

# Briefing - Reissues Project

## Background

The aim of the project is to develop a propensity model to predict whether a reissue case would be successful or not successful.

The current system involves field survey management staff reading forms interviewers have filled in explaining why a case is being reissued. They then make a subjective judgement based on what the interviewer has written on the form. The success rate for reissues is small – less than 15 per cent of them have a successful outcome.

Creating a rule-based model to calculate propensity scores would save the time and resources it takes to read through the forms. It would also standardise what is presently a system based on subjective judgement.

## Method

### Data

To develop the model, main-stage call record datasets from years 2011-2014 for the following surveys were merged together:-

- Family Resources (FRS)
- General Life Style (GLF)
- Household Assets (HAS)
- Health Interview (HIS)
- Living Costs and Food (LCF)
- Survey of Living Conditions(SLC)

All cases that were not part of the population of interest were deleted. The reissue outcome was taken from the reissues stage datasets and matched to each case. The original reissue code regarding whether or not the interviewer thought the respondent would cooperate at reissue stage was requested from Social Survey IM department and matched to the dataset.

### Procedure

A binary dependent variable stating whether or not the reissue was successful was derived from the reissue outcome variable. The following predictor variables were selected during a meeting with stakeholders and methodology was consulted regarding which tests to use on the data:-

- |   |   |   |
|---|---|---|
| • Survey Type   | • Wave  | • Quarter call was made in                                |
| • Call pattern  | • Main refusal reason                             | • Contact pattern   |
| • Contact outcome                                     | • Number of calls                                 | • Total number of minutes to first contact                |
| • Total number of minutes spent on a case             | • Region  | • Length of service                                       |
| • Field manager                                       | • Reissue Code                                    | • Number of calls made during the day on week days        |
| • Number of calls made during the evening on weekdays | • Number of calls made during the day on weekends | • Number of calls made during the evening during weekends |

The above variables were subject to preliminary chi square or t-tests with the outcome (see Appendix One). A t-test explores if there is a difference in averages between successful reissues and not successful reissues. For example one of the variables was total time in minutes spent on calls to a case. The t-test compares the average number of minutes spent on calls to a case for successful outcomes against not successful outcomes and indicates if the difference could have happened by chance or whether it is statistically significant. If the difference is not statistically significant, the variable will not be related to the outcome. A chi-square test is similar to a t-test, but is for categorical variables where cases are in a discrete category, i.e. male or female rather than a measurement. Seven variables passed the tests, they were:-

- Survey type
- Contact pattern
- Reissue code
- Wave
- Contact outcome
- Main refusal reason
- Region

The above variables were entered into a logistic regression model individually. The purpose of this test was:-

1. To see if they can predict the outcome better than the constant. SPSS produces classification tables. The first assigns every respondent to one category, to maximise how well the model can predict the data, it puts all the respondents into the outcome in which most observed cases fell – in this case reissue outcome not successful. This model correctly predicts 86.9 per cent of the cases and reflects the situation as it stands – the survey managements staff sifting through the paperwork are reissuing cases with a 13.1 per cent success rate. The second classification table shows if any improvement is gained by adding the variable.
2. To examine much of the variance they explain. Nagelkerke's  $R^2$  is an indicator of the effect size of the model. For example the variable survey type had a Nagelkerke  $R^2$  of 0.048, indicating that 5 per cent of the explanation as to whether the outcome was successful, was the type of survey the case belonged to. 95 per cent of the variance was being left unexplained, meaning that there is more to predicting the outcome than survey type and adding more variables to the model could increase the effect size.
3. To see if different categories within variables or unit changes affect the outcome. For example, the main refusal reason variable has different categories giving the different reasons why people refused to be interviewed at main-stage or where there was no refusal, whether the case was a partial co-operation or a non-contact etc. SPSS allocated the category 'no refusal (other, i.e. not eligible, lost, rejected)' as the baseline to compare all the other categories against. In Appendix Two, the odds ratio statistic next to 'no refusal (partial interview given at main-stage)' was 60.447 with a significant Wald statistic. This means that a case where a partial interview is given at main-stage is 60.4 times to have a successful outcome at reissue than cases that were not eligible, lost or rejected at main-stage. If the odds ratio is less than one, it means that the re-issue outcome is more likely to be unsuccessful. For example the living costs and food survey has an odds ratio of 0.308, this indicates that the reissue outcome is 69% more likely to be unsuccessful than the baseline. The significant Wald statistic indicates that this did not occur by chance. The confidence intervals indicate the margin of error for the odds ratio.

Appendix One shows how the variables influenced the model in these three ways.

Finally, based on the results of the above test, the six variables were entered into a logistic regression model together. Those that had an impact on the outcome in the previous test were given priority in the model and entered first, those with less influence were entered last.

## Results

The constant model correctly predicted 86.9 per cent of cases when it put all cases into the not successful outcome. The new model correctly predicted 87.1 per cent of cases when all six variables were entered and 87.2 per cent of cases when only main refusal reason, type of survey, reissue code, wave and contact outcome were included. This is not a large improvement on the constant. Nagelkerke  $R^2$  indicated an effect size of ten per cent, meaning that potentially 90 per cent of the variance was left unexplained.

Methodology were consulted and were of the opinion that the model was not powerful enough. Main-stage variables were not having enough influence on the outcome. It was speculated that what the interviewer does at the time of re-issue could be having more impact on the outcome.

However, there were significant Wald statistics next to odds ratios on categories within the five variables, indicating that they did have some use in predicting a positive outcome. Appendix Two provides the Wald statistics and odds ratios for the categories within these variables.

## Conclusion

- The above logistic regression model can predict 0.3 per cent more re-issue cases correctly than the current method.
- The current method is subjective and takes a lot of time and resources. The model is rules based and consistent.
- In terms of time and resources, using the model would require that:-
  - call records at main-stage be aggregated into cases
  - new variables be derived for main refusal reason and contact outcome
  - survey type variable changed from a string to a numerical variable and correctly labelled
  - re-issue codes given by the original interviewers obtained regularly from Social Surveys IM and matched to cases.
- The logistic regression model will create a new variable showing propensity scores for each case. Cases can then be ordered and allocated accordingly.

## Further Research

Explore whether variables at reissue stage are better at predicting a successful outcome and use findings to advise best practice for reissue interviewers.