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Statistical Analysis of Repeated Measures

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Abstract

Repeated measurements are quite common in biological experimentation. Usually, the responses are taken over time, as in weekly growth measurements to establish growth curves. Furthermore, because of these observations are taken from the same experimental units, they are not independent. It is important to note in this context that important assumptions are not the independence of measurements but independence of errors. There are several statistical methods used for analysing repeated measures data including separate analyses at each time point, univariate analysis of variance, analyses of time contrast variables and multivariate method.

In this study, plant height of *Chrysanthemum* (Kapuru) plants was used to compare four methods of repeated measures analysis and their respective advantages and shortcomings. The data was from an experiment that investigated effects of eight day lengths on plant height with ten replications for each treatment. The statistical analysis methods illustrated in this study focus on treatment comparisons at specific times, treatment comparisons averaged over times and on changes over time in specific treatments. Differences between treatments were computed at individual times and averaged across times. Standard errors were computed based on each of the methods of analysis.

Firstly the data were analysed in a CRD at each time point examines treatment effects separately at individual observation times and makes no statistical comparisons among times. There was no inference is drawn about trends over time, so this method is not truly a repeated measures analysis. Therefore it was not a preferred method for final publication because it does not address time effects. In univariate analysis of variance (ANOVA), the data is analysed as a split-plot design for repeated measurements in a CRD. The treatment was considered the main "plot" and time was considered as the sub-plot. The means of the dependent variable over time was changed violating Huynh-Feldt (H-F) condition. Therefore the effect of time and time and treatment interaction were invalid. The "Analysis of Contrasts" method transforms the data to remove subject and time variance. According to the results the interaction effect of time and treatment and their main effects were all significant ($P<0.05$). As their validity depends on whether or not the covariance structure satisfies the sphericity condition, Mauchlys Criterion was used to check for this condition and the sphericity condition was not met. Therefore the multivariate methods of repeated meaurs analysis were done. In this study, how to choose the correct method depending on the data structure and underlying statistical assumptions was classified in repeated measurements.

Keywords: Repeated measures, Sphericity, Split plot design, H-F condition, Analysis of contrast, Multivariate techniques