

IST 597: Homework 7

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Problem 1 (0 points)

Is this function log-concave with respect to x ?

$$\frac{\Gamma(\frac{\nu+1}{2})}{\sqrt{\nu\pi}\Gamma(\frac{\nu}{2})} \left(1 + \frac{x^2}{\nu}\right)^{-\frac{\nu+1}{2}}$$

Problem 2 (100 points)

For this problem you must code your own logistic regression model from scratch. To infer this model, code stochastic gradient descent with momentum (using minibatching) from scratch. **You may *not* use any functions in scikit-learn or any other machine learning framework. Everything must be hand coded. Unlike homework 6, here you may not use existing optimization libraries.** You may however use existing numerical methods (e.g., logarithms, linear algebra etc...) in numpy (or other similar library).

- (30 points) Write the pseudo-code for the model/inference algorithm. Include relevant details including the form of the gradient and the form of your optimizer updates (e.g., the form of SGD with momentum that you are using).
- Implement your model and use it to fit the data in `data_train_hw7_problem2.csv.gz` and then predict the column y in `data_test_hw7_problem2.csv.gz`. In case its not second nature by now, here y is the dependent variable and x_1 to x_{1000} are the independent variables. For this part of the problem, submit two things: (1) Your code which should be neat, organized, and legible; and (2) your predictions `[your last name]_predictions_hw7_p2.csv` which should contain only 1 column with no header (row order corresponding to ordering of the test set).

Notes and Hints:

- I am asking for vanilla logistic regression (Maximum Likelihood, no penalization)
- I strongly encourage you to simulate your own test dataset to ensure that your implementation is correct and efficient. (This is itself a skill you should develop.)
- If you have never written pseudo-code before. Take a look at the following overview of Latex algorithm environments for an idea of what this should look like: <https://www.overleaf.com/learn/latex/algorithms>. I am not asking for something beautiful, just something legible and clear that demonstrates understanding and mastery of the material.

- I will not read through long-winded or messy code. Make sure you take an extra pass through your code before submitting to make sure it is neat and readable. Here your code is not just for partial credit but also to demonstrate that you implemented everything from scratch. You will lose points if I cannot read your code efficiently.