A Brief Tour of NNMODEL's Capabilities

The following procedures will guide you through a brief demonstration of NNMODEL's capabilities:

- **Entering the Data**

Step 1 - In order to create models it is necessary to load the data into NNMODEL. Importing is one method to fill in the data matrix needed to build models. Other methods are direct keyboard entry or using the cut and paste functions to get the data from other Window programs. The following example shows how to load the data from an ASCII file:

1. Select **Import** sub-menu from the File menu, then select **Data From ASCII File** command from the import sub-menu. A **File Open** dialog will appear.
2. Navigate to the TESTSETS sub-directory. A number of files will appear in the file list.
3. Select the file COATING.RAW from the file list and press **OK**. The **Data Import** dialog box will appear.
4. The file COATING.RAW is in standard RAW data format, therefore, no other "cleaning" options need be selected. Press **OK** to create the data matrix.

- **Verifying the Data**

Step 2 - After the data has been loading into NNMODEL the data matrix should be checked to see that only good data has been imported. Outliers, typing mistakes and scaling problems may be seen statistically or graphically. Any problems with the data can be corrected using the built-in matrix editor during this step.

1. Select By Row Matrix command from the Graphs menu. View the thumbnail graphs looking for outliers, scaling problems or patterns that might indicate clustering or cycling.
2. Next select the Scatter Matrix command from the Graphs menu. The graph plots each variable against every other variable in the data matrix. As you can see there are some obvious interdependencies in this data.
3. Select the Distribution Matrix command from the Graphs menu. As you can see the distribution is spread evenly throughout the data space.
4. Select Correlation Analysis from the Data menu. By viewing the Pearson Correlation Coefficients for each valid combination there does not seem to be simple linear relationship between any of the variables.
5. Select 3D Scatter command from the Graphs menu. A variable selection dialog box will appear. Select STARCH for the X-axis, LATEX for the Y-axis and BRIGHT for the Z-axis and press OK. A 3D Scatter graph window will appear. You can rotate the graph using the four rotation icons in the toolbar, copy and paste or print any graph.

- **Creating the Model**

Step 3 - Creating a neural model is as simple as choosing the desired input and output variables. Once the model has been created it must be trained. The following steps will guide you through creating and training a five input - three output model:

1. Assuming the COATING.DM data matrix is still open from the previous step, select the **New Neural Model** command from the File menu. The **Create Neural Model** dialog will appear.

2. Select STARCH, LATEX, HP91, COATWT and CPSI and press **Add In** to add them as inputs to the model. Select BRIGHT, OPAC and GLOSS and press **Add Out** to add them as outputs from model.
3. Press **OK** to create the model. The Neural Model window will appear.
4. Select the **Initialize** command from the Model menu.
5. Select the **Start Training** command from the Model menu. The training will continue until 1000 presentations of the training matrix has been completed.
6. Press the Diskette icon in the toolbar to save the trained model.

- **Analyzing the Model**

Step 4 - Now that the model has been trained it is necessary to find out how well the model performs. You can validate the model by checking the predictions either statistically or graphically. If the model was based on historical or other non-experimental designed data the model should also be tested against data sets not used for training the model. The following steps will guide you through a few graphical procedures:

1. Select **Statistics Report** from the Model menu. Study the statistics, a good model will have an R Square near 1.0 with all the residual statistics near zero. Of course this will never happen in real life (if it does you probability did something wrong).
2. Select **Meas vs Pred** command from the Graphs menu. Separately plot BRIGHT, OPAC and GLOSS variables. Notice how close to the center line the points fall. A good model will have all (or most) of the points falling near the center line. Change the **Tolerance** value in the **Options** menu to .1 and view the 10% tolerance lines.
3. Select **Meas and Pred** command from the Graphs menu. Separately plot BRIGHT, OPAC and GLOSS variables. Notice how the measured and predicted variables overlay.
4. Select **Residuals** command from the Graphs menu. Separately plot BRIGHT, OPAC and GLOSS residuals. Residuals are the difference between the predicted and measured values or model error. Errors can be caused by either random noise in the system or by the model's inability to accurately predict the response due to missing factors or too few number of parameters (hidden neurons).

- **Using the Model**

Step 5 - In many cases just reporting the results of the previous step would be the result of the modeling effort. NNMODEL enables you to generate final reports easily using the Window's clipboard copy and paste functions. Any NNMODEL graph or report can be copied to the clipboard. However, sometimes a more dynamic method of model presentation is needed. NNMODEL will allow you to interrogate the model interactively, or export the model to be used with external programming languages. The following two procedures will demonstrate the interactive and external 'C' methods:

To use the built-in interactive model interrogation:

1. Select **Interrogate Model** command from the Model menu. A dialog box will appear with two grids. The left grid displays the input variables, the current settings, the minimum and maximum values allowed by the model. The right grid displays the output variables and the current predictions.
2. Use the mouse to select an input variable under the value column and

change the value. Press <return> or press the update button. Notice that the output predictions are updated.

To use model in an external 'C' Program:

1. Select the **Export** sub-menu from the File menu and then select **Feed-Forward Neural Model**. The **Export FeedForward Network As** dialog box will appear. Navigate to the NNLIB sub-directory, enter the name COATING.ENN into the **File Name** box, and press **OK**. This will export the coating model to an ASCII file.
2. Switch to the Program Manager and open a DOS session.
3. Change directory to \NNMODEL\NNLIB
4. Execute the program ITEST.EXE and when prompted enter the filename COATING. The ITEST program loads the model and prompts you to enter a value for the input variables STARCH, LATEX, HP91, COATWT and CPSI. Then it displays the predictions for the variables BRIGHT, OPAC and GLOSS. This will continue to loop until you type in the word END.