

Gaussian distribution

- Univariate:
$$N(x; \mu, \sigma^2) = (2\pi\sigma^2)^{-1/2} \exp\left(-\frac{(x - \mu)^2}{2\sigma^2}\right)$$

- Multivariate:
$$N(\mathbf{x}; \boldsymbol{\mu}, \boldsymbol{\Sigma}) = \sqrt{\frac{1}{(2\pi)^N \det \boldsymbol{\Sigma}}} \exp\left(-\frac{1}{2}(\mathbf{x} - \boldsymbol{\mu})^T \boldsymbol{\Sigma}^{-1}(\mathbf{x} - \boldsymbol{\mu})\right) \quad \text{where} \quad \mathbf{x} \in \mathbb{R}^N$$

Joint, marginal, conditional probabilities

- Joint: $P(x, y)$ where $P(\cdot) \in \mathbb{R}^{|X| \times |Y|}$
- Marginal: $P(x) = \sum_y P(X = x, Y = y)$
- Conditional: $P(y|x) = \frac{P(Y = y, X = x)}{P(X = x)}$