Probability Assignment

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To get full credit in this assignment you need to use `numpy`, `scipy` and `pandas` libraries. Sometimes you need to type equations - type equations in Latex math notation. To produce the plots you can use any plotting library you need.

PS1: We run the assignment through chatGPT the questions and you will be referred to the Dean if we find that a robot answered your questions.

PS2: We are also monitoring solution websites and we will take action against anyone that uploads this to a solution website.

Problem 1 (80 points)

A surgeon analyzes surgical videos and models events that occur. He describes the problem statement in here. Your job is to replicate the solution in Python and demonstrate your understanding of the steps performed by including adequate explanation of the code in either markdown cells or inline to the code. You can insert as many markdown or code cells you need to perform the analysis.

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Question 1a (10 points)

Write the code for generating the `gs` variable. This is the simplest random variable of the problem and can be generated independent of the others.

```
# Code here
```

Question 1b (20 points)

We have three variables, `ak`, `pp`, and `ptime`. Write the code for generating these variables from Multivate Gaussian distribution and replicate the associated plots.

```
# Code here
```

Question 1c (20 points)

Perform the probability inrtegral transform and replicate the associated plots.

```
# Code here
```

Question 1d (20 points)

Perform the inverse transform sampling.

```
#Code here
```

Question 1e (10 points)

Replicate the final plot above assigning the correlations between the variables

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```
#Code here
```

Problem 2 (20 points)

You now pretend that the $n = 4$ dimensional data you generated in Problem 1 arrive sequentially one at a time (the co-called **online** learning setting). Introduce the index i to represent the ith arriving data sample $\mathbf{x}_i$.

1. Write the expression of the *sample* correlation matrix (5 points)
2. Write the expression of the sample correlation matrix that can be estimated recursively and plot the elements of the sample correlation matrix from $i = 1$ to $i = 100$ (15 points)

```
#Code here
```