Chapter 4

Measuring Features of Complex Systems

This chapter is a guide to quantifying complexity based on the fruits of the analysis of the previous chapters. Many measures of complexity have been proposed since scientists first began to study complex systems, and the list is still growing. The main lesson of Chapter 3 is that complexity is a multi-faceted phenomenon and that complex systems have a variety of features not all of which are found in all of them. This implies that assigning a single number to complexity cannot do it justice. As the physicist and Nobel laureate Murray Gell-Mann noted early on, "A variety of different measures would be required to capture all our intuitive ideas about what is meant by complexity" (1995, p. 1).

If complexity is a collection of features rather than a single phenomenon, then all quantitative measures of complexity can quantify only aspects of complexity rather than complexity as such. This insight makes it prudent to ask what any purported 'measure of complexity' actually measures. In the final section of this chapter, a few, by now classic, measures of complexity from the 1980s and 1990s, mentioned in many discussions on the subject, are discussed, including effective complexity, effective measure complexity, statistical complexity, and logical depth. The discussion confirms that they each quantify one or two of the features identified in Chapter 3.

The fact that complexity measures ever quantify only one or two features of complexity and never the phenomenon as a whole should inform any practitioner's approach to quantifying complexity. The chapter goes through the features of complex systems identified in Chapter 3 and discusses mathematical means available to quantify them, accompanied by examples. A feature can take different forms in different scientific disciplines, and, therefore,