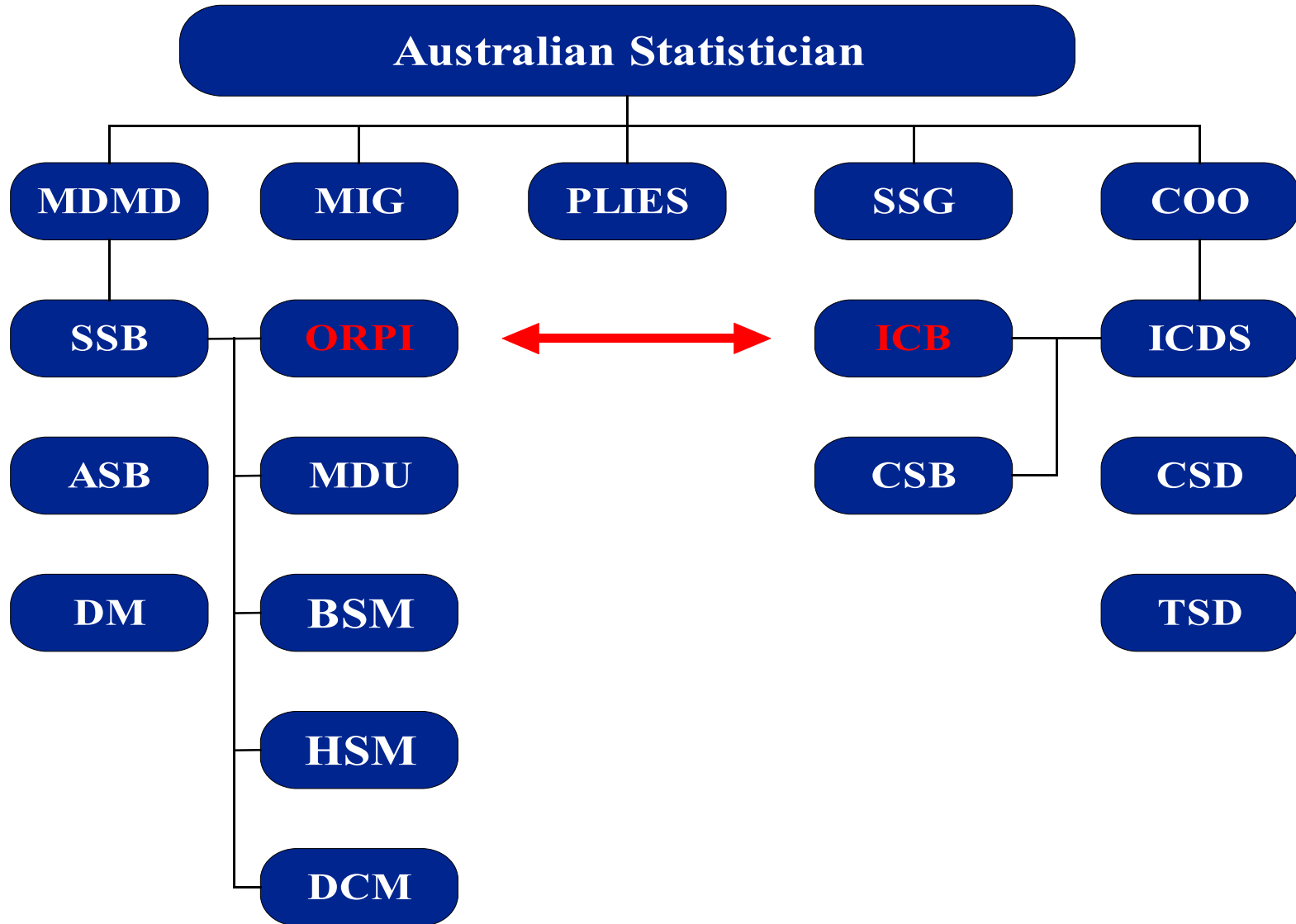


Use of Paradata to Improve Survey Operations for Household and Business Surveys

Operations Research and Process Improvement
Australian Bureau of Statistics

Introduction



Introduction

Population Surveys

- Field collection of social surveys
- 22 office staff, 2.85 million
- ~600 field staff, 23.8 million

Collection Management

- Frame preparation for business surveys
- 24 staff, 2.36 million

Despatch and Collection

- Printing, despatch and collection
- 23 - 48 staff, 3.12 million

Provider Contact

- Compliance, provider relations
- 98 staff, 4.93 million

Administrative Data Acquisition

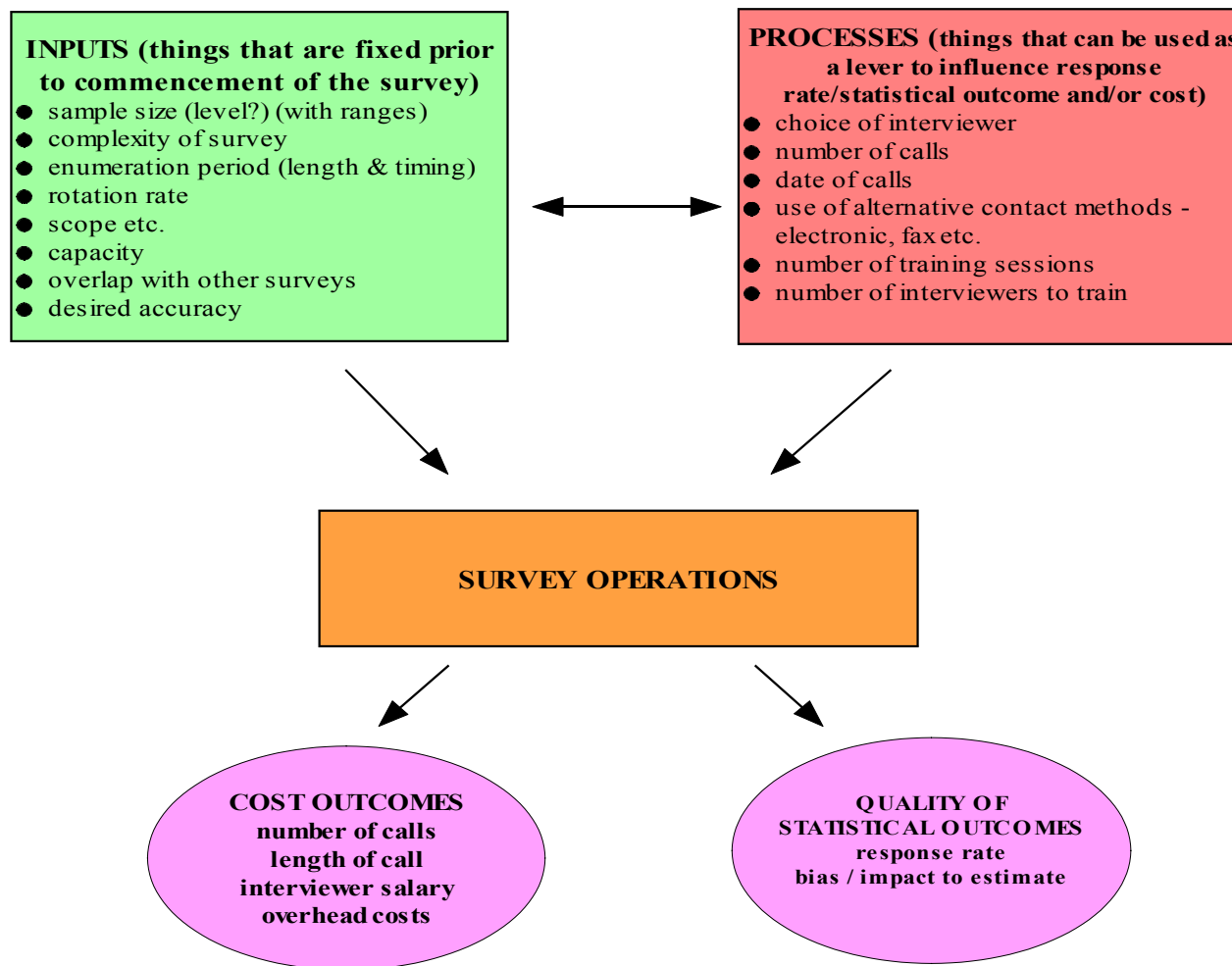
- acquire, transform, cleanse and load
- 7 Staff, 430K budget

Introduction

- Many surveys with different collection and follow-up strategies
 - Household Surveys
 - Field collection by personal visit and telephone interviewing
 - Business Surveys
 - Mail out, mail back survey with telephone interview follow-up
- Operational paradata
 - Increasingly available and being used to improve the efficiency and effectiveness of statistical collections
 - Enable better analysis of costs in achieving particular statistical outcomes

Cost/Response/Quality Framework

- Relationship between the different aspects of survey operations of cost/response/quality



Household Surveys: Paradata

Paradata available include:

- Call records (household/block ID, date, time, outcome of each visit or phone call, + interviewer etc)
- Travel records (interviewer time/mileage for each trip)
- Broad-level cost totals (region x month x major activities)
- Workload type (standard or follow-up)

Household Response Model

Response probability is modelled for individual calls, as stratified logistic function of:

- Call number (first, second, ... to this household this month)
- Type of call (face-to-face or telephone)
- Whether HH is new in sample
- Date and time of call

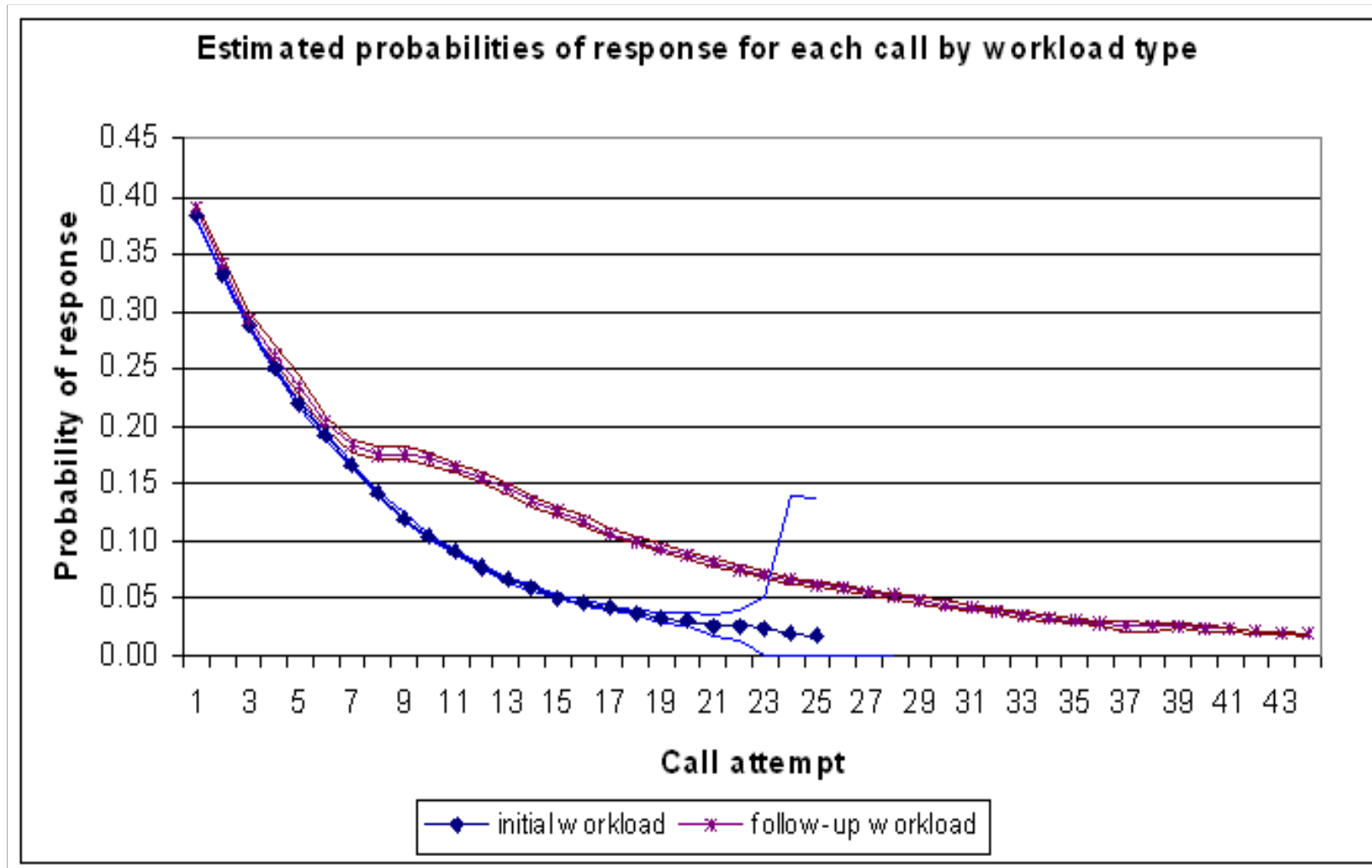
Household Response Model

Final response rate is a function of call-level response rate, and how many calls we make to each HH.

Interpreting the model requires caution because of selection effects. Example: all met HHs would usually get at least 7 contact attempts, but later calls are discretionary – hence visible 'bump' in response rates around calls 8-10 as interviewers focus on those likely to respond.

Household Surveys - Response

Probability of response by call number



Household Cost Model

Interviewer time and distance are modelled as linear functions of work variables (no. of visits to blocks, visits to HHs, and HHs interviewed, stratified by region)

- Multiplying by salary/motor vehicle rates gives costs
- Data quality, methodology, and complexities of pay system create potential for bias, so broad-level totals are used to calibrate the model

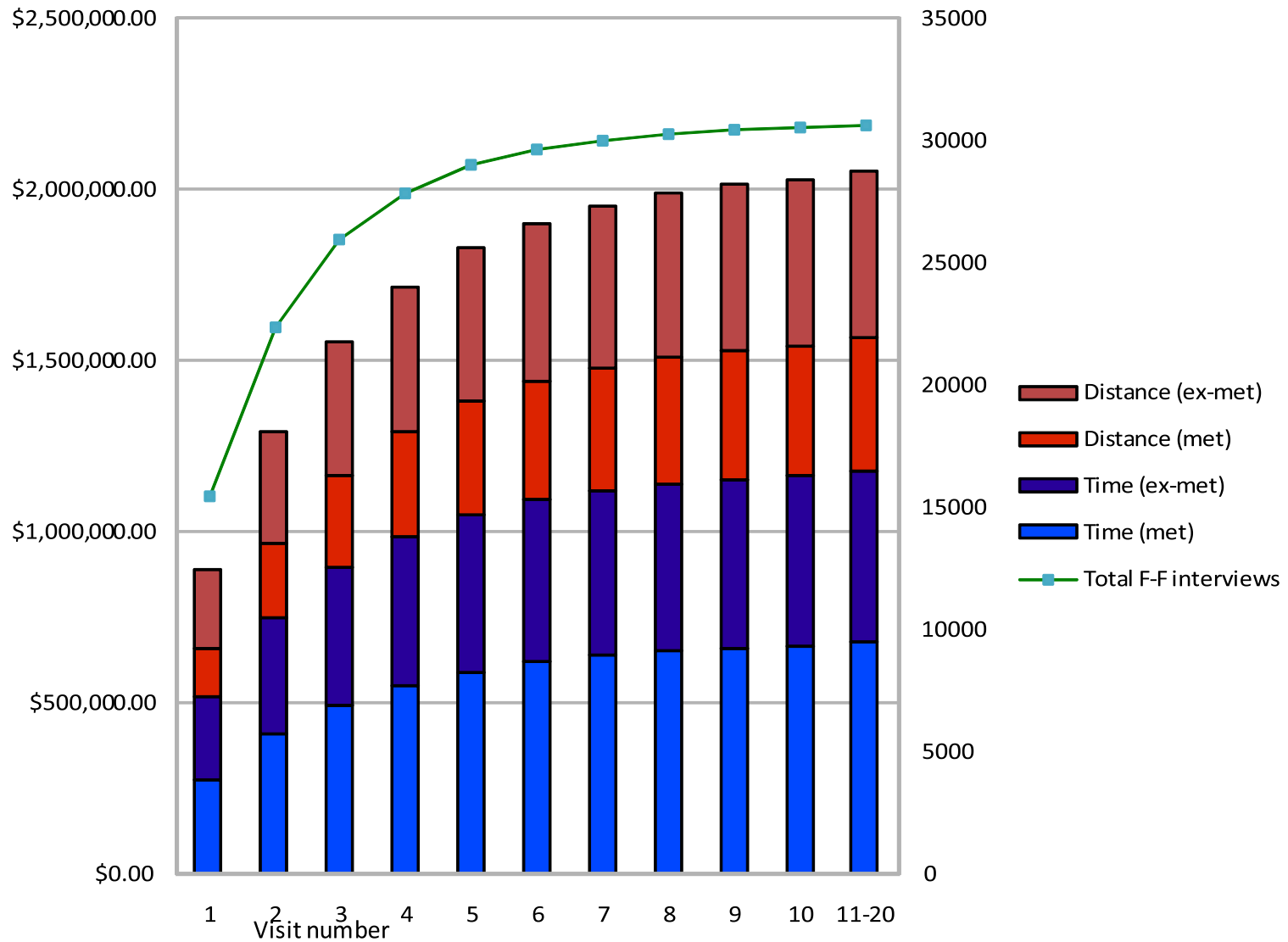
Household Cost Model

Model can be used in two ways:

- To get more information on how current survey costs break down by activity (e.g. are we spending a lot of our money on chasing difficult HHs, or is most of it in the first few calls?)
- To predict cost changes when survey practices change. (Requires estimating changes to work required – e.g. no.s of visits.)

Household Surveys – Cost

Cost at n'th F-F visit (non-language workloads, 7 months of MPS)



Household Bias Model

Different response strategies might yield similar response rates, but different populations – want to estimate effects on output statistics (primarily bias, but also RSEs, etc). Model developed by MDU.

- Basic approach: use survey data, concentrating on the residuals after normal regression weighting
- Fit for these residuals as a linear function of paradata variables (e.g. how many calls required, when interviewed)

Household Bias Model

- Use response model to predict how these paradata variables change in the sample population (e.g. “90 less weekday interviews but 100 more weekend interviews”)
- Use the fitted bias model to predict how these changes will affect estimates for the variable of interest.
- Improved version planned to include estimates of SE effects etc.

Household Surveys – Linked Model

Created to deal with 'integrated' questions – e.g. if an unpopular survey is likely to have poorer response rates, how would that affect cost and data quality?

Based on individual cost/response/bias models, with minor simplifications, and implemented in SAS.

5 major modules:

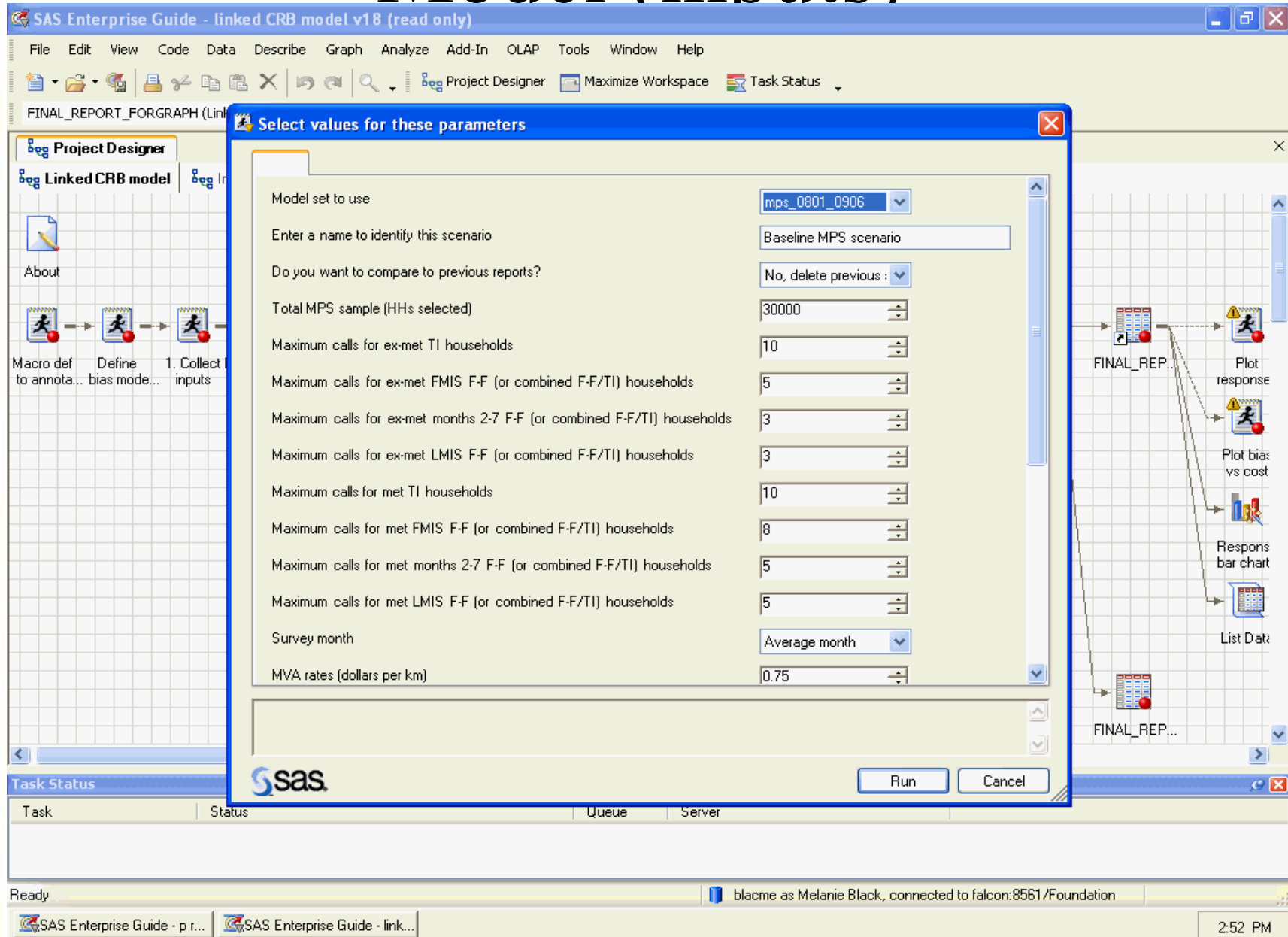
Household Surveys – Linked Model

1. Scenario module inputs a scenario to be evaluated (e.g. a particular contact strategy).
2. Response module applies the response model to predict call-level response probabilities for this scenario, and combines these with the contact strategy to predict final outcomes. 3 outputs:
 - Response rates
 - Work done (e.g. no. of visits made to HHs)
 - Profile of responding sample

Household Surveys – Linked Model

3. Cost module uses this 'work done' data to predict time, mileage, and hence costs.
4. Bias module uses 'paradata profile' of responding population to predict residuals, and hence bias.
5. Finally, the cost/response/bias predictions are collated into a single report showing how different scenarios compare.

Household Surveys – Linked Model (inputs)



The screenshot displays the SAS Enterprise Guide interface for a linked CRB model. A dialog box titled "Select values for these parameters" is open, allowing configuration of the model's execution. The background shows a project designer with a workflow and a task status window.

Parameter	Value
Model set to use	mps_0801_0906
Enter a name to identify this scenario	Baseline MPS scenario
Do you want to compare to previous reports?	No, delete previous :
Total MPS sample (HHs selected)	30000
Maximum calls for ex-met TI households	10
Maximum calls for ex-met FMIS F-F (or combined F-F/TI) households	5
Maximum calls for ex-met months 2-7 F-F (or combined F-F/TI) households	3
Maximum calls for ex-met LMIS F-F (or combined F-F/TI) households	3
Maximum calls for met TI households	10
Maximum calls for met FMIS F-F (or combined F-F/TI) households	8
Maximum calls for met months 2-7 F-F (or combined F-F/TI) households	5
Maximum calls for met LMIS F-F (or combined F-F/TI) households	5
Survey month	Average month
MVA rates (dollars per km)	0.75

Buttons: Run, Cancel

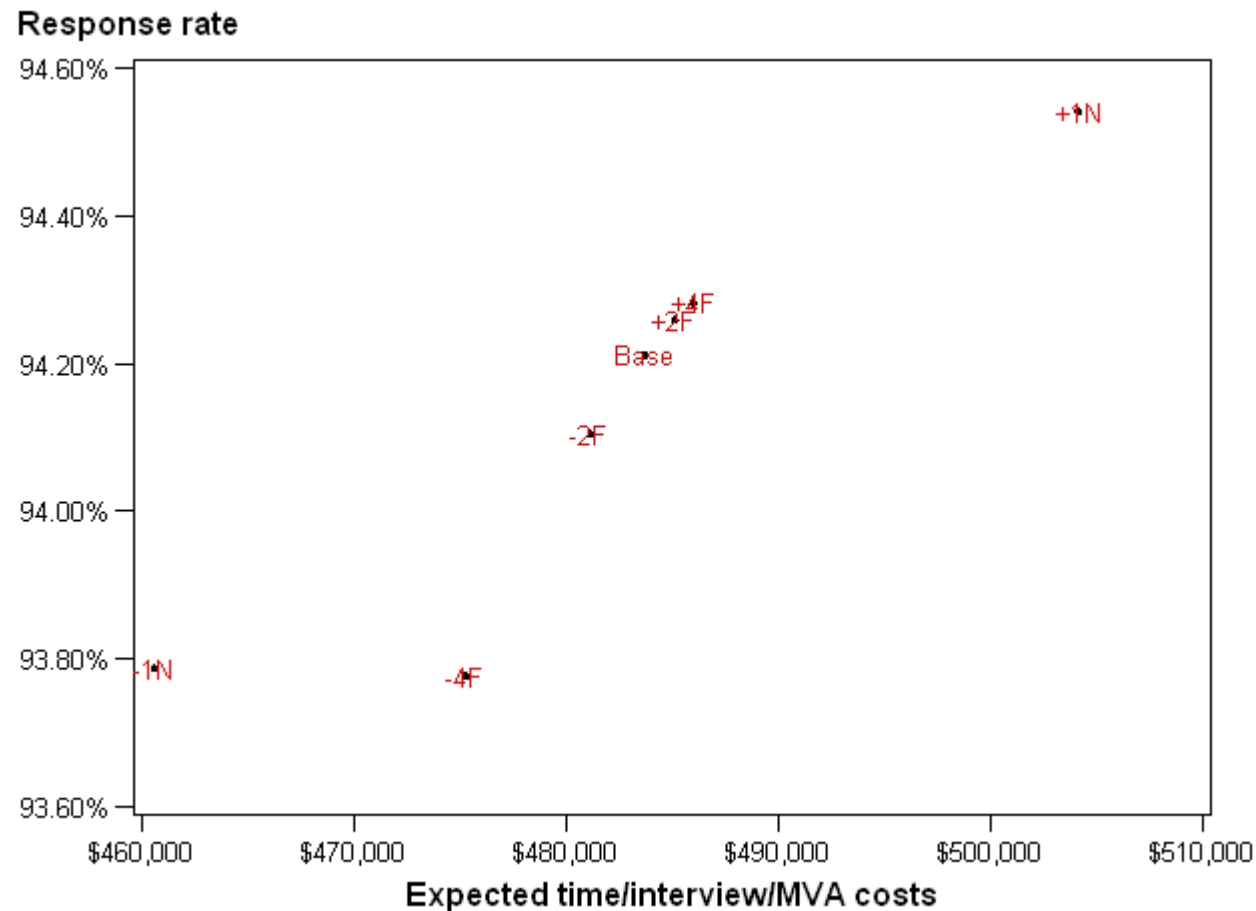
Task Status Window:

Task	Status	Queue	Server

System Tray: Ready | blacme as Melanie Black, connected to falcon:8561/Foundation | 2:52 PM

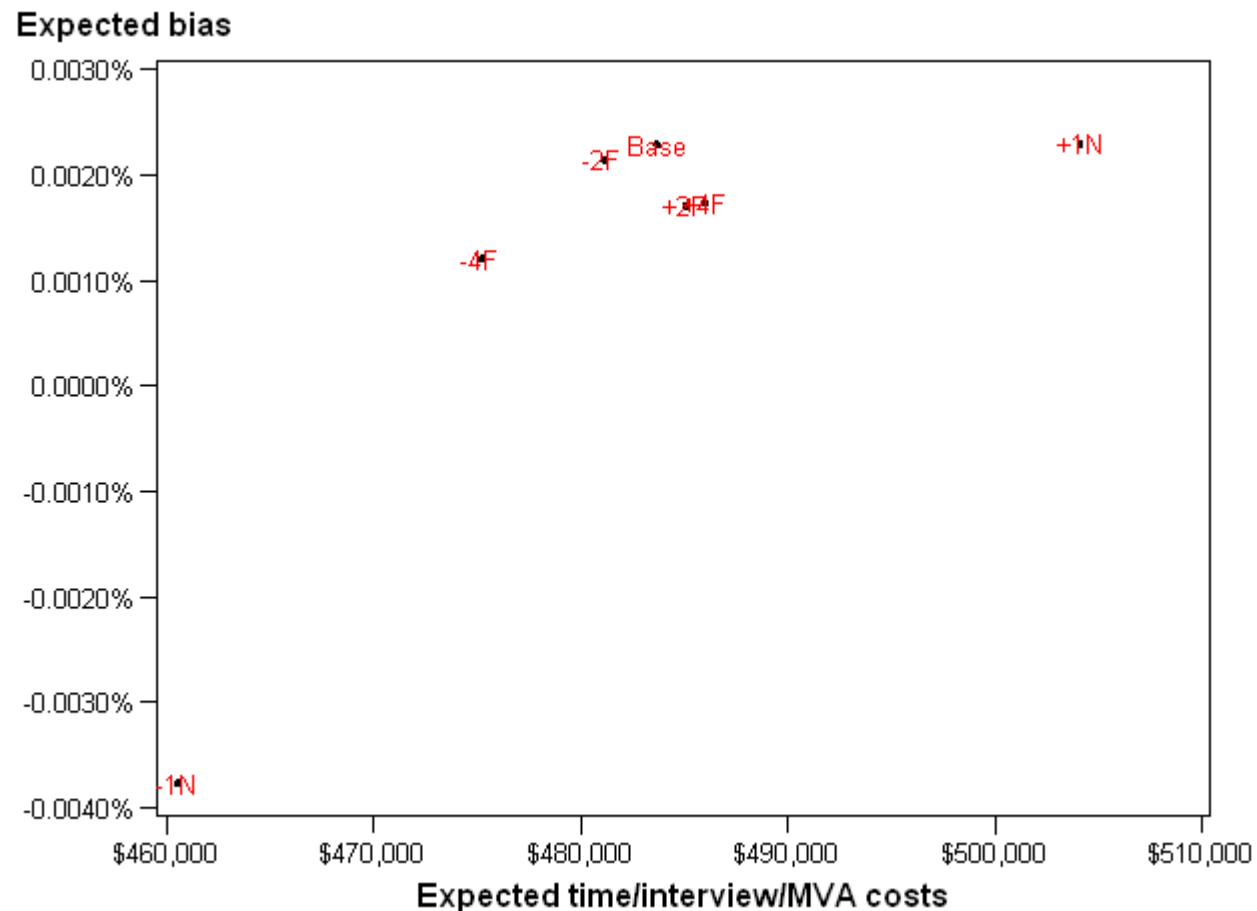
Household Surveys – Linked model (outputs)

Example: effects of follow-up changes on cost
and response



Household Surveys – Linked model (outputs)

Example: effects of follow-up changes on cost
and bias



Household Surveys: Future work

Future paradata (speculative):

- Blaise data (survey timing etc)
- Web-based survey information (similar to call records)
- GPS records of travel?
- Increased level of automated recording (vs manual entry by interviewers)

Household Surveys: Future work

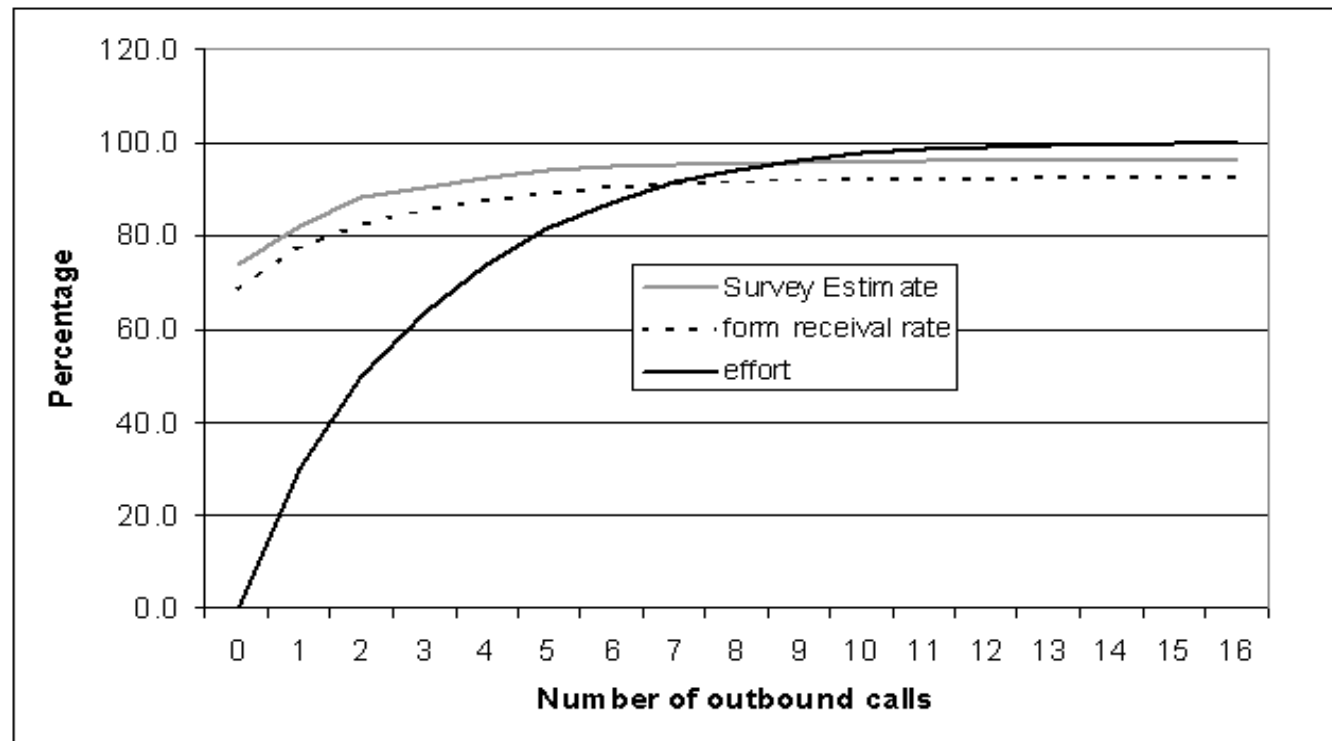
- Refinements to bias model
- Potential inclusion of additional factors e.g. training, survey load/ capacity
- Extension to other surveys
- Investigation of non-PTA costs
- Use of model to guide implementation of changes including field trials of alternative procedures
- Responsive Survey design

Business Surveys: Paradata

- Available paradata
 - Provider Information Management System (PIMS)
 - Record of every telephone contact, interviewer, contact date/time, status (but not length of call)
 - Record of every change to response status
 - Other sources
 - Broad pay information (not by survey)
 - Staffing allocation information

Business Surveys : Effort vs Outcomes

- Contribution to estimate, form receival rate/response rate and cumulative effort by number of outbound telephone calls



- 70% forms returned and 75% estimate achieved without making any outbound calls
- around 20% of effort was spent in making more than 5 outbound calls with a 2% increase to response rate and survey estimate

Business Surveys : Cost Model

- Cost Model
 - Simple spreadsheet to estimate staffing requirements and therefore costs
 - Simple cost structure
 - ORPI improvements to
 - Assumed values e.g. call rates, number of calls etc using paradata
 - Direct inclusion of non follow-up activity
 - Validation of predicted costs against actual costs

Business Surveys : Cost Model

- Cost drivers
 - Sample size, survey frequency
 - Target response rate
 - Volume of Non-IFU activity
 - Related to type of survey
 - Number of calls / day
 - Related to type/ difficulty of survey
 - Inbound call patterns
 - Outbound call patterns
 - Staffing profile

Business Surveys : Cost Model

- Validation of the model – staff days
 - Results for selected surveys

Survey	Actual Days	PCU estimate	Old Cost Model	New Cost Model
QBIS	1519	1638	954	1519
CAPEX	693	720	712	676
AWE	708	647	842	722
AIC 0708	825	850	711	905

Business Surveys : Response Model

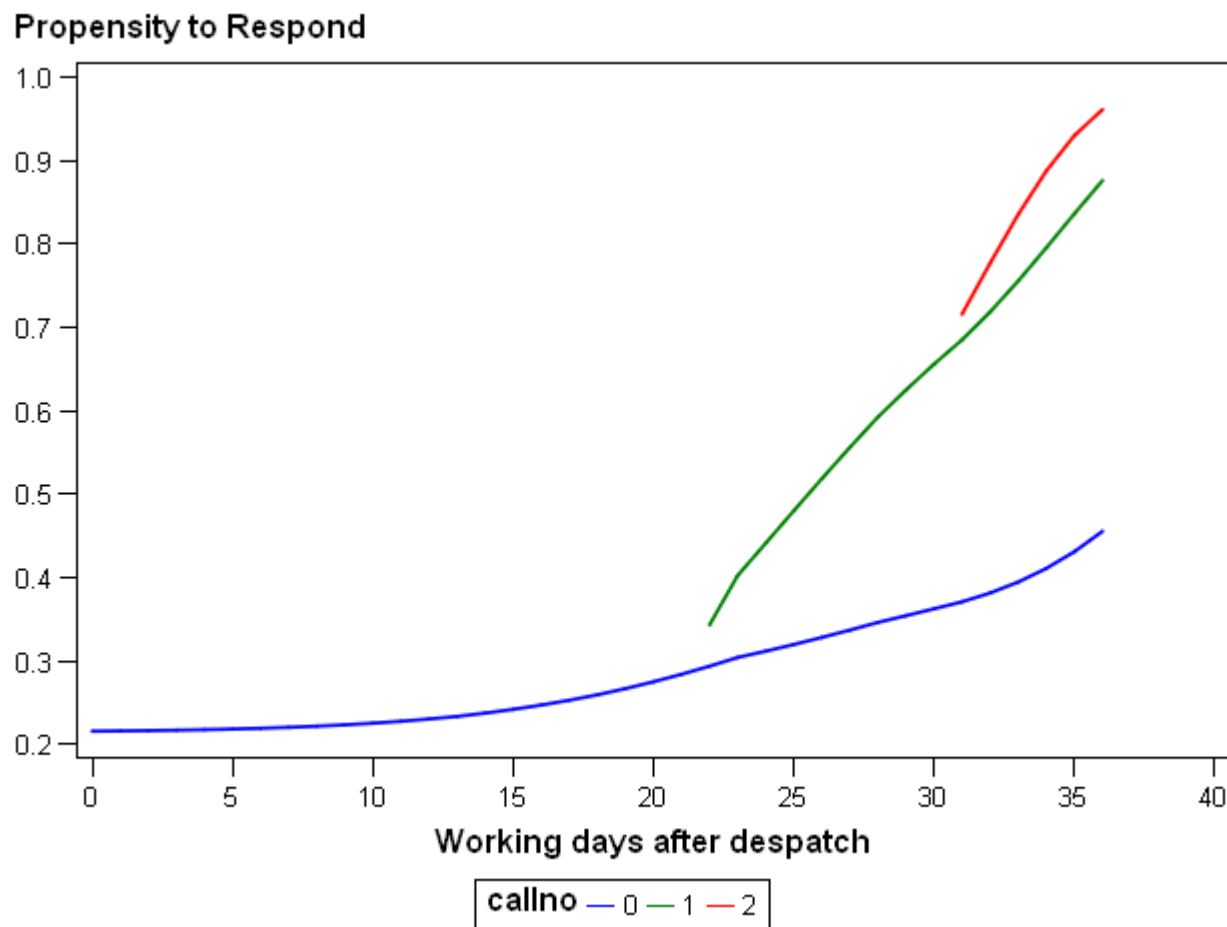
- Brief was to develop a model to predict both individual propensity to respond and overall response rate
- Individual propensity to respond uses a survival analysis model
 - After a call or reminder letter, allows time for a provider to respond
- Overall response rate sums individual propensity to respond

Business Surveys: Response Model

- Response drivers
 - Demographics
 - Size, state of operations
 - Previous response history
 - Gold vs. non-gold providers
 - Significance level
 - Crucial, newly selected, and other
 - Number of calls (in and outbound)
 - Number of reminder letters
 - Day of enumeration cycle

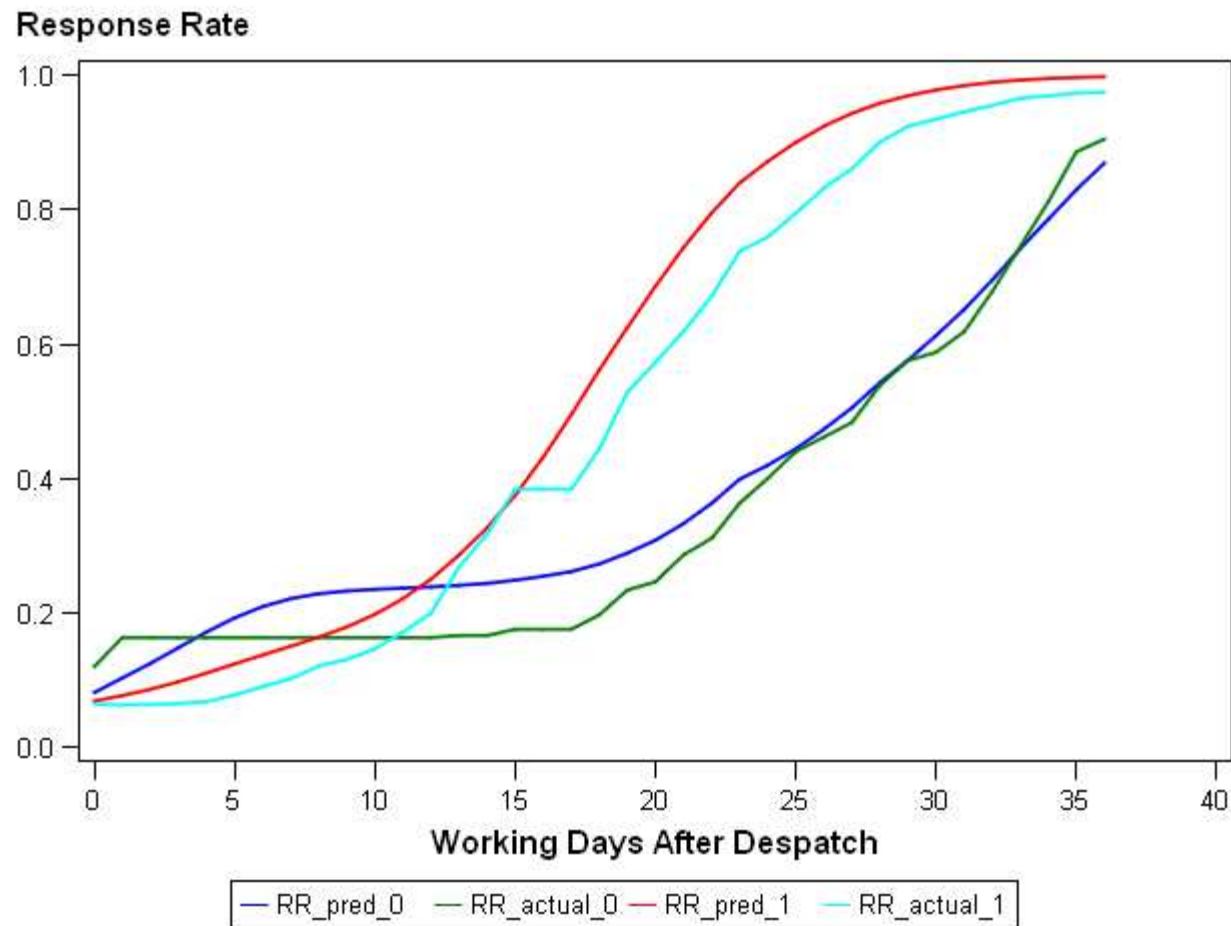
Business Surveys : Response Model

- Example of individual propensity to respond



Business Surveys : Response Model

- Validation of Overall Response Rate



Business Surveys : Bias Model

- Idea is to model residuals : difference between reported values and would-be imputed values
 - For providers who might change response status – 'hard' population
 - Excludes gold providers, crucial units, etc
 - Linear regression model
 - Sum up predicted change in residual for units which change response status for a given IFU strategy change
 - Interested in expected change to estimate and expected change to variance

Business Surveys : Bias Model

- Drivers of Non-response bias
 - Demographics
 - Size, state of operations
 - Number of direct calls
 - Other variables indirectly through definition of 'hard' population
- More variables probably important but can't be included due to data limitations

Business Surveys : Bias Model

- Difficult to validate overall predictions
 - Predictions seem 'reasonable'
- Plan is to undertake field trials of alternative procedures
 - Will give a better idea of model fit
- Model is survey and data item specific
 - Needs to be refit for each survey and important data item

Business Surveys : Linked Model

- Development of interface linking three models for operations client use
- Linked model in Excel for ease of client use, with details hidden
- Inputs include
 - Sample size and composition information
 - Assumed call rates and work volume information (IFU and non-IFU)
 - IFU strategy information
 - Probability of unit receiving given call in particular time intervals

Business Surveys : Linked Model

Model Inputs

	A	B	C	D	E	F	G	H
1								
2	Days Between Reminders							
3	Start - Reminder 1 (R1)	15						
4	Reminder 1 - Reminder 2 (R2)	5						
5	Reminder 2 - Reminder 3 (R3)	5						
6	Reminder 3 - Reminder 4 (R4)	5						
7	Reminder 4 - End (ZE)	5						
8								
9	Call rates – average number of calls per interviewer per day							
10	Assumed call rate per staff day (combined in/out calls)	51						
11	Assumed clearance per staff day for pre-despatch work	15						
12	Assumed clearance of corro of 10 per staff day	10						
13	Assumed clearance of SFMP per staff day	25						
14	Assumed clearance per staff day for pre-IFU work	15						
15								
16	Proportions							
17	Assumed % of selections require SFMP action	0.05						
18	Assumed % units making an incoming call - initial despatch	0.2						
19	Assumed % units making an incoming call - reminder 1	0.1						
20	Assumed % units making an incoming call - reminder 2	0.1						
21	Assumed % units making an incoming call - reminder 3	0.1						
22	Assumed % units making an incoming call - reminder 4	0.1						
23	Assumed % of selections requiring correspondence	0.02						
24								
25	Numbers of calls							
26	Assume PCU 2008/09 charge out rate of \$342	327						
27	Type of IFU staffing pattern	0						
28	Selections requiring pre-despatch activity per cycle	50						
29								
30	Staffing Profile							
31								

To change the number of reminders, set the last time between reminder(s) to 0.

Change Calling Strategy

Update Calculations

Reset Strategy

Add to Strategy Comparisons

For annuals only – enter '1' if IFU staffing patterns are even over a lengthy IFU period, without a massive increase in staffing just before close off (e.g. AIC) and '0' otherwise (e.g. Vineyards)

Business Surveys : Linked Model

Change Strategy - Probability of Being Called

FGOLD	Significance	Size	State	Period	Call Number
<input type="checkbox"/> 0	<input type="checkbox"/> 0	<input type="checkbox"/> 1	<input type="checkbox"/> 0	<input type="checkbox"/> Start - R1	<input type="checkbox"/> 1
<input checked="" type="checkbox"/> 1	<input checked="" type="checkbox"/> 2	<input type="checkbox"/> 2	<input type="checkbox"/> 1	<input type="checkbox"/> R1 - R2	<input type="checkbox"/> 2
<input type="checkbox"/> All	<input checked="" type="checkbox"/> 3	<input checked="" type="checkbox"/> 3	<input type="checkbox"/> 2	<input checked="" type="checkbox"/> R2 - R3	<input type="checkbox"/> 3
<input type="checkbox"/> None	<input type="checkbox"/> All	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> R3 - R4	<input checked="" type="checkbox"/> 4
	<input type="checkbox"/> None	<input checked="" type="checkbox"/> 5	<input checked="" type="checkbox"/> 4	<input type="checkbox"/> R4 - End	<input type="checkbox"/> 5
		<input type="checkbox"/> All	<input type="checkbox"/> 5	<input type="checkbox"/> All	<input type="checkbox"/> 6
		<input type="checkbox"/> None	<input checked="" type="checkbox"/> 6	<input type="checkbox"/> None	<input type="checkbox"/> 7
			<input type="checkbox"/> 7		<input type="checkbox"/> 8
			<input checked="" type="checkbox"/> 8		
			<input type="checkbox"/> All		
			<input type="checkbox"/> None		

Probability of Being Called

Business Surveys : Linked Model

- Model Outputs

Annual Sample Size	77,176								
Form Reveal Rate	82%								
	Response								
	Individual	Cumulative							
R1	19.13%	19.13%							
R2	25.77%	44.90%							
R3	14.77%	59.67%							
R4	16.43%	76.10%							
ze	6.08%	82.18%							
	Response: Gold Providers								
	Non-GP	GP							
R1	10.58%	27.97%							
R2	20.70%	31.00%							
R3	14.03%	15.53%							
R4	20.65%	12.07%							
ze	10.20%	1.83%							
Total	76.16%	88.40%							
	Response: Significance								
	Crucials	New-Ons	Others						
R1	20.59%	11.83%	19.87%						
R2	16.27%	18.67%	27.04%						
R3	18.88%	17.66%	14.23%						
R4	16.25%	19.21%	16.13%						
ze	10.91%	9.68%	5.44%						
Total	82.90%	77.06%	82.71%						
	Response: State								
	State 0	NSW	VIC	QLD	SA	WA	TAS	NT	ACT
R1	#DIV/0!	19.08%	18.48%	18.83%	20.65%	19.47%	21.38%	17.79%	19.80%
R2	#DIV/0!	25.53%	25.56%	25.56%	25.24%	25.94%	27.24%	27.45%	28.95%
R3	#DIV/0!	14.42%	14.39%	15.18%	16.47%	14.66%	16.23%	14.59%	14.69%
R4	#DIV/0!	16.53%	17.55%	15.87%	14.79%	16.66%	15.41%	14.30%	14.23%
ze	#DIV/0!	6.23%	6.15%	6.33%	5.85%	5.89%	4.81%	6.51%	5.11%
Total	#DIV/0!	81.79%	82.13%	81.77%	83.00%	82.62%	85.08%	80.65%	82.77%

Change in Estimate (SSITOT)	-0.01%
Change in Standard Error (SSITOT)	0.00%

Total Costs	
Salaries	\$ 832,566.14
Super	\$ 149,029.34
IT	\$ 98,169.55
Admin	\$ -
Total	\$ 1,079,755.03

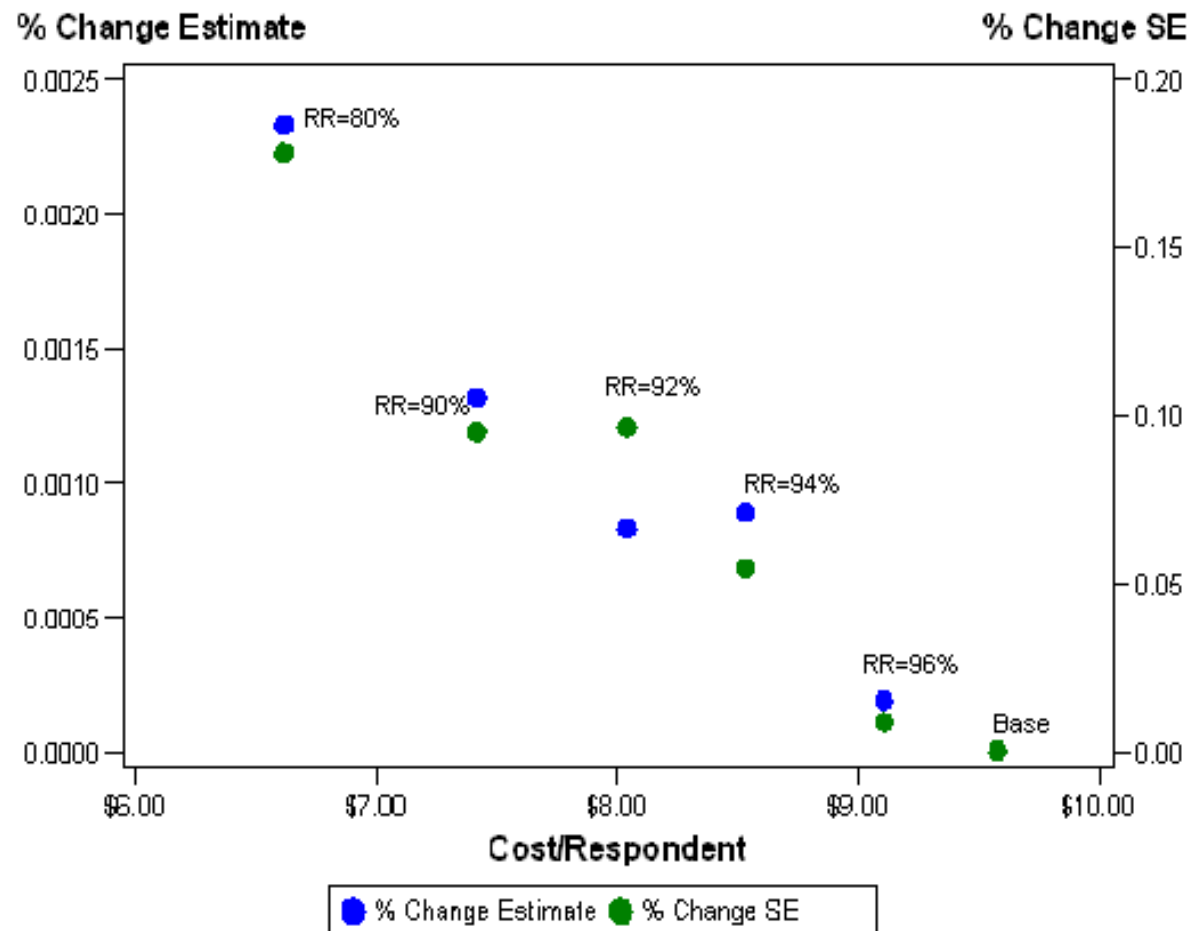
Excludes Super, IT and Admin

	Staff days	Cost
Predispatch	\$ 13.33	\$ 4,360.00
Pre-IFU	\$ 466.50	\$ 152,545.05
SFMP	\$ 154.35	\$ 50,473.10
Correspondence	\$ 154.35	\$ 50,473.10
Inbound Calls	\$ 605.61	\$ 198,033.11
Outbound phase 1	\$ 1,293.62	\$ 423,014.62
Outbound phase 2	\$ -	\$ -
Total	\$ 2,687.76	\$ 878,899.00

	Calls	
	Individual	Cumulative
R1	6,997	6,997
R2	16,850	23,848
R3	14,434	38,282
R4	19,491	57,772
ze	8,202	65,975

Business Surveys : Linked Model

- Scenario comparisons
 - Ceasing follow-up early for non-critical units



Business Surveys : Future Work

- Future paradata (wishlist)
 - CATI data
 - Small, but substantial % data collected via CATI
 - Web collection paradata
 - Audit trails
 - Timing information
 - Improved staffing allocation information
 - Ongoing quality and timeliness improvements to paradata

Business Surveys : Future Work

- Improvements to Bias Model
 - Including implementing a real-time measurements of bias
 - Extension to other surveys
- Potential inclusion of other factors e.g. training, survey capacity
- Inclusion of other costs (e.g. postage)
- Use of model to guide implementation of changes including field trials of alternative procedures
- Responsive survey design

Conclusions

- Developed a framework to manage the trade-off between costs and quality of survey outputs using operational paradata
- Applied this to ABS household and business surveys
- Further work includes extending to more surveys and to more complex operational processes, and to evaluate other scientific methods
- Couple the modelling work with experiments
- Apply influence to paradata design, collection and for responsive design.

Questions

