Developing Statistical Tools for Adaptive Design

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Outline

- **Background**

- **Adaptive Design Method**

- **Examples of Implementation**

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Background

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Response Rate Paradigm and Challenges

- **Achieving a high response rate is often viewed as the primary mechanism for ensuring sample representativeness**

  – **OMB standards and guidelines for statistical surveys (September 2006)**

- **Challenges in data collection**

  – **Response rates lower than expected**

  – **Expended time and cost of data collection**

  – **Potential nonresponse bias of resulting survey estimates**

  – **Inflation of design effect due to more variation in nonresponse-adjusted weights**

- **Achieving high unit and item response rates may require substantial costs and time**

- **Trade-offs between potential level of nonresponse bias at a given point in time with the expected amount of bias reduction, at what cost, and the impact on the schedule**

Efforts to Mitigate Challenges

- **Survey researchers have developed techniques, tools, and instruments**
  - **The use of incentives (monetary and non-monetary)**
  - **Scheduling phone interviews**
  - **Mixed modes of data collection**
  - **Data collection features and options that make it easier for people to respond to the survey (interactive website, shorten questionnaire, tablet, etc.)**

- **Low response rates do not necessarily indicate nonresponse bias, and high response rates do not guarantee that a survey is free of nonresponse bias (Groves 2006; Groves and Peytcheva 2008)**

- **Nonresponse bias is a function of**
  - **Response rate**
  - **Difference in survey outcome between respondents and nonrespondents**
  - **Correlation between response propensity and survey outcome**

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New Development and Direction

- **Implement a state-of-the-art data collection protocol involving active monitoring of survey outcomes and intervention in fielding process to adjust or adapt the data collection strategies (adaptive or responsive design)**

- **OMB allows agencies to change their data collection procedures in their approved surveys (Harris-Kojetin 2014)**
    - **Ad hoc changes**
        - When things are not going as expected
        - Consult with OMB on making changes
    - **Adaptive designs**
        - Planned phases or experiments to inform subsequent phases
        - May plan additional consultation with OMB

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Adaptive Design Method

Definition

- **Gambino, Laflamme, and Wrighte (2010)**

  – **"An adaptive approach to survey data collection is one that *uses information available prior to and during data collection to adjust* the collection strategy for the remaining cases"**

- **Groves and Heeringa (2006) refer to responsive design as a set of the following components**

  – **Identification of design features *impacting survey costs and errors* and indicators of cost and error properties**

  – ***Monitoring* those indicators in the initial phases of data collection**

  – ***Altering* features of the survey *in subsequent phases* based on cost/error tradeoff assessments**

  – **Combining data from separate design phases into a single estimator**
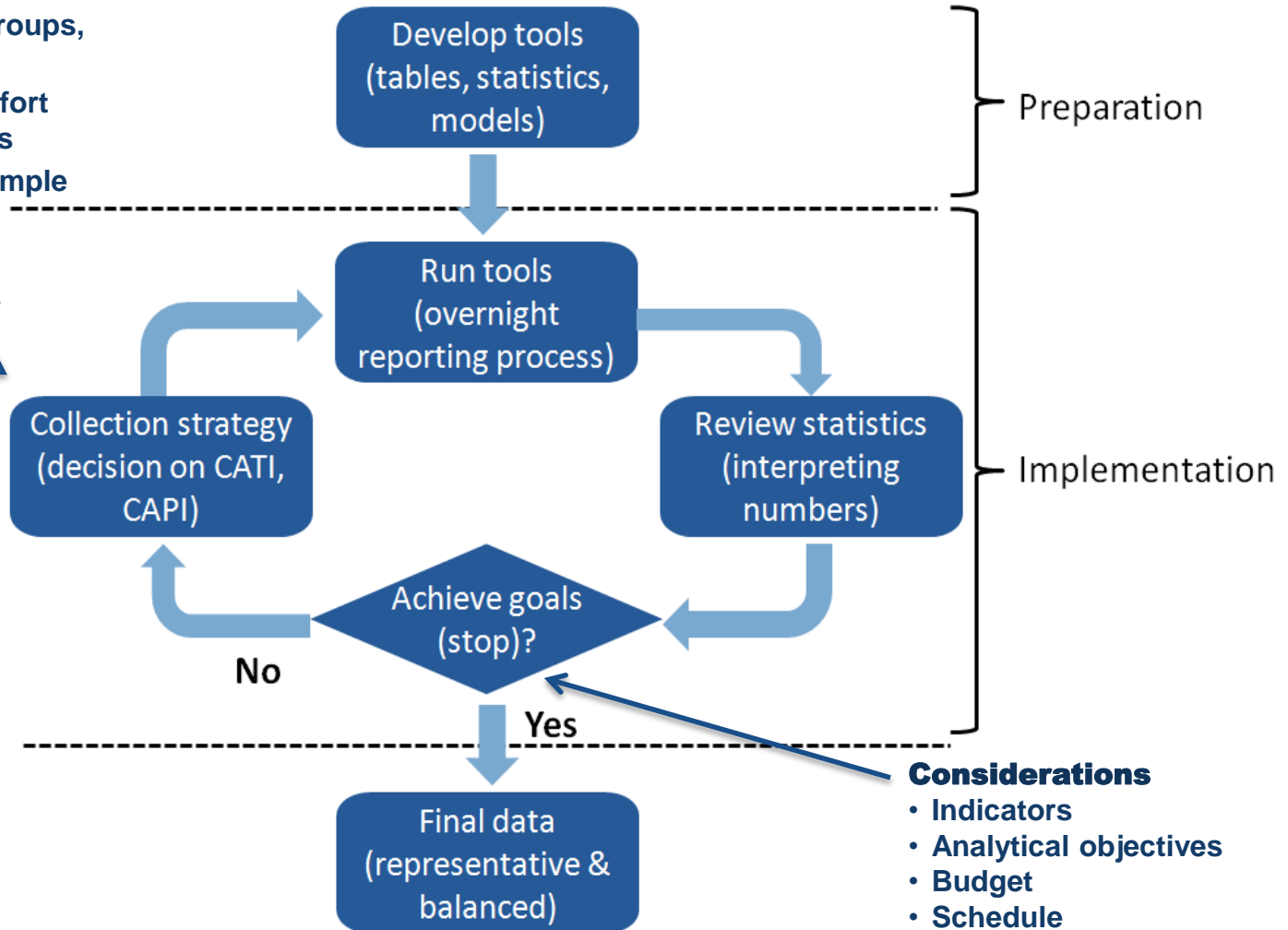
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Motivation

- **Nonresponse bias is a function of**

  - **Response rate**

  - **Difference in survey outcome between respondents and nonrespondents**

  - **Correlation between response propensity and survey outcome**

- **Objectives (may require trade-offs)**

  - **Increase response rate**

  - **Obtain survey results that are representative of the target population**

  - **Balance respondents**

  - **Increase number of completes**

  - **Be able predict, on a periodic basis, response propensity of the remaining sample**

  - **Reduce cost**

  - **Reduce time**

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Operation

Implementation

- **Target certain sample groups, PSUs, or strata**
  - **Lessen or increase effort among released cases**
  - **Release additional sample for specific groups**
- **Alter incentive scheme**
- **Add an additional mode**

Develop tools (tables, statistics, models)

Run tools (overnight reporting process)

Collection strategy (decision on CATI, CAPI)

Review statistics (interpreting numbers)

Achieve goals (stop)?

No

Yes

Final data (representative & balanced)

Preparation

Implementation

Considerations
- **Indicators**
- **Analytical objectives**
- **Budget**
- **Schedule**

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Indicators and Measures

- **Response rates**

  - **Are response rates homogeneous across sample characteristics?**

  - **Present tables and graphs by sampling strata, domain of analysis, sample characteristics**

- **Response propensity (probability or likelihood of response)**

  - **Predict response propensity of the remaining sample for effort decision in later phases**

  - **Use response propensities to evaluate representativeness of current respondents**

- **R-indicators (overall, partial, category level)**

  - **Are survey respondents representative of the sample?**

  - **If all units in the population share the *same probability of responding*, then no nonresponse bias**

  - **Calculate estimates of response probabilities and their variability**

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Indicators and Measures (cont.)

- **Survey outcomes**

  – **Do additional respondents change outcomes (estimates or decision of tests)?**

  – **Does the estimate converge to a value?**

  – **Present tables and graphs for key outcomes**

- **Cost**

  – **Trade-off between cost and error**

  – **Cost model (different incentives, different modes)**

  – **Retrospective power analysis comparing Minimum Detectable Effects achieved at target response rate vs. if the survey is closed right now**

  – **Cost implication**

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Examples of Implementation

Example of Impact Evaluation Study

- **Study design**
  - **Evaluate a demonstration by measuring the impact**
  - **Test whether the impact is positive**
  - **Pre- and post-intervention using treatment groups (T and C)**

- **Survey design**
  - **Baseline survey and follow-up survey**
  - **CATI with CAPI follow-up**
  - **Pre-specified target response rate**

- **Sample design**
  - **Probability sample (or nonprobability sample)**
  - **T vs. C balance across baseline or matching covariates**
  - **Stratified**
  - **Clustered**

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Example of Impact Evaluation Study (cont.)

- **Goals of adaptive design**
  - **High response rate**
  - **Representative respondents**
  - **Balance T vs. C respondents across baseline covariates**

- **Monitoring (daily tables and plots)**
  - **Response rates: overall, T vs. C (overall and by baseline covariates)**
  - **R-indicators (overall, partial, category level): overall, T vs. C**
  - **Statistical tests**
    - Respondents vs. nonrespondents (by baseline covariates)
    - T vs. C respondents (by baseline covariates)
- **Producing individual estimate of response propensity**

Example of Overnight Report

| Variable	Unweighted response rate			R-indicators		
	T Sample	C Sample	T + C	T Sample	C Sample	T + C
Overall	53.04	51.08	52.05	0.862	0.861	0.879
Site				0.036	0.034	0.030
Alabama	57.46	50.36	53.86	0.015	-0.002	0.006
Arizona/Southeast California	51.91	54.10	53.05	-0.004	0.010	0.003
Colorado/Wyoming	50.73	44.48	47.56	-0.005	-0.016	-0.011
DC Metro	52.19	48.26	50.20	-0.003	-0.008	-0.005
Greater Detroit	52.14	56.16	54.17	-0.003	0.018	0.007
Greater Houston	44.73	46.59	45.66	-0.025	-0.014	-0.020
Northern New England	54.89	51.49	53.15	0.004	0.001	0.002
South Florida	50.66	49.33	50.00	-0.008	-0.006	-0.007
Western New York	55.27	53.39	54.32	0.009	0.009	0.009
Wisconsin	57.96	54.08	56.02	0.016	0.010	0.013
Age category				0.038	0.031	0.035
<40	49.67	47.71	48.67	-0.015	-0.015	-0.015
40-<50	49.26	48.59	48.92	-0.020	-0.013	-0.017
50+	57.07	54.34	55.69	0.029	0.024	0.026
Gender				0.026	0.019	0.022
Male	50.52	49.21	49.86	-0.018	-0.013	-0.015
Female	55.69	53.02	54.33	0.018	0.014	0.016
Primary beneficiary				0.015	0.007	0.011
Yes	53.48	51.32	52.40	-0.015	-0.006	-0.010
No	48.46	49.32	48.96	0.004	0.002	0.003
Benefit duration status				0.004	0.002	0.004
Short duration	53.52	50.79	52.65	-0.004	0.001	-0.003
Long duration	52.55	51.17	51.70	0.002	-0.002	0.003

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Example of Overnight Report (cont.)

Variable	Comparison of Respondent vs. Non-Respondent						Comparison of T vs. C Respondents					
	Proportion		Standard Error of Proportion		Test Respondent vs. Non-Respondent		Proportion		Standard Error of Proportion		Test T vs. C respondents	
	Resp.	Non-resp.	Resp.	Non-resp.	Chi-test/ T-test	p-value	T resp.	C resp.	T resp.	C resp.	Chi-test/ T-test	p-value
Overall												
Site Name	.	.	.	.	38.774	0.000	.	.	.	.	1.230	0.999
Alabama	0.144	0.137	0.005	0.005	1.022	0.307	0.140	0.141	0.005	0.005	-0.136	0.892
Arizona/Southeast California	0.102	0.099	0.004	0.004	0.630	0.529	0.098	0.103	0.004	0.004	-0.737	0.461
Colorado/Wyoming	0.065	0.078	0.003	0.004	-2.511	0.012	0.071	0.072	0.004	0.004	-0.125	0.900
DC Metro	0.050	0.055	0.003	0.003	-1.012	0.311	0.053	0.052	0.003	0.003	0.041	0.967
Greater Detroit	0.101	0.094	0.004	0.004	1.184	0.236	0.098	0.097	0.004	0.004	0.137	0.891
Greater Houston	0.076	0.098	0.004	0.004	-3.907	0.000	0.088	0.087	0.004	0.004	0.251	0.802
Northern New England	0.103	0.095	0.004	0.004	1.250	0.211	0.098	0.100	0.004	0.004	-0.451	0.652
South Florida	0.148	0.162	0.005	0.005	-1.908	0.056	0.158	0.153	0.005	0.005	0.640	0.522
Western New York	0.102	0.094	0.004	0.004	1.515	0.130	0.098	0.098	0.004	0.004	-0.059	0.953
Wisconsin	0.108	0.089	0.004	0.004	3.162	0.002	0.099	0.097	0.004	0.004	0.338	0.735
Age Category	.	.	.	.	24.704	0.000	.	.	.	.	0.799	0.671
< 40	0.237	0.257	0.006	0.006	-2.315	0.021	0.244	0.250	0.006	0.006	-0.702	0.483
40 - < 50	0.259	0.288	0.006	0.006	-3.309	0.001	0.277	0.270	0.006	0.006	0.765	0.444
50 +	0.504	0.456	0.007	0.007	4.952	0.000	0.479	0.480	0.007	0.007	-0.077	0.939
Gender	.	.	.	.	32.065	0.000	.	.	.	.	0.296	0.587
Male	0.489	0.545	0.007	0.007	-5.670	0.000	0.520	0.515	0.007	0.007	0.544	0.587
Female	0.511	0.455	0.007	0.007	5.670	0.000	0.480	0.485	0.007	0.007	-0.544	0.587
Primary beneficiary	.	.	.	.	2.993	0.084	.	.	.	.	30.841	0.000
No	0.097	0.107	0.004	0.004	-1.732	0.083	0.086	0.119	0.004	0.004	-5.568	0.000
Yes	0.903	0.893	0.004	0.004	1.732	0.083	0.914	0.881	0.004	0.004	5.568	0.000
Benefit duration status	.	.	.	.	0.246	0.620	.	.	.	.	845.531	0.000
Long duration	0.629	0.634	0.007	0.007	-0.496	0.620	0.492	0.768	0.007	0.006	-30.293	0.000
Short duration	0.371	0.366	0.007	0.007	0.496	0.620	0.508	0.232	0.007	0.006	30.293	0.000

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Overall Response Rates by T/C Group
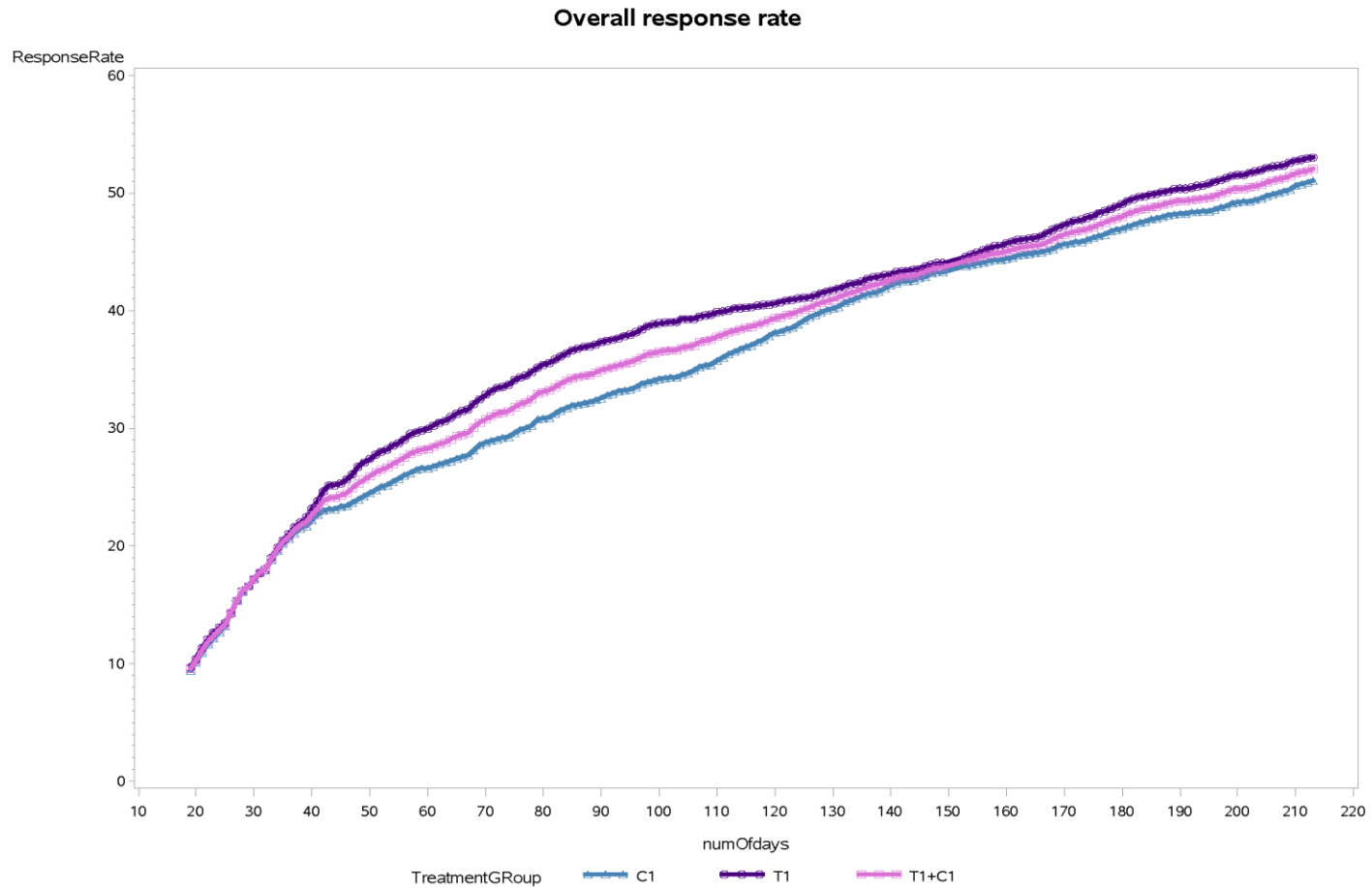
Overall response rate

Particular Site Response Rates by T/C Group

Category level partial response rate
01_C_SITENAME - DC Metro
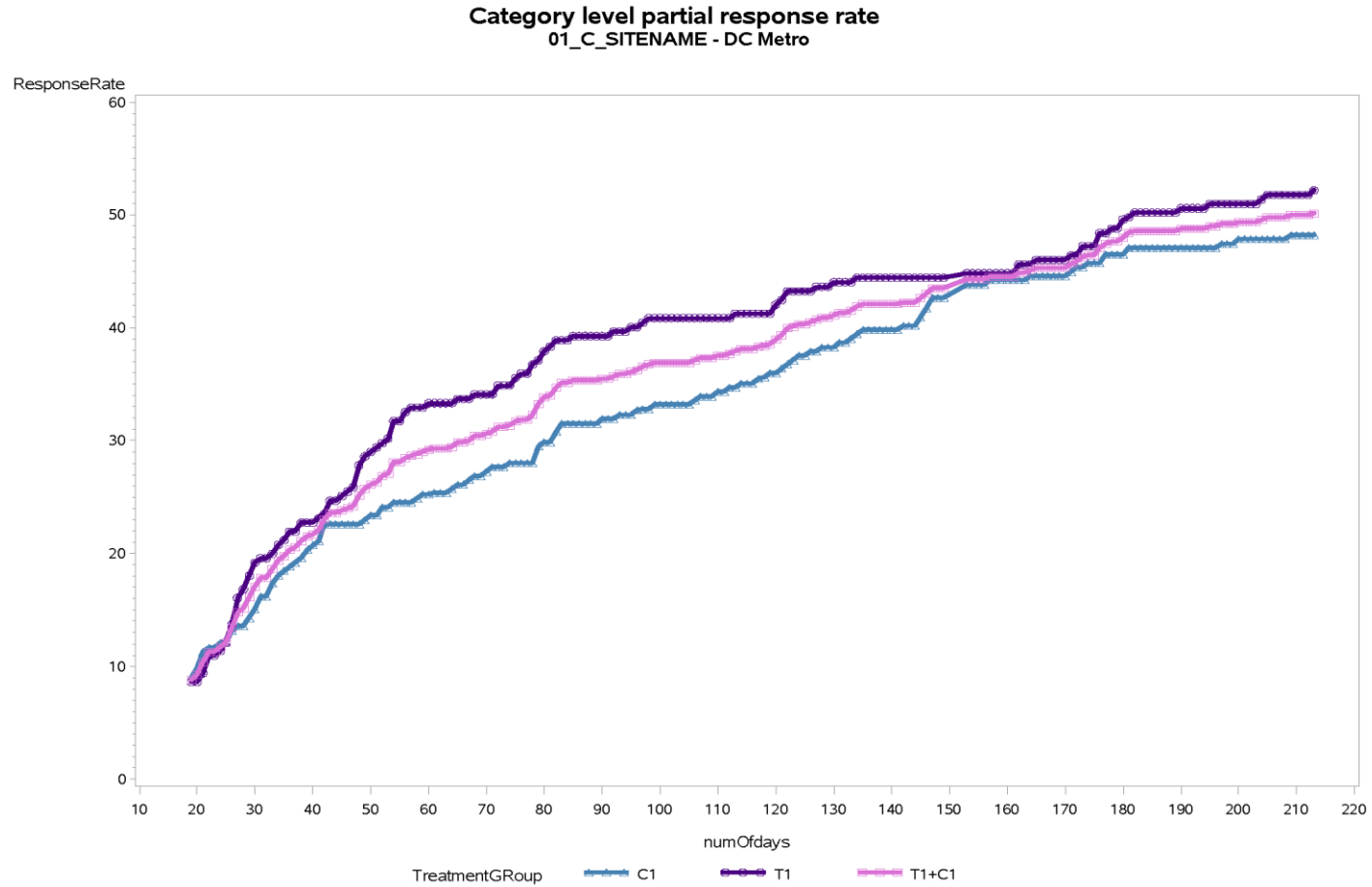
Overall R-Indicators, by T/C Group
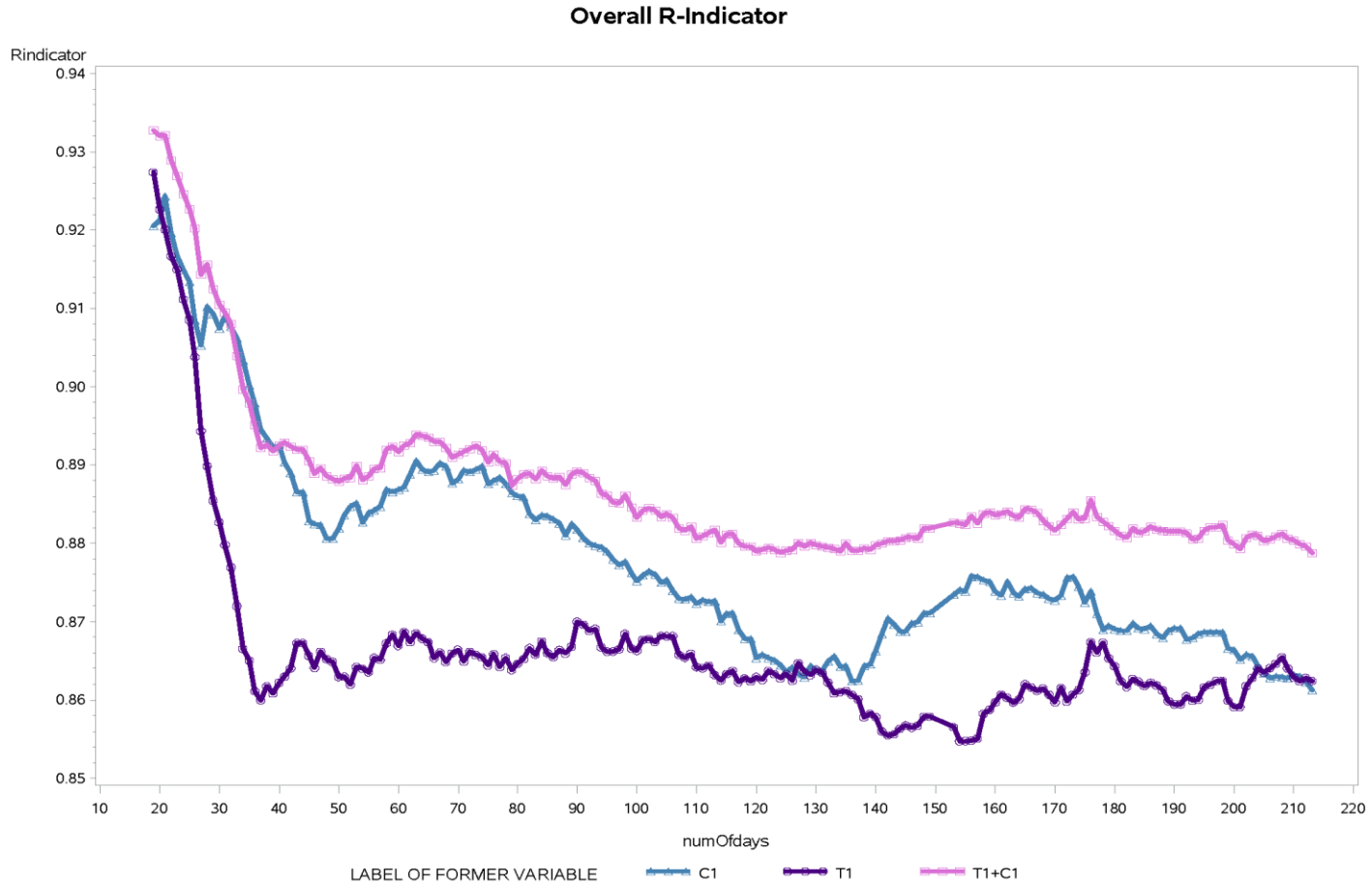
Example of Collection Strategy: Two-Phase Design

Released cases at time _t_

At selected interval

Subset with current or final specified set of dispositions

Paradata

Build model to predict response status

Evaluate

Apply model to all released cases

Released cases' current disposition and predicted propensity to respond at time _t_

Review statistics

Assign primary and secondary cut-offs for propensity score

Not complete and above primary cutoff?

$p > 0.50$ — **YES**

$p \leq 0.50$ — **NO**

Above secondary cutoff?

$p > 0.85$ — **YES** → **Stay in CATI, reduce effort**

Saves cost

$0.50 < p \leq 0.85$ — **NO** → **Maintain full CATI effort, no CAPI**

Determine sampling rate

Sample for CAPI? (Target as desired)

YES → **To CAPI**

Helps to balance

NO → **Stop**

Example of Cost and Precision Trade-off Assessment

Scenario	CPC $ 200 Resp Rate CATI T	C	CATI Follow-up % of CATI NR Acceptable to send to CAPI	% of Acceptable CATI NRs Sampled For CAPI	CPC $ 600 Resp Rate CAPI T	C	Overall response rate (Unwgted)	Overall response rate (Wtd)	Number of completes T	C	T+C	Outcome variable MDE	MDE % of Mean	Approx Interviewer Labor Cost
Scenario 1 (no subsampling, 80% RR) (Reference - Original Plan)							80.0%	80.0%	3,819	3,889	7,708	$213.16	**16.9%**	$3,300,172
Scenario 2	**32.2%**	**32.2%**	**85.0%**	**100.0%**	**37.9%**	**37.9%**	52.5%	52.5%	2,506	2,552	5,058	$305.08	**24.2%**	$1,794,703
Scenario 3	**49.0%**	**20.0%**	**85.0%**	**100.0%**	**59.0%**	**20.0%**	52.5%	52.5%	3,475	1,587	5,062	$322.28	**25.5%**	$1,712,452
Scenario 3	**44.0%**	**44.0%**	**85.0%**	**100.0%**	**64.0%**	**64.0%**	72.3%	72.3%	3,453	3,516	6,969	$234.68	**18.6%**	$2,485,674
Scenario 4	**44.0%**	**44.0%**	**85.0%**	**50.0%**	**64.0%**	**64.0%**	58.2%	72.3%	2,777	2,828	5,604	$282.08	**22.4%**	$1,666,768

Notes: the numbers are made up for illustration purpose only.

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For More Information

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