

EPY 733
Multivariate Statistics

Course Description

This course covers advanced-level multivariate statistical methods, including an overview of the general linear model, assumptions of multivariate statistical procedures, MANOVA and MANCOVA, discriminant function analysis, canonical correlation analysis, cluster analysis, and principal components analysis. The focus of this course will be on conceptual understanding and computer applications, with an introduction to the mathematical underpinnings of the procedures examined.

Course Objectives

The present course aims to address the following knowledge, skills, and dispositions:

By the end of this course, students will have an understanding of

Knowledge and Learning Objectives

- the rationale underlying the use of multivariate statistical procedures;
- the links between univariate and multivariate statistical procedures, underpinned by the general linear model;
- data structures appropriate for multivariate statistical analysis;
- the relationships among multivariate statistical procedures;
- the importance of and procedures for data screening and testing assumptions of multivariate statistical procedures;
- the rationale and procedures for MANOVA;
- the rationale and procedures for cluster analysis;
- the rationale and procedures for discriminant function analysis;
- the rationale and procedures for canonical correlation analysis;
- the rationale and procedures for principal components analysis.

Skills

By the end of this course, students will have the ability to

- screen data and test for assumptions underlying a variety of multivariate statistical procedures
- conduct multivariate statistical procedures, including
 - MANOVA;
 - cluster analysis;
 - discriminant function analysis;
 - canonical correlational analysis;
 - principal components analysis;
- Use computer software for the conduct of these analyses;

- Interpret statistical output and write-up results in line with APA 6th guidelines on the reporting of statistical data; and
- Critique of statistical procedures in the context of substantive research problems.

Dispositions

By the end of this course, it is anticipated that students will have developed

- increased interest in using advanced statistical techniques to answer substantive problems in educational psychology and cognate disciplines;
- The recognition that multivariate statistical procedures allow researchers to better statistically represent the complexity of real-world phenomena;
- enhanced motivation in conducting research that draws on multivariate statistical procedures; and
- Interest in pursuing further studies of advanced quantitative methods, including latent variable and multi-level modeling methodologies.

Materials

Required Materials

Text

Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics* (6th ed). Boston, MA: Pearson.

Software

At a minimum, you will need SPSS to complete all assignments in the course. Furthermore, as there will be a strong computer application focus in our classes, you are strongly encouraged to bring a laptop with SPSS loaded on your machine to get the “hands on” experience that is oftentimes helpful in mastering the statistical procedures covered. You can purchase the student version of SPSS for a reasonable price at various online vendors, such as Hearne Software and Student Discounts. The “IBM SPSS Statistics 24” “Premium Grad Pack” is sufficient for this class. Please note that the suggested vendors are just a few of many options, and you may wish to shop around to see if you can find a better price.

If you wish not to purchase SPSS, it is available in most open computer labs at UNLV including the Graduate Student lounge in the library and CEB-B 131. Before traveling to UNLV to access SPSS, check the following UNLV website to ensure lab availability: <http://oit.unlv.edu/labs-classrooms>. However, you should note the only the **Standard**, as opposed to the premium, SPSS package is available in the university labs. The standard package has reduced functionality relative to the premium option (e.g., the missing value analysis module is absent), which will limit your capacity to perform some analyses.

Supplementary Materials

- Cumming, G. (2012). *Understanding the new statistics: Effect sizes, confidence intervals, and meta-analysis*. New York, NY: Taylor and Francis.
- Field, A. (2013). *Discovering statistics using IBM SPSS statistics (4th Ed)*. Thousand Oaks, CA: Sage.
- Hair, J. F. Jr., Black, W. C., Babin, B. J., Anderson, R. E. (2010). *Multivariate data analysis (7th ed)*. UpperSaddle River, NJ: Prentice Hall.
- Johnson, R. A., & Wichern, D. W. (2012). *Applied multivariate statistical analysis (6th ed)*. Englewood Cliffs, NJ: Prentice Hall.
- Rencher, A. C., & Christensen, W. F. (2012). *Methods of multivariate analysis*. Hoboken, NJ: Wiley.
- Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. New York: Houghton Mifflin.
- Warner, R. M. (2013). *Applied statistics from bivariate through multivariate techniques (2nd ed)*. Thousand Oaks, CA: Sage.

Optional Journal Readings

- Alexander, E. S., & Onwuegbuzie, A. J. (2007). Academic procrastination and the role of hope as a coping strategy. *Personality and Individual Differences, 42*(7), 1301-1310. doi: 10.1016/j.paid.2006.10.008
- Breckenridge, J. N. (2000). Validating cluster analysis: Consistent replication and symmetry. *Multivariate Behavioral Research, 35*, 261-285. doi: http://dx.doi.org/10.1207/S15327906MBR3502_5
- Bird, K. D., & Hadzi-Pavlovic, D. (1983). Simultaneous test procedures and the choice of a test statistic in MANOVA. *Psychological Bulletin, 93*, 167– 178. Doi: <http://dx.doi.org/10.1037/0033-2909.93.1.167>
- Borgen, F. H., & Barnett, D. C. (1987). Applying cluster analysis in counseling psychology research. *Journal of Counseling Psychology, 34*(4), 456-468. doi: <http://dx.doi.org/10.1037/0022-0167.34.4.456>
- Meyers, Lawrence S.; Gamst, Glenn C.; Guarino, Anthony J.. *Applied Multivariate Research: Design and Interpretation* (p. 245). SAGE Publications. Kindle Edition.
- Clatworthy, J., Buick, D., Hankins, M., Weinman, J., & Horne, R. (2005). The use and reporting of cluster analysis in health psychology: A review. *British journal of Health Psychology, 10*(3), 329-358. doi: 10.1348/135910705X25697

- Cole, D. A., Maxwell, S. E., Avery, R., & Salas, E. (1994). How the power of MANOVA can both increase and decrease as a function of the intercorrelations among dependent variables. *Psychological Bulletin*, *115*, 465–474. doi: <http://dx.doi.org/10.1037/0033-2909.115.3.465>
- D'Amico, E. J., Neilands, T. B., & Zambarano, R. (2001). Power analysis for multivariate and repeated measures designs: A flexible approach using the SPSS MANOVA procedure. *Behavior Research Methods, Instruments, & Computers*, *33*(4), 479-484. Doi: 10.3758/BF03195405
- Davey, M., Eaker, D. G., & Walters, L. H. (2003). Resilience processes in adolescents: Personality profiles, self-worth, and coping. *Journal of Adolescent Research*, *18*(4), 347-362. doi: 10.1177/0743558403018004002
- DeCarlo, L. T. (1997). On the meaning and use of kurtosis. *Psychological Methods*, *2*(3), 292-307. doi: <http://dx.doi.org/10.1037/1082-989X.2.3.292>
- Enders, C. K. (2003). Performing multivariate group comparisons following a statistically significant MANOVA.(Methods, Plainly Speaking). *Measurement and Evaluation in Counseling and Development*, *36*(1), 40-57.
- Enders, C. K., & Gottschall, A. C. (2011). The impact of missing data on the ethical quality of a research study. In A. T. Panter & S. K. Sterba (Eds.), *Handbook of ethics in quantitative methodology* (pp. 357–381). New York, NY: Routledge, Taylor & Francis
- Fan, X. (1997). Canonical correlation analysis and structural equation modeling: What do they have in common?. *Structural Equation Modeling: A Multidisciplinary Journal*, *4*(1), 65-79. doi: <http://dx.doi.org/10.1080/10705519709540060>
- Fava, J. L., & Velicer, W. F. (1992a). The effects of over extraction on factor and component analysis. *Multivariate Behavioral Research*, *27*(3), 387-415. Doi: http://dx.doi.org/10.1207/s15327906mbr2703_5
- Fava, J. L., & Velicer, W. F. (1992b). An empirical comparison of factor, image, component, and scale scores. *Multivariate Behavioral Research*, *27*(3), 301-322. doi: http://dx.doi.org/10.1207/s15327906mbr2703_1
- Finch, W. H. (2012). Distribution of variables by method of outlier detection. *Frontiers in psychology*, *3*, 1-12. Doi: 10.3389/fpsyg.2012.00211
- Gorsuch, R. L. (1990). Common factor analysis versus component analysis: Some well and little known facts. *Multivariate Behavioral Research*, *25*(1), 33-39. doi: 10.1207/s15327906mbr2501_3

- Graham, J. W. (2009). Missing data analysis: Making it work in the real world. *Annual review of psychology*, 60, 549-576. doi: 10.1146/annurev.psych.58.110405.085530
- Haase, R. F., & Ellis, M. V. (1987). Multivariate analysis of variance. *Journal of Counseling Psychology*, 34(4), 404-413. doi: <http://dx.doi.org/10.1037/0022-0167.34.4.404>
- Henry, D. B., Tolan, P. H., & Gorman-Smith, D. (2005). Cluster analysis in family psychology research. *Journal of Family Psychology*, 19(1), 121-132. doi: <http://dx.doi.org/10.1037/0893-3200.19.1.121>
- Huberty, C. J. (1984). Issues in the use and interpretation of discriminant analysis. *Psychological Bulletin*, 95(1), 156-171. doi: <http://dx.doi.org/10.1037/0033-2909.95.1.156>
- Huberty, C. J., & Barton, R. M. (1989). An introduction to discriminant analysis. *Measurement and Evaluation in Counseling and Development*, 22, 158– 168.
- Huberty, C. J., & Morris, J. D. (1989). Multivariate analysis versus multiple univariate analyses. *Psychological Bulletin*, 105(2), 302-308. doi: <http://dx.doi.org/10.1037/0033-2909.105.2.302>
- Huberty, C. J., Wisenbaker, J. M., & Smith, J. C. (1987). Assessing predictive accuracy in discriminant analysis. *Multivariate Behavioral Research*, 22, 307– 329. doi: 10.1207/s15327906mbr2203_4
- Konishi, S., & Honda, M. (1990). Comparison procedures for estimation of error rates in discriminant analysis under non-normal populations. *Journal of Statistical Computing and Simulation*, 36, 105-115.
- Lind, K., Glasø, L., Pallesen, S., & Einarsen, S. (2009). Personality profiles among targets and nontargets of workplace bullying. *European Psychologist*, 14(3), 231-237. doi: 10.1027/1016-9040.14.3.231
- Lutz, J. G., & Eckert, T. L. (1994). The relationship between canonical correlation analysis and multivariate multiple regression. *Educational and Psychological Measurement*, 54(3), 666-675. doi: 10.1177/0013164494054003009
- Meade, A. W., & Craig, S. B. (2012). Identifying careless responses in survey data. *Psychological Methods*, 17(3), 437-455. doi: <http://dx.doi.org/10.1037/a0028085>
- Mok, M. M. C., Kennedy, K. J., & Moore, P. J. (2011). Academic attribution of secondary students: Gender, year level and achievement level. *Educational Psychology*, 31(1), 87-104. Doi: <http://dx.doi.org/10.1080/01443410.2010.518596>
- O’connor, B. P. (2000). SPSS and SAS programs for determining the number of components using parallel analysis and Velicer’s MAP test. *Behavior Research Methods, Instruments, & Computers*, 32(3), 396-402. doi: 10.3758/BF03200807

- Olson, C. L. (1976). On choosing a test statistic in multivariate analysis of variance. *Psychological Bulletin*, 83(4), 579-586. Doi: <http://dx.doi.org/10.1037/0033-2909.83.4.579>
- Olson, C. L. (1976). On choosing a test statistic in multivariate analysis of variance. *Psychological Bulletin*, 83(4), 579-586. doi: <http://dx.doi.org/10.1037/0033-2909.83.4.579>
- Olson, C. L. (1979). Practical considerations in choosing a MANOVA test statistic: A rejoinder to Stevens. *Psychological Bulletin*, 86, 1350-1352. doi: <http://dx.doi.org/10.1037/0033-2909.86.6.1350>
- Osborne, J. W. (2006). Power analysis for multivariate and repeated measurements designs via SPSS: Correction and extension of D'Amico, Neilands, and Zambarano (2001). *Behavior research methods*, 38(2), 353-354. doi: 10.3758/BF03192787.
- Osborne, J. W., & Costello, A. B. (2004). Sample size and subject to item ratio in principal components analysis. *Practical Assessment, Research & Evaluation*, 9(11), 8.
- Osborne, J. W., & Overbay, A. (2004). The power of outliers (and why researchers should always check for them). *Practical assessment, research & evaluation*, 9(6), 1-12. <http://PAREonline.net/getvn.asp?v=9&n=6>
- Park, H. S., Dailey, R., & Lemus, D. (2002). The use of exploratory factor analysis and principal components analysis in communication research. *Human Communication Research*, 28(4), 562-577. doi: 10.1111/j.1468-2958.2002.tb00824.x
- Press, S. J., & Wilson, S. (1978). Choosing between logistic regression and discriminant analysis. *Journal of the American Statistical Association*, 73, 699-705.
- Schafer, J. L., & Graham, J. W. (2002). Missing data: our view of the state of the art. *Psychological Methods*, 7(2), 147-177. doi: <http://dx.doi.org/10.1037/1082-989X.7.2.147>
- Sherry, A. (2006). Discriminant analysis in counseling psychology research. *The Counseling Psychologist*, 34(5), 661-683. doi: 10.1177/0011000006287103
- Sherry, A., & Henson, R. K. (2005). Conducting and interpreting canonical correlation analysis in personality research: A user-friendly primer. *Journal of personality assessment*, 84(1), 37-48. doi: http://dx.doi.org/10.1207/s15327752jpa8401_09
- Smith, L., Sinclair, K. E., & Chapman, E. S. (2002). Students' goals, self-efficacy, self-handicapping, and negative affective responses: An Australian senior school student study. *Contemporary Educational Psychology*, 27(3), 471-485. Doi: 10.1006/ceps.2001.1105

- Steinley, D. (2006). K-means clustering: a half-century synthesis. *British Journal of Mathematical and Statistical Psychology*, 59(1), 1-34. doi: 10.1348/000711005X48266
- Stevens, J. P. (1984). Outliers and influential data points in regression analysis. *Psychological Bulletin*, 95(2), 334-344. doi: <http://dx.doi.org/10.1037/0033-2909.95.2.334>
- Steyn Jr, H. S., & Ellis, S. M. (2009). Estimating an effect size in one-way multivariate analysis of variance (MANOVA). *Multivariate Behavioral Research*, 44(1), 106-129. doi: 10.1080/00273170802620238
- Thomas, D. (1992). Interpreting discriminant functions: A data analytic approach. *Multivariate Behavioral Research*, 27, 335– 362. Doi: 10.1207/s15327906mbr2703_3
- Thompson, B. (1991). A primer on the logic and use of canonical correlation analysis. *Measurement and Evaluation in Counseling and Development*, 24(2), 80-95.
- Velicer, W. F., & Jackson, D. N. (1990). Component analysis versus common factor analysis: Some issues in selecting an appropriate procedure. *Multivariate behavioral research*, 25(1), 1-28. Doi: 10.1207/s15327906mbr2501_1
- Woodward, J. A., & Overall, J. E. (1975). Multivariate analysis of variance by multiple regression methods. *Psychological Bulletin*, 82(1), 21-32. doi: <http://dx.doi.org/10.1037/h0076160>
- Zwick, W. R., & Velicer, W. F. (1986). Comparison of five rules for determining the number of components to retain. *Psychological Bulletin*, 99(3), 432-442. doi: 10.1037/0033-2909.99.3.432

Class Format and Teaching Approach

Across most weeks, the class will follow a “lecture-lab” structure for learning advanced statistical methods, comprising the theoretical/mathematical explication of a statistical procedure followed by a computer-based demonstration of the procedure, and, finally, a lab-style practical application of the procedure. In all cases, statistical procedures will be introduced in the context of a plausible research problem in educational psychology to contextualize the selection and use of the procedure. In-class—lab-style—activities and frequent homework assignments are designed to give you authentic “hands-on” experiences with the procedures studied. A specific course schedule is included below to assist in your preparations for classes.

The approach to teaching and learning in this course is predicated on the theory of teaching and learning for understanding (TLfU) within a broad instructional-design framework (Perkins, 1993; Reigeluth, 1999). One teaching objective, based on this instructional design formulation, is to develop generative study topics that are (a) central to the discipline, (b) interesting to students, and (c) connected to their prior and present experiences. To this end, study activities typically foreground the practical implications of the topics examined. A second teaching objective, predicated on the TLfU framework, is to sufficiently induct students into their

discipline, accounting for their prior knowledge and learning experiences (Perkins, 1992; Perkins & Simmons, 1988). Consistent with this objective, the course commences with an introductory topic explicating how the discipline functions as a system of thought and relates new knowledge to existing understandings. Students are introduced to basic concepts, such as the general linear model, matrices, levels of measurement, inter alia, to provide a core basis for their problem solving and inquiry within the course. A final objective of teaching, based on this framework, is to teach for transfer (Brown, 1989; Perkins, 1993). This is a complex, multistage objective that involves preparation for learning, acquiring new knowledge, rehearsing new knowledge, and applying new knowledge. Through this multistage process, learning in one context or with one set of materials (e.g., the textbook) is expected to positively impact performance in another context (e.g., solving a novel problem). This step in the learning process implicates several teaching and learning strategies, including self-reflection, self-regulated learning, cooperative-learning, independent investigation, and problem-based learning, and various combinations thereof.

Assignments

Assignment	Description	Marks/Weighting	Due Date
H/W Assign. #1	Interpretation of statistical output and results write-up concerning data screening and assumptions	20/10%	09/21
H/W Assign. #2	Interpretation of statistical output and results write-up concerning MANOVA	20/10%	10/12
Mid-semester Exam	Brief multiple-choice and short-answer exam on Topics 1-6.	30/15%	10/20
H/W Assign. #3	Interpretation of statistical output and results write-up concerning discriminant analysis	20/10%	11/9
H/W Assign. #4	Interpretation of statistical output and results write-up concerning canonical correlation analysis	20/10%	11/30
Project Report and Presentation	<u>Report</u> : Critique of substantive articles with respect to their application of multivariate statistical procedures <u>Presentation</u> : Presentation of data from critique	Report: 50/20% Presentation: 20/10%	Report: 12/14 Presentation: 11/23
In-class computer assignment	Interpretation of statistical output and results write-up	30/15%	12/14

	concerning principal components analysis		
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Note. Task-specific information will be progressively released during the semester as per the guidelines below. Please note that I reserve the right to change the mode of administration of some of these tasks as required by institutional requirements.

Homework Assignments

In total, there will be four homework tasks designed to provide you with continuous “hand on” experience in performing the statistical procedures covered in the course. The focus of these tasks will be the conduct of statistical analyses using SPSS, interpretation of data, and write-up of results in line with APA6th guidelines. Each homework task will be appraised out of 20 and weighted at 10% of your final grade. This means, cumulatively, the homework tasks are worth 40% of your final grade. Please ensure that you follow the specific instructions for each homework task as the instructions may differ between tasks. Homework tasks, with instructions and rubrics, will be distributed one week before the listed due date and submitted via Web Campus. Assignments submitted late will be penalized at 10% of the raw mark achieved for each business day late.

Mid-Semester Exam

The mid-semester exam is a “take-home” exam, designed to be a summative assessment of the knowledge and skills learned in Topic 1 to 6 (inclusive). The exam will comprise a combination of multiple-choice, short-answer, and short-essay-style items. The exam will be administered electronically and you will have 24 hours to turn-in your paper. The exam will be scored out of 30 and weighted at 15% of your overall grade. Papers turned in late will be penalized at 2% of the raw mark achieved for each hour or part thereof late (e.g., if your work is 30 minutes late, you will be penalized 1% of the grade). I reserve the right to round up to the nearest 5-minute increment for the purpose of computing the late penalty. More specific details regarding the task will be given in the Week 7 class.

Project Report and Presentation

The present assignment contains two parts as follows: (a) project report; and (b) project presentation. The assignment is designed to give you an opportunity to critique the application of multivariate statistical methods in your substantive area of study. In principle, this should be an area of educational psychology or a closely related sub-discipline (e.g., personality psychology). You will choose 10 scientific journal articles and critique these articles in terms of their provision of desiderata according to the statistical procedure(s) used. The report detailing your critique is due 14 December 2016 and should be submitted via Web Campus. Assignments submitted late will be penalized at 10% of the raw mark achieved per business date late. The report is marked out of 50 and weighted at 20% of your final grade.

You will present a working version of your critique in the class session on 23 November 2016. The scheduling of the presentation prior to the submission of the final report is designed to give you the opportunity to revise your work in line with feedback on the presentation. The

presentation is appraised out of 20 and weighted at 10% of your final grade. Specific details for each part of the assignment will be provided on 26 October 2016.

In-Class Computer Assignment

The in-class computer assignment is designed to assess your knowledge of and skills in the conduct of principal components analysis under conventional test-taking conditions. You will conduct a variety of PCAs using SPSS, interpret the output, and write-up results in line with APA6th requirements. You will have 2 hours 15 minutes to complete this task during the final class meeting on 12 December 2016. This task will be marked out of 30 and weighted 15% of your final grade.

Grading Policy

Course grades will be based on the following percentage points.

Letter Grade	Percentage Points
A+	95-100
A	93-94
A-	90-92
B+	87-89
B	83-86
B-	80-82
C+	77-79
C	73-76
C-	70-72
D+	67-69
D	63-66
D-	60-62
F	00-59

Course Schedule and Readings

Week	Week of	Topic	Readings	Optional Readings	Assignments
1	08/29	1: The domain of multivariate statistics + the general linear model + Review of ANOVA and Regression	T & F, Chp 1, 2 (pp. 17-18, 19-25), 3 (pp. 37-46, 49-52, 55-57), 19.	Huberty & Morris (1989)	
2	09/05	2: Data screening and testing assumptions of multivariate statistical procedures: Part I	T & F, Chp 4 (pp. 61-72)	Schafer and Graham (2002); Graham (2009); Enders & Gottschall (2011)	
3	09/12	3: Data screening and testing assumptions of multivariate statistical procedure: Part II	T & F, Chp 4 (pp. 72-116)	DeCarlo (1997); Finch (2012); Meade & Craig (2012); Osborne & Overbay (2004); Stevens (1984)	
4	09/19	4: MANOVA: Part I	T & F, Chp 7	Bird & Hadzi-Pavlovic (1983); Cole, Maxwell, Avery, & Salas (1994); Haase & Ellis (1987); Steyn & Ellis (2009); D'Amico, Neilands, & Zambarano (2001); Olson (1976); Olson (1979); Osborne (2006)	H/W assignment 1 due
5	09/26	5: MANOVA: Part II	T & F, Chp 7	Enders (2003); Mok, Kennedy, & Moore (2011); Woodward & Overall (1975)	
6	10/03	6: Discriminant function analysis: Part 1	T & F, Chp 9	Huberty (1984); Huberty & Barton (1989); Press	

				& Wilson (1978); Sherry (2006)	
7	10/10	7: Discriminant function analysis: Part II	T & F, Chp 9	Achter, Lubinski, Benbow, & Eftekhari-Sanjani (1999); Huberty, Wisenbaker, & Smith (1987); Konishi & Honda (1990) ; Thomas (1992)	H/W assignment 2 due
8	10/17	Mid-Semester examination (take-home)			Mid-semester examination (take-home)
9	10/24	8: Canonical correlation: Part I	T & F, Chp 12	Lutz & Eckert (1994); Sherry & Henson (2005); Thompson (1991)	
10	10/31	9: Canonical correlation: Part II	T & F, Chp 12	Alexander & Onwuegbuzie (2007); Fan (1997); Smith & Sinclair (2002)	
11	11/7	10: Cluster Analysis: Part 1	Hair, Black, Babin, & Anderson (2010).	Breckenridge (2000); Steinley (2006)	H/W assignment 3 due
12	11/14	11: Cluster Analysis: Part II	Hair, Black, Babin, & Anderson (2010).	Borgen & Barnett (1987); Clatworthy, Buick, Hankins, Weinman, & Horne (2005); Davey, Eaker, & Walters (2003); Henry, Tolan, & Gorman-Smith (2005); Lind, Glaso, Pallesen, & Einarsen (2009);	

13	11/21	Project Presentations			Project Presentations
14	11/28	12: Principal components analysis: Part 1	T & F, Chp 13	Gorsuch (1990); Park, Dailey, & Lemus (2002); Velicer & Jackson (1990)	H/W assignment 4 due
15	12/05	13: Principal components analysis: Part II	T & F, Chp 13	O'Connor (2000) Osborne & Costello (2004); Zwick & Velicer (1986); Fava & Velicer (1992a) (1992b);	Project Report Due
16	12/12	In-class computer assignment			In-class computer assignment

Note: full reference details for the optional readings are available above. This course schedule is subject to change. T & F denotes Tabachnick and Fidel (2013). The full reference for Hair et al. (2010) is Hair Jr, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). Cluster analysis. In *Multivariate data analysis* (pp. 483-543). Upper Saddle River, NJ: Prentice Hall (please note that a copy of this chapter will be provided well in advance of the class meeting that requires the text).

UNLV Policies

Use of Electronic Devices - The use of electronic devices such as pagers, cellular phones, or recording devices, or other potentially disruptive activities, is permitted only with the prior explicit consent of the instructor.

Academic Misconduct—Academic integrity is a legitimate concern for every member of the campus community; all share in upholding the fundamental values of honesty, trust, respect, fairness, responsibility and professionalism. By choosing to join the UNLV community, students accept the expectations of the Student Academic Misconduct Policy and are encouraged when faced with choices to always take the ethical path. Students enrolling in UNLV assume the obligation to conduct themselves in a manner compatible with UNLV's function as an educational institution. An example of academic misconduct is plagiarism. Plagiarism is using the words or ideas of another, from the Internet or any source, without proper citation of the sources. See the *Student Academic Misconduct Policy* (approved December 9, 2005) located at: <https://www.unlv.edu/studentconduct/student-conduct>.

Copyright—The University requires all members of the University Community to familiarize themselves with and to follow copyright and fair use requirements. **You are individually and solely responsible for violations of copyright and fair use laws. The university will neither protect nor defend you nor assume any responsibility for employee or student violations of fair use laws.** Violations of copyright laws could subject you to federal and state civil penalties and criminal liability, as well as disciplinary action under University policies. Additional information can be found at: <http://www.unlv.edu/provost/copyright>.

Disability Resource Center (DRC)—The UNLV Disability Resource Center (SSC-A 143, <http://drc.unlv.edu/>, 702-895-0866) provides resources for students with disabilities. If you feel that you have a disability, please make an appointment with a Disabilities Specialist at the DRC to discuss what options may be available to you. If you are registered with the UNLV Disability Resource Center, bring your Academic Accommodation Plan from the DRC to the instructor during office hours so that you may work together to develop strategies for implementing the accommodations to meet both your needs and the requirements of the course. Any information you provide is private and will be treated as such. To maintain the confidentiality of your request, please do not approach the instructor in front of others to discuss your accommodation needs.

Religious Holidays Policy—Any student missing class quizzes, examinations, or any other class or lab work because of observance of religious holidays shall be given an opportunity during that semester to make up missed work. The make-up will apply to the religious holiday absence only. It shall be the responsibility of the student to notify the instructor **within the first 14 calendar days of the course for fall and spring courses (excepting modular courses), or within the first 7 calendar days of the course for summer and modular courses**, of his or her intention to participate in religious holidays which do not fall on state holidays or periods of class recess. For additional information, please visit: <http://catalog.unlv.edu/content.php?catoid=6&navoid=531>.

Transparency in Learning and Teaching—The University encourages application of the transparency method of constructing assignments for student success. Please see these two links for further information:

<https://www.unlv.edu/provost/teachingandlearning>

<https://www.unlv.edu/provost/transparency>

Incomplete Grades—The grade of I—Incomplete—can be granted when a student has satisfactorily completed three-fourths of course work for that semester/session but for reason(s) beyond the student’s control, and acceptable to the instructor, cannot complete the last part of the course, and the instructor believes that the student can finish the course without repeating it. The incomplete work must be made up before the end of the following regular semester for undergraduate courses. Graduate students receiving “I” grades in 500-, 600-, or 700-level courses have up to one calendar year to complete the work, at the discretion of the instructor. If course requirements are not completed within the time indicated, a grade of F will be recorded and the GPA will be adjusted accordingly. Students who are fulfilling an Incomplete do not register for the course but make individual arrangements with the instructor who assigned the I grade.

Tutoring and Coaching—The Academic Success Center (ASC) provides tutoring, academic success coaching and other academic assistance for all UNLV undergraduate students. For information regarding tutoring subjects, tutoring times, and other ASC programs and services, visit <http://www.unlv.edu/asc> or call [702-895-3177](tel:702-895-3177). The ASC building is located across from the Student Services Complex (SSC). Academic success coaching is located on the second floor of the SSC (ASC Coaching Spot). Drop-in tutoring is located on the second floor of the Lied Library and College of Engineering TEB second floor.

Missed Work – Any student missing class quizzes, examinations, or any other class or lab work because of observance of religious holidays shall be given an opportunity during that semester to make up missed work. The make-up will apply to the religious holiday absence only. It shall be the responsibility of the student to notify the instructor no later than the end of the first two weeks of classes of his or her intention to participate in religious holidays which do not fall on state holidays or periods of class recess. This policy shall not apply in the event that administering the test or examination at an alternate time would impose an undue hardship on the instructor or the university that could not reasonably be avoided. For additional information, please visit: <http://catalog.unlv.edu/content.php?catoid=4&navoid=164>. In accordance with the UNLV faculty senate-approved policy regarding class time and assignments missed, students who represent UNLV in any official extracurricular activity shall also have the opportunity to make up assignments, provided that the student provides official written notification to the instructor no less than one week prior to the missed class(es).

UNLV Writing Center—One-on-one or small group assistance with writing is available free of charge to UNLV students at the Writing Center, located in CDC-3-301. Although walk-in consultations are sometimes

available, students with appointments will receive priority assistance. Appointments may be made in person or by calling 702-895-3908. The student's Rebel ID Card, a copy of the assignment (if possible), and two copies of any writing to be reviewed are requested for the consultation. More information can be found at: <http://writingcenter.unlv.edu/>.

Rebelmail—By policy, faculty and staff should e-mail students' Rebelmail accounts only. Rebelmail is UNLV's official e-mail system for students. It is one of the primary ways students receive official university communication such as information about deadlines, major campus events, and announcements. All UNLV students receive a Rebelmail account after they have been admitted to the university. Students' e-mail prefixes are listed on class rosters. The suffix is always @unlv.nevada.edu. **Emailing within WebCampus is acceptable.**

Final Examinations—The University requires that final exams given at the end of a course occur at the time and on the day specified in the final exam schedule. See the schedule at: <http://www.unlv.edu/registrar/calendars>.