

QUEEN MARY, UNIVERSITY OF LONDON

MAS 314

Design of Experiments

Practical 2

17–22 January 2007

1 (Getting Started) When you log on you should select the environment

DOE Design of Experiments (Mathematics Department)

Remember to store all your files and results from this course in your directory DOE.

This practical covers the analysis, and the randomization, of designed experiments when the plots are unstructured.

Now you can start **Genstat**:

```
dept >> GenStat 7.2 ▷ GenStat
```

2 (Example 2) We begin with some fictitious data for Example 2.

plot	spray	yield
1	B	7.46
2	A	5.08
3	C	4.98
4	C	5.21
5	B	6.93
6	A	6.77
7	B	5.60
8	A	5.87
9	C	7.88
10	C	6.75
11	A	4.70
12	B	5.45
13	A	4.61

Read these data into a spreadsheet and name the columns. Convert the first two columns to type **factor** by holding the mouse on them, right-clicking and choosing the appropriate option. For the ‘plot’ column, simply tell **Genstat** that ‘plot’ is a factor with 13 levels. For the ‘spray’ factor, tell **Genstat** that it has 3 levels, and then click on **Labels** to name these *A*, *B* and *C*. Now you should be able to type in all the data.

When you make any change to a spreadsheet, it is a good idea to make sure that the changed data are available to **Genstat**. Do this by

Spread → Update → Changed data to Genstat

To analyse these data:

Stats → Analysis of Variance

In the **Dialogue Box** choose/type

Y-Variate	yield
Treatment Structure	spray

Fill in the estimated values:

$\hat{\tau}_A =$
 $\hat{\tau}_B =$
 $\hat{\tau}_C =$

Hence estimate the differences

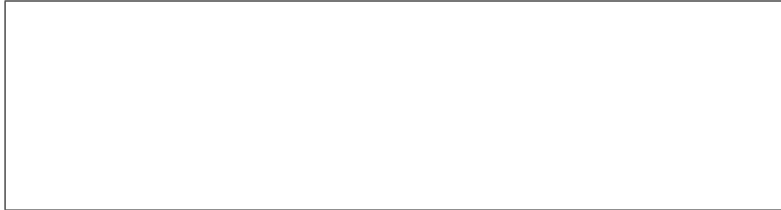
s.e.d

 $\hat{\tau}_A - \hat{\tau}_B =$
 $\hat{\tau}_B - \hat{\tau}_C =$

From the anova table, estimate σ^2 and hence calculate the standard errors of the above two differences and write them in the right of the box above. Does what you have just calculated agree with anything you can find in the output? Explain.

Is there any evidence for differences between the sprays?

What do the final two columns of the anova table indicate?



3 (Simple randomization) Type the following lines in the Input Window and submit them.

```
randomize plot, spray, yield  
print plot, spray, yield
```

You should find that the cells in each column are put into a random order, but it is the *same* random order, because plot 1 still has yield 7.46, and so on.

Now submit those two lines again. Do you get the same random order as before?

Each time that **Genstat** randomizes, it uses a seed as input to the randomization. Usually it chooses a new seed each time. You can provide your own seed if you want, which should be an integer of at most six digits. For example:

```
randomize [seed = 715243] plot, spray, yield
```

We normally use this to randomize the design *before* getting any data. Try this by opening a new spreadsheet with two columns and 13 rows. Call the columns unit and tmt. Put plot labels 1–13 in the first column and then put the three spray treatments into the second column in a systematic order. Update the spreadsheet. Then randomize by

```
randomize [seed = 715243] tmt
```

using a seed of your own choice. Print unit and tmt in the **Output Window**. In what way is this method of randomizing different from the randomization you did before?

If you and your friend use the *same* seed then you should get the same result. (This is useful if you want to re-create the same random order later.)

Save your randomized plan into a new spreadsheet using

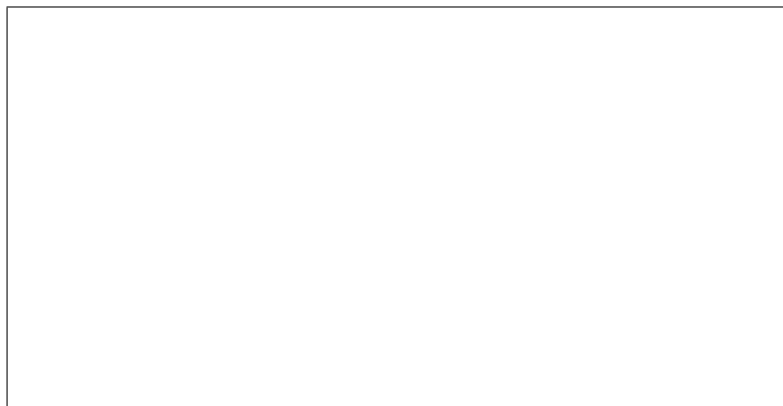
Spread → New → Data in Genstat

While this spreadsheet is highlighted, click on **File** and save the spreadsheet in your DOE directory under a name of your choice.

4 (Feeding chickens) Eight newly-hatched chicks took part in a feeding experiment. Four different feeds (*A*, *B*, *C* and *D*) were made available to two chicks each. At the end of six weeks the weights of the chicks (in grams) were as follows.

weight	410	393	442	424	443	441	500	479
feed	<i>A</i>	<i>A</i>	<i>B</i>	<i>B</i>	<i>C</i>	<i>C</i>	<i>D</i>	<i>D</i>

Read in the data and save it so that it can be used in another session. Analyse the data. Estimate the difference between the six-week weight of chicks on feed *D* and chicks on feed *A*. Give the standard error of that estimate.



5 (Caffeine) The file `DOETUTOR/STU/CAFF.DAT` contains a data vector with 30 values. It is the outcome of an experiment to find out the effects of caffeine on people. 30 people took part in the experiment. Each value is the number of fingertaps made by one person in a fixed time. The first 10 correspond to people who had been administered a placebo; the next 10 to people who had had 100 mg of caffeine; the final 10 to people who had had 200 mg caffeine.

To load these data:

Data → Load → ASCII file

Click on **Browse ...** and find the file `DOETUTOR/STU/CAFF.DAT`. It is probably under 'My Computer'. Read in the data into a variate called `taps` in a new spreadsheet. Then create a factor `caff` with three levels by

Spread → Insert → Column after Current Column

You need to fill this column with 10 '1's followed by 10 '2's followed by 10 '3's. (Of course, the levels of the factor are really 'placebo', etc., but this method makes the levels equal to 1, 2, 3, which is easier for technical reasons.) Right-click on the new column, choose Fill and see if you can work out how to fill in the boxes (the Help is quite good).

First get an overview of the data. Use

Graphics → Boxplot

to draw a boxplot of the data for each treatment. Form a preliminary view about the difference between the treatments.

Then analyse the data.