READERSHIP AND SURVEY NON-RESPONSE

Hans Vorster, Audits & Surveys, Inc. Toronto, Canada
John Smart, Applied Marketing Statistics, Toronto, Canada

The question of the effect of non-response on readership scores has been debated for as long as audience data has been collected. Quite recently, several papers, notably Tom Healy in Hong Kong (1), Val Appel and Julian Baim at the 1991 ARF (2), and Julian Baim again at this Symposium have looked at differing levels of response by demographic characteristics as defined by geodemographic clusters such as PRIZM. More directly, other work has looked at the differences in readership habits of those respondents who were relatively easy to interview as compared to those who were difficult to contact and who might therefore under some circumstances have become non-responders. Specifically, Vorster and Frankel (3) reported in Salzburg that whereas there might indeed be differences in measured reading patterns between the 'easy' group and the 'difficult' group, the latter constituted a small enough percentage of the total that their contribution to overall reading scores was very small, particularly when weighting procedures were conducted to make the achieved sample reflect universe profiles. The Arrowhead project in the U.S. (4), and the concomitant paper presented here by Ivor Thompson (5) concluded that although small in number, more difficult to reach individuals did differ in their reading habits. While this is interesting and important information, none of these papers was designed to address one underlying question which is: "*Would the readership data from any survey have been significantly different if all potential respondents had been interviewed?*" This paper will attempt to provide some insights to an answer.

We could of course answer that question by interviewing everybody. Clearly, in any situation short of one with unlimited funds, this is not possible, and in all practical considerations we will be left with a group of people about whom we know very little. In a probability sample, we at least know where they live, and by that fact we can determine some general characteristics of these unavailable people as demonstrated by Tom Healy. In this paper we set out to refine that process using a number of statistical techniques a) to more accurately impute defining demographic characteristics to this group of non-respondents and b) to extend this to magazine readership. We were not attempting to report on the assumed reading habits of these people in any rigorous sense of measurement, but to determine the statistical probability that had these individuals contributed to the readership data base, the audience levels for any magazine would have been significantly different (on a probability of reading basis) than was in fact reported by the survey. We want to determine the significance and the direction of any change in reading probability as a result of including non-responder demos.

We used Canada's richest data base for this type of analysis, namely the Print Measurement Bureau's most recently released national survey of magazines, PMB'92. Our analysis was conducted in four parts, the results of each of which are then used in the following part.

1. A determination of the demographic factors that most significantly differentiate the reading probability of a specific magazine.

2. The building of a model that will predict a probability of reading of a specific magazine based on its demographic profile.

3. Imputing demographic characteristics of non-responders by means of a detailed census data analysis.

4. Application of the model to ascribe readership to non-responders.

We will describe the process in detail for each of these parts in turn. By way of background, PMB'92 measured some 74 titles during 1990 and 1991. The study was conducted nationally in both English and French and in its complete form consisted of 15,377 respondents. Readership, that is AIR, is determined by a modified Through-The-Book method. For our purposes we used only English speaking adult respondents, and this group comprised 10,354 respondents. Since response rates for the survey were 66.0% overall, we had some 5300 individuals whose households had been selected, but who had not completed a questionnaire.

Since it was impractical to analyze reading probabilities for all 45 English language titles in the study, we selected 6 representative magazines and conducted our investigation on those. They are,

Canadian Business	general business
Canadian House & Home	shelter
Canadian Living	women's service
Maclean's	newsweekly
Reader's Digest	general interest
TV Guide	TV listings weekly

Stage 1

In the first stage we determined the demographic factors that most significantly contributed to the reading of each of our target magazines. We based 'readership' on the probability of reading, that is the frequency of reading, rather than the response to the AIR question because it allows for more scaling in the analysis and thus more statistical routines can be utilized. We did this in the knowledge that frequency and AIR are correlated . Since every respondent who had screened in (via the one year filter question) was asked the frequency question, regardless of the answer to the average issue readership question, we were also able to include some non-AIR readers in our analysis.

In this stage we conducted what is known as a MID (Multivariate Interaction Detector) analysis, also known as AID, in which each of 10 demographic variables was measured for its contribution to the propensity to read a specific title. Put another way, how is the probability of reading affected by specific demographics?

The dependent variable in each case was the frequency of reading, the independent variables used were:

Age
Sex
Marital Status
Education
Occupation
Employment Status
Community Size
Home Ownership
Household Income
Household Size

This analysis produced 6 individual results, an example of which is shown in chart 1. Here we can see that in the case of Canadian Business, the most important consideration in the probability of reading is the respondent's occupation. The analysis selected professionals, executives, managers and other white collar occupations as having a positive affect on readership, while clerical, skilled and unskilled labour and those in primary industries are less likely to read. At the next level, household income becomes a determining factor with people in households earning more than $100,000 per year having a significantly higher probability of reading than those earning less. Finally, following the line of greatest probability, age becomes important, with a break at 50 years of age. Index numbers are shown on each cell relative to the population mean.

From this then we can select three important demographic characteristics for Canadian Business; occupation, household income and age. Constructing similar analyses for other magazines we were able to reduce our list of 10 variables to 4 as follows:

household income
education
age
community size

Unfortunately, employment status and occupation were both eliminated from further consideration in the analysis because we were not able to match the descriptions of the various categories in the study with those in the published census data as was needed in a later stage.

It is important to understand that our research process started out assuming that any breakdown of the study data and the census could be achieved. We quickly learned that some census codes and two dimensional census tables did not currently exist. In Canada it can easily take up to 6 months and not insignificant amounts of money for Statistics Canada to complete a special request for data tabulations from the original census records as would be required for this project. This problem led us to make certain unavoidable compromises.

1. No multi-dimensional or interaction tables could be generated from existing census data. This meant only one important variable could be selected for each of the magazines under study.

2. The census variables that were available for the demographics had to match category by category with the PMB data. This exercise proved somewhat disappointing for employment and occupation, because good fits could not be made for these variables.

These are recognized shortcomings of the current model, but they are not sufficiently serious to terminate the process. On the basis of the demographic variables that were available we could still test for the significance and direction of change of reading probability among non-responders. Version 2 of the model will take the interactions of variables in a multi-dimensional analysis into consideration.

Therefore, removing these two dimensions (employment and occupation) from the list of independent variables and repeating the MID run for Canadian Business produced an almost equally strong effect on increased reading probability from education, with only a slightly reduced level of predictability, and it is this characteristic that was used in the final stages of the analysis for this magazine.

Stage 2

Having established the available demographics that most impact readership from the MID runs, we developed a regression equation which related these demographics to the probabilities of reading. We did this in order to allow us to calculate a direction and change to the reading probability based on the differing demographics of the non-responders as required in the final stage of the analysis. The form we used was as follows:

$$P_m = (B_m * D_i) + K_m$$

where:
P_m = probability of reading magazine M
B_m = regression coefficient for magazine M
D_i = demographic value
K_m = constant for magazine M
i = demographic used

We intend to apply this formula to non-responders and test the differences between data sets containing only responders (reported data) and both responders and non-responders for significance.

Stage 3

The third stage involved the imputation of demographics to non-responders by analyzing the key demographics of responders, as determined by the MID analysis in stage 1, with the known mean values of those demographics in individual enumeration areas or groups of EA's.

In Canada, the enumeration area is the smallest reportable geographic unit in the census. There are some 44,000 in the country and each consists on average of approximately 250 households. The EA forms the primary sampling unit for PMB. Statistics Canada provides demographic descriptions of each EA in the country (subject to some size restrictions). By determining the difference from the mean of any demographic characteristic of responders in a single EA (or group of EA's), and knowing the number of non-responders present in that same EA or group, it is possible to calculate the mean value of that demographic among non-responders.

The equation is as follows:

$$V_t = \frac{(V_r * N_r) + (V_n * N_n)}{N_t}$$

where:

V_t = mean value of variable for all persons from census data
V_r= mean value of variable for responders from survey data
V_n= mean value of variable for non-responders (calculated)
N = number of respondents or non-respondents

Solving for the value of the variable among non-responders

$$V_n = \frac{(V_r * N_r) - (V_t * N_t)}{N_n}$$

For example, in the most simple case, if in a group of 10 identifiable EA's the mean age as reported by the census (V_t) is 38.3 years and we have 60 responders in the study (N_r) with an average age of 32.5 years (V_r), and from the sampling frame we know there are 45 non-responders in those EA's (N_n), we can calculate that the mean age of those non-responders (V_n) must be approximately 46.0 years. We are of course assuming here that the group is large enough to allow for a stable distribution and that therefore calculations of distance from the mean are valid.

This is essentially the process followed for each of the demographic characteristics that were pivotal in affecting reading probability. However, instead of grouping enumeration areas into small clusters of say 10 EA's each, we determined that we were at this stage of development of the model most interested in the overall effect of non-response and hence decided that breaking the sample into smaller clusters and accumulating the results would have the same effect as taking the distance from the mean for all selected EA's. This then required only one analysis per demographic dimension.

Using Canadian Business as an example, we determined that education and household income were determinants in the reading probability of this magazine. The regression equation was then calculated. Using education as the demographic variable and converting the categories into numeric values as follows:

no schooling	1
primary school graduate	2
high school graduate	3
trades certificate	4
community college	5
university diploma	6
Bachelor's degree	7
university diploma above Bachelor	8
Master's degree	9
degree in medicine (MD)	10
doctorate (PhD etc)	11

Using the equation described above, we determined that:

value of education in overall sample (V_t)	4.21
value of education of responders (V_r)	4.04
value of education of non responders (V_n)	4.53

Stage 4

Having calculated the regression coefficient and the constant from data in the respondent file, the regression equation then becomes:

$$P_{CBN} = [1.29^* (V_{Education})] - 0.24$$

Solving this equation for non-respondents, so that $V_{Education}$ is V_n,

$$\begin{aligned} Pn_{CBN} &= (1.29 * 4.53) - 0.24 \\ &= 5.60 \end{aligned}$$

Similarly, the probability of reading Canadian Business among responders was calculated at $Pr_{CBN} = 4.99$. The difference between the two is statistically significant, and the direction of change among non-responders is up. Recalculating the probability of the entire population including non-responders, that is the mean value of probability in the entire selected sample population generated 5.19.

Therefore, we can conclude that non-response reduced the probability of reading, and hence AIR, for this magazine.

We have made no attempt at this time to estimate the degree of potential under-reporting that could have taken place, but merely report that the evidence points to the fact that Canadian Business would have had higher readership scores if all selected respondents had completed an interview.

The same process was undertaken for each of our six magazines and the results shown in Table 1. The principal demographic is the single dimension used in the model for determining the likelihood of reading from stage 1. The mean values (V_t, V_r, V_n) are explained above. Since we used the entire sample set rather than agglomorating portions thereof, the values for each principal demographic are the same across magazine. The probabilities of reading were calculated for each title according to our regression formula and the resulting values tested for significance as shown in the table.

It can be seen that not all magazines were necessarily disadvantaged by a response rate below 100%. Of the six titles examined, four showed significant changes, Canadian Business, Canadian House and Home and Maclean's all suffered some potential audience loss, while TV Guide may in fact have benefited from non-response. The other two magazines, Canadian Living and Reader's Digest showed no significant change. These findings follow logic. The three publications with up ticks are generally aimed at a more upscale audience, the very people most heavily represented among the non-responders. TV Guide is read by people who watch television, are therefore more often at home where they can be interviewed. Finally, both Reader's Digest and Canadian Living are magazines read by a broad spectrum of society and the differences in demographic makeup of responders and non-responders does not play an important role in their audiences.

As an additional step in the analysis we calculated the new mean of probability from the model ($N_t = 15{,}654$) and compared it with the weighted and projected mean from the study (PMB; $N_r = 10{,}354$), as seen in the last two lines of Table 1. These comparisons showed that there were significant differences between the two means. The implication of this is that the weighting system as applied to the study may disadvantage some magazines. If the weighting system does not take into consideration the pivotal demographic correlates of each magazine, then the system may not treat all titles equally. The results of our analysis show that four out of the six had their probability of reading reduced by the weighting system, while in the other two cases it went up. There is a possible solution to this inequity in marginal or formula weighting so that any magazine which is not in balance with its prime demographics (single or multi-dimensionally) can be corrected by a rational process determined by the data.

This is a first attempt to describe the readership patterns of non-responders. We understand that this model is by no means perfect. We believe however that our assumptions are valid and that we have demonstrated the net effect of non-response on reading of certain magazines. We suggest that it would be a fruitful exercise to refine this model, particularly in acquiring census data in a manner compatible with the statistical needs of the model. As already pointed out this means getting multi-dimensional tables that would allow us to look at the interactions of several demographics at once as derived from readership characteristics in phase 1 and establishing the pairing of survey categories with similar ones in the census. We would like to use other multivariate tools in the initial readership determination stages and also suggest it would be interesting to conduct this analysis within sampling strata. All this may result in a more accurate description of the effects that have occurred as a result of non-response, and may lead to a re-evaluation of current weighting procedures.

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