Tuesday - Week 7 !

3-way ANOVA.

1 Factor fixed

2 Factors random

All factors crossed, n = 2 obs./cell.

Complete, balanced factorial design.

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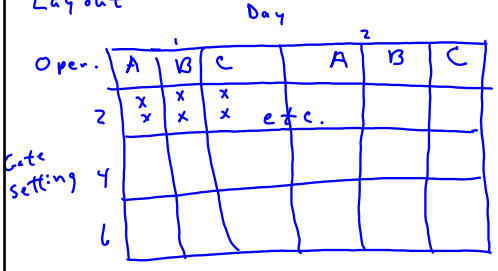
Layout



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Model & Parameters

$$Y_{ijkl} = \mu + D_i + O_j + DO_{ij} + G_k + DG_{ik} + OG_{jk} + DOG_{ijk} + \epsilon_{(ijk)l}$$

$$\sigma_D^2 \quad \sigma_O^2 \quad \sigma_{DO}^2 \quad \phi_G \quad \sigma_{DG}^2 \quad \sigma_{OG}^2 \quad \sigma_{DOG}^2 \quad \sigma_\epsilon^2$$

σ^2, ϕ - Parameters - numerical summaries of population

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Start EMS

	2 R	3 R	3 F	2 K	
D_i	1	3	3	2	
O_j	2	1	3	2	
DO_{ij}	1	1	3	2	
→ G_k	2	3	0	2	$2 \cdot 3 \cdot 2 \cdot \phi_G$
DG_{ik}	1	3	0	2	$1 \cdot 3 \cdot 2 \cdot \sigma_{DG}^2$
OG_{jk}	2	1	0	2	$2 \cdot 1 \cdot 2 \, \sigma_{OG}^2$
DOG_{ijk}	1	1	0	2	$1 \cdot 1 \cdot 2 \, \sigma_{DOG}^2$
$\epsilon_{(ijk)l}$	1	1	1	1	$1 \cdot 1 \cdot 1 \cdot \sigma_\epsilon^2$

$$MS_G \simeq \sigma_\epsilon^2 + 2\sigma_{DOG}^2 + 4\sigma_{OG}^2 + 6\sigma_{DG}^2 + 12\phi_G$$

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2 way ANOVA 1 obs/cell, 3 cases

both fixed

Source	df	EMS
A_i	a-1	$\sigma_\epsilon^2 + b\phi_A$
B_j	b-1	$\sigma_\epsilon^2 + a\phi_B$
AB_{ij}	(a-1)(b-1)	$\sigma_\epsilon^2 + \phi_{AB}$
$\epsilon_{(ijk)l}$	→ 0	σ_ϵ^2

Cannot do "exact" F-test.

" " "correct" "

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To test ϕ_A,

$$F = \frac{MS_A}{MS_{AB}} \sim \frac{\sigma_\epsilon^2 + b\phi_A}{\sigma_\epsilon^2 + \underbrace{\phi_{AB}}_{\geq 0}}$$

really test

$H_0: b\phi_A = (\leq)\ \phi_{AB}$

$H_a: b\phi_A > \phi_{AB} \geq 0$

"Conservative" F test, P-value too large. likely

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For Mixed Model — A fixed, B random

Source	df	EMS
A_i	$a-1$	$\sigma_\epsilon^2 + \sigma_{AB}^2 + b\phi_A$
B_j	$b-1$	$\sigma_\epsilon^2 + a\sigma_B^2$
AB_{ij}	$(a-1)(b-1)$	$\sigma_\epsilon^2 + \sigma_{AB}^2$
$\epsilon_{(ij)k}$	0	σ_ϵ^2

Have exact test for A

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Randomized Complete Block.

5 Hospitals - random

3 Trt's - fixed

30 patients at each hospital randomized to trts.

30 → 10 Trt1, 10 Trt2, 10 Trt3

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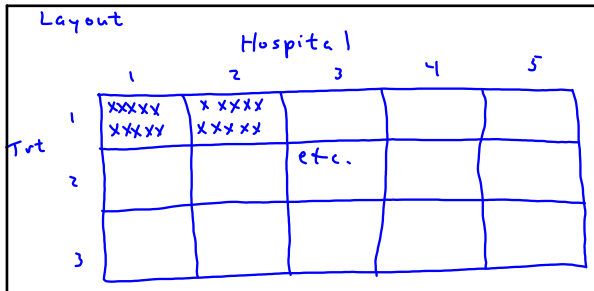
Layout



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Source	df	EMS
H_i	5-1	$\sigma_\epsilon^2 + 30\sigma_H^2$
T_j	3-1	$\sigma_\epsilon^2 + 10\sigma_{HT}^2 + 50\phi_T$
HT_{ij}	(5-1)(3-1)	$\sigma_\epsilon^2 + 10\sigma_{HT}^2$
$\epsilon_{(ij)k}$	5·3(10-1)	σ_ϵ^2

most import. for inference

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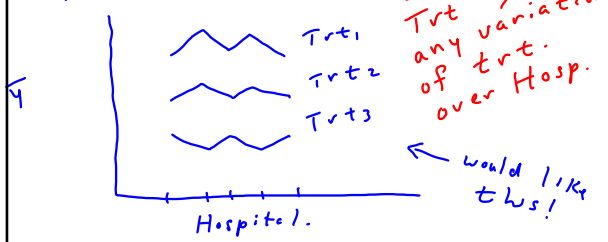
Inference for treatment most important.



Effect of Trt → variation any trt. of trt. over Hosp.

would like this!

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Inference is the effect of Trt. over population of Hospitals.

Q: Can we say which of 5 Hospitals is best?

A: Make Hospital fixed effect!

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Hospitals fixed.

Source	df	EMS	
H_i	4	$\sigma_\epsilon^2 + 30\phi_H$	suppose $p = .001$
T_j	2	$\sigma_\epsilon^2 + 50\phi_T$	
HT_{ij}	8	$\sigma_\epsilon^2 + 10\phi_{HT}$	n.s.
error	9.15	σ_ϵ^2	

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Do range test on Hospital, best $\bar{Y}$ is best Hospital !!!

What is wrong with this ?

Patients not randomized to Hospital.

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Mayo Clinic

Cleveland Clinic

IU Health

⋮

Patient populations not necessarily similar.

Oct 4-4:02 PM

eg.

Mayo clinic may take highest risk patients

Local hospital does not.

Hospital with "least" severe patients in condition may look best !

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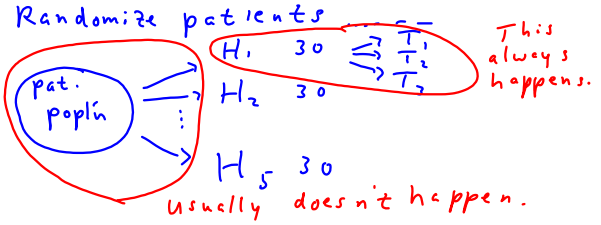
Is there any way to legitimately compare Hospitals?

Randomize patients



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Randomize Complete Block Design

RCBD - Usually multiple runs of same experiment.

Hospital - Block

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