Stats 101B Group 11 Project Report

By Samarjit Kalra, Margaret Koulikova, Tam Le, Lik Teng Ung,
Janice (Jinyi) Li, Alexis Smith, Xinyuan Tian, Huichong Xiao

I. INTRODUCTION

Alcoholic beverages are enjoyed in almost every culture. However, drinking can also lead to accidents and unwanted events such as drunk driving, hurting others and hangovers. According to the National Institute on Alcohol Abuse and Alcoholism (NIAAA), alcohol can decrease the rate of communication between neurotransmitters in the brain. With that, we hypothesize that it will affect our ability to collect our thoughts and balance or coordinate our bodily actions.

Research Question: Does alcohol have an effect on a person's coordination?
(We do expect a person to be less coordinated after drinking alcohol.)

II. METHODS & PROCEDURE

1. Variables to be investigated

Variables	Explanation/ Description
Alcohol (Treatment)	Issued 3 30 ml shots of vodka to the treatment group, which is usually enough to raise one's BAC to a level over 0.087% (the legal limit in the US)
Age (Block)	Coordination capabilities will likely deteriorate with increasing age. Only interested in the effect of alcohol → Block this variable
Gender (Block)	NIAAA suggests women reach a higher BAC with fewer alcohol consumption. Only interested in the effect of alcohol → Block this variable

2. Experimental Design Choice

Since we have 3 factors to investigate and each with a discrete level, we choose to use complete randomized factorial design with blocking. Factorial design is superior over RBCD for our experiment because we will be able to examine the interactions between the factors.

3. Sampling

Random sampling done on the city of Gordes, which was randomly selected by first choosing a random island and then a random city within that island.

After compiling a list of everyone in the island we randomly selected 60 males and 60 males (20 of each per each age group) and then randomly assigned each person within each group of 20 to a treatment (0 shots or 3 shots of alcohol.) Based on power calculation (**Figure 7, Appendix**), we have replicates, n = 10. The metadata is below:

1. Gender (Block): Female, Male
2. Age (Block): 21 - 35, 35 - 50, 51+
3. Alcohol (Treatment): 0 shot of vodka, 3 shots of vodka

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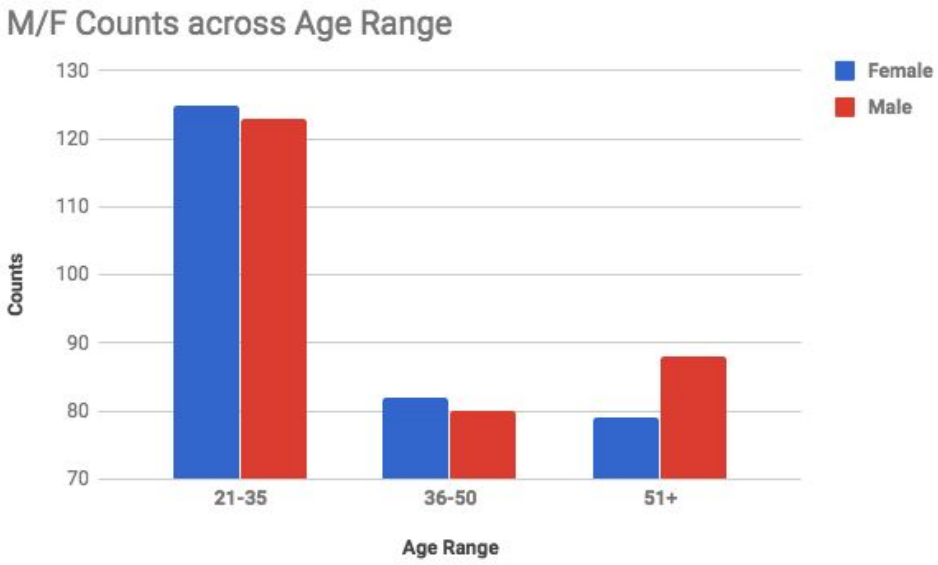


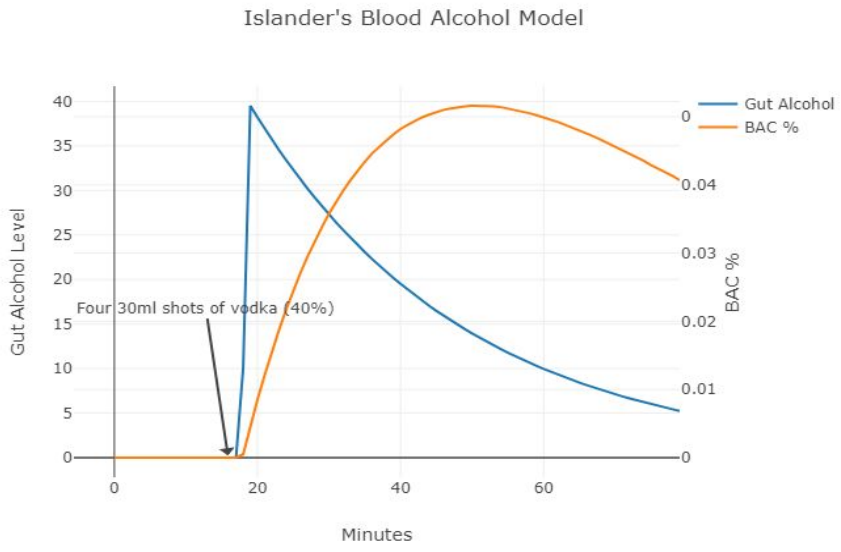
Figure 1: The population of this city is generally younger and within the age of 21-35. The city also has an almost equal proportion of male and female residents.

4. Treatment

We measured coordination capabilities using the balance test. During the balance test, the person is asked to stand on their leg with their eyes closed. The period of time (in seconds) that the person maintained their balance was measured.

a. We first have all subjects perform the balance test and record the time.
b. Next, we randomly assign the treatment to half of our participants. Specifically, we assigned 3 30ml shots of vodka, which is enough to raise the BAC to our desired level.
c. We waited for 15 minutes (based on **Figure 2**) to allow the islanders' BAC to rise.
d. We ask all islanders to perform the balance test again and record the results.

Figure 2: Islander BAC Model for Vodka



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III. RESULTS

CAUTION: Time Difference = Before - After → Higher Positive Response = Lost Balance Quicker

1. Initial Model

```
                                        Df Sum Sq Mean Sq F value   Pr(>F)
factor(gender)                           1      8       8   0.035 0.852234
factor(age)                              2  10324    5162  22.252 1.49e-09 ***
factor(alcohol)                          1   3604    3604  15.535 0.000108 ***
factor(gender):factor(age)               2    658     329   1.419 0.244134
factor(gender):factor(alcohol)           1     12      12   0.052 0.819182
factor(age):factor(alcohol)              2    270     135   0.582 0.559502
factor(gender):factor(age):factor(alcohol)  2     60      30   0.130 0.878183
Residuals                              228  52889     232
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Figure 3: Full Model ANOVA

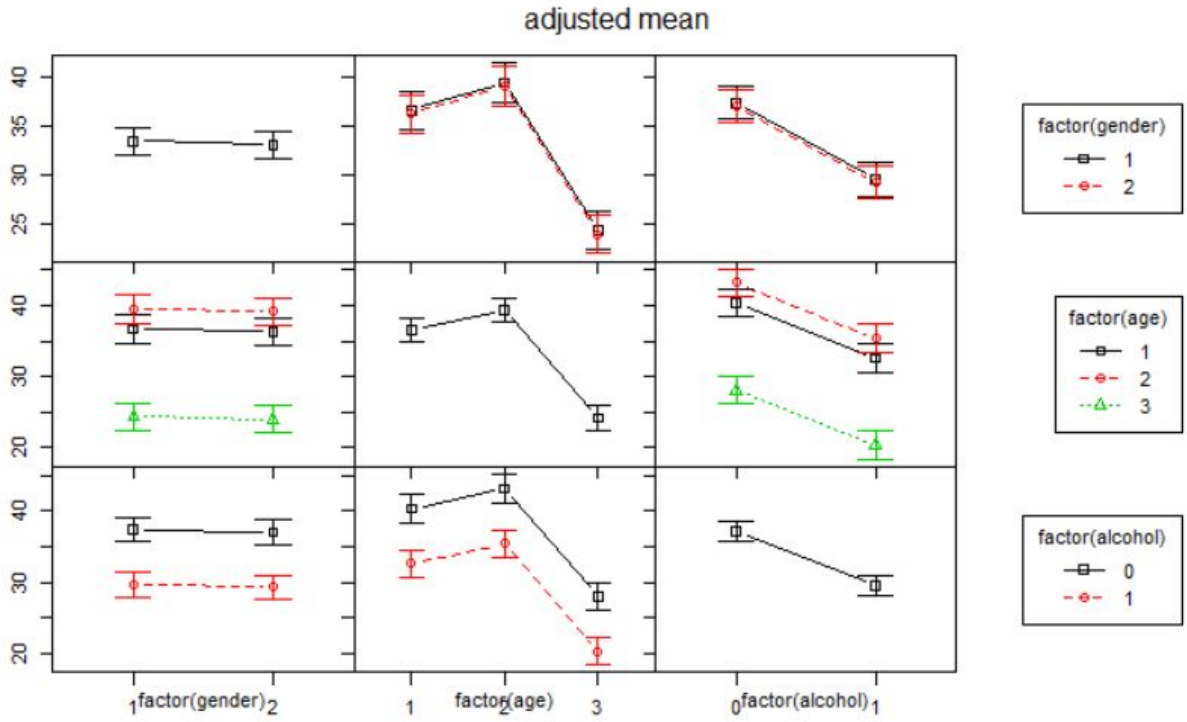

Figure 4: Means and interaction plots. Notice response drop drastically for age 3 (51 +)

Based on the ANOVA and plots, it is safe to remove the interaction terms and gender.

2. Reduced Model

```
                Df Sum Sq Mean Sq F value   Pr(>F)
factor(age)      2  10324    5162   22.60 1.04e-09 ***
factor(alcohol)  1   3604    3604   15.78 9.46e-05 ***
Residuals      236  53898     228
---
signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Figure 5: Reduced Model ANOVA

Reduced ANOVA is much better fit. The final model equation is below (keep in mind time difference was taken to be Before - After; so negate the y):

$$\hat{Y} = 49.508 - 6.150 * Age - 7.750 * Alcohol$$

3. Model Adequacy

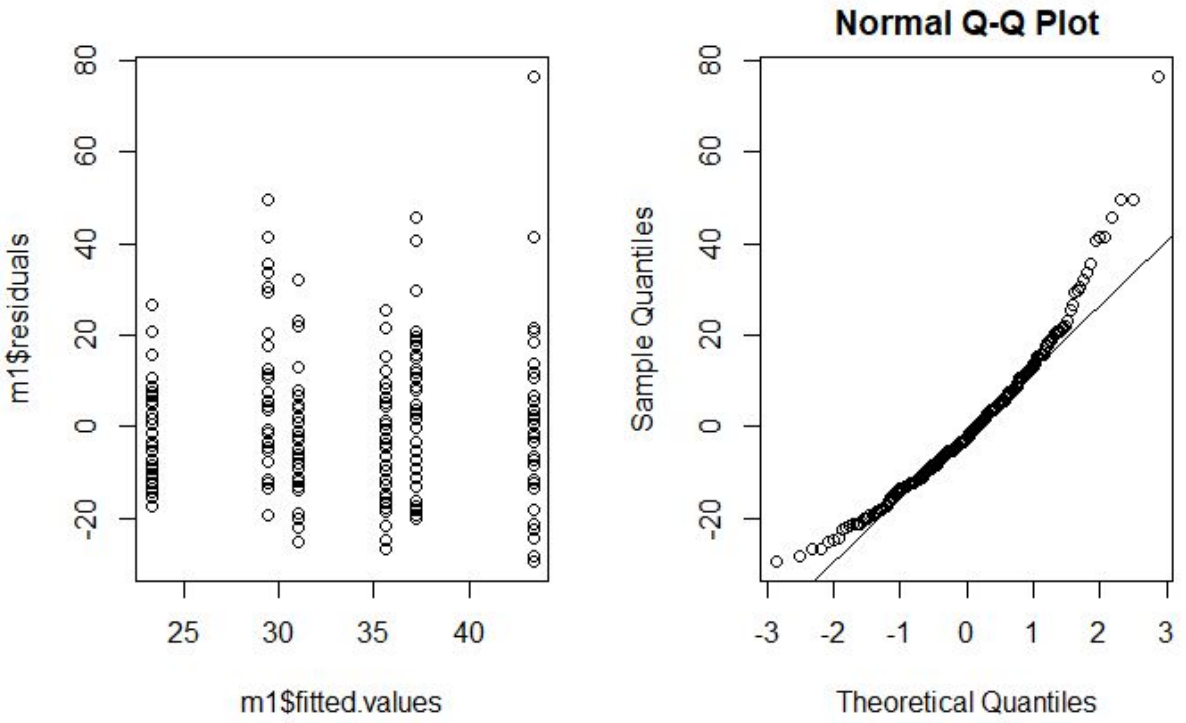

Figure 6: Checking model assumptions. Some deviations, but nothing major.

The Residuals vs. Fitted plot are generally randomly spreaded but extends more towards the positive direction. The Normal Q-Q plot has a straight line but it is heavily tailed. These are not a serious violation of the normal errors assumption.

IV. DISCUSSION

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Based on **Figure 3**, gender and age do not seem to interact significantly, which contradicts NIAAA findings. This is possibly due to the Island's algorithm, which may or may not account for gender effects on alcohol consumption.

Based on **Figure 4** of the middle column, last row, older people have a harder time balancing, which confirms our original assumption.

In **Figure 6**, there are quite a few outliers. This is either because the actual distribution is non-normal (**Figure 8, Appendix**) or because some people are really good at balancing.

Based on **Figure 11, Appendix**, older people aren't that much affected by drinking, balance-wise, which again verifies our assumptions.

Alcohol consumption (particularly something similar to 3 shots of vodka) and age (particularly affects one's balancing holds with alcohol being the higher effect of the two.

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V. REFERENCES

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Peters, R. (2006). *Ageing and the brain*. Postgraduate Medical Journal, 82(964), 84 - 88.
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V. APPENDIX

CAUTION: Time Difference = Before - After → Higher Positive Response = Lost Balance Quicker

```
[1] 37.20833
[1] 29.45833

     Balanced one-way analysis of variance power calculation

              k = 12
              n = 10.11316
              f = 0.4366812
      sig.level = 0.05
          power = 0.9

NOTE: n is number in each group
```

Figure 7: Power calculation to get minimal sample size for each group

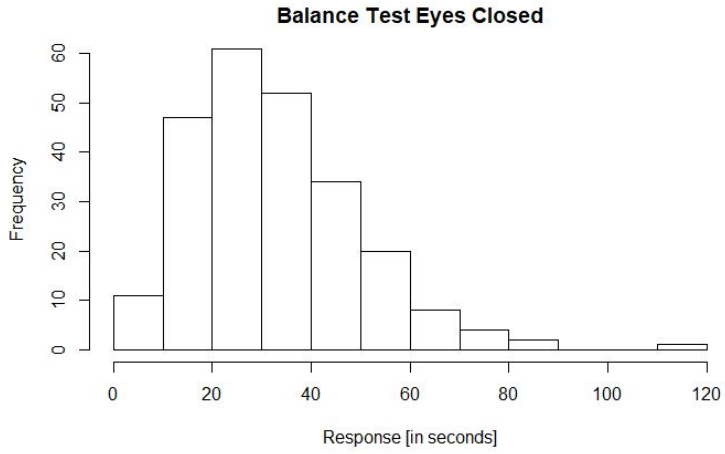

Figure 8: Distribution of balance test drunk or not is right-skewed (e.g. chi-squared, F)

```
  Tukey multiple comparisons of means
    95% family-wise confidence level

Fit: aov(formula = response ~ factor(age) + factor(alcohol))

$`factor(age)`
     diff        lwr        upr     p adj
2-1   2.8  -2.835773  8.435773 0.4711931
3-1 -12.3 -17.935773 -6.664227 0.0000017
3-2 -15.1 -20.735773 -9.464227 0.0000000

$`factor(alcohol)`
     diff       lwr       upr    p adj
2-1 -7.75 -11.59357 -3.906428 9.46e-05
```

Figure 9: Ages 21 - 35 do significantly better balancing than ages 35 - 50 and 51+

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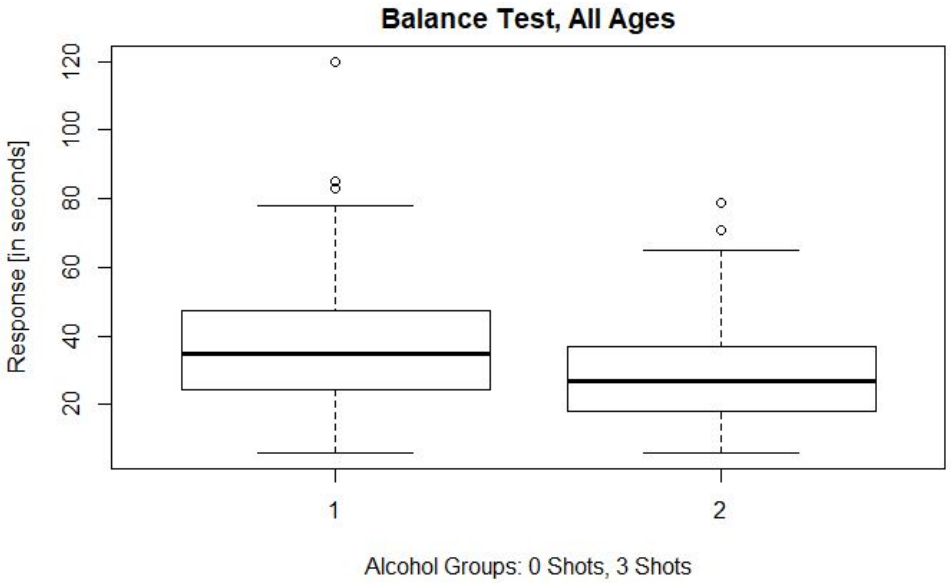

Figure 10: Balance time seems not affected much by alcohol considering all ages.

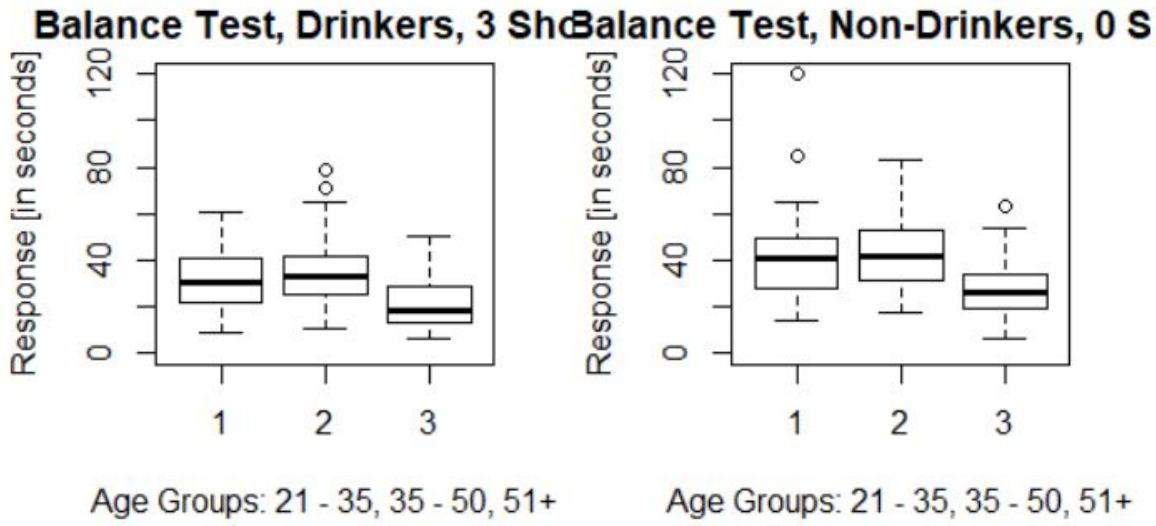

Figure 11: Drinking does make one lose balance quicker (longer time difference). Older people aren't that much affected by drinking, balance-wise.