Addison Andrix and Sydney Prowse 242 Project 5: Kidney Analysis Results

To determine if this relationship is affected by alcohol consumption, a top-down approach using multiple linear regression (MLR) was implemented. This involves building a model with all main effects and interactions, and then performing partial F-tests to see all if the included variables are necessary. First, a partial F-test was performed with the full model including an interaction between kidney function and alcohol consumption and the full model with no interactions which resulted in a p-value of 0.021 (F = 3.968, df = 2 and 132). This indicates there is strong evidence that kidney function and alcohol consumption interact to affect the average survival time of patients after surgery. The resulting model includes an intercept representing patient survival time when kidney function score is zero as well as slopes for kidney function, moderate alcohol consumption, and severe alcohol consumption. Since there is strong evidence of interactions between kidney function and alcohol consumption, two interactions (one between kidney function and moderate alcohol consumption and one between kidney function and severe alcohol consumption) are also included in the model. See Table 1 for the estimates of each of the model parameters described.

Table 1: Parameter Estimates

Variable	Estimate	SE	t-statistic	p-value
Intercept	5.719	0.088	65.126	< 2e-16
Kidney	0.363	0.052	6.945	1.56e-10
Moderate Consumption	0.230	0.130	1.775	0.078
Severe Consumption	0.304	0.152	1.996	0.048
Kidney * Moderate Consumption	-0.096	0.061	-1.577	0.117
Kidney * Severe Consumption	-0.179	0.064	-2.775	0.006

The purpose of the model is to predict survival time after surgery and understand how alcohol consumption affects this, the estimated regression lines will differ based on the level of alcohol consumption.

- Patients who do not consume alcohol: $\hat{log(time)} = 5.719 + 0.363kidney$
- Patients who moderately consume alcohol: $\hat{log(time)} = 5.949 + 0.267kidney$
- Patients who severely consume alcohol: $\hat{log(time)} = 6.023 + 0.184kidney$

For all patients, there is a positive linear relationship between kidney function and survival time across levels of alcohol consumption. For a patient who does not consume alcohol, when their kidney function score increases by one point, the estimated median survival time after surgery in

days increases by 43.8%. If a patient consumes moderate amounts of alcohol, when their kidney function score increases by one point, the estimated median survival time after surgery in days increases by 30.6%. However, if a patient consumes severe amounts of alcohol then when the kidney function score increases by one point, the estimated median survival time in days after surgery increases by 20.2%. As shown below, Figure 1 displays the relationship between kidney function and survival time by the level of alcohol consumption starting with patients who do not consume alcohol, followed by those who moderately consume alcohol, and finally those who severely consume alcohol.

Figure 1: Scatterplot of Patient Kidney Function vs Survival Time by Alcohol Consumption