9^{th} practice sheet Experimental Design

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29. Recall the one-eighth 2^{6-3}_{III} fraction from the lecture

$$I = +ABC = +CDE = +ABDE = -ADF = -BCDF = -ACEF = -BEF$$

We may „double“ this fraction once with

$$I = -ABC = -CDE = +ABDE = +ADF = -BCDF = -ACEF = +BEF$$

to get the regular quarter 2^{6-2}_{IV} fraction I = +ABDE = −BCDF = −ACEF which is doubled a second time with I = −ABDE = −BCDF = +ACEF. The result is the half 2^{6-1}_{IV} fraction I = −BCDF.

Is it possible to double this plan differently, or begin with a different 2^{6-3}_{III} fraction, so that a 2^{6-1} fraction of greater resolution results from two doublings?

30. Leal-Sanchez, Jimenez-Diaz, Maldonado-Barragan, Garrido-Fernandez, and Ruiz-Barba (2002) conducted experiments for the purpose of optimizing the production of bacteriocin from bacteria in controlled laboratory cultures. Bacteriocin is a natural food preservative that can potentially be useful in canned foods. The five factors with two levels each studied in one experiment were the amount of of glucose, initial inoculum size, aeration, temperature, and sodium.

For each of eight selected combinations of the factor levels, an experimental trial was performed in which the bioreaction was allowed to take place under standardized conditions. For each trial, the responses collected were the maximum bacteriocin activity detected, expressed in units of log10 AU/ml, for each of two bacteria strains (A and B).

The experimental design used was a 2^{5-2} single-replicate, regular fractional factorial plan, listed in coded factors along with the responses for each run in the following table:

coded factors					responses	
glucose	inoculum size	aeration	temperature	sodium	strain A	strain B
−	−	−	+	+	0.00	2.44
+	−	−	−	+	2.90	5.05
−	+	−	+	−	2.44	4.10
+	+	−	−	−	3.35	7.03
−	−	+	−	−	3.35	5.28
+	−	+	+	−	2.14	3.95
−	+	+	−	+	2.60	4.82
+	+	+	+	+	1.30	2.74

(a) Determine the generating relation for the design used.

(b) Determine the estimable strings (including all factorial effects) for the experiment. Tentatively assuming that all interactions are absent, compute estimates of the five strings that include main effects, for each of the two responses (strains). Which (if any) of these effect strings are significant? (Use 2-degree-of-freedom t-statistics to answer this).

(c) Based on your analysis in part (b), what 2^{5-2} fraction would you recommend to Leal-Sanchez et al. for the next stage of their investigation?

31. In subsection 13.7.2, we discussed two forms of fold-over designs. In one, the initial runs are augmented by a new set in which only the sign of one factor is reversed; the main effect associated with the selected factor is then aliased with interactions of order at least 4. In the other, the signs of all factors are reversed in the second set of runs; every main effect is then aliased with interactions of order at least 3.

    If the signs of *two* ($< f$) factors, say A and B, are reversed in the second set of runs, what can be said about the resulting aliases of the the two corresponding main effects?

32. For each of the following, write a generating relation for a fractional factorial design of resolution III, for which the main effect for factor A is not confounded with 2- or 3-factor interactions.

    (a) 2^{4-1}

    (b) 2^{6-2}

    (c) 2^{8-3}