Exam 2

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Instructions

- Please hand in a hard copy by **Tuesday, December 11**.
- This is a open resource exam, but you are not allowed to ask post exam questions online.
- You are not allowed to collaborate with classmates and/or people outside of class.
- Please circle or highlight your final answer.
- The total possible point is 50.

Violation of this agreement will result in an **F** on this exam and it will be averaged in as a 0%.

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1. Under the exponential model, we assume T follows an exponential distribution with parameter λ and derived the maximum likelihood for λ to be

$$\hat{\lambda} = \frac{\sum_{i=1}^{n} \Delta_i}{\sum_{i=1} t_i},$$

where Δ_i's is the censoring indicator and t_i's are the observed survival times. Now let's suppose each copy of $\{\Delta_i, t_i\}$ is associated with a weight w_i (this weight could represent sampling weights, propensity score, or counts, etc.).

   a. (5 points) Modify the likelihood presented in note 3 and derived the weighted maximum likelihood estimator for λ. We will denote this $\hat{\lambda}_w$.
   b. (5 points) Use `los` (length of stay) as the weight in *WHAS100*. Apply `survreg` to *WHAS100* to compute $\hat{\lambda}_w$.
   c. (5 points) Use the derivation in 1a and *WHAS100* to compute $\hat{\lambda}_w$.
   d. (5 points) Derive the *information* and the asymptotic variance for $\hat{\lambda}_w$.

2. In exam 1, we have investigated different methods to compare two survival curves. Another way to compare two survival curves is to fit a Cox model using the group indicator as the covariate. Use the complete *WHAS100* dataset and gender as the group indicator for the following questions.

   a. (5 points) Fit a Cox model and print the summary using gender as the covariate.
   b. (5 points) Interpret the estimated regression parameter ($\hat{\beta}$) in terms of hazard ratio.
   c. (5 points) Use part 2a to test for the null hypothesis that there is no significant difference between the two survival curves.

3. a. (5 points) Fit a Cox model with `age` as the (only) covariate. Plot the estimated cumulative hazard function for patients with `age = 50`, `age = 60` and `age = 70`.
   b. (5 points) Fit another Cox model with `age` and `age^2` as covariates. Plot the estimated cumulative hazard function for patients with `age = 50`, `age = 60` and `age = 70`.
   c. (5 points) Interpret the results in 3a and 3b.