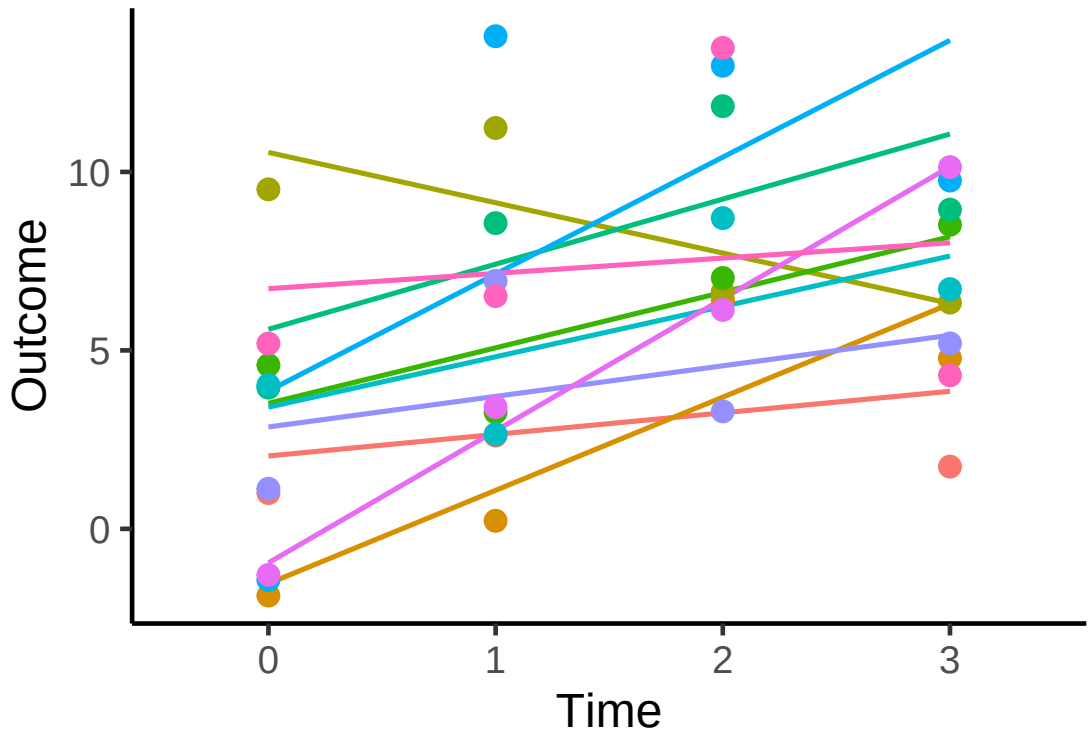
Longitudinal Data Analysis
Spring 2020 Syllabus

Stefany Coxe



Course Information

- PSY 5939 U04
- Thursday, 9:30am - 12:15pm
- PC 449

Instructor Information

- Stefany Coxe, Ph.D.
- Email: stefany.coxe@fiu.edu
- Office: DM 275

- Office Hours: By appointment – send me an email to schedule a time

Course description

This course covers topics related to statistical analysis of longitudinal data, focusing on methods used in the social sciences and health research. Topics include analysis of covariance (ANCOVA), difference scores, statistical mediation, mixed models (with correlated residuals and/or with random effects), and latent growth modeling. You will be able to analyze, interpret, and write up results using these methods.

Learning objectives

- Develop research questions about change over time
- Analyze longitudinal data with statistical models appropriate to the research question, including mixed models and latent growth models
- Interpret statistical analysis output from several software packages
- Write up the results of longitudinal analyses for publication

Prerequisites

Graduate coursework in analysis of variance and linear regression. We will cover a variety of topics in this course, but all of them build on a basic ANOVA and regression (general linear model) framework. A course covering multivariate statistics (such as PSY 5246C) is generally required.

Software

We will use SPSS, SAS, and R for the first part of the course. I expect you to be able to use at least one of these software packages to do things like open datasets, transform variables, conduct simple analyses, etc. I will provide information about the specific procedures you will need to know for this course, including key data re-structuring techniques.

We will use Mplus for latent growth models. I do not expect you to know anything about Mplus; I will provide information on what you need to know about Mplus for this course.

Canvas

Lecture notes, computer code, assignments, and other materials will be posted on Canvas before class. You should make sure they are available to you during class.

Assignments and grading

Homework (60%)

Four homework assignments covering some of the major topic areas of the course: (1) models for 2 waves, (2) mixed models, (3) latent growth models, and (4) statistical mediation. The assignments involve running several analyses, making some decisions based on the analyses, interpreting output, and presenting the results in tables/figures and text.

Project (20%)

You will propose a project using your own dataset or a publicaly available dataset (I will post several to Canvas). This will culminate in a short paper. I want you to focus on **developing longitudinal research questions** and **mapping them on to appropriate longitudinal analyses**. More details to follow during the semester. The final paper is due by April 24.

Presentation (10%)

A short presentation about your final project. I expect that your analyses should be complete (or nearly so) at this point; preparing the presentation should help you organize your thoughts. The main purpose of this presentation is to give you **practice presenting your analysis findings in a group setting**. Presentations will take place in class on April 16. Approximately 15 to 20 minutes per person, including questions.

Proposal (5%)

You will turn in a 1 to 2 page proposal for your project. The purpose of the proposal is to get you to **select a dataset**, start to **solidify your ideas**, and **get feedback** and additional resources from me. You can change the direction of the project later in the semester as you learn more. The proposal is due by March 5.

Discussions (5%)

There will be regular Canvas-based discussions of readings and other class material. These are designed to get you to think about the topics in more detail. In particular, they will focus on the theoretical (i.e., not analysis, not code) side of things.

Grade distribution

A	A-	B+	B	B-	C+	C	F
>= 93	90 - 92.99	87 - 89.99	83 - 86.99	80 - 82.99	77 - 79.99	70 - 76.99	<= 69.99

Tentative Course Outline

Date	Topics	Discussion	Homework
Jan 09	Introduction		
Jan 16	Two waves	Discussion 1	
Jan 23	Mixed models (G)	Discussion 2	HW1: two waves
Jan 30	Mixed models (G)		
Feb 06	Mplus	Discussion 3	HW2: mixed models
Feb 13	Latent growth models		
Feb 20	Latent growth models	Discussion 4	
Feb 27	SPRING BREAK		
Mar 05	Latent growth models		Proposal
Mar 12	Growth mixture	Discussion 5	HW3: latent growth models
Mar 19	Mediation	Discussion 6	
Mar 26	Mediation		
Apr 02	Mixed models (R)	Discussion 7	HW4: mediation
Apr 09	TBD	Discussion 8	
Apr 16	Presentations		
Apr 23	FINALS WEEK		Paper

Due dates subject to change due to hurricane, emergency, scheduling changes, etc.

Homework assignments are due by Friday at midnight.

Discussion assignments are due by Monday at midnight.
See next page for schedule and articles.

Final project due by the end of the day on Friday, April 24, 2020.

Assignment schedule

- **January 24**: Homework 1 - two wave models
- **February 07**: Homework 2 - mixed models
- **March 06**: Proposal
- **March 13**: Homework 3 - latent growth models
- **April 03**: Homework 4 - mediation
- **April 16**: Presentation * THURSDAY in class *
- **April 24**: Final paper

Discussion article schedule

- **January 13**: Ployhart, R. E., & Vandenberg, R. J. (2010). Longitudinal research: The theory, design, and analysis of change. Journal of Management, 36, 94 - 120.

- **January 20**: Kisbu-Sakarya, Y., MacKinnon, D. P., & Aiken, L. S. (2013). A Monte Carlo comparison study of the power of the analysis of covariance, simple difference, and residual change scores in testing two-wave data. Educational and Psychological Measurement, 73(1), 47-62.

- **February 03**: Baldwin, S. A., Imel, Z. E., Braithwaite, S. R., & Atkins, D. C. (2014). Analyzing multiple outcomes in clinical research using multivariate multilevel models. Journal of consulting and clinical psychology, 82(5), 920.

- **February 17**: Curran, P. J., Obeidat, K., & Losardo, D. (2010). Twelve frequently asked questions about growth curve modeling. Journal of cognition and development, 11(2), 121-136.

- **March 09**: Feingold, A. (2009). Effect sizes for growth-modeling analysis for controlled clinical trials in the same metric as for classical analysis. Psychological methods, 14(1), 43.

- **March 16**: Jung, T. & Wickrama, K. A. S. (2008). An introduction to latent class growth analysis and growth mixture modeling. Social and Personality Psychology Compass, 2/1, 302 - 317.

- **March 30**: Maxwell, S. E., & Cole, D. A. (2007). Bias in cross-sectional analyses of longitudinal mediation. Psychological Methods, 12(1), 23 - 44.

- **April 06**: Hubbard, A. E., Ahern, J., Fleischer, N. L., Van der Laan, M., Lippman, S. A., Jewell, N., Bruckner, T., & Satariano, W. A. (2010). To GEE or not to GEE: comparing population average and mixed models for estimating the associations between neighborhood risk factors and health. Epidemiology, 21(4), 467 - 474.

References

Additional approachable readings:

Should be understandable to you while taking this course. Aimed at applied researchers, not quantitative experts.

Collins, L. M., & Graham, J. W. (2002). The effect of the timing and spacing of observations in longitudinal studies of tobacco and other drug use: temporal design considerations. Drug and Alcohol Dependence, 68, S85 - S96.

Curran, P. J., & Hussong, A. M. (2003). The use of latent trajectory models in psychopathology research. Journal of Abnormal Psychology, 112(4), 526 - 544.

Curran, P. J., Obeidat, K., & Losardo, D. (2010). Twelve frequently asked questions about growth curve modeling. Journal of Cognition and Development, 11 (2), 121 - 136.

Duncan, T. E., & Duncan, S. C. (2009). The ABCs of LGM: An Introductory Guide to Latent Variable Growth Curve Modeling. Social and Personality Psychology Compass, 3, 979 - 991.

Feingold, A. (2009). Effect sizes for growth-modeling analysis for controlled clinical trials in the same metric as for classical analysis. Psychological methods, 14(1), 43.

Ferron, J. M., Hogarty, K. Y., Dedrick, R. F., Hess, M. R., Niles, J. D., & Kromrey, J. D. (2008). Reporting results from multilevel analyses. Multilevel modeling of educational data, 391-426.

Hoffman, L., & Stawski, R. S. (2009). Persons as contexts: Evaluating between-person and within-person effects in longitudinal analysis. Research in Human Development, 6, 97 - 120.

Kwok, O. M., Underhill, A. T., Berry, J. W., Luo, W., Elliott, T. R., & Yoon, M. (2008). Analyzing longitudinal data with multilevel models: An example with individuals living with lower extremity intra-articular fractures. Rehabilitation Psychology, 53(3), 370 - 386.

Newsom, J., Jones, R. N., & Hofer, S. M. (Eds.). (2013). Longitudinal data analysis: A practical guide for researchers in aging, health, and social sciences (Vol. 18). Routledge.

Peugh, J. L. (2010). A practical guide to multilevel modeling. Journal of School Psychology, 48(1), 85 - 112.

Ployhart, R. E., & Vandenberg, R. J. (2010). Longitudinal research: The theory, design, and analysis of change. Journal of Management, 36, 94 - 120.

Preacher, K. J., Wichman, A. L., MacCallum, R. C., & Briggs, N. E. (2008). Latent growth curve modeling (No. 157). Sage.

Snijders, T. A. B., and Bosker, R. (2012). Multilevel analysis: An introduction to basic and advanced multilevel modeling (2nd ed.). Sage Publications, Ltd.

Some more technical texts:

Aimed at advanced substantive researchers, quantitative researchers, and statisticians. Provide more details but are more technically diffcult.

Efron, B., & Tibshirani, R. J. (1994). An introduction to the bootstrap. CRC press.

Fitzmaurice, G. M., Laird, N. M., and Ware, J. H. (2011). Applied longitudinal analysis (2nd ed.). Hoboken, NJ: John Wiley & Sons.

Gelman, A. (2006). Multilevel (Hierarchical) Modeling: What It Can and Cannot Do. Technometrics, 48(3), 432 - 435.

Gelman, A., & Hill, J. (2007). Data analysis using regression and multilevel/hierarchical models. Cambridge: Cambridge University Press.

Hedeker, D., & Gibbons, R. D. (2006). Longitudinal data analysis. New Jersey: Wiley.

Hoffman, L. (2015). Longitudinal analysis: Modeling within-person uctuation and change. New York, NY: Routledge Academic.

Hox J. (2010). Multilevel analysis techniques and applications, 2nd edition. Erlbaum: Mahwah, New Jersey.

Johnson, M. (2002). Individual growth analysis using PROC MIXED. SAS User Group International, 27.

Judd, C. M., Westfall, J., & Kenny, D. A. (2012). Treating stimuli as a random factor in social psychology: A new and comprehensive solution to a pervasive but largely ignored problem. Journal of personality and social psychology, 103(1), 54.

Kincaid, C. (2005). Guidelines for selecting the covariance structure in mixed model analysis. In Proceedings of the Thirtieth Annual SAS Users Group International Conference (No. 198-30). Cary, NC: SAS Institute Inc.

MacCallum, R. C., Kim, C., Malarkey, W. B., & Kiecolt-Glaser, J. K. (1997). Studying multivariate change using multilevel models and latent curve models. Multivariate Behavioral Research, 32(3), 215 - 253.

McCoach, D. B., Rifenbark, G. G., Newton, S. D., Li, X., Kooken, J., Yomtov, J., Yomtov, D., Gambino, A., J., & Bellara, A. (online). Does the Package Matter? A Comparison of Five Common Multilevel Modeling Software Packages. Journal of Educational and Behavioral Statistics. Online.

Raudenbush, S. W., and Bryk, A. S. (2002). Hierarchical linear models: Applications and data analysis methods (2nd ed.). Thousand Oaks, CA: Sage Publications.

Singer J. D. & Willett J. B. (2003). Applied longitudinal data analysis. New York: Oxford University Press.

Stroup, W. W. (2012) Generalized linear mixed models: Modern concepts, methods, and applications. Chapman & Hall/ CRC.

Example applied articles:

Examples of applying latent growth models to real research questions. The types of articles that you will be writing in the future. Can also serve as rough templates for your final project.

Atkins, D. C. (2005). Using multilevel models to analyze couple and family treatment data: Basic and advanced issues. Journal of Family Psychology, 19(1), 98 - 110.

Bianconcini, S. (2012). A general multivariate latent growth model with applications to student achievement. Journal of Educational and Behavioral Statistics, 37(2), 339 - 364.

Duperrouzel, J. C., Hawes, S. W., Lopez-Quintero, C., Pacheco-Colón, I., Coxe, S., Hayes, T., & Gonzalez, R. (2019). Adolescent cannabis use and its associations with decision-making and episodic memory: Preliminary results from a longitudinal study. Neuropsychology.

Guglielmi, R. S. (2012). Math and science achievement in English language learners: Multivariate latent growth modeling of predictors, mediators, and moderators. Journal of Educational Psychology, 104(3), 580 - 602.

Hawes, S. W., Trucco, E. M., Duperrouzel, J. C., Coxe, S., & Gonzalez, R. (2019). Developmental pathways of adolescent cannabis use: Risk factors, outcomes and sex-specific differences. Substance use & misuse, 54(2), 271-281.

Johnson, J. K., Gross, A. L., Pa, J., McLaren, D. G., Park, L. Q., Manly, J. J., & Alzheimer's Disease Neuroimaging Initiative. (2012). Longitudinal change in neuropsychological performance using latent growth models: A study of mild cognitive impairment. Brain Imaging and Behavior, 6(4), 540 - 550.

Kieffer, M. J., & Lesaux, N. K. (2012). Development of morphological awareness and vocabulary knowledge in Spanish-speaking language minority learners: A parallel process latent growth curve model. Applied Psycholinguistics, 33(01), 23 - 54.

Montague, M., Enders, C., Cavendish, W., & Castro, M. (2011). Academic and behavioral trajectories for at-risk adolescents in urban schools. Behavioral Disorders, 141 - 156.

Passarotti, A. M., Crane, N. A., Hedeker, D., & Mermelstein, R. J. (2015). Longitudinal trajectories of marijuana use from adolescence to young adulthood. Addictive behaviors, 45, 301 - 308.

Peterson, S. J., Luthans, F., Avolio, B. J., Walumbwa, F. O., & Zhang, Z. (2011). Psychological capital and employee performance: A latent growth modeling approach. Personnel Psychology, 64(2), 427 - 450.

Sibley, M. H., Pelham Jr, W. E., Molina, B. S., Coxe, S., Kipp, H., Gnagy, E. M., Meinzer, M., Ross, J. M., & Lahey, B. B. (2014). The role of early childhood ADHD and subsequent CD in the initiation and escalation of adolescent cigarette, alcohol, and marijuana use. Journal of Abnormal Psychology, 123(2), 362 - 374.

Special topics:

A variety of topics that we don't have time to cover in depth. Consult these sources for more information about specific topics.

Categorical outcomes in mixed models:

Hu, F. B., Goldberg, J., Hedeker, D., Flay, B. R., & Pentz, M. A. (1998). Comparison of population-averaged and subject-specific approaches for analyzing repeated binary outcomes. American Journal of Epidemiology, 147(7), 694 - 703.

Hubbard, A. E., Ahern, J., Fleischer, N. L., Van der Laan, M., Lippman, S. A., Jewell, N., Bruckner, T., & Satariano, W. A. (2010). To GEE or not to GEE: comparing population average and mixed models for estimating the associations between neighborhood risk factors and health. Epidemiology, 21(4), 467 - 474.

Jaeger, T. F. (2008). Categorical data analysis: Away from ANOVAs (transformation or not) and towards logit mixed models. Journal of memory and language, 59(4), 434 - 446.

Centering in mixed models (cross-sectional and longitudinal):

Enders, C. K., & Tofighi, D. (2007). Centering predictor variables in cross-sectional multilevel models: A new look at an old issue. Psychological Methods, 12(2), 121 - 138.

Kreft, I. G., De Leeuw, J., & Aiken, L. S. (1995). The effect of different forms of centering in hierarchical linear models. Multivariate Behavioral Research, 30(1), 1 - 21.

Wang, L., & Maxwell, S. E. (2015). On disaggregating between-person and within-person effects with longitudinal data using multilevel models. Psychological Methods, 20(1), 63 - 83.

Growth mixture, latent class growth, latent transition

Jung, T. & Wickrama, K. A. S. (2008). An introduction to latent class growth analysis and growth mixture modeling. Social and Personality Psychology Compass, 2/1, 302 - 317.

Wang, M., & Bodner, T. E. (2007). Growth mixture modeling: Identifying and predicting unobserved subpopulations with longitudinal data. Organizational Research Methods, 10 (4), 635 - 656.

Collins, L. M., & Lanza, S. T. (2010). Latent Class and Latent Transition Analysis. Hoboken, NJ: John Wiley & Sons.

Mediation:

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of personality and social psychology, 51(6), 1173 - 1182.

Cheong, J., MacKinnon, D. P., & Khoo, S. T. (2003). Investigation of mediational processes using parallel process latent growth curve modeling. Structural Equation Modeling, 10(2), 238-262.

Geldhof, G. J., Anthony, K. P., Selig, J. P., & Mendez-Luck, C. A. (2018). Accommodating binary and count variables in mediation: A case for conditional indirect effects. International Journal of Behavioral Development, 42(2), 300-308.

Hayes, A. F. (2013). Introduction to mediation, moderation, and conditional process analysis: A regression-based approach. Guilford Press.

Judd, C. M., & Kenny, D. A. (1981). Process analysis estimating mediation in treatment evaluations. Evaluation Review, 5(5), 602 - 619.

Lockwood, C. M., & MacKinnon, D. P. (1998, March). Bootstrapping the standard error of the mediated effect. In Proceedings of the 23rd annual meeting of SAS Users Group International (pp. 997-1002).

MacKinnon, D. P. (2008). Introduction to statistical mediation analysis. Routledge.

MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. Psychological Methods, 7(1), 83 - 104.

MacKinnon, D. P., Lockwood, C. M., & Williams, J. (2004). Confidence limits for the indirect effect: Distribution of the product and resampling methods. Multivariate Behavioral Research, 39(1), 99 - 128.

MacKinnon, D. P., Fritz, M. S., Williams, J., & Lockwood, C. M. (2007). Distribution of the product confidence limits for the indirect effect: Program PRODCLIN. Behavior Research Methods, 39(3), 384 - 389.

Maxwell, S. E., & Cole, D. A. (2007). Bias in cross-sectional analyses of longitudinal mediation. Psychological Methods, 12(1), 23 - 44.

Maxwell, S. E., Cole, D. A., & Mitchell, M. A. (2011). Bias in cross-sectional analyses of longitudinal mediation: Partial and complete mediation under an autoregressive model. Multivariate Behavioral Research, 46(5), 816 - 841.

Meeker, W. Q., Cornwell, L. W., & Aroian, L. A. (1981). The product of two normally distributed random variables (No. 7). American Mathematical Society.

Missing data:

Baraldi, A. N., & Enders, C. K. (2010). An introduction to modern missing data analyses. Journal of School Psychology, 48(1), 5-37.

Enders, C. K. (2011). Missing not at random models for latent growth curve analyses. Psychological Methods, 16(1), 1 - 16.

Rhemtulla, M., Jia, F., Wu, W., & Little, T. D. (2014). Planned missing designs to optimize the effciency of latent growth parameter estimates. International Journal of Behavioral Development, 0165025413514324.

Multiple outcomes:

Baldwin, S. A., Imel, Z. E., Braithwaite, S. R., & Atkins, D. C. (2014). Analyzing multiple outcomes in clinical research using multivariate multilevel models. Journal of consulting and clinical psychology, 82(5), 920 - 930.

Bishop, J., Geiser, C., & Cole, D. A. (2015). Modeling latent growth with multiple indicators: A comparison of three approaches. Psychological Methods, 20(1), 43 - 62.

Non-parametric models of change:

Fine, K. L., Suk, H. W., & Grimm, K. J. (2019). An Examination of a Functional Mixed-Effects Modeling Approach to the Analysis of Longitudinal Data. Multivariate behavioral research, 54(4), 475-491.

Power analysis

Brysbaert, M., & Stevens, M. (2018). Power analysis and effect size in mixed effects models: A tutorial. Journal of Cognition, 1, 1 - 20.

Judd, C. M., Westfall, J., & Kenny, D. A. (2017). Experiments with more than one random factor: Designs, analytic models, and statistical power. Annual review of psychology, 68, 601-625.

Two wave approaches (difference scores, partial change scores, ANCOVA):

Allison, P. D. (2005). Fixed effects regression methods for longitudinal data using SAS. SAS Institute.

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). Applied multiple regression/correlation analysis for the behavioral sciences. Routledge.

Kisbu-Sakarya, Y., MacKinnon, D. P., & Aiken, L. S. (2013). A Monte Carlo comparison study of the power of the analysis of covariance, simple difference, and residual change scores in testing two-wave data. Educational and Psychological Measurement, 73(1), 47 - 62.

Lord, F. (1967). A paradox in the interpretation of group comparisons. Psychological Bulletin, 68(5), 304 - 305.

Pike, G. R. (2004). Lord's paradox and the assessment of change during college. Journal of College Student Development, 45(3), 348 - 353.

Tu, Y.-K., Gunnell, D., & Gilthorpe, M. S. (2008). Simpson's paradox, Lord's paradox, and suppression effects are the same phenomenon: The reversal paradox. Emerging Themes in Epidemiology, 5:2.

Course and University Policies

Attendance

I shouldn't have to tell you to attend every class. This is graduate school. If you need to miss class for a good reason (such as illness, religious event, professional activity, or university-sanctioned event), please contact me as soon as possible to make any necessary arrangements. This is particularly important if you will miss class on April 16 (the date of the presentations).

Special Needs

Any student with a disability or other special need that may require special accommodations for this course should make this known to the instructor during the first week of class.

Information	Disability Resource Center
Website:	http://drc.fiu.edu
Email:	drcupgl@fiu.edu
Office:	Graham Center 190
Phone:	305-348-3532

Academic Misconduct

Students at Florida International University are expected to adhere to the highest standards of integrity in every aspect of their lives. Honesty in academic matters is part of this obligation. Academic integrity is the adherence to those special values regarding life and work in an academic community. Any act or omission by a student which violates this concept of academic integrity shall be defined as academic misconduct and shall be subject to the procedures and penalties set forth herein. All students are expected to adhere to a standard of academic conduct, which demonstrates respect for themselves, their fellow students, and the educational mission of the University. All students are deemed by the University to understand that if they are found responsible for academic misconduct, they will be subject to the Academic Misconduct procedures and sanctions, as outlined in the Student Handbook.

Academic Dishonesty

Please refer to your student handbook for a description of what constitutes academic dishonesty. I expect all students to complete and turn in their own work.