**Course Prerequisites**
This course is a graduate-level measurement course. The prerequisites of this course include classical and modern measurement theories, especially item response theory (IRT) and statistical models up to regression.

**Course Objectives**
This seminar focuses on classification and cognitive diagnosis in current psychometric practices and research. It covers classification and cognitive diagnosis based on latent trait models including unidimensional and multidimensional item response theory models and latent class analysis. Though diagnosis could be conducted based on item feature related models such as LLTM and MIRID, this course will only include a light touch on this perspective.

The course starts with an introduction to common psychometric procedures in classification decisions in both summative and formative assessment. It further elaborates latent class based cognitive diagnosis models. The models will be compared with other related models for classification and diagnosis. The framework, model setup and parameter estimation will be discussed. Model parameter estimation will be demonstrated using both Mplus and OpenBugs. Model fit and selection will be addressed. Further extensions will be discussed including topics related to inclusion of covariates, computerized adaptive tests for cognitive diagnosis, integrating process data and item response data for cognitive diagnosis, etc..

It is expected that the introduction to the procedures and the models for classification and cognitive diagnosis will motivate students to think of any potential problems and come up with better solutions, thus initiate original research. Students should read relevant literature before each class so that meaningful discussion will be possible in class. Each class session consists of lectures and discussions. The expected final product of taking this course is to create a proposal for an academic conference in psychometrics such as NCME, AERA Division D, IMPS, or APA, which ultimately leads to a journal publication.

**Textbooks**
**Additional Reference Textbooks**

**Diagnosis modeling**

**Item response theory**

**Journal Papers (will be updated if needed):**


**Useful websites:**

Estimating DCMs with Mplus
[http://jonathantemplin.com/diagnostic-measurement-theory-methods-applications/estimating-dcms-mplus/]

Chapter exercises
[http://jonathantemplin.com/diagnostic-measurement-theory-methods-applications/chapter-exercises/]

DCM courses
[http://jonathantemplin.com/teaching/academic-courses/dcm/]
### Course Topics and Readings

The following table lists the topics to be covered in this course. **This timetable is tentative. Adjustment is very likely to be made along the semester.** Reading materials will be uploaded onto elms and are subject to adjustment.

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topics</th>
<th>Assignments</th>
<th>Readings</th>
</tr>
</thead>
</table>
| 1    | 8/30  | Course overview<br>Procedures for classification and diagnosis        |                     | Embretson & Yang (2014)  
|      |       |                                                                        |                     | DiBello, Roussos, & Stout (2007)                                         |
| 3    | 9/13  | Multidimensional IRT models for classification and diagnosis           |                     | Reckase (2009), Yao & Boughton (2007)                                    |
| 4    | 9/20  | Latent class analysis: overview                                         |                     | Dayton (1999); Dayton & Macready (2007)                                 |
| 5    | 9/27  | Basics of DCM                                                          | HW2                 | Rupp, Templin, & Henson (2010): Ch.5  
|      |       |                                                                        |                     | DiBello, Roussos, & Stout (2007)  
|      |       |                                                                        |                     | Junker & Sijtsma (2001)                                                   |
| 6    | 10/4  | Attribute specification for DCMs                                        | HW3                 | Rupp, Templin, & Henson (2010): Ch.4  
|      |       |                                                                        |                     | Price, Dayton, & Macready (1980)                                         |
| 7    | 10/11 | Non-compensatory DCMs                                                  |                     | Rupp, Templin, & Henson (2010): Ch.6                                    |
| 8    | 10/18 | Compensatory DCMs                                                       | Midterm project due | Rupp, Templin, & Henson (2010): Ch.6                                    |
| 9    | 10/25 | Log-linear modeling for DCMs                                            |                     | Rupp, Templin, & Henson (2010): Ch.7  
|      |       |                                                                        |                     | Henson, Templin, & Willse (2009)                                         |
| 10   | 11/1  | GDM                                                                     |                     | von Davier (2005)                                                         |
| 11   | 11/8  | Model parameter estimation using Mplus                                  | HW3                 | Rupp, Templin, & Henson (2010): Ch.9,10  
|      |       |                                                                        |                     | de la Torre (2009)                                                       |
|      |       |                                                                        |                     | Templin & Hoffman (2013)                                                 |
| 12   | 11/15 | Model parameter estimation using MCMC                                   |                     | Rupp, Templin, & Henson (2010): Ch.11                                    |
| 13   | 11/22 | Model fit                                                               | HW4                 | Rupp, Templin, & Henson (2010): Ch.12                                    |
| 14   | 11/29 | Extended DCMs and other research topics                                 |                     | Rupp, Templin, & Henson (2010): Ch.14  
|      |       |                                                                        |                     | Dayton & Macready (1988)                                                 |
|      |       |                                                                        |                     | de la Torre & Douglas (2004)                                              |
|      |       |                                                                        |                     | Huebner (2010)                                                           |
|      |       |                                                                        |                     | Gierl & Leighton (2007)                                                  |
|      |       |                                                                        |                     | McGlohen & Chang (2008)                                                  |
|      |       |                                                                        |                     | Xu & von Davier (2008)                                                   |
|      |       |                                                                        |                     | von Davier & Carstensen (2007)                                            |
| 15   | 12/6  | Research project presentation                                          | Presentation due    |                                                                            |
| 16   | 12/13 | Final research project                                                 | Final project due    |                                                                            |
**Statistical Software**

You will use Mplus and OpenBUGS for model parameter estimation. You can use R, SAS, or other software programs for simulation studies.


**Formal Course Assessment**

**Homework Assignments**

There will be 4 assignments spaced evenly throughout the semester to give students an opportunity to apply, practice, and think about the concepts learned in class. It is expected that students will be using software programs for homework assignments. When working on the assignments, students are expected to pull together the material from lecture, chapters, and journal papers where applicable. **Homework assignment will be submitted electronically via email in a WORD file attachment and graded homework will be returned via email too.** Late homework assignments will be accepted with a penalty of 10% credit. Graded assignments will generally be returned in the following week after they are submitted. **Students are encouraged to work in groups on homework, but each student must turn in their own write-up.**

In the assignments students should cut and paste relevant portions of the computer output into the appropriate places in the homework to show how solutions are arrived. Assignments should be well-organized and must be word-processed.

**Projects**

There will be two projects. For the midterm project, each student will propose an original research study and write up a proposal based on one of the call for proposals for a conference like AERA Division D, NCME, NCME Graduate Student Poster Session, IMPS, or APA including background, literature review, research questions, and methodology.

Scoring rubrics for final research proposal:

- **Objectives or purposes** Min: 1: (Insignificant) Max: 5: (Critically Significant)
- **Perspective(s) or theoretical framework:** Min: 1: (Not Articulated) to Max: 5: (Well Articulated)
- **Methods, techniques, or modes of inquiry:** Min: 1: (Not Well Executed) to Max: 5: (Well Executed)
- **Scientific or scholarly significance of the study or work:** Min: 1: (Routine) to Max: 5: (Highly Original)

The final project is the completion of your proposed mid-term project with data analysis. **Preliminary analysis should be conducted using either simulated data or real data.** The final project will be evaluated in terms of the following criteria.

- **Objectives or purposes** Min: 1: (Insignificant) Max: 5: (Critically Significant)
- **Perspective(s) or theoretical framework:** Min: 1: (Not Articulated) to Max: 5: (Well Articulated)
- **Methods, techniques, or modes of inquiry:** Min: 1: (Not Well Executed) to Max: 5: (Well Executed)
- **Data sources, evidence, objects or materials Or, for theory or methods based papers, what would be the equivalent bases:** Min: 1: (Inappropriate) to Max: 5: (Appropriate)
- **Results and/or substantiated conclusions or warrants for arguments/point of view (Not available):** Min: 1: (Ungrounded) to Max: 5: (Well Grounded)
- **Scientific or scholarly significance of the study or work:** Min: 1: (Routine) to Max: 5: (Highly Original)
Presentation
This assessment requires students present on their proposed research for the final project. Each student will be given 10-15 minutes to present his/her study and 3-5 minutes for questions. Each presentation will be rated based on the same evaluation criteria as for the final project. Each student will rate other students’ presentations anonymously and students’ ratings will be counted towards the final score for this assessment. Outlier ratings will be dropped.

Course Grades
Students’ homework, exams, and projects’ grades will be combined using a weighted average grading scheme with the corresponding weights given below. Final letter grades will then be assigned based on the given scale.

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Weight</th>
<th>Overall Course Percent</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total homework points</td>
<td>40%</td>
<td>100%-95%</td>
<td>A+</td>
</tr>
<tr>
<td>Total midterm project points</td>
<td>25%</td>
<td>94% - 91%</td>
<td>A</td>
</tr>
<tr>
<td>Total presentation points</td>
<td>10%</td>
<td>90% - 88%</td>
<td>A-</td>
</tr>
<tr>
<td>Total final project points</td>
<td>25%</td>
<td>87% - 85%</td>
<td>B+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>84% - 81%</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80% - 78%</td>
<td>B-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>77% - 75%</td>
<td>C+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>74% - 70%</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>69% - 65%</td>
<td>C-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>64% - 60%</td>
<td>D+</td>
</tr>
<tr>
<td></td>
<td></td>
<td>59% - 55%</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>54% - 50%</td>
<td>D-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≤ 49%</td>
<td>F</td>
</tr>
</tbody>
</table>

Class Policies

Academic integrity: The University of Maryland, College Park has a student-administered Honor Code and Honor Pledge. For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://www.studenthonorcouncil.umd.edu/whatis.html. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. The code prohibits students from cheating, fabrication, facilitating academic dishonesty, and plagiarism. Instances of this include submitting someone else’s work as your own, submitting your own work completed for another class without permission, or failing to properly cite information other than your own (found in journals, books, online, or otherwise). Any form of academic dishonesty will not be tolerated, and any sign of academic dishonesty will be reported to the appropriate University officials.

Special needs: If you have a registered disability that will require accommodation, please see the instructor so necessary arrangements can be made. If you have a disability and have not yet registered with the University, please contact Disability Support Services in the Shoemaker Building (301.314.7682, or 301.405.7683 TTD) as soon as possible.

Religious observances: The University of Maryland policy on religious observances states that students not be penalized in any way for participation in religious observances. Students shall be
allowed, whenever possible, to make up academic assignments that are missed due to such absences. However, the student must contact the instructor before the absence with a written notification of the projected absence, and arrangements will be made for make-up work or examinations.

**Course evaluations:** As a member of our academic community, students have a number of important responsibilities. One of these responsibilities is to submit course evaluations each term through CourseEvalUM in order to help faculty and administrators improve teaching and learning at Maryland. All information submitted to CourseEvalUM is confidential. Campus will notify you when CourseEvalUM is open for you to complete your evaluations for fall semester courses. Please go directly to the website (www.courseevalum.umd.edu) to complete your evaluations. By completing all of your evaluations each semester, you will have the privilege of accessing online, at Testudo, the evaluation reports for the thousands of courses for which 70% or more students submitted their evaluations.

**Missed single class due to illness:** Once during a semester, a student’s self-authored note will be accepted as an excuse for missing a minor scheduled grading event in a single class session if the note documents the date of the illness, acknowledgement from the student that information provided in the note is correct, and a statement that the student understands that providing false information is a violation of the Code of Student Conduct. Students are expected to attempt to inform the instructor of the illness prior to the date of the missed class.*

**Major scheduled grading events:** Major Scheduled Grading Events (MSGE) are indicated on the syllabus. The conditions for accepting a self-signed note do not apply to these events. Written, signed documentation by a health care professional, or other professional in the case of non-medical reasons (see below) of a University-approved excuse for the student’s absence must be supplied. This documentation must include verification of treatment dates and the time period for which the student was unable to meet course requirements. Providers should not include diagnostic information. Without this documentation, opportunities to make up missed assignments or assessments will not be provided.

**Non-consecutive, medically necessitated absences from multiple class sessions:** Students who throughout the semester miss multiple, non-consecutive class sessions due to medical problems must provide written documentation from a health care professional that their attendance on those days was prohibited for medical reasons.

**Non-medical excused absences:** According to University policy, non-medical excused absences for missed assignments or assessments may include illness of a dependent, religious observance, involvement in University activities at the request of University officials, or circumstances that are beyond the control of the student. Students asking for excused absence for any of those reasons must also supply appropriate written documentation of the cause and make every attempt to inform the instructor prior to the date of the missed class.