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1. Consider the multivariate normal distribution $\boldsymbol{X} \sim N_2(\boldsymbol{\mu}, \Sigma)$.

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

   (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 $\boldsymbol{X}$.

   (c) Also, draw the contour plots of the actual densities on the histograms.

Submission Deadline: September 14, 2021, 11:50 PM