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Courses » Design and Analysis of Experiments

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## Unit 9 - Week 8

### Course outline

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Feedback for week 8

Lecture 41:  $2^k$  Factorial Design: Issues with Coded Design Variables

Lecture 42: Blocking and Confounding in  $2^k$  Factorial Design

Lecture 43: Blocking and Confounding in  $2^k$  Factorial Design (Contd.)

Lecture 44: Blocking and Confounding in  $2^k$  Factorial Design (Contd.)

Quiz : Week\_8\_Assignment\_8

Week 9

### Week\_8\_Assignment\_8

The due date for submitting this assignment has passed. **Due on 2018-03-21, 23:59 IST.**

#### Submitted assignment

Questions 1- 5 are based on the following case:

Four experimental trials can be made from a single batch of raw material. Therefore, three batches of raw material will be required to run all three replicates of this design. The Table given below shows the design, where each batch of raw material corresponds to a block. (use  $\alpha = 0.05$ )

#### Chemical Process Experiment in Three Blocks

	Block 1	Block 2	Block 3
	(1) = 28	(1) = 25	(1) = 27
	$a = 36$	$a = 32$	$a = 32$
	$b = 18$	$b = 19$	$b = 23$
	$ab = 31$	$ab = 30$	$ab = 29$
Block totals:	$B_1 = 113$	$B_2 = 106$	$B_3 = 111$

1) The sum of squares of the blocks is:

2 points

- 6.50  
 9.95  
 5.59  
 10.25

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

6.50

2) The mean square of concentration (A) is:

2 points

- 210.22  
 205.55  
 203.74  
 208.33

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

208.33

3) The mean square of error is:

2 points

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- 6.58
- 5.86
- 4.14
- 9.66

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

4.14

4) The p-value for AB is:

2 points

- 0.206
- 0.001
- 0.010
- None of these.

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

0.206

5) The significant effects are:

2 points

- (A, B)
- (A, AB)
- (A, B, AB)
- (B and AB)

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

(A, B)

**Questions 6-10 are based on the following case:**

A  $2^3$  factorial design was used to develop a nitride etch process on a single-wafer plasma etching tool. The design factors are the gap between the electrodes, the gas flow, and the RF power applied to the cathode. Each factor is run at two levels, and the design is replicated twice. The response variable is the etch rate ( $\text{\AA}/\text{m}$ ). Suppose that only four treatment combinations can be tested during a shift, and because there could be shift-to-shift differences in etching tool performance, the experimenters decide to use shifts as a blocking factor. Thus, each replicate of the  $2^3$  design must be run in two blocks. Two replicates are run, with ABC confounded in replicate I and AB confounded in replicate II.

Run	Coded Factors			Etch Rate		Total
	A	B	C	Replicate 1	Replicate 2	
1	-1	-1	-1	550	604	(1) = 1154
2	1	-1	-1	669	650	a = 1319
3	-1	1	-1	633	601	b = 1234
4	1	1	-1	642	635	ab = 1277
5	-1	-1	1	1037	1052	c = 2089
6	1	-1	1	749	868	ac = 1617
7	-1	1	1	1075	1063	bc = 2138
8	1	1	1	729	860	abc = 1589

  

Replicate I ABC Confounded		Replicate II AB Confounded	
(1) = 550	a = 669	(1) = 604	a = 650
ab = 642	b = 633	c = 1052	b = 601
ac = 749	c = 1037	ab = 635	ac = 868
bc = 1075	abc = 729	abc = 860	bc = 1063

6) The sum of square for the replicates is:

2 points

- 3875.06  
 3785.06  
 8375.06  
 3857.06

No, the answer is incorrect.

Score: 0

Accepted Answers:

3875.06

7) The degrees of freedom of error is:

2 points

- 5  
 7  
 9  
 None of these

No, the answer is incorrect.

Score: 0

Accepted Answers:

5

8) The sum of squares of BC is:

2 points

- 18.06  
 20.06  
 21.06  
 23.06

No, the answer is incorrect.

Score: 0

Accepted Answers:

18.06

9) The mean square of ABC is:

2 points

- 6.12  
 7.89  
 8.79  
 9.55

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

6.12

10) The significant main effects are:

2 points

- A, C
- B, C
- A, B
- A, B, and C

**No, the answer is incorrect.**

**Score: 0**

**Accepted Answers:**

A, C

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