AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH (AIUB)

Faculty of Science and Technology (FST)
Department of Mathematics
Undergraduate Program

COURSE PLAN	SEMESTER: SUMMER 2023-2024
I. Course Code and Title MAT 3103: Computational Statistics & Probability **II. Credit** 3 credit hours (3 hours of theory per week) **III. Nature** Core Course for CS and Engineering **IV. Prerequisite** MAT 1205: Integral Calculus & Ordinary Differential Equation.	**V. Vision:** Our vision is to be the preeminent Department of Mathematics through creating recognized professionals who will provide innovative solutions by leveraging contemporary research methods and development techniques of computing that is in line with the national and global context. **VI. Mission:** The mission of the Department of Mathematics of AIUB is to educate students in a student-centric dynamic learning environment; to provide advanced facilities for conducting innovative research and development to meet the challenges of the modern era of computing, and to motivate them towards a life-long learning process.

VII - Course Description:

* Idea about Statistics and study data design and management and effectively carry out data exploration and visualization.
* Define and explain descriptive statistics and their application on real life examples.
* Comprehend the concept of probability and probability distribution to utilize data for assessing theories.
* Realize and explicate various stochastic processes and time series.
* Comprehend various types of sampling along with constructing confidence intervals.
* Understand the basics of hypothesis testing as well as interpret inferential results.
* Delineate correlation and regression to apply more advanced statistical modeling procedures.
* Finally, they will learn the importance of and be able to connect research questions to the statistical and data analysis methods taught to them.
* All techniques will be illustrated using a variety of real data sets, and the course will emphasize different modeling approaches for different types of data sets.

VIII- Course Outcomes (CO) Matrix

By the end of this course, students should be able to:

COs*	CO Description	Level of Domain ***			PO Assessed ****
		C	P	A	
CO1	*Describe* the fundamental concept of Statistics, probability, Stochastic Process, Sampling, Hypothesis, Regression and Simulation.	2			PO-b-1
CO2 **	**Generalize the related ideas of Statistics and Probability to solve real-life problems.**	**2**			**PO-b-1**
CO3 **	**Determine forecasting based on Regression Model and Time Series.**	**3**			**PO-a-4**

CO4	*Illustrate* the sample and find out the estimated statistic. Explain the appropriateness of the developed solution with concept of gathered information. *Compose* and *predict* Statistical Hypothesis.	3			PO-a-4

C: Cognitive; P: Psychomotor; A: Affective Domain

*   CO assessment method and rubric of COs assessment is provided in later section
**   Cos will be mapped with the Program Outcomes (POs) for PO attainment
***   *The numbers under the 'Level of Domain' columns represent the level of Bloom's Taxonomy each CO corresponds to.*
**** *The numbers under the 'PO Assessed' column represent the POs each CO corresponds to.*

IX – Topics to be covered in the class.

Time Frame	CO Mapped	Topics	Teaching Activities	Assessment Strategy(s)
Week 1	CO1	Discussion on OBE and assessment criteria. **Introduction:** Introducing students, the mission and vision of AIUB, Course contents, core objectives of the course, Topics to be covered in the course. **Data Visualization:** Discuss basic definitions, various graphs and diagrams, their uses, and advantages.	Lecture, Brain Storming, Problem Solving, Question-answer	Class Performance
Week 2	CO1	**Descriptive Statistics:** Measures of central tendency and dispersion for both grouped and ungrouped data, data Screening, MATLAB code for the related topic. **Project topic is given**	Lecture, Brain Storming, Problem Solving, Question-answer	Class Performance. **Quiz-1**
Week 3	CO1, CO2	**Probability:** Application of probability, addition and multiplication rules of probability, Conditional probability, Decision tree learning with engineering applications.	Lecture, Brain Storming, Problem Solving, Question-answer	Class Performance
Week 4	CO1, CO2	**Random variable:** Probability function, probability density function, properties of random variable (Mean, Variance)	Lecture, Brain Storming, Problem Solving, Question-answer	Class Performance. **Quiz-2**
Week 5	CO2	**Discrete probability distributions:** Binomial, Poisson and Geometric distribution. **Continuous probability distributions:** Normal, Exponential and Rayleigh distribution. **Project data is collected by students**	Lecture, Brainstorming, Problem Solving, Question-answer	Class Performance. **Quiz-3**
Midterm (Week 6)				
Week 7	CO3	**Time series:** Time series model, Time series modeling, forecasting, prediction, simulation.	Lecture, Brainstorming, Problem Solving, Question-answer	Class Performance
Week 8	CO1	**Stochastic process:**	Lecture, Brainstorming,	Class

Week		Content	Method	Assessment
		Markov process, counting process, Poisson process, examples of Markov and Poisson processes for engineering applications.	Problem Solving, Question-answer	Performance. **Quiz-1**
Week 9	CO4	**Sampling:** Sampling and sampling distribution; test of hypothesis regarding sampling for engineering applications.	Lecture, Brainstorming, Problem Solving, Question-answer	Class Performance
Week 10	CO2, CO4	**Hypothesis testing:** Test of hypothesis concerning means, proportions for engineering applications, test of association.	Lecture, Brainstorming, Problem Solving, Question-answer	Class Performance. **Quiz-2**
Week 11	CO3, CO1	**Correlation and regression:** Correlation, Regression, test regarding Correlation and Regression. **Monte Carlo Methods:** Simulation, Large number theory, Central limit theorem. **Final project report submission**	Lecture, Brainstorming, Problem Solving, Question-answer	Class Performance. **Quiz-3**
Final term (Week 12)				

* *The faculty reserves the right to change, amend, add, or delete any of the contents.*

X – Mapping of PO to Courses and K, P, A

PO Indicator ID	PO Indicators Definition (As per the requirement of WKs)	Domain	K	P	A
PO-b-1	Identify first principles of natural sciences and engineering sciences in practical applications.	Cognitive Level 2 (Understanding)	K1		
PO-a-4	Apply information and concepts in specialized engineering sciences with the in-depth of analysis of a complex computer science and engineering problem.	Cognitive Level 3 (Applying)	K4	P1 P3 P7	

XI – K, P, A Definitions

Indicator	Title	Description
K1	Theory based natural science	A systematic, theory-based understanding of the natural sciences applicable to the discipline
K4	Forefront specialist knowledge for practice	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline
P1	Depth of knowledge required	Cannot be resolved without in-depth engineering knowledge at the level of one or more of K3, K4, K5, K6 or K8 which allows a fundamentals-based, first principles analytical approach
P3	Depth of analysis required	Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models
P7	Interdependence	Are high level problems including many component parts or sub-problems

XII – Mapping of CO Assessment Method and Rubric

The mapping between Course Outcome(s) (COs) and The Selected Assessment method(s) and the mapping between Assessment method(s) and Evaluation Rubric(s) is shown below:

COs	Description	Mapped POs	Assessment Method	Assessment Rubric
CO1	*Describe* the fundamental concept of Statistics, probability, Stochastic Process, Sampling, Hypothesis, Regression and Simulation.	PO-b-1	Quiz/ Term Question & Assignment	Rubric for Quiz/ Term Question & Assignment
CO2	*Generalize* the related ideas of Statistics and Probability to solve real-life problems.	PO-b-1	Quiz/ Term Question & Assignment	Rubric for Quiz/ Term Question & Assignment
CO3	*Determine* forecasting based on Regression Model and Time Series.	PO-a-4	Quiz/ Term Question & Assignment	Rubric for Quiz/ Term Question & Assignment
CO4	*Illustrate* the sample and find out the estimated statistic. Explain the appropriateness of the developed solution with concept of gathered information. Compose and predict Statistical Hypothesis.	PO-a-4	Quiz/ Term Question & Assignment	Rubric for Quiz/ Term Question & Assignment

XIII – Evaluation and Assessment Criteria

CO1: *Describe* the fundamental concept of Statistics, Probability, Stochastic Process, Sampling, Hypothesis, Regression and Simulation.				
Assessment Criteria	**Not Attended/ Incorrect (0)**	**Inadequate (1)**	**Satisfactory (2)**	**Excellent (3)**
Definition	Terms that are not connected to the main concept	Slightly relevance occurs but accuracy is not attained	More relevance is found in the definition	Definition provided with the relevance to the subject matter. Correctly define the terms.
Fundamental concept	Not related to the fundamental concept	Idea about the concept is not very clear	More significant, yet inaccurate in some ways	Basic concept to identify the appropriate technique.
Formulation and Evaluation	Inaccurate formulation	Concept of approaching the formulation is weak	Identified the appropriate methods, but MATLAB code is not properly chosen	Apply the technique correctly or not. Identifies the appropriate necessary MATLAB code.
Correctness of answer	Incorrect answers	Partially correct answer with significant error	Mostly correct answer with minor errors or omission of some steps	Arrived at correct answer, showing every step of calculation.

CO2: *Generalize* the related ideas of Statistics and Probability to solve real-life problems.

Assessment Criteria	Not Attended/ Incorrect (0)	Inadequate (1)	Satisfactory (2)	Excellent (3)
Problem Analysis	Not considered to be a relevant technique	Getting closer to the relevant method	Slightly depart from the relevant methods	Classify the problem with the relevant methods.
Solve the problem applying the knowledge of Statistics and Probability	Incorrect formula is applied	Mentioning the right term but failing to use the right formula	Using the proper technique but failing to write down the appropriate term	Proper usage of techniques mentioning their name
Evaluation	No attempt or applies the steps of solving incorrectly.	There are missing actions in the several steps of the calculation	Illustrating each step even though there are occasional inaccuracy	Accuracy of the calculation on each step
Formulate and compose	incorrect answer is provided, with no step shown.	Partially correct answer is provided, with some errors	Mostly correct answer with minor errors or omission of some steps	Relate the problem with the existing method and make decision

CO3: *Determine* forecasting based on Regression Model and Time Series. *Formulate* the appropriate models.

Assessment Criteria	Not Attended/ Incorrect (0)	Inadequate (1)	Satisfactory (2)	Excellent (3)
Definition	No attempt or misunderstanding of forecasting using Regression and Time series.	Identifies Regression and Time series but struggles to explain its purpose or characteristics.	Demonstrates a clear understanding of Regression and Time series.	Definition provided with the relevance to the subject matter. Correctly and comprehensively define the terms.
Identify the appropriate technique	uses incorrect formulas.	Attempts to formulate the solution but uses partially incorrect or incomplete formulas.	Precisely formulates the solution using appropriate formulas but some steps are missing.	Proper usage of techniques mentioning their name with
Evaluation	applies the model incorrectly.	Makes some progress in applying the model but has significant errors in calculations or steps.	Applies the model with some minor errors or omissions in calculations.	Precision of the calculation on each step
Correctness of answer	Incorrect final answer.	Partially correct answer, with significant errors or deviations from the expected result.	Mostly correct answer, with minor errors or omissions that do not significantly impact the result.	Achieve appropriate decision showing every relevant step of calculation.

CO4: *Illustrate* the sample and find out the estimated statistic. Explain the appropriateness of the developed solution with concept of gathered information. *Compose* and *predict* Statistical Hypothesis.

Assessment Criteria	Not Attended/ Incorrect (0)	Inadequate (1)	Satisfactory (2)	Excellent (3)
Definition	No attempt or false impression of Hypothesis testing and sampling technique.	Distinguishes Hypothesis and sampling technique but struggles to explain its purpose or characteristics.	Demonstrates a clear understanding of hypothesis and sampling technique	Definition provided with the relevance to the subject matter. Correctly and comprehensively define the terms.
Identify the appropriate technique	Uses incorrect formulas.	Tries to formulate the solution but uses partially incorrect or incomplete formulas.	Precisely formulates the solution using appropriate formulas but some steps are missing.	Proper usage of techniques mentioning their name.
Evaluation	Identifies the formulas incorrectly.	Reaches some progress in applying the formulas but has significant errors in calculations or steps.	Applies the formulas with some minor errors or omissions in calculations.	Select the appropriate methods for sampling, estimation, hypothesis, and assessment.
Correctness of answer	Incorrect final answer.	Partially correct answer, with significant errors or deviations from the expected result.	Mostly correct answer, with minor errors or omissions that do not significantly impact the result.	Achieve appropriate decision showing every relevant step of calculation.

XIV – Course Requirements

- Students are expected to attend at least 80% class.
- Students are expected to participate actively in the class.
- For both terms, there will be at least 2 quizzes based on the theoretical knowledge and conceptual understanding of the topic covered discussed in the classes.

XV – Evaluation & Grading System

The tentative marks distribution for course evaluation are as follows:

MID TERM		FINAL TERM	
Attendance	10%	Attendance	10%
Performance	10%	Performance	10%
Quiz (At least 2)	40%	Quiz (At least 2)	40%
Midterm written exam	40%	Final term written exam	40%
Total	100%	Total	100%

Grand Total 100% = 40% of Midterm + 60% of Final Term

Letter	Grade Point	Numerical %
A+	4.00	90-100
A	3.75	85 - < 90
B+	3.50	80 - < 85
B	3.25	75 - < 80
C+	3.00	70 - < 75
C	2.75	65 - < 70
D+	2.50	60 - < 65
D	2.25	50 - < 60
F	0.00	< 50
I		Incomplete
W		Withdrawal
UW		Unofficially Withdrawal

* The evaluation system will be strictly followed as per the AIUB grading policy.

* CO attainment will be achieved with 60% of the evaluation marks.

XVI – Textbook/ References

1. *Introduction to Probability*, Second Edition (Chapman & Hall/CRC Texts in Statistical Science). 2019.

2. Devore, J. L., Farnum, N. R., & Doi, J. A. (2013). *Applied statistics for engineers and scientists*. Cengage Learning.

3. Hastie, T., Tibshirani, R., & Friedman, J. (2009). *The elements of statistical learning: data mining, inference, and prediction*. Springer Science & Business Media.

4. Devore, J. L. (2015). *Probability and Statistics for Engineering and the Sciences*. Cengage Learning.

5. Asimow, L. A., & Maxwell, M. M. (2010). *Probability and Statistics with applications: A problem solving text*. Actex Publications.

6. Lecture notes

XVII- List of Faculties Teaching the Course

FACULTY NAME	SIGNATURE
Associate Professor Dr. Fatema-Tuz-Zohra	
Associate Professor Dr. Mahfuza Khatun	
Assistant Professor Tanzia Zerin Khan	
Associate Professor Md. Mortuza Ahmmed	
Assistant Professor Dr. Ummay Ayesha	
Lecturer Samira Salam	

XIV – Verification

Prepared by: -------------------------------- **Dr. Mahfuza Khatun** *Course Convener* Date:...	Moderated by: -------------------------------- **Dr. M. Mahmudul Hasan** *Point Of Contact* *OBE Implementation Committee* Date:...	Checked by: -------------------------------- **Dr. M. Mostafizur Rahman** *Head, Department of Mathematics* Date:...
Verified by: .... **Dr. Md. Abdullah-Al-Jubair** *Director* *Faculty of Science & Information Technology* Date:...	Certified by: .... **Prof. Dr. Dip Nandi** *Associate Dean,* *Faculty of Science & Information Technology* Date:...	Approved by: .... **Mr. Mashiour Rahman** *Dean,* *Faculty of Science & Information Technology* Date:...