Engineering Probability and Statistics
Computer Homework 2

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1. Generate 1,000 random numbers from normal distribution with $p = 5$ and $std = 10$. Sample from this population 10,000 time with sample size of 5, 10, 20 and 40 and compute mean of each sample and save them in separate data structure for each sample size. Then compute average of means for each sample size and compare with p. Is there any difference for each sample size? Reason for result.[1]

2. Instead of normal distribution, use Poisson distribution in previous question and answer to question.

3. (optional) An engineer has designed a new diesel motor that is used in a car. The car's diesel consumption in gallons per mile C follows the equation $C = 3 + 2X + 1.5Y$, where X is a speed coefficient and Y is the quality diesel coefficient. Suppose the joint density for X and Y is $f_{x,y}(x, y) = ky, 0 \leq x \leq 2, 0 \leq y \leq x$.[2]

   (a) Find k so that $f_{x,y}$ is a valid density function.

   (b) Are X and Y independent?

   (c) Find the mean diesel consumption for the car.

4. (optional) Let X and Y have the joint density function

$$f_{x,y}(x, y) = \begin{cases} Ky & -2 \leq x \leq 2, 1 \leq y \leq x^2 \\ 0 & otherwise \end{cases}$$

   (a) Find K so that $f_{x,y}$ is a valid pdf.

   (b) Find the marginal densities of X and Y.

   (c) Find $P(Y > 1.5|X < 0.5)$.

[1] Hint: This question is solved with statistical viewpoint of central limit theorem; If the distribution is normal with parameters $p = \alpha$ and $std = \beta$, central limit theorem states that sample mean with any size x of sample has normal distribution with $p = \alpha$ and $std = \frac{\beta}{\sqrt{x}}$; But if distribution is not normal, the sample size x should be great enough to use central limit theorem.

[2] Use python functions to solve this problem and next question.