

Randomized Item Response Model

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Abstract

The collection of data through surveys on highly personal and sensitive issues may lead to answering refusals and false responses, making inferences difficult. Obtaining valid and reliable information depends on the cooperation of the respondents, and the willingness of the respondents depends on the confidentiality of their responses. Warner (1965) developed a data collection procedure, the randomized response technique (RR), that allows researchers to obtain sensitive information while guaranteeing privacy to respondents. For example, a randomizing device is used to select a question from a group of questions and the respondent answers the selected question. The respondent is protected since the interviewer will not know which question is being answered. In Warner's and related approaches, there is only sufficient information from a sample of respondents to estimate proportions and related confidence intervals in the population. When using item response theory, individual attitudes can be estimated and other statistical analyses are possible.

An answer of a respondent concerns a real answer to the sensitive question with a certain probability, p , depending on the randomization technique. When using a two-parameter item response theory model, $P(Y | \theta, \alpha, \beta)$, the answer on an item can be modelled as

$$P(Y) = p P(Y | \theta, \alpha, \beta) + (1 - p)\pi, \quad (1)$$

where π is defined by the randomization technique. Since the probability p is known a priori, the item and ability parameters can be estimated from the observed data. The randomization technique only effects the precision of the parameter estimates depending on the value of p . The attitude of an individual towards a sensitive topic can be estimated while obtaining privacy regarding its individual answers. The model can be extended to allow for a nesting of the respondents in groups and explanatory variables concerning characteristics of the respondents or groups. A MCMC method can be used to estimate all parameters simultaneously. Now, a one-way classification or a multilevel analyses is possible, based on the attitudes of the respondents. An analyses of variance, for example, could be interesting for comparing proportions of respondents that are cheating conditional on some grouping variable, gender, socioeconomic status or level of education, without asking respondents directly sensitive questions.

References

- Warner (1965). Randomized Response: A survey technique for eliminating evasive answer bias. *Journal of the American Statistical Association*, 60, pp. 63-69.