

# QUEEN MARY, UNIVERSITY OF LONDON

## MAS 314

## Design of Experiments

### Practical 1

10–15 January 2007

**1 (Getting Started)** This practical reminds you about the statistical computing language Genstat. The work is on the PC network. I assume that you know how to log onto the PC network and how to print files from it.

When you log on you should select the environment

DOE Design of Experiments

Mathematics Department

The first time that you use Genstat for *MAS314 Design of Experiments* you should create a new directory (also called *folder*) in your own space called DOE. Remember to store all your files and results from this course in DOE.

Now you can start Genstat:

```
dept >> GenStat 7.2 ▷ GenStat
```

**2 (Data input by spreadsheet)** You can use Genstat's spreadsheet facilities to read in the following data from the keyboard. Start the session by selecting **Blank Spreadsheet** and then clicking on **OK**.

| area (cm <sup>2</sup> ) | length (cm) | breadth (cm) |
|-------------------------|-------------|--------------|
| 110.0                   | 10.7        | 12.8         |
| 108.6                   | 10.9        | 12.4         |
| 72.8                    | 8.5         | 10.7         |
| 85.2                    | 9.4         | 11.2         |
| 80.5                    | 9.0         | 10.9         |
| 95.0                    | 10.2        | 11.8         |
| 96.8                    | 10.5        | 11.5         |
| 80.9                    | 9.0         | 11.0         |
| 97.3                    | 10.1        | 12.0         |
| 108.0                   | 11.2        | 12.2         |
| 69.0                    | 8.1         | 10.8         |
| 110.0                   | 10.8        | 12.9         |

In the **Dialogue Box** type or choose

|          |  |
|----------|--|
| Rows:    | <input type="text" value="12"/>                                |
| Columns: | <input type="text" value="3"/>                                 |
|          | <input checked="" type="checkbox"/> <b>Set as Active Sheet</b> |

Click on **OK** and then type in the data.

Now edit the column attributes.

Spread → Column → Attributes/Format

In the **Dialogue Box** choose/type

|              |   |
|--------------|---|
| Column:      | <input type="text" value="C1"/>                                   |
| Name:        | <input type="text" value="area"/>                                 |
| Description: | <input type="text" value="area of sycamore leaves in square cm"/> |
| Decimals:    | <input type="text" value="1"/>                                    |
| Width:       | <input type="text" value="6"/>                                    |

Choose the *default* justification and the *fixed* numeric format. Then click on **Apply**.

Similarly, give attributes to columns C2 and C3. When you are satisfied with the outcome, click on **OK**.

**3 (Saving and viewing data)** Save these data in a file as follows. While the spreadsheet window is highlighted,

File → Save

Save it in your DOE folder under a name of your choice.

To get the data into the **Output Window**, ask Genstat to print the data to it. Click on the icon below File to obtain an **Input Window**. Type the following in the **Input Window**:

PRINT area, length, breadth The first word here is the Genstat command. It can be in upper or lower case. The other words are the variates. Does it matter whether they are in upper or lower case?

Run the command by doing

Run → Submit Line

Now look at everything in the **Output Window**. Make sure that you understand every line of output.

If you have lost the **Input Window**, you should be able to get it back by

Window → Input Window;1

**4 (Calculation)** There are two ways of performing calculations on variates. Here we give the example of finding the product of `length` and `breadth`.

**Method 1** Type the following two lines in the **Input Window** and submit them.

```
calculate X1 = length * breadth  
print length, breadth, X1
```

**Method 2** Use the mouse.

Data → Calculations...

In the **Dialogue Box** either type `length * breadth` in the first field, or achieve the same thing by choosing the variates from the **Available Data** and the operator `*` from the table provided. Also type

Save Result in:

Tick the box to print the result in the **Output Window**, and the one to display it in the spreadsheet, remembering to choose the original spreadsheet. Click on **OK**.

In the rest of this practical, `X` denotes either `X1` or `X2`, depending on which method you have used for the calculation.

**5 (Simple graph)** We expect that `area` should be proportional to `X`. To plot a graph of `area` against `X`, proceed as follows.

Graphics → Point Plot

In the **Dialogue Box**, use the **Available Data** to choose

Select Y:   
Select X:

Click on **Next**, type in a title of your choice and then click on **Finish**.

You might like to experiment with the tools available to view the graph on screen. You should be able to move it around and to change its size.

If you have time, you might also like to experiment with other features available when you draw the graph, such as names for the axes, type of plotting symbol, and so on.

**6 (Regression)** We are going to fit a model of the form

$$E(\text{area}) = a + bX.$$

From your graph, can you guess suitable values of  $a$  and  $b$ ?

Genstat can fit the model as follows.

Stats → Regression Analysis → Linear Models...

In the **Dialogue Box** choose/type

**Response Variate**

**Explanatory Variate**

Simple Linear Regression

area

X

Fill in the estimated values:

$\hat{a}$  =  
 $\hat{b}$  =

Also complete the ANOVA table.

| Source | df | SS | MS | VR |
|--------|----|----|----|----|
|        |    |    |    |    |
|        |    |    |    |    |
|        |    |    |    |    |
|        |    |    |    |    |

From the anova table, estimate  $\sigma^2$ .

**7 (Finishing the session)** Select

File → Exit

Remember to log out.