PDHonline Course K154 (4 PDH)

Practical Multi-Factor Test Design and Analysis

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Practical Multi-Factor Test and Analysis

Quiz Questions

1. Multi-Factor testing can identify interactions between controlled factors.
    a. True
    b. False
2. Equipment specifications are not an important consideration in test design.
    a. True
    b. False
3. Uncontrolled factors like weather conditions can be ignored.
    a. True
    b. False
4. The variance of a population is

$$\sigma^2 = \sum_{n=1}^{N}(Sn-\mu)^2/(N-1)$$

    a. True
    b. False
5. The Sample Standard Deviation is the square root of the Sample Variance.
    a. True
    b. False
6. In a normally distributed population, what percentage will be within 1 standard deviation of the mean?
    a. 95.4 %
    b. 50.2 %
    c. 45.7 %
    d. 68.2 %
7. ANOVA is an acronym for
    a. Algebraic Number Variation Analysis
    b. Alternative Numeric Variance Analysis
    c. Analysis of Variance
    d. Action Notation of Variation
8. The null hypothesis of an ANOVA is
    a. All the treatment will give different results.
    b. All the treatments will yield the same results.
    c. The F ratio will equal 1.
    d. The F ratio will be less than 1.
9. A factor tested at two levels has how many degrees of freedom?
    a. 2
    b. 0
    c. 1
    d. 3

10. What is the error term degrees of freedom for a 2^3 test with 3 replications?
    a. 16
    b. 24
    c. 8
    d. 4
11. A 2^3 test with 3 replications indicates a contrast of 16.7 for factor A. What is the Sum of Squares for factor A?
    a. 16.7
    b. 2.0875
    c. 11.62
    d. Not enough information.
12. The mean squares for factor A above is
    a. 16.7
    b. 2.0875
    c. 11.62
    d. Not enough information.
13. A calculated probability for a factor or interaction of 0.05 indicates
    a. A 5% probability of the factor changing the test response.
    b. A 5% probability of the result occurring randomly.
    c. A 5% chance of success.
    d. A 5 % chance of interaction.
14. The Total Sum of Squares for a 2^3 test with 2 replications and a standard deviation on all data of 15.8 is
    a. 3744.6
    b. 237
    c. 16.64
    d. 1.05
15. A normal probability plot of residuals resulting in a straight line indicates a normal distribution and aids in validating the test data.
    a. True
    b. False

A test of vibration levels in a milling process is proposed to test bit size, RPM and feed rate with the objective to minimize the vibration level. The factors are as follows:

	A: Bit Diameter	B : RPM	C: Feed Rate in/min
-	1/8	250	2
+	¼	400	3.5

3 replications are run for each test with the data as follows:

Treatment	REP 1	REP 2	REP 3
1	25.025	17.7375	22.75
2	37.4	30.8	34
3	21.8625	20.7625	19.875

4	56.375	49.9125	51.25
5	25.9875	19.8	23.625
6	33	30.9375	30
7	19.9375	19.525	18.125
8	60.3625	54.8625	54.875

Use the 2 x3 template to fill in the data and perform the calculations for the answers to questions 16-xx.

16. What factors and interactions are calculated to be Statistically Significant at the 95% confidence level?
    a. Bit Diameter and Feed Rate
    b. Bit Diameter and RPM
    c. Bit Diameter, RPM, Bit Diameter and RPM Interaction, Bit Diameter and RPM and Feed Rate Interaction.
    d. Bit Diameter, Feed Rate, RPM and Feed Rate Interaction
17. The largest effect calculated is for
    a. Bit Diameter
    b. RPM
    c. Feed Rate
    d. Bit Diameter and RPM Interaction
18. Treatment 4 conditions are
    a. 1/8 Bit Diameter, 250 RPM and 2 in/min feed rate
    b. 1/4 Bit Diameter, 250 RPM and 3.5 in/min feed rate
    c. 1/8 Bit Diameter, 400 RPM and 2 in/min feed rate
    d. 1/4 Bit Diameter, 400 RPM and 2 in/min feed rate
19. The error Mean Squares is
    a. 120.98
    b. 7.56
    c. 4634.3
    d. 16
20. The lowest resulting vibration would be expected to be
    a. 1/8 Bit Diameter, 250 RPM and 2 in/min feed rate
    b. 1/4 Bit Diameter, 250 RPM and 3.5 in/min feed rate
    c. 1/8 Bit Diameter, 250 RPM and 3.5 in/min feed rate
    d. 1/4 Bit Diameter, 400 RPM and 3.5 in/min feed rate
21. The Signal to Noise Ratio for the Bit Diameter / RPM interaction is
    a. 892
    b. 38.5
    c. 118
    d. 12.2
22. The cumulative probability point (Pk) for the residual of treatment 5, rep 1 is
    a. .604
    b. .062
    c. .479
    d. .813

23. The rank of residual for treatment 4, rep 2 is
    a. 22
    b. 4
    c. 2
    d. 1
24. The residuals plot for this test is a roughly linear line and indicates a normal distribution
    a. True
    b. False
25. The mean value for vibration with a ¼ diameter bit, 400 RPM and 3.5 in/min feed rate is
    a. 33.7
    b. 56.7
    c. 21.8
    d. 31.2