MANOVA ANALYSIS ON MULTITASKING PERFORMANCE

Kalpita Raut
Team 10
University of Maryland
kraut@terpmail.umd.edu

Vyjayanthi Kamath
Team 10
University of Maryland
vkamath@terpmail.umd.edu

ABSTRACT

Multitasking is a skill that requires great focus and determination. It poses several advantages like improved productivity, mental stamina and the ability to cut through the chaos to achieve your goals.

This project aims to analyze multitasking performance but from a gender perspective. Do women fare better than men at multitasking? Or is the other way around?

We will be using Multivariate Analysis of Variance (MANOVA) to analyze the performance of 40 men and 40 women. The findings reveal that there is a significant difference between the two groups (male and female) thus we busted the myth that *"Women are better than men at multitasking"*.

Author Keywords

ANOVA, MANOVA, Variance, Normality, Wilks' Lambda, F Statistic, Etasquared, Power Analysis

INTRODUCTION

Our project involves simultaneous multitasking from a gender perspective.

Independent variable: Gender

Response variable: Time, Quality points, Score Percent

Task 1: Folding 5 sets of clothes while reading an excerpt of 260 words.

Task 2: Dribbling a ball while answering 10 questions based on GK and trivia.

The MANOVA (multivariate analysis of variance) is a type of multivariate analysis used to analyze data that involves more than one dependent variable at a time. MANOVA allows us to test hypotheses regarding the effect of one or more independent variables on two or more dependent variables.

MANOVA comes with three assumptions as follows:

1. **Normal Distribution**: The dependent variable should be normally distributed within groups
2. **Linearity:** All pairs of dependent variables, covariates and dependent variable - covariate should have linear relationships.
3. **Homogeneity of Variances:** The dependent variables exhibit equal levels of variance across the range of predictor variables.

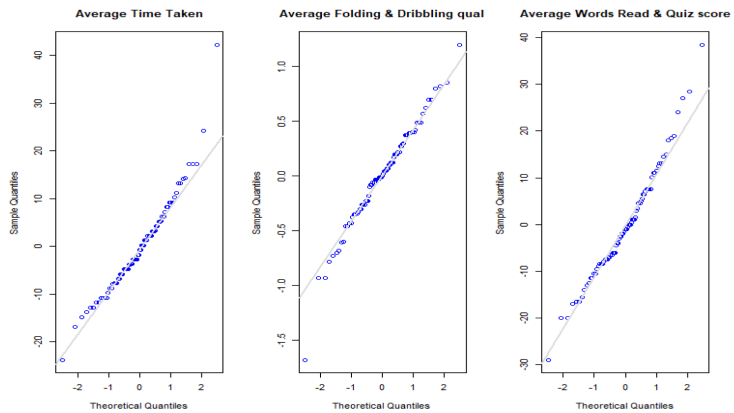

Figure 1: Normality of all response variables

Variable	Mean	Std Deviation
Average Time taken	50.78	10.2
Average Quality	3.971	0.72
Average Score Percent	57.24	11.95

Table 1: Descriptive Stats of the predictor variables

METHODOLOGY

In MANOVA, the hypotheses are set as follows:

H_O: The means of both groups are equal i.e. $\mu_M = \mu_F$

H_A: The mean of one group is different i.e. $\mu_M \neq \mu_F$

In order to see the MANOVA summary we specify the Wilks' Lambda test statistic. Wilks' lambda is a direct measure of the proportion of variance in the combination of dependent variables that is unaccounted for by the independent variable. It is the widely used statistic in MANOVA.

```
> x <- manova(cbind(df$Avg.time, df$Avg.quality,df$Avg.percent) ~ df$Gender, data = df)
> summary(x,test="Wilks")
          Df   Wilks approx F num Df den Df    Pr(>F)
df$Gender  1 0.35892   45.249      3     76 < 2.2e-16 ***
Residuals 78
---
Signif. codes:  0 â***â 0.001 â**â 0.01 â*â 0.05 â.â 0.1 â â 1
```

Figure 2: MANOVA output on R studio

The p-value is significantly lesser than the level of significance 0.05 and the F statistic, 45.249 signifies that the variability between sample means is greater than the variability within sample means. Since the p-value is small (less than α=0.05), we reject H0.

To analyze the effect of gender on the different responses, we run the summary function again.to look at each effect individually.

```
> summary.aov(x)
 Response 1 :
            Df Sum Sq Mean Sq F value Pr(>F)
df$Gender    1   84.0   84.05  0.8022 0.3732
Residuals   78 8171.9  104.77

 Response 2 :
            Df Sum Sq Mean Sq F value    Pr(>F)
df$Gender    1 23.339 23.3388  106.25 3.245e-16 ***
Residuals   78 17.134  0.2197
---
Signif. codes:  0 æ***Æ 0.001 æ**Æ 0.01 æ*Æ 0.05 æ.Æ 0.1 æ Æ 1

 Response 3 :
            Df  Sum Sq Mean Sq F value Pr(>F)
df$Gender    1    43.5  43.513  0.3022 0.5841
Residuals   78 11231.0 143.987
```

Figure 3: summary.aov() output on R studio

We can see that the Quality variable affects gender significantly because of the p-value($3.24e^{-16}$) being lesser than the level of significance(0.05). Thus, the data provide convincing evidence that at least one mean is different from the other. To develop a better understanding of how much this difference is we calculate the effect size.

Effect size is a value which allows you to see how much your independent variable has affected the dependent variable. When using effect size with ANOVA, we use η^2 (Eta squared), rather than Cohen's d with a t-test.

ANOVA

Avgquality

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	23.339	1	23.339	106.246	.000
Within Groups	17.134	78	.220		
Total	40.473	79			

Figure 4: ANOVA output in SPSS for Effect Size

Effect Size η^2 = Treatment Sum of Squares/Total Sum of Squares = 23.339/40.473 = 0.57

According to Cohen's guidelines this is deemed as a large effect size.

Power:

Power of a test is the probability of correctly rejecting H_O. Since, the dependent variable '*Average Quality*' has a large effect, it is the most significant variable. Thus, we calculate the power test on this response variable as:

```
> pwr.anova.test(k=2, n=40, f=0.57, sig.level=0.05)

     Balanced one-way analysis of variance power calculation

              k = 2
              n = 40
              f = 0.57
      sig.level = 0.05
          power = 0.9989462

NOTE: n is number in each group
```

Figure 5: Power test based on Response variable: 'Average Quality'

CONCLUSION

Since the p-value is significantly lower than the significance value and the F-statistic value is large, we rejected the null hypothesis. Thus, we found significant difference in the two means of the groups (male and female). The response variable *'Average Quality of Folding Clothes and Dribbling'* has a significant impact on the results since the it is the only variable with a p-value lower than the significance value. We further calculated the effect size (0.57) and the power analysis (99%) of this response variable and found that its significantly large. Thus, it is safe to say that the myth that 'Women are better than men at multitasking' is busted.

However, the weaknesses in our analysis can be that the sample is not a representative of the entire population. The data collected only represents students in the University of Maryland.

The data that we have collected includes individuals who identify as male and female only. It doesn't take into account individuals who identify as other than the binary system.

With respect to the environment, the windy and chilly weather made it slightly tougher to fold clothes efficiently and thus took a little longer time.

Another weakness can be described as having access to University of Maryland students limited the participant age range to 18-30.

For the reasons stated above, further research must be conducted in order to ensure full inclusivity on all fronts.

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