Worksheet 2

FITTING A SUITABLE MODEL TO THE 'TrafficQueueEG' DATA

1. Open the RegressionFitMorocco.xls excel worksheet file.
2. Go to the Data sheet and delete any data that is in columns A and B.
3. Open the TrafficQueueEG.xls excel worksheet file.
4. Copy the data in Sheet1, cells A3-B33 of the TrafficQueueEG file.
5. Paste this traffic data into the Data sheet of the RegressionFitMorocco file, so that the headings go in cells A10 & B10, and the data starts in cells A11 & B11.
6. Type the number of observations in this traffic data into cell 9B.
7. Save this amended version of the RegressionFitMorocco.xls file as RegressionFitTraffic.xls. (File>Save As…)

We will now try fitting a suitable model to this traffic data. To do this we need to edit some of the Visual Basic Programs attached to this file.

i. If the Visual Basic Tool bar is not activated then go to View>Toolbars>Visual Basic
ii. Click on the Visual Basic Editor icon on the VB Tool bar. This opens the Visual Basic Macros/programs page.
iii. If the 'Project Explorer' window is not already displayed on the screen then open it by going to View>Project Explorer. This window shows a list of the worksheets (Excel Objects) and a list of the Modules. Click on the + sign next to the word Modules to open the Modules file and display a list of all the names of the individual modules attached to this excel file. Double clicking on the name of an individual module in this list brings up the programs belonging to that module.

7. Double click on the 'LogLikelihoodCalc' module. This displays all the programs /functions involved in calculating the loglikelihood.
8. Scroll down to the LogPdf() function. This contains the model function that we will fit to our data. It is a Normal pdf with mean = Eta() and standard deviation = Par(1).
9. Now look at the Eta() Function below. This contains the function that we will assign to the model mean.

We must consider what type of function is appropriate for Eta() and whether it is valid to assume constant variance for the model. Take another look at the plot for the traffic data. Does the variance in the data seem to be constant? No? Then propose a suitable function for the variance. For example functions of the form:
$\theta_1 x / (1-x)^{\theta_2}$, $\theta_1 + \theta_2 x$ (linear function) , $\theta_1 + \theta_2 x + \theta_3^2 x$ (quadratic function), etc...

10. Return to the RegressionFitTraffic excel file and the LogLikelihood module. At the moment the variance is programmed to be constant, Par(1). To create a variance that is dependent on the traffic intensity type in this Visual Basic function above the Function LogPdf().

(NB. ‘ signifies a comment. These are comments for your information and are ignored by the program.)

```
Public Function Par1function(ByRef X As Double, ByRef Par() As Double) As Double

    ‘ This contains the function for sigma = Par(1)
    ‘Change this function to change the standard deviation (sigma)

  (Type your proposed function for the standard deviation (sigma) here, for example..)

    Par1function = Par(1) * X / (1 - X)^2

End Function
```

11. Now go to the LogPdf() Function and amend it so that where it previously called Par(1) it now calls Par1function(X, Par) i.e.

```
LogPdf = -0.5 * (Log(2 * PI) + Log(Par1function(X, Par) * Par1function(X, Par)) _

        + ((Eta(X, Par) – Y) / (Par1function(X, Par)))^2 )
```

12. There is one more place in the program that we must edit to allow for a non-constant variance. Double click on the module ParaBootstrapParMLERoutine in the Project Explorer window. This brings up the macro ParaBootstrapParMLE(). At the top of the page, after the green comment ‘Parametric BootStrap of MLE Pars programme, type in the declaration

```
Dim  Par1 As Double
```

Scroll down till you see the green comment

‘------- Generate the bootstrap sample of Y’s ----.

Amend the three lines of program immediately below this comment so that it reads:

```
For I = 1 To NumObsns

        Par1 = Par1function(XOrig(I), ParMLE())

        YBoot(I) = Eta(XOrig(I), ParMLE()) + WorksheetFunction.NormInv(Rnd(), 0, Par1)

Next I
```

13. The program will now fit a variance term that is dependent on X (traffic intensity). You can try different functions for the variance by going to the Par1function() Function in the LoglikelihoodCalc module and changing the line: Par1function = *(…type the new function here…)*

14. What form should Eta() take?

    Return to the LogLikelihoodCalc module and scroll down to the Eta() function. Comment out (using ‘) the function/s you do not want Eta to take and type in the function you have chosen.

    For example,

```
Public Function Eta(ByRef X As Double, ByRef Par() As Double) As Double

        ‘type in your function for Eta here
        ‘remember not to use Par(1) as this is the parameter reserved for use in the
        ‘standard deviation.

        Eta = (Par(2) + (Par(3) * X))/((1 - X)^Par(4))

End Function
```

15. Now bring back up the excel worksheets and go to the Optimize sheet. Type in the total number of parameters you have now used for Par1function() and Eta() into cell B9. Click on the ‘Clear Iteration Information’ button to clear the screen. Type in a suitable set of initial values (for the Neldermead optimisation algorithm) into Col B starting at cell B11. (NB. Finding suitable starting values can sometimes require trial and error). For the above suggested Eta function, try initial values of b1 = 0.1; b2 = 0.1; b3 = 0.1 and b4 = 1.

16. Press the '1:Optimize' button. Remember to copy the MLE estimate values into the initial value cells and re-optimize until the estimates seem stable. Press '2:Hessian', '3:Cov&Conf Intvls' button to create confidence intervals.
17. Go to the Fit sheet and press the 'Calc Fitted Curve Details' button and 'Make Chart' buttons to see how well your model seems to fit to the data.
18. Go to the Bootstrap sheet. Press the Bootstrap button to create bootstrap parameter estimates. Then press 'MakeScatterPlot' button. Does an assumption of normality seen valid? (i.e. are the points fairly randomly scattered? Or if there is correlation, is it linear rather than non-linear, e.g. quadratic?) You can alter the number of bootstraps performed by altering the number in cell B7.
19. Go to the RegressionFunction sheet. Enter the range of values for X in cells D7 and D8 e.g. 0.95 and 0.2. Press the 'CalcAsympRegnCIs' button and then the 'Calc Bootstrap Regn CIs' buttons. Look at the results graphically by pressing buttons 'Make Asymp Regn CI Chart' and 'Make Bootstrap Regn CI Chart'. You can slow down the drawing of the Bootstrap chart by typing N into cell L9.

20. Are you satisfied with your model fit? If not go back into the Visual Basic programs and try another function for Eta and/or the variance.