Review of Mixed-Up Suite for Windows

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1. Introduction

1.1 Background

The Mixed-Up Suite is a family of standalone programs that fits 2-level mixed effects or random effects models including models for binary, nominal or ordinal outcomes and for count data. The latest member in the family MIXGSUR fits random-effects grouped-time survival models. The Mixed suite is the collaborative work of Donald Hedeker and Robert, D. Gibbons of the University of Illinois at Chicago. Written in Fortran, the first family member MIXOR that fits random-effects probit and logistic model for ordinal outcomes, came out in 1993, followed by MIXREG, MIXNO, MIXPREG and MIXGSUR. They are all started as standalone DOS programs. In recent year, a windows interface for each program has been developed by Discerning System, Inc. which is still undertaking development. Further development of the window interface and marketing of the Mixed suite are undertaken by Scientific Software International, Inc. At the time of the review, the windows version of Mixed-Up Suite does not include the program MIXGSUR for grouped survival time analysis. Instead some of the MIXGSUR features are included in the latest MIXOR V2.0.

Although the Mixed suite can be run under both MS-DOS and Windows, the review only focuses on the windows version.

1.2 Hardware requirement

Mixed-Up suite has been made available for Windows 3, 95, 98, 2000 and XP. Special patches are needed for Windows XP users. They are downloadable from the home site of the suite. The Mixed-Up package for Windows including on-line help, examples and programs occupies only about 3 MB on the hard disk.

1.3 Data input/output functionality

As an estimation-engine only package, the Mixed-Up suite does not have any facility to accommodate data manipulation within the program. For data input, it takes only standard ASCII data file in the form of space delimited with numerical data only.

Missing data should be coded by a unique number. Preparation of data including merging level 1 and level 2 data files, generating dummy variables from categorical covariates, creating interaction terms between variables, variable transformations and the constant term for an intercept should be carried out outside the package. The program only automatically saves a couple of output files in text format showing the model estimates and necessary statistical inference information (*.*out*) as well as residual estimates (*.*res*) for each level 2 unit in the pre-defined format. Users can edit them in other word processors.

The data file to be analysed by the program should include following basic fields:

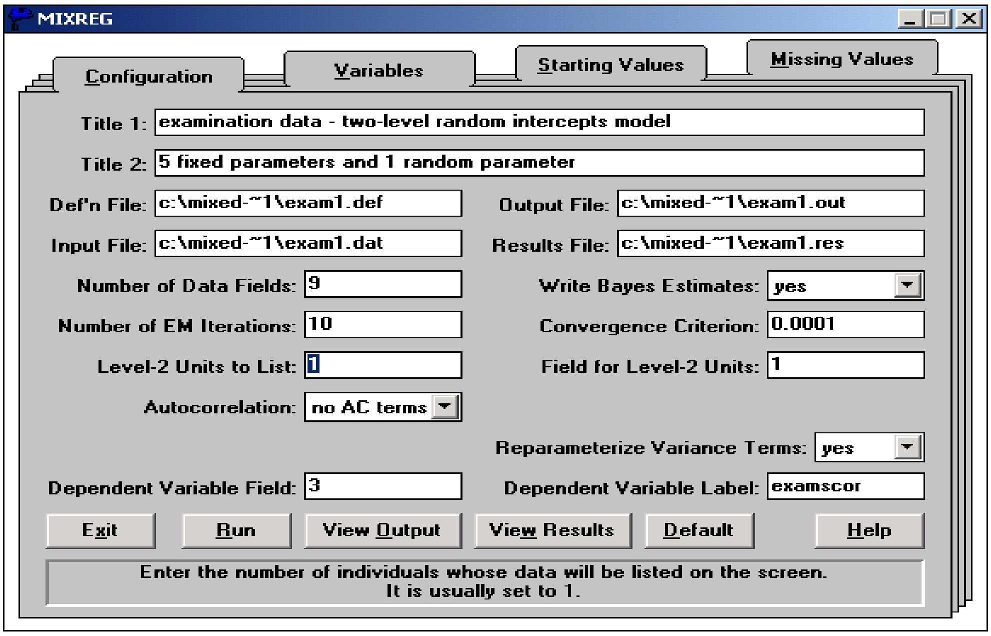
- the cluster id, (must be sorted)
- the response variable
- covariates at level 1 and level 2
- unit vector for the intercept term
- interaction terms if to be included in the model

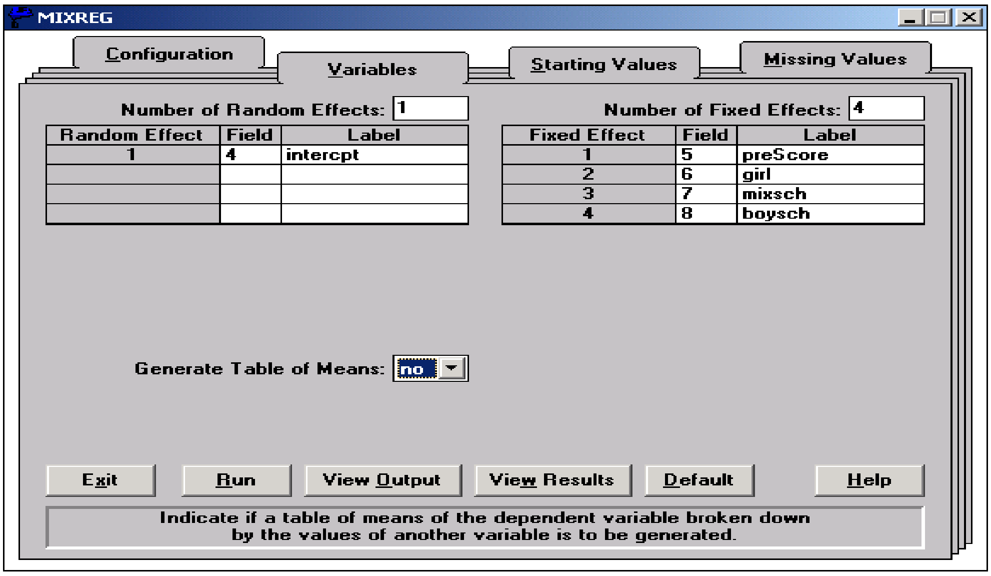
1.4 Other interface features

Several unique features in the Window version of the package are worth mentioning.

First, each program opens with one main screen showing 4 – 5 cards as in the example of MIXOR below. In *Configuration* card, one specifies where the data file is, where the output file goes, how many fields in the data file, the field for the level 2 ID, etc. The file with extension *.*def* in the DOS version of the program defines the model. Any mistake in the file will result wrong model or problems in estimating the model. A learning difficulty for DOS users could be how to make this file correctly. However, in the Window version one does not need to make the file. It is generated automatically by the program using the information from other boxes on different cards in the main screen and saved. In the following example, all a user needs to make is the ASCII data file 'bangGRP.dat' and to point to where the file is in the box of *Input File Name* in *Configuration* card. In the rest of the boxes in different cards and filled with default settings once it opens, one simply makes necessary changes in relevant boxes to reflect the information in the dataset and specification for the model to be fitted.

During the review occasionally the file **.def* was not created correctly and the model estimates were not reported in the output file after filling up the cards correctly. The file **.def* had to be edited manually outside of the program, and the model then ran successfully.





The above two *Configuration* and *Variables* cards cover most of the information needed in estimation and to be provided by users. Usually, users don't need to give starting values for each parameter from the *Starting Values* card but rely on the default settings. All models in the review converged using the default starting values. The facility in the *Missing Values* card allows different missing values for different variables.

The *Variables* card is easy to fill in for both random intercepts and random slopes models. The above example card sets a model of random intercepts and four other fixed effects for the variables pre-school score, gender indicator, mixed and boy school indicators. The fixed effect of the intercept in the random effects box will be estimated by default.

The text box at the bottom of each card provides a help message for any box where the cursor points. For example, in the *Variables* card above, placing the cursor in the box labelled '*Generate Table of Means'*, and the txt message in the box explains explicitly what should go into the box. This interface is particularly user-friendly and helpful in filling the boxes.

Most statistical results after fitting a model are saved in one output file **.out*, including *estimation method*, *number of iteration*, *number of units* for both levels, *size of clusters*, *Log-likelihood*, *Z score* and *p value* for each fixed or random parameters, *intra-correlation coefficient*, *correlation coefficients* between parameters. Not all the statistics are appropriate for all types of models, in particular the non-linear models. Users have to make their own judgement in making inferences based on the outputs.

The program is robust and hardly crashed, although it can fail to produce model estimates or hang due to model misspecification or numerical problems.

2. Standard tools for random effects modelling

Currently, Mixed-Up-Suite for Windows fits following models with a two-level structure only:

- Normal model (including repeated measures model) for continuous outcome;
- Regression model for binary outcome with links of probit, logistic, log-log, clog-log;
- Poisson regression model for count data with or without offset;
- Regression model of cumulative distributions for ordinal outcome with links of probit, logistic, log-log and clog-log;
- Logistic regression model for nominal outcomes;
- Hazard model with right-censoring.

A single level model can be fitted by typing '0' in the box for *Number of Random Effects* in the *Variables* card. Individual level weighting is allowed for all models except for Normal models.

Table 1 summarises the models that can be fitted in the current package for Windows.

Table 1 Multilevel models fitted by Mixed-Up Suite (name of sub-program in brackets)

	Normal (MIXREG)	Binary (MIXOR)	Poisson (MIXPREG)	Nominal (MIXNO)	Ordinal (MIXOR)	Survival (MIXOR)
Algorithm	Fisher scoring, modified	G-H Quadrature	G-H Quadrature	G-H Quadrature	G-H Quadrature	G-H Quadrature
Estimating method	MML	MML	MML	MML	MML	MML
Allowing covariates	Yes	Yes	Yes	Yes	Yes	Yes
Allowing random slopes	Yes	Yes	Yes	Yes	Yes	Yes
Allowing level 2 weighting	No	Yes	Yes	Yes	Yes	Yes
Allowing complex variance	AR(1), MA(1), ARMA(1)	No	No	Full correlation structure between threshold residuals	No	No
Other features and limits	Growth models with autocorrelation.	Four link functions		Logistic link only	Four link functions	Four link functions, grouped data only

Since Marginal Maximum Likelihood (MML) estimators for each fixed and random parameter as well as its accompanying standard error are obtained, asymptotic z-statistics by dividing the parameter estimate by its standard error are exported in the output file by default. As pointed out by the authors, this test statistic could be problematic in testing random parameters or variance-covariance components. So the alternative testing tool is a χ^2 statistic, using the deviance difference between two nested models A and B, i.e. $-2(\log L_B - \log L_A)$. The value of Log L is reported in the output file by the program for each model.

Level 2 residuals are Empirical Bayes estimates. The estimates themselves and the variance-covariance matrix of them are reported in **.res* file.

3. Model specifications – Basic models

Models in this section were fitted on a Dell desktop Pentium 4 (1.6 GHz) with 512 MB RAM running Windows 2000, using the latest version of Mixed-Up-Suite for Windows available freely on the internet.

3.1 Normal models - MIXREG

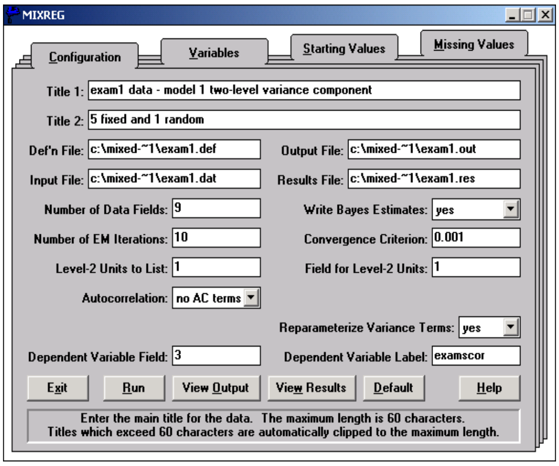
The program MIXREG is used for continuous response with Normal error distribution. The data set is the examination scores of 4.059 students (level 1) of 16 year olds within 65 schools (level 2) of England. The data file ‘**exam1.dat’** loaded for MIXREG consists of following fields in order:

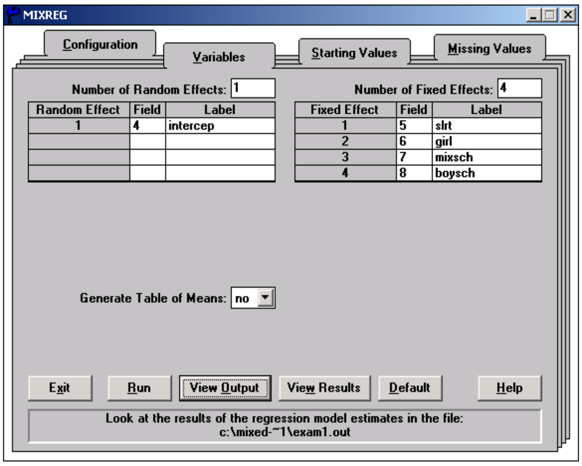
Field 1: School ID (level 2 identifier)
Field 2: Student ID (can be dropped)
Field 3: Normalised exam score (outcome variable)
Field 4: Constant vector of 1
Field 5: Students’ intake score (standardised)
Field 6: Student gender indicator (0 = boys, 1 = girls)
Field 7: Mixed school indicator (1 = mixed school, 0 = other)
Field 8: Boy school indicator (1=boy school, 0 = other)
Field 9: Interaction of intake score and student gender

We built three models:

Model A: random intercepts only with fixed effects of students’ intake, gender and school genders;
Model B: Model A plus an interaction between the intake score and student gender;
Model C: Model B with random slopes of intake score at school level;

The following screens show specification for Model A in the *Configuration* and *Variables* cards. The *Starting Values* card is left at the default of ‘automatic’ instead of ‘user-defined’. In the *Missing Values* card ‘false’ was chosen because of no missing values present in the data.





After clicking on the button *Run* from any one of the four cards, the model will run. Estimates for fixed and random parameters are saved in ‘**exam1.out’** that can be viewed by clicking on the *View Output* button, and level 2 residuals and their variances are saved in ‘**exam1.res’** that can be viewed by clicking on the *View Results* button in any card. The model definition file ‘**exam1.def**’ is created automatically and saved for further models. It can be edited and run using DOS commands.

Specifying Models B or C is easy, simply change the number of fixed or random effects, and type in the number of variables to be added in either part of the model on the *Variables* card. Some results of the three models are displayed in Table 2.

Table 2: Estimates for two-level Normal response models

	Model A	Model B	Model C
Fixed effects			
Intercept	-0.009 (0.076)	-0.009 (0.076)	-0.011 (0.073)
Intake score	0.560 (0.012)	0.563 (0.018)	0.551 (0.026)
Girl	0.167 (0.034)	0.167 (0.034)	0.168 (0.034)
Mixed school	-0.159 (0.087)	-0.159 (0.087)	-0.178 (0.080)
Boy school	0.019 (0.123)	0.019 (0.123)	0.0007 (0.114)
Intake * Girl		-0.005 (0.025)	0.007 (0.029)
Level 2			
Var(intercept)	0.081 (0.016)	0.081 (0.016)	0.080 (0.016)
Cov(Intercept, Intake)			0.020 (0.0065)
Var(Intake)			0.015 (0.0044)
Residual variance	0.562 (0.013)	0.562 (0.013)	0.550 (0.012)
-2*Log Likelihood	9325.4	9325.2	9281.0
Time to run (Approx.)	<3 s	< 3 s	~ 5 s

Note that in Model C the intake variable should only be specified for its random effects in the *Variables* card.

3.2 Growth models for repeated measures data – MIXREG

Being able to handle different kinds of autocorrelation structure in residuals for repeated measures data is a merit of this package. We prepared the following variables in the ASCII data file based on the data of height (cm) of 26 boys between the ages of 11-13 in Oxford in England over 9 occasions approximately 0.25 year apart. For the dataset, significant autocorrelation for the level 1 residuals was found by Goldstein, Healy and Rasbash (1994).

Field 1: Boy ID (level 2 identifier)
Field 2: Occasion number (level 1 ID and time variable)
Field 3: Height (cm) (outcome variable)
Field 4: Age in year, centred
Field 5: Age^2
Field 6: Age^3
Field 7: Age^4
Field 8: Sin function
Field 9: Cosine function
Field 10: Constant

We firstly fitted a simple two-level random slopes model shown in Table 3. Estimation results were comparable with those of the same model fitted by other packages such as SAS, HLM5, SYSTAT and MLwiN. Adding more terms in the fixed part is straightforward via the *Variables* card.

Table 3: Estimates for two-level growth model

	Estimate (SE)
Fixed effects	
Intercept	148.97 (1.539)
Age	6.163 (0.351)
Age^2	1.099 (0.351)
Age^3	0.472 (0.163)
Age^4	-0.348 (0.302)
Level 2	
Var(Intercept)	61.53 (17.08)
Cov(Intercept, Age)	7.97 (3.02)
Var(Age)	2.76 (0.78)
Cov(Intercept, Age)	1.40 (1.41)
Cov(Age, Age^2)	0.88 (0.34)
Var(Age^2)	0.63 (0.23)
Level 1 variance	0.22 (0.025)
-2*Log likelihood	629.2
Seconds to run	< 2 s

Mixed-Up Suite fits five kinds of autocorrelation structures: Stationary AR1, Non-stationary AR1, Stationary MA1, Stationary ARMA(1,1) and General Autocorrelation (Toeplitz structure). For present comparative purposes we are not fitting these.

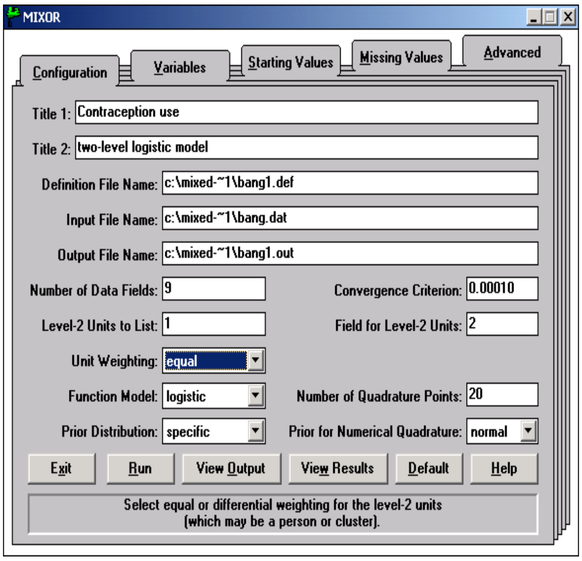
3.3 Regression models for binary data - MIXOR

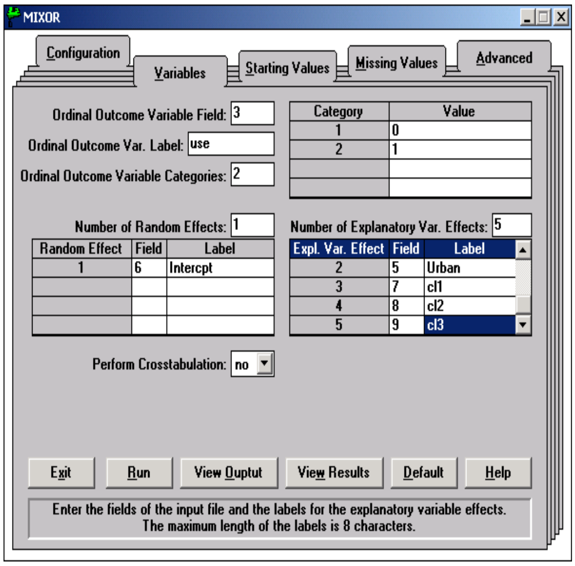
The dataset consists of 1934 women in 60 districts in Bangladesh using or not using contraception for birth control. Factors that may be associated with the choice of use include age of women, type of region of residence and number of living children in the household. The following variables were prepared in the ASCII data file before invoking the program.

Field 1: Women identifier
Field 2: District identifier
Field 3: Indicator of contraceptive use: 1 = use, 0 = not use
Field 4: Age of woman in years centred around mean
Field 5: Constant (for the intercept)
Field 6: Indicator of residence region: 0 = rural, 1 = urban
Field 7: Indicator for 1 living child: one=1, 0=otherwise
Field 8: Indicator for 2 living children: one=1, 0=otherwise

Field 9: Indicator for 3 or more living children: three=1, 0=otherwise

The program MIXOR fits two-level models of random intercepts and random slopes with four link functions available: logit, probit, log-log and clog-log.
To fit a random intercepts logistic model with four covariates in the fixed part of the model, the first two cards, *Configuration* and *Variables* were set up as below. The remaining cards were unchanged by using the default settings.





This model converged within 14 seconds. The other three link functions also worked for the same model, but only the results of logistic model are reported in Table 4.

For the random slopes model, small modifications on the number of random effects and the field of the variable in the *Variables* cards are required. This time MIXOR took more than two minutes to converge. In the output file which can be viewed by clicking at the *View Output* button in any of the cards, some helpful information on the random parameters were reported as follows:

```
Random effect variance & covariance terms (Cholesky of var-covariance matrix)
 Intercpt          0.62551          0.12494          5.00658      0.00000  (1)
 covariance       -0.65101          0.21562         -3.01931      0.00253  (2)
 Urban             0.49305          0.22056          2.23543      0.01269  (1)


 note: (1) = 1-tailed p-value
       (2) = 2-tailed p-value

 Calculation of the random effects variance-covariance matrix
 ------------------------------------------------------------
 Intercpt variance = (0.626 * 0.626) = 0.391
        covariance = (0.626 * -.651) = -.407
 Urban    variance = (-.651 * -.651) + (0.493 * 0.493) = 0.667


 Covariance expressed as a correlation = -.797
```

The converted the random effects variance-covariance matrix enables us to compare the random parameter estimates from the MIXOR procedure directly with that from many other packages.

Table 4: Estimates for two-level logistic models

	Random intercepts model	Random intercepts and slopes model
Fixed effects		
Intercept	-1.689 (0.129)	-1.713 (0.149)
Urban	0.733 (0.094)	0.817 (0.197)
Age, year	-0.027 (0.009)	-0.027 (0.010)
2 live children	1.109 (0.135)	1.126 (0.149)
3 live children	1.377 (0.204)	1.368 (0.224)
4 live children	1.346 (0.187)	1.356 (0.199)
Random coefficients		
Var(Intercept)	0.215	0.391
Cov(Intercept, Urban)		-0.407
Var(Urban)		0.667
-2*loglikelihood	2413.4	2398.3
Seconds to run	~ 15 s	~ 150 s

An approximation to the intra-cluster correlation coefficient (variance partition coefficient) under different link functions for random intercepts model is reported in the output too. For example for the random intercepts model with logistic link this is reported as 6.1%.

```
Calculation of the intracluster correlation
 ------------------------------------------
 residual variance = pi*pi / 3 (assumed)
 cluster  variance = (0.464 * 0.464) =  0.215

 intracluster correlation =  0.215 / ( 0.215 + (pi*pi/3)) = 0.061
```

For the same model with probit link, ICC is reported as 7.4%.

```
Calculation of the intracluster correlation
 ------------------------------------------
 residual variance = 1 (assumed)
 cluster  variance = (0.282 * 0.282) =  0.080

 intracluster correlation =  0.080 / ( 0.080 + 1.000) = 0.074
```

For C log-log link and log-log link model, it is reported as 5.3% and 6.5% respectively.

As noticed in the *Configuration* card, users can either rely on equal unit weighting in fitting unweighted model, or specify a known weighting variable for weighted model. We used this facility on another dataset with known level 1 weights in fitting a single level logistic model with a couple of fixed effects. MIXOR gave results for all fixed effects and their standard errors similar to Stata and MLwiN. The likelihood values between Stata and MIXOR are also similar due to the same estimation algorithm used in the two.

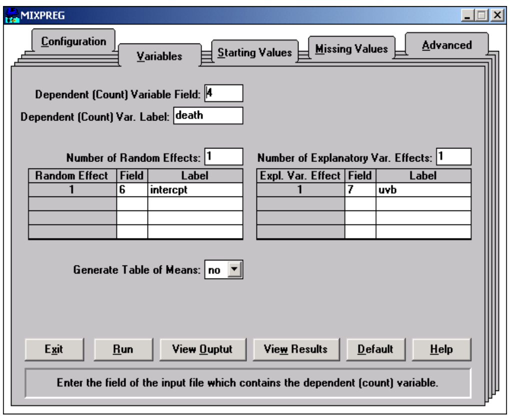
3.4 Two-level Poisson model – MIXPREG

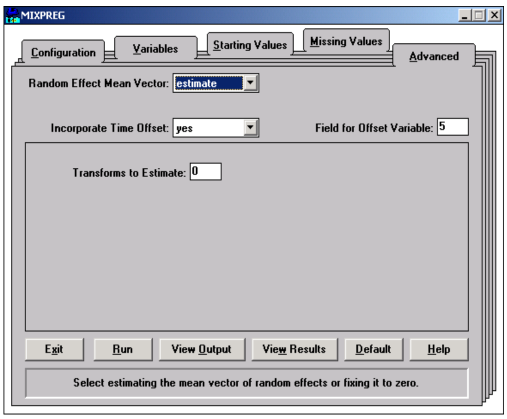
The subprogram MIXPREG stands for Mixed Possion Regression. This tool is reviewed using the malignant melanoma mortality data from 354 counties within 78 regions in 9 European countries. Nine fields are included in the ASCII data file. We only used following variables in fitting a simple two level model with random intercepts among regions and a single fixed effect of the UVB radiation exposure at the county level. Effects of country were ignored in this exercise.

Field 2: Region identifier (Level 2 ID)
Field 3: County identifier (Level 1 ID)
Field 4: Number of male deaths due to MM during 1971-80 (response)
Field 5: Number of expected deaths (offset variable for SMR)
Field 6: Constant vector of 1
Filed 7: Measure of the UVB dose, centred

Specifying the model is similar to the other models reviewed previously via the *Configuration*, *Variables* and *Advanced* cards. The only addition is to tell the program what field number the offset variable is in the *Advanced* card. The following cards show the model settings. Unlike other packages such as SAS or MLwiN where the offset term has to be log transformed before fitting the model, MIXPREG takes the raw data and transforms it while estimating the model.

In the Advanced card, setting of '*Random Effect Mean Vector'* to be zero (instead of 'estimate') will force the intercept to go through the origin, and the variance of intercepts will be changed.





This model converged within 4 seconds. However, with the same estimation procedure, MIXPREG gave different estimates in comparison to Stata. The reason for the difference is unclear.

Table 5: Estimates of two-level Poisson model for Malignant melanoma mortality data from 354 counties within 78 regions of 9 European countries.

	MIXPREG, MML (Quad. points=16)	Stata, ML (Quad. points=16)
Fixed effect		
Intercept	0.105 (0.010)	-0.138 (0.017)
uvbi	-0.052 (0.002)	-0.056 (0.004)
Level 2 variance	0.163	0.130
-2*loglikelihood	2285.9	2250.9

4. Models for categorical outcomes

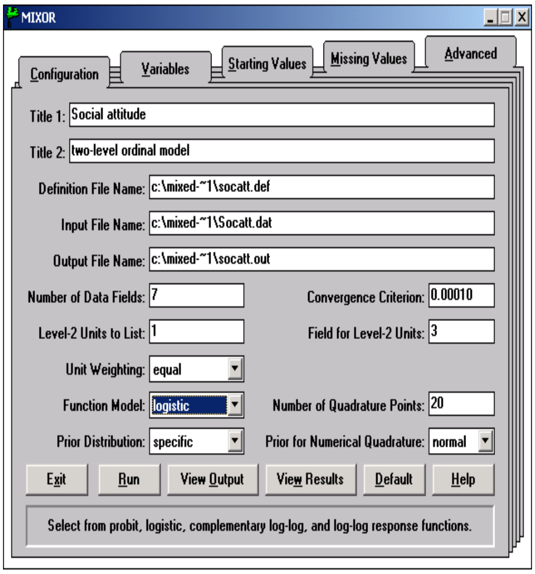
In the Mixed-Up Suite, the terms 'ordinal' and 'nominal' are used to indicate ordered and unordered categorical outcomes respectively. For the ordered outcome, the program MIXOR fits proportional odds models by four link functions (logistic, probit, log-log and C log-log). For the unordered outcome, the program MIXNO fits models with only the logistic function available. Weighting (level 1 weights for single level model and level 2 weights for outcome grouped by the same pattern) is allowed for both types of models. In both programs a maximum of 40 fixed variables can be fitted to outcomes between 2 to 16 categories, and random effects for a maximum 8 variables are allowed.

4.1 MIXOR for the ordered multinomial model

Fitting response with ordered categories for two-level data is one of the earliest developments in MIXOR of the Mixed-Up Suite. Currently MIXOR fits ordinal outcomes with 2-16 categories. For outcomes with 2 categories, models for binary data are implemented. Both random intercepts and random slopes models can be handled for 2-level data with up to 8 random effects. In addition it fits models with fixed effects (up to 3) and interactions with thresholds. To review the basic facility in fitting such models, we use part of the dataset from the British Attitude Survey of 264 respondents at 4 occasions. The outcome is a 7-point scale from most positive to most negative attitude towards to abortion. The variable fields in the data file 'socatt.dat' ready for MIXOR to read includes the following:

Field 1: occasion number
Field 2: outcome of 7-point scale
Field 3: respondent number as level 2 ID
Field 4: indicator for Protestant/Church of England religion
Field 5: indicator for other religions
Field 6: indicator for non-religion
Field 7: vector of ones for the intercept

We first fit a model where a single random component among respondents is specified as below in the card *Variables*. In the fixed part the main effects of different religions are estimated. A logistic link is used for this model. Again we use the default settings in the cards *Starting Values*, *Missing Values* and *Advanced*. This model converged within 3 seconds (Table 6).



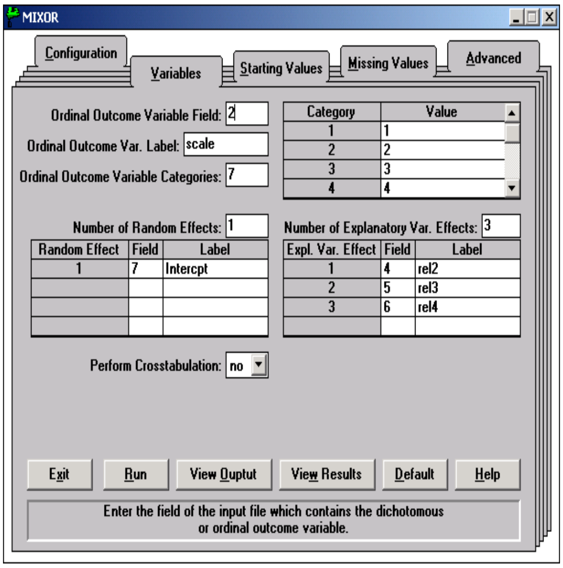


Table 6: Two-level ordinal multinomial model estimates of social attitude scale (1-7 point scale) on abortion from 264 respondents on 4 occasions

	Model A	Model B	
	Quadrature Pts 20,	Quadrature Pts 20,	
Fixed effect	Estimates	Estimates	Interaction of Threshold by Religion group 2
Intercept	-3.908 (0.597)	-3.601 (0.636)	
Religion group 2	-1.731 (0.610)	-2.874 (1.000)	
Religion group 3	-0.503 (0.670)	-0.485 (0.702)	
Religion group 4	-2.726 (0.618)	-2.651 (0.644)	
Threshold 2	1.318 (0.282)	1.150 (0.323)	0.713 (0.733)
Threshold 3	3.970 (0.356)	3.686 (0.420)	1.017 (0.838)
Threshold 4	4.973 (0.373)	4.487 (0.437)	1.475 (0.831)
Threshold 5	5.909 (0.411)	5.387 (0.476)	1.555 (0.880)
Threshold 6	6.879 (0.439)	6.518 (0.514)	1.190 (0.902)
Level 2 SD	2.080 (0.210)	2.068 (0.220)	
-2*loglikelihood	1679.1	1670.6	
Seconds to run	2 – 3 s	~ 5 s	

A positive effect of a covariate is represented by the negative sign if the effects are added to Thresholds. In the *Advanced* card in MIXOR, the box of Model Terms has two options 'Subtract' and 'Add' for user to choose. The sign in association with variable effects for either setting is explained in the output file.

Next we fit Model B assuming that the fixed effect of religion group 2 is no longer constant but varying across 'thresholds'. In the current version of MIXOR, a maximum of 3 fixed effects are allowed to interact with thresholds.

Specification of such model is done in the *Advanced* card in the box for number of 'Explanatory Var. Interactions'. Users are expected to type in a number between 0 and 3 and the program picks them automatically starting from the first fixed variable of the variable list in *Variables* card.

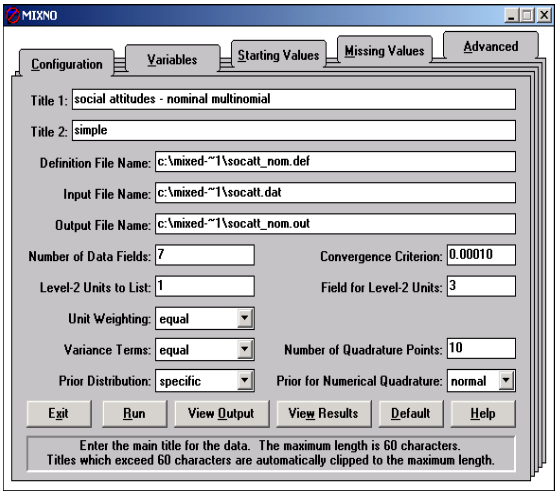
The deviance test statistic is 8.5 with 5 degrees of freedom between Models A and B and suggests no significant difference of the changing religion group 2 effect over thresholds, although the difference between religion group 2 and group 1 is significant at each threshold.

4.2 MIXNO for unordered multinomial model

The same social attitude data are used in this section assuming seven unordered categories. As the random effects on intercepts between respondents are concerned, we expect the program to fit models either with homogeneous variance across all categories or with a full variance-covariance structure between categories at level 2. A random slopes model is also of interest in practice. This review is focused on the random intercepts model.

Model A in Table 7 fits only the mean for each category with a single random term among respondents. This model is specified by changing the default option 'VARYING' to 'EQUAL' in the box Variance Term in the *Configuration* card shown below. In Model B different variance terms for each category are fitted using the default setting. The settings in *Variables* card are same as is Model A for the ordered outcome.

The category number 1 is treated as the base automatically by the program. In our case we wanted category 7 as the base because of greater frequency than other categories. We had to change the codes 1 and 7 around in other software before the model specification in MIXNO. This is rather inconvenient and time consuming in particularly as numerical problems could be caused due to the bad choice of the base category. A box to allow users to specify any category as the base in one of the cards would be a great improvement.



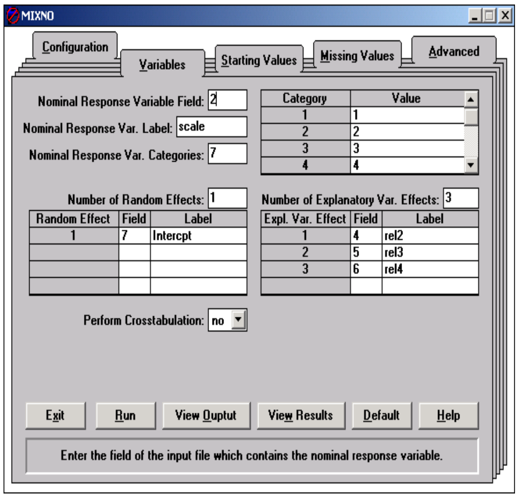


Table 7: Estimates of two-level unordered multinomial model on social attitude scale (1-7 point scale) on abortion from 264 respondents on 4 occasions

	Model A		Model B	
	MIXNO, Quad. Pts 20		MIXNO, Quad Pts 20	
Variable	Fixed	Level 2 SD	Fixed	Level 2 SD
Intercept 1 for category 1	-1.913 (0.239)	2.388 (0.252)	-5.917 (0.880)	6.829 (0.492)
Intercept 2 for category 2	-1.258 (0.236)		-2.597 (0.516)	5.147 (0.391)
Intercept 3 for category 3	0.304 (0.214)		-0.039 (0.332)	4.051 (0.349)
Intercept 4 for category 4	-0.365 (0.224)		-0.270 (0.270)	3.207 (0.365)
Intercept 5 for category 5	-0.389 (0.238)		-0.117 (0.228)	2.436 (0.306)
Intercept 6 for category 6	-0.268 (0.252)		-0.136 (0.180)	1.242 (0.232)
-2*loglikelihood	3425.9		3214.1	
Seconds to run	40 - 50 s		40 - 50 s	

The pairwise correlation coefficients (instead of covariance terms) between the random components of thresholds based on Model B are reported in the output file.

5 Survival models

In the *Advanced* card of MIXOR V2.0, a right-censoring field is allowed for fitting survival models with 2-level structure. The outcome time variable has to be ordinal categorical with a maximum of 16 points. This can limit fitting survival models on most level 1 data where the time variable is continuous with a range beyond 2 – 16 values. However, with the level 2 weighted analysis, aggregated or grouped survival modelling could be carried out if all covariates are not time-dependent and measured at the group level. This model is not explored in this review. We also do not explore multivariate models using MIXREG.

6. Documentation and support

Mixed-Up Suite is currently a well-documented piece of freeware. In its thoughtfully designed website (http://tigger.uic.edu/%7Ehedeker/mix.html) the author and collaborators of the programs have put up very detailed information for users. For each program, there is a guidebook introducing the theory, computational aspects, and use of the program with illustrated real examples. There is also a user manual for the windows version and the DOS version of the program separately to explain step by step the model settings and running under Windows or under DOS. All documents are written in great detail, and are consistent in format and in style. The authors of the program packs have made efforts to ensure the information is accurate, clear and as complete as possible for users. The program website is also kept up to date. At each page in the website one can find a button to reach the author directly. This is useful for technical support or for any questions users might want to ask the author.

As a free package with friendly interface and good documentation to cover standard two-level random effect models for Normal, categorical and count outcomes, the Mixed-Up Suite has very good value for research students and new comers to multilevel modelling.

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