Exercise Sheet 4

1. The following exercise is an example of a two-way ANOVA with a significant interaction where it makes sense to interpret the main effects directly.

A researcher wanted to investigate the effects of regular exercise and gender on heart rate. The factor Exercise has two levels, ‘Control’ and ‘Runners’ indicating whether an individual participates in regular exercise. The factor Gender has two levels ‘Male’ and ‘Female’. Heart rates (in beats per minute) were recorded during aerobic activity for 200 participants in each treatment group.

After the preliminary data analysis, a two-way ANOVA was carried out on the data set, followed by Tukey’s HSD post hoc test. The R output is shown below:

**Figure 1** **Figure 2**

 

**Figure 3**

Df Sum Sq Mean Sq F value Pr(>F)

Gender 1 45030 45030 185.980 < 2e-16 \*\*\*

Exercise 1 168432 168432 695.647 < 2e-16 \*\*\*

Gender:Exercise 1 1794 1794 7.409 0.00663 \*\*

Residuals 796 192730 242

**Figure 4**

Tukey multiple comparisons of means

95% family-wise confidence level

Fit: aov(formula = HR ~ Gender \* Exercise, data = running)

$Gender

diff lwr upr p adj

Male-Female -15.005 -17.16479 -12.84521 0

$Exercise

diff lwr upr p adj

Runners-Control -29.02 -31.17979 -26.86021 0

$`Gender:Exercise`

diff lwr upr p adj

Male:Control-Female:Control -18.000 -22.00595 -13.994054 0

Female:Runners-Female:Control -32.015 -36.02095 -28.009054 0

Male:Runners-Female:Control -44.025 -48.03095 -40.019054 0

Female:Runners-Male:Control -14.015 -18.02095 -10.009054 0

Male:Runners-Male:Control -26.025 -30.03095 -22.019054 0

Male:Runners-Female:Runners -12.010 -16.01595 -8.004054 0

**Figure 5**

omega\_sq(model1)

Gender Exercise Gender:Exercise

0.109712899 0.412000008 0.003801508

* 1. What are the null and alternative hypotheses associated with this analysis?
  2. Report the results of the two- way ANOVA including interpretation of the main and interaction effects.

1. The data for this example comes from a farm-scale trial of animal diets. There are two factors: diet and supplement. Diet is a factor with three levels: barley, oats and wheat. Supplement is a factor with four levels: agrimore, control, supergain and supersupp. The response variable is weight gain after 6 weeks. The data from the experiment is available on Blackboard in the growth.txt file.

Carry out a two-way ANOVA on the data and write up a brief report including the following outputs and any conclusions that you draw.

* + Exploratory data analysis
  + ANOVA table
  + The effect size ω²
  + Model diagnostics