

The Impact of Record Use in the CE Interview Survey

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Roadmap

1. Research Question
2. Materials and Methods
 - ▶ Identifying Rounded Values
 - ▶ Order of Magnitude Effects
 - ▶ Records
3. Results
4. Conclusions



Research Question

Does the use of records reduce the prevalence of rounding in survey responses significantly?

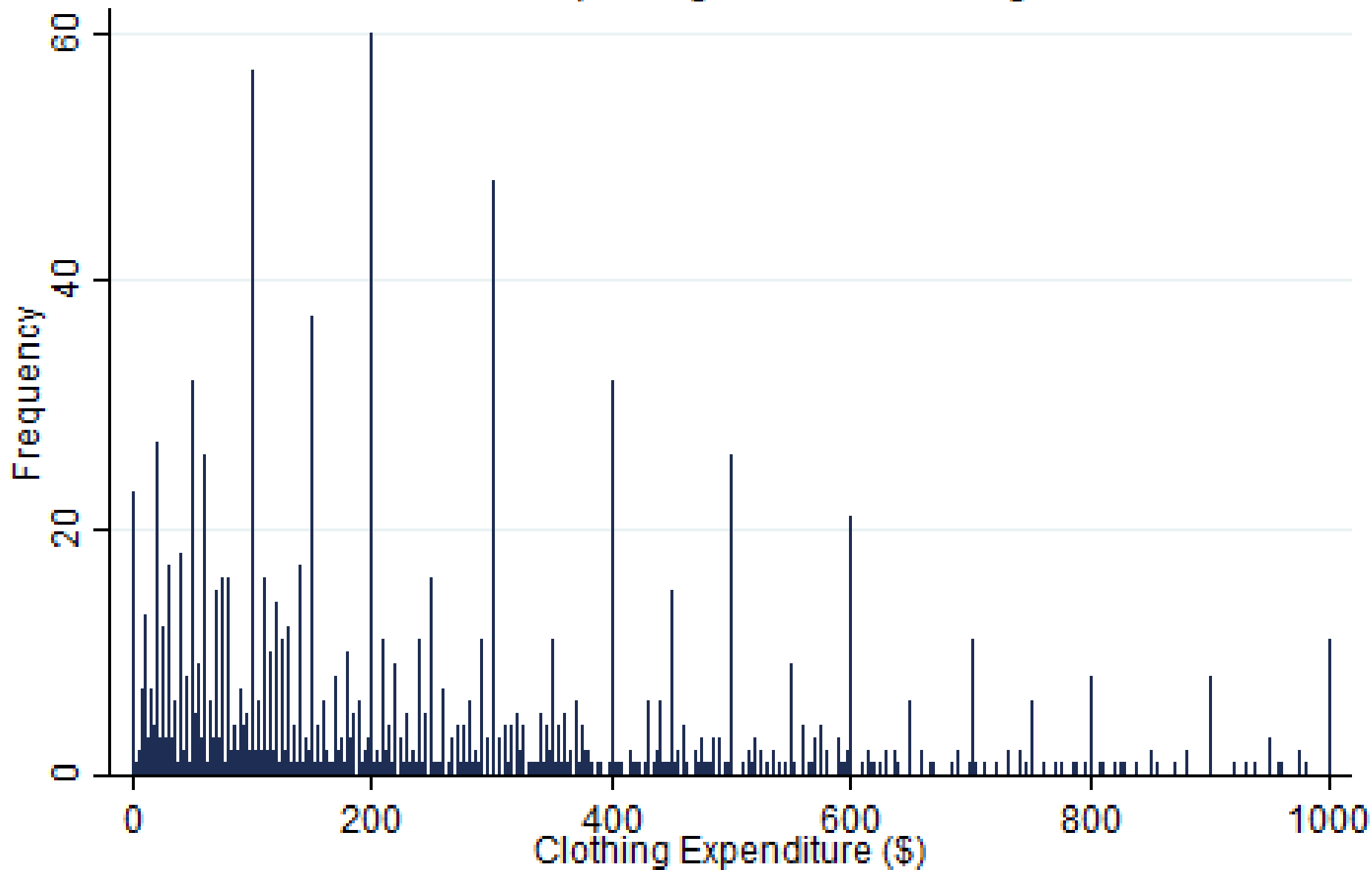
- There are several challenges with answering a question like this one.
 - ▶ What does “rounded response” mean and how to identify them?
 - ▶ Measuring significance in right skewed expenditure distributions.
 - ▶ Record use questions in the survey.



Identifying Rounded Values

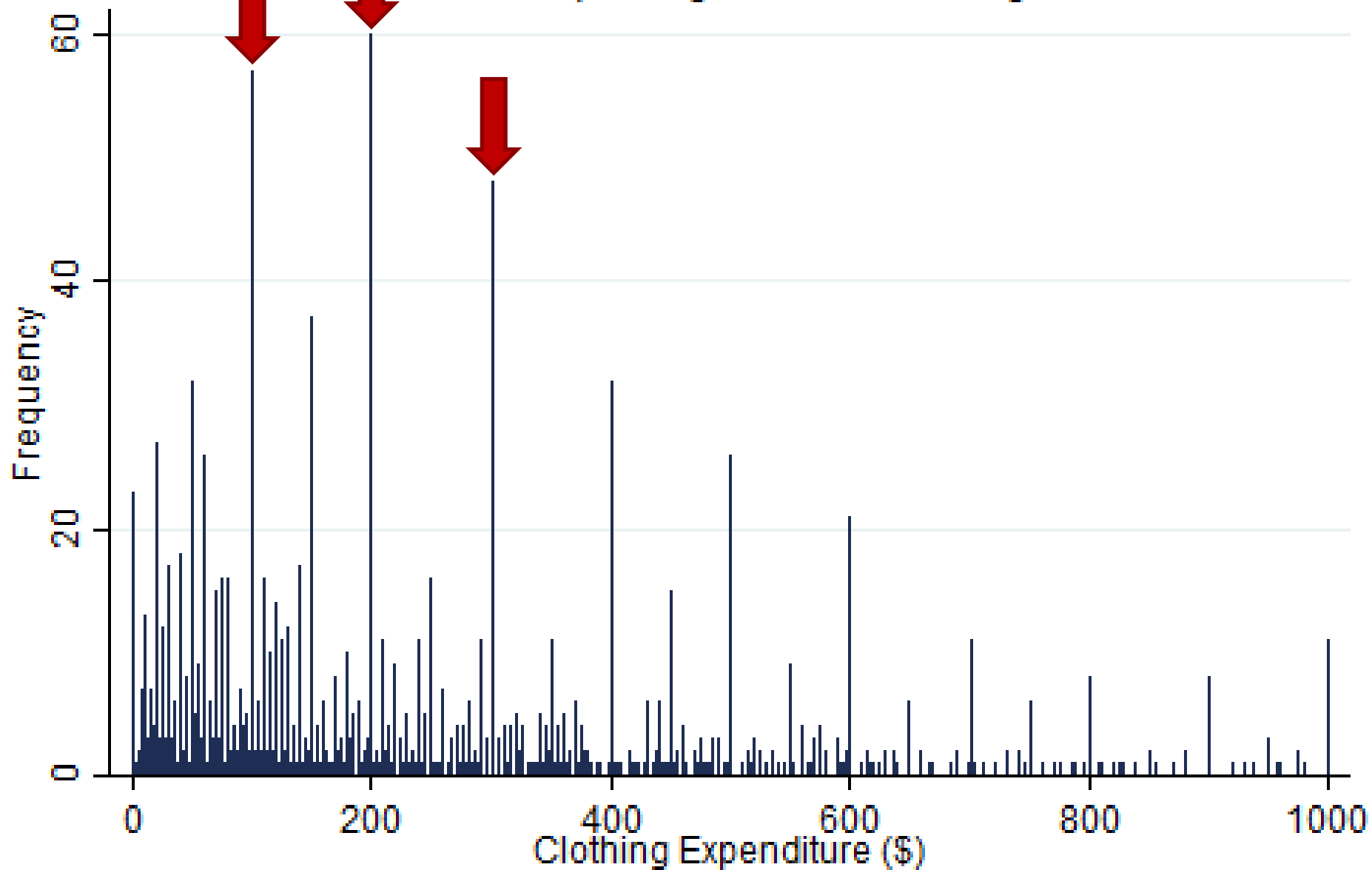
- Notice that most expenditure frequency distributions are “spikey.”
- Coarse data are a red flag for rounded data.
- “Heaping” can be observed in most expenditure distributions and is an example of data coarseness.

Frequency Histogram of Clothing Expenditures
observations spanning two orders of magnitude



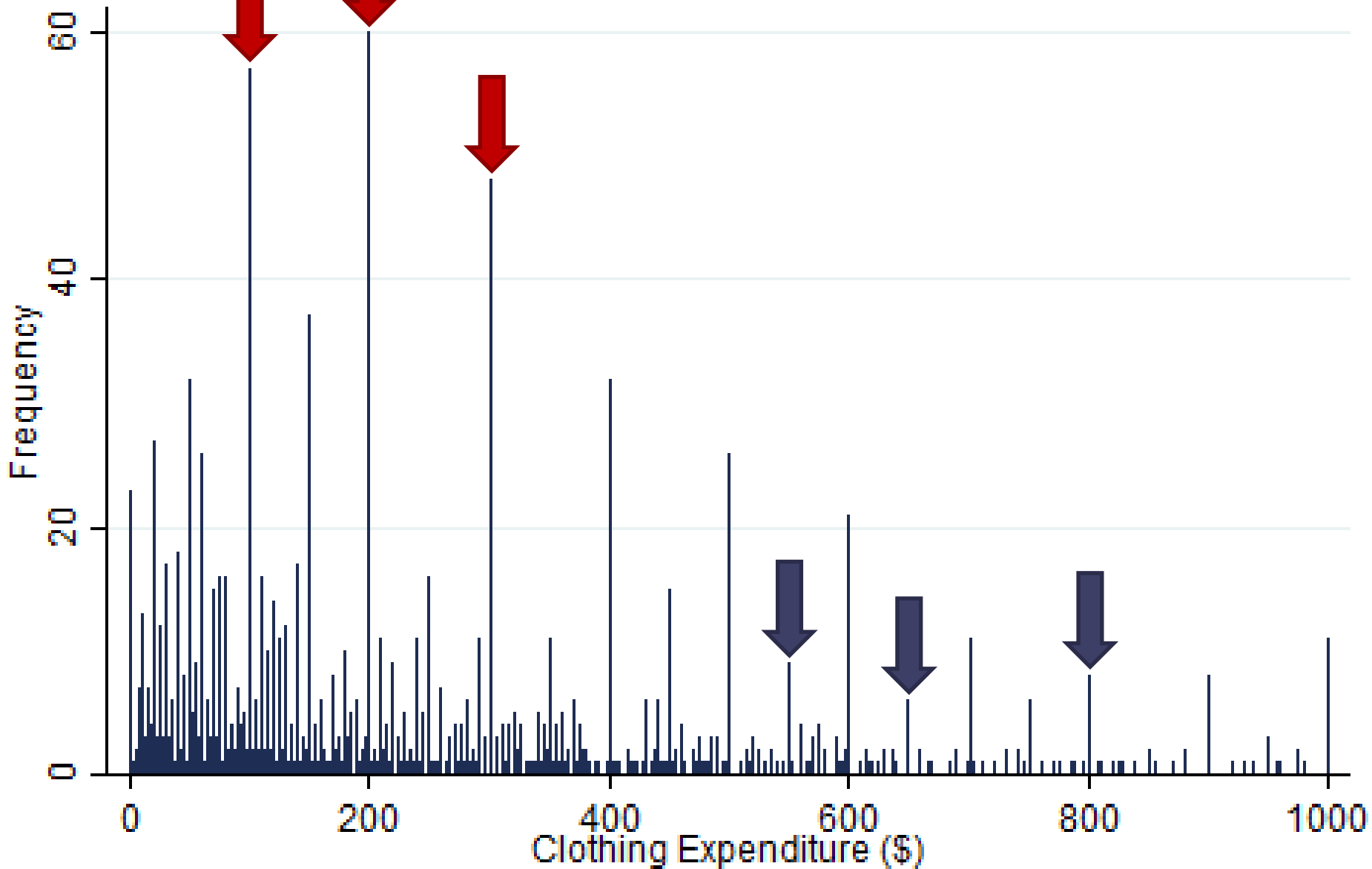
Frequency Histogram of Clothing Expenditures

observations spanning two orders of magnitude

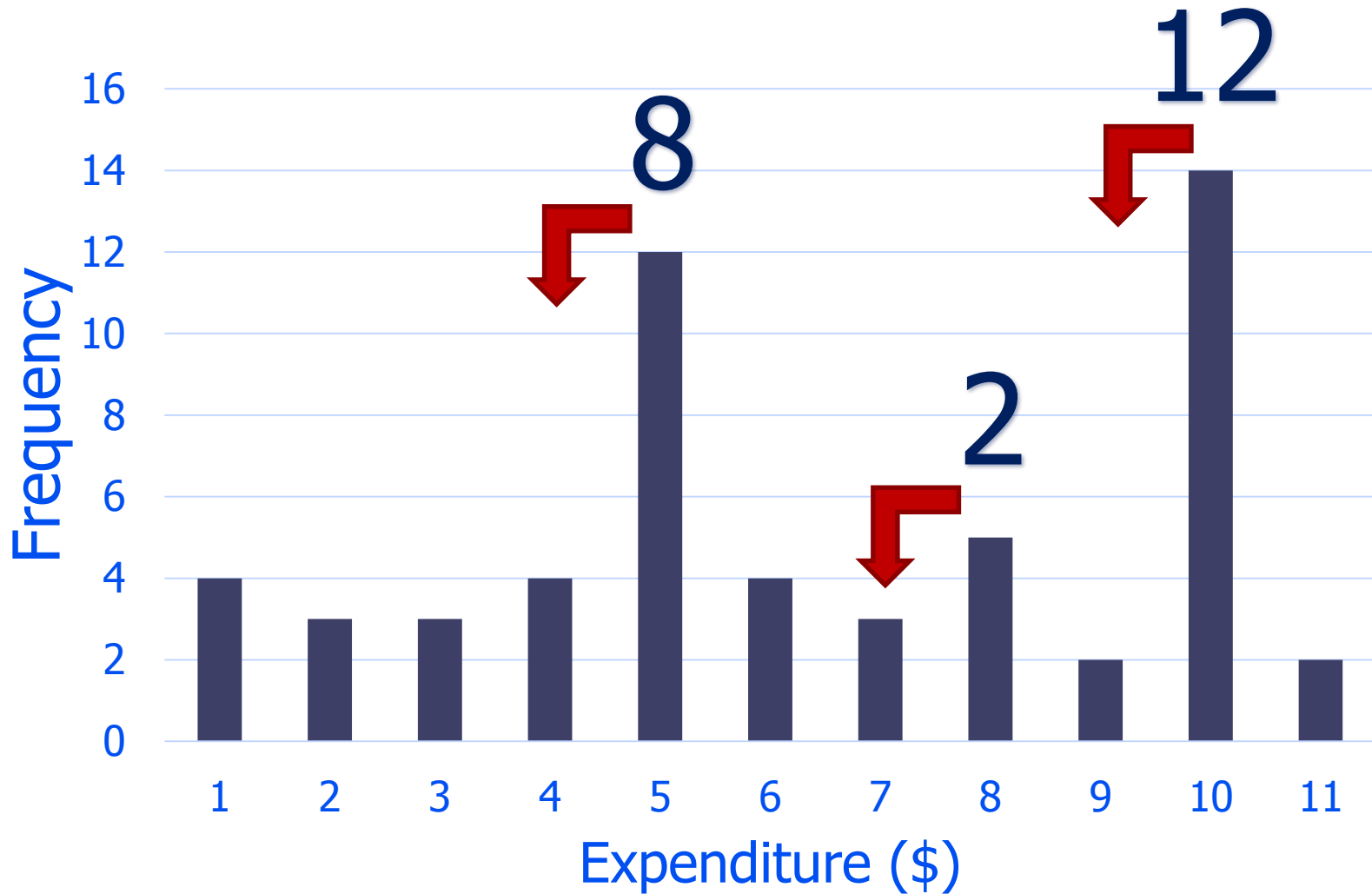


Frequency Histogram of Clothing Expenditures

observations spanning two orders of magnitude



Average "Fall" Approach



Testing Significance

- The distance distributions constructed from the falls are generally non-normal right skewed.
- 68-95-99 Rule fails to provide accurate measure of significance.
- Chebyshev's Inequality as a benchmark for significance.

$$\Pr(|X - \mu| \geq k\sigma) \leq \frac{1}{k^2}$$

Defining the Rounded Value

- A heaped value has the highest probability of being a rounded value.
- Heaped values can be identified as being those expenditure frequency values that are more than **two** standard deviations from the average fall in a given distribution.
- Order of magnitude matters, so we restrict the domain of evaluation on the orders of magnitude.



Record Use

- A household is said to have “used records” when the field representative notes that the household used records greater than 50% of the time.
- Natural Error and Variance in response.
- Hypothesis is that more record use implies less heaping.

Record Use

- About half of households have data for record use with a small variance depending on the selected time frame for analysis.
- Of those who had data collected, about a fourth of these households used records over half the time (defined as a record user)
- Independent Variable of Interest

Record Use Hypothesis

- Heaping is a function of both **record use** and **natural prices**.
- When natural prices align with typically heaped values, record use does not diminish the incidence of heaping.
- Use different expenditure categories to test the hypothesis that record users round less than non-record users.

Rounding Behavior

- Rounding behavior is not correlated with based on CE data:
 - ▶ Age
 - ▶ Sex
 - ▶ Education
 - ▶ Race
- Correlation matrix reveals absolute correlations at all less than 3%.
- Unsurprisingly, the Logistic Regression showed that none of the demographics significantly predicted roundedness.

Mann-Whitney U Test

- Non-parametric test for record use because of the non-normal underlying distributions.
- Allows us to test the hypothesis that the probabilities of randomly selecting a value from two independent non-normal distributions are equal.
- Rank-Sum procedure on two expenditure types on a fixed order of magnitude value domain.



Mann-Whitney U Test

- Record use appears to be generally useful for smaller, large price-variance goods and services that aren't purchased on a repeatable basis.
- The following expenditure types were selected to exemplify the general behavior and to present this juxtaposition.
 - ▶ Clothing and Accessories
 - ▶ Subscriptions

Clothing and Accessories on Value Domain [0,99]

Two-sample Mann-Whitney U test

records	obs	rank sum	expected
0	291	60178	58345.5
1	109	20022	21854.5
combined	400	80200	80200

$H_0: \Pr(\text{rounded value}(\text{records}=0)) = \Pr(\text{rounded value}(\text{records}=1))$

$z = 2.512$

P value = 0.0120

The use of records **dramatically decreased** incidence of identified rounded values. Natural prices do not typically fall on highly divisible values in this expenditure category so the **effect of records is expected to be greater.**

Subscriptions on Value Domain [0,99]

Two-sample Mann-Whitney U test

records	obs	rank sum	expected
0	542	195798.5	195662
1	179	64482.5	64619
combined	721	260281	260281

$H_0: \Pr(\text{rounded value}(\text{records}=0)) = \Pr(\text{rounded value}(\text{records}=1))$

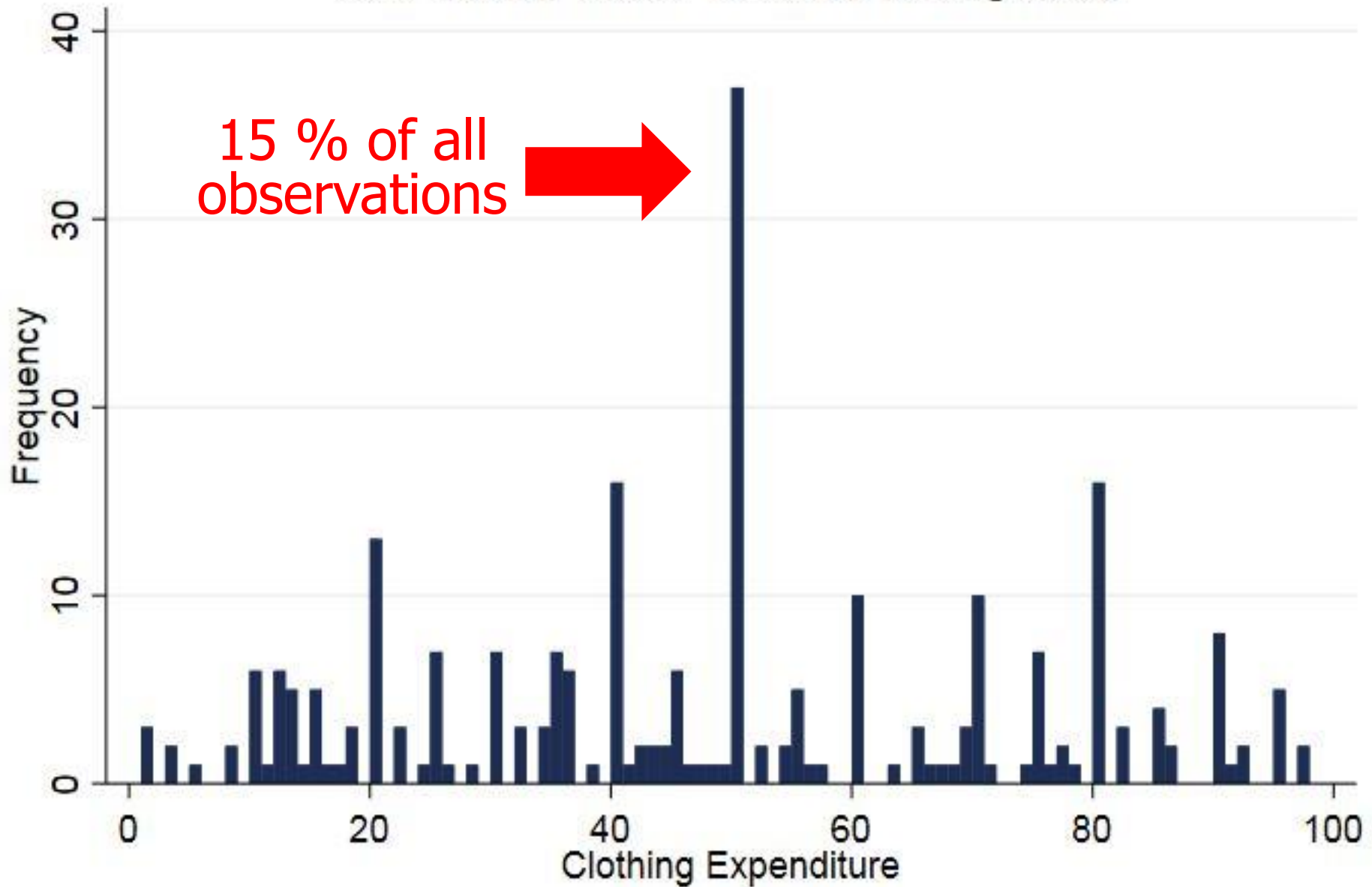
$z = 0.110$

P value = 0.9123

The use of records **did not decrease** incidence of identified rounded values. Natural prices typically fall on highly divisible values in this expenditure category so the **use of records is expected to be ineffectual.**

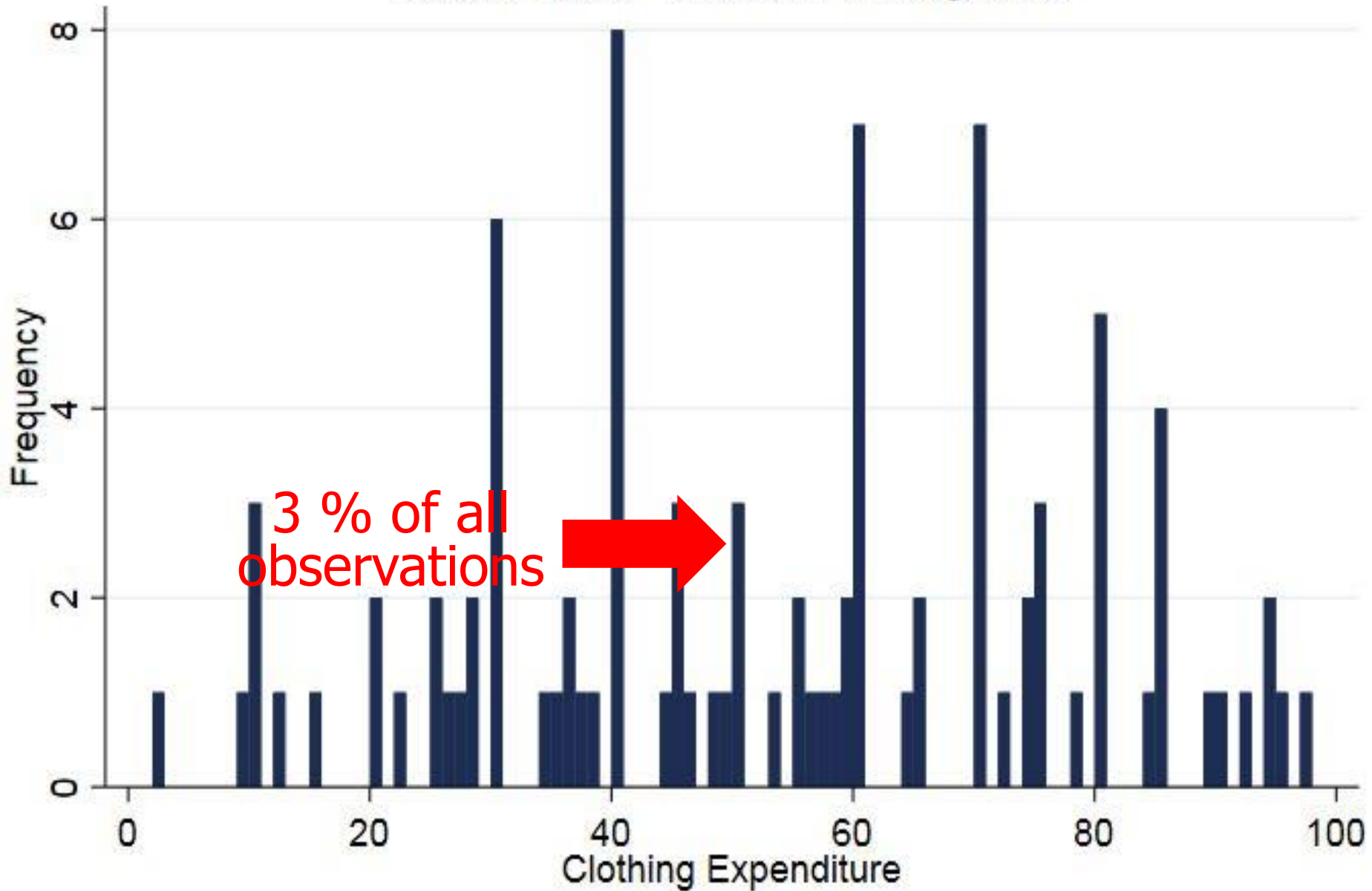
Frequency Histogram of Clothing Expenditures

Non-Record Users - 2 Orders of Magnitude



Frequency Histogram of Clothing Expenditures

Record Users - 2 Orders of Magnitude



Conclusions

- Record use is helpful in improving data quality by reducing the coarseness of data for certain expenditure types.
- Recommendation is to repeat the analysis for every record type on a regular basis to evaluate any changes in consumer preferences or natural prices that may influence the effectiveness of records in a particular expenditure group.
- Spend resources targeting expenditure categories with record use incentives where you know record use makes a difference.



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