STA 431s15 Assignment Two[1]

Question 3 asks you to use SAS. Please bring your log file and your output file to the quiz. There may be questions about them, and you may be asked to hand them in with the quiz.

1. For each of the following distributions, derive a general expression for the Maximum Likelihood Estimator (MLE); don't bother with the second derivative test. Then use the data to calculate a numerical estimate; you should bring a calculator to the quiz in case you have to do something like this.

    (a) $p(x) = \theta(1 - \theta)^x$ for $x = 0, 1, \ldots$, where $0 < \theta < 1$. Data: 4, 0, 1, 0, 1, 3, 2, 16, 3, 0, 4, 3, 6, 16, 0, 0, 1, 1, 6, 10.

    (b) $f(x) = \frac{1}{\theta} e^{-x/\theta}$ for $x > 0$, where $\theta > 0$. Data: 0.28, 1.72, 0.08, 1.22, 1.86, 0.62, 2.44, 2.48, 2.96

    (c) $f(x) = \frac{\alpha}{x^{\alpha+1}}$ for $x > 1$, where $\alpha > 0$. Data: 1.37, 2.89, 1.52, 1.77, 1.04, 2.71, 1.19, 1.13, 15.66, 1.43

    (d) $f(x) = \theta x^{\theta-1}$ for $0 < x < 1$, where $\theta > 0$. Data: 0.04 0.69 0.86 0.24 0.99

2. Let $Y_i = \beta x_i + \epsilon_i$ for $i = 1, \ldots, n$, where $\epsilon_1, \ldots, \epsilon_n$ are a random sample from a normal distribution with expected value zero and variance σ^2. The parameters β and σ^2 are unknown constants. The numbers $x_1, \ldots, x_n$ are known, observed constants.

    (a) What is the parameter space Θ?

    (b) Find the Maximum Likelihood Estimator of the pair (β, σ^2). Show your work.

    (c) Find a Method of Moments estimator of β based on $\overline{Y}$. Don't bother estimating σ^2 by the Method of Moments. Start by calculating $E(\overline{Y})$, which does not equal $E(Y_i)$ for this problem.

    (d) Based on the small data set below, calculate both your MLE and your Method of Moments estimator for β. Your answers are numbers. Bring a calculator in case you have to do something like this on the quiz.

    ```
    x  0.0  1.3  3.2 -2.5 -4.6 -1.6  4.5  3.8
    y -0.8 -1.3  7.4 -5.2 -6.5 -4.9  9.9  7.2
    ```

3. Before the beginning of the Fall term, students in a first-year Calculus class took a diagnostic test with two parts: Pre-calculus and Calculus. Their High School Calculus marks and their marks in University Calculus were also available. The data are given in the file `mathtest.txt`. There is a link on the course web page in case the one in this document does not work.

Once you have the raw data file open in a Web browser, you need to save the page to your computer and drag it to the `myfolders` sub-folder in your shared folder — that is, to the folder that is shared between your computer and the virtual `linux` machine on which SAS is installed. Exactly how you save a web page to your computer depends on your Web browser.

- In Firefox, choose `Save Page As` from the `File` menu.
- In Chrome, click on the wrench icon in the upper right corner, and choose `Save Page As`.
- In Safari, choose `Save As ...` from the `File` menu, and then under `Format`, choose `Page Source`.

In order, the variables in the data file are: Identification code, Mark in High School Calculus, Score on the Pre-calculus portion of the diagnostic test, Score on the Calculus portion of the diagnostic test, and mark in University Calculus.

Using SAS `proc means`, calculate means and standard deviations for all the variables (except Identification code). That's it. Some other numbers will be generated by default as well; know what they are. Bring your log file and output file to the quiz. You may be asked for numbers from your printouts, and you may be asked to hand them in. For full marks, **there must be no warnings, error messages or notes about missing data on your log file.**

Please follow these guidelines. Marks will be deducted if you do not.

- Put your name and student number in a `title` or `title2` statement.
- Do not write anything on the printouts except your name and student number. The other questions are just practice for the quiz, and are not to be handed in.
- Bring your log file to the quiz, *not* just a listing of the program file.
- The log file and the output file must be from the same run of SAS.
- Your output file must have a time and date stamp. This is automatically generated if you save a pdf file or print from SAS Studio.
- You must use *your* installation of SAS, not the installation on someone else's computer.