Lab Six
Computational Probability and Statistics
CIS 2033, Section 002

Due: 9:00 AM, Friday, Dec. 05, 2014

Question 1 Suppose that the number of customers visiting a store in a day can be modeled as a Poisson process. Now, we have a dataset *poiss2.mat* [1], which contains such yearly records for this store. Now,

1. Please estimate the intensity λ for this Poisson process;
2. How about the number of customers visiting this store in a week ? Please also estimate its intensity parameter $\hat{\lambda}$.
3. Please generate 100 weekly records for this store. You can randomly generate 100 numbers from such a Poisson distribution, $Poiss(\hat{\lambda})$. Please save those records in a mat file (e.g., poiss100.mat).

Question 2 Let the random variable X follow an Exponential distribution such that $X \sim Exp(\lambda)$. Please download the dataset, *exp.mat* here [2]. This dataset contains 500 samples as the realization of X. Please empirically estimate λ by using those samples. Let the random variable $Y = 2X$. What kind of specific distribution Y should have and how to compute its parameters. Based on the computed parameters, please randomly generate 100 samples as the realization of Y from its distribution. Please save those 100 samples into a mat file (e.g., exp100.mat).

Question 3 In this question, we will use maximum likelihood estimation to determine the intensity parameters, λ for multiple Poisson processes. Please download the dataset, *poiss3.mat* [3]. In this dataset, there is an instance matrix X with the size of 1000×4. The i-th column of X stores 1000 records for one Poisson process, $Poiss(\lambda_i)$, for $i = 1, 2, 3, 4$. Now,

1. Please use maximum likelihood estimation to determine those parameters $\lambda_i, i = 1, 2, 3, 4$.

[1] `http://astro.temple.edu/~tud09663/data/teaching/cis2033/poiss2.mat`
[2] `http://astro.temple.edu/~tud09663/data/teaching/cis2033/exp.mat`
[3] `http://astro.temple.edu/~tud09663/data/teaching/cis2033/poiss3.mat`

2. Based on the computed parameters, $\lambda_i, i = 1, 2, 3, 4$, please compute the log-likelihoods based on those data samples. For the i-th column, compute the likelihood $L(\lambda_i)$ on those 1000 samples.

Question 4 In this question, we will use maximum likelihood estimation to determine the parameters, λ for multiple Exponential distributions. Please download the dataset, *exp2.mat* [4]. In this dataset, there is an instance matrix X with the size of 500×3. The i-th column of X stores 500 records for one exponential distribution, $Exp(\lambda_i)$, for $i = 1, 2, 3$. Now,

1. Please use maximum likelihood estimation to determine those parameters $\lambda_i, i = 1, 2, 3$.

2. Based on the computed parameters, $\lambda_i, i = 1, 2, 3$, please compute the likelihoods based on those data samples. For the i-th column, compute the log-likelihood $L(\lambda_i)$ on those 500 samples.

[4] `http://astro.temple.edu/~tud09663/data/teaching/cis2033/exp2.mat`