

# Responsiveness and Representativeness in an Establishment Survey of Manufacturers

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# Outline

- Motivation for Research
- Definitions
- Background on the Annual Survey of Manufactures (ASM)
- Research Questions
- Results
- Discussion

# Motivation for Research

- This work stemmed from exploratory work looking into how we might use paradata, response data, cost data, and other auxiliary data to make informed decisions about the ASM and related surveys' data collection process.



# Definitions

- Establishment – typically a single physical location where business is conducted or where services or industrial operations are performed.
- Enterprise – a business organization consisting of one or more domestic establishments that were specified under common ownership or control. The enterprise and the establishment are the same for single-unit firms. Each multi-unit company forms one enterprise.



# ASM – Background and Sample Design

- The ASM is a mandatory response survey providing statistics on employment, payroll, operating expenses, etc.
- There are two sampling strata: mail and nonmail.
  - The ASM mail sample includes approximately 50,000 establishments of which about 20,000 are selected with certainty, and about 30,000 are selected with probability proportional to a composite measure of establishment size.
  - Although the nonmail stratum contained approximately 180,000 individual establishments in 2011, it accounted for less than 7 percent of the estimate for total value of shipments at the total manufacturing level.
- A new sample is selected at five-year intervals beginning the second survey year subsequent to the Economic Census.

# ASM – Data Collection

- Paper forms for ASM and the Company Organization Survey (COS) are mailed together for those units in sample for each survey. The ASM and COS are not conducted in Economic Census years.
- Respondents can choose to report by mail or electronically via either the Economic Census Surveyor software for multi-unit organizations or Web-based Centurion reporting for single-unit organizations.
- In 2011, every enterprise in the sample received a paper form.
  - For the 2012 Economic Census if all 2011 ASM and COS responses for an enterprise were electronic, paper forms were not sent.
- Responses are due within 30 days of receiving the form.

# ASM – Nonresponse Follow-up

- Follow-up commences approximately two months after the initial mailout, and is usually in the form of a mailed letter.
- After the first reminder, there are three additional reminders sent, approximately once a month, until a case is considered a nonrespondent.
- For some very large establishments that are deemed important for estimation purposes, follow-up may occur via telephone.
- Currently, data collection persists for the ASM until the project runs out of time or money.

# ASM - Nonresponse Adjustment

- The ASM does not perform a nonresponse weighting adjustment.
- The ASM does impute individually for every nonrespondent using administrative data, prior, year data, etc.
- Nonrespondents are imputed near the time of close-out processing. Imputation for item nonresponse occurs when the establishment is run through the edits.





# Analysis Questions

1. What is the cumulative unit response rate?  
Total quantity response rate?
2. How much money are we spending on each stage of data collection relative to the achieved response rate?
3. How representative are the respondents of the initial mailing sample?



# Data Sources

- Surveyor
  - Company ID
  - Timestamp for downloading and uploading the software
  - Mode the company last reported
- Business Register (BR)
  - Administrative data
  - Survey response data
- Cost data



# Limitations on the Analysis

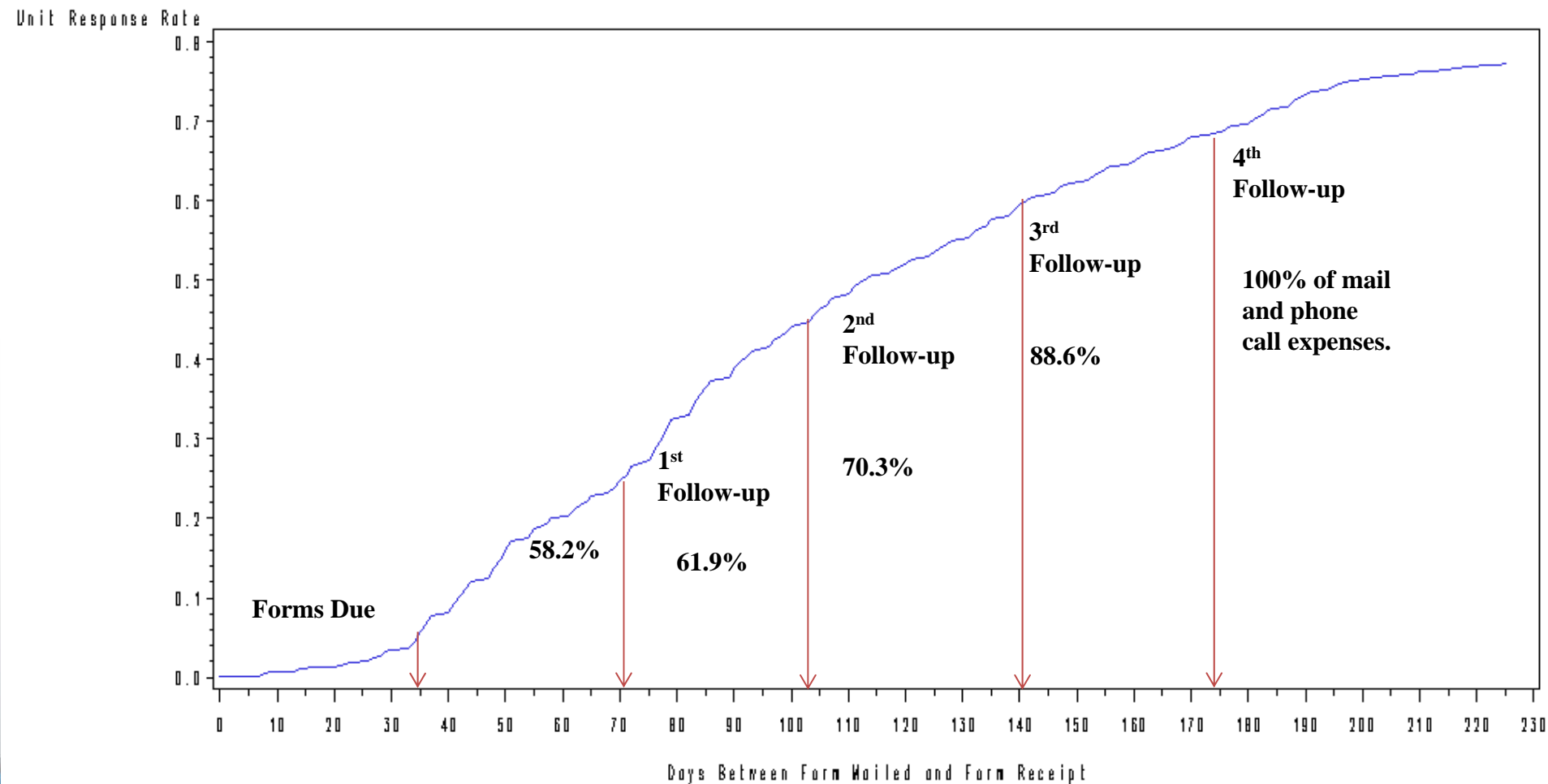
- Response rates are an approximation
- Cost information only reflected mail and phone call costs (direct labor, overhead, and outgoing calls)
- Cannot separate ASM/COS costs



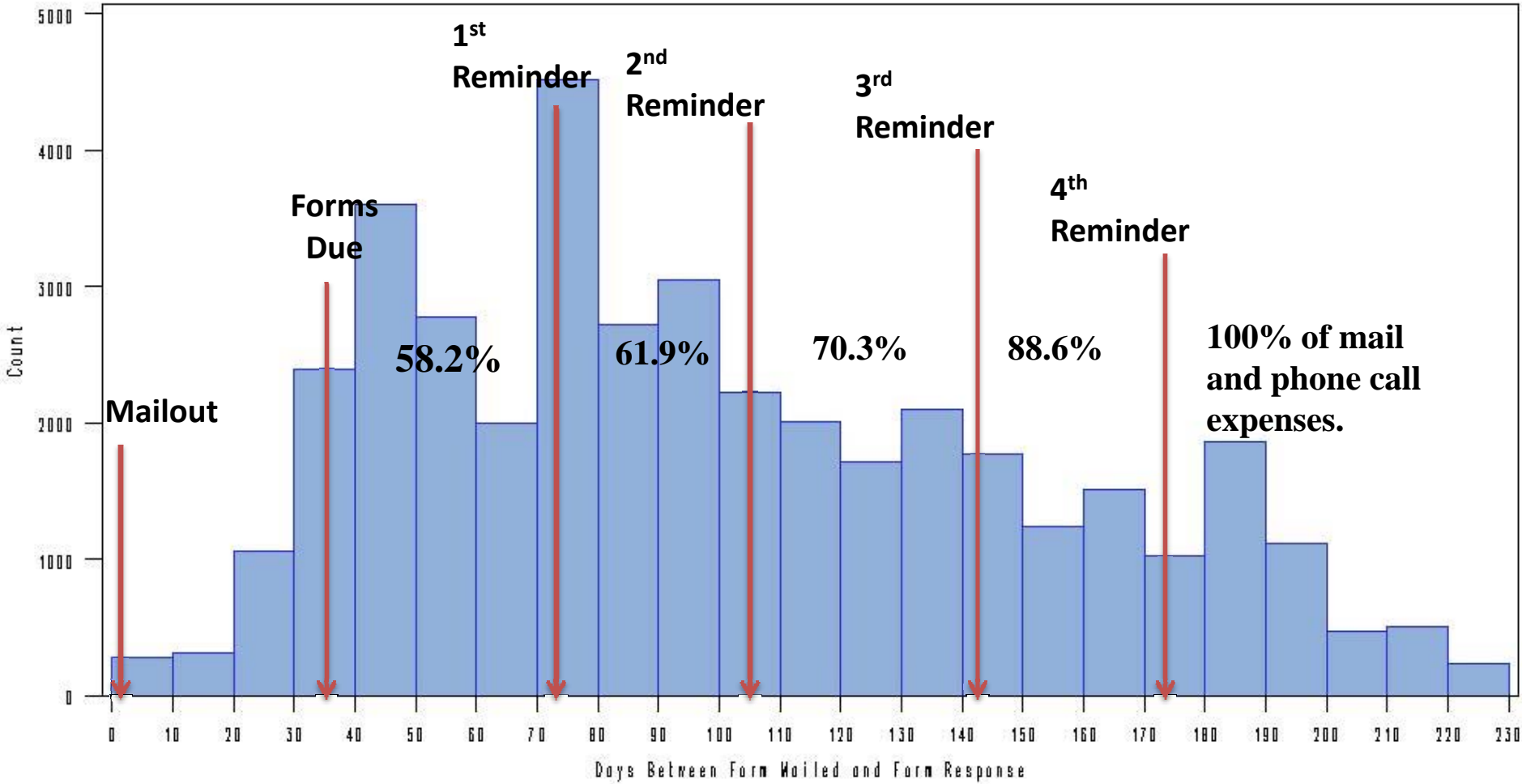
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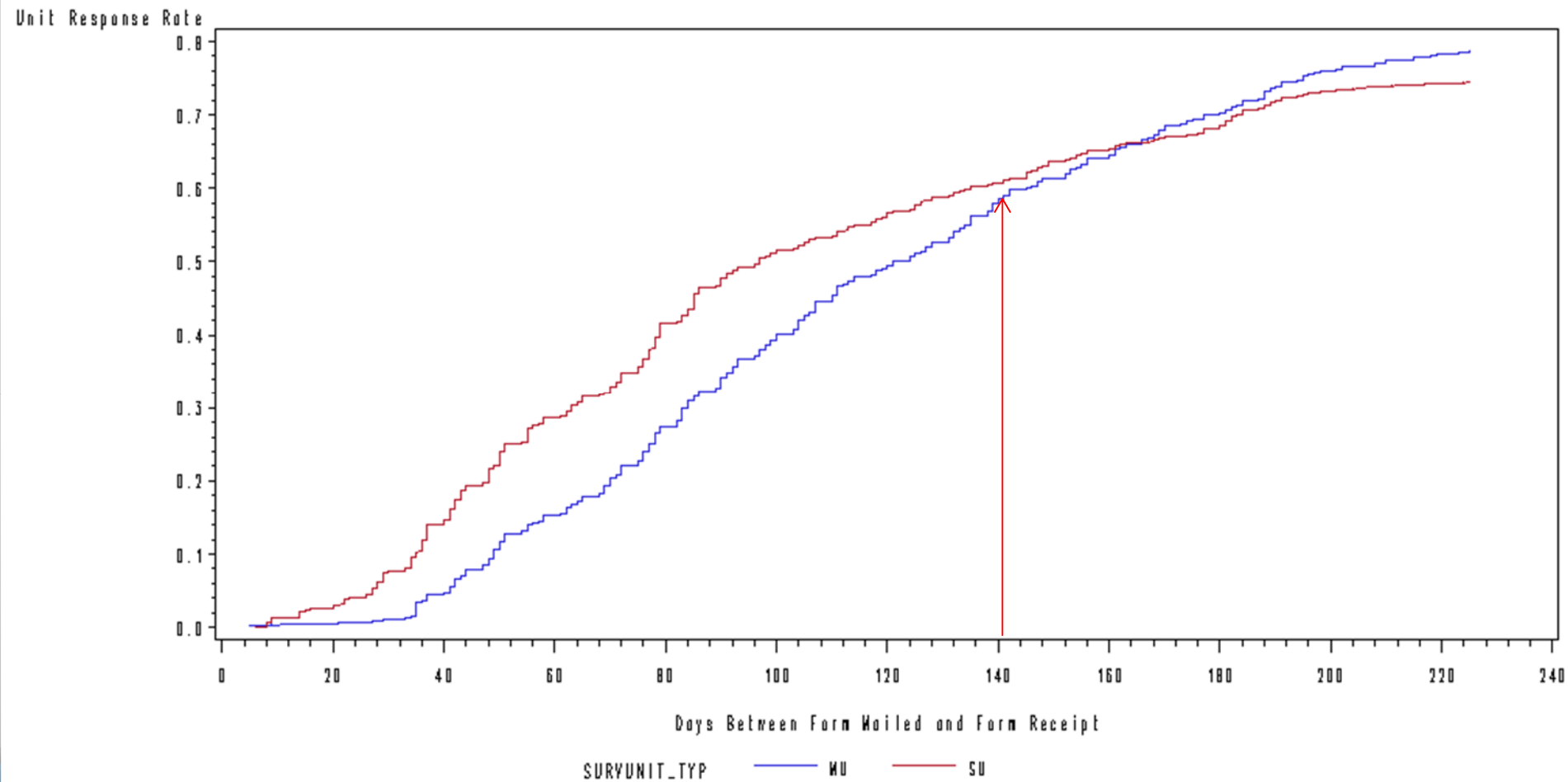
# The Unit Response Rate For the 2011 ASM From When Forms Were Initially Mailed to Respondents.



# The number of responses by 10 day interval for the 2011 ASM



# Unit Response Rate for 2011 ASM for Single and Multi-Unit Respondents



# Total Quantity Response Rate

The TQRR is the proportion of the estimated, weighted total of data item  $t$  reported by the active tabulation units in the statistical period or from sources determined to be equivalent-quality-to-reported data (expressed as a percentage).

The TQRR is computed as follows:

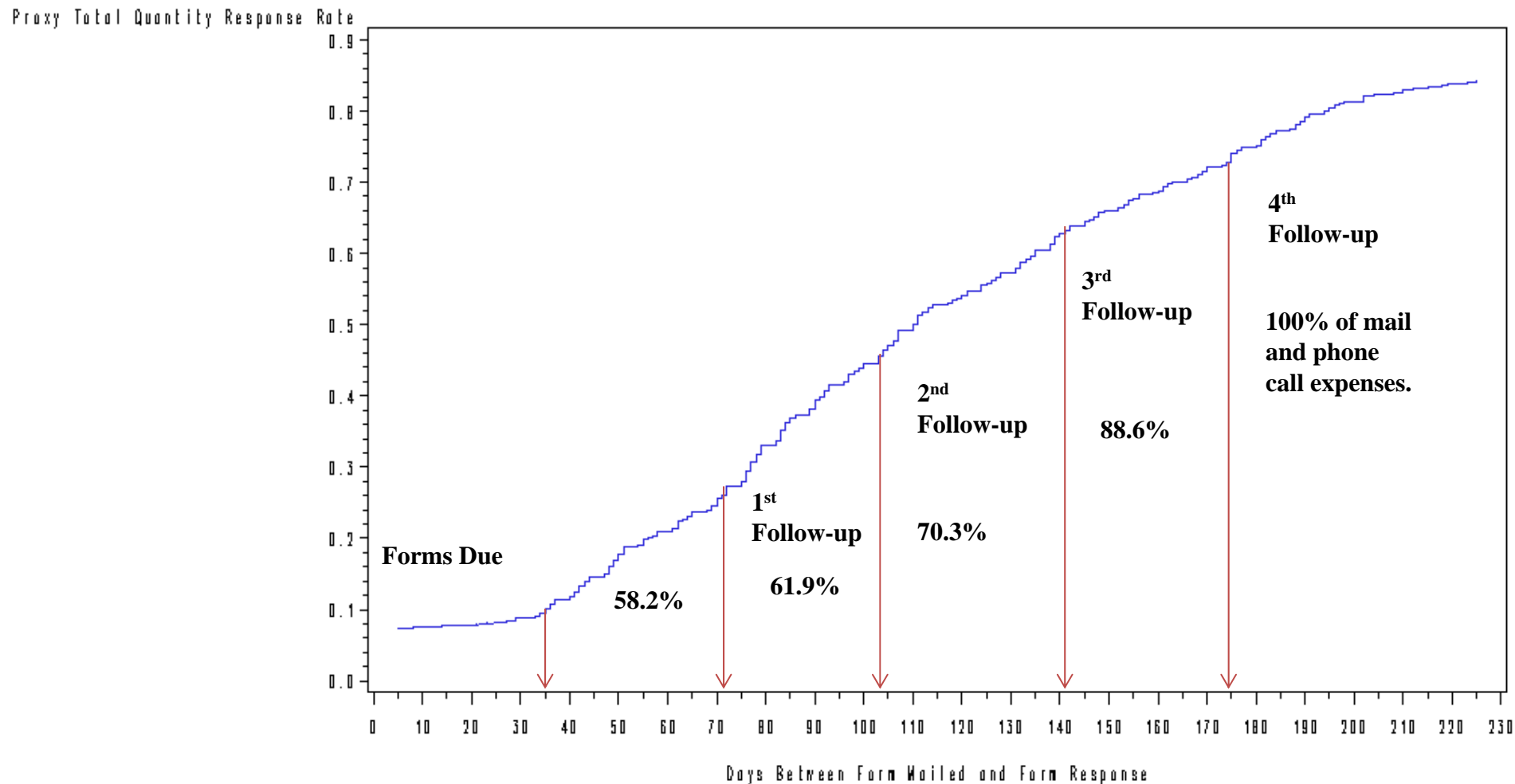
$$TQRR = \left[ \frac{\sum_{i=1}^{N_T} w_i * (r_{ti} + q_{ti}) * t_i}{\sum_{i=1}^{N_T} w_i f_i |t_i|} \right] * 100$$

Where:

- $w_i$  is the design weight of tabulation unit  $i$ ,
- $r_{ti}$  is the indicator variable for reported data for tabulation unit  $i$  and data item  $t$ ,
- $q_{ti}$  is the indicator variable of “equivalent quality” data for tabulation unit  $i$  and data item  $t$ ,
- $t_i$  is the data value for unit  $i$ ,
- $f_i$  is the nonresponse weighting adjustment factor for tabulation unit  $i$ , and
- $N_T$  is the total number of eligible tabulation units.



# The Proxy Total Quantity Response Rate For the 2011 ASM



# Analysis Questions

1. What is the cumulative unit response rate? Total quantity response rate?
2. How much money are we spending on each stage of data collection relative to the achieved response rate?
3. How representative are the respondents of the initial mailing sample?



# Deviation From Representativeness

$$\hat{R}(\hat{\rho}_i) = 1 - 2\hat{S}(\hat{\rho}_i)$$

Where

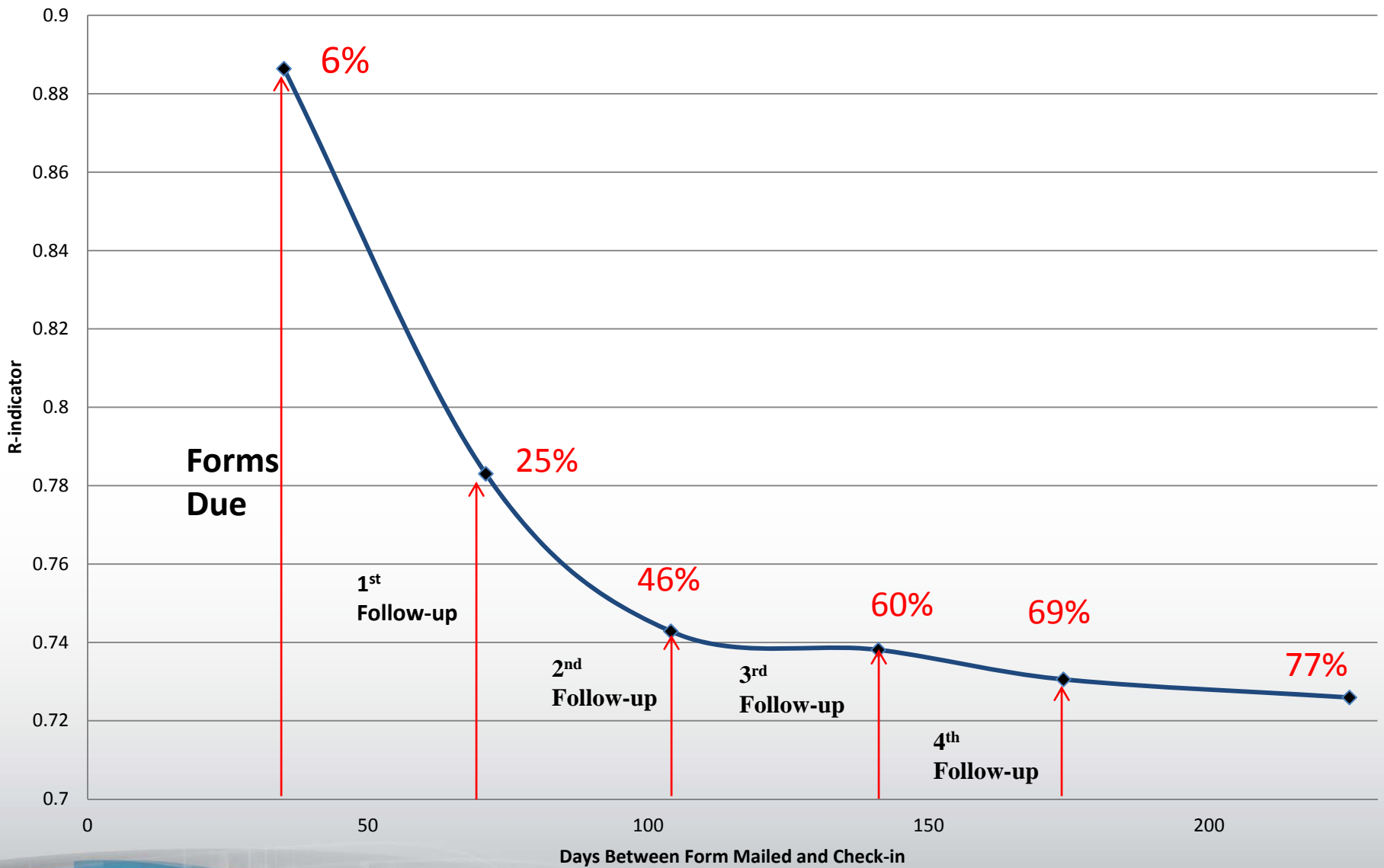
$$\hat{S}(\hat{\rho}_i) = \sqrt{\frac{1}{N-1} \sum_{i=1}^N d_i (\hat{\rho}_i - \hat{\rho})^2}$$



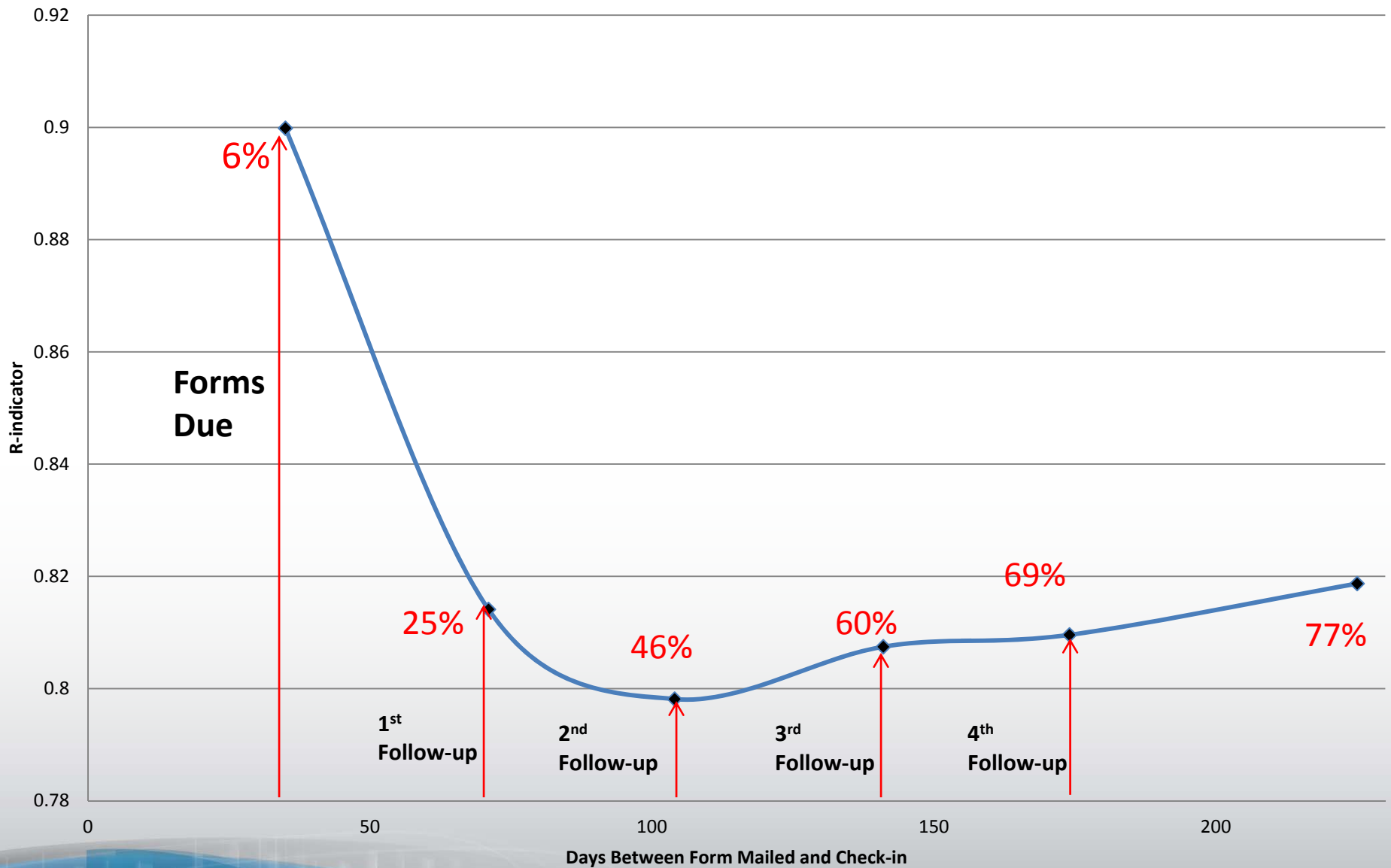
# Calculating the R-Indicators for the ASM

- In our propensity model, we included the design variables six-digit NAICS, employment (as a proxy for measure of size), and state.
- We then calculated the R-indicator for the 51,829 mail cases.
- We did this for six “major events” in the data collection period of the survey.
  - Due date
  - Four follow-up dates
  - End of collection

# R-indicator

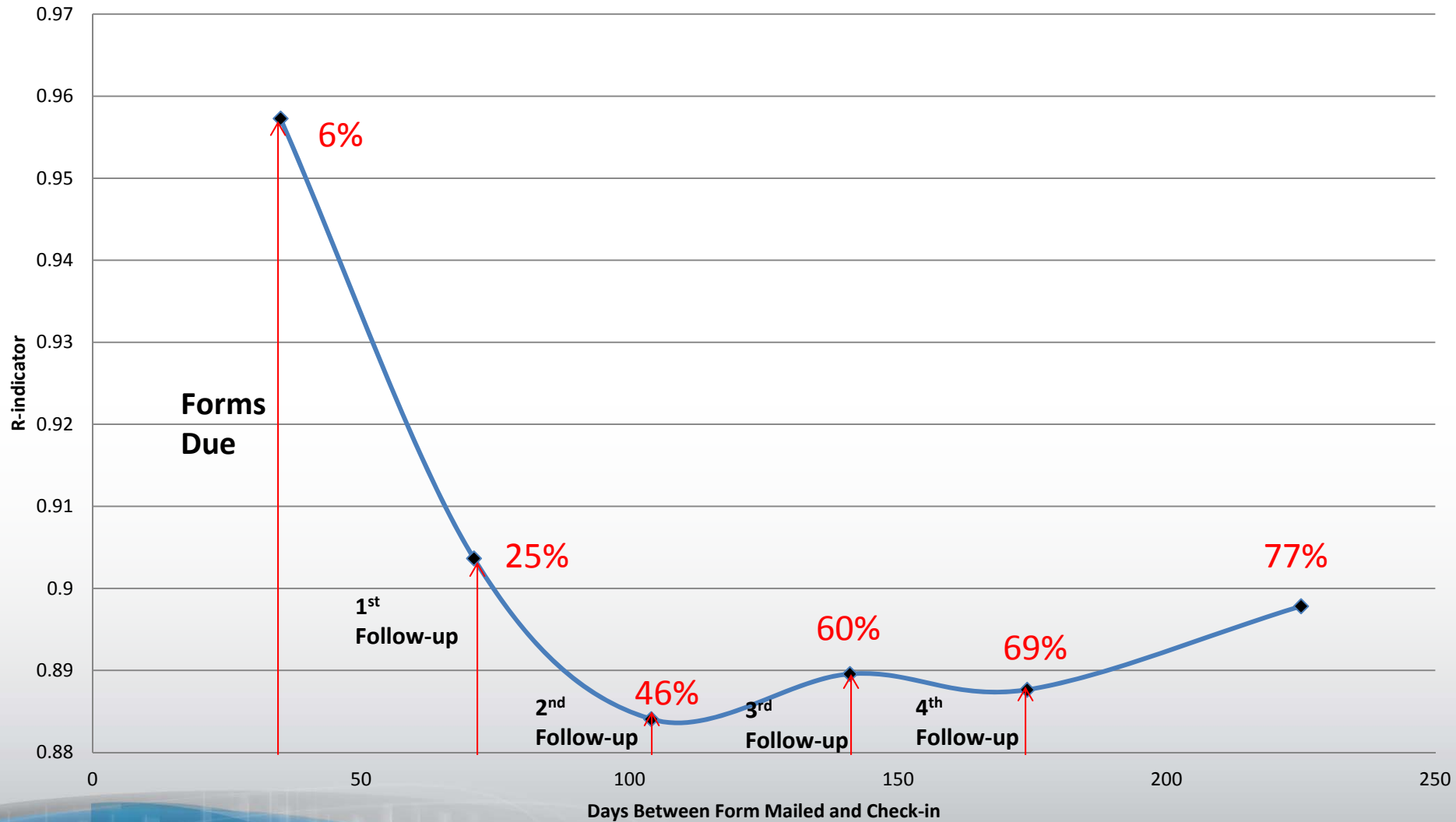


# R-indicator On 6-Digit NAICS Only



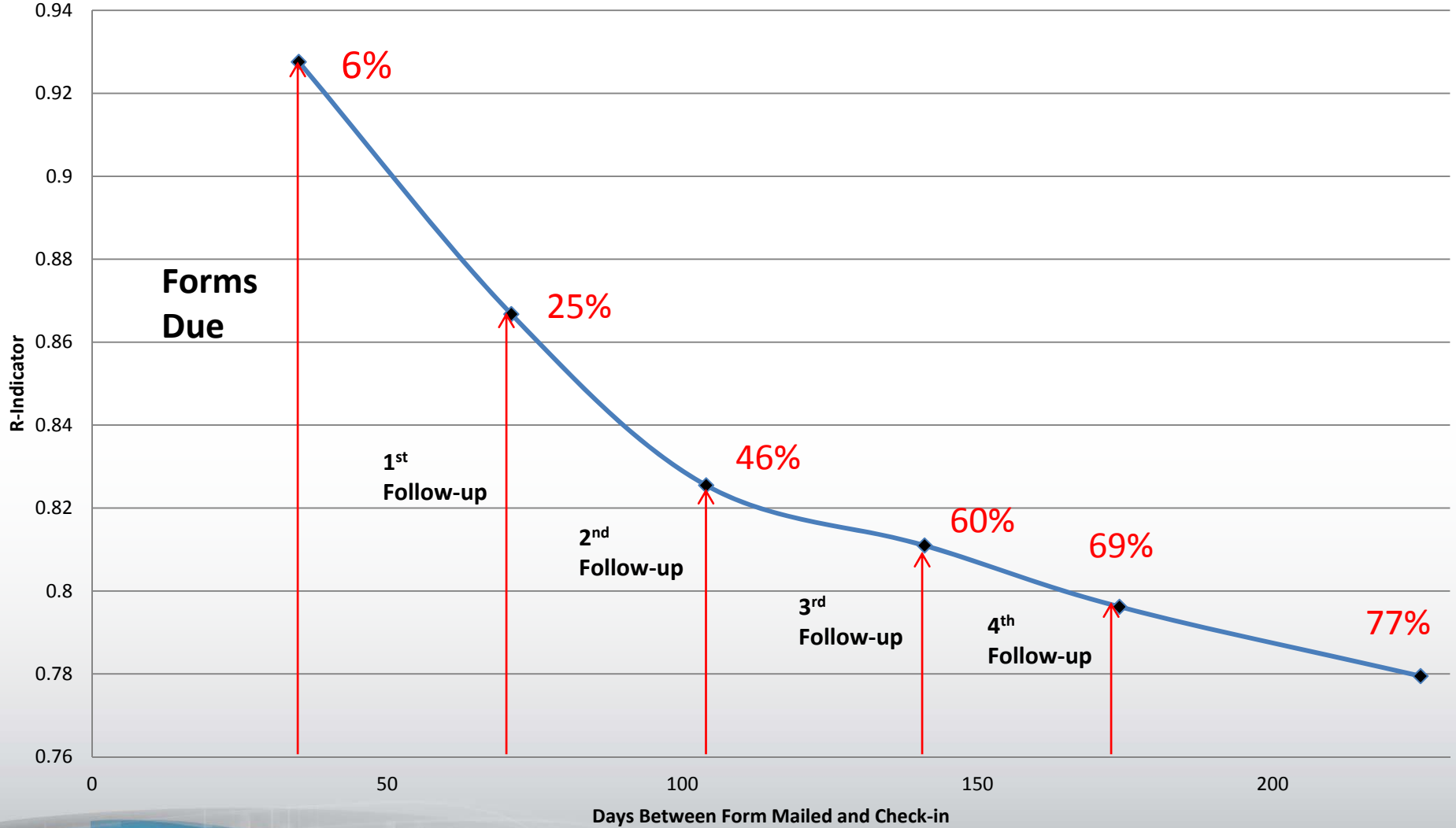


## R-indicator On State Only





## R-indicator On EMP\_SIZE Only







# Unconditional Partial R-Indicator

where:

$w_i$  is the design weight of tabulation unit  $i$ ,  
 $t_i$  is the 2007 Economic Census annual payroll value for tabulation unit  $i$ , and  
 $N_T$  is the total number of eligible tabulation units,

The numerator can then be computed as:

where

$$q + \sum_{i=1}^{N_T} w_i r_{ti} t_i$$

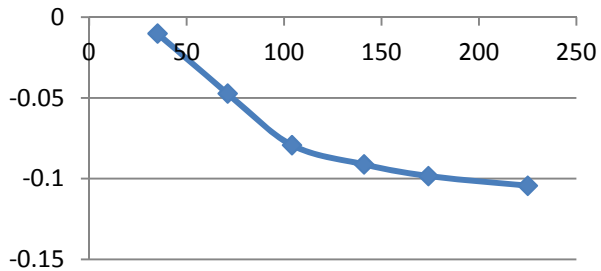
and

where:

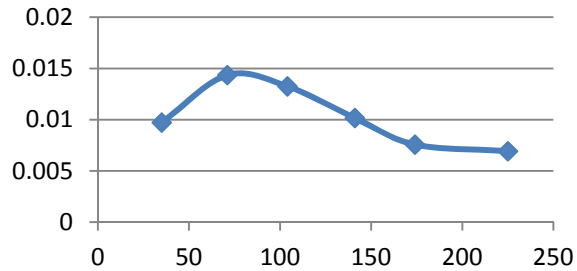
$q$  is the administrative data value calculated from the denominator,  
 $r_{ij}$  is the indicator variable for reported data for tabulation unit  $i$  and data item  $j$ .



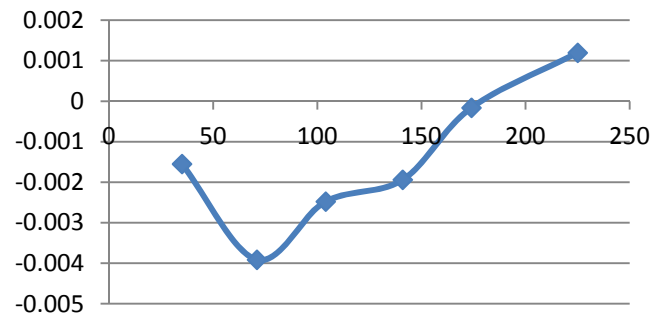
### 0 Employees



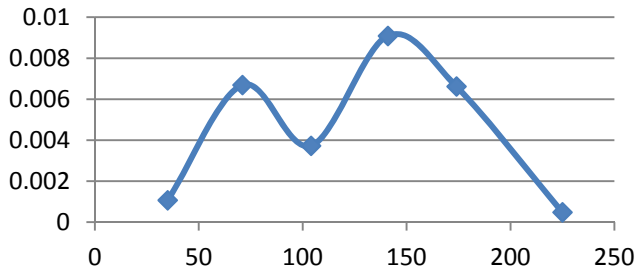
### 15 – 19 Employees



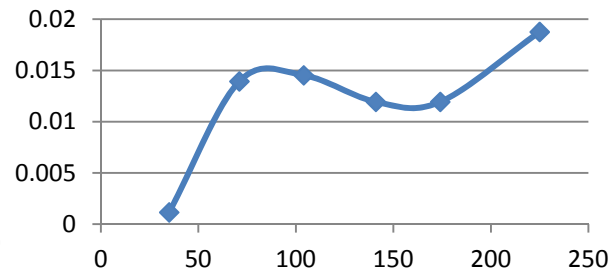
### 2,000 – 2,499 Emp.



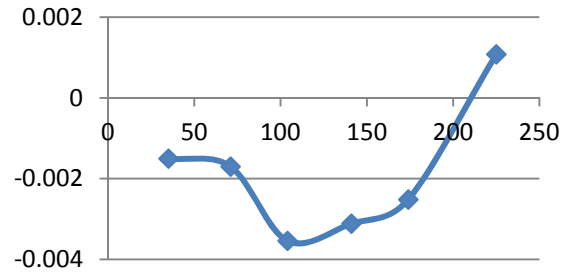
### 1 – 4 Employees



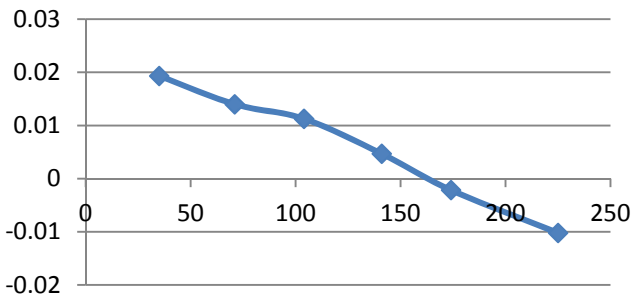
### 20 – 49 Employees



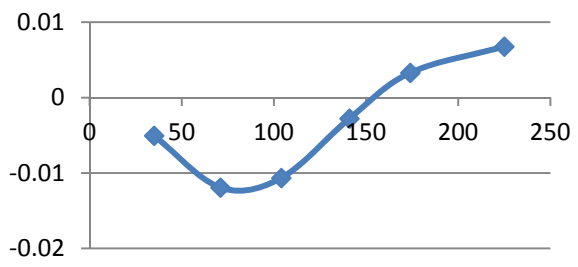
### 2,500 – 2,999 Emp.



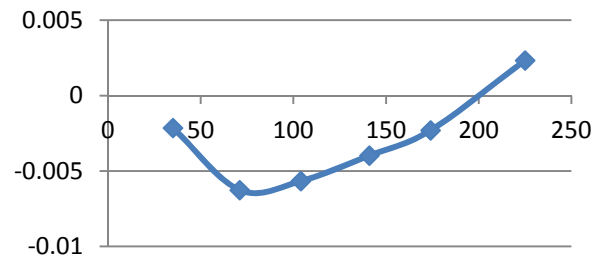
### 5 – 9 Employees



### 1,000 – 1,999 Emp.



### 3,000 + Emp.





# Discussion

- On the surface, the nonresponse follow-ups seem effective. There is a relatively monotonic increase in the URR.
- However, when incorporating cost information we see that the third round follow-up is when the amount we are spending does not translate to an appreciable increase in overall response.
- Also, upon examining the single-units and multi-units, the single-unit URR slope starts to decline around the third follow-up, suggesting that the make-up of respondents is changing.



# Discussion cont'd

- The overall R-indicator suggests that nonresponse follow-up does not seem to be improving the representativeness of respondents. Representativeness appears to be decreasing.
- Under current follow-up protocols, if we use number of employees as a proxy for size, larger (based on number of employees) establishments are becoming over-represented, while smaller establishments tend towards being under-represented.
- While we are trying to improve our response rates, we may be introducing bias into our estimates.
- We certainly want to investigate further what is driving the employment indicators down (or up). Are there specific things that might explain this? And is that really what we want?



# Conclusion

- There are limitations to the R-indicator. It is only as useful as the variables you use to construct the indicator.
- Using R-indicators, in conjunction with traditional response rates led us down a path of inquiry we might not have gone down if we had relied solely on response rates.

# Contact Information

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