

Consensus Building

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DATAWorks 2018 — Springfield, VA



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Consensus

Consensus building (*collaborative problem solving*) is a conflict-resolution process used to settle multiparty disputes — Burgess & Spangler (2003)

Conflict Research Consortium, Univ. of Colorado, Boulder

- **Develop compromise agreement** acceptable to all group members on issue of common interest
 - **Paris Agreement** (2015 UN Climate Change Conf.)
- **Merge independent results** that may be inconclusive on their own, but that, taken together, reinforce each other and support a conclusion decisively
 - **Rosiglitazone meta-analysis**

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Consensus — Related Topics

- Updating on the credences of others
 - How should you update your credence in the truth of a proposition in light of the credences expressed by others?
- Incorporating testimony
 - How should testimony of witnesses about whether an event did or did not occur, and your probabilistic assessment of their reliability, be used to inform your credence in the occurrence of the event?

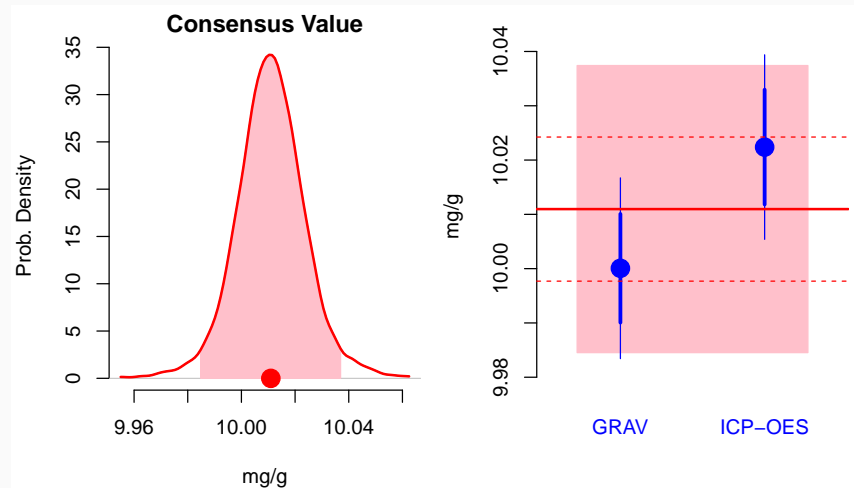
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Consensus Building — Measurement Science

- Blend measurement results obtained by different measurement methods
 - NIST SRM 3161a
Tin reference solution used to calibrate spectrometers
- Intercompare measurement results obtained by different laboratories
 - CCQM-K25
Key comparison to evaluate capabilities of national metrology laboratories when measuring PCBs

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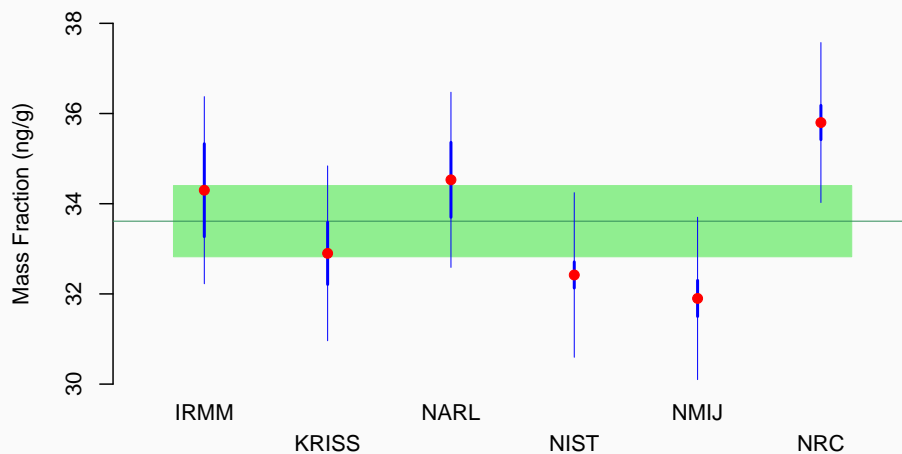
Tin Reference Solution (NIST SRM 3161a)



w_G	10.000 07	mg/g	w_1	10.022 39	mg/g
$u(w_G)$	0.010 01	mg/g	$u(w_1)$	0.010 57	mg/g
ν_G	24		ν_1	28	

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PCB 28 in Sediment



	w /(ng/g)	u /(ng/g)	ν		w /(ng/g)	u /(ng/g)	ν
IRMM	34.30	1.03	60	NIST	32.42	0.29	2
KRISS	32.90	0.69	4	NMIJ	31.90	0.40	13
NARL	34.53	0.83	18	NRC	35.80	0.38	60

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- **Principled, Model-Based**
 - **Koepke et al. (2017)**
Consensus building for interlaboratory studies, key comparisons, and meta-analysis
Metrologia 54(3)
- **NIST Consensus Builder**
<https://consensus.nist.gov>

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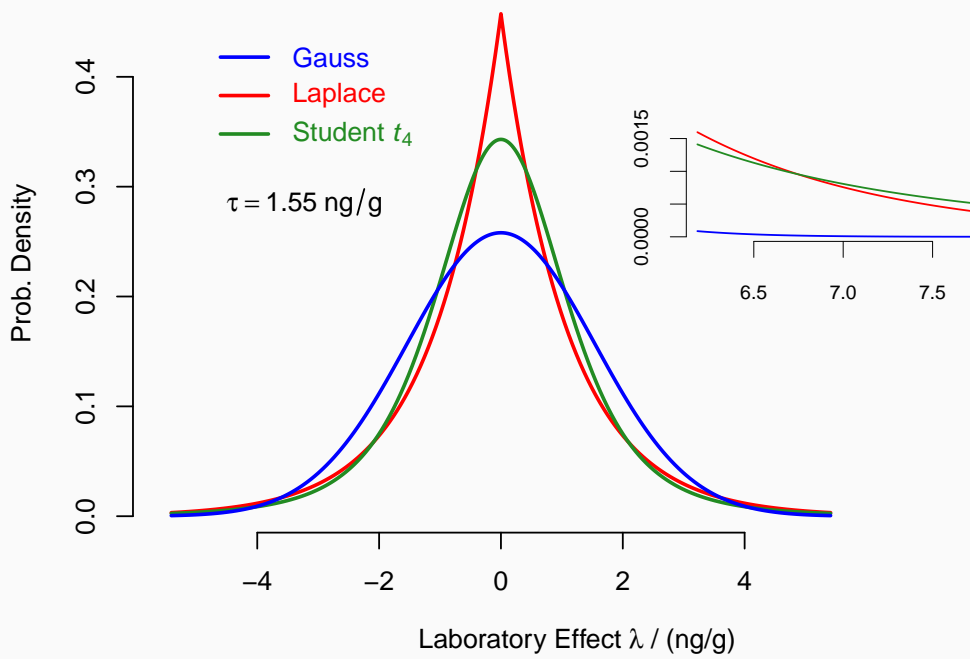
Laboratory Effects Model

- $x_j = \mu + \lambda_j + \varepsilon_j$
 - x_j Value measured by lab $j = 1, \dots, n$
 - μ Measurand
 - λ_j Effect of lab j – Gauss / Laplace / Student
 - ε_j Measurement error for lab j – Gauss

Dark Uncertainty $\tau = SD(\lambda_j)$

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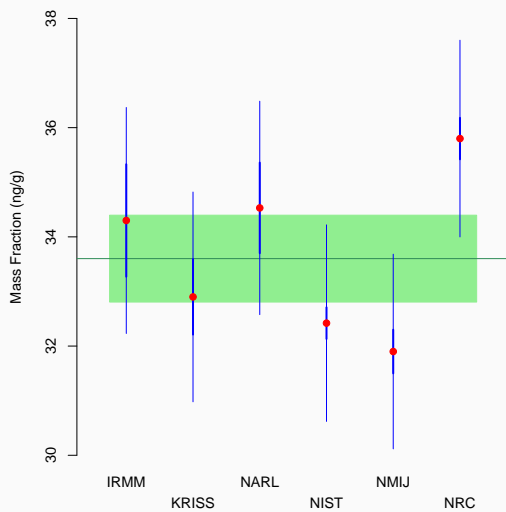
Gauss vs. Laplace vs. Student



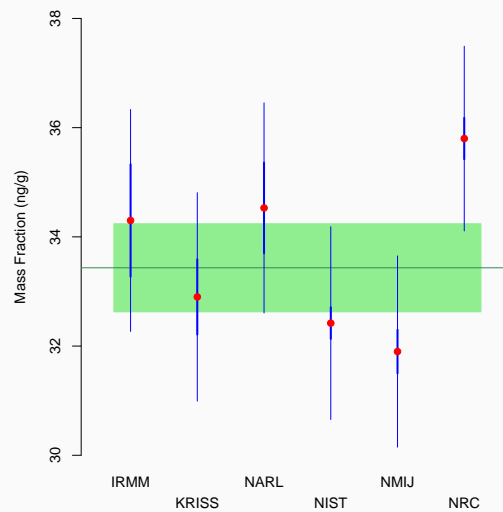
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Hierarchical Bayes – Variants

Gauss + Gauss



Laplace + Gauss



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Pierre Simon, Marquis de Laplace

- Let us imagine that one gives to each voter an urn that contains an infinity of balls by means of which he is able to nuance all the degrees of merit of the candidates; let us also suppose that he draws from his urn a number of balls proportional to the merit of each candidate



A Philosophical Essay on Probabilities, 1840
— On the choices and decisions of assemblies

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Consensus Building — Models

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Mixture Model (Linear Pooling)

- $f = \sum_{j=1}^n w_j \phi_j$

f Probability density of measurand

ϕ_j Probability density for lab j

w_j Weight of lab j

— ϕ_j Gaussian or Student's t

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Committee with several members wish to reach consensus on degree of belief about truth of propositions Q_1, \dots, Q_n

- Each member has her own degree of belief in each Q_j
- Consensus-building function uses all degrees of belief to produce consensus degree of belief in each Q_j

Consensus building is linear pooling if and only if

- *Specificity* — Consensus degree of belief in Q_j produced by function that is Q_j -specific and involves members' degrees of belief in Q_j only
- *Unanimity in Disbelief* — When all committee members disbelieve Q_j so will the consensus

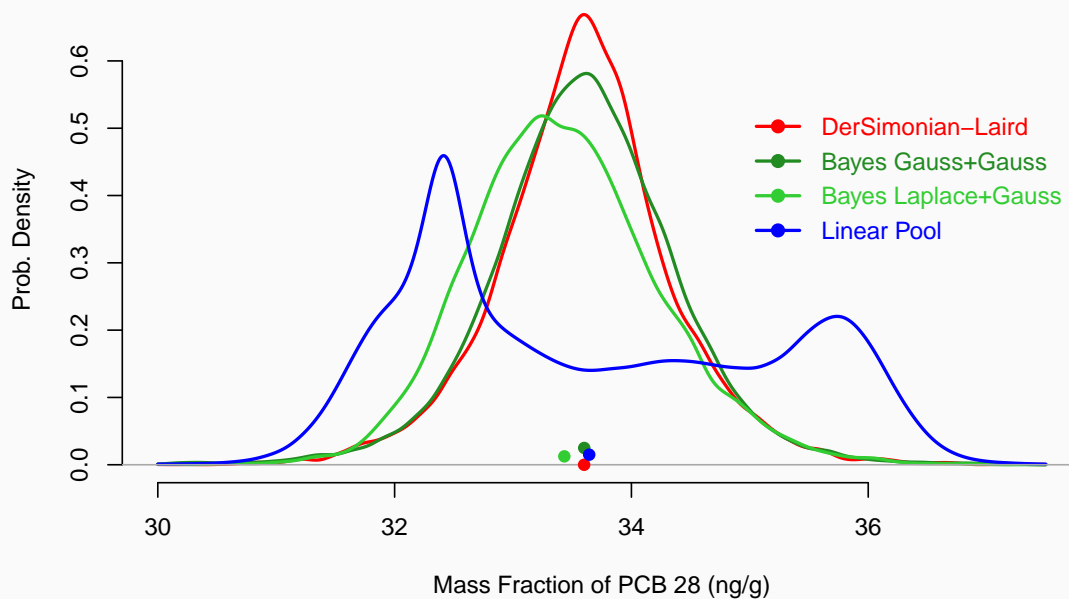
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Consensus Building — Flavors

- **Laboratory Effects Model**
 - **DeSimonian-Laird** — Most widely used / Fast
 - **Hierarchical Bayes** — Most assumptions / Thorough
 - **Gauss-Gauss** — Conventional / Slow
 - **Laplace-Gauss** — Resistant / Slow
- **Mixture Model**
 - **Linear Opinion Pool** — Fewest assumptions / Fast

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Consensus Building – Comparisons



	DL	BG	BL	LP	
w	33.6	33.6	33.5	33.6	ng/g
$U_{95\%}(w)$	1.5	1.6	1.6	2.5	ng/g

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NIST Consensus Builder

- Web App
<https://consensus.nist.gov>
- User's Manual
<https://consensus.nist.gov/NISTConsensusBuilder-UserManual.pdf>
- EXAMPLE: Cholesterol in human serum
 - CCQM-K6: Material B

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