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Section 1

MANE 6313

Subsection 1

Week 11, Module G

Student Learning Outcome

- Select an appropriate experimental design with one or more factors,
- Select an appropriate model with one or more factors,
- Evaluate statistical analyses of experimental designs,
- Assess the model adequacy of any experimental design, and
- Interpret model results.

Module Learning Outcome

Describe Plackett-Burman Designs.

K factors
N - # of runs

Saturated Designs

- **Saturated design** is a resolution III design for investigating up to $k = N - 1$ factors in only N runs, where N is a multiple of 4
- Examples of saturated include designs for 4 runs for up to 3 factors, 8 runs for up to 7 factors, 16 runs for up to 15 factors, etc.

Supersatured Designs

- **Supersatured designs** are designs in which the number of variables $k > N - 1$ is greater than the number of runs minus 1
- Concept was introduced by Satterthwaite in 1959
- More details are found in section 8.8

Regular vs. Nonregular Designs

- A **regular design** is one which all of the effects can be estimated independently of the other effects, and in the case of a fractional factorial, the effects that cannot be estimated are completely aliased with other effects
- **Nonregular designs** are designs in which effect estimates are partially aliased with other effects ½ B or ⅓ G
- Nonregular designs are much more difficult to analyze

Geometric vs. Nongeometric Designs

- **Geometric designs** are designs that can be represented as cubes
- **Nongeometric designs** are designs that cannot be represented as cubes

Plackett-Burman Designs

saturated

- Two-level fractional factorial design for studying up to $k = N - 1$ variables in N runs were N is a multiple of 4
- If N is a power of 2, these designs are identical to resolution III fractional factorial designs
- For $N = 12, 20, 24, 28, 36$, these designs are often of interest
- Plackett-Burman designs may be nonregular and nongeometric
  - Nonregular and nongeometric designs have very complicated aliasing schemes and may not project well (cannot fold-over)

Plackett-Burman Designs in R

- Gromping provides the following table of Plackett-Burman designs

Runs	Original Plackett and Burman	Construction	Max. no. of factors without complete or heavy partial aliasing with any 2fi	Max. no. of factors with (almost) resolution IV	
				default	with `oldver = TRUE`
8	yes	cycling	4	4	
12	yes	cycling	11		
16	no	Hadamard[(a)]	14	(*)	
20	yes	cycling	19		
24	yes	cycling	23		
28	yes	cycling	27		
32	no	cycling[(b)]	31	(*)	
36	yes	cycling	35		
40	yes	doubling	38	19	20
44	yes	cycling	43		
48	yes	cycling	47		
52	yes	cycling blocks	50	(25)	
56	yes	doubling	54	27	28
60	yes	cycling	59		
64	no	doubling	62	31	32
68	yes	cycling	67		
72	yes	cycling	71		
76	yes	cycling blocks	74	(37)	
80	yes	cycling	79		
84	yes	cycling	83		
88	yes	doubling	86	43	44
92	no	Williamson[(c)]	90		
96	yes	doubling	94	47	48
100	yes	cycling blocks	98	(49)	

(*) For $n/2$ factors or less, the regular design from function `FrF2` should be used.
(a) see Box and Tyssedal (2001)

Problem 8.38 (Textbook 9th edition)

- Problem 8.38 utilize a Plackett-Burman design for 19 factors requiring 20 runs
- Your instructor could not get the pb function within FrF2 to produce any Plackett-Burman designs greater than 16 runs
- Therefore, this problem cannot be analyzed