Repeated Measures and Nested factorial designs.

Repeated measures -
- Take observations on same subjects over time.
- Special case of the Nested factorial design.

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Hicks example: paired t-test

Subject	Test: pre	Test: post	diff: post - pre
1	x	x	d_1
2	x	x	
⋮	⋮	⋮	⋮
7	x	x	d_7

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Model

$$Y_{ij} = \mu + S_i + T_j + ST_{ij} \; (+ \epsilon_{(ij)k})$$

since no replications, sometimes ϵ is not in model.

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ANOVA

	Source	df	SS	EMS
Between term	S_i	6	2084.71	$\sigma_\epsilon^2 + 2\sigma_S^2$
Within terms	T_j	1	864.29	$\sigma_\epsilon^2 + \sigma_{ST}^2 + 7\phi_T$
	ST_{ij}	6	37.71	$\sigma_\epsilon^2 + \sigma_{ST}^2$
	$\epsilon_{(ij)k}$	0	...	σ_ϵ^2

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F-test for pre vs. post

$$F = \frac{864.29/1}{37.71/6} = 145$$

This is equivalent to paired t-test & p-values are the same.

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Suppose we ignore Subject in the model.

Layout

Test: pre	Test: post
xxxxxxx	xxxxxxx

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ANOVA for wrong model:

$Y_{ij} = \mu + T_i + \epsilon_{(i)j}$

7 different subjects in each group.

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ANOVA table for wrong model

Source	df	SS
T_i	1	864.29
$\epsilon_{(i)j}$	12	(2084.71
		35.71)
		2120.42

$S_i + ST_{ij}$ in correct Model

$F = \frac{864.29}{2120.42/12} = 4.886$ ↑ larger p-value

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Why did wrong model not give sensitive test?

It did not "control for" Subject to subject variation.

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Why have control groups?

1) If response is a measure of skill, subjects typically can improve on their own.

2) Clinical trials
   i) Placebo effect
   ii) Regression to mean

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Regression to mean:

"Do skittles improve mood?"

Get 100 students, give mood questionaire, pick 10 with worst mood, give these 10 2 bags of skittles & ask one week later their mood score.

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Between Subjects terms in model less sensitive because Subj-Subj variation "large".

Within Subjects terms in model have more sensitive F-tests since error term controls for subj.-subj. variation.

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For design, should I cross Subject with Factor or nest ?

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