Exercise No. 2

Analysis of 2ˆk Factorial Experiment

1. An experiment was run in a semiconductor fabrication plant in an effort to increase yield. Five factors, each at two levels, were studied. The factors (and levels) were A = aperture setting (small, large), B = exposure time (20% below nominal, 20% above nominal), C = development time (30 and 45 s), D = mask dimension (small, large), and E = etch time (14.5 and 15.5 min). The unreplicated 2^5 design shown below was run.

   a. Compute the effect estimates and draw a Daniel plot to determine which of these effects are negligible and can be combined to form the MSE.

   b. Based on your answer in (a), generate the ANOVA table. Interpret the results.

$(1) = 7$	$d = 8$	$e = 8$	$de = 6$
$a = 9$	$ad = 10$	$ae = 12$	$ade = 10$
$b = 34$	$bd = 32$	$be = 35$	$bde = 30$
$ab = 55$	$abd = 50$	$abe = 52$	$abde = 53$
$c = 16$	$cd = 18$	$ce = 15$	$cde = 15$
$ac = 20$	$acd = 21$	$ace = 22$	$acde = 20$
$bc = 40$	$bcd = 44$	$bce = 45$	$bcde = 41$
$abc = 60$	$abcd = 61$	$abce = 65$	$abcde = 63$

2. An experiment was performed to improve the yield of a chemical process. Four factors were selected.

   a. Construct a design with two blocks of eight observations each with ABCD confounded.

   b. Analyze the data given below.

(1)	90	*d*	98
a	74	*ad*	72
b	81	*bd*	87
ab	83	*abd*	85
c	77	*cd*	99
ac	81	*acd*	79
bc	88	*bcd*	87
abc	73	*abcd*	80

3. Consider the data from a 2^4 design. The four factors are D = the amount of dung, N = amount of Nitrogen, P = Phosphorous, and K = Potassium. The 16 treatments are assigned to two blocks of size 8 each. The experiment was run in two replicates. The data is shown below.

   a. Which effect is confounded with blocks?

   b. Analyze the data and draw conclusions.

Rep. I

p	*k*	*d*	*npk*
45	55	53	36
dnk	*dnp*	*dpk*	*n*
41	48	55	42

dp	*nk*	*dk*	*pk*
50	44	43	51
dnpk	(1)	*dn*	*np*
44	58	41	50

Rep. II

npk	*d*	*p*	*dnk*
43	42	39	34
n	*dnp*	*k*	*dpk*
47	52	50	44

nk	*dp*	(1)	*np*
43	52	57	39
pk	*dk*	*dnpk*	*dn*
56	52	54	42