WINKS SDA
Statistical Data Analysis and Graphs

WINKS R Command Summary Reference Guide

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WINKS R COMMANDS SUMMARY

The WINKS program provides a way to use statistical routines written in the R language. WINKS can run the R program, capture the output and display the results in the WINKS viewer. This reference shows how to create R code for WINKS. The code for the R routines accessed by WINKS are in a command file named WINKSRPROGS.WR. The procedures defined in this file appear on the WINKS SDA Analyze menu under the heading "R Routines". (For the GW-WINKS Time Series version, the R code in the file GWRPROGS.WR causes items to appear on the Time Series menu in the "R Routines" menu.) This WINKS R Command Summary Reference Guide explains how the code in the WINKS R files is used to add menu items to the WINKS menus.

The WINKS R code (in the .WR file) defines the contents of two WINKS dialog boxes and specifies how information selected by the user to form these dialog boxes is used in an R code routine.

The WINKSRPROGS.WR file or GWRPROGS.WR file contains code that creates two WINKS dialog boxes and includes the R code for analysis.

The procedures included in the .WR file appears on the WINKS R-Routine menu (R menu item.)

When the user selects the R menu item from the R-Routine menu, the **Variable Selection Dialog Box** appears on the screen, and prompts the user to specify which variables will be used in the R routine

An **Options Dialog Box** may also be defined that allows the user to select options (specified in the .WR file code).

Information from the Variable Selection and Options Dialog box is used to create the appropriate R code needed to run the desired analysis.

The R language code created by the WINKS R procedure is sent to the R language. The R program runs the analysis and produces output that is then displayed in the WINKS viewer, or creates output specified by the code.

Example: Using WINKS R

Before illustrating how you can create a WINKS R program, go through this example of an existing program. This example illustrates how WINKS R is used to select variables from a WINKS data set, and how it allows users to select analysis options, then uses that information to call the R program to calculate a statistical procedure and report results. (For these examples to work, you must have R installed on your computer. If you do not, go to the Appendix for information on installing the free R software program.)

Step 1: In WINKS, open the file SUN.SDA (sunspot time series data). Here are the first few records:
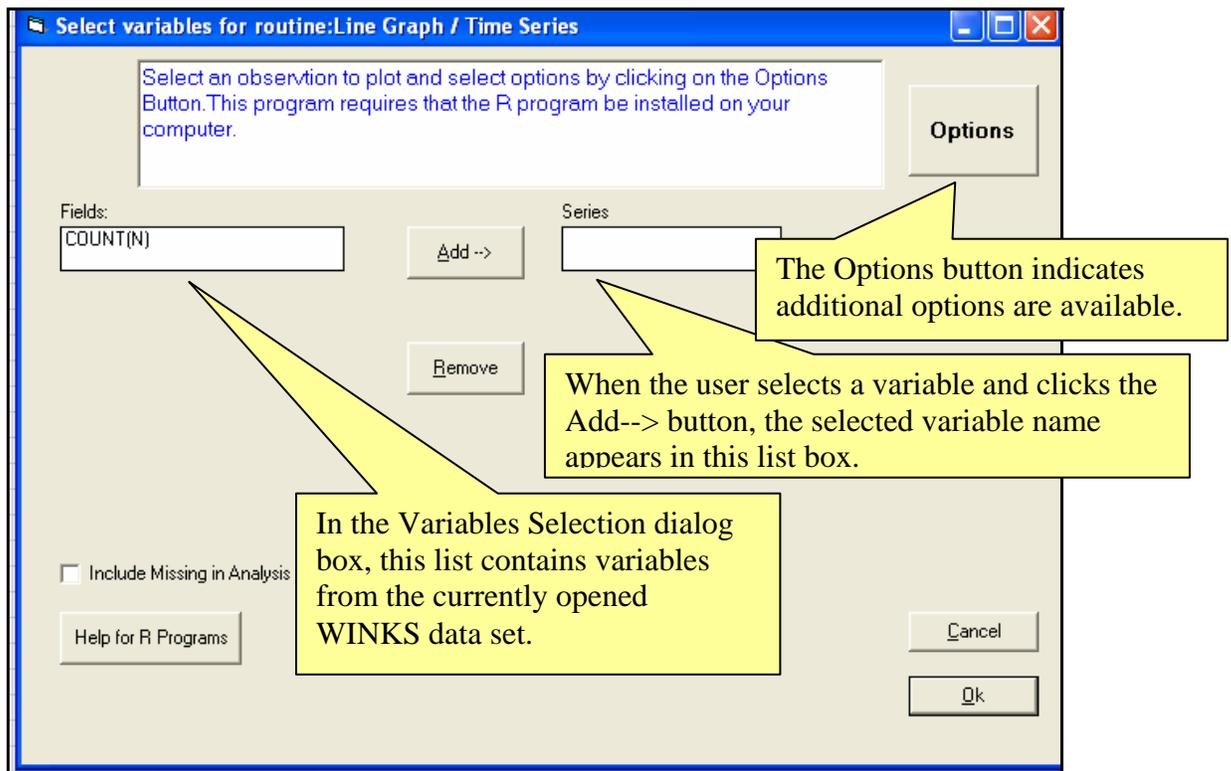
The WINKS R Variable Selection Dialog Box

Make note of the Fields list of variables from the WINKS data set (in this case only one variable), the Add button, Series list box, and the Options button.

Step 3: To indicate what variable will be used in the graph, **click on the variable name** *COUNT* in the Fields list box, and click Add. The *COUNT* variable name is displayed in the Series list box.

Step 4: To select options for the plot, **click the Options Button**. The following dialog box is displayed.
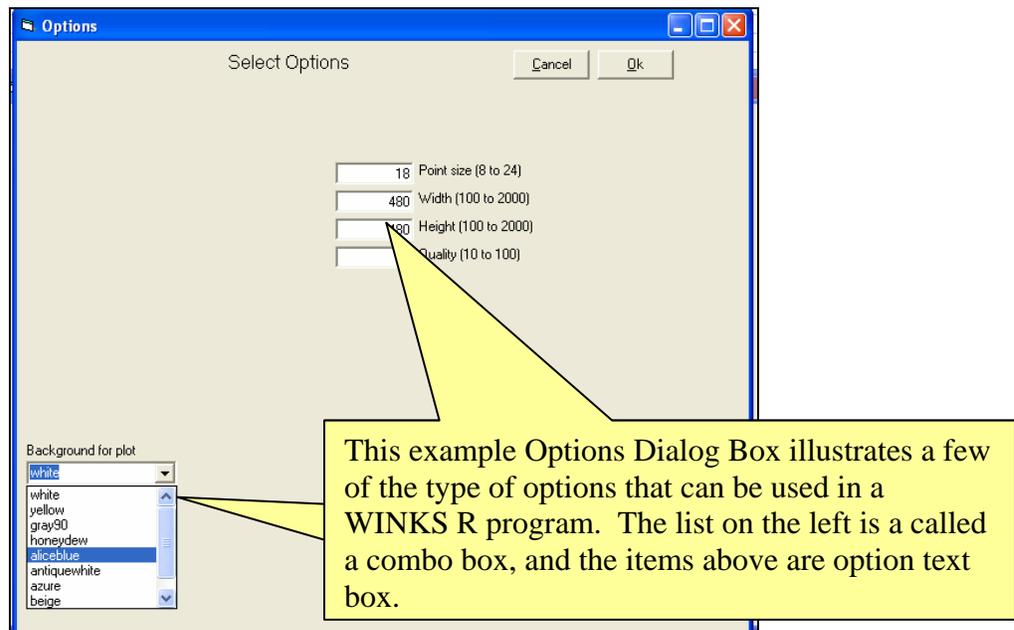
The WINKS R Options Dialog Box

Step 5: The Options Dialog Box allows you to select several options that determine how the line graph is created. For this example, **select the color Alice Blue in the combo box and enter the number 18 in the Point Size option text box. Click Ok.** The program returns to the Variable Selection dialog box.

Step 6: With the variable *COUNT* already selected, click **Ok in the Variable Selection Dialog Box** to display the graph. *(If you get a message that R must be installed or located on your computer, go to the Appendix (Setting up R) in this document for information about setting up R for WINKS.)* The following screen is displayed (the WINKS R Viewer.)
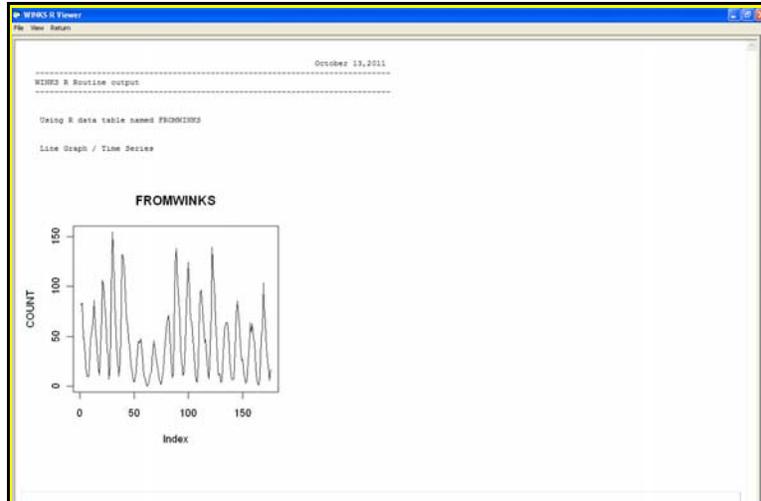
The WINKS R Viewer

Step 6: To see the R code that was used to create this graph, **click the View pull-down menu in the WINKS R Viewer and select Code**. The following R code is displayed:

```
FROMWINKS <- read.table("C://Program Files//TexaSoft//WINKS7//W2R.CSV",header = TRUE,sep
=",",colClasses=c(COUNT="numeric"))
cat("\n Using R data table named FROMWINKS\n\n");
cat("\n Line Graph / Time Series \n\n");
attach(FROMWINKS)
jpeg(file="KSRPLOT1.jpg", width = 480, height = 480, units = "px", pointsize = 18,
quality = 75, bg = "white", res = NA)
plot(COUNT,  type="l",ylab="COUNT", main="FROMWINKS")
```

This tutorial assumes that you already know something about R code, so we don't explain all of the information. This code simply allows you to see what R code is created by WINKS R. It can help you debug a program you write in WINKS R. Note that code reads the selected WINKS data, and uses the data plus the options you selected from the dialog boxes to write the appropriate R code for the requested analysis. **Click Return** to close the Code box.

Note: A similar View menu option (Log) displays the R log created when the WINKS R code was run. It can also be helpful in debugging a WINKS R program.

Step 7: To print the results, C**lick File, Print.** To copy the graph for the purpose of pasting it into another application (such as Word), right click on the graph and select copy. You can also right click on the graph, and select Print to print only the graph.

To exit the WINKS R Viewer, **click Return.**

This example illustrated the "end product" of a WINKS R program. You can create your own WINKS R programs using the information contained in the following pages. These instructions show how to design the Variables Selection and Options dialog boxes and how to a WINKS R program that uses information from a WINKS data set (along with user selected options) to create the R code that will analyze the information and display the results.

Creating the Two WINKS R Dialog Boxes

The two WINKS R dialog boxes specified in the .WR file are

1. **The Variable Selection Dialog Box** – allows the user to select which variables in a WINKS data set are to be used in the WINKS R routine.

2. **The Options Dialog Box** – allows the user to choose options for the WINKS routine.

These dialog boxes are used to allow the user to choose which variables and which options to use for an R-language statistical analysis routine.

An Example Variable Selection Dialog Box

Instructions to the user about how to select variables appear here.

Here is an example **Variable Selection Dialog Box**:

Dependent variables list - you can define the button label text-box label.

These are referred to as "buttons."

Independent variables list.

Group variable list.

Specify an on-line help link.

Your WINKS R-Code file defines which, if any of those items appear in this dialog box. You can specify up to 3 types of variable selection buttons – Dependent, Independent and Group -- (the Remove button is automatic) as well as labels for the buttons and labels for the input text boxes. You can also define how many variables to accept for each of the Dependent, Independent and Group variable lists, and if the selected variables must be a numeric type. Detailed instructions follow.

An Example Options Dialog Box

Here is an example of the Options Dialog Box. All of the items that appear on this box are optional. Define any that you need in order to perform the analysis you want within your R-Code.

Option screen **title -** you specify wording.

Radio Buttons – users choose one only, and that choice specifies a value that you can dynamically use in your R-code.

Check Options – when an item is checked, it specifies a value that you can dynamically place in your R-Code.

Options that can be codes to accept text or numeric values. You can place the information in any text field into your R-Code.

Long text values – allows you to specify information such as titles or any other long text information that you can dynamically include in your R-code.

Select Options for Test   Cancel   Ok

Test Radio Buttons
One   two   five
three   four   six

☑ Any Y\n question caption   500 Num backcast obs (100 to 500)
☑ Check 2   Default Character option
☐ Check 3   4 Option 3
☑ Check 4   1 Option 4
☐ Check 5   2 Option 5
☑ Check 6   2 Option 6
☐ Check 7   2 Option 7
☑ Check 8   2 Option 8
☐ Check 9   3 P Maximum (0 to 20)

This is the label for the long text item 1
This is a test of the long text item 1

An Example Options Dialog Box

Example WINKS R-Command Text File

The WINKS program comes with sample R programs already coded for you to use as examples. For WINKS SDA, the default R code file is named WINKSRPROG.WR. For the specialty GW-WINKS (Applied Time Series Analysis) program, the default R code file is named GWRPROGS.WR. *The GW-WINKS programs support the text Applied Time Series Analysis by Woodward, Gray and Elliott (CRC Press) ISBN: 9781439818374*

- **WINKSRPROG.WR** – Default code programs for WINKS
- **GWPROGS.WR** – Default code programs for GW-WINKS (Time Series)

A .WR file can contain several R routines. The general format for the code used to set up a routine is shown below. The following pages discuss these items in more detail.

Code is in a text file with an extension .WR

```
~BEGIN=Create a Histogram
INSTRUCTIONS=Select a dependent variable and one or more
independent variables.
SELECTTITLE=Regression Analysis
OPTIONTITLE=Select Options
et cetera
```

This section of the WINKS R code defines the name of the routine and the contents of the 2 dialog boxes.

```
~CODESTART
attach(&table)
summary(&table)
jpeg(file="KSRPLOT1.jpg")
hist(&table$&depvar1)
jpeg(file="KSRPLOT2.jpg")
plot(density(&table$&depvar1,na.rm=TRUE))
jpeg(file="KSRPLOT3.jpg")

et cetera
```

This section of the WINKS R code contains R-language code, with special WINKS macro variable names that indicate what information from the dialog boxes will be included in the R code.

```
~CODEEND
~END
```

Ends this WINKS R Routine. To begin another routine, start with another ~BEGIN= statement.

Setting up the Variable Selection Dialog Box

One section of the WINKS R-Code file is used to design the Variable Selection dialog box that is displayed when the user requests the procedure. This dialog box prompts the user to specify a list of WINKS data set variables to be used in the R-Code routine.

The WINKS R Variable Selection Dialog Box allows the specification of 3 types of variables: DEPENDENT, INDEPENDENT, and GROUP. (These names are arbitrary since you can define the labels on the dialog box any way you like.) These variable selections indicate which variables from the currently opened WINKS data set will be used in the R code procedure.

For example, if you design an R code procedure to calculate simple statistics by group, you might want to use the DEPENDENT type variables to specify the variable that refers to the data columns for which you want to calculate statistics and the GROUP type variable to specify the variable (column data) to use as the grouping (or breakout) variable. Specifications for the three main button types are shown in this table:

Dependent Variables	Independent Variables	Grouping variables
DEPMINITEMS=	INDMINITEMS=	GROUPMINITEMS=
DEPMAXITEMS=	INDMAXITEMS=	GROUPMAXITEMS=
DEPMUSTBENUMBER=	INDMUSTBENUMBER=	GROUPMUSTBENUMBER=
DEPCAPTION=	INDCAPTION=	GROUPCAPTION=
DEPBUTTON=	INDBUTTON=	GROUPBUTTON=

Note that you don't have to use any of these variables unless your R code needs that information.

For each variable type you do use, you need to at least specify the "MINITEMS" and "MAXITEMS" options to indicate the minimum and maximum number of WINKS data set variables that are allowed for the particular R procedure. The "MUSTBENUMBER" default is "YES." If a group variable can be of character type, for example, you could specify GROPUMUSTBENUMBER=No.

The default labels and button names for the Variable Selection Dialog Box buttons are

Button type	Label Default	Button default
Dependent	Dependent	Add -->
Independent	Independent	Label -->
Group	Group	Group-->

(The "-->" in the table above is simply visual direction indication that clicking the button will copy the variable name from the variable list on the left into the appropriate analysis list box on the right.)

If the default labels and button names meet the needs for your routine, you do not need to specify the CAPTION or BUTTON options.

The following code illustrates setting up "Dependent," and "Independent" variables for
an analysis. (Group variables follow same pattern.)

```
'----------------------------------------
'    EXAMPLE Regression
'    This is a comment
'----------------------------------------
~BEGIN=Regression Analysis
INSTRUCTIONS=Select a dependent variable and one or more independent
variables.
SELECTTITLE=Regression Analysis
OPTIONTITLE=Select Options

' You can include comments starting with a single quote
# Or use the hash mark to indicate a comment

DEPMINITEMS=1
DEPMAXITEMS=3
DEPMUSTBENUMBER=Y
DEPCAPTION=Dep. Var.
DEPBUTTON= Dep.->

INDMINITEMS=1
INDMAXITEMS=20
INDMUSTBENUMBER=N
INDCAPTION=Ind. Var.
INDBUTTON=Ind.->

Dialog box code continues...

...until

~CODESTART
```

~BEGIN starts a new procedure and **this name appears on the procedures menu (REQUIRED)**

Specify titles to customize the dialog box.

These commands specify which variable specification boxes will appear in the Variable Selection Dialog Box. These are defined in detail later. For example.

DEPMINITEMS=1 means that you specify that the procedure must have at least one of this type of variable specifed.

DEPMAXITEMS=3 means that you'll allow the user to specify up to 3 variables.

DEPMUSTBENUMBER=Y indicates that the variable selected must be numeric.

DEPCAPTION=Dep. Var. specifies the label for the variable text box

DEPBUTTON = Dep.→ specifies the text that appears on the "Add variable" button for this list.

Variables are designated in the R-Code using the macro-type specification & DEPVAR1, &DEPVAR2 (up to however many you specify), &INDVAR1, &INDVAR2, &GPVAR1, &GPVAR2, and so on. More explanation appears later in this tutorial.

The dialog box that appears as a result of this code is:
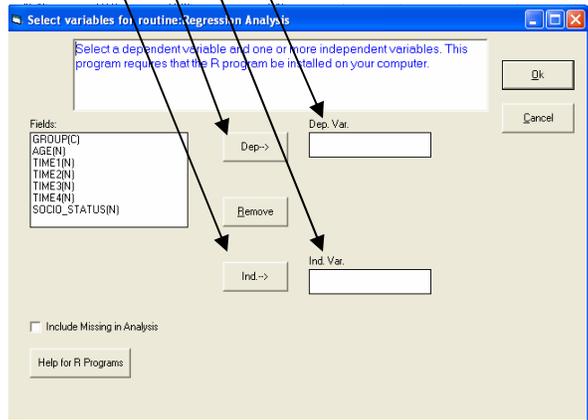
Define a Help Link (in the Variable Selection Dialog Box)

See the dialog box on page 3 – this command defined the HTML link button in the lower left corner. If you have a Help file for a WINKS R routine on the internet, you can define a link to that page using these commands

```
HTMLLINK=http://www.texasoft.com/WINKSR_Guide.pdf
HTMLLABEL=On-Line Help
```

where the HTMLLINK is any valid Internet address and HTMLLABEL is the label that will appear on the button in the variables dialog box. These commands should appear BEFORE the ~CODESTART command.

Continue lines (any place in WINKS R code)

To continue a line, either in the definition of a dialog box, or in R code, begin the line with a "+" plus symbol. For example

INSTRUCTIONS=Select a dependent variable and one or more independent
+ variables. This program requires that the R program be installed on your computer.
+will appear as a single line of code.

The + indicates a continued line.

Using Variable lists (in the Variable Selection Dialog Box)

Some R function arguments require lists where variable names are separated by plus (+) signs or commas (,) such as the following

```
Var1 + Var2 + Var3       or        Var1, Var2, Var3
```

In this case use one of these variable specifications in the R-code:

&indvarlistcomma	**&indvarlistplus**
&depvarlistcomma	**&depvarlistplus**
&gpvarlistcomma	**&gpvarlistplus**

For example, in the following lm function, the **&indvarlistplus** dynamic variable

```
lm(&depvar1 ~ &indvarlistplus,data = &table)
```

is replaced with VAR1 + VAR2 + VAR3 (or whatever variables have been selected by the user the user in the IND variables list.)

```
lm(&depvar1 ~ VAR1+VAR2+VAR3,data = &table)
```

Setting up the Options Dialog Box

The second dialog box you can define is the Options Dialog Box. When any options are specified, an Options Button appears on the Variable Selection Dialog Box. When the user clicks that button, the Options Dialog Box is displayed. Here are some examples of commands that can be used to specify items on the Options Dialog box:

Radio Buttons (in the Options Dialog Box)

The Radio Button option allows you to specify up to 6 Radio Buttons. These buttons are created so that **only one of them can be selected at any one time**. In the example below a selection box (radio button frame) is named "TYPE OF ROTATION." In this frame, three options are presented, but only one option (varimax, promax, or none) is allowed in the R function at any time. The default option is 1 (varimax.)

```
RADIOCAPTION=Frame Caption
RADIO1=Caption,Value
RADIO2=Caption,Value
RADIODEFAULT=1
```

Define up to **6 Radio buttons**. The user can select only one button of the 6 – and whichever button is selected specifies a value that is dynamically designated in the R-Code as **&RADIOSELECTED**

For example, the following code

```
RADIOCAPTION=TYPE OF ROTATION
RADIO1=Varimax Rotation,varimax
RADIO2=Promax Rotation,promax
RADIO3=No Rotation,none
RADIODEFAULT=1
```

Results in the following radio button selection box in the Options Dialog Box:
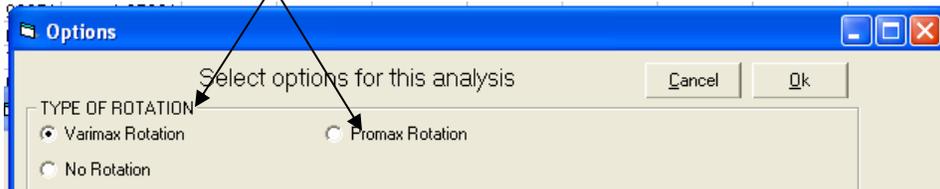
Note how the Radio caption "TYPE OF ROTATION" becomes the name of the Radio Button frame, and the item "RADIO2=Promax Rotation, promax" becomes the second of the 3 defined radio buttons, and the value of &RADIOSELECTED when that button is selected is promax (note the importance of the lower case for the item value.)

When you place the macro variable &RADIOSELECTED anywhere in the R code, it is replaced with the selected value. In this case promax.

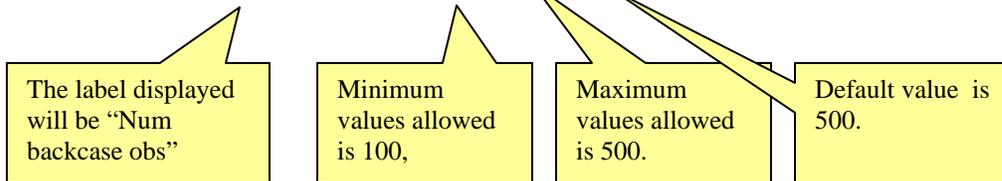Another item you may define in the Options dialog box are Option Values:

Option Values (in the Options Dialog Box)

OPTVALUEs can be specified in two ways, as illustrated below. These can be used to specify any numeric value such as sample or font size, or a text value such as a label. They are indicated in the WINKS R-Code as &OPTVALUE1, &OPTVALUE2, and so on – you may specify up to 9 OPTVALUES.

<u>Case 1</u> – The resulting value from the option can only be numeric:

If you want to **limit the input to always be numeric,** for example:

```
OPTVALUE1=Num backcast obs,100,500,500
```

| The label displayed will be "Num backcase obs" | Minimum values allowed is 100, | Maximum values allowed is 500. | Default value is 500. |

Specifies that the input value must be a number between 100 and 500, and the default value for this input is 500. If the input can be character (or contains any non-numeric symbol) for example:

This code results in the follow option displayed the Options Dialog Box:

```
OPTVALUE1=Num backcast obs,100,500,500
```

500   Num backcast obs (100 to 500)
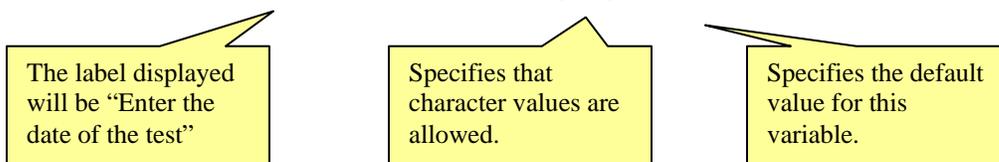
5   low.u (.1 to .9)
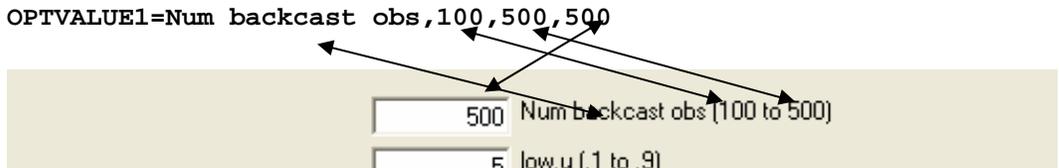
When the macro variable &OPTVALUE1 is included in the R code, it is replaced with the default value of the option, in this case 500, unless the user enters some other value.

<u>Case 2:</u> The option values can be of character type.

In this case a "C" (instead of a minimum and maximum) designates that the option can take on character values. This is followed by a comma and the "defaultname" of the variable.

```
OPTVALUE2=Enter the date of the test, C, defaultname
```

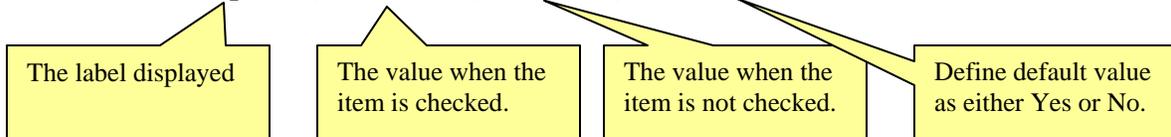| The label displayed will be "Enter the date of the test" | Specifies that character values are allowed. | Specifies the default value for this variable. |

When the macro variable &OPTVALUE2 is included in the R code, it is replaced with the value of the option, which can be a character value.

Check Boxes (in the Options Dialog Box)

Check boxes in the Options Dialog Box are defined options that can be selected (or not.) Thus, they take on one of two values, called the YesValue and the NoValue. Define the check value using the command CHECKVALUE1 (up to CHECKVALUE9.) The value of the associated macro variable &CHECKVALUE1 (up to 9) which can be used in R code depends on whether the checkbox is selected or not. If the checkbox is selected, the value is the YesValue. Otherwise it is the NoValue. Use the following format to define a check value:

```
CHECKVALUE1=Caption, YesValue, NoValue, default (No or Yes)
```

| The label displayed | The value when the item is checked. | The value when the item is not checked. | Define default value as either Yes or No. |

Long Text Items (in the Options Dialog Box)

Long text items (which can be used as comments or titles in your R procedure output) are specified using the TXTLABEL1 and TXTITEM1 commands (up to TXTLABEL2 and TXTIEM2). For example:

```
TXTLABEL1=This is the label for text item 1
TXTITEM1=This text appears in the text box as the default value
```

TXTLABEL1 defines the label for the "title box" and TXTITEM1 defines the default value for the textbox (optional).

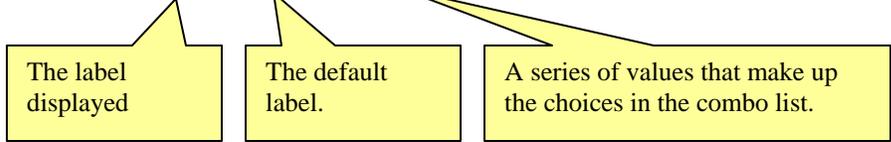These 2 commands result in the following display in the Options Dialog Box:

This is the label for the long text item 1

This text appears in the text box as the default value

You refer the value as &TXTITEM1 (or &TXTITEM2) in R code.
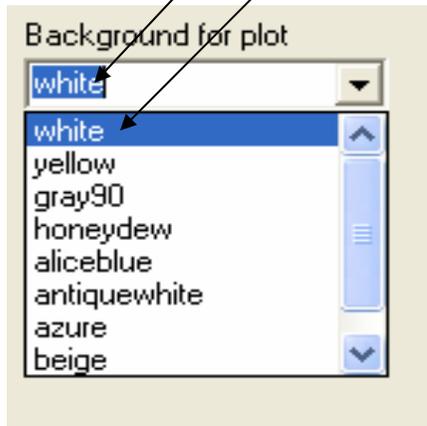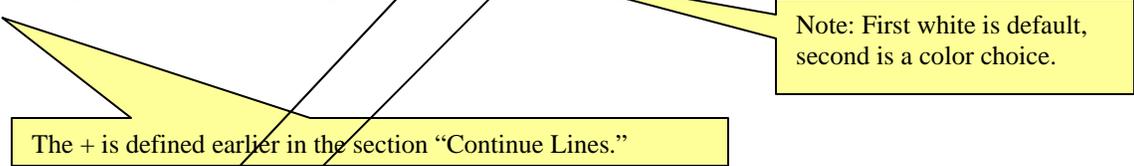
Combo Boxes (in the Options Dialog Box)

Combo boxes are associated with lists of values when you want to enable the user to select one item from a list such as a color, or the abbreviation of a state code. The selected value can then be included in the R code using the macro variables &COMBO1 (up to &COMBO4). The format is label first, then default value, then a list of possible values.

COMBO1, label, default, text1, text2, text3…. textn

| The label displayed | The default label. | A series of values that make up the choices in the combo list. |

For example,

COMBO1=Background for plot,white,white,yellow,gray90,honeydew,aliceblue,
+ antiquewhite,azure,beige,cornsilk

Note: First white is default, second is a color choice.

The + is defined earlier in the section "Continue Lines."

This causes the label "Background for plot" to be displayed and a combo box to appear with the default values of "white' and with the other values listed as options.

To include the selected combo value in R code use &COMBO1 (or whichever combo box you are using.) For example, to include the selected value in the JPEG code, you could do the following:

JPEG(file="KSRPLOT1.jpg", bg = "&COMBO1")

Notes about WINKS R Graphics

There are a number of functions in R that create graphics. These graphics can be written in a number of file formats including (but not limited to) TIFF, JPG and GIF. You can write WINKS R code that will save created in any of these file formats.

WINKS R has the ability to display created graphs in the WINKS R viewer, but it can only display JPEG type graphics. To cause WINKS R to display a graph created in R, you must include a jpeg command in your code before the function that creates the graph. For example,

```
jpeg(file="KSRPLOT1.jpg")
hist(&table$&depvar1)
```

What these two code lines accomplish:

1. The jpeg command defines the filename for a jpeg file (file="KSRPLOT1.jpg").
2. When the hist() function creates a histogram, this jpeg command causes the resulting graph to be stored in the designated file.
3. When the results are displayed in the WINKS R viewer, it "knows" about the jpeg file and displays it along with any text output from the R routine.

If you do not indicate a path for the file, it is stored in the WINKS program folder. Otherwise, you could specify a specific location for the file to be stored. For example

```
jpeg(file="C://WINKSFILES//KSRPLOT1.jpg")
```

would cause the KSPLOT1.jpg file to be stored in the Windows C:\WINKSFILES folder (but the graph would not be displayed in the viewer.)

You could also use R commands such as

```
tiff(file="C://WINKSDILES//KSRPLOT1.tif")
hist(&table$&depvar1)
```

to create a tiff type file names KSRPLOT1.TIF in the C:/WINKSFILES folder, but this file will not be displayed in the WINKS R viewer.

Example – Multiple Regression in WINKS – R

The following example shows code used to define a dialog box followed by the R code to perform a multiple regression analysis, and the results.

```
'----------------------------------------------
'    EXAMPLE Regression using R Code
'----------------------------------------------
~BEGIN=Regression Analysis in R
INSTRUCTIONS=Select a dependent variable and one or more independent
variables. This program requires the R program to have previously
installed on your computer.
SELECTTITLE=Regression Analysis

DEPMINITEMS=1
DEPMAXITEMS=1
DEPMUSTBENUMBER=Y
DEPCAPTION=Dep. Var.
DEPBUTTON=Dep-->

INDMINITEMS=1
INDMAXITEMS=20
INDMUSTBENUMBER=N
INDCAPTION=Ind. Var.
INDBUTTON=Ind.-->

GROUPMIITEMS=0
GROUPMAXITEMS=0
GROUPMUSTNUMBER=N
GROUPCAPTION=Group Var.
GROUPBUTTOMCAPTION=Group

~CODESTART
attach(&table)
summary(&table)
jpeg(file="KSRPLOT1.jpg")
hist(&table$&depvar1)

jpeg(file="KSRPLOT3.jpg")
pairs(&table)
jpeg(file="KSRPLOT4.jpg")
plot(&depvar1 ~ &indvar1,&table)
cor(&table)

gfit <- lm(&depvar1 ~ &indvarlistplus,data = &table)
summary(gfit)
~CODEEND
~END
```

The dialog box created by this code is shown on the next page.

This is the Variable Selection Dialog Box created by the code on the previous page.

In this case, the EXAMPLE.SDA data set is currently open in WINKS, which causes the "Fields" list to include the variable names from that data set.

These instructions were defined by the INSTRUCTIONS= command.

This variable selection item is created using the commands that begin with DEP, such as DEPMINITEMS=1.

Note the label caption "Dep. Var" and the button caption "Dep -- >" that were defined in code by

```
DEPCAPTION=Dep. Var.
DEPBUTTON=Dep-->
```

Variable names are from the currently opened WINKS data set.

This variable selection item is created using the commands that begin with IND, such as INDMINITEMS=1. Note how the label and button caption were defined in code.

Note that there is no GROUP button, since the GROUPMINITEMS=0 indicates no group variable selection is needed. (You could leave the GROUP commands out of the code since they are not needed.)

Creating WINKS R-Code

In the WINKSRPROGS.WR file, the dialog box code is followed by R code, as illustrated in this continuation of the multiple regression example.

WINKS R-code is simply standard R-Code in which certain values are replaced by dynamic values (macro variables) that start with the symbol &, plus a few other commands specific to WINKS R. Almost any program you can create using R-Code can be made easier to use by specifying variables and options using the WINKS dialog boxes. Using WINKS R allows you to utilize the data handling capabilities in WINKS to create a data set that you can then use in R. Here is an example R-code program in WINKS.

The following code is from the Regression Example in the WINKS R programs:

~CODESTART–Start of R code **(REQUIRED)**

```
~CODESTART
#Comment: The attach function gets the
#WINKS codes and makes it available in R.
attach(&table)
# Comment: The summary function produces
# summary statistics
summary(&table)
# Comment: the jpeg function names the
# file where the created graph is saved
jpeg(file="KSRPLOT1.jpg")
# Comment: the hist function produces
# a histogram
hist(&table$&depvar1)
jpeg(file="KSRPLOT2.jpg")
plot(density(&table$&depvar1,na.rm=TRUE))
jpeg(file="KSRPLOT3.jpg")
pairs(&table)
jpeg(file="KSRPLOT4.jpg")
plot(&depvar1 ~ &indvar1,&table)
cor(&table)
# Comment: The lm function calculates the regression and puts the
# results in the gfit array.
gfit <- lm(&depvar1 ~ &indvarlistplus,data = &table)
# Comment: This summary function displays the results of the regression
# analysis.
summary(gfit)
~CODEEND
~END
```

NOTES:
- The WINKS a**ttach(&table)** command is necessary to tell R to use the imported WINKS data set
- The *jpeg* command signals that the next graph will be named as indicated – and displayed in viewer
- Use WINKS R macro variables to indicate where in the code to use the information specified in the WINKS dialog boxes. These are of the form &VARIABLENAME.

~CODEEND and ~END--End of R Code and End of this procedure**. (REQUIRED)**

Note that all lines between ~CODESTART and ~CODEEND are standard R functions.

The results of an analysis resulting from this code are summarized on the following pages:

> **NOTE:** To perform this example analysis in WINKS: Open the LONGLEY.SDA data set and select **Analyze, R Routines, Run R Program, and Regression Analysis in R. Select** *TOTAL* as the dependent variables and *DEFLATOR. GNP. UNEMPARMED. POP*. and *TIME* as independent variables. and **Click Ok.**

From the code shown on the previous page, the WINKS R code

```
attach(&table)
# Comment: The summary function produces
# summary statistics
summary(&table)
```

creates this output (summary statistics):

```
 Regression Analysis in R


       TOTAL            DEFLATOR            GNP              UNEMP
  Min.   :60171   Min.   : 83.00   Min.   :234289   Min.   :1870
  1st Qu.:62713   1st Qu.: 94.53   1st Qu.:317881   1st Qu.:2348
  Median :65504   Median :100.60   Median :381427   Median :3144
  Mean   :65317   Mean   :101.68   Mean   :387698   Mean   :3193
  3rd Qu.:68291   3rd Qu.:111.25   3rd Qu.:454086   3rd Qu.:3842
  Max.   :70551   Max.   :116.90   Max.   :554894   Max.   :4806
       ARMED           POP              TIME
  Min.   :1456    Min.   :107608   Min.   :1947
  1st Qu.:2298    1st Qu.:111789   1st Qu.:1951
  Median :2718    Median :116804   Median :1954
  Mean   :2607    Mean   :117424   Mean   :1954
  3rd Qu.:3061    3rd Qu.:122304   3rd Qu.:1958
  Max.   :3594    Max.   :130081   Max.   :1962
```

The WINKS R code

```
# Comment: the jpeg function names the
# file where the created graph is saved
jpeg(file="KSRPLOT1.jpg")
# Comment: the hist function produces
# a histogram
hist(&table$&depvar1)
```
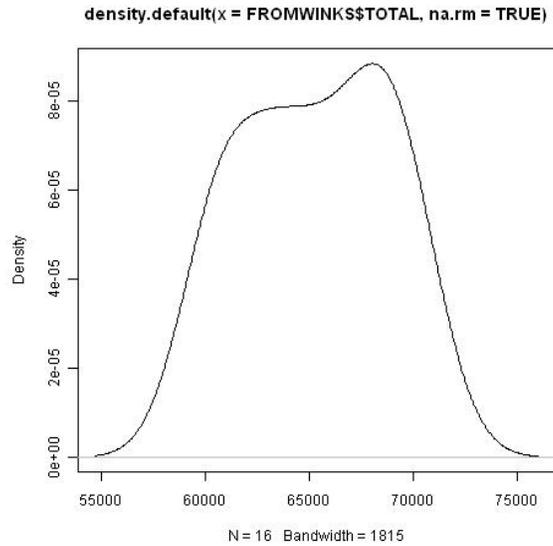
creates this output (a histogram of the dependent variable):

Histogram of FROMWINKS$TOTAL
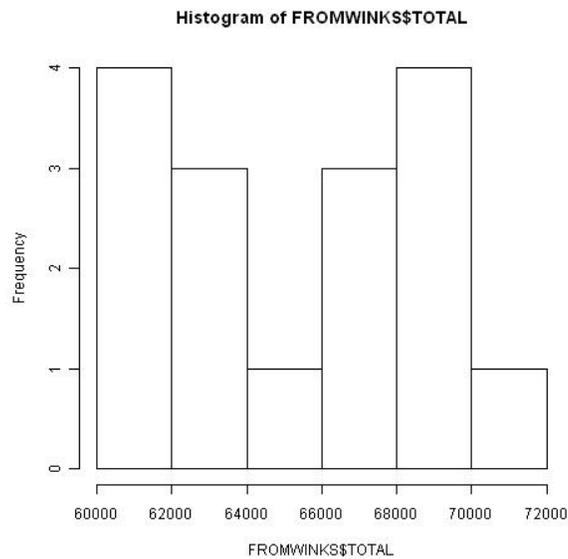
The WINKS R R code
```
            jpeg(file="KSRPLOT2.jpg")
            plot(density(&table$&depvar1,na.rm=TRUE))
```
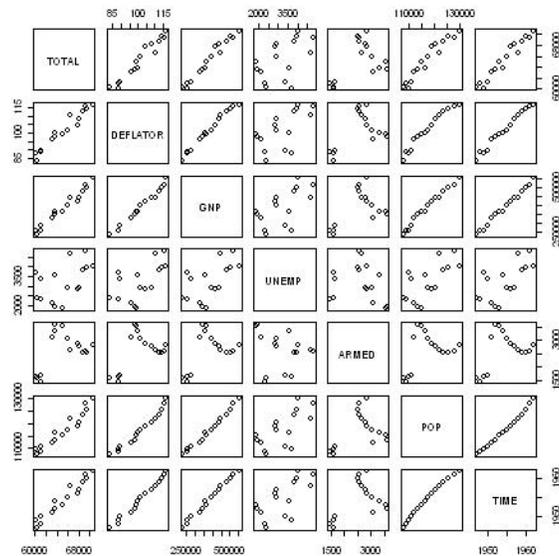creates this output (a density plot of the dependent variable):

The WINKS R R code
```
            jpeg(file="KSRPLOT3.jpg")
            pairs(&table))
```
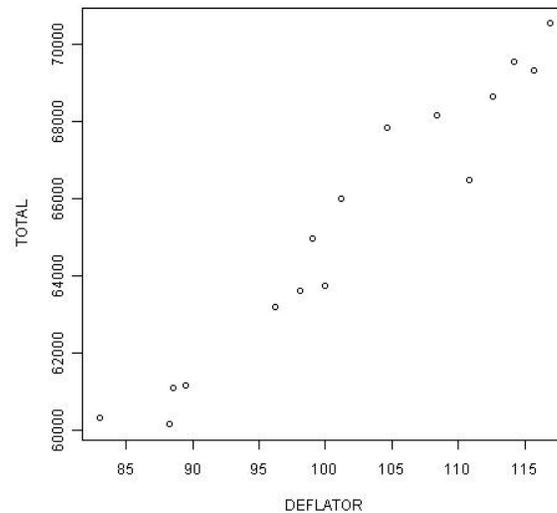creates this output (a scatterplot matrix of the numeric variables in the data set (&table)):

The WINKS R R code
```
            pairs(&table)
            plot(&depvar1 ~ &indvar1,&table)
```
creates this output (a scatter plot of the dependent vs the first independent variable):

The WINKS R R code
```
            cor(&table)
```
creates this output (a table of correlations):

```
                TOTAL   DEFLATOR        GNP      UNEMP      ARMED        POP
TOTAL      1.0000000 0.9708985 0.9835516  0.5024981  0.4573074 0.9603906
DEFLATOR  0.9708985 1.0000000 0.9915892  0.6206334  0.4647442 0.9791634
GNP        0.9835516 0.9915892 1.0000000  0.6042609  0.4464368 0.9910901
UNEMP      0.5024981 0.6206334 0.6042609  1.0000000 -0.1774206 0.6865515
ARMED      0.4573074 0.4647442 0.4464368 -0.1774206  1.0000000 0.3644163
POP        0.9603906 0.9791634 0.9910901  0.6865515  0.3644163 1.0000000
TIME       0.9713295 0.9911492 0.9952735  0.6682566  0.4172451 0.9939528
                 TIME
TOTAL      0.9713295
DEFLATOR  0.9911492
GNP        0.9952735
UNEMP      0.6682566
ARMED      0.4172451
POP        0.9939528
TIME       1.0000000
```

The WINKS R R code

```
# Comment: The lm function calculates the regression and puts the
# results in the gfit array.
gfit <- lm(&depvar1 ~ &indvarlistplus,data = &table)
# Comment: This summary function displays the results of the regression
# analysis.
summary(gfit)
```

creates this output (multiple linear regression results):

```
Call:
    lm(formula = TOTAL ~ DEFLATOR + GNP + UNEMP + ARMED + POP + TIME,
        data = FROMWINKS)

    Residuals:
        Min      1Q  Median      3Q     Max
    -410.11 -157.67  -28.16  101.55  455.39

    Coefficients:
                   Estimate Std. Error t value Pr(>|t|)
    (Intercept) -3.482e+06  8.904e+05  -3.911 0.003560 **
    DEFLATOR     1.506e+01  8.491e+01   0.177 0.863141
    GNP         -3.582e-02  3.349e-02  -1.070 0.312681
    UNEMP       -2.020e+00  4.884e-01  -4.136 0.002535 **
    ARMED       -1.033e+00  2.143e-01  -4.822 0.000944 ***
    POP         -5.110e-02  2.261e-01  -0.226 0.826212
    TIME         1.829e+03  4.555e+02   4.016 0.003037 **
    ---
    Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

    Residual standard error: 304.9 on 9 degrees of freedom
    Multiple R-squared: 0.9955,     Adjusted R-squared: 0.9925
    F-statistic: 330.3 on 6 and 9 DF,  p-value: 4.984e-10
```

Longley (1967) introduced this data set which has often been used in illustrating multiple linear regression procedures in the literature. The variables refer to economic factors.

The output indicates the intercept value and the coefficient values for each of the independent variables. The t-value associated with each coefficient tests its significance in the equation. You can use the p-value associated with each coefficient to make a decision about the validity of having that variable in the equation. A low p-value suggests that the dependent variable, *TOTAL*, is related to the independent variable whose p-value you are examining. In this case, you might question the validity of having *DEFLATOR* (p=0.86), GNP (p=0.31) and POP (p=0.82) in the equation.

This example illustrates the connection between the commands in the WINKS R (.WR) file and the output created by R. All of the commands in the .WR file can be revised by the user (you) to create the R output you want for any analysis, using a WINKS data set as the source of your data.

Creating Additional Analysis Routines for WINKS R

WINKS R allows you to write your own WINKS R routines, and place them on the WINKS R Analysis menu. To add additional procedures to the WINKS R code analyses menu, we recommend that you create a file for each analysis-type or related analyses.

When you write your own WINKS R routines, you must save the .WR file as as n ASCII/TEXT formatted file and specify a filename that **begins with WI and ends with .WR** (for example WI-MYNEWCODE.WR). (For GW-WINKS Time Series, save the file with a name that **begins with GW and ends with .WR**). Save the file in the same directory as the WINKSPROGS.WR or GWPROGS.WR file. WINKS automatically reads this file and uses the code to create new menu items in the R Procedures list.

Any file that starts with WI (or GW for GW-WINKS) and ends with .WR is seen as containing R code for WINKS. For example, you could create the files

WIBOXPLOT.WR
WISCATTERPLOT.WR

(Choose any names that make sense to you, as long as the filename begins with the letters WI and ends in .WR.)

If these two files are in your WINKS R program directory (usually C:\Program Files\TexaSoft\WINKS7), WINKS would add the R items from WIBOXPLOT.WR first, then WISCATTERPLOT.WR, etc (the files are read in alphabetical order by file name. The routines in the files and placed in the WINKS R menu in the order that they appear in the .WR file.) The files in the WINKSRPROGS.WR are always listed first.
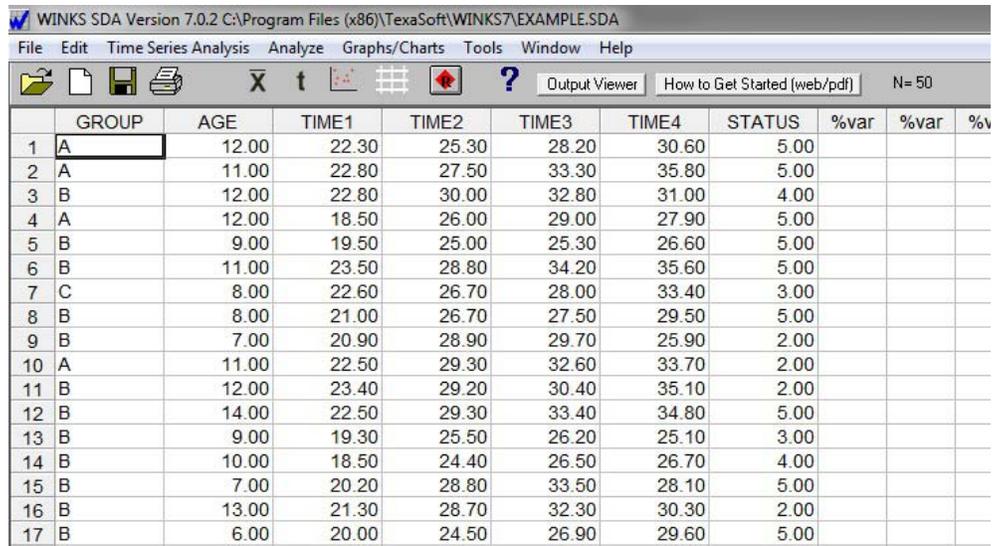
For the Time Series GW-WINKS R menu, use names such as GWname1.WR and GWname2.WR, and so on. As for the WINKS R menu, choose any names that make sense to you, as long as the filename begins with the letters GW and ends in .WR.

HINT: As you develop your WINKS R programs, use the "View, Code file" menu option in the WINSK Output display screen to determine if your specified macro variable substitutions are working as you intended.

A Step-By-Step Example

In this example we show how to use the R function `hist()` to create a histogram using data currently available in the WINKS editor.

Step1: In WINKS, open the data set EXAMPLE.SDA. The figure below shows a few records of this data set.

The purpose of opening this data set is to examine what type of data you might use to create a histogram. In this case, a histogram is created from quantitative (measurement or continuous) data such as is seen in the AGE, TIME1, TIME2 etc columns. So, you'll want a user to be able to select one of these columns of data (by specifying the variable name) and have R create a histogram from that data.

Step 2: Decide what R routine you want to use for your procedure. In this case, use the hist() procedure. Here is the syntax for hist()

```
hist(x, breaks = "Sturges",
     freq = NULL, probability = !freq,
     include.lowest = TRUE, right = TRUE,
     density = NULL, angle = 45, col = NULL, border = NULL,
     main = paste("Histogram of" , xname),
     xlim = range(breaks), ylim = NULL,
     xlab = xname, ylab,
     axes = TRUE, plot = TRUE, labels = FALSE,
     nclass = NULL, warn.unused = TRUE, ...)
```

For this example, we don't need to use all of the arguments for this function, so we'll simplify the function to

```
hist(x, col =)
```

Thus, we'll need to supply two variables (an array of data (x) and an indication of the color of the bars (col=)) to R in order to create the histogram we have in mind.

In WINKS R, that means that we'll use the following code in our R program

```
hist(&depvar1, col=&combo1)
```

where

&depvar1 refers to the column data selected

and

&combo1 refers to the color selected.

Step 3: Build the WINKS dialog box(es).

In a text editor (for example you can use the Notepad editor that comes with Windows), create the following code that defines a DEPENDENT variable:

```
~BEGIN=Create and plot a histogram using R
INSTRUCTIONS=Select a variable for the histogram plot
~BEGIN=Plot 3
SELECTTITLE=Histogram for a selected variable
DEPMINITEMS=1
DEPMAXITEMS=1
DEPMUSTBENUMBER=Y
DEPCAPTION=Histogram Variable
```

You only need to define one dependent variable since only one variable is needed to create a histogram.

Note that this code creates a dependent variable selection textbox that will accept a minimum of 1 variable and a maximum of 1 variable. The item must be a number, and the caption for the selection text box is chosen to be "Histogram Variable." This creates the following dialog box:
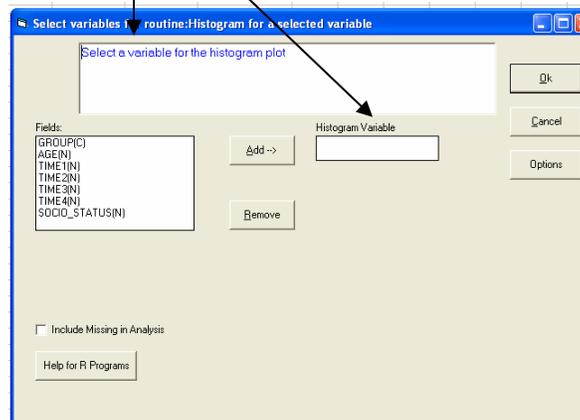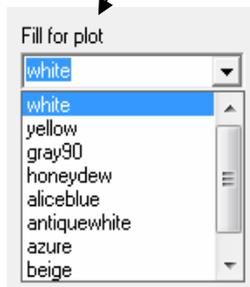
This dialog box creates a WINKS macro variable named &DEPVAR1 that will be used in the upcoming R code.

Step 4: Next, add the following lines to define the option for selecting color.

```
OPTTITLE=Options for Plotting
COMBO1=Fill for plot)white,white,yellow,gray90,honeydew,aliceblue,
+ antiquewhite,azure,beige,cornsilk
```

> Note: The reason there are two "WHITE" items in this list is because the first is the default value. The actual list begins with the second WHITE.

This section of the code creates the following combo box on the Options menu

Fill for plot

```
white
white
yellow
gray90
honeydew
aliceblue
antiquewhite
azure
beige
```

This allows the user to select the color to use for the histogram bars. It creates a WINKS macro variable named &combo1 that will be used in the R code (below).

Step 5: Continuing within the same text file, create the following R code (with WINKS R macro variables embedded in it) to specify the values for needed arguments for functions.

```
~CODESTART
attach(&table)
jpeg(file="KSRPLOT1.jpg")
hist(&depvar1, col='&combo1')
~CODEEND
~END
```

> WINKS macro variable **&combo1** (for the combo box). Note that the macro variable (in this case) needs to be within quotes, since R expects the color name (such as blue) to be in quotes.

> WINKS macro variable **&depvar1.**

Here are explanations of the items in this section

~CODESTART	Indicates the start of the R code section
attach(&table)	Tells R to use the data table currently opened in WINKS
jpeg(file=…etc	Specifies to R where to store the resulting graph. When this graph is defined as a .jpg file, the graph will appear in the WINKS R viewer.
hist(&depvar1… etc	Is an R function – note that the arguments in the function are specified by WINKS macro variables (i.e. WINKS R variables begin with a &.)
~CODEEND	Ends the R code
~END	Ends the WINKS R procedure.

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Step 6: Save the completed WINKS R program in a file that begins with WI and ends in .WR (or for the Time Series menu begins with GW and ends in .WR).

For example, name this file WI_TUTORIAL.WR. Using these naming conventions causes the new procedure to automatically appear on the WINKS R menu. (You must save the file in the WINKS program directory.)

The final code used for this tutorial is shown here:

```
~BEGIN=Create and plot a histogram using R
INSTRUCTIONS=Select a variable for the histogram plot
SELECTTITLE=Histogram for a selected variable
DEPMINITEMS=1
DEPMAXITEMS=1
DEPMUSTBENUMBER=Y
DEPCAPTION=Histogram Variable
OPTTITLE=Options for Plotting
COMBO1=Fill for plot,white,white,yellow,gray90,honeydew,aliceblue,
+ antiquewhite,azure,beige,cornsilk


~CODESTART
attach(&table)
jpeg(file="KSRPLOT1.jpg")
hist(&depvar1, col='&combo1')

~CODEEND
~END

```
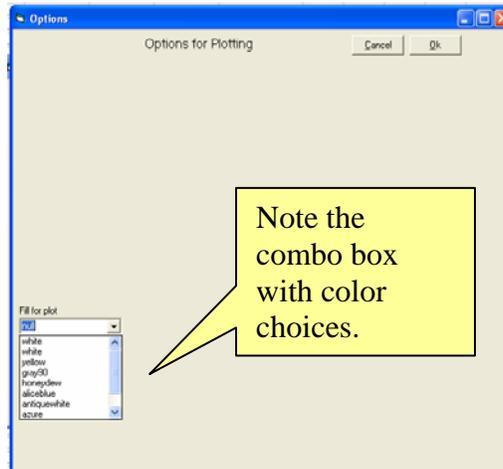
What the User Sees

When the user opens the EXAMPLE.SDA data set and selects the WINKS R procedure named "**Create and plot a histogram using R"** the following dialog box is displayed:
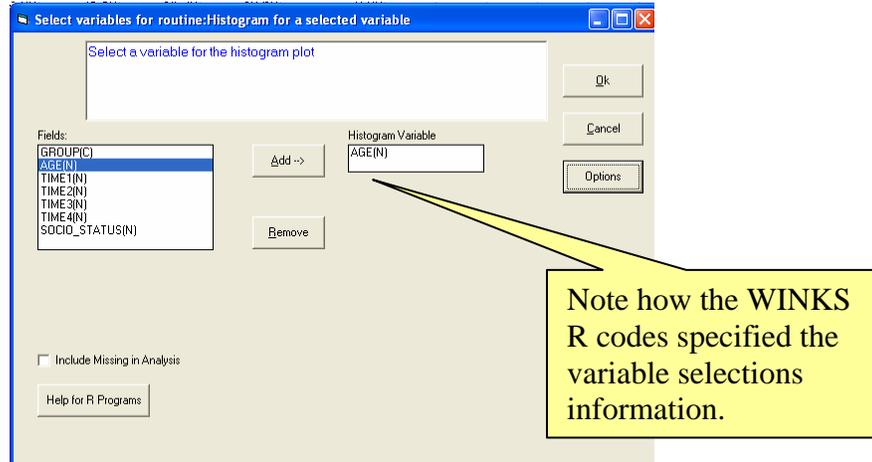
In this example, the variable AGE is selected. If the user clicks on the "Options" button the following dialog box is displayed:

For this example, select the color "aliceblue" and click Ok on the Options Screen and then Ok on the Variable Selection screen. You then obtain the following output.

```
                                                      October 6,2011
   ------------------------------------------------------------------------
   WINKS R Routine output
   ------------------------------------------------------------------------


    Using R data table named FROMWINKS

    Create and plot a histogram using R
```


Histogram of AGE
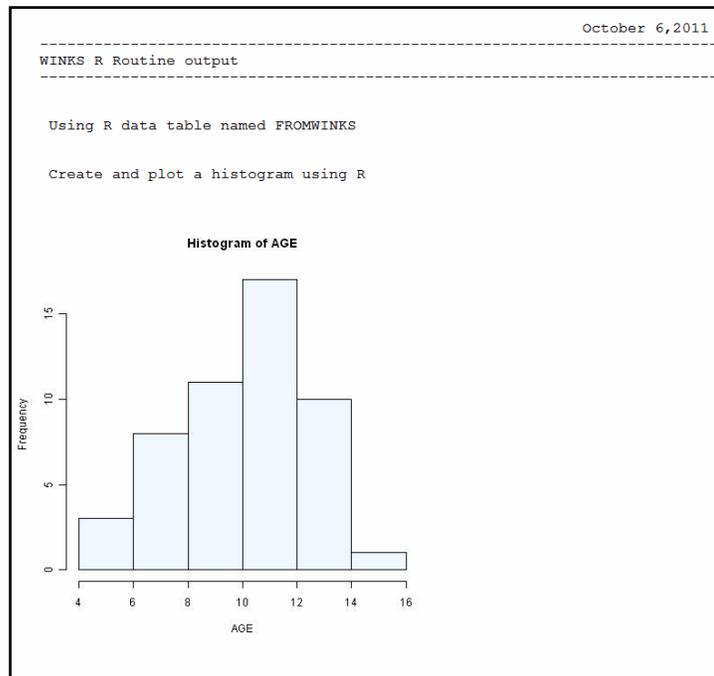
To see the R code that was used to create this histogram, select **View, Code** from the pull down menu on the Viewer. The following code is displayed:

```
FROMWINKS <- read.table("C://WINKSDATA//W2R.CSV",header = TRUE,sep
=",",colClasses=c(AGE="numeric"))
cat("\n Using R data table named FROMWINKS\n\n");
cat("\n Create and plot a histogram using R\n\n");
attach(FROMWINKS)
jpeg(file="KSRPLOT1.jpg")
hist(AGE, col='aliceblue')
```

If your WINKS R code does not create the R code you expect, you can use the contents of this Code file to help debug your program by seeing what was actually sent to the R program. (This example is in a file names WITUTORIAL.WR in your WINKS program directory.)

You can also select **View, Log** to see the R log created by the run. It may also contain information that can help you debug your program if unexpected results occur.

```
Version 10-15-2011
```

Appendix 1: Setting up R for WINKS

To use WINK R you must install the free R program on your computer. To install WINKS R, go to the following web page

http://www.texasoft.com/RHELP.html

or follow these instructions:

In order to run the R programs within WINKS, you must first install the free R program on your computer.

Installing R for WINKS

To install WINKS on your computer, go to the following link

http://cran.cnr.berkeley.edu/

or search on Install Windows R for current information from CRAN.

To install R for the first time on your Windows PC, click on the base link on the R for Windows page. Follow the instructions on this site to install R on your computer.

Preparing WINKS to run R Routines

Once you have installed R on your computer, do the following steps to set up WINKS to run R programs.

Step 1: In the WINKS SDA program select the following menu choices: Analyze, R Routines, R Properties/Setup/Help... The following dialog box is displayed:
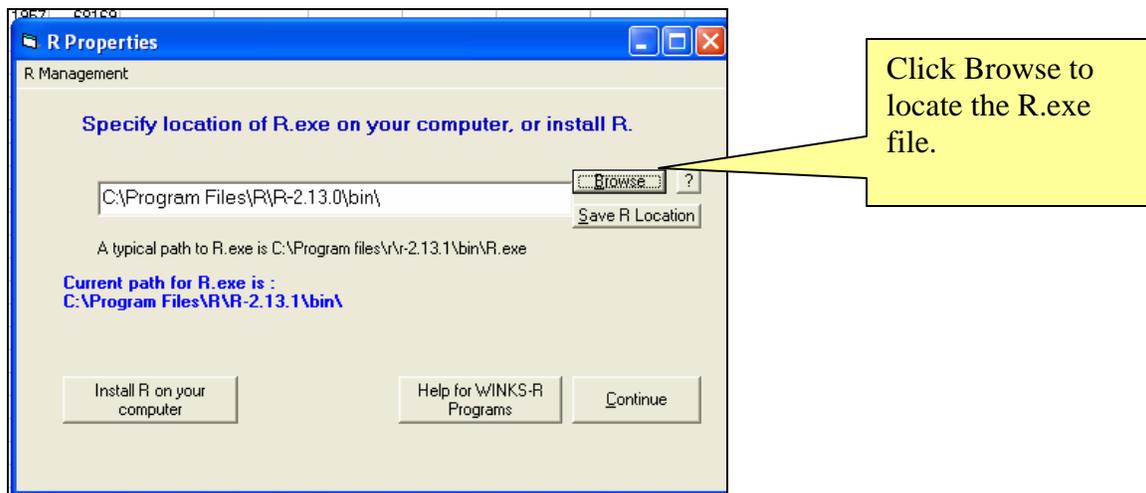
Click on Browse, and from the open dialog box, find the R.exe program on your computer. It is usually in the Windows path

C:\Program Files\R\R-2.13.0\bin

where R-2.13.0 is the version of R you have installed.

It may be in a slightly different patch such as (depends on the version of Windows you have installed)

C:\Program Files (x86)\R\R-2.13.0\bin

Once you locate R.exe, highlight it and **click Open**. You are prompted "Save specified R.exe location) **Answer Yes.**

Another dialog box will indicate "R properties saved." **Click Ok and Continue.**

Your WINKS is now set up to run WINKS R programs.

Appendix 2: Additional Tips for WINKS R

You can include comments in your WINKS R output by using the R cat() function to define lines of text. For example, the following code uses the standard R function cat() to output several lines of text output. The difference in this example is that the code includes WINKS R macro variables (the variables that begin with a &).

```
cat("\n This is a program to test option values in R code from WINKS","\n")
cat("optvalue1= &OPTVALUE1 and optvalue2 = &OPTVALUE2", "\n")
cat("Selected radio value is = &RADIOSELECTED","\n")
cat("check5 = &CHECKVAL5","\n")
cat("Text1 Value= &txtitem1","\n")
```