

SDS 383D Conditionals and Marginals

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A: Marginal Distribution of x_1

$$\mu = (\mu_1, \mu_2)^T \quad \Sigma = \begin{pmatrix} \Sigma_{11} & \Sigma_{12} \\ \Sigma_{21} & \Sigma_{22} \end{pmatrix} \quad (1)$$

$$x_1 = Ax \quad \text{let} \quad A = \begin{pmatrix} 1 & 0 \end{pmatrix} \quad (2)$$

$$E[x_1] = E[Ax] = AE[x] = \begin{pmatrix} 1 & 0 \end{pmatrix} \begin{pmatrix} \mu_1 \\ \mu_2 \end{pmatrix} = \mu_1 \quad (3)$$

$$\text{cov}(x_1) = \text{cov}(Ax) = A\text{cov}(x)A^T \quad (4)$$

$$= \begin{pmatrix} 1 & 0 \end{pmatrix} \begin{pmatrix} \Sigma_{11} & \Sigma_{12} \\ \Sigma_{21} & \Sigma_{22} \end{pmatrix} \begin{pmatrix} 1 \\ 0 \end{pmatrix} = (\Sigma_{11} \quad \Sigma_{12}) \begin{pmatrix} 1 \\ 0 \end{pmatrix} = \Sigma_{11} \quad (5)$$