

**UNIVERSITY OF NORTHERN BRITISH COLUMBIA
COLLEGE OF SCIENCE AND MANAGEMENT
STAT 475-3 Methods for Multivariate Data
2021 January Semester**

Professor: Dr. Kevin J. Keen, P.Stat. **Office:** 10-2524 **Tel:** (250) 960-5014 **email:** Kevin.Keen@unbc.ca

Student Hours:

Mon & Fri 15h30 – 16h30, Tue 14h30 – 15h30 & 19h30 – 20h30, or by appointment.

Class: Tue 11h30 – 14h20

Room: online

Syllabus: This course discusses practical techniques for the analysis of multivariate data. Topics covered include estimation and hypothesis testing for multivariate means and variances; partial, multiple and canonical correlations; principal components analysis and factor analysis for data reduction; multivariate analysis of variance; discriminant analysis; and cluster analysis.

Prerequisites: One of MATH 150-3 or MATH 220-3, and one of MATH 471-3 or STAT 471-3

Precluded: MATH 475-3, MATH 499-3 Applied Multivariate Analysis

Texts: *Methods of Multivariate Statistics* by M. S. Srivastava. Wiley. ISBN: 0-471-22381-6

Computing: Students will be required to use the statistical analysis systems **R/Rcmdr** and **SAS®**. Students additionally have the option to use either the **Windows®**, **Unix** or **Macintosh®** operating systems for **R/Rcmdr**. Due to licensing restrictions, **SAS®** is only available for **Windows®** via the Student Lab on VMware.

Objectives: To learn about the methodology of multivariate statistics and to apply this methodology in the analysis of social survey data, public health data, genetic sequence data, environmental data, business data, imaging data, or other complex data of interest to the student and chosen in consultation with the instructor.

Learning Commons:

Check your Blackboard course list on <https://learn.unbc.ca> or in the student portal at <https://my.unbc.ca> for a link to the **Learning Commons**. The UNBC virtual learning commons is a “one stop shop” for student supports and collaborative online spaces, including Academic Success Centre tutoring, Student Technology Troubleshooters, the online forms of MACE and Nucleus, other drop-in services like Resume and Career help, as well as links to services such as the Library Research Desk and the Academic Advisors. Also keep an eye on the Learning Commons for links to events and workshops!

Disabilities: The Access Resource Centre (ARC) provides service to students with documented disabilities or health conditions, ranging from permanent to temporary, including but not limited to mental health disabilities, learning disabilities and attention deficit disorders, chronic health issues, brain injury, hearing and visual impairments, mobility and other physical disabilities. ARC staff are available by appointment to assess specific needs, provide referrals, and arrange appropriate accommodations to assist students in achieving their academic goals. Students who may have a need for special accommodation are encouraged to contact ARC by email at arc@unbc.ca or by phone 250-960-5682. For more information, please visit unbc.ca/arc.

Student Misconduct, Plagiarism, Cheating, and Conduct in Examinations:

Please read the Undergraduate Regulations and Policies in the *2020-2021 Undergraduate Calendar*.

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2021 January Semester

Evaluation:

Tri-Council Human Ethics Policy Tutorial	5%
Assignments	25%
Final Project Proposal (oral presentation)	10%
Final Project Proposal (written proposal)	10%
Final Project (oral presentation)	10%
Final Project (written report)	40%
	<hr/>
	100%

Grades:

A+ ... 90 – 100%	B+ ... 77 – 79.9%	C+ ... 67 – 69.9%	D+ ... 57 – 59.9%
A ... 85 – 89.9%	B ... 73 – 76.9%	C ... 63 – 66.9%	D ... 53 – 56.9%
A- ... 80 – 84.9%	B- ... 70 – 72.9%	C- ... 60 – 62.9%	D- ... 50 – 52.9%
			F ... 0 – 49.9%

Please check the last day to add/drop January semester courses without financial penalty and the last day to change January semester courses from audit to credit and from credit to audit. Also check the last day to withdraw with a 50% tuition refund and without academic penalty.

Tri-Council Human Ethics Policy Tutorial:

Because it is anticipated that students will be analyzing data obtained from human participants in clinical trials or observational studies, all students are required to complete the online Tri-Council Human Ethics Policy (TCPS) 2 Tutorial Course on Research Ethics (CORE) and supply proof of successful completion. This requirement is regardless of whether the data used in the course is available to the public and downloadable over the internet from government agencies or from collections of previously published data held at postsecondary institutions or government agencies.

Assignments:

1. Students have the opportunity to optionally work on assignments in small groups to develop proficiency with the chosen software packages in a collaborative setting with fellow students and the instructor.
2. In consultation with the instructor, groups of students can choose data to be analyzed in the assignments where possible. The same data can be analyzed in different assignments.
3. Students are encouraged to work together during the computer laboratory sessions during course time.
4. Unless instructions are otherwise, you are expected to hand in individual assignments. If you have worked out the solutions with other students, you must write it up on your own and acknowledge all sources, inclusive of other students, instructors, and UNBC staff, to avoid plagiarism. If using the internet; provide the full webpage reference. If using another book; cite page numbers used. Please note that rules for homework may be different in your other courses.
5. Except for medical or compassionate reasons, late assignments will receive a mark of zero. The final mark for assignments will be based solely on assignments for which marks are recorded and will not include missed assignments that are excused for medical or compassionate reasons.

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Final Project Proposal Oral Presentation and Written Report:

1. The purpose of the oral presentation is to give students the opportunity to develop and exercise oral presentation skills in a formal scientific setting.
2. The oral presentation is to be of 10 minutes duration followed by a 5-minute question period from the audience.
3. Students can prepare a traditional “chalk and talk” lecture using an online whiteboard or develop a LaTeX or Powerpoint® presentation: the choice is theirs.
4. The final project is to be chosen by students in consultation with the instructor.
5. Students are required to plan for a one-hour meeting with the instructor at least 7 days in advance of the oral presentation to discuss their final project. The meeting may not necessarily require a full hour.
6. The written proposal is due the day of the oral presentations on Tuesday 2 March 2021.
7. The written proposal will discuss the final project, the software chosen for the analysis, any data sets to be analyzed and their limitations, the justification for methodological approach, and a consideration of possible obstacles and difficulties anticipated.
8. Except for medical or compassionate reasons, a missed oral presentation will receive a mark of zero.
9. Except for medical or compassionate reasons, a late written report will receive a mark of zero.

Final Project Oral Presentation and Written Report:

1. The final project is to involve the application of multivariate methods to analyze data or the development of a novel multivariate method.
2. Note: any computer software developed by a student for evaluation in the course is the property of the student according to UNBC intellectual property regulations.
3. The choice of final project is to be determined in consultation with the instructor.
4. Stipulations for the written report of the final project are as follows.
 - a) The written portion of the final project is worth 40% of the final grade.
 - b) The report is to be submitted at the end of the last class Tuesday 13 April 2021.
 - c) Except for medical or compassionate reasons which must be documented, written reports submitted late will receive a mark of zero.
5. Stipulations for oral presentation of the final project are as follows.
 - a) The oral presentation is worth 10% of the final grade.
 - b) Oral presentations will be during the last class on Tuesday 13 April 2021.
 - c) The time period for the oral presentation will be randomly assigned at the start of the last class.
 - d) The duration of the presentation is to be 20 minutes followed by a 5-minute question period from the audience.
 - e) The presentation is to be done by prepared overhead transparencies or a Powerpoint® presentation.
 - f) Except for medical or compassionate reasons which must be documented, missed oral presentations will receive a mark of zero.

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Tentative list of topics and activities: (Will be adjusted as necessary.)

Week	Format	Classes	Topics
1	Lecture/Laboratory	Tue 12 Jan	Discussion of course organization. Begin online tutorial on the Tri-Council Policy Statement: Ethical Conduct For Research involving Humans Review of Vectors and Matrices (Appendix A)
2	Lecture/Laboratory	Tue 19 Jan	Chapter 2 Multivariate Normal Distributions Chapter 3 Outliers Detection and Normality Check Chapter 4 Inference on Location—Hotelling's T^2
3	Lecture/Laboratory	Tue 26 Jan	Chapter 4 cont'd Chapter 6 Multivariate Analysis of Variance Assignment 1 Due
4	Lecture/Laboratory	Tue 2 Feb	Chapter 8 Classification and Discrimination Assignment 2 Due
5	Lecture/Laboratory	Tue 9 Feb	Chapter 11 Principal Component Analysis Assignment 3 Due
	No Classes	15 – 19 Feb	Mid-Semester Break
6	Lecture/Laboratory	Tue 23 Feb	Chapter 12 Factor Analysis
7	Presentations Lecture/Laboratory	Tue 2 Mar	Final Project Proposal Oral Presentations Cluster Analysis (Instructor's notes)
8	Lecture/Laboratory	Tue 9 Mar	Chapter 13 Inference on Covariance Matrices Assignment 4 Due
9	Lecture/Laboratory	Tue 16 Mar	Chapter 14 Correlations
10	Laboratory	Tue 23 Mar	Instructor-supervised final project computer laboratory Assignment 5 Due
11	Laboratory	Tue 30 Mar	Instructor-supervised final project computer laboratory
12	Laboratory	Tue 6 Apr	Instructor-supervised final project computer laboratory
13	Presentations	Tue 13 Apr	Final Project Oral Presentations

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Precluded: MATH 475-3, MATH 499-3 Applied Multivariate Analysis, MATH 675-5, STAT 475-3

Texts: *Methods of Multivariate Statistics* by M. S. Srivastava. Wiley. ISBN: 0-471-22381-6

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Final Project Proposal (written proposal)	10%
Final Project (oral presentation)	10%
Final Project (written report)	25%
Final Exam (response to critique)	15%
	100%

Grades:

A+ ... 90 – 100%	B+ ... 77 – 79.9%	F ... 0 – 69.9%
A ... 85 – 89.9%	B ... 73 – 76.9%	
A- ... 80 – 84.9%	B- ... 70 – 72.9%	

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14. Students are required to plan for a one-hour meeting with the instructor at least 7 days in advance of the oral presentation to discuss their final project. The meeting may not necessarily require a full hour.
15. The written proposal is due the day of the oral presentations on Tuesday 2 Mar 2021.
16. The written proposal will discuss the final project, the software chosen for the analysis, any data sets to be analyzed and their limitations, the justification for methodological approach, and a consideration of possible obstacles and difficulties anticipated.
17. Except for medical or compassionate reasons, a missed oral presentation will receive a mark of zero.
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8. The choice of final project is to be determined in consultation with the instructor.
9. Stipulations for the written report of the final project are as follows.
 - a) The written portion of the final project is worth 25% of the final grade.
 - b) The report is to be submitted at the end of the last class Tuesday 4 April 2017.
 - c) Except for medical or compassionate reasons which must be documented, written reports submitted late will receive a mark of zero.
10. Stipulations for oral presentation of the final project are as follows.
 - a) The oral presentation is worth 10% of the final grade.
 - b) Oral presentations will be during the last class on Tuesday 4 April 2017.
 - c) The time period for the oral presentation will be randomly assigned at the start of the last class.
 - d) The duration of the presentation is to be 20 minutes followed by a 5-minute question period from the audience.
 - e) The presentation is to be done by prepared overhead transparencies or a Powerpoint® presentation.
 - f) Except for medical or compassionate reasons which must be documented, a missed oral presentation will receive a mark of zero.

Final Examination:

1. The final examination is based upon the student’s final project. The format is open book with access to any computer resources that the student might require to respond to critical review and questions similar in nature to those that an author might receive from reviewers of a manuscript submitted to journal for publication.
2. The duration of the final examination is 3 hours and it will be scheduled by the Office of the Registrar.

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