Random Effects vs Fixed Effects Group Variance Models

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MEG Users Talk

5/26/06

Outline

- Inference primer
- Random Effects (RFx) - Unweighted
- Fixed Effects (FFx)
- Inference
- Conclusion
- Weighted Random Effects
- Mixed Effects

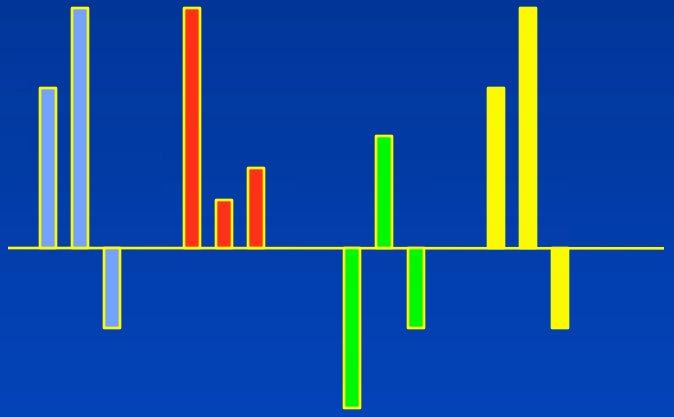
Inference 101

$$t_{dof} = \frac{\text{mean}}{SE}$$

- Mean – bigger is better
- SE (Standard Error) – small is better
- DOF – bigger is better

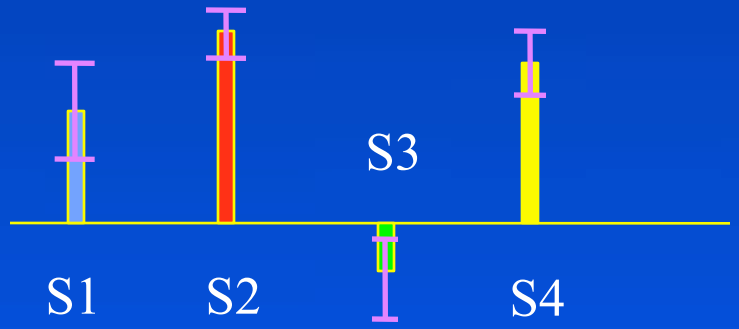
Typical Data

Multiple Individual Observations



N=4 subjects
M=3 observations (presentation)

Individual Means and Variances



Now What?

RFx (Unweighted)

$$t_{dof} = \frac{\text{mean}}{\text{SE}}$$

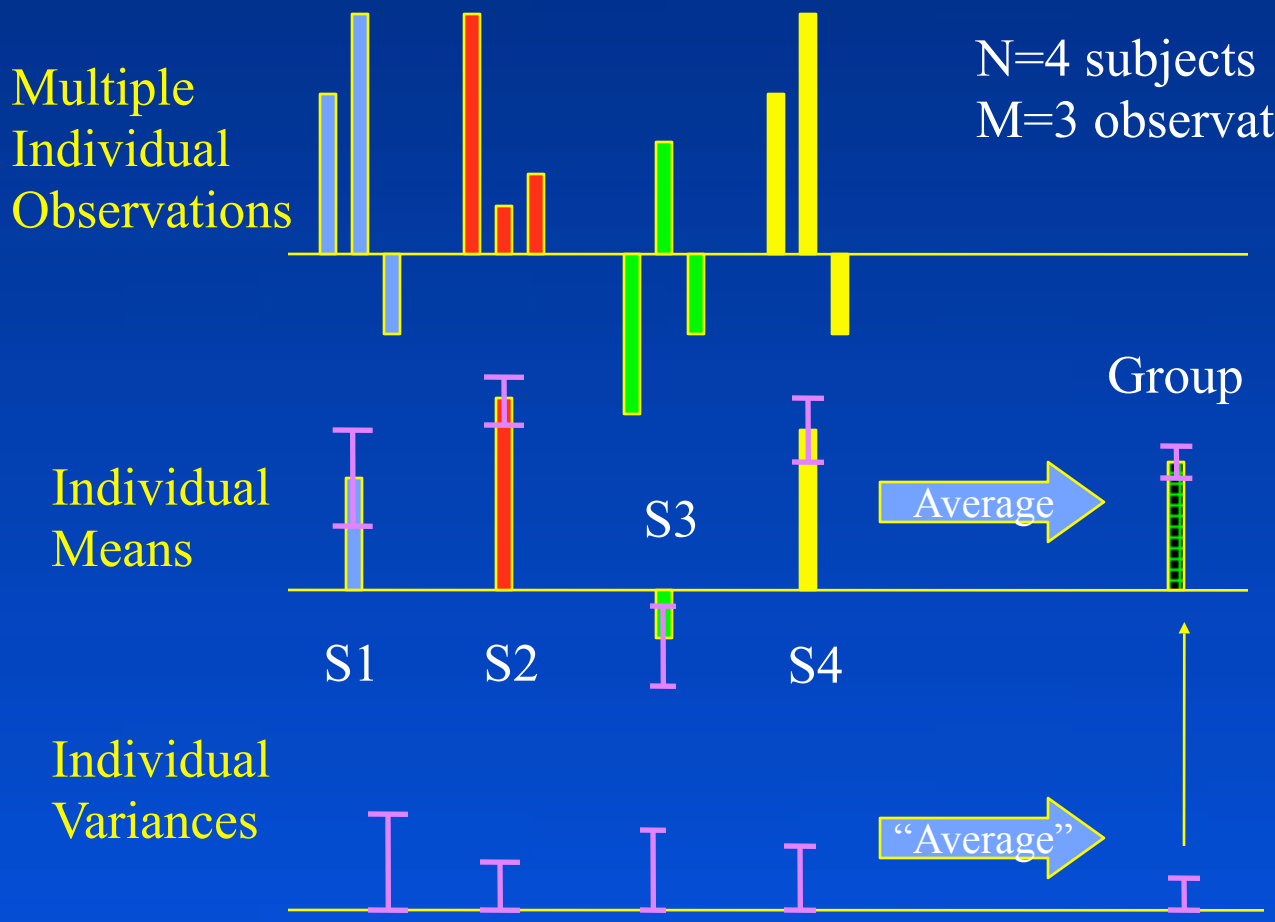
N=4 subjects

Throw away information about within-subject variation.
Ie, pretend within-subject variation = 0.

- DOF = N-1 = 3
- Group average is mean of individual means.
- Group variance is variance across individual means.
- RFx variance is a measure of population variance.
- SE = sqrt(var/N)

FFx

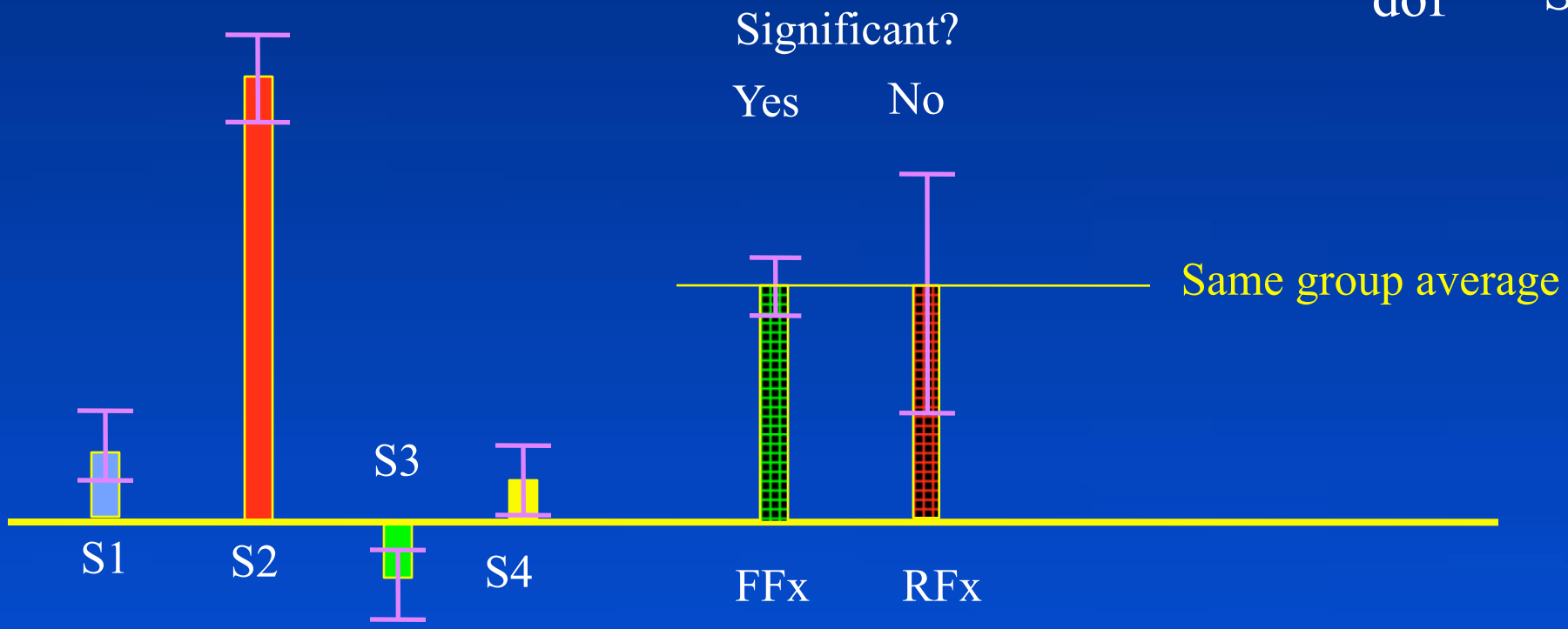
$$t_{dof} = \frac{\text{mean}}{SE}$$



- DOF = N*(M-1)=8
- Group Mean = Mean of Individuals (same as RFx)
- Variance is measure of observation noise (eg, white)
- SE = sqrt((mean var)/(N*M))
- Similar to treating all observations as if they came from the same subject.

FFx vs RFx Inference

$$t_{dof} = \frac{\text{mean}}{SE}$$



- How likely am I to see this effect in one or more of my subjects (ie, a cohort)? Answered by FFx.
- How likely am I to see this effect in the general population? Answered by RFx.

RFx vs FFx

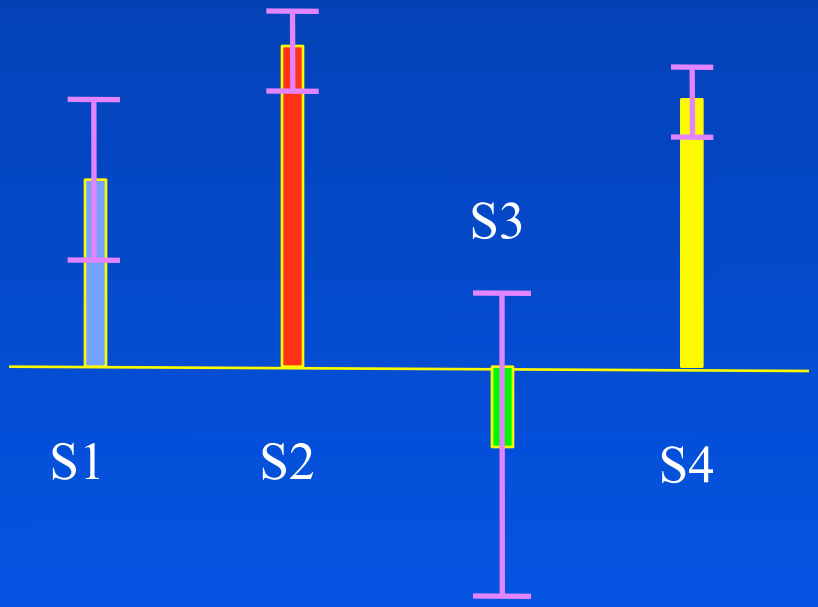
$$t_{dof} = \frac{mean}{SE}$$

	RFx	FFx
Mean	Same	Same
DOF	#Subj (~20)	#Subj*#Obs (~1000)
Power	Weak	Strong
Variance	Population (between-subj)	Observation (within-subj)
Inference	Population	Cohort

RFx - Weighted

- Multiple observations per subject
- Unequal variances

Average = Sum(Wi * Si)
Var = Sum(Wi*(Si-Average))



Weight: Wi = 1/StdDev_i
Normalized: Sum(Weights) = 1

- Same as unweighted when variances are equal
- Same trade-offs as unweighted

Mixed Effects

- Variance computed by RFx is a mixture of within-subject and between-subject variances.
- Use individual variances to help tease apart the within-subject from the between-subject
- Nonlinear
- Fit with Maximum-Likelihood/Bayes