Part III
Statistical Laws and Selected Models

This part of the book consists of three chapters. In Chap. 4, several famous statistical laws connected to research are discussed. The discussion begins with remarks about frequency and rank approaches to research production. Then the special status of the Zipf distribution in the world of non-Gaussian distributions (which are frequently observed in the process of statistical description of properties of research organizations, publications, and citations) is emphasized. The discussion continues with a description of power laws connected to research production. The following statistical laws are considered: the law of Lotka for scientific publications and the corresponding Pareto and Pareto II distributions; the law of Zipf and its extension (the law of Zipf–Mandelbrot); the law of Bradford for scientific journals. In addition, several important effects and statements from the area of research dynamics are described: the concentration-dispersion effect in science, the Matthew effect in science, the invitation paradox, and the Ortega hypothesis. Finally, several remarks about relationships between the discussed statistical laws are mentioned, and a more general point of view on power laws as informetric distributions is presented.

In Chap. 5, the discussion is focused on selected deterministic and probability models of dynamics of research organizations and dynamics of research publications and their citations. The models discussed are from the three main topics of interest: research publications, citations of research publications, and dynamics of research organizations, connected to the dynamics of publications and citations. In addition, the models are selected in such a way that the reader is supplied with information on important tools used in the area of modeling of research systems: epidemic models, birth and death stochastic processes, Yule distribution, Waring distribution, negative binomial distribution, Poisson distribution, mixed Poisson distribution, Gumbel distribution, Weibull distribution, GIGP distribution, generalized Zipf distribution, etc.

This part ends with a chapter containing several concluding remarks on research dynamics, research productivity, and the importance of mathematics in their understanding and description.