Multistage multivariate profile data $\mathbf{X}_{N\times P}$
Data centering and standardization
Hypothesis test by the Tracy-Widom convergence
More significant PCs
No
Stop
Yes
Design a grid of the tuning parameter λ_3
HSMFPCA: solve (6) by Algorithm 1 with each λ_3
Determine the optimal λ_3 by AIC
HSMFPCA: solve (6) by Algorithm 1 with the optimal λ_3
Sparse eigenvector $\hat{\mathbf{v}}$
Data updating $\mathbf{X}_{N\times P}=\mathbf{X}-\mathbf{X}\hat{\mathbf{v}}\hat{\mathbf{v}}^T$