MA323 – Monte-Carlo Simulation

Lab - 5

Dipanshu Goyal 210123083

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1. Generating multivariate distribution.

To generate 10,000 samples from the distribution X such that: -

$$\boldsymbol{X} = \begin{pmatrix} X_1 \\ X_2 \end{pmatrix} \sim N_2(\boldsymbol{\mu}, \Sigma).$$

where,

$$\boldsymbol{\mu} = \begin{pmatrix} 5 \\ 8 \end{pmatrix} \text{ and } \Sigma = \begin{pmatrix} 1 & 2a \\ 2a & 4 \end{pmatrix}$$

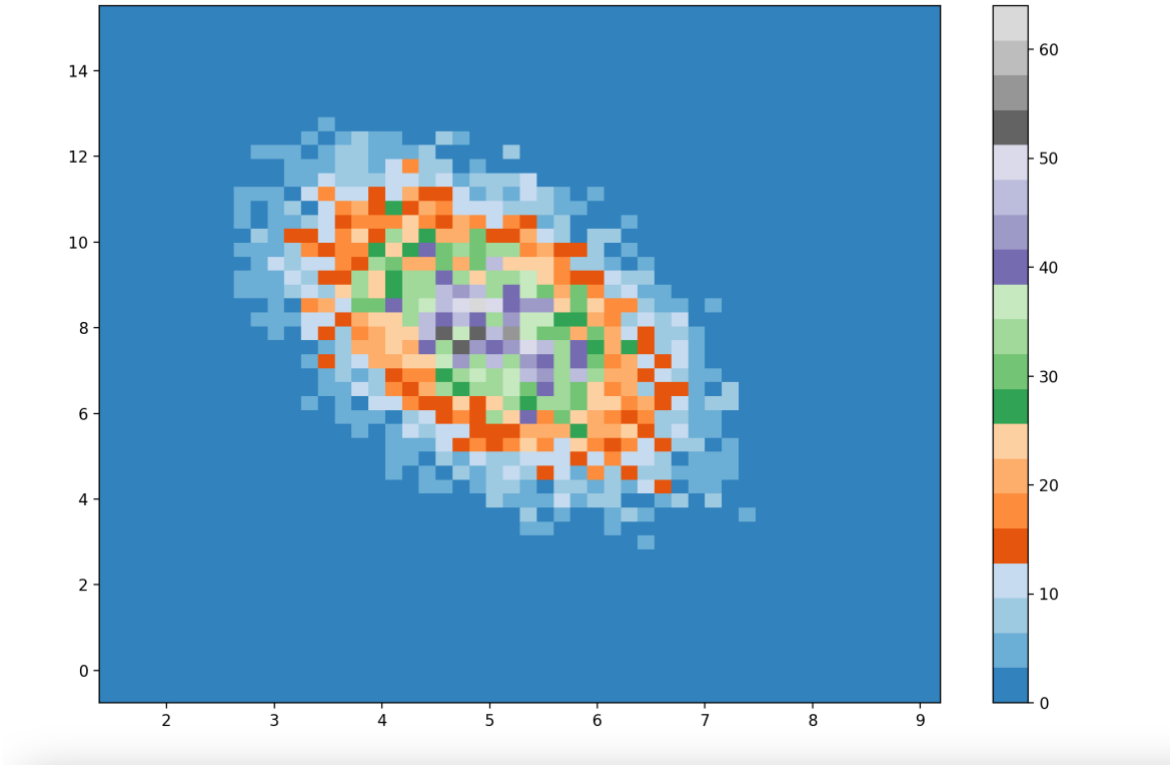
The following steps were taken: -

1. 10,000 samples from N(0, 1) distribution were generated using Box-Muller Method(Marsaglia-Bray or any other method can also be used). These samples are stored in Z.
2. From the given covariance-variance matrix(Σ), a matrix A such that $\Sigma = A.A^T$ was determined using Cholesky Factorization.
3. The distribution $\mathbf{X} \sim N_2(\boldsymbol{\mu}, \Sigma)$ was determined using

$$X = \boldsymbol{\mu} + A\boldsymbol{Z}$$

Thus we can form the 2d-Histogram of the samples and contour plots for the actual distribution as follows: -

2. Plots formed for different values of a.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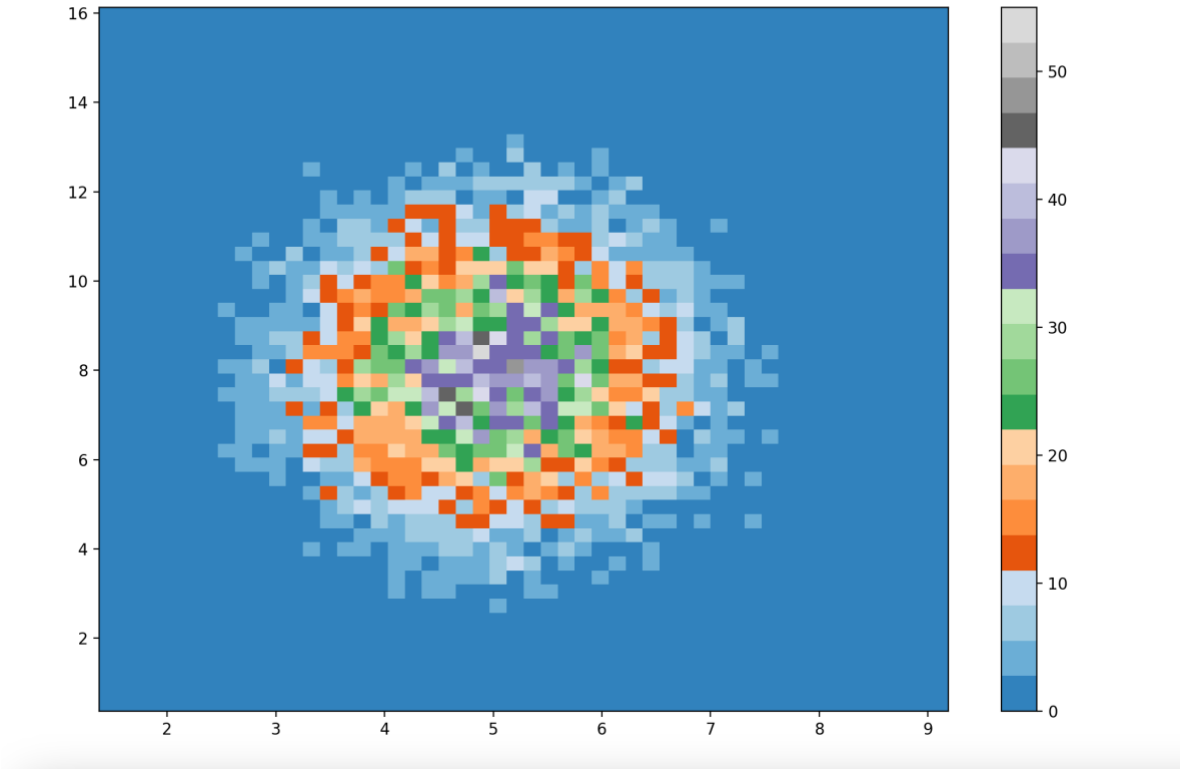
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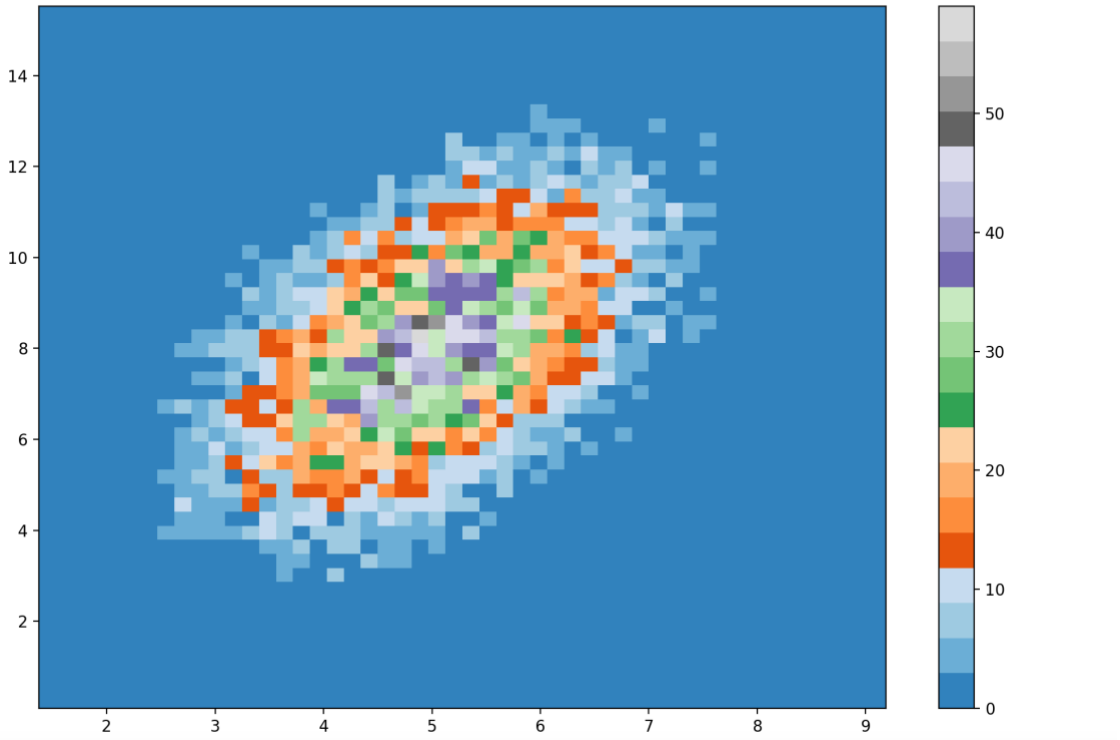
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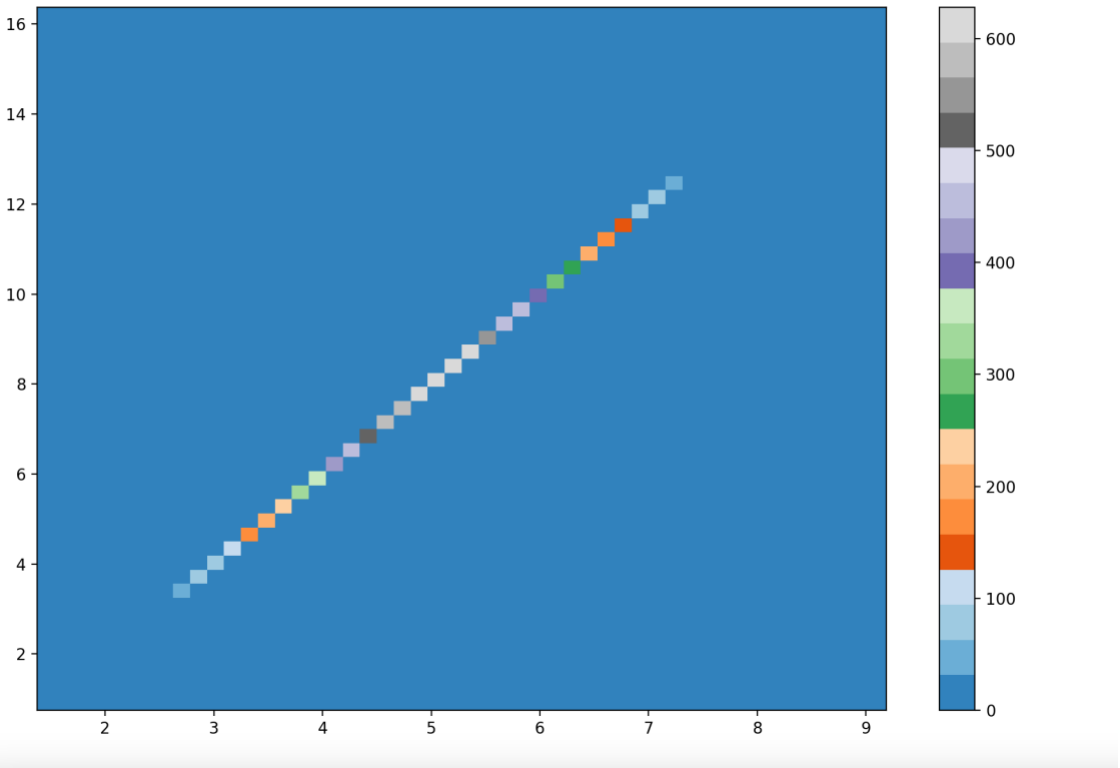
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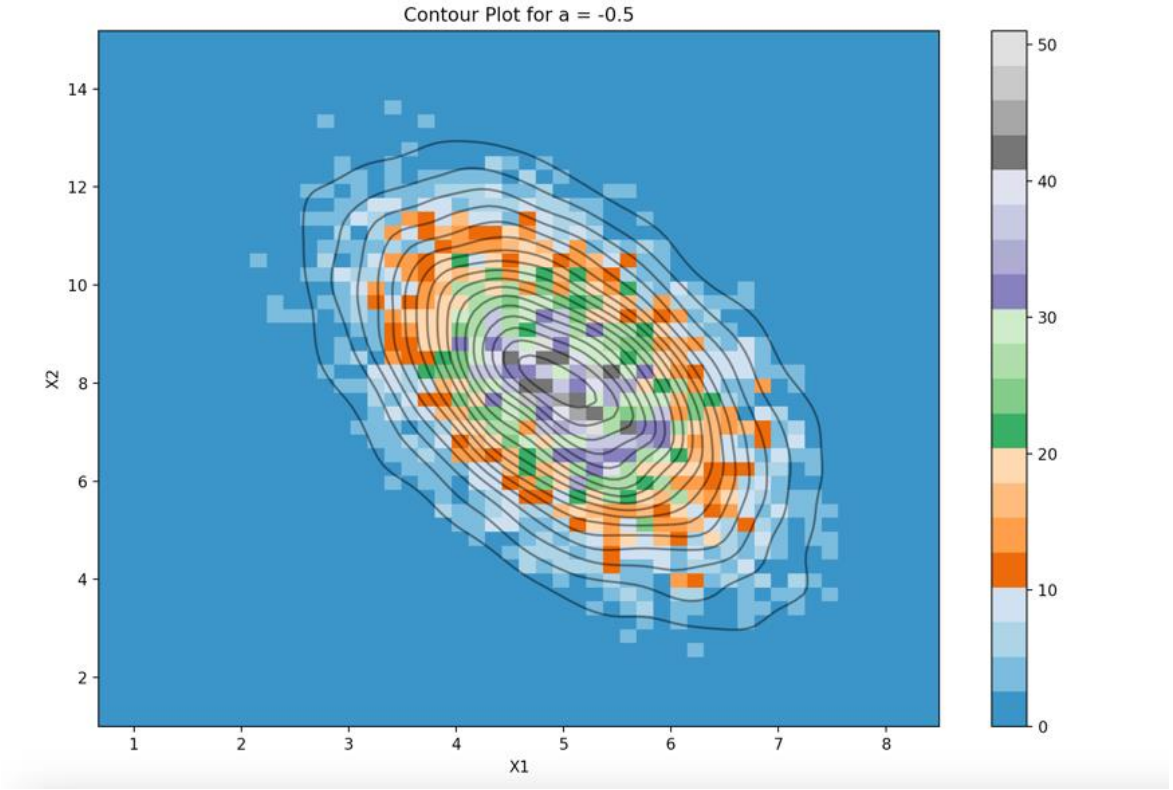
Contour Plot for a = -0.5
X1
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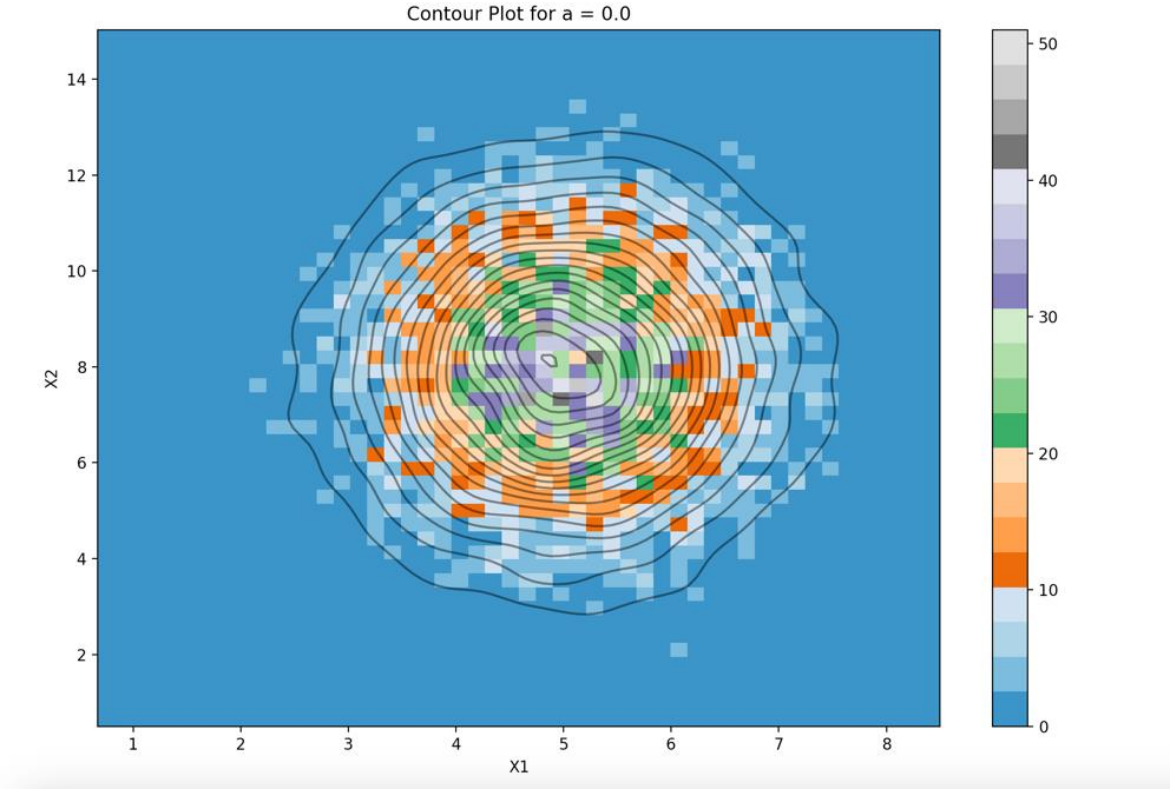
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X1
X2
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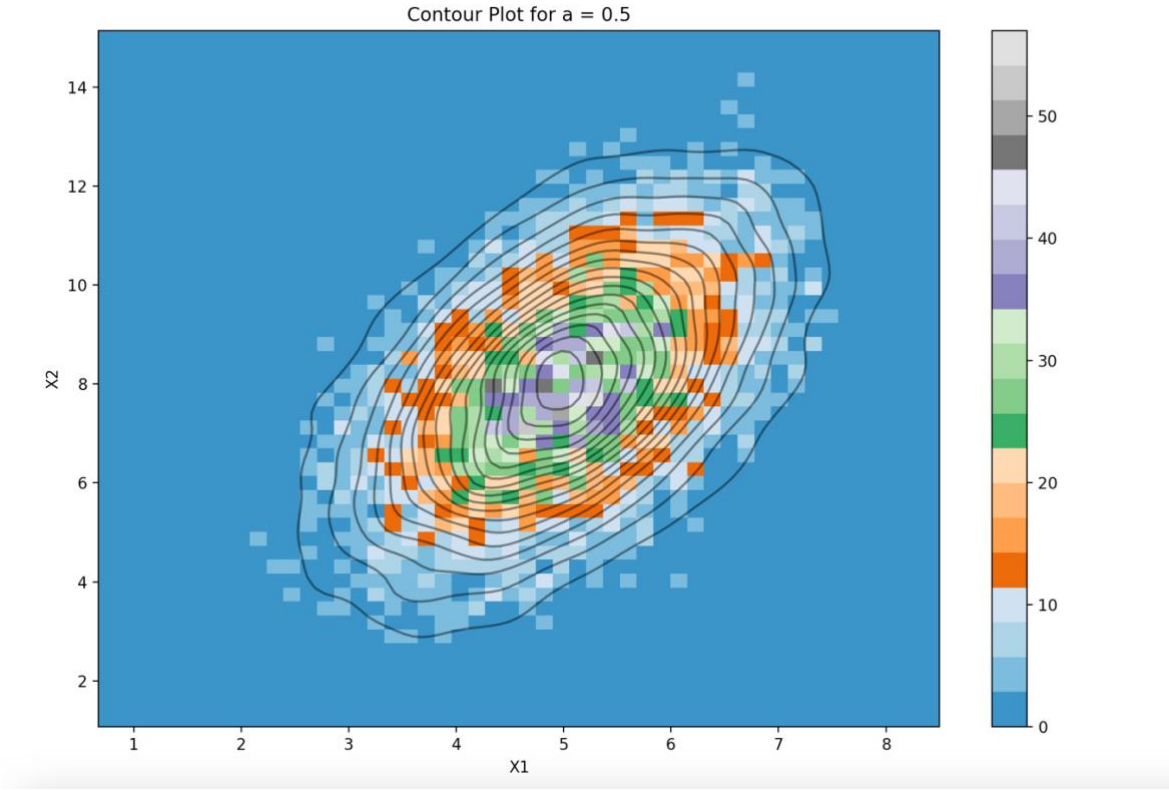
Contour Plot for a = 0.5
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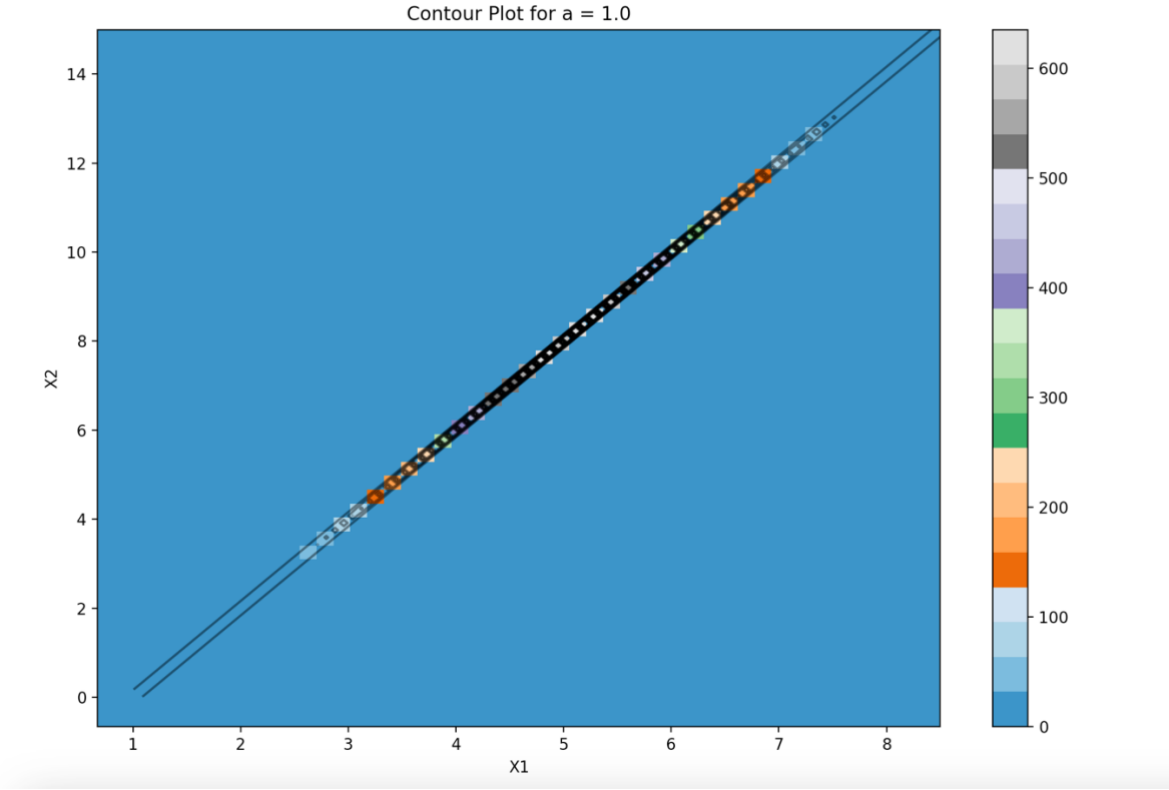
Contour Plot for a = 1.0
X1
X2
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