

hw3

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1 STA 208: Homework 3 (Do not distribute)

1.1 Due Monday 5/21/2018 in class and online by 10am

Instructions: To make grading easier for the TAs please print out your homework and also submit it on canvas. The canvas should include all of your code either in this notebook file, or a separate python file that is imported and ran in this notebook. We should be able to open this notebook and run everything here by running the cells in sequence. The written portions can be either done in markdown and TeX in new cells or written clearly by hand when you hand it in.

- Code should be well organized and documented
- All math should be clear and make sense sequentially
- When in doubt explain what is going on
- You will be graded on correctness of your math, code efficiency and succinctness, and conclusions and modelling decisions

Exercise 1.1 (10 pts)

Recall that surrogate losses for large margin classification take the form, $\phi(y_i x_i^\top \beta)$ where $y_i \in \{-1, 1\}$ and $\beta, x_i \in \mathbb{R}^p$.

The following functions are used as surrogate losses for large margin classification. Demonstrate if they are convex or not, and follow the instructions.

1. exponential loss: $\phi(x) = e^{-x}$
2. truncated quadratic loss: $\phi(x) = (\max\{1 - x, 0\})^2$
3. hinge loss: $\phi(x) = \max\{1 - x, 0\}$
4. sigmoid loss: $\phi(x) = 1 - \tanh(\kappa x)$, for fixed $\kappa > 0$
5. Plot these as a function of x .

(This problem is due to notes of Larry Wasserman.)

1.1.1 1.1.1 exponential loss: $\phi(x) = e^{-x}$,

$\phi''(x) = e^{-x} > 0$, it is convex.