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

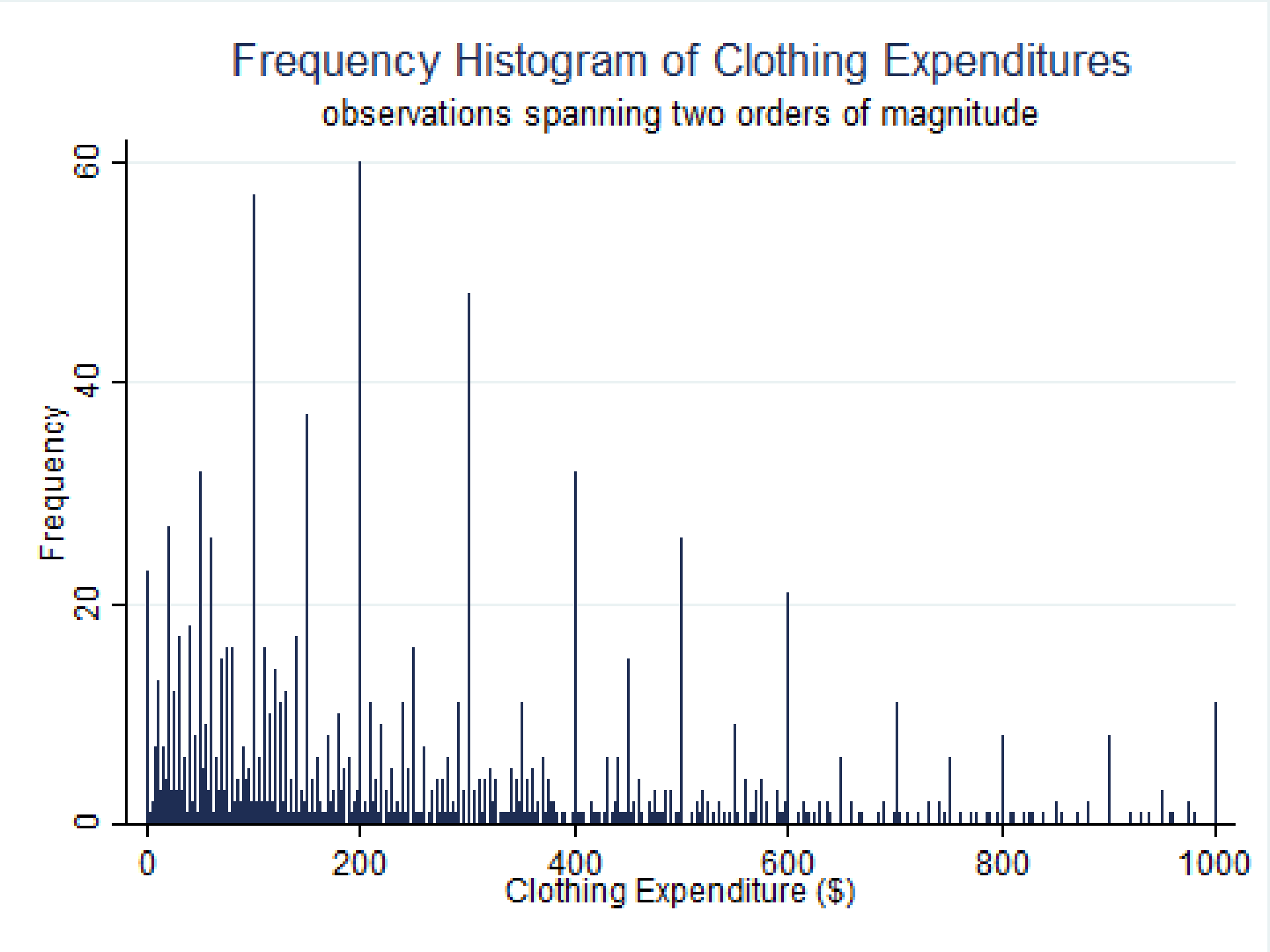
Research Question

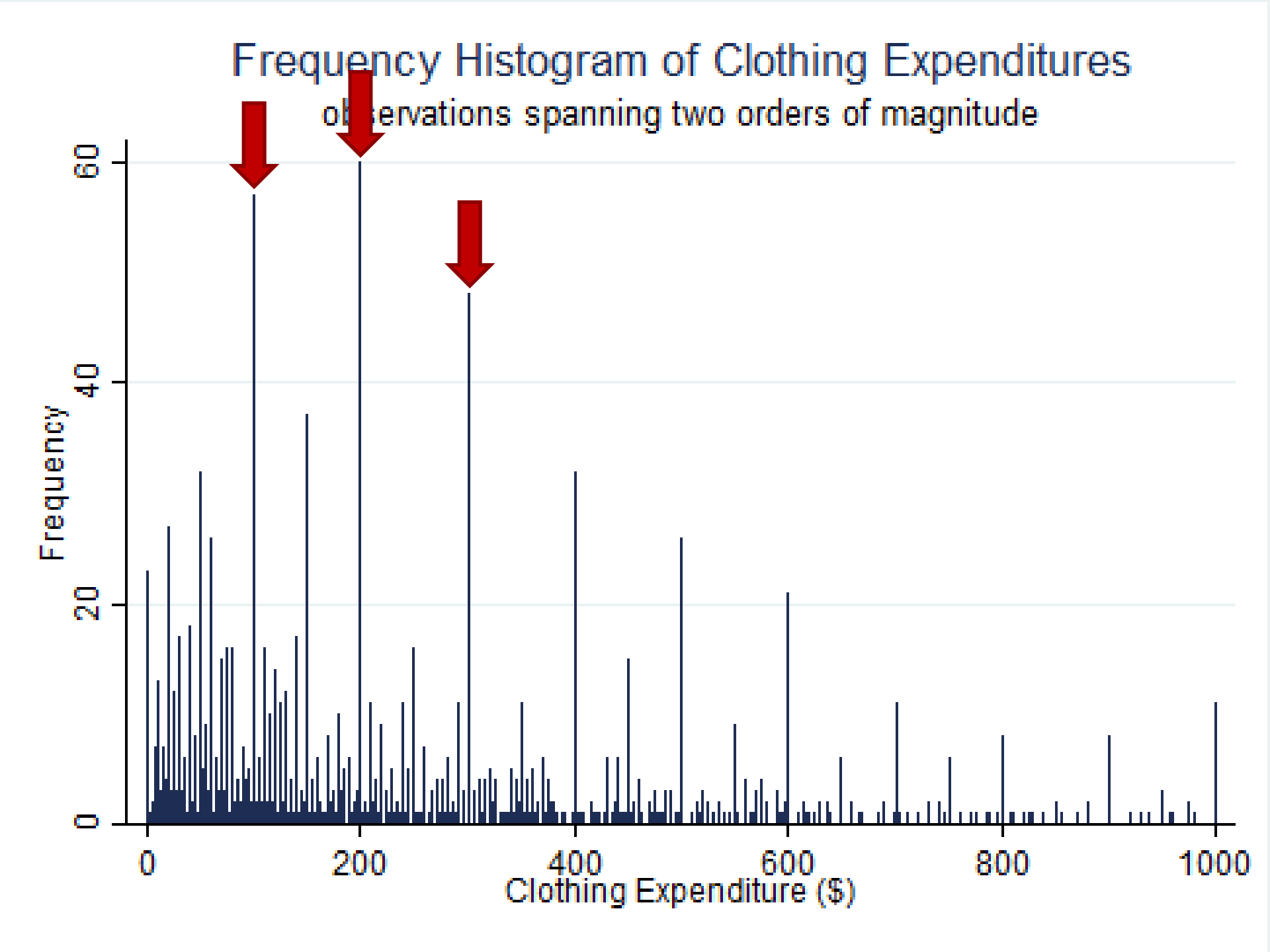
Does the use of records reduce the prevalence of rounding in survey responses significantly?

- 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
0
20
40
60
0
200
400
600
800
1000
Clothing Expenditure ($)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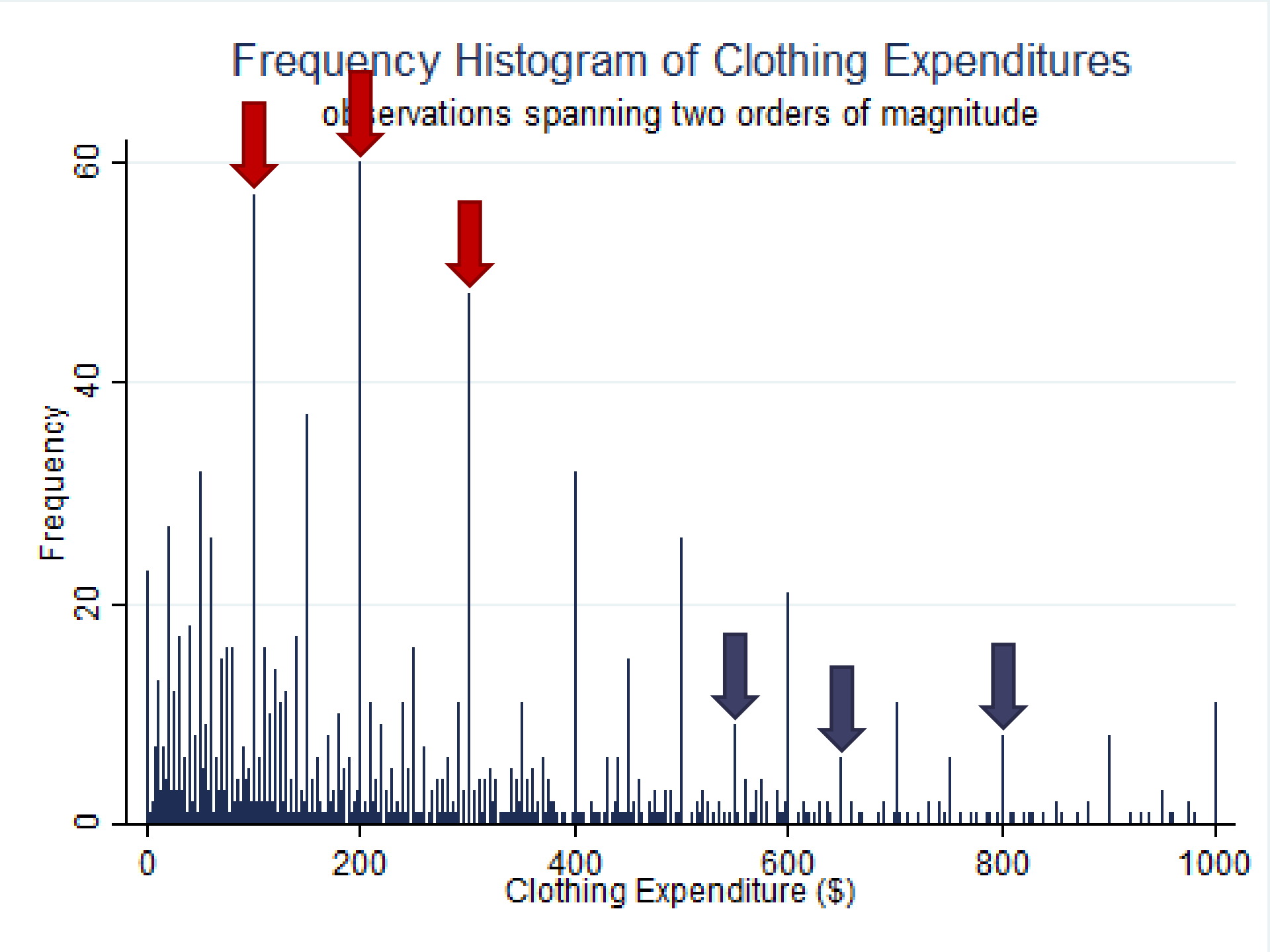
Frequency Histogram of Clothing Expenditures
observations spanning two orders of magnitude
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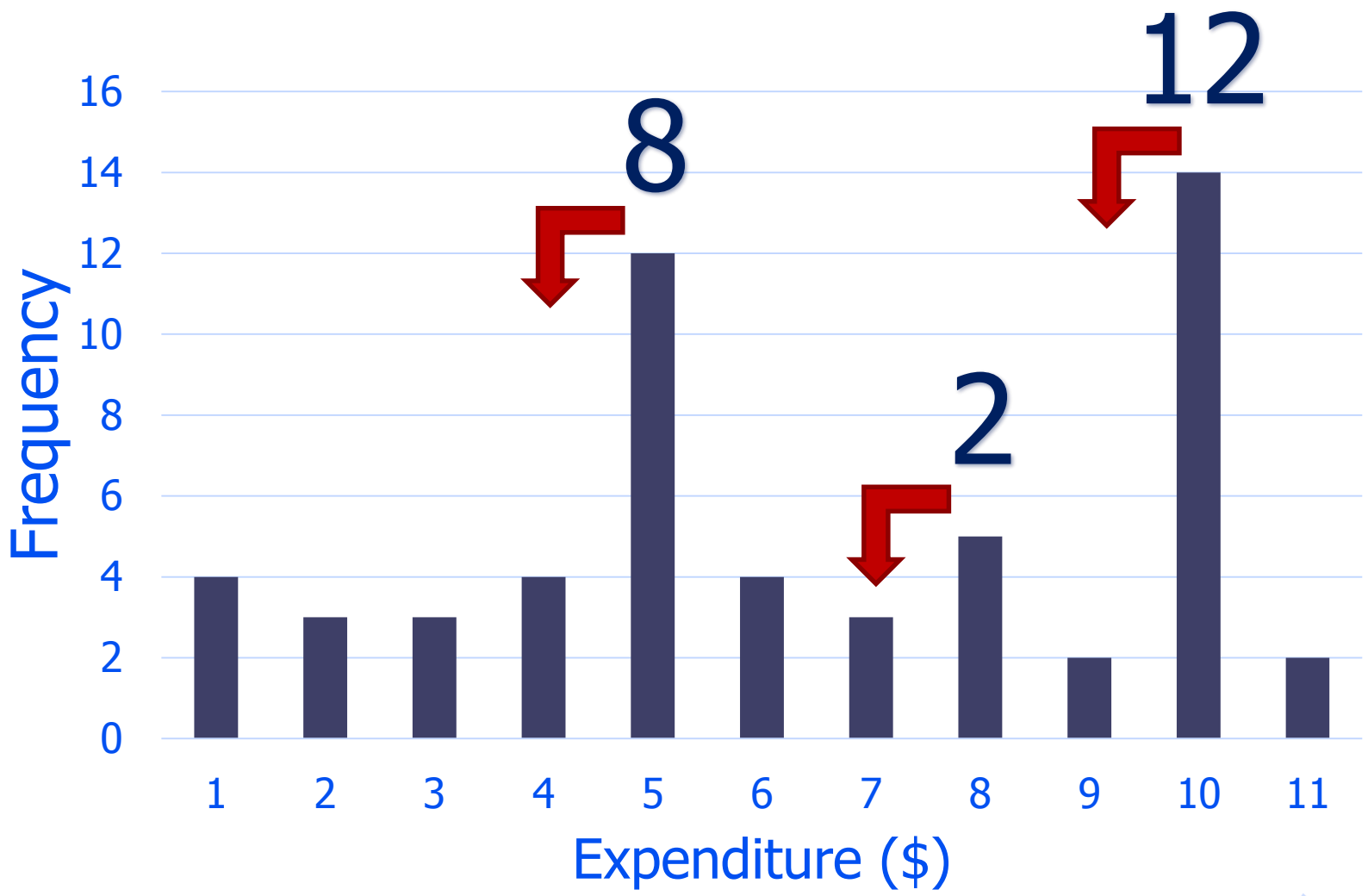
0
20
40
60
0
200
400
600
800
1000
Clothing Expenditure ($)

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(rounded value(records=0)) = Pr(rounded value(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

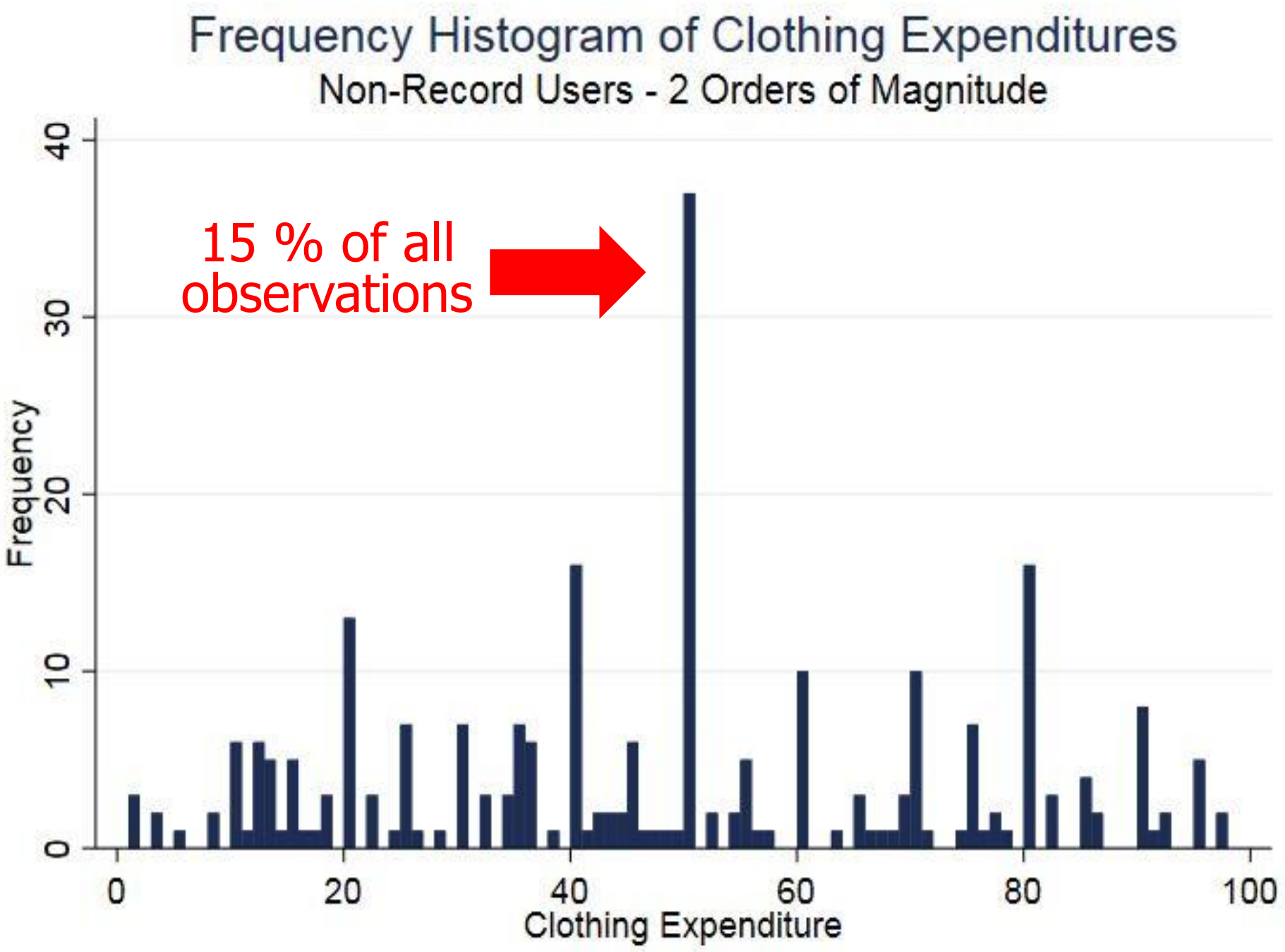
records	obs	rank sum	expected
0	542	195798.5	195662
1	179	64482.5	64619
combined	721	260281	260281

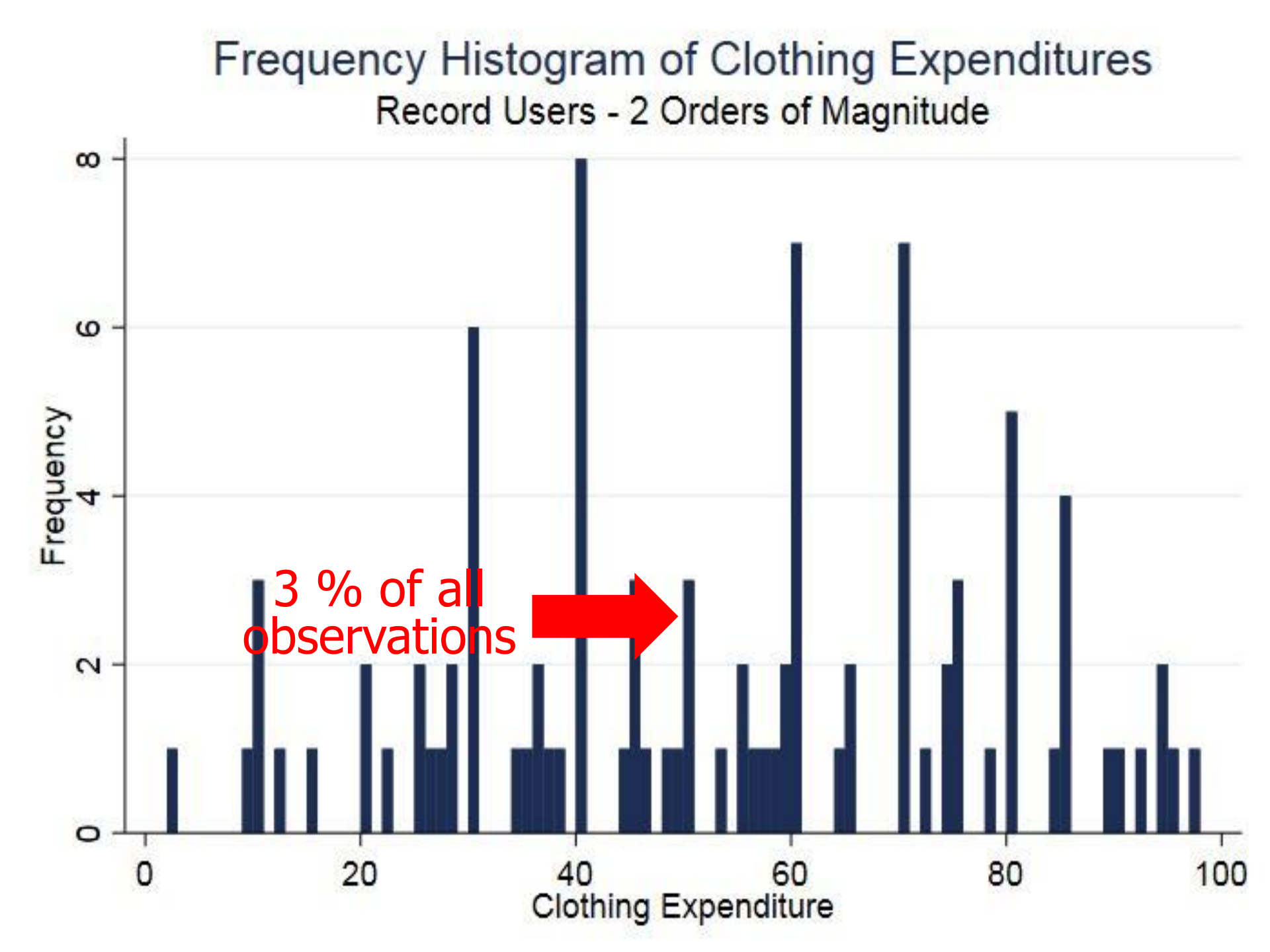
H_0: Pr(rounded value(records=0)) = Pr(rounded value(records=1))

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
15 % of all observations
Frequency
0
10
20
30
40
0
20
40
60
80
100
Clothing Expenditure


Frequency Histogram of Clothing Expenditures
Record Users - 2 Orders of Magnitude
Frequency
0
2
4
6
8
0
20
40
60
80
100
Clothing Expenditure
3 % of all observations

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.

Contact Information

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