

# Math 5346-01: Probability, Statistics, and Signal Processing Laboratory

**Professor:** Dr. Kathleen Gilliam

**Office:** Math 117B; 742-2580 (ext: 253)

**Email:** kathleen.gilliam@ttu.edu

**Office Hours:** MWF 9:50-10:50, 1:00-2:00, and by appointment

**Time/Location:** TTR, 11:00 -12:20, Math 113

**WEB Site:** <http://texas.math.ttu.edu/~kgilliam>

**Textbook:** “Elements of Engineering Probability & Statistics” by R. E. Ziemer

**Homework:** There will be 9 homework assignments for this semester consisting of Matlab exercises and basic theory of probability and statistics. The homework assignments will account for 35% of the grade.

**Daily Lab Assignment:** In each class period, we will discuss new Matlab commands and features and do some practices. Students will be asked to do lab exercises concerning these topics. The daily lab exercises will account for 15% of the grade.

**Test:** There will be one take-home midterm and a **Comprehensive** open book in-class final. Each of the tests will be worth 10%.

**Computer Project:** There will be three computer projects related to signal processing of wind and wind related data using Matlab programming. Each of the projects will be worth 10%.

**Grading Policies:** Grades will be assigned based on your overall course average:

90%-100%	A	80%-89.9%	B	70%-79.9%	C
60%-69.9%	D	59.9% and below	F		

**Lectures:** The schedule below indicates the topics to be covered in class.

CH1: Introduction to statistic and data analysis

1.1 Data classification: Deterministic Vs. Random Data

1.2 Statistical Measurements (min, max, mean, median, variance, sum, hist, plot, etc)

Application: wind time series

3 days

CH2: Fundamental concepts of probability

2.1 Sample space and events

2.2 Axioms of probability

2.3 Total probability and Bayes’ theorem

2.4 One random variables and probability distribution

(PDF, CDF, Uniform, Gaussian, Exponential, Gamma)

2.5 Two random variables and Joint density estimations, marginal distribution, independence

Application: data fit, pressure time series, simulation of random phenomena

6 days

CH3: Elementary statistics

3.1 Mean and variances of random variables

3.2 Extreme values analysis of pressure field

3.3 Linear regression

3.4 Estimation and confidence interval

3.5 Parametric and nonparametric hypothesis Application: wind profiler, test of independent	6 days
CH 4: Time series analysis	
4.1 Auto-and cross-covariance function	
4.2 Moving Average	
4.3 Filtering Techniques Application: gust factor, integral scale	5 days
CH5: Time series analysis in Frequency domain	
5.1 Basic Concept (amplitude, phases, Nyquist)	
5.2 PSD, FFT, IFFT	
5.3 Concept of Alaising, sampling techniques Application: PSD of wind and pressure, Intro to model such as FSU	5 days
CH6: Data simulation	
6.1 Generating wind time series from spectra model	
6.2 Generating time series from AR and ARMA modeling	2 days
CH7 Advanced signal processing in Wind Engineering System ID for wind-load modeling, Wavelet Analysis for wind time series POD of pressure field, Image processing of radar data	1 day

**Final Exam: Dec. 9, Friday, 4:30PM-7:00PM Room Math 113.**

**Disabled Students:** Please advice me of your condition and provide a letter of verification as soon as possible. I will make necessary accommodation.

**Student absence for Observance of Religious Holy Day:** Please advice me of your absence prior to the event and I will make necessary accommodation.

**Expected Learning Outcomes:** In this course, students will learn fundamental concepts of probability and elementary statistics such as probability distributions, linear regression, and parametric and nonparametric hypothesis testing. The students will also learn time-series analysis in both time domain and frequency domain. Special attention will be paid to signal processing techniques such as statistical data analysis, simulation of random phenomena, data fitting and filtering. A major component of this course will involve application of the theoretical techniques to real data. Matlab programming will also be introduced and used extensively in the course.