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1.0 Introduction

1.1 Overview

Robust Analysis of Variance is a powerful modelling tool for estimating total measurement uncertainty. It provides a comparison between sampling and chemical analysis as the two sources of uncertainty, relative to each other, and relative to the overall variance of the measurements.

The method is based on the taking of replicate samples at a number of sites then replicate chemical analyses on these replicate samples. The three components of variability (sampling variance, analytical variance and between location variance) can be separated using classical Analysis of Variance (ANOVA) but it is strongly affected by outlying values and is based on limiting assumptions. These problems are largely overcome by the use of Robust Analysis of Variance.

The model allows data to be input directly into a project or it can be imported from elsewhere, as long as it is arranged in the correct format. Similarly, results can be exported to other applications for further analysis. Results are displayed as a pie chart showing the relative proportions of geochemical, sampling and analytical variance. A more detailed statistical output is also given in the form of a table.

1.2 About ROBAN

The ROBAN model has been adapted from one originated by Professor B. D. Ripley at the University of Oxford with modifications and validation by Michael H. Ramsey at Imperial College, London.

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1.3 Installation

1.3.1 CD ROM Installation

Insert the CD ROM in the drive. The setup program should start automatically. If automatic start-up does not occur run the Setup.exe program, then follow the on screen instructions.

1.3.2 Configuration

The minimum system configuration requirements are as follows:

- 80486 50 MHz processor or equivalent
- 12 Mb of RAM
- 640 by 480 SVGA graphics
- 15 Mb of free disk space
- 20 Mb available swap space

The minimum suggested system configuration is as follows:

- Pentium II 450 MHz processor or equivalent
- 64 Mb of system memory
- 1024 by 768 SVGA graphics
- 50 Mb of free disk space
- 100 Mb available swap space

1.3.3 Operating System

- Windows 2000, Windows NT 4.0, Windows 95*, Windows 98, Windows ME or any compatible 32-bit operating system.
- Note that the program requires version 4.70 or later of COMCTL32.DLL. This file usually resides in the WINDOWS\SYSTEM or WINDOWS\SYSTEM32 directory.
 - * note that older versions of Windows 95 may not support this software as they are not fully 32-bit compliant. Upgrades for earlier version Windows 95 are available from the manufacturer.

More memory and faster processors will enhance the software's performance.

2.0 Editors

2.1 Introduction

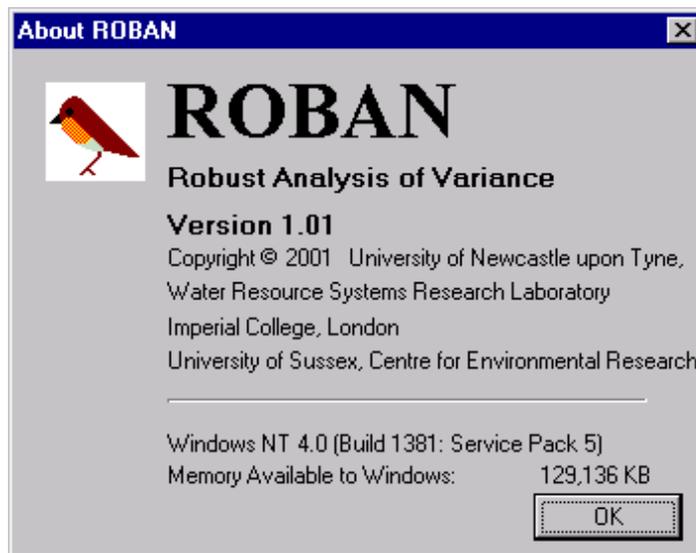
ROBAN contains 3 editors:

- About ROBAN
- ROBAN Main Editor
- Chart Options Editor

2.2 ROBAN About Box

The ROBAN About Box provides information on:

- ROBAN Version Number
- Copyright
- Operating System
- Available Memory



2.3.2 Menus

The menus provide access to the other editors and tools available within the ROBAN model. An outline of all the menu items is given below.

File

The File menu gives access to all project file functions and printing. The File menu allows projects to be created, opened, saved and closed.

Edit

The Edit menu gives access to the clipboard, enabling results to be cut, copied and pasted.

Run

The Run menu gives access to the run button.

Tools

The Tools menu gives access to the Chart Editor and allows files to be imported or exported. It also allows the user to set the proportion of outliers.

Help

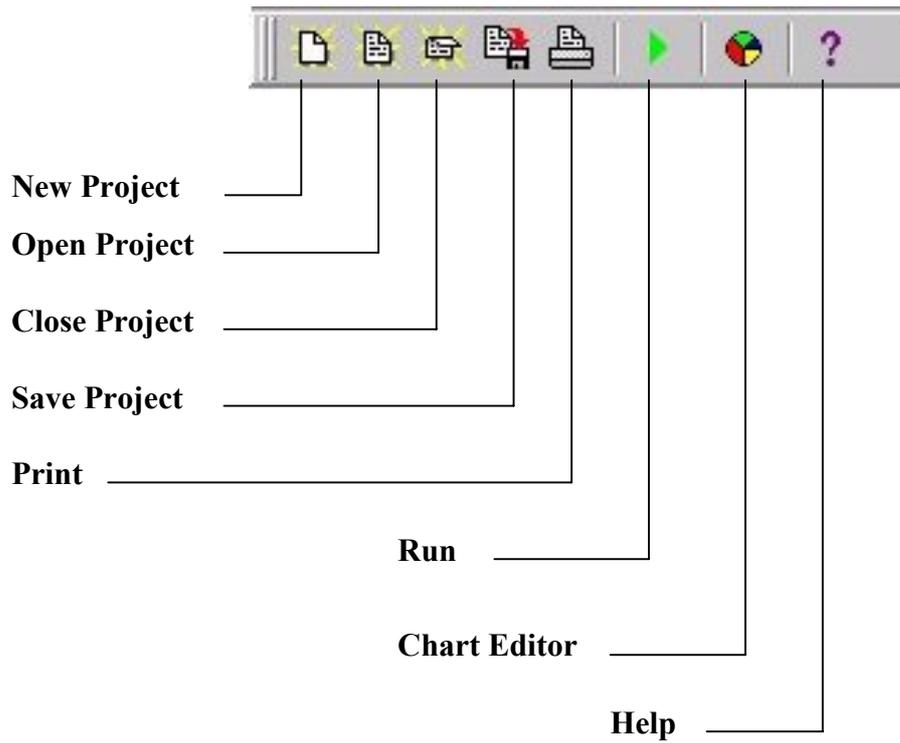
The Help menu gives access to the on-line Reference Manual and the ROBAN About Box.

<u>F</u>ile	<u>E</u>dit	<u>R</u>un	<u>T</u>ools	<u>H</u>elp
New Project Open Project Save Project Save Project As... Print Setup Print Close Exit	Undo Cut Copy Paste Select All	Run	Import File Export File Chart Editor Set Proportion of Outliers	Contents Index About

2.3.3 Toolbar

The toolbar shown below is divided into 4 sections:

- File
- Simulation
- Editors
- Help



2.3.4 Data Page

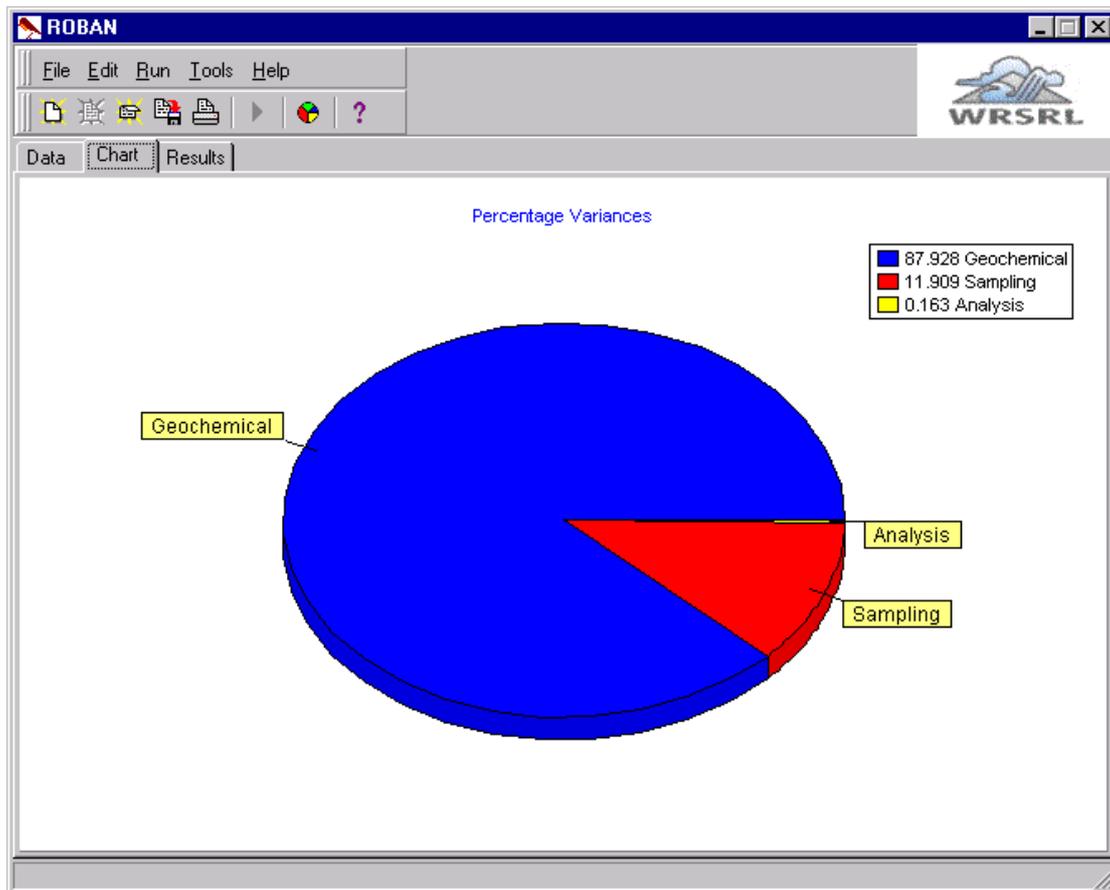
The Data Page displays the data grid which stores the data used in the project. The grid size editors (see section 2.3.1 above) control the number of columns and rows within the grid where each row represents a site and the columns represent the number of replicate samples and the number of replicate analyses. The data must be input in the format shown below:

Site Ref.	Sample 1 Analysis 1	Sample 1 Analysis 2	Sample 2 Analysis 1	Sample 2 Analysis 2

New projects can be created and saved in the Data Page, existing projects can be re-opened and data can be imported from another application as long as it is in the correct format shown above (see section 3).

2.3.5 Chart Page

The Chart Page displays the ROBAN results as a pie chart and is automatically displayed when the run button is pressed. The pie chart shows the relative proportions of geochemical, sampling and analytical variance. A chart editor exists which allows the user to edit the titles, fonts, panel colours, legend and style of the pie chart. The editor is found by clicking the *Chart Options* button on the toolbar while the Chart Page is open or by choosing *Chart Options* from the *Tools* menu. The chart can be printed by choosing *Print* from the *File* menu or by clicking the *Print* button.



2.3.6 Results Page

The Results Page displays a more detailed statistical output in the form of a table. This gives a comparison between the classical ANOVA results and the robust ANOVA results. The results can be printed by choosing *Print* from the *File* menu or by clicking the *print* button. The results can also be cut, copied and pasted by choosing the relevant menu item in the *Edit* menu.

ROBUST ANALYSIS OF VARIANCE

CLASSICAL ANOVA RESULTS

Mean = 289.10000610
Standard Deviation (Total) = 185.71459961

	Geochemical	Sampling	Analysis
Sums of Squares	1989270.12500000	365656.50000000	11331.40136719
Standard Deviation	155.48443604	99.99871826	17.74150848
Percentage Variance	70.09414348	28.99324027	0.91261788

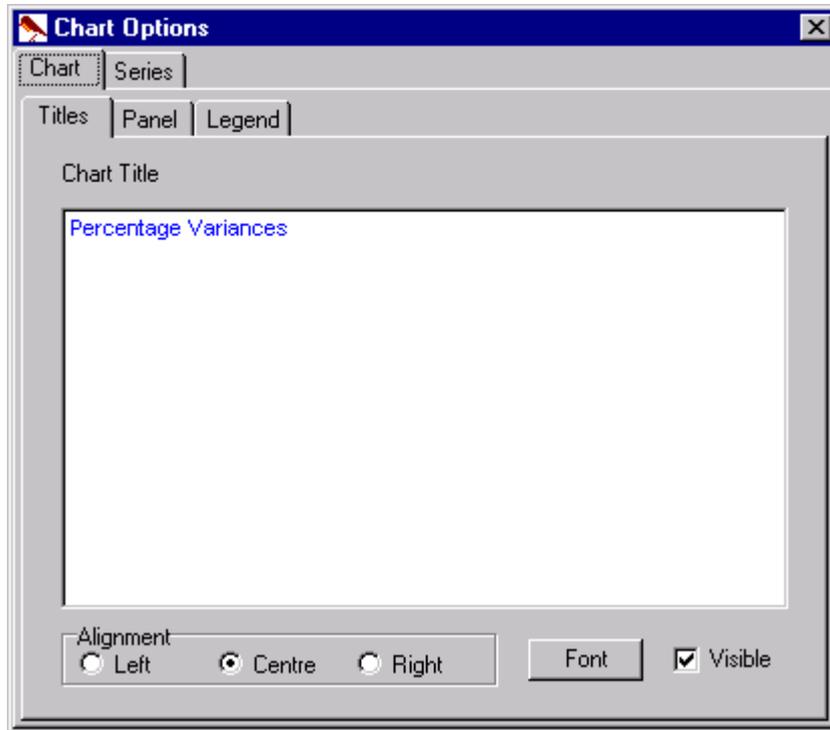
ROBUST ANOVA RESULTS:

Mean = 273.938171
Standard Deviation (Total) = 165.07336426

	Geochemical	Sampling	Analysis	Measurement
Standard Deviation	154.78884888	56.96704102	6.66202164	57.35526276
Percentage Variance	87.92762608	11.90949457	0.16287637	12.07237047
Relative Uncertainty (% at 95% confidence)	-	41.59116689	4.86388706	41.87460438

2.4 Chart Editor

The Chart Editor can be used to alter the charts' titles, style, colour and fonts.



3.0 Projects

3.1 Introduction

Models are built and stored as projects. New projects can be created in ROBAN, existing projects previously created in ROBAN can be re-opened or data can be imported from another application into a new project as long as it is arranged in the correct format.

3.2 Creating a New Project

To create a new project in ROBAN go to the Data Page and choose *new* from the *file* menu or click on the *new* button on the toolbar.

Set the grid on the Data Page to the required size using the grid size editors at the bottom of the page (section 2.3.1).

Type in the data where each row represents a site and the columns represent the number of replicate samples and the number of replicate analyses. See section 2.3.4 for the correct format.

Save the data by choosing *save as* from the *file* menu or click on the *save* button on the toolbar. Enter a filename and click *ok* and the file will automatically be saved with a *.prj* extension.

Run the model by choosing *run* from the *run* menu or by clicking the *run* button on the toolbar.

The results will be displayed in the Results Page.

Save the results by choosing *save as* from the *file* menu or click on the *save* button on the toolbar while on the Results Page. Enter a filename and click *ok* and the file will automatically be saved with a *.rsl* extension. This file can be re-opened at any time from the Results Page by choosing *open* from the *file* menu or by clicking on the *open* button on the toolbar.

Print the results by choosing *print* from the *file* menu or click on the *print* button on the toolbar. To change the setup choose *print setup* from the *file* menu.

To edit the results choose *undo*, *cut*, *copy*, *paste* or *select all* from the *edit* menu.

3.3 Opening an Existing Project

To open an existing project in ROBAN go to the Data Page and choose *open* from the *file* menu or click on the *open* button on the toolbar.

Choose the file you want to open and click *ok*. Note that only files with the extension *.prj* can be opened in this way. These files have been previously saved as projects within ROBAN.

Run the model as in section 3.2 and view the results.

3.4 Importing Data

To open a data file that does not already exist within a ROBAN project set the grid on the Data Page to the required size using the grid size editors at the bottom of the page (section 2.3.1).

Choose *import file* from the *tools* menu.

Choose the file you want to open and click *ok*. Note that the file must be in the correct format (section 2.3.4). Also note that any data already in the grid will be overwritten.

Save the new data file by choosing *save as* from the *file* menu or click on the *save* button on the toolbar. Enter a filename and click *ok* and the file will automatically be saved with a *.prj* extension.

This file now belongs to a ROBAN project and can be re-opened at any time by following the notes given above in section 3.3.

Run the model as before (section 3.2) and view the results.

Files can also be exported as text files to other applications for further analysis (such as excel) by choosing *export file* from the *tools* menu.

4.0 References

Ramsey, M.H., Thompson, M., and Hale, M., 1992, Objective evaluation of precision requirements for geochemical analysis using robust analysis of variance. Journal of Geochemical Exploration, 44, pp 23-36.

Ramsey, M.H., Argyraki, A., 1997, Estimation of measurement uncertainty from field sampling: implications for the classification of contaminated land. The Science of the Total Environment, 198, pp 243-257.

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ROBAN

Robust Analysis of Variance

Reference Manual

Version 1.01

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