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CORRELATION BETWEEN EQA DATA AS A KEY TO DETERMINE OPTIMUM EQA FREQUENCY

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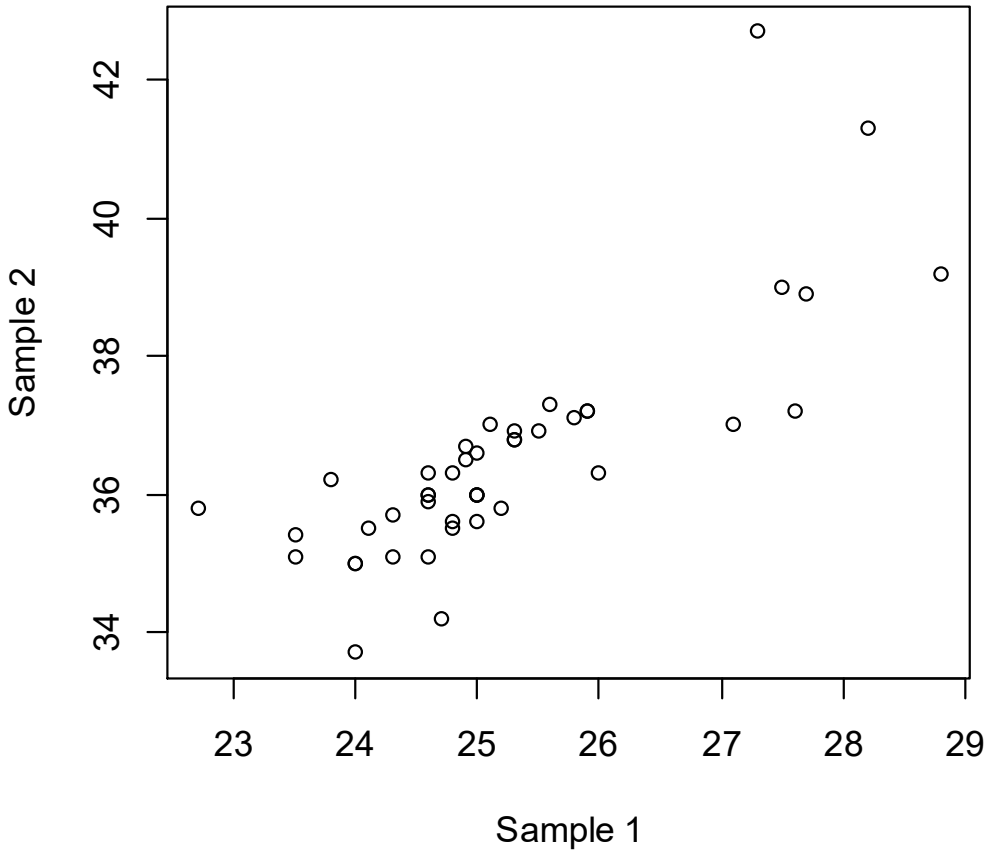
Correlation in EQA data



Correlation

The EQA result that a laboratory reported for one sample is similar to EQA result of another sample

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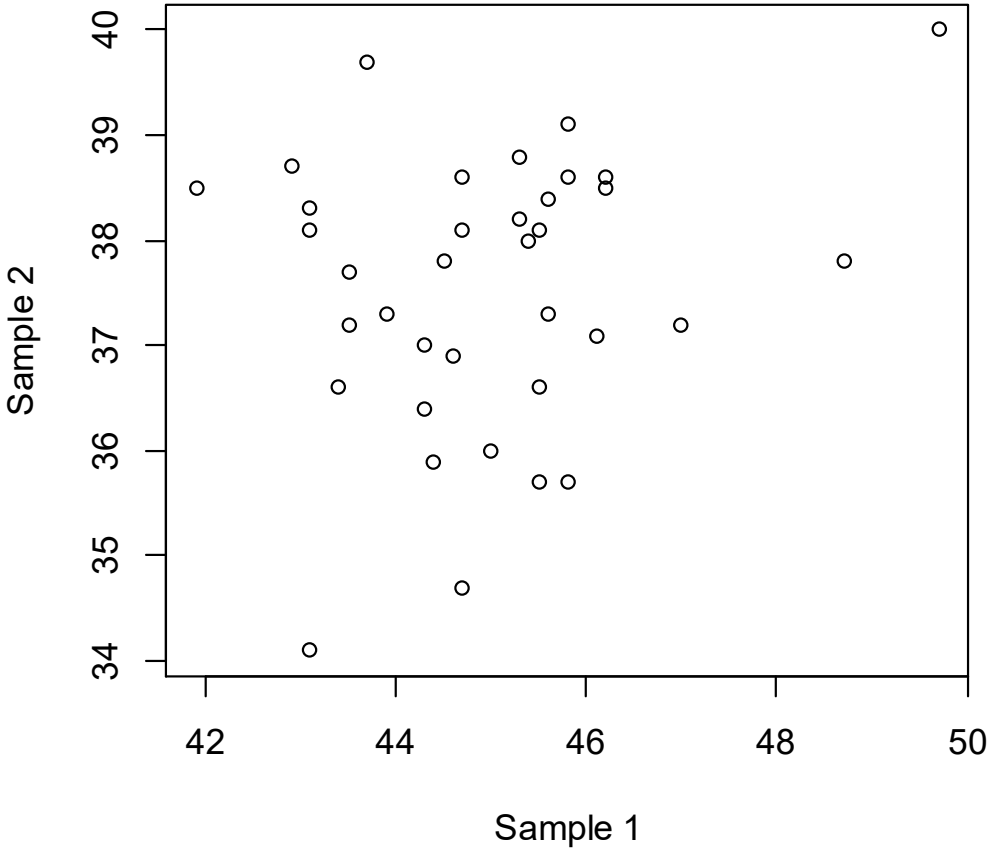
Correlation in EQA data

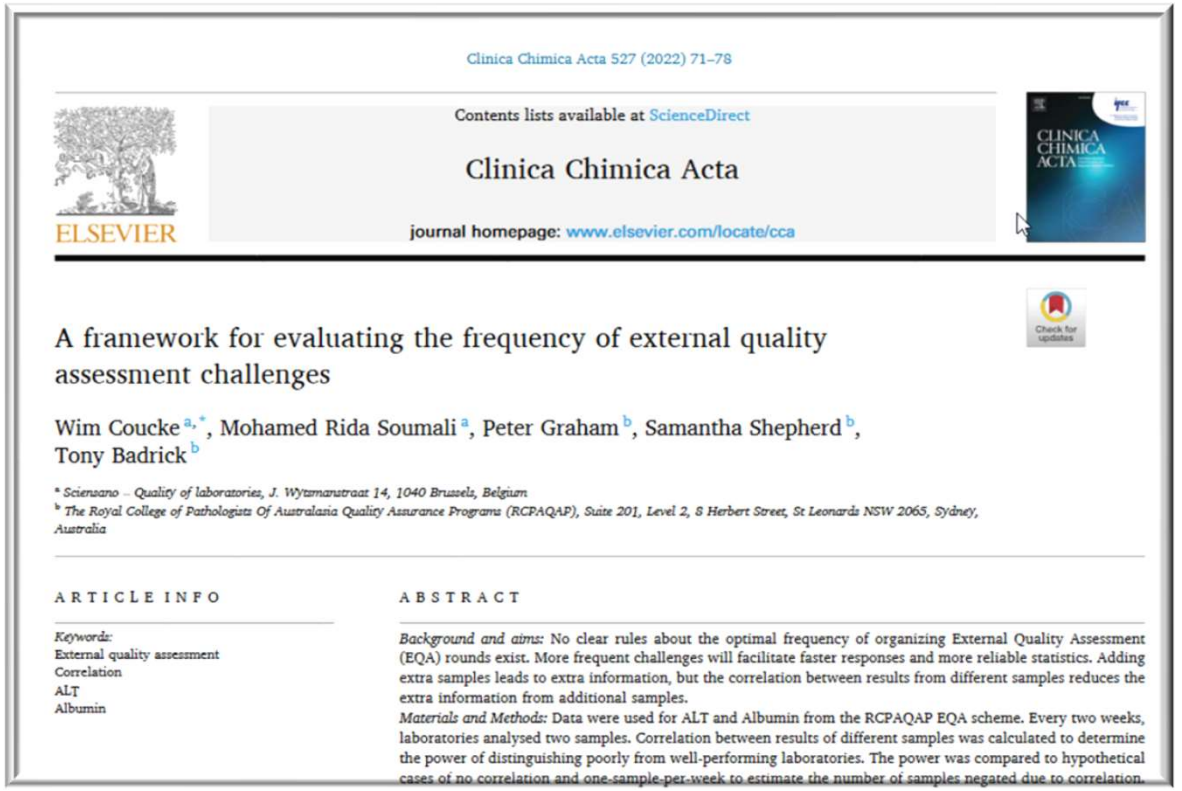


No correlation observed between results obtained by the same laboratories for two samples

Effect of correlation on EQA data

- If correlation is present and neglected, conclusions drawn from EQA data are less powerful than originally estimated

- Frequency can be increased up to point when correlation becomes too important



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A framework for evaluating the frequency of external quality assessment challenges

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ABSTRACT

Background and aims: No clear rules about the optimal frequency of organizing External Quality Assessment (EQA) rounds exist. More frequent challenges will facilitate faster responses and more reliable statistics. Adding extra samples leads to extra information, but the correlation between results from different samples reduces the extra information from additional samples.
Materials and Methods: Data were used for ALT and Albumin from the RCPAQAP EQA scheme. Every two weeks, laboratories analysed two samples. Correlation between results of different samples was calculated to determine the power of distinguishing poorly from well-performing laboratories. The power was compared to hypothetical cases of no correlation and one-sample-per-week to estimate the number of samples negated due to correlation.

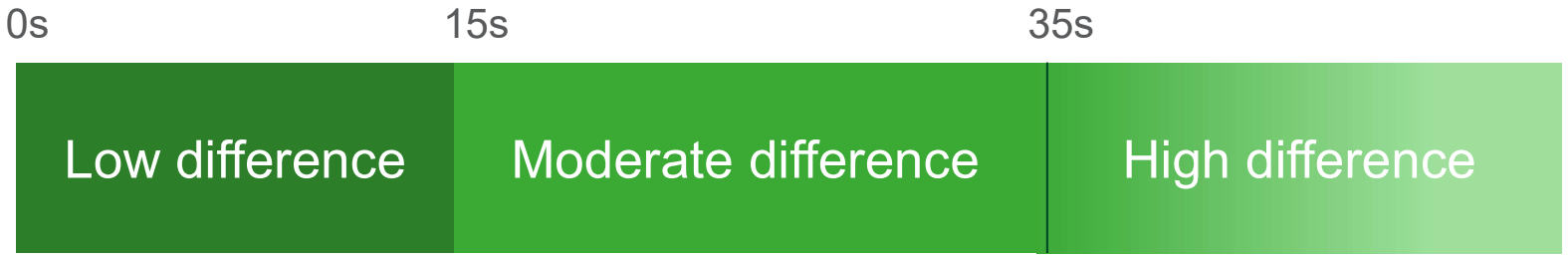
Data

- EQA rounds from 2021 from ECAT
  - aPTT
  - 8 rounds, 2 samples per round
  - 1 result per laboratory/sample
  - 210-233 results per sample
  - Five Peer groups with at least 10 participants for every sample after excluding outliers

Peer group	Number of participants
Stago Cephascreen	37
IL HemosIL SynthASil	46
Siemens Actin FSL	17
Siemens Pathromtin SL	31
Siemens Actin FS	38

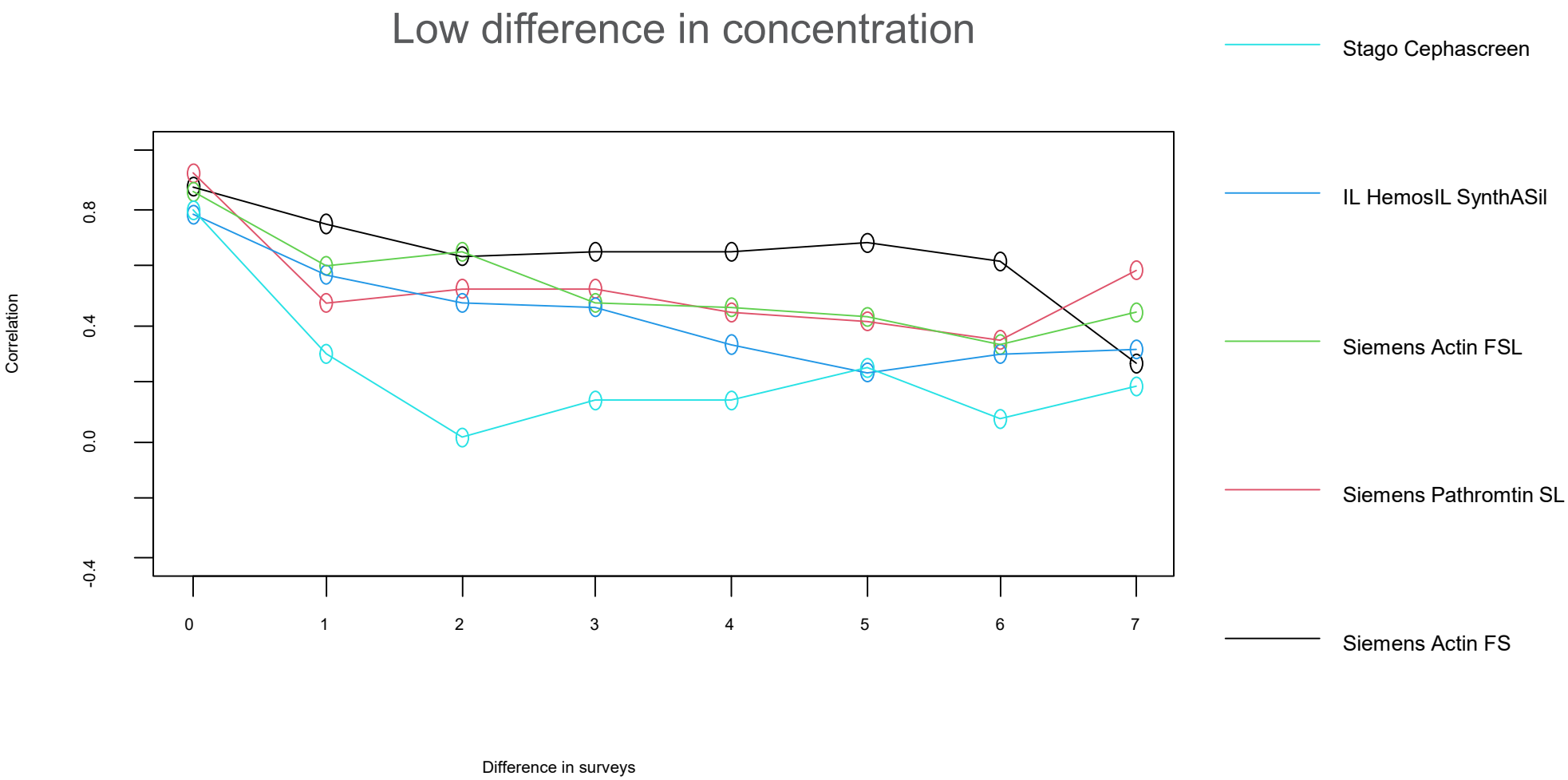
Observed correlation

- For every peer group:
- For every combination of samples:
    - Difference in assigned values

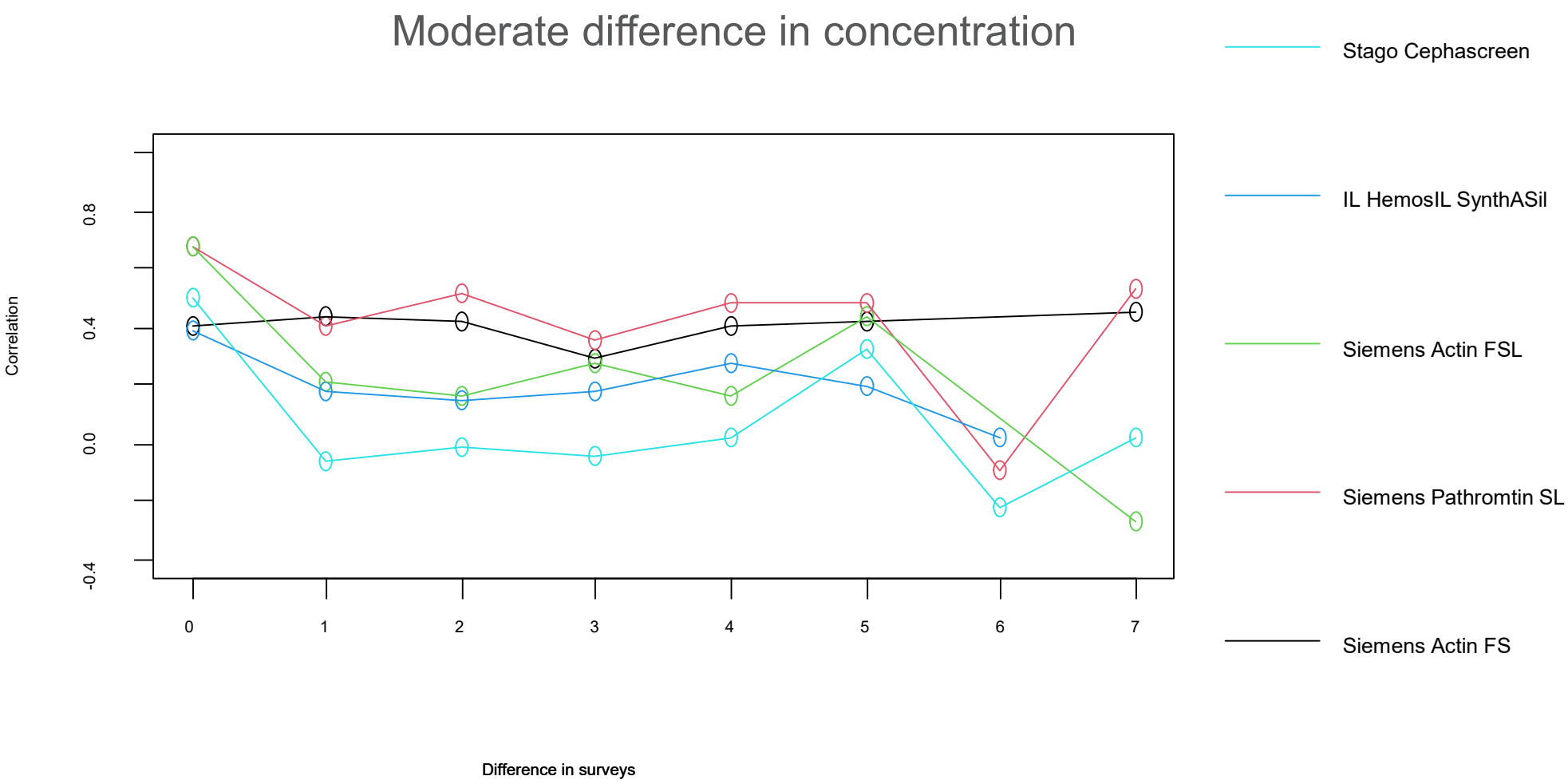


    - Difference between rounds
        - Round 1 sample 1 ↔ Round 1 sample 2: 0
        - Round 1 sample 1 ↔ Round 2 sample 1: 1
        - …
        - Round 1 sample 1 ↔ Round 8 sample 2: 7
- Calculate median correlation per category of difference in assigned values an difference between rounds

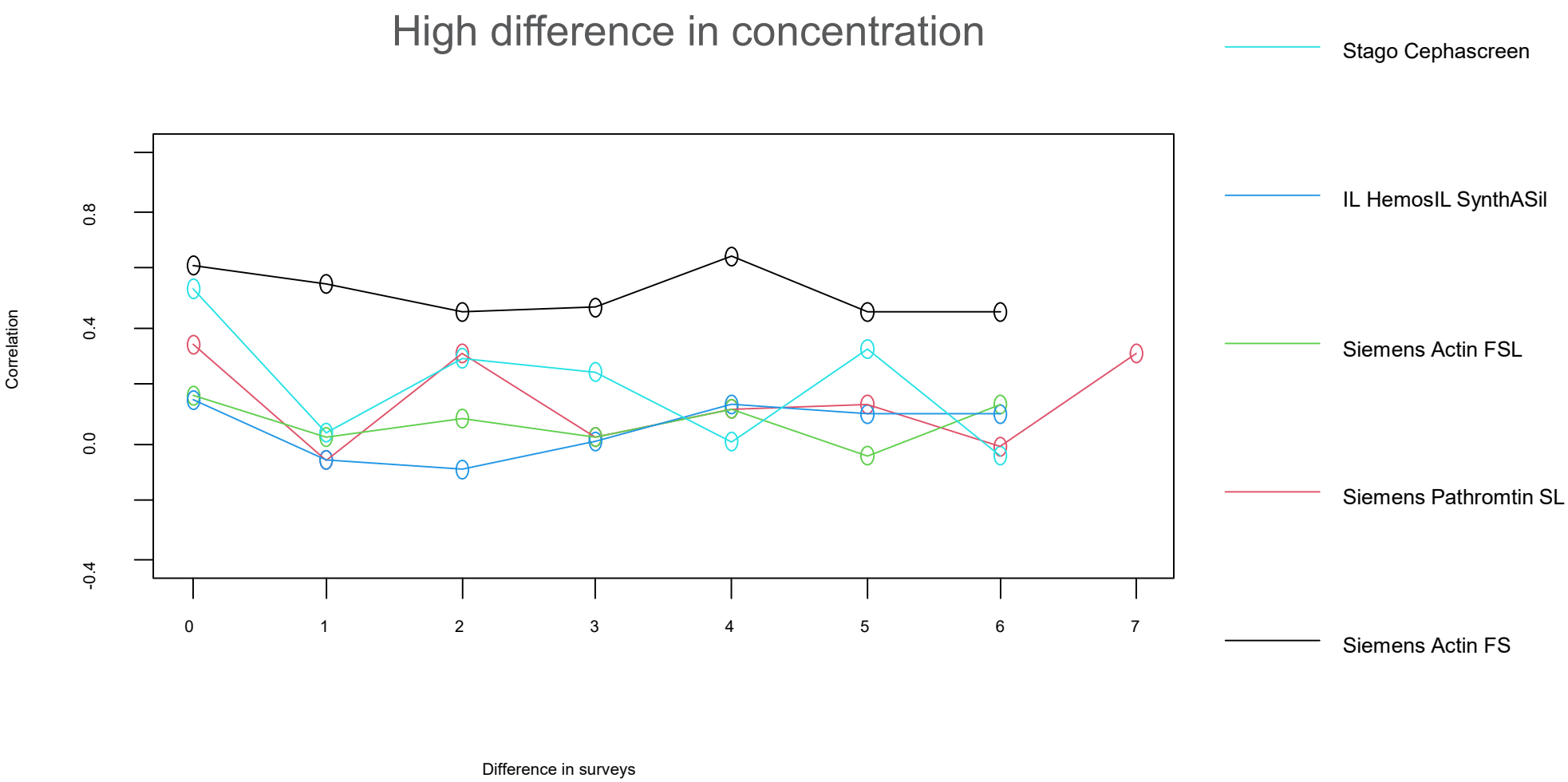
Observed correlation



Observed correlation



Observed correlation



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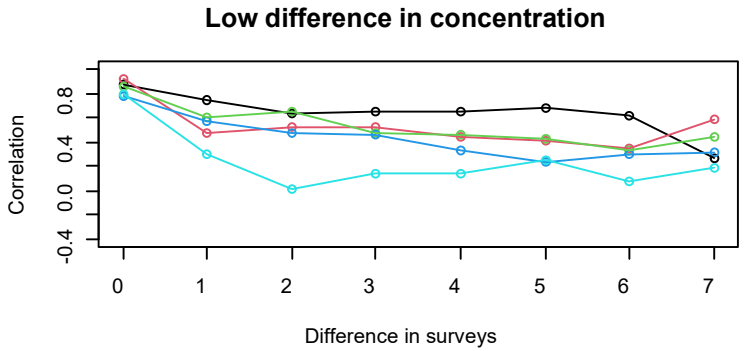

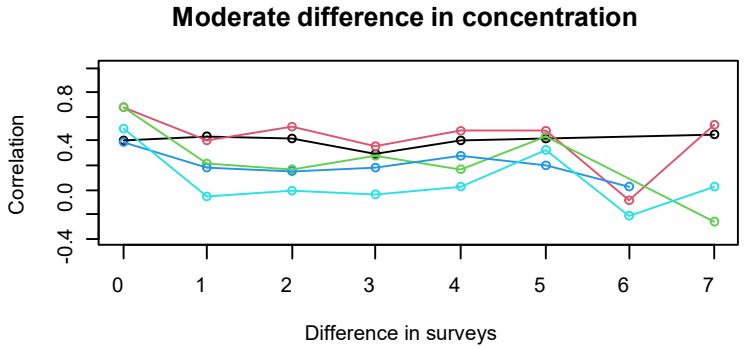

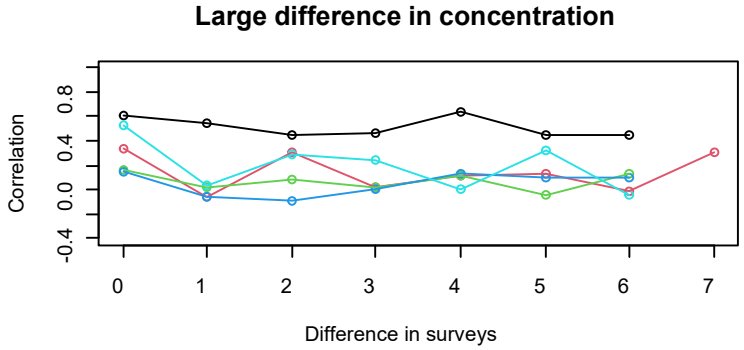

Stago Cephascreen

IL HemosIL SynthASil

Siemens Actin FSL

Siemens Pathromtin SL

Siemens Actin FS

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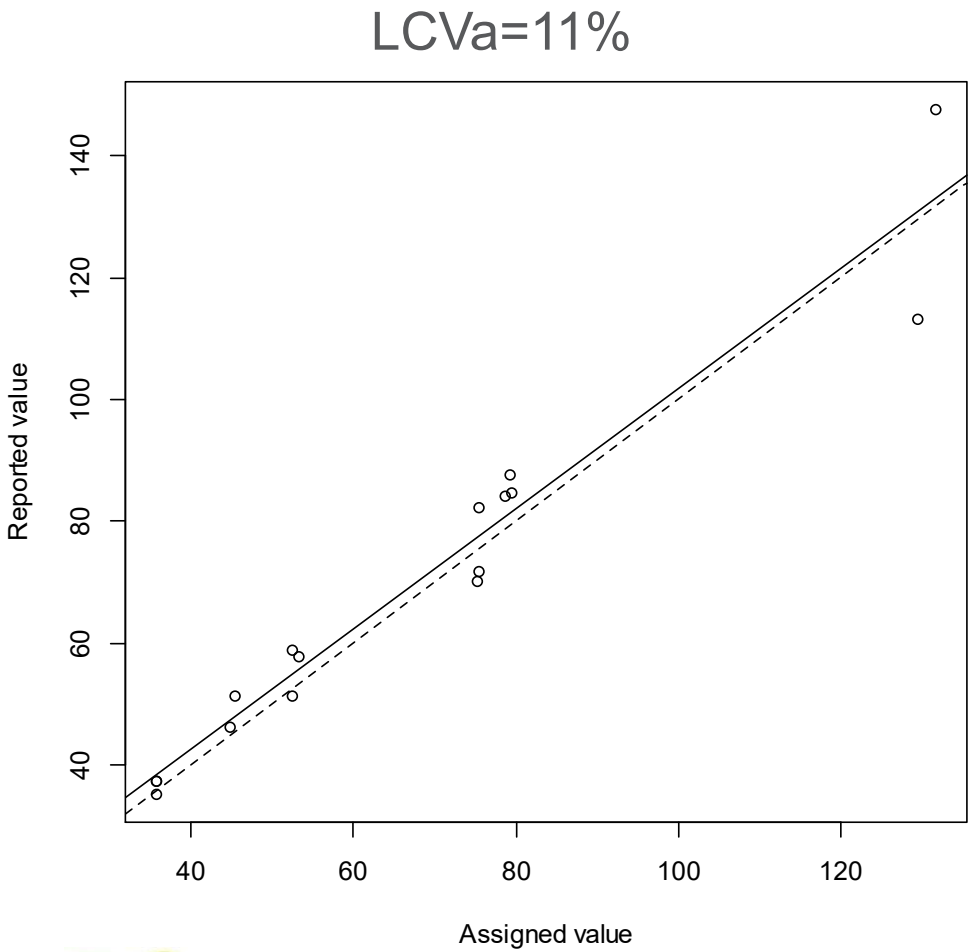
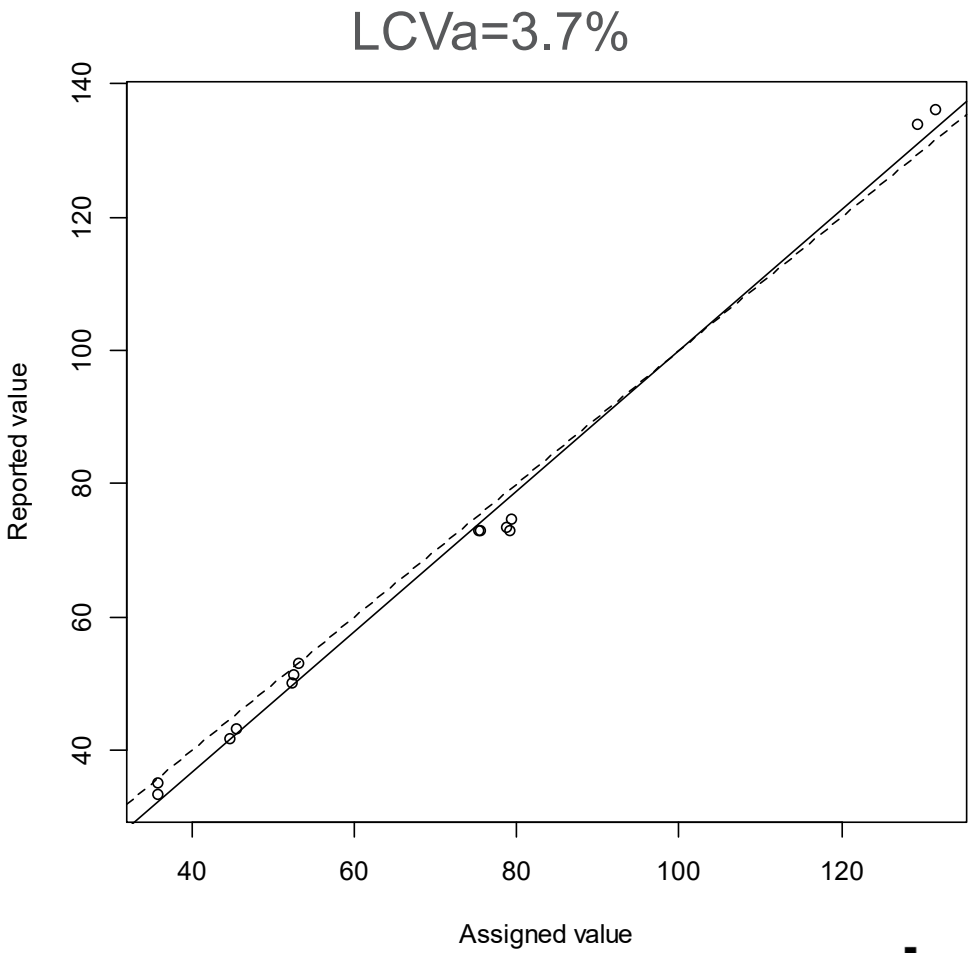
Correlation in EQA data for aPTT

- The closer the rounds are in time, the higher the correlation
  - Highest correlation for samples in same round
- The more the samples have a similar assigned value, the higher the correlation
- Correlation depends on method

LCVa

LCVa: regression error, divided by bias and by mean assigned value





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Effect of correlation of LCVa measurement

What is the probability that a laboratory with lower analytical variability would have a lower LCVa ?

- Example:

Laboratory 1: mean analytical error of 7.35s

Laboratory 2: mean analytical error of 2.72s

What is the chance that laboratory 2 would end up having a lower LCVa than laboratory 1 ?

Effect of correlation on LCVa measurement

Multivariate normal distribution

Laboratory	Round 1		Round 2		Round 3	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
1	25	36.6	31.7	78.5	45.4	49.4
2	24.7	34.2	31.5	73	45.5	49.7
3	25.3	36.9	32.3	78.8	46	50.2
4	24.6	36	31.6	78.8	45.6	49.3
5	24.9	36.5	31.5	78.4	45.3	49.2
6	25	36	31	82	43	47
7	25.2	35.8	31.3	87.9	44.3	47.1

Multivariate normal distribution

- Multivariate normal distribution characterized by 2 parameters:
  - **Vector of means**

	Round 1		Round 2		Round 3	
	Sample 1	Sample 2	Sample 1	Sample 2	Sample 1	Sample 2
Assigned value	25.1	36.3	31.6	80.3	45.1	48.6

  - **Variance-covariance matrix**

    Variance-covariance matrix is the observed correlation matrix multiplied with the observed standard deviation of each sample

Testing different scenarios

Mean vector and variance-covariance matrix can be made up to reflect different scenarios

Scenario	Mean vector and Correlation matrix
Observed correlation	Observed correlations
No correlation	All off-diagonal elements=0
Only samples with highly different assigned values in the same round	Replace correlations and standard deviations of samples in same round with low concentration difference by correlation of samples with high difference
One sample per round, double amount of rounds	Replace correlations of samples in same round with correlation of samples in subsequent rounds
Less samples	Leave values out, give priority to samples in rounds with similar assigned values

Effect of correlation of LCVA measurement

Laboratory A: analytical variability of 0.5 EQA standard deviation

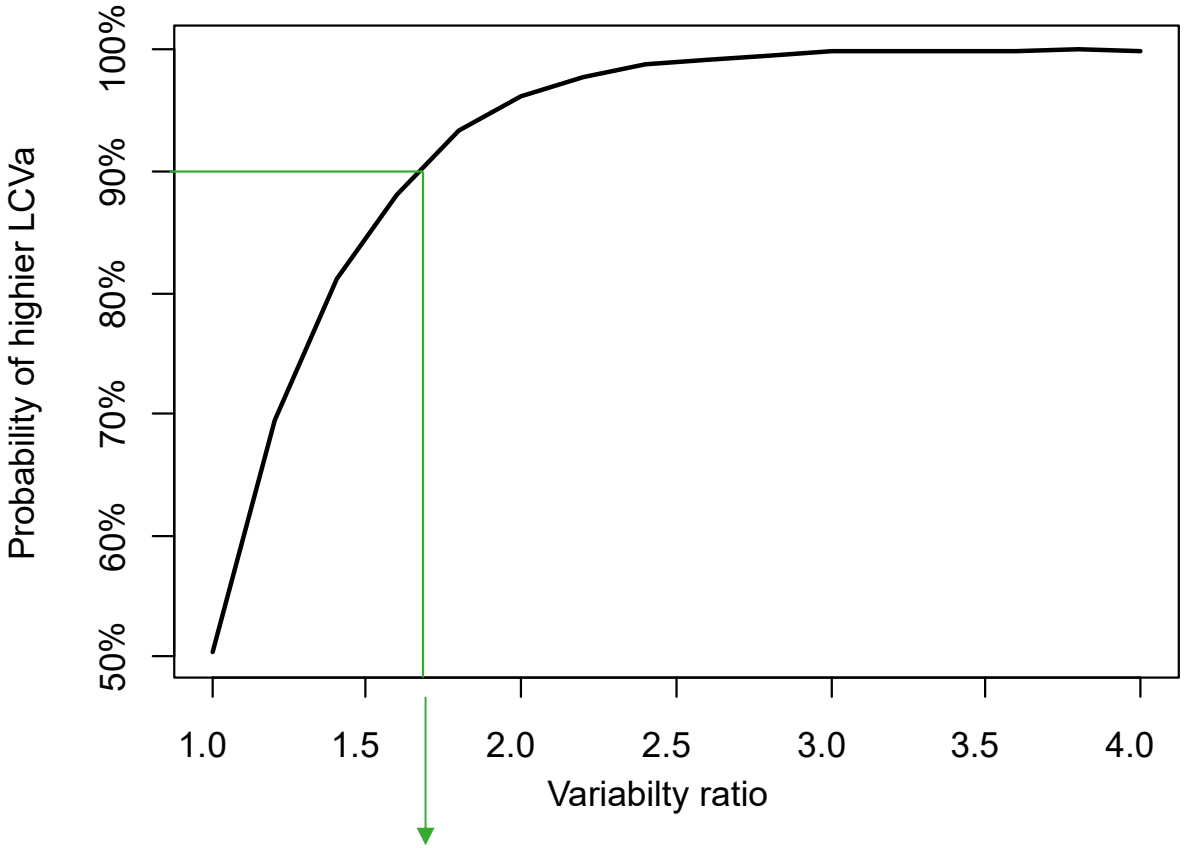
Laboratory B: analytical variability equal to EQA standard deviation

Laboratory C: analytical variability of 2*EQA standard deviation

Laboratory	Chance that LCVa is higher than LCVa of laboratory A			
	No correlation		Correlation	
	N=16	N=8	N=16	N=8
Laboratory B	95.8%	83.7%	92.4%	83.5%
Laboratory C	100%	97.6%	99.7%	97%

Effect of correlation of LCVa measurement

Power of distinguishing between laboratories with high and low variability using LCVa



Laboratory with standard devation 1.77 times larger than other laboratory has 90% chance of having a higher LCVa

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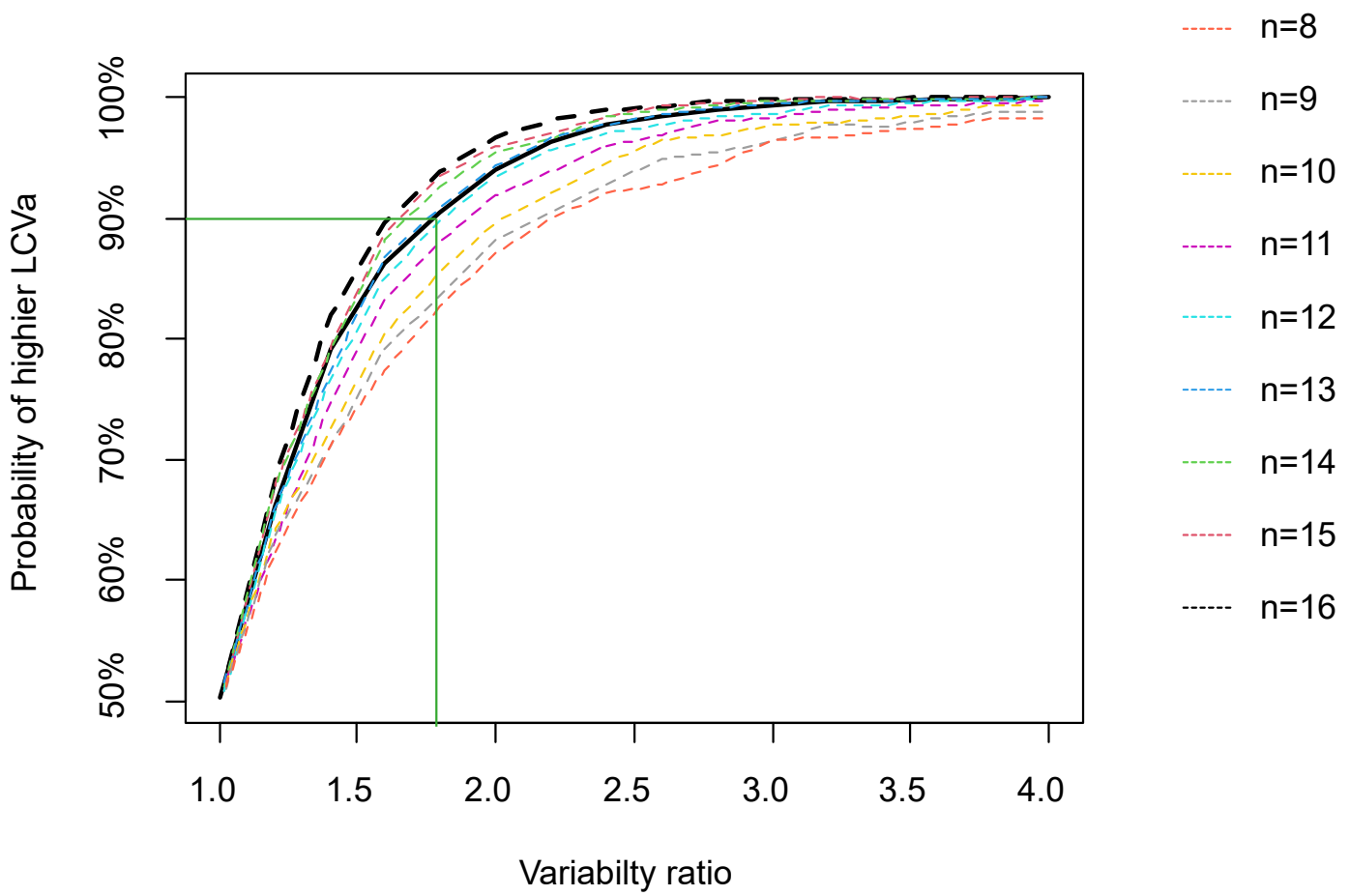
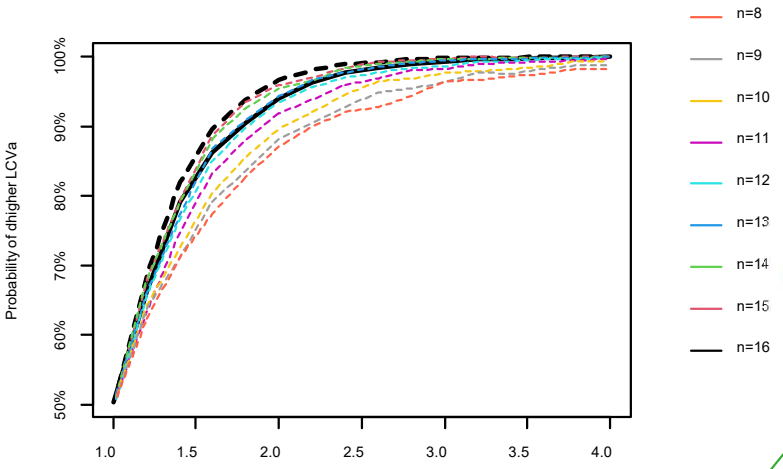
Evaluating effect of correlation



Evaluating effect of correlation

What variability can be distinguish with 90% power ?



	Correlation	No correlation
N=16	1.77	1.62
N=15		1.65
N=14		1.68
N=13		1.76
N=12		1.81

16-13: 3 samples negated

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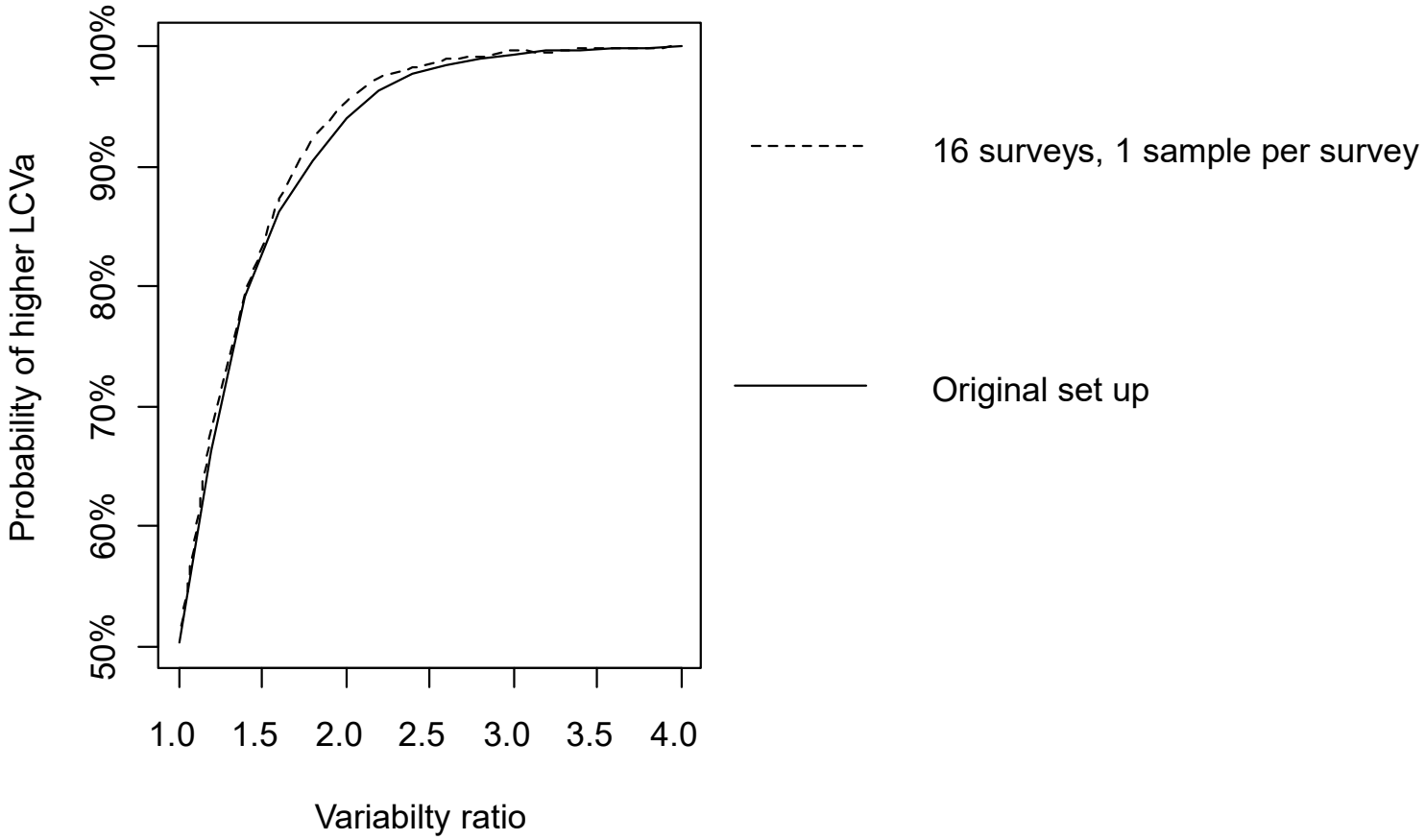
Number of samples negated

Method	Number of samples negated
Stago Cephascreen	3
IL HemosIL SynthASil	5
Siemens Actin FSL	2
Siemens Pathromtin SL	3
Siemens Actin FS	3

What if we would have 16 rounds with one sample each ?



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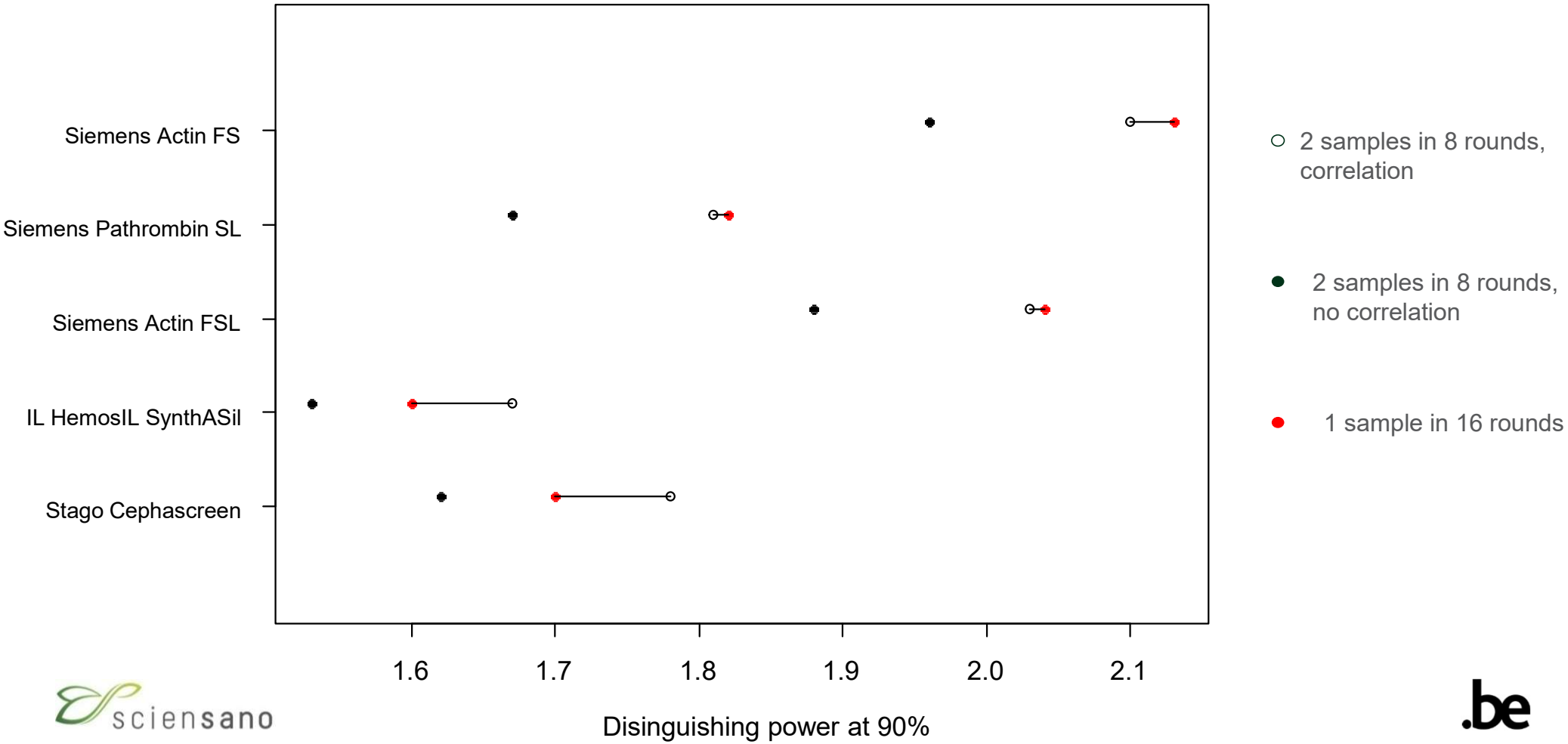

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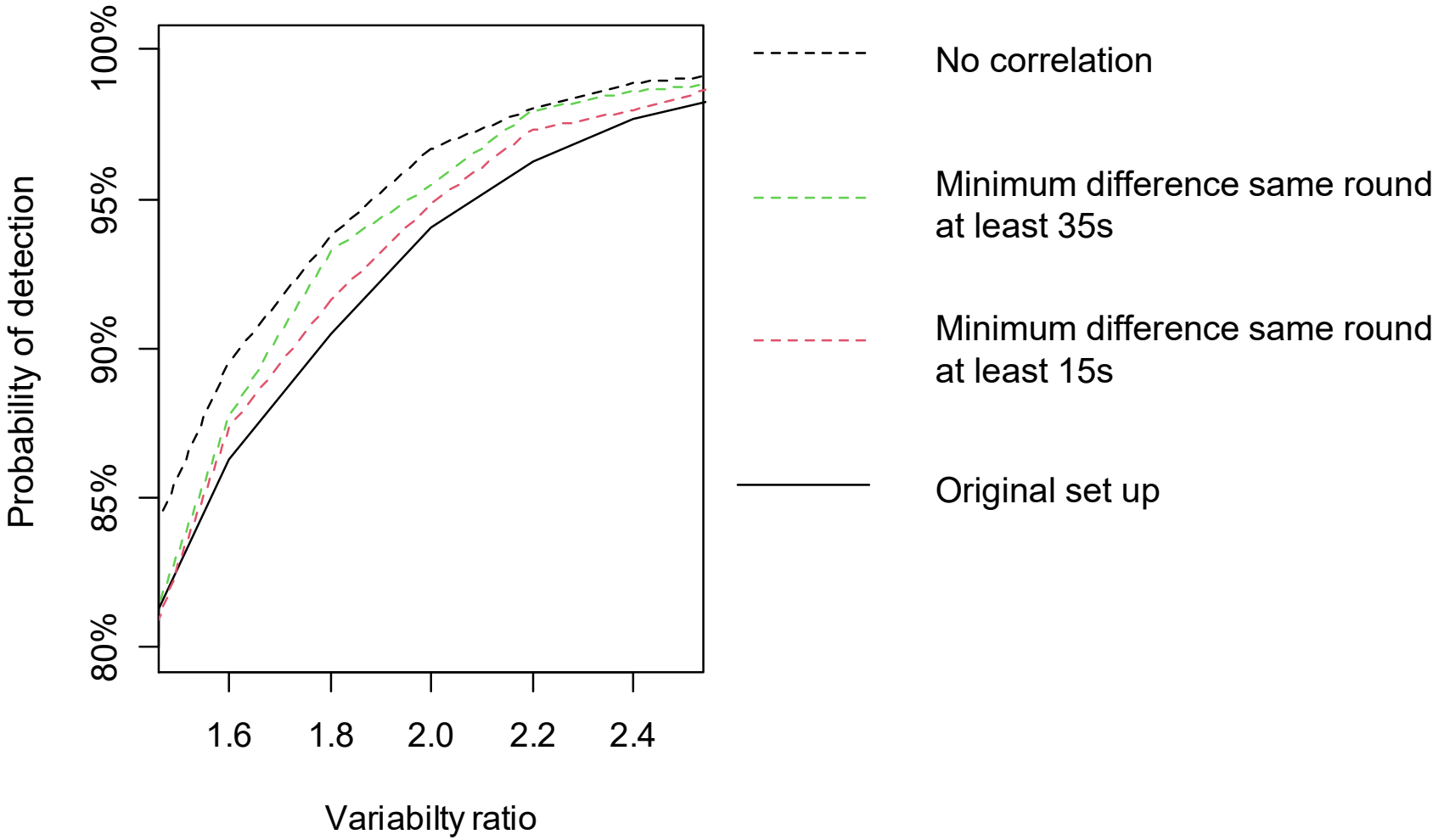
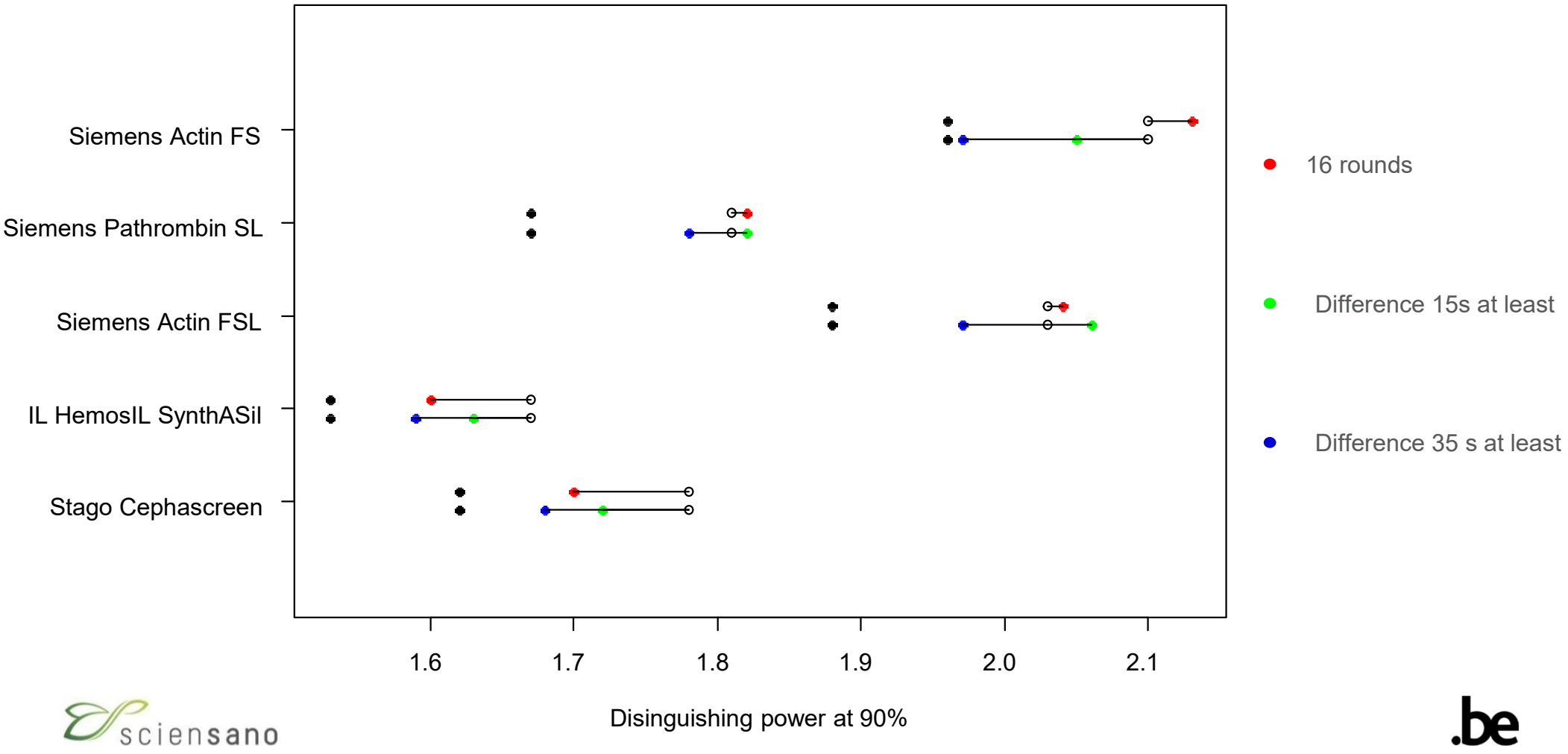
Using sample with higly different assigned values in same round



Using sample with higly different assigned values in same round



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Conclusions

- Correlation between reported EQA data is real
  - High correlation between samples with similar assigned value
  - Hig correlation between samples analyzed within a short time interval
  - Relation correlation – time interval – difference in assigned values is not the same for all methods
- Correlation between reported EQA data has an adverse effect on interpretation of LCVa
  - 10-30% of samples are negated, depending on method
- Reducing effect of correlation by avoiding using samples with similar concentration together