STAT 788 - Homework 2

Daniel Hartig

April 11, 2018

1 How to run

The source file for HW3 is `partial_like_hw3.c`. This program takes two arguments at the command line, the initial guesses of the two parameters β_1 and β_2. These arguments are read at the command line as `b1` and `b2`. The homework assignment is compiled by

```
gcc -o hw3 partial_like_hw3.c -lm.
```

The data file `HW2_2018.dat` must be in the same folder as the executable; then this is executed by

```
./hw3 0.2 0.2
```

with resulting output

```
Maxima: (0.040532, 0.060655).
```

Methodology

As given in Chapter 6 of Zhang, the log-likelihood equation for the Cox proportional hazards model is

$$\mathcal{L}(\boldsymbol{\beta}|\boldsymbol{z}, u) = \sum_{\text{all grid points } u} dN(u) \left[\boldsymbol{z}\boldsymbol{\beta} - \log \left(\sum \exp(\boldsymbol{z}\boldsymbol{\beta}) Y_i(u) \right) \right].$$

Given two explanatory variables z_1 and z_2, such that $\boldsymbol{\beta} = [\beta_1, \beta_2]$, the gradient is

$$\nabla \mathcal{L}(\boldsymbol{\beta}|\boldsymbol{z}, u) = \left[\sum_{\text{all } u} dN(u) \left(z_1 - \frac{\sum z_1 \exp(\boldsymbol{z}\boldsymbol{\beta}) Y_i(u)}{\sum \exp(\boldsymbol{z}\boldsymbol{\beta}) Y_i(u)} \right) \quad \sum_{\text{all } u} dN(u) \left(z_2 - \frac{\sum z_2 \exp(\boldsymbol{z}\boldsymbol{\beta}) Y_i(u)}{\sum \exp(\boldsymbol{z}\boldsymbol{\beta}) Y_i(u)} \right) \right]$$

To find the maximum of the likelihood function, we apply gradient ascent. For a set of parameters $\boldsymbol{\beta} = [\beta_1, \beta_2]$,

$$\boldsymbol{\beta}_{n+1} = \boldsymbol{\beta}_n + \gamma \nabla \mathcal{L}(\boldsymbol{\beta_n})$$

where γ is the step size of the ascent. We continue iteration until either the difference between successive iterations is below a certain threshold (δ) or the maximum number of iterations (`maxiter`) is run. The preset conditions for this implementation are that $\gamma = 0.01$, $\delta = 0.000001$ and `maxiter` $= 100$.