

1. Consider the multivariate normal distribution  $\mathbf{X} \sim N_2(\boldsymbol{\mu}, \Sigma)$ .
    - (a) Taking  $\boldsymbol{\mu} = \begin{pmatrix} 5 \\ 8 \end{pmatrix}$  and  $\Sigma = \begin{pmatrix} 1 & 2a \\ 2a & 4 \end{pmatrix}$  and for each of the four values of  $a = -0.5, 0, 0.5, 1$ , generate 10,000 sample from the distribution of  $\mathbf{X} = \begin{pmatrix} X_1 \\ X_2 \end{pmatrix} \sim N_2(\boldsymbol{\mu}, \Sigma)$ .
    - (b) For the cases  $a$ , plot the 2-dimensional histogram (please see <https://plotly.com/python/2D-Histogram/>) based on 10,000 simulated values of  $\mathbf{X}$ .
    - (c) Also, draw the contour plots of the actual densities on the histograms.
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***Submission Deadline: September 02, 2022, 11:50 AM***