A **probability density function** f_X of a continuous random variable X is such that:

$$\begin{aligned} f_X(x) &\geq 0, \\ \int_{-\infty}^{\infty} f_X(x)\,\mathrm{d}x &= 1, \\ P(a \leq X \leq b) &= \int_a^b f_X(x)\,\mathrm{d}x. \end{aligned} \tag{1}$$

The corresponding **cumulative distribution function** F_X of a continuous random variable X is:

$$F_X(x) = P(X \leq x) = \int_{-\infty}^{x} f_X(u)\,\mathrm{d}u \qquad \text{for} \qquad -\infty < x < \infty. \tag{2}$$

Given F_X, the f_X can be calculated by:

$$\frac{\mathrm{d}}{\mathrm{d}x} F_X(x) = \frac{\mathrm{d}}{\mathrm{d}x} \int_{-\infty}^{x} f_X(u)\,\mathrm{d}u = f_X(x). \tag{3}$$

A **continuous uniform random variable** X over the interval $[a, b]$ has the following probability density function $f(x)$ and cumulative distribution function $F(x)$:

$$f(x) = \frac{1}{b-a}\,, \qquad F(x) = \int_a^x f(u)\ \mathrm{d}u = \frac{x-a}{b-a}\,, \qquad \text{for} \qquad a \leq x \leq b\,. \tag{4}$$

An **exponential random variable** X with the mean $1/\lambda > 0$ has the following probability density function $f(x)$ and cumulative distribution function $F(x)$:

$$f(x) = \lambda\,\mathrm{e}^{-\lambda x}\,, \qquad F(x) = \int_0^x f(u)\ \mathrm{d}u = 1 - \mathrm{e}^{-\lambda x}\,, \qquad \text{for} \qquad x \geq 0\,. \tag{5}$$

A **normal (Gauss) random variable** X with the mean $m \in \mathbb{R}$ and the standard deviation $\sigma > 0$ has the following probability density function $f(x)$ and cumulative distribution function $F(x)$:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}}\,\mathrm{e}^{-\dfrac{(x-m)^2}{2\sigma^2}}\,, \qquad F(x) = \int_{-\infty}^{x} f(u)\ \mathrm{d}u = 0.5 + \Phi\left(\frac{x-m}{\sigma}\right)\,, \qquad \text{for} \qquad x \in \mathbb{R}\,. \tag{6}$$

Here, $\Phi\left(\frac{x-m}{\sigma}\right) = \Phi(z)$ is the Laplace function:

$$\Phi(z) = \frac{1}{\sqrt{2\pi}} \int_0^z \mathrm{e}^{-\dfrac{u^2}{2}}\ \mathrm{d}u\,, \tag{7}$$

which is tabulated for different values of z in the table A.1 of the textbook *Opis naključnih pojavov.* The Laplace function has the following properties:

$$\Phi(\infty) = 0.5 \qquad \text{and} \qquad \Phi(-z) = -\Phi(z)\,. \tag{8}$$

In Equation (6) a **standard normal random variable** Z has been introduced:

$$Z = \frac{X-m}{\sigma}\,. \tag{9}$$

The probability density function of a normal random variable X is usually shortly denoted by $\mathcal{N}(x; m, \sigma)$. The probability density function of a standard normal random variable Z is $\mathcal{N}(z; 0, 1)$ and its probabilities can be calculated using the table A.1 of the textbook *Opis naključnih pojavov.* The transformation (9) is referred to as *standardizing.*

When the parameter n of a binomial distribution is large and the probability of a success is $p \approx 0.5$, the binomial distribution can be approximated by a normal distribution by using:

$$m = np \qquad \text{and} \qquad \sigma = \sqrt{np(1-p)}\,. \tag{10}$$

By an alternative criteria the approximation is good when $np > 5$ and $n(1-p) > 5$.

The normal distribution can be used as an approximation of the Poisson distribution when $\lambda > 5$. The parameters of a normal distribution are then:

$$m = \lambda \qquad \text{and} \qquad \sigma = \sqrt{\lambda}\,. \tag{11}$$

Addition (subtraction) of two independent normal random variables X_1 and X_2 with the probability density functions $\mathcal{N}(x_1; m_1, \sigma_1)$ and $\mathcal{N}(x_2; m_2, \sigma_2)$ results in a normal random variable $Y = X_1 \pm X_2$ with the probability density of:

$$\mathcal{N}(y; m_y, \sigma_y), \qquad \text{where} \qquad m_y = m_1 \pm m_2 \qquad \text{and} \qquad \sigma_y = \sqrt{\sigma_1^2 + \sigma_2^2}\,. \tag{12}$$