course Title	Supply Chain Management
Course Code	DSE304A
Course Type	Discipline Specific Elective
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

This course introduces undergraduate students to the basics of Supply Chain Management with an emphasis on analytical and quantitative techniques used in real-world supply chain decisions. It covers key concepts such as supply chain design, performance measurement, and the role of analytics in improving efficiency. Students learn transportation and supplier selection models, including Northwest Corner Method, Least Cost Method, Vogel's Approximation Method (VAM), and the Hungarian Algorithm. The course also focuses on inventory management, including EOQ, safety stock, reorder levels, and review systems. Further topics include transportation and logistics costing, foreign trade logistics, and decision-making tools such as AHP, TOPSIS, and VIKOR. Through practical examples and case studies, students develop the ability to apply analytical methods to solve basic supply chain problems and support managerial decision-making.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

On completion of this course, the student will be able to:

CO1: Understanding modelling and analytics of supply chain management and apply transportation and assignment models to solve supplier selection and logistics problems.

CO2: Analyze inventory location, layout, and space requirements, and evaluate overall supply chain performance, implement inventory management techniques to support operational decisions

CO3: Evaluate transportation costing, public transport fare fixation, and foreign trade logistics problems using multi-criteria decision making techniques

CO4: Analyze the Cross-Functional Drivers in a supply chain and apply these concepts to real-world case studies for effective managerial decision-making.

4. Course Contents

Unit1: Supply Chain Management: Introduction to Modelling and Analytics for Supply Chain Management, Introduction to Modelling and Analytics in Supply Network, Decisions and Performance Measures, Introduction to Analytics in Supply Chain, Analytics Framework, Design Options for Distribution Network.

Unit2: Supplier selection Analytics: Introduction to transportation problems, Northwest Corner Method, Least Cost Method, Vogel's Approximation Method (VAM), and Hungarian Algorithm.

Unit3: Inventory location and Performance of the entire supply chain: Inventory location models, Inventory layout, Space calculation, Performance of the entire supply chain, Data envelopment analysis, EOQ.

Unit4: Concepts in inventory management: Concepts in inventory management, Safety Stock and Reorder Level, Continuous Review System, Periodic Review System.

Unit5: Transportation Costing: Transport Costing, Public transport costing, Fixing Fares for public transportation system, Foreign trade logistics, Analytical Hierarchy Processing (AHP) Method, Technique of Order Preference by Similarity to Ideal Solution (TOPSIS) Method, TOPSIS and VIKOR Method.

Unit6: Managing Cross-Functional Drivers in a supply chain: Sourcing decisions in a supply chain, Pricing and revenue management in a supply chain, Sustainability and the Supply chain, case study.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3	2	3	2	2	2	2	2	2	2	3	1
CO-2	3	2	3	2	2	2	2	2	2	2	3	1
CO-3	3	2	3	2	2	2	2	2	2	3	3	2
CO-4	3	2	2	3	3	2	2	2	2	2	3	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2024-2028

Numeracy		10
1. Solving Numerical Problems	40	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		20
1. Case Study Presentation	19	
2. Guest Lecture	1	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	0	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		
Total Duration in Hours		60

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ►	SC1	SC2	SC3	
Subcomponent Type ►	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ►	20	20	20	
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Reference Books

Reference Books

Suggested Reading:

1. Supply Chain Management: Strategy, Planning, and Operations – Sunil Chopra, D.V. Kalra, and Gourav Dwivedi.
2. Logistics & Supply Chain Management – Martin Christopher
3. Supply Chain Management: A Logistics Perspective – John J. Coyle, C. Langley, R. Novack, B. Gibson
4. Operations Management: Sustainability and Supply Chain Management – Jay Heizer, Barry Render, Chuck Munson
5. Designing & Managing the Supply Chain: Concepts, Strategies, and Case Studies – David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi
6. Global Logistics and Supply Chain Management – John Mangan, Chandra Lalwani, Tim Butcher

Reference Material:

1. Supply Chain Planning (MIT OCW)
2. Logistics & Supply Chain Management (MIT OCW)

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10 Course Resources
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Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2024-2028

Course Code	Supply Chain Management		
Course Title	DSE304A		
Course Leader's Name		As per Timetable	
Course Leader's Contact Details		Phone:	
		E-mail:	
Course Specifications Approval Date			
Next Course Specifications Review Date			



Course Specifications: Big Data

Course Title	Big Data
Course Code	DSC302A
Course Type	Core Course
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

The Big Data course introduces Big Data concepts, real-life applications, major data sources, and the V's of Big Data, along with a comparison of traditional vs. big data processing systems. It covers Hadoop and its ecosystem, including distributed systems, GFS, MapReduce, YARN, and task processing. The course explores HDFS, focusing on file storage, commands, read/write operations, and rack awareness. It then delves into MapReduce programming, covering its framework, implementation using Python, Hadoop Streaming, job scheduling, and fault tolerance. Finally, it introduces NoSQL databases with a focus on MongoDB, covering SQL vs. NoSQL, database types, CRUD operations, querying, aggregation, indexing, and data modeling in MongoDB.

2. Course Size and Credits:

Number of Credits	05
Credit Structure (Lecture: Tutorial: Practical)	4:0:1
Total Hours of Interaction	90
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1: Understand the basis of Big Data, applications and sources

CO-2: Understand the Hadoop technology used for manages the storage and processing of large amounts of data for applications.

CO-3: Knowledge on the working of HDFS Systems and A fair understanding of MapReduce that is a programming model or pattern within the Hadoop framework that is used to access big data stored in the Hadoop File System (HDFS).

CO-4: Skill to handle unstructured Data

[Signature]
Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M.S. Ramaiah University of Applied Sciences
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4. Course Contents

Unit 1: Introduction to Big Data:

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Introduction to Big Data and its Real-Life applications, Big Data and its Various Aspects, Major Sources of Big Data, Types of Data, V's of Big Data, Conventional Data Processing System and Big Data

Unit 2: Introduction to Hadoop :

Introduction to Hadoop, Introduction to Distributed Systems, Features and Challenges, Introduction to GFS

and MapReduce, Architecture of GFS, Hadoop 2.x, YARN, Architecture of Hadoop, Task Processing in Hadoop, Tools for Hadoop

Unit 3: Hadoop File System:

Introduction to HDFS, File Storage in HDFS, Basic commands in HDFS, Write Operations in HDFS, Rack awareness in Hadoop, Read Operations in HDFS, Features and Limitations of HDFS.

Unit 4: Introduction to MapReduce Programming:

Introduction to MapReduce Framework, Basic Implementation of MapReduce using Python, Hadoop Streaming, The Combiner, The Partitioner, Job Scheduling and Fault Tolerance

Unit 5: NoSQL Databases and MongoDB:

Introduction to NoSQL Databases and MongoDB, Why NoSQL, SQL vs NoSQL, Types of NoSQL Databases & Use Cases, Introduction to MongoDB, Structure of MongoDB, CRUD operations, Querying in Mongo DB, Getting the Data, Comparison Operators, Logical Operators, Regular Expressions, Aggregation in Mongo DB, Data Modelling in Mongo DB, Indexing in Mongo DB

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1		3	2			1				3	1	2
CO-2	3		2			1				3	1	2
CO-3	3		2			1				3	1	2
CO-4	3		2			1				3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		30
Demonstrations		
1. Demonstration using Videos	00	

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2024-2028

2. Demonstration using Physical Models / Systems	00	15
3. Demonstration on a Computer	15	
Numeracy		
1. Solving Numerical Problems	00	00
Practical Work		
1. Course Laboratory	00	30
2. Computer Laboratory	30	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	05	15
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brainstorming Sessions	05	
5. Group Discussions	05	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		90

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Midterm exam	Assignment -1	Assignment-2	
Maximum Marks ▶	20	20	20	
CO				

The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Course Resources

Reference Books:

1. Radha Shankarmani, M Vijayalakshmi, Big Data Analytics, Wiley publications, first Edition 2016.
2. Seema Acharya, Subhashini Chellappan, Big Data and Analytics, Wiley Publication, first edition. Reprint in 2016.
3. Vignesh Prajapati, Data analytics with R and Hadoop, Copyright © 2013, Packt Publishing.
4. "Big Data: A Revolution That Will Transform How We Live, Work, and Think" by Viktor Mayer-Schönberger and Kenneth Cukier
5. "Big Data for Dummies" by Judith Hurwitz, Alan Nugent, Dr. Fern Halper, and Marcia Kaufman
6. "Data Science for Business: What You Need to Know About Data Mining and Data-Analytic Thinking" by Foster Provost and Tom Fawcett
7. "Hadoop: The Definitive Guide" by Tom White

10. Course Organization

Course Code	DSC302A
Course Title	Big Data
Course Leader's Name	As per Timetable

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2024-2028

Course Leader's Contact Details	Phone:	
	E-mail:	
Course Specifications Approval Date		
Next Course Specifications Review Date		




Approved by the Academic Council
Department of Social Sciences
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560054


Rangayathi K.V.
Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560054
Director
School of Social Sciences & School of Law
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560054

Approved by the Academic Council at meeting held on 14th July 2023

Course Specifications: Dissertation

Course Title	Dissertation
Course Code	DSC301A
Course Type	Internship/Group Project
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

Students will undertake an independent research study or group project or internship focusing on a question or topic directly related to Data Science and Analytics in industry or academia. Building upon the research proposal developed during the Research Dissertation phase, students will carry out the research, gather data, analyze it comprehensively, and ultimately submit the final dissertation.

2. Course Size and Credits:

Number of Credits	12
Credit Structure (Lecture: Tutorial: Practical)	0:0:12
Total Hours of Interaction	180
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course,

CO-1 Methodology Design and Justification: Students will be proficient in designing and providing rationale for research methodologies used in data collection.

CO-2 Research Ethics and Approval Process: Students will demonstrate a deep understanding of research ethics and the process of obtaining ethical approval.

CO-3 Effective Data Collection and Data processing & Critical Data Analysis and modelling: Students will be able to employ suitable research methodologies to collect data in a well-informed manner and clean them to put them to good use and possess the skills to critically analyze the collected data and draw conclusions that are sound and substantiated.

CO-4 Academic Presentation: Students will be capable of presenting their research findings and conclusions in a manner consistent with academic standards and expectations.

4. Course Contents

A dissertation is the final and most significant output of your B.Sc (Hons.) Data Science and Analytics Program. Its primary purpose is to convey the essence and results of your research endeavor. Should you successfully complete the course, you have the option to have it formally bound and presented as a physical document.

The structure and content of your dissertation should include the following key elements:

Research Background: Provide a comprehensive overview of the context and existing knowledge in the field that your research addresses. This section should establish the foundation upon which your research is built.

Methodology: Detail the methods and approaches you used to conduct your research. Explain why you chose these methods and how you implemented them to investigate your research questions or objectives.

Experiments: Describe the experiments, studies, or data collection processes you conducted as part of your research. This section should include information on the setup, data collection, and any relevant details regarding your experiments.

Results: Present the outcomes of your research, both in quantitative and qualitative terms. Use tables, figures, and other visual aids as necessary to illustrate your findings.

Analysis: Discuss the interpretation and analysis of the results. Explain the significance of your findings and how they relate to your research questions or objectives. Consider any unexpected results and their implications.

Conclusions: Summarize the key takeaways from your research. Explain how your research contributes to the field and what implications it has. Address any limitations and suggest areas for future research.

References: Ensure your dissertation is well-referenced. Cite all sources, including academic papers, books, and other materials you used during your research.

Structure and Writing: Your dissertation should be meticulously organized and well-written. Pay attention to proper grammar, punctuation, and clarity of expression.

Length: The recommended length for your dissertation is between upto 10,000 words. Be concise and precise in your writing, while ensuring that you cover all necessary information.

Plagiarism: A plagiarism report is used to check originality of a group project by highlighting copied content.

It helps ensure academic integrity and guides corrections before final submission with 10% similarity.

In summary, your dissertation is the culmination of your research efforts in INFO/SENG490, and it should be a high-quality, comprehensive document that showcases your research skills and findings. It serves as a valuable resource for both your academic community and potentially beyond, depending on the scope and significance of your research.

Associate Professor and HOD
Department of Data Sciences and Analytics
M.S. Ramaiah University of Applied Sciences

Ramapriya R.V.
Dean - Academics
M.S. Ramaiah University of Applied Sciences

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	2	2	3	2	2	2	2	2	2	2	3	1

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2024-2028

CO-2	2	2	3	2	2	2	2	2	2	2	3	1
CO-3	2	2	3	2	2	2	2	2	2	3	3	2
CO-4	3	2	2	3	3	2	2	2	2	2	3	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		
Demonstrations		
1. Demonstration using Videos	00	00
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		
1. Solving Numerical Problems	00	00
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	



SEMESTER 7


Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
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Bengaluru


Dean - Academics
M.S. Ramaiah University
Bengaluru


Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru - 560054

Course Specifications: Cloud Computing

Course Title	Cloud Computing
Course Code	DSC401A
Course Type	Department Specific Elective
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

This Cloud Computing course introduces the fundamentals of cloud computing, including its definition, characteristics, and evolution. Students will explore various cloud service models (IaaS, PaaS, SaaS) and deployment models (public, private, hybrid). The course covers core cloud infrastructure components, including virtualization, networking, and storage solutions, with a focus on security. Data analytics in the cloud is examined, with emphasis on tools like AWS Redshift and Athena for data storage and processing. Best practices for cloud development, including DevOps and CI/CD, are explored in detail. Advanced topics include serverless computing, multi-cloud strategies, and the integration of AI and machine learning. Future trends and innovations in cloud computing are also discussed. By the end, students will be equipped with the skills and knowledge needed for cloud-based development and analytics.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

On completion of this course, the student will be able to:

1. Understand the foundational principles, models, and deployment strategies in cloud computing.
2. Analyze and implement secure cloud infrastructure and networking solutions effectively.
3. Apply data analytics tools and techniques in cloud environments for processing and decision-making.
4. Develop and manage cloud-native applications using best practices, CI/CD, and advanced cloud

technologies.

4. Course Contents

Module 1: Introduction to Cloud Computing and Cloud Service Models

Topics: Definition and Characteristics of Cloud Computing, History and Evolution of Cloud Computing, Cloud Service Models: IaaS, PaaS, SaaS, Cloud Deployment Models: Public, Private, Hybrid

Module 2: Cloud Architecture and Infrastructure

Topics: Core Components of Cloud Infrastructure, Virtualization Technologies, Networking in Cloud: VPCs, Load Balancers, Cloud Storage Solutions, Security in Cloud Infrastructure

Module 3: Data Analytics and Analytics Tools in Cloud

Topics: Introduction to Data Analytics in Cloud, Data Storage Solutions: Data Lakes, Data Warehouses, Data Processing: Batch vs. Real-Time Processing, AWS Analytics Tools: Redshift, Athena, QuickSight, Machine Learning and Predictive Analytics in Cloud

Module 4: Cloud Development, Best Practices, and CI/CD

Topics: Cloud Development Best Practices, DevOps and Continuous Integration/Continuous Deployment (CI/CD) in Cloud

Module 5: Advanced Topics in Cloud Computing and Future Trends

Topics: Serverless Computing, Multi-Cloud Strategies, AI and Machine Learning in the Cloud, Future Trends and Innovations in Cloud Computing

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3	2									3	2
CO-2	3	2			3	2	2	3			3	
CO-3			3		3			3			3	2
CO-4			2	3	3	3			2	3	3	3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		15
Demonstrations		25
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	25	
Numeracy		
1. Solving Numerical Problems		

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2024-2028

Practical Work		30
1. Course Laboratory	30	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		5
1. Case Study Presentation	5	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		75

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Midterm exam	Assignment -1	Assignment-2	
Maximum Marks ▶	20	20	20	
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	--
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	--
11.	Presentation Skills	--
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	--

9. Reference Books

Reference Books:

1. **Cloud Computing: Concepts, Technology & Architecture** by Thomas Erl

Book sample : <https://ptgmedia.pearsoncmg.com/images/9780133387520/samplepages/0133387526.pdf>

2. **Architecting the Cloud: Design Decisions for Cloud Computing Service Models** by Michael J. Kavis, Book Preview link
3. **Practical Cloud Security** by Chris Dotson(**O'Reilly Publication on Cloud Computing**)
Practical Cloud Security (O'Reilly)
4. A.Srinivasan and J.Suresh, "Cloud Computing –A Practical Approach for Learning and Implementation", Pearson India Publications2014.
2: RajkumarBuyya, James Broberg, Andrzej, "Cloud Computing: Principles and Paradigms", Wiley India Publications2011.
3: ArshdeepBahga and Vijay Madiseti, "Cloud Computing A Hands on Approach", Universities Press (India) Pvt Ltd. 2014.

Online Resource:

AWS Official Documentation Links: <https://docs.aws.amazon.com/>

Medium daily Articles: A good resource for the crisp understanding of the topics

10. Course Resources

Course Code	DSC401A		
Course Title	Cloud Computing		
Course Leader's Name	As per Timetable		
Course Leader's Contact Details	Phone:		
	E-mail:		
Course Specifications Approval Date			
Next Course Specifications Review Date			



Course Specifications: Natural Language Processing

Course Title	Natural Language Processing
Course Code	DSE403A
Course Type	Discipline Specific Elective
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

This course explores the principles and techniques for processing and analyzing natural language data. Key topics include concepts of Deep Learning, Recurrent Neural Network. Advanced concepts such as neural networks for NLP, word embeddings, sequence models, and transformers (e.g., BERT, GPT) are also covered. Students will apply these techniques to real-world tasks like machine translation, text summarization, and chatbot development. The course emphasizes both theoretical understanding and practical implementation using popular NLP libraries such as NLTK, SpaCy, and Hugging Face.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

- Revisiting the core concepts of Deep Learning and practical aspects of training a deep learning model
- Recurrent Neural Network to train sequence data. Different applications of recurrence-based models, e.g. LSTM, GRU, Sequence to sequence models,
- Representing meaning of word, word embedding; intuition of some popular models e.g. GloVe and Word2Vec
- Attention, Self-attention, basic intuition of Transformers model , Hands-on experience to train different models in PyTorch framework

4. Course Contents

Unit 1: Revisiting the Concepts of Deep Neural Network (8 hours)

Revision of the basic concepts of Neural Network, activation function, logistic regression as a basic building block of NN, Cost function, Performance measure, Computational Graph, Forward and Backward Propagation in NN, Optimization function, Vanishing and Exploding Gradient,

Approved by the Academic Council at meeting held on 14th July 2023

Regularization Techniques

Unit 2: Recurrent Neural Network (15 hours)

Why sequence models and It's applications, Notation, Recurrent Neural Network Model, Backpropagation through time, Different types of RNNs, Language model and sequence generation, Sampling novel sequences, Vanishing gradients with RNNs,

Unit 3: Other variations of RNN (6 hours)

Gated Recurrent Unit (GRU), Long-Short-Term Memory (LSTM), Bidirectional RNN

Unit 4: Natural Language Processing & Word Embeddings

Introduction to Word Embeddings, Word Representation using word embeddings, Properties of word embeddings, Embedding matrix,

Learning Word Embeddings: Word2vec, Negative Sampling, GloVe word vectors

Applications using Word Embeddings: Sentiment Classification, Debiasing word embeddings

Unit 5: Sequence models & Attention mechanism

Various sequence to sequence architectures, Basic Models, Beam Search, Refinements to Beam Search, Error analysis in beam search, BLEU Score, Attention Model Intuition, Attention Model, Intuition of Transformer model

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3	2		3					2	3		2
CO-2	3		2		2			2		3		2
CO-3	3	3		2	2					3	2	
CO-4	3			3		2			3	3		3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		30
1. Solving Numerical Problems	35	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2024-2028

3. Engineering Workshop / Course/Workshop / Kitchen	00	00
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		05
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		00
Total Duration in Hours		75

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ▶	20	20	20	
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester. Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

Associate Professor and HOD

Department of Data Sciences and Analytics

School of Social Sciences

M S Ramaiah University of Applied Sciences

Bangalore - 560054

Dean - Academics

M S Ramaiah University of Applied Sciences

Bangalore

Director

School of Social Sciences & School of Law

M S Ramaiah University of Applied Sciences

Bangalore - 560054

Approved by the Academic Council at meeting held on 14th July 2023

Page 147 of 181

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures, Hands-on
2.	Understanding	Classroom lectures, Self-study, Hands-on
3.	Critical Skills	Assignment, Hands-on
4.	Analytical Skills	Assignment, Hands-on
5.	Problem Solving Skills	Assignment, Examination, Hands-on
6.	Practical Skills	Solving Lab problems
7.	Group Work	Project
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	Project presentation
11.	Presentation Skills	Project presentation
12.	Behavioral Skills	Peer-learning
13.	Information Management	Assignment
14.	Personal Management	Assignment submission deadline
15.	Leadership Skills	Group activities in project

9. Reference Books

Reference Books and Materials:

Beginners:

- Michael A. Nielsen. Neural Networks and Deep Learning
- Eugene Charniak. Introduction to Deep Learning

Later on the course:

- Jacob Eisenstein. Natural Language Processing
- Yoav Goldberg. A Primer on Neural Network Models for Natural Language Processing
- Ian Goodfellow, Yoshua Bengio, and Aaron Courville. Deep Learning

Online resources;

- Andrew Ng, Sequence Model Course : <https://www.youtube.com/watch?v=S7oA5C43Rbc>

10. Course organization

Course Title	Natural Language Processing		
Course Code	DSE403A		
Course Leader's Name	As per Timetable		
Course Leader's Contact Details	Phone:		
	E-mail:		
Course Specifications Approval Date			
Next Course Specifications Review Date			

Course Specifications: Applied Econometrics

Course Title	Applied Econometrics
Course Code	DSE404A
Course Type	Discipline Specific Elective
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

The course aims to develop competence on a set of techniques that are used to estimate and test economic relationships. The methods taught here can be employed in the business and social science disciplines. The emphasis of this course will be on formulating econometric models to analyze data, establish inter-relationship and address real-life decision problems.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO1: Understand the concept of measurement in econometrics and structure of econometric data.

CO2: Develop multiple linear regression model and handle violations in the context of economic applications

CO3: Apply regularization techniques to improve model generalization.

CO4: Synthesize the suitable modelling techniques including panel data techniques in empirical modelling using hands-on software

4. Course Contents

Associate Professor and HOD

Unit 1: Fundamentals of Econometrics

Nature, scope, objectives and methodology of econometrics; steps in empirical economic analysis, distinction between Economic Model and Econometric model; the role of measurement in economics; the structure of economic data: Cross-section, time series, panel and pooled cross-sectional data.

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Approved by the Academic Council at meeting held on 14th July 2023

Page 149 of 181

Unit 2: Classical Linear Regression model

Overview of simple linear regression analysis, interpretation of a Regression Equation, goodness of fit, properties of regression coefficients, the Gauss-Markov theorem and its significance, Linear regression- Maximum Likelihood Estimation

Unit 3: Multiple Linear Regression-Model building & validation

Concept, Partial regression coefficients, Partial correlation coefficients, Multiple correlation coefficient, Tests of significance for regression parameters, Confidence intervals for parameters, Regression diagnostics - Assumptions of Linearity, Normality, Multicollinearity, Heteroscedasticity, Autocorrelation, Outlier detection methods, Handling outliers.

Unit 4: Regularization techniques

The goal of regularization, L1 Regularization (Lasso) technique, L2 Regularization (Ridge), Elastic Net – the approach, methodology, regularization parameters, practical implementation - Hands-on using software

Unit 5: Panel data analysis techniques

Notation for panel data, Understanding panel data, Fixed effects regression using time and/or entity fixed effects - Covariance Model, Within Estimator, Individual Dummy Variable Model, Least Squares Dummy Variable (LSDV) Model, the Random effects model- model building, the Hausman-test, Model validation- serial correlation and heteroskedasticity, Computation of standard errors- robust standard errors for cross sectional dependence.

Unit 6: Econometrics Software - Gretl (Gnu Regression Econometrics and Time-series Library)

Gretl basics, importing data, running a script, basic commands, working with datasets – regression – linear, multiple linear regression techniques

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3	1	1	1		1	1	1	1	3	1	2
CO-2	3	2	2	2	1	1	2	2	2	3	1	2
CO-3	3	2	2	2	1	1	2	2	2	3	1	2
CO-4	3	2	2	2	1	1	2	2	2	3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		25

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2024-2028

Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer	00	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		30
1. Course Laboratory	00	
2. Computer Laboratory	30	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		10
1. Case Study Presentation	05	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	05	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		05
Total Duration in Hours		75

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (60% Weightage of total 100 marks)			Component 2: SEE (40% Weightage of total 100 marks)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Midterm exam	Assignment -1	Assignment-2	40 Marks
Maximum Marks ▶	20	20	20	
CO				Director

The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester. Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	Class Seminars
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	Class Seminars
11.	Presentation Skills	Class Seminars
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	Class Seminars

9. Course Resources

Select Readings:

- Johnston, J: Econometric Methods, McGraw-Hill Book Co., New York.
- Gujarathi, D.N: Basic Econometrics, Fourth Edition, Tata McGraw-Hill, New Delhi.
- Erik Biorn, Econometrics of Panel Data (Methods and Applications), Oxford University Press, 2017.
- Lee C. Adkins, Using gretl for Principles of Econometrics, 2018 Oklahoma State University

Supplementary References:

- Maddala, G.S: Econometrics, McGraw-Hill Book Co., New York, 3rd Rd.
- Tintner, G: Econometrics, John Wiley & Sons, New York.
- Wooldridge, Jeffery M: Econometrics, Cengage Learning India Pvt. Ltd, New Delhi

10.Course Organization

Course Code	DSE404A		
Course Title	Applied Econometrics		
Course Leader's Name	As per Timetable		
Course Leader's Contact Details	Phone:		
	E-mail:		
Course Specifications Approval Date			
Next Course Specifications Review Date			



[Signature]
Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M. S Ramaiah University of Applied Sciences
Bengaluru – 560054

[Signature]
Director
School of Social Sciences & School of Law
M S Ramaiah University of Applied Sciences
Bengaluru – 560054

[Signature]
Rangarath R.V.

Approved by the Academic Council at meeting held on 14th July 2023
Bangalore - 560 054

Course Specifications: Health Care Analytics

Course Title	Health Care Analytics
Course Code	DSE405A
Course Type	Discipline Specific Elective
Department	Data Sciences and Analytics
Faculty	School of Social Sciences

1. Course Summary

The course aims to develop a systematic understanding of knowledge and frameworks in the healthcare domain and build analytical skills to address challenges and issues arising from heterogeneous data at volume and scale in health, turning them into insights for improved efficiency in healthcare.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	3:0:1
Total Hours of Interaction	75
Number of Weeks in a Semester	15
Department Responsible	Data Sciences and Analytics
Total Course Marks	100
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

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

CO1: Obtain knowledge of the healthcare system, the value chain and sources of health data

CO2: Learn the governance structures and frameworks used when working with health data

CO3: Analyze the dynamics of the economic behaviour of stakeholders and its impact on the quality and structure of public health.

CO4: Apply data science techniques to leverage insights from health data.

4. Course Contents

Unit 1: Introduction to Healthcare Industry

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2024-2028

Overview of the Healthcare industry, the difference between Healthcare and Pharma sectors, Healthcare system across by country, Sub-sectors, Business model, Competitive landscape, Current trends and challenges, Common research questions in healthcare

Unit 2: Clinical Data Sources

Data sources in the healthcare industry – primary and secondary, Electronic Medical Records, Electronic Health Records, Challenges associated with data collection, processing and sharing, Public health datasets- Global datasets-ACS, NHIS, HCUP-NIS, BRFSS, WHO; Micro datasets - NSSO, NFHS, IHDS, LASI, and Macro dataset – National Health Accounts, Statista, Ethics and privacy in health data, Analytics in Healthcare - Use cases

Unit 3: Regulators in Healthcare & Health Economics

Major regulatory bodies in the industry- Global and Indian setting, Instruments of regulation, Overview of Healthcare Policies, Market Research Associations, Digital marketing in healthcare industry

Introduction to Health Economics, Production and Allocative efficiency of resources, Financing and Insurance in Healthcare, Public Health and Policies.

Unit 4: Machine learning for Healthcare

Data Visualization, Predictive Analytics – Use cases with Regression, Classification, Clustering, Time-series algorithms in disease prediction, outcome prediction, patient segmentation, Hands-on practical

Unit 5: AI Applications in Healthcare

Scope of AI in clinical practice, diagnostics, operations, public health; Integrating AI into clinical workflows, Best practices of AI applications to promote fair and equitable healthcare solutions, Challenges of regulation of AI applications, Categories of AI application – Case Studies

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)									Programme Specific Outcomes (PSOs)		
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3
CO-1	3	1	1	1		1	1	1	1	3	1	2
CO-2	3	2	2	2	1	1	2	2	2	3	1	2
CO-3	3	2	2	2	1	1	2	2	2	3	1	2
CO-4	3	2	2	2	1	1	2	2	2	3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution												

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		25
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems	00	

Approved by the Academic Council at meeting held on 14th July 2023, Bengaluru

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Bengaluru - 560054
Page 155 of 181

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2024-2028

3. Demonstration on a Computer	00	
Numeracy		
1. Solving Numerical Problems	00	00
Practical Work		30
1. Course Laboratory	00	
2. Computer Laboratory	30	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	05	
2. Guest Lecture	00	
3. Industry / Field Visit	00	10
4. Brain Storming Sessions	00	
5. Group Discussions	05	
6. Discussing Possible Innovations	00	
Term Tests, Laboratory Examination/Written Examination, Presentations		05
Total Duration in Hours		75

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the B.Sc. Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

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Subcomponent ►	SC1	SC2	SC3	
Subcomponent Type ►	Midterm exam	Assignment -1	Assignment-2	
Maximum Marks ►	20	20	20	
CO				
The details of SC1, SC2 or SC3 are presented in the Programme Specifications Document.				

The Course Leader assigned to the course, in consultation with the Head of the Department, shall

provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following

Teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Classroom lectures
2.	Understanding	Classroom lectures, Self-study
3.	Critical Skills	Assignment
4.	Analytical Skills	Assignment
5.	Problem Solving Skills	Assignment, Examination
6.	Practical Skills	Assignment
7.	Group Work	Class Seminars
8.	Self-Learning	Self-study
9.	Written Communication Skills	Assignment, Examination
10.	Verbal Communication Skills	Class Seminars
11.	Presentation Skills	Class Seminars
12.	Behavioral Skills	--
13.	Information Management	Assignment
14.	Personal Management	--
15.	Leadership Skills	Class Seminars

9. Course Resources

Select Readings:

- Celi, L. A., Majumder, M. S., Ordóñez, P., Osorio, J. S., Paik, K. E., & Somai, M. (2020). Leveraging data science for global health, Springer Nature.
- Reddy, C. K., Aggarwal, C. C., Reddy, C. K., & Aggarwal, C. C. (2015). An Introduction to Healthcare Data Analytics, Chapman & Hall, CRC Press.
- Van Der Post, H., & Schwartz, A. (Eds.). (2024, June 26). Health Analytics with Python: A comprehensive guide: Unlock the power of data for health. Reactive Publishing. ISBN 979-8329574371.
- Ewen Harrison & Riinu Pius (2021). R for Health Data Science, Chapman & Hall, CRC Press. R for Health Data Science (ed.ac.uk)

Supplementary References:

- Kubben, P., Dumontier, M., & Dekker, A. (2019). Fundamentals of clinical data science, Springer.
- Santerre, R. E., & Neun, S. P. (2012). Health economics -Theories, Insights, and Industry Studies, 5th edition, South-Western Cengage Learning.
- Peng, R. (2019). R Programming for Data Science, Retrieved from: <https://bookdown.org/rpeng/rprogdatascience/>

[Signature]
Director

School of Social Sciences & School of Law
M.S. Ramaiah University of Applied Sciences
Bengaluru - 560054

[Signature]
Dean - Academics

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Bengaluru - 560054

Programme Structure and Course Details of B.Sc. in Data Sciences and Analytics 2024-2028

- Grolemond, G & Wickham, H. (2017). R for Data Science, Retrieved from: <http://r4ds.had.co.nz/>
- Peng, R. (2020). Exploratory Data Analysis with R, Retrieved from: <https://bookdown.org/rdpeng/exdata/>
- Baumer, B.S., Kaplan, D.T., & Horton N.J. (2023). Modern Data Science with R, Retrieved from: <https://mdsr-book.github.io/mdsr3e/>

10.Course Organization

Course Code	DSE405A		
Course Title	Health Care Analytics		
Course Leader's Name	As per Timetable		
Course Leader's Contact Details	Phone:		
	E-mail:		
Course Specifications Approval Date			
Next Course Specifications Review Date			




Associate Professor and HOD
Department of Data Sciences and Analytics
School of Social Sciences
M S Ramaiah University of Applied Sciences
Bengaluru - 560054


Director
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M S Ramaiah University of Applied Sciences
Bengaluru - 560054