



[Visit Suncam.com for more courses](http://www.suncam.com)

Continuing Education Course #285
What Every Engineer Should Know About
The Design and Analysis of Engineering Experiments II

1. How do we estimate a missing value in an experiment?
 - a. We estimate the mean value by computing the mean of all the observations and subtract from that the number of data points
 - b. We develop an error function then optimize the function with respect to the variable representing the missing value
 - c. We assume the missing value occurred at random and we ignore it.
 - d. None of the above.
2. When we have p missing values out of n data points, we can recover the missing values by doing the following;
 - a. Develop p error functions and optimizing them with respect to the missing values
 - b. Develop error functions less than the number of missing values p and optimize.
 - c. Develop an error function and optimize it by taking partials with respect to each variable representing each missing value and solve the resulting equations
3. On the ANOVA table for missing values, the total degrees of freedom for p missing values out of n data points is:
 - a. $n-p$
 - b. $(n-1)-p$
 - c. $n-2$.
 - d. p
4. Which of the following is true of the Youden Square?
 - a. When the conditions of a Latin Square are met but more than four treatments levels are available per block then we have a Youden Square.
 - b. By definition a Youden Square is an incomplete Latin Square
 - c. When the conditions of a Latin Square are met but only three treatments levels can be applied per block then we have a Youden Square
 - d. b and c
 - e. All of the above
5. Similar to the regular ANOVA table, in the ANOVA table for the Youden Square, all the effects or terms in the ANOVA Table can be tested for significance all at the same time
 - a. True
 - b. False
6. Which of the following is true of Factorial Experiments?
 - a. In a factorial experiment all levels of a given factor are combined with all levels of every other factor in the experiment.
 - b. By factorial design we mean that for each complete trial or realization of the experiment all possible levels of the factors are run and data obtained.

c. The factors in a factorial experiment may have possible functional relationship that defines their behavior relative to the response variable.

d. All of the above

7. Which of the following is (are) the benefits of factorial Design

a. a and b

Questions 8-10

A Factorial Design has Factor A (3 levels), factor B (3 levels), and factor C(4 levels), without replication.

8. A Factorial Design has Factor A (3 levels), factor B (3 levels), and factor C(4 levels), without replication The size of this experiment (total number of data points) is:

a. 36

b. 18

c. 24

d. 9

9. A Factorial Design has Factor A (3 levels), factor B (3 levels), and factor C(4 levels), without replication. The degrees of freedom (df) for Factor A is? while the total degree of freedom (df total) is?

a. df A=2, while df total =24

b. df A= 3, while df total=18

c. df A=1, while df total=9

d. df A=2, while df total=35

10. A Factorial Design has Factor A (3 levels), factor B (3 levels), and factor C (4 levels), without replication. Since there is no replication in this design, the highest-level interaction (ABC in this case) has the same effect as the error term. As a result, their effects are distinguishable.

a. True

b. False

11. A Factorial Design has three factors with three replications per observation. Factor A (3 levels), Factor B (2 levels), and factor C (4 levels) with two (2) replications per data point What is the degree of freedom for the AC interaction?

a. 2

b. 6

c. 3

d. None of the above

12. A Factorial Design has three factors with three replications per observation. Factor A (3 levels), Factor B (2 levels), and factor C (4 levels) with two (2) replications per data point What is the degree of freedom for the ABC interaction?

a. 2

b. 6

c. 12

d. 7

e. None of the above

13. What is the df for the error term

a. 46

b. 47

c. 24

d. None of the above

14. For 2^f factorial, the effect $A_0B_0C_1$ represents what data point?

- a. c
- b. abc
- c. ab
- d. ac

15. For 2^f factorial, the effect $A_1B_0C_1$ represents what data point?

- a. abc
- b. c
- c. ab
- d. ac

16. For a YATES scheme for 2^f design, the number of columns generated by the YATES operations (excluding the column for the divisor and sum of squares-SS) is;

- a. $f+2$.
- b. f
- c. both a and b
- d. None of the above

17. For YATES Scheme for 3^f , $f=3$, $r=3$ with factors A, B, C. What treatment combination is represented by the point or position: 101?

- a. $a_1b_1c_1$
- b. ab_1c_1
- c. a_1c_1
- d. None of the above

18. For YATES Scheme for 3^f , $f=3$, $r=3$ with factors A, B, C. What is the divisor for the effect $A_2B_1C_2$?

- a. 216
- b. 91
- c. 77
- d. 13

19. What is interaction among factors in an experiment?

- a. When the difference in the response between the levels of a one factor is not the same at all levels of the other factors, we have interaction
- b. If a change in a factor (A) produces the same change in the response variable (Y) at one level of another factor (B) than at other levels of factor (B) we have interaction.
- c. Both a and b

20. Which of the following about confounding is true?

- a. Usually the highest level interaction or any interaction whose effect is considered not significant is confounded for the sake of obtaining the true functional relationship among the factors and the response.
- b. Confounding is carried out in blocks.
- c. The sum of squares for the effect or interaction confounded is exactly equal to the sum of squares of the blocks.
- d. All of the a, b, and c

21. Confounding is the process by which unimportant comparisons or interactions are deliberately confused with blocks for the purpose of assessing the more important comparisons with greater precision.

- a. True
- b. False

22. Which of the following statements about confounding is correct?

- a. Confounding is required in factorial experiments in which the number of observations capable of being carried out under strictly comparable conditions is more than the number required for the design.
- b. Any main effect or interaction effect can be confounded with blocks
- c. None of the above

23. For the Kempthorne equation approach to confounding, the number of contrasts in the defining scheme determines the number of Kempthorne equations required. If there are three Kempthorne equations specified for a 2^5 design, how many blocks will be generated and how many elements per block?

- a. 5 blocks with 4 elements per block
- b. 3 blocks with 9 elements per block
- c. 8 blocks with 4 elements per block
- d. None of the above

24. Which of the following is true of fractional factorial designs?

- a. In fractional factorial designs, while we still use confounding to determine which treatment combinations (interactions) are confused with the block, only a fraction of the experiment can be run.
- b. In fractional design we run the total experimental replications regardless of the number of replications required so long as we have a good design.
- c. In fractional factorial designs any confounding scheme consisting of any main effects or interactions may be used.
- d. All of the above

25. For a 2^f fractional design, the factors are A, B, C, D, and E. One of the defining contrasts is ABCD. What are the aliases of AB and BC after proper reduction simplification?

Recall for example: $AB(AB^2C^2) = A^2B^3C^2 = B$, and $A^2B^2C^2(A^3B^2C) = A^5B^4C^3 = AC$

- a. For $AB(ABCD) = A^2B^2CD$, for $BC = AB^2C^2D$
- b. For $AB = AB^2CD$, for $BC = AB^2CD$
- c. For $AB = CD$, for $BC = AD$
- d. None of the above

26. For a 3^f fractional design, the factors are A, B, C, D. One of the defining contrasts is (ABD^2) . What are the aliases of factor A after proper reduction? Note that there are two aliases of factor A, expressed as

$A(ABD^2)$ and $A(ABD^2)^2$

Recall for example for 3^f , $A(AB^2C^2D)$ has two components

1. $A(AB^2C^2D) = A^2B^2C^2D = A^4B^4C^4D^2 = ABCD^2$
 2. $A(AB^2C^2D)^2 = A(A^2B^4C^4D^2) = A^3B^4C^4D^2 = BCD^2$
- a. BC, CD
 - b. AB^2D , BD^2
 - c. ABC, BCD
 - d. None of the above

27. Which of the following is true about Random and Fixed Effects Models?

- a. In the planning stages of an experiment, the engineer must decide whether the levels of the factors are to be set at fixed levels or chosen at random from many possible levels.
- b. Realistically most models are random because even when all the factors have fixed levels. The error term is always considered as random, independent and identically distributed
- c. In the case of temperature or pressure, it is usually desirable to pick random levels since not all possible levels

are practical in a given experiment

- d. All of the above

28. Which of the following is true about the coefficient of determination R^2 ?

- a. The value of R^2 is an indication of how well the variability in the data has been explained by the model
- b. R^2 varies between zero and 1, the higher the value R^2 the better the fit
- c. A high value of R^2 is a good indicator that the model used to fit the data is adequate or reasonably so.
- d. All of the above are true

29. In nested Design, the Expected Mean Square (EMS) determines how best to pool the variance in performing the test of significance.

- a. True
- b. False

30. In Regression analysis, the matrix (X-transpose-X matrix) resulting from the system of normal equations is;

- a. A symmetric matrix
- b. A square matrix
- c. Is always invertible
- d. a and b
- e. All of the above

[Purchase this course on Suncam.com](http://Suncam.com)