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ROYAL UNIVERSITY OF BHUTAN

SHERUBTSE COLLEGE

Definitive Programme Document for
Bachelor of Data Science & Data Analytics Programme

Royal University of Bhutan
December 2023

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1. Programme Specification

1.1 Basic information on the programme

Name of the home base college:	Sherubtse College, Kanglung, Bhutan
Title of the award:	Bachelor of Data Science & Data Analytics
Duration and mode of study:	4 years, full time
Awarding Granting Body:	Royal University of Bhutan
Date of Initial Approval:	12 December 2022

1.2 Aims and Learning Outcomes of the Programme

1.2.1 Aims of the programme

The Bachelor of Data Science & Data Analytics programme aims to provide students with an opportunity to study academic programmes of quality and relevance and prepare for the fast-evolving job markets not just in Bhutan but elsewhere, globally. The programme has been specially designed to churn out graduates with required skills and expertise to deal with the abundance of data sets made available in every sphere of our lives, thanks to the versatility and easy accessibility of Internet connectivity, and digitalization. Everything we produce, buy, sell, and consume leaves a data trail. So, societies are inundated with information from various sources of data on a regular basis. Unless we have the right person and tools to make sense out of these data, they are a treasure but sitting idly in the repositories. Thus, the programme aims to train students to be data professionals who can think with data, work with data, and make sense out of data.

As a data professional, our student will have to be proficient not just in the aspects of computing and data analytics, but also in other domains. In keeping with this, the programme will provide students with necessary knowledge and skills to collect and visualize data, develop websites (both Front and Back Ends) and work on the modern databases. Further, the programme includes a number of programming and applied mathematics/statistics modules to give them training on data analytics and inferences/predictive analysis. Big data technologies and machine learning modules will help students deal with complex data sets and make it useful for predictions and informed decision-making.

Additionally, in order to provide wholesome education and personal development to the students, some elective modules are included in the programme. Through these modules, the students will gain oral and written communication skills, have awareness about local and global values, leadership and interpersonal skills. Some of the elective modules include creative speaking, UI/UX and entrepreneurship which are in high demand in the job markets. Through a series of data science projects, students will be able to make use of all these skills and in the process gain confidence to face new challenges presented in the new environment.

Therefore, the Bachelor of Data Science & Data Analytics programme aims to produce graduates who are not just competent in subject knowledge but also industry-ready to take up jobs and excel at fast-changing working environments. In particular, the skills for career development module and professional certification modules taught during their final year of study will train them to pick up skills to stand out from the rest of the job seekers. Needless to mention that the 48-credit capstone project that the students

have to undertake in the final semester, will test and consolidate the acquired knowledge and skills during their duration of study.

1.2.2 Learning outcomes of the Programme

Upon completion of the programme, graduates will be able to:

1. Perform data processing such as data retrieval, cleaning, processing, analyzing and storage of data.
2. Apply data science technologies and tools to process and analyze structured and unstructured data.
3. Assess appropriate methods to develop the solutions to real-world problems.
4. Use suitable programming languages to process, manipulate and visualize data.
5. Analyze quantitative and qualitative aspects of data for decision-making and situational analysis.
6. Validate results using appropriate statistical methods.
7. Communicate findings through documentation, discussion and/or presentation.
8. Apply principles of data governance and ethics in handling real data.
9. Exhibit critical thinking and logical reasoning in the problem-solving process.
10. Demonstrate ability to work as a team, listen and respond to others, and use negotiation and conflict-resolution skills.
11. Construct functional, user-friendly, and interactive interfaces to communicate with databases.

1.3 Career related opportunities

In the modern digital era, data has become the new oil or gold, driving innovation and decision-making across industries. With the exponential growth of data generated every second, organizations and technology companies are increasingly focusing on leveraging data analytics to extract meaningful insights. The emergence of data science and artificial intelligence has revolutionized the way businesses operate, making prediction, forecasting, and informed decision-making more accurate and efficient. As a result, data analytics has become an indispensable tool in addressing real-world challenges, optimizing operations, and shaping the future of industries.

Governments and agencies worldwide are investing heavily in data-driven policy-making and digital transformation. Bhutan, too, has embarked on its digital transformation journey, recognizing the importance of data-driven decision-making, analytics, and consultancy services. The establishment of the Government Technology Agency (GovTech), national data centers, and digital service platforms has created exciting employment opportunities for skilled data professionals. With the increasing reliance on technology and data for economic planning and governance, there is a growing demand for experts who can analyze and interpret data to drive national development strategies, improve public services, and foster innovation.

The career prospects for graduates specializing in data analytics are promising, as industries across the globe are increasingly seeking professionals with expertise in extracting insights from vast amounts of data. The versatility of data analytics skills allows graduates to explore opportunities in various sectors, including finance, insurance, education, agriculture, business, industry, and computer science. Many

organizations, both in the public and private sectors, rely on data analytics for optimizing operations, predicting market trends, and making informed business decisions. In Bhutan, as well as internationally, data analytics graduates can find employment in government agencies, financial institutions, healthcare systems, and research organizations. The nature of the field also offers flexible career options, including remote work, freelancing, and entrepreneurial ventures in data-driven consultancies.

Graduates of this programme will acquire a strong technical foundation in programming, web development, data analytics, and artificial intelligence and machine learning. These skills will enable them to work in roles such as data analysts, business intelligence analysts, machine learning engineers, financial analysts, and marketing analysts, among others. Additionally, their expertise will be validated through professional certifications in relevant fields, ensuring they meet industry standards and remain competitive in the job market. As part of their academic journey, students will also undertake Capstone projects, where they will apply their knowledge to solve complex real-world problems. These projects will not only showcase their technical abilities but also enhance their problem-solving and analytical skills, making them well-prepared for the challenges of the data-driven world.

With Bhutan's increasing emphasis on digitalization and data-driven governance, graduates will play a vital role in shaping the country's technological and economic landscape. Their ability to analyze data, develop predictive models, and create impactful solutions will make them valuable assets in both national and international job markets. As industries continue to evolve, the demand for data professionals will only grow, offering graduates a future filled with opportunities for innovation, leadership, and career advancement.

1.4 Programme Structure

Yr	Sem	Module 1	Module 2	Module 3	Module 4	Module 5
1	I	BML101 Foundations of Project Management	EPS101 Introduction to Environmental & Global Economics	DAT101 Foundations of Statistical Computing	LAC101 Dzongkha Sháyoen Drétsóel	CSP101 Foundations of Python Programming
	II	MAC101 Foundations of Digital Communication	DAT102 Foundations of Data Science	LAC103 Academic Research Skills	LAC102 Dzongkha Tsómdé	Elective I
2	I	CSP201 Front End Web Development	CSP202 Modern Database Design	DAT201 Mathematics for Data Science I	DAT202 Data Analytics and Visualization	Elective II
	II	CSP203 Back End Web Development	DAT203 AI & Machine Learning	DAT204 Statistical Computing II	DAT205 Data Science Project I	Elective III

3	I	DXT303 User Interaction Design	DAT301 Deep Learning	DAT302 Mathematics for Data Science II	DAT303 Statistical Modelling and Simulation	Elective IV
	II	DAT304 Big Data	DAT305 Research with Advanced Data Analytics	DAT306 Calculus for Data Science	DAT308 Data Science Project II	Elective V
4	I	DAT401 Natural Language Processing	DAT402 Ethics in AI and Data Governance	DAT403 Optimization for Data Science	CRD301 Advanced Skills for Career Development	CRD303 Professional Certification I
	II	CRD304 Industry Capstone Project				CRD401 Professional Certification II

The Bachelor of Data Science and Analytics is designed as a four-year degree programme comprising eight semesters. A programme integrating the elements of computation, mathematical foundations, and statistical thinking at all levels will provide a rich and effective series of modules to prepare graduates for a career in data science and data analytics. The basic requirements for a career in data science are provided by modules from the traditional disciplines of computer science, mathematics, statistics, and domain-specific subjects.

The curriculum structure of the proposed programme is designed in a progressive manner: years 1—foundations; years 2—deep domain; years 3—deep experiential; and years 4—deep specialists. In the foundational year, students will be taught a number of foundational modules in statistics, programming, communication, and project management. Basic academic research skills will be taught so that students are oriented from the start to research methods and ethics.

After completion of First Year Common modules students will choose one from the three programmes viz Bachelors of Economics and Political Science, Bachelor of Communications and Project Management and Bachelor of Data Science and Data Analytic. The choice will be based on their performance in their first year and their preference.

In Year 2, the focus is more on the deep domain modules, which include both frontend and backend web development, database design, machine learning, discrete structures, and algebra. People working with data require modeling data-driven problems to understand the world. Mathematics provides the language for these models. So, a firm foundation in mathematics and statistics will be provided through an essential aspect of the mathematics and statistics module in the curriculum. Data visualization techniques and

data science projects will provide skills for dealing with data and presenting the findings. A few elective modules will complement and reinforce their learning outside their domain.

When students reach Year 3, high-level modules will be introduced to help them learn the concepts in greater depth. Here, students will study User Interaction Designs and delve into the fundamentals of deep learning, followed by advanced data analytics. Big Data, along with the research projects on advanced data analytics, will equip students with the required skills to handle real-life projects.

The Year 4 gives emphasis on career development skills and certifications, followed by a 48-credit Industry Capstone Project. The project will be based on real data that they will have selected as the focus of the study or in a thematic area.

The following modules have been included in the programme.

a. Mathematics & Statistics – 7
b. Data Science - 5
c. Computer Science/IT - 6
d. Project Management – 1
e. Machine Learning – 2
f. Research Methodology - 1
g. Dzongkha Communication - 2
h. Capstone project/Research project – 3
i. Electives – 5
j. Professional Certification/Career development – 3
k. Environmental and Global Economics - 1
l. Digital Communication - 1

Electives

Student after completing Year I Semester I will select one elective track from the three offered. The elective tracks are Entrepreneurship, Public Communication and UI UX. Once students have selected a track, students will be taking 5 modules, one each semester starting from Year I Semester II. For details on elective tracks, please refer to the elective tracks document.

Students in the three elective tracks will be from all the three programmes viz Bachelors of Economics and Political Science, Bachelor of Communications and Project Management and Bachelor of Data Science and Data Analytics. So there will be a mix of students from all the three programmes in the three elective tracks.

1.5 Learning and Teaching Approach

With the new programme, Sherubtse will adopt a new pedagogy based on the 12 Principles of Modern Pedagogy: compile, contribute, combine, change, correlate, compare, catch, cooperate, connect, communicate, collaborate, and learn collectively. The aim is to provide an ideal environment for encouraging the individual student to develop self-efficacy, analytical systems, and critical thinking skills, and a problem-solving mindset and approach.

This paradigm shift in the teaching-learning approach has been geared toward producing job-ready graduates equipped with broader skills and knowledge. This type of student, called T-shaped graduates, learns by linking up different perspectives from different specialties, whereas the traditional method of focusing more on content knowledge and theory tends to produce the so-called "I-shaped" graduates who are well versed in a specific area of expertise and learn by drilling more deeply into a particular field. However, because I- shaped graduates lack practical skills, they frequently struggle to apply their discipline knowledge to real-life situations. The reason T-shaped graduates fare better is that their breadth of knowledge and experience enables faster adaptation to role changes and better communication and teamwork skills in multidisciplinary, multidimensional, or multicultural contexts. As a result, the need for tertiary education institutions to strike a balance between developing discipline-specific skills and education focused on broader core graduate attributes has become increasingly emphasized.

Thus, the programme will adopt this pedagogy to make our learners' industry-ready. While occasional lectures will be used to explain and simplify theoretical concepts, the emphasis will be more on hands-on practices through tutorials and practical sessions. In addition, learners are expected to explore and work independently towards achieving the objectives of the programme. This will include peer collaboration, reading, assignments, and virtual learning through the use of educational technology.

In Year 1, tutors will apply the inquiry-based learning approach to administer common integrator modules. Students will be expected to compile general information, contribute to group work, process and reuse the works of others, and make improvements based on the feedback. As they progress to Year 2, students will be introduced to domain knowledge and professional learning. This will be done through a directed learning approach whereby students will be trained to generate and correlate data from technology-based activities, compare the works of others, participate in virtual and online activities of various types, and learn the art of communicating with experts and professionals. Likewise, in Year 3, as they enter the deep experiential phase, tutors will adopt the social learning approach. Here, students will be taught to pick up and hone their ability to access high-quality content based on the format needed, communicate effectively with other professionals, publish their works with a variety of media, connect with other people, and learn collaboratively. Finally, in Year 4, students will delve into becoming deep specialists by employing the inquiry, directed, and social learning approaches with tutors acting as mere facilitators.

Throughout the learning process, tutors will facilitate learners' opportunities to seek information from various sources, synthesize information, and create knowledge through projects and case studies. These teaching and learning approaches will be complemented by an agile learning environment called "Sherubtse Digital Studio," which shall have a comfortable working space with adequate movable assets and furniture.

1.6 The Assessment Approach

The assessment approach will be entirely formative to frequently assess whether learning objectives are being met. This will be supplemented with immediate feedback to ensure students identify their own gaps and work with their tutors towards filling them.

Assessment will take the following forms:

- Written assignment
- Practical assessment/practical skills demonstration
- Elevator pitch
- Guided discussions
- Oral presentation/public speaking
- Project work
- Portfolios
- Prototype design
- Problem-solving based assignments
- Quiz
- Class test

The weightage of formative assessment components will differ based on the nature and objectives of each module.

For the capstone project, the assessment will be rigorous and based entirely on the research process, shown through a written report and the oral presentation of the project. The project report accounts for 70% of the total weightage, and oral presentation will account for 30%.

1.7 Regulations

1.7.1 Entry requirements

The candidates aspiring to enroll in this programme must have completed the Bhutan Higher Secondary Education Certificate (BHSEC) examination or equivalent examinations with a minimum of 50% in either business mathematics or pure mathematics. The ability rating points will be used to shortlist the aspiring candidates for the skills test administered by the college. A total of 100–110 of the best students based on the ability rating points will be eligible for the "Data & Visualization Skills Test," out of which the top 50 will be selected.

Programme	**Eligibility Criteria**	**Ability Rating**
Bachelor of Data Science & Data Analytics	Class XII pass candidates with a minimum of 50% in Mathematics and/or Business Mathematics	Mathematics/Business Mathematics - 5 English - 3 Dzongkha - 3 2 other subjects - 1

The weighting assigned to a subject is based on the relevance of the subject to the programme. The selection criteria are subject to revision as per the policy guideline of the RUB and Sherubtse College. Progression from one level to another level will be determined by University progression regulation specified in the Wheel of Academic Law (WAL) of the RUB and Sherubtse College Academic Guidelines.

1.7.2 Assessment and progression requirements

To pass a module, a student must obtain a minimum of 50% overall including both the continuous assessment (CA) and semester-end examination (SE). However, a student must obtain a minimum of 40% each in CA and SE. **Note that all the assessment categories are mandatory and must achieve a pass mark (minimum 40%) in each assessment category.**

1.7.3 Re-assessment

A student is eligible for re-assessment if the number of failed modules is less than 30% of the total number of modules prescribed for the semester. Upon passing the failed module(s) in re-assessment, a student will not be awarded more than 50%, this being the minimum pass mark.

1.7.4 Repeat Module(s)

A student may repeat a failed module any number of times within the normal registration period for completing an award, where he or she:

- Has failed in the re-assessment of a module(s). In such an event, the student shall meet all assessment requirements of those modules, both CA and SE. For students under this category, attendance in lectures is not mandatory.

- Has failed more than 30% of the total number of modules prescribed for that semester. In such an event, the student shall meet all teaching, learning and assessment requirements of the failed modules. For students under this category, attendance in lectures is mandatory.

- For any particular semester, a student cannot register for more than 2 repeat modules in addition to the modules prescribed for the semester

1.7.5 Role of Programme Board of Examiners

The Board of Examiners shall, in the light of the University's general assessment regulations and the programme specific regulations, determine, for each module, the mark to be assigned to each student's performance. The Programme Board of Examiners shall determine whether each student shall:

- be eligible for an award
- be allowed to continue on the programme, possibly with provision for re-assessment in certain modules and/or for the repeat of certain modules, or
- be required to withdraw from the programme

Detailed information on progression criteria is available in "D1 Re-assessment and Repeat of a Module" of "The Wheel of Academic Law" (www.rub.edu.bt).

1.8 Planned Student Numbers

A proposed intake of 50 students for the initial cohort, followed by 75 students in subsequent cohorts for the next five years for the programme is reflected in the following table. To ensure quality teaching, learning, and assessment, the cohort will be divided into sections of 25 students each.

Year	2023	2024	2025	2026	2027
Year 1	50	75	75	75	75
Year 2		50	75	75	75
Year 3			50	75	75
Year 4				50	75
Total	**50**	**125**	**200**	**275**	**300**

1.9 Programme Management, Quality Assurance and Enhancement

To ensure quality and proper monitoring both in terms of delivery and assessments, a closely coordinated system of programme management mechanisms are in place that is in line with the guidelines spelt in "The Wheel of Academic Law" (www.rub.edu.bt) and the "Academic Affairs Guidelines" (www.sherubtse.edu.bt). This is enabled through specific responsibilities delegated to dedicated staff and institution of several committees, and through timely student feedback, as outlined below.

The following sections provide an overview of the mandatory university-wide quality assurance and enhancement procedures:

Dean of Academic Affairs (DAA)

DAA maintains and implements academic regulations/guidelines, supports and implements innovative approaches to teaching-learning and quality across all programmes in the College. DAA is responsible for maintaining the health of all programmes at the College.

Head of the School (HoS)

HoS provides organizational and academic leadership for programmes offered by the department, and is accountable to the DAA in the day-to-day operations. HoS is responsible for maintaining the health of programmes within the department.

Programme Leader (PL)

PL provides organizational and academic leadership for the programme and is directly accountable to the HoD. PL is responsible for maintaining the health of the programme and reporting issues related to the programme to appropriate committees. PL is also responsible for drafting the Annual Programme Monitoring Report and it's reporting to the Programme Committee and College Academic Committee and final submission to the Programmes and Quality Committee.

Module Tutor (MT)

MT is directly accountable to PL and is responsible for teaching and assessment of a particular module as per the semester plan agreed upon with the PL. Importantly, MT evaluates the relevancy and currency of the module descriptor and recommends the need for updates to the PL. When there are multiple tutors teaching the same module, a Module Coordinator (MC) is appointed, who is responsible for ensuring the health of the module as per the definitive programme document. At the conclusion of the semester, the MT (or the MC) prepares module reports for the modules taught in the semester. Module reports provide insights on issues related to the delivery of modules and plan of actions for the subsequent year, which are reported in the Annual Programme Monitoring Report.

College Academic Committee (CAC)

CAC is the highest decision-making body for all matters related to academic affairs in the College. In particular, CAC serves as the guarantor of academic standards and quality in respect of the design, delivery, development and promotion of best practice in curricula, programmes, general educational matters and research within the College. It is responsible for implementation of the University academic quality assurance policies and procedures covering the development and the monitoring of taught programmes, learning and teaching and the academic support of students within the College. CAC is chaired by the DAA, with members constituting of President, Dean of Student Affairs, Dean of Research & Industrial Linkages, elected staff representatives (HoDs & selected PLs), elected student representatives (two student leaders), representative of other groups of staff (Librarian & ICT Officer), an external member and one senor academic as a secretary.

Programme Committee (PC)

At the programme level, PC is responsible for the effective conduct, organization and development of the programme, including appointment of module tutors, allocation of teaching-learning resources required for the semester. PC is chaired by the PL, with all MTs/Module Coordinators of the programme and at least three students of the programme representing different cohorts, constituting the membership.

Student Consultative Meetings (SCM)

The purpose of the SCM is to involve students in the operation of programmes and in improving the effectiveness of their own education. The SCM is convened at the Departmental level once in the mid-semester. The meeting provides a forum for the students to provide feedback on all elements of the programme such as the delivery of the modules; the subject of the modules; the effectiveness of the teaching, learning and assessment approaches; the adequacy of teaching learning resources; progression and achievement; guidance and support as well as examples of good practice. The SCM is chaired by DAA, with HoD, PLs and at least two student representatives from each year of the programme constituting the membership.

Student Module Evaluation (SME)

SME is another quality assurance and enhancement mechanism in which students are engaged in the assurance and enhancement of their educational experience. Through this mechanism, the College seeks feedback from all the students enrolled for the module in terms of module delivery, resources available, quality of learning and teaching, relevance of assessment methods, and the professionalism of module tutors. SME is done at the end for semester through use of the RUB-wide standard module evaluation form, integrated into the VLE. The line managers (Programme Leaders, Head of Departments and Dean of Academic Affairs) at the College review the feedback for every module and actions are taken when the new semester starts.

Annual Programme Monitoring Report (APMR) and Module Report (MR)

APM is a key component of the University's quality assurance and enhancement processes which provides assurance of the continued quality, standards and relevance of programmes in operation. APMR ensures that programmes leading to an award of the University meet their aims and learning outcomes effectively, while at the same time, it strives to enhance the quality of learning and teaching

at the University. It is a continuous process of appraising the performance of programmes throughout the year culminating in a consolidated Annual Programme Monitoring Report at the end of the academic year. The Programme Leader is responsible for compiling the APMR.

The MR provides a critical appraisal of the delivery of a module by reviewing its current strengths and weaknesses, and provides evidence upon which to plan the improvement of the module. It feeds the APMR by providing informed, evidence-based action points for the programme of which the module forms a part. Module tutor (or the module coordinator) is responsible for producing the module report.

Programme Board of Examiners (PBoE)

As outlined in "The Wheel of Academic Law", the PBoE ensures that module assessments are in compliance with the validated/reviewed module descriptors and the progression of students to the next level is assessed in compliance with RUB regulations. PBoE is chaired by a senior member of the staff cognisant of the programme but not closely involved in it, with HoD, PLs, staff with assigned responsibility for assessments, and an external examiner appointed by the Academic Board constituting the membership.

Moderation of Assessments

Moderation is a quality assurance process to ensure assessment is accurate, consistent and fair. It also assures that the results are an accurate reflection of performance and can be relied upon by students and staff within the university, as well as by external stakeholders. As required by the RUB regulation: "D8 Moderation of Assessments" of "The Wheel of Academic Law" (www.rub.edu.bt), at Sherubtse College all 'assessment tasks' and 'assessed student works' constituting 20% or more of the total assessment weighting of a module are moderated through internal and external moderation process. Internal moderation is done by a moderation committee, consisting of tutors from same discipline, who may or may not teach the module. External moderation is the review of examination questions and a representative sample of answer scripts, and assessed components of continuous assessment tasks for a module by the external examiner(s) for a programme.

Role of External Examiners

External examiners are independent advisers for a programme in operation. They contribute to the quality assurance and enhancement of a programme by providing an external view on assessments, student achievements, academic standards and a range of academic matters related to the delivery of a programme. The roles and responsibilities of external examiners are outlined in regulation D3 "External Examiners" in The Wheel of Academic Law.

In addition to the university-wide mandatory procedures, Sherubtse has instituted the following internal quality assurance and enhancement initiatives:

Department Academic Committee (DAC)

Given multiple programmes offered by each department at Sherubtse College, the DAC of Mathematics and Computer Science is mandated with the responsibility of promoting academic quality and standards of the department, besides implementing resolutions of the CAC at the departmental level. The committee is chaired by the HoD, with PLs and all MTs constituting the membership.

Semester Guide (SG)

At Sherubtse College, one staff member is appointed as SG from among the module tutors for each cohort of students for every programme. SG is responsible for giving guidance on both academic and non-academic matters, which includes counseling/parenting, advising on class attendance records, and reporting specific academic needs of students to MT and PL.

1.10 Academic Staff

Data Science is the fusion of three disciplines: Statistics, Mathematics, Computer Science, and domain-specific areas. The strength of Sherubtse College's ability to offer this programme is in the availability of human and other resources required to deliver the programme smoothly.

The following table shows the staff profile of the School of Data Science and Data Analytics.

Sl. No.	Name	Designation	Qualification	No. of years in a teaching position	Status
1	Mr. Sangay Thinley	Lecturer	M.Sc. Computer Applications	19	Regular
2	Mr. Karma Dorji	Lecturer	Undergoing PhD in Data Science	14	Regular
3	Mr. Phub Namgay	Lecturer	PhD, Data Science	7	Regular
4	Mr. Ngawang Choeda	Assistant Lecturer	Undergoing Masters in Data Science	1	Regular
5	Mr. Norbu Zangpo	Assistant Lecturer	Undergoing Masters in Data Science	2	Regular
6	Mr. Dawa Wangchuk Gyelpo	Associate Lecturer	MSc Statistics	4	Regular
7	Ms. Chimi Lhazom	Assistant Lecturer	Undergoing Masters in Actuarial Science	3	Regular
8	Mr. P Paulraj	Assistant Professor	MCom	18	Fixed Term
9	Mr. Balamurugan	Assistant Professor	MSc, MPhil, Mathematics	36	Fixed Term
10	Mr. Thinley Namgyel	Lecturer	MSc Mathematics	16	Regular
11	Mr. Pema Tshering	Lecturer	MSc Mathematics	14	Regular

12	Mr. Pema Wangdi	Lecturer	MSc Mathematics	13	Regular
13	Ms. Samten Choden	Associate Lecturer	Undergoing PhD in Mathematics	13	Regular
14	Mr. Dechen Lhundup	Associate Lecturer	MSc Mathematics	8	Regular
15	Mr. Ugyen Samdrup Tshering	Associate Lecturer	MSc in Applied Mathematics	4	Regular
16	Mr. Karma Dorji	Associate Lecturer	M.Sc in Applied Mathematics	1	Regular
17	Mr. Tashi Wangchuk	Associate Lecturer	MSc in Applied Mathematics	1	Regular

Professional Development Programmes

Sl.No.	**Area**	**No. of Faculty**	**Timeline**
1.	AI and Machine Learning	10	Jan. 2024
2.	Big Data Technologies	3	July 2024
3.	Research with Advanced Data Analytics	10	Jan. 2025
4.	Natural Language Processing	8	July 2025

1.11 Resource needs

Accommodation

With the phasing out of other liberal arts and humanities programmes and reduction in student intake for various programmes offered at Sherubtse College, there would not be a problem in terms of availability of classrooms, accommodation and other academic facilities.

Equipment

The provisional budget estimated for Bachelor of Data Science & Data Analytics programme is Nu. 23.9 million. This will include human resources, technical requirements, and other expenses. The college has also procured a number of titles on Data Science and Statistics. Furthermore, with plans to maximize the use of online resources, or the E-library, library expenditures will be significantly reduced. Ultimately, the college is planning to do away with physical books and replace them with an online Oreilly.com

subscription for most technology references. There are also free resources available, such as DITT's Udemy and DataCamp, which can be used by both faculty and students.

Library Support

Sherubtse College Library has a good collection of subject-specific books, journals, and periodicals of various disciplines. The library also has access to online journals and e-library facilities such as ProQuest eBook Central, JSTOR, EBSCO, DOAJ, etc. Furthermore, the college plans to maximize the use of online resources, or the E-library and leverage on free resources available, such as DITT's Udemy and DataCamp.

Computing Support

Currently, the college has five general computer labs with a total capacity of 135 computers, out of 75 computers housed in three computational labs have high performance machines (16 GB) with graphics utility. Additionally, the School has set up one Data Science lab specifically for carrying out capstone projects and other high-end usage. It has 30 machines with 32 GB ram and customized graphics and other capabilities.

Other Support Facilities

The college has the following support facilities for the smooth functioning of the programme:

- Reading Space: There are spacious reading places in the library, student service centre and around the academic block of the College for students' use after class hours.
- Wi-Fi connections are available around the academic blocks, student service centre, library and the administrative building. Further, there is a dedicated lab with Wi-Fi facilities available from 8.30 am to 10 pm for the students' use.
- Student service centre also has a counselling centre with the three trained counsellors who are available as and when students require. Further, a toll-free number 6006 can be contacted any time for availing counselling related services.
- Student service centre also has a Happiness and Wellbeing Center that frequently conducts Mindfulness and Yoga sessions, which can be attended by interested students. It also has a mini library with books related to mindfulness and personality development.
- Student Service Centre also hosts a reprographic centre where students can avail printing and photocopying services with nominal charges.
- Collaboration Room: This room is attached to the existing Data Science Lab which can be used by students for brainstorming and conducting seminars.

- **2. Module Descriptors**

2.1 Year 1, Semester I

BML101 Foundations of Project Management

Module Code and Title: BML101 Foundations of Project Management
Programme: Bachelor of Economics and Political Science, Bachelor of Digital Communications and Project Management, Bachelor of Data Science and Data Analytics
Credit Value: 12
Module Tutor: Sonam Choeki Wangmo

General objectives

The module aims to provide students with a comprehensive introduction to the fundamental principles of project management. Through a diverse array of teaching methodologies, including theoretical instruction and hands-on class activities, students will acquire a robust understanding of key project management concepts and terminologies.

The curriculum is designed to equip learners with practical skills in applying various project management tools and techniques, enabling them to effectively tackle real-world challenges across diverse project types. By engaging with case studies, students will gain valuable insights into the practical application of project management principles, enhancing their ability to analyze and solve complex project-related problems. Ultimately, the module seeks to cultivate a strong foundation in project management, empowering students to confidently navigate and successfully manage projects in their future professional endeavors.e.

Learning outcomes

On completion of this module, students will be able to:

1. Demonstrate a comprehensive understanding of fundamental project management concepts and terminologies.
2. Apply key project management tools and techniques to solve practical problems in various project scenarios.
3. Analyze and evaluate case studies to gain insights into real-world project management practices.
4. Develop critical thinking skills in the context of project management decision-making.
5. Collaborate effectively in group settings to complete project-related tasks and discussions.
6. Utilize relevant project management tools for planning, execution, and monitoring of projects.
7. Interpret and apply theoretical knowledge to practical project management situations.
8. Demonstrate the ability to manage projects across different industries and contexts.
9. Engage in self-directed learning to continuously improve project management skills and knowledge.

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
Contact	Teaching	2	35
	Practical exercises	2	25
Independent	Independent study, guest lecture and project work	4	60
	Total		**120**

Assessment approach
Assessment will be carried out on a continuous basis through the following assignments:

A. Development of a Project Charter: 10%

As an individual assignment, students will develop a project charter for a project of their choice. The project should be related to a topic of their interest or an area of study. Students should carefully consider their choice of project, as it will be used in assessment 3 and 4.

The task will be assessed based on the following criteria:

5 marks Content: *Clearly defines project scope, objectives, stakeholders, and constraints.*
2 marks Coherence and clarity: *Logical flow, well-structured, and easy to understand.*
2 marks Creativity and originality: *Demonstrates innovative thinking and unique approach.*
1 mark Compliance with assignment requirement: *Adheres to APA guidelines, formatting, and submission criteria.*

B. Quiz: 15%

In this case study, the students will delve into the critical realm of Agile methodologies and their application in real-world scenarios. By selecting and dissecting a specific business scenario, they will gain hands-on experience in scoping challenges, choosing the appropriate Agile framework, forming effective cross-functional teams, and implementing Agile practices. This task equips them with the skills to align Agile principles with organizational goals, prioritize value delivery, create value roadmaps, and measure success through relevant KPIs. Ultimately, it empowers students to develop practical recommendations for sustaining Agile practices, preparing them for careers in today's dynamic business landscape, where agility and value creation are paramount. This assessment will assess the learning outcomes 1, 7, and 8.

The case study will be assessed using the following criteria:

5 marks Scoping the Scenario: *Clearly defines the business problem, context, and constraints.*
5 marks Agile Framework Selection: *Justifies the choice of an Agile framework with relevance to the scenario.*
5 marks Team Formation and Roles: *Defines team structure, roles, and responsibilities effectively.*
5 marks Agile Practices Implementation: *Applies Agile practices appropriately to address the scenario.*
5 marks Value-Driven Approach: *Aligns Agile implementation with value delivery principles.*
5 marks Creating the Value Roadmap: *Develops a clear roadmap outlining key Agile milestones.*
5 marks Measuring Success: *Identifies and justifies relevant KPIs for evaluating Agile success*
5 marks Conclusion and Recommendations: *Provides insightful recommendations for sustaining Agile practices.*

C. Case study: 30%

The students will select either a completed or ongoing project within the Trashigang area that aligns with their previously developed project charter from Assessment 1. They will then embark on a comprehensive analysis, evaluating the project's adherence to established project management frameworks, including project phases, life cycles, process groups, and the integration of the 8 performance domains or 10 knowledge areas. This in-depth examination will span from the project's inception to its current state or completion.

Upon concluding their case study report, the students will synthesize their findings into a concise yet impactful 5-minute oral presentation. This presentation will not only encapsulate the essence of their project charter and case study report but also showcase their ability to distill complex project management concepts into clear, actionable insights. Through this assignment, students will hone their analytical skills, creative problem-solving abilities, and professional communication competencies, all while gaining hands-on experience in real-world project management scenarios.This assessment will assess the learning outcomes 3, 5, and 6.

The task will be assessed based on the following criteria:

For case study report;

20 marks	Content: *Depth of analysis, alignment with project management frameworks, integration of project phases, life cycles, and performance domains/knowledge areas*.
3 marks	Coherence and clarity: *Logical flow, structured argument, clarity in explanation.*
2 marks	References: *Proper citation, credibility of sources, adherence to APA academic standards.*

For presentation;

2 marks	Content: *Concise summary of key findings and discussions, relevance to project charter and case study.*
2 marks	Creativity and engagement: *Effective use of visuals, storytelling, audience engagement.*
1 marks	Time management: *Adherence to time limit, smooth pacing*

D. Collaborative Project Management Plan Development: 45%

In this group assignment, students will collaborate in teams of 5-6 to develop a robust project management plan based on a previously selected project charter from Assessment 1, incorporating insights and recommendations from Assessment 2. The learners will apply various project management tools and techniques to create a detailed plan that addresses key aspects of project execution, monitoring, and control. The assignment will culminate in a 15-minute video presentation, where the students will succinctly summarize their project management plan, highlighting its key components and strategies.

This task is designed to enhance the students' ability to work effectively in teams, apply theoretical concepts to practical scenarios, and develop crucial presentation skills. The assignment will be evaluated based on its thoroughness, practicality, and alignment with best practices in project management, while the video presentation will be assessed on clarity,

content, and the team's ability to effectively communicate their plan's core elements. This assessment will assess the learning outcomes 4 and 9.

The task will be assessed based on the following criteria:

For the written assignment;

5 marks Thoroughness of the Plan: *Clear objectives, scope, and deliverables with well-defined strategies.*

5 marks Practicality and Feasibility: *Realistic implementation with consideration of constraints.*

6 marks Application of Project Management Tools: *Effective use of frameworks and methodologies.*

5 marks Incorporation of Insights from Previous Assessments: *Logical integration of past feedback and analysis.*

4 marks Clarity and Organization: *Well-structured, logically sequenced, and professionally presented.*

For the presentation;

2 marks Clarity of Communication: *Logical flow, articulation, and ease of understanding.*

3 marks Content Quality: *Accuracy, relevance, and depth of information.*

2 marks Team Collaboration: *Balanced participation and role distribution.*

3 marks Engagement and Delivery: *Confidence, enthusiasm, and audience engagement.*

For the peer evaluation;

2 marks Contribution to the team effort: Active and meaningful participation.

3 marks Communication and collaboration: *Effective sharing of ideas and open communication within the team..*

2 marks Responsibility and accountability: *Fulfillment of assigned tasks and meeting deadlines.*

3 marks Quality of work: *Consistency in delivering high-quality work throughout the project.*

Overview of the assessment approaches and weighting

Continuous assessment	**Areas of Assignment**	**Quantity**	**weighting**
A (Theory)	Development of a Project Charter	1	10
	Quiz	3	15
	Case study report	1	25
	PM plan development	1	25
B (Practical)	Case study video presentation	1	5
	PM plan development presentation	1	10
	Peer evaluation (PM plan dev.)	1	10
Total		100	

Pre-requisites: None

Subject matter

Unit I:Introduction to Project and Project Management

1.1. Define a project and identify the importance of initiating a project

1.2. Define project management
1.3. Identify the difference between the PMBOK 6 and PMBOK 7
1.4. Discuss the project management principles
1.5. Describe the 10 knowledge areas and 8 performance domains of project management
1.6. Understand the process for project management certification.

Unit II: Eight Performance Domains of Project management

2.1. Discuss the eight performance domains of project management
2.2. Identify the different performance domains in a project
2.3. Understand the tools for project management.

Unit III: Structuring a project

3.1. Recognize and comprehend the key elements of the project management life cycle
3.2. Explain the project phases and life cycle
3.3. Identify the project phases in projects

Unit IV: Project Management Process Groups

4.1. Explain the project management process groups
4.2. Identify the project process groups in projects
4.3. Map the project process groups into the 8 performance domains
4.4. Create charts for the 8 performance domains in relation with the project process groups using project management tools

Unit V: Agile Project Management

5.1. Discuss the principles of agile project management
5.2. Explain the phases of agile project management
5.3. Evaluate the benefits and drawbacks of agile project management
5.4. Compare and contrast the agile project management with predictive and waterfall project management
5.5 Describe a hybrid project management

Reading List
Essential Reading

Horine, G. (2017). Project Management Absolute Beginner's Guide (4th edition). Que Publishing.

Institute, P. M. (2021). A Guide to the Project Management Body of Knowledge (Seventh edition). Project Management Institute.

Kerzner, H. R. (2002).Strategic planning for project management using a project management maturity model. John Wiley & Sons.

Pinto, J. K., & Pearson. (2016). Project management: achieving competitive advantage. Boston: Pearson.

What is Agile Project Management (APM)? | Definition from TechTarget. (n.d.). CIO. Retrieved 12 April 2023, from https://www.techtarget.com/searchcio/definition/Agile-project-management

Date: February, 2025.

EPS101 Introduction to Environmental and Global Economics

Module Code and Title: EPS101 Introduction to Environmental and Global Economics
Programme: Bachelors of Economics and Political Science, Bachelor of Digital Communications and Project Management, Bachelor of Data Science and Data Analytics
Credit: 12
Module Tutor(s): Ugyen Lhendup

General Objective
This module will introduce students to environmental issues and equip them to analyze these issues from an economic and global perspective. This module aims to provide students the relevant theories, methodological tools and evidence to understand pertinent environmental problems. Students then will be able to apply these concepts to evaluate local and global environmental policies and issues.

Learning Outcomes
On completion of the module, students will be able to:
1. Identify the pertinent environmental issues.
2. Explain economic concepts and linkages to environmental problems.
3. Describe economic concepts related to the environment.
4. Discuss the importance of valuation on environmental problems.
5. Evaluate different valuation methods to measure environmental goods.
6. Analyze the repercussions of environment degradation on the economy.
7. Evaluate the current policies and identify alternative policies.
8. Evaluate environmental policies.
9. Demonstrate and debate challenges related to sustainability issues for economic growth.

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
Contact	Lecture	3	**60**
	Presentation and discussion	1	
Independent study	Self-directed study	1	**60**
	Written assignments	1.5	
	Peer reviewed	1	
	Case study	0.5	
Total		8	**120**

Assessment Approach
The assessment approach consisted of continuous assessment of 60 marks and semester end examination of 40 marks on following approaches:

A. Mock Presentation (5%)
Students will be assigned in groups of four to five members to write an assignment. The group assignment will be provided after completion of the teaching of real-world environmental issues. The students will complete an assignment of 800 to 1000 words as a group. The group assignment is

intended for peer learning, deep learning, long-term information retention, strengthening communication and teamwork skills, and to examine contemporary environmental issues. Assignment topics will be determined by the module tutor and will assess the student's understanding of environmental problems and its causes and implications. The group assignment will be assessed by module tutor and peers. Peer evaluation fosters consistent evaluation of participation, quality, and quantity of work. The assignment will assess the learning outcomes 1,2,3,5.

Peer Evaluation Criteria

1 mark Participation and engagement: *Actively participated in all stages of the assignment. Contributed to group meetings and discussions with valuable input and ideas.*
2 marks Content quality: *Provided well-researched, relevant, and thoughtful content that directly contributed to understanding environmental issues.*
1 mark Teamwork and collaboration: *Worked collaboratively, and helped the team in meaningful discussion.*
1 mark Report contribution: *Contributed to drafting and finalizing the report, ensuring clear and concise communication. Actively assisted with editing and refining the assignment for coherence, grammar, and flow.*

Module Tutor Evaluation Criteria

1 mark Structure: *The assignment is well-organized with a clear introduction, body, and* conclusion. The structure enhances the readability and flow of the work.
3 marks Understanding the issues: *Demonstrates a comprehensive understanding of the* environmental issues and their causes. Provides relevant context and insights that show depth of knowledge on the topic.
3 marks Analysis of impact: *Provides a thorough analysis of the impact of the* environmental issue(s) on various stakeholders, such as communities, economies, and ecosystems. The analysis is insightful and well-supported by evidence.
2 marks Substantial use of relevant literature: *The assignment makes substantial use of* high-quality, relevant literature (e.g., peer-reviewed articles, books, reports) to support arguments and provide evidence.
1 mark Grammar and reference: *The assignment is grammatically correct, and references* are properly formatted.

B. Individual Assignment (15%)

Students will be tasked to critically evaluate different environmental valuation methodologies used and their merits and limitations. The written assignment will cover topics related to the interlinkage between the environment and economics, externalities and valuation of environmental resources. The assignment will be for 1000 to 1500 words. The assignment will be written in three drafts; the first draft to be peer-reviewed, the second and final essay to be assessed based on the following criteria. Learning outcomes 1,2,3,4, and 5 will be assessed by this assessment.

Second Draft Criteria

2 marks Introduction, body and content: *Clearly define topic and outline the key issues related to environmental valuation. The body presents a well-organized and* detailed discussion. The content is informative, accurate, and focused, ensuring that the arguments are supported by evidence and directly related to the topic.

2 marks Arguments and informed critic: *Demonstrates a deep understanding of* various environmental valuation methodologies and their applications. Th arguments are well-supported with evidence and examples. Acknowledges the merits and limitations of different methodologies, offering insightful analysis of how they relate to environmental and economic factors.

1 mark Organization: *A logical flow, with clear transitions with distinct introduction,* body, and conclusion sections.

Final Draft Criteria

2 marks Introduction, body and content: *Clearly define topic and outline the key issues related to environmental valuation. The body presents a well-organized and* detailed discussion. The content is informative, accurate, and focused, ensuring that the arguments are supported by evidence and directly related to the topic.

2 marks Arguments and informed critic: *Demonstrates a deep understanding of* various environmental valuation methodologies and their applications. Th arguments are well-supported with evidence and examples. Acknowledges the merits and limitations of different methodologies, offering insightful analysis of how they relate to environmental and economic factors.

1 mark Organization: *A logical flow, with clear transitions with distinct introduction,* body, and conclusion sections.

C. Case Study (25%)

Students will be allocated into groups of four to five members each and assigned a case study relating to environmental policies. They will have to write a case study report of 10 marks and deliver a presentation after conducting the case study of 15 marks**.** This is to foster the students' ability to work with other students and develop oral presentation skills. This assignment will cover learning outcomes 6,7, and 8.

Case Study Report Criteria

Students will be required to write a report on a case study which will assess their evaluation of different environmental protection measures followed across different countries. The report will focus on the environmental policy of Bhutan and its comparison with other countries' environmental policies. Groups will compare and contrast existing environmental policies and draw a critical analysis. The report will be able to inform the tutor about the student's preparedness for the presentation and knowledge on the environmental policies. Groups will submit reports in three drafts to keep track of their progress. The case study will be assessed based on the following criteria:

2 marks Structure: *The report has a clear, well-organized structure with a logical flow of sections (introduction, body, conclusion) and well-defined headings.*

2 marks Policy assessment: *The report provides a thorough assessment of Bhutan's environmental policies and those of other countries, covering*

key aspects with proper context.

3 marks Comparative analysis: *The report offers a strong comparative analysis, highlighting key differences and similarities between Bhutan's policy and those of other countries, supported by factual evidence*.

3 marks Critical analysis: *The report offers a critical analysis of the policies, evaluating their effectiveness, identifying weaknesses, and discussing broader implications.*

Case Study Presentation Criteria

Oral presentation will be conducted after the completion of the case study report to provide students with better understanding of the related concepts. Each group will make a ten-minute presentation comparing and critiquing environmental protection measures. The presentations will be assessed based on the following criteria:

2 marks. Structure: *The presentation is well-structured, with a clear introduction, body, and conclusion. Ideas flow logically, and key points are effectively highlighted.*

4 marks Content: *The presentation offers a detailed overview of the case study, with a strong comparison and critique of environmental protection measures, supported by accurate and relevant evidence.*

4 marks Delivery: *The presenters speak clearly, confidently, and at an appropriate pace. They engage the audience with enthusiasm, maintain eye contact, and use effective body language.*

2 marks Presentation aids: *Visual aids (slides, charts, graphs) are used effectively to enhance the presentation. They are clear, well-designed, and support the key points.*

3 marks Question and answer: *The group answers questions clearly, showing a Strong understanding of the case study and related concepts.*

D. Class participation (5%)

This mode of assessment is to encourage active participation of the students in their learning journey.

Assessment Criteria

1 mark Participation: *Participate in all group activities*

2 marks Contribution: *Engage in class discussions as an individual*

2 marks Engagement: *Listen attentively in the class and compete the tasks given including assignment*

E. Semester End Examination (40%)

There will be a Semester End Examination (SEE) for a duration of three hours. The exam will cover all topics in the module. More weighting will be given to the last unit on sustainable development.

Overview of the assessment approaches and weighting

Continuous assessment	Area of assignment	Quantity	Weighting (%)

A (Theory)	a. Peer evaluation-1st draft	1	5
	b. Tutor Evaluation-final draft	1	10
	a. First draft (peer-review)	1	0
	b. Second Draft	1	5
	c. Final Draft	1	10
B (Practical)	a. Case study report	1	10
	b. Presentation of case study report	1	15
	a. Class participation	1	5
C. Semester End Examination			40
Total			**100**

Pre-requisites: None

Subject Matter

Unit I: Overview of Environmental Issues

1.1 Nature and causes of emerging global environmental problem
- 1.1.1 Trends in global temperature change
- 1.1.2 Vulnerability of climate change
- 1.1.3 Ozone depletion substance
- 1.1.4 Human activities and greenhouse gas emission
- 1.1.5 Emerging water pollution

1.2 Economic and social implications of environmental problem
- 1.2.1 Effects of ozone depletion, climate change and air and water pollution on society, environmental and economics
- 1.2.2 Mitigation strategies for air and water pollution, climate change & ozone depletion
  - 1.2.2.1 International agreements on pollution, climate change and ozone depletion
  - 1.2.2.2 International actions to combat pollution: Male Declaration
  - 1.2.2.3 International actions to combat climate change: UNFCC, IPCC, Paris Agreement
  - 1.2.2.4 International actions to combat ozone depletion e.g., Vienna Convention, Montreal Protocol

Unit II: Interlinkage between the Environment and the Economy

2.1 Economics concepts related to environment 2.1.1. Circular Flow of Income
- **2.1.1** Pareto Optimality
- **2.1.2** Market failure
- **2.1.3** Externalities
- **2.1.4** Public and private ownership of resources

2.2 Relationship between the environment and economics
- 2.2.1 Environment and development trade-off using Production Possibility Frontier (PPF)
- 2.2.2 Environment Kuznets Curve
- 2.2.3 Material balance model

2.2.4 Repercussions of environment degradation on the economy
2.2.5 Positive and normative economic analysis
2.2.6 The roots of environmental degradation; industrialization, population growth, urbanization, excessive deforestation, etc.

Unit III: Valuation of Environment Resources

3.1 Importance of valuing the environmental goods
3.2 Types of value (use value and non-use value)
3.3 Internalizing externalities
3.3.1 Cost-Benefits Analysis (CBA)
3.3.2 Concepts of Willingness to Pay (WTP) and Willingness to Accept (WTA)
3.3.3 WTP and demand curve
3.3.4 Divergence in WTP and WTA for same environmental goods
3.4 Tourism taxation as a solution, payment for ecosystem services in Bhutan, and green tax
3.5 Approaches/methods to environmental valuation methods
3.5.1 Stated preference methods (Contingent Valuation method (CV)
3.5.2 Discrete Choice Method (DC)
3.5.3 Revealed Preference methods (Hedonic Pricing method, Travel Cost method, Preventive Expenditure Method)
3.6 Concepts of environmental/green accounting
3.6.1 Components of Green Accounting
3.6.2 Scale of environmental accounting (global. national and corporate environmental accounting)
3.7 Approaches to environmental management
3.7.1 Common and control regulation
3.7.2 Market based regulation
3.7.3 Voluntary regulation
3.8 Pollution tax
3.8.1 Pigouvian tax
3.8.2 Benefits and limitation of Pigouvian tax

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Unit IV: Environmental Policies

4.1 Environmental policies and regulation of Bhutan
4.1.1 National Environmental Protection Act of Bhutan, 2007
4.1.2 Water act of Bhutan 2011
4.1.3 Waste Prevention and management act of Bhutan 2009
4.1.4 Forest and natural conservation act of Bhutan 2023
4.2 The stakeholders involved in formulation and implementation of environmental policy in Bhutan
4.2.1 National Environmental Commission of Bhutan
4.2.2 RSPN, WWF, UN, BTF
4.3 Compare and contrast the environmental policies of Bhutan with other countries (case study)
4.4 Polluter pay principal policy
4.5 Environmental emergencies
4.6 Financial Incentives and Charges for Environmental Compliance
4.7 Evaluation of environmental policies of Bhutan (case study)

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Unit V: Sustainable Development

5.1 Concepts of sustainable development
5.2 Economic Approach of sustainability

5.2.1 Weak and strong view of sustainability
5.3 Ecological Approach of sustainability
5.4 Economic perspective on sustainability
5.5 Ecological perspective on sustainability
5.6 International action to combat environmental problems
5.6.1 The 17 United National Sustainable Development Goals
5.7 Applicability of Sustainability in practice
5.8 Approaches to address current sustainability issues:
5.8.1 Problem-solving approach vs regional approach

- **Reading list**

Essential Reading:

Kolstad, C.D. (2000) Environmental Economics, Oxford University Press: UK Resources, N. (2012). Environmental Economics. Science, 321(5896), 12–13. Retrieved from http://usir.salford.ac.uk/5586/

Scientific Assessment of Ozone Depletion: Twenty Questions and Answers About the Ozone Layer. https://csl.noaa.gov/assessments/ozone/2018/twentyquestions.

Shogren, J. F., & Taylor, L. O. (2008). On behavioural-environmental economics. Review of Environmental Economics and Policy, 2(1), 26–44. http://doi.org/10.1093/reep/rem027

- **Additional Reading:**

Common, M, (1996) Environmental and Resource Economics: An Introduction (2nd ed.). Longman, 1996.

Costanza, R. & Pattern, B.C. (1995) Ecological Economics, Vol. 15, pp. 193-296. Fisher, A.C. (1981) Resource and Environmental Economics, Cambridge University Press.

Daly, H. E., Farley, J. C. (2006). Ecological Economics: Principles and Applications. Canada: Braille Jymico Incorporated.

Harman. E Daly (2008) Ecological Economics and Sustainable Development, Edward Elgar Publishing.

Date: February 2025.

CSP101 Foundations of Python Programming

Module Code and Title:	CSP101 Foundations of Python Programming
Programme	Bachelor of Economics and Politics, Bachelor of Digital Communications and Project Management, Bachelor of Data Science and Data Analytics
Credit:	12
Module Tutor(s):	Sangay Thinley, Norbu Zangpo, Ngawang Choeda
Module Coordinator:	Sangay Thinley

General Objective

This module aims to provide students with a solid foundation in Python programming with a focus on data analysis. Students will learn fundamental programming principles and constructs in Python and apply them to manipulate and analyse data using popular data science libraries such as NumPy, Pandas,

and Matplotlib. By the end of the module, students will be able to write programs to extract insights from data, perform data manipulation and cleaning, and create informative data visualizations.

Learning Outcome

On completion of the module, students will be able to:

1. Explain fundamental programming concepts, including algorithms and flowcharts, for problem-solving.
2. Write, test, and debug Python programs using an IDE, applying appropriate syntax and constructs.
3. Utilize variables, data types, and operators to perform calculations and manipulate data in Python.
4. Implement loops, decision statements, and functions to develop structured and reusable Python programs.
5. Apply Python's core data structures (strings, lists, sets, tuples, dictionaries) to solve computational problems.
6. Use NumPy arrays for efficient data storage, manipulation, and analysis, including slicing, indexing, and aggregations.
7. Perform data manipulation using Pandas, including reading/writing files, handling missing data, and filtering datasets.
8. Extract and summarize key insights from structured datasets using Pandas and NumPy operations.
9. Create and customize visual representations of data using Matplotlib for effective data storytelling.
10. Develop simple data-driven applications using Python libraries for data analysis and visualization.

Teaching and Learning Approaches

Type	Approach	Hours per week	Total credit hours
Contact	Lecture, Guided Discussions, Presentation	2	30
	Practical	2	30
Independent study	Assignments, Lab Exercises & Projects	2	30
	Self-study	2	30
Total			120

The module will be delivered through a combination of lectures, practical sessions, and interactive teaching sessions. During lectures, the tutor will introduce the fundamental theories and concepts of Python programming, providing students with a strong theoretical foundation. Teaching sessions will reinforce these concepts through guided discussions and demonstrations, where students are encouraged to bring their laptops and actively engage in coding exercises. Practical sessions will focus on applying the concepts learned in lectures and teaching sessions, allowing students to write, test, and debug Python programs in a hands-on environment.

Assessment Approach

The assessment will be carried out on a continuous basis through the following approaches:

A. Online Quiz: (20%)

VLE quiz will be conducted twice in a semester. The first quiz will be conducted after completion of the first two topics and the second one after completion of the last three topics of the subject matter. Each quiz will be conducted for a duration of 1 hour.

B. Assignment: (25%)

A programming assignment will be given to the students after completing all the topics. The assignment will require the students to apply basic constructs of the Python language such as functions and loops in their solutions. The students will also be required to load and manipulate data, perform analysis, and create insightful visualisations using Python.

The evaluation will be based on the rubric:

Criteria	**Excellent (5)**	**Good (4)**	**Satisfactory (3)**	**Needs Improvement (2-1)**
Code Implementation & Functionality (5%)	Code runs correctly, efficiently implements required constructs (functions, loops) with no errors.	Code runs with minor issues but meets most requirements.	Code runs with errors but attempts to implement key constructs.	Code is incomplete or does not meet the requirements.
Data Handling & Manipulation (5%)	Data is successfully loaded, cleaned, and manipulated using appropriate Pandas/NumPy functions.	Data is handled well with minor inefficiencies or missing steps.	Basic data manipulation is attempted but lacks completeness.	Data handling is incorrect or missing.
Analysis & Insights (5%)	Data analysis is accurate, meaningful, and provides clear insights.	Analysis is mostly accurate, but some insights could be improved.	Basic analysis is present but lacks depth or clarity.	Analysis is incorrect, unclear, or missing.
Visualization & Presentation (5%)	Visualizations are clear, well-labeled, and effectively convey insights.	Visualizations are mostly effective but could be improved in clarity.	Basic charts are present but lack necessary labels or interpretation.	Visualizations are unclear, missing, or incorrectly used.
Code Readability & Documentation (5%)	Code is well-structured, properly commented, and easy to	Code is mostly readable with some comments.	Code lacks clarity, with minimal or no comments.	Code is difficult to read, poorly structured, or undocumented.

	understand.			

C. Practical Test: (25%)

Practical Test will be conducted after the completion of the module and will cover all the units. The test will be conducted for 3 hours to test the student's ability to implement a given set of problems (a question from Topics 1 and 2, and another question from Topics 3, 4 and 5).

D. Weekly Lab Assignment: (30%)

Weekly Lab Assignments will be based on the concepts taught in the theory class. Students will be provided a set of programming questions every week covering the concepts taught in each topic. The students will have to submit the solutions at the end of the lab session through the VLE.

The assessment criteria for for weekly lab assignment will follow:

Criteria	**Full Marks (3)**	**Partial Marks (2-1)**	**No Marks (0)**
Completion & Accuracy (3%)	All problems are attempted and solved correctly.	Some problems attempted; minor errors present.	No attempt or solutions are incorrect.
Code Functionality (3%)	Code runs correctly and meets all requirements.	Code runs with minor issues but partially meets requirements.	Code does not run or is incomplete.
Use of Concepts (3%)	Proper application of taught concepts (loops, functions, libraries, etc.).	Some application of concepts, but not fully optimized.	Concepts are misused or missing.
Code Readability (3%)	Code is well-structured, properly formatted, and easy to understand.	Code is somewhat readable but lacks structure or comments.	Code is messy, unorganized, or unreadable.

Overview of the assessment approaches and weighting

Sl.No.	**Areas of assessment**	**Quantity**	**Weighting (%)**
A	Online Quiz	2	20
B	Assignment	1	25
C	Practical Test	1	25
D	Weekly Lab Assignment	15	30
Total		**19**	**100**

Pre-requisites: None

Subject Matter

Unit I: Fundamentals of Programming

1.1 Introduction to Computer Programming and Programming Languages

1.2 Basic Concepts of Programming
1.3 Algorithm Design and Development
1.4 Flowcharts: Representing Algorithms Visually

Unit II: Introduction to Python Programming

2.1 Setting Up Python Environment and IDE Usage:
    2.1.1 Writing
    2.1.2 Testing
    2.1.3 Debugging
2.2 Variables and Data Types in Python
2.3 Operators and Expressions for Data Manipulation
2.4 Control Structures: Conditional Statements and Loops
2.5 Functions: Definition, Application, and Reusability
2.6 Data Collections: Strings, Lists, Tuples, Sets, and Dictionaries
2.7 Choosing the Right Data Collection for a Given Problem

Unit 3: Data Manipulation with NumPy

3.1 Introduction to NumPy and its Applications
3.2 Understanding NumPy Arrays and Data Types
3.3 Array Indexing, Slicing, and Reshaping
3.4 Universal Functions (ufuncs) and Aggregation Methods
3.5 Boolean Logic, Masking, and Filtering Arrays
3.6 Reading Tabular Data Files and Extracting Insights

Unit 4: Data Analysis with Pandas

4.1 Introduction to Pandas and its Data Structures (DataFrames, Series)
4.2 Importing and Exporting Data from Various Sources (Text, Excel, CSV)
4.3 Data Selection, Filtering, and Indexing Techniques
4.4 Data Modification and Assignment Methods
4.5 Handling Missing Data and Data Cleaning
4.6 Basic Data Manipulation for Visualization

Unit 5: Data Visualization with Matplotlib

5.1 Introduction to Matplotlib and its Components
5.2 Creating Different Types of Charts (Line, Bar, Scatter, Histogram, etc.)
5.3 Customizing Visualizations: Labels, Titles, and Legends
5.4 Presenting Data Effectively Through Plots

Laboratory Sessions:

1. **Lab Session 1: Introduction to Programming Concepts**
   Task:
   - Writing basic Python scripts in an IDE
   - Designing simple algorithms and implementing them in Python
   - Drawing and converting flowcharts into Python programs

2. **Lab Session 2: Python Basics and Control Structures**
   Task:
   - Declaring and using variables with different data types
   - Using arithmetic, logical, and comparison operators
   - Implementing conditional statements (if-else)

- Writing loops (for, while) for iterative processing
- Creating and using functions for modular programming

3. **Lab Session 3: Working with Python Data Structures**
   Task:
   - String manipulations (slicing, formatting, methods)
   - Creating and modifying lists, tuples, sets, and dictionaries
   - Choosing the appropriate data structure for a given problem

4. **Lab Session 4: Introduction to NumPy**
   Task:
   - Creating and manipulating NumPy arrays
   - Performing array indexing, slicing, and reshaping
   - Applying NumPy universal functions (ufuncs) for data analysis
   - Using boolean logic for array filtering

5. **Lab Session 5: Data Processing with Pandas**
   Task:
   - Creating and exploring Pandas Series and DataFrames
   - Importing and exporting data from CSV and Excel files
   - Selecting, filtering, and modifying data in Pandas
   - Handling missing values and cleaning datasets

6. **Lab Session 6: Advanced Data Analysis with Pandas**
   Task:
   - Using Pandas groupby and aggregation functions
   - Applying filtering and transformation techniques
   - Performing basic exploratory data analysis (EDA) on real datasets

7. **Lab Session 7: Data Visualization with Matplotlib**
   Task:
   - Creating basic charts (line, bar, scatter, histogram)
   - Customizing visualizations with titles, labels, legends, and styles
   - Comparing multiple datasets in a single plot

8. **Lab Session 8: Mini Data Analysis Project**
   Task:
   - Applying Python, NumPy, Pandas, and Matplotlib to analyze an open dataset
   - Data cleaning, manipulation, and visualization
   - Writing a short report summarizing findings

Reading List

Essential Reading:

Deitel, P., & Deitel, J. (2020). *Introduction to Python for Computer Science and Data Science Learning to Program with AI, Big Data and the Cloud*. Pearson.

Nelli F. (2018). *Python data analytics with pandas Numpy and Matplotlib* (2nd ed.). Apress. https://doi.org/10.1007/978-1-4842-3913-1

Additional Reading:

Lutz, M. (2013). *Learning Python* (5th ed.). OReilly.

Rao, R. N. (2017). *Core python programming*. Dreamtech press.

Sedgewick, R., Wayne, K., & Dondero, R. (2015). *Introduction to programming in Python: An interdisciplinary approach*. Addison-Wesley.

Date: February, 2025.

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DAT101 Statistical Computing I

Module Code and Title:	DAT101 Statistical Computing I
Programme:	Bachelor of Economics and Political Science, Bachelor of Digital Communications and Project Management, Bachelor of Data Science and Data Analytics
Credit Value:	12
Module Tutors:	Karma Dorji, Ugyen Samdrup Tshering, P Paulraj
Module Coordinator:	P Paulraj

General Objective:

The module aims to give students a thorough understanding of the basic ideas and methods of statistical computing. In addition to developing their skills in data administration, processing, and interpretation, students will get practical experience utilizing spreadsheets and their functionalities to analyze and visualize data. Students will gain the critical thinking and problem-solving abilities required to pursue further education or careers in statistical analysis by learning how to apply statistical methods to real-world problems through workshop-style instruction, hands-on activities, and independent study.

Learning Outcomes:

On completion of the module, students will be able to:

1. Elucidate the significance of statistics in resolving practical issues.
2. Utilize statistical tools for data organization, manipulation, and analysis.
3. Determine the many forms of data, including qualitative and quantitative.
4. Manage a spreadsheet package's fundamental statistical functions.
5. Make a distinction between inferential and descriptive statistics.
6. Utilize the table tool to arrange and filter data, then use the Pivot Table tool to conduct fundamental statistical analysis such as frequency distribution.
7. Use the Data Analysis tool to examine both univariate and bivariate data;
8. Simulate the many probability distribution types, including continuous and discrete probability distributions.
9. Determine the many forms of sampling methods, including probability sampling and non-probability sampling techniques.
10. Model different kinds of sampling distributions.
11. Use charts and graphs to effectively convey the statistical analysis.
12. Utilize Data analysis Tool to do hypothesis testing and make inferences.

13. Simulate hypothesis testing using Statistical functions.

Learning and Teaching Approach:

Type	Approach	Hours per week	Total credit hours
Contact	Lecture	2	75
	Laboratory Session	3	
Independent study	Group Project & Presentation	1	45
	Self-Study	2	
Total			120

The module will be taught using teaching sessions and practical sessions.

Teaching methods: Tutors can use a combination of lectures, labs, and online resources to introduce the concepts and tools of data science. Tutors may also use interactive software such as Orange to demonstrate how to perform data analysis tasks using visual programming.

Learning tasks: Tutors can assign students various types of data sets (such as text, images, audio, etc.) and ask them to perform data analysis tasks using Orange or other software tools. Students may be required to present their findings in a report or a presentation. Tutors can also design group projects where students collaborate to solve a real-world data problem using data science techniques.

To teach this module one of the following Open Source tools will be used: Apache OpenOffice Calc/Google Sheet.

These tools do not require much coding and manage to deliver better results than the paid versions like Microsoft Excel, Zoho Sheet, Smartsheet, and so on.

Assessment Approach:
The assessment will be carried out on a continuous basis through the following approaches.

A. In-Class Activity: (20%)
During the course of the semester, students will complete numerous in-class activities such as group discussions, problem-solving exercises, case studies, and short quizzes. At the end of the in-class activity session, groups may be asked to present their work to the class, or to submit their completed work for grading or evaluation. The activities also provide opportunities for students to collaborate with their peers and receive feedback from their instructor/peers, which can further enhance their learning experience. The final grade will be based on the average of all in-class activity marks, which accounts for 20% of the overall grade of the module.

B. Individual Assignment: (15%)
Students will have to complete two individual assignments throughout the semester, which in combination will make up 15% of their final grade. The first assignment will concentrate on descriptive statistics, while the second assignment will centre on inferential statistics. Through these assignments, students will have the opportunity to enhance their abilities in data analysis, interpretation, and proficiency in statistical techniques by utilizing spreadsheets. The individual assignment will be assessed on the basis of following criteria:

- Academic Writing and Integrity (10%)
- Statistical Analysis and Reasoning (50%)
- Formal Statistical Reporting (20%)
- Presentation (20%)

Further, each component of the marking criteria will be assessed using the rubrics below;

Criteria	Excellent (4)	Proficient (3)	Developing (2)	Needs Improvement (1)
Academic Writing and Integrity (10%)	Writing is clear, well-structured, and free of errors. Proper citations are used, and originality is evident.	Writing is mostly clear, with minor errors. Some citations may be missing, but originality is maintained.	Writing lacks clarity and structure, with several errors. Some citations are missing or incorrect.	Writing is unclear, poorly structured, and contains multiple errors. Citations are missing or plagiarism is evident.
Statistical Analysis and Reasoning (50%)	Correct application of statistical techniques with strong reasoning. Data is well-analyzed, and conclusions are logical.	Mostly correct statistical techniques with some minor errors. Reasoning is sound, and conclusions are reasonable.	Statistical techniques are applied but with some errors. Analysis lacks depth, and conclusions are weak.	Incorrect or missing statistical techniques. Reasoning is flawed, and conclusions are not supported by analysis.
Formal Statistical Reporting (20%)	Report is well-organized, follows proper format, and presents statistical results clearly and correctly.	Report is organized, but some formatting or clarity issues exist. Statistical results are mostly correct.	Report is somewhat disorganized, with errors in formatting and statistical reporting.	Report lacks organization, is unclear, or has major errors in statistical reporting.
Presentation (20%)	Presentation is professional, well-structured, and visually appealing. Data visualization is used effectively.	Presentation is clear and mostly structured, with appropriate visuals and explanations.	Presentation is somewhat unclear or lacks engagement. Visuals are used but not effectively.	Presentation is disorganized, difficult to follow, or lacks proper visuals and explanations.

C. Practical Test: (40%)

Throughout the semester, the student will undertake three individual practical tests, which together account for 40% of the final grade. Practical Test 1 will be conducted for one hour after the completion of the first three units and will contribute 10% to the final grade. Practical Test 2 will also be one hour long, assessing content from the next two units, and will contribute 10% to

the final grade. Practical Test 3 will be conducted at the end of the semester, lasting two hours. This test will cover all the units taught throughout the semester and will contribute 20% towards the final grade

These tasks will provide students with opportunities to acquire skills in collecting, analyzing, and interpreting data and to develop proficiency in using suitable statistical techniques. The evaluation of the practical tests will be conducted based on a rubric that delineates the standards and requirements for each test.

D. Group Project: (25%)

The students will collaborate in groups of three or four to complete a project that focuses on applying statistical concepts to real-life data. The project will involve formulating statistical questions, designing an analysis plan, selecting appropriate statistical methods, and effectively communicating results. Through this project, students will have the opportunity to improve their data analysis and interpretation skills using relevant statistical techniques with real-world datasets.

The outline of the group project is as given below;

1. **Project proposal**

   As a group, students will be tasked with preparing a project proposal within a word limit of approximately 1000-1500 words. The proposal should include a clear and concise description of the project's relevance and significance, as well as an overview of existing knowledge in the context of the project. Students should identify the knowledge gap they aim to address and outline the expected outcomes of their study. Additionally, they must describe the type of data they will be working with, its characteristics, and how it will support answering the research question. The proposal should also detail the specific aims and methodology of the project, including the computational and statistical approaches to be utilized. Finally, the division of labor must be clearly defined, with tasks assigned among group members, accompanied by a table outlining each member's background and job assignments. The project proposal will be assessed based on the following marking criteria:

   a. Motivation and Background (20%)
   b. Research Question/Hypothesis (20%)
   c. Dataset (15%)
   d. Aims and Methodology (30%)
   e. Division of Labor (15%)

Criteria	Excellent (4)	Proficient (3)	Developing (2)	Needs Improvement (1)
Motivation and Background	The motivation and background demonstrate exceptional depth, clarity, and critical analysis, highlighting the project's unique contributions.	The motivation and background are well-presented, providing a clear understanding of the project's context and significance.	The motivation and background provide some relevant information but lack depth or clarity.	The motivation and background are not adequately addressed or are missing important information.

Research Question	The research question/hypothesis is exceptionally well-crafted, demonstrating originality, innovation, and a strong alignment with the project's objectives.	The research question/hypothesis is clearly defined, specific, and directly aligns with the project's objectives.	The research question/hypothesis is somewhat clear but lacks specificity or may not align with the project's objectives.	The research question/hypothesis is unclear, vague, or not properly formulated.
Dataset	The dataset chosen is exceptional, providing rich, high-quality data that allows for in-depth analysis and meaningful insights.	The dataset selected is appropriate, relevant, and sufficiently comprehensive for addressing the project's objectives.	The chosen dataset is somewhat relevant, but it may have limitations or gaps in terms of data quality or coverage.	The dataset selection is inappropriate, incomplete, or lacks relevance to the project.
Aims and Methodology	The aims and methodology are exceptionally well-developed, demonstrating a comprehensive and innovative approach to achieving the project's objectives.	The aims and methodology are well-defined, clearly articulated, and directly aligned with the project's objectives.	The aims and methodology are somewhat clear but may lack detail or may not fully address the project's objectives.	The aims and methodology are poorly defined, lacking clarity, or not aligned with the project's objectives.
Labor Division	The division of labor is exceptional, demonstrating a strategic allocation of tasks that maximizes each group member's strengths and promotes efficient collaboration.	The division of labor is clearly outlined, assigning specific responsibilities to each group member and demonstrating a fair and effective distribution of tasks.	The division of labor provides a basic outline of tasks, but it may lack specificity or clarity in assigning responsibilities.	The division of labor is not clearly outlined or lacks a logical distribution of tasks among group members.

2. **Project report**
   In a group, students will prepare a comprehensive report for their project, ensuring that the following tasks are completed within a word limit of approximately 2000-2500 words. The report should:

- Introduce the research question or problem statement, providing context and background information.
- Describe the research methodology, including the data collection process, any statistical techniques used, and the analysis of the results.
- Present the findings of the research in a clear and concise manner, incorporating tables, charts, or graphs to support the conclusions.
- Discuss the implications of the research, including any limitations or areas for future study.
- Conclude with a summary of the findings and their significance, along with any recommendations based on the research.

The project report will be assessed based on following marking criteria:

a. Introduction and Overview of Research (10%)
b. Research Question and Statistical Hypotheses (10%)
c. Methodology (15%)
d. Descriptive Statistics (10%)
e. Statistical Analysis (20%)
f. Results and Discussions (20%)
g. Writing Technique (10%)
h. References (5%)

Criteria	**Excellent (4)**	**Proficient (3)**	**Developing (2)**	**Needs Improvement (1)**
Introduction and overview of research	Provides a clear and thorough background and introduction.	Provides a partial or incomplete background and introduction.	Provides a background and introduction that is not related to the project.	Introduction and/or background not provided.
Research questions	States a specific, measurable research question.	States a clear research question but may not be easily or properly measured.	States a vague, untestable research question.	No clear research question posed.
Methodology	Provides a clear explanation of the project's methods including data collection plan and appropriate statistical analysis.	Provides an adequate explanation of project's methods. Some minor deficiencies seen in methods and statistical analysis.	Provides an unorganized or inadequate explanation of experimental methods. Data collection unclear and/or statistical analysis incorrectly applied or not clearly explained.	Explanation of experimental method is missing.

Descriptive Statistics	Appropriate graphs and summary statistics are used to give a preliminary answer to the research question, effectively summarizing the data and its characteristics.	Adequate presentation with relevant graphs and summary statistics, providing a reasonable understanding of the data and its characteristics .	Partially accurate presentation with some inconsistencies or missing details, utilizing some graphs and summary statistics to address the research question.	Inaccurate or incomplete presentation of descriptive statistics, lacking appropriate graphs and summary statistics to address the research question.
Statistical Analysis	Thorough and comprehensive statistical analysis, utilizing appropriate tests and procedures, with clear explanations of the analysis methods, highlighting the insights gained and the research question addressed	Adequate statistical analysis, utilizing appropriate tests and procedures, with clear explanations of the analysis methods and their relevance to the research	Partially conducted statistical analysis with some errors or incomplete explanations	Inappropriate statistical tests conducted or tests not conducted/explained correctly
Results and Discussions	Results and interpretation of data described and presented in final format. Impact of results and external validity are described. Strengths and limitations described. Conclusions support the project results.	Some minor data collection and analysis remains to be completed; strengths, limitations, or external validity not described thoroughly. Conclusion are partially supported by the project results.	Significant data collection and analysis remains to be completed; or statistical analysis, strengths, limitations, or external validity poorly described. Conclusions are not supported by the project results	Results are incomplete or do not match project methods. Data analysis has major flaws. Conclusions are not supported by the analysis.
Writing Technique	Excellent writing technique, showcasing clear and coherent expression, precise organization,	Good writing technique, demonstrating clarity, coherence, and proper organization	Requires improvements in writing technique, with some sections being unclear or inconsistent	Poor writing technique with numerous style, grammar, and organization issues

	and adherence to style and grammar conventions			
References	Comprehensive and accurate references, incorporating a wide range of relevant and properly cited sources in APA style	Adequate references, including relevant sources and following proper APA citation style	Inadequate references, with some missing or improperly cited sources not in APA style	Missing or incomplete references, not in APA style

3. **Project presentation**
   Each group will prepare a 10-15 minutes PowerPoint presentation to effectively communicate their project findings. The presentation should be clear, well-structured, and visually engaging, and it must include:

   - Title Slide: Project title, group members, and date.
   - Introduction: Research question, significance, and background.
   - Methodology: Data collection, research techniques, and analysis methods.
   - Findings: Key results with tables, charts, or graphs.
   - Discussion: Interpretation, implications, and limitations.
   - Conclusion & Recommendations: Summary and future research directions.

   Each member should actively participate, ensuring a balanced delivery. Slides should be concise, visually appealing, and not overloaded with text. The presentation will be assessed based on following criteria:

   a. Delivery (20%)
   b. Knowledge and Content (20%)
   c. Analysis and Evaluation (20%)
   d. Coherence and Organization (15%)
   e. Quality of Presentation (10%)
   f. Teamwork (10%)
   g. Response to questions (5%)

   The following rubrics will be used to assess the components of each of the marking criteria mentioned above:

Criteria	**Excellent (4)**	**Proficient (3)**	**Developing (2)**	**Needs Improvement (1)**

Delivery	Clear, engaging, and well-paced.	Mostly clear, with minor lapses.	Some issues with clarity or timing.	Unclear, poorly timed, and disengaging.
Knowledge and Content	Confident, well-researched, and explains key ideas effectively.	Mostly confident, with minor gaps in depth or explanation.	Some understanding, but lacks depth.	Limited knowledge and unclear explanations.
Analysis and Evaluation	Strong analysis with well-supported arguments.	Good analysis with some room for depth.	Basic analysis with limited depth.	Weak or superficial analysis.
Coherence and Organization	Well-structured, smooth transitions, and logical flow.	Mostly organized, with minor gaps.	Somewhat organized but inconsistent.	Disorganized and lacks flow.
Quality of Presentation	Visually appealing with effective use of visuals.	Mostly well-designed with minor flaws.	Acceptable but inconsistent visuals.	Poor design, formatting, or visuals.
Teamwork	Well-coordinated and integrated group effort	Mostly cohesive with minor gaps.	Some collaboration, but inconsistent.	Poor teamwork and disjointed presentation.
Response to Questions	Confident, clear, and accurate responses.	Mostly clear and accurate, with minor gaps.	Some responses lack depth or clarity.	Weak or unclear responses, showing little understanding.

Overview of assessment approaches and weighting

Areas of assessment	**Quantity**	**Weighting**
A. In-Class Activity	2	20%
B. Individual Assignment	2	15%
C. Practical Test	3	40%
D. Group Project	1	25%
Total		**100%**

Pre-requisites: None

Subject Matter:

Unit I: Introduction to Statistics and Spreadsheet Package

1.1 Definition and Scope of Statistics
1.2 Descriptive Statistics vs. Inferential Statistics
1.3 Types of Data: nominal, ordinal, scalar data, qualitative and quantitative data
1.4 Variables: Discrete vs. Continuous variables.
1.5 Data Organization
1.5.1 Frequency Distribution: type and construction of frequency distribution tables

1.5.2 Graphical representation of frequency distribution: Histogram, Frequency Polygon, Cumulative frequency curve or the Ogives

1.6 Sampling Techniques

1.6.1 Probability Sampling and Non-probability Sampling techniques.

Unit II: Analysis of Univariate Data

2.1 Central Tendency

2.1.1 Mean, Median, and Mode and the Relationship between Mean, Median and Mode

2.1.2 Quartiles, Deciles and Percentiles

2.2 Dispersion

2.2.1 The Range, Quartile Deviation, and Mean Deviation

2.2.2 Variance and Properties of Variance

2.2.3 Standard Deviation and Application of Standard Deviation

2.2.4 Relationship between the measures of dispersion (Without derivation)

2.2.5 Coefficient of variation (Definition and examples).

2.2.6 Skewness and Kurtosis (without derivation)

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Unit III: Analysis of Multivariate Data

3.1 Bivariate data and scatter diagram

3.2 Covariance and properties (without derivation)

3.3 Simple correlation and properties (without derivation)

3.4 Correlation coefficients: Pearson, Kendall, Spearman (without derivation)

3.5 Simple Linear regression

3.6 Principle of least square and curve fitting (without derivation)

3.7 Coefficient of determination and standard error (Definition and examples)

Unit IV: Theory of Probability & Probability Distributions

4.1 Probability concepts

4.1.1 Random experiment, sample space, event

4.1.2 Classical definition, axiomatic definition and relative frequency definition of probability

4.1.3 Concept of probability measure

4.1.4 Addition and multiplication theorem (limited to three events with proof)

4.1.5 Conditional probability and Bayes Theorem-numerical problems (without proof)

4.2 Random Variables

4.2.1 Definition- probability distribution of a random variable

4.2.2 Probability mass function and their properties (without derivation)

4.2.3 Probability density function and (cumulative) distribution function and their properties (without derivation)

4.3 Discrete probability distributions (without proof)

4.3.1 Bernoulli

4.3.2 Binomial distribution

4.3.3 Poisson distribution

4.4 Continuous probability distributions (without proof)

4.4.1 Uniform distributions

4.4.2 Exponential

4.4.3 Normal distributions.

Unit V: Sampling Distributions

5.1 The rationale for sampling

5.2 Sample and Population

5.3 Statistics and parameter

5.4 Sampling distributions (without proof)

5.4.1 Sampling distributions of the mean
5.4.2 Sample variance from a normal population

Unit VI: Hypothesis Testing

6.1 The rationale for hypothesis testing
6.2 General procedure for hypothesis testing
6.3 The null and alternative hypothesis
6.4 One-tailed and Two-tailed tests
6.5 Errors in hypothesis testing
6.6 Critical Region
6.7 Level of Significance of a test
6.8 Confidence intervals and the margin of error
6.9 Parametric test (without derivation)
6.9.1 One sample t-test
6.9.2 Paired t-test
6.9.3 Two independent sample t-test
6.9.4 Fisher's exact test
6.9.5 F-test
6.10 Non-parametric test (without derivation)
6.10.1 Chi-square goodness of fit test
6.10.2 Chi-square test

Laboratory Sessions:

1. **Unit I Lab Sessions:**
   - Lab 1: Statistical Functions in Spreadsheet Package
   - Lab 2: Different types of frequency distribution table in Spreadsheet Package
   - Lab 3: Charts and graphs in Spreadsheet Package
2. **Unit II Lab Sessions:**
   - Lab 4: Calculation of various measures for a given set of data using Spreadsheet Package
   - Lab 5: Data manipulation in Spreadsheet Package
3. **Unit III Lab Sessions:**
   - Lab 6: Correlations using Spreadsheet Package
   - Lab 7: Regression and multiple regression in Spreadsheet Package
4. **Unit IV Lab Sessions:**
   - Lab 8: Calculation of Expectation of random variables in Spreadsheet Package
   - Lab 9: Discrete & Continuous Probability Distribution using Spreadsheet Package
5. **Unit V Lab Sessions:**
   - Lab 10: Defining variables and data entry in Spreadsheet Package
   - Lab 11: Sample and Sample size calculation in Spreadsheet Package
   - Lab 12: Calculation of standard error and confidence interval in Spreadsheet Package
6. **Unit VI Lab Sessions:**
   - Lab 13: Hypothesis testing using Spreadsheet Package
   - Lab 14: Comparison of means and interpretation of P-values using Spreadsheet Package

Reading List

Essential Reading:

Lock, R. H., Lock, P. F., Morgan, K. L., Lock, E. F., & Lock, D. F. (2020b). *Statistics: Unlocking the Power of Data*. John Wiley & Sons.

Levin, J., Fox, J. A., & Forde, D. (2016). *Elementary Statistics in Social Research, Updated Edition*. Pearson.

Sullivan, M. (2022c). *Fundamentals of Statistics: Informed Decisions Using Data* (6th ed.). Pearson.

Triola, M. F. (2018). *Elementary statistics using Microsoft Excel* (6th ed.). Pearson.

Additional Reading:

Linneman, T. J. (2017). *Social Statistics: Managing Data, Conducting Analyses, Presenting Results*.Taylor and Francis Group.

Miller, I., & Miller, M. (2018). *John E. Freund's Mathematical Statistics with Applications*. Boston: Pearson.

Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2016b). *Probability and Statistics for Engineers and Scientists*. New Delhi: Pearson Education.

Date: February, 2025.

LAC101 རྫོང་ཁ་ཤེས་ཡོན་འབྲི་རྩལ།

སྦྱོང་ཚན་ཨང་དང་མིང་།	LAC101 རྫོང་ཁ་ཤེས་ཡོན་འབྲི་རྩལ།
ལས་རིམ།	དཔལ་འབྱོར་དང་སྲིད་དོན་ཚན་རིག། ཨང་ཅན་རྒྱུན་འབྲེལ་དང་ལས་འགུལ་འཛིན་སྐྱོང་། གནས་སྡུད་ཚན་རིག་དང་དབྱེ་དཔྱད་གནས་སྡུད་ཚན་རིག།
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སྦྱོང་ཚན་འགོ་འདྲེན་པ།	ཤེས་རབ་རྩེ་མཐོ་རིམ་སློབ་གྲྭ་ཆེན་མོ།

སྤྱིར་བཏང་ལས་དོན།

སྦྱོང་ཚན་འདི་གིས་སློབ་ཕྲུག་གི་རྒྱུད་ལུ་ རྫོང་ཁའི་བརྡ་སྤྲོད་རིག་པའི་ཤེས་ཡོན་དང་། རིག་རྩལ་ཚུ་འཐོབ་སྟེ་དེ་ཚུལ་བཞིན་དུ་ལག་ལེན་འཐབ་ཐོག་ལས་ གཞུང་སྒེར་གྱི་ནང་ལུ་ ལྷོགས་གྲུབ་ཚུ་བཏོན་ཏེ་ཕྱག་ཕྱིད་ཞུ་ཚུགས་པའི་དམིགས་གཏད་བསྐྱེད་པ་ཡིན།

སློབ་སྦྱོང་གྲུབ་འབྲས།

སྦྱོང་ཚན་འདི་མཇུག་བསྡུཔ་ད་སློབ་ཕྲུག་ཚུ་གིས།

༡. རྫོང་ཁའི་སྐད་ཡིག་གི་འབྱུང་ཁུངས་དང་སྐད་ཡིག་ལྷབ་དགོ་པའི་དགོས་པ་ཚུ་སླབ་ཚུགས།

༢. ལུང་འདྲེན་དང་རྒྱབ་རྟེན་བཀོད་ཐངས་ཚུ་ལམ་ལུགས་དང་འཁྲིལ་བྲི་ཚུགས།

༣. རྗེས་འཇུག་གི་སྒྲ་བཏོན་ཚུལ། ཚིག་མཚམས། བརྗོད་མཚམས། དོན་མཚམས་བཟོ་སྟེ་བྲི་ཚུགས།

༤. མིང་ཚིག་བརྗོད་པ་དང་ཁྱད་ཚིག་ཚུ་འབྲི་སླབ་འབད་ཚུགས།

༥. ཡི་གུའི་སྦྱོར་བ་ཚུ་མ་འཛོལ་བར་བྲི་ཚུགས།

༦. ཡིག་འགྲུལ་གཏོང་ལེན་དང་དེའི་འབྱུང་ཁུངས་ཚུ་འབྲི་སླབ་འབད་ཚུགས།

༧. རྫོང་ཁའི་ལྡེ་སྒྲོམ་བཙུགས་ནི་དང་མཇུབ་གནོན་རྒྱབ་ཚུགས།

སློབ་སྦྱོང་དང་སློབ་སྟོན་ཐབས་ལམ།

དབྱེ་བ།	ཐབས་ལམ།	བདུན་ཕྲག་གཅིག་ནང་ཆུ་ཚོད།	སྦྱོང་འཐུས་ཆུ་ཚོད།
དངོས་འབྲེལ།	གསལ་བཤད། སྤྱན་འབུལ།	༢	༦༠
	སློབ་ཁང་སྦྱོང་ལྷ། གྲོས་སྡུར།	༢	
རང་སྦྱོང་།	ལས་འགུལ་བྲི་ནི། ཀི་དེབ་དང་ལྷག་དེབ་ལྷག་ནི།	༤	༦༠
སྦྱོང་ཚན་འདིའི་དོན་ལུ་ཡོངས་སྡོམ་ཆུ་ཚོད།			༡༢༠

དབྱེ་ཞིབ་ཐབས་ལམ།

འོག་གི་ཚད་གཞི་ཚུ་ ལག་ལེན་འཐབ་སྟེ་ སྐུགས་བྱིན་ནི་ཨིན།

ཀ དུས་རྒྱུན་དབྱེ་ཞིབ་དང་པ། རྫོང་ཁའི་སྐད་ཡིག་གི་འབྱུང་རབས་འབྲི་སླབ། སྡེ་ཚན་གྱི་ལས་འགུལ། (༥%)

རྫོང་ཁའི་སྐད་ཡིག་འབྱུང་རབས་ཀྱི་སྐོར་ལས་འབྲི་ནི་དང་ སླབ་ནི་ཚུ་ཐོགས་ཆགས་ག་ནི་ཡང་མེད་པར་འབད་ཚུགས་དགོཔ་ཨིན།

འདི་གི་དོན་ལུ་དོན་ཚན་གཅིག་ལུ་གཞི་བཞག་སྟེ་ བྲི་དགོཔ་ཨིན། སྐད་ཡིག་གི་འབྱུང་ཁུངས་ཀྱི་ སྐོར་ལས་ ཚིག་འབྲུ་ ༣༠༠ ལས་ ༧༠༠ གི་བར་ན་འབད་མི་ རྩོམ་བྲིས་ཅིག་བྲི་དགོ། རྩོམ་བྲིས་ནང་ལུ་སྐད་ཡིག་གི་འབྱུང་

ཁུངས་ཚུ་བཤད་པ་རྒྱབ་སྟེ་འོང་དགོ། རྩོམ་འབྲི་ནང་ལུ་སྐད་ཡིག་ལྷབ་དགོ་པའི་དགོས་པ་ཚུ་འོང་དགོ།
དེའི་དོན་ལུ་ དབྱེ་ཞིབ
ཚར་གཅིག་འབད་ནི་ཨིན། དབྱེ་ཞིབ་ཐབས་ལམ་འདི་གིས་སྐད་ཡིག གི་སྐོར་ལས་འབྲི་སླབ་འབད་ཚུགས།
རྫོང་ཁའི་སྐད་ཡིག་
གི་འབྱུང་ཁུངས་བཤད་ཚུགས། སྐད་ཡིག་ལྷབ་དགོ་པའི་དགོས་པ་ཚུ་སླབ་ཚུགས།

ཤེས་ཚད་ཀྱི་ལྟོགས་གྲུབ།	སྐུགས་ཀྱི་ཚད་གཞི། (༥%)			
ཤེས་ཚད་ལྟོགས་གྲུབ་ཀྱི་ནང་གསེས།	སྐད་ཡིག་གི་སྐོར་ལས་བཤད་པ། (༢%)	སྐད་ཡིག་གི་ཁུངས་གཏུགས། (༡%)	དོན་མཚམས། (༡%)	ཚིག་གི་གཅོད་མཚམས། (༡%)
(མཆོག་གྱུར།)	སྐད་ཡིག་གི་སྐོར་ལས་བཤད་པ་རྩེ་ཕུད་ཕྱིན་པ།(༢)	སྐད་ཡིག་དང་འབྲེལ་གནད་ཀྱི་ཡིག་ཆ་ལུ་མཆོག་གྱུར་ཁུངས་གཏུགས་ཡོད་པ། (༡)	དོན་མཚམས་མཆོག་གྱུར་སྦེ་བཅད་དེ་ཡོད་པ། (༡)	ཚིག་གི་གཅོད་མཚམས་མཆོག་གྱུར་སྦེ་བཅད་དེ་ཡོད་པ།(༡)
(རབ)	སྐད་ཡིག་གི་སྐོར་ལས་བཤད་པ་རབ།(༡.༥)	སྐད་ཡིག་དང་འབྲེལ་གནད་ཀྱི་ཡིག་ཆ་ལུ་ཁུངས་གཏུགས་རབ། (༠.༧)	དོན་མཚམས་རབ་སྦེ་བཅད་དེ་ཡོད་པ།(༠.༧)	ཚིག་གི་གཅོད་མཚམས་རབ་སྦེ་བཅད་དེ་ཡོད་པ།(༠.༧)
(འབྲིང་།)	སྐད་ཡིག་གི་སྐོར་ལས་བཤད་པ་འབྲིང་།(༡)	སྐད་ཡིག་དང་འབྲེལ་གནད་ཀྱི་ཡིག་ཆ་ལུ་ཁུངས་གཏུགས་འབྲིང།(༠.༥)	དོན་མཚམས་འབྲིང་སྦེ་བཅད་དེ་ཡོད་པ།(༠.༥)	ཚིག་གི་གཅོད་མཚམས་འབྲིང་སྦེ་བཅད་དེ་ཡོད་པ།(༠.༥)
(ཐ)	སྐད་ཡིག་གི་སྐོར་ལས་བཤད་པ་ཐ་མ།(༠.༥)	སྐད་ཡིག་དང་འབྲེལ་གནད་ཀྱི་ཡིག་ཆ་ལུ་ཁུངས་གཏུགས་ཐ་མ།(༠.༢)	དོན་མཚམས་ཐ་མ་སྦེ་བཅད་དེ་ཡོད་པ།(༠.༢)	ཚིག་གི་གཅོད་མཚམས་ཐ་མ་སྦེ་བཅད་དེ་ཡོད་པ།(༠.༢)

ཁ དུས་རྒྱུན་དབྱེ་ཞིབ་གཉིས་པ། ལུང་འདྲེན་དང་རྒྱབ་རྟེན་འབད་ཐངས། ངོ་རྐྱང་གི་ལས་འགུལ། (༢༠%)

སློབ་རིག་དང་འབྲེལ་བའི་དཔེ་དེབ། འབྲི་རྩོམ། ལས་འགུལ་གྱི་རིགས་ ག་ཅི་ར་བྲིས་ཏེ་འབད་རུང་
ལུང་འདྲེན་དང་རྒྱབ་རྟེན
འབད་ཐངས་ཚུ་ ཤེས་ཐབས་ཀྱི་དོན་ལུ་ གནད་དོན་གང་རུང་ཅིག་ལུ་གཞི་བཅོལ་ཏེ་
རྩོམ་བྲིས་ཅིག་འབྲི་ནི་ཨིན། ཁྱོད་ཀྱིས་ལུང་

འདྲེན་དང་ རྒྱབ་རྟེན་འབད་ཐངས་ཀྱི་སྐོར་ལས་ ཚིག་འབྲུ་ ༥༠༠ ལས་ ༡༠༠༠ གི་བར་ན་འབད་མི་
རྩོམ་བྲིས་ཅིག་བྲི་དགོ།
རྩོམ་བྲིས་ནང་ལུ་ཐད་ཀར་དང་ཚིག་སྒྱུར་གྱི་ལུང་འདྲེན།
བརྡ་བརྒྱུད་དང་བརྒྱུད་པའི་ལུང་འདྲེན་ཚུ་ཚུདཔ་སྦེ་འོང་དགོ། ལུང་འདྲེན་
དང་ རྒྱབ་རྟེན་འབད་ ཐངས་ཡང་
རྒྱལ་སྤྱིའི་རྒྱབ་རྟེན་འབད་ཐངས་ཀྱི་ཐབས་ཤེས་ཨེ་པི་ཨེ་ལམ་ལུགས་དང་འཁྲིལ་དགོ། རྩོམ་
བྲིས་ཀྱི་གནད་དོན་དང་འབྲེལ་བའི་ལུང་ འདྲེན་ཚུ་འོང་དགོ། དབྱེ་ཞིབ་འདི་གིས་རྩོམ་རིག་ག་ཅི་ར་འབྲི་རུང་
རྒྱལ་སྤྱིའི་ལམ
ལུགས་ཀྱི་ལུང་འདྲེན་དང་རྒྱབ་རྟེན་འབད་ཐངས་དང་འཁྲིལ་ཏེ་མ་འཛོལ་བར་འབྲི་ཚུགས།
ཐད་ཀར་གྱི་ལུང་འདྲེན་དང་ཚིག་སྒྱུར
ལུང་འདྲེན་གཉིས་ཀྱི་ཁྱད་པར་ཕྱེ་སྟེ་འབྲི་ཚུགས།
རང་གི་ཞིབ་འཚོལ་དང་འབྲེལ་བའི་རྒྱུ་ཁུངས་འཚོལ་ཞིབ་འབད་ཚུགས། ལུང་
འདྲེན་དང་རྒྱབ་རྟེན་འབད་དགོ་པའི་དགོས་ཁུངས་འབྲི་སླབ་འབད་ཚུགས།

ཤེས་ཚད་ཀྱི་ལྟོགས་གྲུབ།	སྐུགས་ཀྱི་ཚད་གཞི། (༢༠%)			
ཤེས་ཚད་ལྟོགས་གྲུབ་ཀྱི་ནང་གསེས།	ལུང་འདྲེན་འབད་ཐངས། (༦%)	རྒྱབ་རྟེན་འབད་ཐངས། (༦%)	དོན་ཚན་དང་འབྲེལ་བའི་ལུང་འདྲེན། (༩%)	གཅོད་མཚམས། (༩%)
(མཆོག་གྱུར།)	ཐད་ཀར་དང་ཚིག་སྒྱུར་གྱི་ལུང་འདྲེན།བརྡ་བརྒྱུད་དང་བརྒྱུད་པའི་ལུང་འདྲེན་ཚུ་འཛོལ་བ་ག་ནི་ཡང་མེདཔ་སྦེ་བྲིསནུག། (༦)	དཔེ་དེབ་ཀྱི་རྒྱབ་རྟེན་འབད་ཐངས་ཚུ་ག་ར་ཕོགཔ་སྦེ་བཀོད་ནུག། (༦)	རྩོམ་བྲིས་ཀྱི་དོན་ཚན་དང་འཁྲིལ་ཏེ་ལུང་འདྲེན་ཡང་ག་ར་ཕོགཔ་སྦེ་བཀོད་ནུག། (༩)	མིང་ཚིག་གི་ཚིག་མཚམས། བརྗོད་མཚམས། དོན་མཚམས་ཚུ་ཚུལ་མཐུན་སྦེ་བྲིས་ནུག། (༩)
(རབ)	ཐད་ཀར་དང་ཚིག་སྒྱུར་གྱི་ལུང་འདྲེན། བརྡ་བརྒྱུད་དང་བརྒྱུད་པའི་ལུང་འདྲེན་གཅིག་འཛོལ་ཏེ་བྲིས་ནུག། (༩)	དཔེ་དེབ་ཀྱི་རྒྱབ་རྟེན་འབད་ཐངས་གཅིག་མ་ཕོག་པས། (༩)	རྩོམ་བྲིས་ཀྱི་དོན་ཚན་དང་འཁྲིལཔ་ད ལུང་འདྲེན་གཅིག་འོས་འབབ་མེདཔ་སྦེ་བཀོད་ནུག། (༣)	མིང་ཚིག་གི་ཚིག་མཚམས། བརྗོད་མཚམས། དོན་མཚམས་ཚུ་འཛོལ་བ་ཨ་ཅི་རེ་འདུག། (༣)

(འབྲིང་།)	ཐད་ཀར་དང་ཚིག་སྒྱུར་གྱི་ལུང་འདྲེན། བརྡ་བརྒྱུད་དང་བརྒྱུད་པའི་ལུང་འདྲེན་གཉིས་འཛོལ་ཏེ་བྲིས་ནུག། (༣)	དཔེ་དེབ་རྒྱབ་རྟེན་འབད་ཐངས་གཉིས་མ་ཕོག་པས། (༣)	རྩོམ་བྲིས་ཀྱི་དོན་ཚན་དང་འཁྲིལཔ་ད་ལུང་འདྲེན་གཉིས་འོས་འབབ་མེདཔ་སྤེ་བཀོད་ནུག། (༢)	ཚིག་མཚམས། བརྗོད་མཚམས། དོན་མཚོས་ག་རའི་ནང་ཚུལ་མཐུན་སྤེ་མིན་འདུག། (༢)
(ཐ)	ཐད་ཀར་དང་ཚིག་སྒྱུར་གྱི་ལུང་འདྲེན། བརྡ་བརྒྱུད་དང་བརྒྱུད་པའི་ལུང་འདྲེན་གསུམ་འཛོལ་ཏེ་བྲིས་ནུག། (༢)	དཔེ་དེབ་ཀྱི་རྒྱབ་རྟེན་འབད་ཐངས་གསུམ་དེ་ཅིག་མ་ཕོག་པས། (༢)	རྩོམ་བྲིས་ཀྱི་དོན་ཚན་དང་འཁྲིལཔ་ད་ལུང་འདྲེན་གསུམ་འོས་འབབ་མེདཔ་སྤེ་བཀོད་ནུག། (༡)	ཚིག་མཚམས། བརྗོད་མཚམས། དོན་མཚམས་ཚུ་འབྲི་ནིའི་རིག་རྩལ་ར་མིན་འདུག། (༡)

ག དུས་རྒྱུན་དབྱེ་ཞིབ་གསུམ་པ། རྫོང་ཁའི་ངག་གཤིས་དང་འཁྲིལ་བའི་འབྲི་ལྷག སློབ་ཁང་འབྲི་རྒྱུགས། (༢༠%)

རྫོང་ཁའི་སྐད་ཡིག་ལུ་ རང་གཤིས་ཀྱི་རྗོད་སྒྲ་དང་ འབྲི་ལུགས་ཐུན་མོང་མ་ཡིན་པ་ཚུ་ཡོདཔ་ལས་ རྫོང་ཁའི་ངག་གཤིས་དང་འཁྲིལ་ཏེ་ འབྲི་ལྷག་དང་སྦྱང་བརྩོན་འབད་དགོཔ་ཚུ་ཡོདཔ་ཡིན། དེའི་ཤེས་རྟོགས་ལྟ་ནིའི་དོན་ལུ་ དྲི་བའི་མཐོ་ཚད་དྲུག་གི་འཐོབ་རིམ་དང་འཁྲིལ་ཏེ་ གདམ་འཐུའི་དྲི་བ། ལན་ཐུང་གི་དྲི་བ། ལན་རིང་གི་དྲི་བ་ཚུ་ གང་འཚམས་བཟོ་སྟེ་ སློབ་ཁང་འབྲི་རྒྱུགས་ཕྱི་ཨེལ་ཡི་དང་ ཤོག་ཐོག་གང་རུང་ཅིག་ ཐུན་ཚན་༡གི་རིང་སྐུགས་༢༠% གི་འབྲི་རྒྱུགས་རྒྱབ་དགོཔ་ཡིན། སློབ་ཁང་འབྲི་རྒྱུགས་ཀྱི་སྐུགས་ཀྱི་དབྱེ་ཚད་ཚུ་ དམིགས་བསལ་སྤེ་མེད། ཡིན་རུང་ དྲི་བ་དང་བསྟུན་ཏེ་ སྐུགས་བྱིན་མི་ལས་ དྲི་བའི་ལན་ཚུ་ ལེགས་ཤོམ་སྤེ་དབྱེ་ཞིབ་འབད་དེ་ སྐུགས་བྱིན་དགོཔ་ཡིན། དབྱེ་ཞིབ་ཐབས་ལམ་འདི་གིས་རྗེས་འཇུག་གི་སྒྲ་ཧྲིལ་བུ་བཏོན་དགོཔ་དང་ མ་དགོ་པའི་རིགས་ཚུ་ ཁྱད་པར་ཕྱེ་སྟེ་འབྲི་ཚུགས། རྗེས་འཇུག་དང་མིང་མཐའ་མེད་རུང་ཡོདཔ་བཟུམ་སྤེ་ ལྷག་ཐངས་ཀྱི་རྣམ་གཞག་ཚུ་ཤེས་ཚུགས། ཚིག་མཚམས། བརྗོད་མཚམས། དོན་མཚམས་འབྲི་ཐངས་ཚུ་ཤེས་ཚུགས། དུས་གསུམ་ལས་མིང་འདི་ མང་ཤོས་ཅིག་ བྱ་ཚིག་ག་ཅི་ལས་འགྲུབ་ཡིན་ན་ཧ་གོ་ཚུགས། མིང་རྐྱང་། བྱ་ཚིག་ལས་མིང་། ཁྱད་ཚིག་ལས་མིང་ཚུའི་ཁྱད་པར་ཕྱེ་སྟེ་འབྲི་ཚུགས། ཁྱད་ཚིག་གི་རིགས་ངོས་འཛིན་འབད་དེ་འབྲི་ཚུགས་ནི་ཚུ་ཡིན།

སྐུགས་ཀྱི་ཚད་གཞི། (༢༠%)

སློབ་ཁང་འབྲི་རྒྱུགས་ཀྱི་སྐུགས་ཀྱི་དབྱེ་ཚད་ དམིགས་བསལ་སྤེ་མེད་ ཡིན་རུང་
དྲི་བ་དང་བསྟུན་ཏེ་སྐུགས་བྱིན་མི་ལས་ དྲི་བའི་
ལན་ཚུ་ལེགས་ཤོམ་སྤེ་དབྱེ་ཞིབ་འབད་དེ་ སྐུགས་བྱིན་ནི།

ང་ དུས་རྒྱུན་དབྱེ་ཞིབ་བཞི་པ། ཕྲད་རྣམ་དབྱེ་དང་དུས་གསུམ་རྣམ་གཞག་གི་ཐོག་ལུ་སྡེ་ཚན་གྱི་སྤྱན་ཞུ། (༢༠%)

བརྡ་སྤྲོད་ཀྱི་ནང་ལུ་ གནད་དགག་ཆེ་ཤོས་ཅིག་ ཕྲད་རྣམ་དབྱེ་དང་ དུས་གསུམ་གྱི་བྱ་ཚིག་འདི་ཡིན། རྗོད་པ་ཐུང་དུ་ཅིག་ལས་མ་བྲིས་རུང་བརྡ་སྤྲོད་པའི་གཞུང་དང་འཁྲིལ་དགོ། དེ་ལུ་བརྟེན་ ཕྲད་རྣམ་དབྱེ་དང་ དུས་གསུམ་གྱི་ཐོག་ལུ་ སློབ་སྟོན་པས་སྡེ་ཚན་རེ་ལུ་དོན་ཚན་རེ་བྱིན་ཏེ་ སློབ་ཁང་སྤྱན་ཞུ་འབད་དགོ། དེའི་དོན་ལུ་ སློབ་ཁང་གི་སློབ་ཕྲུག་མང་ཉུང་དང་བསྟུན་ སྡེ་ཚན་བཟོ་སྟེ་ སྡེ་ཚན་རེའི་དུས་ཡུན་སྐར་མ་༡༥ གི་རིང་ལུ་ སྤྱན་ཞུ་འབད་ནི། ཟིན་བྲིས་དང་པ་དང་མཐའ་དཔྱད་ལུ་སྐུགས་བྱིན་ནི་ཡིན། དབྱེ་ཞིབ་འདི་གིས་ཕྲད་རྣམ་དབྱེ་དང་དུས་གསུམ་གྱི་སྐོར་ལས་ ཚུལ་མཐུན་གྱི་བཅའ་སྒྲིག་རྐྱབ་སྟེ་ སྤྱན་ཞུ་འབད་ཚུགས། རྩོམ་བྲིས་ག་ཅི་ར་འབྲི་རུང་ བརྡའི་སྦྱོར་བ་དང་འཁྲིལ་ཏེ་ མ་འཛོལ་བར་འབྲི་ཚུགས། བྱེད་འབྲེལ་དང་བྱེད་མེད་ཀྱི་བྱ་ཚིག་གི་ཁྱད་པར་ཕྱེ་སྟེ་འབྲི་ཚུགས། ཆོས་རྫོང་གཉིས་ལུ་ ཕྲད་རྣམ་དབྱེ་དང་དུས་གསུམ་གྱི་བྱ་ཚིག་དང་འཇུག་ཚུལ་གྱི་ཁྱད་པར་ ཧ་གོ་སྟེ་འབྲི་ཚུགས། རྟགས་ཀྱི་དབྱེ་བ་ངོས་འཛིན་དང་ མིང་མཐའ་སྔ་མ་དང་ཕྱི་མ་གཉིས་ཀྱི་སྐོར་ལས་འབྲི་སླབ་འབད་ཚུགས།

སྐུགས་ཀྱི་ཚད་གཞི། (༢༠%)										
ཤེས་ཚད་ཀྱི་ལྟོགས་གྲུབ།	**ཟིན་བྲིས་དང་པ། (༡༠%)**						**མཐའ་དཔྱད་དབྱེ་ཞིབ། (༡༠%)**			
ཤེས་ཚད་ལྟོགས་གྲུབ་ཀྱི་ནང་གསེས།	**དོན་ཚན་གྱི་ནང་དོན། (༣%)**	**ཡིག་སྦྱོར་དང་ཡིག་སྡེབ། (༣%)**	**ཁུངས་གཏུགས་ཀྱི་ཡིག་ཆ་འཚོལ་ཞིབ། (༢%)**	**སྤྱན་ཞུའི་བཅའ་སྒྲིག། (༢%)**			**དོན་ཚན་གྱི་ནང་དོན། (༣%)**	**ཡིག་སྦྱོར་དང་ཡིག་སྡེབ། (༣%)**	**ཁུངས་གཏུགས་ཀྱི་ཡིག་ཆ་འཚོལ་ཞིབ། (༢%)**	**སྤྱན་ཞུ་འབད་ཐངས། (༢%)**
(མཆོག་གྱུར།)	དོན་ཚན་དང་འཁྲིལ་ཏེ་ནང་དོན་གཏིང་ཟབ་དྲག་རྩེ་ཕུད་ཕྱིན་པ་སྦེ་འདུག། (༣)	བརྡ་སྦྲོད་པའི་གཞུང་དང་འཁྲིལ་ཏེ་ འཛོལ་བ་མེདཔ་སྦེ་བྲིས་ཡོདཔ། (༣)	ཁུངས་གཏུཊ་ཀྱི་ཡིག་ཆ་བཞི་འཚོལ་ཞིབ་འབད་དེ་བྲིས་ནུག། (༢)	འཕར་གཟུཊ་སྟོན་འཕྲུལ།ཤོག་བྱང་། ཟིན་བྲིས། བྱང་ཤིང། ས་སྒྱུག་སོཊ་ལག་ལེན་ལུ། (༢)			དོན་ཚན་དང་འཁྲིལ་ཏེ་ནང་དོན་གཏིང་ཟབ་དྲག་རྩེ་ཕུད་ཕྱིན་པ་སྦེ་འདུག། (༣)	བརྡ་སྦྲོད་པའི་གཞུང་དང་འཁྲིལ་ཏེ་ འཛོལ་བ་མེདཔ་སྦེ་བྲིས། (༣)	ཁུངས་གཏུཊ་ཀྱི་ཡིག་ཆ་བཞི་འཚོལ་ཞིབ་འབད་དེ་བྲིས་ནུག། (༢)	འཕར་གཟུཊ་སྟོན་འཕྲུལ།ཤོག་བྱང་། ཟིན་བྲིས། བྱང་ཤིང། ས་སྒྱུག་སོཊ་ལག་ལེན་ལུ། (༢)

(རབ)	དོན་ཚན་དང་འཁྲིལ་ཏེ་ནང་དོན་གྱི་གཏིང་ཟབ་འདི་རབ་སྦེ་བཀོད་ནུག། (༢)	ཡིག་སྦྱོར་དང་ཡིག་སྡེབ་ཚུ་གཉིས་དེ་ཅིག་འཛོལ་ཏེ་བྲིས་ནུག། (༢)	ཁུངས་གཏུགས་ཀྱི་ཡིག་ཆ་གསུམ་འཚོལ་ཞིབ་འབད་དེ་བྲིས་ནུག། (༡.༥)	འཕར་གཟུགས་སྟོན་འཕྲུལ་/ཤོག་བྱང་། ཟིན་བྲིས། ཚུ་མཁོ་ཆས་ལག་ལེན་ལུ། (༡.༥)			དོན་ཚན་དང་འཁྲིལ་ཏེ་ནང་དོན་གྱི་གཏིང་ཟབ་འདི་རབ་སྦེ་བཀོད་ནུག། (༢)	ཡིག་སྦྱོར་དང་ཡིག་སྡེབ་ཚུ་གཉིས་དེ་ཅིག་འཛོལ་ཏེ་བྲིས་ནུག།(༢)	ཁུངས་གཏུགས་ཀྱི་ཡིག་ཆ་གསུམ་འཚོལ་ཞིབ་འབད་དེ་བྲིས་ནུག།(༡.༥)	འཕར་གཟུགས་སྟོན་འཕྲུལ་/ཤོག་བྱང་། ཟིན་བྲིས། ཚུ་མཁོ་ཆས་ལག་ལེན་ལུ།(༡.༥)
(འབྲིང་།)	དོན་ཚན་དང་འཁྲིལ་ཏེ་ནང་དོན་གྱི་གཏིང་ཟབ་འདི་འབྲིང་ཙམ་ལས་མིན་འདུག། (༡)	ཡིག་སྦྱོར་དང་ཡིག་སྡེབ་ཚུ་བཞི་དེ་ཅིག་འཛོལ་ཏེ་བྲིས་ནུག། (༡)	ཁུངས་གཏུགས་ཀྱི་ཡིག་ཆ་གཉིས་འཚོལ་ཞིབ་འབད་དེ་བྲིས་ནུག། (༡)	འཕར་གཟུགས་སྟོན་འཕྲུལ་རྒྱངམ་གཅིག་མཁོ་ཆས་ལག་ལེན་འཐབ་མི་ལུ། (༡)			དོན་ཚན་དང་འཁྲིལ་ཏེ་ནང་དོན་གྱི་གཏིང་ཟབ་འདི་འབྲིང་ཙམ་ལས་མིན་འདུག། (༡)	ཡིག་སྦྱོར་དང་ཡིག་སྡེབ་ཚུ་བཞི་དེ་ཅིག་འཛོལ་ཏེ་བྲིས་ནུག། (༡)	ཁུངས་གཏུགས་ཀྱི་ཡིག་ཆ་གཉིས་འཚོལ་ཞིབ་འབད་དེ་བྲིས་ནུག། (༡)	འཕར་གཟུགས་སྟོན་འཕྲུལ་རྒྱངམ་གཅིག་མཁོ་ཆས་ལག་ལེན་འཐབ་མི་ལུ། (༡)
(ཐ)	དོན་ཚན་དང་འཁྲིལཕ་ད་ནང་དོན་འདི་ཐ་མ་ཅིག་ལས་མིན་འདུག། (༠.༥)	ཡིག་སྦྱོར་དང་ཡིག་སྡེབ་ཚུ་དྲུག་དེ་ཅིག་འཛོལ་ཏེ་བྲིས་ནུག། (༠.༥)	ཁུངས་གཏུགས་ཀྱི་ཡིག་ཆ་གཅིག་དེ་ཅིག་འཚོལ་ཞིབ་འབད་དེ་བྲིས་ནུག། (༠.༥)	སྤྱན་ཞུའི་མཁོ་ཆས་ག་ནི་ཡང་མེད་པར་ཁ་སྐམ་གྱི་ཐོག་ལས་སྤྱན་ཞུ་འབད་མི་ལུ། (༠.༥)			དོན་ཚན་དང་འཁྲིལཕ་ད་ནང་དོན་འདི་ཐ་མ་ཅིག་ལས་མིན་འདུག། (༠.༥)	ཡིག་སྦྱོར་དང་ཡིག་སྡེབ་ཚུ་དྲུག་དེ་ཅིག་འཛོལ་ཏེ་བྲིས་ནུག།(༠.༥)	ཁུངས་གཏུགས་ཀྱི་ཡིག་ཆ་གཅིག་དེ་ཅིག་འཚོལ་ཞིབ་འབད་དེ་བྲིས་ནུག།(༠.༥)	སྤྱན་ཞུའི་མཁོ་ཆས་ག་ནི་ཡང་མེད་པར་ཁ་སྐམ་གྱི་ཐོག་ལས་སྤྱན་ཞུ་འབད་མི་ལུ།(༠.༥)

ཅ དུས་རྒྱུན་དབྱེ་ཞིབ་ལྡ་པ། ད་སྲོལ་དང་སྔར་སྲོལ་གྱི་ཞུ་ཡིག་འབྲི་ཐངས། བཤེར་ཡིག་དང་གན་རྒྱ་འབྲི་ཐངས། མགྲོན་བརྡ་དང་གྲོས་ཆོད་འབྲི་ཐངས་ཀྱི་སྐོར། ངོ་རྒྱང་གི་ལས་འགུལ། (༢༠%)

གཞུང་སྐེར་གྱི་ཡིག་འགྲུལ་ཚུ་ གཅེར་བཏེགས་ཏེ་ སྒྲིག་བཟོད་དང་ཁྱད་ཆོས་ཚང་བའི་ཐོག་ལས་ ཚུལ་མཐུན་སྤེ་ འབྲི་ཤེས་ནེའེ་དོན་ལུ་ བརྩོད་དོན་གང་རུང་ཅིག་ལུ་ གཞི་རྟེན་འབདཝ་དེ་ དཔོལ་དང་སྡུར་སྡེལ་གྱི་ཞུ་ཡིག་འབྲི་ཐངས། བཤེར་ཡིག་དང་གན་རྒུ་འབྲི་ཐངས། མཐོན་བརྟ་དང་ཐོས་ཆོད་འབྲི་ཐངས་ཀྱི་དཔེ་ཅེ་བཟོད་དེ་ ལས་འགྱལ་བྱེ་ནེ་ཕེན། དབྱེ་ཞིབ་འདི་གིས་ཡི་གུ་གཏེར་ལེན་གྱི་སྐབས་ དཔོལ་དང་སྡུར་སྡེལ་གཉིས་ཀྱི་ཁྲལ་ བར་གྱི་ སྡེ་འཕྲི་ཚུགས། དཔོལ་དང་སྡུར་སྡེལ་གཉིས་ཀྱི་སྒྲིག་བཟོད་དང་ གྲུས་ཞབས་ཀྱི་འཛོབ་རིམ་དང་འཁྲིལ་ཏེ་ འབྲི་ཚུགས། ཁྱིམས་འབྲེལ་གྱི་བཤེར་ཡིག་དང་གན་རྒུ་ཚུ་ ཁྱིམས་གཞུང་གི་འཛོབ་རིམ་དང་འཁྲིལ་འབྲི་ཚུགས། མཐོན་ཞུ་དང་ཐོས་ཆོད་ཀྱི་འབྲི་ལུགས་དང་འཁྲིལ་ ཚུལ་མཐུན་སྤེ་འབྲི་ཚུགས།

ཤེས་ཚད་ཀྱི་སྤྱོད་གས་གྲུབ།	སྐུགས་ཀྱི་ཚད་གཞི། (୨୦%)			
ཤེས་ཚད་སྤྱོད་གས་གྲུབ་ཀྱི་ནང་གསེས།	སྒྲིག་བཟོད། (୨୦%)	གྲུས་ཞབས་འཛོབ་རིམ། (୧%)	མིང་ཚིག་ཐ་སྙད་དང་སྐད་ཡིག་ལག་ལེན། (୧%)	འབྲི་བཟོད།(୨%)
(མཚོག་སྤྱི།)	ཡིག་འགྲུལ་གྱི་འཛོབ་ལམ་དང་འཁྲིལ་ སྒྲིག་བཟོད་ཀྱི་ཁྱད་ཆོས་ཚུ་མ་འཛོལ་བར་བྱིས་ནུག། (୨୦)	ཡིག་འགྲུལ་གྱི་ ཡུལ་དང་འཁྲིལ་ཏེ་ གྲུས་ཞབས་ཀྱི་འཛོབ་རིམ་ཚུ་ མ་འཛོལ་བར་བྱིས་ནུག། (୧)	དོན་ཚན་དང་འཁྲིལ་བའི་མིང་ཚིག་དང་སྐད་ཡིག་གི་ཚིག་གཞི་བཙུགས་ཐབས་ཚུ་ མཆོག་ཏུ་སྤྱད་པ་སྤེ་བྱིས་ནུག། (୧)	ཨོག་གུའི་ཞིང་ཁམས། ཨོག་གུའི་གཡས་གཡོན་གྱི་འབྱི་མཚམས། ཚིག་མཚམས། བརྗོད་མཚམས། དོན་མཚམས་ཚུ་ འབྲི་བཟོད་ཀྱི་ཁྱད་ཆོས་ལྟ་དང་ལྡན་སྤེ་བྱིས་ནུག (୨)
(རབ)	སྒྲིག་བཟོད་ཀྱི་ཁྱད་ཆོས་གཅིག་འཛོལ་ཏེ་ བྱིས་ནུག། (୭)	གྲུས་ཞབས་ཀྱི་འཛོབ་རིམ་གཅིག་ འཛོལ་ཏེ་བྱིས་ནུག། (୩)	དོན་ཚན་དང་འཁྲིལ་བའི་མིང་ཚིག་དང་སྐད་ཡིག་གི་ཚིག་གཞི་བཙུད་ཐབས་ཚུ་རབ། (୩)	འབྲི་བཟོད་ཀྱི་ཁྱད་ཆོས་ལྟ་ནང་ལས་ གཅིག་ཚུལ་དང་མཐུན་སྤེ་མ་བྱིས་བས། (୨.୫)
(འབྲིང་)	སྒྲིག་བཟོད་ཀྱི་ཁྱད་ཆོས་གཞིས་དེ་ཅིག་ འཛོལ་ཏེ་བྱིས་ནུག། (୫)	གྲུས་ཞབས་ཀྱི་འཛོབ་རིམ་གཞིས་དེ་ཅིག་འཛོལ་ཏེ་ བྱིས་ནུག། (୨)	དོན་ཚན་དང་འཁྲིལ་བའི་མིང་ཚིག་དང་སྐད་ཡིག་ཚིག་གཞི་བཙུགས་ཐབས་ཚུ་འབྱིང་ཙམ། (୨)	འབྲི་བཟོད་ཀྱི་ཁྱད་ཆོས་ལྟ་ནང་ལས་ གཞིས་དེ་ཅིག་ཚུལ་མཐུན་མེད་པས་སྤེ་བྱིས་ནུག། (୨)

(ཐ)	སྒྲིག་བཀོད་ཀྱི་ཁྱད་ཆོས་གསུམ་དེ་ཅིག་འཛོལ་ཏེ་བྲིས་ནུག། (༣)	གུས་ཞབས་ཀྱི་འཐོབ་རིམ་གསུམ་དེ་ཅིག་འཛོལ་ཏེ་བྲིས་ནུག། (༡)	དོན་ཚན་དང་འཁྲིལ་བའི་མིང་ཚིག་དང་སྐད་ཡིག་གི་ཚིག་གཞི་བཙུཊ་ཐངས་ཚུ་ཐ་མ། (༡)	འབྲི་བཀོད་ཀྱི་ཁྱད་ཆོས་ལྔ་ནང་ལས་བཞི་དེ་ཅིག་འབྲི་ལུཊ་དང་མ་མཐུན་སྦེ་བྲིས་ནུག།(༠.༥)

ཆ དུས་རྒྱུན་དབྱེ་ཞིབ་དྲུག་པ། རྫོང་ཁའི་མཛུབ་གནོན་རྐྱབ་ཐངས། ངོ་རྐྱང་གི་ལས་འགུལ། (༡༥%)

རྫོང་ཁའི་ཡི་གུ་ག་ཅི་འབྲི་རུང་ ཐོགས་ཆགས་མེད་པར་ མཛུབ་གནོན་རྐྱབ་སྟེ་ བྲི་ཤེས་དགོཔ་ཨིན། དེ་འབདཔ་ལས་ རྫོང་ཁ་གོང་འཕེལ་ལྷན་ཚོགས་ཀྱི་ཡོངས་འབྲེལ་འཆར་སྒོ་ https://www.dzongkha.gov.bt/dz/tools ནང་ལུ་ "རྫོང་ཁ་མཛུབ་གནོན་སློབ་སྟོན་རིམ་ལུགས་" ཟེར་མི་དང་འཁྲིལ་སྦྱང་བ་འབད་དེ་ མཛུབ་གནོན་སྤྱན་འབུལ་ཕུལ་དགོ། གློག་རིག་ནང་ལས་འཐོབ་ཡོད་པའི་བརྒྱ་ཆ་དང་འཁྲིལ་ཏེ་ བརྒྱ་ཆ་ ༡༥% གུར་ཕབ་སྟེ་ སྐུགས་བྱིན་ནི་ཨིན། དབྱེ་ཞིབ་འདི་གིས་གློག་རིག་ནང་ རྫོང་ཁའི་ཡིག་གཟུགས་བཙུགས་ཏེ་ འབྲི་ཚུགས། འགྲུལ་འཕྲིན་ནང་ རྫོང་ཁའི་ཡིག་གཟུགས་བཙུགས་ཏེ་ འབྲི་ཚུགས། གློག་རིག་དང་འགྲུལ་འཕྲིན་ནང་ལུ་ རྫོང་ཁའི་ལྡེ་སྒྲོམ་བཙུཊ་ཐངས་ཤེས་ཚུཊ། རྫོང་ཁ་ཡི་གུའི་གྱལ་གཅོད་མཚམས་ རིམ་སྒྲིག་འབད་དེ་ འབྲི་ཚུགས། ཁྱོད་ཀྱིས་རྫོང་ཁའི་མཛུབ་གནོན་ཡང་ སློབ་ཁང་དང་ ཡང་ན་ གློག་རིག་ཁང་མིག་ནང་ལུ་སྦེ་ ཐུན་ཚན་ ༡ གི་རིང་ལུ་ རྫོང་ཁའི་མཛུབ་གནོན་རྐྱབ་ཐངས་སྤྱན་འབུལ་ཕུལ་དགོ།

ཤེས་ཚད་ཀྱི་ལྟོག་གྲུབ།	སྐུགས་ཀྱི་ཚད་གཞི། (༡༥%)		
ཤེས་ཚད་ལྟོག་གྲུབ་ཀྱི་ནང་གསེས།	གློག་རིག་ནང་ རྫོང་ཁའི་ཡིག་གཟུགས་བཙུགས་ཏེ་ འབྲི་ཚུགས། (༦)	གློག་རིག་དང་འགྲུལ་འཕྲིན་ནང་ལུ་ རྫོང་ཁའི་ལྡེ་སྒྲོམ་བཙུཊ་ཐངས་ཤེས་ཚུཊ། (༥)	རྫོང་ཁ་ཡི་གུའི་གྱལ་གཅོད་མཚམས་ རིམ་སྒྲིག་འབད་དེ་ འབྲི་ཚུགས། (༩)
(མཆོག་གྱུར)	གློག་རིག་ནང་ རྫོང་ཁའི་ཡིག་གཟུགས་བཙུགས་ཏེ་ འབྲི་ཚུགས་མི། (༦)	གློག་རིག་དང་འགྲུལ་འཕྲིན་ནང་ལུ་ རྫོང་ཁའི་ལྡེ་སྒྲོམ་བཙུཊ་ཐངས་ཤེས་མི།(༥)	རྫོང་ཁ་ཡི་གུའི་གྱལ་གཅོད་མཚམས་ རིམ་སྒྲིག་འབད་དེ་ འབྲི་ཚུགས་མི།(༩)
(རབ)	གློག་རིག་ནང་ རྫོང་ཁའི་ཡིག་གཟུགས་བཙུགས་ཏེ་ ཧ་ལམ་འབྲི་ཚུགས་མི།(༩)	གློག་རིག་དང་འགྲུལ་འཕྲིན་ནང་ལུ་ རྫོང་ཁའི་ལྡེ་སྒྲོམ་ནང་ཧ་ལམ་བཙུཊ་ཤེས་མི།(༣)	རྫོང་ཁ་ཡི་གུའི་གྱལ་གཅོད་མཚམས་ རིམ་སྒྲིག་འབད་དེ་ ཧ་ལམ་ འབྲི་ཚུགས་མི།(༣)

(འབྲིང་)	གློག་རིག་ནང་ རྩིང་ཁའི་ཡིག་གཟུགས་བརྙན་ཆ་ཤས་ཀྱི་ ཚ་ཙི་འཕྲི་ཐུགས་མི།(༣)	གློག་རིག་དང་འགྲུལ་འཕྲིན་ནང་ལུ་ རྩིང་ཁའི་ལྟེ་སྦྲེལ་ནང་ཚ་ཙི་བརྙུན་ཤེས་མི།(༢)	རྩིང་ཁ་ཡི་གྱའི་ཐྲལ་གཅོད་མཚམས་ རིམ་སྤྲིག་འབད་དེ་ ཚ་ཙི་ཤེ་འབྲི་ཐུགས་མི།(༢)
(ཐ)	གློག་རིག་ནང་ རྩིང་ཁའི་ཡིག་གཟུགས་བརྙན་ཆ་ཤས་ཀྱི་ འབྲི་མ་ཐུགས་མི།(༢)	གློག་རིག་དང་འགྲུལ་འཕྲིན་ནང་ལུ་ རྩིང་ཁའི་ལྟེ་སྦྲེལ་ནང་བརྙུན་མ་ཤེས་ མི།(༡)	རྩིང་ཁ་ཡི་གྱའི་ཐྲལ་གཅོད་མཚམས་ རིམ་སྤྲིག་འབད་དེ་ འབྲི་མ་ཐུགས་མི།(༡)

དབྱེ་ཞིབ་ཐབས་ལམ་དང་ལྷིད་ཚད་ཀྱི་བཀོད་རིས།

དུས་རྒྱུན་དབྱེ་ཞིབ།	དབྱེ་ཞིབ་ཀྱི་དབྱེ་བ།	གྲངས་ཁ།	སྐྱགས་ཀྱི་བརྒྱ་ཆ།
ཀ (གསལ་བཤད་)	ཀ སྤྱོབ་ཁང་ཆོས་རྒྱུགས།	༡	༣༠
	ཁ སྤྱན་འབྲལ།	༣	༣༠
	ག མཇུག་གཏོན།	༡	༡༤
ཁ (སྤྱོང་ལྷ)	ང་ ལས་འགྱེལ།	༣	༩༤
	ཡོངས་སྡོམ།	**༡༠༠**	

སྤྱོང་ཚན་སྡོན་ཚང། ཨེདྷ།

སྤྱོང་ཚན་གྱི་ནང་དོན།

ལས་ཚན་དང་པ། སྐད་ཡིག་གི་འབྱུང་རབས།

- ༡.༡ སྐད་ཡིག་གི་གོ་དོན།
- ༡.༢ སྐད་ཡིག་དང་ཁ་སྐད་ཀྱི་ཁྱད་པར།།
- ༡.༣ འབྲུག་རྒྱལ་ཁབ་ནང་ཁ་སྐད་ཀྱི་རིགས་དང་ གཞུང་སྐད་འདི་ རྩིང་ཁ་བཞག་དགོ་པའི་ཁྱངས།
- ༡.༤ རྩིང་ཁའི་སྐད་ཡིག་གི་འབྱུང་རབས་རགས་བསྡུས།
- ༡.༥ རྩིང་ཁ་འདི་ཡིག་ཐོག་ལུ་འབྲི་སྟེལ།
- ༡.༦ སྐད་ཡིག་ལྷབ་དགོ་པའི་སྐོར།
- ༡.༧ སྐད་ཡིག་གི་ཐན་གཏོད།

ལས་ཚན་ གཉིས་པ། ལུང་འདེན་དང་རྒྱབ་རྟེན་འབད་ཐངས།

༢.༡ ལུང་འདེན།

༢.༡.༡ ཐད་ཀར་གྱི་ལུང་འདེན་ཐངས།

༢.༡.༢ ཚོགས་སྒྲུབ་གྱི་ལུང་འདེན་ཐངས།

༢.༡.༣ ངོ་རྒྱང་རྒྱུན་འཛིལ་ལུང་འདེན།

༢.༡.༤ བརྒྱུད་པའི་ལུང་འདེན་ཐངས།

༢.༡.༥ བརྟན་བརྒྱུད་ལུང་འདེན་དང་འཛིལ་བའི་ལུང་འདེན་འབད་ཐངས།

༢.༢ རྒྱབ་རྟེན།

ལས་ཚན་ གསུམ་པ། རྫོང་ཁའི་དགེ་གཤེས།

༣.༡ མགོ་འདོགས་དབྱངས་གསུམ་ཞུགས་པའི་རྫོང་སྐྱ།

༣.༢ རྗེས་འཇུག་གི་སྐྱ་ཟིལ་བུ་བཏོན་དགོས་དང་ མ་དགོ་པའི་རིགས།

༣.༣ རྗེས་འཇུག་མེད་རྒྱང་ཡོད་པ་བཟུམ་གྱི་མིང་ཚིག།

༣.༤ མིང་མཐའ་མེད་རྒྱང་ཡོད་པ་བཟུམ་གྱི་མིང་ཚིག།

༣.༥ ཚོགས་མཚམས།

༣.༦ བརྩོད་མཚམས།

༣.༧ དོན་མཚམས་བཟོ་སྟེ་འབྱི་ཐངས།

༣.༨ མིང་ཚིག་བརྩོད་པ་དང་ཁྱད་ཚིག།

ལས་ཚན་ བཞི་པ། ཕྱད་དང་རྣམ་དཕྱེ།

༤.༡ བྱེད་སྒྲ།

༤.༡.༡ སྒའི་སྦྱོར་ཚུལ

༤.༡.༢ དོན་གྱི་སྦྱོར་ཚུལ།

༤.༢ བྱེད་སྒྲ་རྒྱས་པ།

༤.༣ བྱེད་སྒྲ་ཉེ་བ།

༤.༤ བྱེད་སྒྲ་རིང་བ།

༤.༥ རང་བཞིན་གྱི་འཇུག་ཚུལ།

༤.༦ རྒྱུ་མཚན་གྱི་འཇུག་ཚུལ།

༤.༣ ལྡོག་བཅས།

༤.༣.༡ སྒའི་སྦྱོར་ཚུལ།

༩.༣.༢ དོན་གྱི་སྦྱོར་ཚུལ།

༩.༩ འདི་དང་དེ་གཉིས་ཀྱི་འཇུག་ཚུལ།

༩.༥ འབད་དང་སྤེ་གཉིས་ཀྱི་འཐོབ་ཚུལ།

ལས་ཚན་ ལྔ་པ། དུས་གསུམ་རྣམ་གཞག།

༥.༡ བྱེད་འབྲེལ་དང་བྱེད་མེད་ཀྱི་གོ་དོན།

༥.༢ བྱེད་འབྲེལ་དང་བྱེད་མེད་ཀྱི་ཁྱད་པར།

༥.༣ བྱེད་འབྲེལ་དང་བྱེད་མེད་ཀྱི་དུས་གསུམ་བྱ་ཚིག་གི་དཔེར་བརྗོད།

༥.༤ སྔོན་འཇུག་ལྔས་དུས་གསུམ་ལུ་གཙོ་རིམ་སྤེ་འཇུག་ཚུལ་ངོ་སྤྲོད།

༥.༥ རྗོང་ཁའི་ནང་དུས་གསུམ་ལུ་ཡིག་སྡེབ་སོ་སོར་མེད་མིའི་བྱ་ཚིག་ངོས་འཛིན་དང་དེའི་དཔེར་བརྗོད།

༥.༦ སྔོན་རྗེས་མིང་གསུམ་གྱི་རྟགས་ཀྱི་ངོ་སྤྲོད་དང་དབྱེ་བ།

༥.༧ སྔ་མ་གང་ལྟར་འགྱུར་བའི་ངོ་སྤྲོད་དང་ དེའི་འཇུག་ཚུལ།།

༥.༨ ཕྱི་མ་གང་ལྟར་འགྱུར་བའི་ངོ་སྤྲོད་དང་ དེའི་འཇུག་ཚུལ།

ལས་ཚན་ དྲུག་པ། ཡིག་འགྲུལ།

༦.༡ ཡིག་འགྲུལ་གྱི་ངོ་སྤྲོད་དང་ དེའི་དགོས་ཁུངས།

༦.༢ སྔར་སྲོལ་ཡི་གུ་དང་ད་སྲོལ་འབྲི་ཐངས་ཀྱི་སྒྲིག་བཀོད།

༦.༣ གུས་ཞབས་ཀྱི་འཐོབ་རིམ།

༦.༤ ད་སྲོལ་དང་སྔར་སྲོལ་གྱི་ཞུ་ཡིག་འབྲི་ཐངས།

༦.༥ བཤེར་ཡིག་གི་གོ་དོན་དང་ དེའི་འབྲི་ཐངས།

༦.༦ གན་རྒྱའི་གོ་དོན་དང་ དེའི་འབྲི་ཐངས།

༦.༧ ངག་བརྗོད་འབྲི་ཐངས།

༦.༨ སྔར་སྲོལ་དང་ད་སྲོལ་གྱི་མགྲོན་ཞུ་འབྲི་ཐངས་ཀྱི་དོན་ འབྲི་ཐངས།

༦.༩ ཁྱབ་བསྒྲགས་དང་གསལ་བསྒྲགས་གོ་དོན་དང་ དེའི་འབྲི་ཐངས།

༦.༡༠ གྲོས་ཆོད་ཀྱི་གོ་དོན་དང་ དེའི་འབྲི་ཐངས།

ལས་ཚན་ བདུན་པ། བརྡ་དོན་འཕྲུལ་རིག།

༧.༡ གློག་རིག་ནང་ རྗོང་ཁའི་ཡིག་གཟུགས་བཙུགས་ཐངས།

༧.༢ འགྲུལ་འཕྲིན་ནང་ལུ་ རྗོང་ཁའི་ཡིག་གཟུགས་བཙུགས་ཐངས།

༧.༣ གློག་རིག་དང་འགྲུལ་འཕྲིན་ནང་ལུ་ རྗོང་ཁའི་ལྡེ་སྒྲོམ་བཙུགས་ཐངས།

༧.༤ རྗོང་ཁ་ཡི་གུའི་གྱལ་གཅོད་མཚམས་ཚུ་ རིམ་སྒྲིག་འབད་ཐངས།

ལྷག་དགོ་པའི་དཔེ་ཐོ།

ངེས་པར་དུ་ལྷག་དགོ་པའི་དཔེ་ཐོ།

འབྲུག་རྒྱལ་འཛིན་གཙུག་ལག་སློབ་སྡེ། (༢༠༡༩) *རྫོང་ཁ་བརྡ་དོན་སྤྲོད་ལེན།* འབྲུག། ཐིམ་ཕུ། འབྲུག་རྒྱལ་འཛིན་གཙུག་ལག

སློབ་སྡེ།

རྫོང་ཁ་གོང་འཕེལ་ལྷན་ཚོགས། (༢༠༡༩) *འབྲུག་གི་ཡིག་བསྐུར་རྣམ་གཞག།* འབྲུག། ཐིམ་ཕུ། སྤུན་གཉིས་མཐུན་འབྲེལ་པར་སྐྲུན་དང་དཔེ་སྐྲུན་ཁང་།

རྫོང་ཁ་གོང་འཕེལ་ལྷན་ཚོགས། (༢༠༡༡) *རྫོང་ཁའི་དུས་གསུམ་རབ་གསལ།* འབྲུག། ཐིམ་ཕུ། སྤུན་གཉིས་མཐུན་འབྲེལ་པར་སྐྲུན་དང་དཔེ་སྐྲུན་ཁང་།

རྫོང་ཁ་གོང་འཕེལ་ལྷན་ཚོགས། (༢༠༡༣) *རྫོང་ཁའི་བརྡ་གཞུང་སྣང་བའི་སྒྲོན་མེ།* འབྲུག། ཐིམ་ཕུ། སྤུན་གཉིས་མཐུན་འབྲེལ་པར་སྐྲུན་དང་དཔེ་སྐྲུན་ཁང་།

རྫོང་ཁ་གོང་འཕེལ་ལྷན་ཚོགས་ཀྱི་ཡོངས་འབྲེལ་འཆར་སྒོ་ནང་ཡོད་མི་ རྫོང་ཁ་མཛུབ་གནོན་སློབ་སྟོན་རིམ་ལུགས།(ཕིན་ཌོས)དང རྫོང་ཁ་མཛུབ་གནོན་སློབ་སྟོན་རིམ་ལུགས།(ཨེ་པཱལ)གཉིས་ཀྱི་འབྲེལ་མཐུད།

https://www.dzongkha.gov.bt/uploads/files/downloads/Dzongkha_ typing_ tutor_ setup_1.0.0_c7399525fb25292adef98df4b71d3329.exe

རྫོང་ཁ་གོང་འཕེལ་ལྷན་ཚོགས། (༢༠༢༢) *རྫོང་ཁའི་ལུང་འདྲེན་དང་རྒྱབ་རྟེན་བཀོད་ཐངས་དཔེ་དེབ།* འབྲུག། ཐིམ་ཕུ། རྫོང་ཁ་གོང་འཕེལ་ལྷན་ཚོགས།

ཁ་སྐོང་ལྷག་དགོ་པའི་དཔེ་ཐོ།

ཐུབ་བསྟན་བརྩོན་འགྲུས། (༡༩༩༣) *སུམ་རྟགས་འགྲེལ་པ་ནོར་བུའི་མེ་ལོང་།* མི་སོར། སེར་སྨད་འཕྲུལ་སྤར་ཁང་།

པདྨ་རྒྱལ་མཚན་དང་བསོད་ནམས་ཆེ་དབང་། (༢༠༡༣) *དུས་གསུམ་ཕྱོགས་བསྒྲིགས་ཀུན་གསལ་མེ་ལོང་།* Dhi Publication

པདྨ་རྒྱལ་མཚན། (༢༠༡༡) *བརྡ་སྤྲོད་པའི་གྲུབ་མཐའི་གླེང་བརྗོད་ཆེན་མོ་འཛམ་གླིང་རྒྱན་གཅིག།* ལྡི་ལི། ཆོས་སྤྱོད་དཔེ་སྐྲུན་ཁང་།

རྫོང་ཁ་གོང་འཕེལ་ལྷན་ཚོགས། (༡༩༩༥) *རྫོང་ཁའི་ཡིག་སྐུར་རྣམ་གཞག་བློ་གསར་དགྱེས་པའི་མགུལ་རྒྱན་པདྨའི་ཕྲེང་བ།* འབྲུག། ཐིམ་ཕུ། ཀེ་ཨེམ་ཀྲི།

རྫོང་ཁ་གོང་འཕེལ་ལྷན་ཚོགས། (༢༠༠༢) *རྫོང་ཁའི་བརྡ་གཞུང་གསར་པ།* འབྲུག། ཐིམ་ཕུ། རྫོང་ཁ་གོང་འཕེལ་ལྷན་ཚོགས། རྫོང་ཁ་ཡུ་ནི་ཀོཊ་རིམ་ལུགས་བཙུགས་ཐངས་དང་རིམ་སྒྲིག་ལམ་སྟོན།

https://www.dzongkha.gov.bt/uploads/files/publications/A_guide_to_installation_and_configuration_of_Unicode_Tools_for_Dzongkha_689180bbfee5de068edab6ea1a6449d1.pdf

སི་ཏུ་ཆོས་ཀྱི་འབྱུང་གནས། (༢༠༠༩) *མཁས་པའི་འགུལ་རྒྱན་མུ་ཏིག་ཕྲེང་མཛེས།* ལྡི་ལི། བོད་གཞུང་ཤེས་རིག་དཔར་ཁང་།

སྤྱི་ཚེས: སྤྱི་ཟླ་༢ ༢༠༢༥།

2.2 Year 1, Semester II

MAC101 Foundation of Digital Communication

Module Code and Title: MAC101 Foundation of Digital Communication
Programme: Common module
Credit: 12
Module Tutor(s): Anju Chhetri and Sangay Lhaden
Module Coordinator: Anju Chhetri

General Objective

The module will introduce how digital platforms have revolutionised the communication process across all aspects of human lives. Students will learn how digital technologies can be leveraged for a variety of purposes, ranging from personal to business related communication needs. The module will cover the principles of communication, which will be used to analyse digital platforms and technologies. Learners will be introduced to digital tools and strategies for trans-medial communication. They will have knowledge and skills of using digital tools that are curated to craft and communicate information. The module will enhance their learning throughout their study at university and beyond, through project-based learning, practical sessions and critiquing of existing digital applications used by various organisations. Further, it will also enhance students' capacity to critically reflect on their own learning.

Learning Outcomes

On completion of the module, students will be able to:

1. Define digital communication as a process.
2. Analyze the different ways of storytelling in digital platforms.
3. Identify ethical dilemmas associated with digital communication.
4. Examine the implications and case studies of emerging digital technologies.
5. Use digital tools to design digital campaigns.
6. Navigate effectively through design software for digital communication.
7. Use design principles such as colour theory, typography and layout.
8. Analyse the importance of brand messaging, storytelling and brand experience.
9. Explain marketing and its fundamentals.
10. Create different types of digital content.
11. Use AI content creators for quick content creation.

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
Contact	Facilitation and discussion	1	**60**
	In-class exercises	0.5	
	Lab tutorial	1.5	
	Lab Practice	1	
Independent study	Field work	1.5	**60**
	Script writing	1.5	

	Designing	1	
Total		8	**120**

Assessment Approach
The assessment will be carried out on a continuous basis through the following approaches:

A. **Digital Product Critique (10%)**
This assessment will enable students to identify distinctive features of digital communication through the critical analysis of digital products. This individual assignment is intended to familiarise students with the dynamic functions of digital platforms enabling communication in a trans medial environment. Students will be asked to critique at least 5 existing digital platforms and analyse its unique features, advantages and disadvantages and storytelling techniques. This assessment will assess the learning outcome 1 and 2.

Digital Product Critique Assessment Criteria

2 marks	Analysis of communication process: *Communication process is appropriately identified (precisely stated, appropriately rationalised, and strongly supported.)*
4 marks	Comparative analysis*: Justification of comparison, aspects of product critiqued and analysis drawn from it*
4 marks	Supporting materials: *Variety of explanations, examples, visuals, statistics, analogies, authoritative quotes, etc., and make appropriate reference to information or analysis that significantly supports the presentation.*

B. **Create Brand Identity (20%)**
Students will create a “Brand Identity” brochure using open-source design tool. Students will use the key elements of the brand's communication approach, including brand identity, messaging, visual branding, storytelling, and consistency. They will Identify the target audience and evaluate how effectively the brand communicates with them. They will Select a business idea of interest. Brainstorm and conceptualise the mission, vision for the brand. Conduct in-depth research on the brand's communication strategy and campaigns. Create the brand brochure highlighting core values, mission statement, and unique selling proposition (USP). Determine how these elements are communicated through the brand's messaging and visual branding. This assessment will assess the learning outcome 5, 8 and 9.

Brand Identity Assessment Criteria

4 marks	Brand Introduction: *Clear description, name and justifications*
4 marks	Quality of mission and vision*: Clear and concise*
4 marks	Colour and typography: *colour and typography elements appropriately addressed*
4 marks	Design Consistency: Images, words, colour and other elements align consistently.
4 marks	Digital tool: *Adequate use of digital tools mandated by the programme*

C. **Content Creation (30%)**

As part of this assignment, students will create a digital content piece using an open-source digital tool introduced in practical sessions. The content may be in any digital format but must effectively reflect brand identity and value through design and storytelling. This assignment assesses Learning Outcomes 10 and 11.

Content Creation Assessment Criteria

5 marks Platform & Format: *The content aligns with the chosen digital platform and follows its specific features and format requirements.*
8 marks Storytelling & Purpose*: The content demonstrates a clear purpose, well-defined goals, and an understanding of the target audience. The message is engaging and effectively conveyed.*
5 marks Use of Tools: *The student demonstrates proficiency in using an open-source AI or digital tool to enhance content creation.*
6 marks *Visual & Audio Quality: The visuals and/or audio are high quality, clear, and effectively enhance the content's engagement and message*.
6 marks Script & Narrative: *The script is well-structured, engaging, and supports the storytelling aspect of the content. It maintains clarity and coherence throughout.*

D. Group Project (Digital Campaign) (40 %)

For their final project, digital communication students will develop a simple digital campaign for a brand, product, or cause using a social media ads manager. Students must present their campaign to the class, demonstrating their ability to apply knowledge and skills to real-world scenarios. The project will assess the learning outcomes 1 to 11 based on the following criteria:

Group Project (Digital Campaign) Assessment Criteria

8 marks Use of Tools: *Demonstrates appropriate and effective use of digital tools, including social media ads manager and relevant platforms.*
10 marks Research & Strategy: *Conducts thorough research and develops a clear, data-driven campaign strategy aligned with objectives and audience insights.*
8 marks Quality of Presentation: *Communicates ideas effectively, engages the audience, and presents content in a structured, professional manner.*
10 marks Quality of Visuals & Written Content*: Ensures high-quality visuals, compelling copy, and a cohesive message that enhances the campaign's effectiveness.*
4 marks Adherence to Brand Value*: Aligns campaign elements with the brand's identity, values, and messaging to maintain consistency and authenticity*.

Overview of the assessment approaches and weighting

Continuous assessment	**Areas of assignments**	**Quantity**	**Weighting (%)**
A (Theory)	A. Digital critique	1	10%
	B. Brand Identity	1	20%
B (Practical)	C. Content Creation	1	30%
	D. Group Project	1	40%
Total		**100**	

Pre-requisites: None

Subject Matter

Unit I: Introduction to Digital Communication

- 1.1 Define Communication
  - 1.1.1 Transmission model of Communication
  - 1.1.2 Interaction model of Communication
  - 1.1.3 Transactional model of communication
- 1.2 Principles of communication
- 1.3 Communication and perception
- 1.4 Definition of digital media and digital communication
  - 1.4.1 Distinctive feature of digital media enabled communications
  - 1.4.2 Forms of digital communication and platforms
  - 1.4.3 Digital Media and Convergence
  - 1.4.4 Digital communication for business
- 1.5 Interactive Storytelling
  - 1.5.1 A brief History, Convergence
  - 1.5.2 Old tools/New tools, Character, dialogue and emotions, immersive entertainment
- 1.5.3 Contemporary examples from social media platforms

Unit II: Ethics in Digital Communication

- 2.1 General professional ethics in digital world
- 2.2 Concept of Confidentiality in effective communication
- 2.3 Digital work environment and its ethical challenges
- 2.4 Digital communication and its audience
- 2.5 Digital footprint and its consequences
- 2.6 Concept of privacy and digital identity
- 2.7 Concept of Cyberbully and relevant case studies
- 2.8 Intellectual property and digital products
- 2.9 Ethical considerations in artificial intelligence
  - 2.9.1 Blockchain and ethical usage
  - 2.9.2 design a digital communication plan with all ethical considerations

Unit III: Introduction to Digital Tool

- 3.1 Understanding digital tools
  - 3.1.1 Canva interface
- 3.2 Branding and Identity
  - 3.2.1 Creating consistent visual branding elements (logo, color scheme, fonts),
  - 3.2.2 Applying brand guidelines to design projects
  - 3.2.3 Learning the basics of colour theory and its application
  - 3.2.4 Understanding typography and font selection
  - 3.2.5 Exploring layout and composition techniques
- 3.4 Social Media Graphics
  - 3.4.1 Designing engaging Instagram and Facebook posts
  - 3.4.2 Creating attention-grabbing thumbnails for YouTube videos
  - 3.4.2 Designing Twitter headers and LinkedIn banners"
- 3.5 Image Editing
  - 3.5.1 Enhancing and retouching images
  - 3.5.2 Adjusting brightness, contrast, and saturation
  - 3.5.3 Removing backgrounds and creating transparent images
- 3.6 Web Design
  - 3.6.1 Designing website headers, banners, and hero images,
  - 3.6.2 Creating user-friendly web graphics and icons
  - 3.6.3 Understanding responsive design principles

3.7 Presentation Design
    3.7.1 Creating professional slide decks for presentations
    3.7.2 Using visual elements to enhance storytelling
    3.7.3 Designing effective charts and graphs

Unit IV: Brand Communication

4.1 Evolution of brand storytelling and post advertising era
    4.1.1 What is branding, brand identity, brand value and brand experience
    4.1.2 Approaches to Marketing (basic concepts, marketing in digital world)
    4.1.3 Strategic brand storytelling, Tactical Brand story, Company Centric story, Customer-Centric

Unit V: Content Creation

5.1 Content Principles
    5.1.1 law of relevance and law of coherence
    5.1.2 Coherence Vs preference
    5.1.3 Relevant cases and examples
5.2 Define the purpose and goals
5.3 Identify target audience
5.4 Content Type and Format
5.5 Research on topic and brainstorm ideas
5.6 Scripting and Storyboarding
5.7 Gather and prepare assets for production
5.8 Post production
    5.8.1 Basics of photography
    5.8.2 Videography
    5.8.3 Audio and visual editing

Reading List

Essential Reading:

Moin, S. M. A. (2020). Brand storytelling in the digital age: Theories, practice and application. Palgrave Macmillan.

Miladi, N. (Ed.). (2021). Global media ethics and the digital revolution. Routledge.

Chiaravalle, B., & Schenck, B. F. (2014). Branding for dummies. John Wiley & Sons.

Fawkes, J., & Gregory, A. (2001). Applying communication theories to the Internet. Journal of Communication Management, 5(2), 109-124. https://doi.org/[DOI if available]

Haig, M. (2005). Brand failures: The truth about the 100 biggest branding mistakes of all time. Kogan Page Publishers.

Williams, R. (2015). The non-designer's design book: Design and typographic principles for the visual novice. Pearson Education.

Additional Reading:

van Dijck, J. (2013). The culture of connectivity: A critical history of social media. Oxford University Press.

Boyd, d., & Ellison, N. B. (2007). Social network sites: Definition, history, and scholarship. Journal of Computer-Mediated Communication, 13(1), 210-230. https://doi.org/[DOI if available]

Goffman, E. (1959). The presentation of self in everyday life. Doubleday.

Rheingold, H. (2012). Net smart: How to thrive online. MIT Press.

Turkle, S. (2011). Alone together: Why we expect more from technology and less from each other. Basic Books.

University of Southern California. (2021). Digital communication ethics. Retrieved from https://online.usc.edu/programs/articles/digital-communication-ethics/

Date: February 2025.

DAT102 Foundations of Data Science

Module Code and Title:	DAT102 Foundations of Data Science
Programme	Bachelor of Economics and Politics, Bachelor of Digital Communications and Project Management, Bachelor of Data Science and Data Analytics
Credit:	12
Module Tutor(s):	Norbu Zangpo, Ngawang Choeda
Module Coordinator:	Norbu Zangpo

General Objective

The aim of this module is to provide students with a practical foundation in data science, focusing on the skills and tools necessary for real-world data analysis using visual software such as Orange. Students will gain experience working with various types of data, including structured and will learn how to use software tools to perform common data analysis tasks such as data pre-processing, data visualization, and predictive modelling. Throughout the course, students will be challenged to apply their knowledge to real-world data problems, working individually and in teams to develop practical data analysis solutions

Learning Outcome

On completion of the module, students will be able to:

1. Describe the definition, scope, and applications of data science across various domains.
2. Identify and categorize different types of data and explain their characteristics and uses in data science.
3. Explain the data science lifecycle and the roles of key stakeholders involved in the process.
4. Analyze ethical considerations, legal frameworks, and privacy issues related to data science.
5. Assess and address issues of bias, fairness, and the social implications of data science.
6. Apply statistical methods, including descriptive statistics and probability distributions, to analyze data.
7. Execute techniques for data cleaning, preprocessing, and transformation to ensure high-quality data.
8. Utilize data wrangling tools to integrate, merge, and visualize data from multiple sources.
9. Implement machine learning algorithms, including supervised and unsupervised learning, to solve data science problems.

10. Evaluate machine learning models using appropriate performance metrics and optimize model parameters for improved accuracy.

Teaching and Learning Approaches

Type	Approach	Hours per week	Total credit hours
Contact	Lecture, Guided Discussions, Presentation	2	30
	Practical	3	45
Independent study	Assignments, Lab Exercises & Projects	1	15
	Self-study	2	30
Total			120

The module will be taught using teaching sessions and practical sessions.

Teaching methods: Tutors can use a combination of lectures, labs, and online resources to introduce the concepts and tools of data science. Tutors may also use interactive software such as Orange to demonstrate how to perform data analysis tasks using visual programming.

Learning tasks: Tutors can assign students various types of data sets (such as text, images, audio, etc.) and ask them to perform data analysis tasks using Orange or other software tools. Students may be required to present their findings in a report or a presentation. Tutors can also design group projects where students collaborate to solve a real-world data problem using data science techniques.

Assessment Approach

The assessment will be carried out on a continuous basis through the following approaches.

A. Online Quizzes: (20%)

Online Quizzes will be conducted after completion of every Unit as part of the continuous performance monitoring of the students. There will be a total of 5 quizzes (each worth 5%) out of which the best 4 will be considered for 20%. The quiz will be conducted for a duration of 1 hour through the VLE platform.

B. Group Assignment: (35%)

The group project requires examining a sizable dataset that has been provided, cleaning and preprocessing the data, exploring and visualising the data, using statistical analysis and machine learning techniques to draw conclusions and create predictive models, and present the results to the class. The objective is to use the knowledge and abilities acquired in the course to solve a practical issue.

The project will evaluated based on the following criteria:

Data Cleaning and Preprocessing: (20%)

Exploration and Visualization: (20%)

Statistical Analysis and Machine Learning: (25%)

Results and Interpretation: (20%)

Group Collaboration and Presentation: (15%)

C. Lab Assessment: (35%)

There are three parts to the laboratory assessment: lab work, a practical test, and a viva.

Applying the understanding of data science ideas to tasks involving data cleaning, visualization, statistical analysis, and machine learning is required for the lab assignments.

The practical exam will be a timed, in-person examination that will gauge how well the student can use the knowledge and abilities gained in the course to address problems that arise in the real world.

Oral examinations are part of the interview. Students will be questioned about the ideas covered in the course and asked to describe the reasoning and methodology for finishing the lab assignments and practical exam.

D. Class Activities: (10%)

Participation in class discussions, online forums, and other interactive activities can also be assessed. This can include the quality and quantity of contributions made by the student, as well as their ability to provide constructive feedback to their peers.

Overview of the assessment approaches and weighting

Sl.No.	Areas of assessment	Quantity	Weighting (%)
A	Online Quizzes	4	20
B	Group Assignment	1	35
C	Lab Assessment	1	35
D	Class Activities	1	10
Total		**7**	**100**

Pre-requisites: None

Subject Matter

Unit I: Introduction to Data Science

1.1 Basics of Data Science
- 1.1.1 Define Data Science and explain its key components.
- 1.1.2 Scope and applications of Data Science across various domains such as business, healthcare, finance, etc.

1.2 Understanding Data
- 1.2.1 Different types of data: structured, unstructured, semi-structured.
- 1.2.2 Data collection methods and sources.
- 1.2.3 Importance of data in the modern world.

1.3 Stakeholders in Data Science
- 1.3.1 Roles of data scientists, data engineers, analysts, and other stakeholders in the data science lifecycle.
- 1.3.2 Collaboration between data scientists and business decision-makers.

1.4 Data Science Tools and Frameworks

1.4.1 Overview of popular tools used in data science (e.g., Python, R, Jupyter Notebooks, SQL, Hadoop, TensorFlow, etc.).

1.4.2 Introduction to frameworks used for machine learning and data analysis (e.g., Scikit-learn, Pandas).

1.5 Data Science Lifecycle

1.5.1 Phases of the data science lifecycle: Problem definition, data collection, data preprocessing, modeling, evaluation, and deployment.

Unit II: Data Ethics and Privacy

2.1 Ethical Implications in Data Science

2.2 Overview of ethical considerations and implications in the use of data (privacy, consent, transparency).

2.3 Privacy and Legal Frameworks

2.3.1 Key concepts in data privacy and security (e.g., GDPR, HIPAA).

2.3.2 Legal frameworks governing data collection and analysis.

2.4 Bias and Fairness

2.4.1 Understanding bias in data and algorithms.

2.4.2 Methods to address fairness issues in data and machine learning Models.

2.5 Historical and Current Ethical Issues

2.5.1 Case studies of ethical dilemmas in data science (e.g., biased hiring algorithms, misuse of personal data).

2.5.2 Ongoing debates and solutions in data ethics.

2.6 Evaluating Data Sources and Tools

2.6.1 Best practices for evaluating and selecting data sources and tools with ethical considerations.

Unit III: Fundamentals of Data Analysis

3.1 Overview of Data Analysis

3.1.1 Importance and scope of data analysis in data science.

3.1.2 Organizing the data analysis process: problem definition, data collection, cleaning, and analysis.

3.2 Exploratory Data Analysis (EDA)

3.2.1 Techniques for exploring and visualizing data (e.g., summary statistics, histograms, scatter plots).

3.3 Descriptive Statistics

3.3.1 Calculating and interpreting key statistical measures: mean, median, mode, variance, standard deviation.

3.4 Probability Distributions

3.4.1 Overview of common probability distributions (normal, binomial, Poisson) and their use in data analysis.

3.5 Multiple Regression Analysis

3.5.1 Introduction to multiple regression analysis for predicting outcomes.

3.5.2 Model selection techniques and evaluation of multiple regression Models.

3.6 Supervised vs Unsupervised Learning

3.6.1 Introduction to supervised learning techniques (e.g., classification,

regression).
3.6.2 Introduction to unsupervised learning techniques (e.g., clustering, association rules).

Unit IV: Data Management and Wrangling

4.1 Data Management in Data Science
4.1.1 Importance of managing large volumes of data.
4.1.2 Identifying and handling issues related to data quality.
4.2 Data Cleaning and Preprocessing
4.2.1 Techniques for cleaning data: handling missing values, dealing with outliers, and encoding categorical variables.
4.2.2 Data preprocessing techniques such as normalization, scaling, and Transformation.
4.3 Merging and Integrating Data
4.3.1 Combining multiple datasets from different sources and formats.
4.3.2 Techniques for data integration and handling different data structures.
4.4 Data Visualization
4.4.1 Creating effective data visualizations (e.g., bar charts, line plots, pie charts).
4.4.2 Using visualization tools to identify patterns and communicate insights.

Unit V: Machine Learning

5.1 Introduction to Machine Learning
5.1.1 Define machine learning, its scope, and its importance in the context of data science.
5.1.2 Difference between Artificial Intelligence, Machine Learning, and Deep Learning.
5.2 Types of Machine Learning
5.2.1 Overview of different types of machine learning (supervised, unsupervised, and reinforcement learning).
5.2.2 Discussion on classification, regression, clustering, and association rule Learning.
5.3 Supervised Learning Algorithms
5.3.1 Detailed explanation of classification and regression algorithms (e.g., Decision Trees, Random Forests, KNN, Logistic Regression).
5.4 Unsupervised Learning Algorithms
5.4.1 Clustering algorithms (e.g., K-Means, DBSCAN) and their applications.
5.5 Model Performance Evaluation
5.5.1 Understanding and calculating performance metrics: accuracy, precision, recall, F1-score, AUC.
5.5.2 Cross-validation and overfitting.
5.6 Hyperparameter Tuning
5.6.1 Techniques for optimizing machine learning models using grid search, random search, and Bayesian optimization.
5.7 Building a Predictive Model
5.7.1 End-to-end process of building a predictive machine learning model:

data preparation, model selection, training, evaluation, and deployment.

Laboratory Sessions:

1. **Lab Session 1: Getting Started with Data Science**

   Activities:

   - Introduce Python basics and environment setup (e.g., installing libraries such as NumPy, Pandas).
   - Perform basic data manipulations with Python.
   - Explore data science libraries and tools (e.g., Pandas, Matplotlib).
   - Discuss the data science life cycle through examples.

2. **Lab Session 2: Ethical Considerations in Data Collection and Analysis**

   Activities:

   - Review case studies on data ethics and privacy issues.
   - Work with publicly available datasets and examine ethical concerns related to data collection.
   - Identify potential privacy risks in data and propose mitigation strategies.
   - Discuss the importance of fairness and bias in machine learning models.

3. **Lab Session 3: Exploratory Data Analysis (EDA)**

   Activities:

   - Load a dataset and perform initial exploratory data analysis (EDA).
   - Use statistical methods to summarize the data (mean, median, mode).
   - Visualize data distributions and relationships using scatter plots, histograms, and box plots.

4. **Lab Session 4: Descriptive Statistics and Probability Distributions**

   Activities:

   - Calculate and interpret descriptive statistics for a dataset.
   - Use Python to plot different probability distributions (e.g., normal, binomial) and compare them with actual data.
   - Apply probability distributions to real-world problems.

5. **Lab Session 5: Data Cleaning and Preprocessing**

   Activities:

   - Handle missing values, remove duplicates, and deal with outliers.
   - Normalize and standardize numerical features.
   - Encode categorical variables for machine learning models.

6. **Lab Session 6: Data Integration and Merging**

Activities:

- Merge datasets from different sources (CSV, Excel, SQL).
- Apply data transformation techniques like reshaping and pivoting.
- Perform simple joins and aggregations on merged datasets.

7. **Lab Session 7: Data Visualization**

   Activities:

   - Use Matplotlib and Seaborn to create various charts (bar charts, line plots, heatmaps).
   - Create interactive plots using Plotly or similar libraries.
   - Interpret the visualizations to draw insights.

8. **Lab Session 8: Introduction to Supervised Learning**

   Activities:

   - Train a classification model (e.g., logistic regression, decision trees) on a labeled dataset.
   - Evaluate model performance using accuracy, precision, recall, and F1-score.
   - Perform hyperparameter tuning using grid search or random search.

9. **Lab Session 9: Unsupervised Learning and Clustering**

   Activities:

   - Apply K-Means clustering on an unlabeled dataset.
   - Evaluate the clusters and interpret the results.
   - Use dimensionality reduction techniques like PCA to visualize clusters.

10. **Lab Session 10: Model Evaluation and Hyperparameter Tuning**

    Activities:

    - Split a dataset into training and testing sets.
    - Train a regression or classification model and evaluate its performance.
    - Fine-tune model parameters to improve accuracy using cross-validation and hyperparameter optimization.

11. **Lab Session 11: Building a Predictive Machine Learning Model**

    Activities:

    - Select an appropriate machine learning algorithm for a predictive task.
    - Train the model on the training dataset and test it on the test dataset.
    - Evaluate the model's performance using performance metrics and compare different algorithms.

Reading List

Essential Reading:

McKinney, Wes. (2017). Python for Data Analysis. O'Reilly Media, Inc.

Grus, Joel. (2015). Data Science from Scratch: First Principles with Python. O'Reilly Media, Inc.

James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). An Introduction to Statistical Learning: with Applications in R. Springer.

Hastie, T., Tibshirani, R., & Friedman, J. (2009). The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Springer.

Date: February, 2025.

LAC103 Academic Research Skills

Module Code and Title:	LAC103 Academic Research Skills
Programme:	Bachelor of Economic and Political Science, Bachelor of Digital Communication and Project Management, Bachelor of Data Science and Data Analytics
Credit:	12
Module Tutor(s):	Sonam Dendup, Sangay Choden, Tshering Samdrup
Module Coordinator:	Sonam Dendup

General Objective

This module aims to develop critical thinking and academic writing skills, with a particular emphasis on research. Students will learn to locate and evaluate sources, analyze evidence, and identify underlying assumptions in various reading materials. The course covers rhetorical concepts to help students understand contexts and audiences, aiding in both comprehension and composition of texts. Additionally, students will explore multiple composing processes and will be introduced to disciplinary writing conventions, including understanding plagiarism, how to avoid it, and proper source documentation.

Learning Outcomes

On completion of the module, students will be able to:

1. Analyse audience characteristics and write effectively to address their needs.
2. Write concise and accurate summaries of texts.
3. Identify and apply an effective workflow in their writing projects.
4. Recognize and explain the interconnection between reading and writing.
5. Deliver academic presentations effectively.
6. Employ rhetorical strategies to communicate ideas effectively.
7. Apply revision techniques to improve their writing.
8. Locate relevant sources on a given topic and document them accurately.
9. Integrate sources effectively to support their personal ideas.
10. Reflect on and identify their growth and development as writers.
11. Synthesize their knowledge and deepen their understanding of a chosen subject through writing.

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Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
Contact	Facilitation and discussion	1.5	**60**
	Writing Workshop/Group work	2	
	Presentations	0.5	
Independent study	Portfolio writing and revising	2	**60**
	Forum participations	0.5	
	Reading assigned readings	1.5	
Total		8	**120**

Assessment Approach
The assessment will be carried out on a continuous basis through the following approaches:

Portfolio 1: Personal and Academic Writing

A. Personal Essay (7%): The writing assignment will be a personal essay on a topic selected by the tutor. The assignment will provide students to explore how their life experiences have affected how they think/ feel about the selected topic. The essay should be 500-600 words. Students should follow the guide provided in *Storytelling, Narration, and the 'Who Am I' Story*.

1 Mark Vividness of events: *Events are vividly described with strong sensory details, making the story immersive*.
1 Mark Character Development: *Characters are well-developed through actions, dialogue, and thoughts, making them feel real*.
1 Mark Narrative time: *Time shifts (past/present) and pacing are used effectively for storytelling*.
1 Mark Dominant Impression: *Essay creates a strong, consistent central impression that evokes emotions*.
1 Mark Show and don't tell: *Skillfully uses action, dialogue, and detail to show emotions and experiences*.
1 Mark Organization & Clarity: Grammar, Mechanics & Style: *Writing is polished, with few or no grammar/spelling errors*.
1 Mark Grammar, Mechanics & Style: *Writing is polished, with few or no grammar/spelling errors*.

B. Summary (7%): Students will select an essay from a pool on a selected topic and write a 500-600 word summary on it. This summary will be part of the class text to be used by your classmates in writing the third essay in this portfolio. The goals of the assignment are to read accurately and condense information such that key ideas are identified and summarized correctly.

2 Marks Comprehension: *Clearly identifies main ideas.*
2 Marks Clarity, Coherence: *Logical flow and easy to understand*.
1 Mark Conciseness: *Avoids unnecessary details and repetition.*
1 Mark Structure and Organization: Grammar, Mechanics & Style: *Well structured summary with author and article title*
1 Mark Grammar, Mechanics & Style: *Writing is polished, with minimal grammar/spelling errors*.

C. **Response Using Personal Experience (16%):** This assignment will entail to provide a response to ideas from readings summarized earlier using personal experience. It should summarize the main ideas from your classmate's reading and how and why those ideas are similar or different from your own personal experiences.

4 Marks Summary: *Clearly and accurately summarize authors key points in an organized and concise manner*

4 Marks Response and Interpretation: *Thoughtfully engages with the author's ideas, making insightful connections to personal experiences, knowledge, or real-world examples.*

4 Marks Argument and Positioning: *Clearly establishes a strong, well-supported position (agree, disagree, or partial agreement) with reasoning and examples*.

4 Marks Clarity Organization and Grammar*: Writing is clear, well-organized, and nearly free of grammar/spelling errors.*

Portfolio 2 Source Evaluation and Response

D. **Source Evaluation (15%):** In smaller groups, students will explore multiple sources of text using library resources on a particular issue. Students will then write an essay that summarizes the texts and discusses how ideas are expressed and for what purpose they are intended.

2 Marks Summary of the source: *Provides a comprehensive and concise summary of the courses*.
2 Marks Depth of analysis: *Demonstrate insightful critique and through evaluation*.
2 Marks Use of evidence: *Integrates strong and relevant examples throughout*.
2 Marks Comparison of sources: *Provides strong comparative insights with well-developed contrasts*.
2 Marks Intended audience and purpose: *Clearly identifies that intended audience and purpose for each source*.
2 Marks Use of rhetorical strategies: *Analyse rhetorical strategies effectively, providing insights*.
1 Marks Evaluation of credibility: *Evaluates the credibility of sources thoroughly and accurately*.
1 Mark Reflection and engagement: *Demonstrate deep reflection and engagement with sources*.
1 Mark Organization and clarity: *Well organized and clear, with logical flow of ideas*.

E. **Response Using sources (20%):** In this 1200-1500 word essay, students will revisit the response format they used previously. Rather than relying solely on personal experience, they will incorporate external sources to substantiate their agreement or disagreement with the author's ideas. This approach is common in academic writing and serves as a foundation for developing independent arguments.

4 Marks Agreement/disagreement with author: *Clear statement of agreement or disagreement with justifications.*

4 Marks Use of sources*: Effectively incorporates a variety of sources to support the argument; all sources are relevant and credible.*

3 Marks Audience awareness: *Clearly identifies and addresses the target audience; understand and meets their expectation for focus, organization, evidence and style*.

3 Marks Organization and coherence: *Well organized with clear logical flow of ideas; paragraphs are well-structured and transitions are smooth*.
3 Marks Balance of thoughts: *Balance of personal insights and outside source material; sources enhances and complements the argument.*
2 Marks Proper Citation: *All sources are cited in APA format with no errors*.
1 Mark Grammar and style: *No grammatical, spelling or punctuation errors. Good writing style*.

Miscellaneous Process

F. Quiz (10%): Two online quizzes will be conducted, based on the assigned weekly readings. These quizzes will be designed to assess students' understanding and engagement with the course material.

G. **Free Writing (5%):** Students will engage in weekly 10-minute free writing exercises on various topics. Each piece should be between 150 and 300 words. Completion of each exercise will earn 0.5%, contributing to the final grade. This activity encourages idea generation, creativity, and writing fluency without pressure for perfection.

H. **Attendance (5%):** Regular attendance is crucial for participating in class activities and discussions. Students are allowed to miss up to three classes without any penalty. However, for each additional absence, 1% will be deducted from the attendance grade. Missing eight or more classes will result in a zero for this component.

I. **Forum Participation (5%):** Students will be assessed based on the frequency and quality of their contributions. High-quality participation involves following and building on existing conversations and contributions should be thoughtful, relevant, and encourage further dialogue among peers.

J. Reflecting on Your Writing – (10%): Module Postscript: In this last assignment, the student will write a reflection essay of 600–800 words to show how their writing knowledge and skills developed over the semester. They will discuss what they have learned about academic writing.

2 Marks Development of writing skill: *Clearly demonstrate significant development in writing skills over the semester*.
3 Marks Understanding of academic writing: *Explain what has been learnt about academic writing*.
3 Marks Evaluation of earlier essay: *Provide comprehensive evaluation of an essay using tools and topics discussed throughout the semester and mention how you would improve if you revise again*.
1 Marks *Organization and clarity: Well organized with a clear logical flow of ideas; paragraphs are well-structured and transitions are smooth*.
1 Marks Grammar and style: *No grammatical, spelling or punctuation errors. Good writing style.*

Overview of the assessment approaches and weighting

Continuous assessment	Areas of assessment	Quantity	Weighting (%)
A Portfolio 1	A. Personal Essay	1	7%
	B. Summary	1	7%
	C. Responses using personal experience	1	16
B Portfolio 2	D. Source Evaluation	1	15
	E. Comparison of two discourse	1	20
	F. Reflecting on your writing		
	G. Homework, attendance and Participation		
Total		**100**	

Pre-requisites: None
Subject Matter

1. **Unit I: Writing Process and Reading Strategies**
   - 1.1. Writing Process and Workflow
     - 1.1.1. Understanding the stages of the writing process (prewriting, drafting, revising, editing, and publishing).
     - 1.1.2. Applying effective workflow techniques tailored to writing projects.
   - 1.2. Interconnection Between Reading and Writing
     - 1.2.1. Exploring the influence of reading on writing and vice versa.
     - 1.2.2. Analyzing examples to understand how reading can inspire and improve writing.
   - 1.3. Reading for Different Purposes
     - 1.3.1. Identifying and distinguishing between various purposes for reading (e.g., learning, pleasure, research).
     - 1.3.2. Implementing appropriate reading strategies for different contexts.
   - 1.4. Reading as a Prewriting Strategy
     - 1.4.1. Using reading materials to generate ideas and develop critical thinking skills before writing.
     - 1.4.2. Engaging in prewriting activities based on insights gained from reading.
   - 1.5. Collecting, Planning, and Organizing Writing
     - 1.5.1. Techniques for collecting information, planning, and organizing writing projects.
     - 1.5.2. **Implementing strategies such as brainstorming, outlining, and using graphic organizers.**

2. **Unit II: Audience Awareness and Summarizing**
   - 2.1. Audience Analysis and Writing
     - 2.1.1. Analyzing audience characteristics to tailor writing effectively.
     - 2.1.2. Understanding genre conventions to meet the expectations of readers and writers.
   - 2.2. Summarizing Texts
     - 2.2.1. Understanding the importance of summarizing in various contexts.
     - 2.2.2. Techniques for writing concise and accurate summaries.
3. **Unit III: Organizing, Revising, and Academic Writing**
   - 3.1. Rhetorical Strategies in Writing
     - 3.1.1. Employing rhetorical strategies to communicate ideas effectively.
     - 3.1.2. Techniques for organizing material logically to present information clearly.
   - 3.2. Revision Techniques
     - 3.2.1. Applying revision strategies to improve written work.

3.2.2. Understanding and constructing academic arguments with appropriate style and tone.

4. Unit IV: Finding, Evaluating, and Responding to Sources

4.1. Locating and Documenting Sources

4.1.1. Techniques for finding relevant sources on a topic and documenting them accurately.

4.1.2. Strategies for presenting data clearly to readers.

4.2. Integrating Personal Experience with Data

4.2.1. Blending personal experiences with data to support arguments.

4.2.2. Using sources effectively to bolster personal ideas.

5. Unit V: Reflection on Writing

5.1. Self-Awareness and Development as a Writer

5.1.1. Reflecting on personal growth and development in writing.

5.1.2. Consolidating knowledge and deepening understanding of subjects through writing.

Reading List

Essential Reading

Daniels-Lerberg, T., Driscoll, D., Stewart, M., & Vetter, M. (Eds.). (2023). *Writing spaces: Readings on writing* (Vol. 5). Parlor Press.

Driscoll, D., Heise, M., Stewart, M., & Vetter, M. (Eds.). (2021). *Writing spaces: Readings on writing* (Vol. 4). Parlor Press.

Driscoll, D., Stewart, M., & Vetter, M. (Eds.). (2020). *Writing spaces: Readings on writing* (Vol. 3). Parlor Press.

Lowe, C., & Zemliansky, P. (Eds.). (2010). *Writing spaces: Readings on writing* (Vol. 1). Parlor Press.

Lowe, C., & Zemliansky, P. (Eds.). (2011). *Writing spaces: Readings on writing* (Vol. 2). Parlor Press.

Additional Reading

American Psychological Association. (2020*). Publication manual of the American Psychological Association 2020: The official guide to APA style* (7th ed.). American Psychological Association.

Date: February 2025.

LAC102 རྫོང་ཁ་རྩོམ་རིག།

སྦྱོང་ཚན་ཨང་དང་སྦྱོང་ཚན་མིང་།	LAC102 རྫོང་ཁ་རྩོམ་རིག།
ལས་རིམ།	དཔལ་འབྱོར་དང་སྲིད་དོན་ཚན་རིག། ཨང་ཅན་རྒྱུན་འབྲེལ་དང་ལས་འགུལ་འཛིན་སྐྱོང་། གནས་སྡུད་ཚན་རིག་དང་དབྱེ་དཔྱད་གནས་སྡུད་ཚན་རིག།
སྦྱོང་འཐུས།	༡༢ །
སྦྱོང་ཚན་སློབ་སྟོན་པ།	རྫོང་ཁའི་ལེགས་བཤད་པ།
སྦྱོང་ཚན་འགོ་འདྲེན་པ།	ཤེས་རབ་རྩེ་མཐོ་རིམ་སློབ་གྲྭ་ཆེན་མོ།

སྤྱིར་བཏང་ལས་དོན།

སྦྱོང་ཚན་འདིའི་དམིགས་གཏད་འདི་ སློབ་ཕྲུག་ཚུ་གིས་ གཞུང་སྐེར་གྱི་ལྟ་གཡོག་ག་ཅི་ནང་འབད་རུང་ རྫོང་ཁའི་རྩོམ་རིག་གི་ལྟ་ཚུ་ ཤེས་ཡོན་འབྲི་རྩལ་དང་ལྡནམ་སྤེ་ བྲི་ཚུགས་ནིའི་དོན་ལུ་ཨིན། དེ་མ་ཚད་ སྦྱོང་ཚན་འདི་ལུ་བརྟེན་ རྫོང་ཁའི་རྩོམ་བྲིསཔ་ཅིག་འབད་སྡོད་ཚུགས་ནིའི་དམིགས་པ་བསྐྱེདཔ་ཨིན།

སློབ་སྦྱོང་གྲུབ་འབྲས།

སྦྱོང་ཚན་འདི་མཇུག་བསྡུཔ་ད་ སློབ་ཕྲུག་ཚུ་གིས།

༡ སྤྱིར་བཏང་རྩོམ་རིག་གི་དགོས་ཁུངས་ཚུ་སླབ་ཚུགས།

༢ སྲུང་རིགས་ཉན་ནི། ལྷག་ནི། སླབ་ནི་དང་སྲུང་གསར་རྩོམ་འབད་དེ་བྲི་ཚུགས།

༣ སྲུང་། གཏམ་བརྒྱུད། ལོ་རྒྱུས་ཚུ་ལུ་གཞི་བཅོལ་ཏེ་ འཁྲབ་སྲུང་རེ་གསར་གཏོད་འབད་དེ་བྲི་ཚུགས།

༤ གནའ་དེང་དང་འབྲེལ་བའི་དུས་ཐུང་གློག་བརྙན་བཟོ་སྐྲུན་འབད་དེ་སྟོན་ཚུགས།

༥ ཁ་བཤད་རྩང་མོ་བློ་ཟེ་ཚུ་འཐེན་སྒྱུར་དང་ དཔེ་དོན་སྦྱར་ཏེ་གསར་རྩོམ་འབད་དེ་བྲི་ཚུགས།

༦ འབྲི་རྩོམ་གྱི་ཁྱད་ཆོས་ཚང་བའི་ཐོག་ལས་ ལུང་རིགས་ཚུ་དྲངས་ཏེ་འབྲི་རྩོམ་བྲི་ཚུགས།

༧ ཚོགས་བཤད་ཀྱི་ཐབས་རིག་ཚུ་ཐོབ་སྟེ་ མི་མང་གི་སྤྲུག་ལུ་ གསལ་བཤད་གཏང་ཚུགས།

སློབ་སྦྱོང་དང་སློབ་སྟོན་ཐབས་ལམ།

དབྱེ་བ།	ཐབས་ལམ།	བདུན་ཕྲག་གཅིག་ནང་ཆུ་ཚོད།	སྦྱོང་འཐུས་ཆུ་ཚོད།
དངོས་འབྲེལ།	གསལ་བཤད།	༢	༦༠
	སྦྱོང་ལྟ།	༡	
	སྤྱན་ཞུ།	༡	
རང་སྦྱོང་།	ལས་འགུལ།	༢	༦༠
	དཔེ་མཛོད།	༢	
སྦྱོང་ཚན་འདིའི་དོན་ལུ་ཡོངས་སྡོམ་ཆུ་ཚོད།		༤	༡༢༠

དབྱེ་ཞིབ་ཐབས་ལམ།

སྦྱོན་ཚན་འདིའི་དོན་ལུ་ དུས་རྒྱུན་དབྱེ་ཞིབ་ཀྱི་ཐོག་ལས་འབད་དགོཔ་ཨིན།

ཀ དུས་རྒྱུན་དབྱེ་ཞིབ་དང་པ། སྲུང་ཐུང་བྲི་ནི། ངོ་རྐྱང་ལས་འགུལ། (༢༠%)

ཁ་རྒྱུན་གྱི་སྲུང་དང་རྟོག་བཟོའི་སྲུང་ གང་རུང་གི་ཁྱད་ཆོས་ཚང་བའི་ཐོག་ལས་ ཚིག་འབྲུ་ ༥༠༠ ལས་ ༡༠༠༠ གི་བར་ན་ སྲུང་ཐུང་བྲི་དགོ། ཁ་རྒྱུན་གྱི་སྲུང་དང་རྟོག་བཟོའི་སྲུང་ ག་ཅི་ར་འབྲི་རུང་ སྲུང་གི་འབྱུང་རིམ། གནས་དུས། མི་སྣ། རྙོགས་གཞི། ཞི་ཐབས། མཐའ་འབྲས་སོགས་ཀྱི་ཁྱད་ཆོས་ཚང་དགོ། སྲུང་དེ་ཡང་ སྲུང་རིང་། སྲུང་འབྲིང་། སྲུང་ཐུང་གསུམ་ལས་ སྲུང་ཐུང་གདམ་སྟེ་ ཚིག་ལྷུག་པའི་ཐོག་ལས་བྲི་དགོ། འོག་གི་ཚད་གཞི་དང་འཁྲིལ་ཏེ་ སྐུགས་བྱིན་ནི་ཨིན། དབྱེ་ཞིབ་འདི་ལུ་བརྟེན་ སྤྱིར་བཏང་སྲུང་གི་གནད་ཁུངས་སྐོར་ལས། སྲུང་གི་ཁྱད་ཆོས་དང་དབྱེ་བ། སྲུང་གི་བརྗོད་གཞི་ཚུའི་སྐོར་དང་ རྟོག་བཟོའི་སྲུང་རེ་གསར་རྩོམ་འབད་དེ་ བྲི་ཚུགས།

ཁ འཁྲབ་སྲུང་བྲི་ནི། སྡེ་ཚན་ལས་འགུལ། (༢༠%)

ཤེས་ཚད་ཀྱི་ཚོགས་གྲྭ།	སྐུགས་ཀྱི་ཚད་གཞི། ༡༠%			
ཤེས་ཚད་ལྟོགས་གྲྭ་ཀྱི་ནང་གསེས།	སྡུང་འགོ་བཙུགས། (༤%)	བརྩོད་དོན། (༦%)	འབྲུང་རིམ། (༦%)	སྡུང་མཇུག་བསྡུ་ཐངས། (༤%)
(མཆོག་གྲུར།)	སྡུང་གི་བརྩོད་དོན་འདི་གསལ་རིལ་རི་སྦེ་ ཏ་ཡོ་ཚུགསལ་སྦེ་བྱེས་ཏེ་འདུག། (༤)	སྡུང་གི་འགོ་བཙུད་འབྱི་ཐབས་འདི་ གནམ་མེད་ས་མེད་སྤྱོ་བ་ཆེ་ ཏོག་ཏོ་སྦེ་བྱེས་ནུག། (༥)	སྡུང་གི་རིག་སྟེབས་དང་འཁེལ་ཏེ་ འབྲུང་རིམ་ཚུའི་ཡོ་རིམ་ཞིབ་ཐང་ སྦེ་བཟོད་སྤྲིག་འབད་ནུག། (༥)	སྡུང་གི་བཅུད་དོན་ཚུ་བཏོན་ཏེ་ ལྷག་མི་ཚུ་ སྤྱོ་བ་ཆེ་ཏོག་ཏོ་སྦེ་འབྲུང་ཚུགས་ པའི་གསར་གཏོད་འབད་དེ་མཇུག་བསྡུ་ནུག། (༤)
(རབ)	སྡུང་གི་བརྩོད་དོན་འདི་དེ་ཅིག་གསལ་རིལ་རི་སྦེ་ ཏ་ཡོ་ཚུགས་པས། (༣)	སྡུང་གི་འགོ་བཙུགས་འབྱི་ཐབས་འདི་ སྤྱོ་བའི་ཚོར་སྣང་ཙི་ཅི་རེ་འབྲུང་ཚུའབྱེས་སྦེ་བྱེས་ནུག། (༥)	སྡུང་དང་འཁེལ་ཏེ་ འབྲུང་རིམ་ཚུའི་ཡོ་རིམ་ཞིབ་པར་ སྦེ་ཡོད་རུང་ གཅིག་དེ་ཅིག་འཕོལ་ཏེ་འདུག། (༥)	སྡུང་མཇུག་བསྡུ་འདི་བཙུད་དོན་ ཚུ་བཏོན་ཏེ་ཡོད་རུང་ལྷག་མི་ཚུ་ སྤྱོ་བའི་དོན་ལུ་ གསར་གཏོད་ཆེན་མོ་ཅིག་མིན་འདུག། (༣)
(འཕྲིང་)	སྡུང་གི་དོན་ཚན་དང་འཁེལ་བའི་ བརྩོད་དོན་གསལ་རིལ་རི་མིན་འདུག། (༢)	སྡུང་གི་འགོ་བཙུགས་འབྱི་ཐབས་འདི་ སྤྱོ་བ་ཡོད་པ་སྦེ་མ་བྱེས་ བས། (༤)	ང་དང་འཁེལཁ་དང་འབྲུང་རིམ་ཚུའི་ གོ་རིམ་བཟོད་ཐབས་ཚུ་ཙ་ཅི་ཅི་ཅིག་མི་བཏུབ་པས། (༤)	སྡུང་མཇུག་བསྡུ་འདི་ལྷག་མི་ཚུ་ སྤྱོ་བ་བྱུང་ཡོད་རུང་ སྡུང་གི་བཅུད་དོན་འདི་གསལ་ རིལ་རི་སྦེ་བཟོད་དེ་མིན་འདུག། (༢)
(ཐ)	སྡུང་གི་བརྩོད་དོན་འདི་གཅི་ཙི་ཞིན་ན། ཏ་ར་གོ་མི་ཚུགས་པས། (༡)	སྡུང་གི་འགོ་བཙུད་འབྱི་ཐབས་ འདི་དང་འདི་ཟེར་ཏ་མི་གོ་ བས། (༣)	སྡུང་གི་འབྲུང་རིམ་ཚུ་ སྡུང་དང་འཁྲིལ་བའི་གོ་རིམ་ཚུ་ མང་ཉོས་ཅིག་གོང་འོག་ནོར་ཏེ་ཐེ་ སཔ། (༣)	སྡུང་མཇུག་བསྡུ་ཐངས་ཀྱི་དམི་ གསལ་རིལ་རི་སྦེ་ བཏོན་ཏེ་ཐེ་ཟེར་ཐེ་ཐེ་ ཐེག་གཏོང་ཐབས་ཀྱི་ཐེ་ཐེ་ ཐེ་ཐེ་ཐེ་

སྐུགས་བྱིན་ནི་ཡིན། དབྱེ་ཞིབ་འདི་གིས་ སྤྱིར་བཏང་འཁྲབ་སྲུང་གི་རྒྱབ་ཁུངས་སྐོར་ལས། འཁྲབ་སྲུང་གི་ཁྱད་ཆོས་ངོས་འཛིན་འབད་ནི། གནའ་དེང་འཁྲབ་སྲུང་གི་བརྗོད་གཞིའི་སྐོར་ལས་དང་ ཁྱད་རྣམ་ཚང་བའི་འཁྲབ་སྲུང་རེ་ རྩོམ་བྲིས་འབད་དེ་བྲི་ཚུགས།

སྐུགས་ཀྱི་ཚད་གཞི། (༢༠%)								
ཤེས་ཚད་ཀྱི་ལྟོགས་གྲུབ།	ཟིན་བྲིས་དང་པ། (༡༠%)				མཐའ་དཔྱད་དབྱེ་ཞིབ། (༡༠%)			
ཤེས་ཚད་ལྟོགས་གྲུབ་ཀྱི་ནང་གསེས།	འགོ་བཙུགས་དང་མཇུག་བསྡུ་འབྲི་ཐངས། (༢%)	བརྗོད་གཞི། (༣%)	མཐོང་སྣང་། (༢%)	རྟོག་གཞི་དང་ཞི་ཐབས། (༣%)	འགོ་བཙུགས་དང་མཇུག་བསྡུ་འབྲི་ཐངས། (༢%)	བརྗོད་གཞི། (༣%)	མཐོང་སྣང་། (༢%)	རྟོག་གཞི་དང་ཞི་ཐབས། (༣%)
(མཆོག་གྱུར།)	དོན་ཚན་དང་འཁྲིལ་དཔྱེ་གཏམ་ལུང་རིཊ་ཚུ་དྲངས་ཏེ་འཁྲབ་སྲུང་གི་བརྗོད་དོན་འདི་ཧ་གོཕ་ཚུཊཔ་སྤེ་བྲིས་ཏེ་འདུག། (༢)	འཁྲབ་སྲུང་གི་འགོ་བཙུཊ་འབྲི་ཐངས་འདི་གནམ་མེད་ས་མེད་སྤྲོ་བ་ཆེ་ཏོག་ཏོ་སྤེ་བྲིས་ནུག། (༣)	འཁྲབ་སྲུང་གི་མཐོང་སྣང་དང་འབྱུང་རིམ་ཚུའི་རིམ་སྒྲིག་ཚུ་ལེཊ་ཤོམ་སྤེ་བྲིས་ནུག། (༢)	འཁྲབ་སྲུང་གི་རྟོགས་གཞི་ཆེ་ཆུང་ག་དེ་སྤེ་ཡོད་རུང་དཀའ་རྟོཊ་ཚུ་ཧ་གོ་སྟེ་དེ་འབྲེལ་གྱི་ཐབས་རིག་བཏོན་ཏེ་འཇམ་ཏོང་ཏོ་སྤེ་ཞི་ཐབས་འབད་ནུག། (༣)	དོན་ཚན་དང་འཁྲིལ་དཔྱེ་གཏམ་ལུང་རིཊ་ཚུ་དྲངས་ཏེ་འཁྲབ་སྲུང་གི་བརྗོད་དོན་འདི་ཧ་གོཕ་ཚུཊཔ་སྤེ་བྲིས་ཏེ་འདུག། (༢)	འཁྲབ་སྲུང་གི་འགོ་བཙུཊ་འབྲི་ཐངས་འདི་གནམ་མེད་ས་མེད་སྤྲོ་བ་ཆེ་ཏོག་ཏོ་སྤེ་བྲིས་ནུག། (༣)	འཁྲབ་སྲུང་གི་མཐོང་སྣང་དང་འབྱུང་རིམ་ཚུའི་རིམ་སྒྲིག་ཚུ་ལེཊ་ཤོམ་སྤེ་བྲིས་ནུག། (༢)	འཁྲབ་སྲུང་གི་རྟོགས་གཞི་ཆེ་ཆུང་ག་དེ་སྤེ་ཡོད་རུང་དཀའ་རྟོཊ་ཚུ་ཧ་གོ་སྟེ་དེ་འབྲེལ་གྱི་ཐབས་རིག་བཏོན་ཏེ་འཇམ་ཏོང་ཏོ་སྤེ་ཞི་ཐབས་འབད་ནུག། (༣)
(རབ)	འཁྲབ་སྲུང་གི་འགོ་བཙུགས་འབྲི་ཐངས་འདི་སྤྲོ་བ་ཡོདཔ་སྤེ་མ་བྲིས་བས། (༡.༥)	འཁྲབ་སྲུང་གི་དོན་ཚན་དང་འཁྲིལ་བའི་བརྗོད་དོན་གསལ་རིལ་རི་མིན་འདུག།	འཁྲབ་སྲུང་གི་མཐོང་སྣང་དང་འབྱུང་རིམ་བཀོད་ཐངས་ཚུ་ཨ་ཙི་ཅིག་མི་བཏུབ་པས། (༡.༥)	རྟོཊ་གཞི་ཆུང་ཀུ་ཅིག་ལས་མེད་རུང་དེ་འབྲེལ་གྱི་དཀའ་ངལ་སེལ་ནི་ལུ་ཨ་ཙི་ཅིག་	འཁྲབ་སྲུང་གི་འགོ་བཙུགས་འབྲི་ཐངས་འདི་སྤྲོ་བ་ཡོདཔ་སྤེ་མ་བྲིས་བས། (༡.༥)	འཁྲབ་སྲུང་གི་དོན་ཚན་དང་འཁྲིལ་བའི་བརྗོད་དོན་གསལ་རིལ་རི་མིན་འདུག།	འཁྲབ་སྲུང་གི་མཐོང་སྣང་དང་འབྱུང་རིམ་བཀོད་ཐངས་ཚུ་ཨ་ཙི་ཅིག་མི་བ	རྟོཊ་གཞི་ཆུང་ཀུ་ཅིག་ལས་མེད་རུང་དེ་འབྲེལ་གྱི་དཀའ་ངལ་སེལ་ནི་ལུ་ཨ་ཙི་ཅིག་ལྟ་

		(༢.༥)		ལྷ་ཁག་བཏང་ནུག། (༢.༥)		(༢.༥)	ཏུབ་པས། (༡.༥)	ཁག་བཏང་ནུག། (༢.༥)
(འབྲིང་།)	འཁྲབ་སྲུང་གི་འགོ་བཙུཊ་འབྲི་ཐངས་འདི་དང་འདི་ཟེར་ཧ་མི་གོ་བས། (༡)	འཁྲབ་སྲུང་གི་བརྗོད་དོན་འདི་ག་ཅི་ཡིན་ན། ཧ་ར་གོ་མི་ཚུགས་པས། (༢)	འཁྲབ་སྲུང་གི་མཐོང་སྣང་དང་འབྱུང་རིམ་ཚུ་མང་ཤོས་ཅིག་མི་བཏུབ་པས། (༡)	རྙོཊ་གཞི་ཆུང་ཀུ་ཅིག་ལས་མེད་རུང་དེ་འབྲེལ་གྱི་དཀའ་ངལ་སེལ་ནི་ལུ་གནམ་མེད་ས་མེད་ལྷ་ཁག་བཏང་ནུག། (༢)	འཁྲབ་སྲུང་གི་འགོ་བཙུཊ་འབྲི་ཐངས་འདི་དང་འདི་ཟེར་ཧ་མི་གོ་བས། (༡)	འཁྲབ་སྲུང་གི་བརྗོད་དོན་འདི་ག་ཅི་ཡིན་ན། ཧ་ར་གོ་མི་ཚུགས་པས། (༢)	འཁྲབ་སྲུང་གི་མཐོང་སྣང་དང་འབྱུང་རིམ་ཚུ་མང་ཤོས་ཅིག་མི་བཏུབ་པས། (༡)	རྙོཊ་གཞི་ཆུང་ཀུ་ཅིག་ལས་མེད་རུང་དེ་འབྲེལ་གྱི་དཀའ་ངལ་སེལ་ནི་ལུ་གནམ་མེད་ས་མེད་ལྷ་ཁག་བཏང་ནུག། (༢)
(ཐ)	འཁྲབ་སྲུང་གི་འགོ་བཙུགས་འབྲི་ཐངས་ར་མིན་འདུག། (.༥)	འཁྲབ་སྲུང་གི་བརྗོད་དོན་འདི་དང་འདི་ཟེར་བའི་ག་ནི་ཡང་སྟོན་ནི་མིན་འདུག། (༡.༥)	མཐོང་སྣང་དང་འབྱུང་རིམ་ཚུ་གོ་རིམ་སྤེ་མེན་པར་ག་འཐོབ་རྒྱབ་སྟེ་བྲིས་ནུག། (.༥)	འཁྲབ་སྲུང་གི་རྙོཊ་གཞི་དང་འཁྲིལ་ཏེ་དཀའ་ངལ་ཞི་ཐབས་ཀྱི་དོན་ལུ་འདི་དང་འདི་ཟེར་ཞ་ག་ནི་ཡང་བཀོད་དེ་མིན་འདུག། (༡.༥)	འཁྲབ་སྲུང་གི་འགོ་བཙུགས་འབྲི་ཐངས་ར་མིན་འདུག། (.༥)	འཁྲབ་སྲུང་གི་བརྗོད་དོན་འདི་དང་འདི་ཟེར་བའི་ག་ནི་ཡང་སྟོན་ནི་མིན་འདུག། (༡.༥)	མཐོང་སྣང་དང་འབྱུང་རིམ་ཚུ་གོ་རིམ་སྤེ་མེན་པར་ག་འཐོབ་རྒྱབ་སྟེ་བྲིས་ནུག། (.༥)	འཁྲབ་སྲུང་གི་རྙོཊ་གཞི་དང་འཁྲིལ་ཏེ་དཀའ་ངལ་ཞི་ཐབས་ཀྱི་དོན་ལུ་འདི་དང་འདི་ཟེར་ཞ་ག་ནི་ཡང་བཀོད་དེ་མིན་འདུག། (༡.༥)

ག དུས་ཐུང་གློག་བརྙན་བཟོ་སྐྲུན་འབད་ནི། སྡེ་ཚན་ལས་འགུལ། (༢༠%)

སློབ་ཁང་གི་སློབ་ཕྲུག་མང་ཉུང་དང་འཁྲིལ་ཏེ་ སྡེ་ཚན་བཟོ་ཐོག་ལས་ དུས་ཐུང་གློག་བརྙན་གྱི་བརྗོད་བྱ་གནའ་དེང་གང་རུང་ཅིག་ལུ་གཞི་བཞག་སྟེ་ དུས་ཡུན་སྐར་མ་ ༥ གི་དོན་ལུ་ དུས་ཐུང་གློག་བརྙན་བཟོ་སྐྲུན་འབད་དེ་སྤྱན་འབུལ་ཕུལ་དགོཔ་ཡིན། འཁྲུལ་ཆས་འདི་ འགྲུལ་འཕྲིན་པར་ཆས་ ལག་ལེན་འཐབ་སྟེ་བཟོ་ནི་ཡིན། དེ་ནང་ལུ་ གཞུང་སྐད་རྗོང་ཁ་ལུ་ གཞན་གྱི་ཁ་སྐད་ལྷད་ཞུགས་མེད་པའི་བློ་ཚིག་ཚུ་འོང་དགོ། གློག་བརྙན་གྱི་བློ་ཚིག་ནང་ལུ་ སྒྲ་གཏམ། སྐོར་གཏམ། དཔྱེ་གཏམ།

ལུང་དྲངས་ཚུ་དགོ། དུས་ཐུང་གི་གློག་བརྙན་ཅིག་ཨིན་རུང་ འདི་ནང་འཁྲབ་རྩེདཔ་གཙོ་བོ་དང་ཡན་ལག། མཐོང་སྣང་། གནས་དུས། རྟོགས་གཞི། ཞི་ཐབས། མཐའ་འབྲས་ཚུ་ ཚང་བའི་གློག་བརྙན་ཅིག་འོང་དགོ། འདི་ནང་དབྱེ་ཞིབ་ཚར་གཉིས་འབད་ནི་ཨིན། ཟིན་བྲིས་དང་པ་དང་ མཐའ་དཔྱད་དབྱེ་ཞིབ་འདི་ འོག་གི་ཚད་གཞི་དང་འཁྲིལ་ཏེ་ སྐུགས་བྱིན་ནི་ཨིན། དབྱེ་ཞིབ་འདི་ལུ་བརྟེན་ སྤྱིར་བཏང་གློག་བརྙན་གྱི་དགོས་ཁུངས་དང་ཁྱད་ཆོས། གློག་བརྙན་གྱི་དབྱེ་བ་ཚུ་ འབྲི་སླབ་འབད་ཚུགས། གློག་བརྙན་གྱིས་མི་སྡེ་ལུ་ཕན་གནོད་དང་ གདོང་ལེན་གྱི་སྐོར་ལས་འཚོལ་ཞིབ་འབད་ནི། བརྗོད་གཞི་གནའ་དེང་གང་རུང་ཅིག་ལུ་གཞི་རྟེན་འབད་དེ་ དུས་ཐུང་གློག་བརྙན་གསར་སྐྲུན་འབད་དེ་ སྤྱན་འབུལ་ཕུལ་ཚུགས།

སྐུགས་ཀྱི་ཚད་གཞི། (༢༠%)								
ཤེས་ཚད་ཀྱི་ལྟོ་གས་གྲུབ།	**ཟིན་བྲིས་དང་པ།** (༡༠%)				**མཐའ་དཔྱད་དབྱེ་ཞིབ།** (༡༠%)			
ཤེས་ཚད་ལྟོགས་གྲུབ་ཀྱི་ནང་གསེས།	**གློག་བརྙན་གྱི་བརྗོད་དོན།** (༣%)	**མཐོང་སྣང་།** (༢%)	**འཁྲབ་རྩེདཔ།** (༣%)	**བློ་ཚིག་དང་རྒྱབ་རྟེན་སྙན་ཆ།** (༢%)	**གློག་བརྙན་གྱི་བརྗོད་དོན།** (༣%)	**མཐོང་སྣང་།** (༢%)	**འཁྲབ་རྩེདཔ།** (༣%)	**བློ་ཚིག་དང་རྒྱབ་རྟེན་སྙན་ཆ།** (༢%)
(མཆོག་གྱུར།)	གློག་བརྙན་འདི་གནའ་དེང་གི་དུས་དང་འཁྲིལ་བའི་གནད་དོན་གུར་གཞི་བཅོལ་ཏེ་ བརྗོད་བྱའི་དོན་ཚུ་ གསལ་རིལ་རི་སྤེ་སྟོནམ་མས། (༣)	སྲུང་གི་མཐོང་སྣང་དང་འཁྲིལ་ཏེ་ པར་ཆས་ཚུ་ རྩེ་ཕུད་ཕྱིན་པ་སྤེ་ལག་ལེན་འཐབ་ནུག། (༢)	འཁྲབ་རྩེདཔ་ཚུ་གིས་ངལ་རངས་དང་སྤྲོ་བ་ཆེ་ཏོག་ཏོ་སྤེ་འཐུས་ཤོར་མེད་པར་འཁྲབ་སྟོན་འབད་ཡི། (༣)	བློ་ཚིག་སླབ་ནི་ལུ་ ཁ་བདེ་ལྕེ་བདེ་དྲག་དང་། སྲུང་གི་མཐོང་སྣང་དང་འཁྲིལ་ཏེ་ རྒྱབ་རྟེན་གྱི་སྙན་ཆ་ཡང་ཕོག་པ་སྤེ་འབྲེལ་མཐུད་འབད་དེ་འདུག། (༢)	གློག་བརྙན་འདི་གནའ་དེང་གི་དུས་དང་འཁྲིལ་བའི་གནད་དོན་གུར་གཞི་བཅོལ་ཏེ་ བརྗོད་བྱའི་དོན་ཚུ་ གསལ་རིལ་རི་སྤེ་སྟོནམ་མས། (༣)	སྲུང་གི་མཐོང་སྣང་དང་འཁྲིལ་ཏེ་ པར་ཆས་ཚུ་ རྩེ་ཕུད་ཕྱིན་པ་སྤེ་ལག་ལེན་འཐབ་ནུག། (༢)	འཁྲབ་རྩེདཔ་ཚུ་གིས་ངལ་རངས་དང་སྤྲོ་བ་ཆེ་ཏོག་ཏོ་སྤེ་འཐུས་ཤོར་མེད་པར་འཁྲབ་སྟོན་འབད། (༣)	བློ་ཚིག་སླབ་ནི་ལུ་ ཁ་བདེ་ལྕེ་བདེ་དྲག་དང་། སྲུང་གི་མཐོང་སྣང་དང་འཁྲིལ་ཏེ་ རྒྱབ་རྟེན་གྱི་སྙན་ཆ་ཡང་ཕོག་པ་སྤེ་འབྲེལ་མཐུད་འབད་དེ་འདུག། (༢)
(རབ)	གློག་བརྙན་འདི་གནའ་དེང་གི་དུས་དང་འཁྲིལ་བའི་གནད་དོན་གུར་གཞི་བཅོལ་ཏེ་ཡོད་རུང་ བརྗོད་བྱའི་དོན་ཨ་ཙི་ཅིག་གས	སྲུང་གི་མཐོང་སྣང་དང་འཁྲིལ་ཏེ་ པར་ཆས་ཚུ་རབ་སྤེ་ལག་ལེན་འཐབ་ནུག། (༡.༥)	འཁྲབ་རྩེདཔ་གཙོ་བོ་གིས་སྤྲོ་བ་ཆེ་ཏོག་ཏོ་འཁྲབ་ཡོད་རུང་ འཁྲབ་རྩེདཔ་༡གིས་འཐུས་ཤོར་བྱུང་ཡི། (༢.༥)	བློ་ཚིག་སླབ་ནི་ལུ་ ཨ་ཙི་རེ་ཁ་དིག་ནི་དང་ སྲུང་གི་མཐོང་སྣང་དང་འཁྲིལ་ཏེ་ རྒྱབ་རྟེན་གྱི་སྙ	གློག་བརྙན་འདི་གནའ་དེང་གི་དུས་དང་འཁྲིལ་བའི་གནད་དོན་གུར་གཞི་བཅོལ་ཏེ་ ཡོད་རུང་ བརྗོད་བྱའི་དོན་ཨ་ཙི་ཅིག་གས	སྲུང་གི་མཐོང་སྣང་དང་འཁྲིལ་ཏེ་ པར་ཆས་ཚུ་ རབ་སྤེ་ལག་ལེན་འཐབ་ནུག། (༡.༥)	འཁྲབ་རྩེདཔ་གཙོ་བོ་གིས་སྤྲོ་བ་ཆེ་ཏོག་ཏོ་འཁྲབ་ཡོད་རུང་ འཁྲབ་རྩེདཔ་༡གིས་འཐུ	བློ་ཚིག་སླབ་ནི་ལུ་ ཨ་ཙི་རེ་ཁ་དིག་ནི་དང་ སྲུང་གི་མཐོང་སྣང་དང་འཁྲིལ་ཏེ་ རྒྱབ་རྟེན་གྱི་སྙ

	ལ་ཆ་སྦེ་མིན་འདུག། (༢.༥)			ན་ཆ་གཅིག་འབྲེལ་མཐུད་མིན་འདུག། (༡.༥)	ལ་ཆ་སྦེ་མིན་འདུག།(༢.༥)		ས་ཤོར་བྱུང་ཡི། (༢.༥)	ན་ཆ་གཅིག་འབྲེལ་མཐུད་མིན་འདུག། (༡.༥)
(འབྲིང་།)	གློག་བརྙན་འདི་གནའ་དེང་གི་དུས་བསྟུན་གནད་དོན་གུར་ཡོད་རུང་བརྗོད་བྱའི་དོན་ག་ཅི་ཞིན་ན། ཧ་གོ་མི་ཚུགས་པས། (༢)	པར་ཆས་ཚུ་སྲུང་གི་མཐོང་སྣང་དང་འཁྲིལ་ཏེ་ལག་ལེན་འཐབ་སྟེ་མིན་འདུག། (༡)	འཁྲབ་རྩེདཔ་གཙོ་བོ་དང་འཁྲབ་རྩེདཔ་གསུམ་གྱིས་འཐུས་ཤོར་ཡི། (༢)	བློ་ཚིག་ལེཊ་ཤོམ་སྦེ་སླབ་མ་ཚུཊ་ཁར་སྲུང་གི་མཐོང་སྣང་དང་འཁྲིལ་ཏེ་རྒྱབ་རྟེན་གྱི་སྙན་ཆ་གསུམ་འབྲེལ་མཐུད་མིན་འདུག། (༡)	གློག་བརྙན་འདི་གནའ་དེང་གི་དུས་བསྟུན་གནད་དོན་གུར་ཡོད་རུང་བརྗོད་བྱའི་དོན་ག་ཅི་ཞིན་ན། ཧ་གོ་མི་ཚུགས་པས། (༢)	པར་ཆས་ཚུ་སྲུང་གི་མཐོང་སྣང་དང་འཁྲིལ་ཏེ་ལག་ལེན་འཐབ་སྟེ་མིན་འདུག། (༡)	འཁྲབ་རྩེདཔ་གཙོ་བོ་དང་འཁྲབ་རྩེདཔ་གསུམ་གྱིས་འཐུས་ཤོར་ཡི། (༢)	བློ་ཚིག་ལེཊ་ཤོམ་སྦེ་སླབ་མ་ཚུཊ་ཁར་སྲུང་གི་མཐོང་སྣང་དང་འཁྲིལ་ཏེ་རྒྱབ་རྟེན་གྱི་སྙན་ཆ་གསུམ་འབྲེལ་མཐུད་མིན་འདུག། (༡)
(ཐ)	གློག་བརྙན་འདི་གནའ་དེང་གི་དུས་བསྟུན་གནད་དོན་གུར་ཡོད་རུང་བརྗོད་བྱའི་དོན་ཟེར་སྟོན་ནི་མིན་འདུག། (༡.༥)	པར་ཆས་ཚུ་སྲུང་གི་མཐོང་སྣང་དང་འཁྲིལ་ཏེ་མེན་པར་ག་འཐོབ་རྒྱབ་སྟེ་ལག་ལེན་འཐབ་ནུག། (.༥)	འཁྲབ་རྩེདཔ་གཙོ་བོ་དང་འཁྲབ་རྩེདཔ་ཡན་ལག་ག་ར་གིས་འཐུས་ཤོར་བྱུང་ཡི། (༡.༥)	བློ་ཚིག་དག་དིག་བཏང་ལེཊ་ཤོམ་སྦེ་སླབ་མ་ཚུཊ་ཁར་སྲུང་གི་མཐོང་སྣང་དང་འཁྲིལ་ཏེ་རྒྱབ་རྟེན་གྱི་སྙན་ཆ་གཅིག་ཡང་འབྲེལ་མཐུད་མིན་འདུག། (.༥)	གློག་བརྙན་འདི་གནའ་དེང་གི་དུས་བསྟུན་གནད་དོན་གུར་ཡོད་རུང་བརྗོད་བྱའི་དོན་ཟེར་སྟོན་ནི་མིན་འདུག། (༡.༥)	པར་ཆས་ཚུ་སྲུང་གི་མཐོང་སྣང་དང་འཁྲིལ་ཏེ་མེན་པར་ག་འཐོབ་རྒྱབ་སྟེ་ལག་ལེན་འཐབ་ནུག། (.༥)	འཁྲབ་རྩེདཔ་གཙོ་བོ་དང་འཁྲབ་རྩེདཔ་ཡན་ལག་ག་ར་གིས་འཐུས་ཤོར་བྱུང་ཡི། (༡.༥)	བློ་ཚིག་དག་དིག་བཏང་ལེཊ་ཤོམ་སྦེ་སླབ་མ་ཚུཊ་ཁར་སྲུང་གི་མཐོང་སྣང་དང་འཁྲིལ་ཏེ་རྒྱབ་རྟེན་གྱི་སྙན་ཆ་གཅིག་ཡང་འབྲེལ་མཐུད་མིན་འདུག། (.༥)

ང ཁ་བཤད་བྲི་ནི། ངོ་རྒྱང་ལས་འགུལ། (༡༥%)

ཁ་བཤད་འདི་ རང་སོའི་གཡུས་སྒོ་ནང་ དར་ཁྱབ་ཡོད་པའི་ཁ་བཤད་དང་། ཡང་ན་ སློབ་གྲྭའི་ཉེ་འདབས་ཀྱི་གཡུས་སྒོ་ཚུ་ནང་སོང་སྟེ་ ལས་རིམ་ག་ཅི་བཟུམ་ནང་ལུ་ ཁ་བཤད་རྒྱབ་སྲོལ་འདུག་ག། ཁ་བཤད་ཀྱི་དགོས་ཁུངས་དང་བཅས་ ཞིབ་འཚོལ་འབད་དེ་ ཁ་བཤད་ཀྱི་ནང་ལུ་ བཅད་ལྷུག་སྤེལ་མའི་རང་བཞིན་དང་བསྟུན་ ངོ་རྒྱང་གི་ལས་འགུལ་ ཚིག་འབྲུ་ ༥༠༠ ལས་ ༡༠༠༠ གི་བར་ན་འབད་མི་ ཁ་བཤད་ཅིག་བྲི་ནི་ཞིན། འབྲུག་པའི་ལམ་སྲོལ་ནང་ཡོད་པའི་ཁ་བཤད་ཀྱི་རིགས་ ག་ཅི་བཟུམ་ཡོད་རུང་རྗོང་ཁ་ནང་སྐད་སྒྱུར་འབད་དེ་ བྲི་ཆོག། འོག་གི་ཚད་གཞི་ཚུ་ ལག་ལེན་འཐབ་སྟེ་ སྐུགས་བྱིན་ནི་ཞིན། དབྱེ་ཞིབ་འདི་གིས་

ཁ་བཤད་ཀྱི་སྐོར་ལས་ འཛོལ་ཞིབ་འབད་དེ་ ཁ་བཤད་ཆུབ་ནི་དང་ ཚང་མོ་བློ་ཟེ་ཚུ་འཐེན་སྤྱུར་དང་ དེའི་དོན་སྤྱར་ཏེ་ ཐག་རྟོགས་སྐན་རྩོམ་རེ་ རང་སྤྱོབས་ཀྱི་ཆོག་གསར་རྩོམ་འབད་དེ་ བྱེ་ཚུགས།

ཤེས་ཚད་ཀྱི་ལྟོག་ས་སྤྱབ།	སྤྱགས་ཀྱི་ཚད་གཞི། (༧༥%)			
ཤེས་ཚད་ལྟོགས་སྤྱབ་ཀྱི་ནང་གསེས།	བརྗོད་དོན།(༦%)	གཅོད་མཚམས། (༣%)	སྐན་ཆོག (༩%)	འཛེལ་གཏུགས། (༣%)
(མཆོག་སྤྱར།)	ཁ་བཤད་ཀྱི་ཡུལ་དུས་གནས་ལུང་དཔང་བསྟུན་ཏེ་ཁ་བཤད་ཀྱི་གནད་དོན་ཡུན་རིང་ཐུང་སུམ་ཆ་ཚང་རྫོགས་ཡོད་མེད་ལ་ལྟ་བ། (༦)	ཁ་བཤད་དང་འཁྲིལ་ཏེ་བཅད་ལྡུག་སྐྱེལ་མ་དང་། ཆོག་མཚམས། བརྗོད་མཚམས། དོན་མཚམས་ཚུ་ཚུལ་མཐུན་སྐྱེ་བྱེས་ནུག། (༣)	ཁ་བཤད་དང་བསྟུན་པའི་མིང་ཆོག་གི་ཐ་སྙད་གསར་པ་དང་སྐད་ཡིག་གི་ཆོག་གཞི་ཕྱན་སུམ་ཆ་ཚོགས་ཏོག་ཏོ་སྐྱེ་བྱེས་ནུག། (༤)	རྒྱབ་རྟེན་ཚུལ་མཐུན་བཟོ་ནུག (༢)
(རབ)	ཁ་བཤད་ཀྱི་ཡུལ་དུས་འཁྲིལ་ཏེ་ཡོད་རུང་གནད་དོན་མ་འཁྲིལ་བའི་ཁ་བཤད་ཚ་ཚེ་རེ་འདུག། (༤)	ཁ་བཤད་དང་འཁྲིལ་བཅད་ལྡུག་སྐྱེལ་མ་སྐྱེ་ཡོད་རུང་། ཆོག་མཆོས་བརྗོད་མཆོས། དོན་མཆོས་ཚུ་ཚ་ཚེ་རེ་ཚུལ་མཐུན་མེན་ནུག། (༢.༤)	ཁ་བཤད་ཀྱི་མིང་ཆོག་གི་ཐ་སྙད་གསར་པ་ཡོད་རུང་སྐད་ཡིག་གི་ཆོག་གཞི་དེ་ཅིག་ཐུན་སུམ་ཆོད་ཏོག་ཏོ་མེན་འདུག། (༩.༤)	རྒྱབ་རྟེན་ཚུལ་མཐུན་རབ་སྐྱེ་བཟོད་ནུག (༡.༤)
(འཐིད།)	ཁ་བཤད་འདི་ཡུལ་ཀྱི་གནས་སྐྱངས་འཁྲིལ་རུང་གནད་དོན་ལེ་ཤ་ཅིག་ར་མ་ཚོག་བས། (༩)	བཅད་ལྡུག་སྐྱེལ་མ་དང་ཆོག་མཆོ་བརྗོད་མཚམས། དོན་མཆོས་ག་རའི་ནང་ཚུལ་མཐུན་སྐྱེ་མེན་འདུག། (༢)	ཁ་བཤད་ཀྱི་མིང་ཆོག་གི་ཐ་སྙད་གསར་པ་ཚ་ཚེ་རེ་ཡོད་རུང་སྐད་ཡིག་གི་ཆོག་གཞི་ཡང་རེ་ཅིག་གཞི་མེན་འདུག། (༩)	རྒྱབ་རྟེན་ཚུལ་མཐུན་འཐིད་སྐྱེ་བཟོད་ནུག (༡)
(ཐ)	ཁ་བཤད་འདི་ཡུལ་ཀྱི་གནས་སྐྱངས་དང་འཁྲིལ་རུང་གནད་དོན་གུར་མ་ཚོག་བས། (༣)	བཅད་ལྡུག་སྐྱེལ་མ་དང་ཆོག་མཆོས་ བརྗོད་མཚམས། དོན་མཚམས་ཚུ་འཐེའི་ནེའི་རིག་རྩལ་ར་མེན་འདུག། (༡.༤)	ཁ་བཤད་ཀྱི་མིང་ཆོག་གི་ཐ་སྙད་གསར་པ་ཅིག་མེད་ཁའི་ཁར་ སྐད་ཡིག་གི་ཆོག་གཞི་ཡང་མེན་འདུག། (༣.༤)	རྒྱབ་རྟེན་ཚུལ་མཐུན་ཐ་མ་སྐྱེ་བཟོད་ནུག (.༤)

ཅ འཐེ་རྩོམ་གྱི་ནི། ངོ་ཆུང་ལས་འགུལ། (༧༥%)

ཤེས་ཚད་ཀྱི་ལྟོགས་གྲུབ།	སྐུགས་ཀྱི་ཚད་གཞི། (༡༥%)			
ཤེས་ཚད་ལྟོགས་གྲུབ་ཀྱི་ནང་གསེས།	ངོ་སྤྲོད་དང་མཇུག་བསྡུ།(༣%)	གནད་དོན་དང་འཁྲིལ་ལུང་རིགས། (༦%)	ཡིག་སྦྱོར། (༣%)	གཅོད་མཚམས། (༣%)
(མཆོག་གྱུར།)	དོན་ཚན་གྱི་རྒྱབ་ཁུངས་ངོ་སྤྲོད་དང་དགག་སྒྲུབ་ཀྱི་བཅུད་དོན་བཏོན་ཏེ་མཇུག་བསྡུ་ཐངས་ཚུ་མཆོག་གྱུར་སྤེ་བཀོད་ནུག། (༣)	འབྲི་རྩོམ་འདི་ དོན་ཚན་དང་འཁྲིལ་དོན་མཚམས་རེའི་ཁུངས་གཟང་ཡོད་པ་མ་ཚད་ དཔེ་གཏམ་ལུང་རིཊ་ལྔ་ལས་ལྷག་བཀོད་དེ་ཡིད་ཆེས་འདྲོངས་མ་སྤེ་བྲིས་ནུག། (༦)	ཡི་གུའི་སྦྱོར་བ་ཚུ་འཛོལ་ཞ་མེད་པར་བྲིས་ནུག། (༣)	ཚིག་མཚམས། བརྗོད་མཚམས། དོན་མཚམས་ཚུ་བཞག་སྟེ་ཚུལ་མཐུན་ཏོག་ཏོ་སྤེ་བྲིས་ནུག། (༣)
(རབ)	དོན་ཚན་གྱི་རྒྱབ་ཁུངས་ངོ་སྤྲོད་དང་དགག་སྒྲུབ་བཅུད་བཏོན་ཏེ་མཇུག་བསྡུ་ཐངས་ཚུ་རབ་གྲལ་སྤེ་བཀོད་ནུག། (༢.༥)	འབྲི་རྩོམ་འདི་ དོན་ཚན་དང་འཁྲིལ་དོན་མཚམས་རེའི་ཁུངས་གཟང་ཡོད་པ་མ་ཚད་ དཔེ་གཏམ་ལུང་རིཊ་ཚུ་བཞི་དེ་ཅིག་བཀོད་དེ་ཡིད་ཆེས་འདྲོངས་མ་སྤེ་བྲིས་ནུག། (༥)	ཡི་གུའི་སྦྱོར་བ་ཚུ་ཨ་ཅི་རེ་འཛོལ་ཏེ་བྲིས་ནུག། (༢.༥)	ཚིག་མཚམས། བརྗོད་མཚམས། དོན་མཚམས་ཚུ་ཨ་ཅི་རེ་འཛོལ་ཏེ་ བྲིས་ནུག། (༢.༥)
(འབྲིང་།)	དོན་ཚན་གྱི་རྒྱབ་ཁུངས་ངོ་སྤྲོད་དང་དགག་སྒྲུབ་ཀྱི་བཅུད་དོན་བཏོན་ཏེ་མཇུག་བསྡུ་ཐངས་འབྲིང་ཙམ་འདུག། (༢)	འབྲི་རྩོམ་འདི་ དོན་ཚན་དང་འཁྲིལ་དོན་མཚམས་རེའི་ཁུངས་གཟང་ཡོད་རུང་ དཔེ་གཏམ་ལུང་རིཊ་ཚུ་གསུམ་ལས་བཀོད་དེ་མིན་འདུག། (༩)	ཡི་གུའི་སྦྱོར་བ་ཚུ་ལེ་ཤ་འཛོལ་ཏེ་བྲིས་ནུག། (༢)	ཚིག་མཚམས། བརྗོད་མཚམས། དོན་མཚམས་ཚུ་ལེ་ཤ་འཛོལ་ཏེ་བྲིས་ནུག། (༢)
(ཐ)	དོན་ཚན་གྱི་རྒྱབ་ཁུངས་ངོ་སྤྲོད་དང་དགག་སྒྲུབ་ཀྱི་བཅུད་མཇུག་བསྡུ་ཐངས་ཐ་མ་ལས་མིན་འདུག། (༡.༥)	འབྲི་རྩོམ་འདི་དོན་ཚན་དང་འཁྲིལ་ དོན་མཚམས་རེའི་ཁུངས་ཨ་ཅི་རེ་གཟང་ནུག། དཔེ་གཏམ་ལུང་རིཊ་ཡང་གཅིག་ལས་བཀོད་དེ་མིན་འདུག། (༣)	ཡི་གུའི་སྦྱོར་བ་་ཚུ་ གནམ་མེད་ས་མེད་འཛོལ་ཏེ་བྲིས་ནུག། (༡.༥)	ཚིག་མཚམས། བརྗོད་མཚམས། དོན་མཚམས་ཚུ་ གནམ་མེད་ས་མེད་འཛོལ་ཏེ་ བྲིས་ནུག། (༡.༥)

འབྲི་རྩོམ་གྱི་གནད་དོན་གང་རུང་ཅིག་ལུ་གཞི་བཞག་སྟེ་ འབྲི་རྩོམ་གྱི་ཁྱད་རྣམ་དང་ལྡན་པའི་འབྲི་རྩོམ་ཚིག་འབྲུ་ ༥༠༠ ལས་ ༡༠༠༠ གི་བར་ན་འབད་མི་ འབྲི་རྩོམ་ཅིག་བྲི་དགོ། འབྲི་རྩོམ་ནང་ ལུང་འདྲེན་དང་རྒྱབ་རྟེན་འབད་ཐངས་ཚུ་ ལམ་ལུགས་དང་འཁྲིལ་ཏེ་བཀོད་དགོ། འབྲི་རྩོམ་འདི་ ཤེས་ཡོན་འབྲི་རྩལ་དང་ལྡན་མ་སྤེ་ བྲི་དགོ། འདི་ནང་དབྱེ་ཞིབ་ཚར་གཉིས་འབད་ནི་ཨིན། འོག་གི་ཚད་གཞི་དང་འཁྲིལ་ཏེ་ སྐུགས་བྱིན་ནི་ཨིན། དབྱེ་ཞིབ་འདི་ལས་ སྤྱིར་བཏང་འབྲི་རྩོམ་ཟེར་བའི་སྐོར་ལས། འབྲི་རྩོམ་གྱི་དབྱེ་བ་དང་ འབྲི་རྩོམ་གྱི་ཁྱད་ཆོས་ངོས་འཛིན་འབད་དེ་ ལུང་རིགས་ཚུ་དྲངས་ཏེ་ འབྲི་རྩོམ་བྲི་ཚུགས།

ཆ ཚོགས་བཤད། ངོ་རྐྱང་ལས་འགུལ། (༡༠%)

ཚོགས་བཤད་འདི་ གནད་དོན་གང་རུང་གི་ཐོག་ལས་ སློབ་ཁང་ནང་ལུ་ ཆ་རོགས་དམང་གི་གདོང་ཁར་ཐོན་ཏེ་ དུས་ཡུན་སྐར་མ་ ༥ གི་དོན་ལུ་ ཚོགས་བཤད་ཀྱི་ཁྱད་ཆོས་ཚང་བའི་ཐོག་ལས་གསལ་བཤད་གཏང་དགོཔ་ཨིན། འདི་ལུ་དབྱེ་ཞིབ་ཚར་གཅིག་འབད་ནི་ཨིན། འོག་གི་ཚད་གཞི་ཚུ་ ལག་ལེན་འཐབ་སྟེ་ སྐུགས་བྱིན་ནི་ཨིན། དབྱེ་ཞིབ་འདི་ལུ་བརྟེན་ ཚོགས་བཤད་ཟེར་བའི་དོན་དང་དབྱེ་བ། ལུགས་མཐུན་དང་ལུཊ་ཡངས་ཚོཊ་བཤད་གཉིས་ཀྱི་སྐོར་ འབྲི་སླབ་འབད་ཚུགས། ཚོགས་བཤད་ཀྱི་ཐབས་རིག་འཐོབ་སྟེ་མི་མང་གི་སྦྱུག་ལུ་གསལ་བཤད་གཏང་ཚུགས།

དབྱེ་ཞིབ་ཐབས་ལམ་དང་ལྗིད་ཚད་ཀྱི་བཀོད་རིས།

ཤེས་ཚད་ཀྱི་ལྟོགས་གྲུབ།	སྐུགས་ཀྱི་ཚད་གཞི། (༡༠%)			
ཤེས་ཚད་ལྟོགས་གྲུབ་ཀྱི་ནང་གསེས།	སྐད་ཡིག་དང་རྗོད་སྒྲ། (༣%)	ཐོགས་ཆགས་མེད་པ། (༣%)	སྐད་ཀྱི་སེང་ཕབ། (༢%)	རྣམ་འགྱུར་དང་སྤོབས་པ། (༢%)
(མཆོག་གྱུར།)	དོན་ཚན་དང་འཁྲིལ་ཏེ་སྐད་ཡིག་གི་མིང་ཚིག་ལག་ལེན་དང་རྗོད་སྒྲ་དག་ཏོག་ཏོ་སྦེ་སྤྱན་ཞུ་རྩེ་ཕུད་ཕྱིན་པ། (༣)	གསལ་བཤད་ལྡབ་ལྡིབ་དང་ཐོགས་ཆགས་མེད་པ། (༣)	གསལ་བཤད་ཀྱི་གནད་ཀ་དང་འཁྲིལ་ཏེ་རང་བཞིན་གྱི་སྐད་ཀྱི་སེང་ཕབ་མཆོག་གྱུར། (༢)	གཟུགས་ཀྱི་རྣམ་འགྱུར་དང་བློ་སྤོབས་དཔའ་མ་ཞུམ་མེད་པར་གསལ་བཤད་འབད་ཡོད། (༢)
(རབ)	དོན་ཚན་དང་འཁྲིལ་ཏེ་སྐད་ཡིག་གི་མིང་ཚིག་ལག་ལེན་དང་རྗོད་སྒྲ་དག་ཏོག་ཏོ་སྦེ་སྤྱན་ཞུ་རབ། (༢.༥)	གསལ་བཤད་ལྡབ་ལྡིབ་དང་ཐོགས་ཆགས་ཅུང་ཙམ། (༡.༥)	གསལ་བཤད་ཀྱི་གནད་ཀ་དང་འཁྲིལ་ཏེ་རང་བཞིན་གྱི་སྐད་ཀྱི་སེང་ཕབ་རབ། (༢.༥)	གཟུགས་ཀྱི་རྣམ་འགྱུར་དང་བློ་སྤོབས་་ཞུམ་ཙམ་གྱི་གསལ་བཤད་འབད་ཡོད། (༡.༥)
(འབྲིང་།)	དོན་ཚན་དང་འཁྲིལ་ཏེ་སྐད་ཡིག་གི་མིང་ཚིག་ལག་ལེན་དང་རྗོད་སྒྲ་དག་ཏོག་ཏོ་སྦེ་སྤྱན་ཞུ་འབྲིང་། (༢)	གསལ་བཤད་ལྡབ་ལྡིབ་དང་ཐོགས་ཆགས་ཆེ་བ། (༡)	གསལ་བཤད་ཀྱི་གནད་ཀ་དང་འཁྲིལ་ཏེ་རང་བཞིན་གྱི་སྐད་ཀྱི་སེང་ཕབ་ཡོད་མེད་ཙམ། (༢)	གཟུགས་ཀྱི་རྣམ་འགྱུར་དང་བློ་སྤོབས་གང་རུང་གི་དཔའ་ཞུམ་གྱི་གསལ་བཤད་འབད་ཡོད། (༡)
(ཐ)	དོན་ཚན་དང་འཁྲིལ་ཏེ་སྐད་ཡིག་གི་མིང་ཚིག་ལག་ལེན་དང་རྗོད་སྒྲ་དག་ཏོག་ཏོ་སྦེ་སྤྱན་ཞུ་ཐ་མ། (༡.༥)	གསལ་བཤད་ལྡབ་ལྡིབ་དང་ཐོགས་ཆགས་ཆེས་ཆེ་བ། (.༥)	གསལ་བཤད་ཀྱི་གནད་ཀ་དང་འཁྲིལ་ཏེ་རང་བཞིན་གྱི་སྐད་ཀྱི་སེང་ཕབ་ཐངས་གཅིག། (༡.༥)	གཟུགས་ཀྱི་རྣམ་འགྱུར་དང་བློ་སྤོབས་གཉིས་ཀ་དཔའ་ཞུམ་གྱི་གསལ་བཤད་འབད་ཡོད། (.༥)

ཐབས་ལམ།	དབྱེ་ཞིབ་ཀྱི་དབྱེ་བ།	གྱངས་ཁ།	སྐུགས་ཀྱི་བརྒྱ་ཆ།
དུས་རྒྱུན་དབྱེ་ཞིབ།	ཀ སྲུང་འབྲི་སླབ་ཉན་གསུམ།	༡	༢༠
	ཁ འཁྲབ་སྲུང་བྲི་ནི།	༡	༢༠
	ག ཁ་བཤད་འབྲི་སླབ་ཉན་གསུམ།	༡	༡༥
	ང འབྲི་རྩོམ་བྲི་ནི།	༡	༡༥
	ཅ གློག་ཐུང་བཟོ་སྐྲུན།	༡	༢༠
	ཆ གསལ་བཤད་གཏང་ནི།	༡	༡༠
		ཡོངས་སྡོམ།	༡༠༠

སྔོན་ཚང་། རྫོང་ཁ་ཤེས་ཡོན་འབྲི་རྩལ། LAC101

ནང་དོན།

ལས་ཚན་དང་པ། རྩོམ་རིག།

༡.༡ རྩོམ་རིག་གི་སྤྱི་དོན།

༡.༢ རྩོམ་རིག།

༡.༢.༡ སྤྱིར་བཏང་གི་རྩོམ་རིག།

༡.༢.༢ སྒྱུ་རྩལ་གྱི་རྩོམ་རིག།

༡.༣ རྩོམ་རིག་གི་སྐྱོན་སེལ།

ལས་ཚན་གཉིས་པ། སྲུང་།

༢.༡ སྤྱིར་བཏང་སྲུང་གི་སྤྱི་དོན།

༢.༢ སྲུང་གི་ཁྱད་རྣམ་དང་དབྱེ་བ།

༢.༣ སྲུང་གི་བརྗོད་དོན།

༢.༤ སྲུང་རྩེད་པའི་བཀོད་རིས།

༢.༥ སྲུང་རྩེད་པའི་བྱ་འགུལ།

༢.༦ སྲུང་གི་གནས་སྟངས།

༢.༧ སྲུང་གི་འབྱུང་རིམ།

༢.༨ སྲུང་གསར་རྩོམ།

ལས་ཚན་གསུམ་པ། འཁྲབ་སྲུང་འབྲི་ཐངས།

༣.༡ འཁྲབ་སྲུང་གི་ངོ་སྤྲོད།

༣.༡.༡ བློས་གར་འཁྲབ་སྲུང།

༣.༡.༢ གློག་བརྙན་འཁྲབ་སྲུང་།

༣.༢ གནའ་དེང་འཁྲབ་སྲུང་གི་བརྗོད་གཞི།

༣.༣ འཁྲབ་སྲུང་གི་ཆ་རྐྱེན།

༣.༣.༡ མཐོང་སྣང་འགོ་བརྗོད།

༣.༣.༢ བྱ་འགུལ/མཐོང་སྣང་འགྲེལ་བཤད།

༣.༣.༣ འཁྲབ་རྩེད་པའི་མིང་།

༣.༣.༤ བློ་ཚིག།

༣.༤ འཁྲབ་སྲུང་གསར་རྩོམ།

ལས་ཚན་བཞི་པ། གློག་ཐུང་བཟོ་སྐྲུན།

༤.༡ གློག་བརྙན་གྱི་དགོས་ཁུངས།

༤.༢ གློག་ཐུང་གི་ཁྱད་རྣམ་དང་དབྱེ་བ།

༤.༣ གློག་བརྙན་གྱི་དམིགས་གཏད་དང་མི་སྡེ་ལུ་ཕན་གནོད།

༤.༤ གློག་བརྙན་གྱི་བཀོད་ཤོག་རིམ་སྒྲིག།

༤.༥ གློག་ཐུང་གསར་སྐྲུན།

ལས་ཚན་ལྔ་པ། སྙན་རྩོམ།

༥.༡ སྤྱིར་བཏང་སྙན་རྩོམ་གྱི་ངོ་སྤྲོད།

༥.༢ ཁ་བཤད།

༥.༣ བློ་ཟེ།

༥.༤ རྩང་མོ།

༥.༥ དཔྱེ་གཏམ།

༥.༦ སྙན་རྩོམ་གསར་རྩོམ།

ལས་ཚན་དྲུག་པ། འབྲི་རྩོམ།

༦.༡ འབྲི་རྩོམ་གྱི་ངོ་སྤྲོད།

༦.༢ འབྲི་རྩོམ་གྱི་བཀོད་རིས།

༦.༣ འབྲི་རྩོམ་འབྲི་ཐངས།

༦.༣.༡ ངོ་སྤྲོད་འབྲི་ཐངས།

༦.༣.༢ བར་གྱི་གནད་དོན་འབྲི་ཐངས།

༦.༣.༣ མཇུག་བསྡུ་འབྲི་ཐངས།

༦.༩ འབྲི་རྩོམ་གསར་རྩོམ།

ལས་ཚན་བདུན་པ། ཚོགས་བཤད།

༧.༡ ཚོགས་བཤད་སྤྱི་དོན།

༧.༢ ཚོགས་བཤད་ཀྱི་དབྱེ་བ།

༧.༣ ཚོགས་བཤད་ལུགས་མཐུན།

༧.༩ ཚོགས་བཤད་ལུགས་ཡངས།

༧.༥ ཚོགས་བཤད་པའི་སེམས་ཁར་ངེས་ཐབས།

༧.༦ ཚོགས་བཤད་སྦྱང་བ།

ལྷག་དགོ་པའི་དཔེ་ཐོ།

ངེས་པར་དུ་ལྷག་དགོ་པའི་དཔེ་ཐོ།

ཀུན་བཟང་རྡོ་རྗེ། (༢༠༡༡) **བློ་ཟེ་ལྷའི་པི་ཝང་།** འབྲུག། ཐིམ་ཕུ། ནོར་བུ་རབ་བརྟན་པར་ཁང་། རྫོང་ཁ་གོང་འཕེལ་ལྷན་ཚོཊ།

ཀུན་བཟང་རྡོ་རྗེ། (༢༠༡༥) **དཔེ་གཏམ་དོན་གྱི་རྒྱན་ཆ།** ཐིམ་ཕུ། རྫོང་ཁ་གོང་འཕེལ་ལྷན་ཚོགས།

འཆི་མེད་རིག་འཛིན་རྡོ་རྗེ། (༢༠༡༡) **རྩང་མོའི་ཀི་དེབ་བློ་རིག་མེ་ཏོག།** འབྲུག། ཐིམ་ཕུ། ནོར་བུ་རབ་བརྟན་པར་ཁང་། རྫོང་ཁ་གོང་འཕེལ་ལྷན་ཚོགས།

རྫོང་ཁ་གོང་འཕེལ་ལྷན་ཚོགས། (༡༩༩༩) **རང་གྲོལ་དང་དབྱངས་སྒྲོན།** འབྲུག། ཐིམ་ཕུ། རྫོང་ཁ་གོང་འཕེལ་ལྷན་ཚོགས།

རྫོང་ཁ་གོང་འཕེལ་ལྷན་ཚོགས། (༢༠༡༨) **གློག་བརྙན་གྱི་མིང་ཚིག།** འབྲུག། ཐིམ་ཕུ། རྫོང་ཁ་གོང་འཕེལ་ལྷན་ཚོགས།

རྫོང་ཁ་གོང་འཕེལ་ལྷན་ཚོགས། (༢༠༡༢) **འབྲུག་གི་ཁ་རྒྱུན་སྲུང་སྣ་ཕྱོགས་བསྡེབས་རྣ་བའི་དགའ་སྟོན།** དེབ་དང་པ། འབྲུག། ཐིམ་ཕུ། སྤུན་གཉིས་མཐུན་འབྲེལ་དཔེ་སྐྲུན་དང་པར་སྐྲུན་ཁང་།

ཡེ་ཤེས་དབང་འདུས། (༢༠༡༠) **ཚོགས་བཤད་ཀྱི་ལམ་སྟོན་ལག་དེབ་གསར་བསྒྲིགས།** འབྲུག། ཐིམ་ཕུ། ཀེ་ཨེམ་ཀྱི་དཔར་བསྐྲུན་ཁང་།

ཁ་སྐོང་ལྷག་དགོ་པའི་དཔེ་ཐོ།

ཀརྨ་རྡོ་རྗེ། (༢༠༢༢) **རྩོམ་རིག་ལྷབ་སྦྱང་།** འབྲུག། ཐིམ་ཕུ། ཀུན་གསལ།

བཀྲ་ཤིས་ཕུན་ཚོགས། (༢༠༢༣) **སྒྲུ་རྩལ་རྩོམ་རིག།** འབྲུག། ཐིམ་ཕུ། Bhutan Printing Solutions

སྤྱི་ཚེས: སྤྱི་ཟླ་༢ ༢༠༢༥།

2.3 Year 2, Semester I

DAT202 Data Analytics and Visualization

Module Code and Title: DAT202 Data Analytics and Visualization
Programme: Bachelor of Data Science and Data Analytics
Credit: 12
Module Tutor(s): Pema Wangdi

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General Objective

This module aims to introduce students to design fundamentals, allowing them to identify and critique components of effective visualised data, charts and the visualisation of complex relationships using popular programming language. Students will also learn to use popular data analytics tools to do data wrangling and munging to prepare the data for visualisation.

Learning Outcomes

On completion of the module, students will be able to:

1. Read and write data from external sources
2. Perform data cleansing and preparation for data analysis
3. Explain the concept of exploratory data analysis
4. Explain the ethics of using data in storytelling
5. State the purpose of data visualization and different types of visualisation
6. Create basic plots (eg; line chart, bar plot, histogram, scatter plot, pie chart)
7. Design and build dashboards
8. Analyze the various charts generated in the dashboards
9. Connect and retrieve data from the database servers
10. Visualize the fetched data using data visualization package
11. Demonstrate the application of Data Visualization using use cases such as Digital Marketing, Education, E-commerce, etc.

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
Contact	Teaching	2	60
	Practical and group work	2	
Independent study	Assignments, projects, self-study	4	60
Total		**8**	**120**

The module will be taught using tutorial sessions and practical sessions.

During the tutorial sessions, students will learn the key programming concepts required for data preparation, analysis and visualisation. Additionally, activities such as small-group discussion and presentation will be held during the tutorials. This allows students to have more opportunities to participate in discussions and to have better class interactions.

In the practical lessons, students will be working on practical exercises that are designed for students to solve problems using the knowledge learned from the tutorial lessons. Practical exercises are designed to help students to acquire essential skills that not only give a fluid transition to higher level of study but also improve their understanding of the module.

Assessment Approach

The assessment will be carried out on a continuous basis through the following approaches.

A. Quiz: (25%)

Students will attempt a total of **five quizzes** through the **Virtual Learning Environment (VLE)** upon the completion of **Units I through V**. Each quiz will have a duration of **one hour** and will contribute **5%** to the overall course grade, amounting to a total of **25%** for all quizzes combined.

The quizzes will act as checkpoints to monitor and reinforce learning, ensuring that students build a solid understanding of the materials while progressing through the course. They not only assess performance but also contribute to the overall learning experience by keeping students aligned with the course objectives.

B. Laboratory Reports and Homework: (10%)

The Laboratory Reports and Homework component accounts for 10% of the overall grade and is designed to reinforce students' understanding of the concepts and techniques introduced in the theory and lab sessions. Over the course of the semester, students will participate in a total of 13 lab sessions, during which they will work on various hands-on exercises and real-world problems to develop practical skills in data visualization.

For each lab session, students are required to maintain a detailed lab report that documents the tasks performed, the methodologies applied, and the results obtained. These reports serve as a reflective tool for students to analyze their progress and ensure a thorough understanding of the exercises conducted in the lab. Additionally, after every lab session, a set of homework questions will be assigned to reinforce the concepts taught during the session.

Students are expected to work on the homework assignments independently and submit their solutions via the Virtual Learning Environment (VLE) within the stipulated deadlines. These assignments provide an opportunity for students to practice and apply their learning beyond the structured lab environment, ensuring they gain confidence in using data visualization tools and techniques.

C. Practical Test: (25%)

The students will attempt **two practical tests** that collectively contribute **20%** to the overall grade. The Practical Test I, worth **10%**, will be conducted **mid-semester**, while the Practical Test II,

worth **15%**, will take place **towards the end of the semester**. Each test will have a duration of **two hours** and will comprehensively evaluate the students' ability to apply the concepts and techniques taught during the course.

These practical tests are designed to evaluate students' hands-on proficiency in applying tools and techniques to real-world datasets, fostering their ability to work independently and solve problems effectively. By progressing from foundational tasks such as data reading, writing, and basic exploratory data analysis in the Practical Test I to advanced tasks like data visualization and dashboard creation in the Practical Test IIt, these assessments ensure a structured and progressive evaluation of technical skills. They promote critical thinking, independent decision-making, and the ability to synthesize learning into meaningful insights, preparing students for real-world data analysis scenarios while bridging the gap between theoretical knowledge and practical application.

The details of the practical tests are as follows:

1. **Practical Test I (10%):**
   Objective: Evaluate foundational skills in **data handling** and **basic analysis**, which are critical for more advanced tasks later in the course. This test will assess students' ability to perform **data reading**, **data writing**, and **basic exploratory data analysis (EDA)**.

   Students will be provided with a raw dataset and will be expected to:
   - Import and handle datasets in various formats (e.g., CSV, Excel).
   - Clean, preprocess, and structure data appropriately for analysis.
   - Conduct basic EDA, including summary statistics, handling missing values, and deriving initial insights from the data.

2. **Practical Test II (15%):**
   Objective: Test the students' ability to use visualization techniques for effective **data communication** and demonstrate a deeper understanding of the data. This test will assess students' proficiency in **data visualization** and their ability to **create dashboards** that effectively communicate insights.

   Students will be tasked to:
   - Develop interactive and static visualizations using tools or libraries taught in class (e.g., Matplotlib, Seaborn, Plotly).
   - Create meaningful dashboards with multiple visual components to provide a holistic view of the dataset.
   - Ensure clarity, interpretability, and relevance of their visualizations to the problem at hand.

D. Data Analysis Project: (40%)

Students will use any open datasets and perform thorough data analysis using a data wrangling process. In the report, they need to explain the steps in data wrangling and what tools they used for analysis.

After cleaning the data, the students will need to create dashboards for visualising the analysed result. They should be able to explain the data analysis result through the graphs, charts or plots and what further suggestions or ways they can provide to improve the analysis result through visualisation. The final report will be assessed based on the following rubrics:

Competency	Excellent (80% - 100%)	Proficient (60% - 80%)	Developing (40% - 60%)	Need Improvement (< 40%)
1. Problem statement (5%)	Description of the data and the fields contained inside provided clearly	Data is described but fields inside the data are not described.	Description of data and fields is not clear	No description is provided about data and its field.
	Problem inside the data is defined and the expected result mentioned clearly.	Problem is defined but not clear with what you want to achieve.	Problem of the data and the result you want to achieve is not clear.	Problem is not defined and the desired result is not mentioned.
	Research question is distinctly stated and explained	Research question and explanation is generalized	Research question is ambiguous	No research question is stated
2. Data Cleaning and Preparation (15%)	No missing values found in the dataset	Maximum of the missing values are handled but few remains	More number of missing values found	Missing values are not handled
	No duplicate values found in the dataset	Few of the duplicated values found	More number of duplicated values found	Duplicated values are not handled
	Explained clearly the process to handle the ambiguities	Explain the process but not so clear	Incomplete explanation provided	No explanation provided to handle the ambiguities
3. Data Analysis (20%)	Explored and creatively solved the analysis questions	Solved the analysis questions but not so creative enough	Analysis question is solved using class concept	Analysis question is not solved
	Complete and unambiguous description of Analysis is presented	Complete but ambiguous description of Analysis is presented	Incomplete and ambiguous Description is provided	No description is provided
	Insights drawn is reasonable	Insight is drawn but it is not reasonable	No proper insight drawn	No insight drawn at all
	Clear and correct answer provided	Correct but not a clear	Incomplete response	No response to questions

		response provided	provided	asked/incorrect response
	Confidently presenting your analysis	Presenting but not so confident	No proper presentation	No presentation provided

Overview of the assessment approaches and weighting

Sl.No.	Areas of assessment	Quantity	Weighting (%)
A	Quiz	5	25
B	Laboratory Reports & Homework	1	10
C	Practical Test	2	25
D	Data Analysis Project	1	40
Total		**9**	**100**

Pre-requisites: CSP101 Foundations of Python Programming

Subject Matter

Unit I: Data Wrangling and Analysis using Data Analysis Packages

1.1 Review of python programming

1.1.1 Setup programming environment.

1.1.2 Declare and use variables using standard data types.

1.1.3 Explain operator precedence and write expressions using assignment, arithmetic, comparison, bitwise and logical operators.

1.1.4 Implement conditional code (flow control) and loops

1.1.5 Define and invoke functions

1.1.6 Handle exceptions using try-catch-finally statements (includes file handling).

1.1.7 Apply Packages, Modules, Classes and Objects.

1.1.8 Apply List/Dictionary/Set Comprehension.

1.1.9 Apply Lambda, reduce, filter, map and iterators.

1.2 Read and write data from external sources.

1.3 Create and use different data structures.

1.4 Perform basic numerical operations between 2 or more sets of data

1.5 Apply essential functionalities using data analysis packages

1.6 Perform data cleansing and preparation

1.7 Apply join, combine and reshape data.

1.8 Apply Pivot tables and cross-tabulation onto data.

Unit II: Exploratory Data Analysis

2.1 Explain the concept of exploratory data analysis.

2.2 Apply descriptive statistics.

2.3 Apply GroupBy operations

2.4 Analyze correlation between different variables.

Unit III: Introduction to Data Visualization

3.1 Explain the purpose of data visualization

3.2 Explain ethics of using data in storytelling.

3.3 Create basic plots (eg; line chart, bar plot, histogram, scatter plot, pie chart) using matplotlib libraries

3.4 Create basic plots (eg; line chart, bar plot, histogram, scatter plot, pie chart) using seaborn libraries

3.5 Plot charts for one variable, two variables and many variables using data visualization package.

Unit IV: Building Visual Reports

4.1 Explain the uses of different types of Dashboards

4.2 Demonstrate how to build Dashboard Components.

4.3 Demonstrate how to generate a Dashboard using Bokeh.

4.4 Demonstrate how to generate a Dashboard using Flask.

4.5 Explain how to analyze the various charts generated.

Unit V: Connect Database and Visualize Data

5.1 Introduction to SQL and NoSQL

5.2 Introduction to docker

5.3 Connect to the database.

5.4 Demonstrate how to fetch data from a database.

5.5 Demonstrate how to visualize the fetch data using the data visualization package.

Unit VI: Application of Data Visualization

6.1 Demonstrate the data analysis result by designing appropriate charts.

6.2 Demonstrate the application of Data Visualization using use cases such as Digital Marketing, Education, E-commerce.

Laboratory Sessions:

1. **Lab Session 1: Programming Basics I**
    a) Perform input and output and import functions
    b) Work with data types, assignments, arithmetic operations, and logical operators
    c) Work with conditional statements and loops and iterations
2. **Lab Session 2: Programming Basics II**
    a) Use python lists, sets, tuples, and dictionaries
    b) Write python functions
    c) Read file, data from URL and write data
3. **Lab Session 3: Data Wrangling and analysis using NumPy I**
    a) Install, update, and import NumPy
    b) Create NumPy arrays (1-D, 2-D, 3-D)
    c) Inspect NumPy arrays (shape, ndim, size, len function)
    d) Use the type function and dtype property

e) Make a copy of NumPy arrays
f) Perform basic sorting operations

4. **Lab Session 4: Data Wrangling and analysis using NumPy II**
   a) Perform basic subsetting operations
   b) Use Boolean indexing and indexing using WHERE
   c) Manipulate Arrays (flatten, reshape, transpose, concatenate, split, extract, convert)
5. **Lab Session 5: Data Wrangling and analysis using NumPy III**
   a) Perform mathematical operations to array
   b) Apply statistical methods (sum, mean, sqrt, multiplication, std, var, min/max, argmin/argmax, cumsum/cumprod)
   c) Load a NumPy array from a text file, and save it to text file
6. **Lab Session 6: Data Wrangling and analysis using Pandas I**
   a) Create Pandas series (with default index and user-specified index, object with a dict object, with a datetime dtype)
   b) Create Pandas dataframe (with NumPy array and default index, and user-specified index)
   c) Create Pandas dataframe with nested dict object and with dict of list, with datatime object
   d) Convert into dataframe
7. **Lab Session 7: Data Wrangling and analysis using Pandas II**
   a) Loading data and saving data to CSV and Excel
   b) View top/bottom samples of dataset, display the shape, index, and columns of a series and dataframe
   c) Display statistical information of series and dataframe
   d) Subset columns and rows
8. **Lab Session 8: Exploratory Data Analysis**
   a) Compute the correlation between two variables
   b) Find and replace missing values with mean or mode
   c) Perform variable transformation (logarithmic) and outlier detection for continuous variables
   d) Analyze the multicollinearity
9. **Lab Session 9: Data Visualization using Matplotlib**
   a) Install, update, and import matplotlib libraries
   b) Create line graphs
   c) Create multiple figures and plots, add text and annotations, axis labels, subtitles and legends
   d) Create bar plot, pie chart, histogram, and scatter plots
10. **Lab Session 10: Data Visualization using Seaborn**
    a) Install, load, and import Seaborn libraries
    b) Create scatter plots, count plot, dist plot, and line graphs
    c) Add advanced aesthetic details to the plots
    d) Recreate the graphs from matplotlib using Seaborn
11. **Lab Session 11: Interactive data visualization using Bokeh**
    a) Plot basic graphs using Bokeh library
    b) Customize Bokeh plots
    c) Create interactive graphs using Bokeh server

12. Lab Session 12: Interactive data visualization using Flask

a) Create environment for flask
b) Set basic route and dynamic route
c) Embed static Bokeh plots in flask
d) Embed interactive Bokeh server plot in flask

13. Lab Session 13: Connecting to database and visualizing data

a) Install mySQL workbench and docker
b) Install mySQL database in docker
c) Connect mySQL workbench to mySQL database
d) Run your SQL in workbench
e) Connect to mySQL database and fetch data

Reading List

Essential Reading (e-books):

Healy, K. (2018). *Data Visualization: A Practical Introduction*. Princeton University Press.

Knaflic, C. N. (2015). *Storytelling with Data: A Data Visualization Guide for Business Professionals*. Wiley.

VanderPlas, J. (2016). *Python Data Science Handbook: Essential Tools for Working with Data*. O'Reilly Media.

Wintjen, M., and Vlahutin, A. *Practical Data Analysis Using Jupyter Notebook.*

Additional Reading:

Yau, N. (2011). *Visualize This: The FlowingData Guide to Design, Visualization, and Statistics*. Wiley.

Date: February 2025.

CSP201 Front-End Web Development

Module Code and Title: CSP201 Front-End Web Development
Programme: Bachelor of Data Science and Data Analytics
Credit: 12
Module Tutor(s): Norbu Zangpo, Thinley Namgyel
Module Coordinator: Thinley Namgyel

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General Objective

The aim of this module is to introduce the fundamental web technologies and basic web design principles to develop a functional interactive and responsive web site. Topics include mark-up, styling, interactive language for front end web development and production pipeline for bringing development to production.

Learning Outcomes

On completion of the module, students will be able to:

1. Structure web pages using semantic HTML5 elements for accessibility and SEO.
2. Style elements with CSS selectors, box model, and layout techniques.
3. Develop responsive designs using Flexbox, Grid, and media queries.
4. Apply CSS typography for text styling and formatting.
5. Create and validate forms using HTML5 elements and built-in validation.
6. Use CSS frameworks like Bootstrap for responsive design.
7. Enhance interactivity by manipulating the DOM with JavaScript.
8. Develop dynamic pages using JavaScript functions, scripts, and event handling.
9. Integrate JavaScript libraries (e.g., jQuery) for efficiency.
10. Build complete web interfaces combining HTML, CSS, and JavaScript.

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
Contact	Teaching	2	60
	Practical and group work	2	
Independent study	Assignments, projects, self-study	4	60
Total		**8**	**120**

The module will be taught using teaching sessions and practical sessions. During teaching sessions, students will learn about the theories and concepts of structured programming language. During practical sessions, students will implement programming concepts learned in teaching sessions using a structured programming language.

Assessment Approach

The assessment will be carried out on a continuous basis through the following approaches.

A. Quizzes: (10%)

Hour-long quizzes will be conducted fortnightly either online through VLE or paper-based in-class to monitor the learning progress of students, the total scores of which will be converted into 10%.

B. Lab Exam: (20%)

A comprehensive lab exam will be conducted in the final week of the semester to assess the student's practical knowledge on JS HTML DOM. Assessment will be based on the use of DOM document objects (such as Finding, Changing, Adding and Deleting HTML Elements, Adding Events Handlers and Finding HTML Objects). The lab exam will be for a duration of two hours.

C. Assignment: (30%)

In this assignment, students are expected to design, develop, test and deploy a responsive web site using HTML, CSS3 based on a theme given in the assignment. The marking will be based on the following rubric:

Criteria	Excellent (10-9)	Good (8-7)	Satisfactory (6-5)	Needs Improvement (4-0)
Design & Layout (20%)	Well-structured, visually appealing, and highly user-friendly layout. Effective use of whitespace, typography, and colors.	Organized layout with good use of whitespace and colors. Minor inconsistencies in alignment or spacing.	Basic structure with some inconsistencies in spacing, alignment, or typography. Needs more refinement.	Poorly structured layout with cluttered or unorganized content. Unattractive design.
HTML Structure & Semantic Elements (15%)	Uses appropriate and valid semantic HTML5 elements. Clean and well-organized code.	Uses semantic elements but with minor misuse or missing elements. Code is fairly structured.	Uses mostly non-semantic tags or inconsistent HTML structure. Some errors in markup.	Poorly structured HTML with incorrect use of elements. Many validation errors.
CSS Styling & Aesthetics (15%)	Consistently applies CSS to enhance aesthetics. Proper use of colors, fonts, margins, padding, and styles.	Good use of CSS but minor inconsistencies in styles or spacing.	Basic styling applied but lacks consistency. Needs refinement in font, spacing, or colors.	Poor or inconsistent styling. Minimal CSS use. Overuse of default browser styling.
Responsiveness & Media Queries (20%)	Fully responsive design, adapts well to all screen sizes. Effective use of media queries.	Mostly responsive with minor issues on certain screen sizes. Media queries applied but need some improvements.	Partially responsive with visible layout breaking points. Limited use of media queries.	Not responsive. Layout does not adjust to different screen sizes. No media queries used.
Navigation & Usability (10%)	Intuitive navigation, easy to use, clear menu structure. All links work correctly.	Mostly user-friendly with minor navigation issues. Some links may not work.	Basic navigation but lacks clarity or consistency. Some links are broken.	Poor navigation, unclear structure. Many broken links or inaccessible content.
Code Quality & Best Practices (10%)	Clean, well-commented, and properly indented code. Follows best	Mostly clean code with minor indentation or commenting issues. Few	Code is cluttered or lacks comments. Some best	Poorly written code, no indentation or comments. Many best

	practices and accessibility standards.	best practice errors.	practice violations.	practice violations.
Testing & Deployment (10%)	Thoroughly tested on multiple browsers and devices. Successfully deployed on a live platform.	Tested on multiple browsers/devices but minor issues exist. Deployed successfully.	Limited testing done, some compatibility issues. Website is not fully deployed.	No testing performed. Website does not work properly or is not deployed.

D. Project: (40%)

In this project, students are expected to design, develop, test and deploy an interactive, responsive web site using HTML, CSS3, JS and Bootstrap based on a theme given in the project instructions.

The final project will be assessed based on the following:

Criteria	Excellent (10-9)	Good (8-7)	Satisfactory (6-5)	Needs Improvement (4-0)
Project Planning & Documentation (10%)	Well-documented project plan, including clear objectives, wireframes, and a structured development process.	Good documentation with a clear plan, but some minor details missing.	Basic documentation provided but lacks depth and structure.	Poor or missing documentation, unclear objectives and structure.
HTML Structure & Semantic Elements (10%)	Uses proper semantic HTML5 elements. Code is well-organized, clean, and adheres to best practices.	Mostly structured well with minor misuse of semantic elements.	Basic structure with some use of non-semantic elements. Some code inconsistencies.	Poorly structured HTML, missing semantic elements, many validation errors.
CSS Styling & Aesthetics (10%)	Well-designed UI with appropriate colors, typography, spacing, and consistent styling. Visually appealing and professional.	Good use of CSS with minor inconsistencies in styles or spacing.	Basic styling but lacks consistency and refinement in font, spacing, or colors.	Poor or inconsistent styling. Minimal CSS use. Overuse of default browser styling.
JavaScript Interactivity & Functionality (15%)	Well-implemented interactivity using JavaScript. Functional and enhances user experience. No errors.	Interactive elements are functional, but some minor issues exist.	Basic JavaScript functionality implemented, but lacks complexity or refinement.	Little to no JavaScript functionality, or it contains major errors.
Bootstrap & Responsive Design (15%)	Fully responsive across all devices, effective use of Bootstrap for layout and styling.	Mostly responsive with minor display issues on some devices. Bootstrap used correctly.	Partially responsive, but layout breaks at some screen sizes. Some Bootstrap misuse.	Not responsive. Poor or no Bootstrap integration. Layout does not adapt to different screens.
Navigation &	Intuitive, user-	Mostly user-	Basic navigation	Poor navigation

Usability (10%)	friendly navigation. All links and menus work correctly. Smooth user experience.	friendly, but minor navigation issues. Some links may not work.	but lacks clarity or consistency. Some broken links.	structure, difficult to use, many broken links.
Code Quality & Best Practices (10%)	Clean, well-commented, and properly indented code. Follows best practices and accessibility standards.	Mostly clean code with minor indentation or commenting issues. Few best practice violations.	Code is cluttered or lacks comments. Some best practice violations.	Poorly written code, no indentation or comments. Many best practice violations.
Testing & Deployment (10%)	Thoroughly tested on multiple browsers and devices. Successfully deployed on a live platform.	Tested on multiple browsers/devices but minor issues exist. Deployed successfully.	Limited testing done, some compatibility issues. Website is not fully deployed.	No testing performed. Website does not work properly or is not deployed.
Creativity & Innovation (10%)	Unique, creative approach to design and interactivity. Goes beyond basic requirements.	Some creative elements, but mostly follows standard design patterns.	Basic design, minimal creativity, meets only core requirements.	Lacks creativity, generic and unoriginal design.

Overview of the assessment approaches and weighting

Sl.No.	Areas of assessment	Quantity	Weighting (%)
A	Quiz	5	10
B	Lab Exam	1	20
C	Assignment	1	30
D	Project	1	40
Total		**9**	**100**

Pre-requisites: None

Subject Matter

Unit I: Markup Language

1.1 Introduction to HTML5

1.1.1 HTML vs. HTML5: Evolution and Features

1.1.2 HTML Document Structure

- 1.2 Content Structuring with HTML5
  - 1.2.1 Semantic Elements
  - 1.2.2 Non-Semantic Elements
- 1.3 Working with Text & Media
  - 1.3.1 Headings, Paragraphs, and Lists
  - 1.3.2 Images, Videos, and Audio Elements
  - 1.3.3 Hyperlinks and Anchors
- 1.4 Data Structuring with Tables
  - 1.4.1 Creating Tables
  - 1.4.2 Table Attributes (Borders, Merging Cells, Captions)
  - 1.4.3 Accessibility Considerations in Tables
- 1.5 Forms and User Input
  - 1.5.1 Basic Form Elements
  - 1.5.2 HTML5 Form Validation

Unit II: Web Styling

- 2.1 Introduction to CSS
  - 2.1.1 CSS Syntax and Structure
  - 2.1.2 Applying CSS (Inline, Internal, External)
  - 2.1.3 Understanding Cascading, Inheritance, and Specificity
- 2.2 CSS Selectors & Advanced Selection
  - 2.2.1 Element, Class, ID, and Grouping Selectors
  - 2.2.2 Descendant, Child, Sibling, and Adjacent Sibling Selectors
  - 2.2.3 Pseudo-Elements and Pseudo-Classes
- 2.3 Box and Content Model
  - 2.3.1 Understanding the Box Model (Margin, Border, Padding, Content)
  - 2.3.2 Visibility & Display Properties
  - 2.3.3 Outlining Elements
- 2.4 Positioning & Layout Control
  - 2.4.1 CSS Units of Measurement (px, em, rem, vh, vw, %)
  - 2.4.2 Width & Height Properties
  - 2.4.3 Positioning (Static, Relative, Absolute, Fixed)
  - 2.4.4 Floating and Clearing Elements
- 2.5 Typography and Text Styling
  - 2.5.1 Font Properties
  - 2.5.2 Text Alignment, Indentation, and Decoration
  - 2.5.3 Word and Letter Spacing
  - 2.5.4 Web Safe Fonts and Google Fonts

Unit III: Layout Formatting and Grid

- 3.1 CSS Flexbox
  - 3.1.1 Understanding the Flexbox Model
  - 3.1.2 Flex Container and Flex Items
  - 3.1.3 Spacing and Aligning Flex Items
  - 3.1.4 The `flex` Property (grow, shrink, basis)

- 3.1.5 Creating a Responsive Flexbox Layout
- 3.2 CSS Grid
  - 3.2.1 Grid Container and Grid Items
  - 3.2.2 Sizing Columns and Rows
  - 3.2.3 Placing and Spanning Grid Items
  - 3.2.4 Aligning Grid Items & Tracks
  - 3.2.5 Grid vs. Flexbox: When to Use Each
- 3.3 Responsive Design
  - 3.3.1 Viewport and Media Queries
  - 3.3.2 Adaptive Layouts (Mobile-First vs. Desktop-First)
  - 3.3.3 Breakpoints and Fluid Grids
  - 3.3.4 Responsive Navigation and Menus

Unit IV: CSS Framework

- 4.1 Introduction to CSS Frameworks
  - 4.1.1 Benefits of Using a Framework
  - 4.1.2 Popular Frameworks: Bootstrap, Tailwind CSS, Bulma
  - 4.1.3 Understanding Utility Classes
- 4.2 Using Media Queries in Frameworks
  - 4.2.1 Customizing Layouts for Different Devices
  - 4.2.2 Flexible Grids and Containers
- 4.3 CSS Framework Utilities & Components
  - 4.3.1 Buttons, Forms, Alerts, Modals
  - 4.3.2 Navigation Bars & Cards

Unit V: Bootstrap

- 5.1 Getting Started with Bootstrap
  - 5.1.1 Setting up Bootstrap (CDN vs. Local)
  - 5.1.2 Bootstrap Grid System
- 5.2 Bootstrap Components
  - 5.2.1 Buttons, Forms, Input Groups
  - 5.2.2 Cards, Badges, Alerts
  - 5.2.3 Carousels and Sliders
- 5.3 Bootstrap JavaScript Components
  - 5.3.1 Modal Windows
  - 5.3.2 Dropdowns & Tooltips
  - 5.3.3 Accordions & Collapsible Elements
- 5.4 Customizing Bootstrap
  - 5.4.1 Theming with Bootstrap Variables
  - 5.4.2 Extending Bootstrap with Custom CSS

Unit VI: Interactivity with DOM and JavaScript

- 6.1 Introduction to JavaScript
  - 6.1.1 JavaScript Syntax & Variables

6.1.2 Functions and Event Handling
6.2 Document Object Model (DOM)
6.2.1 Understanding the DOM Tree
6.2.2 Selecting & Manipulating HTML Elements
6.2.3 Adding and Removing Elements Dynamically
6.3 CSS Manipulation with JavaScript
6.3.1 Changing Styles Dynamically
6.3.2 Animations with JavaScript
6.4 JavaScript for Forms & Validations
6.4.1 Form Events and Input Validation
6.4.2 Preventing Default Form Behavior
6.5 Advanced JavaScript Concepts
6.5.1 Introduction to AJAX and Fetch API
6.5.2 Working with JSON Data
6.5.3 Local Storage & Session Storage
6.6. JavaScript Libraries
6.6.1 Using jQuery for DOM Manipulation
6.6.2 jQuery Event Handling

Laboratory Sessions

1. **Lab Session 1: Introduction to HTML5**
   - Setting up a development environment (VS Code, live server)
   - Creating a basic HTML5 document
   - Understanding DOCTYPE, `<html>`, `<head>`, `<body>` structure

2. **Lab Session 2: Semantic HTML & Content Structuring**
   - Using `<header>`, `<nav>`, `<section>`, `<article>`, `<aside>`, `<footer>`
   - Comparing semantic and non-semantic elements

3. **Lab Session 3: HTML Forms and Tables**
   - Creating tables with `<table>`, `<thead>`, `<tbody>`, `<tr>`, `<td>`
   - Designing forms with `<input>`, `<select>`, `<textarea>`, `<button>`
   - Form validation using required attributes

4. **Lab Session 4: Introduction to CSS**
   - Writing internal, external, and inline CSS
   - Understanding CSS syntax and selectors

5. **Lab Session 5: Advanced CSS Selectors & Specificity**
   - Using class, ID, descendant, child, and sibling selectors
   - Understanding specificity, inheritance, and the cascade

6. **Lab Session 6: Box Model and Positioning**
   - Implementing padding, margin, borders, and content

- Exploring relative, absolute, and fixed positioning

7. **Lab Session 7: Flexbox Layout**
    - Creating a responsive layout using Flexbox
    - Adjusting spacing, alignment, and ordering

8. **Lab Session 8: CSS Grid System**
    - Designing a structured web page using CSS Grid
    - Understanding grid rows, columns, and item placement

9. **Lab Session 9: Responsive Design with Media Queries**
    - Implementing breakpoints for different screen sizes
    - Using relative units (em, rem, %)

10. **Lab Session 10: Applying a CSS Framework (Bootstrap or Tailwind)**
    - Using predefined classes for layouts, buttons, forms, and navigation
    - Customizing framework components

11. **Lab Session 11: Bootstrap Components & Utilities**
    - Implementing grids, buttons, navbars, modals, and forms

12. **Lab Session 12: Developing a Bootstrap-based Web Page**
    - Creating a fully responsive web page using Bootstrap

13. **Lab Session 13: JavaScript Fundamentals**
    - Writing basic JavaScript functions and event handlers
    - Manipulating DOM elements

14. **Lab Session 14: Advanced DOM Manipulation & jQuery**
    - Changing content dynamically using JavaScript
    - Handling events and animations using jQuery

15. **Lab Session 15: Final Project (Web Page Development)**
    - Integrating HTML, CSS, Bootstrap, and JavaScript
    - Developing a fully functional responsive website

Reading List

Essential Reading:

Coulson, L., Jephson, B., Larsen, R., Park, M., and Zburlea, M. (2019). *The HTML and CSS Workshop.*

DT Editorial Services (2018) *HTML5 IN SIMPLE STEPS*

Labrecque, J., Love, J., Rosenbaum, D., Turner, N., Mehla, G., Hosford, A,L., Sloot, F., and Kirkbride, P. (2019). *The JavaScript Workshop*
https://www.w3schools.com/
Frain, B. (2019). *Responsive Web Design with HTML5 and CSS3: Build responsive and future- proof websites to meet the demands of modern web users* (Second Edition)

Date: February, 2025.

DAT201 Mathematics for Data Science I

Module Code and Title: DAT201 Mathematics for Data Science I
Programme: Bachelor of Data Science and Data Analytics
Credit: 12
Module Tutor(s): Dechen Lhendup

General Objective

This module aims to acquaint students with the fundamental elements of Discrete Mathematics, integrated with Python programming. Through this, students will develop a solid understanding of key mathematical concepts such as Propositional Logic, Proof Techniques, Sets, Relations and Functions, Recurrence Relations, Algebraic Structures, and Graph Theory, along with their practical applications.

Learning Outcomes

On completion of the module, students will be able to:

1. Define and use mathematical logic and proof techniques with confidence.
2. Translate everyday language into logical expressions and evaluate their validity.
3. Construct truth tables and verify logical operations in Python.
4. Analyze set operations, properties, and relations using Python.
5. Classify and analyze different types of functions and apply them in real-world scenarios.
6. Solve combinatorial problems using counting principles and other techniques.
7. Use Python to generate permutations, combinations, and solve counting problems with applications in probability.
8. Obtain solutions to linear homogeneous recurrence relations, and represent solutions using generating functions.
9. Explain algebraic structures and verify their properties using formal proofs and Python-based simulations.
10. Implement group operations and group theory concepts.
11. State properties of congruence relations and verifying group structures in modular arithmetic systems.
12. Integrate Python libraries (NumPy, Pandas, Matplotlib) for scientific computing, data manipulation, and visualization in discrete mathematics contexts.

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours

Contact	Teaching	2	60
	Practical and group work	2	
Independent study	Assignments, projects, self-study	4	60
Total		**8**	**120**

The module will employ a combination of teaching sessions and practical sessions.

In the teaching sessions, students will learn the definitions, theories, and principles of discrete mathematics. Additionally, the interactive activities such as small-group discussions and presentations where students will engage and showcase their skills in problem-solving.

During practical sessions, students will actively participate in exercises and work on examples to apply what they've learned. These exercises will not only enhance their proficiency in Python programming but also deepen their comprehension of how mathematics is applied in the field of Data science and Data analytics.

Assessment Approach

The assessment will be carried out on a continuous basis through the following approaches.

A. Assignment: (20%)

Students will demonstrate their comprehension of key concepts through two assignments, each contributing 10% to the overall grade.

- Assignment I (10%): Apply your knowledge and understanding of Propositional Logic to solve a set of problems by writing detailed solutions.
- Assignment II (10%): Utilize concepts from Counting to address and solve various counting-related problems.

These assignments are designed to assess students' grasp of the theoretical aspects and their ability to apply them in practical problem-solving contexts.

B. Term Test: (20%)

Students will undertake two term tests, each contributing 10% to the final grade. Both tests are closed-book written assessments conducted over a duration of 1 hour to evaluate students' understanding of core concepts.

- Term Test I (10%): Assesses knowledge of Proof Techniques, Set Theory, Relations, and Functions.
- Term Test II (10%): Focuses on Algebraic Structures, Morphisms, and an Introduction to Graph Theory.

These tests aim to evaluate students' conceptual understanding and their ability to apply mathematical reasoning in problem-solving scenarios.

C. Practical Test: (30%)

Students will undertake two practical tests to assess their proficiency in Python programming. These tests are designed to evaluate their ability to apply programming concepts and problem-solving skills in a real-time coding environment. Each test will be a closed-book assessment, conducted in the lab for a duration of 2 hours.

- Practical Test I (15%): Evaluates fundamental Python programming skills and the ability to implement basic problem-solving techniques.
- Practical Test II (15%): Assesses advanced programming concepts and the application of more complex problem-solving strategies.

Students are required to write Python programs in response to the given problems, ensuring adherence to correct syntax and logical structure to avoid errors and produce accurate outputs.

D. Quizz: (30%)

Students will take three quizzes distributed throughout the semester, each contributing 10% to the overall grade. These quizzes aim to ensure continuous assessment of students' understanding by comprehensively covering the topics in the syllabus.

Quiz structure and expectations:

- Each quiz will consist of a specified number of questions to be completed within 1 hour.
- The quizzes will assess both conceptual knowledge and problem-solving skills.
- Students are expected to manage their time effectively and provide accurate, well-structured responses.

This continuous evaluation approach will help reinforce key concepts and track students' progress over the semester.

Overview of the assessment approaches and weighting

Sl.No.	Areas of assessment	Quantity	Weighting (%)
A	Assignments	2	20
B	Term Test	2	20
C	Practical Test	2	30
D	Quiz	3	30
Total		**9**	**100**

Pre-requisites: CSP101 Foundations of Python Programming

Subject Matter

Unit I: Elementary logic and Methods of proof

1.1 Foundations of Mathematical Logic

1.1.1 Mathematical Notation and Definitions

- 1.1.2 Introduction to Logical Propositions and Statements
- 1.1.3 Translating Everyday Language Statements into Formal Logic

1.2 Propositional Logic

- 1.2.1 Syntax and Semantics of Propositional Logic
- 1.2.2 Logical Connectives: AND, OR, NOT, IMPLICATION, BICONDITIONAL
- 1.2.3 Constructing Truth Tables
- 1.2.4 Logical Equivalence, Tautology, Contradiction, and Contingency
- 1.2.5 Operations in Propositional Logic Using Logical Identities
- 1.2.6 Boolean Logic: Formulating and Analyzing Statements

1.3 Methods of Proof

- 1.3.1 Introduction to Mathematical Proof Techniques
- 1.3.2 Proof by Forward Reasoning (Direct Proofs)
- 1.3.3 Proof by Contradiction
- 1.3.4 Proof by Contraposition
- 1.3.5 Proofs Involving "If and Only If" Conditions

1.4 Predicate Logic and Quantifiers

- 1.4.1 Introduction to Predicates and Quantifiers (Universal and Existential)
- 1.4.2 Translating Quantified Statements into Formal Logic
- 1.4.3 Logical Equivalence in Predicate Logic

1.5 **Logical Arguments and Validity**

- 1.5.1 Evaluating the Validity of Arguments Using Truth Tables
- 1.5.2 Constructing Valid Arguments with Mathematical Reasoning
- 1.5.3 Logical Identities for Verifying Arguments

Unit II: Sets, Relations and Functions

2.1 Introduction to Sets

- 2.1.1 Fundamental Concepts of Sets
- 2.1.2 Set Notation: Roster Form and Set-Builder Notation
- 2.1.3 Types of Sets: Finite, Infinite, Countable, and Uncountable Sets
- 2.1.4 Cardinality of Sets
- 2.1.5 Cantor’s Diagonal Argument and Proof of the Power Set Theorem
- 2.1.6 Schroeder-Bernstein Theorem

2.2 Set Operations and Properties

- 2.2.1 Union, Intersection, Difference, and Cartesian Product
- 2.2.2 Power Set of a Given Set
- 2.2.3 Proving Set Properties Using Venn Diagrams
- 2.2.4 Inclusion-Exclusion Principle

2.3 Relations and Representations

- 2.3.1 Introduction to Relations and Binary Relations
- 2.3.2 Properties of Relations: Reflexive, Symmetric, Transitive
- 2.3.3 Equivalence Relations and Partial Ordering Relations
- 2.3.4 Matrix Representation of Relations
- 2.3.5 Directed Graph Representation of Relations

2.4 Operations on Relations

2.4.1 Composition of Relations
2.4.2 Inverse Relations
2.4.3 Verifying Equivalence Relations and Partial Ordering Relations
2.5 Functions and Their Properties
2.5.1 Definition and Representation of Functions
2.5.2 Types of Functions: Injective (One-to-One), Surjective (Onto), Bijective (One-to-One Correspondence)
2.5.3 Composition and Inverse of Functions
2.5.4 Application of Functions in Real-World Scenarios
2.2 Python Integration with Functions
2.2.1 Predefined and User-Defined Functions in Python
2.2.2 Creating and Manipulating Functions in Python
2.2.3 String Handling and Data Manipulation with Python
2.2.4 Operations on Sets, Tuples, Lists, and Strings in Python
2.6 Advanced Concepts in Functions
2.6.1 Countable vs. Uncountable Sets
2.6.2 Proving Countably Finite and Countably Infinite Sets
2.6.3 Cantor's Diagonal Argument in Depth

Unit III: Introduction to Counting, Algebraic Structures and Morphisms

3.1 Introduction to Counting Principles
3.1.1 Fundamental Counting Principles
3.1.1.1 The Sum Rule and Product Rule
3.1.1.2 The Principle of Inclusion and Exclusion
3.1.2 Permutations and Combinations
3.1.2.1 Generating Permutations (with and without repetition)
3.1.2.2 Generating Combinations (with and without repetition)
3.1.3 The Pigeonhole Principle
3.1.3.1 Basic Pigeonhole Principle
3.1.3.2 Generalized Pigeonhole Principle
3.1.4 Applications in Probability and Real-Life Problems
3.1.4.1 Solving Counting Problems Using Probability
3.2 Advanced Counting Techniques
3.2.1 The Binomial Theorem
3.2.1.1 Expanding Binomial Expressions
3.2.1.2 Calculating Binomial Coefficients
3.2.2 Linear and Nonlinear Recurrence Relations
3.2.2.1 Explicit Formulas for Recurrence Relations
3.2.2.2 Solving Linear Homogeneous Recurrence Relations
3.2.3 Generating Functions
3.2.3.1 Understanding Generating Functions
3.2.3.2 Finding the Closed Form of a Generating Function
3.2.3.3 Series Expansions of Generating Functions
3.3 Introduction to Algebraic Structures

- 3.3.1 Semigroups, Monoids, and Groups
  - 3.3.1.1 Definitions and Properties
  - 3.3.1.2 Examples and Applications
  - 3.3.1.3 Verifying Properties: Closure, Associativity, Identity, and Inverses
- 3.3.2 Subgroups and Group Theory
  - 3.3.2.1 Conditions for a Subgroup
  - 3.3.2.2 Group Homomorphisms and Isomorphisms

3.4 Rings, Integral Domains, and Fields

- 3.4.1 Rings and Integral Domains
  - 3.4.1.1 Properties and Examples
- 3.4.2 Fields
  - 3.4.2.1 Definition and Properties
  - 3.4.2.2 Field Operations and Examples
- 3.4.3 Algebraic Structures with Two Binary Operations
  - 3.4.3.1 Understanding Structures like Rings and Fields

3.5 Congruence and Modulo Arithmetic

- 3.5.1 Congruence Modulo n
  - 3.5.1.1 Definition and Examples
  - 3.5.1.2 Properties of Congruence Relations
- 3.5.2 The Group Structure of Congruence Modulo n
  - 3.5.2.1 Closure, Associativity, Identity, and Inverses in Modulo Arithmetic
  - 3.5.2.1 Verifying Group Properties for Congruence Modulo n

3.6 Group Theory and Proof Techniques

- 3.6.1 Definition and Properties of Groups
  - 3.6.1.1 Group Axioms: Closure, Associativity, Identity, Inverses
- 3.6.2 Examining Algebraic Structures for Group Properties
  - 3.6.2.1 Proofs and Counterexamples
  - 3.6.2.2 Verifying Whether a Structure is a Group

3.7 Morphism and Applications in Algebra

- 3.7.1 Morphism Between Algebraic Structures
  - 3.7.1.1 Homomorphisms and Isomorphisms
  - 3.7.1.2 Properties and Applications of Morphisms

Laboratory Sessions:

Unit I: Elementary logic and Methods of proof

Lab Session 1: Python Integration with Propositional Logic

- Creating Truth Tables in Python
- Programming Logical Operations and Verifying Logical Equivalence
- Writing Python Programs to Solve Problems in Propositional Logic

Lab Session 2: Python Integration with Predicate Logic

- Writing Python Programs for Predicate Logic Operations
- Constructing Programming Instructions for Quantifier-Based Problems

Lab Session 3: Guess-Check Algorithms and Approximate Solutions

- Introduction to Guess-and-Check Algorithms
- Python Implementation for Approximate Solutions

Unit II: Sets, Relations and Functions

Lab Session 4: Python Integration with Sets

- Performing Set Operations in Python (Union, Intersection, Difference)
- Working with Sets, Tuples, and Lists in Python
- Python for Cardinality and Power Set Computation

Lab Session 5: Python Integration with Functions

- Predefined and User-Defined Functions in Python
- Creating and Manipulating Functions in Python
- String Handling and Data Manipulation with Python
- Operations on Sets, Tuples, Lists, and Strings in Python

Lab Session 6: Python Libraries for Scientific Computing and Data Analysis

- Introduction to Python Packages: NumPy, Pandas, and Matplotlib
- Using NumPy for Set Operations and Numerical Analysis
- Using Pandas for Data Manipulation
- Visualizing Data and Relations with Matplotlib
- File Processing in Python for Data Analysis

Unit III: Introduction to Counting, Algebraic Structures and Morphisms

Lab Session 7: Python Integration with Counting

- Pseudocode for Permutations and Combinations
- Python Implementation for Generating Permutations and Combinations
- Counting and Probability Problems
- Python Scripts for Solving Counting and Probability Problems

Lab Session 8: Python Integration with Algebraic Structures

- Implementing Basic Algebraic Structures in Python
- Using Python to Model Semigroups, Monoids, and Groups
- Group Operations
- Python Functions for Group Operations and Verifying Properties

Reading List

Essential Reading (e-books):

Fortney, J. P. (2020). *Discrete mathematics for computer science : An example-based introduction*. CRC Press LLC.

Garnier, R., & Taylor, J. (2009). *Discrete mathematics : Proofs, structures and applications, third edition*. Taylor & Francis Group.

McKinney, W. *Python for Data analysis*

Additional Reading:

T., W. R., & Ray, A. T. (2021). *Practical discrete mathematics : Discover math principles that fuel algorithms for computer science and machine learning with python*. Packt Publishing, Limited.

Date: February 2025.

CSP202 Modern Database Design

Module Code and Title: CSP202 Modern Database Design
Programme: Bachelor of Data Science and Data Analytics
Credit Value: 12
Module Tutors: Sangay Thinley

General Objectives:

Data ubiquity has been one of the defining characteristics of the present time. We are surrounded by data in various sizes and forms, such as structured and unstructured. Systematic and efficient storage, use, and management of user data are pivotal to the day-to-day operations of organizations. This module introduces the students to the foundational concepts and practical skills essential for designing and implementing modern database systems. The students will be acquainted with the traditional relational/SQL databases and the contemporary non-relational/NoSQL databases in an application-oriented manner.

Learning Outcomes:

On completion of the module, students will be able to:

1. Discuss the need of databases, its architecture, and schemas.
2. Explain the basic concepts of Database Systems.
3. Discuss the basic concepts of the relational data model.
4. Design Entity Relationship (ER) models to represent database schemas.
5. Apply Entity-Relationship (ER) modelling technique to database design.
6. Refine database design by normalization.
7. Construct database queries using Structured Query Language (SQL) language to create, manipulate and retrieve data in a relational database.
8. Populate relational database.
9. Use NoSQL Database Systems.

Learning and Teaching Approach:

Type	**Approach**	**Hours per week**	**Total credit hours**
Contact	Teaching	3	75
	Practical sessions	2	
Independent Study	Assignment/Project	1	45
	Self-Study	2	
Total		**8**	**120**

The module will be taught using a blend of tutorials and practical sessions.

During the tutorial sessions, students will learn the key concepts and principles to design and implement modern database systems. In addition, Activities such as small-group discussions and presentations will be held during the tutorials. This gives students more opportunities to participate in discussions and have better class interactions.
In the practical lessons, students will be working on practical exercises that are designed for students to solve problems using the knowledge learned from the tutorial lessons.

Assessment approach:

A. Individual Assignment: (15%)

Each student will submit a written assignment on topics related to relational database concepts, such as ER/EER model, relational algebra, and normalization. They are expected to use relevant tools for the design-related questions.

Each individual student will be given a chance to select any business problems and develop an ER/EER diagram based on the selected topic.

Assessment Criteria:

Criteria	**10 – 7 Exemplary**	**4 - 6 Satisfactory**	**1 - 3 Needs Improvement**
Notation (x2)	Diagram uses an appropriate E-R notation. The notation is used correctly for all elements of the diagram.	Diagram uses an appropriate E-R notation. The notation is used correctly for most elements of the diagram.	Diagram does not use an appropriate E-R notation or uses a notation incorrectly for most or all elements.
Professionalism (x1)	Diagram presents a professional appearance. It could be shared with a “real-world” customer without any changes.	Diagram largely presents a professional tone. It could be shared with a “real-world” customer with minor changes.	The diagram is unprofessional. Major revisions would be necessary before sharing the document with a “real-world” customer
Entity Sets (x2)	Diagram captures all entity sets necessary for a database that would satisfy the initial problem statement	Diagram captures most entity sets necessary for a database that would satisfy the initial problem statement.	Diagram captures few or none of the entities sets necessary for a database that would satisfy the initial problem statement.
Attributes ad Keys (x1)	Diagram captures all attributes and primary keys	Diagram captures most attributes and primary keys	Diagram captures none or few of the attributes and primary keys

	necessary for a database that would satisfy the initial problem statement.	necessary for a database that would satisfy the initial problem statement.	necessary for a database that would satisfy the initial problem statement.
Relationships (x2)	Diagram captures all relationships necessary for a database that would satisfy the initial problem statement.	Diagram captures most relationships necessary for a database that would satisfy the initial problem statement.	Diagram captures none or few of the relationships necessary for a database that would satisfy the initial problem statement.

B. CA2: Group Project: (30%)

Students will collaborate in groups of three to four on a mini database project designed to provide hands-on experience with the key stages of the database design process. This project aims to enable them to apply the skills acquired during the course in a practical, application-oriented context. Each group will be required to analyze system requirements, develop appropriate conceptual, logical, and physical database designs, implement CRUD (Create, Read, Update, Delete) operations on their databases, and submit a comprehensive project report. Additionally, they will present their solutions to demonstrate their understanding and implementation. Project topics will be selected in consultation with the tutor to ensure relevance and alignment with learning objectives. The final project grade will be determined by combining the marks awarded for the written report and the presentation.

The following criteria will be used to evaluate the project report and presentation:

Project Report [15%]

Table of Contents, Introduction	3%
Conceptual and Logical Database Design	3%
Database Implementation	6%
References	3%

Project Presentation [15%]

Project Demo	8%
Content	3%
Delivery (Verbal, non-verbal expression, eye contact)	3%
Time management	1%

C. VLE Quiz: (15%)

One quiz will be conducted on VLE upon coverage of at least 40% of the subject matter to assess the students' overall understanding of the subject matter. This quiz will contain 30 Multiple Choice

Questions, each question will carry 1 mark and it will be scaled-down to 10%. The test will be conducted for a duration of 30 minutes.

D. Practical Test: (30%)

The practical test will be conducted towards the end of the semester. It is aimed at assessing student's practical competency in creating and manipulating relational and non-relational databases.

The module tutor will prepare three sets of practical questions comprising relational and non-relational databases. Each student will get one set of questions and need to solve the problem using the desired query language.

After completing each question from the set, the students need to show their output to the module tutor for the assessment. Students will need to submit their solution through the VLE submission link.

E. Class Test: (10%)

One class test will be conducted upon coverage of at least 60% of the subject matter. The test will include the ER model and Normalization. The test will be conducted for a duration of 90 minutes.

Overview of the assessment approaches and weighting

Sl.No.	Area of Assignments	Quantity	Weighting
A	Individual Assignment	1	15%
B	Group Project	1	30%
C	Quiz	1	15%
D	Practical Test	1	30%
E	Class Test	1	10%
	Total	**5**	**100%**

Pre-requisites: None

Subject Matter

Unit I: Introduction & DBMS Architecture

1.1. Introduction- Data, Database, Database management system
  1.1.1. Characteristics of the database approach
  1.1.2. Role of Database administrators
  1.1.3. Role of Database Designers, End Users
  1.1.4. Advantages of Using a DBMS and When not to use a DBMS.
1.2. DBMS Architecture
1.3. Data Models

1.3.1. Categories of Data models, Schemas, Instance, and Database states
1.4. DBMS Architecture and Data Independence
1.4.1. The Three schema architecture
1.4.2. Data Independence
1.5. DBMS language and interface
1.6. Classifications of Database Management Systems.

Unit II: Data Modelling Using Entity-Relationship Model

2.1. Using high level conceptual Data models for Database Design
2.2. An Example Database Application
2.3. Entity types
2.4. Entity Sets
2.5. Attributes and Keys
2.6. Relationships
2.7. Relationship types
2.8. Roles and Structural constraints
2.9. Weak Entity Types
2.10. Drawing E- R Diagrams.

Unit III: Database Design

3.1. Introduction to Logical Database Design
3.2. Relational Data Model
3.3. Super Key, Candidate Keys, Primary Key
3.4. Codd's Rules
3.5. Relational Algebra
3.6. Integrity Constraints
3.7. Transforming ER diagrams into relations
3.8. Functional Dependencies
3.9. Normalization – 1NF, 2NF, 3NF, BCNF and 4NF

Unit IV: System Implementation (SQL)

4.1. Introduction to SQL
4.1.1. Inserting, Updating, and Deleting data
4.1.2. Processing Single Tables
4.1.3. Manipulation Data in SQL
4.2. Processing Multiple Tables
4.2.1. Joining Multiple Tables (Equi Joins)
4.2.2. Joining a Table to itself (self Joins)
4.2.3. Sub queries Union
4.2.4. Intersect & Minus Clause
4.3. Creating view
4.3.1. Renaming the Column of a view
4.3.2. Updating, Selection, Destroying view
4.3.3. Granting Permissions

Unit V: NoSQL

5.1 Introduction to NoSQL
5.2 Types of NoSQL Databases
5.3 Use Cases for NoSQL
5.4 Creating and Managing Document Databases
5.5 Manipulating Data in Document Databases

Laboratory sessions:

1. Create a sample database (e.g., employee, bank, university).
2. Use Data Definition commands to create tables and constraints in tables.
3. Use Data Manipulation commands for insert, delete, update, and list rows from table.
4. Use where, order, having, join clauses with logical operators and special operators to retrieve data from tables.
5. Use relational operators and sub query operators to join tables.
6. Manipulate data stored in document database

Each laboratory session will begin with a concise overview of the relevant concepts to ensure students have the necessary theoretical foundation before proceeding to the practical tasks. Sample datasets will be provided to facilitate hands-on learning, and students will be required to document their work and share their code for review and feedback. To streamline database management, students will utilize industry-standard tools such as MySQL Workbench and MongoDB Compass. This approach ensures a comprehensive understanding of both relational and non-relational databases, equipping students with the skills needed to work effectively in real-world database environments.

Some of the practical sessions will be used for group discussions for projects.

Reading List

Essential Reading:

Elmasri, R., & Navathe, S. B. (2016). *Fundamentals of Database Systems* (7 ed.). Pearson.

Silberschatz, A., Korth, H. F., & Sudarshan, S. (2019). *Database System Concepts* (7 ed.). McGraw-Hill.

Sadalage, P., & Fowler, M. (2012). *NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot*

Additional Reading:

Deitel, P., & Deitel, H. (2007). *Internet & world wide web: how to program*. Prentice Hall Press.

Ramakrishnan, R., & Gehrke, J. (2000). *Database management systems*. McGraw Hill.

Williams, K., Brundage, M., Dengler, P., Gabriel, J., Hoskinson, A., Kay, M. R. & Vanmane, M. (2000). *Professional XML databases*. Birmingham, UK: Wrox press.

Date: February, 2025.

2.4 Year 2, Semester II

DAT203 Artificial Intelligence and Machine Learning

Module Code and Title: DAT203 Artificial Intelligence and Machine Learning
Programme: Bachelor of Data Science and Data Analytics
Credit: 12
Module Tutor(s): Phub Namgay

General Objective

The module aims to provide students with a solid foundation in artificial intelligence (AI) and machine learning (ML)while emphasizing practical applications. Students will gain hands-on experience in designing, implementing, and optimizing machine learning models. The module covers supervised and unsupervised learning techniques, ensemble methods, machine learning pipelines, data engineering, and model deployment. Additionally, students will explore real-world AI applications, industry use cases, and ethical considerations in AI development.

Learning Outcomes

On completion of the module, students will be able to:

1. Explain core concepts of Artificial Intelligence (AI) and Machine Learning (ML), including their real-world applications.
2. Differentiate between supervised, unsupervised, and reinforcement learning, and apply them to appropriate problem domains.
3. Install, configure, and effectively utilize machine learning libraries such as Scikit-learn, TensorFlow, and PyTorch.
4. Perform data engineering tasks, including data acquisition, feature engineering, missing value handling, encoding, and feature scaling.
5. Develop and evaluate supervised learning models (regression and classification) using key algorithms like Decision Trees, SVM, and Neural Networks.
6. Implement unsupervised learning techniques, including clustering (k-Means, DBSCAN) and association rule mining.
7. Apply ensemble learning methods (bagging, boosting, and stacking) to improve model performance.
8. Optimize machine learning models using cross-validation, hyperparameter tuning, and model selection techniques.
9. Design, build, and deploy end-to-end ML pipelines for production-ready AI applications.
10. Critically analyze ethical considerations, biases, and challenges in AI development across various industries.

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
	Teaching	2	

Contact	Practical and group work	2	60
Independent study	Assignments, projects, self-study	4	60
Total		**8**	**120**

The module will be taught using a blend of tutorial sessions and practical sessions.
During the tutorial sessions, students will learn the key concepts and principles of AI and Machine Learning. In addition, activities such as small-group discussions and presentations will be held during the tutorials. This allows students to have more opportunities to participate in discussions and to have better class interactions.

In the practical lessons, students will be working on practical exercises that are designed for students to solve problems using the knowledge learned from the tutorial lessons.

Assessment Approach
The assessment will be carried out on a continuous basis through the following approaches.

A. Quizzes: (20%)

A total of four online quizzes each worth 5% will be conducted for a duration of one hour upon the completion of each unit. These quizzes are aimed at testing students' understanding of the subject on a continuous basis.

B. Lab Assignment: (20%)

Two lab assignments, each worth 10%, will be assigned individually, one in the first half and one in the second half of the semester. These assignments would include topics in data engineering, supervised learning, unsupervised learning, and ensemble learning.

C. Term Test: (20%)

A two-hour closed-book written test covering theoretical and conceptual ML knowledge will be conducted around mid of the semester.

D. Project: (40%)

This is a group project aimed to enable students to apply what they have learned throughout the semester to create an AI/Machine Learning solution to solve real-world problems. Students are required to deploy their AI/ML application on a live server. Moreover, each group will have to prepare the technical documentation for their AI/Machine Learning application.

The project will consist of FOUR parts:

1. Part 1: Proposal Presentation (10%)

2. Part 2: Model Presentation (10%)
3. Part 3: Final Presentation (15%), and
4. Part 4: Final Report (5%)

Each part will be assessed based on the following rubrics:

Part 1: Proposal Presentation (10%)			
Competencies	**0 - 1 (Needs Improvement)**	**2 - 3 (Proficient)**	**4 - 5 (Excellent)**
Project Identification (5)	Problem statement, project topic and keyword evidence lack of effort or depth of thinking about the project.	Problem statement are vague and fuzzy, project topic doesnot connect to problem statement, keyword are not specific	Problem statement are clear and specific, project topic relates to problem statement, keyword links to project
Define proper aims, objectives, and scope (5)	Aims, Goals, Objectives and scope were not clearly stated.	Aims, Goals and Objectives lacked overall organization of project ideas. The reader had to make considerable effort to understand the underlying flow of ideas and scope.	Aims, Goals and Objectives were well organized and clearly written. Scope of the project is clear and specific
Project Features (5)	The audience had to make considerable effort to understand the underlying requirement and flow of ideas lacking clarity in all components	Background and the literature review lacks clarity. The functional and nonfunctional requirements lack clarity. The architecture does not connect for the frontend, backend and storage	Background and the literature review were well organized and clearly written. The functional and nonfunctional requirements are easy to follow. The architecture was appropriate for the frontend, backend

		technology implementation and project deployment. The transitions and workflow are not not easy to understand	and storage technology implementation and project deployment. The transitions and workflow were easy to follow.
Individual Presentation (5)	Presentation could not connect to the overall concept of the project (the contribution of each member based on the role that has given in the documents)	Presentation were not consistent throughout, lacks confidence in the presenter, could partially connect to the overall concept of the project (the contribution of each member based on the role that has given in the documents)	Presentation Illustrate and connects to the overall concept of the project (the contribution of each member based on the role that has given in the documents)
Q & A (5)	Couldn't comprehend question, couldn't answer any question or could answer only one question	Able to comprehend question question and able to answer 2 to 3 question	Able to answer 3 or more question
Group contributions (5)	Rarely contributed to the group and were not able to explain their own task.	Occasionally contributed to the group project and were fairly able to explain their individual task.	Constantly contributed thoughts and ideas to the group and were able to give clear explanations.

Part 2: Model Presentation (10%)

Competencies	0 - 1 (Needs Improvement)	2 - 3 (Proficient)	4 - 5 (Excellent)
Content & Technical Depth (5)	- Lacks essential technical details or misrepresents the model's workings. - Fails to clearly explain key components (architecture, algorithms, evaluation), or the explanation is inaccurate. - Little or no connection to the real-world problem.	- Covers the key technical aspects of the model with clear explanations. - Most important components (architecture, algorithms, evaluation) are well-addressed with adequate detail. - Shows a good understanding of the solution's relevance.	- Presents a comprehensive and technically detailed overview of the AI/ML model. - Clearly explains the model's architecture, algorithms, data preprocessing, and evaluation metrics. - Demonstrates strong understanding of how the solution addresses the real-world problem.
Demonstration & Deployment (5)	- The live demonstration is incomplete or missing. - Fails to effectively showcase the AI/ML application's functionality or discuss deployment aspects. - Practical examples are absent or unclear.	- Demonstrates the deployed application with clear examples. - Explains most features and benefits, including basic deployment details. - Some aspects of the live demonstration could be more polished.	- Effectively demonstrates the live AI/ML application deployed on a server. - Provides clear, practical examples of how the model functions in real-time. - Highlights key features and benefits, and explains deployment challenges and solutions.
Presentation Skills & Organization (5)	- Presentation is poorly organized and difficult to follow. - Speakers appear unprepared or unclear, with significant issues	- Presentation is well-organized and clear, with minor lapses in engagement or delivery. - Speakers are generally	- Presentation is highly organized, engaging, and professionally delivered. - Speakers maintain excellent eye contact, clear

	in engagement and delivery. - The overall structure undermines the clarity of the technical content.	confident and articulate, with a logical structure.	voice modulation, and effective pacing. - The content is well-structured and flows logically from introduction to conclusion.
Q&A and Audience Engagement (5)	- Fails to answer questions effectively, with responses that are unclear, incorrect, or incomplete. - Shows little to no engagement with the audience and lacks confidence in addressing inquiries.	- Answers questions clearly and adequately. - Demonstrates good understanding and provides generally satisfactory responses. - Engages with the audience, though some answers may lack depth.	- Responds to questions with confidence and clarity, demonstrating deep understanding. - Engages the audience effectively, providing insightful answers that reflect strong grasp of the subject matter. - Handles challenging questions with poise.

Part 3: Final Presentation (15%)			
Competencies	**0 - 1 (Needs Improvement)**	**2 - 3 (Proficient)**	**4 - 5 (Excellent)**
Quality (5)	The project demonstrates numerous errors, omissions, or inaccuracies. It lacks a clear structure or organization, making it difficult to follow. It does not meet the basic requirements or objectives	The project meets most of the requirements and objectives. It demonstrates a reasonable level of accuracy and organization. It project may have minor errors or areas for improvement, but overall it is satisfactory.	The project exceeds the requirements and objectives. It demonstrates a high level of accuracy and organization. It goes beyond expectations, showcasing creativity and innovation

Demonstration (5)	The project demonstration is unclear, disorganized, or difficult to follow. The student fails to effectively communicate the purpose, process, or results of the project. The student demonstrates a lack of understanding of the project or its components.	The project demonstration provides a basic understanding of the purpose, process, and results. The student communicates the key elements of the project adequately, though improvements can be made. The student demonstrates a reasonable level of understanding of the project and its components.	The project demonstration effectively communicates the purpose, process, and results. The student engages the audience, clearly explaining and showcasing the key elements of the project. The student demonstrates a thorough understanding of the project and its components, answering questions confidently and providing additional insights.
Presentation (5)	Presentation could not connect to the overall concept of the project (the contribution of each member based on the role that has given in the documents)	Presentation were not consistent throughout, lacks confidence in the presenter, could partially connect to the overall concept of the project (the contribution of each member based on the role that has given in the documents)	Presentation Illustrate and connects to the overall concept of the project (the contribution of each member based on the role that has given in the documents)
Q & A (5)	Couldn't comprehend question, couldn't answer any question or could answer only one question	Able to comprehend question question and able to answer 2 to 3 question	Able to answer 3 or more question
	Rarely contributed to the group and were not able to	Occasionally contributed to the group project and	Constantly contributed thoughts and ideas

Group contributions (5)	explain their own task.	were fairly able to explain their individual task.	to the group and were able to give clear explanations.

Part 4: Final Documentation (5)			
Competencies	**0 - 1 (Needs Improvement)**	**2 - 3 (Proficient)**	**4 - 5 (Excellent)**
Content and organization (5)	The documentation lacks a central theme, clear point of view, and logical sequence of information. Much of the information is irrelevant and is not according to the specified format. References and citations are not appropriate	Information is connected to a theme and prepared according to the specified format. Details are logical and most of the information is relevant to the document. References and citations are appropriate but not mentioned well.	Documentation is according to the specified format, includes a clear statement of purpose. Events and messages are presented in a logical order, with relevant information that supports the intended ideas. References and citations are appropriate and well mentioned.
Closure (5)	The document ends abruptly and does not convey the theme/message. Results are not presented properly. Project report is not summarized and concluded.	The document ends in a manner that will adequately cause the viewer to remember the theme/message. Results are presented in a good manner. Project report's summary and conclusion are not very appropriate.	The document ends in an effective and creative manner that will cause the viewer to remember the theme/message.Results are presented in a very appropriate manner. The Project Report is well summarized and concluded.

Overview of the assessment approaches and weighting

Sl.No.	Area of Assessment	Quantity	Weighting

A.	Quizzes	4	20%
B.	Lab Assignments	2	20%
C.	Term Test	1	20%
D	Project	1	40%
	Total	**8**	**100%**

Pre-requisites: CSP101 Foundations of Python Programming

Subject Matter

Unit I: Introduction to Artificial Intelligence

1.1 AI vs. Human Intelligence & Traditional Information Processing
1.2 Foundations of artificial intelligence
1.3 History of artificial intelligence
1.4 AI State-of-the-Art: Current Trends & Breakthroughs

Unit II: Introduction to Machine Learning

2.1 Supervised, Unsupervised & Reinforcement Learning
2.2 ML Tools Overview: Scikit-learn, TensorFlow, PyTorch
2.3 Installation and configuration of machine learning Frameworks

Unit III: Data Engineering

3.1 Data Acquisition & Feature Engineering
3.2 Data Cleaning, Missing Values, Encoding Techniques
3.3 Handling Unbalanced Datasets (SMOTE, Oversampling)
3.4 Feature Scaling & Feature Selection

Unit IV: Supervised Learning

4.1 Regression & Classification Techniques
4.2 Implementation of Linear Regression, KNN, Naïve Bayes, SVM, Decision Trees, Neural Networks
4.3 Model Evaluation (MSE, RMSE, R^2, Precision, Recall, F1-Score)
4.4 Hyperparameter Tuning: Grid Search & Cross-Validation
4.5 ML Pipelines & Deployment

Unit V: Unsupervised Learning

5.1 Clustering:
    5.1.1 k-Means,
    5.1.2 Agglomerative Clustering,
    5.1.3 DBSCAN
5.2 Association Rule Mining**:**
    5.2.1 Apriori Algorithm
5.3 Model Evaluation & Efficiency Analysis

Unit VI: Ensemble Learning

6.1 Voting, Stacking, Bagging, Boosting
6.2 Implementation of Random Forest, Gradient Boosting, AdaBoost, XGBoost
6.3 Model Comparison with Single Learners
6.4 Implementation of ensemble learning algorithms

Unit VII: Applications of AI & ML

7.1 AI in Healthcare, Finance, Robotics, Cybersecurity, and Autonomous Vehicles
7.2 AI Challenges & Ethical Considerations (Bias, Fairness, Privacy)

Laboratory Sessions:

1. **Practical 1: Introduction to to AI**
    a) Explore AI concepts and Applications
    b) Explore Machine Learning concepts and applications
    c) Explore Deep learning concepts and applications.
2. **Practical 2: Data Wrangling with Pandas, Matplotlib and Seaborn**
    a) Explain pandas dataframe and series data structure.
    b) Use appropriate methods to load and save data of different format
    c) Use panda's dataframe and series method to work with structured dataset
    d) Use matplotlib and seaborn libraries to visualize data.
3. **Practical 3: Categorical Features - Imputation and Encoding**
    a) Feature engineering techniques for categorical features.
    a) Prepare categorical features for training machine learning models
4. **Practical 4: Numerical Features - Outlier detection, Transformation, Scaling Features**
    a) Apply required feature engineering techniques to numerical as well as categorical features.
    b) Prepare features for training machine learning model
5. **Practical 5: Supervised Learning - Linear Models**
    a) Load required dataset and library for training machine learning model
    b) Implement sklearn LinearRegression algorithm for simple linear model as well as multiple linear model.
    c) Find MSE for the created model
    d) Make prediction for unseen data
6. **Practical 6: Supervised Learning - Classification**
    a) Split the given dataset into train and test set
    b) Create classification machine learning model
    c) Evaluate the model performance for both train and test dataset
7. **Practical 7: Supervised Learning - Logistic Regression**
    a) Split the given dataset into train and test set
    b) Create classification machine learning model
    c) Evaluate the model performance for both train and test dataset
8. **Practical 8: Supervised Learning - Non-linear models**

a) Differentiate and identify overfitting and underfitting issues in machine learning
b) Apply polynomial features to overcome under fitted models and use non-linear models
c) Implement regularization to overcome overfitted models

9. **Practical 9: Supervised Learning - Decision Tree**
    a) Implement decision tree algorithm for regression and classification problems
10. **Practical 10: Evaluation Metrics for Supervised Learning**
    a) Apply feature engineering techniques required for both numerical and categorical features
    b) Use different evaluation methods for classification problems
11. **Practical 11: Understanding Machine Learning Pipeline**
    c) Implement preprocessing steps with machine learning pipeline
    d) Train pipeline model
    e) Save model
12. **Practical 12: Unsupervised Learning - KMean Clustering**
    a) Differentiate supervised and unsupervised learning
    b) Implement KMean clustering on given dataset
13. **Practical 13: Unsupervised Learning - Agglomerative Clustering**
    a) Implement Agglomerative clustering on given dataset
    b) Differentiate between the various clustering algorithms
14. **Practical 14: Ensemble Learning: Bagging & Random Forest**
    a) Use a dataset (e.g., the Iris dataset) to build and evaluate a bagging model versus a single decision tree.
    b) Implement a random forest classifier with scikit-learn, tune hyperparameters (e.g., number of trees, maximum depth), and compare its performance against the bagging model.
15. **Practical 15: Ensemble Learning: Voting & Stacking Ensemble Techniques**
    a) Create individual classifiers (e.g., logistic regression, decision tree, SVM) and combine them into a majority voting ensemble using scikit-learn's VotingClassifier.
    b) Experiment with both hard voting (majority rule) and soft voting (averaged probabilities) and analyze performance improvements over the individual models.
    c) Build several base learners (e.g., random forest, gradient boosting, and k-nearest neighbors) and then use a meta-learner (e.g., logistic regression) to integrate their predictions.
    d) Use cross-validation to evaluate the performance of the stacking ensemble compared to individual base learners.

Reading List

Essential Reading:

Geron, A. *Hands-on-Machine Learning with Scikit-Learn, Keras, and TensorFlow*

Hapke, H. & Nelson C. *Building Machine Learning Pipelines.*

Muller, A.,C. and Guido, S. *Introduction to Machine Learning with Python (A Guide f or Data Scientists)*

Russell, S. and Norvig, R. *Artificial Intelligence: A Modern Approach*.

Additional Reading:

Goodfellow, I., Bengio, Y., & Courville, A. *Deep Learning*

Mitchell, T. *Machine Learning*

Date: February 2025

CSP203 Back End Web Development

Module Code and Title: CSP203 Back End Web Development
Programme: Bachelor of Data Science and Data Analytics
Credit: 12
Module Tutor(s): Norbu Zangpo

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General Objective

This module equips students with the knowledge and skills required to design and develop secure, reliable, and scalable backend web applications that can handle high-volume concurrent connections—essential for modern web applications. Students will learn to implement object-oriented server-side applications using the Model-View-Controller (MVC) architecture, expose APIs, and integrate database systems efficiently. The course emphasizes best practices in backend development, including testing, deployment, and security.

Learning Outcomes

On completion of the module, students will be able to:

1. Explain multi-tiered web application architecture and the purpose and benefits of backend systems in modern web applications.
2. Configure the development environment and tools for both frontend and backend development, ensuring seamless integration.
3. Describe the capabilities of Node.js, explain its event-driven architecture, and justify its use in backend development.
4. Install and configure Node.js using various package managers or source installation on POSIX-like systems.
5. Define Node.js modules and manage dependencies effectively using npm and Yarn.
6. Design and implement a web application backend using the MVC architecture to ensure separation of concerns.
7. Set up and configure both SQL and NoSQL databases, establish data connectivity, and implement structured data models.

8. Differentiate between RESTful and non-RESTful approaches and develop RESTful APIs for backend services.
9. Implement API consumption in the frontend by connecting and integrating backend services.
10. Apply different testing methodologies and perform automated testing to ensure a robust and error-free backend system.
11. Evaluate and implement various deployment options, containerize the web application, deploy it to a live server, and conduct post-deployment testing.

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
Contact	Teaching	2	60
	Practical and group work	2	
Independent study	Assignments, projects, self-study	4	60
Total		**8**	**120**

The module will be delivered through a combination of theory-based teaching sessions and hands-on practical sessions.

During teaching sessions, students will be taught the concepts related to the technology and architecture used for backend development and testing processes.

During practical sessions, students will be required to implement theoretical concepts into working code, reinforcing their understanding through hands-on development exercises.
Group projects will be assigned to encourage collaborative problem-solving, team-based development, and peer learning. Likewise, exercises will help to build the logic for developing backend components and also improve their understanding of the module. Other assignments and self-study will encourage students to explore additional resources and complete coding exercises outside of class hours.

Assessment Approach

A number of continuous assessments will be used to evaluate student performance on a regular basis.

A. Quizzes: (20%)
A total of two in-class and two online quizzes, each worth 5%, will be conducted to assess the understanding of concepts taught in the class.

B. Presentations: (20%)
Students will illustrate their project using a technical poster and oral presentation. This is followed by a demonstration of their final product. The assessment will be done based on the following criteria:

Component	Criteria	Excellent (90 - 100%)	Proficient (70 - 89%)	Developing (50 - 69%)	Needs Improvement (< 50%)
Technical Poster	Content & Technical Depth (25%)	Content is highly detailed, accurate, and shows a deep understanding of the project. Includes all key technical aspects and clearly explains methodology.	Content is accurate and covers most technical aspects with minor omissions; shows good understanding of the project.	Content is basic, with some technical details missing or unclear; understanding is superficial in places.	Content is incomplete or largely inaccurate, lacking essential technical details and clear explanation.
	Design & Visual Presentation (25%)	Poster is visually engaging, well-organized, and uses high-quality graphics and layout. Information is easy to navigate and understand.	Poster is clear and organized; visuals support the content adequately with minor layout or clarity issues.	Poster is somewhat cluttered or disorganized, making it harder to follow; visuals are basic or not fully aligned with content.	Poster lacks organization and clarity; visuals are poor or missing, significantly detracting from understanding.
	Overall Clarity & Communication (Poster) (25%)	The poster communicates complex ideas very clearly and succinctly, with excellent use of language and minimal errors.	The poster communicates ideas clearly for the most part, with only a few language or clarity issues.	The poster communicates basic ideas, but there are noticeable language issues or unclear sections.	The poster is confusing or difficult to understand due to poor language, structure, or significant errors.
	Integration of Research and Practical	The poster effectively integrates research,	The integration of research and practical work	There is some evidence of integration,	Little or no integration of research, theory, and

	Work (25%)	theory, and practical project work, demonstrating strong linkage between concepts and implementation.	is clear with minor gaps; most concepts are well connected to the project's implementation.	but key connections between theory and practice are weak or partially missing.	practical work is evident; connections are unclear or absent.
Oral Presentation	Delivery & Communication Skills (30%)	The presentation is highly engaging, clear, and well-paced; the speaker uses excellent eye contact, voice modulation, and body language.	The speaker is clear and communicates effectively, though there may be occasional lapses in engagement or clarity.	The presentation is delivered with some hesitation or monotony; communication is understandable but lacks engagement.	The speaker is unclear, disengaged, or difficult to understand; poor communication significantly impedes the presentation.
	Organization & Structure (30%)	The presentation is extremely well-organized, with a logical flow that makes the project's objectives, methodology, and outcomes very clear.	The presentation is well-structured and mostly logical; key points are presented in an understandable sequence.	Organization is somewhat unclear or disjointed; the structure may confuse the audience at times.	The presentation lacks clear organization and structure, making it difficult to follow or understand.
	Handling of Q&A / Audience Engagement (20%)	The presenter handles questions confidently and comprehensively, demonstrating deep	The presenter responds well to questions, showing adequate understanding and engagement with the	The presenter struggles to answer some questions or shows limited engagement with the audience.	The presenter is unable to answer questions adequately and/or does not engage with the audience.

		knowledge and engaging effectively with the audience.	audience.		
	Use of Visual Aids / Presentation Materials (20%)	Visual aids (slides, charts, etc.) are highly effective, professional, and significantly enhance the understanding of the presentation.	Visual aids are clear and helpful, with only minor issues in design or effectiveness.	Visual aids are present but may be poorly designed or only somewhat effective in supporting the presentation.	Visual aids are lacking, poorly designed, or do not support the presentation, hindering audience understanding.
Final Product Demonstration	Functionality & Technical Performance (40%)	The final product functions flawlessly, meeting or exceeding all requirements with robust performance and minimal errors.	The product meets most requirements and performs well, though minor issues may be present that do not significantly impede functionality.	The product functions but has several noticeable issues or errors that affect overall performance; some features may be incomplete.	The product fails to function as intended, with significant errors or missing features that prevent a successful demonstration
	Innovation & Complexity (30%)	The product demonstrates a high level of innovation and technical complexity; solutions are creative and effectively address the problem.	The product shows good technical complexity and some innovative elements that meet the project's objectives.	The product demonstrates limited innovation or complexity; solutions are somewhat conventional and may only partially address the problem.	The product shows minimal innovation or complexity; technical solutions are rudimentary or ineffective.
	Usability & User Experience (20%)	The product offers an excellent user	The product is user-friendly with minor	Usability is average; the product works but	The product is difficult to use, with significant

		experience, with intuitive navigation, responsive design, and clear functionality; users can easily interact.	usability issues that do not significantly hinder user interaction.	may be confusing or less intuitive for users in some areas.	usability issues that hinder user interaction and overall experience.
	Demonstration & Explanation (10%)	The demonstration is clear, well-structured, and thoroughly explains the product's features, technical details, and benefits to the audience.	The demonstration explains most aspects of the product adequately, with a clear outline of features and benefits, despite minor lapses.	The demonstration covers the product's features but lacks clarity or depth in explaining key technical details.	The demonstration is unclear or incomplete, failing to effectively explain the product's functionality or benefits.

C. Lab Exercise Submission: (20%)

Students are expected to complete and submit regular lab exercises to ensure understanding of practical lessons.

D. Project: (30%)

Students will carry out a project to design, develop, test and deploy a backend server event-driven application using the MVC architecture along with RESTful web service. Students must also demonstrate an example of practical service consumption of their application. This assignment can be assigned either in group or individual depending on the class size and other requirements deemed necessary by the tutor.

The assessment will be done based on the following rubrics:

Component	**Excellent (90 - 100%)**	**Proficient (70 - 89%)**	**Developing (50 - 69%)**	**Needs Improvement (< 50%)**
	Requirements are thoroughly analyzed and documented. - The design is	Requirements are adequately documented with minor gaps.	Basic requirements are documented, but key details are missing.	Requirements are poorly documented or incomplete. - The design is

1. Project Planning & Design (20%)	highly detailed, clearly outlining the MVC architecture, event-driven aspects, and RESTful service endpoints. - Diagrams and design documents (e.g., flowcharts, UML) are comprehensive and insightful.	- The design clearly covers the MVC and event-driven aspects with a well-structured outline of RESTful services. - Diagrams and design documents are complete but may lack some depth.`	- The design shows an understanding of MVC and RESTful concepts, though the integration of event-driven elements is not fully addressed. - Diagrams are present but lack clarity or completeness	unclear or missing critical components (e.g., MVC structure, event-driven logic, RESTful endpoints). - Diagrams and documentation are minimal or absent.
2. Implementation & Coding (30%)	- Code is highly modular, clean, and well-commented, following best practices. - The application fully implements an event-driven, MVC-based backend with robust RESTful web services. - The code is efficient, with a clear structure and strong adherence to the design.	Code is well-organized and adequately commented. - The implementation of the MVC pattern, event-driven processing, and RESTful endpoints is correct with minor issues. - Overall, the code meets the project requirements.	Code functions but is somewhat disorganized or lacks consistent commenting/documentation. - The implementation of MVC and RESTful services is present but may have some design or efficiency issues, and the event-driven aspects are only partially integrated.	Code is poorly organized, difficult to follow, or lacks comments. - The implementation does not properly address the MVC architecture, event-driven logic, or RESTful services, leading to significant functional or structural issues.
	Comprehensive testing is evident, including unit, integration, and system tests (preferably using TDD). - Test cases cover a broad	Adequate testing is provided with most key scenarios covered. - Test cases are documented and the	Some testing is performed, but test coverage is limited or inconsistent. - Test cases are documented minimally and several bugs or issues remain	Testing is insufficient or largely absent. - The application has significant bugs or issues due to a lack of systematic quality

3. Testing & Quality Assurance (20%)	range of scenarios, with high test coverage and clear documentation of outcomes. - The application is robust and bug-free.	application is stable, though minor issues or gaps in coverage exist. - TDD is partially implemented.	unresolved.	assurance practices.
4. Deployment & Documentation (15%)	The application is successfully deployed to a live environment or containerized solution, with clear, detailed deployment instructions. - Documentation is comprehensive, covering installation, configuration, and usage guidelines, as well as system architecture details.	The deployment is successful with minor issues, and instructions are clear. - Documentation covers most aspects of installation and usage but may lack some details in architecture or troubleshooting.	The application is deployed, but the process is somewhat cumbersome or error-prone. - Documentation is provided but is incomplete or unclear in some areas.	Deployment fails or is not attempted. - Documentation is minimal, unclear, or missing critical instructions for installation and use.
5. Presentation & Demonstration (15%)	The demonstration is highly professional, clearly showcasing the application's architecture, functionality, and service consumption. - The presenter explains technical details	The demonstration is clear and covers all major aspects of the project. - The presenter explains the project well and responds adequately to questions. - Service consumption examples are	The demonstration covers basic functionality, but some aspects of the architecture or service consumption are only superficially explained. - The presenter shows some hesitation or lacks depth in answering	The demonstration is unclear, incomplete, or fails to effectively showcase the application. - The presenter is unable to adequately explain technical details or answer questions, and

	confidently and handles questions with depth. - The demonstration effectively highlights innovative aspects and practical usage.	shown with minor clarity issues.	questions.	practical service consumption is not demonstrated.

Overview of the assessment approaches and weighting

Sl.No.	Area of Assessment	Quantity	Weighting
A.	Quizzes	4	20%
B.	Presentations	1	20%
C.	Lab Exercises	1	20%
D	Project	1	40%
	Total	**7**	**100%**

Pre-requisites: CSP101 Foundations of Python Programming & CSP202 Modern Database Design

Subject Matter

Unit I: Fundamentals of Backend Development

1.1 Introduction to Backend Technology

1.1.1 The role and importance of of backend systems in web applications

1.1.2 Difference between frontend and backend functions

1.2 Multi-tiered Web Application Architecture

1.2.1 Types of layer (presentation, business logic, data)

1.2.2 Interaction between the layers

1.3 Purpose and Setup of Backend Systems

1.3.1 Benefits of using a dedicated backend

1.3.2 Setting up the development environment and tools for both frontend and backend work

Unit II: Introduction to Node.js

2.1 Node.js Landscape and Capabilities

2.1.1 Overview of Node.js and its ecosystem.

2.1.2 Explanation of its event-driven architecture and asynchronous processing

2.2 Rationale for Using Node.js

2.2.1 Discuss why Node.js is chosen for backend development in modern web applications

2.3 Installation and Initial Testing
    2.3.1 Identify system requirements for Node.js.
    2.3.2 Install Node.js using package managers and from source on POSIX-like systems.
    2.3.3 Run and test basic Node.js commands to ensure proper setup.
2.4 Node.js Modules and Package Management
    2.4.1 Define a Node.js module
    2.4.2 Load modules using `require` and ES6 `import` syntax
    2.4.3 Npm (Node Package Manager) and its role in managing packages
    2.4.4 Yarn as an alternative package management system

Unit III: MVC Web Framework

3.1 MVC Architecture Fundamentals
    3.1.1 Model-View-Controller (MVC) architecture
    3.1.2 Separation of concerns and benefits of the MVC pattern
3.2 Designing the Backend Architecture
    3.2.1 Translating application requirements into a structured MVC design
    3.2.2 Creating design blueprints for a web application using MVC principles

Unit IV: Persistent Storage and Data Transactions

4.1 Setting Up Persistence Storage
    4.1.1 Configuring both SQL and NoSQL databases.
    4.1.2 Establishing data connectivity between the backend and databases.
4.2 Implementing Data Models
    4.2.1 Designing models to represent business requirements.
    4.2.2 Implementing tables and relationships in SQL databases and collections/documents in NoSQL databases.
4.3 Performing Data Transactions
    4.3.1 Creating entity classes based on model design.
    4.3.2 Implementing CRUD (Create, Read, Update, Delete) operations with data validation and aggregation logic.
    4.3.3 Addressing data access methods and handling transactions.

Unit V: API Development and Frontend Integration

5.1 Web API as a Backend Service
    5.1.1 Define web services and differences between RESTful and RESTless approaches.
    5.1.2 Implement RESTful web services and test them using tools such as REST Client or Postman.
5.2 Implementing the Controller and Frontend Views
    5.2.1 Setting up frontend boilerplate code that consumes backend web services.
    5.2.2 Designing and implementing controller logic to bridge the backend and frontend.
    5.2.3 Developing view logic that presents data from the backend effectively.
5.3 Performing Transactions with Backend Services
    5.3.1 Integrating the backend transactions with frontend requirements, ensuring seamless data flow and user interaction

Unit VI: Testing and Deployment of Web Application

6.1 Testing the Application

6.1.1 Describing, explaining, and implementing various testing methods for backend systems.

6.1.2 Introducing Test Driven Development (TDD) and writing effective test cases.

6.1.3 Developing automated test cases to ensure an error-free backend.

6.2 Deploying the Application

6.2.1 Reviewing different deployment options and strategies for web applications.

6.2.2 Containerizing the application using tools like Docker.

6.2.3 Deploying the application to a live server and conducting post-deployment testing to verify performance and stability.

Laboratory Sessions

1. **Practical 1: Development Environment Setup**
   Task: Install and configure IDEs, version control tools, and development workspaces.

2. **Practical 2: Installing and Exploring Node.js**
   Task: Install Node.js, explore the REPL, and run basic scripts.

3. **Practical 3: Working with Node.js Modules**
   Task: Create and import custom modules using CommonJS and ES6 syntax.
4. **Practical 4: Building a Basic MVC Application with Node.js**
   Task: Set up an Express.js application following MVC principles.

5. **Practical 5: Integrating SQL and NoSQL Databases**
   Task: Connect to databases, implement schemas, and perform CRUD operations.

6. **Practical 6: Creating and Testing RESTful APIs**
   Task: Implement API endpoints and test them using Postman.

7. **Practical 7: Frontend Integration**
   Task: Build a simple frontend to consume backend APIs..

8. **Practical 8: Implementing Authentication & Security**
   Task: Implement authentication mechanisms and secure API endpoints.

9. **Practical 9: Automated Testing & Debugging**
   Task: Write unit tests and perform debugging using Node.js testing frameworks.

10. **Practical 10: Deployment and Performance Testing**
    Task: Containerize the application using Docker and deploy it to a live server.

Reading List

Essential Reading:

Herron, D. (2020). *Node.js Web Development*

Hinkula, J. (2019.) *Hands-On Full-Stack Web Development with Spring Boot 2 and React.*

Sebastian (2019*) Hands-On Full-Stack Web Development with GraphQL and React*

Date: February 2025.

DAT205 Data Science Project I

Module Code and Title: DAT205 Data Science Project I
Programme: Bachelor of Data Science and Data Analytics
Credit: 12
Module Tutor(s): Phub Namgay

General Objective

This module provides a platform for students to apply Python programming skills in acquiring, preprocessing, analyzing, and visualizing real-world datasets. Students will integrate database management, statistical analysis, and front-end web development to create interactive data visualizations. The final deliverables include a structured project report and an interactive presentation that demonstrates interdisciplinary problem-solving in data science.

Learning Outcomes

On completion of the module, students will be able to:

1. Acquire datasets from free sources or self-collection methods.
2. Clean, transform, and prepare raw data using Python libraries.
3. Apply statistical techniques to explore datasets and identify trends.
4. Develop clear and informative visualizations using Python-based tools.
5. Build interactive, web-based data visualizations.
6. Integrate knowledge from multiple disciplines to solve data-driven problems.
7. Address ethical considerations in data collection, processing, and reporting.
8. Formulate a well-structured and ethically responsible research plan.
9. Communicate findings effectively through structured reports and presentations.
10. Demonstrate teamwork, project management, and critical thinking in data science.

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
	Lecture and Guided Discussions	2	

Contact	Consultations and progress review meetings	2	60
Independent study	Independent Research and Development.	4	60
Total		**8**	**120**

The module will have only two hours of teaching in a week. The teaching sessions are mainly to familiarize students with project ideas, proposal write up, report writing and references, and presentation techniques. Other topics would include ethical issues and project implementations besides others.

Additionally, activities such as small-group discussion and presentation will be held during the in-class sessions. This allows students to have more opportunities to participate in discussions and to have better class interactions. Another two hours of contact per week will be for consultations and progress review meetings with the tutor.

Assessment Approach

The data science project is an individual project that forms a key component of the programme, designed to assess students' ability to apply theoretical knowledge to real-world problems. The assessment process is structured into several phases to ensure a comprehensive and meaningful learning experience. The assessment will be carried out on a continuous basis through the following approaches.

A. Project Proposal: (20%)

Students will prepare a detailed project proposal upon topic confirmation and tutor approval. Each student will make a 10-minute in-class presentation. The proposal will be assessed based on clarity of problem identification, well-defined objectives and scope, project features, presentation quality, and ability to respond to questions.

The detailed assessment criteria is as follows:

Part A: Project Proposal (20%)			
Competency	**Needs Improvement (0 - 1)**	**Proficient (2 - 3)**	**Excellent (4 - 5)**
Project Identification (5)	Unclear problem statement and weak connection between topic and keywords.	Problem is somewhat clear, but lacks depth in topic selection and keyword alignment.	Well-defined problem statement, relevant topic, and appropriate keywords.
Objectives and	Aims and scope are unclear or	Some organization, but	Clearly structured aims, goals, and

Scope (5)	poorly defined.	flow is inconsistent.	scope with logical flow.
Project Features (5)	Background, literature review, and system architecture are disjointed.	Some clarity but lacks technical depth.	Well-integrated review, requirements, and architecture that align with the project's vision.
Presentation (5)	Unclear communication and lack of connection to project concepts.	Moderately clear, but lacks confidence and engagement.	Confident, well-structured presentation with strong articulation of project vision.
Q & A (5)	Unable to answer questions clearly.	Can answer basic questions with some hesitation.	Responds confidently and accurately to queries.

B. Progress Review: (20%)

Students will maintain a project diary and participate in weekly progress meetings with the tutor. The students will submit the two project progress report, each worth 10%. The progress review will be assessed on the following components:

Part B: Progress Review (20%)			
Competency	**Needs Improvement (0 - 1)**	**Proficient (2 - 3)**	**Excellent (4 - 5)**
Project Status (5)	Poorly documented progress with no clear updates.	Reasonably clear status update with minor gaps.	Clear, well-documented updates with insights into progress and challenges.

Deliverables (5)	Missing key deliverables or poor quality	Most deliverables are complete but require refinement.	High-quality, complete deliverables with strong documentation.
Timeline Management (5)	No clear milestones or significant delays.	Some deviations but managed with reasonable adjustments.	Effective time management with well-structured milestones.
Project Diary (5)	Minimal or missing entries with little reflection.	Mostly detailed, with key progress points noted.	Comprehensive, well-documented reflections on progress, challenges, and decisions.

C. Project Report: (40%)

Students will submit their final project report for evaluation by the module tutor. The report will be assessed based on criteria:

Part C: Project Report (40%)			
Competency	**Needs Improvement (0 - 1)**	**Proficient (2 - 3)**	**Excellent (4 - 5)**
Introduction (5)	Lacks clarity and coherence; objectives, scope, and significance are poorly defined or missing. - Fails to capture the reader's interest..	- Offers a good overview with stated objectives and scope; however, may lack some depth or clarity in significance. - The introduction sets the stage but may not fully engage the reader.	- Provides a clear, concise, and engaging overview of the project. - Clearly states objectives, scope, and significance, setting the stage for the report. - Demonstrates a strong contextual understanding.
	- Incomplete or	- Adequate review	- Comprehensive

Literature Review (5)	poorly organized literature review with minimal reference to relevant sources. - Lacks critical analysis and synthesis, undermining the foundation of the research	covering most relevant sources with some critical analysis. - Shows an understanding of the background literature, though integration may not be fully comprehensive	review of relevant literature with critical analysis. - Effectively integrates multiple sources to support the research plan. - Demonstrates in-depth understanding and synthesis of prior work.
Methodology (5)	- Methodology is vague or incomplete, with insufficient details on the research design, data processing strategies, and overall approach. - Little to no justification of the chosen methods is provided.	- Provides a clear description of the methodology, including key tools and techniques. - Most steps are explained and justified, although some aspects (such as DMPS) may be less detailed.	- Describes the research design and data acquisition/preprocessing methods in detail. - Clearly explains the tools, techniques, and processes (including DMPS) used in the study. - Justifies methodological choices with strong rationale and relevance to objectives
Results (5)	- Results are poorly presented or incomplete, lacking clarity and organization. - Visualizations and tables are missing or ineffective, making interpretation difficult.	- Presents results clearly using appropriate visual aids, with minor lapses in organization or clarity. - Most results are tied to the project objectives, though some explanations may be less	- Clearly presents the data and results with appropriate visualizations and tables. - Results are well-organized, accurate, and directly tied to the objectives. - Provides detailed

		detailed.	explanations of findings, enabling clear understanding.
Findings (5)	- Findings are unclear, unsupported by evidence, or missing key aspects of the research questions. - Lacks depth and fails to demonstrate the implications of the data analysis.	- Offers clear findings with adequate support from the data. - Most research questions are addressed, though some insights may be less thoroughly explored or novel contributions less emphasized.	- Provides insightful, well-articulated findings that address the research questions. - Findings are thoroughly supported by data and analysis. - Clearly highlights novel contributions or unexpected outcomes.
Interpretation (5)	- Interpretation is weak or missing, with little connection to the literature or research objectives. - Fails to discuss the implications or acknowledge limitations of the study.	- Offers a clear interpretation of the results with connections to the literature and objectives, though some nuances or limitations may be underexplored. - Implications are generally well articulated.	- Provides a deep and nuanced interpretation of the results, linking them effectively to the literature review and research objectives. - Clearly discusses implications, limitations, and the significance of the findings.
Metadata & DMPS (Data Management and Processing Strategies) (5)	Fails to adequately document metadata or describe the DMPS. - Lacks clear explanation of data management practices,	- Adequately documents metadata and DMPS, ensuring data integrity and reproducibility. - Some minor details or justifications may	- Provides detailed and clear documentation of the metadata, data management, and processing strategies used. - Explains how data integrity and

	compromising the integrity or reproducibility of the research.	be missing, but overall documentation is solid.	reproducibility are ensured. - Demonstrates strong technical understanding and justification of DMPS choices.
Recommendations & Applications (5)	- Recommendations are vague, unsupported, or missing. - Fails to connect the findings to practical applications or provide a meaningful direction for future work.	- Provides clear recommendations and identifies practical applications, though some suggestions may lack depth. - Future directions are mentioned, but the connection to the analysis may be less robust.	- Presents well-founded, actionable recommendations based on the findings. - Clearly articulates practical applications and future directions. - Demonstrates a strong linkage between analysis, recommendations, and real-world impact.

D. Project Presentation: (20%)

Students will present project findings and insights through interactive web-based visualizations to the module tutor. The 20-minute long presentation will include 5-minutes of question and answer sessions. The assessment will be assessed based on the following criteria:

Part D: Project Presentation (20%)			
Competency	**Needs Improvement (0 - 1)**	**Proficient (2 - 3)**	**Excellent (4 - 5)**
Quality (5)	Unstructured, inaccurate, or lacks coherence.	Mostly accurate but needs improvement.	High-quality, well-structured, exceeding expectations.
Demonstration (5)	Lacks clarity and logical flow.	Provides a reasonable walkthrough of the project.	Engages the audience with a compelling and structured demonstration.
Presentation (5)	Poor confidence and inconsistent flow.	Somewhat structured but needs refinement.	Confident, well-paced, and engaging presentation.
Q & A (5)	Unable to answer questions clearly.	Can answer 2-3 questions with minor gaps.	Answer all questions confidently with depth.

Timeline:
The different aspects of the project will follow the following timeline:

Week 1: Project introduction & Brainstorming project ideas
Week 2: Ethical discussions & Draft project topic(s)
Week 3: Topic finalisation and Proposal Draft
Week 4: **Project Proposal Presentation**
Week 5: Literature Review & Data Workflow
Week 6: Data Collection
Week 7: **Project Progress Review 1**
Week 8 - 11: Project improvements
Week 12: **Project Progress Review 2**
Week 13: Project improvements
Week 14: **Project Report Submission**
Week 15: **Project Presentation**
Week 16: **Project Presentation**

Overview of the assessment approaches and weighting

Sl.No.	Areas of assessment	Quantity	Weighting (%)

A	Project Proposal	1	20
B	Progress Review	2	20
C	Project Report	1	40
D	Project Presentation	1	20
Total		**4**	**100**

Pre-requisites: DAT202 Data Analytics & Visualization, CSP201 Front End Web Development, CSP202 Modern Database Design

Subject Matter

Unit I: Introduction to Data Science Project and Ethics

1.1 Overview:

1.1.1 Purpose and process of data science projects

1.1.2 The importance of interdisciplinary skills in data science.

1.2 Ethical Consideration in Data Science

1.2.1 Ethical issues, data privacy, and responsible data handling.

1.2.2 Case studies illustrating ethical dilemmas in data science.

1.2.3 Legal and regulatory frameworks affecting data collection and use

1.3 Activity:

1.3.1 Develop a set of ethical guidelines for your own data science projects, addressing potential risks and biases.

Unit II: Project Proposal, Planning and Formulation

2.1 Developing research questions

2.2 Literature review and proper citation

2.3 Data collection methodologies

Unit III: Project Integration, Reporting, and Communication

3.1 Combining data science workflows

3.2 Report writing best practices

3.3 Interactive storytelling and presentation

Reading List

Essential Reading:

Gonzalez, J., & D'Agostino McGowan, L. (2020). *Practical Data Science for Data Scientists*. O'Reilly Media

Grus, J. (2015). *Data Science from Scratch: First Principles with Python*. O'Reilly Media.

Provost, F., & Fawcett, T. (2013). *Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking*. O'Reilly Media.

Date: February 2025.

DAT202 Statistical Computing II

Module Code and Title: DAT202 Statistical Computing II
Programme: Bachelor of Data Science and Data Analytics
Credit: 12
Module Tutor(s): Karma Dorji & Dawa Wangchuk Gyalpo
Module Coordinator: Dawa Wangchuk Gyalpo

General Objective

The aim of the module is to provide students with advanced skills and knowledge in statistical computing using the R programming language. Building upon the foundational concepts covered in Statistical Computing I, this module delves deeper into the intricacies of data manipulation, statistical inference, and hypothesis testing. It equips learners with a strong foundation in R programming, covering from basic syntax and data structures to advanced operations and custom function creation. The emphasis on data manipulation and visualization, facilitated by the use of R packages, ensures that students can effectively import, clean, and visualize data from various sources. Additionally, the module delves into probability theory and distributions, providing valuable insights into both discrete and continuous probability distributions and their real-world applications. Furthermore, the inclusion of parametric and non-parametric hypothesis testing methodologies empowers learners to make informed decisions based on sound statistical principles.

Overall, this module strikes a balance between theory and hands-on practice, making it a valuable resource for individuals seeking to enhance their data analysis and statistical skills using the R programming language.

Learning Outcomes

On completion of the module, students will be able to:

1. Apply the basic syntax and fundamental data structures of the R programming language for data manipulation and analysis;
2. Perform data import and export operations from various sources (e.g., CSV, Excel, databases) and manipulate datasets using R;
3. Construct visualizations (e.g., histograms, scatterplots, boxplots) using R to effectively represent data;
4. Explain the characteristics and properties of discrete and continuous probability distributions and their applications in statistical analysis;
5. Calculate probabilities and statistical measures (e.g., mean, variance, standard deviation) using probability distributions in practical scenarios;
6. Conduct parametric and non-parametric hypothesis tests (e.g., t-tests, chi-square tests, ANOVA, sign test, binomial etc) to analyze data and draw conclusions;
7. Evaluate the suitability of statistical methods, including non-parametric approaches, for different types of data and research questions;
8. Evaluate the results of statistical analyses and their implications in real-world data-driven decision-making processes;

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
Contact	Teaching	2	60
	Practical and group work	2	
Independent study	Assignments, projects, self-study	4	60
Total		**8**	**120**

The module will be taught using teaching sessions and practical sessions.

Teaching sessions provide an overview of key concepts and theories, and include demonstrations of software and tools used in statistical computing. During the practical session, students will apply the concepts learned in theories to real-world data. Exercises will improve their R-programming prowess.

The learning tasks include:

Simple data cleaning and preparation where students learn how to manipulate and prepare data for analysis, including data collection, cleaning, and transformation techniques.

Data analysis and visualization where students learn how to apply statistical methods and techniques to analyse data and visualize results using R-programming software.

Interpretation and communication, where students learn how to interpret and communicate statistical results.

Assessment Approach

The assessment will be carried out on a continuous basis through the following approaches.

A. Quiz: (10%)

Students will sit for two quizzes using Moodle (Virtual Learning Environment) for a duration of 30 to 40 minutes to monitor the learning progress of students. Quiz 1 will cover Units I and II, while Quiz 2 will cover the remaining units, III through V, and each quiz will contribute **5%** to the overall course grade, amounting to a total of **10%** for all quizzes combined.

B. Lab Exercises: (10%)

Every lab exercise needs to be submitted at the end of each lab class on VLE. Submission before the deadline and correctness will be considered.

C. Assignments: (20%)

Students will complete two individual or group assignments, each carrying a weightage of 10%, contributing a total of 20% to the final grade. These assignments are designed to assess students' ability to apply their conceptual understanding to practical problem-solving. The first assignment will be given at the beginning of the semester, allowing students to engage with fundamental concepts and apply their initial learning. The second assignment will be assigned after the first

assignment is submitted, incorporating more advanced topics. Each assignment will be evaluated based on the criteria outlined below;

- Academic Writing and Integrity (10%)
- Statistical Analysis and Reasoning (50%)
- Formal Statistical Reporting (20%)
- Presentation (20%)

D. Term Test: (30%)

Students will sit for two term tests. Term Test 1 will assess content from Units I and II and will be conducted out of 40 marks over a duration of two hours during the mid-semester. Term Test 2 will assess content from Units III through V and will be administered out of 40 marks over a duration of two hours during the end-semester exam. Each test contributes 15% to the total course marks, amounting to a combined total of 30% toward the final grade.

E. Practical Test: (30%)

Students will sit for two practical tests each carrying a weightage of 20%, where they will apply their programming skills in solving problems using R language.

Students will sit for two two-hour practical tests. The first test, covering Units I and II, focuses on R syntax, data structures, and data visualization, and carries 20% of the final grade. The second test, covering Units III, IV, and V, evaluates practical applications of probability theory, hypothesis testing, and statistical distributions using R, also accounting for 20% of the final grade. Together, these tests contribute 40% to the overall grade.

Overview of the assessment approaches and weighting

Sl.No.	Area of Assessment	Quantity	Weighting
A.	Quiz	2	10%
B.	Lab Exercises	1	10%
C.	Individual Assignment	2	20%
D.	Term Test	2	30%
E.	Practical Test	2	30%
	Total	**9**	**100%**

Pre-requisites: DAT101 Statistical Computing I

Subject Matter

Unit 1: R Syntax and Data Structures

1.1 Concept of variables and common data types in R (numeric, character, logical, factors)
1.2 Use of operators (arithmetic, logical, relational) and the help function (to perform calculations and access documentation)
1.3 Application of vectors, matrices, lists, and data frames for data organization and manipulation
1.4 Implementation of control statements (loops and conditional statements)
1.5 Advanced operations (shuffling, custom function creation) for real-world data analysis

Unit 2: Packages, Graphics, and Data Visualization

2.1 Installation, loading, and management of R-packages for data manipulation and visualization

2.2 Accessing and importing data from various sources (CSV, Excel, databases)
2.3 Data manipulation techniques (cleaning, transforming, filtering, reshaping)
2.4 Visualization methods in R (scatter plots, bar charts, pie charts, histograms, density plots, bubble plots)

Unit 3: Probability Theory and Distributions

3.1 Definition and calculation of the expectation of a random variable
3.2 Discrete probability distributions (discrete uniform, negative binomial, hyper-geometric) and their applications
3.3 Continuous probability distributions (gamma, chi-square, Beta, double exponential) and their applications
3.4 Use of moments and moment-generating functions to analyze probability distributions
3.5 Application of probability distribution concepts to practical statistical problems

Unit 4: Parametric Hypothesis Testing

4.1 Core concepts and significance of statistical hypothesis testing in decision-making
4.2 Foundational principles of Bayesian Testing and its distinctions from traditional hypothesis testing
4.3 Likelihood Ratio Test for hypothesis testing
4.4 Calculation of error probabilities (Type I, Type II) and power function in hypothesis testing
4.5 Use of ANOVA (single-factor, multiple comparisons, two-factor) and their applications

Unit 5: Non-Parametric Hypothesis Testing

5.1 Fundamental principles and importance of non-parametric hypothesis testing
5.2 Application of the Chi-Square independence test to assess variable independence
5.3 Non-parametric tests (binomial test, sign test, sign rank test for one and two samples)
5.4 One-way and two-way layout non-parametric tests (Kruskal-Wallis test, Friedman test)
5.5 Multiple comparison tests in non-parametric analysis and interpretation of results

Laboratory Sessions:

1. **Practical 1: Introduction to R Basics**
   a) Install R and RStudio, and familiarize yourself with the interface.
   b) Create and manipulate variables of different data types (numeric, character, logical, factors).
   c) Perform basic arithmetic, logical, and relational operations.
   d) Use the help() function to explore R documentation.
2. **Practical 2: Data Structures in R**
   a) Create and manipulate vectors, matrices, and lists.
   b) Create a data frame and perform basic operations (subsetting, adding/removing columns).
   c) Write and execute loops (for, while) and conditional statements (if-else).
   d) Create a custom function to solve a simple data manipulation problem.
3. **Practical 3: Working with R Packages**
   a) Install and load essential packages (tidyverse, readxl, dplyr).
   b) Import data from CSV, Excel, and databases into R.

c) Clean and transform datasets (e.g., handle missing values, filter rows, reshape data).

4. **Practical 4: Data Visualization in R**
   a) Create basic plots (scatter plots, bar charts, pie charts) using base R.
   b) Use ggplot2 to create advanced visualizations (histograms, density plots, bubble plots).
   c) Customize plots (add titles, labels, legends, and themes).
5. **Practical 5: Probability Basics**
   a) Calculate probabilities and expectations for discrete and continuous random variables.
   b) Use R to compute moments and moment-generating functions for given distributions.
6. **Practical 6: Probability Distributions**
   a) Simulate data from discrete distributions (uniform, binomial, hyper-geometric) and analyze their properties.
   b) Simulate data from continuous distributions (gamma, chi-square, exponential) and visualize their density functions.
   c) Solve real-world problems using probability distributions (e.g., calculate probabilities, expected values).
7. **Practical 7: Introduction to Hypothesis Testing**
   a) Perform a one-sample t-test and interpret the results.
   b) Conduct a two-sample t-test and compare means.
   c) Perform a Likelihood Ratio Test and interpret the output.
8. **Practical 8: ANOVA and Error Analysis**
   a) Perform a single-factor ANOVA and interpret the results.
   b) Conduct a two-factor ANOVA and analyze interactions.
   c) Calculate Type I and Type II error probabilities and power for a given hypothesis test.
9. **Practical 9: Non-Parametric Tests**
   a) Perform a Chi-Square independence test and interpret the results.
   b) Conduct a binomial test and sign test for one-sample and two-sample scenarios.
   c) Perform a Wilcoxon signed-rank test and interpret the output.
10. **Practical 10: Advanced Non-Parametric Tests**
    a) Conduct a Kruskal-Wallis test for one-way layout data.
    b) Perform a Friedman test for two-way layout data.
    c) Use multiple comparison tests in non-parametric analysis and interpret the results.

Reading List

Essential Reading:

Lock, R. H., Lock, P. F., Morgan, K. L., Lock, E. F., & Lock, D. F. (2020b). *Statistics: Unlocking the Power of Data*. John Wiley & Sons.

Miles J., & Field A. (2012). *Discovering Statistics Using R.*

Grolemund G., & Wickham H. (2012). *R for Data Science: Import, Tidy, Transform, Visualize, and Model Data 1st Edition*.

Date: February 2025.

2.5 Year 3, Semester I

DAT301 Deep Learning

Module Code and Title: DAT301 Deep Learning
Programme: Bachelor of Data Science and Data Analytics
Credit: 12
Module Tutor(s): Ngawang Choeda

General Objective

This module provides students with a strong foundation in deep learning, covering key architectures such as Multilayer Perceptrons (MLP), Convolutional Neural Networks (CNN), and Recurrent Neural Networks (RNN). The course also introduces transformers, transfer learning, cloud-based deployment, and ethical AI considerations. Students will build, train, fine-tune, and deploy models using TensorFlow and Keras.

Learning Outcomes

On completion of the module, students will be able to:

1. Explain the structure of digital images, coordinate systems, and color spaces.
2. Perform image processing operations such as pixel modification and transformations.
3. Implement fundamental neural network architectures and optimize hyperparameters.
4. Develop image classifiers and object detection models using CNNs.
5. Build sequence models using RNNs
6. Apply Transformers for NLP applications.
7. Utilize transfer learning with pre-trained models for deep learning tasks.
8. Deploy deep learning models using Flask/Django or cloud services.
9. Evaluate deep learning applications with ethical and real-world considerations.

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
Contact	Teaching	2	60
	Practical and group work	2	
Independent study	Assignments, projects, self-study	4	60
Total		**8**	**120**

The module will be taught using teaching sessions and practical sessions.

During the tutorial sessions, students will be taught the key concepts on deep learning algorithms. In addition, activities such as small-group discussion and presentation will be held during the tutorials. This allows students to have more opportunities to participate in discussions and to have better class interactions.

In the practical lessons, students will be working on practical exercises that are designed for students to apply the key theories and knowledge learnt to create deep learning models to solve real-world problems.

Assessment Approach

The assessment will be carried out on a continuous basis through the following approaches.

A. Quizzes: (25%)

After completing each unit, an hour-long quiz will be conducted either online via VLE or in-class to assess the conceptual understanding of the subject. In total, there will be 5 quizzes, and each quiz is worth 5% of the total weightage.

B. Lab Assessment: (20%)

Each student will be given two lab assignments on the topic Image Fundamentals and Convolutional Neural Network to test their practical knowledge. Each lab assignment carries 10 marks which is in total worth 20% to the total weightage.

C. Term Test: (15%)

A closed-book written term test will be conducted in the middle of the semester for a duration of 2 hours. This term test is aimed at assessing the conceptual grasp of the subject matters taught thus far.

D. Project: (40%)

A group project worth 40% will be assigned to enable them to apply the concepts and skills learnt in the module. Through this project, students will be able to conceptualize, and create a computer vision application for the real-world problems which they will have to deploy on a live server and produce technical documentation for the said application.

Criteria	**Exemplary (90 - 100%)**	**Proficient (70 - 89%)**	**Developing (50 - 69%)**	**Needs Improvement (< 50%)**
1. Project Concept & Design (20%)	- Clearly identifies a relevant real-world problem and proposes an innovative solution. - Provides comprehensive design documents (e.g., flowcharts,	- Identifies a relevant problem with a clear solution design. - Provides good design documentation and rationale, though with minor gaps or less innovation.	- Presents a basic problem statement and design but lacks depth or detail. - Design documentation is minimal or unclear.	- Fails to define a clear problem or design a coherent solution. - Lacks supporting documentation and rationale.

	architecture diagrams) with clear rationale.			
2. Technical Implementation & Functionality (30%)	- Implements a robust, efficient computer vision application with high accuracy. - Code is well-structured, optimized, and follows best practices. - All required features work seamlessly.	- Develops a functional application with most features working as expected. - Code is generally well-organized, with minor issues in optimization or style.	- The application runs but contains several errors or inefficiencies. - Code clarity and organization need improvement; some key features are only partially implemented.	- The application is largely non-functional or incomplete. - Code is poorly organized and difficult to understand; major features are missing.
3. Deployment on Live Server (20%)	- Successfully deploys the application on a live server with high availability and performance. - Deployment process is smooth, well-documented, and shows robust integration of components.	- Deploys the application on a live server with minor issues affecting performance or integration. - Deployment documentation is adequate.	- The application is deployed but shows evident performance or integration issues. - Deployment documentation is incomplete or unclear.	- Fails to deploy the application or deployment is non-functional. - Lacks clear documentation; significant issues with integration and performance persist.
4. Technical Documentation (20%)	- Provides comprehensive, clear, and well-organized documentation. - Includes detailed instructions, design diagrams, and usage guidelines that support reproducibility and future	- Offers clear and complete documentation with most required details. - Includes design diagrams and instructions, though some sections may be less detailed.	- Documentation is provided but is incomplete, poorly organized, or lacks sufficient detail in key areas. - Diagrams and instructions are minimal or unclear.	- Documentation is insufficient, poorly structured, or missing critical information. - Lacks necessary diagrams, instructions, or clarity for reproducing the work.

	enhancements.			
5. Presentation & Demonstration (5%)	- Delivers a clear, engaging, and professional presentation. - Effectively demonstrates the application with comprehensive explanations and answers questions confidently.	- Provides a clear presentation with a good demonstration of the application. - Addresses questions adequately, with minor lapses in engagement or clarity.	- Presentation is delivered but lacks clarity or depth in the demonstration. - Responses to questions are limited or show gaps in understanding.	- Presentation is poorly organized or delivered, with an ineffective demonstration. - Unable to adequately address questions or explain key aspects of the project.
Group contributions (5%)	Actively involved and contributed thoughts and ideas to the group and were able to give clear explanations.	Constantly contributed thoughts and ideas to the group and were able to give clear explanations.	Occasionally contributed to the group project and were fairly able to explain their individual task.	Rarely contributed to the group and were not able to explain their own task.

Overview of the assessment approaches and weighting

Sl.No.	Area of Assessment	Quantity	Weighting
A.	Quizzes	5	25%
B.	Lab Assessment	1	20%
C.	Term Test	1	15%
D	Project	1	40%
	Total	**8**	**100%**

Pre-requisites: DAT203 Artificial Intelligence and Machine Learning

Subject Matter

Unit I: Fundamentals of Image Processing

1.1 Digital images, pixels, and color channels
1.2 Image representation and coordinate systems
1.3 Image modifications and transformations
1.4 Color spaces and conversions

1.5 Installation of OpenCV and image processing libraries

Unit II: Fundamentals of Neural Networks

2.1 Biological vs artificial neurons
2.2 Perceptron and multilayer perceptron (MLP)
2.3 Activation functions, loss functions, and optimization techniques
2.4 Backpropagation and hyperparameter tuning
2.5 Designing MLP models for classification and regression

Unit III: Convolution Neural Networks (CNN)

3.1 CNN architecture: filters, pooling, padding, stride
3.2 Batch normalization and dropout in CNNs
3.3 Image augmentation techniques
3.4 Object classification vs object detection

Unit IV: Recurrent Neural Networks (RNN) & Transformers

4.1 Understanding sequential data
4.2 RNN structure and backpropagation through time (BPTT)
4.3 Vanishing/exploding gradient problems in RNNs
4.4 Introduction to Transformers and self-attention

Unit V: Transfer Learning & Model Deployment

5.1 Introduction to transfer learning
5.2 Using pretrained models (ResNet, VGG, EfficientNet)
5.3 Fine-tuning pretrained models on custom datasets
5.4 Model deployment: Flask/Django and cloud deployment (Colab, AWS, Hugging Face Spaces)

Unit VI: Deep Learning Applications and Ethical AI

6.1 Applications of deep learning in healthcare, finance, education
6.2 Challenges of deep learning (bias, fairness, explainability)
6.3 Introduction to **Explainable AI (XAI) techniques**

Laboratory Sessions

1. **Lab Session 1: Image Processing with OpenCV**
   Task:
   a) Reading, displaying, and modifying images
   b) Image transformations (rotation, cropping, resizing)
   c) Color space conversions (RGB to Grayscale, HSV, LAB)

2. **Lab Session 2: Implementing Neural Networks with TensorFlow/Keras**
   Task:

a) Implementing an MLP classifier for MNIST handwritten digit recognition
b) Fine-tuning hyperparameters: number of layers, neurons per layer, learning rate
c) Experimenting with dropout and batch normalization

3. **Lab Session 3: Building and Deploying CNN-based Image Classifier**
   Task:
   a) Evaluating model performance using a confusion matrix
   b) Deploying a trained model using Flask/Django (local server)

4. **Lab Session 4: Text Classification with RNN & Transformers**
   Task:
   a) Implementing an RNN for sentiment analysis
   b) Using a pretrained Transformer (e.g., BERT, DistilBERT) for NLP tasks

5. **Lab Session 5: Transfer Learning & Model Deployment**
   Task:
   a) Fine-tuning a pretrained CNN (ResNet, MobileNet) on a custom dataset
   b) Deploying the model on Hugging Face Spaces or AWS Lambda

6. **Lab Session 6: Model Interpretability & XAI**
   Task:
   a) Visualizing CNN feature maps to understand model decisions
   b) Using SHAP (Shapley Additive Explanations) and LIME (Local Interpretable Model-agnostic Explanations)

●
Reading List

Essential Reading:

Géron, A. (2019). *Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow.* United States of America: O'Reilly Media.

Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning.* MIT Press.

Gulli, A., Kapoor, A., & Pal, S. (2019). *Deep Learning with TensorFlow 2 and Keras*. Packt.

Rosebrock, A. (2017). *Deep Learning for Computer Vision with Python-Starter Bundle*. PYIMAGESEARCH.

Additional Reading:

Chollet, F. (2021). *Deep Learning with Python.* Manning Publications.

Vaswani, A. et al. (2017). *Attention Is All You Need* (Transformer Paper).

Online courses:

a) Fast.ai Deep Learning Course
b) Andrew Ng's Deep Learning Specialization (Coursera)

Date: February 2025.

DAT302 Mathematics for Data Science II

Module Code and Title: DAT302 Mathematics for Data Science II
Programme: Bachelor of Data Science and Data Analytics
Credit: 12
Module Tutor(s): Tashi Wangchuk

General Objective

This module introduces the fundamental concepts of linear algebra integrated with Python programming. The module familiarises students with the theory and practical aspects of Linear Equations, Linear Mappings, Matrix decomposition and Eigenvalue problems using the properties of vectors, matrices, and determinants. This module will assist students in Python programming by enabling them to write algorithms and utilize these algorithms for practical applications.

Learning Outcomes

On completion of the module, students will be able to:

1. Apply elementary row operations to solve systems of linear equations and determine their consistency.
2. Compute matrix operations such as multiplication, transposition, and inversion, both manually and using NumPy/SymPy.
3. Define vectors, vector spaces, and subspaces, and explain their properties with geometrical interpretations.
4. Determine the linear dependence and independence of vectors and identify the basis and dimension of a vector space.
5. Describe linear transformations, their associated matrices, and properties such as range, kernel, and composition.
6. Compute inner products, vector norms, and apply the Gram-Schmidt orthogonalization process.
7. Evaluate eigenvalues and eigenvectors, discuss their properties, and compute them using NumPy/SymPy.
8. Define and apply matrix diagonalization and orthogonality concepts in vector and matrix contexts.
9. Perform Singular Value Decomposition (SVD) for image compression.
10. Use NumPy/SymPy module in Python to solve system of linear equations, perform vector operations and compute linear transformations.

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
Contact	Teaching	2	60
	Practical and group work	2	
Independent study	Assignments, assignments, self-study	4	60
Total		**8**	**120**

The module will be taught using tutorial sessions and practical sessions.
During the tutorial sessions, students will learn the theoretical concepts of linear algebra, including vectors, matrices, eigenvalues, and matrix decompositions. They will also develop basic programming skills needed to apply these concepts using NumPy for data preparation, matrix operations, and visualization. Group discussions and presentations will be included to encourage active participation and deeper understanding.

In the practical lessons, students will solve problems by applying their knowledge of vectors, matrices, eigenvalues, and decomposition techniques to real-world scenarios. These hands-on exercises will help them build essential computational skills, ensuring a smooth transition to advanced studies while strengthening their understanding of key linear algebra concepts.

Assessment Approach
The assessment will be carried out continuously through the following approaches.

A. Quiz: (20%)

Students will attempt a total of **four quizzes** through the **Virtual Learning Environment (VLE)** upon the completion of **Units I through IV**. Each quiz will have a duration of **one hour** and will contribute **5%** to the overall course grade, amounting to a total of **20%** for all quizzes combined.

The Quizzes will serve as checkpoints to track and strengthen learning, helping students understand the material as they move through the course. They check progress and help students stay engaged with the course objectives.

B. Assignment: (10%)

One major written assignment will be given in a semester. In written assignments, a set of problems (Not over 10) spread over at least 50% of the course content will be given to the learners, which are to be solved by the students independently. (S)he may be called to attend a viva voce to justify his work.

C. Laboratory Reports and Homework: (10%)

The Laboratory Reports and Homework component contributes 10% to the overall grade and is designed to reinforce students' understanding of matrix operations, vector spaces, linear transformations, eigenvalues, and singular value decomposition. Throughout the semester, students will participate in 11 lab sessions, where they will apply theoretical concepts through hands-on exercises using NumPy and other computational tools.
For each lab session, students must maintain a detailed lab report documenting the tasks performed, methods used, and results obtained. These reports serve as a reflection tool, helping students track their progress and deepen their understanding of key concepts. After each lab, students will also complete homework assignments to further practice and apply what they have learned.

Students are expected to complete assignments independently and submit them via the Virtual Learning Environment (VLE) before the deadline. These exercises provide an opportunity to strengthen problem-solving skills and gain confidence in using computational techniques for matrix operations, vector calculations, transformations, and decomposition methods.

D. Practical Test: (30%)

Students will take two practical tests, which together account for 30% of the overall grade. Practical Test I, worth 10%, will be held mid-semester, while Practical Test II, worth 20%, will take place towards the end of the semester. The test will last two hours and three hours, respectively, and will assess students' ability to apply key concepts and computational techniques covered in the course.

These tests are designed to evaluate students' practical proficiency in matrix operations, vector spaces, linear transformations, eigenvalues, and singular value decomposition. They will challenge students to independently solve mathematical problems using NumPy and other computational tools, reinforcing their problem-solving skills and analytical thinking. Practical Test I will focus on fundamental concepts such as matrix operations, solving systems of linear equations, and basic vector computations. Practical Test II will assess more advanced topics, including eigenvalue decomposition, linear transformations, and singular value decomposition, ensuring a structured and progressive evaluation of technical skills.

The details of the practical tests are as follows:

1. **Practical Test I (10%)**
   Objective: Assess foundational skills in matrix operations, vector calculations, and solving systems of linear equations. This test will evaluate students' ability to:

   - Perform matrix addition, multiplication, inversion, and transposition.
   - Solve systems of linear equations using Gaussian elimination and NumPy's linear algebra functions.
   - Determine vector independence and compute row and column spaces.

2. **Practical Test II (20%)**
   Objective: Test students' ability to apply advanced mathematical techniques for linear transformations, eigenvalues, and singular value decomposition. This test will assess students' proficiency in:

   - Computing eigenvalues and eigenvectors manually and using NumPy.
   - Applying the Gram-Schmidt orthogonalization process.
   - Performing singular value decomposition and interpreting results in data analysis and image processing.

These assessments ensure that students not only understand theoretical concepts but can also apply them effectively, bridging the gap between mathematical theory and computational practice

E. Term Test: (30%)

Students will take two term tests, each accounting for 15% of the final grade.

- **Term Test I** will assess foundational topics, including matrix operations, solving systems of linear equations, vector spaces, and their geometric interpretations. Students will be tested on their ability to perform matrix computations, apply row operations, determine the consistency of linear systems, and analyze vector independence and basis.

- **Term Test II** will focus on advanced concepts such as linear transformations, eigenvalues, eigenvectors, diagonalization, and singular value decomposition. It will evaluate students' understanding of linear maps, orthogonality, Gram-Schmidt

orthogonalization, and the applications of SVD in data analysis and dimensionality reduction.

These tests are designed to ensure a structured assessment of both fundamental and advanced mathematical concepts, reinforcing theoretical understanding and computational proficiency.

Overview of the assessment approaches and weighting

Sl.No.	Area of Assessment	Quantity	Weighting
A.	Quizzes	4	20%
B.	Assignment	1	10%
C.	Lab Assessments and Homework	1	10%
D.	Practical Test	2	30%
E.	Term Test	2	30%
	Total	**10**	**100%**

Pre-requisites: DAT201 Mathematics for Data Science I & CSP101 Foundations of Python Programming

Subject Matter

Unit I: Matrix Operations and Solving System of Linear Equations

1.1 Define matrices and explain different types of matrices.
1.2. Perform different types of matrix operations.
1.3. Solving system of linear equations.
1.4 Perform elementary row operations.
1.5 Check the consistency of the system of linear equations.
1.6 Geometrical Interpretation of Solution of a system of linear equations.
1.7 Explain the transpose and inverse of a matrix.
1.8 Implement matrix multiplication, transpose of a matrix and matrix inversion using NumPy
1.9 Solve the system of linear equations using NumPy's linear algebra functions.

Unit II: Vector Spaces

2.1 Define vectors and give a geometrical interpretation of vectors.
2.2 Definition, properties and examples of vector spaces and subspaces.
2.8 Perform different types of vector operations.
2.9 Implement different types of vector operations using NumPy arrays.
2.3 Linear combination of vectors.
2.4 Explain linear dependence and linear independence of vectors.
2.6 Discuss the basis and dimension of a vector space.
2.6 Row and column space of Matrix. Row and Column rank.
2.7 Implement linear dependence and linear independence of vectors using NumPy's linear algebra functions.

Unit III: Linear Transformations and Inner Product Spaces

3.1 Definition, properties and examples of linear transformation.
3.2 Explain the Range and Kernel of a Linear Map.
3.3 Elaborate on the composition of Linear Maps and Inverse of a Linear Map.
3.3 Discuss the matrix associated with a Linear Map.
3.4 Implement composition of Linear Maps and Inverse of a Linear Map using NumPy's linear algebra functions.

3.5 Definition and examples of Inner Product and Inner Product Spaces.
3.6 Calculate the norm of a vector
3.7 Explain Orthogonality and orthogonal projections.
3.8 Solve examples of Orthogonal Sets and othe orthogonalization process.
3.9 Explain the Gram-Schmidt orthogonalization process.

Unit IV: Eigenvalues and Eigenvalues

4.1 Explain eigenvalues and eigenvectors.
4.2 Evaluate eigenvalues and eigenvectors.
4.3 Discuss properties of eigenvectors and eigenvalues.
4.4 Compute eigenvalues and eigenvectors using NumPy.
4.5 Visualize eigenvectors and their corresponding eigenvalues.
4.6 Define Diagonalization
4.7 Diagonalize a matrix.

Unit V: Singular Value Decomposition

5.1 Explain singular value decomposition.
5.2 Discuss the application of SVD in data compression and image processing.
5.3 Perform Singular Value Decomposition on matrices using NumPy.
5.4 Apply SVD for image compression.

Laboratory Sessions

1. **Practical 1: Matrix Operations and Solving Systems of Linear Equations.**

   a) Implement Gaussian elimination to solve systems of linear equations.

   b) Check the consistency of a system using rank conditions.

   c) Use NumPy to solve systems of equations.

2. **Practical 2: Matrix Operations Using NumPy**

   a) Perform matrix addition, subtraction, multiplication, and inversion.

   b) Compute the transpose of a matrix.

   c) Verify properties of matrices using NumPy functions.

3. **Practical 3: Vector Spaces.**

   a) Define vectors and perform basic vector operations (addition, scalar multiplication, dot product, and cross product).

   b) Visualize vectors in 2D and 3D using Matplotlib.

4. **Practical 4: Vector Spaces.**

   a) Implement linear dependence and independence tests using NumPy.

   b) Find the basis and dimension of a given vector space.

   c) Compute row space, column space, and rank of a matrix.

5. **Practical 5: Linear Transformations and Inner Product Spaces.**

   a) Define and apply linear transformations.

   b) Compute the range and kernel of a linear transformation.

c) Use NumPy to represent and visualize linear transformations.

6. **Practical 6: Linear Transformations and Inner Product Spaces.**
   a) Compute vector norms and inner products.
   b) Apply the Gram-Schmidt orthogonalization process to generate an orthonormal basis.
   c) Solve problems on orthogonal sets using NumPy.
7. **Practical 7: Eigenvalues and Eigenvectors.**
   a) Find eigenvalues and eigenvectors of a matrix manually and using NumPy.
   b) Verify eigenvector properties (e.g., linear independence).
   c) Interpret eigenvectors geometrically.
8. **Practical 8: Eigenvalues and Eigenvectors.**
   a) Determine whether a matrix is diagonalizable.
   b) Compute the diagonalization of a given matrix.
   c) Implement orthogonal projections using NumPy.
9. **Practical 9,10&11: Singular Value Decomposition (SVD).**
   a) Compute the SVD of a matrix using NumPy.
   b) Analyze the properties of singular values and singular vectors.
   c) Compare SVD with eigenvalue decomposition.
   d) Implement image compression using SVD.
   e) Visualize how reducing singular values affects image quality.
   f) Apply SVD to reduce dimensionality in data analysis.

Reading List

Essential Reading (e-books):

Anton, C, & Rorres, C. (2014). *Elementary of Linear Algebra: Application Version,* (11th ed.). Wiley.

Strang, G. (2019). *Linear Algebra and Learning from Data*. Wellesley-Cambridge Press.

Lay, D. C, & Lay. R. S, & McDonald, J. J, (2016). *Linear Algebra and its Application,* (5th ed.). Pearson.

Additional Readings:

Brownlee. J, (2018). *Basics of Linear Algebra for Machine Learning*.

Date: February 2025.

DAT303 Statistical Modelling and Simulation

Module Code and Title: DAT303 Statistical Modelling and Simulation
Programme: Bachelor of Data Science and Data Analytics
Credit: 12

Module Tutor(s): Dawa Wangchuk Gyalpo

General Objective

This module aims to provide students with an advanced understanding of time series analysis, stochastic modelling, and their practical applications. Students will learn to implement various stochastic and time series models, evaluate model performance, and apply these techniques to real-world data using R. This module also covers basic Bayesian statistics.

Learning Outcomes

On completion of the module, students will be able to:

1. Define basic Bayesian statistics with examples
2. Explain basic time series with examples
3. Apply forecasting strategies for time series data
4. Implement basic stochastic models
5. Analyze autoregressive models
6. Perform different time series models
7. Evaluate various time series models
8. Employ different methods of stochastic process
9. Describe simulation techniques and their usage
10. Apply different methods of stimulation in statistics
11. Conduct importance sampling and MCMC method

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
Contact	Lecture	2	60
	Group Discussion		
	Presentation		
	Practical labs	2	
Independent study	Quiz, lab assessment	1	60
	Project	2	
	Self-study	1	
Total		**8**	**120**

The module will be taught using tutorial sessions and practical sessions.

During the teaching sessions, students will learn the key concepts and principles of statistical modelling and simulation. In addition, activities such as small-group discussions and presentations will be held during the teaching session. This allows students to have more opportunities to participate in discussions and to have better class interactions.

In the practical lessons, students will be working on practical exercises that are designed for students to solve problems using the knowledge learned from the tutorial lessons.

Assessment Approach

The assessment will be carried out on a continuous basis through the following approaches.

A. Quiz: (15%)

Students will attempt a total of **four quizzes** through the **Virtual Learning Environment (VLE)** upon the completion of **Units I through IV**. Each quiz will have a duration of **30 minutes** and will contribute **3.75%** to the final grade, amounting to a total of **15%** for all quizzes combined.

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B. Class Test: (15%)

This closed-book written assessment will take place midway through the semester and will have a duration of **2 hours**. The test will be graded out of **40** marks, with **15%** of the total score contributing to the final grade.

This test serves as a critical checkpoint in the semester, allowing students to assess their understanding of key concepts covered so far. It helps reinforce learning, identify areas needing improvement, and prepare for the final examination. Additionally, by contributing to the final grade, it encourages consistent study habits and engagement with the module material.

C. Lab Assessment: (30%)

Each student will complete **two lab assignments** designed to enhance their practical understanding of key concepts, including: time series analysis, basic stochastic model, stochastic process and simulation. Each assignment contributes **15%** to the final grade.

The detail of lab assignments are as follows:

1. **Lab Assignment I (15%)**

   This will cover the concepts of time series analysis and basic stochastic models. Student will be evaluated based on:

   a. Understanding patterns, trends, and forecasting in sequential data
   b. Applying probabilistic models to analyze random processes.

2. **Lab Assignment II (15%)**

   This will cover the concepts of stochastic processes and simulation techniques. Student will be evaluated based on:

   a. Examining how systems evolve over time under uncertainty.
   b. Implementing simulations to model real-world scenarios and analyze outcomes.

The lab assignments aim to develop students' ability to apply theoretical concepts in practical scenarios. They assess not only technical proficiency but also analytical thinking, problem-solving skills, and clarity in documentation. Below is a detailed breakdown of the assessment criteria:

1. **Exploratory Data Analysis (EDA) and Preprocessing (10 marks)**
   - Evaluates the initial examination of the dataset, including summary statistics, missing values, and data distribution.

- Assesses the use of appropriate visualization techniques to identify patterns and anomalies.
- Checks for proper data cleaning, handling of missing values, and feature selection where necessary.

2. **Model Selection and Implementation (15 marks)**
    - Evaluates the choice of an appropriate time series or stochastic model based on the problem statement and data characteristics.
    - Assesses the correctness, efficiency, and justification of model selection.
    - Considers the proper use of algorithms, libraries, and coding best practices in implementation.

3. **Interpretation and Analysis (15 marks)**
    - Examines the depth of insights derived from the results, including discussion of trends, patterns, and anomalies.
    - Assesses how well students connect their findings with theoretical concepts and real-world implications.
    - Encourages the use of well-structured narratives and visual representations to support analysis.

4. **Code Quality and Documentation (10 marks)**
    - Evaluates code readability, structure, and efficiency, ensuring well-organized and optimized implementation.
    - Checks the completeness of documentation, including explanations of methodology, assumptions, and key challenges encountered.
    - Encourages proper commenting and structured reporting for clarity and reproducibility.

D. Project: (40%)

This project is designed to provide students with an opportunity to integrate and apply the concepts learned throughout the semester. The project focuses on the practical application of time series analysis and stochastic modeling to solve real-world problems using data. Working in teams of 3 to 5 members, students will collaboratively address complex analytical challenges by selecting, implementing, and interpreting models.

Throughout the project, students will engage in various stages of the analytical process, including **data collection, model selection, implementation, and result interpretation**. They will also work on communicating their findings clearly through both a **written report** and a **formal presentation**. The project is designed to develop both technical skills and soft skills, such as teamwork, communication, and problem-solving, which are essential for success in both academia and industry.

Key Steps in the Project:

1. **Problem Identification**:
   Each group will identify a real-world problem that can be analyzed using time series or stochastic models. The problem should be meaningful and relevant, with a dataset that can provide insights into the problem domain.

2. **Data Collection & Preprocessing**:
   Students will source and clean the dataset for analysis, which may involve tasks like handling missing data, outliers, and normalizing values. They will also perform **Exploratory Data Analysis (EDA)** to uncover patterns and relationships within the data.

3. **Model Selection & Justification**:
   Based on the nature of the data, each group will select an appropriate **stochastic model** or **time series model**. Students must justify their model choice, explaining how it fits the data and the problem at hand. They will also describe the assumptions made in their modeling process.

4. **Model Implementation & Analysis**:
   Students will implement the chosen model using relevant software and programming tools. The project will involve computational work such as **simulation**, **parameter estimation**, and **forecasting**. Students will analyze the model's performance, interpreting the results and identifying any limitations or areas of improvement.

5. **Visualization & Reporting**:
   The results will be clearly visualized using charts, graphs, or other methods to facilitate interpretation. The group will document their methodology, findings, challenges faced, and conclusions in a detailed report.

6. **Group Presentation**:
   The final stage of the project involves a **group presentation**, where each member will have a role in explaining different aspects of the project. The presentation should highlight key insights, methodologies, and results. Students will be required to **defend their choices** during the subsequent question-and-answer session.

Project Deliverables:

i) Project Report: A comprehensive report that includes the following:

- **Introduction**: Background and problem statement.
- **Methodology**: Data collection, model selection, and implementation steps.
- **Results**: Analysis, visualizations, and interpretation of results.
- **Conclusion**: Key insights, challenges faced, and possible future improvements.

ii) Group Presentation: A **10-15** minute presentation summarizing the project, focusing on the problem, methodology, results, and conclusions. Each member should present a section of the project and participate in the Q&A session.

Below is a detailed breakdown of the project criteria:

Project Evaluation (25%)

Criteria	Weightage (%)	Description
Abstract & Project Description	3	Clearly defines the scope, objectives, and significance of the project. Explains the problem, dataset, and model approach in a concise manner.
Problem Identification & Data Selection	5	Evaluates the clarity and relevance of the problem being addressed, as well as the appropriateness and quality of the dataset chosen for analysis.
Model Selection, Implementation & Visualization	7	Assesses the selection of an appropriate model, the accuracy of the implementation, and the clarity of visualizations used to present results. Ensures correct application of modeling techniques.
Analysis & Interpretation of Results	6	Measures the depth of analysis and the ability to interpret and explain findings in the context of the problem. The ability to link results to real-world implications is critical.
Documentation	4	Evaluates the completeness, clarity, and structure of the project report. The report should be well-organized, clearly written, and include all necessary components.

Presentation Evaluation (15%)

Criteria	Weightage (%)	Description
Coherence with Project Report & Overall Organization	5	Assesses how well the presentation aligns with the project report. It should be logically structured, easy to follow, and provide a clear summary of the project's key elements.
Individual Presentation Skills	5	Evaluates the ability of each group member to present their section confidently, clearly, and engagingly. Presentation skills such as clarity, pacing, and audience engagement are key.
Performance in Q&A Session	5	Assesses the group's ability to respond to questions effectively. This includes the ability to explain complex concepts, defend the model choices, and engage in thoughtful discussion about the results and methodology.

Below is rubrics for grading project:

Project rubric

Criteria	Excellent (80-100%)	Good (60-80%)	Satisfactory (40-60%)	Needs improvement (<40%)
Abstract & Project Description	The abstract and description are well-written, clear, and concise. The project scope, objectives, and significance are thoroughly explained.	The abstract and description are clear but may lack some detail or clarity in explaining the significance.	The abstract and description are somewhat unclear or vague, lacking sufficient detail or context.	The abstract and description are incomplete or unclear, with insufficient explanation of the project's objectives or significance.
Problem Identification & Data Selection	The problem is well-defined, highly relevant, and clearly tied to the chosen dataset. The data is appropriately selected and fully supports the analysis.	The problem is clearly defined, but the dataset selection may have some limitations. The data supports the analysis but lacks depth or variety.	The problem is identified but lacks clarity or relevance to the dataset. The data selection is somewhat limited or not fully aligned with the analysis.	The problem is unclear or irrelevant. The dataset selected does not appropriately support the analysis.
Model Selection, Implementation & Visualization	The model selection is appropriate and thoroughly justified. The implementation is efficient, accurate, and well-documented. Visualizations are clear and enhance understanding of results.	The model selection is appropriate with some justification. Implementation is mostly correct with minor issues. Visualizations are clear but may lack some depth or clarity.	The model selection is somewhat appropriate, but justification is weak. Implementation has errors or lacks full functionality. Visualizations are somewhat unclear or incomplete.	The model selection is poorly justified or inappropriate. The implementation is incomplete or incorrect, with poor or no visualizations.
Analysis & Interpretation of Results	Results are analyzed thoroughly with deep insights	Results are analyzed with moderate insight.	Results are analyzed but with limited depth or insight.	Results are poorly analyzed, and interpretation is

	drawn from the data. Interpretation is clear, logical, and highly relevant to the problem.	Interpretation is mostly clear but lacks depth in some areas.	Interpretation lacks clarity or connection to the problem.	either missing or unclear. No meaningful insights are drawn.
Documentation	The report is well-organized, detailed, and clearly written. All components are included, and methodology is fully explained with proper citations.	The report is organized, but may lack some details or clarity in sections. The methodology is mostly clear.	The report is somewhat disorganized, with missing sections or unclear explanations. Methodology is not fully explained.	The report is disorganized, incomplete, or unclear. Important components are missing, and methodology is poorly explained.

Presentation rubric

Criteria	**Excellent (80-100%)**	**Good (60-80%)**	**Satisfactory (40-60%)**	**Needs improvement (<40%)**
Coherence with Project Report & Overall Organization	The presentation is highly organized, logically structured, and perfectly aligned with the project report. It covers all essential aspects in a clear and concise manner.	The presentation is organized and aligned with the project report, but some minor details may be missing or unclear.	The presentation is somewhat organized but lacks clear structure or cohesion with the project report. Some parts of the project are not clearly explained.	The presentation is disorganized, with little to no connection to the project report. Many key points are missing or unclear.
Individual Presentation Skills	Each group member presents confidently, clearly, and engages	Group members present clearly and confidently, but there may be slight issues	Group members present with some difficulty or lack confidence.	Group members are unprepared or fail to present clearly. Pacing and delivery are

	effectively with the audience. The pacing and delivery are excellent.	with pacing or engagement.	Delivery may be unclear or poorly paced.	poor, with little audience engagement.
Performance in Q&A Session	Group answers questions confidently and accurately, providing well-reasoned explanations. Members engage thoughtfully with questions, demonstrating a deep understanding.	Group answers questions well but may have minor gaps in knowledge or detail. They engage with the questions appropriately.	Group answers some questions but lacks depth or clarity in their responses. Limited engagement or hesitation is noted.	Group struggles to answer questions, providing unclear or inaccurate responses. There is little to no engagement with the questions.

Overview of the assessment approaches and weighting

Sl.No.	Area of assessment	Quantity	Weightage %
A.	Quiz	4	15
B.	Class test	1	15
C.	Lab assessment	2	30
D.	Project	1	40
	Total		**100%**

Pre-requisites: DAT204 Statistical Computing II

Subject Matter

Unit I: Introduction to Bayesian Statistics

1.1 Define Bayesian statistics
1.2 Review Bayes' Theorem
1.3 Explain prior distribution
1.4 Explain posterior distribution
1.5 Evaluate Bayes' estimates
1.6 Evaluate conjugate priors
1.7 Define Bayesian testing

Unit II: Introduction to Time Series

2.1 Define time series

2.2 Explain time series plot, trend and seasonal variation
2.3 Analyze decomposition of time series
2.4 Analyze correlation in time series
2.5 Explain ergodic series, autocorrelation and correlogram
2.6 Apply forecasting strategies: Bass model, exponential smoothing, Holt-Winters method

Unit III: Basic Stochastic Models

3.1 Determine white noise and its prediction
3.2 Explain the process of random walks
3.3 Implement random walks model
3.4 Interpret autoregressive models
3.5 Apply autoregressive models

Unit IV: Time Series Modelling

4.1 Perform classic linear regression in time series context
4.2 Analyze stationary models such as MA and ARMA
4.3 Apply non-stationary models such as ARIMA, SARIMA and ARCH
4.4 Evaluate different methods of evaluating time series model

Unit V: Stochastic Process

5.1 Explain basics of stochastic process
5.2 Identify the Markov chains, Poisson processes and Brownian motion
5.3 Evaluate Markov chains, Poisson processes and Brownian motion

Unit VI: Statistical Simulation

6.1 Define simulation
6.2 Apply methods of generating random numbers and Monte Carlo simulation
6.3 Evaluate variance reduction techniques such as control variates, antithetic variates and stratified sampling
6.4 Apply Bootstrap method for estimating sampling distribution and constructing confidence interval
6.5 Conduct importance sampling and MCMC method

Laboratory Sessions

1. **Practical 1: Time Series Basics I**
    a) Understand time series data
    b) Plot time series data
    c) Decompose time series
2. **Practical 2: Time Series Basics II**
    a) Analyze correlation in time series
    b) Compute and plot autocorrelation
    c) Apply exponential smoothing and Holt-Winter methods
3. **Practical 3: Basic Stochastic Models I**

a) Demonstrate random walk
b) Apply random walk models

4. **Practical 4: Basic Stochastic Models II**
    a) Perform autoregressive models
    b) Analyze autoregressive models
5. **Practical 5: Time Series Modelling I**
    a) Perform classic regression in time series
    b) Evaluate the classic regression model
6. **Practical 6: Time Series Modelling II**
    a) Apply stationary models
    b) Evaluate stationary models
7. **Practical 7: Time Series Modelling III**
    a) Apply non-stationary models
    b) Evaluate non-stationary models
8. **Practical 8: Stochastic Process I**
    a) Apply Markov chain and Poisson processes
9. **Practical 9: Stochastic Process II**
    a) Apply Brownian motion
10. **Practical 10: Statistical Simulation I**
    a) Generate random numbers
    b) Apply Monte Carlo Simulation
11. **Practical 11: Statistical Simulation II**
    a) Perform variance reduction techniques
12. **Practical 12: Statistical Simulation III**
    a) Apply Bootstrap method
    b) Demonstrate MCMC method

Reading List

Essential Reading (e-books):

Gelman, A., Carlin, J. B., Stern, H. S., H. S., Dunson, D.B., Vehtari, A., & Rubin, D. B. B. (2013). *Bayesian Data Analysis (3rd ed.).* CRC Press.

Madhira, S., & Desmukh, S. (2023). *Introduction to Stochastic Processes Using R*. Springer.
Ross, S.M. (1995). *Stochastic Processes.* John Wiley & Sons.

Shumway, R.H, & Stoffer, D. S. (2017). *Times Series Analysis and Its Applications.* Springer.

Date: January 2025

CSC106 User Interaction Design

Module Code and Title: CSC106 User Interaction Design
Programme: Bachelor of Data Science and Data Analytics

Credit: 12

Module Tutor(s): Karma Dorji

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General Objective

This module equips students with the knowledge and skills required to design intuitive and engaging user interfaces for various platforms, including mobile and tablets. Students will explore the principles of interaction design, conduct user research, develop personas, create prototypes, and perform usability testing to enhance user experience. Through this, students will be able to design user-centric applications by applying best practices in UI/UX design.

Learning Outcomes

On completion of the module, students will be able to:

1. Describe the interactive design process and its role in developing user-centric applications.
2. Differentiate between User Interface (UI), User Experience (US), and User Interface Design (UID).
3. Explain the key stages of the interactive design process and their connection to the software development life cycle.
4. Apply design thinking and ideation techniques to solve user problems effectively.
5. Incorporate user-centric and accessibility principles when establishing design requirements.
6. Identify key stakeholders and characterize target users through personas
7. Map user journeys to capture needs, behaviours, and interactions.
8. Plan and execute qualitative user research, including unbiased interviews and question formulation.
9. Analyze user interview data to identify needs and application features
10. Generate insights from research to refine the design problems and requirements.
11. Develop essential design documents following industry best practices.
12. Design and classify clickable prototypes that support user interactions

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
Contact	Teaching	2	60
	Practical and group work	2	
Independent study	Assignments, projects, self-study	4	60
Total		**8**	**120**

The module will be delivered through a combination of lectures, group discussions, case studies, and practical lab sessions. Students will explore current trends in UI/UX design, participate in interactive workshops, and gain hands-on experience in designing, developing, testing, and refining user interfaces.

The practical sessions will provide students hands-on for designing, developing, implementing and evaluating user-interfaces.

Assessment Approach
The assessment will be carried out on a continuous basis through the following approaches.

A. User interaction Analysis: (10%)
Students will redesign an existing mobile app. Students are required to come up with a proposal to solve problems through mobile application interaction. They are required to list down the good and bad interaction design choices using the 5 dimensions of interaction design and make improvements by creating mockups.

The project will be assessed based on the following rubric:

Criteria	**Exemplary (90 - 100%)**	**Proficient (70 - 89%)**	**Developing (50 - 69%)**	**Needs Improvement (< 50%)**
1. Problem Identification & Analysis (20%)	- Clearly identifies and analyzes key issues in the existing app using the 5 dimensions of interaction design. - Provides detailed examples of both good and bad design choices.	- Identifies major issues and offers a solid analysis using the 5 dimensions, though some details may be lacking.	- Identifies some issues but the analysis is incomplete or superficial in applying the 5 dimensions.	- Fails to properly identify or analyze the design problems; little or no use of the 5 dimensions.
2. Application of the 5 Dimensions (30%)	- Effectively applies all 5 dimensions (e.g., words, visuals, time, space, behavior) to evaluate the app's interaction design. - Clearly lists and contrasts good and bad	- Applies most of the 5 dimensions accurately, with clear examples, but may omit one dimension or provide less detail on one aspect.	- Attempts to use the 5 dimensions but does so inconsistently or with limited detail. - Some dimensions are not adequately addressed.	- Minimal or incorrect application of the 5 dimensions; lacks clear analysis of interaction design choices.

	design choices across all dimensions.			
3. Proposed Redesign Solutions (20%)	- Proposes innovative and well-justified solutions that directly address the identified issues. - Recommendations are clearly supported by the analysis.	- Proposes effective redesign solutions that address the main issues, though some recommendations may lack full justification.	- Proposes solutions that partially address the issues; recommendations are vague or insufficiently supported by the analysis.	- Fails to propose clear redesign solutions or recommendations are poorly developed and unsupported.
4. Quality of Mockups (20%)	- Provides highly professional, clear, and detailed mockups that effectively illustrate the proposed improvements. - Mockups clearly reflect enhancements in interaction design.	- Presents good-quality mockups that adequately show the proposed redesign; minor details may be missing or less polished.	- Provides mockups that are basic or rough; the proposed improvements are only partially evident or lack clarity.	- Mockups are incomplete, unclear, or absent; do not effectively convey the redesign.
5. Clarity & Organization of the Proposal (10%)	- The proposal is exceptionally well-organized, clearly written, and professionally presented. - Logical structure and flow make it easy to understand the analysis and redesign rationale.	- The proposal is clear and well-organized overall, with minor issues in structure or clarity that do not detract significantly from understanding.	- The proposal is somewhat disorganized or unclear in places, making it harder to follow the analysis and recommendations.	- The proposal is poorly organized, unclear, or unprofessional, significantly hindering comprehension of the project's rationale.

B. Identify User Personas and stories: (25%)

Students will establish requirements based on the existing app from A. They are to describe the users and stakeholders as well as create 3 - 5 user personas and their user stories. Additionally, they are to design a series of 3 different low-fidelity prototype alternatives using paper wireframes. The evaluation will be done based on the following criteria:

Criteria	**Exemplary (90 - 100%)**	**Proficient (70 - 89%)**	**Developing (50 - 69%)**	**Needs Improvement (< 50%)**
1. Requirements Analysis & Stakeholder Identification (30%)	- Thoroughly identifies and describes all relevant stakeholders and users. - Clearly defines detailed requirements based on insights from CA1. - Justifies choices with strong evidence and rationale.	- Identifies and describes most key stakeholders and users. - Provides clear requirements that address the core needs of the app with minor omissions or less depth in rationale.	- Identifies some stakeholders and users, but descriptions are incomplete or generic. - Requirements are partially defined, with limited justification and depth.	- Fails to adequately identify stakeholders or users. - Requirements are vague, incomplete, or unsupported by insights from the existing app.
2. User Personas & User Stories (35%)	- Develops 3–5 detailed, diverse, and realistic user personas that accurately reflect the target audience. - Provides clear, well-structured user stories that capture user needs, pain points, and goals. - Personas and stories	- Creates user personas and corresponding user stories that are clear and mostly complete. - Most personas and stories reflect user needs, though some details or diversity may be lacking. - Alignment with requirements is evident.	- Provides limited or somewhat generic user personas; user stories are basic and only partially capture user needs. - Some alignment with requirements is present but lacks depth or detail.	- Provides few or no meaningful user personas and user stories. - The submission does not adequately reflect user needs or align with the established requirements.

	align strongly with requirements.			
3. Low-Fidelity Prototype Alternatives (35%)	- Produces three distinct, creative, and well-detailed low-fidelity paper wireframes. - Each prototype clearly illustrates a different design alternative that effectively addresses user requirements. - Demonstrates strong insight into user interaction design.	- Develops three viable low-fidelity prototypes that address the design requirements. - Alternatives are clear and differentiated, though some may be less creative or detailed. - Prototypes generally reflect user needs.	- Produces fewer than three prototypes or prototypes that are very basic and lack clear differentiation. - The design alternatives are only partially developed, with limited insight into user needs and interaction.	- Prototypes are missing, overly simplistic, or do not reflect the established requirements. - There is little to no evidence of iterative or alternative design thinking in the wireframes.

C. Interface Project (mobile apps): (30%)

Based on the A proposal and interaction design principles learned, students will develop a prototype of the mobile application that incorporates the improved interaction flow for their application and refine the sitemap and wireframes produced in A. Using a prototyping tool, they are to create an high-fidelity interactive prototype based on their proposed wireframes. A usability study based on their prototype will also be conducted and collated into a report.

Criteria	**Exemplary (90 - 100%)**	**Proficient (70 - 89%)**	**Developing (50 - 69%)**	**Needs Improvement (< 50%)**
1. Improved Interaction Flow & Design Refinement	- Clearly integrates design improvements based on CA1 and interaction design principles. - Refined	- Incorporates design improvements and refines the sitemap and wireframes effectively, with minor omissions.	- Shows basic attempts to improve the interaction flow and refine design documents. - Sitemap and wireframes are	- Fails to integrate improved interaction flow. - Refinements to the sitemap and wireframes are minimal, unclear, or

(25%)	sitemap and wireframes are highly detailed, coherent, and justified. - Demonstrates deep understanding of user flows and interaction best practices.	- Interaction flow is clear and consistent, though some refinements could be more detailed.	partially refined but lack depth or clear justification in parts.	unsupported by design principles.
2. High-Fidelity Prototype Development (35%)	- Produces a highly interactive, visually polished prototype using a prototyping tool. - The prototype accurately reflects the refined wireframes with smooth navigation and consistent design elements. - All key features are fully functional and intuitive.	- Develops a functional high-fidelity prototype that largely reflects the proposed design. - Minor issues in navigation, visual consistency, or functionality are present but do not hinder overall user experience.	- Delivers a prototype that demonstrates basic design elements but suffers from noticeable usability issues or inconsistencies. - Some key features are incomplete or require further refinement.	- The prototype is poorly executed, lacking interactivity or visual coherence. - Key features are missing or nonfunctional, and the design does not reflect the refined wireframes.
3. Usability Study & Report (30%)	- Conducts a comprehensive usability study with clear objectives, robust data collection, and insightful analysis. - The report is well-organized,	- Performs a solid usability study with defined methodology and clear analysis. - The report covers key findings and recommendations, though	- Conducts a basic usability study with limited data or analysis. - The report is incomplete or lacks depth in discussing methodology, findings, or recommendatio	- Usability study is poorly planned or executed, with minimal data or analysis. - The report is disorganized, missing critical sections, or fails to provide actionable

	detailing methodology, user feedback, data interpretation, and actionable recommendations. - Evidence of iterative improvements is strong.	some sections could be more detailed or better organized.	ns.	insights.
4. Overall Integration & Presentation (10%)	- The final submission is exceptionally well-integrated and professionally presented. - The prototype, design refinements, and usability study report are clearly connected, with a logical flow and effective communication of ideas. - Visual and written elements are cohesive.	- The overall work is well-integrated with clear presentation. - The components (prototype, design, and report) are mostly cohesive, with minor lapses in organization or clarity.	- Shows some integration among components, but the presentation is somewhat disjointed or unclear in parts. - The overall flow between the prototype and the report could be improved for better clarity.	- Lacks clear integration; the prototype, design refinements, and usability study report appear disconnected. - The final presentation is disorganized, making it difficult to understand the overall design rationale and outcomes.

D. Interface Project (tablet apps): (35%)

Using the mobile application designed in A, students will design a version of the tablet application, providing more features and functionalities to further improve the user experience. Students are required to give a 5 min presentation of the project with a product demo of both the mobile and tablet application.

This project will be assessed based on the following rubrics:

Criteria	**Exemplary (90 - 100%)**	**Proficient (70 - 89%)**	**Developing (50 - 69%)**	**Needs Improvement (< 50%)**

1. Tablet Application Design & Functionality (40%)	• Exceptionally designed tablet app following best practices for tablet UI. • Enhanced usability and responsiveness with a polished, aesthetically pleasing interface. • All functionalities are fully implemented and work flawlessly.	• Well-designed tablet app that mostly adheres to tablet UI guidelines. • Good usability and design consistency with only minor issues. • Most functionalities work as expected with only minor glitches.	• Design shows basic effort but lacks consistency or polish. • Usability is limited, and some functionalities are incomplete or inconsistent. • The overall interface feels underdeveloped.	• Design is inadequate or fails to follow tablet UI best practices. • Major usability issues with broken or missing functionalities. • The interface appears disjointed and unrefined.
2. Enhanced Features & Improved User Experience (30%)	• Introduces innovative additional features that significantly enhance the user experience. • Provides clear justification and strong evidence for the improvements. • The enhancements add real value beyond the mobile app.	• Adds useful additional features that improve user experience. • Features are well implemented with reasonable justification. • Enhancements build on the existing mobile app effectively.	• Additional features are present but lack innovation or depth. • Improvements only partially enhance the user experience. • Justification for enhancements is minimal or vague.	• Minimal or no additional features beyond the mobile app. • Fails to demonstrate meaningful improvements in user experience. • Lacks clear justification for any proposed enhancements.
3. Integration & Consistency with the Mobile Application	• The tablet version is seamlessly integrated with the mobile app, maintaining a consistent design	• Good integration with the mobile app; design and functionality are mostly consistent. • Minor inconsistencies	• Noticeable inconsistencies exist between the mobile and tablet versions. • Integration is partial, leading to some user confusion or	• The tablet version fails to align with the mobile app in design or functionality. • Experience across platforms is

(15%)	language and functionality. • Users can easily transition between platforms with a coherent experience.	are present but do not significantly affect the overall user experience.	disrupted experience.	disjointed, hindering user transition and overall usability.
4. Presentation & Product Demo (15%)	• Delivers a clear, professional, and well-rehearsed 5-minute presentation. • The product demo effectively showcases both the mobile and tablet applications, highlighting key functionalities and improvements. • Responds confidently and insightfully to questions.	• Presents the project in a clear and organized manner. • The demo effectively shows the primary functionalities of both apps, with minor lapses in delivery. • Answers questions adequately.	• Presentation is somewhat unclear or disorganized. • The demo only partially showcases the apps' functionalities; key aspects are underexplained. • Responses to questions are tentative or incomplete.	• Presentation is poorly organized or unclear, making it difficult to understand the project. • The demo fails to effectively showcase the functionalities of the mobile and tablet apps. • Unable to answer questions satisfactorily.

Overview of the assessment approaches and weighting

Sl.No.	Area of assessment	Quantity	Weightage %
A.	User interaction Analysis	1	10
B.	Identify User Personas and stories	1	25
C.	Interface Project (mobile apps)	1	30
D.	Interface Project (tablet apps)	1	35
	Total	**4**	**100%**

Pre-requisites: None

Subject Matter

Unit I: Interactive Design Process

1.1 Introduction to UI, UX, and UID
1.2 Stages of the Interactive Design Process
1.3 Relationship between SDLC & User-Centric Design
1.4 Design Thinking for problem-solving

Unit II: User-centricity and Accessibility

2.1 Identifying Stakeholders & Target Users
2.2 Creating User Personas & User Stories
2.3 Mapping User Journeys & Pain Points
2.4 Ensuring Accessibility & Inclusivity in Design

Unit III: User Research & Insights

3.1 Importance of User Research
3.2 Preparing Unbiased Interview Questions
3.3 Conducting Qualitative User Interviews
3.4 Analyzing Research Data to extract insights

Unit IV: Prototyping & Interaction Design

4.1 Sitemaps, Wireframes & Storyboarding
4.2 Low, Medium & High-Fidelity Prototyping
4.3 Best Practices in UI/UX Design
4.4 Clickable prototypes using industry-standard tools

Laboratory Sessions

1. **Practical 1: Ideation & Interactive Design Process**
   Objective: Introduce students to the interactive design process and design thinking.

   Activities:
   a) Case Study Analysis:
      Review a sample app case study and discuss its UI, UX, and overall interaction design.
   b) Design Thinking Workshop:
      Engage in brainstorming activities (using sticky notes or digital collaboration tools) to generate ideas for improving a given interface.
   c) Process Mapping:
      Create a flow diagram that outlines the stages of the interactive design process, including key steps of the Software Development Life Cycle integrated with user-centric design.

   Deliverable:
   A documented design process flow and a collection of ideation outputs that justify design decisions.

2. **Practical 2: User Research, Personas & Journey Mapping**
   Objective: Equip students with skills to conduct user research and develop detailed user personas and journey maps.
   Activities:

   a) Research Preparation:
      Prepare unbiased qualitative research questions tailored for a target audience.
   b) Simulated User Interviews:
      Conduct mock user interviews (role-played in small groups) to gather insights into user needs and pain points.
   c) Data Analysis:
      Analyze interview notes to identify common themes and user requirements.
   d) Persona & Journey Map Creation:
      Develop 3–5 detailed user personas and create corresponding journey maps that illustrate user interactions, emotions, and pain points.

   Deliverable:
   A set of user personas accompanied by journey maps and a brief summary report of the research findings.

3. **Practical 3: Accessibility & User-Centric Requirements**
   Objective: Emphasize the importance of accessibility and user-centricity in design.

   Activities:
   a) Stakeholder Analysis:
      Identify and list key stakeholders and user groups for an existing app.
   b) Accessibility Audit:
      Review a sample mobile app or website to identify accessibility issues (using checklists or guidelines such as WCAG).
   c) Requirement Formulation:
      Based on the audit, outline key user-centric requirements and suggest modifications to enhance accessibility.

   Deliverable:
   A concise report that documents identified accessibility issues, outlines user and stakeholder requirements, and proposes actionable recommendations.
4. **Practical 4: Rapid Prototyping with Paper Wireframes**
   Objective: Enable students to translate research insights into low-fidelity design deliverables.

   Activities:
   a) Design Deliverables Overview:
      Review the purpose and components of design documents (sitemaps, storyboards, and wireframes).
   b) Paper Wireframing:
      Sketch multiple (e.g., three) low-fidelity prototypes for a mobile/tablet interface using paper, focusing on layout, navigation, and key interactive elements.

c) Annotation & Discussion:
Annotate the wireframes to explain design choices and engage in a peer-review session to discuss strengths and areas for improvement.

Deliverable:
A set of 3 different annotated paper wireframe prototypes and a brief reflection on design choices.

5. **Practical 5: Digital Prototyping & Interactive Mockups**
Objective: Introduce students to converting low-fidelity ideas into high-fidelity, clickable prototypes using digital tools.

Activities:
a) Tool Introduction:
Brief tutorial on a prototyping tool (e.g., Figma, Adobe XD, Sketch).
b) Digital Wireframing:
Recreate paper wireframes digitally, ensuring consistency in layout and interactivity.
c) Interactive Mockup Development:
Build a clickable prototype that simulates user interaction flows.
d) Feedback & Iteration:
Conduct a quick peer review or usability walkthrough and refine the prototype based on feedback.

Deliverable:
A high-fidelity interactive prototype that aligns with the original design vision, along with a short summary of feedback and improvements made.

Reading List

Essential Reading (e-Textbook):

Dan Saffer (2009) Designing for Interaction (2nd ed.)

Additional Reading:

Alan Cooper, Robert Reimann, David Cronin, Christopher Noessel (September 2014) About Face: The Essentials of Interaction Design. Wiley; 2014

Don Norman (2013) The Design of Everyday Things: Revised and Expanded Edition. Basic Books; Revised edition; November 2013

Helen Sharp (2019) Interaction Design: Beyond Human-Computer Interaction. Wiley; 5th edition; May 2019

Jenifer Tidwell, Charles Brewer, Aynne Valencia (2020) Designing Interfaces: Patterns for Effective Interaction Design. O'Reilly Media (February 4, 2020)

Jon Yablonski (2020) Laws of UX: Using Psychology to Design Better Products & Services. O'Reill (May 12, 2020)

Leah Buley (2016) The User Experience Team of One: A Research and Design Survival Guide. Rosenfeld Media (July 9, 2013)

Steve Krug (2013) Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability. New Riders (December 24, 2013)

Date: February 2025.

2.6 Year 3, Semester II

DAT304 Big Data

Module Code and Title: DAT304 Big Data
Programme: Bachelor of Data Science and Data Analytics
Credit: 12
Module Tutor(s): Phub Namgay

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General Objective

This module aims to equip students with a solid foundation in Big Data technologies, enabling them to design, implement, and manage scalable data processing and storage systems. Students will gain hands-on experience with industry-leading tools such as Hadoop, Spark, NoSQL databases (MongoDB, Cassandra, Redis), Apache Kafka, Hive, and HBase. They will learn how to set up clusters, process data efficiently, and integrate different tools within the Hadoop ecosystem to handle real-world data challenges.

Learning Outcomes

On completion of the module, students will be able to:

1. Install and configure the Hadoop ecosystem and its components.
2. Explain the architecture and key concepts of Hadoop.
3. Apply the concepts of the Hadoop Distributed File System (HDFS).
4. Manage storage and resource allocation in Hadoop.
5. Evaluate scenarios where NoSQL databases are more suitable than traditional databases.
6. Perform SQL queries on Spark data using PySpark SQL.
7. Develop and implement a Kafka Streams application for real-time data processing.
8. Integrate Hive with Apache Spark for unified data processing across multiple frameworks.
9. Perform CRUD operations in HBase.
10. Integrate HBase with Apache Phoenix to enable SQL-based querying.

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
Contact	Teaching	2	75
	Practical and group work	3	
Independent study	Assignments, projects, self-study	3	45
Total		**8**	**120**

The module will be taught through a combination of theory and hands-on practical sessions.

- Lectures & Tutorials: Cover foundational concepts, theories, and discussions to clarify students' understanding.
- Practical Sessions: Hands-on exercises where students apply concepts to real-world datasets.
- Group Discussions & Presentations: Enhance peer learning and improve understanding of key concepts.

Assessment Approach

A. Quizzes: (25%)

Following the conclusion of each unit, students will be required to attempt a one hour quiz to evaluate the conceptual comprehension of the material. There will be a total of five quizzes, with each quiz contributing 5% to the overall grade.

B. Laboratory Assessments: (20%)

This group assessment involves teams consisting of 2-4 members collaboratively working on two lab assessments assigned by the instructor. The lab assessments will focus on practical applications of Hadoop and Spark, with datasets provided by the instructor. Each lab assessment will contribute 20% to the final grade, evaluating students' practical knowledge and skills in these technologies.

C. Practical Test: (15%)

After concluding all units, a comprehensive practical test will be administered, featuring practical questions derived from each unit. The question(s) associated with each unit will contribute 5% to the final grade. The duration of the practical test will be 2 hours.

D. Project: (40%)

For this project the students can work in groups of 3 or 4. The objective of the project is to let the student use the tools and techniques taught and apply these tools to perform data analytics on a real data set. The datasets are available freely online on various websites. The size of the data set will be at the discretion of the module tutor.

The project will consist of the following components:

a) Phase 1: Project proposal (10%)
b) Phase 2: Project milestones (10%)
c) Phase 3: Final Report (20%)

Each phase will be assessed based on the following rubrics:

Phase 1: Project Proposal (10%)			
Competencies	**0 - 1 (Needs Improvement)**	**2 - 3 (Proficient)**	**4 - 5 (Excellent)**
	Problem	Problem	Problem statement

Project Identification (5)	statement, project topic and keyword evidence lack of effort or depth of thinking about the project.	statement are vague and fuzzy, project topic does not connect to problem statement, keyword are not specific	are clear and specific, project topic relates to problem statement, keyword links to project
Define proper aims, objectives, and scope (5)	Aims, Goals, Objectives and scope were not clearly stated.	Aims, Goals and Objectives lacked overall organization of project ideas. The reader had to make considerable effort to understand the underlying flow of ideas and scope.	Aims, Goals and Objectives were well organized and clearly written. Scope of the project is clear and specific
Project Features (5)	The audience had to make considerable effort to understand the underlying requirement and flow of ideas lacking clarity in all components	Background and the literature review lacks clarity. The functional and nonfunctional requirements lack clarity. The architecture does not connect for the frontend, backend and storage technology implementation and project deployment. The transitions and workflow are not not easy to understand	Background and the literature review were well organized and clearly written. The functional and nonfunctional requirements are easy to follow. The architecture was appropriate for the frontend, backend and storage technology implementation and project deployment. The transitions and workflow were easy to follow.
	Presentation could not connect to the	Presentation were not consistent	Presentation Illustrate and

Individual Presentation (5)	overall concept of the project (the contribution of each member based on the role that has given in the documents)	throughout, lacks confidence in the presenter, could partially connect to the overall concept of the project (the contribution of each member based on the role that has given in the documents)	connects to the overall concept of the project (the contribution of each member based on the role that has given in the documents)
Q & A (5)	Couldn't comprehend question, couldn't answer any question or could answer only one question	Able to comprehend question question and able to answer 2 to 3 question	Able to answer 3 or more question

Phase 2: Project Milestones (10%)			
Competencies	**0 - 1 (Needs Improvement)**	**2 - 3 (Proficient)**	**4 - 5 (Excellent)**
Project Status (5)	Provides unclear or incomplete information on the current status; little or no insight into progress or challenges.	Provides an accurate summary of project status with most key aspects covered and some detail on challenges.	- Clearly and accurately reports the current status with detailed explanations of work completed and challenges encountered. - Demonstrates a deep understanding of project progress
	Major deliverables are missing, of	Most deliverables are complete and	- All deliverables are complete, of

Deliverables (5)	poor quality, or do not meet the project requirements; documentation is absent or very unclear	meet project requirements with minor issues in quality or documentation.	high quality, and meet or exceed the project requirements. - Includes supplementary materials or documentation that enhance understanding
Timeline Management (5)	- Timeline is vague or missing; significant deviations are not addressed, with little evidence of effective time management.	- Timeline is clearly defined with most milestones addressed; minor deviations are explained with reasonable adjustments.	- Provides a clear, detailed timeline showing completed tasks and future milestones. - Demonstrates effective time management and realistic adjustments to schedule.

A final report shall contain approximately 2000 – 2500 words with all the following components:

a) Abstract
b) Introduction
c) Related work
d) Approach and method used
e) Experimental details
f) Result Analysis

The report will be report will be assessed based on criteria:

Phase 3: Project Report (20%)			
Competencies	**0 - 1 (Needs Improvement)**	**2 - 3 (Proficient)**	**4 - 5 (Excellent)**
Introduction (5)	Lacks clarity and coherence; objectives, scope, and significance are poorly defined	- Offers a good overview with stated objectives and scope; however, may lack	- Provides a clear, concise, and engaging overview of the project. - Clearly states

	or missing. - Fails to capture the reader's interest..	some depth or clarity in significance. - The introduction sets the stage but may not fully engage the reader.	objectives, scope, and significance, setting the stage for the report. - Demonstrates a strong contextual understanding.
Literature Review (5)	- Incomplete or poorly organized literature review with minimal reference to relevant sources. - Lacks critical analysis and synthesis, undermining the foundation of the research	- Adequate review covering most relevant sources with some critical analysis. - Shows an understanding of the background literature, though integration may not be fully comprehensive	- Comprehensive review of relevant literature with critical analysis. - Effectively integrates multiple sources to support the research plan. - Demonstrates in-depth understanding and synthesis of prior work.
Methodology (5)	- Methodology is vague or incomplete, with insufficient details on the research design, data processing strategies, and overall approach. - Little to no justification of the chosen methods is provided.	- Provides a clear description of the methodology, including key tools and techniques. - Most steps are explained and justified, although some aspects (such as DMPS) may be less detailed.	- Describes the research design and data acquisition/preprocessing methods in detail. - Clearly explains the tools, techniques, and processes (including DMPS) used in the study. - Justifies methodological choices with strong rationale and relevance to objectives
	- Results are poorly presented	- Presents results clearly using	- Clearly presents the data and

Results (5)	or incomplete, lacking clarity and organization. - Visualizations and tables are missing or ineffective, making interpretation difficult.	appropriate visual aids, with minor lapses in organization or clarity. - Most results are tied to the project objectives, though some explanations may be less detailed.	results with appropriate visualizations and tables. - Results are well-organized, accurate, and directly tied to the objectives. - Provides detailed explanations of findings, enabling clear understanding.
Findings (5)	- Findings are unclear, unsupported by evidence, or missing key aspects of the research questions. - Lacks depth and fails to demonstrate the implications of the data analysis.	- Offers clear findings with adequate support from the data. - Most research questions are addressed, though some insights may be less thoroughly explored or novel contributions less emphasized.	- Provides insightful, well-articulated findings that address the research questions. - Findings are thoroughly supported by data and analysis. - Clearly highlights novel contributions or unexpected outcomes.
Interpretation (5)	- Interpretation is weak or missing, with little connection to the literature or research objectives. - Fails to discuss the implications or acknowledge limitations of the study.	- Offers a clear interpretation of the results with connections to the literature and objectives, though some nuances or limitations may be underexplored. - Implications are generally well articulated.	- Provides a deep and nuanced interpretation of the results, linking them effectively to the literature review and research objectives. - Clearly discusses implications, limitations, and the significance of the findings.

Recommendations & Applications (5)	- Recommendations are vague, unsupported, or missing. - Fails to connect the findings to practical applications or provide a meaningful direction for future work.	- Provides clear recommendations and identifies practical applications, though some suggestions may lack depth. - Future directions are mentioned, but the connection to the analysis may be less robust.	- Presents well-founded, actionable recommendations based on the findings. - Clearly articulates practical applications and future directions. - Demonstrates a strong linkage between analysis, recommendations, and real-world impact.

Overview of the assessment approaches and weighting

Sl.No.	Area of assessment	Quantity	Weightage %
A.	Quizzes	5	25
B.	Laboratory Assessment	1	20
C.	Practical Test	1	15
D.	Project	1	40
	Total	**8**	**100%**

Pre-requisites: CSP202 Modern Database Design

Subject Matter

Unit I: Introduction to Hadoop and Big Data

1.1 Overview of Big Data
1.2 Introduction to Hadoop and its ecosystem
1.3 Comparison: Hadoop vs Traditional Systems
1.4 Limitations of Traditional Data Analytics Architectures
1.5 Types of Data in Big Data Analytics
1.6 Hadoop Cluster Architecture & Configuration
1.7 HDFS (Hadoop Distributed File System) and its Components
    1.7.1 Name Node, Data Node, Data Blocks
    1.7.2 HDFS Commands
    1.7.3 Introduction to MapReduce
    1.7.4 MapReduce Workflow

1.7.5 Configuring MapReduce in Hadoop
1.7.6 Writing MapReduce Programs in Python

Unit II: Apache Spark

2.1 Fundamentals and Role of Apache Spark
2.2 Resilient Distributed Datasets (RDDs)
2.2.1 Transformations & Actions in PySpark
2.3 Spark SQL & DataFrame Operations
2.4 Spark Streaming for Real-Time Data Processing
2.5 Implementing Machine Learning with MLlib
2.6 Graph Processing with GraphX

Unit III: NoSQL Databases

3.1 Characteristics of NoSQL Databases
3.2 CRUD Operations in MongoDB
3.3 Data Modeling in Cassandra
3.4 Document Retrieval in Couchbase (IN1QL Queries)
3.5 Key-Value Operations in Redis
3.6 Scaling NoSQL Databases Horizontally
3.7 Performance Optimization through Indexing & Caching

Unit IV: Apache Kafka

4.1 Real-Time Data Streaming with Apache Kafka
4.2 Kafka Architecture: Brokers, Partitions, Zookeeper
4.3 Building a Producer-Consumer Model
4.4 Implementing Kafka Streams for Data Processing
4.5 Kafka Integration with External Data Sources
4.6 Kafka Monitoring Tools & Performance Metrics

Unit V: Apache Hive and HBase

4.1 Introduction to Hive
5.2 Creating & Managing Tables in HiveQL
5.3 Advanced Queries (Joins, Subqueries, UDFs)
5.4 Partitioning & Bucketing in Hive
5.5 Integrating Hive with Apache Spark
5.6 HBase Overview & Installation
5.7 CRUD Operations in HBase
5.8 Scans, Filters, and Transactions in HBase
5.9 HBase Integration with Apache Phoenix

Laboratory Sessions

1. **Lab Session 1: Introduction to Hadoop and HDFS**

   Objective: Install Hadoop and explore HDFS commands.

   Tasks:

   a) Install Hadoop on a local machine or use a pre-configured VM (e.g., Cloudera QuickStart VM).
   b) Explore HDFS commands
   c) Learn the roles of NameNode and DataNode
   d) Perform basic file operations in HDFS

2. **Lab Session 2: MapReduce Programming**

   Objective: Write and execute a MapReduce program.

   Tasks:

   a) Write a simple MapReduce program in Python (using Hadoop Streaming)
   b) Configure and run the MapReduce job on Hadoop.
   c) Analyze the output and understand the MapReduce workflow (map, shuffle, sort, reduce).

3. **Lab Session 3: Apache Spark Basics with PySpark**

   Objective: Perform basic transformations and actions on RDDs.

   Tasks:

   a) Install PySpark and set up a Spark session.
   b) Create RDDs from a dataset (e.g., a text file).
   c) Perform transformations (map, filter, flatMap) and actions (count, collect, reduce).
   d) Write a PySpark program to analyze a dataset (e.g., count word frequencies).

4. **Lab Session 4: Spark SQL and DataFrames**

   Objective: Perform SQL queries on Spark DataFrames.

   Tasks:

   a) Load a dataset (e.g., CSV or JSON) into a Spark DataFrame.
   b) Perform basic SQL queries (select, filter, groupBy, aggregate).
   c) Write a PySpark SQL program to analyze a dataset (e.g., sales data).

5. **Lab Session 5: NoSQL Database – MongoDB**

   Objective: Perform CRUD operations in MongoDB**.**

   Tasks:

   a) Install MongoDB and set up a local database.
   b) Perform CRUD operations:
      - Insert documents.
      - Query documents.

- Update and delete documents.

c) Design a simple data model for a use case (e.g., student records).

6. Lab Session 6: NoSQL Database – Cassandra

Objective: Design a data model and perform queries in Cassandra.

Tasks:

a) Install and configure Cassandra.

b) Create a keyspace and table.

c) Perform CRUD operations using CQL (Cassandra Query Language).

d) Design a data model for a use case (e.g., IoT sensor data).

7. Lab Session 7: Apache Kafka Basics

Objective: Set up Kafka and create a producer-consumer application.

Tasks:

a) Install and configure Apache Kafka and Zookeeper.

b) Create a Kafka topic.

c) Write a producer to publish messages to the topic.

d) Write a consumer to read messages from the topic.

8. Lab Session 8: Kafka Streams and Integration

Objective: Perform real-time data processing using Kafka Streams.

Tasks:

a) Write a Kafka Streams application to process streaming data (e.g., word count).
b) Integrate Kafka with an external data source using Kafka Connect.
c) Monitor Kafka using tools like Kafka Manager or Conduktor.

9. Lab Session 9: Apache Hive

Objective: Perform data analytics using HiveQL.

Tasks:

a) Install and configure Apache Hive.
b) Create tables and load data into Hive.
c) Perform queries involving joins, subqueries, and aggregations.
d) Explore partitioning and bucketing strategies.

10. Lab Session 10: Apache HBase

Objective: Perform CRUD operations and integrate HBase with Phoenix.

Tasks:

a) Install and configure Apache HBase.
b) Perform CRUD operations using the HBase shell.
c) Use filters and scans to query data.
d) Integrate HBase with Apache Phoenix and perform SQL queries.

Reading List

Essential Reading:

Bengfort, B., & Kim, J. (2016). *Data Analytics with Hadoop: An Introduction for Data Scientists*. O'Reilly Media.

White, T. (2015). *Hadoop: The Definitive Guide*. O'Reilly.

Kunigk, J., et al. (2018). *Architecting Modern Data Platforms: A Guide to Enterprise Hadoop at Scale*. O'Reilly Media.

Additional Reading:

Holmes, A. (2014). *Hadoop in Practice*. Manning.

Karanth, S. (2014). *Mastering Hadoop*. Packt Publishing.

DT Editorial Services. (2016). *Big Data Black Book*. Dreamtech Press.

Date: February 2025.

DAT306 Calculus for Data Science

Module Code and Title:	DAT306 Calculus for Data Science
Programme:	Bachelor of Data Science and Data Analytics
Credit:	12
Module Tutor(s):	R Balamurugan

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General Objective

Calculus is the mathematical study of continuous change. The aim of this module is to provide students with useful tools to check how things will change by perturbation in something else. Students will be able to build mathematical models where there is change, analyze changes in relationships within data sets and optimize the models by iteratively reducing errors.

Learning Outcomes

On completion of the module, students will be able to:

1. Examine a given function for continuity/discontinuity at a given point and identify types of discontinuities
2. Apply various rules of differentiation to find the differential coefficient of a given function
3. Identify the intervals in which a given function is increasing or decreasing

4. Derive Taylor series approximation of a function to a given level of accuracy
5. Evaluate indefinite and definite integrals of a given function
6. Find the area, volume and surface area of solids of revolution in a given interval using definite integrals
7. Find the partial derivatives of a given multivariable function
8. Examine a given function for extreme values
9. Evaluate derivatives, integrals and partial derivatives of a given function in python using Sympy and Numpy libraries
10. Use calculus techniques to fit a regression model for the given data set and examine the fitness of the model using RMSE and R^2
11. Implement regression models in python using gradient descent algorithm
12. Express output vector of a simple neural network in terms of weights matrix, input vector and bias vector
13. Fit a model for a simple neural network using ReLU and sigmoid activation function and check the accuracy of the model and implement it python

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
Contact	Teaching	2	60
	Tutorial/ Practical	2	
Independent study	Assignments, projects, self-study	4	60
Total		**8**	**120**

The module will be delivered using regular classroom teaching, tutorial and practical sessions. In the teaching sessions, students will learn the key concepts and their applications. Tutorial sessions will be conducted by making students try practice problems. This will help the tutor to assess the understanding of the students and provide help to those who are lacking behind. During practical sessions, students will use python libraries to solve problems and fit models. This will improve their programming and problem-solving skills.

Assessment Approach

The assessment will be carried out on a continuous basis through the following approaches.

A. Assignment: (20%)

Students' understanding and comprehension of key concepts and their applications will be assessed using two assignments. Sets of problems will be provided to the students which are to be solved and submitted individually.

- Assignment I (10%): Students will apply their knowledge acquired in single and multivariable calculus to solve a set of problems by writing detailed solutions. This will be a home assignment.

- Assignment II (10%): This will test the students' understanding of regression models and neural networks. This will be supervised class work for two hours duration. Students will have to solve a given set of problems in a group (not more than three students) and submit the solutions.

B. Online Quizzes: (20%)

There will be two online quizzes (in Moodle VLE platform), each contributing 10% to the final grade. Each quiz will have 30 multiple choice questions and are to be attempted in 1 hour.

- Online quiz I (10%): Assesses learning outcomes 1 to 6
- Online quiz II (10%): Assesses learning outcomes 7,8,10,11 and 12

C. Practical Test: (20%)

There will be two practical tests during the semester. Students will have to write code in python using Jupyter notebook to solve given problems. Each test will be for one and a half an hour duration. This will assess the students' ability to apply programming skills in coding problems related to calculus, curve fitting and neural networks.

- Practical Test I (10%): Assesses skills in finding derivatives, partial derivatives, evaluating indefinite and definite integrals using Sympy and Numpy libraries in python. (To assess learning outcome 9).
- Practical Test II (10%): Assesses curve fitting (linear, polynomial and logistic) skills and implementation of neural networks in python using TensorFlow and Keras libraries (To assess learning outcome 13).

D. Semester End Examination: (40%)

There will be a Semester End Examination for a duration of three hours. Questions from all the units of the subject matter will be included.

Overview of the assessment approaches and weighting

Sl.No.	Area of assessment	Quantity	Weightage %
A.	Assignment	2	10
B.	Online Quizzes	2	25
C.	Practical Test	2	30
D.	Semester-End Examination	1	40
	Total	**7**	**100%**

Pre-requisites: CSP101 Foundations of Python Programming

Subject Matter

Unit I: Differential Calculus

1.1 Functions and their graphs
    1.1.1 Definition of function, their domain, codomain and range
    1.1.2 Types of functions
    1.1.3 Graphs of functions
1.2 Limits
    1.2.1 Definition of left and right limits
    1.2.2 Existence of limit of a function
    1.2.3 Evaluation of limits
    1.2.4 Algebra of limits
    1.2.5 Relation between limits and graph of a function
1.3 Continuity
    1.3.1 Definition of continuity at a given point
    1.3.2 Continuity in an interval
    1.3.3 Discontinuity of a function
    1.3.4 Types of discontinuity
    1.3.5 Geometrical meaning of discontinuity
    1.3.6 Algebra of continuous functions
1.4 Differentiation
    1.4.1 Definition of left and right derivative
    1.4.2 Derivative of a function at a point
    1.4.3 Geometrical meaning of derivative
    1.4.4 Rules of differentiation
    1.4.5 Derivative of algebraic, exponential, trigonometric and inverse trigonometric and logarithmic functions
    1.4.6 Differentiation by substitution
    1.4.7 Higher order derivatives
1.5 Application of derivatives
    1.5.1 Sign of derivatives, increasing and decreasing functions
    1.5.2 First and second order conditions for local extrema
    1.5.3 Extreme values of a function
    1.5.4 Optimization problems
1.6 Series approximation of functions
    1.6.1 Mean value theorems
    1.6.2 Geometrical meaning of Rolle's and Lagrange's mean value theorems
    1.6.3 Taylor's series expansion of elementary functions
    1.6.4 Maclaurin's series expansion of elementary functions

Unit II: Integral Calculus

2.1 Methods of integration
    2.1.1 Antiderivatives and indefinite integrals
    2.1.2 Integration by substitution
    2.1.3 Integration by parts
    2.1.4 Integration of rational algebraic functions
    2.1.5 Integration by partial fractions
2.2 Definite integrals

2.2.1 Riemann sums
2.2.2 Definite integrals
2.2.3 Geometrical meaning of definite integrals
2.2.4 Properties of definite integrals
2.2.5 Evaluation of definite integrals using properties

2.3 Application of integrals
2.3.1 Area between a curve and the coordinate axes
2.3.2 Area between a curve and a line
2.3.3 Area between two curves
2.3.4 Volumes of revolution
2.3.5 Surface areas of solids of revolution
2.3.6 Lengths of plane curves
2.3.7 First order differential equations
2.3.8 Initial value problems and mathematical modelling

Unit III: Multivariable calculus

3.1 Limit and continuity
3.1.1 Functions of several variables
3.1.2 Existence of limits
3.1.3 Evaluation of limits
3.1.4 Continuity at a given point

3.2 Partial derivatives
3.2.1 Definition of partial derivatives
3.2.2 Geometrical meaning of partial derivatives
3.2.3 Higher order partial derivatives
3.2.4 Homogeneous functions
3.2.5 Euler's theorem

3.3 Linearization and extreme values
3.3.1 Linearization of functions at a given point
3.3.2 Conditions for local extrema
3.3.3 Saddle points
3.3.4 Examination of given functions for extreme values

Unit IV: Curve Fitting

4.1 Meaning of weights and biases in a model
4.2 Loss function
4.3 Minimization of loss function
4.4 Accuracy of a model using RMSE and R^2
4.5 Fitting a linear regression line using gradient descend
4.6 Fitting a polynomial regression
4.7 Fitting logistic regression

Unit V: Simple Neural Networks

5.1 Definition of simple neural networks

5.2 Weights and biases in a neural network
5.3 Activation function
5.4 Sigmoid and ReLU activation functions
5.5 Loss function
5.6 Learning rate
5.7 Determination of optimum weights and biases

Laboratory Sessions

1. Use matplotlib.pyplot library to graph a given function
2. Use Sympy and Numpy libraries in python
    a) to evaluate limits
    b) find derivatives
    c) find antiderivatives
    d) partial derivatives
3. Use TensorFlow library autograd function to evaluate derivative at a point
4. Use TensorFlow library to fit a
    a) linear and polynomial regression
    b) logistic regression
5. Use backpropagation gradient descent algorithm to fit a model for a simple neural network

Reading List

Essential Reading:

Cristina, S., & Saeed, M. (2022). *Calculus for Machine Learning* (v1.00).

Nield, Thomas, (2022). *Essential Math for Data Science*. O'Reilly Media Inc.

Heinbockel, J.H. (2012). *Introduction to Calculus*, volume I.

Hass, J., Heil, C., & Weir, M. (2017). *Thomas' Calculus* (14th ed.). Pearson.

Additional Reading:

Deisenroth, M. P., Faisal, A. A., & Ong, C. S. (2020). *Mathematics for Machine Learning* (1st ed.). Cambridge University Press.

Morley, S. (2020). *Applying Math with Python*. Packt Publishing Ltd.

Date: February 2025.

DAT308 Data Science Project II

Module Code and Title: DAT308 Data Science Project II
Programme: Bachelor of Data Science and Data Analytics
Credit: 12

Module Tutor(s): Karma Dorji

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General Objective

The primary objective of this module is to provide students with hands-on experience in solving real-world problems using data science techniques. Students will integrate knowledge from programming, data visualization, AI/ML, deep learning, and statistical computing to acquire, clean, analyze, and interpret complex datasets. The course emphasizes critical problem-solving and allows students to work on local challenges where data-driven solutions can be impactful. Students will also develop skills in team collaboration, technical communication, and project management, while addressing ethical considerations in data analysis. By the end, students will be prepared for their capstone project and future data science roles.

Learning Outcomes

On completion of the module, students will be able to:

1. Identify and formulate a relevant data science problem with measurable objectives.
2. Collect, clean, and preprocess real-world datasets efficiently.
3. Implement suitable data visualization techniques to explore and communicate insights.
4. Develop and optimize statistical models and machine learning algorithms for problem-solving.
5. Design and implement an interactive web-based or dashboard solution for data-driven decision-making.
6. Apply deep learning models where applicable, ensuring proper evaluation and fine-tuning.
7. Utilize database systems to store, retrieve, and manage structured/unstructured data effectively.
8. Adhere to best practices in project management, version control, and collaborative development.
9. Critically assess the ethical implications of data collection, analysis, and modeling.
10. Present findings coherently through technical reports, research posters, and oral presentations to a general audience.

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
Contact	Regular meetings with the module tutor and project groups.	2	30
Independent study	Researching project topics, dataset acquisition, development, and interactions with stakeholders (if applicable). Preparing deliverables and reports.	6	90
Total		**8**	**120**

The module will have only two hours of teaching in a week. The teaching sessions are mainly to familiarize students with project ideas, proposal write up, report writing and references, and

presentation techniques. Other topics would include ethical issues and project implementations besides others.

Additionally, activities such as small-group discussion and presentation will be held during the in-class sessions. This allows students to have more opportunities to participate in discussions and to have better class interactions.

Project Timeline

Week 1	Introduction to the project cycle: problem identification, proposal writing, and feasibility study
Week 2	Project planning: defining scope, selecting datasets, and establishing objectives
Week 3 - 4	Data collection, cleaning, and exploratory data analysis
Week 5 - 6	Model selection, implementation, and experimentation with AI/ML techniques
Week 7 - 8	Web-based or dashboard integration for presenting data-driven insights
Week 9 - 10	Performance evaluation, optimization, and error analysis
Week 11 - 12	Ethical considerations, documentation, and storytelling with data
Week 13	Draft submission, peer review, and refinement
Week 14	Final submission and project presentation to faculty, industry experts, and peers
Week 15	Reflection, feedback session, and course wrap-up

Expected Deliverables

- **Project Proposal**: A well-defined problem statement, objectives, methodology, and expected outcomes.
- **Code Repository**: Well-documented code with proper version control (GitHub/Bitbucket).
- **Data Report**: Insights from data preprocessing and exploratory analysis.
- **Dashboard/Web Application**: Interactive interface for results visualization (if applicable).
- **Final Report**: Comprehensive documentation covering problem definition, methodology, implementation, and conclusions.
- **Presentation**: Formal defense of the project findings to faculty and invited experts.

Assessment Approach

The assessment will be carried out on a continuous basis through the following approaches.

A. **Project Proposal: (15%):**

Students will prepare a detailed project proposal upon topic confirmation and tutor approval. The proposal will be assessed based on the following criteria:

Part A: Project Proposal (20%)			
Competency	**Needs Improvement (0 - 1)**	**Proficient (2 - 3)**	**Excellent (4 - 5)**
Problem Definition (5)	Unclear or irrelevant problem	Clearly defined but lacks relevance	Well-defined, relevant, and impactful
Objectives and Scope (5)	Vague or unachievable.	Defined but needs refinement.	Clear, realistic, and achievable with specific milestones.
Methodology(5)	Methodology is unclear or inappropriate for the problem.	Basic but feasible methodology.	Well-structured and robust methodology.
Feasibility & Resources (5)	No resources identified, unrealistic	Identifies some resources, needs further planning.	Well-thought-out resource plan with contingency.
Presentation and Structure (5)	Poorly structured, hard to follow.	Clear but lacks professional polish.	Well-organized, professional, and clear.

B. Data Collection & Cleaning: (20%)

Students will engage in data collection and cleaning processes, which they will document and submit. The tutor will assess the process based on the following components:

Part B: Data Collection & Cleaning (20%)			
Competency	**Needs Improvement (0 - 1)**	**Proficient (2 - 3)**	**Excellent (4 - 5)**
Data Acquisition(5)	No relevant data identified.	Some data identified, needs more refinement.	High-quality, relevant, and diverse data

			sources identified.
Data Quality (5)	Incomplete, messy, or unreliable data.	Data cleaned with some issues.	High-quality, clean, and reliable dataset.
Data Transformation (5)	Poor transformation or none attempted.	Some data transformation applied, but with limited success.	Effective transformation with well-documented methods.
Handling Missing Values/Outliers (5)	Missing values/outliers ignored or handled poorly.	Some handling of missing values and outliers.	Robust handling with justification.
Documentation & Transparency (5)	No documentation or unclear.	Basic documentation.	Well-documented and transparent process.

C. Data Analysis & Modeling: (30%):

Students will perform data analysis and model selection, which they will submit for evaluation by the module tutor. The report will be assessed based on criteria:

Part C: Data Analysis & Modeling (30%)			
Competency	**Needs Improvement (0 - 1)**	**Proficient (2 - 3)**	**Excellent (4 - 5)**
Choice of Techniques (5)	Inappropriate techniques or no clear methodology.	Basic methods chosen with some justification.	Advanced techniques well-chosen and well-justified.
Model Performance (5)	Poor model performance with no meaningful results.	Adequate performance, some room for improvement.	High-performance models with insightful results.

Exploratory Data Analysis (EDA) (5)	Minimal EDA conducted.	Basic EDA conducted, with some insights drawn.	Thorough EDA with meaningful insights.
Insight Generation (5)	No actionable insights derived.	Some insights with limited application.	Deep, meaningful insights with clear recommendations.
Reproducibility (5)	Not reproducible.	Some reproducibility achieved.	Fully reproducible with well-commented code and workflows.

D. Communication & Presentation: (15%):

Students will present project findings and insights through interactive web-based visualizations to the module tutor. The assessment will be assessed based on the following criteria:

Part D: Communication & Presentation (15%)			
Competency	**Needs Improvement (0 - 1)**	**Proficient (2 - 3)**	**Excellent (4 - 5)**
Quality (5)	Unstructured, inaccurate, or lacks coherence.	Mostly accurate but needs improvement.	High-quality, well-structured, exceeding expectations.
Demonstration (5)	Lacks clarity and logical flow.	Provides a reasonable walkthrough of the project.	Engages the audience with a compelling and structured demonstration.
Presentation (5)	Poor confidence and inconsistent flow.	Somewhat structured but needs refinement.	Confident, well-paced, and engaging presentation.
Q & A (5)	Unable to answer questions clearly.	Can answer 2-3 questions with minor gaps.	Answers all questions confidently with depth.

E. Final Project Report: (20%)

The final project report will be assessed based on the following rubric:

Part E: Final Project Report (20%)			
Competency	**Needs Improvement (0 - 1)**	**Proficient (2 - 3)**	**Excellent (4 - 5)**
Report Structure (5)	Poor structure, hard to follow.	Some structure but needs refinement.	Well-organized, logical structure.
Content & Depth (5)	Superficial content with little depth.	Content is adequate but lacks depth.	Comprehensive, in-depth content with clear insights.
Technical Detail (5)	Minimal technical detail.	Adequate technical detail, but lacks depth.	Excellent technical detail with supporting analysis.
Clarity of Writing (5)	Unclear, poorly written.	Clear but lacks professional polish.	Well-written, clear, and professional.
References & Citations (5)	No references or incorrect citations.	Some references, but incomplete.	Correct and comprehensive references and citations.

Overview of the assessment approaches and weighting

Sl.No.	Area of assessment	Quantity	Weightage %
A.	Project Proposal	1	15
B.	Data Collection and Cleaning	1	20
C.	Data Analysis & Modelling	1	30
D.	Communication & Presentation	1	15
E.	Final Project Report	1	20
	Total	**4**	**100%**

Pre-requisites: DAT205 Data Science Project I

Subject Matter

In prior modules, students explored fundamental theoretical principles and practical methodologies necessary for initiating a data science project. Consequently, this module will not delve into content previously covered but rather build upon the foundational knowledge acquired during those terms.

Reading List

Essential Reading:

E-books:

Géron, A. (2019). *Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow* (2nd ed.). O'Reilly Media.

Klosterman, S. (2019). *Data science projects with Python: A case study approach to gaining valuable insights from real data with machine learning* (1st ed.). Packt Publishing.

Knaflic, C. N. (2015). *Storytelling with data: A data visualization guide for business professionals*. Wiley.

Provost, F., & Fawcett, T. (2013). *Data science for business: What you need to know about data mining and data-analytic thinking*. O'Reilly Media.

VanderPlas, J. (2016). *Python data science handbook: Essential tools for working with data*. O'Reilly Media.

Research Papers & Case Studies:

Hardt, M., Recht, B., & Singer, Y. (2021). *A guide to data science project management*. *Harvard* https://hdsr.mitpress.mit.edu/pub/mkkpr41c/release/2

Kelleher, J. D., Namee, B. M., & D'Arcy, A. (2020). *Data science in action: Case studies*. Springer. Retrieved from https://link.springer.com/book/10.1007/978-3-030-59990-0

KDNuggets. (n.d.). *Data science case studies*. Retrieved from https://www.kdnuggets.com/data-science-case-studies.html

Date: February, 2025.

DAT305 Research with Advanced Data Analytics

Module Code and Title: DAT305 Research with Advanced Data Analytics
Programme: Bachelor of Data Science and Data Analytics
Credit: 12
Module Tutor(s): Ugyen Samdrup Tshering

General Objective

This module equips students with the skills and knowledge to conduct independent research using advanced data analytics techniques. Students will learn to critically evaluate existing research, formulate

research questions, design and execute research projects, analyze and interpret data using sophisticated methods, and effectively communicate their findings.

Learning Outcomes

On completion of the module, students will be able to:

1. Demonstrate an in-depth understanding of research paradigms, ethical considerations, and key concepts in data science research methodology.
2. Critically evaluate existing research literature to identify gaps, strengths, and limitations, and formulate well-defined research questions.
3. Apply advanced data analysis techniques to address real-world data science challenges effectively.
4. Analyze and interpret research data using appropriate statistical and analytical methods.
5. Design and develop innovative research projects by integrating diverse data sources, methodologies, and analytical techniques to address problems.
6. Communicate research findings effectively through well-structured reports and presentations.
7. Develop and implement research methodologies that align with the objectives and constraints of data-driven investigations.
8. Apply ethical considerations and responsible data practices in all stages of the research process, ensuring compliance with legal and regulatory frameworks.
9. Demonstrate proficiency in data visualization and storytelling techniques to effectively communicate insights to both technical and non-technical audiences.
10. Identify challenges and limitations in data science research and propose potential solutions or alternative approaches to improve research outcomes.

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
Contact	Teaching	2	60
	Practical and group work	2	
Independent study	Assignments, projects, self-study	4	60
Total		**8**	**120**

This module leverages diverse teaching methods to equip student with research skills. Lectures will lay the foundation with key concepts, frameworks, and methodologies. Seminars will delve deeper through discussions on research papers, case studies, and ethical considerations. Practical exercises translate theory into practice by providing hands-on experience with cutting-edge tools and techniques. Guest lectures will bring real-world perspectives from industry experts and researchers. Finally, group supervision offers personalized guidance and feedback throughout their research journey.

Assessment Approach

The assessment will be carried out on a continuous basis through the following approaches.

A. Literature Review: (25%)

Students are required to carry out an in-depth literature review focusing on a selected research topic within the field of data analytics. The literature review should provide a thorough analysis of relevant academic sources, critically examining their strengths and weaknesses while identifying research gaps. Additionally, students must articulate a clear research question that is well-supported by the reviewed literature and aligned with identified gaps in the field. The literature review should be 8-10 pages (approximately 3000-4000 words) in length and will assess Learning Outcomes 1, 2, and 5. The grading rubric is as follows:

Criteria	Excellent (80% - 100%)	Good (60% - 80%)	Satisfactory (40% - 60%)	Need Improvement (< 40%)
Comprehensiveness & Depth of Literature Review (35%)	Extensive, in-depth review of relevant, high-quality sources. Strong synthesis and critical analysis.	Good coverage with relevant sources, minor gaps in depth or analysis.	Adequate coverage, mostly descriptive analysis. Key sources may be missing.	Limited sources with minimal critical analysis and missing key studies.
Critical Evaluation & Research Gaps (30%)	Clear, insightful evaluation of strengths, weaknesses, and well-defined research gaps.	Solid evaluation with minor gaps in identifying research gaps.	Some evaluation, but lacks depth or clear identification of gaps.	Minimal or no evaluation. Research gaps are vague or not addressed.
Clarity & Relevance of Research Question (20%)	Well-defined, relevant research question clearly supported by the literature.	Clear research question, mostly aligned with the literature with minor issues.	Vague research question or weak alignment with the literature.	Unclear or poorly formulated research question.
Writing Quality & Organization (15%)	Clear, coherent, well-organized, and formal academic style with no major errors.	Mostly clear and organized, minor errors in writing style or organization.	Acceptable organization, but several issues with clarity or grammar.	Disorganized, unclear, with numerous errors that hinder readability.

B. Research Proposal: (25%)

Students will develop a well-defined research proposal, including a research question, literature review summary, proposed methodology, and timeline. The proposal should demonstrate feasibility and logical structure. The expected length of the proposal is 3-5 pages (approximately

1000-2000 words) and it will assess Learning Outcomes 1, 2, and 5. The research proposal will be graded as follows:

1. **Research Question (25%)**
    - Excellent (90-100%): Clear, specific, and well-defined research question that is feasible and relevant to the field. The question addresses a clear gap or problem in the literature.
    - Good (75-89%): The research question is clear and relevant, but may lack some specificity or full alignment with the literature gap.
    - Satisfactory (60-74%): The research question is somewhat vague or lacks clear relevance to the field. It may be too broad or poorly defined.
    - Needs Improvement (<60%): The research question is unclear, poorly defined, or irrelevant to the field.

2. **Literature Review Summary (25%)**
    - Excellent (90-100%): A comprehensive summary of key literature, demonstrating critical engagement with sources, and clear identification of research gaps.
    - Good (75-89%): A well-organized summary that covers relevant literature, though may lack depth or critical analysis. Some gaps may not be fully addressed.
    - Satisfactory (60-74%): A basic literature summary with some relevant sources, but lacks critical evaluation or depth. Key studies may be omitted.
    - Needs Improvement (<60%): Limited literature review, with few or irrelevant sources. Lacks analysis or synthesis of existing research.

3. **Proposed Methodology (25%)**
    - Excellent (90-100%): Methodology is clearly defined, appropriate for the research question, and demonstrates feasibility. Well-supported with rationale for chosen methods.
    - Good (75-89%): Methodology is appropriate but may lack detail or justification for certain choices. Feasible but may need further clarification.
    - Satisfactory (60-74%): Methodology is vaguely defined or lacks clear justification. Some methods may not align with the research question.
    - Needs Improvement (<60%): Methodology is unclear, inappropriate for the research question, or lacks sufficient detail and justification.

4. **Timeline and Feasibility (5%)**
    - Excellent (90-100%): Clear and realistic timeline that outlines key milestones and deadlines. Demonstrates feasibility and considers potential challenges.
    - Good (75-89%): Timeline is mostly realistic with clear milestones, but some deadlines may be overly ambitious or unclear.
    - Satisfactory (60-74%): Timeline is vague or lacks detail. Some milestones or deadlines may be unrealistic or missing.
    - Needs Improvement (<60%): Timeline is unclear, unrealistic, or not included.

5. **Clarity, Structure, and Writing Quality (20%)**
    - Excellent (90-100%): Proposal is well-organized, logically structured, and written clearly with formal academic language. No significant errors.
    - Good (75-89%): Proposal is clear and organized, with minor errors in structure or writing style that do not impede understanding.

- Satisfactory (60-74%): Organization is acceptable, but there are several issues with clarity, writing style, or structure that affect readability.
- Needs Improvement (<60%): Proposal is poorly organized, unclear, or contains numerous errors in writing that hinder comprehension.

C. Data Analysis and Interpretation Report: (30%)

Students will collect, clean, and analyze data using appropriate analytical methods. The report should include methodology, visualizations, key findings, and interpretation. The report should be 10-15 pages (approximately 4000-6000 words) and will assess Learning Outcomes 3, 4, and 5. The grading rubric is as follows:

1. **Data Collection and Cleaning (20%)**
   - Excellent (90-100%): Clear and detailed explanation of the data collection process. Data cleaning methods are thoroughly described, appropriate, and well-executed. Missing or erroneous data are properly addressed.
   - Good (75-89%): Data collection is clearly described, and cleaning methods are appropriate with minor gaps in explanation. Data issues are mostly addressed.
   - Satisfactory (60-74%): Data collection process is mentioned but lacks detail. Cleaning methods are explained but may be incomplete or improperly applied.
   - Needs Improvement (<60%): Data collection and cleaning are either unclear or insufficiently described. Several data issues remain unaddressed or improperly handled.

2. **Methodology and Analytical Methods (30%)**
   - Excellent (90-100%): Methodology is clearly defined, appropriate to the data and research question, and well-executed. The choice of analytical methods (e.g., statistical tests, machine learning models) is justified and aligns with the goals of the report.
   - Good (75-89%): Methodology is clear and appropriate, though some aspects may lack detailed justification or minor details may be missing. Analytical methods are mostly suitable for the research.
   - Satisfactory (60-74%): Methodology is described but lacks sufficient detail or justification. Analytical methods may be poorly chosen or applied inconsistently.
   - Needs Improvement (<60%): Methodology is poorly defined or inappropriate for the data. Analytical methods are not well justified or improperly applied, hindering the analysis.

3. **Data Visualization (15%)**
   - Excellent (90-100%): Clear, accurate, and well-labeled visualizations (graphs, charts, tables) that effectively communicate key findings. Visualizations are appropriately chosen for the data type and analysis.
   - Good (75-89%): Visualizations are clear and mostly accurate but may lack some labels or clarity. Most visualizations are appropriate for the data but may not be fully optimized for interpretation.
   - Satisfactory (60-74%): Visualizations are included but may lack clarity, appropriate labels, or are not fully suited to the data. Some visualizations may be misleading or underused.

- Needs Improvement (<60%): Visualizations are unclear, inaccurate, or poorly formatted. Some data may not be visualized, or visualizations do not aid in interpreting the findings.

4. **Key Findings and Interpretation (20%)**
    - Excellent (90-100%): Key findings are clearly stated, logically presented, and directly tied to the analysis. Interpretation is thorough, insightful, and linked to the research question and literature. Findings are well-supported with evidence from the data.
    - Good (75-89%): Findings are presented clearly and interpretation is mostly accurate, but may lack depth or a direct connection to the research question. Some evidence may be underexplored.
    - Satisfactory (60-74%): Findings are identified but may lack clarity or depth in interpretation. Interpretation is sometimes disconnected from the data or the research question.
    - Needs Improvement (<60%): Findings are unclear or incomplete, and interpretation is weak, inaccurate, or missing. There is little connection to the data or research question.

5. **Report Structure and Organization (15%)**
    - Excellent (90-100%): Report is well-organized with clear sections (Introduction, Methodology, Analysis, Findings, Conclusion). Logical flow and smooth transitions between sections. Well-written and easy to follow.
    - Good (75-89%): Organization is mostly clear with minor issues in flow or transitions. Sections are well-defined, but some parts may need more clarity or detail.
    - Satisfactory (60-74%): Report structure is acceptable but lacks clarity in some sections. Transitions may be abrupt or sections may not fully follow a logical order.
    - Needs Improvement (<60%): Poorly organized report. Sections are missing, unclear, or illogical. Writing is difficult to follow due to poor structure or lack of coherence.

D. Presentation of Research Findings: (20%)

Students will deliver a 15–20-minute oral presentation summarizing their research topic, methodology, key findings, and implications. A Q&A session will follow, where students are expected to defend their research. The presentation will assess Learning Outcome 6 and it will be grading according to:

1. **Clarity and Organization (25%)**
    - Excellent (90-100%): The presentation is well-structured with a clear introduction, body, and conclusion. The flow of ideas is logical, and transitions between sections are smooth.
    - Good (75-89%): The presentation is organized, but transitions between sections may be slightly unclear or abrupt. The overall structure is understandable.
    - Satisfactory (60-74%): The presentation is somewhat disorganized, with unclear transitions or sections that don't flow logically. Some points may need better explanation or connection.
    - Needs Improvement (<60%): The presentation lacks clear organization, making it difficult to follow. Ideas are not logically sequenced, and transitions are poor.

2. **Content and Depth (35%)**
    - Excellent (90-100%): The presentation covers all key aspects of the research, including the topic, methodology, key findings, and implications, in great detail. Information is accurate, relevant, and well-explained.
    - Good (75-89%): The presentation covers the main aspects of the research, but may lack detail or clarity in some sections. Key findings and implications are well explained, though may need further depth.
    - Satisfactory (60-74%): The presentation covers most key areas, but some aspects (e.g., methodology or findings) may be underexplored or insufficiently explained.
    - Needs Improvement (<60%): The presentation lacks important details or misrepresents aspects of the research. Key areas such as methodology, findings, or implications are unclear or missing.

3. **Engagement and Delivery (10%)**
    - Excellent (90-100%): The presenter engages the audience effectively through clear speech, confident body language, and eye contact. Voice is clear, varied, and paced appropriately for understanding.
    - Good (75-89%): The presenter engages the audience well but may lack confidence in some areas or could improve eye contact, body language, or pacing.
    - Satisfactory (60-74%): The presenter speaks clearly but may lack engagement, with monotone delivery or minimal eye contact. Pacing may be too fast or too slow.
    - Needs Improvement (<60%): The presenter struggles with engagement, and the delivery is unclear, rushed, or hard to follow. Limited eye contact or poor body language detracts from the message.

4. **Q&A Defense and Responsiveness (15%)**
    - Excellent (90-100%): The presenter responds to questions confidently and thoroughly, demonstrating a deep understanding of the research. Answers are clear, well-articulated, and directly address the questions.
    - Good (75-89%): The presenter responds to questions adequately, with some gaps in explanation or confidence. Answers may be somewhat general or lack depth in places.
    - Satisfactory (60-74%): The presenter answers most questions but may struggle with complex inquiries or provide incomplete responses. May need to clarify points.
    - Needs Improvement (<60%): The presenter struggles to respond to questions or provides unclear or incorrect answers. Demonstrates limited understanding or preparation for the Q&A session.
5. **Visual Aids and Supporting Materials (15%)**
    - Excellent (90-100%): Visual aids (slides, charts, etc.) are clear, professional, and support the presentation effectively. They are well-organized and enhance understanding without overwhelming the audience.

- Good (75-89%): Visual aids are helpful and mostly clear but may need slight improvement in design, clarity, or organization. They support the presentation but could be better integrated.
- Satisfactory (60-74%): Visual aids are used but may be unclear, overly complex, or poorly formatted. Some visuals may not clearly support the main points of the presentation.
- Needs Improvement (<60%): Visual aids are poorly designed, difficult to read, or not used effectively. They do not enhance understanding or are missing altogether.

Overview of the assessment approaches and weighting

Sl.No.	Area of assessment	Quantity	Weightage %
A.	Literature Review	1	25
B.	Research Proposal	1	25
C.	Data Analysis and Interpretation Report	1	30
D.	Presentation of Research Findings	1	20
	Total	**4**	**100%**

Pre-requisites: LAC103 Academic Research Skills

Subject Matter

Unit I: Introduction to Research Methodology in Data Science

1.1 A foundational understanding of research paradigms, ethics, and key concepts in research methodology in data science.
1.2 The key stages of the research process in data science.
1.3 Ethical considerations and responsible research practices in data science.
1.4 Research questions that are relevant, feasible, and address research gaps.
1.5 Critical evaluation of existing research literature to identify strengths, weaknesses, and opportunities.

Unit II: Advanced Data Analysis Techniques

2.1 Advanced data analysis techniques applied to real-world problems using appropriate tools (e.g., big data tools, machine learning algorithms, deep learning models).
2.2 Selection and justification of the most appropriate techniques based on the research question and data characteristics.
2.3 Effective utilization of data visualization techniques to communicate findings clearly and concisely.
2.4 Evaluation of the performance and limitations of different data analysis methods.

Unit III: Research Design and Methodology

3.1 Differentiation between quantitative and qualitative research methods in data science.
3.2 Research projects designed and implemented using appropriate methodologies and tools.
3.3 Effective data collection strategies developed considering ethical considerations.
3.4 Data cleaning and preparation for analysis using advanced techniques.
3.5 Formulation and testing of hypotheses using appropriate statistical methods.

Unit IV: Research Project Development

4.1 Development and refinement of a research proposal for the chosen topic.
4.2 Comprehensive literature review conducted to support the research question.
4.3 Detailed research methodology outlined, including data collection, analysis, and interpretation plans.
4.4 Identification and addressing of potential challenges and limitations of the research project.
4.5 Incorporation of feedback from instructors and peers to improve the research proposal.

Unit V: Data Analysis and Interpretation

5.1 Application of advanced data analysis techniques to the research project data.
5.2 Critical interpretation of results, considering potential biases and limitations.
5.3 Drawing meaningful conclusions from data analysis aligned with the research question.
5.4 Identification of patterns and trends in the data and explaining their implications.
5.5 Formulation of recommendations for future research based on findings.

Unit VI: Research Communication and Dissemination

6.1 Effective communication of research findings in written reports, following academic formatting guidelines.
6.2 Creation of clear and compelling presentations using visuals and data storytelling techniques.
6.3 Tailoring communication style to different audiences, including technical and non-technical stakeholders.
6.4 Participation in discussions and addressing questions about the research confidently.
6.5 Identification of appropriate avenues for disseminating research findings (e.g., conferences, publications).

Reading List

Essential Reading:

Downey, A. B. (2017). Thinking like a data scientist: Learning to explore, analyze, and communicate data (2nd ed.). Sebastopol, CA: O'Reilly Media.

Mason, H. (2020). Writing for data science: Tips, tools, and techniques for effective communication. Sebastopol, CA: O'Reilly Media.

McKinney, W. (2017). Python for data analysis: Wrangle, manipulate, visualize, and model data (2nd ed.). Sebastopol, CA: O'Reilly Media.

Provost, F., & Fawcett, T. (2014). Data science for business: What you need to know about data mining, machine learning, and big data (2nd ed.).Sebastopol, CA: O'Reilly Media.

Date: January 2025.

2.7 Year 4, Semester I

DAT402 Ethics in AI and Data Governance

Module Code and Title: DAT402 Ethics in AI and Data Governance
Programme: BSc in Data Science and Data Analytics
Credit Value: 12
Module Tutor: Sangay Thinley

General Objective

This module introduces ethics and security with respect to data and data science. The module will teach students the importance of applying ethical principles and respecting privacy while handling data. Further, the module will equip students with knowledge on key data management principles and data governance.

Learning Outcomes
On completion of the module, students will be able to:

1. Utilize best practices for data ethics while dealing with data.
2. Apply ethical principles to respect privacy of data.
3. Explain the importance of data security.
4. Present an analysis of case studies in breach of security and data ethics.
5. Describe data analysis problems in structures framework.
6. Apply the principle of data protection to their work.
7. Describe key data management principles.
8. Explore major data protection laws
9. Explain the importance of data governance.

Learning and Teaching Approach:

Type	Approach	Hours per week	Total credit hours
Contact	Lecture	4	75
	Presentation	1	
Independent study	Self-study	3	45
	Total		**120**

The teaching methods and learning tasks offer diverse opportunities for students to engage with the objectives of AI ethics and data governance, promoting critical thinking, practical skills development, and ethical decision-making abilities. The module will be taught using a blend of tutorials and discussion sessions.

During the tutorial sessions, students will learn the key concepts and principles of ethical considerations to be made for using AI and data science projects. In addition, Activities such as small-group

discussions and presentations will be held during the tutorials. This gives students more opportunities to participate in discussions and have better class interactions.

Assessment Approach

A. Quizzes: (10%)

Students will sit for two quizzes using Moodle (Virtual Learning Environment) for a duration of 30 to 40 minutes to monitor the learning progress of students. There will be two quizzes: one before the midterm and one after the end of all units.

B. Group Discussions: (30%)

Students will work in teams (maximum 4 students per group and debate on topics like AI in surveillance, autonomous weapons, healthcare, criminal justice etc. The following rubrics will be used for assessing the students' performance in the debate:

Criteria	5 (Excellent)	4 (Good)	3 (Satisfactory)	2 (Needs Improvement)	1 (Poor)
Content Knowledge	Demonstrates deep understanding of AI concepts, ethical issues, and real-world applications.	Shows solid understanding of AI concepts and ethical issues.	Demonstrates basic understanding of AI concepts but lacks depth.	Shows limited understanding of AI concepts and ethical issues.	Demonstrates little to no understanding of AI concepts or ethical issues.
Critical Thinking	Presents well-reasoned arguments with strong evidence and counterarguments.	Presents logical arguments with some evidence and counterarguments.	Presents arguments with limited evidence or counterarguments.	Arguments are weak, with little evidence or counterarguments.	Arguments are unclear, unsupported, or irrelevant.
Communication	Speaks clearly, confidently, and persuasively; uses appropriate tone and body language.	Speaks clearly and confidently; tone and body language are mostly effective.	Speaks clearly but lacks confidence or persuasive tone.	Speech is unclear or hesitant; tone and body language are ineffective.	Speech is difficult to understand; tone and body language are poor.
Teamwork	Collaborates effectively with teammates; builds on others' ideas and shares time fairly.	Works well with teammates; shares time and ideas appropriately.	Cooperates with teammates but may dominate or contribute unevenly.	Struggles to collaborate; may interrupt or fail to contribute.	Does not collaborate or contribute to the team effort.

Criteria	5 (Excellent)	4 (Good)	3 (Satisfactory)	2 (Needs Improvement)	1 (Poor)
Engagement	Actively listens, responds thoughtfully, and engages with opposing arguments.	Listens and responds to opposing arguments effectively.	Listens but may not fully engage with or respond to opposing arguments.	Rarely listens or responds to opposing arguments.	Does not listen or engage with opposing arguments.

C. Case Study Analyses and Presentation: (30%)

Students will work in groups to analyse/critically come up with case studies reports that align with course objectives and content. Based on the group work, each group will make a 15-20 minutes presentation about the findings of the case study.

At least 10% (2% overall) of this component will be graded by their peers. The following criteria will be used for the presentation:

Criteria	Weightage
Quality of Content	8%
Clarity	2%
Audience Engagement	2%
Time Management	2%
Speaking skills, Confidence, Eye Contact	2%
Peer Grading	4%

To ensure that the group work is assessed fairly, the following peer evaluation form (Adapted from a peer evaluation form developed at Johns Hopkins University (October, 2006)) will be used. The total marks obtained from the peer evaluation will be converted to 2%.

Peer Evaluation Form for Group Work

Your name _____

Write the name of each of your group members in a separate column. For each person, indicate the extent to which you agree with the statement on the left, using a scale of 1-4 (1=strongly disagree; 2=disagree; 3=agree; 4=strongly agree). Total the numbers in each column.

Evaluation Criteria	Group member:	Group member:	Group member:
Attends group meetings regularly and arrives on time.			

Contributes meaningfully to group discussions.			
Completes group assignments on time.			
Prepares work in a quality manner.			
Demonstrates a cooperative and supportive attitude.			
Contributes significantly to the success of the project.			
TOTALS			

Feedback on team dynamics:

1. How effectively did your group work?
2. Were the behaviors of any of your team members particularly valuable or detrimental to the team? Explain.
3. What did you learn about working in a group from this project that you will carry into your next group experience?

D. Term Test: 30%

A term test for the duration of two hours will be conducted covering all the units of the module. The test will be conducted out of 60.

Overview of assessment approaches and weighting:

Areas of assessment	Quantity	Weighting
Quizzes	2	10%
Group Discussions	1	30%
Case Study Analyses and	1	30%
Term Test	1	30%

Pre-requisites: None

Subject Matter:

Unit I: Introduction

1.1 Introduction to Privacy, Security and Ethics of AI and Data
1.2 Definitions and Concepts: Rights and interests, Personal data, A responsible organisation
1.3 Bias and Fairness in AI

Unit II: Ethics of Big Data

2.1. Values and Actions
2.2. Turning Values Into Actions
2.3. Elements of Data Ethics
2.4. Benefits of Ethical Inquiry
2.5. Ethical Decision Points
2.6. Privacy, Security, Ownership, Evidence-based Decision-Making

2.7. Intellectual Property

Unit III: Best Practices for Data Ethics

3.1 Keep Data Ethics in the Spotlight
3.2 Consider the Human Lives and Interests Behind the Data
3.3 Focus on Downstream Risks and Use of Data
3.4 Treat Data as a Conditional Good
3.5 Establish Chains of Ethical Responsibility and Accountability
3.6 Practice Data Disaster Planning and Crisis Response
3.7 Promote Values of Transparency, Autonomy, and Trustworthiness
3.8 Consider Disparate Interests, Resources, and Impacts
3.9 Invite Diverse Stakeholder Input
3.10 Make Ethical Reflection & Practice Standard, Pervasive, Iterative, and Rewarding

Unit IV: Data Protection

4.1 Introduction to Data protection
4.2 Importance of Data Protection
4.3 GDPR: General Data Protection Regulation
4.4 CCPA: The California Consumer Privacy Act
4.5 Information, Communication and Media Act of Bhutan

UNIT V: DATA GOVERNANCE

5.1 Introduction to data governance
  5.1.1 Anatomy of data governance
  5.1.2 Data governance framework
  5.1.3 Benefits of data governance
5.2 Data governance tools
  5.2.1 Metadata – Dublin Core and Darwin Core
  5.2.2 Data Management plans (DMPs) – H2020 Programme DMPs
  5.2.3 Enterprise Information Management (EIM) maturity model
  5.2.4 Data sharing platforms– figshare and re3data
5.3 Data governance challenges
  5.3.1 Data protection and privacy
  5.3.2 Citizen generated data
5.4 Licences for data governance
  5.4.1 Creative Commons (CC)
  5.4.2 Open Data Commons Attribution Licence (ODB-by)
  5.4.3 Open Database Licence (ODbL)

UNIT VI: DATA MANAGEMENT AND STEWARDSHIP

6.1 FAIR data principles
  6.1.1 Introduction to FAIR
  6.1.2 Data FAIRification process
  6.1.3 Interpretation and implementation of FAIR
6.2 TRUST principles
  6.2.1 Introductions to TRUST principles
  6.2.2 CoreTrustSeal certification
6.3 Five-Star Linked Open Data

6.3.1 Introduction to Linked Data
6.3.2 Five-Star deployment scheme
6.3.3 Five-Star vs FAIR data principles
6.4 Case Study: Health Information Exchange

Reading List:

Essential Reading

Davis, K. (2012). Ethics of Big Data. OReilly

Ladley, J. (2019). Data Governance: How to Design, Deploy and Sustain an Effective Data Governance Program. Academic Press.

Lee, W.W., Zankl, W., Chang, H. (2016). An Ethical Approach to Data Privacy Protection. ISACA Journal.

Mashima, D., Rajan,S.P. (2016). Big Data: Security and Privacy Handbook. Cloud Security Alliance.

Perry, Y. (2019, September 17). Meeting Data Compliance with a Wave of New Privacy Regulations. Retrieved from https://cloud.netapp.com/blog/data-compliance-regulations-hipaa-gdpr-and-pci-dss

Tellenbach, B., Rennhard, M., & Schweizer, R. (2019). Applied Data Science. Springer

Vallor, S. (2020, May 10). An Introduction to Data Ethics. Santa Clara University. Retrieved from https://www.scu.edu/media/ethics-center/technology-ethics/IntroToDataEthics.pdf

White, G., Ariyachandra, T. (2016). Big Data Analytics: Examining the Grey Areas of Big Data Analytics. Issues of Information Systems.

Additional Reading

Bunnik, A.,Cawley, A.,Mulqueen, M.,Zwitter, A. (2016). Big Data Challenges. Palgrave Macmillan

Freeman, L.A, Peace, A.G. (2005). Information Ethics: Privacy and Intellectual Property. Information Science Publishing.

Date: February, 2025.

DAT401 Natural Language Processing

Module Code and Title: DAT401 Natural Language Processing
Programme: Bachelor of Data Science and Data Analytics
Credit Value: 12
Module Tutor: Pema Tshering

General Objective:

This module provides a critical introduction to key topics in natural language processing with hands-on experience of using existing software tools and developing applications to process texts and access linguistic resources. This module presents programming concepts by example, in the context of a linguistic processing task. The students will learn to write programs to access text from local files and from the web, in order to get hold of an unlimited range of language materials. This module also covers some fundamental techniques in Natural Language Processing, including sequence labeling, n-gram

models and tagging. The students will be exposed to some important machine learning techniques, including decision trees, naive Bayes' classifiers, and maximum entropy classifiers.

Learning Outcomes:

On completion of the module, students will be able to:

1. Explain the use of software tools such as corpus readers, stemmers, taggers and parsers.
2. Manipulate texts using regular expressions and classify texts into classes using predictive models.
3. Use NLP methods to analyze sentiment of a text document.
4. Critically appraise existing Natural Language Processing (NLP) applications such as chatbots and translation systems.
5. Write programs to access text from local files and web, analyze and produce formatted output.
6. Identify lexical categories and how they are used in language processing.
7. Use grammars to describe the structure of an unlimited set of sentences, represent the sentence and build a syntax tree using parsers.
8. Compare and contrast the use of parsing techniques for context-free grammar problems.
9. Build a system that extracts structured data, such as tables, from unstructured text by applying techniques such as chunking and named-entity recognition.
10. Investigate problems, limitations and challenges in natural language.

Learning and Teaching Approach:

Type	Approach	Hours per week	Total credit hours
Contact	Lecture	3	90
	Laboratory session	3	
Independent study	Written Assignment	1	15
	Self-study	1	15
Total			**120**

Assessment approach:

The assessment will be carried out on a continuous basis through the following approaches.

A. **CA1: Online Quiz (10%)**

Two online quizzes, each worth 5%, will be conducted for the duration of one hour to assess the understanding of the topics discussed in the class. One quiz will be conducted before midterm and one quiz towards the end of the semester.

B. CA2: Assignment (15%)

This individual assignment is intended for students to apply NLP techniques to analyze and classify sentiments in product reviews from an e-commerce platform. Each student will develop a sentiment analysis model to classify product reviews as **positive, negative, or neutral**. The assignment requires data preprocessing, feature extraction, model training, evaluation, and insightful analysis of the results.

The assignment will be assessed based on the following rubric:

- **Data Preprocessing & Feature Engineering (20%)** – Proper handling of text data.
- **Model Selection & Performance (30%)** – Implementation and comparison of different models.
- **Evaluation & Analysis (20%)** – Metrics, misclassification analysis, and improvements.
- **Visualization & Interpretability (15%)** – Word clouds, bar charts, SHAP/LIME.
- **Report Quality & Code Documentation (15%)** – Clear writing and structured code.

C. CA3: Research Article Analysis (25%)

Students will be provided peer reviewed research articles on the field of Natural Language Processing by the faculty, in which they have to thoroughly critique, analyze and submit a 1000-word report. The report will be assessed using the following guidelines:

- Understanding of the Article (20%)
- Critical Analysis & Evaluation (25%)
- Application & Relevance to NLP (15%)
- Structure, Clarity & Organization (10%)
- Use of References & Supporting Literature (10%)
- Conclusion & Personal Insights (15%)

D. CA4: Project (50%)

This will be a group project with each group consisting of four students. It will provide an opportunity for students to apply their newly acquired skills. The project requires a detailed report of 2,500–3,000 words. Additionally, each group will deliver a PowerPoint presentation of their project, lasting approximately 10–15 minutes. The project will be evaluated based on the following criteria:

Criteria	**Excellent (4) - 80-100%**	**Good (3) - 60-79%**	**Satisfactory (2) - 40-59%**	**Needs Improvement (1) - Below 40%**

i) Project Proposal (15%)				
Clarity of Objectives & Scope (10%)	Clearly defines project goals, scope, and expected outcomes with strong justification.	Mostly clear objectives with some justification.	Objectives are somewhat vague or lack strong justification.	Unclear or missing objectives with little to no justification.
Feasibility & Methodology (10%)	Demonstrates a well-thought-out approach with realistic methodology.	Good methodology, but minor gaps in feasibility.	Basic methodology with some feasibility concerns.	Poor methodology or unrealistic project scope.
ii) Project Report (30%)				
Understanding & Application of Concepts (15%)	Demonstrates deep understanding of NLP concepts with insightful application and analysis.	Shows good understanding of NLP concepts with relevant application.	Demonstrates basic understanding, but lacks depth in application.	Limited understanding of NLP concepts with minimal application.
Structure, Clarity & Organization (10%)	Report is well-structured, logically organized, and flows seamlessly.	Mostly well-organized with minor inconsistencies.	Some organization issues, making it hard to follow.	Poorly structured with unclear flow.
Quality of Research & References (10%)	Strong use of credible sources, properly cited, with insightful analysis.	Good research effort with mostly relevant sources.	Limited research, some sources lack credibility.	Minimal or no research, improper citations.
Writing Style, Grammar & Formatting (5%)	Well-written, free from errors, and follows formatting guidelines.	Few errors, mostly clear and well-structured.	Several errors affecting readability.	Poorly written, difficult to understand.
iii) Presentation (30%)				
Content &	Clear, insightful explanation of	Covers key aspects with	Basic coverage, lacking depth in	Unclear, incomplete, or

Explanation (10%)	project objectives, methodology, and results.	minor gaps in explanation.	explanation.	off-topic presentation.
Visual Appeal & Engagement (10%)	Well-designed slides, visually appealing, and highly engaging.	Good design with some engaging elements.	Basic slides, minimal effort in engagement.	Poorly designed slides, lacks engagement.
Delivery & Team Collaboration (5%)	Confident, well-paced delivery with all members contributing equally.	Good delivery with minor pacing issues, most members contribute.	Uneven participation, some members less involved.	Weak delivery, minimal team collaboration.
iv) Overall Impact & Creativity (25%)				
Originality & Innovation (10%)	Demonstrates creativity and original thinking in project execution.	Some innovative elements but mostly conventional.	Limited originality, mostly derivative work.	Lacks creativity, heavily reliant on existing materials.
Relevance & Practicality (5%)	Highly relevant to NLP with practical real-world implications.	Good relevance with some practical aspects.	Moderately relevant with limited practical value.	Weak relevance, lacks practical application.

An overview of assessment approaches and weighting:

CA1	10%
CA2	15%
CA3	25%
CA4	50%
Total	**100%**

Pre-requisites: DAT203 Artificial Intelligence and Machine Learning, DAT202 Statistical Computing II

Subject Matter:

Unit I: Introduction to Natural Language Processing

1.1 Natural language and philosophy
1.2 Language syntax and structure
1.3 Grammar
1.4 Word order topology
1.5 Language semantics

1.6 Text corpora and text analytics
1.7 Computing with language
1.8 Computing with language: Simple statistics
1.9 Automatic and natural language understanding

Unit II: Accessing Text Corpora and Lexical Resources

2.1 Accessing text corpora
2.2 Loading your own text corpora
2.3 Conditional frequency distribution
2.4 Lexical resources
  2.4.1 Wordlist corpora
  2.4.2 Comparative wordlists
  2.4.3 Shoebox and toolbox lexicons
2.5 Wordnet
  2.5.1 Senses and synonyms
  2.5.2 The wordnet hierarchy

Unit III: Processing Raw Text and Writing Structured Programs

3.1 Accessing text from the web and local disk
3.2 Processing strings
3.3 Encoding and decoding texts
3.4 Using regular expressions to detect word patterns and tokenizing texts
3.5 Writing structured programs and algorithm design:
    3.5.1 Recursion
    3.5.2 Space time trade off
3.6 Introduction to Python libraries
    3.6.1 Natural Language Toolkit (NLTK)
    3.6.2 TextBlob
    3.6.3 spaCy

Unit IV: Categorizing and Tagging words

4.1 Part-of-Speech tagging
4.2 Tagged corpora
    4.2.1 Representing tagged tokens
    4.2.2 Reading tagged corpora
    4.2.3 Part of speech tag set
4.3 Mapping words to properties using python dictionaries
4.4 Automatic tagging
4.5 N-Gram tagging
    4.5.1 Unigram tagging
    4.5.2 General N-Gram tagging
4.6 Combining taggers
    4.6.1 Tagging the token with the bigram tagger
    4.6.2 Using the default tagger and unigram tagger to combine tagger
4.7 Storing tagger

4.8 Bag of Words model
    4.8.1 N-grams
    4.8.2 Apply TF-IDF vectorizer

Unit V: Classifying and Extracting Information from Text

5.1 Supervised classifications
    5.1.1 Decision trees
5.2 Evaluation
    5.2.1 Naïve Bayes classifiers
5.3 Information extraction architectures
5.4 Chunking
    5.4.1 Chunking with regular expressions
    5.4.2 Non phrase chunking
5.5 Developing and evaluating chunkers
5.6 Regression in linguistic structure
5.7 Named entity recognition
    5.7.1 Identifying named entities
5.8 Ensemble Classifiers
    5.8.1 Stacking
    5.8.2 Blending
    5.8.3 Bagging
    5.8.4 Boosting

Unit VI: Analyzing Sentence Structures and Grammars

6.1 Context free grammars
    6.1.1 Writing your own grammar
    6.1.2 Recursion in syntactic structure
6.2 Parsing with context free grammars
    6.2.1 Recursive descent and shift reduce parsers
6.3 Grammar development
6.4 Grammatical features
6.5 Processing feature structures
6.6 Extending feature-based grammars

Unit VII: Understanding Semantics and Linguistic Data

7.1 understanding natural languages
7.2 Propositional logic
7.3 First order logic
7.4 Semantics of English sentences
7.5. Semantics of Dzongkha sentences
7.6 Discourse semantics
7.7 Life cycle of a corpus
7.8 Using XML for linguistic structures
7.9 Obtaining data from word processor files

Unit VIII NLP Applications and Advanced Techniques

- 8.1 Reading and exploring dataset
- 8.2 Pre-processing data
  - 8.2.1 Remove punctuations
  - 8.2.2 Tokenization
  - 8.2.3 Remove stopwords
  - 8.2.4 Using Stemming
  - 8.2.5 Using a lemmatizer
- 8.3 Vectorizing data
  - 8.3.1 Bag-of-words or CountVectorizer
  - 8.3.1 N-grams
  - 8.3.2 Apply TF-IDF vectorizer
- 8.4 Feature creations
  - 8.4.1 Create features of texts using the domain knowledge
- 8.5 Building ML classifiers
  - 8.5.1 Support vector machines

List of Laboratory Sessions:

1. Development of Corpus
2. Preprocessing of Text
3. Implementation of text representation using statistic and non-statistical model
4. Implementation of text representation application
5. Implementation of Features extraction
6. Implementation of Tokenization and Segmentation
7. Implementation of POS taggers
8. Implementation of Syntactic Analysis
9. Implementation of Semantic Analysis
10. Implementation Text classification
11. Development of Named Entity Recognition System

Reading List

Essential Reading:

Bird, S., Klein, E., & Loper, E. (2009). *Natural language processing with python: Analyzing text with the natural language toolkit.* O'Reilly Media, Inc.

Sarkar, D. (2019). *Text analytics with Python: A practitioner's guide to natural language processing*. Apress.

Additional Reading:

Eisenstein, J. (2019). *Introduction to natural language processing*. MIT Press.

Collobert, R., Weston, J., Bottou, L., Karlen, M., Kavukcuoglu, K., & Kuksa, P. (2011). *Natural*

language processing (almost) from scratch. Journal of machine learning research, 12(ARTICLE), 2493-2537.

Norbu, T., & Namgyel, T. (2019). *Languages and Technology in Bhutan.* Proceedings of the Language Technologies for All (LT4ALL), 235-238.

Mikolov, T., Chen, K., Corrado, G., & Dean, J. (2013). *Efficient Estimation of Word Representations in Vector Space.* arXiv preprint arXiv:1301.3781.

Date: February, 2025.

DAT403 Optimization for Data Science

Module Code and Title: DAT403 Optimization for Data Science
Programme: Bachelor of Data Science and Data Analytics
Credit: 12
Module Tutor(s): Ugyen Samdrup Tshering

General Objective

This module aims to teach how to model large scaled modern problems as optimization problems and gain insight into the principles underlying gradient-based algorithms (namely deterministic and stochastic methods) for solving such problems. Students will learn a variety of optimization algorithms, how to apply them, interpret the results, and how to communicate their conclusions.

Learning Outcomes

On completion of the module, students will be able to:

1. Understand key optimization concepts and classify optimization problems.
2. Analyze optimization applications in data science tasks.
3. Formulate and solve linear and integer programming problems.
4. Interpret optimization models and the role of convexity.
5. Apply nonlinear and convex optimization techniques effectively.
6. Use heuristic and metaheuristic algorithms for problem-solving.
7. Evaluate optimization algorithms for efficiency and applicability.
8. Implement optimization models using relevant software tools.

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
Contact	Teaching	2	60
	Practical and group work	2	
Independent study	Assignments, projects, self-study	4	60

Total	**8**	**120**

Assessment Approach

The assessment will be carried out on a continuous basis through the following approaches.

A. CA1: Quizzes (20%)

Students will take four quizzes via the Virtual Learning Environment (VLE) after completing each Unit. Each quiz will last one hour and will account for 5% of the total course grade, contributing a combined 20%. These quizzes will function as progress checks to help students solidify their understanding of the content while advancing through the course.

B. **CA2: Lab Assessment (20%)**

Each student will complete four lab assignments covering key topics in optimization: linear programming, nonlinear optimization, heuristic and metaheuristic techniques. Each assignment will contribute 5% to the total course grade, amounting to a combined weight of 20%. The lab assignments are designed to strengthen students' practical understanding of optimization techniques by providing hands-on experience with real-world applications. They aim to enhance problem-solving and analytical skills by challenging students to apply theoretical concepts to practical scenarios. Through these assignments, students will develop proficiency in using various optimization tools and software, enabling them to implement and analyze optimization models effectively. Additionally, the assignments will encourage critical thinking by requiring students to interpret optimization results, draw meaningful conclusions, and explore alternative solutions to complex problems.

The assignments are broken down as follows:

1. Assignment 1: Linear Programming
    a. Formulate and solve optimization models using the simplex method.
    b. Analyze and interpret results with sensitivity analysis.

2. Assignment 2: Nonlinear Optimization
    a. Solve unconstrained and constrained nonlinear problems using gradient-based techniques.
    b. Apply optimization algorithms like gradient descent.

3. Assignment 3: Convex Optimization
    a. Identify convexity properties and solve convex optimization problems.
    b. Explore practical applications in data science.

4. Assignment 4: Metaheuristic Techniques
    a. Implement heuristic methods such as Genetic Algorithms (GA) or Particle Swarm Optimization (PSO).
    b. Compare performance with traditional optimization techniques.

The lab assignments will be graded based on the following criteria:

1. **Problem Formulation (20%)**:

1.1. Clearly defines the optimization problem with correct assumptions, constraints, and structure.
1.2. Identifies key variables and provides a detailed problem statement.

2. **Implementation (30%)**:
   2.1. Correct application of optimization techniques using appropriate tools/software.
   2.2. Well-structured code and correct execution with minimal errors.
3. **Analysis & Interpretation (25%)**:
   3.1. Thorough analysis of results, with clear interpretation and logical conclusions.
   3.2. Insightful evaluation of optimization outcomes.
4. **Documentation & Presentation (15%)**:
   4.1. Well-organized, clear, and concise report with appropriate visuals (graphs, tables) and explanations.
   4.2. Proper formatting and clarity in writing.
5. **Originality & Effort (10%)**:
   5.1. Demonstrates creativity, initiative, and significant effort in tackling the problem.
   5.2. Explores innovative solutions or alternative approaches where applicable.

C. **CA3: Class Test (20%)**

Two written tests will be conducted during the semester, each contributing 10% to the overall course grade. The first test will be scheduled after the completions of Units I and II, focusing on optimization concepts, linear programming, and related techniques. The second test will be scheduled after the completion of Units III and IV, focusing on nonlinear optimization, convex optimization, and metaheuristic methods. These tests will assess students' ability to apply key concepts, solve optimization problems, and critically analyze results.

D. CA4: Project (40%)

This project offers students the opportunity to apply their knowledge of optimization techniques to a **real-world problem**. Students will choose a practical optimization challenge, define the problem, and develop a comprehensive approach to solve it. The project will assess their ability to **formulate mathematical models**, **analyze data**, and **implement optimization methods**. Additionally, the project will evaluate how effectively students communicate their **findings** and **recommendations**, demonstrating their ability to translate technical results into actionable insights. By working on this project, students will showcase their proficiency in optimization and its application in diverse fields, as well as their **critical thinking**, **problem-solving**, and **communication** skills.

This project gives students the opportunity to use their optimization knowledge in a practical real-life situation. Students will choose, define, and tackle an optimization problem. This project will showcase their proficiency in mathematical modelling, data analysis, optimization implementation, as well as their ability to communicate findings and recommendations effectively. The grading rubric for the project is as follows:

Criteria	Excellent	Good	Fair	Needs Work
Problem Definition (10%)	Clearly defines a relevant and feasible optimization problem with	Defines a relevant problem with minor gaps in problem	Defines a problem but lacks clarity in objectives or constraints.	Problem is unclear, poorly defined, or unrealistic.

	precise objectives and constraints.	statement or objectives.		
Data Collection and Preprocessing (15%)	Collects relevant, high-quality data; pre-processes it effectively, ensuring it is clean and ready for analysis.	Collects adequate data; pre-processing is mostly correct with minor errors.	Data collection is limited; pre-processing may have significant gaps.	Data collection or pre-processing is insufficient or incorrect.
Mathematical Modelling (20%)	Develops a robust mathematical model that accurately represents the problem and includes all key variables.	Model is accurate but may miss some variables or assumptions.	Model is partially correct, with important assumptions or variables missing.	Model is incomplete, with major errors or missing key components.
Results and Recommendations (15%)	Provides a thorough analysis of results with insightful, practical recommendations based on findings.	Results are analyzed with good recommendations, though some may be lacking depth.	Results are somewhat analyzed, with basic recommendations that lack depth or relevance.	No meaningful analysis or recommendations provided.
Project Report and Presentation (15%)	Well-organized, clear, and comprehensive report with detailed analysis, visuals, and proper referencing; engaging presentation.	Good report and presentation with minor gaps in clarity, organization, or detail.	Report is basic; lacks clarity or depth in analysis; presentation is unpolished.	Report is incomplete or poorly organized; the presentation lacks clarity.

The **project requirements** include the following:

1. **Written Report**: A well-structured document detailing the problem definition, data collection process, mathematical model, optimization methods, analysis of results, and key recommendations.
2. **Code/Implementation**: The working code or models used to solve the optimization problem, showcasing the application of optimization techniques.

3. **Presentation**: A concise presentation summarizing the project, methodology, results, and recommendations.

The final submission will include both the written report and the presentation, where students will present their findings and discuss their approach with peers and instructors. Feedback on both components will be provided to help students improve their ability to effectively communicate complex ideas.

Overview of the assessment approaches and weighting

CA1	20%
CA2	20%
CA3	20%
CA4	40%
Total	100%

Pre-requisites: None

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Subject Matter

Unit I: Introduction to Optimization

1.1. The concept of optimization and its role in problem-solving across various fields.
1.2. Understanding the different types of optimization problems, including linear, nonlinear, and integer programming.
1.3. Distinguishing between continuous and discrete optimization problems.
1.4. Providing real-world examples of optimization applications in diverse domains such as logistics, finance, and engineering.
1.5. Exploring the applications of optimization in data science tasks like resource allocation, machine learning model training, and feature selection.
1.6. The role of gradients, derivatives, and convexity in optimization methods.

Unit II: Linear and Integer Programming

2.1 Defining linear programming (LP) and its application in real-world problems.
2.2 Understanding the key components of LP, including objective functions, constraints, and decision variables.
2.3 Interpreting the structure of LP problems and understanding their geometric representation.
2.4 Solving LP problems graphically to identify feasible and optimal solutions.
2.5 Applying the simplex method for optimizing LP models.
2.6 Introduction to integer programming (IP) and its extension from linear programming to address real-world problems with mixed-integer constraints.
2.7 Utilizing the branch and bound method to find optimal solutions for integer programming problems.

Unit III: Nonlinear and Convex Optimization

3.1 Defining and solving unconstrained optimization problems using gradient-based methods, such as gradient descent.
3.2 The formulation and solution of constrained optimization problems and the application of Karush-Kuhn-Tucker (KKT) conditions.
3.3 Understanding the characteristics of convex and concave functions and their importance in optimization.

3.4 Formulating convex optimization problems and recognizing their significance in data science applications.
3.5 Discussing various convex optimization algorithms, including interior-point methods, and exploring their practical applications.
3.6 Examining real-world data science scenarios where nonlinear and convex optimization techniques are essential.

Unit IV: Heuristic and Metaheuristic Algorithms

4.1 Introduction to heuristics and their applicability in solving a wide range of data science optimization problems.
4.2 Exploring particle swarm optimization (PSO) and ant colony optimization (ACO) as population-based optimization techniques inspired by natural behaviors.
4.3 Comparing and contrasting PSO and ACO algorithms and determining their suitability for different types of optimization problems.
4.4 Explaining simulated annealing and genetic algorithms, and their use in optimization tasks in data science, along with their strengths and limitations.
4.5 Exploring advanced topics in heuristic and metaheuristic optimization, such as hybrid algorithms and memetic algorithms, and their applications in complex real-world problems.

Reading List

Essential Reading:

Boyd, S., & Vandenberghe, L. (2004). *Convex optimization*. Cambridge University Press.

Bazaraa, M. S., Sherali, H. D., & Shetty, C. M. (2013). *Nonlinear programming: Theory and algorithms* (3rd ed.). Wiley.

Güler, O. (2010). *Foundations of optimization*. Springer Science & Business Media.

Nesterov, Y. (2018). Lectures on Convex optimization. Springer.

Sra, S., Nowozin, S., & Wright, S. J. (2012). *Optimization for machine learning*. MIT Press.

Talbi, E.-G. (2009). *Metaheuristics: From design to implementation*. Wiley.

Date: January 2025.

CRD303 Professional Certification I

Module Code and Title: CRD303 Professional Certification I
Programme: Bachelor of Data Science and Data Analytics
Credit: 12
Module Tutor(s): Sangay Thinley

General Objective

This module aims to support students in obtaining professional certifications relevant to data science, providing them with opportunities to acquire credentials in high-demand fields associated with data science and analytics from reputable organizations. These certifications validate students' skills according to international standards, offering tangible credentials that demonstrate their expertise to potential employers. The certifications must be in areas such as Data Engineering, Artificial Intelligence (AI), Machine Learning (ML), and other pertinent domains determined by the program committee and deemed equivalent to the 12 credits.

Learning Outcomes

On completion of the module, students will be able to:

1. acquire professional certifications relevant to data science from reputable organizations
2. demonstrate ability to navigate online certification courses and access relevant materials
3. demonstrate proficiency in professional tools and platforms required for certification in areas such as Data Engineering, AI & ML, Cloud Computing, and Web Development.
4. implement cloud-based solutions for data storage, computing, and analytics by utilizing cloud platforms like AWS, Azure, or Google Cloud.
5. integrate ethical considerations and best practices in AI and ML solutions, ensuring fairness, transparency, and compliance with data privacy regulations.
6. analyze and solve complex problems using statistical and algorithmic approaches that align with industry certification standards.
7. prepare for and pass professional certification exams by mastering the content, structure, and problem-solving approaches required by certification bodies.
8. communicate technical solutions effectively, presenting data-driven insights and solutions to diverse stakeholders in both written and oral formats.
9. practice self-directed learning and time management

Learning and Teaching Approach:

Type	Approach	Hours per week	Total credit hours
Independent study	Online lectures, projects, self-study	8	60
Total		**8**	**120**

This module adopts a fully self-directed learning approach. There will be no formal lectures, workshops, or practical sessions provided to the students. Instead, students are expected to take full responsibility for their learning journey by enrolling in and completing online certification courses.

College Management will be responsible for:

- Providing fees for the certification and assisting in completing other formalities

Programme Committee (PC) will be responsible for:

- Identifying and selecting appropriate online certification courses.
- Appointing faculty advisor to keep track and assist students complete the certification

Faculty Advisor (FA) will offer support to students in various capacities, including:

- Aiding students in completing registration forms and coordinating fee payments.
- Guiding students in self-directed study and fulfilling prescribed certification requirements.
- Providing strategies for scheduling and preparing for certification examinations.
- Reviewing resources and materials offered by certification course providers.
- Helping students navigate certification course platforms and access relevant materials.
- Monitoring the progress of students to ensure that they do not procrastinate and leave a significant portion of the learning materials until the end of the semester.
- Providing encouragement and motivation to keep students engaged throughout the duration of the course.
- Administering various forms of assessment, such as presentations, quizzes, etc., to evaluate students' understanding and progress.

The college will cover the fees upon submission of valid registration forms. Students must successfully complete the prescribed certification requirements, including scheduling and appearing for examinations, within a single semester to fulfil module requirements.

A student must choose (subject to PC's approval) the following certifications:

AWS Certified Data Engineer - Associate

Means of Assessment

Successful completion of prescribed certification exams (100% of the module grade).

Students must enrol in and complete prescribed certification exams within the semester. They must provide certificates of completion to fulfil module requirements.

Overview of the assessment approaches and weighting

Certification Exam	100%

Pre-requisites: All modules up to Year 3.

Subject Matter

As per the certification providers. Students must pass the prescribed certification exam(s) and provide certificates of completion within the semester to fulfil module requirements and be eligible to receive their BSc degree in Data Science and Data Analytics.

Reading List:

Essential Readings

i. Certifications. Google Cloud. https://cloud.google.com/learn/certification#why-get-google-cloud-certified

ii. Your Guide to Data Science Certifications in 2024 | Coursera. https://www.coursera.org/in/articles/data-science-certification

iii. IBM Data Scientist Training. https://www.ibm.com/training/learning-path%20+%20'/'%20+%20ibm-data-scientist-596

iv. AWS_certification_paths.pdf. https://d1.awsstatic.com/training-and-certification/docs/AWS_certification_paths.pdf?trk=3e1113f5-401b-401e-9767-6653d3775639&sc_channel=el

v. Get AWS Certified. https://training.resources.awscloud.com/get-aws-certified

vi. AWS Certified Cloud Practitioner - Exam Prep. https://training.resources.awscloud.com/aws-certified-cloud-practitioner-exam-prep

vii. IBM Data Science Professional Certificate (COURSERA) :(https://www.coursera.org/professional-certificates/ibm-data-science?utm_source=gg&utm_medium=sem&utm_campaign=01-CourseraCatalog-DSA-US&utm_content=01-CourseraCatalog-DSA-US&campaignid=9918777773&adgroupid=128025796489&device=c&keyword=&matchtype=&network=g&devicemodel=&adpostion=&creativeid=536102998478&hide_mobile_promo&gclid=CjwKCAiAv_KMBhAzEiwAs-rX1HnkkFeoypmHNWInkAVej_Jg2Nws1Ztno5uL7eGMet_VC7laomWl7BoCHk4QAvD_BwE#courses)

viii. Applied Data Science with Python (University of Michigan) (https://online.umich.edu/series/applied-data-science-with-python/)

ix. AWS Certified AI practitioners (https://aws.amazon.com/certification/certified-ai-practitioner/?ch=sec&sec=rmg&d=1)

x. AWS Certified Cloud Practitioner (https://aws.amazon.com/certification/certified-cloud-practitioner/?ch=sec&sec=rmg&d=1)

Additional **Reading:**

Date: February, 2025.

2.8 Year 4, Semester II

CRD304 Industry Capstone Project

Module Code and Title: CRD304 Industry Capstone Project
Programme: Bachelor of Data Science and Data Analytics
Credit: 48
Module Tutor(s): Phub Namgay

General Objective

This module aims to bridge theoretical knowledge with practical skills, allowing students to tackle real-world challenges in Bhutan through a hands-on industry project. By applying data science and analytics techniques, students will acquire critical thinking, problem-solving, and professional skills. This immersive experience fosters adaptability, decision-making, and meaningful contributions to local industries

Learning Outcomes

On completion of the module, students will be able to:

1. Define problem statements, set objectives, and manage project timelines effectively.
2. Engage with local industries to develop data-driven solutions.
3. Collect, clean, and preprocess data from diverse sources.
4. Apply AI/ML, statistical modeling, and big data techniques for insights.
5. Develop and deploy scalable, user-friendly data applications.
6. Present findings using interactive visualizations and reports.
7. Adhere to data privacy, security, and ethical guidelines.
8. Collaborate in teams, demonstrate leadership, and communicate effectively.
9. Maintain well-structured documentation for all project stages.
10. Integrate domain knowledge with AI/ML for holistic problem-solving.
11. Ensure solutions are scalable, sustainable, and aligned with Bhutan's priorities.

Learning and Teaching Approach

Type	Approach	Hours per week	Total credit hours
Independent study	Articles search and review	8	120
Industry/Project	Field work, coding, model development, testing	16	240
Consultations with Supervisor	Progress reviews, feedback, reporting	2	30
Presentation & Documentation	Reports, proposal, final presentation, ethics Review	6	90
Total		**32**	**480**

The module is 100% students-driven, with students leading their project under the guidance of faculty member(s) identified by the Capstone Project Committee.

Capstone Project Committee (CPC)

The CPC serves as the apex body for overseeing capstone projects, consisting of the Head of School (HoS), Programme Leader (PL), and supervisors. The HoS/PL will act as the capstone project coordinator, appointed during the first CPC meeting convened by the PL.

Responsibilities of the CPC:

- Define project modalities and ensure alignment with academic and industry standards.
- Identify industry linkages and facilitate formal agreements.
- Approve project topics based on student proposals.
- Nominate and appoint faculty supervisors.
- Identify external reviewers for the final project defense and report evaluation.

Responsibilities of the Capstone Project Coordinator:

- Issue Appoint Orders for supervisors upon CPC recommendation.
- Chair CPC meetings and presentation seminars.
- Oversee administrative tasks such as project planning, rubrics, and templates.
- Invite external reviewers for evaluations.
- Monitor project milestones and report critical issues.
- Present a working report to CPC members at the semester's conclusion.

Supervisor Responsibilities:

Students will work under the guidance of a nominated faculty supervisor, who will:

- Provide mentorship and timely feedback on all project components.
- Report student progress and concerns to the CPC and PL.
- Meet students fortnightly to monitor progress and resolve issues.
- Assess all project components except the final defense.

Assessment approach

The capstone project will include a number of components which will be assessed at an appropriate time. Each assessment component will be evaluated based on structured rubrics to ensure fairness and clarity. The rubrics outline criteria across four performance levels: **Excellent (80-100%)**, **Good (60-79%)**, **Satisfactory (40-59%)**, and **Needs Improvement (Below 40%)**.

Data Collection Field Visits:

As a part of their data collection, students will design questionnaires, tools, and instruments for data collection, conducting field visits under CPC and supervisor guidance. Logistics and financial support will be arranged by the Programme Leader in consultation with the College management.

A. CA1: Project Proposal (20%)

Students will present their detailed project proposal to the CPC. The proposal shall cover the following aspects (but not limited to):

1) Problem Definition
2) Requirement Analysis
3) Method(s)
4) Project Plan and Schedule
5) Project Governance
6) Risk Analysis
7) Quality Assurance and KPI

The proposal will be evaluated based on the following rubric:

Criteria	**Excellent (4) - 80-100%**	**Good (3) - 60-79%**	**Satisfactory (2) - 40-59%**	**Needs Improvement (1) - Below 40%**
Problem Definition (20%)	Clearly defines a relevant and significant problem; well-contextualized with supporting evidence.	Defines a relevant problem with some contextual details but lacks depth.	Problem is vaguely stated with minimal context and supporting evidence.	Problem is unclear or lacks relevance to the field of study.
Requirement Analysis (15%)	Thorough identification of all key requirements (functional & non-functional) with justification.	Identifies most key requirements but lacks depth in justification.	Identifies only a few requirements with limited justification.	Requirements are unclear or missing.
Method(s) (15%)	Well-defined methodology with strong justification and feasibility, aligned with project goals.	Methodology is clear but lacks some justification or feasibility analysis.	Methodology is stated but lacks clarity, feasibility, or alignment with objectives.	Methodology is unclear or missing.
Project Plan & Schedule (15%)	Detailed, realistic timeline with clear milestones, dependencies, and contingency planning.	Timeline is provided with milestones but lacks detail in dependencies or risk management.	Basic timeline with unclear milestones; lacks contingency planning.	No clear project schedule; milestones missing or unrealistic.

Project Governance (10%)	Clearly outlines team roles, responsibilities, and decision-making processes with justification.	Defines roles and decision-making processes but lacks justification.	Team roles are unclear or decision-making structure is incomplete.	No governance structure or lacks clarity.
Risk Analysis (10%)	Identifies key project risks with well-defined mitigation strategies and impact assessment.	Identifies major risks but lacks detailed mitigation strategies or impact analysis.	Lists risks but with weak or missing mitigation strategies.	Risk analysis is unclear or missing.
Quality Assurance & KPI (15%)	Clearly defines quality standards, KPIs, and measurable success criteria.	Defines KPIs but lacks clarity in measuring success or ensuring quality.	Quality standards and KPIs are vaguely defined.	No clear KPIs or quality assurance measures.

B. CA2: Reflection Journal (15%)

Students will submit an individual reflection journal to their respective supervisor fortnightly, utilizing a template provided by the project coordinator and supervisor. This journal should encompass insights into lessons acquired, encountered risks, and implemented mitigations, providing updates on their progress.

The journal will be assessed using the rubric:

Criteria	**Excellent (4) - 80-100%**	**Good (3) - 60-79%**	**Satisfactory (2) - 40-59%**	**Needs Improvement (1) - Below 40%**
Clarity & Depth of Reflections (40%)	Provides clear, detailed insights into lessons learned with strong personal reflection.	Reflects on lessons learned but lacks depth or clarity.	Superficial reflection with limited insight.	Little to no reflection or unclear writing.
Risk Identification & Mitigation (30%)	Clearly identifies risks and discusses well-thought-out mitigation strategies.	Identifies risks but provides only basic mitigation strategies.	Mentions risks but lacks clear mitigation plans.	Risks and mitigations are unclear or missing.

Progress Updates & Documentation (30%)	Regular, well-documented updates with clear evidence of progress.	Updates provided but lacks detail or consistency.	Irregular updates with minimal documentation.	Inconsistent or missing progress updates.

C. CA3: Poster Presentation (10%)

The project team is required to create and showcase a poster during the project presentation, with a designated time frame of 15-30 minutes. The poster will function as a visual aid to enhance comprehension of the project and should be presented in a PDF or PPT file format, spanning 1-2 pages. The evaluation will be carried out using the rubric:

Criteria	**Excellent (4) - 80-100%**	**Good (3) - 60-79%**	**Satisfactory (2) - 40-59%**	**Needs Improvement (1) - Below 40%**
Topic Coverage (30%)	Clearly presents key project details with in-depth explanation.	Covers main points but lacks depth in some areas.	Basic coverage with missing key details.	Unclear or insufficient topic explanation.
Creativity (20%)	Highly engaging, innovative design, and visually appealing.	Creative but lacks uniqueness.	Some creativity but design feels basic.	Minimal effort, lacks visual appeal.
Design & Presentation (30%)	Well-organized, professional layout, and easy to follow.	Mostly clear but could improve in structure.	Some clutter or inconsistencies in design.	Poorly structured and difficult to follow.
Self-Explanatory (20%)	Poster effectively communicates the project without additional explanation.	Mostly understandable but needs some verbal clarification.	Requires significant verbal explanation.	Content is unclear without extensive explanation.

D. CA4: Project Defense (20%)

Students are required to deliver a project presentation to the panel members, with a time frame of 45-60 minutes. The assessment of the project presentation will consider the following criteria:

				Needs

Criteria	Excellent (4) - 80-100%	Good (3) - 60-79%	Satisfactory (2) - 40-59%	Improvement (1) - Below 40%
Content Coverage (30%)	Thorough, well-structured, and insightful; all key aspects covered.	Covers most key areas but lacks depth in some sections.	Basic coverage with missing critical details.	Unclear, lacks coherence, and major gaps in content.
Presentation Quality (25%)	Clear, confident, and engaging; well-paced delivery.	Mostly clear but could improve in confidence and flow.	Some hesitation, lacks engagement, and pacing issues.	Unstructured, lacks clarity, and poorly delivered.
Q&A Handling (20%)	Responds confidently with well-reasoned answers.	Answers most questions effectively but lacks depth in some.	Struggles with some responses; limited depth.	Unable to address key questions or provide logical responses.
Use of Visuals (15%)	High-quality, relevant visuals that enhance understanding.	Good visuals but some areas need improvement.	Minimal visuals or lack of relevance.	Poor or missing visuals, affecting clarity.
Professionalism & Time Management (10%)	Well-prepared, maintains eye contact, and stays within the time limit.	Professional but slightly exceeds or falls short on time.	Somewhat prepared but lacks confidence or time control.	Poorly managed, unprepared, and significantly over/under time.

E. CA5: Project Report (35%)

The project teams are required to submit a comprehensive project report in both electronic as well as in hard copy to the supervisor, who will submit it to the project coordinator. Evaluation of the final project report will be based on the following criteria:

Criteria	Excellent (4) - 80-100%	Good (3) - 60-79%	Satisfactory (2) - 40-59%	Needs Improvement (1) - Below 40%
Introduction (10%)	Clearly defines project scope, objectives, and significance with strong contextual background.	Provides a clear introduction but lacks depth in scope or significance.	Basic introduction with some missing elements.	Unclear, lacks purpose, or missing introduction.

Literature Review (10%)	Demonstrates strong understanding of existing research, critically analyzes relevant studies, and establishes clear connections to the project.	Reviews relevant studies but lacks depth in critique or connection to the project.	Covers basic literature but lacks depth or critical analysis.	Weak or missing review of existing research.
Methodology (15%)	Clearly explains the approach, techniques, and tools used with strong justification.	Methodology is clear but lacks strong justification or minor gaps in execution.	Methodology is present but lacks depth or justification.	Unclear or poorly explained methodology.
Project Outcomes (15%)	Well-defined, measurable, and impactful results with strong evidence.	Outcomes are mostly clear but lack strong evidence of impact.	Outcomes are vague or partially defined.	Outcomes are unclear, poorly articulated, or missing.
Discussion & Analysis (15%)	Deep, well-structured analysis of results, linking findings to literature and practical implications.	Good discussion but lacks depth in linking findings to literature or real-world implications.	Basic discussion with some analysis but lacks strong connections.	Weak or missing discussion and analysis.
Outstanding Issues & Risks (10%)	Identifies key unresolved challenges and risks with clear explanations and mitigation strategies.	Identifies some issues but lacks depth in analysis or solutions.	Mentions issues but lacks proper articulation or mitigation strategies.	Does not address outstanding issues adequately.
Recommendations (10%)	Thoughtful, well-reasoned recommendations with actionable insights.	Reasonable recommendations but lack strong justification.	Basic recommendations with limited relevance.	Weak or missing recommendations.
Resources &	Comprehensive use of relevant	Good use of sources, but	Limited use of relevant	Insufficient or irrelevant

Citations (5%)	sources, properly cited and well-integrated.	some may lack relevance or citations.	sources; some key references missing.	sources; poor citation.
Report Quality (10%)	Well-structured, professional writing, with clear formatting and minimal errors.	Well-written but with minor formatting or clarity issues.	Adequately structured but lacks professional presentation.	Poorly structured, difficult to follow, or poorly formatted.

The CPC, and an external evaluator, preferably possessing a technical background from other departments or organizations, will evaluate the various components of the capstone project. The supervisors will be responsible for assessing components A, B, and E, accounting for 65% of the total project grade. This assessment will be moderated by other supervisors and the project coordinator. Meanwhile, the CPC and external evaluator will be tasked with evaluating components C, D, and E. Before undergoing assessment for components C, D, and E, students must submit and validate their project materials by presenting them to both the supervisor and the project coordinator. Only upon receiving verification from these evaluators can the students proceed to be assessed in the subsequent components (C, D, and E).

Areas of assessment	**Quantity**	**Weighting**	**Assessor**	
			Panel	**Supervisor**
A. Project Proposal	1	20%		✓
B. Reflection Journal	4	15%		✓
C. Poster Presentation	1	10%	✓	
D. Project Defense	1	20%	✓	
E. Project Report	1	35%	✓	✓

Project Timelines and Key Milestones:

Time	**Activity**	**People Responsible**
Week 1	● **Project team approval** ● **Project topic approval**	CPC & Supervisor
Week 2	● Proposal Writing	Supervisor
Week 3	● **Proposal Presentation & Approval** ● **Reflection Journal 1 submission**	Supervisor & CPC
	● Literature Review	Supervisor

Week 4	● Methodology	
Week 5	● **Methodology approval** ● Model(s) Development ● **Reflection Journal 2 submission**	Supervisor
Week 6	● Data Collection ● Field Visits	Supervisor & PL
Week 7	● Midterm Review ● Data Cleaning	Supervisor & Coordinator
Week 8	● Model Training ● **Reflection Journal 3 submission**	Supervisor
Week 10	● Model Training & Testing ● Poster Preparation	Supervisor
Week 11	● **Poster Presentation**	CPC, Reviewer, Supervisor
Week 12	● **Project Report Draft Submission** ● **Reflection Journal 4 submission**	Supervisor
Week 13	● Project finalisation and pre-defense	Supervisor
Week 14	● Incorporate Supervisors' comments and feedback ● **Final Report Submission (soft and hardcopy)**	Supervisor
Week 15	● **Project Defense**	CPC, Reviewer, Supervisor

Ethical Considerations:

Formal ethics approval is mandatory for projects involving human subjects, sensitive data, or external collaborations**.** The capstone project must be conducted in line with the code of ethics and intellectual property policies of the Royal University of Bhutan. The CPC will assist the students in obtaining the ethical permit approvals and fulfilling other necessary requirements. The College Research Committee (CRC) will be responsible for giving the ethical clearance for the project and other guidance.

The CPC will monitor and ensure that the ethical considerations are taken seriously across all phases of the capstone project. Moreover, the project coordinator will orient students on project ethics and personally conduct a seminar at the beginning of the semester.

Overview of the assessment approaches and weighting

CA1	20%
CA2	15%
CA3	10%
CA4	20%
CA5	35%

Total	100%

Pre-requisites: DAT305 Research with Advanced Data Analytics & DAT308 Data Science Project II

Reading List

Essential Reading (e-books):

Burke, J., & Dempsey, M. (2021). *Undertaking capstone projects in education: A practical guide for students*. Routledge. https://doi.org/10.4324/9781003159827

Smith, J. (2023). *Capstone excellence: A comprehensive guide to conceiving, crafting, and completing your college capstone project*. Independent Publishing. https://www.amazon.com/Capstone-Excellence-Comprehensive-Conceiving-Completing-ebook/dp/B0C7S62V45

Harvard University. (n.d.). *Data science: Capstone* [Online course]. Harvard Online. https://www.harvardonline.harvard.edu/course/data-science-capstone

IBM. (n.d.). *IBM applied data science capstone* [GitHub repositories]. IBM Data Science Professional Certificate.

Zorin, E. (n.d.). *IBM applied data science capstone*. GitHub. https://github.com/evgenyzorin/IBM-Applied-Data-Science-Capstone

Youssef, Y. (n.d.). *IBM applied data science capstone*. GitHub. https://github.com/Y-OUSSE-F/IBM----Applied-Data-Science-Capstone

Additional **Reading:**

Date: February 2025.

CRD401 Professional Certification II

Module Code and Title: CRD401 Professional Certification II
Programme: Bachelor of Data Science and Data Analytics
Credit: 12
Module Tutor(s): Pema Wangdi

General Objective

This module aims to support students in obtaining professional certifications relevant to data science, providing them with opportunities to acquire credentials in high-demand fields associated with data science and analytics from reputable organizations. These certifications validate students' skills according to international standards, offering tangible credentials that demonstrate their expertise to potential employers. The certifications must be in areas such as Data Engineering, Artificial Intelligence

(AI), Machine Learning (ML), and other pertinent domains determined by the program committee and deemed equivalent to the 12 credits.

Learning Outcomes

On completion of the module, students will be able to:

1. acquire professional certifications relevant to data science from reputable organizations
2. demonstrate ability to navigate online certification courses and access relevant materials
3. demonstrate proficiency in professional tools and platforms required for certification in areas such as Data Engineering, AI & ML, Cloud Computing, and Web Development.
4. implement cloud-based solutions for data storage, computing, and analytics by utilizing cloud platforms like AWS, Azure, or Google Cloud.
5. integrate ethical considerations and best practices in AI and ML solutions, ensuring fairness, transparency, and compliance with data privacy regulations.
6. analyze and solve complex problems using statistical and algorithmic approaches that align with industry certification standards.
7. prepare for and pass professional certification exams by mastering the content, structure, and problem-solving approaches required by certification bodies.
8. communicate technical solutions effectively, presenting data-driven insights and solutions to diverse stakeholders in both written and oral formats.
9. practice self-directed learning and time management

Learning and Teaching Approach:

Type	Approach	Hours per week	Total credit hours
Independent study	Online lectures, projects, self-study	8	60
Total		**8**	**120**

This module adopts a fully self-directed learning approach. There will be no formal lectures, workshops, or practical sessions provided to the students. Instead, students are expected to take full responsibility for their learning journey by enrolling in and completing online certification courses.

College Management will be responsible for:

- Providing fees for the certification and assisting in completing other formalities

Programme Committee (PC) will be responsible for:

- Identifying and selecting appropriate online certification courses.
- Appointing faculty advisor to keep track and assist students complete the certification

Faculty Advisor (FA) will offer support to students in various capacities, including:

- Aiding students in completing registration forms and coordinating fee payments.
- Guiding students in self-directed study and fulfilling prescribed certification requirements.
- Providing strategies for scheduling and preparing for certification examinations.
- Reviewing resources and materials offered by certification course providers.

- Helping students navigate certification course platforms and access relevant materials.
- Monitoring the progress of students to ensure that they do not procrastinate and leave a significant portion of the learning materials until the end of the semester.
- Providing encouragement and motivation to keep students engaged throughout the duration of the course.
- Administering various forms of assessment, such as presentations, quizzes, etc., to evaluate students' understanding and progress.

The college will cover the fees upon submission of valid registration forms. Students must successfully complete the prescribed certification requirements, including scheduling and appearing for examinations, within a single semester to fulfil module requirements.

A student must choose (subject to PC's approval) one of the following certifications:

1. AWS Certified Machine Learning Engineer - Associate
2. AWS Certified Data Engineer - Associate

Means of Assessment
Successful completion of prescribed certification exams (100% of the module grade).

Students must enrol in and complete prescribed certification exams within the semester. They must provide certificates of completion to fulfil module requirements.

Overview of the assessment approaches and weighting

Certification Exam	100%

Pre-requisites: All modules up to Year 3.

Subject Matter
As per the certification providers. Students must pass the prescribed certification exam(s) and provide certificates of completion within the semester to fulfil module requirements and be eligible to receive their BSc degree in Data Science and Data Analytics.

Reading List:
Essential Readings

1. AWS Certified Machine Learning Engineer - Associate (https://aws.amazon.com/certification/certified-machine-learning-engineer-associate/?ch=sec&sec=rmg&d=1)
2. Associate Big Data Analyst (Data Science Council of America). https://www.dasca.org/Content/Docs/associate-big-data-analyst-program-brochure.pdf

Additional Readings

1. Certifications. Google Cloud. https://cloud.google.com/learn/certification#why-get-google-cloud-certified
2. Your Guide to Data Science Certifications in 2024 | Coursera. https://www.coursera.org/in/articles/data-science-certification
3. IBM Data Scientist Training. https://www.ibm.com/training/learning-path%20+%20'/'%20+%20ibm-data-scientist-596
4. AWS_certification_paths.pdf. https://d1.awsstatic.com/training-and-certification/docs/AWS_certification_paths.pdf?trk=3e1113f5-401b-401e-9767-6653d3775639&sc_channel=el
5. Get AWS Certified. https://training.resources.awscloud.com/get-aws-certified

Date: January 2025.