Math 473 HW10 Spring 2023. Due Friday, April 21.

1) 3.14: The lung cancer data has the *time* until death or censoring and *status* = 0 for censored and 1 for uncensored. Then the covariates are *age*, *sex* = 1 for M and 2 for F, *ph.ecog* = Ecog performance score 0-4, *ph.karno* = a competitor to ph.ecog, *pat.karno* = patient's assessment of their karno score, *meal.cal* = calories consumed at meals excluding beverages and snacks and *wt.loss* = weight loss in last 6 months. The *R* output will use a stratified proportional hazards model that is stratified on *sex* with variables *ph.ecog*, *pat.karno* and *wt.loss*.

a) Copy and paste commands from (http://parker.ad.siu.edu/Olive/regsas.txt) for this problem into *R*. Click on the left window and hit *Enter*. Include the plot in *Word*. Also include the *R* output in *Word*.

b) Test whether $\boldsymbol{\beta} = \mathbf{0}$.

c) Based on the plot, do females or males appear to have better survival rates?

2) 2.14: Copy and paste commands from (http://parker.ad.siu.edu/Olive/regsas.txt) for this problem into *SAS*. The myelomatosis data is from Allison (1995, p. 31, 158-161, 269). The 25 patients have tumours in the bone marrow. The patients were randomly assigned 2 drug treatments *treat*. The variable *renal* is 1 if renal (kidney) functioning is normal and 0 otherwise.

A stratified proportional hazards (SPH) model makes sense if the effect of *Renal* varies with time since randomization (if there is a time–Renal interaction). In this situation the PH model would be inappropriate since time–variable interactions are not allowed in the PH model. Notice that the results in a) and b) below are different. The analysis does need to control for the variable *Renal* to obtain good estimates of the treatment effect, but both the SPH model in a) and the PH model in c) may be adequate

a) The SAS program produces output for 3 models. The first model is a SPH model with stratification on *Renal*. Perform a Wald test on $\beta_1$ corresponding to *treat*. (In the output, $\hat{\beta}_1 = 1.46398$.)

b) The 2nd model is a PH model with the predictor *treat*. Perform a Wald test on $\beta_1$ corresponding to *treat*. (In the output, $\hat{\beta}_1 = 0.56103$.)

c) The 3rd model is a PH model with the predictors *treat* and *Renal*. Perform a Wald test on $\beta_1$ corresponding to *treat*. (In the output, $\hat{\beta}_1 = 1.22191$.)

```
output for problem 2
a) SPH  variable estimate SE      chisq   pr> chisq
        treat    1.46398  0.65965 4.9254  0.0265

b) PH   treat    0.56103  0.50976 1.2113  0.2711

c) PH   treat    1.22191  0.59779 4.1781  0.0409
        venal    4.27792  1.19119 12.8974 0.0003
```

3) **4.2.** Find shorth(5) for the following data set. Show work.

```
6   76   90   90   94   94   95   97   97   1008
```