

# STA4042 24-25T1 Quiz 1

October, 14<sup>th</sup>

## Small proofs (15 + 15 + 15 + 15 = 60 points)

1. Express the negative log-likelihood of the Poisson regression model, and justify the derived formula (poisson densities express  $\frac{\lambda^k}{k!} e^{-\lambda}$  and given a predictor  $x \in \mathbb{R}^p$ , we look for a regression parameter  $\beta \in \mathbb{R}^p$  such that  $\lambda = \beta^T x$ ).
2. Explain how the principal components are computed in PCA, and justify these computations (i.e., what is the goal and how do we arrive at the expression for principal components).
3. Express the bias and variance components of the prediction error, explaining their contributions due to the variability of both noise and the training data sample.
4. Express the logistic loss and explain its connection to logistic regression.

## Algorithmic Descriptions (15 + 15 + 10 = 40 points)

1. Describe the steps of the  $k$ -nearest neighbor algorithm for a regression task.
2. Express the discriminants in linear discriminant analysis (LDA) and explain how they are used to classify data.
3. Formulate the solution for spectral clustering using a given kernel  $K : \mathbb{R}^p \times \mathbb{R}^p \rightarrow \mathbb{R}$ .