Biostat 653 Homework 3

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1 6.1.1

See the SAS output. Weight increases over time in all the three groups. Group 1 and 3 grows approximately linearly and at the same rate. Group 2 grows linearly before week 2, and after that it still grows linearly but the rate is reduced.

2 6.1.2

See the SAS code.

3 6.1.3

Since the observations are balanced and the rate of increase is assumed to be constant, we treat time as a continuous variable. See the SAS output. Since the p-value for the Test 3 test of time $\times$ group is less thant 0.0001, we reject the null hypothesis at $\alpha = 0.05$ and conclude that the rate of increase is significantly different between at least two of the three groups.

4 6.1.4

See the SAS output.

5 6.1.5

Expected increase in mean weight:

1. Group 1: 26.2151
2. Group 2: $26.2151 - 7.0963 = 19.1188$
3. Group 3: $26.2151 - 2.0944 = 24.1207$

6 6.1.6

Group 2 shows a clear "bend" at time=2, so we add a linear spline after that. To test whether the effect of the spline is significant, we use a contrast to test whether the coefficients for $time_2$, $time_2 * I(Group = 2)$, and $time_2 * I(Group = 3)$ are all equal to zero. See the SAS output. Since the p-value for the contrast is 0.0003, we reject the null hypothesis at $\alpha = 0.05$ and conclude that the effect of the spline is significant.

7 6.1.7

The BIC for the linear spline model (884.8) is lower than the BIC of the linear model (891.8). Moreover, our LRT statistic is

$$l = (829.2 - 812.3) = 16.9 > 7.8147 = \chi^2_{3,0.95},$$

so we should use the spline model to represent hte pattern of change.

8 6.1.8

Additive 2 significantly reduces the rate of increase for weight, and the effect is even stronger after the second week.

Additive 3 also significantly reduces the rate of increase for weight, but the effect after week 2 is not significantly different from before week 2.

9 SAS code

```
libname bs653 "~/biostat653";

data ratuniv;
set bs653.rat;
time=0; wt=Y1; output;
time=1; wt=Y2; output;
time=2; wt=Y3; output;
time=3; wt=Y4; output;
time=4; wt=Y5; output;
drop Y1 Y2 Y3 Y4 Y5;
run;

proc sort data = ratuniv;
        by group time;
run;

proc means data = ratuniv noprint;
        var wt;
        by group time;
        output out = ratmean
                Mean(wt) = meanWt;
run;

proc sgplot data = ratmean;
        series x = time y = meanWt / markers group = group;
run;

proc mixed data=ratuniv method=ml;
class ID Group(ref="1");
model wt=time Group*time/solution chisq outp=ratuniv_pred;
repeated/type=un subject=ID;
run;

proc sgplot data = ratuniv_pred;
        series x = time y = pred / markers group = group;
run;

data ratuniv_spline;
set ratuniv;
time_2 = max(time-2, 0);
run;

proc mixed data=ratuniv_spline method=ml;
```

```
class ID Group(ref="1");
model wt=time time_2 Group*time Group*time_2/solution chisq outp=ratuniv_spline_
repeated/type=un subject=ID;
contrast "time_2 and Group*time_2" time_2 1, Group*time_2 1 -1 0, Group*time_2 1
run;

proc sgplot data = ratuniv_spline_pred;
        series x = time y = pred / markers group = group;
run;
```