# SSY345 - Sensor fusion

## Lecture: 1

### Probability mass function (pmf) (discrete)

$P_r\{z=i\} \geq 0$ for all $i$

$\sum_z P_r\{z\} = 1$

### Probability density function (pdf) (continous)

$p(z) \geq 0$ for all $z$, and $\int p(z)dz = 1$

### Conditional distribution (product rule)

$p(x,z) = p(z|x)p(x)$, if $p(x) \neq 0 \Rightarrow p(z|x) = \frac{p(x,z)}{p(x)}$

### Law of total probability (sum rule)

- Discrete: $P_r\{z\} = \sum_{x \in S_x} P_r\{x,z\} = \sum_{x \in S_x} P_r\{z|x\} P_r\{x\}$
- Continous: $p(z) = \int_{x \in S_x} p(x,z)\,dx = \int_{x \in S_x} p(z|x)p(x)\,dx$

## Expected value (mean vector)

$$\mathbb{E}\{x\} = \int x \, p(x) \, dx$$

## Covariance matrix

$$\mathrm{Cov}\{x\} = \mathbb{E}\{[x - \mathbb{E}\{x\}][x - \mathbb{E}\{x\}]^T\}$$

## Law of large numbers

$$\lim_{n \to \infty} \frac{1}{n} \sum_{i=1}^{n} x_i = \mathbb{E}_{p(x)}\{x\}$$

## Gaussian distribution

$$x \sim N(\mu, Q)$$

$$\Rightarrow \text{pdf: } p(x) = N(x; \mu, Q) = \frac{1}{\sqrt{|2\pi Q|}} \exp\left(-\frac{1}{2}(x-\mu)^T Q^{-1} (x-\mu)\right)$$