

Rrt (b) of take-home

Stat 225
3-1-18

①

$$\begin{bmatrix} .8 \\ .81 \\ .75 \\ .77 \\ .78 \\ .85 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 & -1 & -1 & -1 & -1 & -1 \end{bmatrix} \begin{bmatrix} \mu \\ \tau_1 \\ \tau_2 \\ \tau_3 \\ \tau_4 \\ \beta_1 \\ \vdots \\ \beta_5 \end{bmatrix} + \vec{\epsilon}$$

Run as a regression & find SSE & dfe

Re run without the columns corresponding to the τ_i 's & find SSE & dfe.

②

$$F = \frac{\frac{SSE_{\text{red}} - SSE_{\text{full}}}{dfe_{\text{red}} - dfe_{\text{full}}}}{MSE_{\text{full}}}$$

Group project: Construct a 3^{5-2} design

Tasks: ① Find all generators

② Aliases up to 2-way

③ Summary ANOVA

④ Find the 27 runs

$$\begin{aligned} I &= ABCD \\ &= BCDE \end{aligned}$$

Generators:

(3)

$$I = ABCD = BCD\theta = A^2 B^2 C^2 D^2 = B^2 C^2 D^2 E^2 \\ = A^2 B^2 C^2 D^2 E = A^2 BCD E^2 = AE^2 = A^2 E \quad (\text{Res II})$$

Relations

$$A = A^2 = E^2 = E = A^2 E^2 = AE$$

$$B = B^2$$

$$C = C^2$$

$$D = D^2$$

$$AB = CD = C^2 D^2 = A^2 B^2 = BE = B^2 E^2$$

$$AB^2 = A^2 B = B^2 E = BE^2$$

$$AC = A^2 C^2 = BD = B^2 D^2 = CE = C^2 E^2$$

$$AC^2 = A^2 C = CE^2 = C^2 E$$

$$AD = A^2 D^2 = BC = B^2 C^2 = DE = D^2 E^2$$

$$AD^2 = A^2 D = DE^2 = D^2 E$$

$$BC^2 = B^2 C$$

$$BD^2 = B^2 D$$

$$CD^2 = C^2 D$$

(4)

	Source	df
	A	2
	B	2
	C	2
	D	2
AB	AB	2
	AB^2	2
AC	AC	2
	AC^2	2
AD	AD	2
	AD^2	2
	BC	2
	BD	2
	CD	2
	Total	26

A	B	C	$D = ABC$	$E = A$	terms
0	0	0	0	0	(1)
1	0	0	1	1	a^2de
2	0	0	2	2	a^2de^2
0	1	0	1	0	b^2d
1	1	0	2	1	ab^2de
2	1	0	0	2	$a^2b^2de^2$
0	2	0	2	0	b^2d^2
1	2	0	0	1	ab^2e
2	2	0	1	2	$a^2b^2de^2$
0	0	1	1	0	cd
1	0	1	2	1	ab^2cd
2	0	1	0	2	a^2cd^2
0	1	1	2	0	bcd^2
1	1	1	0	1	ab^2cd
2	1	1	1	2	a^2bcd^2
0	2	1	0	0	b^2d
1	2	1	1	1	ab^2cde
2	2	1	2	2	$a^2b^2cde^2$
0	0	2	2	0	c^2d^2
1	0	2	0	1	a^2c^2e
2	0	2	1	2	$a^2c^2de^2$
0	1	2	0	0	bcd^2
1	1	2	1	1	ab^2cde
2	1	2	2	2	$a^2b^2cde^2$
0	2	2	1	0	b^2c^2d
1	2	2	2	1	ab^2c^2de
2	2	2	0	2	$a^2b^2c^2de^2$

$$L_1 = x_1 + x_2 + x_3 \quad (3)$$

$$L_2 = x_1 \quad (3)$$

(5)

HW #6

due 3/8/18

p. 229 #31a

p. 296 #21a

p. 319 #21

5.31. An article in *Quality Progress* (May 2011, pp. 42–48) describes the use of factorial experiments to improve a silver powder production process. This product is used in conductive pastes to manufacture a wide variety of products ranging from silicon wafers to elastic membrane switches. Powder density (g/cm^3) and surface area (cm^2/g) are the two critical characteristics of this product. The experiments involved three factors—reaction temperature, ammonium percent, and stirring rate. Each of these factors had two levels and the design was replicated twice. The design is shown below.

Ammonium (%)	Stir Rate (RPM)	Temperature (°C)	Density	Surface Area
2	100	8	14.68	0.40
2	100	8	15.18	0.43
30	100	8	15.12	0.42
30	100	8	17.48	0.41
2	150	8	7.54	0.69
2	150	8	6.66	0.67
30	150	8	12.46	0.52
30	150	8	12.62	0.36
2	100	40	10.95	0.58
2	100	40	17.68	0.43
30	100	40	12.65	0.57
30	100	40	15.96	0.54
2	150	40	8.03	0.68
2	150	40	8.84	0.75
30	150	40	14.96	0.41
30	150	40	14.96	0.41

- (a) Analyze the density response. Are any interactions significant? Draw appropriate conclusions about the effects of the significant factors on the response.

6.21. I am always interested in improving my golf scores. Since a typical golfer uses the putter for about 35–45 percent of his or her strokes, it seems reasonable that improving one's putting is a logical and perhaps simple way to improve a golf score ("The man who can putt is a match for any man."—Willie Parks, 1864–1925, two time winner of the British Open). An experiment was conducted to study the effects of

four factors on putting accuracy. The design factors are length of putt, type of putter, breaking putt versus straight putt, and level versus downhill putt. The response variable is distance from the ball to the center of the cup after the ball comes to rest. One golfer performs the experiment, a 2^4 factorial design with seven replicates was used, and all putts are made in random order. The results are shown in Table P6.4.

■ TABLE P6.4

The Putting Experiment from Problem 6.21

Design Factors				Distance from Cup (replicates)						
Length of putt (ft)	Type of putter	Break of putt	Slope of putt	1	2	3	4	5	6	7
10	Mallet	Straight	Level	10.0	18.0	14.0	12.5	19.0	16.0	18.5
30	Mallet	Straight	Level	0.0	16.5	4.5	17.5	20.5	17.5	33.0
10	Cavity back	Straight	Level	4.0	6.0	1.0	14.5	12.0	14.0	5.0
30	Cavity back	Straight	Level	0.0	10.0	34.0	11.0	25.5	21.5	0.0
10	Mallet	Breaking	Level	0.0	0.0	18.5	19.5	16.0	15.0	11.0
30	Mallet	Breaking	Level	5.0	20.5	18.0	20.0	29.5	19.0	10.0
10	Cavity back	Breaking	Level	6.5	18.5	7.5	6.0	0.0	10.0	0.0
30	Cavity back	Breaking	Level	16.5	4.5	0.0	23.5	8.0	8.0	8.0
10	Mallet	Straight	Downhill	4.5	18.0	14.5	10.0	0.0	17.5	6.0
30	Mallet	Straight	Downhill	19.5	18.0	16.0	5.5	10.0	7.0	36.0
10	Cavity back	Straight	Downhill	15.0	16.0	8.5	0.0	0.5	9.0	3.0
30	Cavity back	Straight	Downhill	41.5	39.0	6.5	3.5	7.0	8.5	36.0
10	Mallet	Breaking	Downhill	8.0	4.5	6.5	10.0	13.0	41.0	14.0
30	Mallet	Breaking	Downhill	21.5	10.5	6.5	0.0	15.5	24.0	16.0
10	Cavity back	Breaking	Downhill	0.0	0.0	0.0	4.5	1.0	4.0	6.5
30	Cavity back	Breaking	Downhill	18.0	5.0	7.0	10.0	32.5	18.5	8.0

- (a) Analyze the data from this experiment. Which factors significantly affect putting performance?

7.21. Consider the 2^6 design in eight blocks of eight runs each with $ABCD$, ACE , and $ABEF$ as the independent effects chosen to be confounded with blocks. Generate the design. Find the other effects confounded with blocks.