HSNC UNIVERSITY,MUMBAI

HSNCU Syllabus
School of Applied Sciences
Syllabus of BSc Data Science and Business Analytics

Board of Faculty of Science & Technology

Board of Studies in the Subject of Data Science & Business Analytics

1. Name of the Chair Person: Dr.Nandini Sengupta, Associate professor, Department of Economics
2. Name of the Co – Chairperson: Mrs. Shailaja. J. Rane, Co- Ordinator of Data Science and Business Analytics.

Teachers from the college:
3. Beenarani Karutharan, Assistant Professor, Department of Computer science
4. Mrs.Mrunal M Hardikar , Assistant Professor, Department of Mathematics

External Professor:
5. Rosemary Gosling, Director of External Studies(Retd) for the London School of Economics and Political Science (LSE)
6. Dr. Santosh Bothe, Founder and Director AiSense(Start up funded by BIRAC, Govt. of India), Principal, Saraswati College, Shegaon, Affliated to SGBU Amravati University.

External experts:
7. Prof. Parag Mahulikar is Ex- Dean and Senior Professor of Marketing at IES Management College and Research Centre, Bandra, India and Management Consultant.
8. Dr. Alok Deepak Dabade, Assistant Professor, Department of Statistics, University of Mumbai.
9. Dr. Sujata Suvarnapathki, Assitant Professor, Department of Statistics, Ramnarayan Ruia Autonomous College, Matunga, Mumbai.
10. Subhash kumar, Assistant Professor, MCA, MPHIL IT department, St.Xavier's college, Mumbai.
11. Industry Expert: Vinayak Deshpande, Managing Director, Sankhya Analytical Research Pvt. Ltd.
12. Industry Expert: Nishad Kapadia, MCA, Technical trainer,Data and Solution Architect Project Manager, TeraData, Mumbai.
13. Industry Expert: Gaurav Tiwari MSc, Working in Kotak Mahindra bank Ltd.,
14. Industry Expert: Praveena Premanand Menon, MSc in Big Data Analytics.

Alumni: Proposed names Sara kale, Pranit Kadam

Part –I

Outline of Choice Based Credit System as outlined by University Grants Commission:

R. ** : The Definitions Of The Key Terms Used In The Choice Based Credit System And Grading System Introduced From TheAcademicYear2023-2024 AreAs Under:**

1. **Core Course:** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a core course.

2. **Elective Course:** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

2.1 **Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective. The University/Institute may also offer discipline related Elective courses of interdisciplinary nature (to be offered by main discipline/subject of study).

2.2 **Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project. A Project/Dissertation work would be of 6 credits. A Project/Dissertation work may be given in lieu of a discipline specific elective paper.

2.3 **Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective.

P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

3. **Choice Base Credit System:** CBCS allows students to choose inter- disciplinary, intra-disciplinary courses, skill oriented papers (even from other disciplines according to their learning needs, interests and aptitude) and more flexibility for students.

4. **Honours Program:** To enhance employability and entrepreneurship abilities among the learners, through aligning Inter Disciplinary / Intra Disciplinary courses with Degree Program. Honours Program will have 40 additional credits to be undertaken by the learner across three

years essentially in Inter / Intra Disciplinary course.

A learner who joins Regular Undergraduate Program will have to opt for Honours Program in the first year of the Program. However, the credits for honors, though divided across three years can be completed within three years to become eligible for award of honours Degree.

5. **Program:** A Program is a set of course that are linked together in an academically meaningful way and generally ends with the award of a Degree Certificate depending on the level of knowledge attained and the total duration of study, B.Sc. Programs.

6. **Course:** A 'course' is essentially a constituent of a 'program' and may be conceived of as a composite of several learning topics taken from a certain knowledge domain, at a certain level. All the learning topics included in a course must necessarily have academic coherence, i.e. there must be a common thread linking the various components of a course. A number of linked courses considered together are in practice, a 'program'.

7. **Bridge Course:** Bridge course is visualized as Pre semester preparation by the learner before commencement of regular lectures. For each semester the topics, whose knowledge is considered as essential for effective and seamless learning of topics of the Semester, will be specified. The Bridge Course can be conducted in online mode. The Online content can be created for the Bridge Course Topics.

8. **Module and Unit:** A course which is generally an independent entity having its own separate identity, is also often referred to as a 'Module' in today's parlance, especially when we refer to a 'modular curricular structure'. A module may be studied in conjunction with other learning modules or studied independently. A topic within a course is treated as a Unit. Each course should have exactly 3 Units.

9. **Self-Learning: 20% of the topics will be marked for Self-Learning.** Topics for Self Learning are to be learned independently by the student, in a time- bound manner, using online and offline resources including online lectures, videos, library, discussion forums, fieldwork, internships etc.

Evaluative sessions (physical/online), equivalent to the credit allocation of the Self Learning topics, shall be conducted, preferably, every week for each course.

Learners are to be evaluated real time during evaluative sessions. The purpose of evaluative sessions is to assess the level of the students' learning achieved in the topics earmarked for Self-Learning.

The teacher's role in these evaluative sessions will be that of a Moderator and Mentor, who will guide and navigate the discussions in the sessions, and offer concluding remarks, with proper reasoning on the aspects which may have been missed by the students, in the course of the Self-Learning process.

The modes to evaluate self-learning can be a combination of the various methods such as written reports, handouts with gaps and MCQs, objective tests, case studies and Peer learning. Groups can be formed to present self- learning topics to peer groups, followed by Question and Answer sessions and open discussion. The marking scheme for Self-Learning will be defined under Examination and Teaching.

The topics stipulated for self-learning can be increased or reduced as per the recommendations of the Board of Studies and Academic Council from time to time. All decisions regarding evaluation need to be taken and communicated to the stakeholders preferably before the commencement of a semester. Some exceptions may be made in exigencies, like the current situation arising from the lockdown, but such ad hoc decisions are to be kept to the minimum possible.

10. **Credit Point:** Credit Point refers to the 'Workload' of a learner and is an index of the number of learning hours deemed for a certain segment of learning. These learning hours may include a variety of learning activities like reading, reflecting, discussing, attending lectures / counseling sessions, watching especially prepared videos, writing assignments, preparing for examinations, etc. Credits assigned for a single course always pay attention to how many hours it would take for a learner to complete a single course successfully. A single course should have, by and large a course may be assigned anywhere between 2 to 8 credit points wherein 1 credit is construed as corresponding to approximately 30 to 40 learning hours.

11. **Credit Completion and Credit Accumulation:** Credit completion or Credit acquisition shall be considered to take place after the learner has successfully cleared all the evaluation criteria with respect to a single course. Thus, a learner who successfully completes a 4 CP (Credit Point) course may be considered to have collected or acquired 4 credits. Learner level of performance above the minimum prescribed level (viz. grades / marks obtained) has no bearing on the number of credits collected or acquired. A learner keeps on adding more and more credits as he completes successfully more and more courses. Thus, the learner 'accumulates' course wise credits.

12. **Credit Bank:** A Credit Bank in simple terms refers to stored and dynamically updated information regarding the number of Credits obtained by any given learner along with details regarding the course/s for which Credit has been given, the course-level, nature, etc. In addition, all the information regarding the number of Credits transferred to different programs or credit exemptions given may also be stored with the individual's history.

13. **Credit Transfer:** (performance transfer) When a learner successfully completes a program, he/she is allowed to transfer his/her past performance to another academic program having some common courses and Performance transfer is said to have taken place.

14. **Course Exemption:** Occasionally, when two academic programs offered by a single university or by more than one university, may have some common or equivalent course-content, the learner who has already completed one of these academic programs is allowed to

skip these 'equivalent' courses while registering for the new program. The Learner is 'exempted' from 'relearning' the common or equivalent content area and from re-appearing for the concerned examinations. It is thus taken for granted that the learner has already collected in the past the credits corresponding to the exempted courses.

Part-II

O*** The fees for transfer of credits or performance will be based on number of credits that a learner has to complete for award of the degree.**

The Scheme of Teaching and Examination:

The performance of the learners shall be evaluated in two components: Internal Assessment with 15 marks by way of continuous evaluation and by Semester End Examination with 60 marks by conducting the theory examination.

INTERNAL ASSESSMENT: - It is defined as the assessment of the learners on the basis of continuous evaluation as envisaged in the credit-based system by way of participation of learners in various academic and correlated activities in the given semester of the programme.
A). Internal Assessment – 10 marks of Practical (internal Components of the Practical Course)

1. For Theory Courses

Sr. No.	Particulars	Marks
1	Self-Learning Evaluation	15 Marks

2. For Courses with Practicals

Each practical course can be conducted out of 25 marks with 10 marks for internal and 15 marks for external **Practical's (Internal component of the Practical Course)**

Sr. No	Evaluation type	Marks
1	Journal	05
2	Viva	05

The semester end examination (external component) of 60% for each course will be as follows:

i) **Duration** – **2 Hours**

ii) **Theory Question**

Paper Pattern: -

1. There shall be four questions each of 15 marks. On each unit there will be one question and the fourth one will be based on entire syllabus.
2. All questions shall be compulsory with internal choice within the questions. (Each question will be of 25 marks with options.)
3. Question may be subdivided into sub-questions a, b, c… and the allocation of marks depend on the weightage of the topic.

The marks will be given for all examinations and they will be converted into grade (quality) points. The semester-end, final grade sheets and transcripts will have only credits, grades, grade points, SGPA and CGPA.

3. Project:

• Project which can in the following forms
− Case Studies
− Videos
− Blogs
− Research paper (Presented in Seminar/Conference)
− Field Visit Report
− Presentations related to the subject (Moot Court, Youth Parliament, etc.)
− Internships (Exposition of theory into practice)
− Open Book Test
− any other innovative methods adopted with the prior approval of Director Board of Examination and Evaluation.

4. Self-Learning Evaluation:

− **20% OF THE TOPICS OF CURRICULUM ARE LEARNED BY THE STUDENT THROUGH SELF LEARNING USING ONLINE / OFFLINE ACADEMIC RESOURSE SPECIFIED IN THE CURRICULUM.**

− **HENCE 20% OF THE LECTURES SHALL BE ALLOCATED FOR EVALUATION OF STUDENTS ON SELF LEARNING TOPICS**

− **The identified topics in the syllabus shall be learnt independently by the students in a time bound manner preferably from online resources. Evaluative sessions shall be conducted by the teachers and will carry 10 Marks.**

CLUB the self-learning topics into 3-4 GROUPS OF TOPICS ONLY FOR EVALUATION.

- PRESCRIBE TIME DURATION (IN DAYS) FOR COMPLETION OF EACH GROUP OF TOPIC AND EARMARK SELF LEARNING EVALUATION LECTURES IN THE IMETABLE. HENCE EACH GROUP OF TOPIC CAN BE ASSIGNED 3 REGULAR LECTURES FOR THIS EVALUATION FOR THE ENTIRE CLASS

3 Sub Topics

Each evaluative session shall carry 5 Marks.

4 Sub Topics

Each evaluative session shall carry 5 Marks

EVALUATION OF SELF LEARNING TOPICS CAN COMMENCE IN REGULAR LECTURES ASSIGNED FOR SELF LEARNING EVALUATION IN THE TIMETABLE

3 Evaluative sessions

Each evaluative session shall carry 5 Marks

4 Evaluative sessions

Each evaluative session shall carry 5 Marks

Methods for Evaluation of Self-learning topics:

− Seminars/presentation (PPT or poster), followed by Q&A − Objective questions /Quiz / Framing of MCQ questions.

− Debates

− Group discussion

− You-Tube videos (Marks shall be based on the quality and viewership)

− Improvisation of videos

− Role Play followed by question-answers

TEACHERS CAN FRAME OTHER METHODS OF EVALUATION ALSO PROVIDED THAT THE METHOD, DULY APPROVED BY THE COLLEGE EXAMINATION COMMITTEE, IS NOTIFIED TO THE STUDENTS AT LEAST 7 DAYS BEFORE THE COMMENCEMENT OF THE EVALUATION SESSION AND IS FORWARDED FOR INFORMATION AND NECESSARY ACTION AT LEAT 3 DAYS BEFORE THE COMMENCEMENT OF THE EVALUATION SESSION.

− Viva Voce

− Any other innovative method

SEMESTER END EXAMINATION: -

It is defined as the examination of the learners on the basis of performance in the semester end theory

/ written examinations.

B. Semester End Examination- 60 Marks

1) Duration – These examinations shall be of 2 Hours duration.

2) Question Paper Pattern: -

i. There shall be four questions each of 15 marks.

ii. All questions shall be compulsory with internal choice within the questions.

iii. Question may be sub-divided into sub-questions a, b, c, d & e only and the allocation of marks depends on the weightage of the topic.

THE MARKS OF THE INTERNAL ASSESSMENT SHOULD NOT BE DISCLOSED TO THE STUDENTS TILL THE RESULTS OF THE CORRESPONDING SEMESTER IS DECLARED.

HSNC University, Mumbai

(2023-2024)

Ordinances and Regulations

With Respect to

Choice Based Credit System (CBCS)

For the Programmes Under

The Faculty of Science and Technology

For the Course

Data Science & Business Analytics

Curriculum – First Year Undergraduate Programmes

Semester-I and Semester -II

2023-2024

Data Science & Business Analytics
Part 1- Preamble

B. Sc. Data Science and Business Analytics program is of minimum 140 credits cover six semesters. Data is the new oil. The analytics may be input for human

decisions or may drive fully automated decisions. It helps decision maker in building strategies to perform deep-dive understanding and provide descriptive, predictive, and prescriptive analytics. It is used to run the business effectively and is instrumental in growing the business. It is the area for huge potential for corporate investments. Business Analytics include identifying KPIs, measurement strategy, data analysis, complex statistical model and analysis, data mining and deep understanding of cause-and-effect models. Business analytics can drive key decision making in the organization and help executive decision makers in building strategy, predictive analysis, forecasting, risk analysis, identify and prevent fraud, market analysis, etc. Data Scientists use these skills can provide insights into discrete data sets, build complex model and present them in Scorecard format and use the same in executive reviews to lead data-driven discussion and decisions. Some of the impactful use of this is in the areas of Management Information Systems, Financial Service, Marketing Research, Process Improvements, Six Sigma, Process Excellence, Scorecard, Dashboard, End-to-End Product Management, etc.

The program emphasizes both theory and modern applications of Data Science and Business analytics and is structured to provide knowledge and skills in depth necessary for the employability of students in industry, in academics and other government and non-government organizations. The program has some unique features like independent projects, number of elective courses and extensive computer training of statistical computations including standard software packages like C++, SQL, SPSS, SAS, MINITAB, R and PYTHON etc. Due to Cluster University, the department got the academic autonomy and it has been utilized to add the new and need based elective courses. The independent project work is one among the important components of this program. The syllabus has been framed to possess a decent balance of theory, methods, and applications of statistics. It is possible for the students to study basic courses from other disciplines like economics, life sciences, computer science and Information Technology in place of optional/electives. The thrust of the course is to prepare students to enter a promising career after graduation, as also provide to them a platform for pursuing higher studies

resulting in postgraduation degrees.

1. Course objective: The main course objectives are:

➢ Provide hands-on training to students to develop and enhance the strong analytical, quantitative modelling skills and business skills for solving team-based, real-world business problems and to make students ready for the role of Data Scientist.

➢ Provide opportunity to work on some real-life data/problems or simulated data through building the business Intelligence reports, scorecard and dashboard.

SEMESTER-I

US-FDS-101 Analytics- I

Objective: The objective of the course is to make the students conversant with various techniques used in summarization, certainty involved in uncertainty in happening of events, decision making and analysis of data. The focus will be both on theoretical as well as practical approach using commonly used Statistical Software.

US-FDS-102 Foundations of data science

Objective: Students will learn the ethics and privacy concerned with data while collecting data, dealing with the data through different case studies.

MS Excel skill will make able to: Indicate the names and functions of the Excel interface components, Enter, and edit data, Format data and cells, Construct formulas, including the use of built-in functions, and relative and absolute references, Create and modify charts, Preview and print worksheets Using the Excel online Help feature along with Data visualization and Data Analytics.

US-FDS-101-i Mathematical Foundation - I

Objective: The primary objective to provide mathematical background and sufficient experience on various topics of discrete mathematics logic and proofs, combinatorics, graphs, algebraic structures and formal languages.

SEMESTER-II

US-FDS-201 Analytics-2

Objective: The objective of the course is to provide a systematic account of theory of testing and closely related theory of point estimation and confidence sets, together with their applications.

US-FDS-202 R-Programming

Objective: The objective of the course is to make the students conversant with various techniques

used in summarization and analysis of data. The focus will be both on theoretical as well as practical approach using FOSS Statistical Software.

US-FDS-201-i Mathematical Foundation - II

Objective: Techniques of linear algebra useful in various Statistics courses will be covered in this course. After learning this course, the students will be well equipped to apply these techniques in many major Statistics courses like Linear Inference, Multivariate Analysis and Operations Research etc.

2. Salient features, how it has been made more relevant.

➢ Syllabus is prepared by top most industry experts, eminent statisticians, Data Scientists and reputed faculties of HSNC University.

➢ Skills covered includes Statistics, Data Analytics, Business Analytics, Data Visualization, machine learning algorithm, Text Mining, Forecasting/ Predictive Analytics, Hypothesis Testing etc.

➢ Tools and Technology covered includes R, Python, My SQL, NO SQL, Tableau, Power BI, Machine Learning, Artificial Intelligence, SPSS, Minitab, Excel, and many more.

➢ Course includes several Assignments and Case Studies.

➢ Getting industrial experience by working on industry relevant live projects and internship.

➢ University has tie up with 100+ companies to provide job to many students.

➢ University has a dedicated placement cell for the participants who will complete course.

➢ Teaching Faculties will include good blend of Academicians and Industry Experts.

➢ Focus is to prepare Participants with clear, concise concept to experts in data Science field to add quality and value to institute they join.

➢University/ College has well placed Alumni working at top position.

3. Learning Outcomes.

Students will learn Analytics from basics concepts to creating basic models for predictions. Students will learn how analytics is actually used large corporations like Microsoft, Jio, Amazon and other top companies globally. In the hands-on session, Students will gain skills on identifying opportunities for Analytics, Machine Learning, IoT, AI, Blockchain, coming up with right set of metrics/KPIs, use cases, defining the metrics, measuring, and implementing it. Students will be able to come up with specific

Analytics Opportunities, Define Metrics and KPIs successfully for any business.

Part 2- The Scheme of Teaching and Examination is as under:

Semester – I

Summary

Sr. No.	Choice Based Credit System			Subject Code	Remarks
1	Core Course (Analytics – I, Foundation of Data Science, Mathematical Foundation-I,), (Practical's of US-FDS-101, US-FDS-102, US-FDS101-i)			US-FDS-101 US-FDS-102, US-FDS-101-i, US-FDS-1P1	
2	Elective Course	Discipline Specific Elective (DSE) Course			
		2.1	Interdisciplinary Specific Elective (IDSE) Course (Introduction to Cyber Security)	US-FDS-ME1	
		2.2	Dissertation/Project		
		2.3	Generic Elective (GE) Course		
3	Vocational course				
4	Ability Enhancement Courses (AEC)				

First Year Semester I Internal and External Detailed Evaluation Scheme

Major Papers (03)

Sr. No.	Subject Code	Subject Title	Periods Per Week						Marks			
			Units	S. L.	L	T	P	Credit	S. L.E	CT	SEE	
1	US-FDS-101	Analytics- I	3	20%	3	0	0	3	05	10	60	75
2	US-FDS-102	Foundations of data science	3	20%	3	0	0	3	05	10	60	75
3	US-FDS-101-i	Mathematical Foundation - I	3	20%	3	0	0	3	05	10	60	75
4	US-FDS-1P1	Practicals of US-FDS-101, US-FDS-102, US-FDS-101-i	3 practical per batch	0	0	0	3	3	0	0	25 marks per practical	75
	Total Hours / Credit							12	300			

*** Three hours per week to be taken for CONTINUOUS self –learning Evaluation.**

First Year Semester I - Units – Topics – Teaching Hours

S.N	Subject Code	Subject Unit Title		Hours	Total No. of Hours	Credit	Tot al Marks
1	US-FDS-101	I	Measures of central tendency and Measures of Dispersion	15	45	3	75 (60+15)
		II	Correlation and regression analysis	15			
		III	Elementary Probability Theory and few Discrete Distributions	15			
2	US-FDS-102	I	Data Ethics and Privacy	15	45	3	75 (60+15)
		II	Basics of Excel	15			
		III	Advanced Excel	15			
3	US-FDS-101-i	I	Discrete Mathematics	15	45	3	75 (60+15)
		II	Introduction to Combinatorics	15			
		III	Introduction to Graph Theory	15			
4	US-FDS-1P1	I	Practical's of US-FDS-101, US FDS-102, US-FDS-101-i	25	25 x 3=75	3	75
		II		25			
		III		25			
			TOTAL			12	300

- **Lecture Duration =1 Hour.**
- **One Credit =15 hours**

L: Lecture: Tutorials P: Practical Ct-Core Theory, Cp-Core Practical, SLE- Self learning evaluation CT-Commutative Test, SEE- Semester End Examination, PA-Project Assessment, AT- Attendance

Part -3 Detailed Scheme Theory

Curriculum Topics along with Self-Learning topics

US-FDS-101 Analytics- I (Total Hours : 45 Lectures)

Unit	Content	No. of Lectures
1	Measures of central tendency: 1.1 Concept of central tendency of data. Requirements of good measure 1.2 Locational averages: Median, Mode, and Partition Values: Quartiles, Deciles, and Percentiles. 1.3 Mathematical averages Arithmetic mean (Simple, weighted mean, combined mean), Geometric mean, Harmonic mean, 1.4 Empirical relation between mean, median and mode 1.5 Merits and demerits of using different measures &their applicability Measures of Dispersion, Skewness & Kurtosis: 1.6 Concept of dispersion. Requirements of good measure. 1.7 Absolute and Relative measures of dispersion: Range, Quartile Deviation, Mean absolute deviation, Standard deviation,Variance and Combined variance. 1.8. Raw moments and central moments and relations between them. 1.9 Concept of Skewness and Kurtosis: Measures of Skewness: Karl Pearson's, Bowley's and Coefficient of skewness based on moments. Measure of Kurtosis, Box Plot.	15
2	Correlation and regression analysis: 2.1 Scatter Diagram, Product moment correlation coefficient and its properties. Spearman's Rank correlation. (With and without ties) 2.2 Concept of linear regression. Principle of least squares. Fitting a straight line by method of least squares. 2.3 Relation between regression coefficients and correlation coefficient. 2.4 Concept and use of coefficient of determination (R^2). 2.5 Fitting a quadratic curve by method of least squares. 2.6 Fitting of exponential curves.	15
3	3.1 Probability Basic definitions of probability, Events, Properties of probability 3.2 Conditional probability - Multiplication rule, Independence, Law of total probability, Bayes' theorem 3.3 Random Variables - Random variable, Discrete random variable, Probability mass function, Cumulative density function 3.4 Expectation and Variance - Expectation of a discrete random variable, Variance, and standard deviation of a discrete random variable. Properties of Expectation and variance. Correlation coefficient.	15

	3.5 Binomial and Poisson random variables - Bernoulli trials, Binomial distribution, Expectation and variance of a binomial random variable, Poisson distribution. 3.6 Continuous random variable, Expectation and variance.	

Teaching of the unit will be done through teaching mode and through self-learning mode. Evaluation of self-learning topics to be undertaken before the concluding lecture instructions of the respective UNIT.

Self-Learning topics (Unit wise)

Sub Unit	Topics
1.2	Median, Mode,
1.3	Arithmetic mean (Simple, weighted mean, combined mean),
1.7	Range, Quartile Deviation, Mean absolute deviation,
2.1	Scatter Diagram,
3.1	Probability Basic definitions of probability, Events, Properties of probability
3.3	Random experiment, sample space and random variable

Online Resources

'Introduction to Probability and Statistics' by Prof. G. Srinivasan from IIT Madras available on the Swayam portal https://nptel.ac.in/courses/111/106/111106112/
'Introduction to Probability Theory and Stochastic Processes' by Prof. S Dhramaraja from IIT Delhi available on the Swayam portal https://nptel.ac.in/courses/111/102/111102111/ for unit II
Statistics for Business Economics' by Dr. Patel from University School of Sciences available on the Swayam portal http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/227
'Business Statistics' by Dr Mukesh Kumar Barua from IIT Roorkee available on the Swayam portal https://nptel.ac.in/courses/110/107/110107114/

US-FDS-102 Foundations of data science (Total Hours : 45 Lectures)

Unit	Content	No. of Lectures
1	Data Ethics and Privacy: 1.1 Disinformation 1.2 Bias & Fairness 1.3 Ethical Foundations & Practical Tools 1.4 Privacy and surveillance 1.5 How did we get here? Our Ecosystem 1.6 Algorithmic Colonialism, and Next Steps	15
2	2.1 Getting started with Excel 2.2 Understanding OneDrive 2.3 Creating and opening workbooks 2.3 Saving and sharing workbooks 2.4 Cell Basics 2.5 Modifying Columns, Rows, and Cells 2.6 Formatting Cells 2.7 Understanding Number Formats 2.8 Working with Multiple Worksheets 2.9 Find and replace 2.10 Page layout & printing 2.11 View Tab 2.12 Introduction to Formulas 2.13 Cell referencing	15
3	3.1 Introduction to Basic Functions 3.2 Sorting 3.3 Filtering 3.4 Working with Duplicates 3.5 Range vs Table format 3.6 Basic Charts 3.7 Advance Charts 3.8 Sparklines 3.9 Quick Analysis 3.10 Conditional Formatting 3.11 Data Validation 3.12 What if Analysis 3.13 Solver 3.14 Text Functions 3.15 Date & Time Functions 3.16 Logical Functions 3.17 Lookup Functions 3.18 Conditional Calculations 3.19 Database Functions 3.20 Pivot Tables	15

Self-Learning topics (Unit wise)

Sub Unit	Topics
1.4	Privacy and surveillance
2.7	Understanding Number Formats

2.9	Find and replace
3.2	Sorting
3.6	Basic Charts

Online Resources

Useful Excel for Beginners created by *Dinesh Natarajan Mohan*
Excel Quick Start Tutorial : 36 Minutes to Learn the Basics created by *Jeff Knowlton*
www.mygreatlearning.com offers **Excel for Beginners** course.

US-FDS-101-i Mathematical Foundation - I **(Total Hours : 45 Lectures)**

Unit	Content	No. of Lectures
1	**Discrete Mathematics** 1.1 Set Theory - Number system, Sets and their operations, 1.2 Relations and functions - Relations and their types, Functions and their types 1.3 Quadratic Functions - Quadratic functions, Minima, maxima, vertex, and slope, Quadratic Equations 1.4 Functions - Horizontal and vertical line tests, Exponential functions, Composite functions, Inverse functions 1.5 Logarithmic Functions - Properties, Graphs, Exponential equations, Logarithmic equations.	15

2	**Introduction to Combinatorics** 2.1 Counting techniques, pigeonhole principle, inclusion-exclusion. 2.2 Summation techniques: manipulations of sums and multiple sums, finite calculus 2.3 Asymptotics and the big-Oh notation 2.4 Recurrence relations, solving recurrences using generating functions. 2.5 Master Theorem for solving recurrences.	15
3	**Introduction to Graph Theory** 3.1 Graph Theory - Representation of graphs, Breadth-first search, Depth-first search, 3.2 Applications of BFS and DFS; Directed Acyclic Graphs - Complexity of BFS and DFS, Topological sorting 3.3 Longest path, Transitive closure, Matrix multiplication Graph theory Algorithms - Single-source shortest paths, Dijkstra's algorithm, Bellman-Ford algorithm, 3.4 All-pairs shortest paths, Floyd– Warshall algorithm, Minimum cost spanning trees, Prim's algorithm, Kruskal's algorithm.	15

Self-Learning topics (Unit wise)

Sub Unit	Topics
1.1	Number system, Sets and their operations
1.2	Functions and their types
2.1	Counting techniques, pigeonhole principle, inclusion-exclusion.
3.1	Representation of graphs, Breadth-first search, Depth-first search,
3.2	Applications of BFS and DFS; Directed Acyclic Graphs - Complexity of BFS and DFS, Topological sorting

Online Resources

'Discrete Mathematics' by Prof.Sajith Gopalan,Prof.Benny George K from IIT Guwahati available on the Swayam portal https://nptel.ac.in/courses/106/103/106103205/
'Discrete Mathematics' by Prof. Sourav from Chennai Mathematical Institute available on the Swayam portal https://nptel.ac.in/courses/111/106/111106086/

Detailed Scheme Practicals

Code Practical: US-FDS-1P1

Title of Paper: Practicals of US-FDS-101, US-FDS-102, US-FDS-101-i

Title of Paper	Content	No. of Lectures
US-FDS 101	Practicals based on US-FDS-101(Using Excel)	3 hours per Batch per Practical
US-FDS 102	Practicals based on US-FDS-102	3 hours per Batch per Practical
US-FDS 101-i	Practicals based on US-FDS-101-i	3 hours per Batch per Practical

US-FDS-101 Analytics- I References:

1. Medhi J.: Statistical Methods, An Introductory Text, Second Edition, New Age InternationalLtd.
2. Agarwal B.L.: Basic Statistics, New Age InternationalLtd.
3. Spiegel M.R.: Theory and Problems of Statistics, Schaum's Publications series. TataMcGraw Hill.
4. Kothari C.R.: Research Methodology, Wiley EasternLimited.
5. David S.: Elementary Probability, Cambridge UniversityPress.
6. Hoel P.G.: Introduction to Mathematical Statistics, Asia PublishingHouse.
7. Hogg R.V. and Tannis E.P.: Probability and Statistical Inference. McMillanPublishing Co. Inc.
8. Pitan Jim: Probability, Narosa PublishingHouse.
9. Goon A.M., Gupta M.K., Dasgupta B.: Fundamentals of Statistics, Volume II: The World Press Private Limited,Calcutta.
10. Gupta and Kapoor: Fundamentals of Applied Statistics, S. Chand
11. Gupta and Kapoor: Fundamentals of Mathematical Statistics, S. Chand
12. Sharma S. D.: Operations Research, Kedar Nath Ram Nath
13. Taha Hamdy A.: Operations Research-An Introduction, Tenth Edition, Pearson

US-DS-102 Foundations of data science References:

1.Excel Statistics-A Quick Guide, Nel J. Salkind, Sage Publications.
2.Zeynep Tufekci, How social media took us from Tahrir Square to Donald Trump.
3.Timnit Gebru et al, Datasheets for Datasets.
4. Rachelle Hampton, The Black Feminists Who Saw the Alt-Right Threat Coming.

US-FDS-101-i Mathematical Foundation-I References:

1. Coddington, E. A. (1989). An introduction to ordinary differential equations. New York: Dover.
2. Raisinghania, M. (2013, Fifteenth Edition). Ordinary and Partial Differential Equations. S. Chand.
3. Rosen, K. (2012, Seventh Edition). Discrete Mathematics and its Applications. Mc Graw Hill.

Part 5- The Scheme of Teaching and Examination is as under: First Year Semester- II

Summary

Sr. No.	Choice Based Credit System			Subject Code	Remarks
1	Core Course (Analytics – II, R-Programming, Mathematical Foundation - II, Practicals of US-FDS-201,US-FDS-202, US-FDS-201-i)			US-FDS201, US-FDS-202, US-FDS201i US-FDS-2P2	
2	Elective Course	Discipline Specific Elective (DSE) Course			
			1Interdisciplinary Specific Elective (IDSE) Course (Visual represenrtation using R/EXCEL)		
			2 Dissertation/Project		
			3 Generic Elective (GE) Course		
3	Ability Enhancement Courses (AEC)				
4	Vocational course (NOSQL)				

First Year Semester -II Internal and External Detailed Evaluation Scheme

Sr. No.	Subject Code	Subject Title	Periods Per Week						Total Marks			
			Units	S.L.	L	T	P	Credit	S. L. E	CT	SEE	
1	US-FDS-201	Analytics- II	3	20%	3	0	0	3	05	10	60	75
2	US-FDS-202	R-programming	3	20%	3	0	0	3	05	10	60	75
3	US-FDS-201-i	Mathematical Foundation-II	3	20%	3	0	0	3	05	10	60	75
4	US-FDS-2P2	Practicals of US-FDS-201, US-FDS-202, US-FDS-201-i	3 Practical per batch	0	0	0	3	3	0	0	25 marks Per practical	75
	Total Hours / Credit							12				300

*** Three hours per week to be taken for CONTINUOUS self -learning Evaluation.**

First Year Semester – II Units – Topics – Teaching Hours

S. N	Subject Code	Subject Unit Title		Hours	Total No. of Hours	Credit	Tot al Marks
1	US FDS 201	I	Continuous Distributions	15	45	3	75 (60+15)
		II	Estimation	15			
		III	Testing of hypothesis	15			
2	US FDS 202	I	Fundamentals of R	15	45	3	75 (60+15)
		II	Data Handling	15			
		III	Statistical Computing	15			
3	US FDS 201-i	I	Matrices	15	45	3	75 (60+15)
		II	Vector Spaces	15			
		III	Linear Transformation	15			
4	US FDS 2P2	I	Practicals of US-FDS-201, US FDS-202, US-FDS-201-i	25	25x3=75	3	75
		II		25			
		III		25			
			TOTAL			12	300

- **Lecture Duration =1 Hour.**
- **One Credit =15 hours**

Part -6 - Detailed Scheme Theory

Curriculum Topics along with Self-Learning topics

Teaching of the unit will be done through teaching mode and through self-learning mode. Evaluation of self-learning topics to be undertaken before the concluding lecture instructions of the respective UNIT.

US-FDS-201 Analytics-II (Total Hours: 45 Lectures)

Unit	Content	No. of Lectures
1	1.1Continuous Probability distributions: Normal Distribution and Exponential distribution. 1.2 Central Limit theorem (statement only). Estimation: 1.3 Concept of Parameter, statistic, estimator, and estimate. 1.4 Properties of good estimator (Only names), unbiasedness and standard error of an estimator. (Development of critical region is not expected.) 1.5.Sampling distribution of sample means and sample proportion (For large sample only). 1.6 Point and Interval estimate of single proportion, difference of two proportions. Confidence intervals for (i) Mean of Normal population, (ii) difference between means of two independent Normal populations having the same variance	15
2	2.1 Student's t distribution: Estimation of mean and difference between two means using t distribution. 2.2 Chi Square distribution. Estimation of variance using Chi square distribution. 2.3 F distribution. Estimation of ratio of variance using F distribution. 2.4 Testing of hypothesis: Concept of hypothesis, Simple Hypothesis and composite hypothesis, Null and alternate hypothesis, Types of errors, Critical region, Level of significance. 2.5 Large sample tests: Test of significance for specified value of mean of Normal population. Test of significance for difference between means of two independent Normal populations with equal variances and inequal variances.	15
3	Statistical Tests:	15

	3.1 Exact sample tests using t distribution: Independents and Dependent samples (Paired t test) 3.2 Applications of Chi-Square: Testing for association, Testing for variance, Testing for goodness of fit. 3.3 Applications of F: Test procedure for testing equality of variances of two independent Normal populations i. Mean is known ii. Mean is unknown. 3.4 Concept of ANOVA, One way and Two way anova	

Self-Learning topics (Unit wise)

Sub Unit	Topics
1.3	Concept of Parameter, statistic, estimator, and estimate.
1.6	Interval estimation for difference between proportions
2.5	Test of significance for difference between means of two independent Normal populations with equal variances
3.3	Applications of F: Test procedure for testing equality of variances of two independent Normal populations when Mean is known

Online Resources

1. 'Probability and Statistics' by Prof. Somesh Kumar from IIT Kharagpur available on the Swayam portal https://nptel.ac.in/courses/111/105/111105090/
2. 'Statistics for Business Economics' by Dr. Patel from University School of Sciences available on the Swayam portal http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_ug.php/227
3. 'Business Statistics' by Dr Mukesh Kumar Barua from IIT Roorkee available on the Swayam portal https://nptel.ac.in/courses/110/107/110107114/ for unit I and unit II.

US-FDS-202 R-Programming **(Total Hours: 45 Lectures)**

Unit	Content	No. of Lectures
1	1 Fundamentals of R 1.1 Introduction to R features of R, installation of R, Starting and ending R session, getting help in R ,	15

	1.2 Value assigning to variables. 1.3 Basic Operations: +, -, *, ÷, ^, sqrt. 1.4 Numerical functions: log 10, log , sort, max, unique, range, length, var, prod, sum, summary, dim, sort, five num etc. 1.5 Reading and writing data: From and to CSV files and HTML. 1.6 Data Type: Vector, list, matrices, array and data frame 1.7 Variable Type: logical, numeric, integer, complex, character and factor. 1.8 Operations on matrices. 1.9 Control statements: if, if-else, if-else-if, while loop, for loop. 1.10 Defining functions and Printing outputs.	
2	Data Handling 2.1 Data Manipulation: Selecting random N rows, removing duplicate row(s), dropping a variable(s), Renaming variable(s), sub setting data, creating a new variable(s), selecting of random fraction of row(s), appending of row(s) and column(s), simulation of variables. 2.2 Data Processing: Data import and export, setting working directory, checking structure of Data :Str(), Class(),, Changing type of variable (for eg as.factor, as.numeric) 2.3 Introduction to dplyr and data.table packages 2.4 Data Visualisation using simple functions and ggplot: Simple bar diagram, subdivided bar diagram, multiple bar diagram, pie diagram, Box plot for one and more variables, histogram, frequency polygon, scatter plot eg plot(), correlation plot.	15
3	Statistical Computing: 3.1 Descriptive Statistics: Averages, Positional Averages, Dispersion, Skewness , Kurtosis, Correlation Curve Fitting and Regression 3.2 Some Probability Distributions: Plotting of pmf/pdf, cdf, computation of probabilities of Binomial, Poisson, Normal, Exponential. 3.3 Statistical Tests for t, Chi-square, F and ANOVA 3.4 Operations Research Techniques: A Concept and Mathematical Formulation of Linear Programming Problem, Transportation Problems and Assignment Problems. Numerical problems of all above using lpSolve.	15

Self-Learning topics (Unit wise)

Sub Unit	Topics
1.1	Introduction to R features of R, installation of R, Starting and ending R session, getting help in R
1.8	Operations on matrices.
2.4	Data Visualisation using simple functions and ggplot: Simple bar diagram, subdivided bar diagram, multiple bar diagram, pie diagram, Box plot for one and more variables, histogram, frequency polygon, scatter plot eg plot(), correlation plot.
3.1	Descriptive Statistics: Averages, Positional Averages, Dispersion, Skewness , Kurtosis, Correlation Curve Fitting and Regression

Online Resources

1. 'Introduction to R Software' by Prof. Shalabh from IIT Kanpur available on the Swayam portal https://nptel.ac.in/courses/111/104/111104100/
2. 'Descriptive Statistics with R Software' by Prof. Shalabh from IIT Kanpur available on the Swayam portal https://nptel.ac.in/courses/111/104/111104120/ for unit I, unit II and unit III.
3. 'Introduction to R' by Santu Ghosh from Rajiv Gandhi University of Health Sciences available on the Swayam portal http://ugcmoocs.inflibnet.ac.in/ugcmoocs/view_module_pg.php/1851

US-FDS-201-i Mathematical Foundation - II **(Total Hours : 45 Lectures)**

Unit	Content	No. of Lectures
1	**Matrices** 1.1Matrices: Definition, Properties, Basic operations, 1.2 Determinants of Matrices and applications of determinants for 3rd and Higher order, 1.3 Inverse of matrix, Trace of matrix, Partition of matrix, Idempotent matrix 1.4 Echelon forms, canonical form, 1.5 Solving linear equations, 1.6 Characteristic roots and characteristic vectors, properties of characteristics roots, 1.7 Quadratic forms, positive and Positive semi definite matrix	15
2	**Vector Spaces** 2.1 Definitions and Examples. 2.2 Vector Subspaces. 2.3 Linear Independence. 2.4 Basis and Dimensions of a Vector Space. 2.5 What is the rank/dimension for a vector space; 2.6 Rank and dimension using Gaussian elimination	15
3	**Linear Transformations** 3.1 Definitions and Examples. 3.2 Representation by a matrix. 3.3 What is a linear mapping 3.4 Kernel and Image of a Linear Transformation, finding bases for the kernel and image 3.5 Rank-Nullity theorem. 3.6 Linear Isomorphism.	15

Self-Learning topics (Unit wise)

Sub Unit	Topics
1.1	Matrices: Definition, Properties, Basic operations
1.2	Determinants of Matrices and applications
1.5	Solving linear equations
2.5	What is the rank/dimension for a vector space
2.6	Rank and dimension using Gaussian elimination

Online Resources

1. 'Basic Linear Algebra' by Prof. I. K. Rana from IIT Bombay available on the Swayam portal https://nptel.ac.in/courses/111/101/111101115/ for unit 1.
2. 'Linear Algebra' by Prof. Pranav Haridas from Kerala School of Mathematics available on the Swayam portal https://nptel.ac.in/courses/111/106/111106135/
3. 'Introduction to Abstract and Linear Algebra' by Prof. Sourav Mukhopadhyay from IIT Kharagpur available on the Swayam portal https://nptel.ac.in/courses/111/105/111105112/

Detailed Scheme Practicals

Code Practical: US-FDS-2P2

Title of Paper: Practicals of US-FDS-201, US-FDS-202, US-FDS-201-i

Title of Paper	Content	No. of Lectures
US-FDS 201	Practicals based on US-FDS-201	3 hours per Batch per Practical
US-FDS 202	Practicals based on US-FDS-202	3 hours per Batch per Practical
US-FDS 201-i	Practicals based on US-FDS-201-i	3 hours per Batch per Practical

US-FDS-201 Analytics- II References:

1. Medhi J. : Statistical Methods, An Introductory Text, Second Edition,New Age InternationalLtd.
2. Agarwal B.L. : Basic Statistics, New Age InternationalLtd.
3. Spiegel M.R. : Theory and Problems of Statistics, Schaum's Publications series. TataMcGrawHill.
4. Kothari C.R. : Research Methodology, Wiley EasternLimited.
5. David S. : Elementary Probability, Cambridge UniversityPress.
6. Hoel P.G. : Introduction to Mathematical Statistics, Asia PublishingHouse.
7. Hogg R.V. and Tannis E.P. : Probability and Statistical Inference. McMillanPublishing Co. Inc.
8. Pitan Jim : Probability, Narosa PublishingHouse.
9. Goon A.M., Gupta M.K., Dasgupta B. : Fundamentals of Statistics, Volume II : The World Press Private Limited,Calcutta.
10. Gupta and Kapoor: Fundamentals of Applied Statistics, S. Chand
11. Gupta and Kapoor: Fundamentals of Mathematical Statistics, S. Chand

US-DS-202 R-Programming References:

1. Crawley, M. J. (2006). Statistics - An introduction using R. John Wiley, London
2. Purohit, S.G.; Gore, S.D. and Deshmukh, S.R. (2015). Statistics using R, second edition. Narosa Publishing House, New Delhi.
3. Shahababa , B. (2011). Biostatistics with R, Springer, New York
4. Verzani, J. (2005). Using R for Introductory Statistics, Chapman and Hall /CRC Press, New York

US-FDS-201-i Mathematical Foundation-II References:

1. S. Kumaresan , Linear Algebra: A Geometric Approach, Prentice Hall of India, New Delhi, 1999.
2. M. Artin, Algebra, Prentice Hall of India , New Delhi, (1994).
3. K. Hoffmann and R. Kunze Linear Algebra, Second Ed. Prentice Hall of India New Delhi, (1998). 4. S. Lang, Introduction to Linear Algebra, Second Ed. Springer-Verlag, New Yark, (1986).
5. A. Ramchandra Rao and P. Bhimasankaran, Linear Algebra, Tata McGraw Hill, New Delhi (1994).
6. G. Schay, Introduction to Linear Algebra, Narosa, New Delhi, (1998).
7. L. Smith, Linear Algebra, Springer –Verlag, New York, (1978).
8. G. Strang, Linear Algebra and its Applications. Third Ed. Harcourt Brace Jovanovich, Orlando, (1988).
9. T. Banchoff and J. Werner, Linear Algebra through Geometry. Springer-Verlag, New Yark, (1984).
10. H. Anton and C. Rorres, Elementary Linear Algebra with Applications, Seventh Ed., Wiley, (1994).

Multi-Disciplinary Elective

Year	Sem.	Papers	Paper Code	Course Title Network security and Data visualization techniques using Softwares	No of Credits	No of Lectures Hours	Total Credits
1	I	ME1	US-FDS-ME1	MIS and EXCEL for Financial functions	2	30	2
	II	ME2	US-FDS-ME2	Data analysis using R/EXCEL	2	30	2

MS-FDS-ME1: MIS and EXCEL for Financial functions (Total Hours: 30 Lectures)

Unit	Content	No. of Lectures
I	Introduction to MIS and Excel Basics Understanding Management Information Systems (MIS) and its importance Introduction to Microsoft Excel: Interface, Navigation, and Data Entry Basic Excel Functions: Sum, Average, Count, and IF statements Data Management in Excel Sorting and Filtering Data Data Validation and Conditional Formatting Working with Tables and PivotTables Advanced Excel Functions for Financial Analysis Financial Functions: NPV, IRR, PMT, and more Time Value of Money (TVM) calculations Analyzing data with Goal Seek and Solver Data Visualization and Charts Creating Charts: Line, Bar, Pie, and Scatter plots	15

	Customizing Charts and Adding Trendlines Interactive Dashboards in Excel	
II	Advanced Data Analysis Techniques Using Excel's Data Analysis Tool Pak Introduction to Power Query for data transformation Scenario Analysis and Sensitivity Analysis Financial Modelling and What-If Analysis Building Financial Models in Excel Performing What-If Analysis with Data Tables Monte Carlo Simulation using Excel Macros and Automation in Excel Introduction to Excel Macros and VBA (Visual Basic for Applications) Creating and Running Macros Automation and Efficiency Tips Integrating External Data and Collaborating in Excel Importing data from external sources (e.g., SQL databases) Collaborating on workbooks using Excel Online and SharePoint Data security and protection Project Work and Case Studies Practical projects involving MIS and Financial Data Analysis Analyzing real-world business scenarios using Excel Troubleshooting and Best Practices	15

US-FDS-ME2:Data analysis using R/EXCEL(**Total Hrs: 30 Lectures)**

Unit	Content	No. of Lectures
I	Statistical Computations 1.1Some Probability Distributions: Plotting of pmf/pdf, cdf, computation of probabilities of Binomial, Poisson, Normal, Exponential 1.2 Operations Research Techniques: Concept and Mathematical Formulation of Linear Programming Problem, Transportation Problems and Assignment Problems. Numerical problems of all above using Solver. 1.3Concept and Numerical Problems with Excel add-in MegaStat, Real analysis tool pak	15

II	Data Visualisation using simple functions and ggplot: Simple bar diagram, subdivided bar diagram, multiple bar diagram, pie diagram, Box plot for one and more variables, histogram, frequency polygon, scatter plot eg plot(), correlation plot.	15

Vocational Courses Linked to Major/Minor

Year	Sem.	Papers	Paper Code	Course Title	No of Credits	No of Lectures Hours	Total Credits
I	I	V1	US-FDS-V1	**Analyzing Social Media Networks with NodeXL - I**	1	30	1
I	II	V1	US-FDS-V2	**Analyzing Social Media Networks with NodeXL - II**	1	30	1

US-FDS-V1 & V2: Analyzing Social Media Networks with NodeXL (Total Hours: 30 Lectures)

Sem	Content	No. of Lectures
I	Understanding the basics of social media networks and their relevance in research and real-world applications. Introduction to NodeXL: Installation, setup, and basic functionalities. Identifying relevant data sources for social media network analysis. Collecting data from popular social media platforms Data preprocessing and cleaning techniques to handle noise and irrelevant information. Creating visual representations of social media networks using NodeXL. Customizing graph layouts, colors, and labels to enhance visual understanding. Visualizing large networks using filtering and zooming techniques. Case study based on all the topics covered.	30
II	Understanding fundamental network metrics like degree centrality, betweenness centrality, and clustering coefficient. Analyzing network structures and identifying influential nodes and communities. Hands-on exercises for calculating and interpreting metrics. Introduction to community detection algorithms and their application in social media networks. Identifying and visualizing communities within social media networks using NodeXL. Analyzing temporal patterns in social media data. Visualizing and interpreting network dynamics over time.	30

	Case study based on all the topics covered.	