PSYCHOMETRICS APPLIED TO HEALTHCARE PROFESSIONS EDUCATION

COURSE PROGRAMME

Psychometric properties such as reliability and validity are essential components in the utility of assessment in medical education. Many teachers from the healthcare professions are interested in knowing more about psychometrics and how they can apply psychometric analysis in their institutions. At the same time, it might be difficult for them to find the opportunity of having a course where they can learn not only the theoretical concepts of Psychometrics, but also their strengths and limitations, in a manner that they can understand. Furthermore, learning how to do the psychometric analyses might be a challenging task for non-psychometricians. For those reasons, the European Board of Medical Assessors (EBMA) now offers the new course on "Psychometrics Applied to Healthcare Professions Education", destined to persons in the introductory and intermediate who wish to learn the theory and the practice of Psychometrics.

During this course several practical exercises will be done by participants. Each one of the participants is expected to bring their own device (BYOD) with the latest versions of R (https://cran.r-project.org/), RStudio (https://www.rstudio.com/products/rstudio/download/) and Exametrika (http://www.rd.dnc.ac.jp/~shojima/exmk/exmk53.zip) installed. Nevertheless, participants are not expected to have previous experience with any of this software.

Participants are invited to also bring their own datasets and use their free time to apply the techniques learned during the course. In the last day of the course, participants who would like to make a short presentation of their work and get feedback will have that option.

Course instructors:

Cees van der Vleuten, PhD, is a Professor of Education of the Department of Educational Development and Research of the Faculty of Health, Medicine and Life Sciences. Since 2005 he has been the Scientific Director of the School of Health Professions Education. His primary expertise lies in evaluation and assessment. He has published widely in this domain, holds numerous academic awards, including several career awards. In 2005 he received John P. Hubbard Award for significant contribution to research and development of assessment of medical competence from the National Board of Medical Examiners in the US. In 2010 he received a Dutch royal decoration for the societal impact of his work and in 2012 the Karolinska Prize for Research in Medical Education. He serves frequently as a consultant internationally. He holds honorary academic appointments in the School of Medicine, Flinders University, Adelaide in Australia, Western Sydney University, Sydney in Australia, the University of the Witwatersrand, Johannesburg in South-Africa, and the Uniformed Services University of the Health Sciences, Bethesda, United States of America.

Carlos Collares, MD, MSc, PhD, FACMT, is Assistant Professor of Medical Education in the Department of Educational Development and Research of the Faculty of Health, Medicine and Life Sciences as well as Assessment Specialist for the European Board of Medical Assessors. He moved from Brazil to the Netherlands after applying techniques used on the validity and reliability studies of neurobehavioral test batteries to the analysis of assessment tools used in medical education, particularly progress testing. He has implemented the International Progress Test to institutions in the Netherlands, Finland, Mexico and Saudi Arabia, and collaborates with progress testing programmes in Australia and Mozambique. He has also assisted on the implementation of a computerized adaptive version of the International Progress Test, which, by dynamically adjusting the difficulty of the test according to the test takers' performance, shortens the test, reduces testing time and increases the reliability of scores, especially for students in the early academic years.

Day 1 – Introduction to psychometrics – Carlos Collares

09.00 *Welcome and overview of the day*

09.10 *Interactive lecture: What is Psychometrics?*

10.30 *Coffee/tea break*

10.45 *Interactive lecture: What is Validity and Reliability?*

12.00 *Lunch*

13.00 *Small-group exercise: Simulated Post-Test Review Committee.*

14.30 *Coffee/tea break*

14.45 *Practical exercise: making your own classical test theory analysis*

16.00 *Plenary discussion and Take-home messages*

16.30 *Closing*

This module focuses on
- The scope of Psychometrics and an overview of the main psychometric theories;
- The concepts of validity and reliability;
- The contributions of psychometrics to the quality assurance of testing;
- Classical test theory analyses.

Activities and working formats
- Interactive lectures;
- Small-group exercises.

Objectives
- Comprehension of fundamental psychometric concepts;
- Enabling participants to perform and interpret their own classical test theory analysis.

Preparatory and/or further reading
van der Vleuten CP, Schuwirth LW, Scheele F, Driessen EW, Hodges B. (2010). The assessment of professional competence: building blocks for theory development. Best Pract Res Clin Obstet Gynaecol, 24(6):703-19.
Schuwirth LW, van der Vleuten CP. (2011) General overview of the theories used in assessment: AMEE Guide No. 57. Medical Teacher, 33(10):783-97.
Schuwirth, L. W., & Vleuten, C. P. (2006). A plea for new psychometric models in educational assessment. Medical Education, 40(4), 296-300.

Day 2 – Generalizability theory – Cees van der Vleuten

09.00	*Welcome and overview of the day*
09.10	*Interactive lecture: The nuts and bolts of generalizability theory?*
10.30	*Coffee/tea break*
10.45	*Making sense out of published papers using generalizability theory.*
12.00	*Lunch*
13.00	*Application of generalizability theory to the design, implementation and quality assurance of OSCEs.*
14.45	*Coffee/tea break*
15.00	*Practical exercise: making your own generalizabilty theory analysis.*
16.00	*Plenary discussion and Take-home messages*
16.30	*Closing*

This module focuses on
- Why and when is generalizability theory useful?
- What is a generalizability study?
- What is a decision study?

Activities and working formats
- Interactive lectures;
- Small-group exercises.

Objectives
- Comprehension of fundamental concepts of generalizability theory;
- Enabling participants to perform and interpret their generalizability theory analysis.

Preparatory reading
Bloch, R., & Norman, G. (2012). Generalizability theory for the perplexed: a practical introduction and guide: AMEE Guide No. 68. *Medical teacher, 34*(11), 960-992.

Further reading
Shavelson, R. J., & Webb, N. M. (1991). *Generalizability theory: A primer.* Sage.
Brennan RL. *Generalizability Theory*. Iowa: ACT Publications, New York: Springer 2001.

Day 3 – Exploratory methods – Carlos Collares

09.00 *Welcome and overview of the day*

09.10 *Interactive lecture: How can we find the internal structure of an assessment tool? An overview of the available methods (Part I – Exploratory factor analysis/Principal component analysis/Principal axis factoring)*

10.30 *Coffee/tea break*

10.45 *Interactive lecture: How can we find the internal structure of an assessment tool? An overview of the available methods (Part II – New methods: Exploratory Structural Equation Modelling, Lasso Regularization and Exploratory Graph Analysis)*

12.00 *Lunch*

13.00 *Practical exercise: comparing different exploratory methods*

14.30 *Coffee/tea break*

14.45 *Practical exercise: comparing different exploratory methods (continuation)*

16.00 *Plenary discussion and Take-home messages*

16.30 *Closing*

This module focuses on
- The available exploratory methods to find the internal structure of an assessment tool;
- Exploratory analyses in practice.

Activities and working formats
- Interactive lectures;
- Practical exercises.

Objectives
- Comprehension of the different exploratory methods;
- Enabling participants to perform and interpret their exploratory analyses.

Preparatory and/or further reading
Field, A. (2013). Discovering statistics using IBM SPSS statistics. Sage.
Williams, B., Onsman, A., & Brown, T. (2010). Exploratory factor analysis: A five-step guide for novices. Australasian Journal of Paramedicine, 8(3).
Asparouhov, T. & Muthén, B. (2009). Exploratory structural equation modeling. Structural Equation Modeling, 16, 397-438.
Sun, J., et al. (2016). Latent variable selection for multidimensional item response theory models via L_1 regularization. Psychometrika, 81(4), 921.
Golino, H. F., & Epskamp, S. (2016). Exploratory graph analysis: a new approach for estimating the number of dimensions in psychological research. *arXiv preprint arXiv:1605.02231*.

Day 4 - Confirmatory methods and Item response theory – Carlos Collares

09.00 *Welcome and overview of the day*

09.10 *Interactive lecture: Understanding confirmatory factor analysis*

10.30 *Coffee/tea break*

10.45 *Interactive lecture: Understanding item response theory*

12.00 *Lunch*

13.00 *Practical exercise: making confirmatory factor analyses*

14.30 *Coffee/tea break*

14.45 *Practical exercise: making item response theory analyses*

16.00 *Plenary discussion and Take-home messages*

16.30 *Closing*

This module focuses on
- Unidimensional and Multidimensional Item Response Theory (UIRT/MIRT);
- Confirmatory factor analysis (CFA);
- The comparison between the UIRT/MIRT and CFA approaches.

Activities and working formats
- Interactive lectures;
- Practical exercises.

Objectives
- Comprehension of CFA and UIRT/MIRT;
- Enabling participants to perform and interpret their own CFA and UIRT/MIRT analyses.

Preparatory and/or further reading
De Champlain, A. F. (2010). A primer on classical test theory and item response theory for assessments in medical education. Medical education, 44(1), 109-117.
Downing, S. M. (2003). Item response theory: applications of modern test theory in medical education. Medical Education, 37(8), 739-745.
Jackson, D. L., Gillaspy Jr, J. A., & Purc-Stephenson, R. (2009). Reporting practices in confirmatory factor analysis: an overview and some recommendations. Psychological Methods, 14(1), 6.

Day 5 – Developments in psychometrics – Carlos Collares

09.00	*Welcome and overview of the day*
09.10	*Interactive lecture: Computerized adaptive testing*
10.00	*Coffee/tea break*
10:15	*Interactive lecture: Many-Facets Rasch Model*
11.00	*Coffee/tea break*
11.15	*Interactive lecture: Measurement invariance*
12.00	*Lunch*
13.00	*Interactive lecture: Network psychometrics*
14.00	*Coffee/tea break*
14.15	*Presentations by the participants (optional)*
16.15	*Plenary discussion and Take-home messages*
16.30	*Closing*

This module focuses on
- Emerging topics and techniques on Psychometrics.

Activities and working formats
- Interactive lectures;
- Demonstrations.

Objectives
- Introduce the participants to the emerging topics on Psychometrics;
- Demonstrate applications for these techniques.

Preparatory and/or further reading
Chang, H. H. (2015). Psychometrics behind computerized adaptive testing. Psychometrika, 80(1), 1-20.
Muthén, B. & Asparouhov T. (2014). IRT studies of many groups: The alignment method. Frontiers in Psychology, Volume 5, DOI: 10.3389/fpsyg.2014.00978
Reise, S. P., Widaman, K. F., & Pugh, R. H. (1993). Confirmatory factor analysis and item response theory: two approaches for exploring measurement invariance. Psychological Bulletin, 114(3), 552.
Epskamp, S., Rhemtulla, M., & Borsboom, D. (2016). Generalized network psychometrics: Combining network and latent variable models. *arXiv preprint arXiv:1605.09288*.
Kim, E. S., & Yoon, M. (2011). Testing measurement invariance: A comparison of multiple-group categorical CFA and IRT. Structural Equation Modeling, 18(2), 212-228.