Statistical Package for Augmented Designs

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STATISTICAL PACKAGE FOR AUGMENTED DESIGNS (SPAD)

Introduction

In agricultural experiments often the existing practices or check varieties called control treatments are compared with new varieties or germplasms collected through exotic or domestic collections, called test treatments. In some cases experimental material for test treatments is limited and it is not possible to replicate them in the design. However, adequate material is available for replicating control treatments in the design. Augmented Designs are useful for such experimental situations. An augmented design is any standard design in control treatments augmented with additional (new or test) treatments in complete or incomplete blocks in one-way heterogeneity setting. A survey of the literature reveals that generally these experiments are conducted using an augmented randomized complete block design. In an augmented randomized complete block design, the test treatments are replicated once in the design and control treatments appear exactly once in each block. However, the experimenters often like to know how many times the control treatments be replicated in each block so as to maximize the efficiency per observation for making test treatments vs control treatments(s) comparisons?

It has been established that the optimum replication number of each control treatment in every block of the design is given by square root (number of control treatments + number of blocks – one) multiplied by square root of number of test treatments divided by (number of control treatments multiplied by number of blocks), provided that the number of test treatments is more than the (number of control treatments + number of blocks – one). However, for single control treatment, the optimum replication number of control treatment in each block is given by square root (number of test treatments divided by number of blocks). This optimum replication number of control treatments is obtained by maximizing the efficiency per observation in the design.

There may, however, arise a situation when the optimum replication number of control treatments is not an integer. In such a situation one has to decide as to what integral value of the replication number is to be chosen. It has been established that if the optimum replication number (r) is larger than #. 42, then take $r^* = \text{int}(r) + 1$ and for values of r smaller than or equal to #. 42, take $r^* = \text{int}(r)$ for $u \geq 2$. For $u = 1$, the same rule applies but the cut off value of r is taken as #. 45 instead of #. 42.

With this end in view, a user-friendly, menu driven, graphic user interface (GUI) based Statistical Package called **STATISTICAL PACKAGE FOR AUGMENTED DESIGN (SPAD)** has been developed at IASRI by a team comprising of Abhishek Rathore, Rajender Parsad and VK Gupta. The package generates randomized layout of augmented designs and performs the analysis of data generated. For given number of test treatments, number of control treatments and number of blocks, it computes the optimum replication number of each control treatment in every block of the design such that the efficiency per observation of the test treatments vs control treatment(s) comparisons is maximum. The package also provides flexibility in choosing the replication number of each control treatment in every block. The user can define the replication of each control treatment in every block. Once the user defines the number of test treatments, number of control

treatments, and number of blocks in the design, the randomized layout of the design is generated. The package also provides the analysis of the data generated from augmented designs. A null hypothesis on any user-defined contrast can also be tested.

The package is very useful for classroom teaching as well as for the researchers in statistics with interest in experimental designs. The package has been developed using Microsoft Visual C++ 6.0. Software is completely stand-alone and can be installed on any hardware platform with 32 Bit Microsoft Windows Operating System. Software can be executed with minimum specification of RAM for host Operating System. Installation of SPAD takes 2 MB of hard disk space and at least 1 MB free space for its working. Software is menu driven and is very user friendly. It has a rich edit control for text editor and supports cut, copy, paste, undo, find and find-replace facilities. A Context Sensitive Help with Contents, Index and Search facilities is also available. The software is designed to assist experimenters in planning and analyzing augmented designs.

Generation of augmented design

We begin with the generation of randomized layout of augmented complete block design with each control replicated a ($\geq$ 1) times in each block. When a = 1, it reduces to usual augmented randomized complete block design and when a = r, the number of replications of control treatments per block that maximize the efficiency per observation, then we get the randomized layout of the augmented complete block design that maximizes the efficiency per observation with respect to test treatments vs control treatment(s) contrasts. One can select the option Augmented Designs from the menu and then select the sub-option Generate Design. On selecting the sub-option Generate Design, a form for entering the design parameters is displayed. For generation of randomized layout of augmented design, the input in terms of number of control treatments, number of test treatments and blocks available with experimenter is required. Once the user enters the design parameters, the replication of control treatment(s) that maximizes the efficiency per observation is automatically computed and suggested to the experimenter. There is flexibility for user to change the replication number of the control treatments. To change replication of control treatments, one has to check on the "Change Replication of Control" check box. This will enable an edit box for replication of control treatments, where desired number of replication for control treatments can be given.

Once the desired number of replications of control treatment(s) is entered, the box for entering replication of test treatments and block sizes get activated. Software also displays the total number of plots required. The block sizes are to be entered by the user. The package accepts blocks with unequal sizes also.

Analysis of data generated from augmented design

The data pertaining to an augmented block design is analyzed as per procedure of analysis of general block designs. The treatment sum of squares is partitioned into different components of interest viz. (i) among test treatments, (ii) among control treatments, and (iii) among test treatments and control treatments. The pairwise comparisons of treatment effects can be simplified for an augmented complete block design in which each of the control treatments appears in each block 'a' times. For an augmented incomplete block design, the significance of all possible pairwise treatment comparisons can be tested by automatically generating all the possible elementary

treatment contrasts.

For performing the analysis of data generated through an augmented block design, an ASCII data file in a specified format is required. The existing ASCII data file can be opened in the SPAD window using File-Open options. A new data file can also be created in the SPAD window using File-New option. One can also copy and paste data into SPAD editor from any windows based software like Excel or which supports clipboard operations. For creation of data file in a specified format, the treatments are renumbered as 1, 2, ..., u, u + 1, ..., u + w. Here first u treatments are the control treatments and u+1, ..., u + w are the test treatments. Data file contains at least three columns; first column represents **block number**, second column represents **treatment number** and third column consists of **observed value** of character. If there is more than one character to be analyzed, then the characters can be entered from fourth column onwards. There is no limitation on the number of characters present in the file. All these data values must be separated by a SPACE or a TAB.

For performing the analysis of the data generated through an augmented block design, one can select the sub-option Analyze Block Design from Option Augmented Design in the menu. A click on sub-option Analyze Block Design displays a dialog box. In this dialog box user must specify the character to analyze. This box will only appear if data file has more then one character. Once a character is selected for the analysis, complete analysis with two ANOVA tables; one for testing the equality of treatment effects and another for testing the equality of block effects, R^2, Coefficient of Variation, Root Mean Square Error (RMSE), General Mean and adjusted treatment means is generated. For partitioning the treatment sum of squares into components of interest viz. (i) among test treatments, (ii) among control treatments, and (iii) among test treatments vs control treatments, one can select the sub-option Contrast Analysis. There are three options within the contrast analysis viz. (i) Augmented CB design, (ii) GBD for Tests vs Control(s) and (iii) User Defined Contrasts. Here Tests is used for test treatments and Control(s) for control treatment(s). If the data is generated from an augmented design in which each control treatment appears equally often in all the blocks, then the option Augmented CB design can be used for obtaining partitioned sum of squares and critical differences for performing all possible pairwise treatment comparisons. If the data is generated from an augmented incomplete block design, then the option GBD for Tests vs Control(s) may be used. In this option, the exact probability levels of significance of all possible pairwise treatment comparisons are given in a (u + w) x (u + w) matrix. A null hypothesis on any other contrast of interest can be tested using the option User Defined Contrasts.

For further details, please contact:

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