ABSTRACT: Driven by the analysis of constrained data objects, e.g. population of nonnegative data and population of diffusion tensor image data, we propose a novel statistical framework, nested cone analysis. The novel methods directly work with the constraints, and identify a sequence of approximations to the original data by different ranks. These methods provide a nested learning sequence, which properly handles both the complicated constraints and the goodness of fit. Simulations and applications are used to illustrate the usefulness of our methods.