
Questions and Sample Answers for Chapter 3

Section 1 – Questions

Question 1

Which of the following statistical models are typically utilized specifically and directly for the grouping / classification of respondents?

- a. Diagnostic classification models
- b. Latent class models
- c. Cluster analysis methods
- d. Logistic regression models
- e. Item response theory models
- f. Exploratory and confirmatory factor analysis models
- g. All of the above
- h. None of the above

Question 2

Would a DCM be an appropriate statistical model for the following use context where a coach is looking to identify his best starting line-up? Explain.

In an effort to improve his football team's performance, the coaching staff used pre-season to collect data on the performance of all his players. The coach required his players to wear heart rate monitors so that he could log their exertion levels; his coaching staff recorded performance during practices as well as whether or not players came to practice on time and were ready to play. Players completed self-assessment questionnaires at the end of each week. The players completed brief in-person interviews at the beginning of pre-season and again at the season's mid-point discussing their goals and commitment to the upcoming season. The coach has identified what he wants and needs from his players. With two weeks left to go before the season starts, the coach is looking at all of the data he has collected and is ready to put it all together so that he can identify the first and second lines and the starters can begin practicing together.

Question 3

Although there are several differences between the CDS and ECD frameworks, both similarly locate the model selection process within the diagnostic assessment process. Which of the following statements best matches the role of statistical models for evidence-based reasoning as described in the CDS and ECD frameworks?

- a. The selection of the statistical model should be the first step in the assessment design process because the statistical model drives the diagnostic assessment narrative.
- b. The selection of a statistical model is critical because whether or not a diagnostic assessment is valid hinges on the validity of the statistical model.
- c. The selection of a statistical model is secondary to the identification of the purpose of the assessment which the statistical model is then intended to support .
- d. The selection of the statistical model should be limited to the selection of an appropriate DCM, as these models lead to the reduction in classification error and are thus best suited to the diagnostic assessment process across contexts and research purposes.

Section 2 – Sample Answers

Question 1

Correct answers: a, b and c

Similar to general latent class models, diagnostic classification models are restricted latent class models that are specifically designed to classify respondents into mutually exclusive latent classes. These models are parametric in nature, contrary to cluster analysis methods, most of which are non-parametric procedures. Logistic regression models, even though they model binary or multinomial categorical outcome variables, are usually used for making predictions on a homogeneous cohort, unless mixture models are used that superimpose a latent class structure onto the logistic regression model. Item response and factor analysis models contain continuous latent variable scales that do not lead to direct statistical classifications of respondents even though follow-up processes such as standard-setting can be used to artificially “cut-up” such scales into different levels that support classifications.

Question 2

A DCM might be an appropriate statistical model to use but its application would require a few adaptations; a simple latent class model with order restrictions or other clustering approaches might work just as well.

The purpose of the assessment is to classify players according to a variable that is ordinal in nature with three levels, *Primary Line*, *Secondary Line*, and *Back-Up Players*. While a DCM can accommodate multiple data sources and will classify players, it requires a specification of multiple attributes and their relationships to observed responses on the various tests that the players are given. It is not directly clear what these attributes would be and how exactly particular attribute profiles would relate to the simple classification into the three player groups. A simple latent class model with three classes where order restrictions are placed on the probabilities for individual indicators might work just as well or even better here.

If such specifications could be developed, then a DCM may be useful because it could generate diagnostic profiles that can be used by the coach and his staff to identify the ways in which players' would need to improve their skills and or refocus their motivation in order to make the starting line-up. Importantly, the data from players would be longitudinal / time-series data, though, which violates some of the model assumptions of DCMs therefore making population inference uncertain. This may not be required for the use context though in which case the results of a DCM calibration may be used descriptively. Overall, the data stream is relatively complex and care would have to be exerted to use a DCM for data analysis here.

Question 3

Correct answer: c

The role of statistical models for creating evidence-based assessment arguments – which are like the rhetorical framing of a story – should be supportive in nature – like the grammar of a language that is used to create this story. Thus, the purpose of the assessment should guide the selection and the application of suitable statistical diagnostic models so (a) is not the correct answer.

As explained by Kane (2007), claims and inferences are validated. Tests, test scores, and statistical models cannot be validated because they are physical, numerical, and mathematical objects, respectively. Thus, (b) is not the correct answer either.

Neither framework prescribes a particular statistical model even though some models have been used rather frequently in applications of the two frameworks in the peer-reviewed literature (e.g., variants of the linear logistic test model for the CDS framework and Bayes nets for the ECD framework). In fact, the ECD framework has been developed so that it is broadly applicable independent of which statistical model(s) are selected, so (d) is not the correct answer either.