

Professor: Ronald Christensen

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Phone: They removed it in a pseudo budget cut.

Office Hours: Normally, T, Th, 12:30-1:30 and by appointment. Probably by email or Zoom appt.

Time: T, Th, 11:00 – 12:15

Place: Probably **Zoom**

Prerequisites: Stat 4/528 or 4/540.

Material: We will review matrix algebra and the matrix approach to linear models (regression and ANOVA) because the use of matrices is key in multivariate analysis. We will then look at examples of multifactor analysis of variance because of its similarities to multivariate analysis of variance. We will examine multivariate analysis of variance (MANOVA), Discriminant Analysis, Principal Component Analysis, and Factor Analysis. Other topics will be considered as time allows. First among these will be Multidimensional Scaling and Cluster Analysis. Another possible topic is Correspondence Analysis.

Texts: Both texts are available on line. We will use parts of both.

- Primary Text: *Statistical Learning* by Ronald Christensen available at <https://www.stat.unm.edu/~fletcher/SL.pdf>. We will begin with Appendices A, B and C. Then we will cover Chapters 9 through 12. Associated R code is available at <https://www.stat.unm.edu/~fletcher/R-SL.pdf>.
- Secondary Text: Appendices B and C are rather terse so I will actually use the **first edition** of Christensen's, *Analysis of Variance, Design, and Regression* available at <https://www.stat.unm.edu/~fletcher/anreg.pdf>. I am going to use the first edition of the book for two reasons. First, we will cover a relatively small amount of the book that applies to matrices, matrix linear models, MANOVA, and principal components. This material is also covered in the second edition. Computing commands for the *second edition* are available at <https://www.stat.unm.edu/~fletcher/Rcode.pdf>. Second, to make it easier on students we will focus on balanced MANOVA whereas the second edition focuses on unbalanced analyses.

Homework: Homework will be assigned but not graded. You are encouraged to form groups to work together on homework to solidify your knowledge of the material.

Grading: **You are required to keep legible copies of all work**, except in-class examinations. Most likely, several quizzes will determine your grade, however I may choose to give some tests.

- Sup. Texts:
- Everitt and Dunn, (2001). *Applied Multivariate Data Analysis*, Second Edition. **If I had to use someone else's book, I would use this one.**
 - Christensen, Ronald (2001). *Advanced Linear Modeling*. **The book is written at much too high a level for this class but I extracted material from this book for *Statistical Learning*. Computer commands for *Statistical Learning* were similarly extracted from the associated computing commands for this book available at www.math.unm.edu/~fletcher/linmod2.html.**
 - There are excellent books by Seber, Eaton, and Muirhead at a higher level.
 - Anderson, T.W. (2003). *An Introduction to Multivariate Statistical Analysis*, Third Edition. John Wiley and Sons, New York. **Quite theoretical but different from the others.**
 - Dillon, Wm. R. and Goldstein, Matthew (1984). *Multivariate Analysis: Methods and Applications*. John Wiley and Sons, New York.
 - Hand, D.J. (1981). *Discrimination and Classification*. John Wiley and Sons, New York.
 - Hastie, T., Tibshirani, R. and Friedman, J. (2001). *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*. Springer, New York.
 - Johnson, Richard A. and Wichern, Dean W. (2007). *Applied Multivariate Statistical Analysis*, Sixth Edition. Prentice-Hall, Englewood Cliffs, NJ. **The standard text for classes like this.**
 - Lachenbruch, P.A. (1975). *Discriminate Analysis*. Hafner Press, New York.
 - Marden, James I. (2015). *Multivariate Statistics: Old School*. <http://stat.istics.net/Multivariate>.
 - Mardia, K.V., Kent, J.T., and Bibby, J.M. (1979). *Multivariate Analysis*. Academic Press, New York. **Hard to read because of typeface. Perhaps at the level beyond this course.**
 - Morrison, Donald F. (2004). *Multivariate Statistical Methods*, Fourth Edition. Duxbury Press, Pacific Grove CA. **My first text.**
 - Press, S. James (1982). *Applied Multivariate Analysis: Using Bayesian and Frequentist Methods of Inference*, Second Edition. R.E. Krieger, Malabar, FL. (Latest reprinting, Dover Press, 2005). **Bayesian.**
 - Rencher, Alvin C. and Christensen, William F. (2012). *Methods of Multivariate Analysis*, Third Edition. Wiley, New York.
 - Whittaker, Joe (1990). *Graphical Models in Applied Multivariate Statistics*. John Wiley and Sons, New York. **Very interesting but very different approach.**