

Research Project

Effect of different music on memory in middle-aged persons.

One-way ANOVA

Introduction

This study investigates the effects of music on the memory of middle aged persons between 45 to 65 years of age. The aim of the study is to determine if there is any effect in type of music exposure in relation to memory in middle aged persons. Specifically, variability in the means of measured memory in selected individuals exposed to three different types of music.

Method

The methodology detailed herein describes the conduct of experimentation. The statistical design follows a One-Way Analysis of Variance(ANOVA) of 1 continuous response variable and 1 categorical explanatory variable with 3 levels.

Participants of ages 45 to 60 from 3 islands were approached for the study. Consent was sought from all participants prior to conduct.

To eliminate pseudoreplication, a blocking-simple randomization method was implemented. 45 Subjects, 15 from each island, were split into blocks of 3 with 1 subject from each island to eliminate any associative factors of demographic nature. A music treatment was then randomly assigned by way of dice throw. Notably, participants were also checked for clashing surnames before admission into the study to ameliorate associative genetic factors. In this virtual environment, islander surnames inevitably clash due to difficulties in generating unlimited surnames. The sample population is limited as a consequence of meaning to maintain independent replication and randomization. Hence, the limitation of statistical power is recognized, however, more effort is invested into randomization and independent replication to avoid Type I error and still produce definitive findings.

Each participant was subjected to a 30-card memory game which required subjects to flip two cards each time, the aim being to flip pairs of identical cards, failing which, both cards are returned face down. The game ends when all 30 cards have been successfully paired. Participants attempted the game before exposure("B") and after exposure("A") to either classical, country or dance music("Levels"). Subjects were given a distinct deck on their second attempt. Measurements of time taken by subjects for game completion were taken at both instances.

The difference between the two measurements was calculated by subtracting A from B.

A one-way ANOVA was subsequently carried out against the 'Difference' and 'Levels'. This model however, will not identify the main cause of variability.

Results

Results from the ANOVA returned a P-Value of 0.0114, well below our threshold of 0.05 for our chosen 95-percent confidence interval, appearing prima facie, to reject the null hypothesis of non-variance in means. Pertaining to the suitability of the chosen model, the 3 ANOVA assumptions are categorically addressed:

Firstly, the distribution of our response variable, being the difference in measured memory, was broadly checked for approximate normal distribution through simple graphical interpretation. Due to the acknowledged limitations of the sample size as detailed in our methodology, a Sharpiro-Wilks(P=0.2086) test was also performed to check for any departures in normality of distribution, which is more important for a relatively smaller sample size in an ANOVA.

Secondly, the assumption of equal variances of the response variable for each level of independent variable, is markedly more significant as non-conformity could directly result in a Type I error by underestimation of the significance level. From observing the box plot variances through visual estimation of the box-and-whisker length and performing a Fligner-Killeen(P=0.8673) test, it was found that the homogeneity of variances was acceptable and subsequently, a failure to reject the null hypothesis of equal variance.

Finally, the assumption of independent response variables, and by extension, data points. Any overlooked associative factors which could inflate or cause the response variable to be underestimated would be replicated and ultimately lead to a Type I error, which was the main consideration for putting more emphasis on the randomisation and independent replication process before testing for normality and homogeneity as pseudoreplication could render efforts to enforce the other two points futile.

Additionally, one other advantage of using a difference as the response variable is the visibility of the baseline performance.

```
> model1 = aov(Difference ~ MusicType, data=island)
> summary(aov(model1))
           Df Sum Sq Mean Sq F value Pr(>F)
MusicType   2   353.2    176.6   4.989 0.0114 *
Residuals  42  1486.7     35.4
---
```

Figure 1. Analysis of Variance (One-Way)

```
Shapiro-Wilk normality test
data:  Difference
W = 0.9615, p-value = 0.2086
```

```
data: island$Difference  
W = 0.96614, p-value = 0.2086
```

Figure 2. Test for normality of distribution

```
> fligner.test(Difference~MusicType, data=island)  
  
Fligner-Killeen test of homogeneity of variances  
  
data: Difference by MusicType  
Fligner-Killeen:med chi-squared = 0.28478, df = 2, p-value =  
0.8673
```

Figure 3. Test for homogeneity of variance

```
> oneway.test(Difference~MusicType, data=island)  
  
One-way analysis of means (not assuming equal variances)  
  
data: Difference and MusicType  
F = 4.9839, num df = 2.000, denom df = 27.861, p-value =  
0.01411
```

Figure 4. One-Way Anova(Non-assumption of equal variance)

```
> TukeyHSD(aov(Difference ~as.factor(MusicType) , data))  
Tukey multiple comparisons of means  
95% family-wise confidence level  
  
Fit: aov(formula = Difference ~ as.factor(MusicType), data = data)  
  
$`as.factor(MusicType)`  
      diff      lwr      upr    p adj  
country-classical -2.646667 -7.924613  2.631280 0.4491881  
dance-classical    4.160000 -1.117946  9.437946 0.1470327  
dance-country      6.806667  1.528720 12.084613 0.0086612
```

Figure 5. Turkey Honest Significant Difference(Post-hoc main effect analysis)

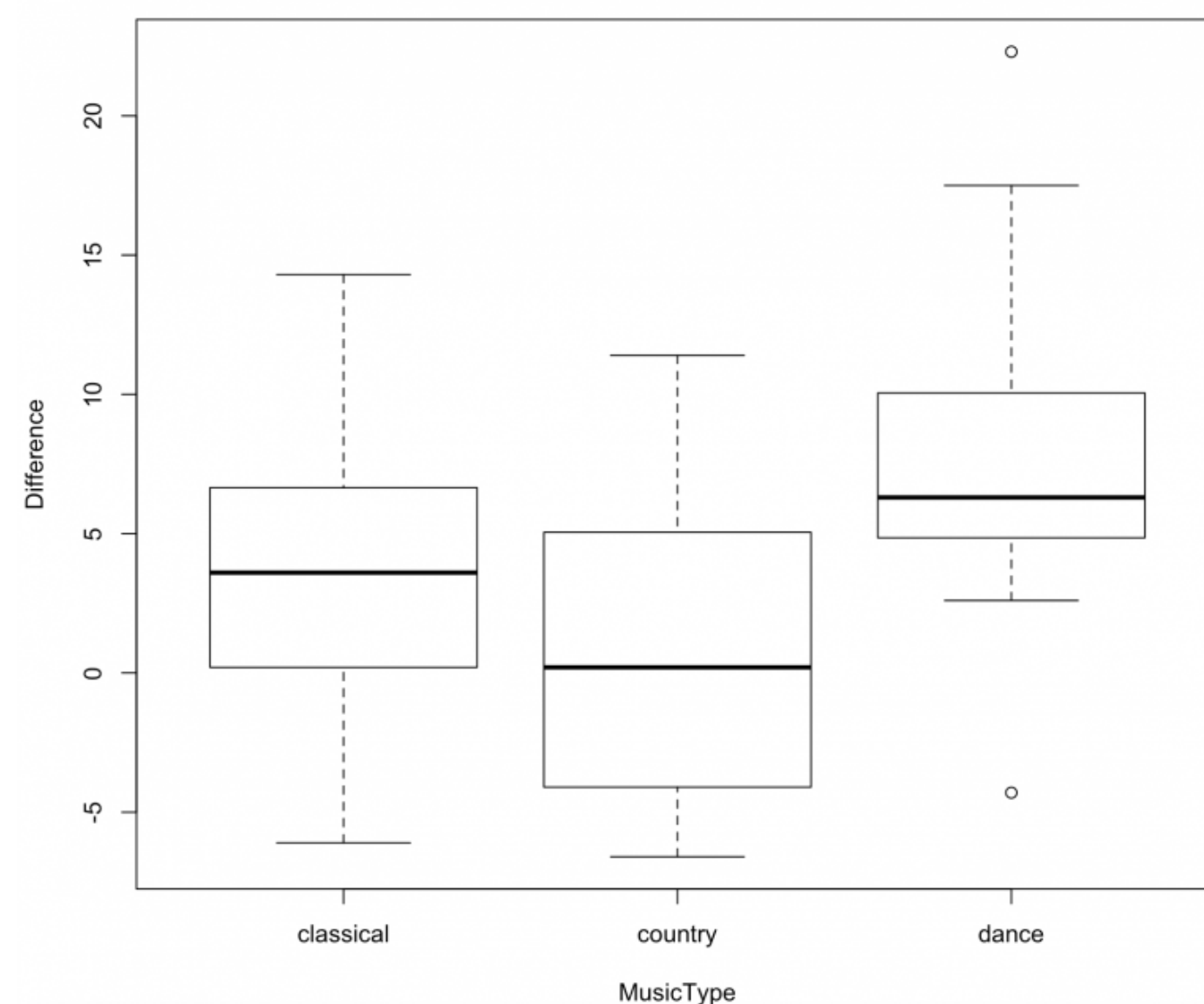
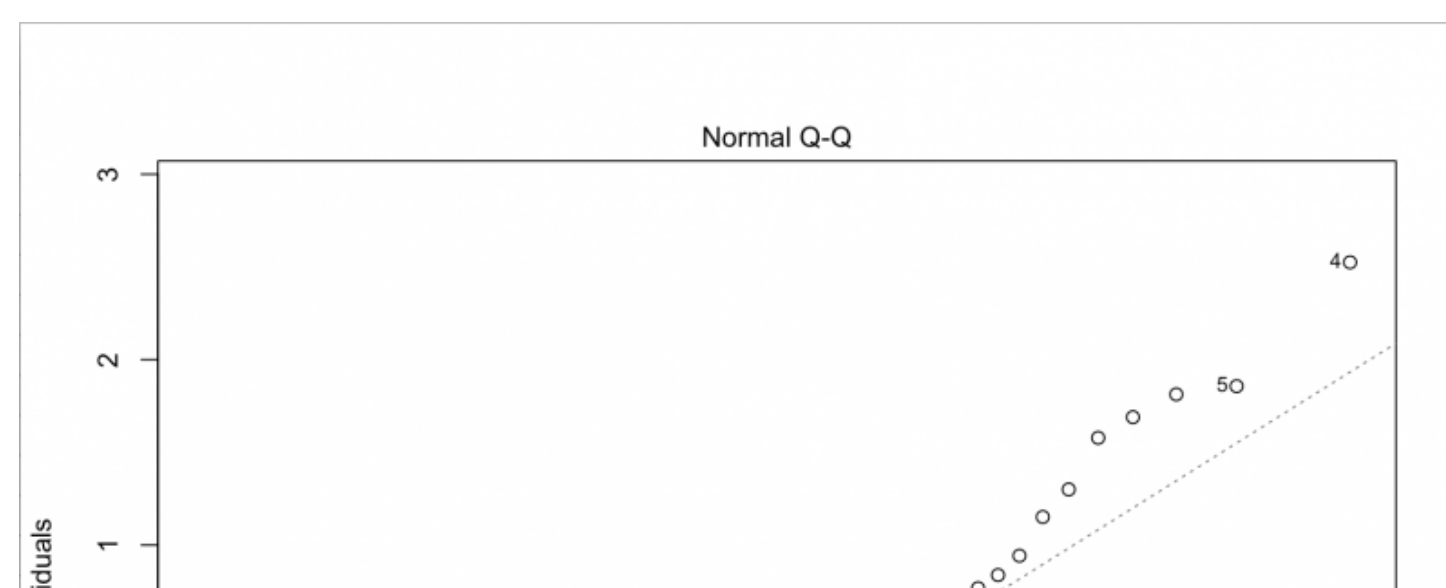


Figure 6. Box Plot



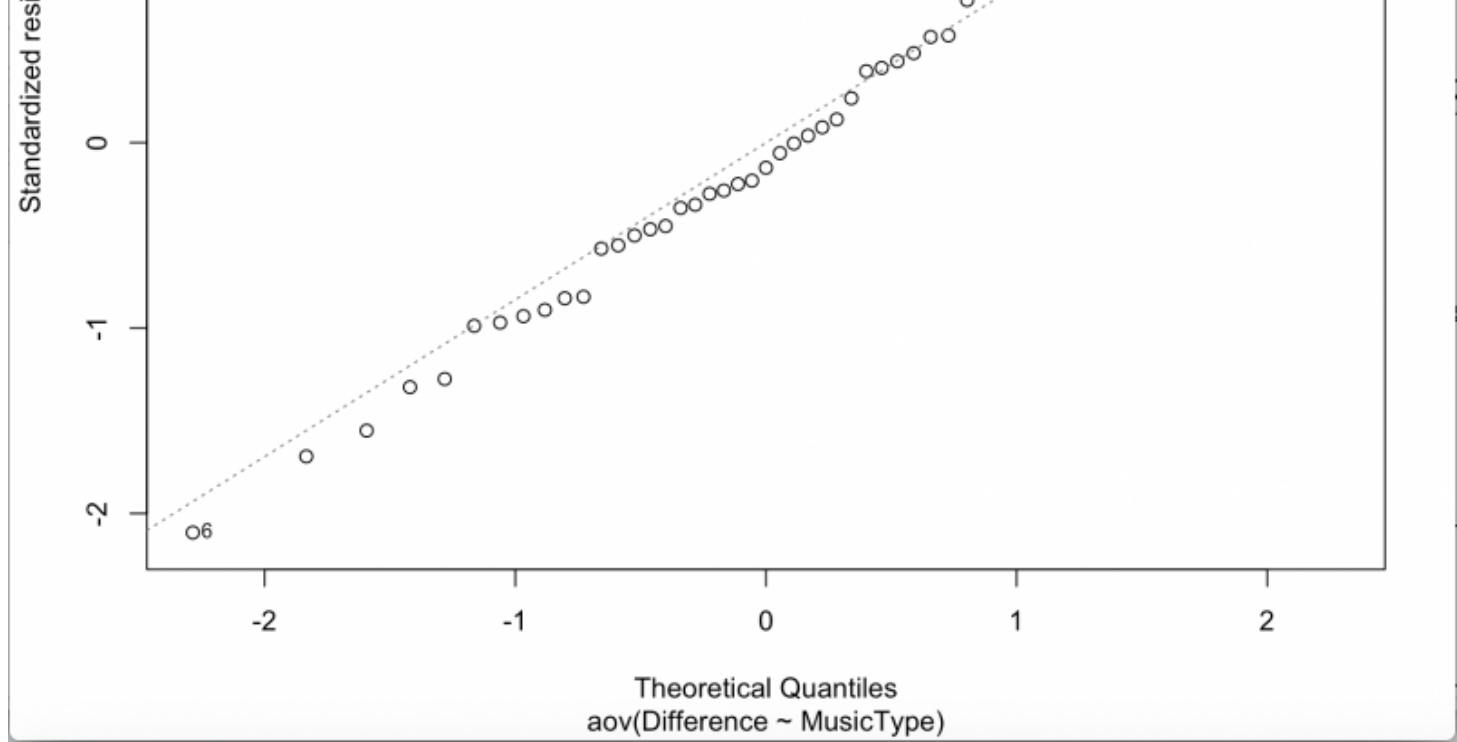


Figure 7. Normal Plot

Conclusion

Satisfying the aforementioned criteria with substantiation, an ANOVA test unassuming equal variances was also performed to check for significant departures from the standard ANOVA test. Test values were found to remain consistent.

In furtherance of curiosity after all efforts, a post-hoc analysis was found to identify the possible main effect. The Tukey Honest Significant Difference test was applied to check for the significant variances in comparative means as the assumptions underlying this test are similar to those of ANOVA.

It was found that the most significant difference existed between Dance and Country music. In conclusion, there is strong evidence of an effect between memory and type of music exposure in middle-aged persons.