Course Outline

Probability and Statistics for Engineers-I
Stat 1103

About the Instructor

Mahbub Latif

- Professor of Applied Statistics and Data Science
- Institute of Statistical Research and Training (ISRT) at the University of Dhaka

Educational Qualifications

- PhD in Applied Statistics (University of Goettingen, Germany) [2005]
- MSc in Statistics (University of British Columbia, Canada) [2001]
- BSc and MSc in Statistics (University of Dhaka, Bangladesh) [1993, 1995]

Homepage @ ISRT

- https://www.isrt.ac.bd/people/mlatif/

Contact details

Office

- Room 104, ISRT Building

Email

- mlatif@iit.du.ac.bd

Meetings

- Sundays 8:00-9:00 am, Tuesdays 8:00-10:00 am

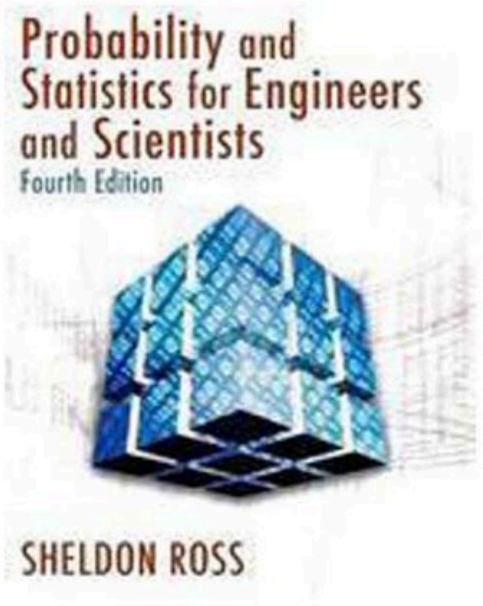
Office hours

- TBA

About the Course

Textbook

- **Sheldon M. Ross** (2009). *Introduction to Probability and Statistics for Engineers and Scientists*, fourth edition. Elsevier.



Reference Book

- **Anthony Hayter** (2012). *Probability and Statistics for Engineers and Scientists*, fourth edition. Cengage Learning.

Course contents

Introduction to Statistics (Chapter 1)

- *Data Collection and descriptive Statistics*
- *Inferential Statistics and probability models*
- *Populations and Samples*

Descriptive statistics (Chapter 2)

- *Describing data sets*: Frequency tables and graphs; Relative frequency tables and graphs; Grouped data, histograms, ogives, stem and leaf plots;
- *Summarizing data sets*: Sample mean, sample median, sample mode; Sample variance and sample standard deviation; Sample percentiles and box plots;
- *Chebyshev's inequality*
- *Normal data sets*
- *Paired data set and sample correlation coefficient*

Course contents

Elements of Probability (Chapter 3)

- *Sample space and events*; *Venn diagrams and algebra of events*; *Axioms of probability*; *Conditional Probability*; *Bayes' Theorem*; *Independent Events*;

Random Variables and Expectation (Chapter 4)

- *Random Variables*; *Types of Random Variables*; *Jointly Distributed Random Variables*; *Expectation*; *Properties of Expected Values*; *Variance*; *Covariance and Variance of Sums of Random Variables*; a Moment *Generating Functions*; *Chebyshev's inequality and weak law of large numbers*;

Special Random Variables (Chapter 5)

- *The Bernoulli and Binomial Random Variables*; *The Poisson Random Variables*; *The hypergeometric random variable*; *Uniform Random Variables*; *Normal Random Variables*; *Exponential random Variables*; *Gamma Distribution*

- *Distributions arising from normal distribution*: Chi-Square Distribution, t-Distribution and F-Distribution

Course contents

Distributions of Sampling Statistics (Chapter 6)

- *The sample mean*; *Central Limit Theorem*; *The sample variance*; *Sampling Distribution from a Normal Population*; *Sampling from a Finite Population*;

Parameter Estimation (Chapter 7)

- *Maximum Likelihood Estimators*; *Interval Estimates*; *Estimating the difference in Means of Two Normal Populations*; *Approximate Confidence Interval for the Mean*; *Confidence Interval of the Mean of the Exponential Distribution*; *Bayes' Estimator*

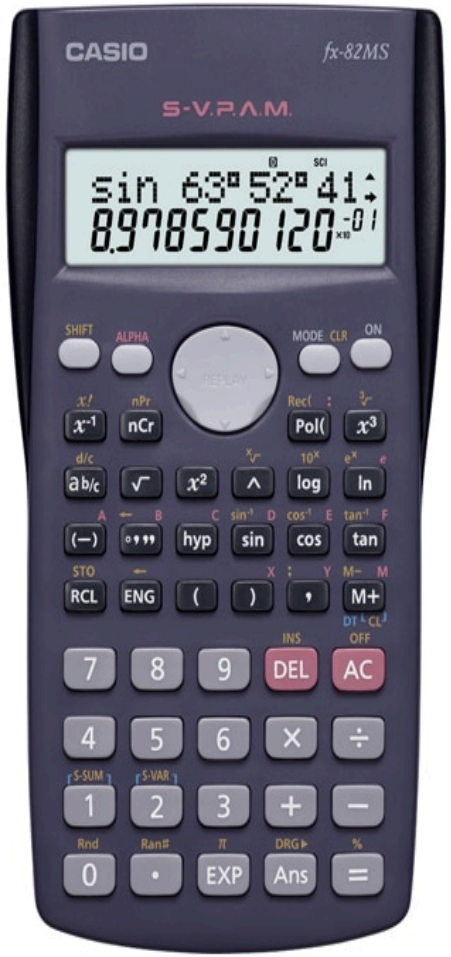
Grading distribution

Grading tool	% points
Midterm	20
Quiz (4x)	10
Attendance + Participation	5
Assignments (x)	5
Final Exam	60
Total	100

Some useful stuffs for the course!

A Scientific Calculator

- You should bring a scientific calculator to all the classes and exams.
- Mobile phone cannot be used as a calculator!



Differentiation

- Derivative of a function $y = f(x)$ is defined as

$$\frac{dy}{dx} = \frac{d}{dx} f(x)$$

- $E.g.$ $y = 2x^2 + 5x + 10$

$$\frac{dy}{dx} = \frac{d}{dx}(2x^2 + 5x + 10) = 4x + 5$$

Differentiation

- $y = [g(x)]^n \;\Rightarrow\; \frac{dy}{dx} = n[g(x)]^{n-1}\left[\frac{dg(x)}{dx}\right]$

$$E.g.\quad y = (2x+3)^4$$

$$\frac{dy}{dx} = 8(2x+3)^3$$

- $y = g(x)f(x) \;\Rightarrow\; \frac{dy}{dx} = \frac{dg(x)}{dx}f(x) + g(x)\frac{df(x)}{dx}$

$$E.g.\quad y = (2x+3)(x^2+5)$$

$$\frac{dy}{dx} = 2x(2x+3) + 2(x^2+5)$$

Differentiation

- $y = \frac{g(x)}{f(x)} \Rightarrow \frac{dy}{dx} = \frac{f(x)\frac{dg(x)}{dx} - g(x)\frac{df(x)}{dx}}{f(x)^2}$
- $y = \ln x \Rightarrow \frac{dy}{dx} = \frac{1}{x}$
- $y = e^x \Rightarrow \frac{dy}{dx} = e^x$
- $y = e^{g(x)} \Rightarrow \frac{dy}{dx} = e^{g(x)}\left[\frac{dg(x)}{dx}\right]$

Integration

- For $n \neq -1$,

$$y = x^n \quad \Rightarrow \quad \int_a^b x^n \, dx = \frac{x^{n+1}}{n+1}\bigg|_a^b = \frac{b^{n+1} - a^{n+1}}{n+1}$$

- It can be shown

$$\frac{d}{dx}\frac{x^{n+1}}{n+1} = (n+1)\frac{x^n}{(n+1)} = x^n$$

Integration

- $\int_a^b e^x dx = e^x \Big|_a^b = e^b - e^a$

$$E.g. \quad \int_1^2 e^x dx = e^2 - e^1$$

- $\int_a^b e^{kx} dx = \frac{e^{kx}}{k} \Big|_a^b = \frac{e^{kb} - e^{ka}}{k}$

$$E.g. \quad \int_1^2 e^{5x} dx = \frac{e^{10} - e^5}{5}$$