Hierarchical models are widely used statistical models for analyzing discrete data. To each simplicial complex we associate a vector configuration and corresponding toric variety, whose intersection with the probability simplex is the hierarchical model. We describe combinatorial results on these toric varieties including a classification of which simplicial complexes produce unimodular toric varieties and results on operations on the simplicial complexes that preserve normality of the toric varieties. (Received September 15, 2015)