

Assignment 5

Due date: 6 December 2023

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1. (30%) Consider a mixture of two Gaussian distributions

$$0.4\mathcal{N}\left(\begin{bmatrix} 10 \\ 2 \end{bmatrix}, \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}\right) + 0.6\mathcal{N}\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 8.4 & 2.0 \\ 2.0 & 1.7 \end{bmatrix}\right).$$

compute the marginal distributions of each dimension.

2. (30%) Consider the following example. Compute the conditional distributions $p(x | Y = y_1)$ and $p(y | X = x_3)$.

	y_1	0.01	0.02	0.03	0.1	0.1
Y	y_2	0.05	0.1	0.05	0.07	0.2
	y_3	0.1	0.05	0.03	0.05	0.04
		x_1	x_2	x_3	x_4	x_5

X

3. (40%) Exercise in the slides.

ML Math - Probability & Distributions
Gaussian Distribution
Sums and Linear Transformations

Exercise

Another example of *reverse transformation*.

$Y \sim \mathcal{N}(\mu_y, \Sigma)$ and $\mathbf{y} = \mathbf{A}\mathbf{x}$ for $\mathbf{x}, \mathbf{y} \in \mathbb{R}^M$, and \mathbf{A} is invertible

- $p(\mathbf{y}) = \mathcal{N}(\mathbf{y} | \mathbf{A}\mathbf{x}, \Sigma)$.
- Compute $\mathbb{E}[\mathbf{x}]$.
- Compute $\mathbb{V}[\mathbf{x}]$.
- Derive $X \sim \mathcal{N}(?, ?)$.

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