

Applications Guide 3WayPack
TUCKALS3: Analysis of Chopin Data

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January 2, 2004

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TUCKALS3: Analysis of Chopin Data

1.1 Introduction

In this part of the Application Guide the major aspects of the analyses that were used in writing the paper by Takashi Murakami and Pieter M. Kroonenberg, "Three-mode models and individual differences in semantic differential data", published in *Multivariate Behavioral Research*. We will refer to this paper as the M&K-paper.

The analysis procedure consisted of six parts.

1. Perform a Tucker3 analysis for all permissible models with $3 \times 3 \times 3$ components or less.
2. After choosing a model (here: the $2 \times 3 \times 2$ - model), perform the basic Tucker3 analysis.
3. Rotate the obtained core array to extreme simplicity.
4. Construct the required joint plots.
5. Perform a bootstrap analysis for the selected model to assess stability (using an experimental version of the Tuckals3 program).
6. Perform a Procrustes analysis on the bootstrap results for the scale mode to evaluate the stability of the scale space.

In the following sections a brief indication is presented how these analyses (except the last two) can be performed. In particular, we will show the

relevant screens of the present version of the Interface of 3WayPack with which the analyses were performed. This version of the Application Guide is, however, only a very preliminary one. More details for the majority of the choices and procedures as well as detailed explanation and guidance, be it for an older version of 3WayPack, can be found in the User's Manual, which is also available on the web from the Three-Mode Company at <http://three-mode.leidenuniv.nl/>. Eventually, this Application Guide will be expanded with annotated output.



FIGURE 1.1. 3WayPack: Opening screen

1.2 Data Description

Music appreciation and the evaluation of the characteristics of musical pieces have been frequently researched with semantic differential scales. In the present study, Chopin's Preludes were judged on semantic differential scales by 38 Japanese university students (21 males and 17 females). For students to be eligible for the study they had to be familiar with classical music in advance so that they could be expected to provide appropriate judgments about the music. The concepts were the 24 short piano solo pieces (or Preludes) making up Op. 28 composed by Frederic Chopin, played by Samson François on Angel, AA-8047. They were copied on a cassette tape, and edited for the experiment. Eighteen pairs of adjectives were selected from previous research on semantic differential studies of music. It was expected that the students would judge rather objectively on all but two scales on the basis of key (mainly, major or minor) and tempo of each Prelude. In contrast, it was expected that they would express subjective

evaluations on the scales, UNATTRACTIVE–ATTRACTIVE and UNINTERESTING–INTERESTING. Before the final analysis, the codings of some scales were reversed to induce as many positive correlations among them as possible. Detailed of the experimental procedure can be found in Murakami and Kroonenberg (2001).

1.3 Opening Screen 3WayPack

Figure 1.1 shows the opening screen of 3WayPack. The user needs to supply a Job Name first, then the data set on which the analysis is going to be performed. Subsequently, one of the programs from the available ones needs to be selected, Tuckals3 in this case, and optionally a title to label the output can be provided. If all is correct, hitting the F2 key will bring up the Data Definition screen.

1.4 Data Definition Screen

In the Data Definition screen the size of the data is specified ($24 \times 20 \times 38$) as well as the labels for each of the modes (Preludes, Scales, Students). If present, one or more missing value codes can be supplied. The data structure can be as frontal slices stacked under each other or the data can be in a standard SPSS-like format, i.e. one or more consecutive records for each level of the first mode. If a free format is not applicable, a precise fortran-type format needs to be specified, and finally labels for the levels of the three modes can be introduced, so that the output is readable. If all is correct we move with F2 to the Main Menu.

1.5 Main Menu: The Command Centre

As perusal of the screen shows, the Main Menu is the nerve centre of the program. Options for the analysis program are specified, the program is executed, output is viewed, the editor is called, plots are created and the browser is started from this menu. In addition, if it is desired to perform additional analyses on the results, this can be done via the Postproc(essing) option. This Main Menu is the same for all analysis programs in 3WayPack.

1.6 Tuckals3 Analyses

In this part of the Applications Guide we will only look at the options and procedures necessary to fit the Tucker3 model and the related postprocess-

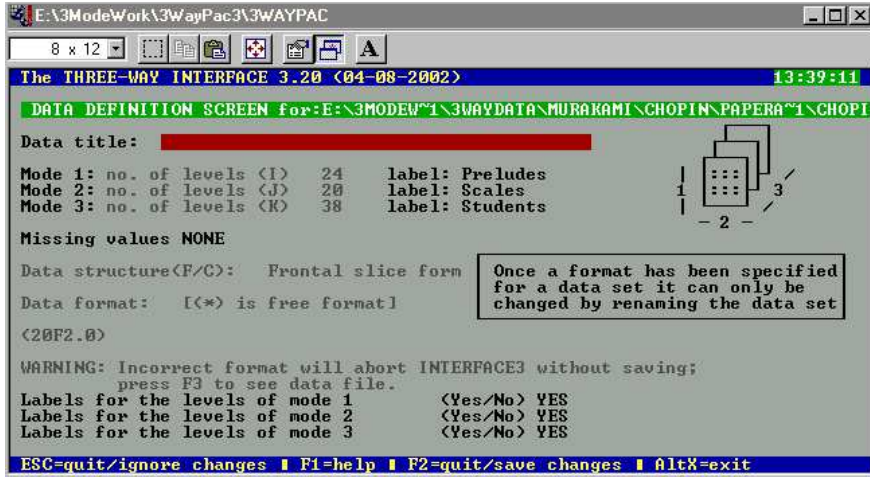


FIGURE 1.2. 3WayPack: Data definition screen

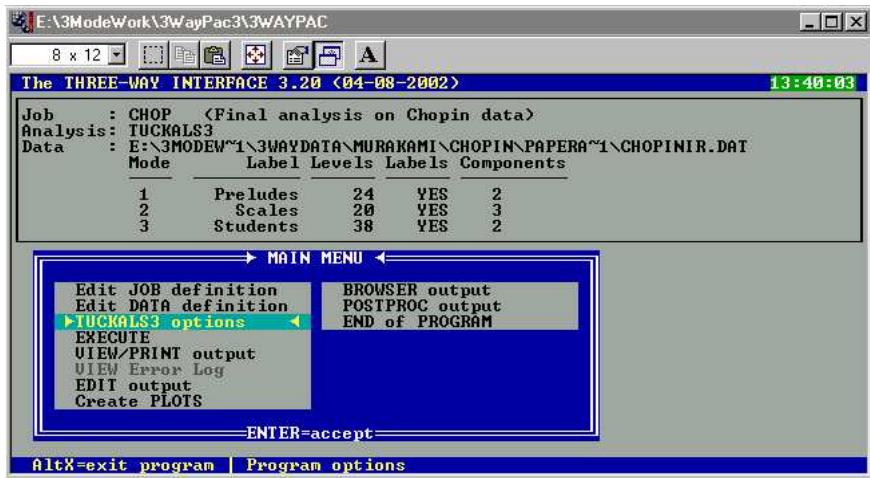


FIGURE 1.3. 3WayPack: Main Menu

ings. Not all options will be mentioned and the user should explore these options on her or his own. More details can be found in the User's Manual.

1.6.1 Tuckals3 options

The number of components to be fitted depends on whether one wants to do an analysis for all models with numbers of components less than or equal a given number or whether one wants to fit a specific model. The present screen shows the number of components for fitting a $2 \times 3 \times 2$ -model with 2 components for the Preludes, 3 components for the Scales and 2 components for the Subjects. At present, we will skip the following options: Missing data, Initial configurations, and Plot options.

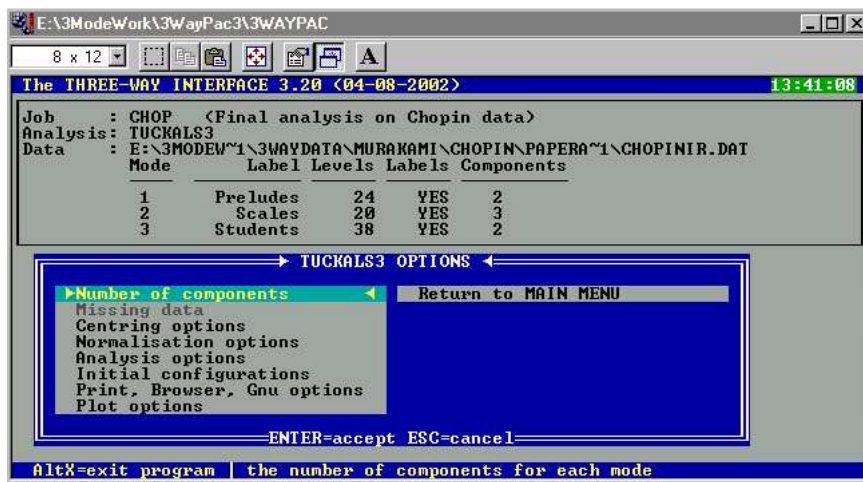


FIGURE 1.4. Tuckals3: Options menu

1.6.2 Analysis options

In the Analysis options screen (Figure 1.5, primarily technical options are available such as setting the number of iterations and the accuracy of the convergence criterion, and the use of acceleration techniques. However, the most important one is the setting of the option "Compute the fit of ALL PERMISSIBLE ANALYSIS ..." to Yes or No ¹.

¹Eventually the menus will be rearranged so that this option is more visible.

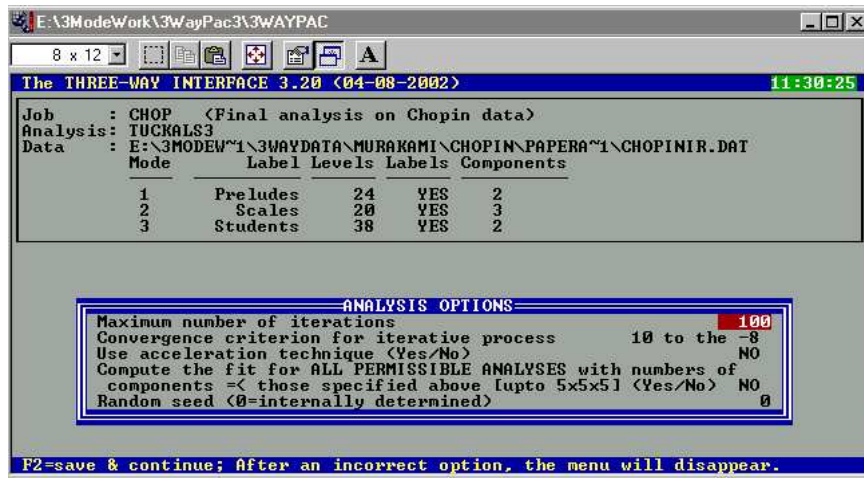


FIGURE 1.5. Tuckals3: Options menu

NO: Regular analysis with $2 \times 3 \times 2$ components

This value is the default condition in which a single model is analysed in detail, and extensive output can be produced, probably more than one can poke a stick at.

YES: All analyses with less than $2 \times 3 \times 2$ components

The specifications for the other options when all permissible models are fitted should be the same as for the complete fitting of a single model, therefore no specific additional attention needs to be paid to setting parameters for such an analysis. It should be noted that the output is very different and many types of output are not available in the all-permissible-models case. The only output produced is that necessary to compare the models, irrespective of specifications of other types of output.

1.6.3 Centring options

Centring in three-mode analyses needs careful attention and some considerations are contained in the M&K paper. Not all possible centring are possible in the Tuckals program but most standard ones are included. Additional centring can be done via the preprocessing program Preproc3.

As discussed in the M&K-paper, we have centred here across Preludes or per column of the data array, i.e. $J \times K$ scale-per-student means are removed from the data set. This will result in the centring of the Prelude components.

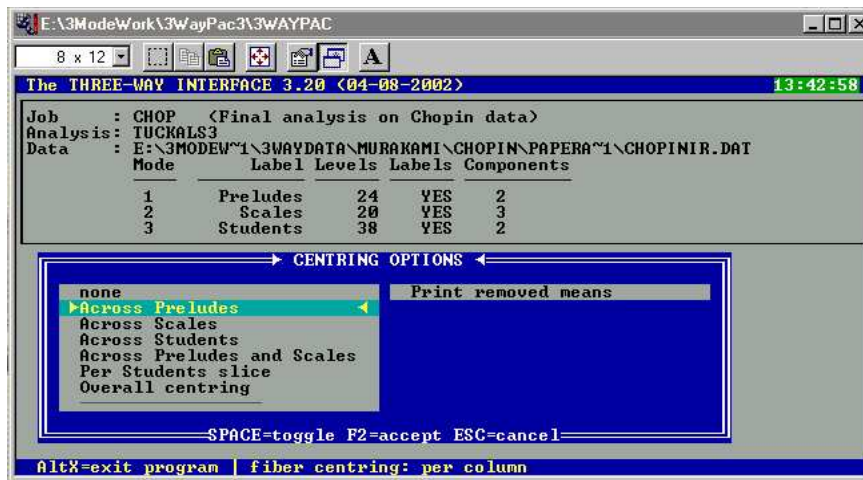


FIGURE 1.6. Tuckals3: Centring options

1.6.4 Normalisation options

Normalisation is more straightforward and in this case we have equalised the sum of squares of the semantic differential scales, so that differences in variances between the scales are removed from the analysis.

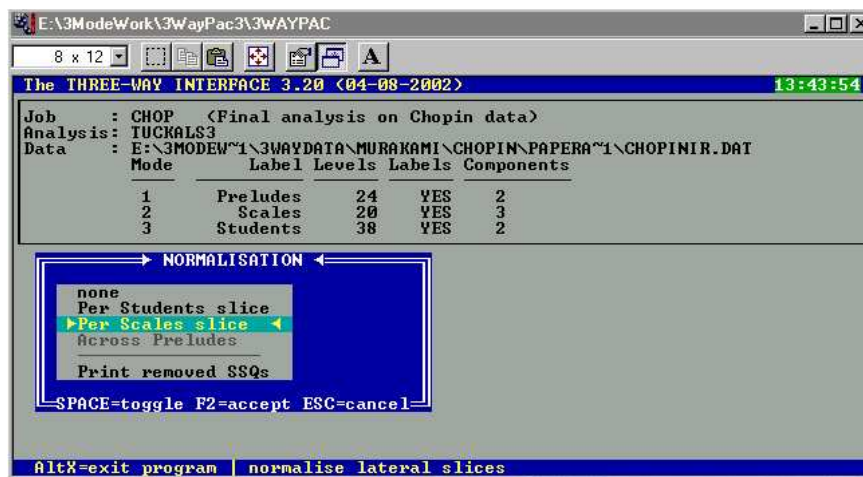


FIGURE 1.7. Tuckals3: Normalisation options

1.6.5 Print options

The Print, HTML, and Gnuplot Options menu allows control of many parts of the output. Note that output which can be read with a browser and publication quality (vector) plots produced with Gnuplot are only available when the options have been set (see screen), but more importantly in the configuration file (IF3.CFG) the exact locations of the Browser and GnuPlot executables have to be specified.

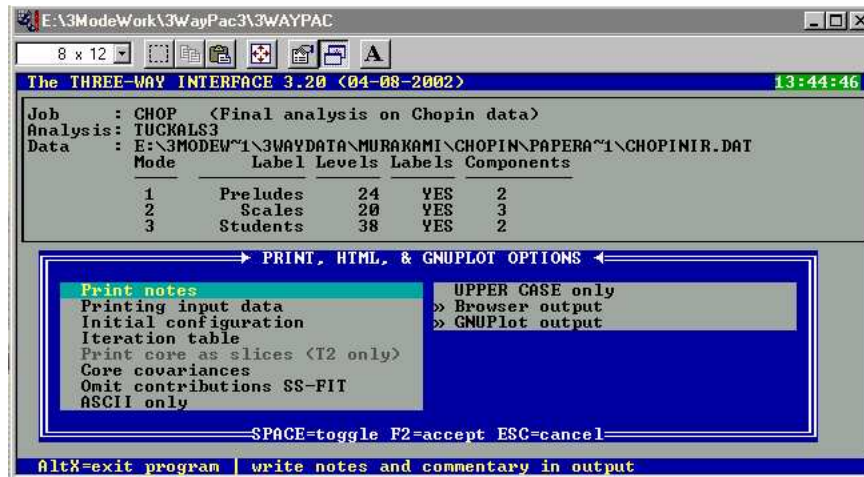


FIGURE 1.8. Tuckals3: Print options

1.7 Postprocessing

Once the main analysis has been carried out, often the results need to be rotated for better interpretability, need to be plotted for presentation and inspection of pattern, and residuals need to be calculated to assess the quality of the model. All these activities can be carried out with the postprocessing options.

The postprocessing programs are accessible from the Main Menu screen (Figure 1.3) after one has returned from a Tuckals analysis. Note that because there is output several options to deal with the output are no longer grey.

1.7.1 Types of postprocessing

First we will rotate the components via T3Rococo (Simultaneous rotations of core array and components), which program also can be used for

exclusively rotating the core array. In the Type of Postprocessing screen (Figure 1.9, we also see several other programs: T3Rotate is a program for rotating components with traditional procedures like varimax and oblimin, Residual calculates and plots residuals, Jointplt produces plots for two modes given the components of the third mode. The greyed AnacorP2 is only available after the first part of three-mode correspondence analysis has been carried out earlier.

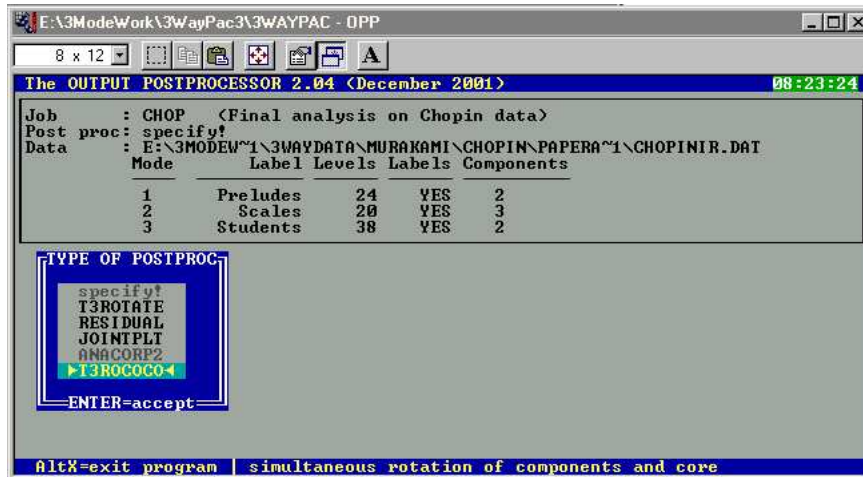


FIGURE 1.9. Postprocessing: Types of postprocessing

1.7.2 Rotation of core array

T3Rococo is a program to rotate both the three component matrices and the core array, but it can also rotate just core array, which is needed here. Again the Main Menu (Figure 1.10) is the nerve centre for the preprocessing operation.

Rococo: Main menu

The Main Menu screen of all postprocessing programs (Figure 1.10) is very similar to the Main Menu screen for the analysis programs, and has similar options. (Figure 1.3).

Rococo: Options menu

Given we have pressed Enter for the T3Rococo Options, we come into the options screen for the program (Figure 1.11). Options for rotations can be specified independently for each mode, be it that some combinations are not sensible but the program itself sorts this out. Separate sections for

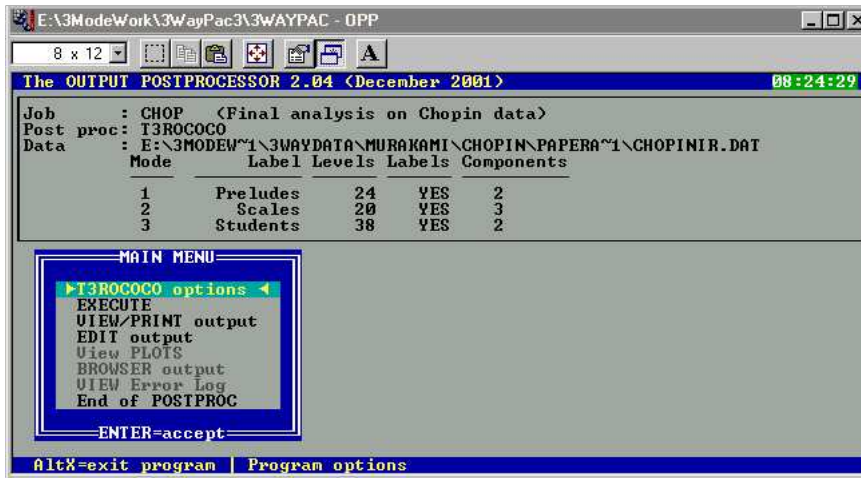


FIGURE 1.10. T3Rococo: Main menu

specifying what should be printed and plotted are available in the menu. The analysis options are mainly technical but the option to only rotate the core is one of them.

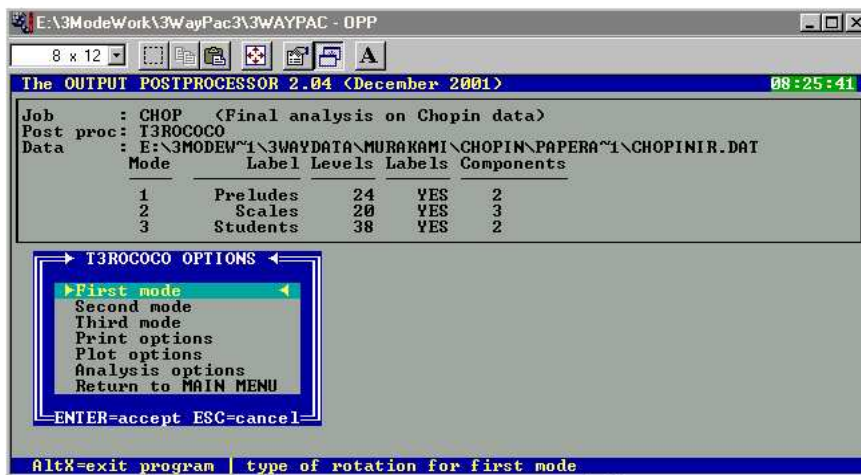


FIGURE 1.11. T3Rococo: Options Menu

Rococo: Rotations menu

Figure 1.12 show the rotations possible in the Rococo program for the second mode. Those of the other two modes are identical. It is necessary to specify whether this mode needs to be rotated and which weight should

be used. Details about the different kind of specifications of the weights and their effect on the analysis are contained in (Kiers, 1998d). Here, it is specified that we do not want to rotate the components but only the core array and the weights are left at their default values.

Important for the present analysis is the specification that the components of the second mode (here: variables or scales) are weighted with their eigenvalues. This is the standard situation in two-mode PCA, but not necessarily in three-mode analysis. In order to get a properly scaled simple core array this specification is essential (see below).

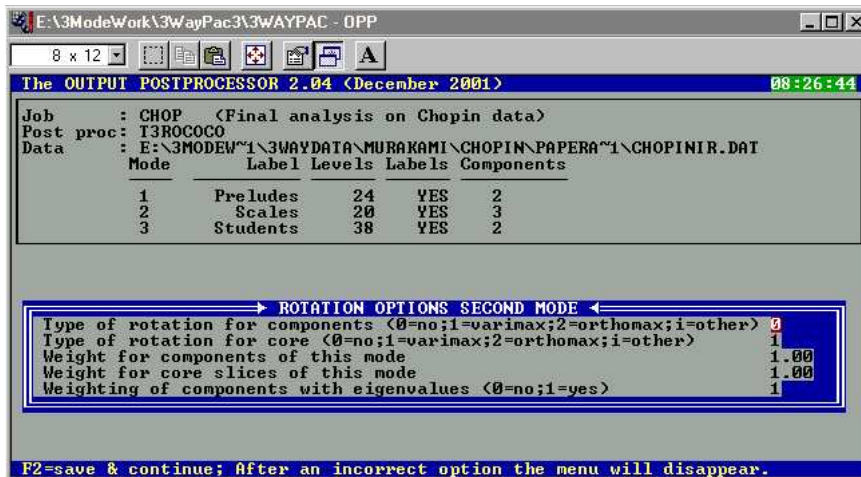


FIGURE 1.12. T3Rococo: Rotation options

Rococo: Analysis menu

In the M&K paper, the number of components is such that $P \times R - 1 = Q$, so that an extremely simple core array exists, as was proven in (Murakami, Ten Berge, & Kiers, 1998). This extremely simple core array will be produced if we specify in the Analysis Options screen (Figure 1.13) that we only want an orthomax rotation for the core. In order to have the desired scaling we should have specified the proper weighting of the scales mode (see above).

1.7.3 Joint Plots

In order to combine information of the three sets of components and the core array, it is extremely useful to construct plots which show more than mode at a time. Joint biplots are biplots,² in which two or three modes

²See at <http://three-mode.leidenuniv.nl/document/biplot.pdf>, for an elementary introduction by (Kroonenberg, 1995)

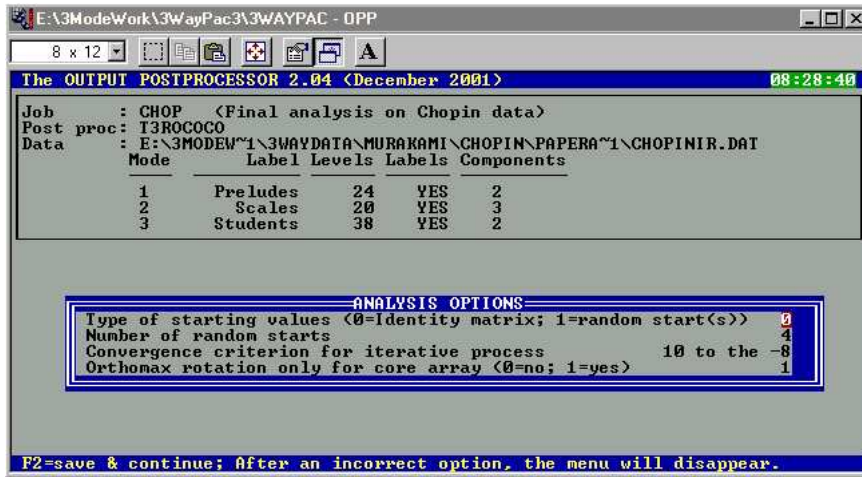


FIGURE 1.13. T3Rococo: Analysis options

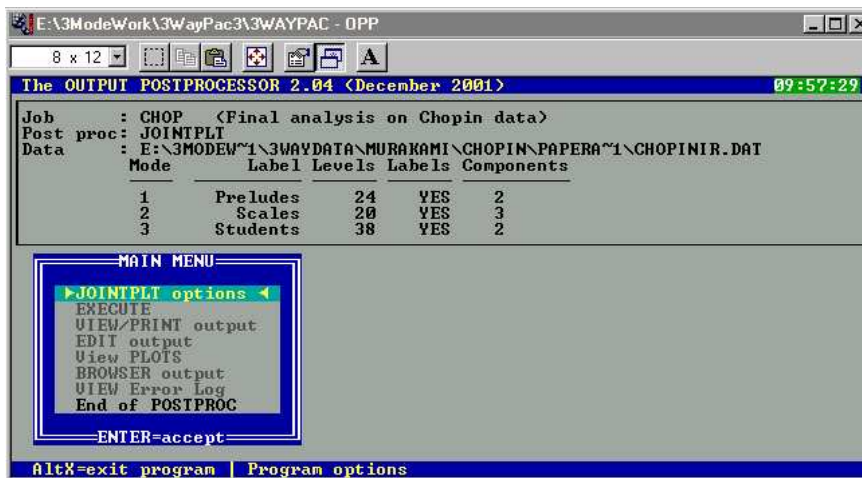


FIGURE 1.14. JointPlt: Main menu

are plotted for each component of the other mode. Further details on joint biplots can be found in (Kroonenberg, 1983c). The name of the joint plot program is JointPlt.

JointPlt: Main menu

The Main Menu screen for JointPlt (Figure 1.14) is the same as that of all Postprocessing programs and the only option available when entering the Main menu for the first time is the one to specify the options for the program.

Jointplt: Options menu

There are three further menus with options which can be selected in this menu (Figure 1.15): (1) types of joint biplot – which two modes should be displayed in a joint biplot, (2) analysis options – containing the choice for varimax rotations for improved interpretation as well as a specification whether the modes should be scaled symmetrically, and (3) specification types of output.

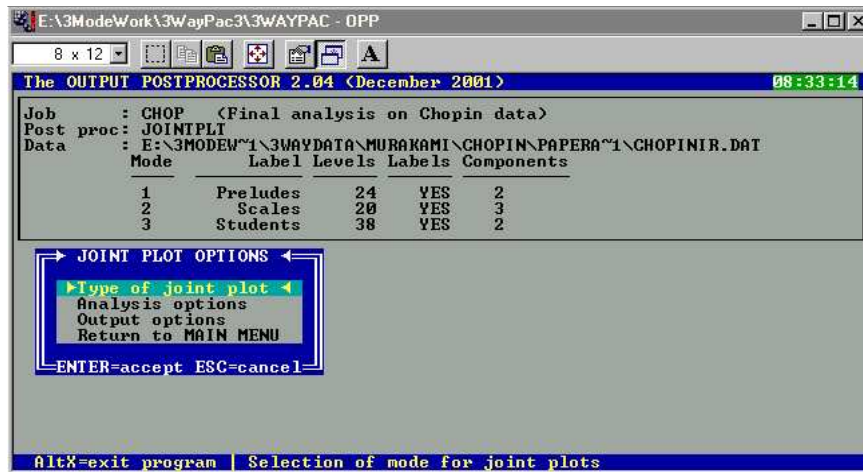


FIGURE 1.15. JointPlt: Options menu

JointPlt: Type of joint plots

For the Chopin data, we want the Preludes and Scales in a single plot, both for the first component of the students mode, which indicates their consensus and for the second mode which is related to their individual differences. Thus we choose the first option in this screen (Figure 1.16). The arrows entry is used to indicate for which of the two modes the levels should be connected to the origin with arrows.

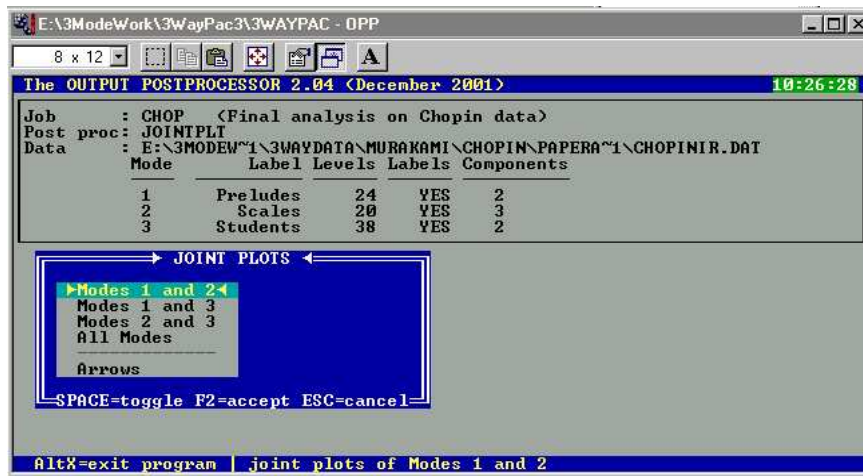


FIGURE 1.16. JointPlt: Type of joint plots

The programs produce two kinds of plots, line printer plots and vector and/or bitmap plots. The latter produced with the freeware program GnuPlot (<http://www.gnuplot.info>). However, even these plots need to be edited with programs like Lotus' Freelance or Microsoft Powerpoint in order to be organised and informative enough for publication.

References

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