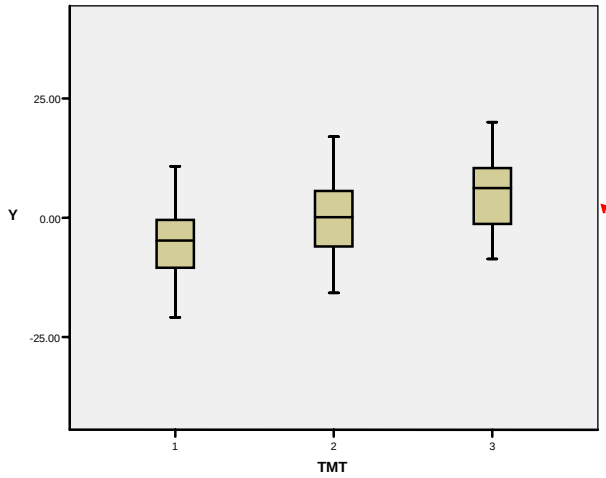
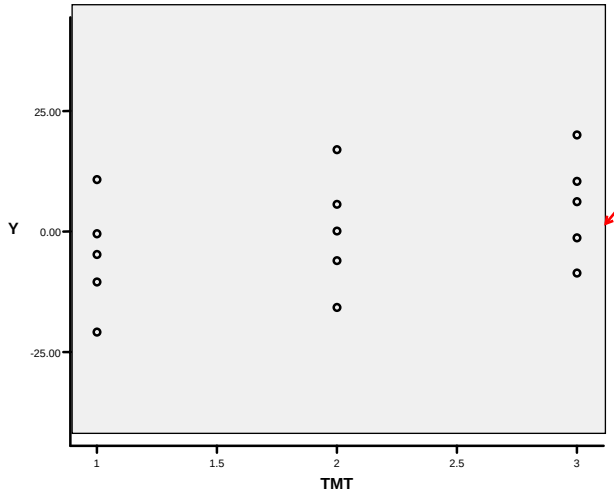
MATH 204 : PRINCIPLES OF STATISTICS 2
The Need for Blocking in an RBD Analysis

Consider the following response data: five measurements collected in three treatment groups:

	1	2	3	4	5
Group 1	**-20.88**	**-4.76**	**-0.46**	**10.78**	**-10.47**
Group 2	**-15.75**	**0.11**	**5.64**	**16.98**	**-6.03**
Group 3	**-8.62**	**6.20**	**10.42**	**20.05**	**-1.29**





Boxplot and pointplot display raw data; it appears that the assumptions of normality and equal variances are valid here.

Y

Levene Statistic	df1	df2	Sig.
.012	2	12	.988

Levene's Test indicates that the equal variances assumption is met.

ANOVA for a CRD: Y

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	276.179	2	138.090	1.012	.393
Within Groups	1637.801	12	136.483		
Total	1913.980	14			

Thus the CRD analysis and ANOVA-F test imply that there is **NO DIFFERENCE** between TREATMENTS.

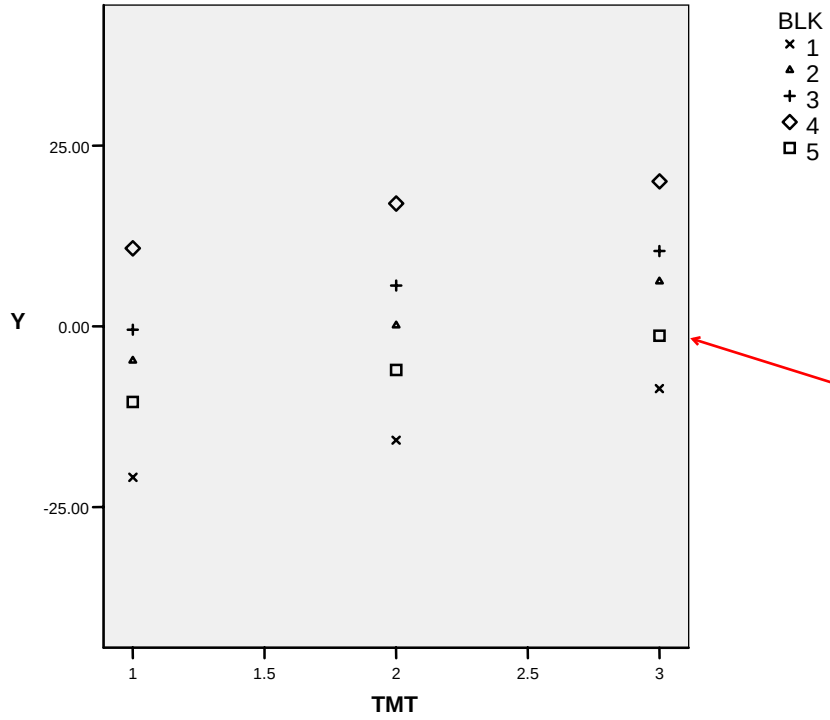
Analysis using RBD with columns taken as blocks:

Dependent Variable: Y

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1907.802	6	317.967	411.720	.000
Intercept	.246	1	.246	.318	.588
TMT	276.179	2	138.090	178.805	.000
BLK	1631.623	4	407.906	528.177	.000
Error	6.178	8	.772		
Total	1914.226	15			
Corrected Total	1913.980	14			

Significant difference between treatments !

Significant difference between blocks defined by columns of data table.



Pointplot reveals hidden structure due to blocking factor; there is systematic variation due to block which is not recognized by the CRD analysis.

In fact, there is hidden structure in the data. If this structure is taken into account, evidence that the treatment means are significantly different is uncovered. The reason that the CRD and one-way ANOVA do not discover this is that they assume that the variability can be decomposed as

$$SS = SST + SSE$$

whereas in fact

$$SS = SST + SSB + SSE$$

that is, the CRD assumes that the random variability that is observed is MUCH LARGER than it actually is. Once the variation due to BLOCKS is taken into account, the ANOVA-F test result for TREATMENTS becomes significant.