

### 1. Course Information:

Course : 6765.80 – Data Analysis for Scientists and Engineers  
Semester : Fall 2023 # of Credit Hours: 3.0  
Meeting Time : Thursday from 6:10PM to 8:40PM  
Location : Tompkins 405 (In person)

### 2. Instructor and Contact Information:

Name : J. René van Dorp, Professor  
Campus Address : 800 22<sup>nd</sup> Street, Office 2800, Washington DC 20052  
Phone : 202-994-6638  
E-mail : [dorpjr@gmail.com](mailto:dorpjr@gmail.com)  
Office hours : Wednesdays 1:00PM to 4:00PM- by appointment via link on [my faculty-page](#).

### 3. Course Description:

Univariate Inference: Confidence intervals, hypothesis and goodness-of-fit testing;  
Multivariate inference methods: the Hotelling T-squared test, multiple linear regression,  
principle component analysis, one way ANOVA, two-way ANOVA and 2<sup>K</sup> 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. 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 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 principal component analysis by evaluating the eigenvectors and eigenvalues of the sample correlations matrix and use these to evaluate principle component loadings and variances. Students will learn to perform and interpret principal component analysis results using the software MINITAB and MS EXCEL.
- e. Perform One-Way and Two-Way Analysis of Variance (ANOVA). Students will learn to perform and interpret principal component analysis results using the software MINITAB and MS EXCEL.

## 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 includes 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](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 in accordance to the outline schedule.** 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 prior to the next class for discussion. The homework will not be graded, but is assigned to enhance your understanding of course materials and prepare yourself for the exams. Electronic solutions of the homework will be provided.

### 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:

15% - Class Attendance and Participation

40% - Midterm Exam (In-Class)

45% - Final Project Reports (one due on 12/7/2023 and one on 12/15/2023)

### 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**

	Week	Date	Reading Assignments	Topics	Homework Assigned
Part 1: Statistical Review	1	08/24/23	CH. 15 , CH. 16	Exploratory data analysis: Graphical + Numerical Summaries	Homework Set 1
	1	08/24/23	CH. 17	Basic Statistical Models	
	2	08/31/23	CH. 19, CH. 20	Unbiased estimators, Efficiency and MSE	Homework Set 2
	2	08/31/23	CH. 23	Confidence intervals for the mean: Essentials	
Part 2: Statistical Inference	3	09/07/23	LN S3	Estimator distribution, Confidence Intervals for mean and Variance	Homework Set 3
	3	09/07/23	LN S3	Hypothesis Testing, MLE, MOM	
	4	09/14/23	LN S4	Goodness-of-Fit, Credibility Intervals	Homework Set 4
	4	09/14/23	LN S4	Two Sample Hypothesis Testing, Joint Normal Distribution	
Part 3: Hotelling	5	09/21/23	LN S5	Vectors and Matrices, Matrix Algebra, Linear Combinations,	Homework Set 5
	5	09/21/23	LN S5	Coordinate Systems, Geometric Interpretation	
	6	09/28/23	LN S6	Joint Normal Distribution, Multivariate Point Estimation	Homework Set 6
	6	09/28/23	LN S6	Generalized Variance, Hotelling's $T^2$ Test	Practice Exam
Midterm Review	7	10/05/23		Discuss Solution HW Set 6	
	7	10/05/23		Discuss Solution Practice Exam	
		10/12/23		FALL BREAK	
		10/12/23		FALL BREAK	
	8	10/19/23		EXAM - PART 1, PART 2 and PART 3	
	8	10/19/23		EXAM - PART 1, PART 2 and PART 3	
Part 5: Regression	9	10/26/23	LN S9	Simple Linear Regression, Model Testing, Parameter Inference, Multiple Regression	Homework Set 7
	9	10/26/23	LN S9	Discuss Solution Midterm Exam	
	10	11/02/23	LN S10	Residual Diagnostics, Outlier Detection	
	10	11/02/23	LN S10	Comparing Imbedded Models, Forecasting	
Part 6: PCA	11	11/09/23	LN S11	Principal Component Analysis (PCA), Introduction, How it works	Homework Set 8
	11	11/09/23	LN S11		
	12	11/16/23	LN S12	Principal Component Analysis (PCA) Case Study	
	12	11/16/23	LN S12		
		11/23/23		THANKS GIVING BREAK	
		11/23/23		THANKS GIVING BREAK	
Part 7: ANOVA	13	11/30/23	LN S13	One-Way Analysis of Variance (ANOVA)	Homework Set 9
	13	11/30/23	LN S13		
	14	12/07/23	LN S14	Two-Way ANOVA, 2K ANOVA	
	14	12/07/23	LN S14	FINAL PROJECT REPORT PART 5 DUE	
	15	12/14/23			
	15	12/14/23		FINAL PROJECT REPORT PART 6 DUE	

# University policies

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## 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](http://studentconduct.gwu.edu/academic-integrity), email [rights@gwu.edu](mailto: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](http://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](http://disabilitysupport.gwu.edu) if you have questions or need assistance in accessing electronic course materials.

# Academic support

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## 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](http://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](http://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](http://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](http://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.