# LINEAR MODELS FOR UNBALANCED DATA pdf

## 1: r - Unbalanced mixed effect ANOVA for repeated measures - Cross Validated

*This newly available and affordably priced paperback version of Linear Models for Unbalanced Data offers a presentation of the fundamentals of linear statistical models unique in its total devotion to unbalanced data and its emphasis on the up-to-date cell means model approach to linear models for unbalanced data.*

The four-way G x M x L x Y dataset 51 cultivars, 2 managements, 18 locations and 7 years was unbalanced Table 1. Only seven cultivars were tested during the entire trial period Table 1. The rest of the cultivars were tested for shorter durations, but the durations were longer than three growing seasons Piepho et al. This outcome was the result of favouring popular cultivars over poorly performing ones. Cultivars included in our dataset were usually assessed at all of the 18 trial locations for a given year. Only a few cultivars Fregata, Kobra Plus and Sakwa were not tested in all locations. In each location and year, individual trials were established as a two-factor strip-plot split-block design with two replications Mintenko et al. Within the blocks, the cultivars were arranged in sub-blocks, and the two crop managements in the other sub-blocks were arranged perpendicularly to the sub-blocks with the cultivars. The plot size planted was  Statistical methods For the statistical analysis of the unbalanced grain yield derived from raw G x M x L x Y data, we used a two-stage combined analysis, commonly recommended and practiced in METs Smith et al. First, the analysis of the LS means was conducted to test the significance of the effects of G, M, L, Y and their interactions. Then, an analysis was performed based on LMM as shown below: In this stage of the analysis, the cultivar effects were considered to be random because the cultivars evaluated were considered to be a representative sample of the wide range of genetic and phenotypic diversity in cultivars germplasm population released recently in Poland and other European countries Smith et al. The locations were assumed to be fixed because they are not truly random samples from a target region and they have a repeatable nature Virk et al. The significance of fixed effects in equation 1 was tested with the Wald F test Anderson et al. The variance components for random effects were estimated using the restricted maximum likelihood REML method Patterson and Thompson,  The likelihood ratio test was used to evaluate the significance of the random effects in equation 1. Secondly, an analysis of the LS means in the G x M x L x Y table was also conducted to assess cultivar adaptation to environment and crop management estimates of adjusted means for the considered combinations , based on an LMM with some nested effects as follows: In which G L ki is the random effect of thek-th cultivar at within the j-th location, G L Ykji is the random effect of interaction between the k-th cultivar at thej-th location and the i-th year; G L Mkjl is the random effect of the interaction between the k-th cultivar at thej-th location and the l-th crop management intensity and the k-th cultivar at the j-th environment; G L MYijkl is the random effect of the residual, comprising both the interaction between the i-th yearl-th crop management intensity and effect of thek-th cultivar at the j-th environment location, the l-th crop management intensity and thei-th year as well as the error term associated with a mean Xijkl; other abbreviations were compatible with equation 1. For the random effects of cultivars at locations G L ki in equation 2 , we assumed a factor analytic FA structure of the genetic variance-covariance matrix Smith et al. This variance-covariance structure is a parsimonious form of the fully unstructured variance-covariance matrix Kelly et al. It is as flexible as the unstructured matrix, but with a smaller number of parameters. The FA models have been considered as giving the best fit for many different datasets, and superior in terms of selection of the best adapted cultivars Kelly et al. The factor analytic structure is a decomposition of the unstructured variance-covariance matrix, based on a factor analysis with Cholesky factorization So and Edwards,  For equation 2 , we used a factor analytic structure with six components. Piepho and Kelly et al. These estimates were used to calculate the adjusted means for the considered combinations of factors, using the algorithm described by Welham et al. Traditional methods of pairwise comparisons of means in unbalanced data and a large number of levels of factors are not useful. Decision, where adjusted means differed, was based on confidence intervals, calculated as two times the standard error of the means Piepho,  Due to the number of cultivars evaluated in the PVTS, as in other METs, it is difficult to effectively interpret and distinguish various adaptive response patterns of these entries. Therefore, the cultivars tested in this study were classified based on their yield response to environments adjusted means for the G x L combinations. The 51 cultivars were grouped based on adjusted means for grain yield at each location separately for the two crop management intensities Curti et al. Cultivars with similar patterns of response to location were included in the same group. The dendrogram was cut when the fusion of groups explained at least 0. For equations 1 and 2 , in the second stage of the combined analysis, we assumed homogeneous residual error variances across locations and years. However, these assumptions simplify the LMMs and allow an unweighted two-stage analysis of the considered data. Therefore, this analysis can deliver information that is sufficiently accurate for making recommendations on released cultivars across agro-ecosystems and crop managements. Equations 1 and 2 were fit using ASReml 3. Results and Discussion The Wald F test for the fixed effects in equation 1 indicated a statistically significant main effect of crop management Table 3. The HIM resulted in an average increase in grain yield of 1. This result contrasts to previous studies where no significant yield response to crop management was detected Liu et al.

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Books[ edit ] Shayle R. The Collected Works of Shayle R. Searle; Casella, George  Generalized, Linear, and Mixed Models 1st ed. Willett, Lois Schertz; Searle, S. Matrix algebra for applied economics. Matrix algebra for business and economics. Selected journal articles[ edit ] s Cowpertwait, P. Journal of Applied Mathematics and Decision Sciences. Research Letters in the Information and Mathematical Sciences. Archived from the original on 14 October  Journal of Dairy Science. Chance, New Directions for Statistics and Computers. Linear Algebra and its Applications. Communications in Statistics - Simulation and Computation. Charles Roy Henderson ". Charles Roy Henderson, â€”". Bulletin of the Institute of Mathematical Statistics. Wherefrom, whereat and whereto? Communications in Statistics - Theory and Methods. Uses editors parameter link Searle, S. Mathematische Operationsforschung und Statistik, Series Statistics. Linear and Multilinear Algebra. S with unbalanced data". An Alternative to Least Squares Means". The Canadian Journal of Statistics. Journal of the American Statistical Association. Topics in Variance Component Estimation". The Annals of Mathematical Statistics. Journal of Animal Science. Factors affecting the iodine number of the fat from the fatty and muscular tissues of cattle". The Journal of Agricultural Science.

## 3: Linear Models for Unbalanced Data : Shayle R. Searle :

*Constantinos N. Tsiantis, Sample size computing for factorial designs: an extension of the Athenian representative method, Proceedings of the 15th american conference on Applied mathematics, p, April May 02, , Houston, USA.*

A company wanted to replace the machines used to make a certain component in one of its factories. Six employees were randomly selected to participate in the experiment, each of whom was to operate each machine three different times. The data recorded were overall scores, which took into account the number and quality of components produced. Open this data file via the File - Open Examples menu; it is in the Datasets folder. A portion of this file is shown below: Notice that two dependent variables are reported: This example will illustrate the ability of Variance Estimation and Precision to analyze balanced models models where the same number of responses is recorded for each factor combination and unbalanced models models where an unequal number of responses is recorded for the factor combinations. From the Statistics menu, select Variance Estimation and Precision to display the Variance Estimation and Precision Startup Panel , in which you can specify the variables for the design. Select Machine and Person as Grouping variables. Click OK to return to the Startup Panel. Simply click the Factor codes button to display the Select codes for indep. Also, you can specify the maximum degree of interactions to include in the default design by entering a value in the Level of interactions field. To specify this estimation method for both dependent variables, verify that both dependent variables are selected in the Dependents list box lower right-hand corner and then select ANOVA in the Estimating method drop-down list. Next we need to specify the sums of squares to use for each dependent variable. You can specify a different estimation method and sum of squares type for each dependent variable by selecting the dependent variable of interest e. For our example, select UnbalancedScore in the Dependents list box, then select the Type I option button in the Sum of squares group box. In the same manner, you can also specify a different custom design for each dependent variable and save those designs to the spreadsheet. We will do this next. For example, if the indexes of a factor A continue to increment across the levels of another factor B , then in the default design factor A is nested within factor B [A B ]. This default design is displayed in the Design representation box and is used to generate results in the ANOVA table when no dependent variables have been selected for the analysis. Note that if you have specified a different design from the one suggested by STATISTICA, you can replace this initial spreadsheet default design with the design specified for the first dependent variable selected in the Dependents list box. To do so, select the Use the design for the first selected dependent variable as the default design to save check box before clicking the Save design button. Specifying fixed and random effects. Let us continue with our example. Recall that the company in our example was evaluating three brands of machines. Because these three brands of machines are the complete set of possible machines and not a random sample from a larger population of machine brands, Machine is a fixed effect. On the other hand, the six employees who participated in the study are a random sample from the pool of all available employees, and hence, Person is a random effect. To specify fixed and random effects for the BalancedScore model, select BalancedScore in the Dependents list box then click the Customize design button to display the Define Custom Design dialog. Notice that those two effects have changed from fixed to random. Notice that the Design representation box has been updated to reflect the current Design effects and Random effects. Next, select UnbalancedScore and specify the same design for that dependent variable. Now, let us save this current design by clicking the Save designs button. Once a design has been saved to a spreadsheet, the spreadsheet title bar changes from Data: The title bar see above also has an asterisk after the spreadsheet name. This indicates that changes have been made to the spreadsheet i. If you want to keep the changes you have made to the spreadsheet, you will also need to save it. For spreadsheets with stored Variance Estimation and Precision designs, variable selections are based on the saved design. This dialog provides options for reviewing summary results, performing residual analysis, evaluating the variance components i. First let us review the results for the BalancedScore response. This table summarizes the main results of the analysis. To test the significance of effects in mixed or random models, error terms must be constructed that contain all the same sources of random variation except for the variation of the respective effect of interest. Error df and Den. Error MS, that indicate the appropriate error term to use in tests of significance for each effect and the degrees of freedom associated with that term. Reported F and p values are based on those denominator synthesis mean squares. Within rounding, these estimates agree with those presented by Milliken and Johnson Here again, denominator synthesis error terms have been reported and used. Within rounding, these results also match those reported by Milliken and Johnson. Milliken and Johnson also reported variance estimates for the UnbalancedScore dependent variable. The Variance Estimation and Precision module provides several ways for reviewing the variance estimates; we will look at two of them. First, click the Collapse variance components button to display the Collapse Variance Components dialog. This dialog shows the variance estimates for each random effect and its degrees of freedom. It also provides an option for collapsing variance components. As reported in Milliken and Johnson, the variance estimate for Person is To do that, select both effects in the Collapse Variance Components dialog, then click the Collapse button. The Collapsed Name dialog will be displayed, enabling you to specify a name for the combined effect. When you click OK on that dialog, the Collapse Variance Components table will be updated to reflect the combined effect. Note that you can send the contents of this dialog to a spreadsheet by clicking the Output button. Now, click Close to close this dialog and return to the Summary tab of the Variance Estimation and Precision Results dialog. You can also review the variance estimates and if desired all combined estimates of a specified level using the Collapse table option. First, enter a 2 in the Collapse level edit field to indicate that we want to review all variance component estimates and all possible two-way combined variance estimates. Then click the Collapse table button. The resulting spreadsheet reports six effects: Note that additional options for reviewing and plotting variance estimates are available on the Variance Evaluation tab of the Variance Estimation and Precision Results dialog. The spreadsheet above shows the coefficients used to construct the linear combinations of sources of variation based on the Type I ANOVA method for the UnbalancedScore dependent variable.

## 4: Shayle R. Searle - Wikipedia

*Methods of Analysis of Linear Models with Unbalanced Data F. M. SPEED, R. R. HOCKING, and 0.P. HACKNEY* The objective of this article is to review existing methods for analyz-.*

## 5: Four-way data analysis within the linear mixed modelling framework

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## 6: Linear Models for Unbalanced Data (ExLib) by Shayle R. Searle | eBay

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## 7: Unbalanced linear mixed effect modeling for longitudinal data with lme4 - Cross Validated

*LINEAR MODELS FOR UNBALANCED DATA Shayle R. Searle CORRIGENDA BUMB June Page/Line , , , and /running head: THE NO-INTERACTION MODEL should be TESTING FOR INTERACTIONS.*

## 8: STATISTICA Help | Example 1: Balanced and Unbalanced Two-Way Mixed Models

*Analysis of Variance, Design, and Regression: Linear Modeling for Unbalanced Data, Second Edition presents linear structures for modeling data with an emphasis on how to incorporate specific ideas (hypotheses) about the structure of* *the data into a linear model for the data. The book carefully analyzes small data sets by using tools that are.*

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