

Using the GWS Library

by

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I. S-Plus Background:

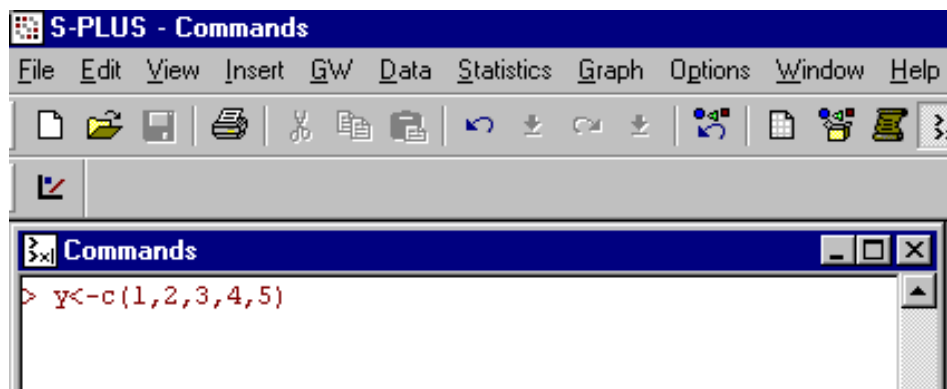
Before getting into using the library, a few points about S-Plus will be made.

A. Entering a vector.

To enter data in vector form, use the command `c()` in the **Commands Window**. For example, let's say we want to enter a vector with values 1,2,3,4,5. Use the command below.

```
y <- c(1,2,3,4,5)
```

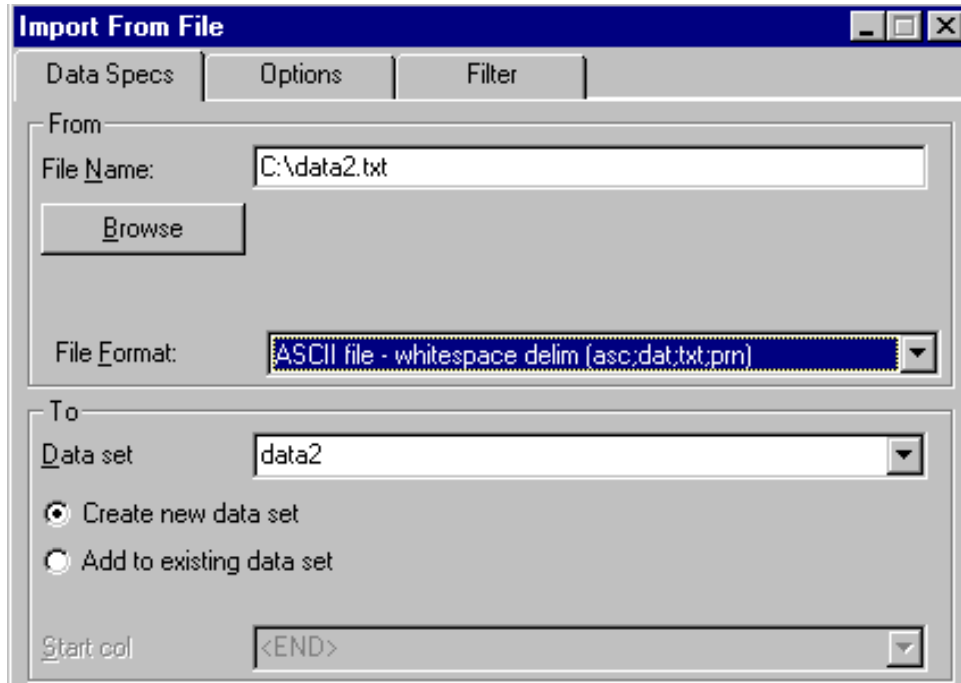
Your window will look like the following.



B. Importing a new dataset.

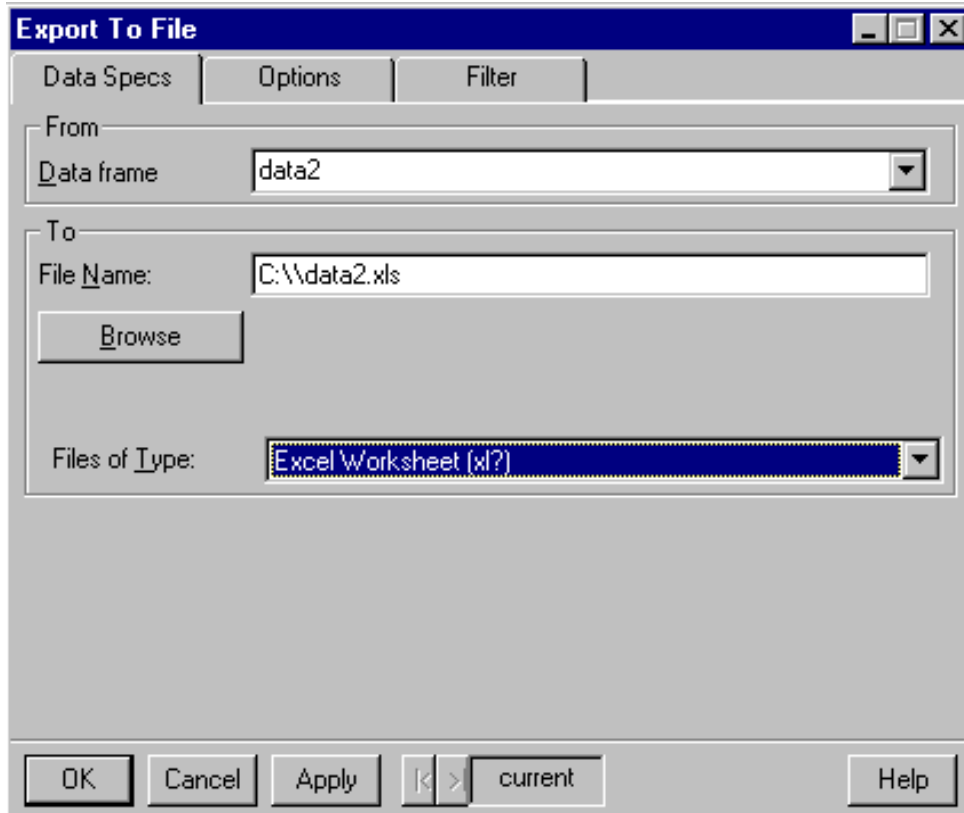
To import a new dataset, use the following commands. Go to the **File** menu down to "**Import Data**" then over to "**From File...**"

You can either Browse to the specific file you wish to import by clicking on the Browse button, or you can type the file location in the **File Name:** box. Specify the format of the file in the File Format dropdown box. For instance, let's say we want to import a file from the C drive titled data2.txt. (Note that the *.txt file is an ASCII file – whitespace delimited (asc;dat;txt;prn) file.) The user has the option of renaming the file as it is imported into S-Plus by typing a new filename in the "To – Dataset" box. Either using the Browse button or typing in the location of the file should yield a window that looks like the figure below. Click OK to finish importing the data. Your imported data will pop-up in a new window. You can close it if you wish.



C. *Exporting a dataset from S-Plus to a file of a different format.*

To export a dataset, go to the **File** menu and down to “**Export Data**” then over to “**To File...**” A new window will pop-up titled “Export To File”. In the Data frame box, type in the S-Plus object that contains the data you wish to export. Then you can either type in the location and name of the datafile you wish to export in the “To – Filename:” box, or you can click the Browse button to find the destination the file you will export. Again, specify the format of the file you want to export to in the “Files of Type:” dropdown box. For example, let’s say we now want to export our data2 vector we previously imported as an Excel file on our C drive. To do this, type in data2 in the “Data frame” box. Specify that we want our filename to be called data2.xls on the C drive. Make sure that the box titled “Files of Type:” now shows Excel Worksheet (xl?). See Figure below. Click OK to finish exporting the file. The first row of the exported dataset will contain the name of the column or vector.



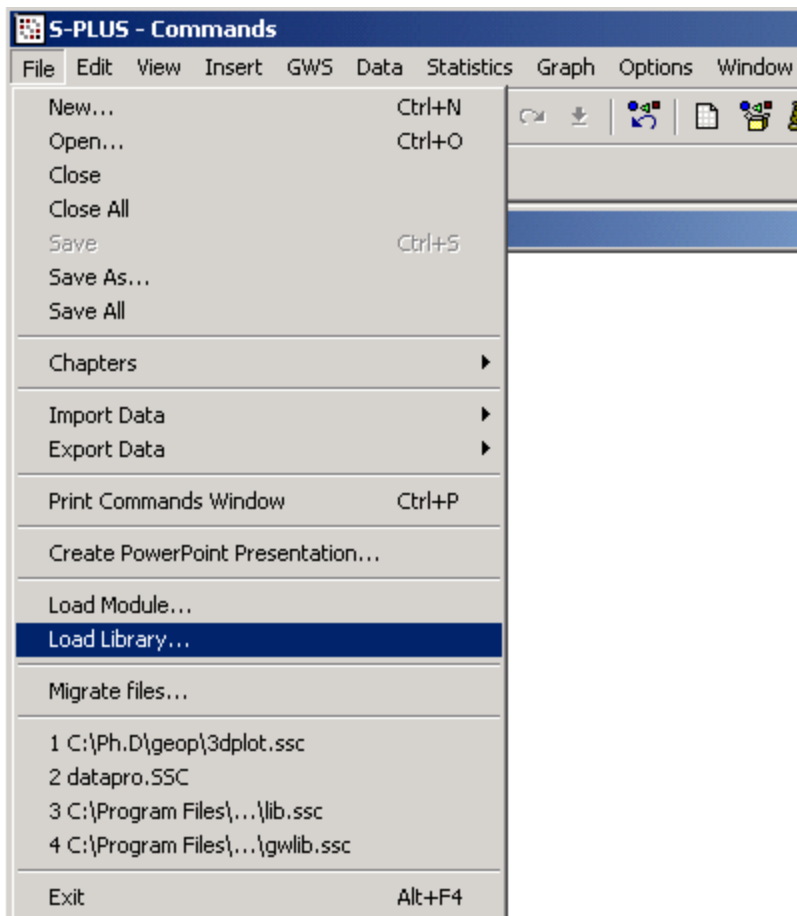
II. Loading the “GWS” Library:

Before you can load the library, the library must be copied into the S-Plus library folder. This folder typically resides in the following location.

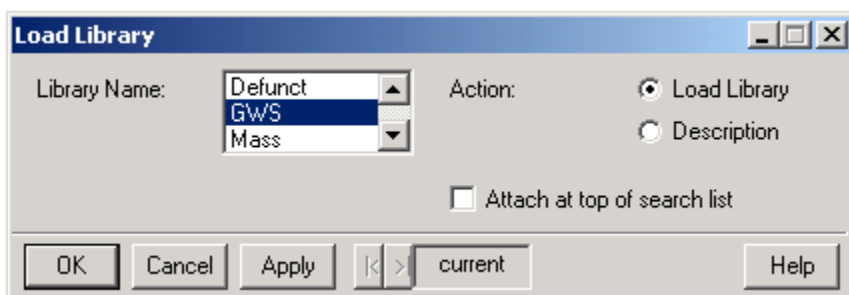
C:\Program Files\Insightful\splus6\library.

System requirement for using the library is S-Plus 5 or higher.

Start S-Plus. Then go to the File menu and down to “Load Library”.



In this list of library names, select “GWS” and click OK.



Each time you restart S-Plus, you will need to reload the library.

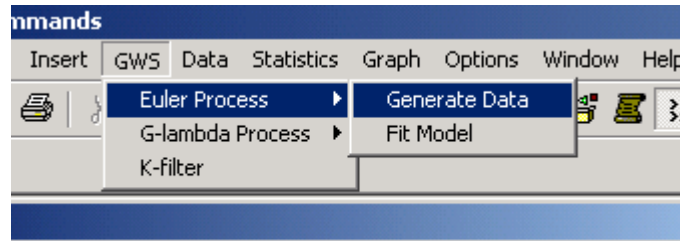
III. Generating a realization from a shifted discrete Euler model:

This program can generate an equally spaced data set from a discrete Euler model whose dual process is an AR (p) process.

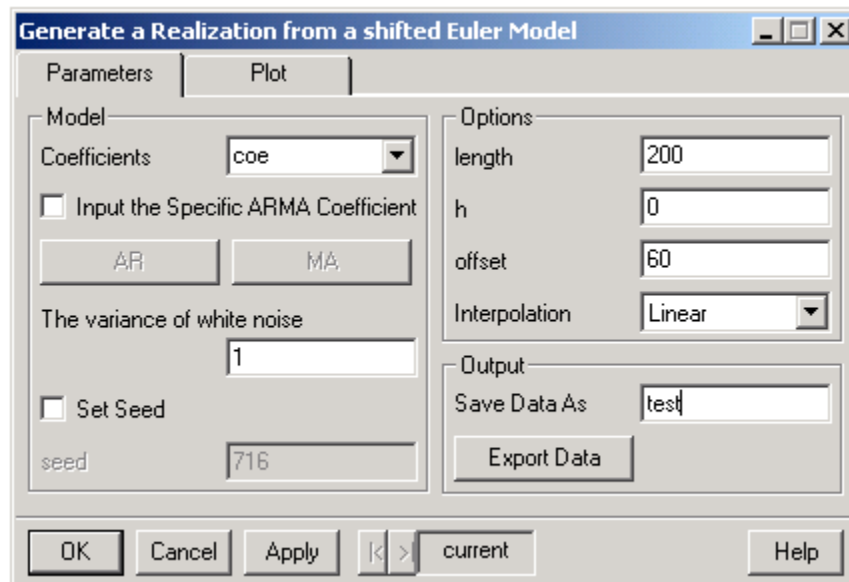
Example: Generate an equally spaced data set from the model

$$Y(t) - 1.732 * Y\left(\frac{t}{h}\right) + 0.9 * Y\left(\frac{t}{h^2}\right) = a(t) \text{ with offset } 60.$$

a). Under menu “GWS”, select Euler Process and click “Generate Data”.



b). In the dialog box, input the parameters of the model and select the output.



A. Parameters Options

1. Coefficients.

In the example, the coefficients of model are (1.732, -0.9). If you already have the coefficients dataset in S-Plus, just type the name of the dataset, i.e. **coe** in box.

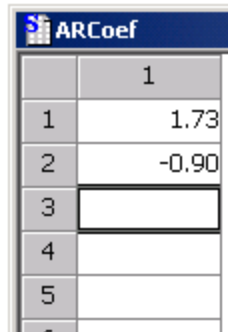
2. Input the Specific ARMA Coefficient (optional).

When this box is checked, we can set the specific coefficients for both AR and MA parts of the M-stationary model. The default value is unchecked.

3. AR and MA

The two buttons are only available when the box “**Input the Specific ARMA Coefficient**” is checked.

Click the “**AR**” and input the first coefficient, i.e. 1.732 in the first line and the second coefficient, i.e. -0.9 in the second line of the new dialog box. Close the new dialog box. It is similar to the button “**MA**”. If there is no coefficient in MA part, then we don’t need click it.

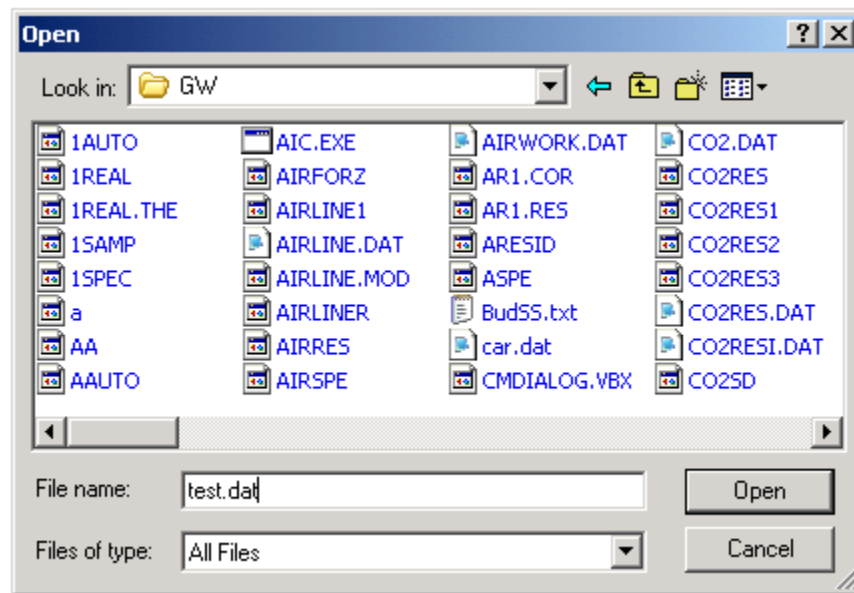


	1
1	1.73
2	-0.90
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4. **The variance of white noise** (required)
Specify the variance of the white noise process. The default value is 1.
5. **Set Seed** (optional).
When this box is checked, we can set the specific random seed to generate the data. The default value is unchecked.
6. **Seed** (optional)
The random seed can be any integer. The function is valid only if “Set Seed” is checked; otherwise, the seed will be randomly chosen.
7. **Length** (required)
Specify the length of the realization to be generated. The default value is 200.
8. **h** (required)
Specify the value of h in the model. The default value is 0. If h is not greater than 1, the computer will pick h. If you specify a specific value of h, it should be greater than 1.
9. **offset** (required)
Specify the value of the offset. The default value is 60. The offset can be any positive value.
10. **Save Data As** (optional)
This option lets you save the generated data, which you might use in S-Plus later, as a dataset in S-Plus. Input whatever name you want, i.e. **test**.

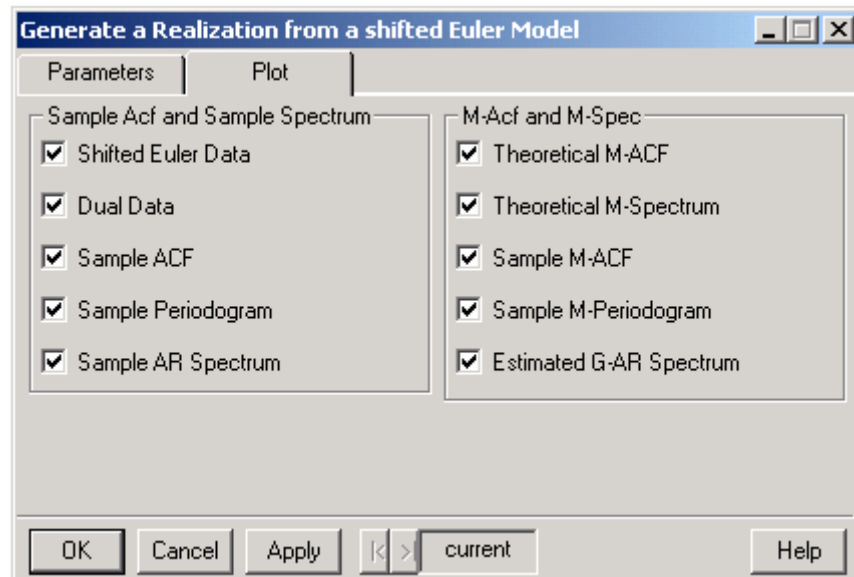
11. Export Data (optional)

Save the equally spaced data into a TXT file in the computer. Click the button and browse to the folder you to which you wish to export the equally spaced data. Input the name of file, i.e. **c:\gw\test.dat**, and then click **Open**. The exported data will be a txt file with the first entry equaling the total number of data points exported.



B. Plots Options

Select your outputs. Default is to output all results.



Shifted Euler Data:	The equally spaced dataset.
Dual Data:	The dual data of the shifted Euler data.
Sample ACF:	The sample autocorrelation function of the equally spaced data.
Sample Periodogram:	The sample periodogram of the equally spaced data.
Sample AR Spectrum:	The AR spectrum after fitting an AR model to the data.
Theoretical M-ACF:	Theoretical ACF based on the discrete dual.
Theoretical M-Spectrum:	Theoretical M-spectrum.
Sample M-ACF:	The sample ACF based on dual data.
Sample M-Periodogram:	The sample M-periodogram
Estimated G-AR Spectrum:	The M-spectrum of the fitted Euler model.

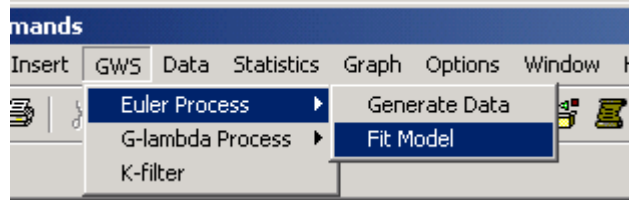
After specializing **parameters** and **plot** options, click **OK**.

The program will give a short report and a two-page plot by default.

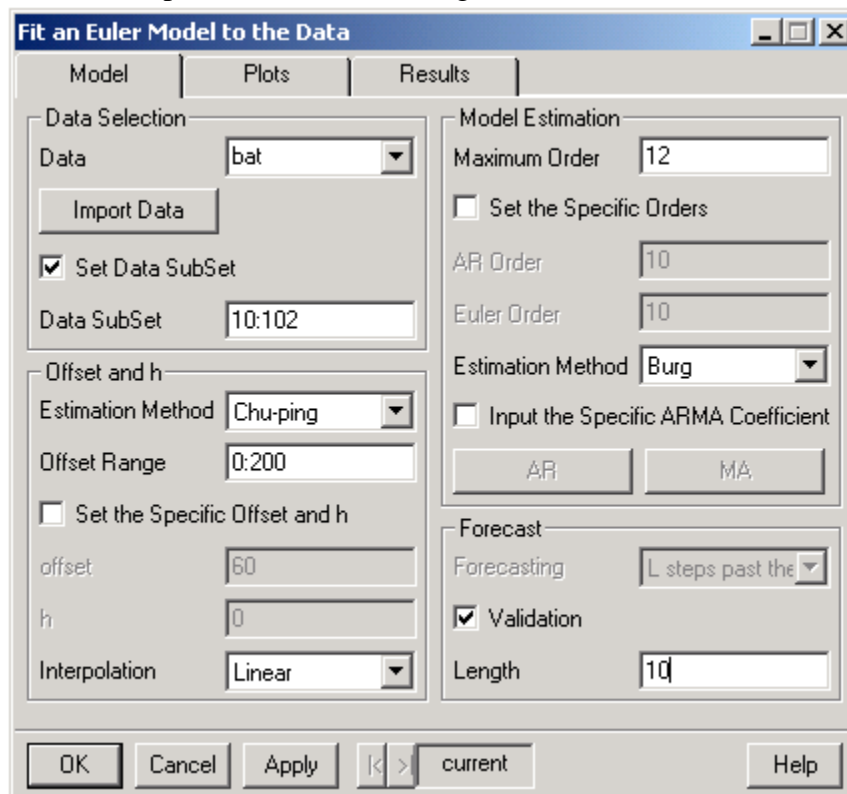
If a name of the data set is given in **Save Data As** , i.e. **test**, S-Plus will generate a dataset named **test** for the equally spaced data.

IV. Fitting an Euler model to an equally spaced dataset:

a). Under menu “GWS”, select Euler Process and click “Fit Model”.



b) Input the data and parameters in the dialog box.



A. Model Options

1. **Data:** Input the name of the time series dataset, i.e. **bat**, if it is already in S-Plus. The dataset can be a vector or matrix with one column. If the dataset hasn't been imported into S-Plus yet, please click the button “**Import Data**” button and follow the directions for importing data.

2. **Import Data:** The function is used when you want to import data from a data file in your computer. The function only supports TXT data files.

3. a.) **Set Data Subset**

Check this box if you wish to analyze a subset of the data.

b.) Data SubSet

Enter the range of the data you wish to use from lowest to highest, separated by a colon. In our example, 10:102 means to get the data from 10th to 102nd. The function is valid only if Set Data Subset has been checked.

4. The Method for Picking Offset and h

There are three methods for choosing offset and h. These are Chu-ping, Huiping and Eunha. The default method is Chu-ping, and the default maximum offset is 200.

5. Set the Specific offset and h

This function allows us to set the specific offset and h, which we might get from other methods. The function is valid only if “Set the Specific offset and h” has been checked.

6. Interpolation For now there is only one option for interpolation, linear.

7. Maximum Order Set the maximum order for both AR and Euler model.

8. Set the Specific Orders for models

You can specify the orders for the models. Set the specific orders for AR and Euler models respectively. The function is valid only if “Set the Specific Order for models” has been checked.

9. Estimation Method

You can choose the estimation method you prefer for estimating the coefficients of the model. The options are Burg, Yule-Walker and MLE. The default is Burg.

10. Input the Specific ARMA Coefficient (optional).

When this box is checked, we can set the specific coefficients for both AR and MA parts of the Euler model.

11. AR and MA

The two buttons are only available when the box “**Input the Specific ARMA Coefficient**” is checked.

Click the “**AR**” and input the first coefficient, i.e. 1.732 in the first line and the second coefficient, i.e. -0.9 in the second line of the new dialog box. Close the new dialog box. It is similar to the button “**MA**”. If there is no coefficient in MA part, then we don’t need click it.

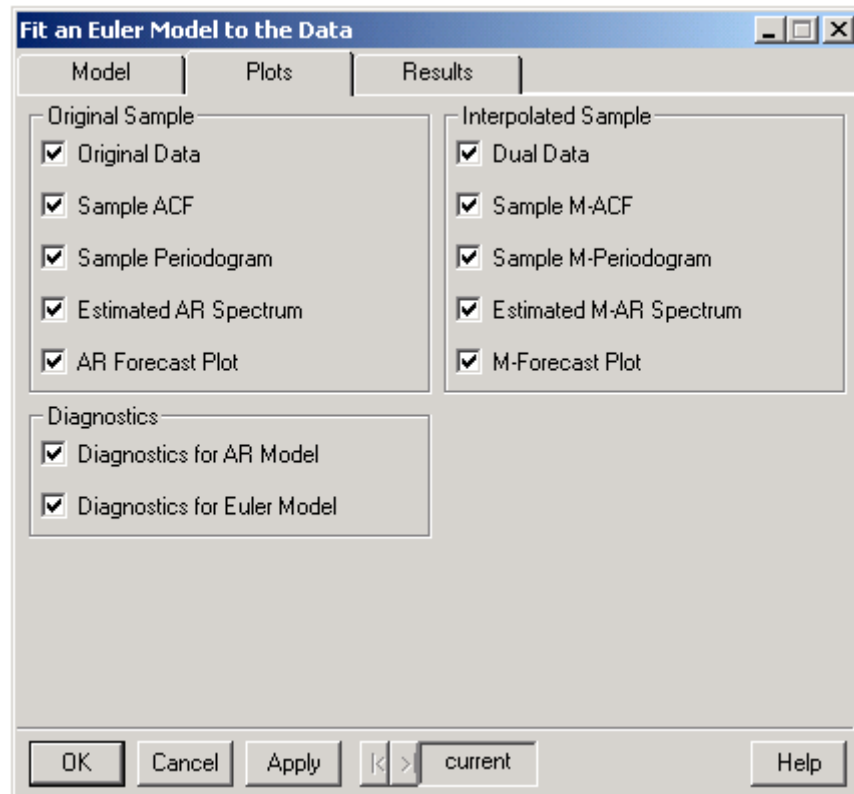
12. Forecasting, Validation and Length

There are several options in for forecasting. The default option is validation. If you want to use this option, input the length (L) for validation. The validation method leaves the last L data points out of the estimation procedures. If you uncheck the validation option,

you will have three types of forecast methods to choose. These are “L steps past the end”, “Last L step”, and “Last L step update”.

B. Plots Options

To specify which plots you would like to create, click on the “Plots” tab of the dialog box.

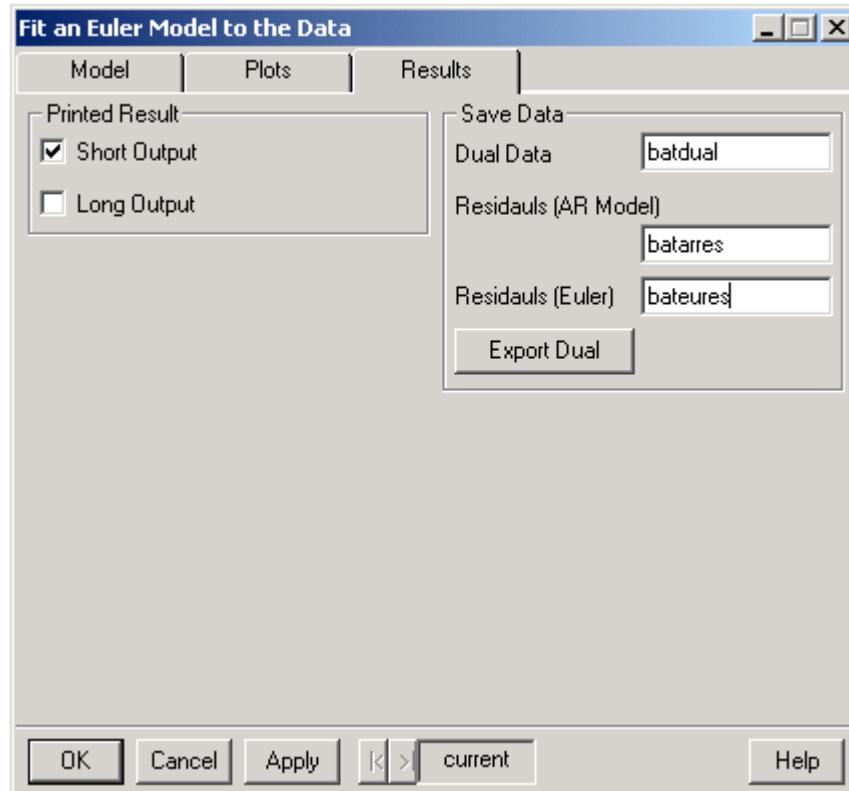


- Original Data:** The plot of the original data
- Sample ACF:** The plot of sample ACF of the original data
- Sample Spectrum:** The plot of sample periodogram of the original data
- Estimated AR Spectrum:** The plot of spectrum based on the best fitted AR model to the original data
- AR Forecast Plot :** The forecast based on the fitted AR model
- Dual Process:** The dual data
- Sample M-ACF:** The plot of sample ACF of the interpolated data
- Sample M-Spectrum:** The plot of the sample M-periodogram
- Estimated M-AR Spectrum:** The M-spectrum based on the Euler model fitting the interpolated data
- M-Forecast Plot:** The forecast plot using the Euler model
- Diagnostic for AR Model:** Diagnostic plots for the AR model

Diagnostic for Euler Model: Diagnostic plots for the Euler model

C. Results Options

To specify options for the results to be displayed, click on the results tab in the dialog box. Note, at this point there is no difference between the short output and the long output.



1. Dual Data

To save the dual data in S-Plus, type in the name for the dual data, i.e. **batdual**, in the Dual Data box.

2. Residuals (AR Model)

To save the residuals from the AR model in S-Plus, type in the name for these residuals, i.e. **batarres**, in the Residuals (AR Model) box.

3. Residuals (Euler)

To save the residuals from the Euler model in S-Plus, type in the name for these residuals, i.e. **bateures**, in the Residuals (Euler) box.

4. Export Dual

If you want to export the dual data to be used outside of S-Plus, click on the "Export Dual" button. Browse to the folder to which you wish to export the dual data. Type in the desired name for the file. Click "Open". This will export the dual data in TXT format. The first entry of the exported dataset will be the length of the dataset.

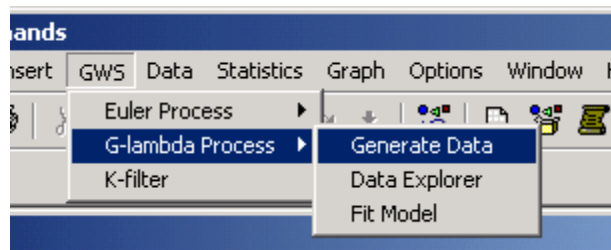
Click OK to fit the model.

V. Generating a realization from a $G(\lambda)$ -Stationary model:

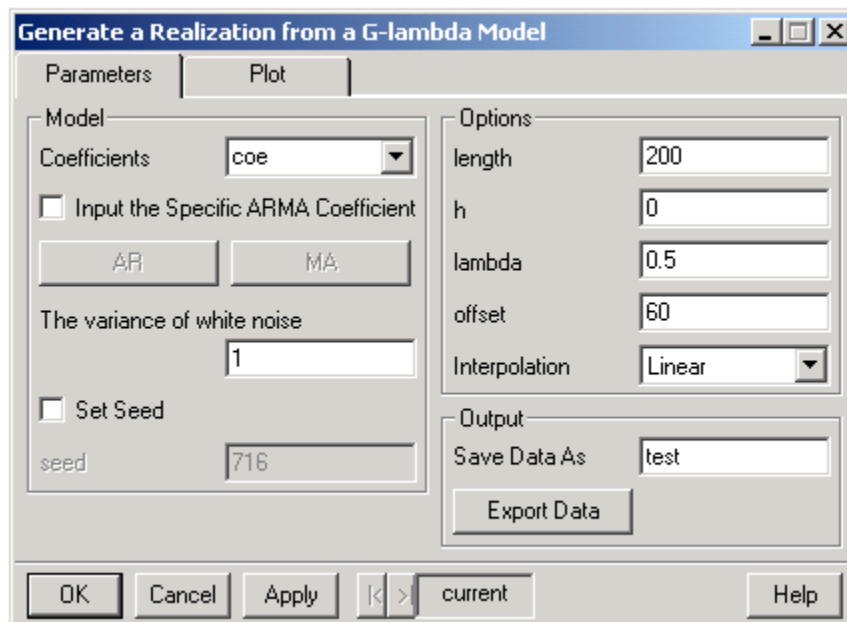
This program can generate an equally spaced data set from a discrete $G(\lambda)$ model whose dual process is an AR (p) process.

Example: Generate an equally spaced data set from a $G(\lambda)$ model with dual model $Y_t - 1.732 * Y_{t-1} + 0.9 * Y_{t-2} = a_t$, offset 60 and $\lambda=0.5$.

a). Under menu “GWS”, select $G(\lambda)$ Process and click “Generate Data”.



b). In the dialog box, input the parameters of the model and select the output.



A. Parameter Options

1. Coefficients.

In the example, the coefficients of model are (1.732, -0.9). If you already have the coefficients dataset in S-Plus, just type the name of the dataset, i.e. **coe** in box.

2. Input the Specific ARMA Coefficient (optional).

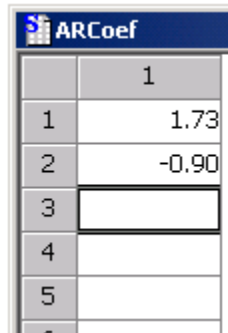
When this box is checked, we can set the specific coefficients for both AR and MA parts of the $G(\lambda)$ -stationary model. The default value is unchecked.

3. AR and MA

The two buttons are only available when the box “**Input the Specific ARMA Coefficient**” is checked.

Click the “**AR**” and input the first coefficient, i.e. 1.732 in the first line and the second coefficient, i.e. -0.9 in the second line of the new dialog box. Close the new dialog box. It is similar to the button “**MA**”. If there is no coefficient in MA part, then we don’t need click it.

Click the “**Coe**” and input the first coefficient, i.e. 1.732 in the first line and the second coefficient, i.e. -0.9 in the second line of the new dialog box. Close the new dialog box.



	1
1	1.73
2	-0.90
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4. The variance of white noise (required)

Specify the variance of the white noise process. The default value is 1.

5. Set Seed (optional).

When this box is checked, we can set the specific random seed to generate the data. The default value is unchecked.

6. Seed (optional)

The random seed can be any integer. The function is valid only if “Set Seed” is checked; otherwise, the seed will be randomly chosen.

7. Length (required)

Specify the length of the realization to be generated. The default value is 200.

8. h (required)

Specify the value of h in the model. The default value is 0. If h is not greater than 1, the computer will pick h . If you specify a specific value of h , it should be greater than 1.

9. lambda (required)

Specify the value of λ . The default value is 0.5. λ can be any number.

10. offset (required)

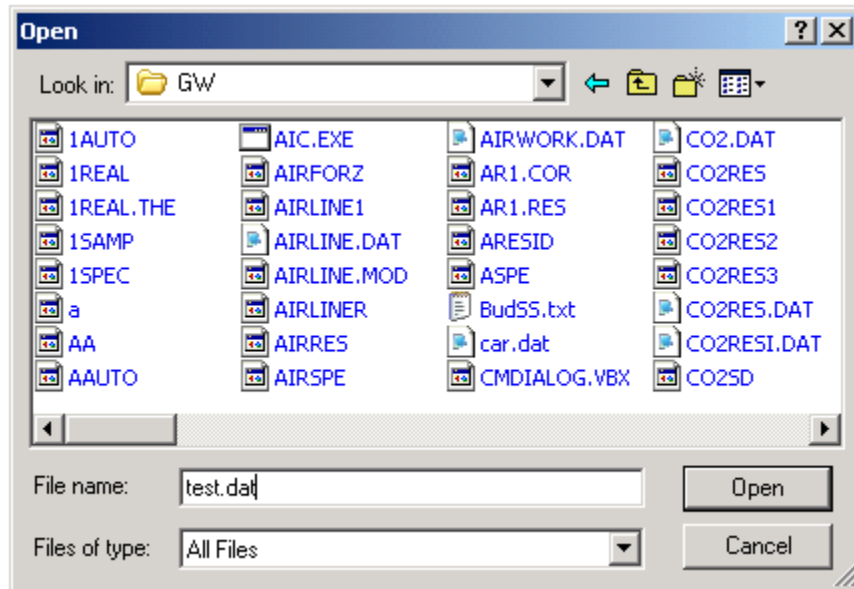
Specify the value of the offset. The default value is 60. The offset can be any positive value.

11. Save Data As (optional)

This option lets you save the generated data, which you might use in S-Plus later, as a dataset in S-Plus. Input whatever name you want, i.e. **test**.

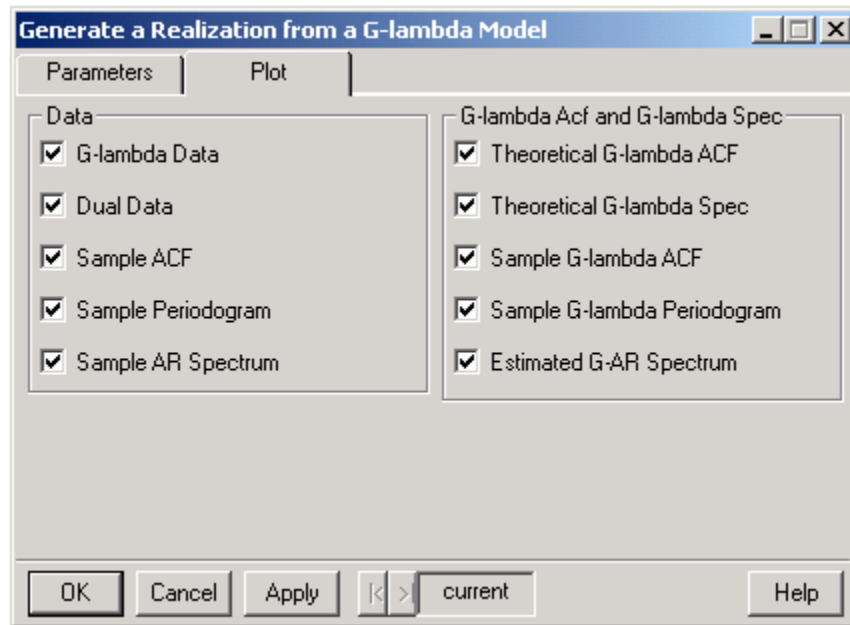
12. Export Data (optional)

Save the equally spaced data into a TXT file in the computer. Click the button and browse to the folder you to which you wish to export the equally spaced data. Input the name of file, i.e. **c:\gw\test.dat**, and then click **Open**. The exported data will be a txt file with the first entry equaling the total number of data points exported.



B. Plots Options

Select your outputs. Default is to output all results.



G-lambda Data: The equally spaced dataset.

Dual Data: The dual data of the shifted $G(\lambda)$ data.

Sample ACF: The sample autocorrelation function of the equally spaced data.

Sample Periodogram: The sample periodogram of the equally spaced data.

Sample AR Spectrum: The AR spectrum after fitting an AR model to the data.

Theoretical G-lambda ACF: Theoretical ACF based on the discrete dual.

Theoretical G-lambda Spec: Theoretical $G(\lambda)$ spectrum.

Sample G-lambda ACF: The sample ACF based on dual data.

Sample G-lambda Periodogram: The sample $G(\lambda)$ -periodogram based on dual data.

Estimated G-AR Spectrum: The $G(\lambda)$ -spectrum of the fitted $G(\lambda)$ model.

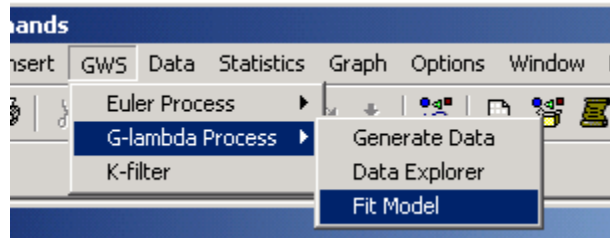
After specializing **parameters** and **plot** options, click **OK**.

The program will give a short report and a two-page plot by default.

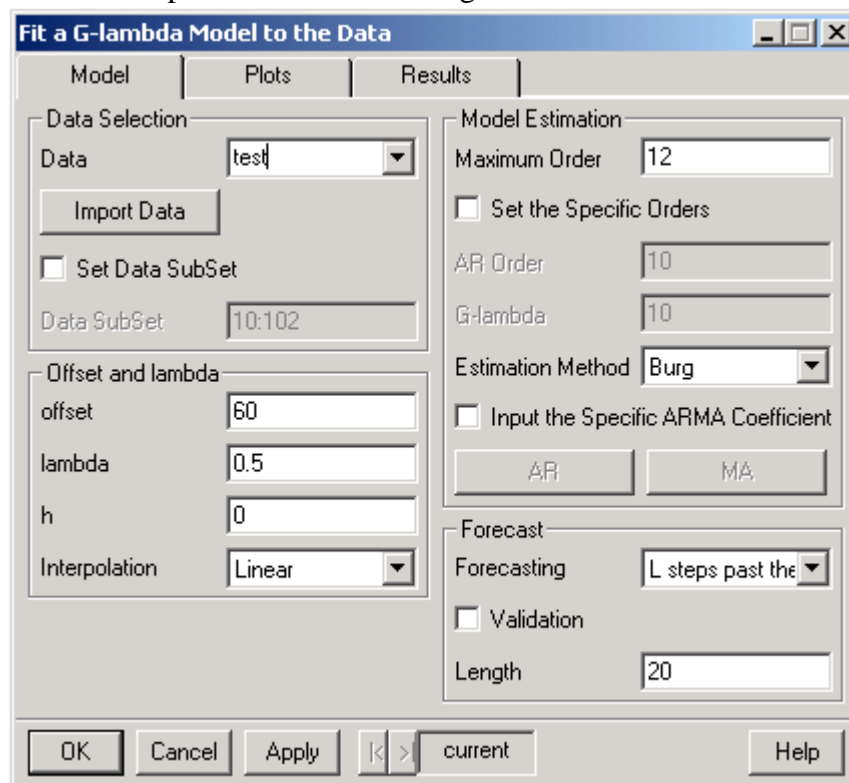
If a name of the data set is given in **Save Data As**, i.e. **test**, S-Plus will generate a dataset named **test** for the equally spaced data.

VI. Fitting a $G(\lambda)$ -stationary model to an equally spaced dataset:

a). Under menu “GWS”, select G-lambda Process and click “Fit Model”.



b) Input the data and parameters in the dialog box.



A. Model Options

1. **Data:** Input the name of the time series dataset, i.e. **test**, if it is already in S-Plus. The dataset can be a vector or matrix with one column. If the dataset hasn't been imported into S-Plus yet, please click the button “**Import Data**” button and follow the directions for importing data.

2. **Import Data:** The function is used when you want to import data from a data file in your computer. The function only supports TXT data files.

3. a.) **Set Data Subset**

Check this box if you wish to analyze a subset of the data.

b.) **Data SubSet**

Enter the range of the data you wish to use from lowest to highest, separated by a colon.

4. **Offset**

This function allows us to set the specific offset, which we might get from other methods (Data Explorer). The default is 60.

5. **lambda** You can specify the value of λ , which we might get from other methods (Data Explorer). The default is 0.5.

6. **h** You can set the specific sampling rate. The default value is 0, which means that the computer will help you pick a sampling rate.

6. **Interpolation** For now there is only one option for interpolation, linear.

7. **Maximum Order** Set the maximum order for both AR and $G(\lambda)$ -stationary model.

8. **Set the Specific Orders for models**

You can specify the orders for the models. Set the specific orders for AR and $G(\lambda)$ -stationary models respectively. The function is valid only if “Set the Specific Order for models” has been checked.

9. **Estimation Method**

You can choose the estimation method you prefer for estimating the coefficients of the model. The options are Burg, Yule-Walker and MLE. The default is Burg.

10. **Input the Specific ARMA Coefficient** (optional).

When this box is checked, we can set the specific coefficients for both AR and MA parts of the $G(\lambda)$ -stationary model.

11. **AR and MA**

The two buttons are only available when the box “**Input the Specific ARMA Coefficient**” is checked.

Click the “**AR**” and input the first coefficient, i.e. 1.732 in the first line and the second coefficient, i.e. -0.9 in the second line of the new dialog box. Close the new dialog box. It is similar to the button “**MA**”. If there is no coefficient in MA part, then we don’t need click it.

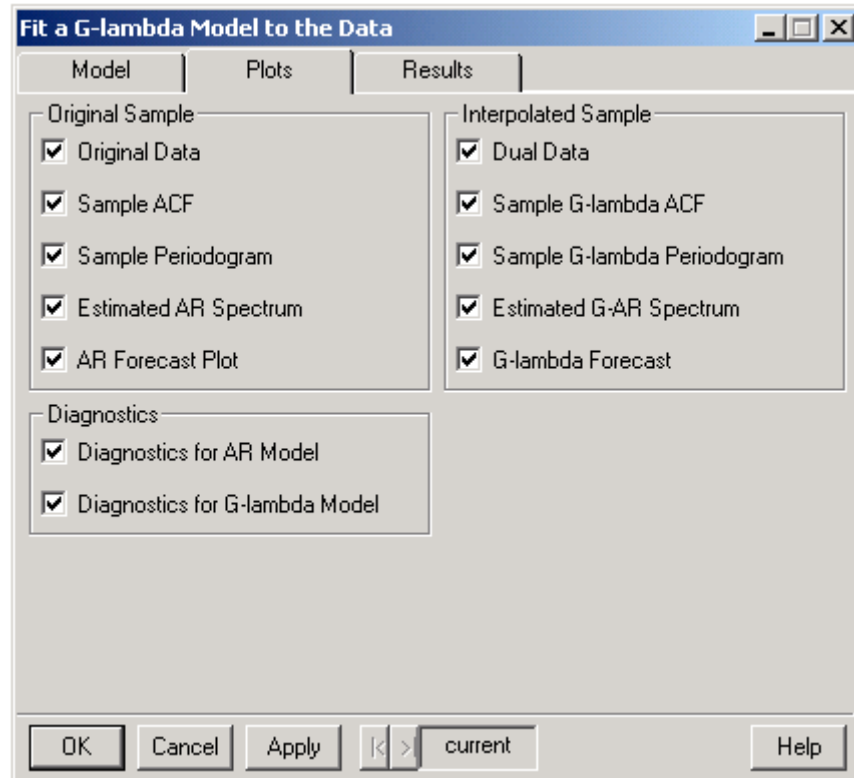
10. **Forecasting, Validation and Length**

There are several options in for forecasting. The default option is forecasting. If you want to use validation, check the validation box and input the length (L) for validation. The validation method leaves the last L data points out of the estimation procedures. If you uncheck the validation option, you will have three types of

forecast methods to choose. These are “L steps past the end”, “Last L step”, and “Last L step update”.

B. Plots Options

To specify which plots you would like to create, click on the “Plots” tab of the dialog box.



Original Data: The plot of the original data

Sample ACF: The plot of sample ACF of the original data

Sample Periodogram: The plot of sample periodogram of the original data

Estimated AR Spectrum: The plot of spectrum based on the best fitted AR model to the original data

AR Forecast Plot: The forecast based on the fitted AR model

Dual Data: The dual data

Sample M-ACF: The plot of sample ACF of the interpolated data

Sample G-lambda Periodogram: The plot of the sample $G(\lambda)$ -periodogram of the interpolated data

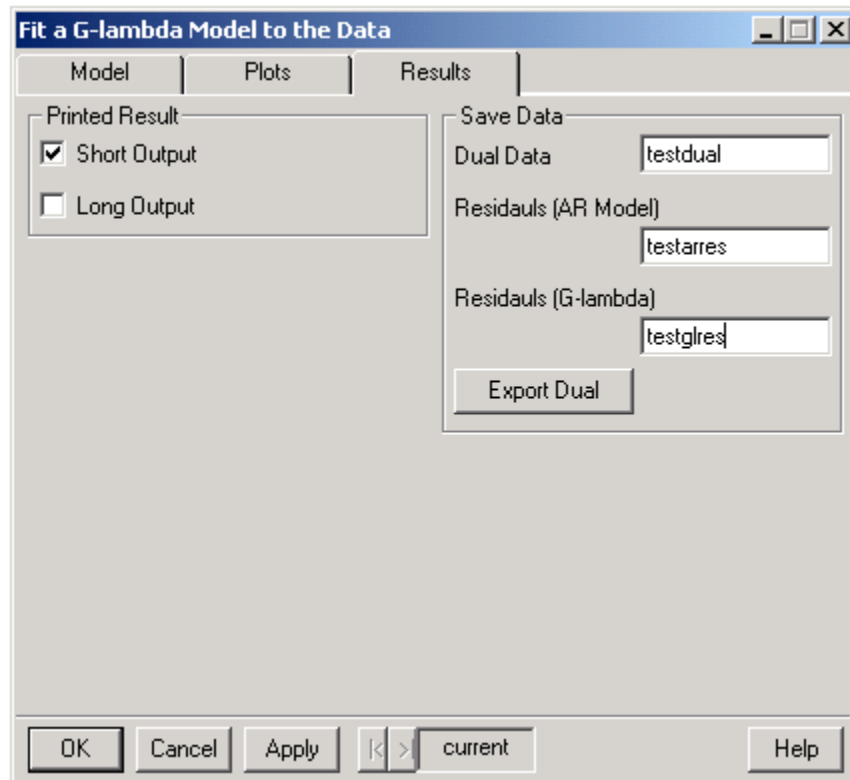
Estimated G-lambda AR Spectrum: The $G(\lambda)$ -spectrum based on the $G(\lambda)$ -stationary model fitting the interpolated data

G-lambda Forecast Plot: The forecast plot using the $G(\lambda)$ -stationary

	model
Diagnostic for AR Model:	Diagnostic plots for the AR model
Diagnostic for G-lambda Model:	Diagnostic plots for the $G(\lambda)$ -stationary model

C. *Results Options*

To specify options for the results to be displayed, click on the results tab in the dialog box. Note, at this point there is no difference between the short output and the long output.



1. **Dual Data**

To save the dual data in S-Plus, type in the name for the dual data, i.e. **testdual**, in the Dual Data box.

2. **Residuals (AR Model)**

To save the residuals from the AR model in S-Plus, type in the name for these residuals, i.e. **testarres**, in the Residuals (AR Model) box.

3. **Residuals (G-lambda)**

To save the residuals from the $G(\lambda)$ -stationary model in S-Plus, type in the name for these residuals, i.e. **testglres**, in the Residuals (G-lambda) box.

4. **Export Dual**

If you want to export the dual data to be used outside of S-Plus, click on the “Export Dual” button. Browse to the folder to which you wish to export the dual

data. Type in the desired name for the file. Click “Open”. This will export the dual data in TXT format. The first entry of the exported dataset will be the length of the dataset.

Click OK to fit the model.