# Representativeness (R-index) and Nonresponse Bias Patterns in Household Surveys

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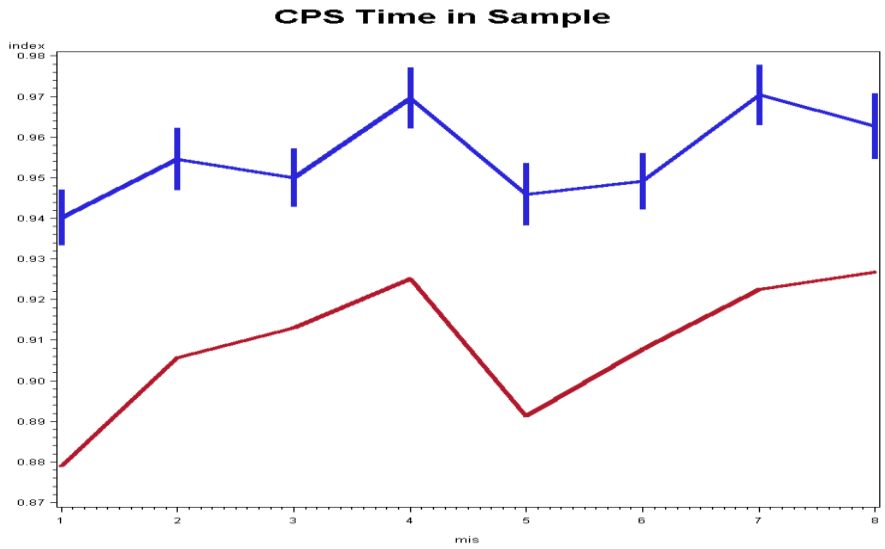
Nonresponse rates have been used as a proxy for survey quality since they indicate the relative potential for nonresponse bias. Recently the R-index (Schouten) has generated interest in an alternative approach that better represents the potential for bias by focusing more on coverage than nonresponse. The patterns of nonresponse rates (e.g.; seasonal, time in sample) and the R-index can provide insight into the usefulness of nonresponse rates and representativeness. In this study, I was interested in a replacement for the traditional response rate for a survey. The response rate doesn't reflect the actual bias, only some potential for bias. The R-index, based on models of nonresponse and their relationship to survey characteristics shows some potential to reflect a survey's "representativeness". The current study uses different measures of nonresponse bias, nonresponse rates, and the R-index to see if there are patterns for bias and representativeness which might be different than for response rates alone. Two surveys, the Current Population Survey (CPS), and the Consumer Expenditure Quarterly Survey (CEQ) will be used in this analysis. There are a number of different variations on r-indicators. The response probabilities are usually estimated with a model; often a logistic or probit model. This R-indicator is based on the standard deviation of estimated response probabilities. It is defined by

$$M(\rho)= 1 - 2\, S(\rho)$$

The response data set is representative if all response probabilities are equal. In this case the standard deviation is zero, and M(p) takes on the value 1. The response data set is not representative if there is much variation in response probabilities. This is reflected by a large standard error. The maximum value the standard error can assume is 0.5. In this case the value of the R-indicator is equal to 0. Schouten, B., Cobben, F. & Bethlehem, J. (SM 2009). The variances are often estimated with bootstrapping, and software in SAS and R is available.

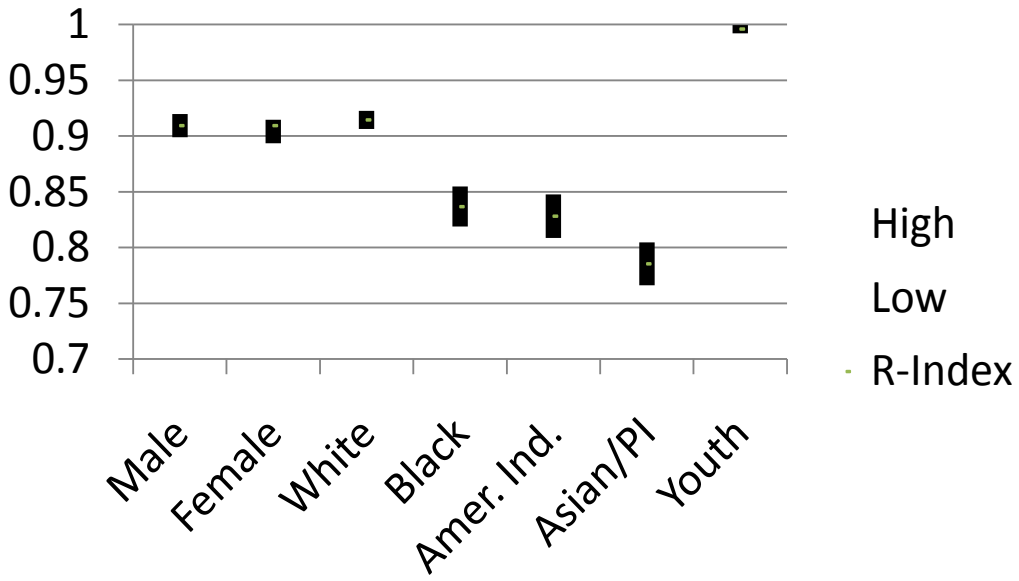
Usually, the R-index shows coefficients to describe the index and contributions to it. I tried graphical methods in the hopes of seeing more interesting patterns, but they gave the same interpretation.

The R-index is an index which uses a propensity score model for nonresponse and relates that to other variables (usually frame variables, such as urbanicity, poverty, etc.).



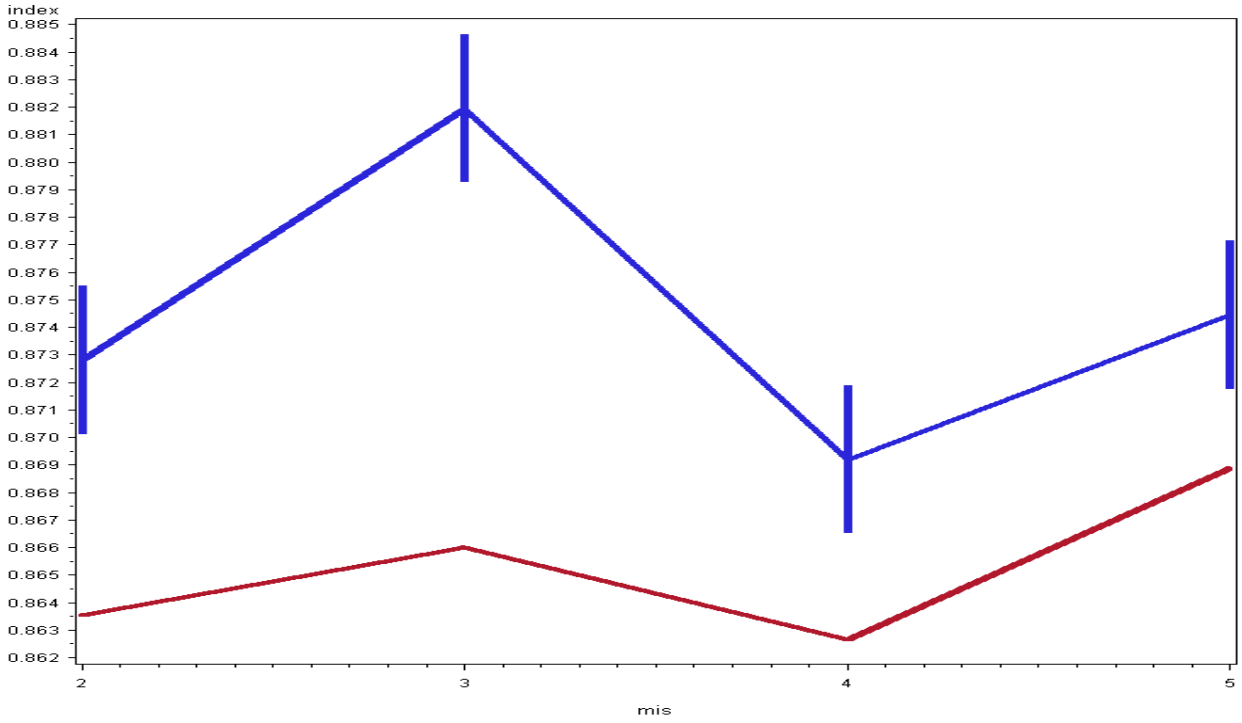

This shows the 95% confidence intervals for the R-index(in blue), which are somewhat flatter than the response rate (in red). Since one of the major flaws in nonresponse studies is in what we don't know, the use of confidence intervals which account for our estimation of both the measure of interest and our model of nonresponse would be helpful.

R-index and demographics:



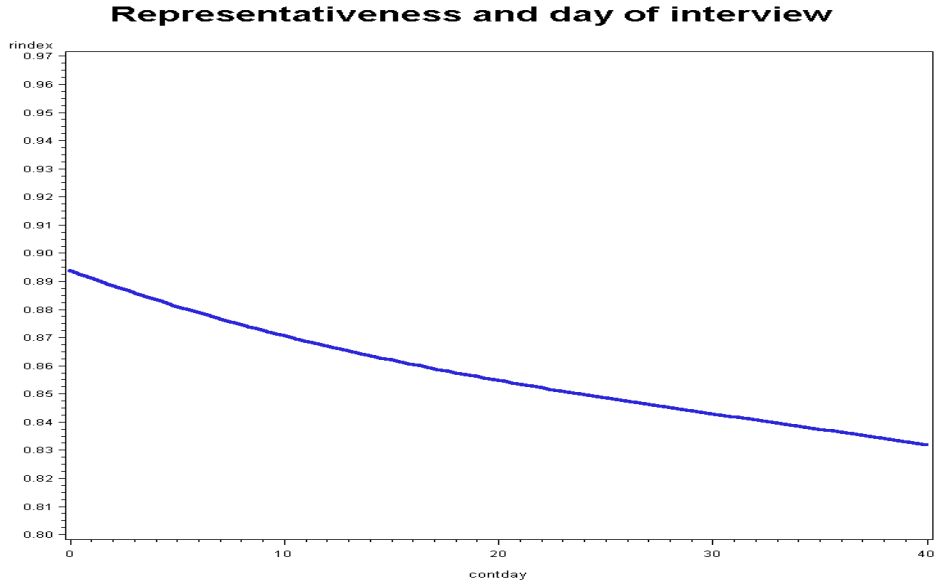

The R-indices for gender shows no problem, but there might be some differences in nonresponse for race. This is similar to coverage estimates. Youth shows no problem, although their coverage rates tend to be lower.

CE R-index (blue) and response rate (red) by time in sample:



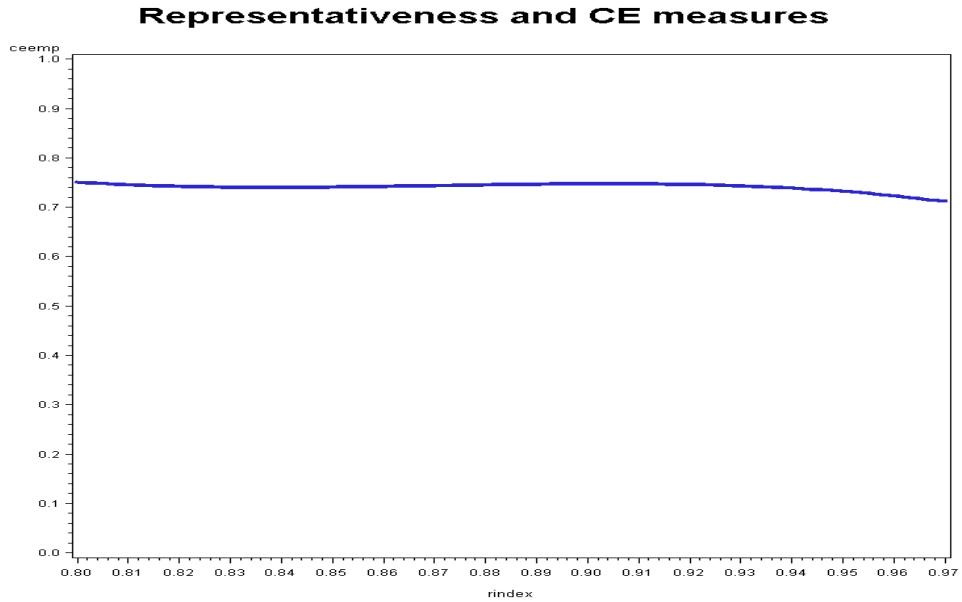

For the CE, the R-index follows the response rate pattern, but is more variable, in contrast to the CPS, where it was flatter.

CE R-index and day of interview:



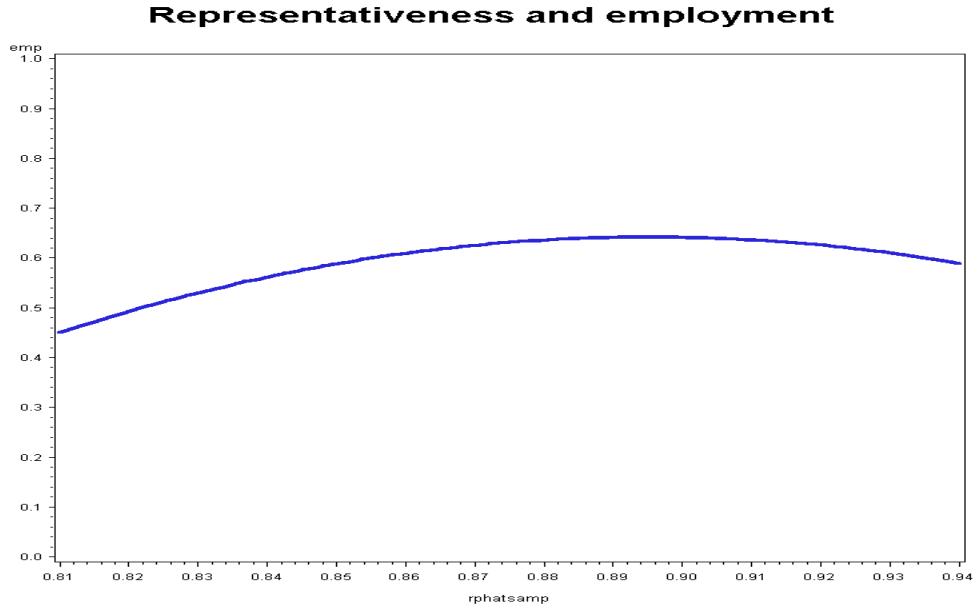

The R-index is often used for studying survey processes. This cubic regression between the r-index and the day of the interview shows that the later interviews are not like the sample frame. Other models, such as splines, may show other patterns.

Regression of R-index and CE employment:




While other variables can be added to the model to gauge their relationship to the r-index, employment didn't show any effect. I was hoping a regression might show some pattern, for example a decrease at the extremes. The flat line tells me that if there is any bias, it's not detectable by the propensity model adjusting for the frame variables. Similar effects were found for total expenditures and earned income.

CPS R-index and employment:




A cubic regression relating employment to the representativeness shows the CPS employed measure has little relationship over the range of the representativeness scores.

Summary and limitations:
The family of R-indices may provide a useful tool, particularly for evaluating survey processes. It doesn't substitute for bias studies. Its confidence limits are particularly useful. It is very dependent on the models used. Other R-indicies, such as maximum bias may be more relavant. Other alternatives, such as bias profiles, would be more trouble. I expect a single index will be useful for program managers to evaluate overall survey performance.

Reference:
Schouten, B., Cobben, F. & Bethlehem, J. (2009), Indictators of Representativeness of Survey Nonresponse. Survey Methodology 35, pp. 101-113.