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STAT 407-001

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1A) Two-factor factorial

Factors: house paints and sides of houses

ANOVA	SS	df	MS	F	P
House paints	SSA	3	SSA/3	MSA/MSE	
Sides of houses	SSB	3	SSB/3	MSB/MSE	
Residual/Error	SSE	9	SSE/9		
Total	SST	15	SST/15		

We must also make the assumption of independence of houses so there is no added variability and that there is no interaction term between house paints and sides of house

1B) RCBD

Block by

ANOVA	SS	df	MS	F	P
Drug	SSA	3	SSA/3	MSA/MSE	
Residual	SSE	36	SSE/36		
Total	SST	39	SST/39		

Treatments must be randomized by ordering the volunteers as 1 through 40 and ~~sample~~ sampling in a random order. Then attach a string of drug type (1, 2, 3, 4, 1, 2, 3, 4, ...) to ~~the~~ volunteers

1C) Latin squares design

Block: ~~the~~ rabbits

ANOVA	SS	df	MS	F	P
Sites	SSA	4	SSA/4	MSA/MSE	
Rabbits	SSB	4	SSB/4	MSB/MSE	
Residual	SSE	16	SSE/16		
Total	SST	24	SST/24		

This is a good design for this study because we have $p=5$ rabbits, $p=5$ sites, and $p^2=25$ total sites. There are not enough rabbits to do every possible permutation of site order for a full design

$$2A) Y_{ijk} = \mu + \tau_i + \beta_j + (\tau\beta)_{ij} + \epsilon_{ijk} \quad (i=1,2; j=1,2,3; k=1,2,3)$$

Y_{ijk} : response variable

μ : intercept term

τ_i : culture media

β_j : times of growth of virus

$(\tau\beta)_{ij}$: interaction term

ϵ_{ijk} : error/residual

We are assuming normality, ~~homoscedastic~~ equal variance, and that the data are random.

2B) ANOVA

	df	SS	MS	F	p
Media	1	8.9	8.9	0.3691	
Time	2	230.4	115.2	0.8711	
Media*Time	2	79.1	39.55		
Error	12	122.6	10.22		

3b

3a

2b

$$2c) \bar{y}_1 - \bar{y}_2 \pm t_{0.025, 12} \sqrt{MSE \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}$$

$$13.3 - 23.8 \pm 2.179 \sqrt{10.22 \left(\frac{1}{9} + \frac{1}{9} \right)}$$

$$-10.5 \pm 2.179 \sqrt{\frac{20.44}{3}}$$

$$-10.5 \pm 2.179$$

3c) I do not believe the interaction effect is significant in this model.

3d) $H_0: \sigma_1 = \sigma_2 = \dots = \sigma_b$ (H_A : at least one σ_i is diff.)

3e) From the output of the Levene's test (rejecting the null hypothesis), we can see that this is not an adequate model, as the equal variance assumption is violated. We also see variation in the residual plots and specifically a megaphone effect in the residuals vs. predicted plot.

$$\begin{array}{r} 3955 \\ 2 \overline{) 79.1} \\ \underline{6} \\ 19 \\ \underline{18} \\ 11 \end{array}$$

$$\begin{array}{r} 102 \\ 12 \overline{) 122.6} \\ \underline{24} \end{array}$$

$$\begin{array}{r} 114 \\ 89 \overline{) 102.6666} \\ \underline{89} \\ 136 \\ \underline{131} \\ 56 \\ \underline{56} \\ 0 \end{array}$$

$$\bar{y}_1 - \bar{y}_2$$

$$13.3 - 23.8$$

$$-10.5 \pm t_{0.025, 9}$$

$$\sqrt{F_{MSE} \left(\frac{1}{9} + \frac{1}{1} \right)}$$

$$\begin{array}{r} 89 \\ 445 \overline{) 399} \\ \underline{356} \\ 43 \end{array}$$

$$\begin{array}{r} 23.8 \\ 13.3 \\ 10.5 \end{array}$$

$$20.44$$

$$\begin{array}{r} 399 \\ 445 \overline{) 399} \\ \underline{399} \\ 0 \end{array}$$