

# Type I error of repeated measures ANOVA with non-sphericity and very extreme deviation from normality

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## Poster

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## Abstract

**Background.** Recent studies have shown that repeated measures analysis of variance (RM-ANOVA) is generally robust to violation of normality provided the sphericity assumption is fulfilled. However, violation of sphericity has an important impact in terms of Type I error. In this scenario, the Greenhouse-Geisser (F-GG) and Huynh-Feldt (F-HF) adjustments have been widely used as alternatives to the F-statistic. However, the performance of both F-GG and F-HF remains unclear when sphericity is violated under very extreme violation of normality. **Objective.** The aim of this study was to analyse the performance of the F-statistic, F-GG and F-HF in terms of Type I error, with designs including three repeated measures, very extreme violation of normality (i.e.  $\gamma_1 = 3$ ,  $\gamma_2 = 21$ ), epsilon values ranging from the lower to its upper limit (from .50 to 1), and a wide range of sample sizes (from 10 to 300). **Method.** Monte Carlo simulation was performed, with results being interpreted according to Bradley's liberal criterion. **Results.** F-GG and F-HF are generally robust when normality is violated, provided that there is no extreme violation of sphericity (i.e. epsilon values  $\leq .60$ ). In this case, their robustness depends on the sample size, and they are liberal with small sample sizes. **Conclusions.** The more severe the violation of both normality and sphericity, the larger the sample size needed to achieve robustness of F-GG and F-HF. Further studies with a larger number of repeated measures are needed to analyse robustness of these statistics with extreme violation of both normality and sphericity. This research was supported by grant PID2020-113191GB-I00 from the MCIN/AEI/10.13039/501100011033.

## Keywords

Greenhouse-Geisser, Huynh-Feldt, ANOVA, repeated measures

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