

STATISTICS 402 - Assignment 7
Due March 27, 2009

The activities in this homework involve four treatments; A, B, C, and D and five blocks; white, blue, green, yellow and pink. The treatments could be food additives, the blocks litters of mice, and the response amount of weight gained. Alternatively, the treatments could be a combination of starting technique (without starting blocks, with starting blocks) and shoes (no spikes, spikes) with the response the time to run 400-meters, the blocks would be different individual runners.

Activity 1: The first activity consists of two different randomizations, complete randomization and restricted randomization (blocking) and their subsequent analyses.

a) Complete Randomization

- Shuffle all 20 squares so that they are well mixed.
- Deal out 5 squares and record the values for Treatment A in the table below.
- Deal out 5 squares from the remaining 15 and record the values for Treatment B.
- Deal out 5 squares from the remaining 10 and record the values for Treatment C.
- There should be 5 squares remaining, record the values for Treatment D.

Treatment			
A	B	C	D

b) Analysis of CRD

- Compute treatment means and construct an Analysis of Variance table.
- Report the value of the F-test and P-value for comparing treatments. What do these tell you about the differences between the various treatments?
- Note particularly the value for the mean square error.
- If the F-test indicates that there are some statistically significant differences follow up with an appropriate multiple comparison procedure. That is, compute a value for the adjusted Least Significant Difference (Bonferroni), or Kramer-Tukey HSD, and use it to determine which of the treatment means differ significantly.
- Look at plots of residuals versus treatments and the distribution of residuals. What do these plots tell you about the conditions necessary for the analysis above?

c) Restricted Randomization, Blocking

- Take the 4 white squares and shuffle them so they are well mixed.
- Deal out one white square and record the value for treatment A.
- Deal out another white square and record the value for treatment B.
- Deal out another white square and record the value for treatment C.
- For the remaining white square record the value for treatment D.
- Repeat the above steps for the blue, green, yellow and pink squares.

	Treatment			
	A	B	C	D
White				
Blue				
Green				
Yellow				
Pink				

d) Analysis of RCBD

- Compute treatment means and construct an Analysis of Variance table. Be sure to include a block effect in your model.
- Report the value of the F-test and P-value for comparing treatments. What do these tell you about the difference between the various treatments?
- Note particularly the value for the mean square error.
- If the F-test indicates that there are some statistically significant differences among the treatments follow up with a multiple comparison procedure. That is, compute a value for the adjusted Least Significant Difference (Bonferroni), or Kramer-Tukey HSD, and use it to determine which of the treatment means differ significantly.
- Look at plots of residuals versus treatments and the distribution of residuals. What do these plots tell you about the conditions necessary for the analysis above?

e) Comparison of Designs

- Compare the results of the two analyses. With each design/analysis indicate what treatment means are significantly different.
- Compare the estimates of error variability (e.g. Mean Square Error) for the two designs, complete randomization and restricted randomization. What do you notice?
- Write a one-paragraph explanation of the importance of blocking in this experiment?

Activity 2: The second activity looks at the effect of block size. So that there will be balance in the simulated experiments use only the Blue, Green, Pink and Yellow squares for this activity.

a) 4 Blocks

To save you some time, rather than redo the randomization using four blocks, use the data from Activity 1, part c) but exclude the white block, i.e. use only the data for the Blue, Green, Pink and Yellow blocks.

	Treatment			
	A	B	C	D
Blue				
Green				
Yellow				
Pink				

- Compute treatment means and construct an Analysis of Variance table. Be sure to include a block effect in your model.
- Report the value of the F-test and P-value for comparing treatments. What do these tell you about the difference between the various treatments?
- Note particularly the value for the mean square error.
- If the F-test indicates that there are some statistically significant differences among the treatments follow up with a multiple comparison procedure. That is, compute a value for the adjusted Least Significant Difference (Bonferroni), or Kramer-Tukey HSD, and use it to determine which of the treatment means differ significantly.

b) 2 Blocks – Blue/Green and Pink/Yellow

Shuffle the Blue and Green squares together until they are well mixed. Deal out two and record the values for A. Deal out two from the remaining 6 and record the values for B. Deal out two from the remaining 4 and record the values for C. For the remaining two squares record the values for D. Repeat this process with the Pink and Yellow squares.

	Treatment			
	A	B	C	D
Blue/Green				
Pink/Yellow				

- Compute treatment means and construct an Analysis of Variance table. Be sure to include a block effect in your model.

- Report the value of the F-test and P-value for comparing treatments. What do these tell you about the difference between the various treatments?
- Note particularly the value for the mean square error.
- If the F-test indicates that there are some statistically significant differences among the treatments follow up with a multiple comparison procedure. That is, compute a value for the adjusted Least Significant Difference (Bonferroni), or Kramer-Tukey HSD, and use it to determine which of the treatment means differ significantly.

c) 2 Blocks – Blue/Pink and Green/Yellow

Shuffle the Blue and Pink squares together until they are well mixed. Deal out two and record the values for A. Deal out two from the remaining 6 and record the values for B. Deal out two from the remaining 4 and record the values for C. For the remaining two squares record the values for D. Repeat this process with the Green and Yellow squares.

	Treatment			
	A	B	C	D
Blue/Pink				
Green/Yellow				

- Compute treatment means and construct an Analysis of Variance table. Be sure to include a block effect in your model.
- Report the value of the F-test and P-value for comparing treatments. What do these tell you about the difference between the various treatments?
- Note particularly the value for the mean square error.
- If the F-test indicates that there are some statistically significant differences among the treatments follow up with a multiple comparison procedure. That is, compute a value for the adjusted Least Significant Difference (Bonferroni), or Kramer-Tukey HSD, and use it to determine which of the treatment means differ significantly.

d) Comparison

- Compare the results of the three analyses. With each design/analysis indicate what treatment means are significantly different.
- Compare the estimates of error variability (e.g. Mean Square Error) for the three designs, blocking with 4 blocks and the two experiments blocking with 2 blocks. What do you notice?
- Which design was most effective in reducing the Mean Square Error?