

Precise and representative estimates in LCI via statistical sampling

Andreas Citroth, Michael Srocka
21 May 2007

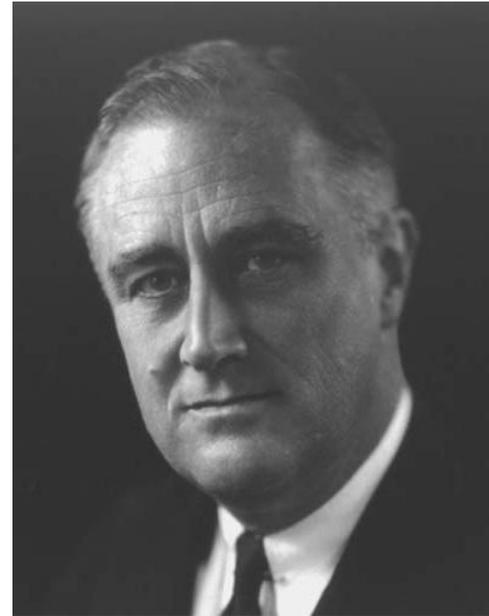
Outline

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

1. Representativeness and statistical sampling

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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AMERICA SPEAKS

THE NATIONAL WEEKLY POLL OF PUBLIC OPINION

Today
Election Forecast

Next Sunday
The Election to 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

WASHINGTON, May 21 (AP)—The Institute of Public Opinion today announced that Franklin D. Roosevelt will receive approximately 54% of the popular vote in the White House for another four-year term.

In a national survey which indicates that in most cases there will be a change in the kind of candidates in 1936, the Institute has found that 55.7% of the total vote in 1936 will go to the major party candidates, with the Institute giving the vote to Franklin D. Roosevelt in the White House for another four years.

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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 54% of the major party vote (minor parties eliminated), or 49% for Alfred M. Landon and Frank Knox. In 1932 the President received 53.1% of the major party vote.
- 3—With minor parties included, President Roosevelt's percentage of the total popular vote will be approximately 49%, or 45% for Landon.
- 4—The President will receive a minimum of 315 electoral votes. The number necessary to win is 269. 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 1,000,000 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

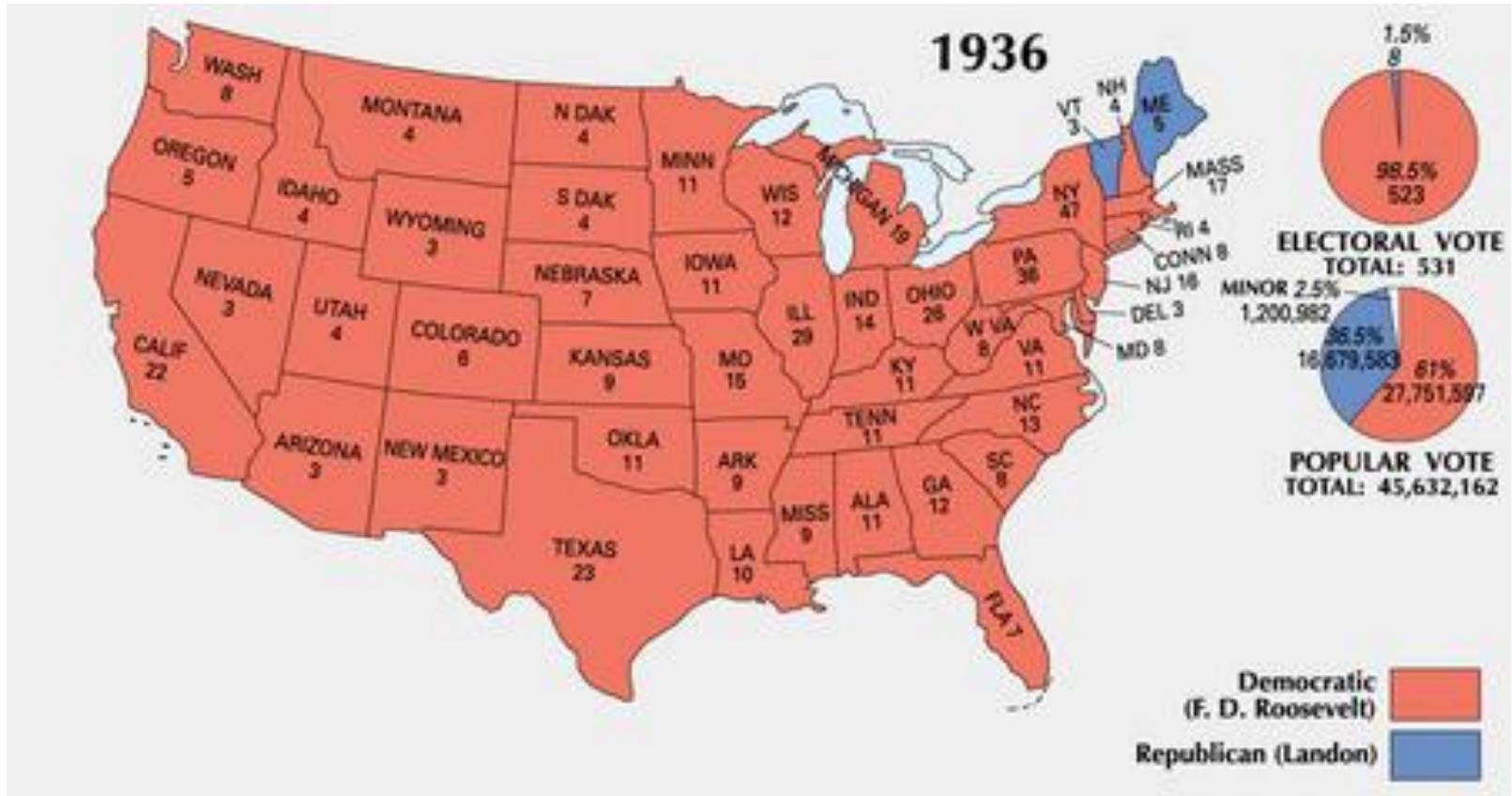
The election will test the Institute's poll methods. The Institute's latest survey indicates that in most cases there will be a change in the kind of candidates in 1936, the Institute has found that 55.7% of the total vote in 1936 will go to the major party candidates, with the Institute giving the vote to Franklin D. Roosevelt in the White House for another four years.







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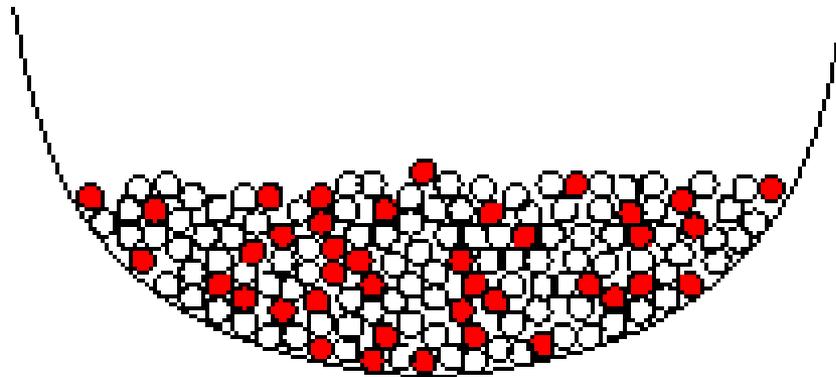
Failed expertise

- Literary digest predicted the previous 5 presidential elections correctly.
- “As Maine goes, so goes the nation”

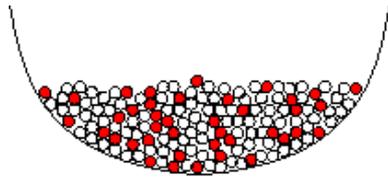
Reason: Biased sampling

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

What *is* statistical random sampling?



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 $\pm 15\%$ 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.

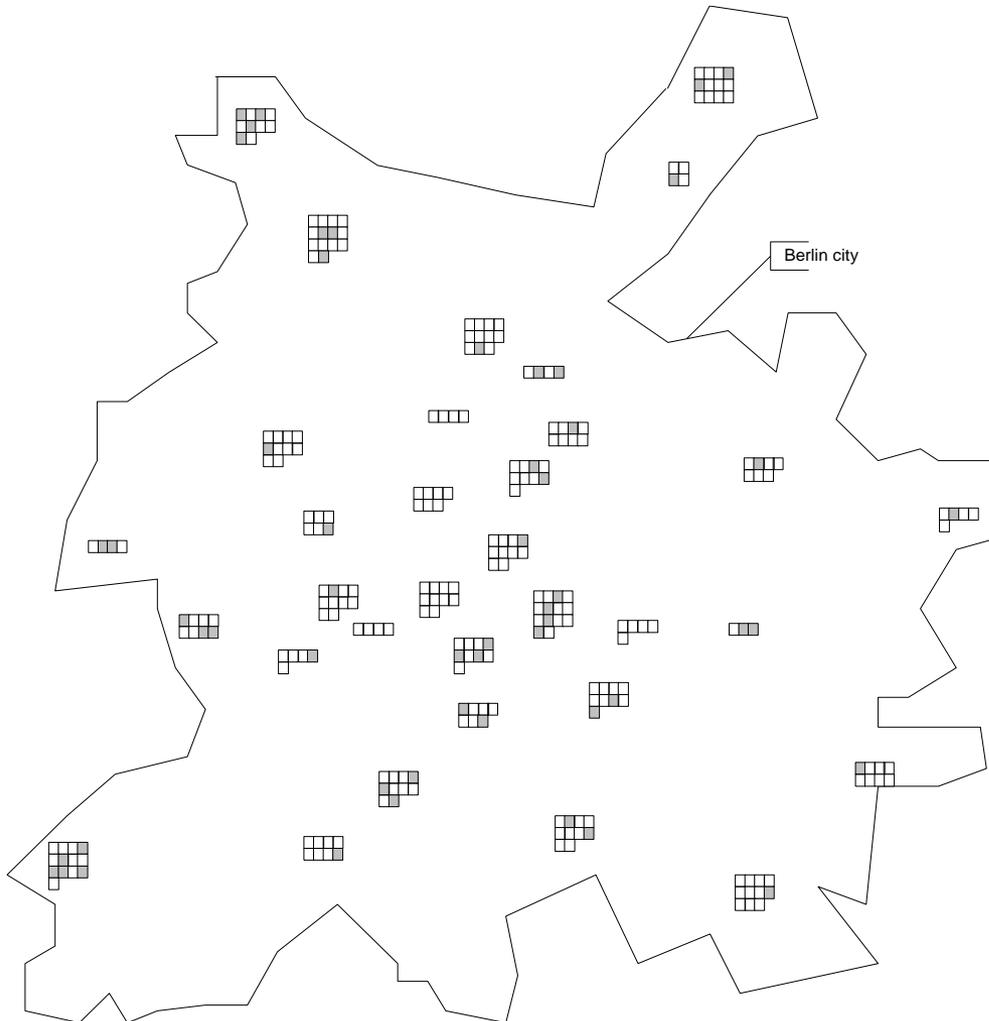
Sources: Google maps, meinestadt.de !

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

→ 1215 markets altogether

Name	Str.	PLZ	Region
Abteikirch 33		12167	
2. Ass	Alte Postkammer Str. 7	10785	
3. Ass	Al-Hausdorf 64	12621	
4. Ass	Alkenen Str. 101	12601	
5. Ass	Al-Ruhde 28	12957	
6. Ass	Am Jukturm 31	13098	
7. Ass	Am Jukturm 31/31	13097	
8. Ass	An den Fährsteigen 5	13097	
9. Ass	Artenow Chert an Grotte 10	13469	
10. Ass	Baldenche Str. 56	10326	
11. Ass	Baile 4	13397	
12. Ass	Bahnhofstr. 33/36	12956	
13. Ass	Berliner Str. 53/2	10716	
14. Ass	Berliner Str. 137	10716	
15. Ass	Bismarckstr. 1867	12169	
16. Ass	Bresgauer Str. 1b	14129	
17. Ass	Brunnen 132	13356	
18. Ass	Buchholzer Str. 62/66	13156	
19. Ass	Buckener Chaussee 100	12277	
20. Ass	Buckener Damm 95	12149	
21. Ass	Budberg 32	13057	
22. Ass	Burgkammer 63	13465	
23. Ass	Chapman 28	13008	
24. Ass	Chapman 5	10396	
25. Ass	Dingelinger Str. 1	12683	
26. Ass	Dornow 39	12443	
27. Ass	Dorfstr. 22	13059	
28. Ass	Dorow 1	10907	
29. Ass	Döringstr. 1	12147	
30. Ass	Dorfstr. 24	10716	
31. Ass	Eggenhainisch Str. 85	13659	
32. Ass	Eichenallee 141/165	13403	
33. Ass	Eichenallee 1b	13603	
34. Ass	Eberharder Str. 74	10316	
35. Ass	Erdbeeren 42	10907	
36. Ass	Erdbeere 9	13107	
37. Ass	Friedrichstr. 1	14198	
38. Ass	Frankfurter Allee 117	10395	
39. Ass	Franz-Mehring-Platz 1	10243	
40. Ass	Frankfurter Allee 326	12689	
41. Ass	Gartenstraße Str. 19/198	12698	
42. Ass	Geltinger 26-30	13098	
43. Ass	Geltinger Str. 111	10316	
44. Ass	Gewitzstr. 2-3	13347	
45. Ass	Gewitzgassestraße 10	12247	
46. Ass	Gewitzhof 19-20	13097	
47. Ass	Gewitzstr. 12	13097	
48. Ass	Großendamm Str. 160	10439	
49. Ass	Großstraße 4	12957	
50. Ass	Heidestraße 15	13107	
51. Ass	Heinrichstr. 108	10367	
52. Ass	Heugarten 148	13156	
53. Ass	Heugarten 37	13127	
54. Ass	Heugarten 81	13156	
55. Ass	Heugarten 9	13095	
56. Ass	Heubanner Str. 26a	10711	
57. Ass	Heinrich-Heine-Platz 8/12	10179	

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



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

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2nd stage, yoghurt cup sampling, Further analysis

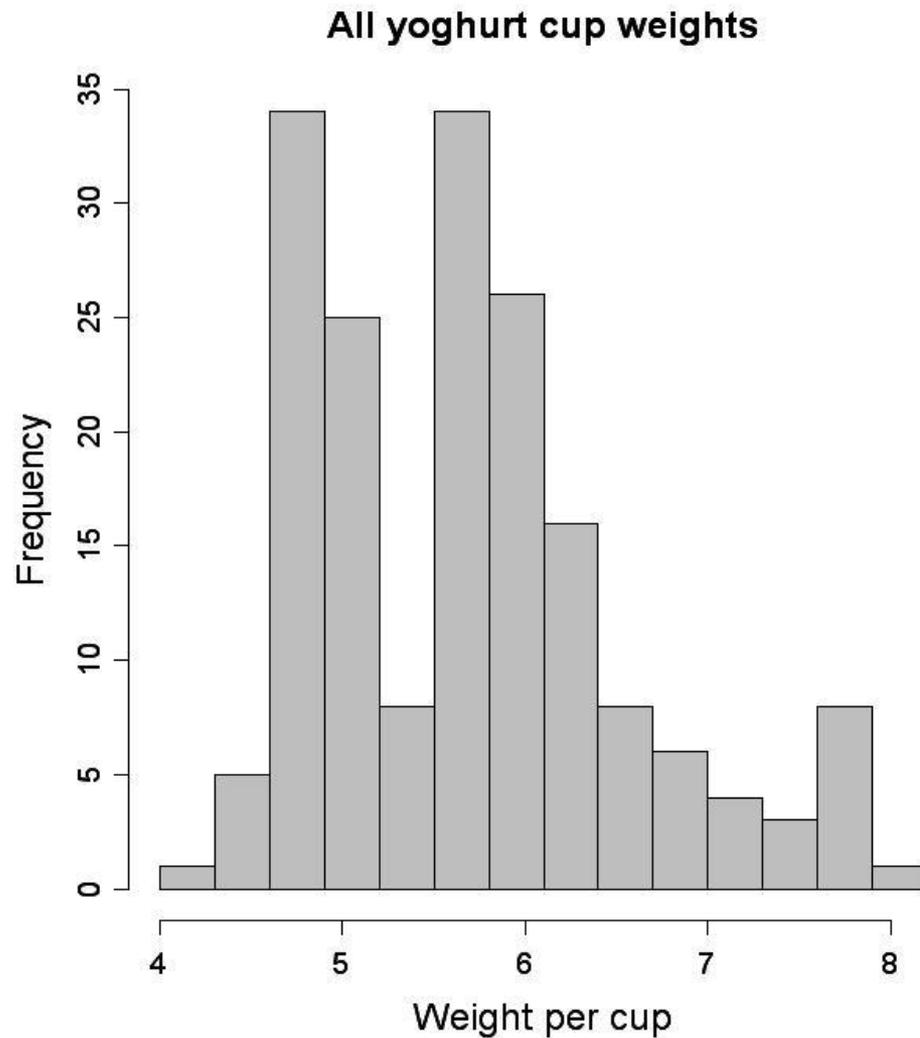
Sampling of yoghurt cups in the selected supermarkets

Overall around **150** yoghurt cups.

Cups were emptied, cleaned, and weighed.

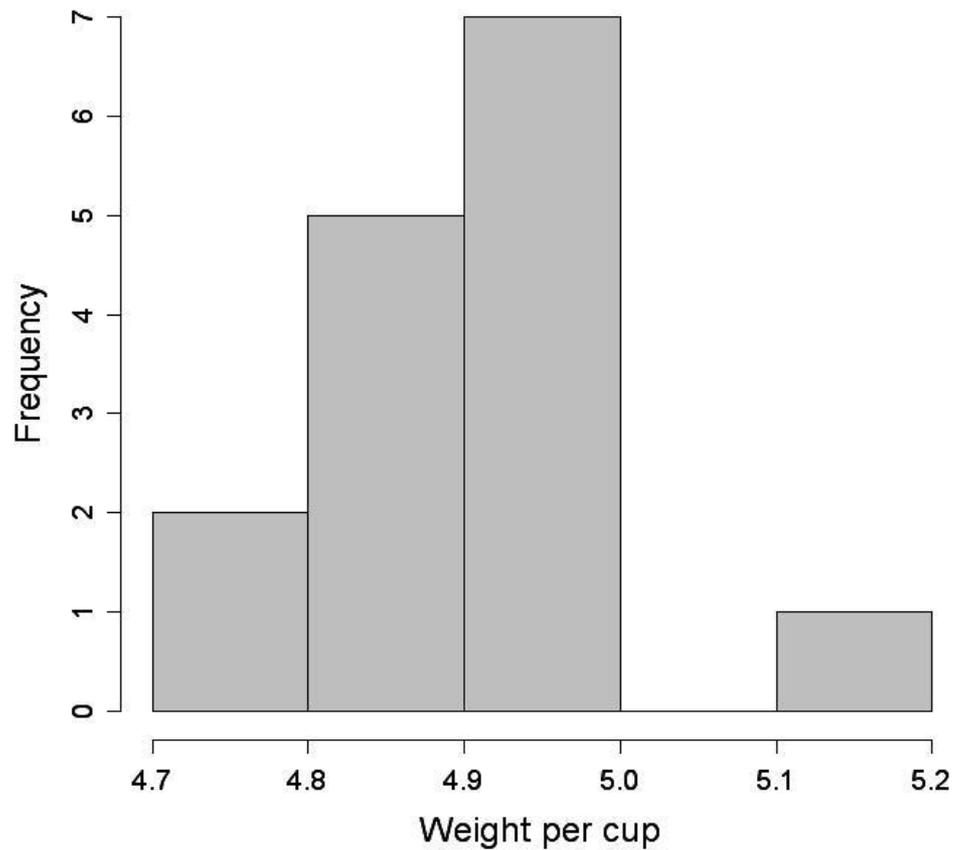
Data were entered into a small Access database,
and analysed with statistical software (R+).

Data exploration, 1

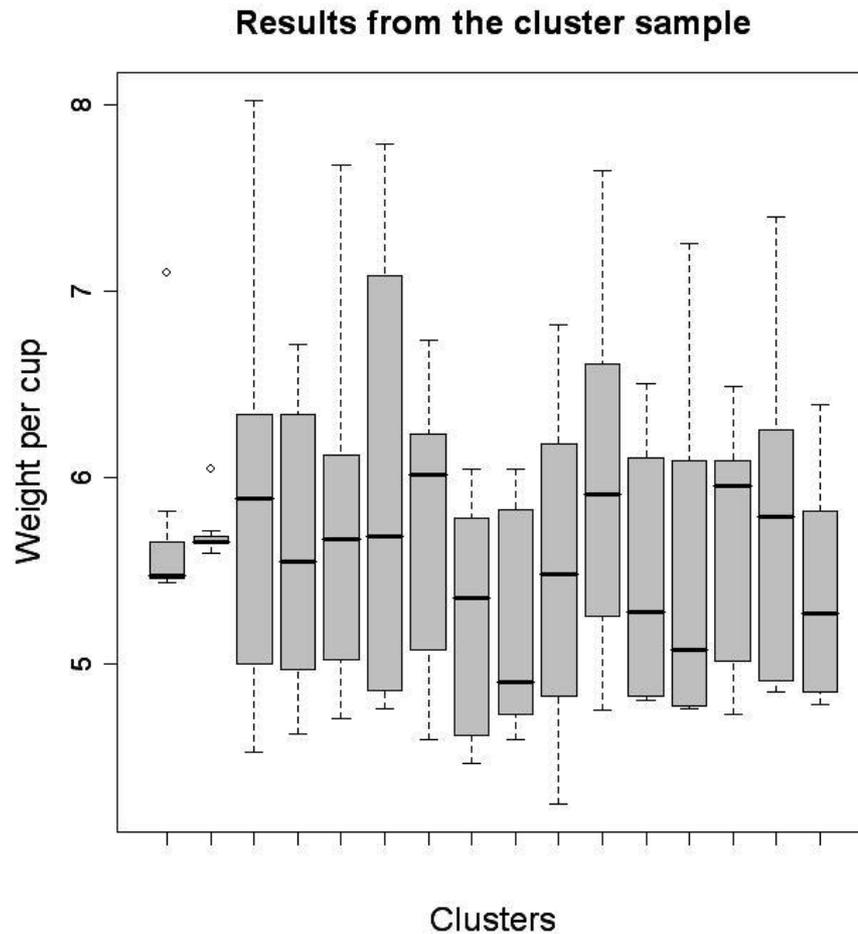


Data exploration, 2

Results from a single cup type (Ehrmann Almighurt)

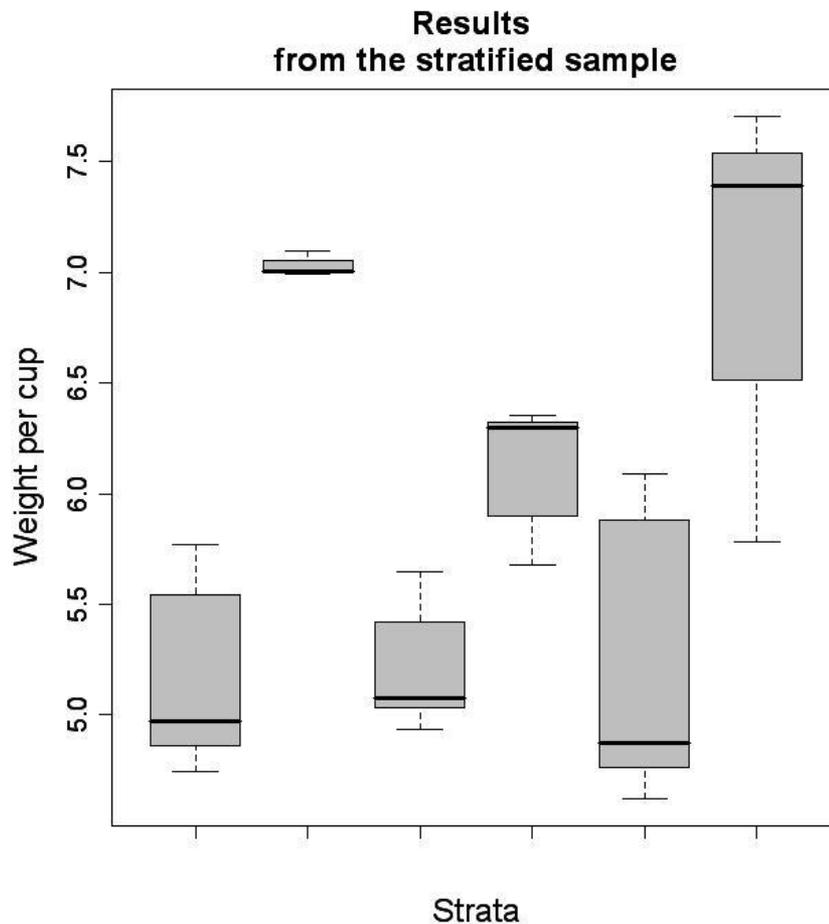


Data analysis: clustering (supermarkets)

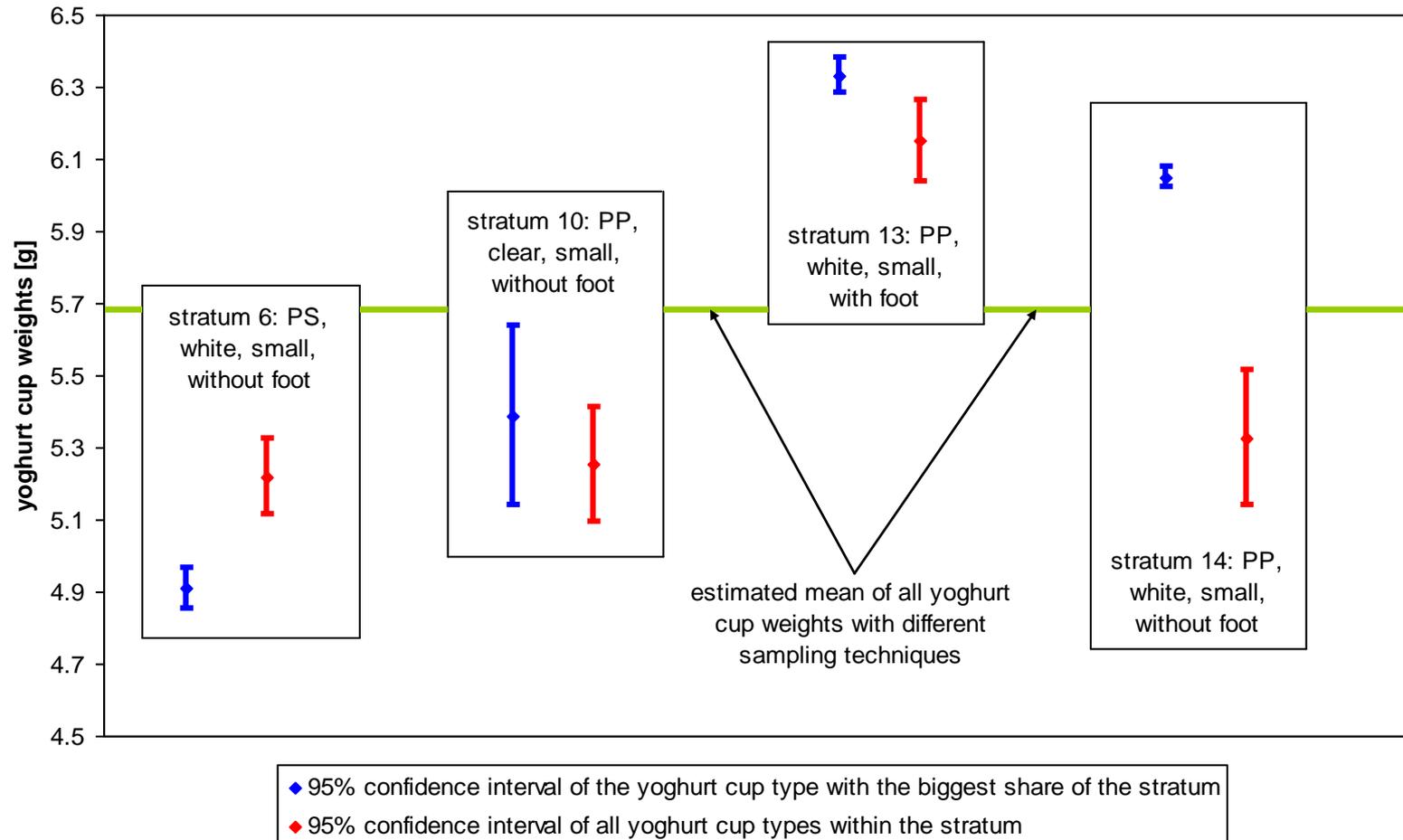


Data analysis: stratification

(types of yoghurt cups, shapes of cups)

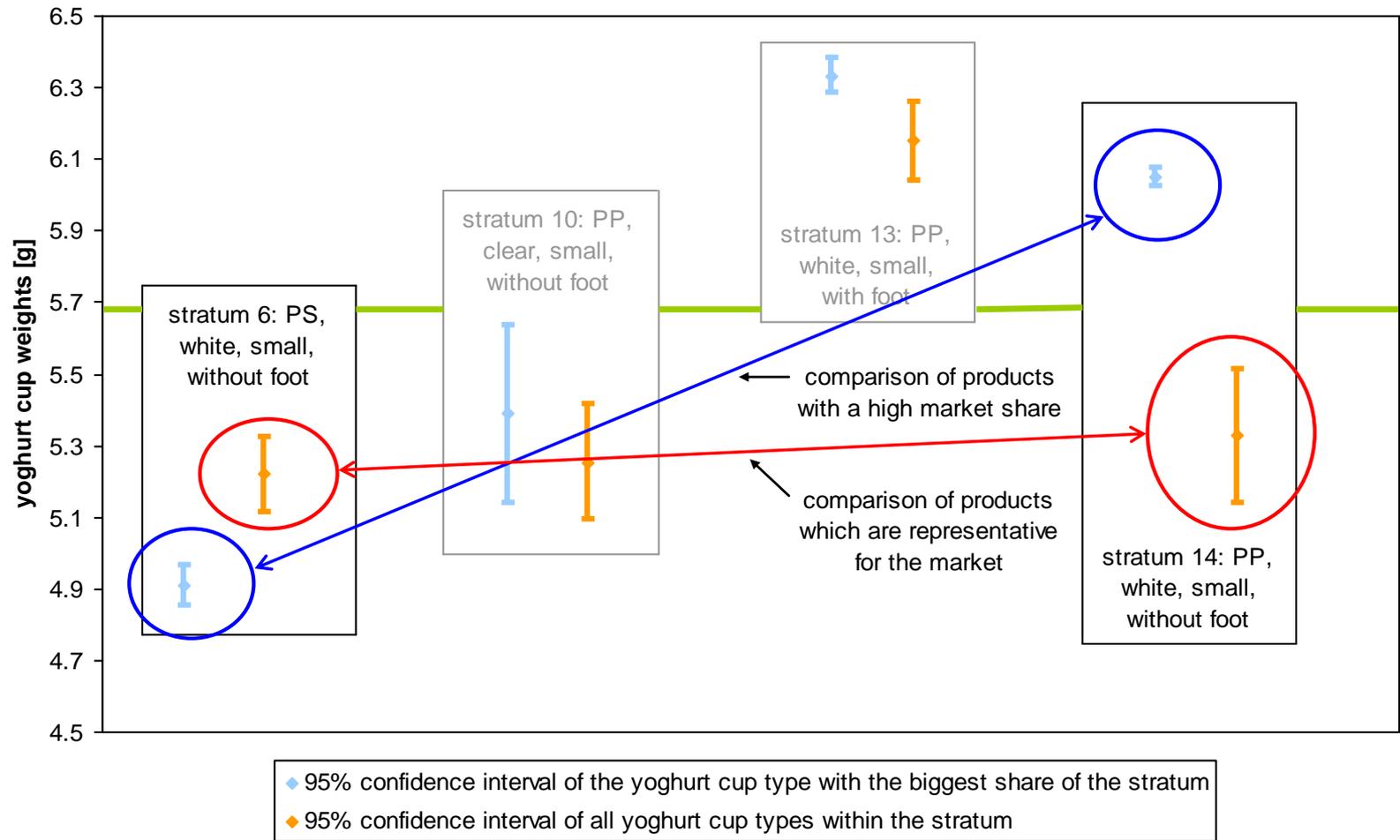


Calculation results: Representative estimates



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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