1. $y_{n+2} + a y_{n+1} + b y_n = 0.$

This is a *second-order linear homogeneous difference equation* defined on a discrete set of points $x = 0, 1, 2, \ldots$ The notation $y_n = y(n)$ is adopted here.

Suppose λ_1 and λ_2 are roots of the characteristic equations

$$\lambda^2 + a\lambda + b = 0. \tag{1}$$

If $\lambda_1 \neq \lambda_2$, the general solution of the difference equation is expressed as

$$y_n = y_1 \frac{\lambda_1^n - \lambda_2^n}{\lambda_1 - \lambda_2} - y_0 b \frac{\lambda_1^{n-1} - \lambda_2^{n-1}}{\lambda_1 - \lambda_2}, \tag{2}$$

where y_1 and y_0 are arbitrary constants (the values of the unknown function at the first two points).

In the case of complex conjugate roots in solution (2), one should separate the real and imaginary parts.

If $\lambda_1 = \lambda_2$, the general solution of the difference equation is given by

$$y_n = y_1 n \lambda_1^{n-1} - y_0 b (n-1) \lambda_1^{n-2}.$$

References

Kuczma, M., *Functional Equations in a Single Variable*, Polish Scientific Publishers, 1968.

Doetsch, G., *Guide to the Applications of the Laplace and Z-Transforms* [in Russian], Nauka, Moscow, 1971 (page 215); English edition: Van Nostrand Reinhold Co., London, 1971.

Mirolyubov, A. A., and Soldatov, M. A., *Linear Homogeneous Difference Equations* [in Russian], Nauka, Moscow, 1981.

Polyanin, A. D. and Manzhirov, A. V., *Handbook of Integral Equations: Exact Solutions (Supplement. Some Functional Equations)* [in Russian], Faktorial, Moscow, 1998.

