

EE 372 Random Signals

Term Project

Due date/time: June 6, 2023 05:59

Hello everyone, here is the greatest opportunity to apply what you have learnt throughout the semester. So have fun! :)

We want you to generate basically two random variables X and Y . Then, guess what we will ask you, of course estimate X from Y via different methods. Here is your guideline for the project:

1. Generate Gaussian Random Variable X by using values of a uniform random variable U . Here, you are expected to use Box-Muller Transform to generate the random variable X . Most of the sources give algorithms, therefore; I recommend you to understand what the transformation is. As you can guess, copy-paste in your codes will be penalized (In my opinion, wikipedia explains the transformation sufficiently for this project. All you need to do is write the codes for the formulations and apply monte-carlo so that you will have enough number of points for a Gaussian distribution.). Also, those of you using Gaussian Random Value generator functions will have penalized grade.
2. If you completed the first step, congratulations you almost finished 50% of the project. In this part, you are expected to generate Bivariate Gaussian Random Variables X and Y . Luckily, you can directly use built in functions of MATLAB or Python. Take the mean and the variance values of X from the first part, choose “reasonable :)” mean and variance for Y and combine them under mvnrnd function (ofc. It is a MATLAB example).
3. Perfect, now you have 2 random variables X and Y . Hereupon, you will estimate X from Y by using below:
 - Nothing (blind estimation). Show the power of 6th sense.
 - Assuming that $X > \text{mean}(Y)/2$
 - Optimal estimation given Y
 - Linear estimation given Y
 - Maximum likelihood (ML) estimation given Y
 - Maximum a posteriori (MAP) estimation given Y

You should repeat each case 1000 times (again monte-carlo), observe the convergence and calculate the mean-squared error (MSE).

You can prepare your codes in MATLAB or Python. Your codes should be compact and well-designed. Please remember, we will check your projects and we will run each code one by one. If your code takes half an hour then it is not a well-designed one. Also, your code should show MSE for each case together when we compile them. You must upload only 1 source file, otherwise you will be graded according to only 1 of the files you uploaded.

Finally, I want to emphasize one great great red line.

You can talk to your friends, discuss about the algorithms, compare your results. Writing codes is exactly the same as talking. You can say the same thing, but you all use different words and expressions in daily life. Therefore, excuses like “Hocam biz beraber düşündük, aynı şeyi yazmışız, birbirimizden almadık” will never be accepted :). When we realize excess similarity in your codes, you will be penalized.

Rsch Asst Uzay BENGİ