

The *Center for Integrated Latent Variable Research (CILVR)* in the *Department of Measurement, Statistics and Evaluation (EDMS)* at the *University of Maryland* is pleased to present a workshop entitled

## **DIAGNOSTIC MEASUREMENT: THEORY, METHODS, AND APPLICATIONS**

taught by

**Prof. André A. Rupp**

This mini-course is targeted to measurement professionals with at least basic training in statistics and who are interested in learning about the theory, methods, and applications of modern latent-variable models for classifying respondents. The models that are the focus of this workshop are known as *diagnostic classification models (DCMs)* or, alternatively, *cognitive diagnosis models* and *restricted latent class models* (Rupp & Templin, 2008). These models are typically viewed as scaling alternatives to multidimensional item response theory and confirmatory factor analysis models. They can be applied in a variety of disciplines in the social and behavioral sciences where diagnostic decisions are desired. For example, DCMs can help to describe the statistical properties of the instruments, whether respondents have mastered certain skills, or which cognitive processes they engage in when responding to the instruments. The data may come from a variety of instruments including large-scale achievement tests, psychological questionnaires, or consumer reports.

The structure of this course is based on the upcoming textbook on this topic, which was written by the instructor of the course and two of his colleagues in this field (Rupp, Templin, & Henson, 2010). In the first part of the course, which is the ‘*Theory*’ section, substantive motivations for utilizing DCMs in practice will be discussed along with frameworks for the principled design of diagnostic assessments and associated validation and implementation studies. Emphasis will be placed on how the nature of DCMs influences these research endeavors and how the encoding of relevant latent characteristics of respondents can be accomplished for DCMs.

In the second part of the course, which is the ‘*Methods*’ section, DCMs will be compared and contrasted to other measurement models with latent variables and a taxonomy will be developed. Subsequently, core DCMs will be explicitly discussed in terms of the parameters they contain and the interpretations they support. In addition, a general log-linear modeling framework (Henson, Templin, & Willse, 2008) that is similar to a general linear modeling framework in statistics will be introduced, which allows the estimation of many DCMs and supports exploratory as well as confirmatory analyses. In a more technical section of the course, the estimation of the attribute structure, respondent parameters, and item parameters will be discussed with an eye toward what practitioners need to keep in mind when they want to apply DCMs in practice.

In the third part of the course, which is the ‘*Applications*’ section, procedures that are necessary for applying DCMs in practice will be described. These include assessing the fit of DCMs to response data, both globally and at the item level, as well as determining how information about item characteristics can be most succinctly described with these models. Moreover, the use of DCMs for the assembly of diagnostic assessments based on statistical information functions will be described before the course closes with an outlook toward advanced topics for DCMs.

Even though the last section focuses specifically on applying DCMs, examples will be used throughout the entire course to illustrate various characteristics of DCMs. For example, data from arithmetic assessments and psychological screening instruments will be used to show what parameter estimates in these contexts look like, how they can be interpreted, and how that information can be used to make decisions about the quality of the assessment and the profiles of the respondents. The course is designed to give participants an integrated knowledge about DCMs vis-à-vis alternative latent variable models from item response theory and confirmatory factor analysis. While the first part of the course is conceptual and decidedly non-statistical in nature, the second and third parts of the course gradually build a solid statistical knowledge of DCMs. Consequently, a basic education in statistical methods, akin to at least two introductory statistics courses along with at least an introductory course in test development and measurement is recommended to take full advantage of the course.

Software programs for estimating DCMs such as the CDM interface for *Mplus* (Templin, 2006), the LCDM software (Burke & Henson, 2008), and some code in *R* (<http://cran.r-project.org/>) will be used throughout the course. Note that all of these are freely available with the exception that the CDM interface requires the commercial program *Mplus* ([www.statmodel.com](http://www.statmodel.com)) to be installed. Links to relevant websites for downloading these programs will be provided on the presenter's website (<http://www.education.umd.edu/EDMS/fac/Rupp/>) before the course. Therefore, participants are encouraged to bring their own laptops. If a current version for *Mplus* is installed on the laptop, participants can reproduce some analyses using the CDM interface, but this is not necessary to participate successfully in the course.

**Date:** May 28 - 29, 2009 (Thursday and Friday), 8:30 a.m. – 5:00 p.m.

**Schedule:** 8:30 – 9:00 Continental breakfast (provided)  
*(both days)* 9:00 – 12:30 Workshop  
12:30 – 1:30 Lunch (on your own)  
1:30 – 5:00 Workshop

**Location:** University of Maryland, [Adele H. Stamp Student Union \(Building # 163\)](#), Benjamin Banneker Room

**Price:** \$450 for both days combined; \$295 for full-time students

Course fee includes electronic copies of all handouts, an electronic copy of the textbook co-written by the presenter, and continental breakfasts. Participants are responsible for their own lodging, lunches, evening meals, and parking. For more information about the University campus please visit [www.maryland.edu](http://www.maryland.edu). Note that the University provides a free shuttle to and from the College Park metro station (about a 10 minute ride), which is part of the Washington, D.C. metro system.

## Presenter

André A. Rupp is a faculty member in the *Department of Measurement, Statistics and Evaluation (EDMS)* at the *University of Maryland* where the workshop is being held. Over the years, he has worked in different research positions in Canada, Germany, and the United States. Before coming to EDMS, he worked at the national research institute for standards-based assessment in Germany, which gave him a comprehensive understanding of how conflicting demands of assessment designers, curriculum experts, measurement specialists, and policy-makers need to be negotiated for successful large-scale assessment projects. Thus, he brings a unique perspective to the workshop that relates to both the methodological and the applied spectrum of large-scale assessment work.

His research interests center on investigating how the theoretical potential of DCMs can be best realized in interdisciplinary practice, especially in educational assessment. His mission is to aid practitioners in dissecting and translating the often relatively complex landscape of the educational measurement literature into meaningful guidelines for best practice. He wants to specifically facilitate communication between experts with different backgrounds and belief-systems within interdisciplinary projects that use multidimensional measurement models generally and DCMs specifically. Most recently, in collaboration with colleagues at the University of Wisconsin at Madison, he has started to explore how such models can be used to analyze complex data arising out of simulation-based epistemic games to provide feedback that supports learning in such environments.

## References

- Burke, M. J., & Henson, R. (2008). *LCDM user's manual*. Greensboro, NC: University of North Carolina at Greensboro. More information available online at <http://www.uncg.edu/~rahenson/nsfsoftware.html>
- Henson, R., Templin, J., & Willse, J. (in press). Defining a family of cognitive diagnosis models. *Psychometrika*.
- Rupp, A. A., & Templin, J. (2008). Unique characteristics of diagnostic classification models: A comprehensive review of the current state-of-the-art. *Measurement: Interdisciplinary Research and Perspectives*, 6, 219-262.
- Rupp, A. A., Templin, J., & Henson, R. (2010). *Diagnostic measurement: Theory, methods, and applications*. New York: The Guilford Press.
- Templin, J. (2006). *CDM user's guide*. Kansas, NE: University of Kansas. Retrieved on January 15, 2009 from <http://jtemplin.myweb.uga.edu/cdm/index.html>