

Design and Analysis of Experiments – Quiz 2

- 1) What is the name of a design of experiments in which all levels of a given factor are combined with all levels of every other factor in the experiment (all possible combinations of the levels of the factors are investigated).
- 2) Name of a design of experiments in which two levels are applied for each factor.
- 3) A design of experiments that requires the smallest number of runs for studying the effects of k factors.
- 4) The difference in response between the levels of one factor is not the same at all levels of the other factors (e.g. the effect of factor A depends on the level of factor B). What is the name of this phenomenon?
- 5) A multifactor design of experiments in which the levels of one factor (e.g. factor B) are similar but not identical for different levels of another factor (the levels of one factor are sub-samples of levels of another factor).
- 6) A design in which three factors are under study and each factor is applied at three levels.
- 7) A design of experiments model where all factors are run at fixed (as opposed to random) levels and where it is valid to make conclusions about the levels tested.
- 8) Sum of Squares of factor A in a two-factor (A and B), two levels factorial design with n replicates.
- 9) Sum of Squares of the error term of a two-factor (A and B), two levels factorial design with n replicates.
- 10) The Mean Square of factor B in a two-factor (A and B), two levels factorial design with n replicates.
- 11) The Degrees of Freedom for the interaction factor in a two-factor (A and B), two levels factorial design with n replicates.
- 12) The Mean Square for the Error term in a two-factor (A and B), two levels factorial design with n replicates.
- 13) The F-ratio for the A factor in a two-factor (A and B), two levels factorial design with n replicates.
- 14) A design of experiment model used in screening experiments in which many factors are considered with the purpose of identifying those factors that have large effects and in which it is assumed that certain high-order interactions are negligible.
- 15) How many factors has a 2^{7-3} fractional factorial design?

16) How many runs has a 2^{8-3} fractional factorial design?

A Factorial Design of Experiments is performed with two factors A and B each run at two levels “High” and “Low”. The experiment is replicated three times (n=3). The data are shown below:

Treatment Combination	Replicates			
	I	II	III	Total
A Low and B Low	29	26	27	82
A High and B Low	34	31	33	98
A Low and B High	18	19	22	59
A High and B High	32	29	30	91

Standard Order Notation

Run	A	B	AB	Treatment Combinations	Responses (Total)
1	—	—	+	(1)	82
2	+	—	—	a	98
3	—	+	—	b	59
4	+	+	+	ab	91

- 17) What is the Sum of Squares and Mean Square for factor A? (use formulas for Contrasts)
- 18) What is the Sum of Squares and Mean Square for factor B?
- 19) What is the Mean Square for the interaction factor?
- 20) What is the Mean Square for the error term?
- 21) What is the F-ratio of factor A?
- 22) What is the F-ratio of factor B?
- 23) Which factor is significant, A, B, or both?
- 24) Is the interaction effect big or small?

Answers:

- A) **Fixed Effects Model** B₁) **Small** B₂) **Big**
- C) $\frac{SS_B}{b-1}$ D) **21.33**
- E) **3³ Factorial Design** F₁) **26.5** F₂) **18.7**
- G) **Full Factorial Design** H₁) **192** H₂) **206**
- I₁) **A** I₂) **B** I₃) **Both** J₁) **8** J₂) **32**

$$K) \frac{[ab + a - b - (1)]^2}{4n}$$

$$M) \frac{MS_A}{MS_{error}}$$

O) **Interaction**

Q) **(a-1)(b-1)**

S₁) 7 S₂) 4

$$U) \frac{SS_{error}}{ab(n-1)}$$

$$W) \frac{[ab + b - a - (1)]^2}{4n}$$

$$Y) \frac{[ab + (1) - a - b]^2}{4n}$$

L) **Taguchi Design**

N₁) 72 N₂) 75

P₁) 2.83 P₂) 6.49

R) **Nested Design**

T) **2^K Factorial Design**

V) **Fractional Factorial Design**

X₁) 54.2 X₂) 67.8

Z) **SS_T - SS_A - SS_B - SS_{AB}**