Precise and representative estimates in LCI via statistical sampling

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GreenDeLTa TC

SOUND LIFE CYCLE ANALYSES

Outline

1. Introduction:
   Representativeness and statistical sampling
2. A case study: Yoghurt cups in Berlin
3. Conclusions

1. Representativeness and statistical sampling

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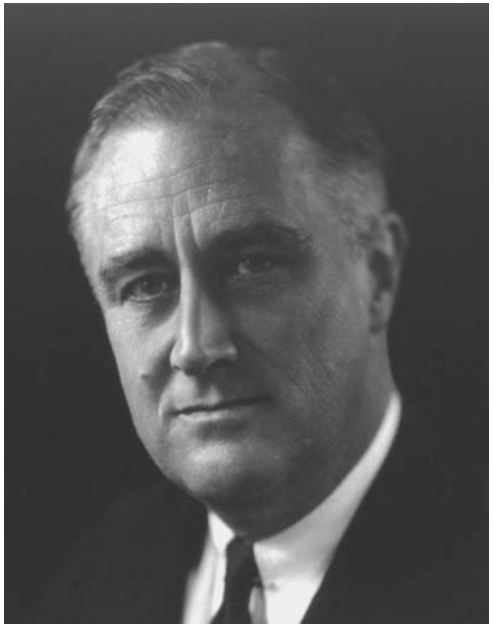
Landon vs. Roosevelt

US presidential election 1936



Predictions

- Literary digest:
  Questionnaire, sent to > 10 million
  > 2 million returned, analysed

  → "clear win for Landon, 370 votes" (of around 530)

- George Gallup:
  5,000 people questioned, via random sampling

  → clear win for Roosevelt, > 315 votes

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Today
Election Forecast

AMERICA SPEAKS
THE NATIONAL WEEKLY POLL of PUBLIC OPINION

Next Sunday
The Election in Review

Institute Forecasts the Re-election of Franklin D. Roosevelt, Gives Him 54% of Popular Vote, Minimum of 315 Electors

Major Party Percent Is 55.7; New York in F.D.R. 'Sure' Column

Election Forecast

1—The American Institute of Public Opinion predicts the re-election of Franklin D. Roosevelt and John N. Garner.

* * *

2—The Institute's latest presidential poll indicates that Roosevelt will receive approximately 56% of the major party vote (minor parties eliminated), to 44% for Alfred M. Landon and Frank Knox. In 1932 the President received 59.1% of the major party vote.

* * *

3—With minor parties included, President Roosevelt's percentage of the total popular vote will be approximately 54%, to 46% for Landon.

* * *

4—The President will receive a minimum of 315 electoral votes. The number necessary to win is 266. Should last-minute shifts in the group of states where the race is nip-and-tuck give this entire group to Roosevelt, he would receive more electoral votes than in 1932, when he polled 472.

* * *

5—William Lemke, candidate of the Union Party, will poll fewer than 1,500,000 popular votes, and carry no state.

* * *

6—Norman Thomas, Socialist candidate, will poll about half as many votes as in 1932, when he received 884,000.

Election Will Test Clashing Poll Methods

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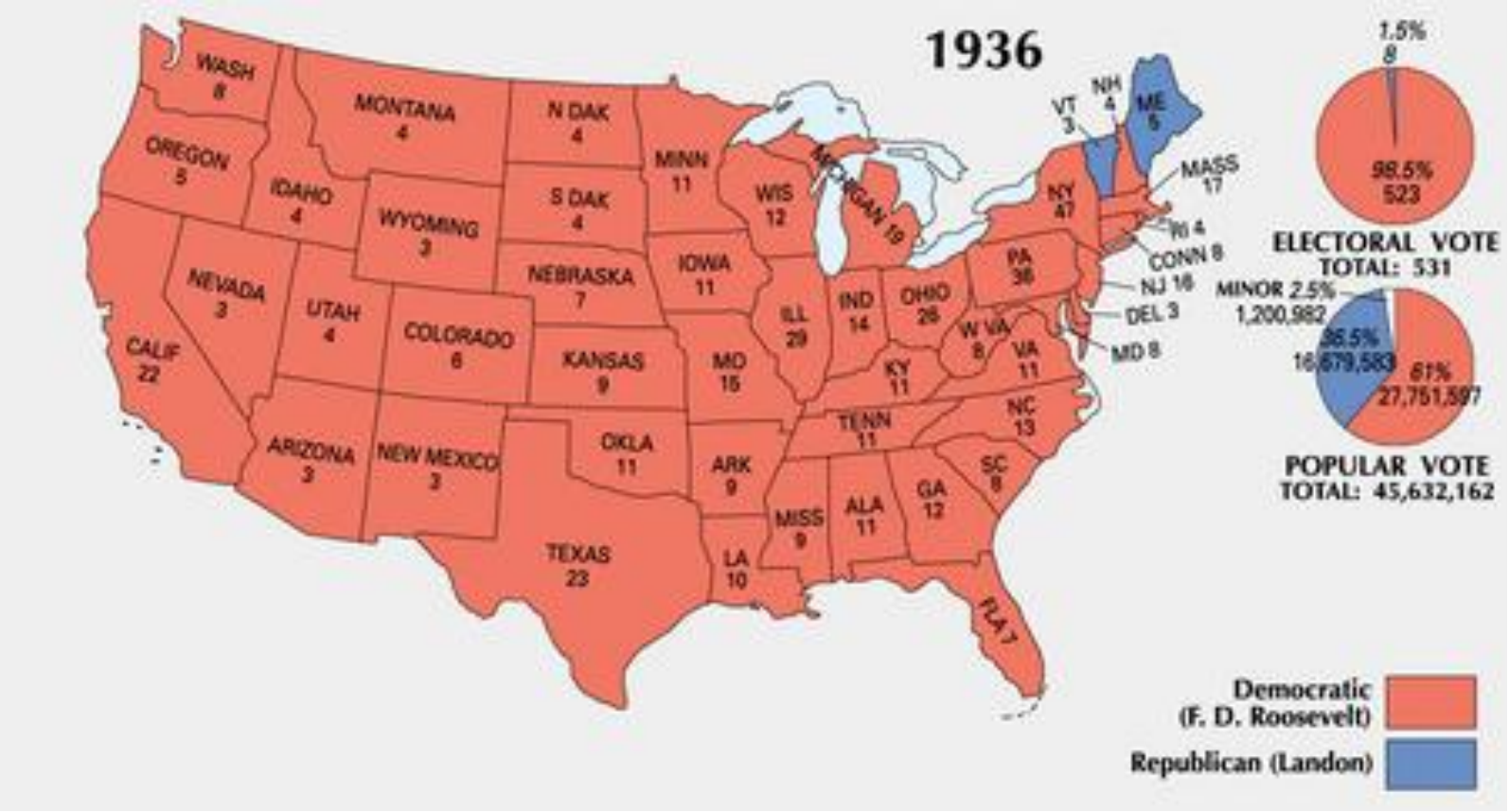


Failed expertise

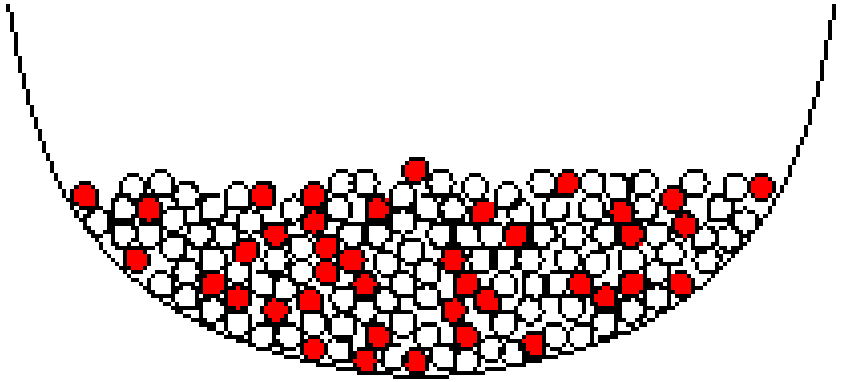
- Literary digest predicted the previous 5 presidential elections correctly.

- "As Maine goes, so goes the nation"

Reason: Biased sampling

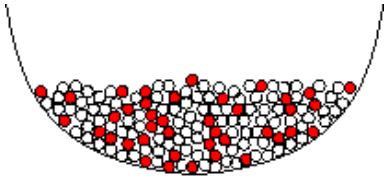
- Addressees of the questionnaire were readers of the Literary digest
  → higher education, higher income.
  Not representative.

What *is* statistical random sampling?



Source: matheprisma.de

What *is* statistical random sampling?



→Each ball is accessible

→Random selection

→Unbiased: each ball has the same chance

Intermediate conclusion

Statistical sampling is a smart technique to ensure representativeness.

It requires, though, access to all objects which the sampling shall represent.

2. The weight of yoghurt cups at point of sale in Berlin

A case study

The problem

- Weight of the cups is crucial for the outcome of an LCA that compares several types of yoghurt cups

- Weight seems to vary ± 15% for some types

- Only few measurements from converting companies available.

- Differences in weight influence ranking and recommendations.

Idea, goal and approach

"Aim of the case study is to provide a precise and representative estimate for the weight of plastic yoghurt cups for 150 g yoghurt at point of sale in Berlin, in food markets, available for consumers on one specific day"

Statistical sampling is applied, in two stages.
The first stage are supermarkets,
The second stage are the yoghurt cups in these markets.

1st stage, supermarkets

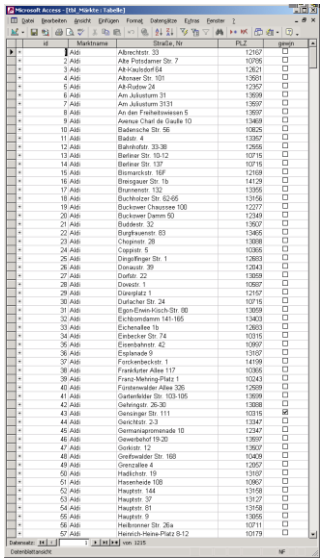
Requirement:

Obtain a complete list of supermarkets in Berlin.

Sources: Google maps, meinestadt.de !

→ HTML files, imported in small Access database, quality checked

→ 1215 markets altogether



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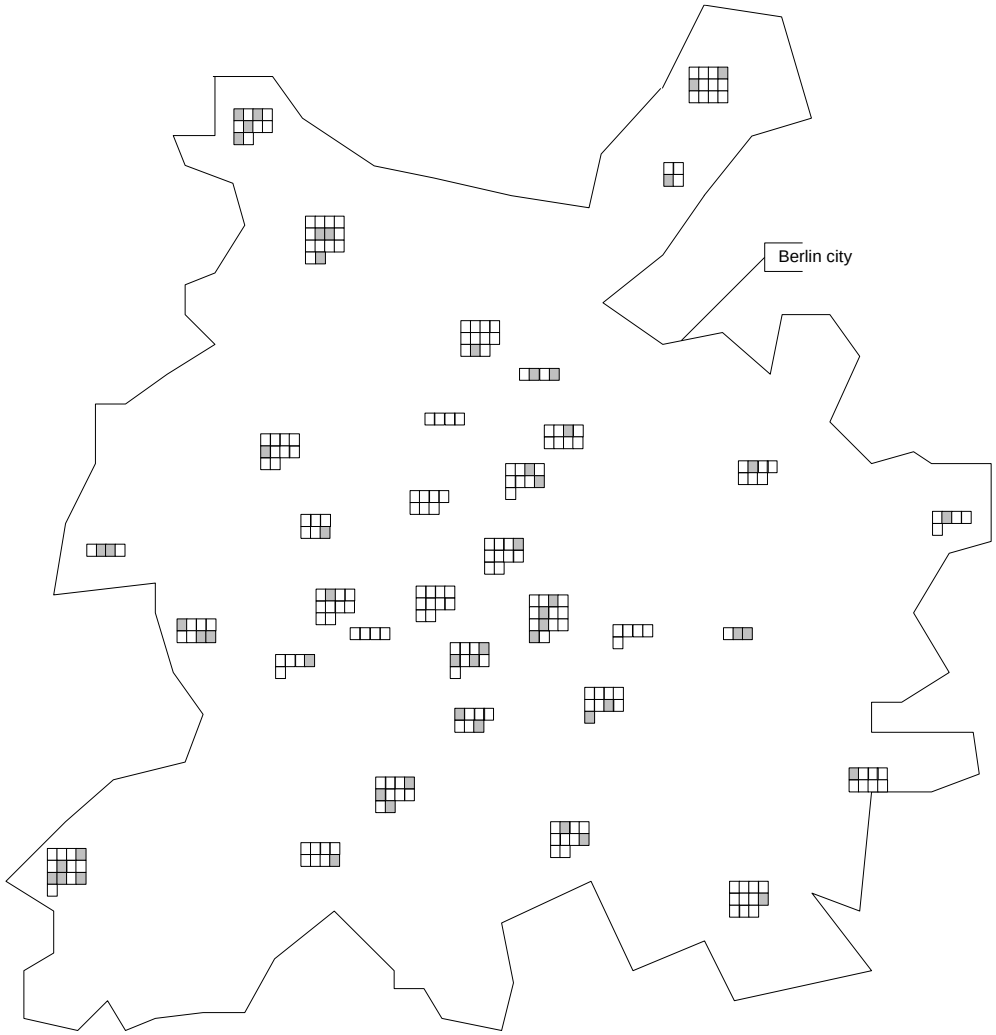
1st stage, supermarkets:
Random selection of about 40 markets



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1st stage, supermarkets: Replacement of “abandoned” markets

2nd stage, yoghurt cup sampling, Further analysis

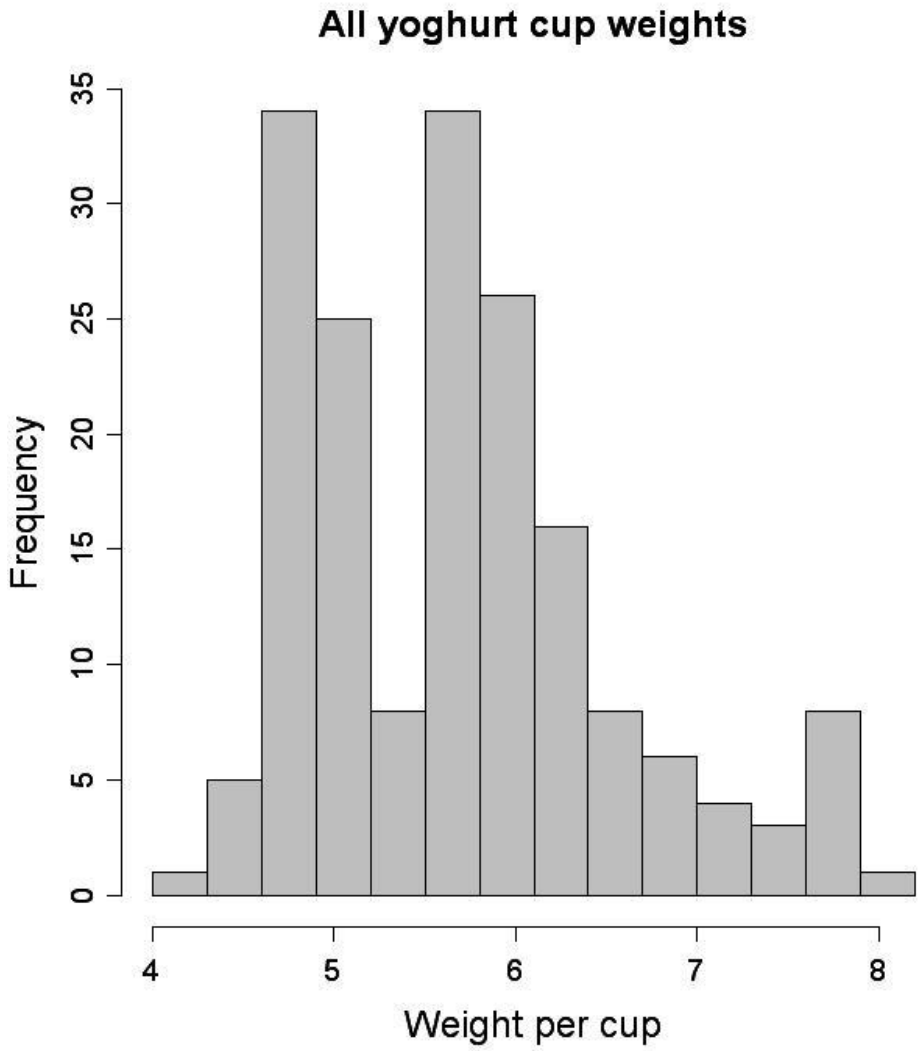
Sampling of yoghurt cups in the selected supermarkets

Overall around 150 yoghurt cups.

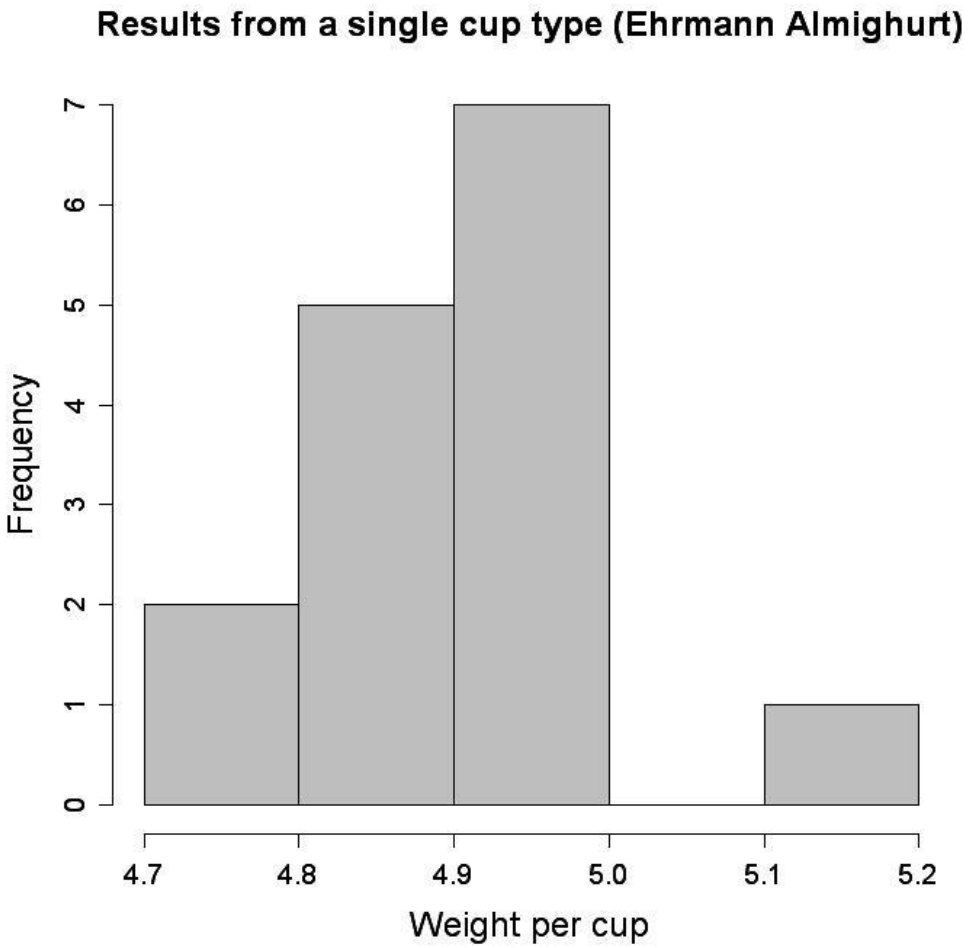
Cups were emptied, cleaned, and weighed.

Data were entered into a small Access database,
and analysed with statistical software (R+).

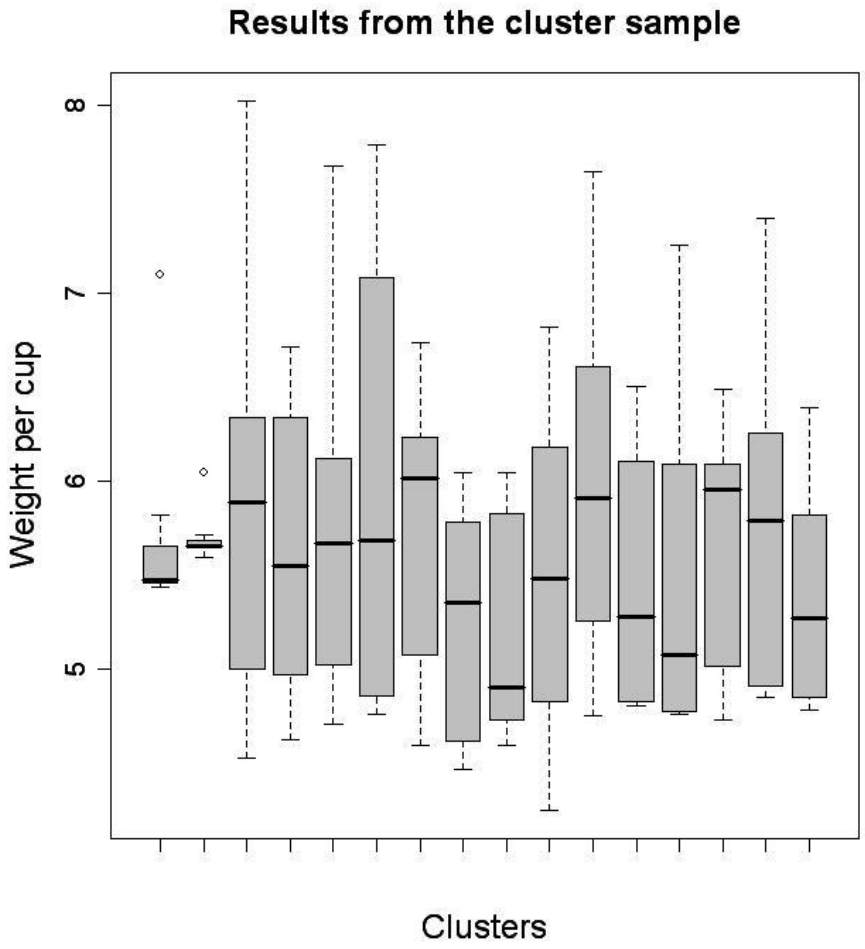
Data exploration, 1



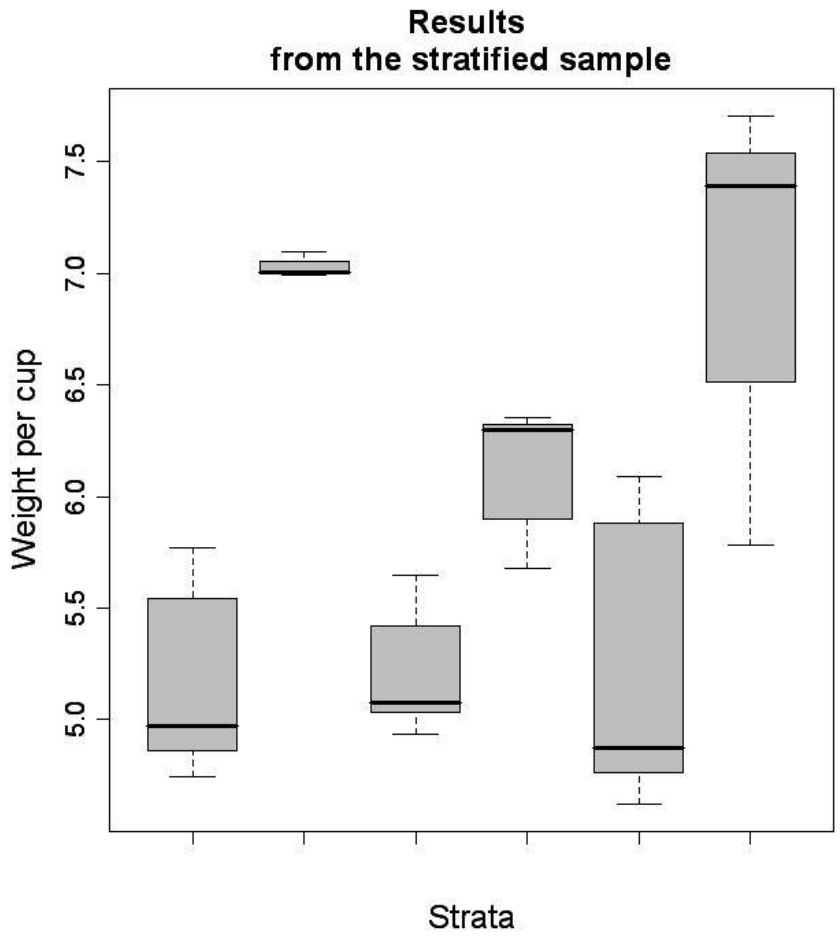
Data exploration, 2



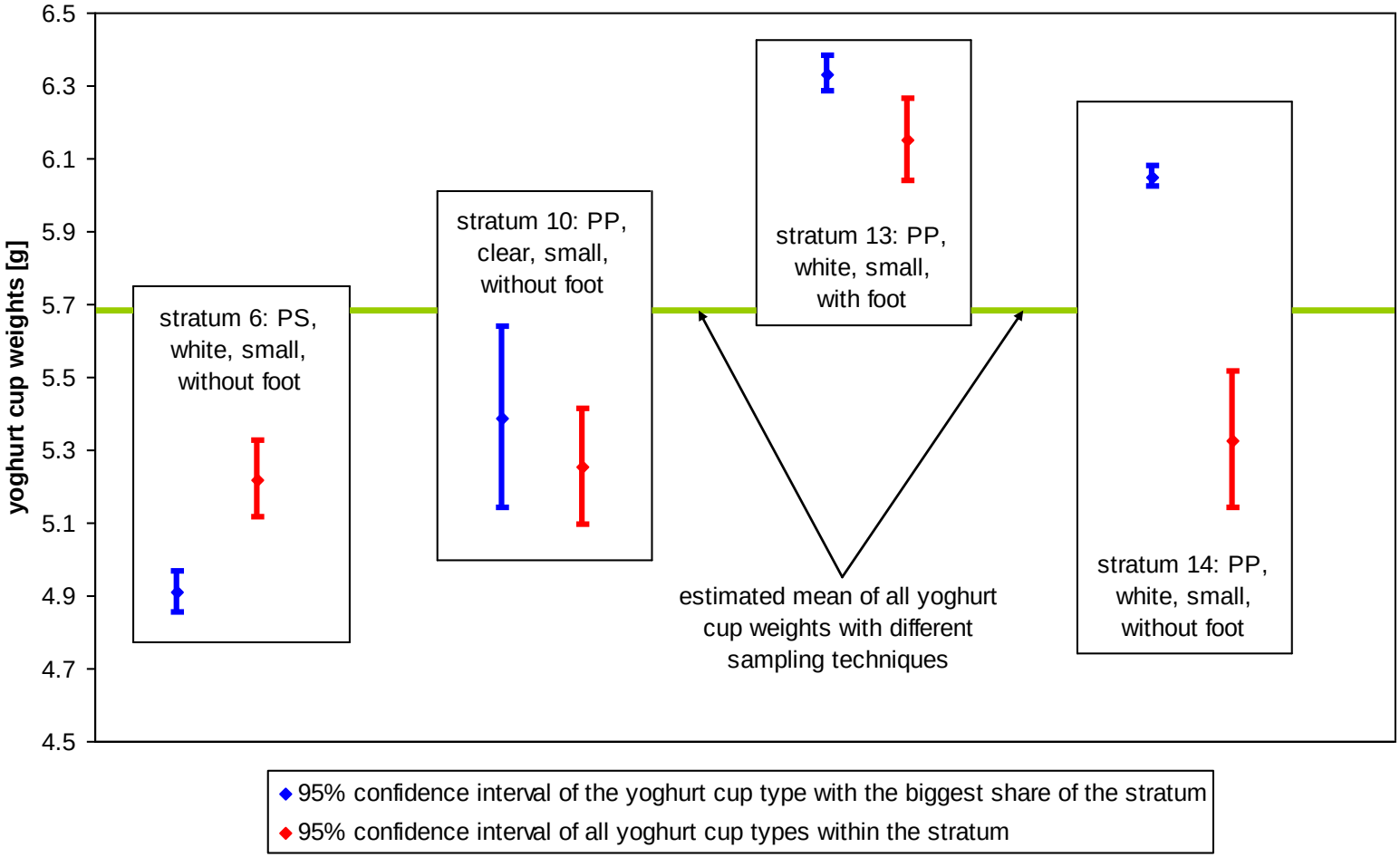
Data analysis: clustering (supermarkets)



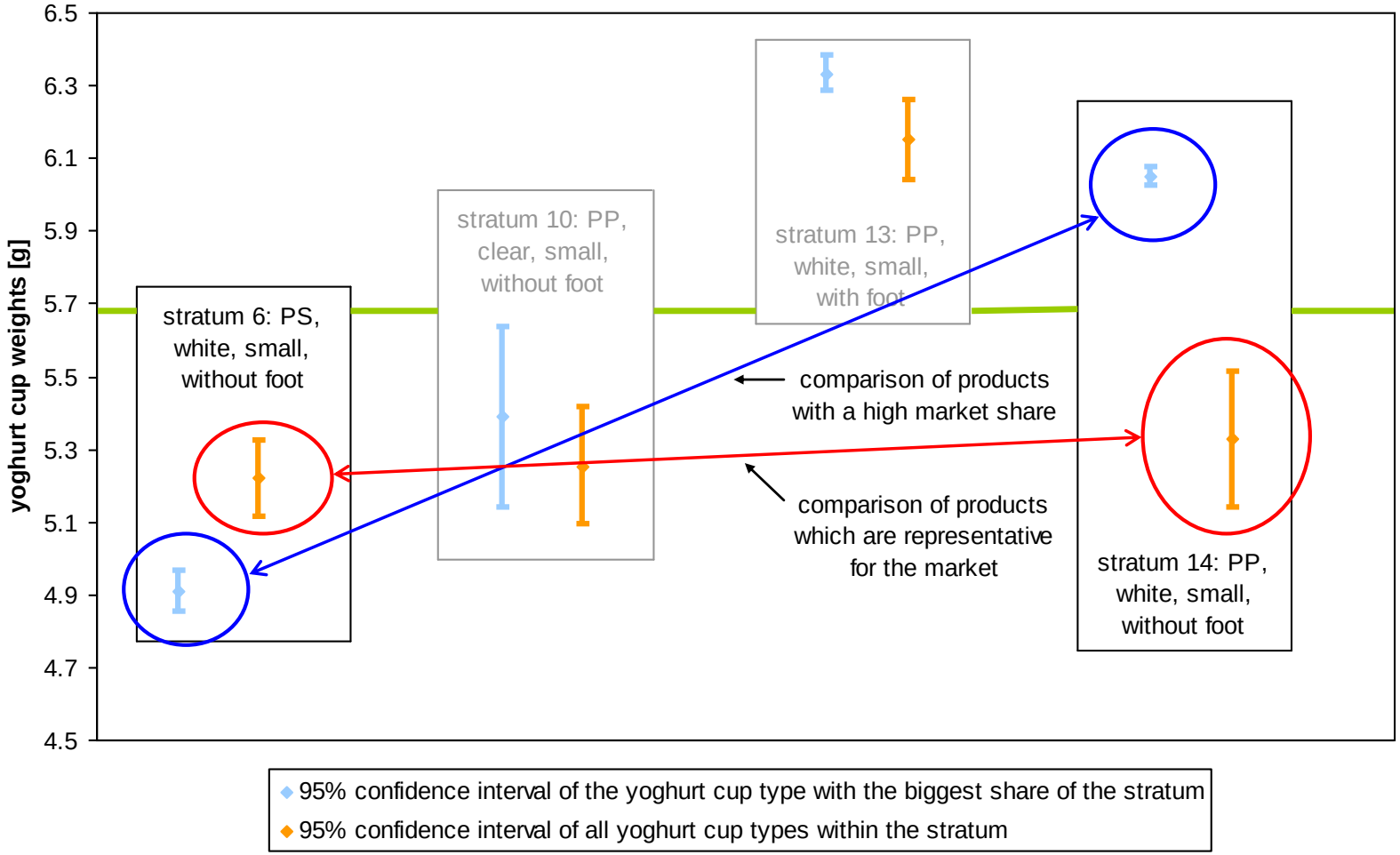
Data analysis: stratification (types of yoghurt cups, shapes of cups)



Calculation results: Representative estimates



Calculation results: Market leaders vs. representative estimates



3. Conclusions

Conclusions

- Market leaders do not ensure representativeness
- Statistical sampling in the case study was possible due to newly available internet data
- Although the sample was small, estimates are highly precise
- The case study validated a central parameter of an LCA study
- There seems much more to explore: Which parameters to validate, which data, which procedures.

Thank you!

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