Project 6: Multiple Regression

04/21/2021

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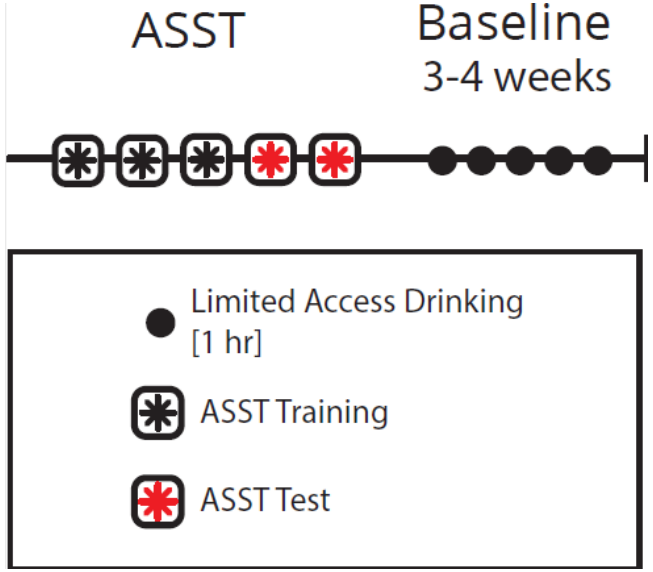
Background

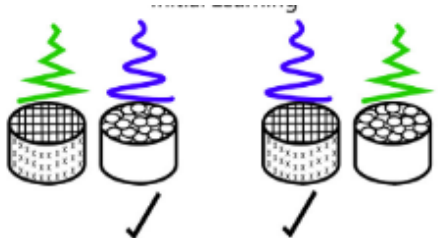
- Alcohol consumption patterns vary by individuals
- Previously, in our lab we have found that chronic stress and alcohol exposure has been shown to decrease cognitive performance (Rodberg et al., 2017)
- Attentional set shifting task (ASST) measures behavioral flexibility and cognitive ability in rodents

Can alcohol consumption be predicted from baseline cognitive performance and sex?

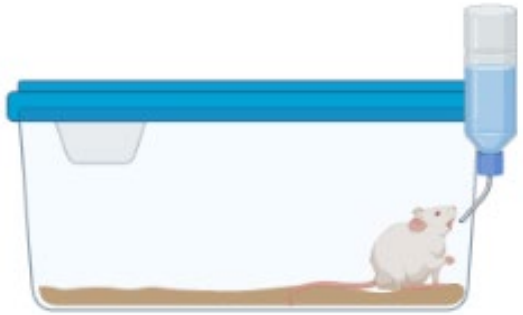
Methods

- 16 mice (10 female, 9 male)
- Attentional set shifting
- Cognitive ability measured by performance index
- Baseline drinking (1hr, 15%)
- Drinking is calculated as grams EtOH/kg of bodyweight
  - Daily EtOH consumption averaged across last 2 weeks of baseline drinking



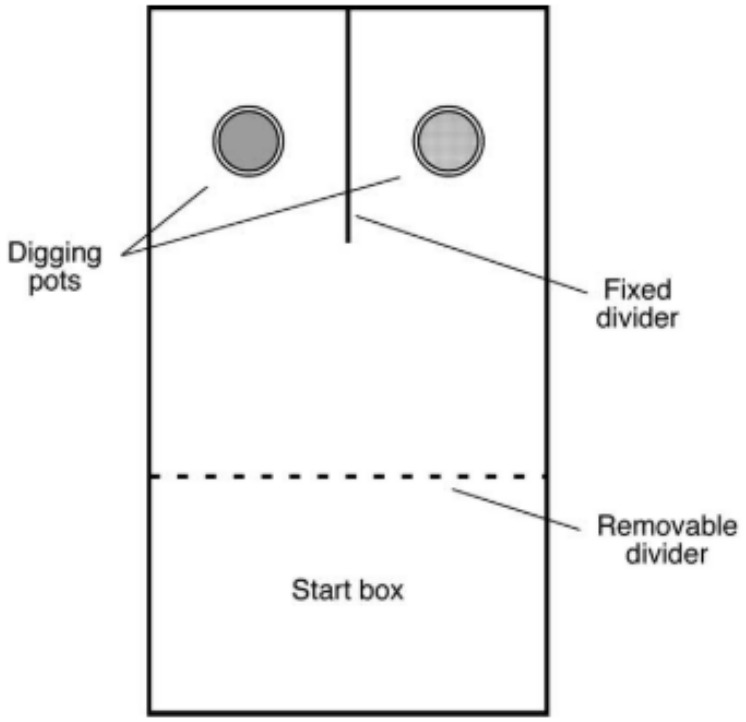


Attentional Set Shifting

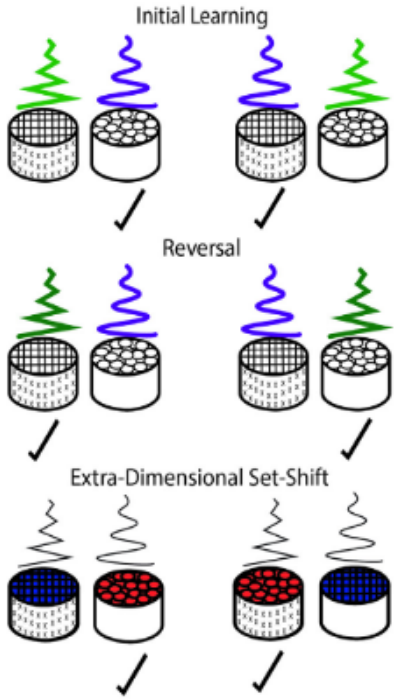


Baseline Drinking

Attentional Set Shifting Task



(Lapiz and Morilak, 2006)



(Hurtubise and Howland, 2017)

	Dimension	
Task	Relevant	Irrelevant
SD	Odor	Texture
CD	Odor	Texture
CDR	Odor	Texture
ID	Odor	Texture
IDR	Odor	Texture
ED	Texture	Odor

Combinations	
Correct	Incorrect
Cloves	Sage
Cloves and Velvet	Sage and Silk
Cloves and Silk	Sage and Velvet
Sage and Velvet	Cloves and Silk
Sage and Silk	Cloves and Velvet
Basil and Tinfoil	Cumin and Coarse Sandpaper
Basil and Coarse sandpaper	Cumin and Tinfoil
Cumin and Tinfoil	Basil and Coarse Sandpaper
Cumin and Coarse Sandpaper	Basil and Tinfoil
Burlap and Cinnamon	Fine Sandpaper and Thyme
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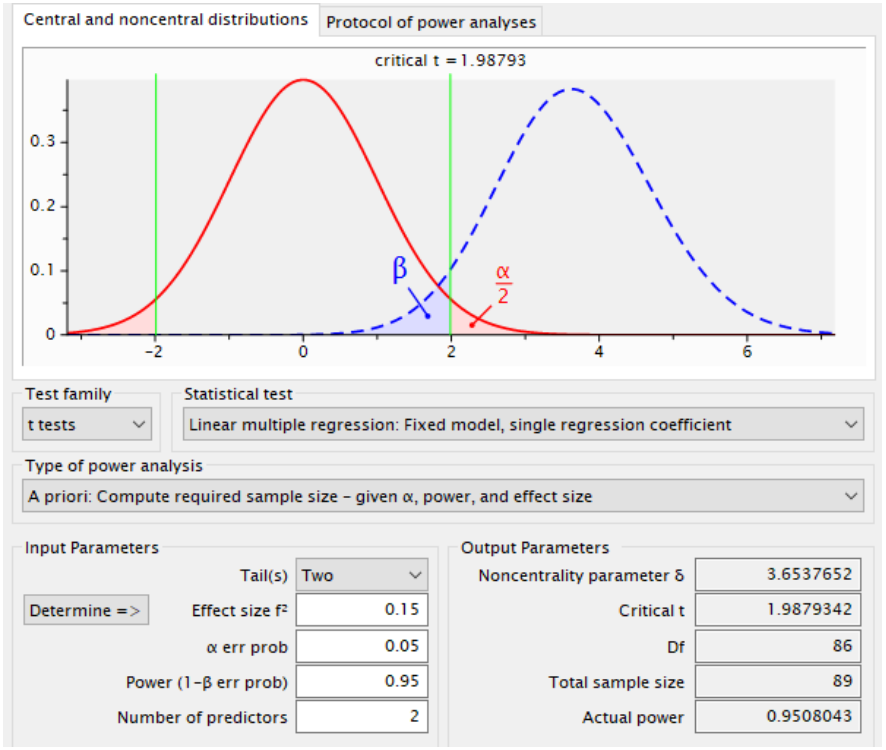
(Rodberg et al., 2017)

Variables

- Quantitative predictor: Cognitive performance (performance index)
  Calculate performance index for each animal:
    1) Stage reached
    2) Average trials per stage
    3) Average % incorrect
  Higher performance index (PI) = better cognitive performance
- Qualitative predictor: Sex
  Male(0) or Female(1)
- Outcome variable : Average g/kg EtOH consumed at baseline

Apriori power analysis

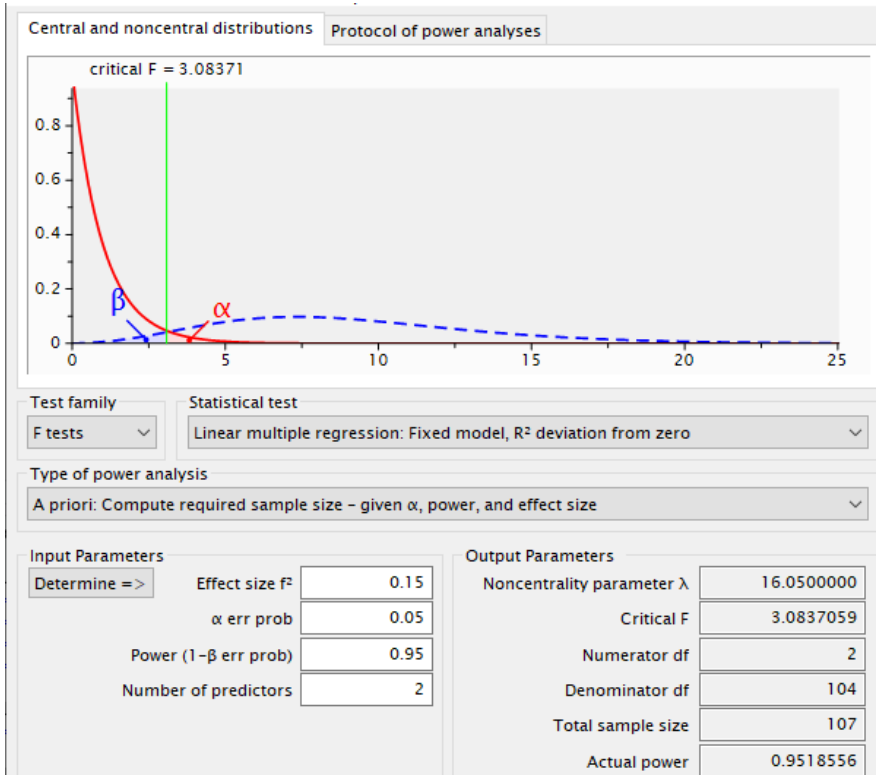


Individual β

Is a single coefficient different than 0?

f^2 = .15 (medium effect)

Sample size = 89



All β

Are all coefficients different than 0?

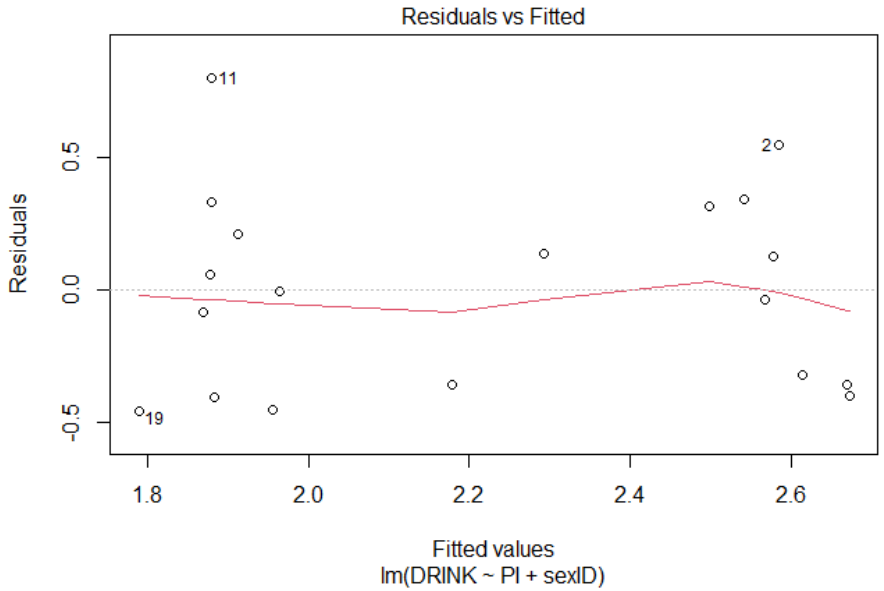
f^2 = .15 (medium effect)

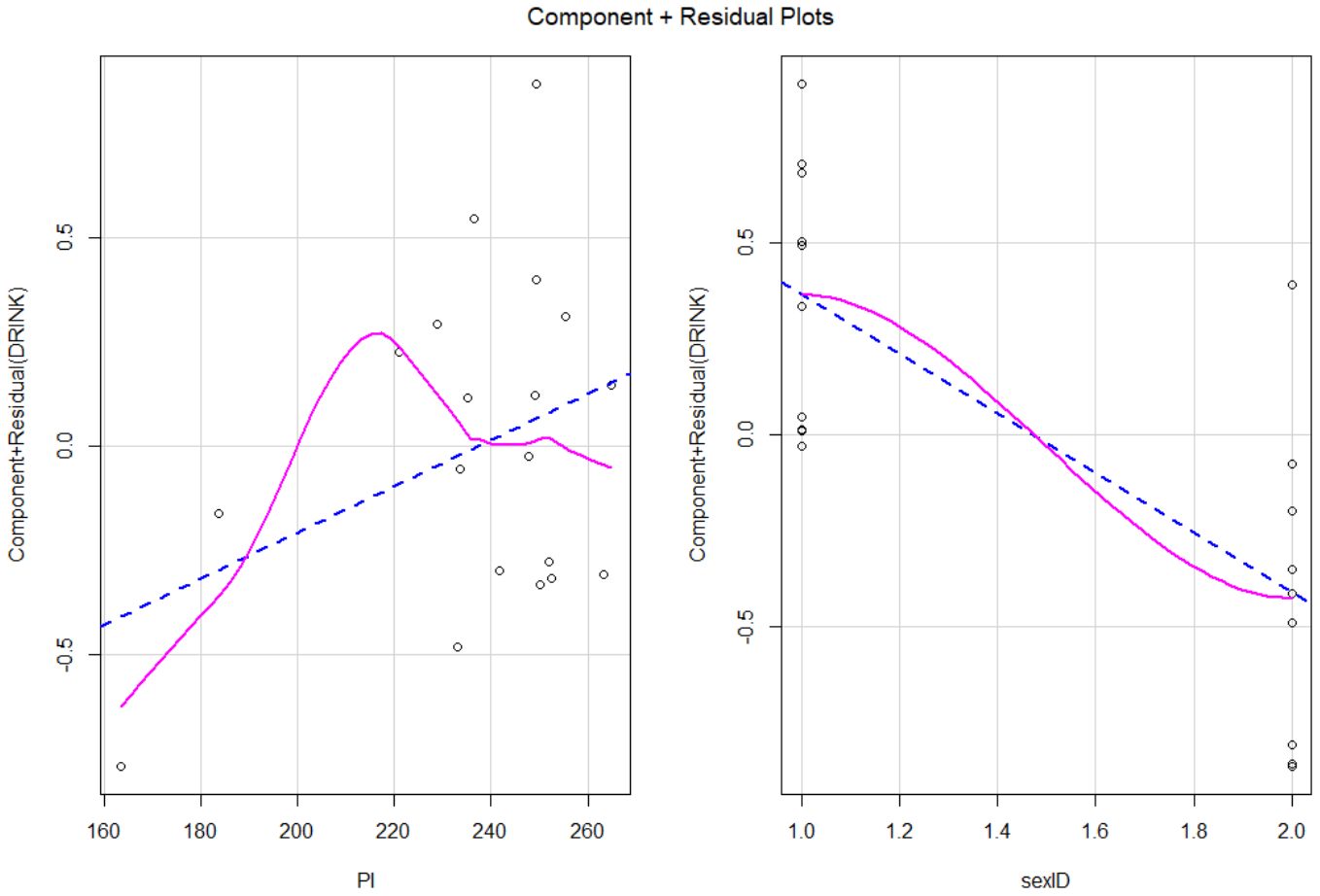
Sample size = 107

This study was underpowered

Assumptions:

Linearity: Harvey-Collier test
females: p-value = 0.2932
males: p-value = 0.971
linearity is not violated



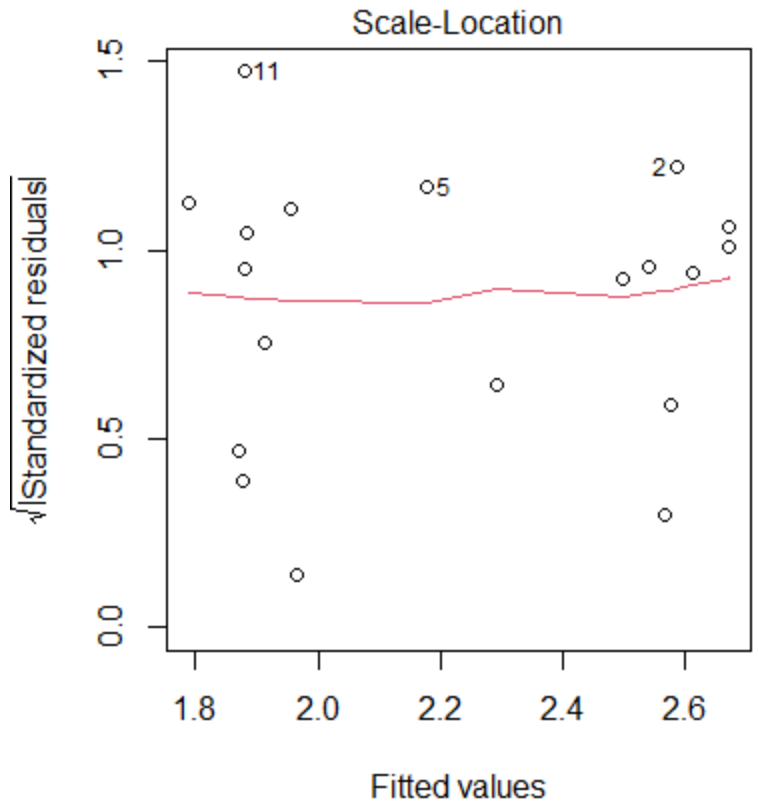


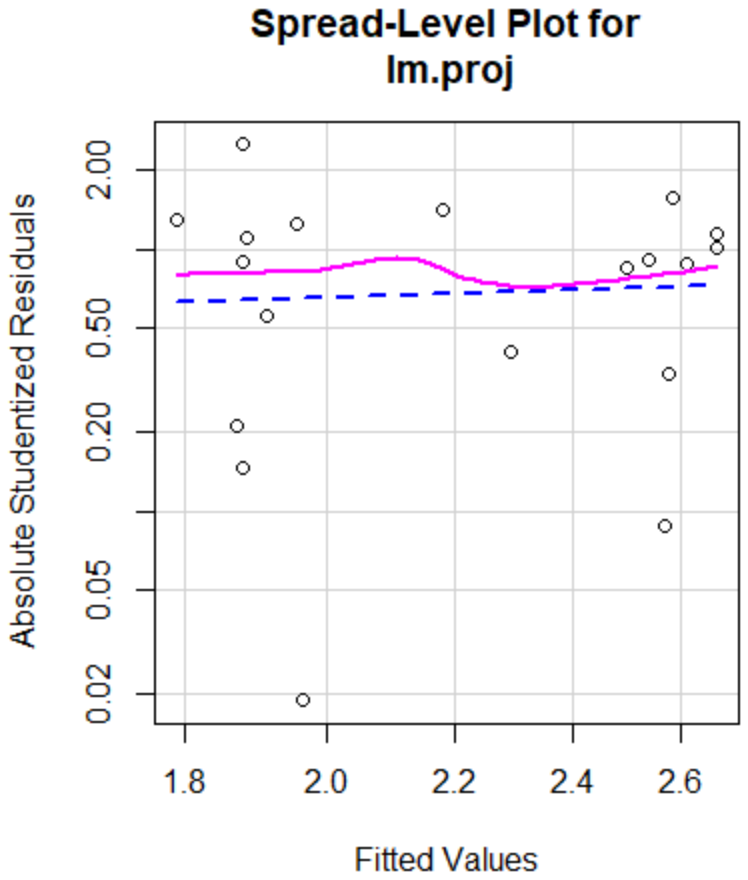
Assumptions:

Homoscedasticity: Non-constant Variance Score Test

p-value = 0.63174

Equal variance is not violated



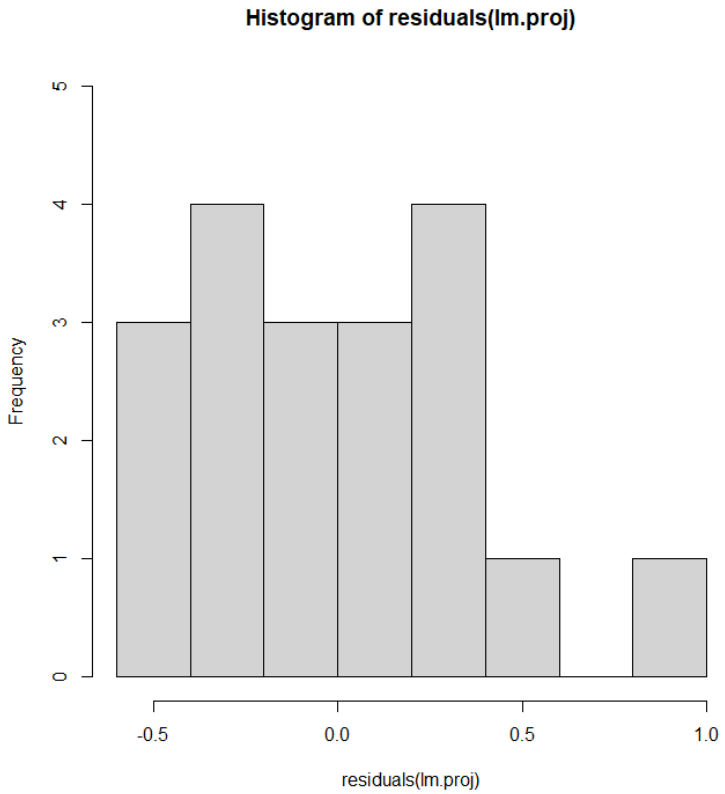


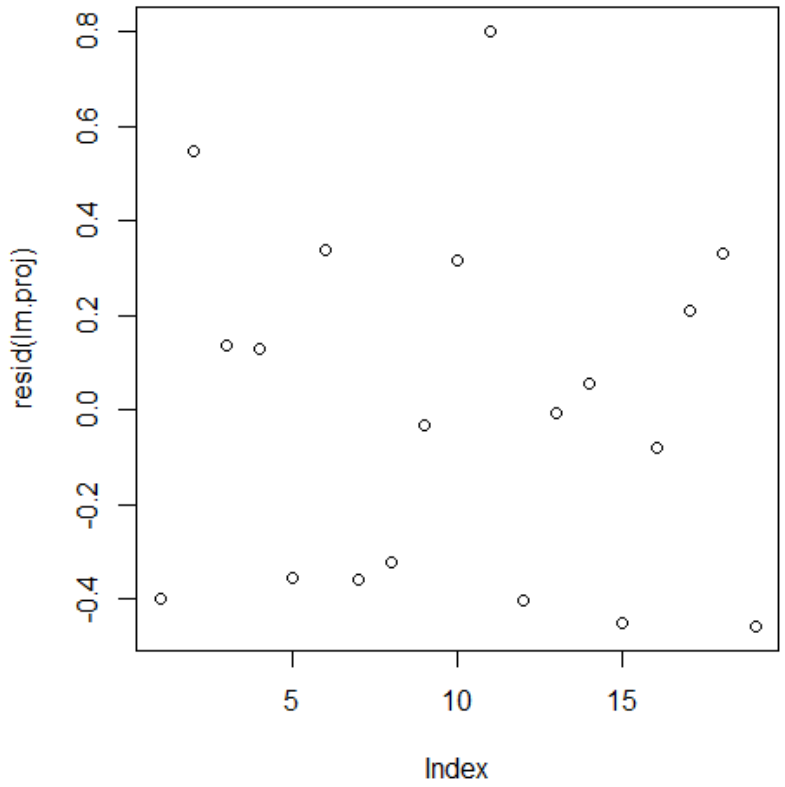
Assumptions:

Normality of residuals: Anderson-Darling normality test

p-value = 0.2298

Normality is not violated





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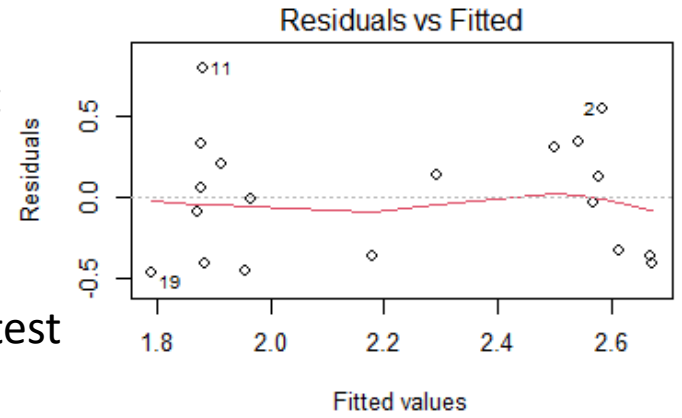
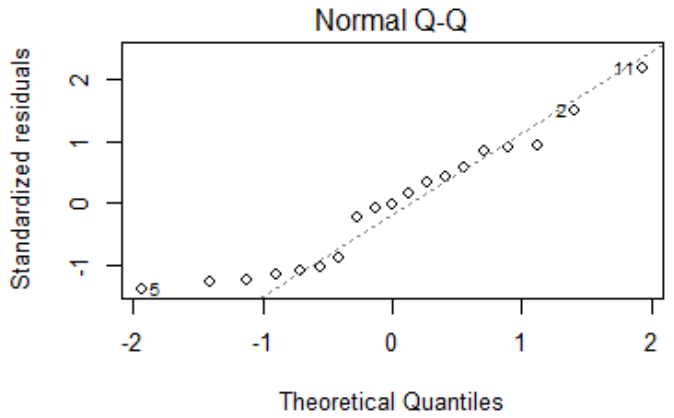
Autocorrelated errors: Durbin Watson Test

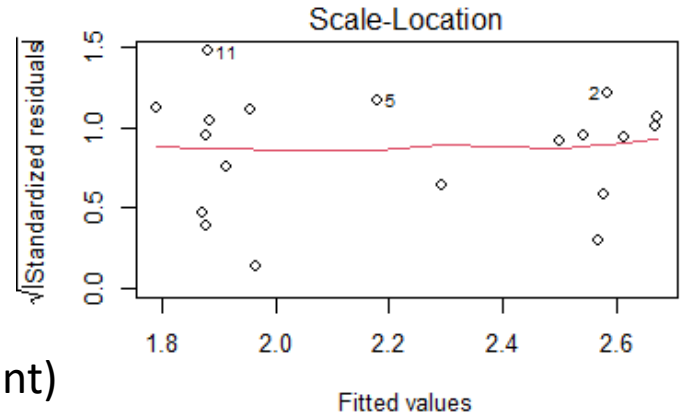
test for independence of order (not relevant)

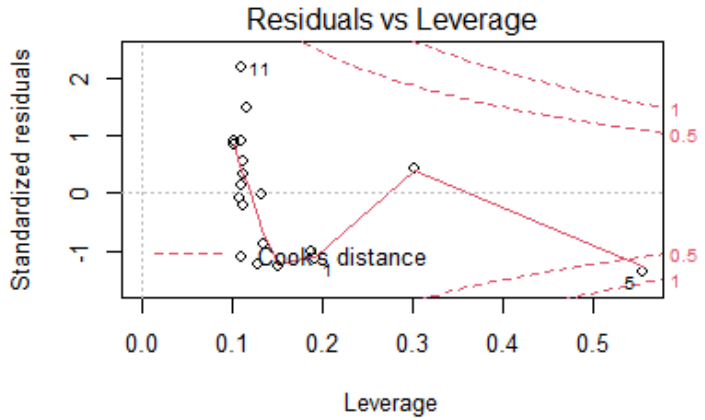
p-value = 0.836

independence of order is not violated





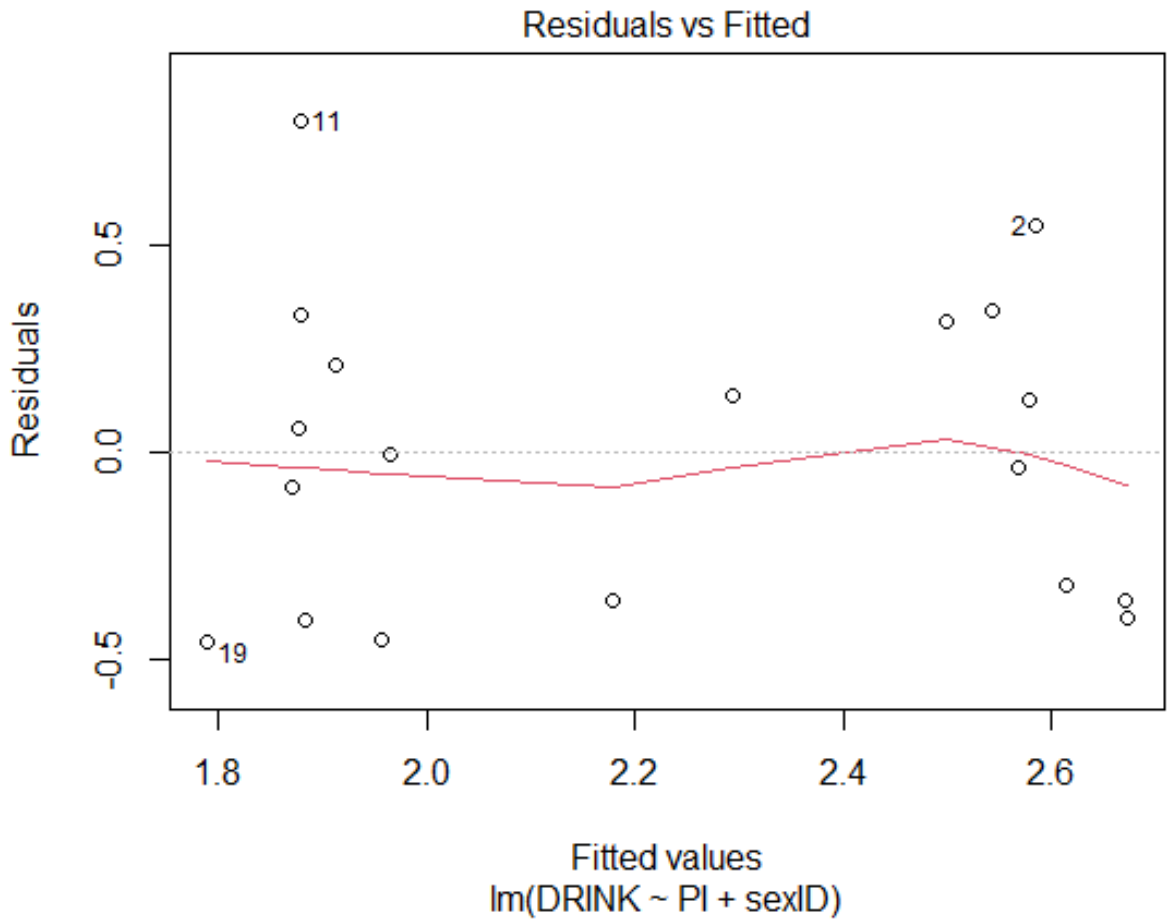




Outliers and influential points

Outliers:

Studentized residuals : No studentized residuals with Bonferroni $p < 0.05$



Outliers and influential points

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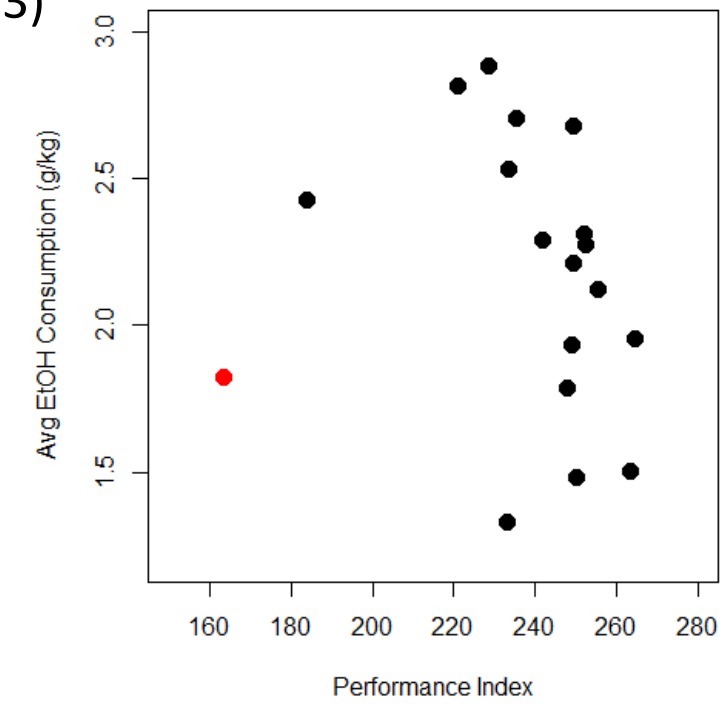
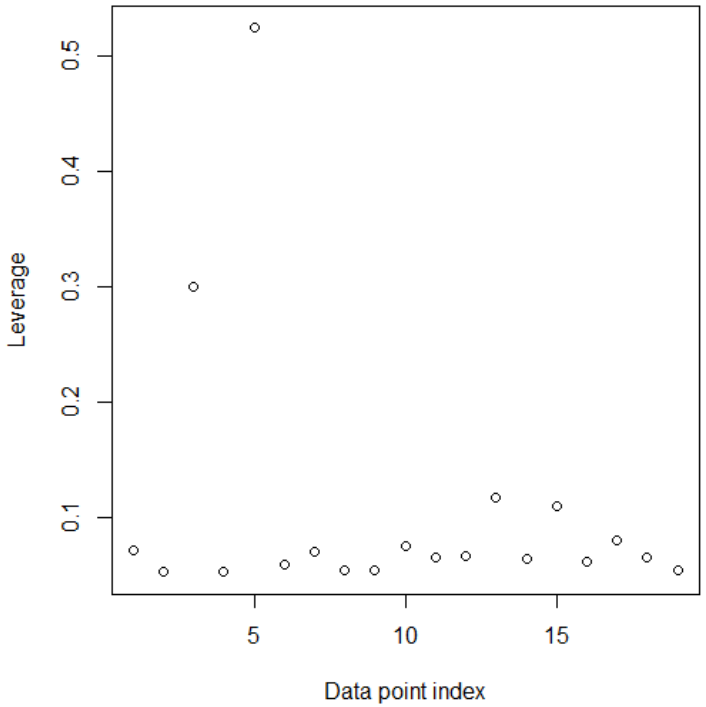
Leverage:
One data point with cutoff $(2(p+1)/N = 0.3157895)$
(5) Female, PI(163.333), EtOH(1.823)





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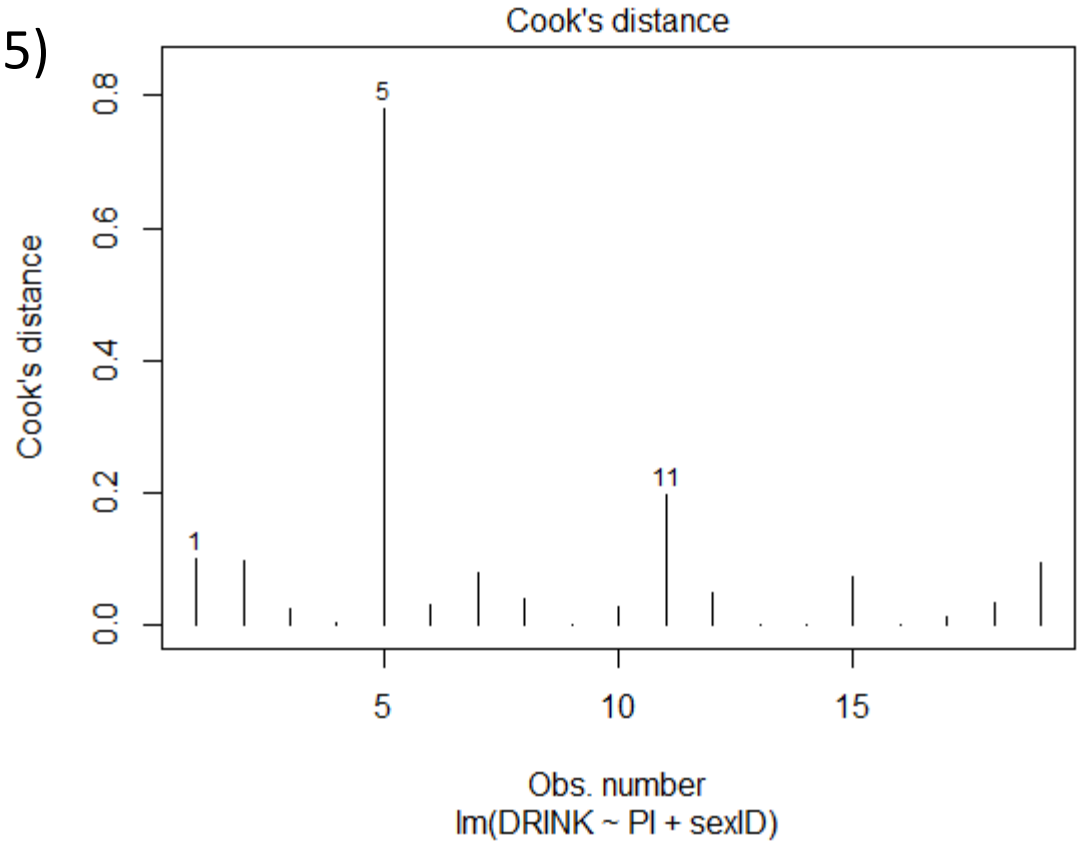
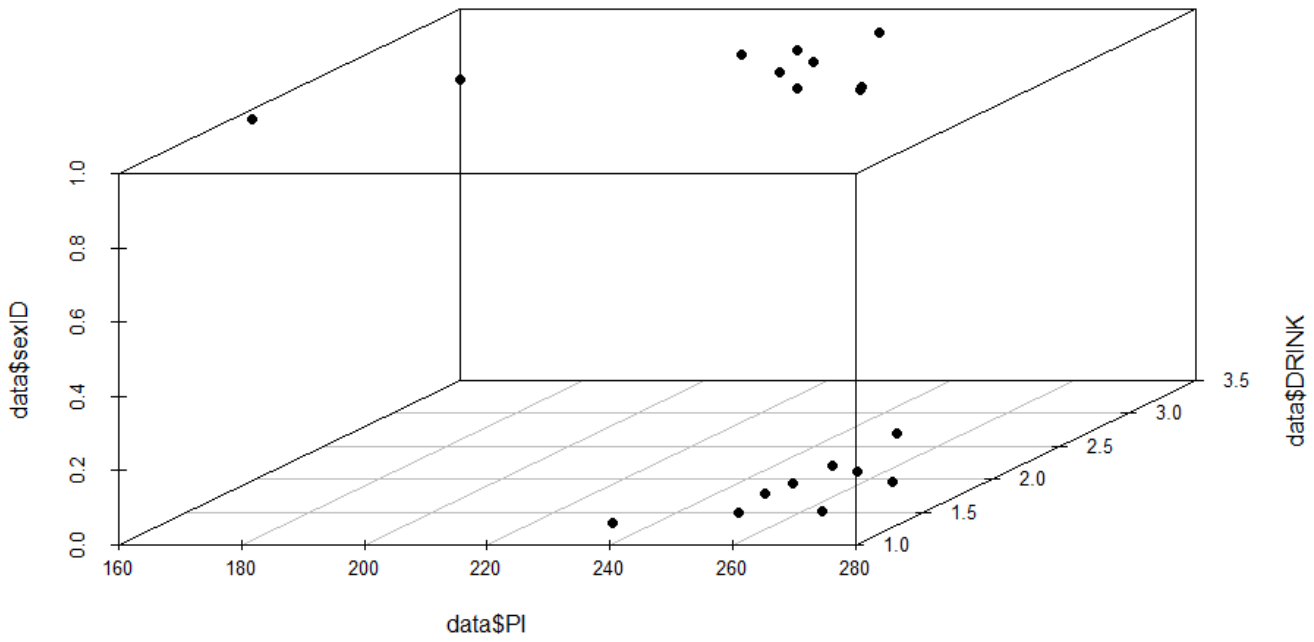
Influential Points:
Cooks Distance: Data point 5 and 11



Multiple Regression



Intercept: 0.496

95% CI: (-1.81, 2.802)

P-value: 0.655

Male EtOH consumption when PI is 0

Coefficient: PI: 0.0055

95% CI: (-0.0036, 0.0147)

P-value: 0.215

Change of 1 in PI in males, EtOH increases by 0.0055

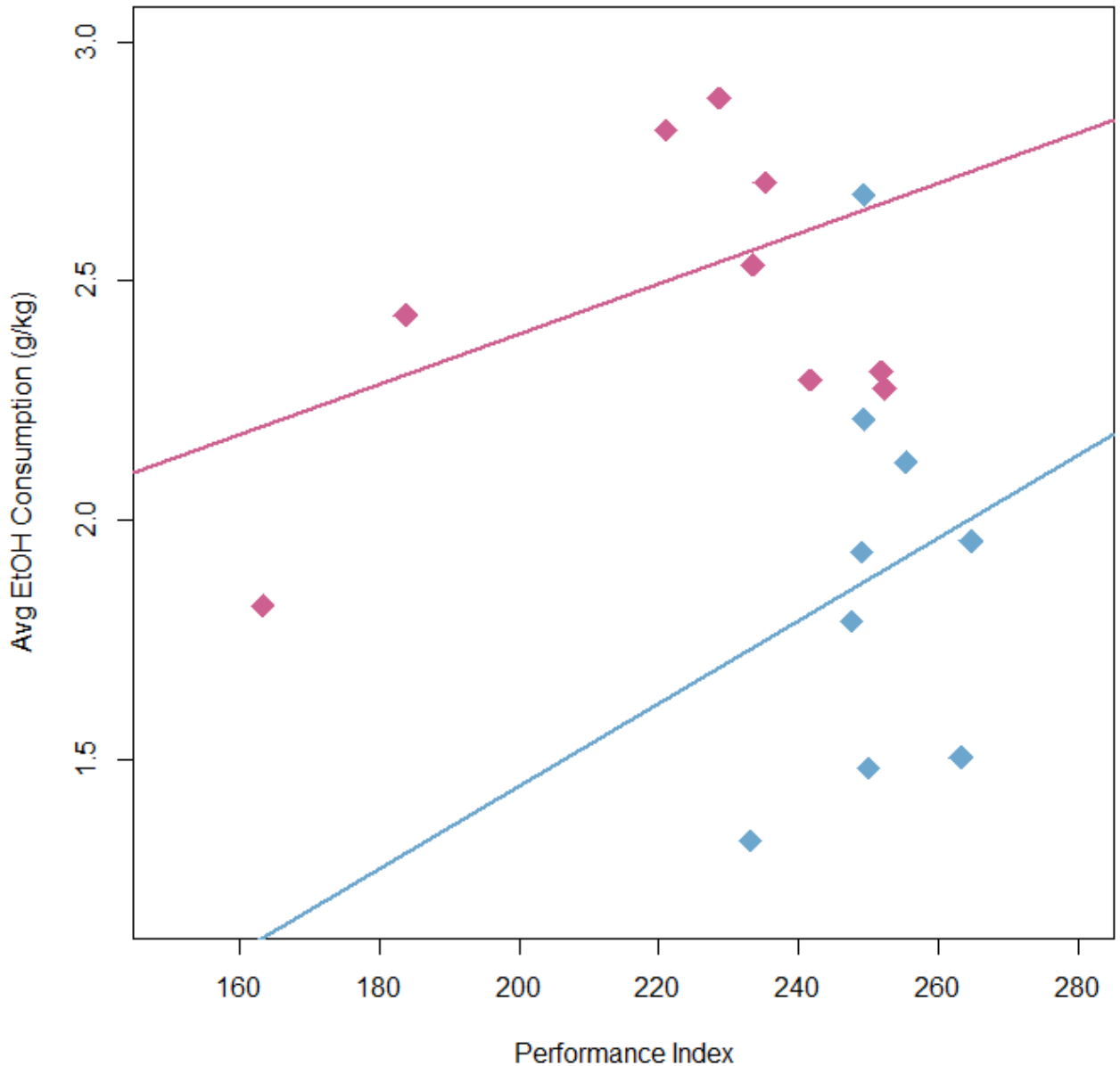
Coefficient: Sex: 0.7775

95% CI: (0.3261, 1.2289)

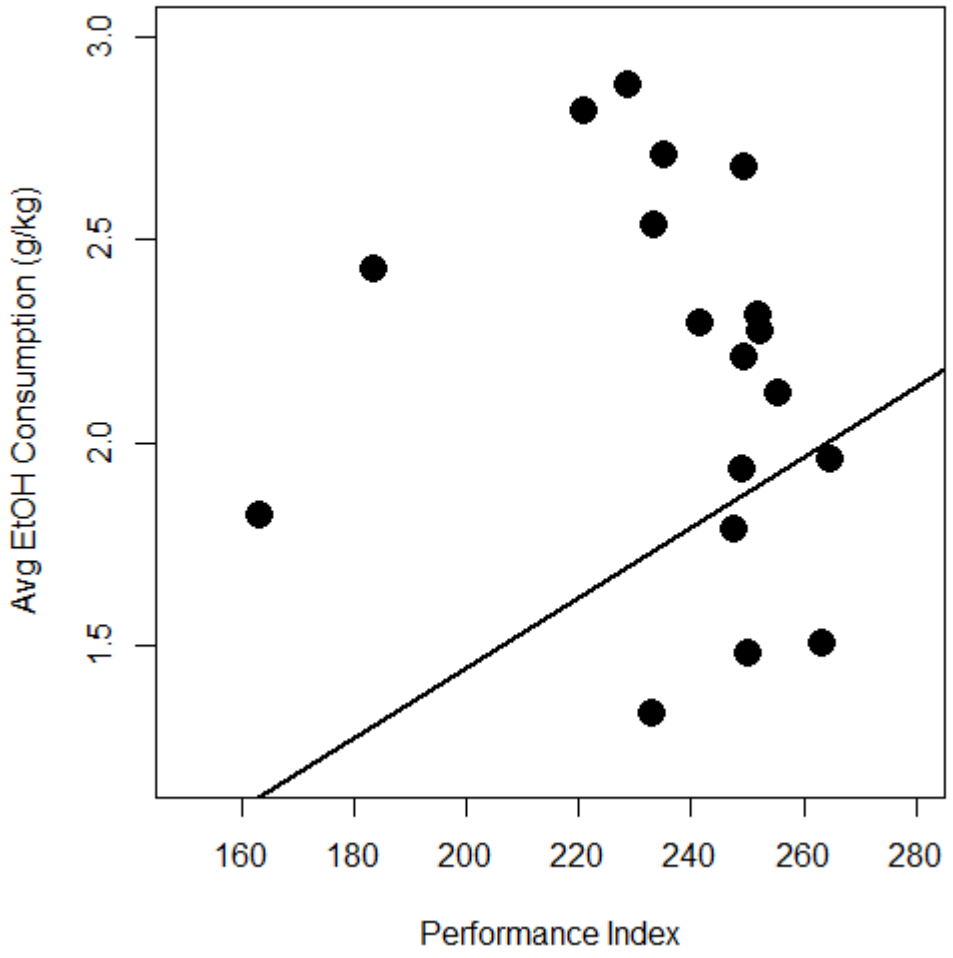
P-value: 0.00215

Females, compared to males, have an EtOH consumption 0.7778 higher when PI is 0

Overall F = 6.977, P-value = 0.006628, R2 = 0.4658


Avg EtOH Consumption (g/kg)
3.0
2.5
2.0
1.5
160
180
200
220
240
260
280
Performance Index

Multiple Regression with Interaction



Intercept: -0.2827
P-value: 0.942

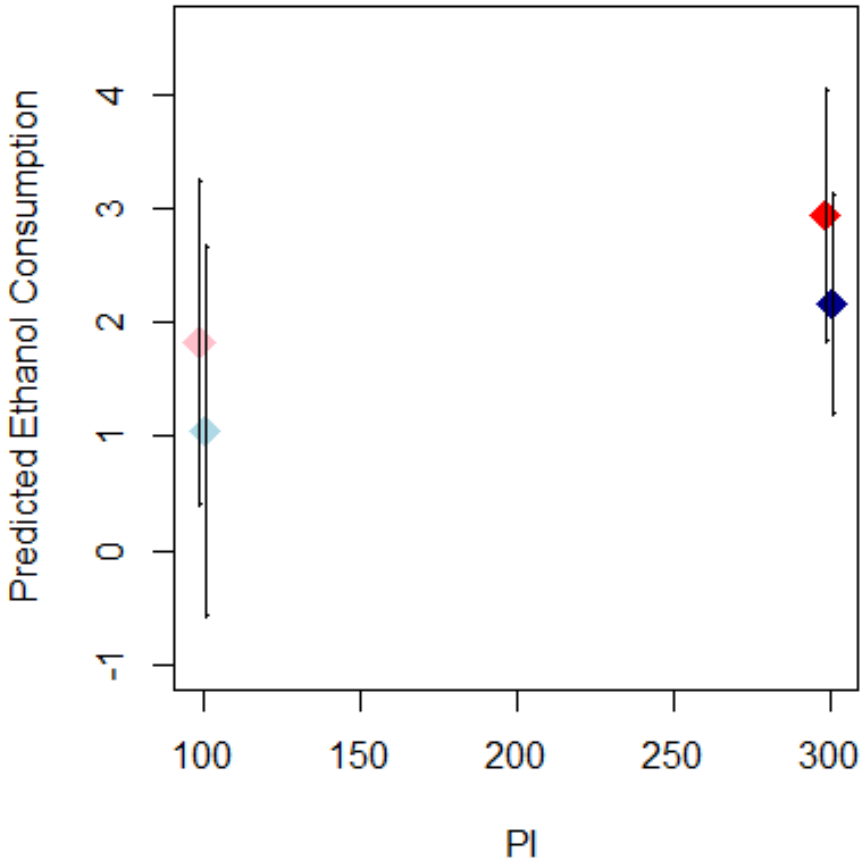
Coefficient: PI: 0.0086
P-value: 0.580

Coefficient: Sex: 1.62
P-value: 0.690

Coefficient: Interaction: -0.0034
P-value: 0.835

Overall F: 4.389, P-value=0.0209, R2: 0.4674

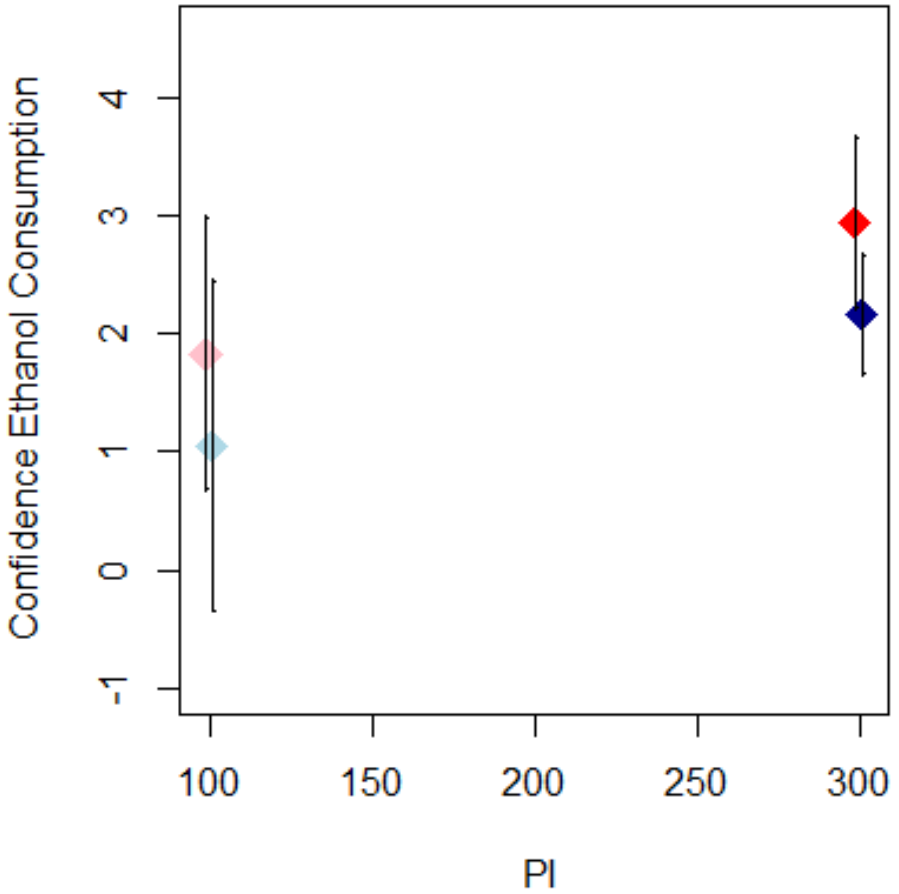
Inference on mean Y's and new values



Predicting an Individual's Score

Female
PI (100): 1.828 ± 1.431
PI (300): 2.937 ± 1.107

Male
PI (100): 1.051 ± 1.633
PI (300): 2.16 ± 0.98



Predicting conditional mean

Female
PI (100): 1.828 ± 1.167
PI (300): 2.937 ± 0.733

Male
PI (100): 1.051 ± 1.406
PI (300): 2.16 ± 0.522

Partial F-test and Step-wise Regression

Partial F-test

Drink~PI: P-val = 0.002154

Drink~Sex: P-val = 0.215

Drink~Interaction: P-val = 0.835

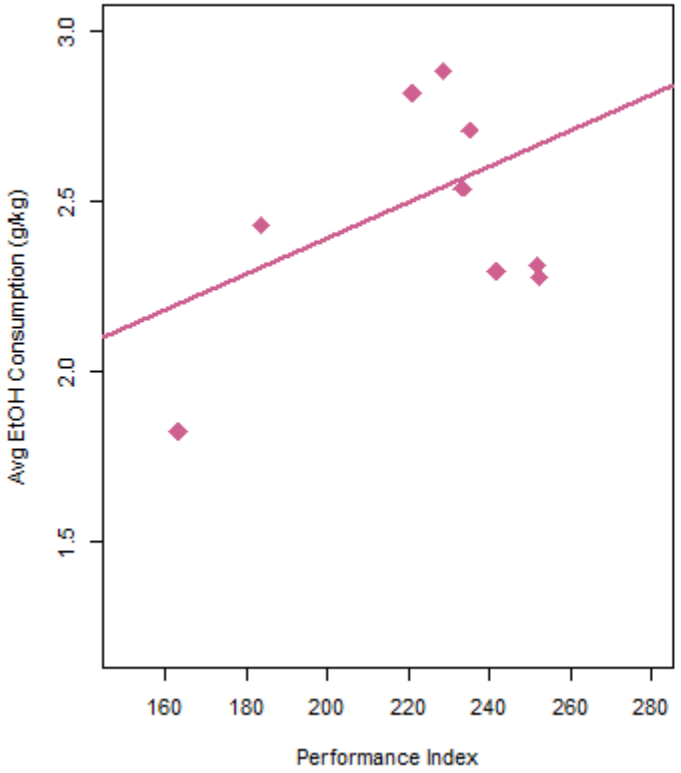
Step-wise regression

Keep sex, and removes PI and the interaction coefficient

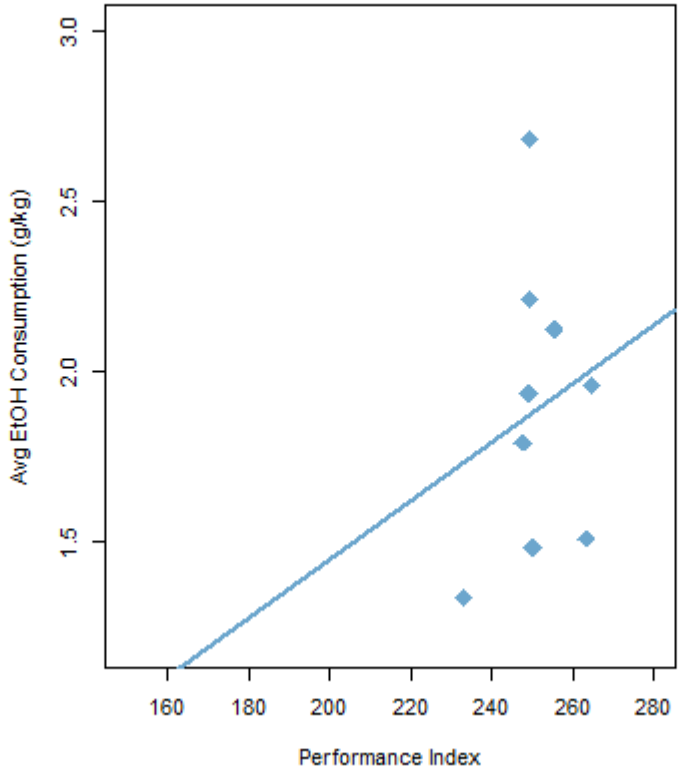
```
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   1.8903     0.1329  14.219 7.21e-11 ***
sexID         0.6301     0.1832   3.438  0.00314 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.3988 on 17 degrees of freedom
Multiple R-squared:  0.4102,    Adjusted R-squared:  0.3755
F-statistic: 11.82 on 1 and 17 DF,  p-value: 0.003136
```

Correlations

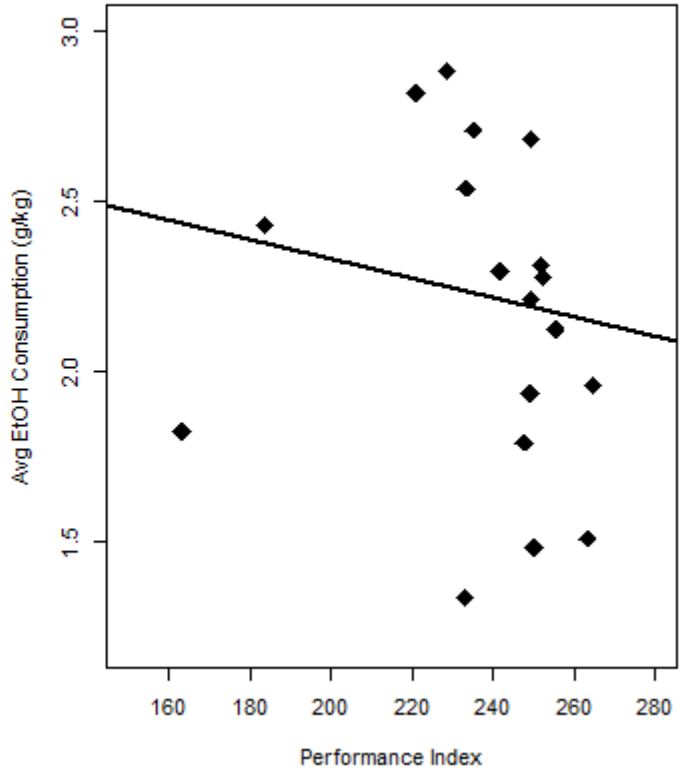
Female
Cor: 0.4054454
Pval: 0.2451



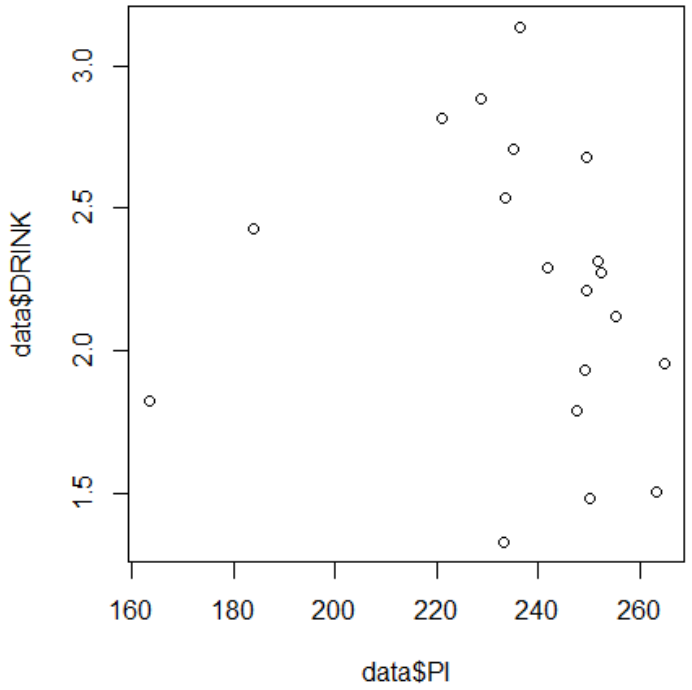
Male
Cor: 0.1913489
Pval: 0.6219

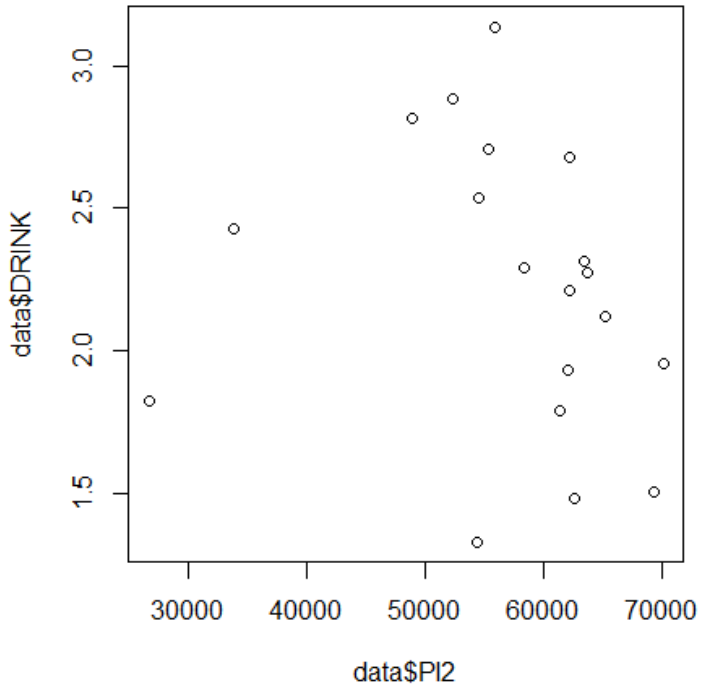


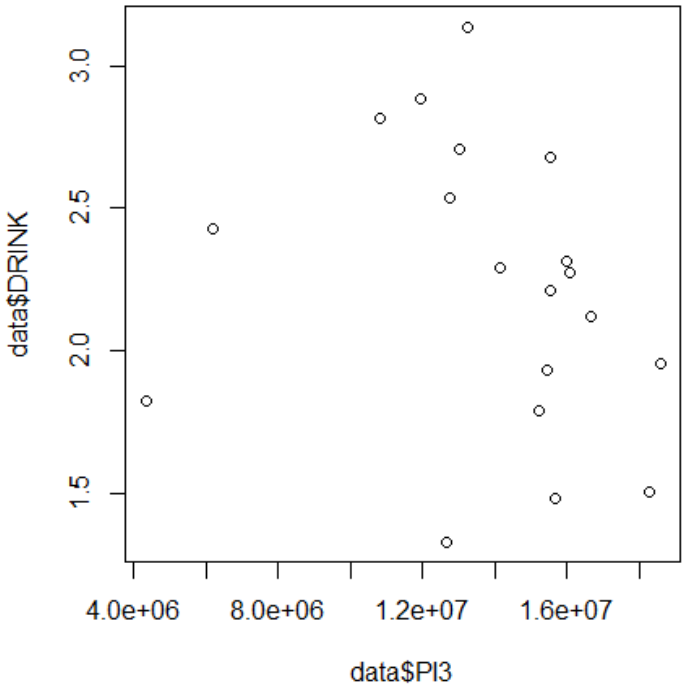
All
Cor: -0.1442282
Pval: 0.5558



Trend Analysis







Linear:
P-val: 0.5558163
Not linear

Quadratic:
P-val: 0.04182113
Yes quadratic

Cubic:
P-val: 0.7610691
Not cubic

Conclusions

- This study was underpowered
- Sex and not PI or the interaction improved the model's ability to predict EtOH consumption
  - Multiple regression
  - Stepwise regression
  - Partial F test
- There was a positive correlation between PI and EtOH consumption within each sex
  - Not significant
- There was a negative correlation between PI and EtOH consumption when collapsing across sex
  - Not significant