Design of Experiments Quiz B

Instructions: The purpose of this test is to evaluate the performance of the instructor and the general effectiveness of the course. The test does not necessarily indicate your performance in the course. It is a designed experiment. To keep your scores private a code number has been written on the title page of your textbook. Please write that code number on the top of your answer sheet. Your pre-course scores will be matched by the code number to your post-course scores for a similar test that will be given during the last class period. Your code number must also appear on the post-course test so do not lose your textbook. Please answer each question by circling your response on the attached answer sheet. The answer "I don't have a clue" is provided to give you an alternative to guessing at answers. Please use this choice if you can't eliminate some of the possible answers provided and make a reasonable guess from among the remaining few choices. This will give us a better indication of where you started and where you ended up.

1. An experiment is to be performed to compare the means of four machines by measuring 8 parts from each machine. How many error degrees of freedom will there be?

   (a) $31 - 3 = 28$
   (b) $31 - 3 - 7 = 21$
   (c) $31 - 3 - 7 - 21 = 0$
   (d) None of the above.
   (e) Don't have a clue.

2. For ANOVA and regression models to be valid:

   (a) The model residuals must be normally distributed.
   (b) The error variances must be constant at all points in the design space.
   (c) The observations must be independent.
   (d) a and b
   (e) a, b, and c
   (f) Don't have a clue.

3. The post-ANOVA tests that you might use to check for differences in the means are:

   (a) Tukey's Quick Test
   (b) Tukey's Pairwise Comparisons test
   (c) Boxplot slippage test
   (d) Bonferoni's method
   (e) Shouldn't be considered unless the ANOVA F statistic is significant.
   (f) All of the above.
   (g) Don't have a clue.

4. For the ANOVA output below, the coefficient of determination $\left(r^2\right)$ for the experiment is:

Source	*df*	*SS*	*MS*	*F*	*p*
Team	2	52.2	21.6	1.87	0.173
Dice	2	422.2	210.6	15.1	0.000
Team $*$ *Dice*	4	89.2	22.3	1.60	0.203
Error	27	376.5	13.9		
Total	35	939.0			

   (a) 939
   (b) 376.5/939
   (c) $\sqrt{376.5/939}$
   (d) $1 - 376.5/939$
   (e) Don't have a clue.

5. For the ANOVA output above, at $\alpha = 0.05$ the statistically significant terms are:

   (a) Dice
   (b) Team and Interaction
   (c) Dice and Error
   (d) Can't tell
   (e) Don't have a clue

6. In a two variable experiment with 4 levels of the first variable, 3 levels of the second, and two replicates how many degrees of freedom will there be to determine the interaction effect?

   (a) 12
   (b) 6
   (c) 7
   (d) 2
   (e) None of the above.
   (f) Don't have a clue.

7. If the model residuals are not normally distributed then:

   (a) A different model should be considered.
   (b) A variable transformation should be considered.
   (c) A careful residuals analysis should be performed.
   (d) A quadratic term might have to be added to the linear model.
   (e) The variance might not be constant over the range of x.
   (f) More than one of the above.
   (g) Don't have a clue.

8. If temperature is a design variable in an experiment, and if the low and high levels for temperature are 30C and 50C, respectively, then what will be the coded level corresponding to 35C?

   (a) 5
   (b) -5
   (c) -1
   (d) -0.5
   (e) Don't have a clue.

9. If the r^2 in a linear regression model is very low (e.g. <20%) then:

   (a) The model and its results shouldn't be used at all.
   (b) The slope of the regression line will not be statistically significant.
   (c) The independent variable only explains a small fraction of the observed variation in the response.
   (d) A quadratic model will not improve the fit.
   (e) Don't have a clue.

10. How many variables are involved in a 2^4 factorial experiment?

    (a) 1
    (b) 2
    (c) 4
    (d) 16
    (e) Not enough information is given.
    (f) Don't have a clue.

11. How many runs are there in one replicate of a 3^4 factorial experiment?

    (a) 3
    (b) 4
    (c) 12
    (d) 81
    (e) Not enough information is given.
    (f) Don't have a clue.

12. A 2^4 full factorial experiment will have how many two factor-interactions?

    (a) 2
    (b) 4
    (c) 6
    (d) 8
    (e) None of the above.
    (f) Don't have a clue.

13. When a run or runs are lost from a full-factorial experiment:

    (a) Some or all of the off diagonal terms in the correlation matrix will be non-zero.
    (b) The constant term in the model no longer represents the expected value of the response when all variables are at their 0 level.
    (c) The data can still be analyzed as long as there are still some error degrees of freedom.
    (d) It might be necessary to eliminate a variable from the model.
    (e) All of the above.
    (f) Don't have a clue.

14. Center cells are added to a 2^n experiment for the purpose of:

    (a) Adding error degrees of freedom without unbalancing the experiment.
    (b) Adding error degrees of freedom without the need to replicate the experiment.
    (c) Providing an opportunity to test for evidence of linear lack of fit.
    (d) All of the above.
    (e) Don't have a clue.

15. How many variables are there in a 2^{7-3} experiment?

    (a) 7
    (b) 3
    (c) 4
    (d) 16
    (e) Don't have a clue.

16. How many generators must be used to build the 2^{6-2}_{IV} experiment?

    (a) 2
    (b) 6
    (c) 4
    (d) 16
    (e) None of the above.
    (f) Don't have a clue.

17. If two replicates of a 2^{7-3} experiment are built then the experiment design becomes a:

    (a) 2^{7-4}
    (b) 2^{7-2}
    (c) 2^4
    (d) The experiment design is still 2^{7-3}
    (e) Don't have a clue.

18. If a fractional factorial design has resolution IV then:

    (a) Main effects are confounded with four-factor or higher order interactions.
    (b) Main effects are confounded with three-factor or higher order interactions.
    (c) Main effects are confounded with two-factor or higher order interactions.
    (d) Two-factor interactions are confounded with other two-factor interactions.
    (e) Two-factor interactions are confounded with other two-factor or higher order interactions.
    (f) b and e
    (g) Don't have a clue.

19. A fractional factorial design with generators 6=123, 7=124, and 8=2345:

    (a) Has 8 variables.
    (b) Is a one-eighth fraction of the full factorial experiment.
    (c) Has design resolution IV.
    (d) All of the above.
    (e) Don't have a clue.

20. How many 1/16th fractional factorial designs have to be combined to construct a 2^{6-2} experiment?

    (a) Four complementary 1/16th fractions
    (b) Two complementary 1/16th fractions
    (c) Four replicates of one 1/16th fractional factorial.
    (d) Two replicates of one 1/16th fractional factorial.
    (e) None of the above.
    (f) Don't have a clue.

21. The 2^n plus centers design:

    (a) Requires that all n of the variables are quantitative.
    (b) Can only determine if curvature is present in the experiment, but not which variable or variables the curvature is caused by.
    (c) Does not require any special number of center cells.
    (d) Could be the first block or blocks of a central composite design.
    (e) All of the above.
    (f) Don't have a clue.

22. Occam's Razor is:

    (a) A special experiment design to screen for the significant variables from among many different variables.
    (b) Is on display at NIST.
    (c) A statement that the simplest model that describes the data is the best model.
    (d) Another name for the Pareto principle.
    (e) Don't have a clue.

23. Which of the following analysis techniques could be used to analyze an experiment with both qualitative and quantitative variables where each variable has only two levels?

    (a) ANOVA
    (b) Regression
    (c) General Linear Model
    (d) Binary logistic regression
    (e) a, b, and c
    (f) Don't have a clue.

24. For central composite designs:

    (a) The number of center cells is not important.
    (b) The variables can be qualitative or quantitative.
    (c) The position of the star points is not important.
    (d) Every variable must have at least three quantitative levels.
    (e) a and b
    (f) a, b, c and d
    (g) None of the above.
    (h) Don't have a clue.