Name: _____

1 Objective: Least squares spline fitting on fish growth data

To study the effect of temperature on growth of fish, fingerlings of a certain species were put into four tanks that were kept at 25, 27, 29 and 31 degrees C. Every seven days, starting on day 14, one fish was randomly selected from each tank and its length and tank and age were recorded. Below we work only with fish from the 29 degree tank.

2 Key Words

Spline, R^2-value

3 Reading data

Read in the data from an external text file. Then plot to get an idea of growth.

```
DATA fish;
        infile 'C:...\fish29.dat' ;
        input age length;
run;

PROC plot data = fish;
        plot length * age = 'o';
run;
```

4 Splines

From the plot it appears that the growth does not follow either a line, a quadratic or a cubic, but instead a 1-spline (a continuous piecewise linear curve) with one bend at about 80th day. We'll try fitting all of these and compare R^2 values and predicted graphs, just to be sure.
To do the fitting, we need a data set with appropriate new columns:

```
DATA fishx; set fish;
        a2 = age*age;
        a3 = age*a2;
        aspl = max( age - 80, 0 );      /* this allows a linear change after 80 */
        aspl2 = aspl**2;                /* this allows quadratic change after 80 */
run;
```

5 Regression models

Now run various regression models and output predicted values, and merge for plotting.

```
PROC reg data = fishx;
        model length = age;             /* linear */
        output out=l p=pl;
        model length = age a2;          /* quadratic */
        output out=q p=pq;
        model length = age a2 a3;       /* cubic */
        output out=c p=pc;
        model length = age aspl;        /* one spline */
        output out=s1 p=ps1;
        model length = age aspl aspl2;  /* two spline */
        output out=s2 p=ps2;
run;

DATA all;
        merge l q c s1 s2;
run;
```

6 Turn In

[A] Look at the regression output and list R^2 for each model:

Table 1: R^2 - values for each model

Model	Linear	Quadratic	Cubic	One spline	Two spline
$\mathbf{R^2}$	_____	_____	_____	_____	_____

[B] Plot various fits and see if figures change as R^2 changes:

[1] Set graphic environment as in Lab 7 and make `gplot` for [2–5]

[2] Use `gplot` as in Lab 7 to overlay the data points [dots] and predicted linear [circles] and predicted quadratic [squares]. SKETCH and LABEL with R^2.

[3] Use `gplot` as in Lab 7 to overlay the data points [dots] and predicted cubic [circles] and predicted 1-spline [squares]. SKETCH, R^2.

[4] Use `gplot` as in Lab 7 to overlay the data points [dots] and predicted 1-spline [triangles] and predicted 2-spline [squares]. SKETCH.

[5] Describe the differences in the two splines in [4].

[6] Write down the equation given for 1-spline model. Interpret the slopes of 2 line segments in 1-spline figure.