

PLSC 724 - Exam 2 Practice Questions

1. Assume you have ten wheat varieties and you plan a yield trial. List some of the points you should consider in choosing a design. Possible designs are CRD, RCBD, and latin square.
2. Given that  $t=8$  and  $r>1$ , which design (CRD, RCBD, LS) has the largest and which design the least number of degrees of freedom for experimental error?
3. Tell how the randomization procedure for the crd is different from the RCBD?
4. Fill in the following diagram with possible randomizations for a CRD and RCBD. Be sure you assign treatments to the experimental units in such a way that the crd cannot be mistaken for a rcdb.  $T=5, r=3$ .



5. In a rcdb, what is the purpose of grouping treatments into blocks?
6. In a rcdb, is it most desirable to have variation between or within blocks?
7. Given an RCBD with sampling, what is the cause of `sampling error`?
8. What precisely, contributes to `sampling error sum of squares`?
9. Define experimental error for the RCBD.
10. Write the linear additive model for the RCBD, and then define each term.
11. What should you conclude if you find that the F-test for replications is significant in an RCBD?
12. Assume you have an RCBD with  $t=8$  and  $r=3$ . If F for treatments is significant at the .05 level, what can you conclude? What additional statistical procedure would be informative?
13. Assume you have an RCBD in which you have six treatments and four replications. Data from two experimental units are missing.
  - A) List the procedure you would follow to obtain estimates Of the missing data.
  - B) How many degrees of freedom would you have for `error`?
14. The formula to calculate an estimate for a missing plot for an

RCBD is  $(rB + tT - G)/(r - 1)(t - 1)$ .  
 Define each term in the numerator.

15. Assume you have an RCBD and have ten treatments with four reps. If treatment `A` is repeated three times within each rep., show the degrees of freedom for the sources of variation making up experimental error.
16. Assume five treatments and four replications of an RCBD and treatment two is repeated twice in every block and treatment five is repeated three times in every block. List all the sources of variation and their degrees of freedom. Show possible randomizations of replications one and two.
17. Assume you have 6 treatments and 3 replications in an RCBD. Treatments 1 and 2 repeated two times in each replication. List the randomization procedure and then show how the procedure is used to do the randomization.
18. A) given the following data, compute treatment sums of squares

	T1	T1	T2	T3	T4	T5	
R1	36	34	46	38	52	57	263
R2	42	43	50	47	53	51	286
R3	45	49	52	44	61	64	315
	123	126	148	129	166	172	864

- B) how many degrees of freedom are there for treatments, experimental error, and t1/reps?
- C) Calculate the standard error of a difference appropriate for comparing treatments one and four, assuming the error mean square is 722 and you cannot calculate a pooled error term.

19. Given the following data:

	T1	T2	T3	T4	T5	T6	
R1	50	68	28	32	20	17	215
R2	62	74	36	34	30	29	265
R3	75	93	49	53	37	40	347
	187	235	113	119	87	86	827

- A) Compute treatment SS, assuming a normal RCBD.
- B) Compute treatment SS, assuming an RCBD with T3=T4 and T5=T6, that is, two treatments are each repeated twice in each replication.

- C) Compute  $\bar{T}_5 = T_6 / \text{reps}$  SS (same assumption as part b).
- D) How many degrees of freedom would you have for the source of variation listed in part C?
- E) Continuing the conditions stated in part B, assume experimental error SS equals 55.56, compute the standard error you would need to compare  $T_1$  with  $T_3 = T_4$  (assume you cannot calculate a pooled error term).

20. From the following analysis of variance table, compute the mean square error and an estimate of sigma square epsilon.

SOV	DF	SS
Replication	3	237
Treatments	11	594
Exp. Error	33	627
Samp. Error	96	672

- 21. Assume a rcbd and you calculate the lsd and Duncan's mrt at the 95% level of significance. If the lsd was 11.5, Would the lsr value for  $p=2$  be larger, equal, or smaller?
- 22. Assume you have a rcbd with six treatments and four replications, but treatment one is repeated three times within each replication.
  - A) Show symbolically how to calculate treatment sums of squares. Use actual numbers for the denominators.
  - B) Show, in detail, how to calculate an lsd comparing treatment one with treatment 3. Assume you did not pool Exp. Error with  $\bar{T}_1$  within reps when making F-tests. How many degrees of freedom would be associated With the  $t$  value?
- 23. Given an RCBD with 8 treatments and 4 replications, assume you have two missing plots, one in treatment 4 rep 2, and one in treatment 7 rep 4. What are the degrees of freedom for treatments and for experimental error?
- 24. Given the following information, list the degrees of freedom for the indicated sources of variation.
 

Rcbd, $t=12$ , $r=4$	Latin square
T1 repeated 3 times per rep	R=5, 3 latin squares
T1 within reps	Trts x sq
Exp. Error	Exp. Error
- 25. What is the normal range in size for latin square?
- 26. What is the main disadvantage of a) small numbers of treatments in a latin square and b) large numbers of treatments

in a latin square.

27. What is the minimum size latin square on which a complete analysis can be obtained.
28. Why are 3x3 latin squares seldom used?
29. If you were conducting an experiment with 20 treatments, what would be the biggest disadvantage of using a latin square?
30. Assume a 6x6 latin square. If you have data missing for two experimental units, how many degrees of freedom do you have for treatments and for error?
31. Diagram three different 4x4 standard latin squares.
32. List the sources of variation and degrees of freedom for the combined analysis of 3, 4x4 latin squares.
33. Tell (or illustrate) precisely how to compute the treatment SS and treatment x square ss if you have two 4x4 latin squares.
34. A latin square design has 50 degrees of freedom for sampling error and 74 degrees of freedom for total. How many degrees of freedom would you have for experimental error?
35. How many degrees of freedom are there for exp. Error in a 7x7 latin square?
36. Diagram a standard 4x4 latin square and show how to randomize it. Explain randomization procedure.
37. Use the following data to compute 1) SS A), 2) SS B and 3) SS AxB.

	R0	R1
a0 b0 c0	7	9
a0 b0 c1	12	11
a0 b1 c0	13	16
a0 b1 c1	18	20
a1 b0 c0	15	19
a1 b0 c1	22	20
a1 b1 c0	24	27
a1 b1 c1	33	29

38. What is the difference, if any, between a 3 to the fourth power factorial and a 3 x 4 factorial?
39. Assume you have a 2 to the third power factorial, with treatments arranged in a latin square. What would be the size of the latin square?

40. Assume you have a 3 x 4 factorial in a rcbd with 5 blocks. Factor A is fixed and B is random. Show how to compute the variance of a treatment mean for A, B, and AB. Use actual numbers for the denominators.
41. Assume you have an RCBD with a 2 to the third power factorial arrangement.
- Write the expected mean square for B if A and B are fixed and C is random.
  - What mean square would be the appropriate denominator in making an F-test for B?
42. Assume you apply a herbicide (rates of 4, 8, and 12 ounces per acre) to each of six wheat varieties using a CRD with  $r=4$ , a 3 x 6 factorial arrangement. List all sources of variation and degrees of freedom.
43. Indicate the degees of freedom for all error terms given the Following conditions ( $R=4$ ,  $A=5$ ,  $B=2$ ,  $C=3$ ): RCBD
- Factorial
  - Given situation A, what is the formula for the standard error between two B means, assuming all factors are fixed. Use numbers where possible.
44. Write the expected mean square for C assuming A and C are fixed variables and B is a random variable.
45. What would be the appropriate denominator to make an F-test of C, given the conditions of question 44?
46. Write the expected mean square for B, if A is random and B and C are fixed.
47. Given 3 factors, A, B, and C, write the expected mean square For B if A and B are random and C is fixed.
48. Write the expected mean square for  $A \times D$ , assuming a four factor Factorial with Aand B fixed, and C and D random. What term would be the denominator of an F-test of the  $A \times D$  mean square?
49. Given the following table of treatment totals,  $r=5$ , compute the main effect of A and the effect of  $A \times B$ .

	a1	a2
b1	25	50
b2	40	80

50. From the following table of treatment means, compute the simple effects of A, simple effects of B, main effect of A, main effect of B, and interaction effect. Label each answer.

a1	a2
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b1	60	75
b2	70	100