Robustness of ANOVA

Violation of the independence assumption affects the accuracy of the standard errors and thus the results of significance tests. If the observations are positively correlated then standard errors might be underestimated which can lead to test statistics that are too large. Significance might be detected when it is not truly there which results in an increase in Type I error rate. If the observations are negatively correlated, then the opposite situation arises. That is, standard errors are overestimated. Test statistics might be too small and true significance is not detected. Thus, the result for negatively correlated data is that power might suffer and the ability of the statistical test to detect a true difference is reduced.

ANOVA is robust against departures from normality especially with a large enough sample size. This means that the probability of incorrectly rejecting the null hypothesis is not appreciably increased over the set alpha value. But power might suffer when the normality assumption is violated. This means that the probability of rejecting the null hypothesis, when it is false, decreases, which is nothing but the power of the test. Hence, the ability of the test to detect a true difference is reduced. When the sample sizes are equal ANOVA is robust against non-constant variances. However, when sample sizes of the groups are unequal, the effect of non-constant variances is more pronounced. If the variances of the groups with a larger sample size are larger, the ANOVA loses power. (That is, the ability of the test to detect a true difference is reduced.) On the other hand, if the variances of the groups with the smaller sample sizes are larger then the Type I error rate might increase. (That is, the probability of incorrectly rejecting the null hypothesis is increased.) For more details about the effects of non-constant variances with unequal sample sizes, click the Information button.
