ANOVA for Randomized Block Design
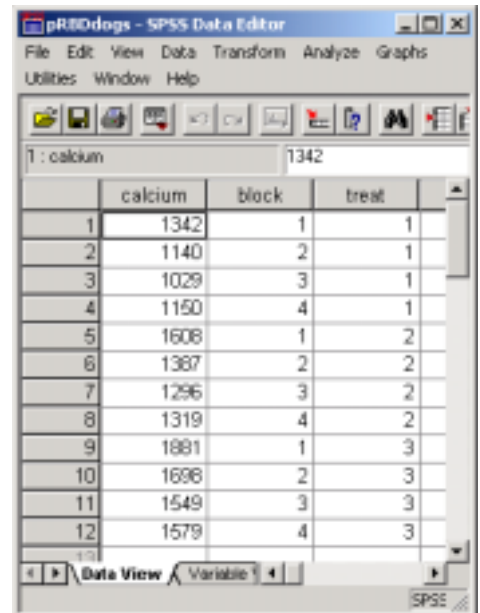
I. SPSS for ANOVA of Randomized Block Design.

Example: Effect of digitalis on calcium levels in dogs

Goal: To determine if the level of digitalis affects the mean level of calcium in dogs when we block on the effect for dog.

A study was conducted to compare the effect of three levels of digitalis on the level of calcium in the heart muscle of dogs. It is sufficient to note that the general level of calcium uptake varies from one animal to another so that comparisons of digitalis levels had to be blocked on heart muscles. That is the tissue for a heart muscle was regarded as a block and comparisons of the three levels of digitalis (A, B, and C) were compared based on the heart muscle of 4 dogs.

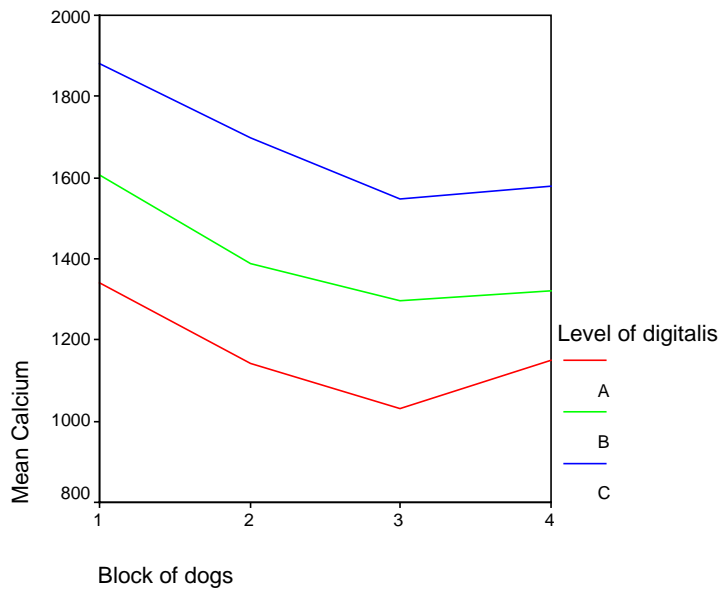| Dog	Level of Digitalis		
	A	B	C
1	1342	1608	1881
2	1140	1387	1698
3	1029	1296	1549
4	1150	1319	1579

1. **Data Entry**

   The first column will be the calcium levels for all 12 observations (call it **calcium**). The second column will tell what treatment was given. This will be a column of 1, 2, or 3 (call it **treat**). The next column will tell what block. Type 1, 2, 3 or 4 (call it **block**).

2. **View the data using Profile Line Chart**

   To view line graph, click on **Graphs\Line\Multiple\Define**. Click **calcium** over to the circle labeled **Other summary function**. Click the blocking variable (in this case **block**) over to the **Category Axis:** box and then click the treatment variable (in this case **treat**) over to the **Define Lines: by** box. Then hit **OK**.

There does appear to be a difference in the three treatments since the three lines are not on top of each other.

Block of dogs

3. State Hypotheses

Treatments: H_0: $\mu_1=\mu_2=\mu_3$; Ha: At least two of the means differ.
If H_0 is rejected, then level of digitalis was affecting calcium levels.
Blocking: H_0: $\mu_1=\mu_2=\mu_3=\mu_4$; Ha: At least two of the means differ.
If H_0 is rejected, then blocking factor was important in this experiment.

4. Analysis

To perform the Blocked ANOVA, click on **Analysis(Statistics)\General Linear Model\Univariate...**. Click **calcium** over to the **Dependent Variable** box. Click both **treat** and **block** over to the **Fixed Factor(s)** box. Now click **Model** in the upper right hand corner. In that dialogue box put the circle for **Custom** and then click both **treat** and **block** over to the right hand box. In the middle, click the down arrow to **Main Effects**. Then click off the arrow in the box labeled **Include Intercept in Model**. Then hit **Continue** and then hit **OK**.

Tests of Between-Subjects Effects

Dependent Variable: Calcium

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Model	24718632.5[a]	6	4119772.083	4059.222	.000
BLOCK	173415.000	3	57805.000	56.955	.000
TREAT	524177.167	2	262088.583	258.237	.000
Error	6089.500	6	1014.917		
Total	24724722.0	12			

[a]. R Squared = 1.000 (Adjusted R Squared = 1.000)

5. Multiple Comparisons

Repeat the above, but click the **Post Hoc** button and click the **treat** (Treatment) variable over to the box labeled **Post Hoc Tests for:** Then click the appropriate case (the output below is Tukey's HSD).

Calcium

Tukey HSD[a,b]

Level of digitalis	N	Subset		
		1	2	3
A	4	1165.25		
B	4		1402.50	
C	4			1676.75
Sig.		1.000	1.000	1.000

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 1014.917.

a. Uses Harmonic Mean Sample Size = 4.000.

b. Alpha = .05.

The conclusion is that each pair is significantly different.

II. Do An Exercise

Using decoys is a common method of hunting waterfowl. A study compared the effectiveness of three different decoy types – taxidermy-mounted decoys, plastic shell decoys, and full-bodied plastic decoys – in attracting Canada geese to sunken pit blinds. In order to account for an extraneous source of variation, three pit blinds were used as blocks in the experiment. Thus, a randomized block design with three treatments (decoy types) and three blocks (pit blinds) was employed. The response variable was the percentage of a goose flock to approach within 50 meters of the pit blind on a given day. The data are given in the following table.

Blind	Shell	Full-Bodies	Taxidermy-Mounted
1	8.3	15.6	23.5
2	13.4	11.4	20.7
3	17.3	13.4	26.5

Perform the analysis using SPSS to compare the response means of the three decoy types. Write a summary of your analysis. You must have the problem briefly explained, state the hypothesis to be tested, interpret the SPSS output and draw conclusion, and do at least what has been shown in the example.

III. Find and Read the Multiple Comparison Methods using SPSS Help.