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Estimating the Uncertainties of Algorithm A Means

Quantifying uncertainties of consensus means

From standard deviation with traditional formula

$$u(x_{pt}) = 1.25 \times \frac{s^*}{\sqrt{n}}$$

The factor 1.25 is used to account for possible contamination with outliers

Using bootstrapping techniques

- Take the original data set with *n* data
- Sample from it another *n* data **with replacement**
- Use this bootstrap sample to calculate a robust mean
- Repeat that a large number of times N (typically N ≥ 1000)
- Calculate the standard deviation of these N robust means

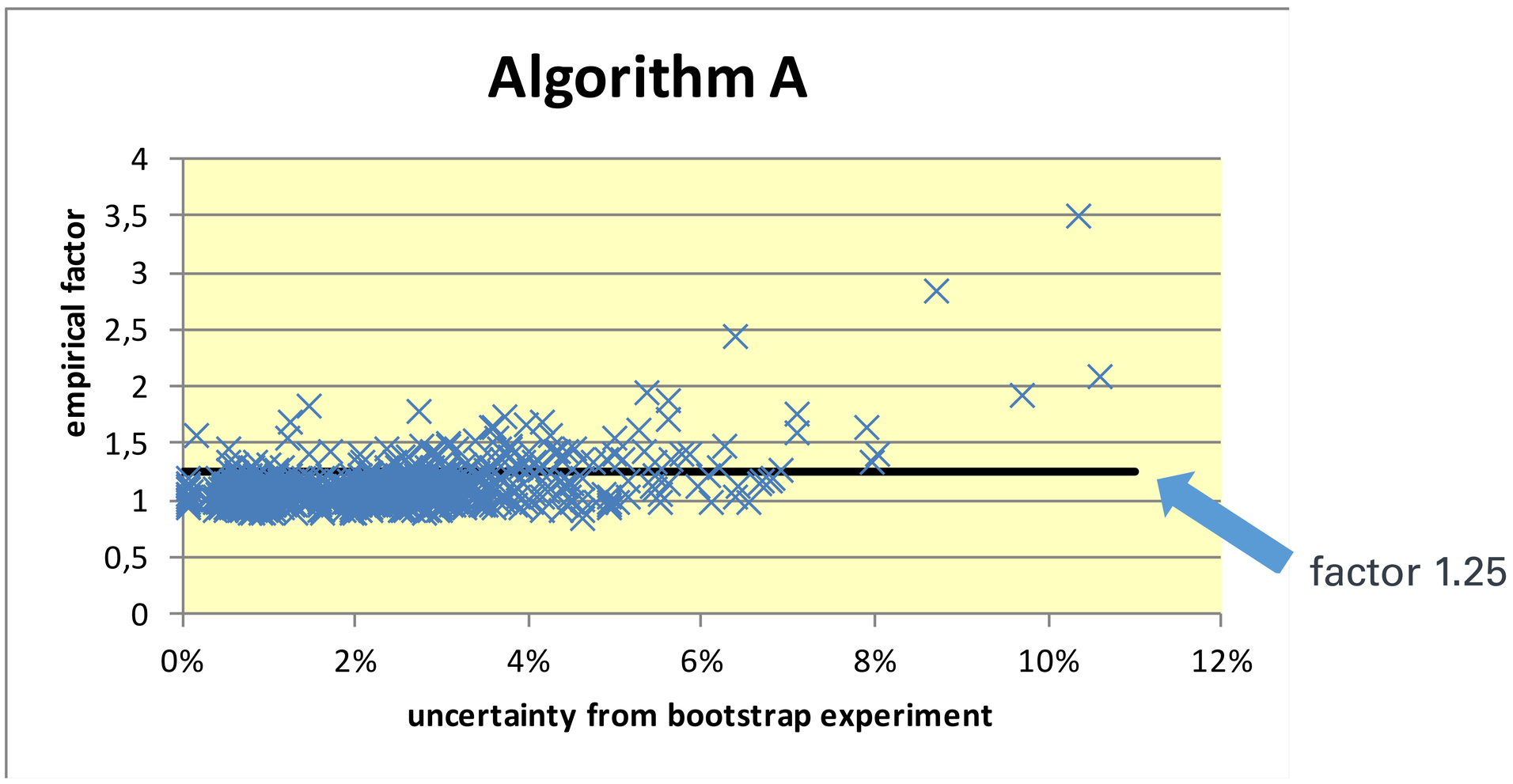
Data

- 930 real water PT data sets from AQS BW PTs
- Robust consensus means and robust standard deviations calculated using Algorithm A for traditional uncertainty
- For each of the 930 data sets 4000 bootstrap samples to calculate the uncertainty of the robust mean

Is the factor 1.25 adequate?

- Empirical factor calculated for each data set from bootstrap estimate of uncertainty, robust standard deviation and number of data

$$f_{emp} = \frac{u_{bs}}{\frac{s^*}{\sqrt{n}}}$$



Conclusions

Assuming that the bootstrap experiment gives a more reliable estimate of the uncertainty it can be concluded:

- For low relative uncertainties the contamination with outliers seems to be well covered by the factor 1.25
- In some cases a factor up to 2 would be necessary
- For high relative uncertainties the factor 1.25 seems not to be adequate

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