

In sufficient dimension reduction, the second-order inverse regression methods, such as the principal Hessian directions and directional regression, commonly require the predictor to be normally distributed. In this paper, we introduce a type of elliptical distributions called the quadratic variance ellipticity family, which covers and approximates a variety of commonly seen elliptical distributions, with the normal distribution as a special case. When the predictor belongs to this family, we study the properties of the second-order inverse regression methods and adjust them accordingly to preserve the consistency. When the dimension of the predictor is sufficiently large, we also show the consistency of the original methods, which strengthens a previous result in Li & Wang (2007). Simulation study is conducted to illustrate the effectiveness of the adjusted methods.