Psychometric Modeling Visiting Scholar

August 1, 2017

The Achievement and Assessment Institute (AAI) at the University of Kansas seeks faculty and researchers interested in a visiting scholar appointment to conduct psychometric modeling research using Bayesian networks or diagnostic classification modeling as part of a research collaboration or sabbatical. Recipients will receive access to a large data set and the opportunity to expand their research agenda in the areas of Bayesian networks or diagnostic classification modeling. Funding is available. Arrangements can be made for summer or semester-long appointments. The scope of the project will be arranged between AAI and the researcher, but will require a final written report. Interested individuals should contact DLM staff by **September 11, 2017** at dlm@ku.edu to express their interest.

Background

The Dynamic Learning Maps® (DLM®) Alternate Assessment System delivers large-scale accountability assessments in English language arts, mathematics, and science to students in a 17-state consortium. The assessment is based on an underlying set of learning map models in English language arts and mathematics, and a science learning map model that is under development. Assessments measure student performance on academic content standards at five skill levels and features spring adaptive testing. Due to the unique design of the assessment system, DLM assessments are scored using diagnostic classification modeling in order to provide student mastery information for each measured skill.

Additional information about DLM assessments can be found on the DLM website (dynamiclearningmaps.org) or in the section of this packet called Overview of Dynamic Learning Maps Assessments. The Technical Manual for the assessment, including additional information on the assessment system, is available here: http://dynamiclearningmaps.org/about/research/publications

Scope of Work

The DLM consortium invites faculty and researchers to serve in a visiting scholar appointment with the aim of conducting research using DLM data in the areas of Bayesian networks or diagnostic classification modeling. Work could be conducted at the University of Kansas or at the applicant's own institution. In addition, an initial on-site visit will be arranged by DLM staff and paid for by the DLM project. Suggested research ideas are included below; however, other relevant research topics will also be considered. Interested individuals may request a summer or one- to two-semester appointment, and may also apply for support for follow-up studies upon successful completion of earlier projects.

Potential research topics include, but are not limited to, the following:

- Application of a Bayesian network to propagate information across nodes within a learning map model*

* High priority in DLM research agenda

- Evaluation of test design considerations for an assessment system based on a learning map structure (e.g., number of items per node, amount of overlap between nodes assessed)*
- Defining a psychometric model that supports making inferences across linkage levels (skills) within an Essential Element (content standard), where not all levels are tested*
- Evaluation of a learning map structure in instances of missing/sparse data (e.g., node reversals or over-specification)
- Methods for assessing model fit in diagnostic models (DCMs or Bayes Nets)
- Score reporting on diagnostic assessments including standard errors of measurement
- Aggregation of scores from several models into a single reported score
- Assessing differential item functioning based on dichotomous mastery status obtained from DCM or Bayes Nets
- Identifying mis-fitting items in diagnostic assessments (scored using DCMs or Bayes Nets)
- Evaluating the impact of node mastery classification thresholds

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Deliverables

The scope of research to be conducted during the appointment will be agreed upon by AAI and the visiting scholar prior to the beginning of the appointment. During the appointment, written monthly briefs will be submitted at the end of each month to update project staff on progress towards the research goals. A final research report will be submitted at the conclusion of the appointment. AAI may also request delivery of any scripts created for the purposes of fulfilling the fellowship. At the discretion of AAI, the recipient may be invited to present to the DLM Technical Advisory Committee.

Overview of Dynamic Learning Maps Assessments

The Dynamic Learning Maps Alternate Assessment System delivers alternate assessments based on alternate achievement standards to students with the most significant cognitive disabilities in 17 partner states. The DLM system is based on an underlying learning map network that consists of nodes, or individual skills, and the connections between them. Nodes in the map span from early foundational skills to knowledge, skills, and understandings demonstrated by students who are college- and career-ready.

The alternate content standards measured by the assessment are called Essential Elements (EEs). Each EE is measured by five linkage levels. The Target level is the grade-level expectation. Three precursors, Initial Precursor, Distal Precursor, and Proximal Precursor, represent reduced breadth and complexity of the grade-level target. The Successor level is a level beyond the Target for students who have gone beyond the grade-level expectation for the EE. The use of five linkage levels allows all students in the alternate assessment population to access grade-level content at a level that is appropriate to them.

In total, there are 255 EEs and 1,275 linkage levels measured by the assessment. Each linkage level measures one or more nodes in the underlying map structure, with the total map consisting of thousands of nodes and connections. Not all nodes in the learning maps are tested, and there is variable missing data due to the adaptive design of the assessment.

Dynamic Learning Maps assessments are calibrated and scored using a diagnostic modeling approach rather than more traditional psychometric approaches. The level of scoring and reporting is the linkage level for each EE. Currently, each of the 1,275 linkage levels is separately calibrated and scored using latent class analysis, with item parameters for all items measuring the linkage level assumed to be fungible or exchangeable.

Mastery of the linkage level can be demonstrated one of three ways: 1) the student's posterior probability from the model is at or above the threshold of 0.8; 2) the student's percent of correct responses for all items measuring the linkage level is at or above 80%; or 3) a two-down mastery rule, whereby if the student is assessed on a higher linkage level and does not demonstrate mastery via posterior probability or percent correct, mastery is assumed at a linkage level two levels below the lowest level tested and not mastered. Using this scoring method, a student's mastery of each linkage level is determined. The total linkage levels mastered in the grade and content area are used to determine the student's overall performance level.

Operational research to date has explored using the log-linear cognitive diagnosis model (LCDM) to concurrently calibrate and score all linkage levels measuring an EE. In addition, simulation studies have been conducted to evaluate whether multi-linkage level testlets may support concurrent calibration using the LCDM in the future. Model fit has been evaluated for both a fungible and non-fungible model using univariate, bivariate, and trivariate fit indices.

Data is available for approximately 90,000 students in grades three through high school across two operational assessment years in English language arts, mathematics, and science.