**“Application of latent variable models in evaluating diagnostic tests and its software development”**

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In many medical studies, the definitive outcome is inaccessible due to cost, time and difficulty of measurement. A valid surrogate endpoint is then measured in place of the biologically definitive or clinically most meaningful endpoint. For example, biomarkers are very often used as surrogates of observing new cases of cancer in testing treatments for cancer prevention, where event rates are low and a long time may be needed to obtain definitive outcomes. Functional disability is commonly quantified as self-reported responses to a series of questions about difficulty performing tasks of routine living, because no obvious single measure of disability exists.

Latent variable models are recognized as an effective statistical tool for analyzing surrogates. Such models treat the unobserved definitive outcome as the one to be analyzed for relations with risk factors, and the measured surrogates as quantities that imperfectly determine the object of interest. Analysis based on latent variable models is parsimonious, explicitly recognize errors in measurement, and can give well-summarized inferences on the theory underlying the choice of surrogates.

The author has recently developed a very flexible latent variable model for analyzing surrogates. I also addressed issues about selecting the number of dimensions needed to characterize the surrogates' distribution and diagnosing various latent variable model assumptions. In this project, I propose to extend the latent variable model developed by the author to evaluate the validity and reliability of diagnostic tests. This application is important because the model enables us to evaluate tests without knowing the gold standard. I also plan to incorporate the latent variable methodologies developed by the author into an easy-to-use statistical software capable of being used effectively by all levels of participants of data analysis.

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