AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH (AIUB)
Faculty of Science and Technology (FST)
Department of Mathematics
Undergraduate Program

COURSE PLAN   SUMMER: 2022-2023

| I. Course Code and Title
MAT 3103: Computational Statistics & Probability

II. Credit
3 credit hours (4 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	*Apply* the fundamental concept of Statistics, probability, Stochastic Process, Sampling, Hypothesis, Regression and Simulation.	3			PO-a-2
**CO2 **	***Predict* the related ideas of Statistics and Probability to solve real-life problems.**	**3**			**PO-a-2**
**CO3 **	***Distinguish* forecasting based on Regression Model and Time Series. *Interpret* the appropriate model.**	**2**			**PO-b-1**
CO4	*Illustrate* the sample and find out the estimated statistic. Explain the appropriateness of the developed solution with concept of gathered information. *Analyze* and compose Statistical Hypothesis.	4			PO-b-2

IX – Topics to be covered in the class:

Time Frame	Topics	Teaching Activities	Assessment strategy (s)	CO Mapped
Week 1	**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. **Descriptive Statistics:** Measures of central tendency and dispersion for both grouped and ungrouped data, data Screening, MATLAB code for the related topic.	Lecture, Brain Storming, Problem Solving, Question-answer	Class Performance	CO1, CO2
Week 2	**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 Quiz-1	CO1, CO2
Week 3	**Random variable:** Probability function, probability density function, properties of random variable (Mean, Variance)	Lecture, Brain Storming, Problem Solving, Question-answer	Class Performance. Quiz-2	CO1, CO2
Week 4	**Discrete probability distributions:** Binomial, Poisson and geometric distribution.	Lecture, Brain Storming, Problem Solving, Question-answer	Class Performance	CO2
Week 5	**Continuous probability distributions:** Normal, exponential and Rayleigh distribution.	Lecture, Brain Storming, Problem Solving, Question-answer	Class Performance. Quiz-3	CO2
Week 6	**Midterm**			
Week 7	**Time series:** Time series model, Time series modeling, forecasting, prediction, simulation.	Lecture, Brain Storming, Problem Solving, Question-answer	Class Performance	CO1, CO3
Week 8	**Stochastic process:** Markov process, counting process, Poisson process, examples of Markov and Poisson processes for engineering applications.	Lecture, Brain Storming, Problem Solving, Question-answer	Class Performance. Quiz-1	CO1
Week 9	**Sampling:** Sampling and sampling distribution; test of hypothesis regarding sampling for engineering applications.	Lecture, Brain Storming, Problem Solving, Question-answer	Class Performance	CO1, CO4

Week 10	**Hypothesis testing:** Test of hypothesis concerning means, proportions for engineering applications, test of association.	Lecture, Brain Storming, Problem Solving, Question-answer	Class Performance	CO2, CO4
Week 11	**Correlation and regression:** Correlation, regression, test regarding correlation and regression.	Lecture, Brain Storming, Problem Solving, Question-answer	Class Performance Quiz-3	CO3, CO1
	Monte Carlo Methods: Simulation, Large number theory, Central limit theorem.			
Week 12	**Final Term**			

- *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-a-2	Apply information and concepts of mathematics with the familiarity of issues.	Cognitive Level 3 (Applying)	K2		
PO-b-1	Identify first principles of natural sciences and engineering sciences in practical applications.	Cognitive Level 2 (Understanding)	K1		
PO-b-2	Formulate solutions, procedures, and methods using first principles of mathematics for engineering sciences.	Cognitive Level 4 (Analyzing)	K2		

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
K2	Conceptual based mathematics	Conceptually based mathematics, numerical analysis, statistics and the formal aspects of computer and information science to support analysis and modeling applicable to the discipline

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	*Apply* the fundamental concept of Statistics, probability, Stochastic Process, Sampling, Hypothesis, Regression and Simulation.	PO-a-2	Quiz/ Term Question & Assignment	Rubric for Quiz/ Term Question & Assignment
CO2	*Predict* the related ideas of Statistics and Probability to solve real-life problems.	PO-a-2	Quiz/ Term Question & Assignment	Rubric for Quiz/ Term Question & Assignment
CO3	*Distinguish* forecasting based on Regression Model and Time Series. *Interpret* the appropriate model.	PO-b-1	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. *Analyze* and compose Statistical Hypothesis.	PO-b-2	Quiz/ Term Question & Assignment	Rubric for Quiz/ Term Question & Assignment

XIII – Evaluation and Assessment Criteria

CO1: *Apply* the fundamental concept of Statistics, probability, Stochastic Process, Sampling, Hypothesis, Regression and Simulation

Assessment Criteria	Not Attended/ Incorrect (0)	Inadequate (1-2)	Average (3)	Good (4)	Excellent (5)
Evaluation Criteria	**Evaluation Definition**				
Definition	Definition provided with the relevance to the subject matter. Correctly define the terms.				
Fundamental concept	Basis concept to identify the appropriate technique.				
Formulation and Evaluation	Apply the technique correctly or not. Identifies the appropriate necessary MATLAB code.				
Correctness of answer	Arrived at correct answer, showing every step of calculation.				

CO2: *Predict* the related ideas of Statistics and Probability to solve real-life problems.					
Assessment Criteria	**Not Attended/ Incorrect (0)**	**Inadequate (1-2)**	**Average (3)**	**Good (4)**	**Excellent (5)**
Evaluation Criteria	**Evaluation Definition**				
Problem Analysis	Classify the problem with the relevant methods.				
Solve the problem applying the knowledge of Statistics and Probability	Proper usage of techniques mentioning their name				
Evaluation	Correctness of the calculation on each step				
Formulate and compose	Relate the problem with the existing method and make decision				

CO3: *Distinguish* forecasting based on Regression Model and Time Series. *Interpret* the appropriate model.					
Assessment Criteria	**Not Attended/ Incorrect (0)**	**Inadequate (1-2)**	**Average (3)**	**Good (4)**	**Excellent (5)**
Evaluation Criteria	**Evaluation Definition**				
Definition	Definition provided with the relevance to the subject matter. Correctly and comprehensively define the terms.				
Identify the appropriate technique	Proper usage of techniques mentioning their name.				
Evaluation	Correctness of the calculation on each step				
Correctness of answer	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. *Analyze* and compose Statistical Hypothesis.					
Assessment Criteria	**Not Attended/ Incorrect (0)**	**Inadequate (1-2)**	**Average (3)**	**Good (4)**	**Excellent (5)**
Evaluation Criteria	**Evaluation Definition**				
Definition	Definition provided with the relevance to the subject matter. Correctly and comprehensively define the terms.				
Identify the appropriate technique	Proper usage of techniques mentioning their name.				
Evaluation	Select the appropriate methods for sampling, estimation, and assessment.				
Correctness of answer	Achieve appropriate decision showing every relevant step of calculation.				

XIV – Course Requirements

- Students are expected to attend at least 80% of total classes.
- 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:

1. Attendance --- 10%
2. Performance -- 10%
3. Quiz (at least 2) -- 40%
4. Mid/final term assessment --------------------------------- 40%
   Total--- 100%
   Grand Total ---------- 40% of Midterm + 60% of Final term

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

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(Failed)
I	Incomplete	
W	Withdrawal	
UW	Unofficially Withdrawal	

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

1. Associate Professor Dr. Mahfuza Khatun
2. Assistant Professor Dr. Jannatul Fardous
3. Associate Professor Md. Mortuza Ahmmed
4. Assistant Professor Dr. Ummay Ayesha

XIV – Verification:

Prepared by: ------------------------------- **Md. Mortuza Ahmmed** Associate Professor Date:..	Moderated by: ------------------------------- **Dr. Mahfuza Khatun** Associate Professor Date:..	
Checked by: ------------------------------- **Dr. Mohammad Mahmudul Hasan** *Point of Contact* *OBE Implementation Committee for CS* Date:..	Certified by: .... **Dr. Dip Nandi** *Associate Dean,* *Faculty of Science &* *Information Technology* Date:................................	Approved by: .... **Mr. Mashiour Rahman** *Dean,* *Faculty of Science &* *Information Technology* Date:...