**DSCI 501: Math/Prog Foundations for DSCI**

**Course Syllabus**

Credits: 3-hour lecture [3 credits]

Winter 2021

Short Title: Math/Prog Foundations

**General Information**

*Course Coordinator(s): Dr. Bhupesh Shetty*

*Class Timing; Location: 6:30-09:20 PM; Blackboard ultra*

*Instructor Contact Information: bys24@drexel.edu*

*Office Hours; Location: 3-5 PM; Blackboard ultra*

# Student Learning Information

## Course Description

Linear algebra, calculus, probability and statistical methods are essential foundation areas required for an effective understanding and application of data science. In this course, students will get a gentle introduction to these important areas of quantitative reasoning. Along with introducing basics of linear algebra, calculus, probability, and statistical methods, this course will also introduce their computational application through the python programming language. Concepts will be demonstrated using various python packages.

*College/Department*: College of Computing & Informatics

*Repeat Status*: Not repeatable for credit

*Restrictions*: None

*Prerequisites*: None

## Course Purpose within a Program of Study

This course provides a strong introduction to quantitative foundations to students with little or no background in mathematics and statistics. This course will also provide instruction for the application of these foundations through the Python programming language.

## Statement of Expected Learning

The course objectives are to:

* obtain an overview of the linear algebra and calculus required for solving data science problems;
* understand probabilistic frameworks and different statistical methods applied in data science;
* learn hands-on Python programming techniques for quantitative applications; and
* develop skills for quantitative reasoning and computational tools to solve data science problems.

As learning outcomes, students completing this course should be able to use their understanding of data science quantitative foundations and their Python implementations to successfully complete courses in the MSDS curriculum.

# Course Materials

## Recommended Texts, Readings, and Resources

All text readings are supplemental to the course lecture notes and will be assigned on a weekly basis. The Python Data Science Handbook is available to Drexel students through the University Libraries. Specific text information is as follows:

* Data Science from Scratch (DSFS). ISBN: 978-1491901427, O’Riley Media, April 2015
* Python Data Science Handbook (PDSH). ISBN: 978-1491912058, O’Riley Media, November 2016
* The Data Science Handbook (TDSH). ISBN: 9781119092940, John Wiley & Sons, 2017

**Required and Supplemental Materials and Technologies**

Note: instructions and discussion of the following materials and technologies are provided in Chapter 0 of the course lecture notes. Students are expected to have the following by the start of the first week:

* A Github account: https://www.github.com
* A command line environment with Python (version 3) installed
* The Jupyter notebooks interactive development environment

## Lecture Notes

The course lecture notes are broken down into the following topics, which roughly correspond to a week of content each. More information on course scheduling can be found in that section, below.

Chapter 0: System configuration and numeracy

Chapter 1: Introduction to linear algebra

Chapter 2: Matrix operations, inversion, and eigen decompositions

Chapter 3: Functions, transformations, and limits

Chapter 4: Differential transformations and function optimization

Chapter 5: Integral transformations and function accumulation

Chapter 6: Counting and probabilistic fundamentals

Chapter 7: Introduction to statistics and descriptive summarization

Chapter 8: Statistical estimation and confidence evaluation

# Assignments, Assessments, and Evaluations

## Graded Assignments and Learning Activities

Homework: Three structured, individual assignments

Exams: One midterm and one final exam

## Grading Matrix

Students will not receive letter grades for individual assignments. Grades are calculated as:

Exams: 40% (15% Midterm, 25% Final)

Homework: 60% (4 x 15%)

Total: 100%

## Course Schedule

The schedule is tentative and is likely to vary somewhat based on knowledge of students in the class section. The table below shows the initial schedule for the term.

|  |  |  |
| --- | --- | --- |
| **Week** | **Topics** | **Tasks** |
| 0 | * Getting started with Jupyter Notebook and Python |  |
| 1 | * Introduction to Linear Algebra * Vectors, vector operations * Dot product, basis | HW 1 |
| 2 | * Matrix, Matrix operations, inversions * Transformation, LU Decomposition | Prog. HW 1 |
| 3 | * Orthogonality, Gram Schmidt rule * Eigen vectors and application | Prog. HW 2 |
| 4 | * Introduction to Calculus * Functions, Derivatives * Multivariate calculus | HW2 |
| 5 | * Gradient, Jacobian and Hessian * Applications * Taylor series and linearization | Prog. HW3 |
| 6 | * Exam week | Exam 1 |
| 7 | * Counting * Probabilistic foundation | HW 3 |
| 8 | * Conditional probability * Applications: Naïve Bayes’ | Prog. HW4 |
| 9 | * Discrete and Continuous random variables * Central limit theorem, confidence interval, hypothesis testing * P-values |  |
| 10 | Final exam week | Final exam |

All work is graded on a numeric scale of 0 to 100.

## Grade Scale

The following scale will be used to convert points to letter grades:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *Points* | *Grade* | *Points* | *Grade* | *Points* | *Grade* |
| 97-100 | A+ | 82-86.99 | B | 70-71.99 | C- |
| 92-96.99 | A | 80-81.99 | B- | 67-69.99 | D+ |
| 90-91.99 | A- | 77-79.99 | C+ | 60-66.99 | D |
| 87-89.99 | B+ | 72-76.99 | C | 0-59.99 | F |

Note that the instructor may revise this conversion if/when necessary.

**Academic Policies**

This course follows university, college, and department policies, including but not limited to:

* Academic Integrity, Plagiarism, Dishonesty and Cheating Policy:  <https://drexel.edu/provost/policies/academic-integrity/>
* Students with Disability Statement:  https://drexel.edu/disability-resources/support-accommodations/student-family-resources/
* Course Add/Drop Policy: <https://drexel.edu/provost/policies/course-add-drop/>
* Course Withdrawal Policy: http://drexel.edu/provost/policies/course-withdrawal

The instructor(s) may, at his/her/their discretion, change any part of the course before or during the term, including assignments, grade breakdowns, due dates, and schedule. Such changes will be communicated to students via the course web site. This web site should be checked regularly and frequently for such changes and announcements.

Students [requesting accommodations](http://drexel.edu/oed/disabilityResources/students/) due to a disability at Drexel University need to request a current Accommodations Verification Letter (AVL) in the [ClockWork database](http://accommodate.drexel.edu/ClockWork/) before accommodations can be made. These requests are received by Disability Resources (DR), who then issues the AVL to the appropriate contacts. For additional information, visit the DR website at [drexel.edu/oed/disabilityResources/overview/](http://drexel.edu/oed/disabilityResources/overview/), or contact DR for more information by phone at 215.895.1401, or by email at [disability@drexel.edu](mailto:disability@drexel.edu).