1. Course Information:

Course : EMSE 4765.10/6765.80 – Data Analysis for Scientists and Engineers
Semester : Spring 2025 # of Credit Hours: 3.0
Meeting Time : Tuesdays from 12:45PM to 3:15PM
Location : Tompkins 405 (In person)

2. Instructor and Contact Information:

Name : J. René van Dorp, Professor
Campus Address : 800 22nd Street, Office 2800, Washington DC 20052
Phone : 202-994-6638
E-mail : dorpjr@gmail.com
Office hours : Mondays 1:00PM to 4:00PM

3. Course Description:

Inference methods in a single dimension: estimation, confidence intervals, hypothesis testing and goodness-of-fit testing; multivariate data analysis techniques using matrices and vectors: the Hotelling T-squared test, multiple linear regression, one way ANOVA, two-way ANOVA and 2^K ANOVA.

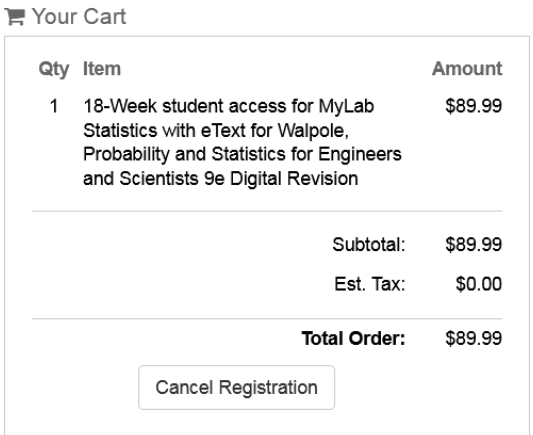
4. Prerequisite Requirement:

APSC 3115: Engineering Analysis III (or any other undergraduate Applied Statistics course from a physical or natural sciences program).
http://www.seas.gwu.edu/~dorpjr/APSC3115/Intro.html

5. Required online Textbook Subscription:

Probability and Statistics for Engineers and Scientists, 9th Edition, with MyLabs subscription, Walpole, Myers, Myers and Ye, Pearson Publishing, 2017. Registration instructions can be found here.

Select the following option when registering:



6. Optional Textbooks (e-books available for free using Springer-Link):

- "A Modern Introduction to Probability and Statistics, Understanding Why and How" by F.M. Dekking, C. Kraaikamp, H.P. Lopuhaä and L.E. Meester, Springer-Verlag, 2005.
- "Modern Mathematical Statistics with Applications", by by Devore, Jay L., Berk, Kenneth N., 2nd ed. 2012.

7. Remote Access to SEAS Computer Labs: Minitab available in Tomkins 405 and 406

https://seascf.seas.gwu.edu/remote-access-labs

8. Required Software:

MS EXCEL – Available remotely in Tompkins 405 & 406.

MINITAB – Available remotely in Tompkins 405 & 406. Six months or twelve months rental of the MINITAB Software is available for students at a discounted rate at:

http://www.onthehub.com/minitab/

9. Recommended Software:
Recommended Software: R and R Studio: Students will be introduced to the open source R statistical software environment.

10. Learning Outcomes
As a result of completing this course, students will be able to:

- **a.** Perform univariate statistical inference techniques involving confidence intervals, hypothesis test, distribution fitting and goodness-of-fit testing. Students will learn to perform these inference techniques in MS EXCEL.
- **b.** Perform multivariate statistical inference techniques involving estimation of the sample mean vector, the sample variance covariance matrix and use these to perform the Hotelling T^2 hypothesis test on a single multivariate sample and two multivariate samples. Students will learn to perform these inference techniques in MS EXCEL.
- **c.** Perform regression analysis involving multiple explanatory variables using matrix algebra in MS EXCEL. Student will learn to perform and interpret regression analysis results using the software MINITAB
- **d.** Perform One-Way and Two-Way ANOVA using the software MINITAB.

11. Attendance
Regular class attendance is strongly encouraged. You will be held responsible for all the class discussions as well as the reading assignments. Here is the university policy:
https://registrar.gwu.edu/university-policies#attendance

12. Independent Learning

In a 15-week semester, including exam week, students are expected to spend a minimum of 100 minutes of out-of-class work for every 50 minutes of direct instruction, for a minimum total of 2.5 hours a week. A 3-credit course should include 2.5 hours of direct instruction and a minimum of 5 hours of independent learning or a total minimum of 7.5 hours per week. More information about GW's credit hour policy can be found at: https://provost.gwu.edu/policies-procedures-and-guidelines and click on Assignments of Credit Hour Policy (PDF), Or see the PDF pages (webpage); https://provost.gwu.edu/files/downloads/Resources/Assignment-of-Credit-Hours_Final_Oct-2016.pdf

13. Method of Instruction:

One hour and 20 minutes lecture including homework discussion (time permitting), followed by a 10 minute break and a one hour lecture. Microsoft Excel and Minitab are used to perform statistical analysis during the class sessions and the homework. During class sessions the only software programs that should be open on your desktop are either Adobe Acrobat (for viewing the notes) or Microsoft Excel or MINITAB for statistical analysis. **Reading assignments will have to be completed before class. Homework will have to be completed and handed-in accordance to the outline schedule one class after it was assigned and before the class starts.** During the class sessions (except for the break of course) **a student is not to check his e-mail, the internet and should not engage in instant messaging sessions. Basically, your attention should be directed towards the class material.**

14. Homework Grading Policy:

Homework will have to be completed as per the outline of the course. A minimum of five of the homework sets are assigned in Pearson's Mylabs and are to be completed by the students online as per the class schedule. **Not registering on time for the Pearson's Mylabs instruction website results in not being able to complete the homework and therefor zero points for the homework completion.** Some homework problems will have to be completed prior to the next class for discussion **and uploaded through Blackboard**. **Homework assignments passed the due date will not receive any credit.**

15. Midterm Exam and Final Reports:

Students will complete an **in-class Midterm Exam using Microsoft Excel + MINITAB** (using a lab computer or the student's laptop). Theoretical questions will be answered in an exam booklet. The MS EXCEL file, the MINITAB file and the exam booklet will be part of the grading of the midterm exam. Two multivariate datasets will be provided to the students for **data analysis research**. Students will be required to perform multivariate data analyses using those datasets and **write a final report for each dataset detailing their analysis steps, final analysis results and analysis conclusions**. **Students are required to submit the electronic files associated with the final reports through**

blackboard as well as **an electronic copy of the final report** that will be graded.
Students are required to work on their own to perform the multivariate analysis using those multivariate data sets and write the final report on their own.

16. Grading:
10% - Class Attendance
20% - Homework
30% - Midterm Exam (In-Class)
40% - Multivariate Data Analyses + Final Reports

17. Homework Set and Reading Assignments:
Homework sets, Lecture notes and recommended chapters for reading will be assigned prior to class as indicated in the outline below.

Class Schedule is Subject to change, please check the schedule regularly

	Session	Date	Day of Week	Reading Assignments	Topics	Homework Assigned
Part 1: Prob. and Stats. Reviw	1	14-Jan	Tuesday	Ch. 1, 2, 3	Why Prob. And Stats?, Probability Calculus Review	Homework Set 1
	1	14-Jan	Tuesday	Ch. 4, 5	Discr. and Cont. Distributions Review	36 Points
	2	21-Jan	Tuesday	Ch. 7, 10	Expectation, Variance and Covariance Review	Homework Set 2
	2	21-Jan	Tuesday	Ch. 15 , 16	Exploratory data analysis: Graphical + Numerical Summaries Review	23 Points
	3	28-Jan	Tuesday	Ch. 17	Basic Statistical Models Review	Homework Set 3
	3	28-Jan	Tuesday	Ch. 23	Confidence intervals for the mean: Essentials Review	20 Points
Part 2: Statistical Inference	4	4-Feb	Tuesday	LN S4	Estimator distributions, Confidence Intervals for mean and Variance	Homework Set 4
	4	4-Feb	Tuesday	LN S4	Hypothesis Testing, Type I Error and Type II Erros	15 Points
	5	11-Feb	Tuesday	LN S5	Goodness-of-Fit, Method-of-Moments, Maximum Likelihood	Homework Set 5
	5	11-Feb	Tuesday	LN S5	Credibility Intervals, Two Sample Hypothesis Testing	20 Points
Part 3: Multivariate Estimation	6	18-Feb	Tuesday	LN S6	Joint Normal Distribution, Vectors and Matrices, Matrix Algebra, Linear Combinations,	Homework Set 6
	6	18-Feb	Tuesday	Ch. 2	Coordinate Systems, Geometric Interpretation, Joint Normal Distribution, Multivariate Point Estimation	26 Points
	7	25-Feb	Tuesday	LN S7	Single Sample Hotelling's T^2 Test	Homework Set 7
	7	25-Feb	Tuesday		Two Sample Multivariate Hotelling's T^2 Test	32 Points
Midterm Examination	8	28-Feb	Friday		Discuss Solution Practice Exam, Homework Set 7	Practice Exam
	8	28-Feb	Friday			Not for credit
	9	**4-Mar**	**Tuesday**		**MIDTERM EXAM - PART 1, PART 2 and PART 3**	
	9	**4-Mar**	**Tuesday**		**MIDTERM EXAM - PART 1, PART 2 and PART 3**	
		11-Mar	**Tuesday**		**Spring Break**	
		11-Mar	**Tuesday**		**Spring Break**	
Part 4: Regression Analysis	10	18-Mar	Tuesday	LN S9, Ch. 3	Simple Linear Regression, Model Testing, Parameter Inference	Homework Set 8
	10	18-Mar	Tuesday			12 Points
	11	25-Mar	Tuesday	LN S11, Ch. 3	Multiple Regression, Residual Diagnostics	Homework Set 9 12 Points
	11	25-Mar	Tuesday			**REGRESSION DATA SET AVAILABLE**
	12	1-Apr	Tuesday	LN S12, Ch. 3	Outlier Detection, Comparing Imbedded Models	
	12	1-Apr	Tuesday		Forecasting	
Part 5: Principle Component Analysis	13	8-Apr	Tuesday	LN S13	One-Way Analysis of Variance (ANOVA)	Homework Set 10
	13	8-Apr	Tuesday			25 Points
	14	15-Apr	Tuesday	LN S14	Two-Way ANOVA, 2K ANOVA	
	14	15-Apr	Tuesday			**ANOVA DATA SET AVAILABLE**
	15	**29-Apr**	**Tuesday**		**FINAL REPORT PART 4 DUE ON April 29th, 2025**	
	15	**6-May**	**Tuesday**		**FINAL REPORT PART 5 DUE ON MAY 6th, 2025**	

University policies

Academic Integrity Code

Academic integrity is an essential part of the educational process, and all members of the GW community take these matters very seriously. As the instructor of record for this course, my role is to provide clear expectations and uphold them in all assessments. Violations of academic integrity occur when students fail to cite research sources properly, engage in unauthorized collaboration, falsify data, and otherwise violate the Code of Academic Integrity. If you have any questions about whether or not particular academic practices or resources are permitted, you should ask me for clarification. If you are reported for an academic integrity violation, you should contact Student Rights and Responsibilities (SRR) to learn more about your rights and options in the process. Consequences can range from failure of assignment to expulsion from the University and may include a transcript notation. For more information, please refer to the SRR website at studentconduct.gwu.edu/academic-integrity, email rights@gwu.edu, or call 202-994-6757.

University policy on observance of religious holidays

Students must notify faculty during the first week of the semester in which they are enrolled in the course, or as early as possible, but no later than three weeks prior to the absence, of their intention to be absent from class on their day(s) of religious observance. If the holiday falls within the first three weeks of class, the student must inform faculty in the first week of the semester. For details and policy, see "Religious Holidays" at provost.gwu.edu/policies-procedures-and-guidelines.

Use of Electronic Course Materials and Class Recordings

Students are encouraged to use electronic course materials, including recorded class sessions, for private personal use in connection with their academic program of study. Electronic course materials and recorded class sessions should not be shared or used for non-course related purposes unless express permission has been granted by the instructor. **Students who impermissibly share any electronic course materials are subject to discipline under the Student Code of Conduct.** Please contact the instructor if you have questions regarding what constitutes permissible or impermissible use of electronic course materials and/or recorded class sessions. Please contact Disability Support Services at disabilitysupport.gwu.edu if you have questions or need assistance in accessing electronic course materials.

Academic support

Writing Center

GW's Writing Center cultivates confident writers in the University community by facilitating collaborative, critical, and inclusive conversations at all stages of the writing process. Working alongside peer mentors, writers develop strategies to write independently in academic and public settings. Appointments can be booked online at gwu.mywconline.

Academic Commons

Academic Commons provides tutoring and other academic support resources to students in many courses. Students can schedule virtual one-on-one appointments or attend virtual drop-in sessions. Students may schedule an appointment, review the tutoring schedule, access other academic support resources, or obtain assistance at academiccommons.gwu.edu.

Support for students outside the classroom

Disability Support Services (DSS) 202-994-8250

Any student who may need an accommodation based on the potential impact of a disability should contact Disability Support Services at disabilitysupport.gwu.edu to establish eligibility and to coordinate reasonable accommodations.

Counseling and Psychological Services 202-994-5300

GW's Colonial Health Center offers counseling and psychological services, supporting mental health and personal development by collaborating directly with students to overcome challenges and difficulties that may interfere with academic, emotional, and personal success. healthcenter.gwu.edu/counseling-and-psychological-services.

Safety and Security

- Monitor GW Alerts and Campus Advisories to Stay Informed before and during an emergency event or situation
- In an emergency: call GWPD/EMeRG 202-994-6111 or 911
- For situation-specific actions: refer to GW's Emergency Response Handbook and Emergency Operations Plan
- In the event of an armed Intruder: Run. Hide. Fight.