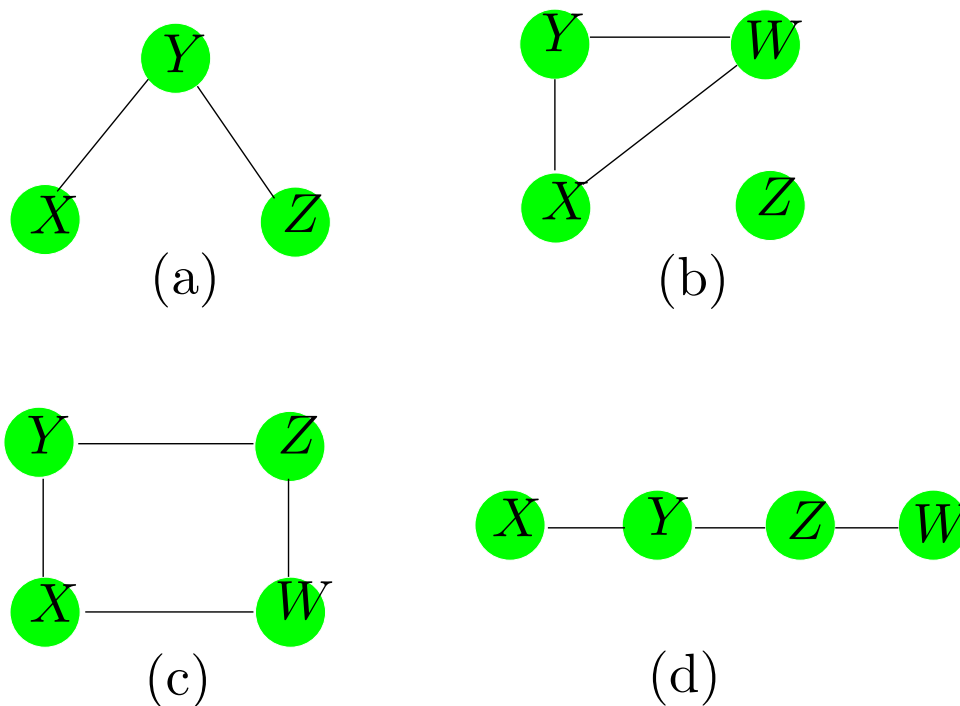
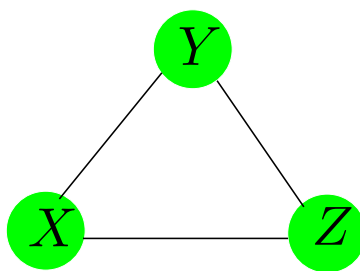


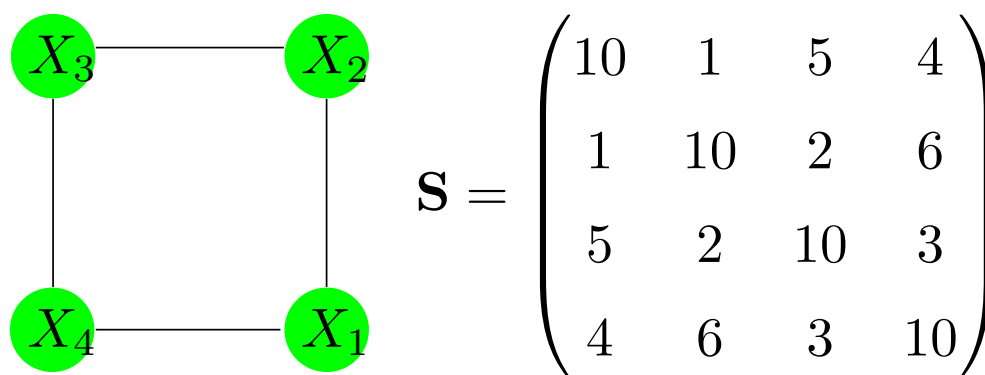
**FIGURE 17.1.** *Example of a sparse undirected graph, estimated from a flow cytometry dataset, with  $p = 11$  proteins measured on  $N = 7466$  cells. The network structure was estimated using the graphical lasso procedure discussed in this chapter.*



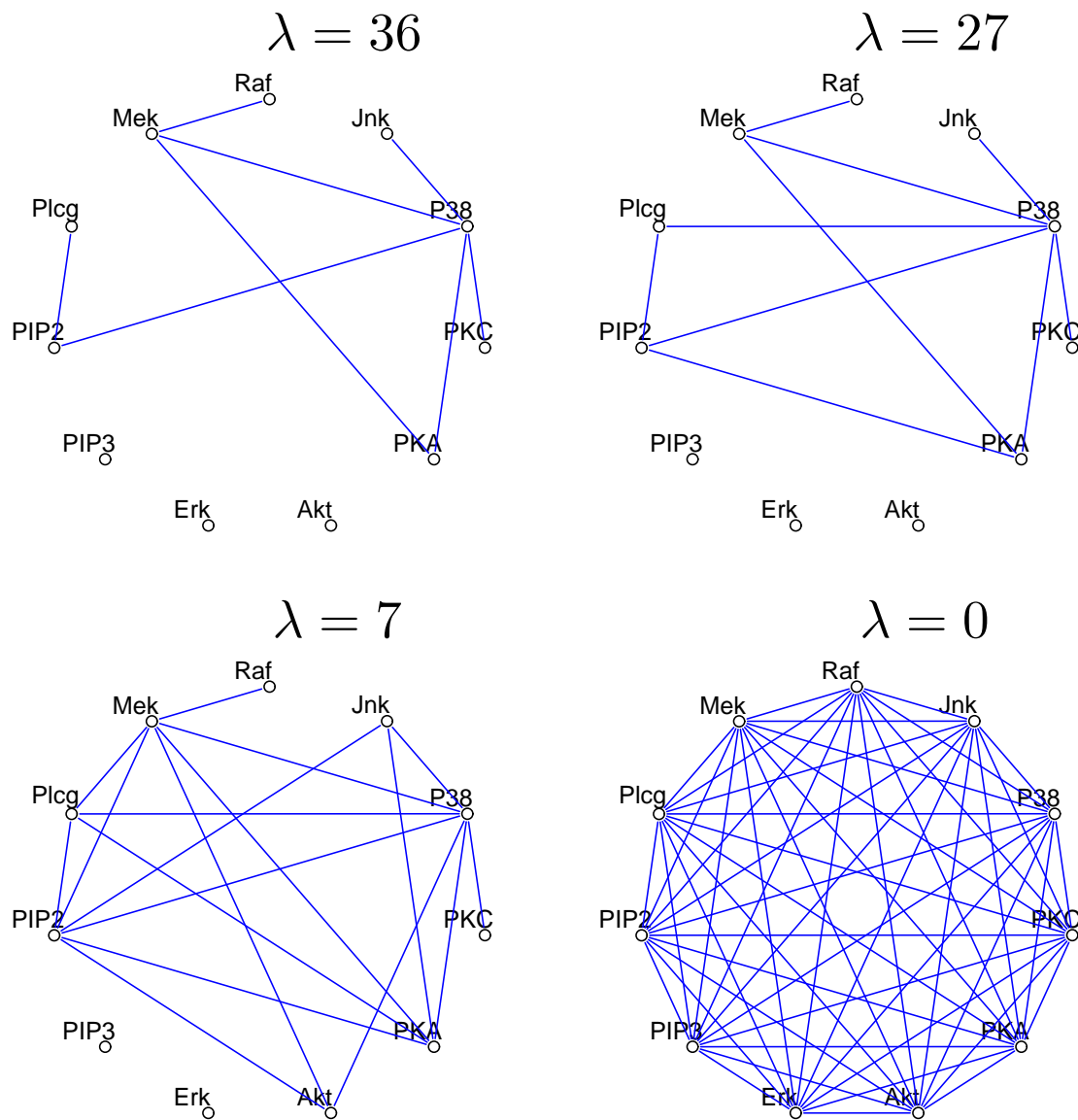
**FIGURE 17.2.** *Examples of undirected graphical models or Markov networks. Each node or vertex represents a random variable, and the lack of an edge between two nodes indicates conditional independence. For example, in graph (a),  $X$  and  $Z$  are conditionally independent, given  $Y$ . In graph (b),  $Z$  is independent of each of  $X$ ,  $Y$ , and  $W$ .*



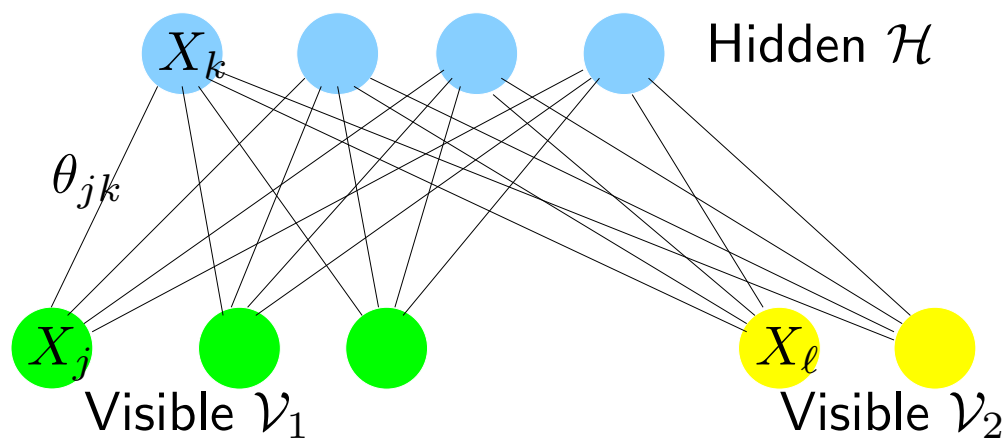
**FIGURE 17.3.** *A complete graph does not uniquely specify the higher-order dependence structure in the joint distribution of the variables.*



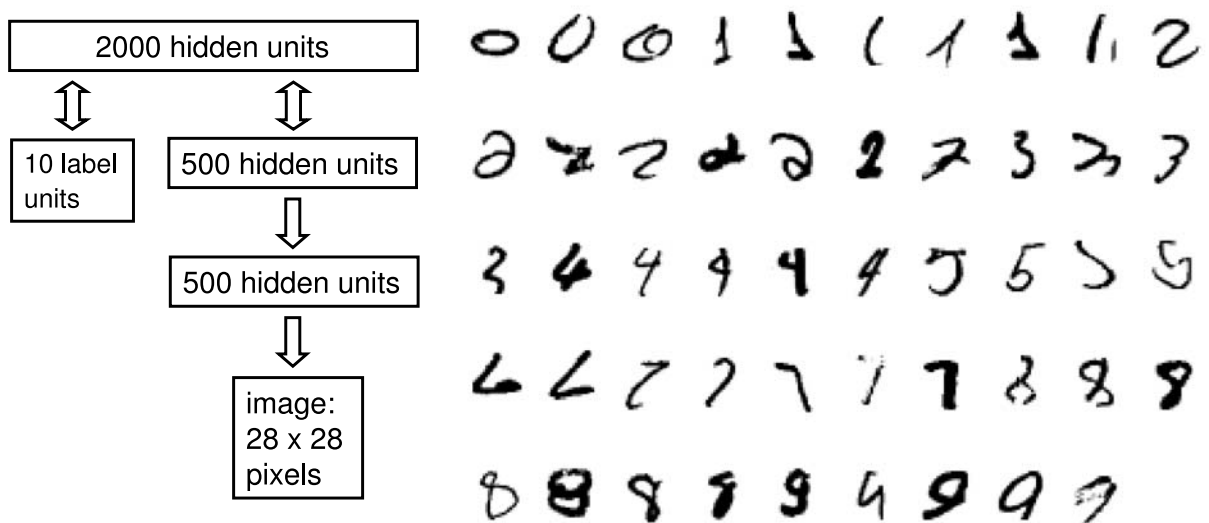
**FIGURE 17.4.** A simple graph for illustration, along with the empirical covariance matrix.



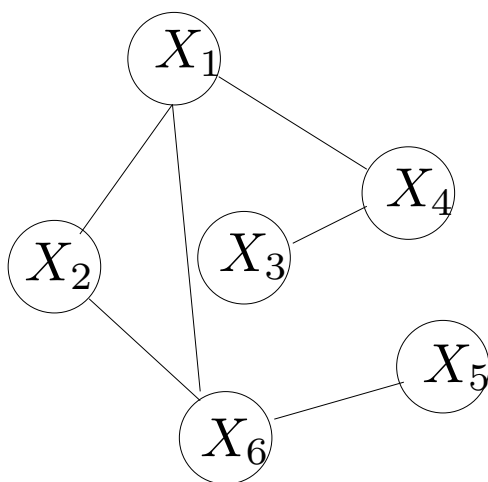
**FIGURE 17.5.** Four different graphical-lasso solutions for the flow-cytometry data.



**FIGURE 17.6.** A restricted Boltzmann machine (RBM) in which there are no connections between nodes in the same layer. The visible units are subdivided to allow the RBM to model the joint density of feature  $\mathcal{V}_1$  and their labels  $\mathcal{V}_2$ .



**FIGURE 17.7.** Example of a restricted Boltzmann machine for handwritten digit classification. The network is depicted in the schematic on the left. Displayed on the right are some difficult test images that the model classifies correctly.



**FIGURE 17.8.**