APPENDIX

It is a natural reaction for the reader to assume that the response variances for complementary variables (like "native" and "foreign-born") should be equal. That this is not necessarily true is shown by the following example.

Suppose that an interviewer is assigned a unit which contains n persons of whom X_1 have a given characteristic (e.g., native) and the remainder X_2 have the complementary characteristic (e.g., foreign-born). Let p denote the probability that the interviewer will record any given person in the unit. Let π_1 denote the conditional probability that the interviewer will classify a recorded person as having the first characteristic, when in fact that person does have the first characteristic, and let π_2 denote the conditional probability that the interviewer will classify a recorded person as having the first characteristic, when in fact that person has the second characteristic. (I.e., π_1 is the probability that a native person is classified as native, and π_2 is the probability that a foreign-born person is classified as native.)

Let ξ_1, ξ_2 denote the number of persons classified by the interviewer in the two classes. Thus

$$E\ \xi_1 = p\,\pi_1 X_1 + p\,\pi_2 X_2$$

$$E\ \xi_2 = p(1-\pi_1)X_1 + p(1-\pi_2)X_2$$

and

$$\text{Var}\ \xi_1 = p\,\pi_1(1-p\,\pi_1)X_1 + p\,\pi_2(1-p\,\pi_2)X_2$$

$$\text{Var}\ \xi_2 = p(1-\pi_1)[1-p(1-\pi_1)]X_1 + p(1-\pi_2)[1-p(1-\pi_2)]X_2$$

Since, clearly, no sampling of the population is involved here, these variances are simple response variances.

We may now note that, if $p = 1$ (i.e., if there is no response variability in recording the number of persons), then $\text{Var}\ \xi_1 = \text{Var}\ \xi_2 = \pi_1(1-\pi_1)X_1 + \pi_2(1-\pi_2)X_2$. If, however, $p < 1$ then it can be shown that $\text{Var}\ \xi_1 > \text{Var}\ \xi_2$ if and only if

$$(2\pi_1-1)X_1 + (2\pi_2-1)X_2 > 0.$$

In the case of nativity, X_1 is a much larger number than X_2, and π_1 is very nearly 1. Thus the inequality condition is satisfied quite strongly for these characteristics. To illustrate, take

$$p = .95$$

$$\pi_1 = .995$$

$$\pi_2 = .20$$

$$X_1 = .95N$$

$$X_2 = .05N$$

where N is the total number of persons in the unit. Thus

$$\frac{\text{Var}\ \xi_1}{\text{Var}\ \xi_2} = 4.2\ .$$