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On sample eigenvalues in a generalized spiked population model. (English) [Zbl 1301.62049]


Summary: In the spiked population model introduced by I. M. Johnstone [Ann. Stat. 29, No. 2, 295–327 (2001; Zbl 1016.62078)], the population covariance matrix has all its eigenvalues equal to unit except for a few fixed eigenvalues (spikes). The question is to quantify the effect of the perturbation caused by the spike eigenvalues. J. Baik and J. W. Silverstein [J. Multivariate Anal. 97, No. 6, 1382–1408 (2006; Zbl 1220.15011)] establishes the almost sure limits of the extreme sample eigenvalues associated to the spike eigenvalues when the population and the sample sizes become large. In a recent work [the authors, Ann. Inst. Henri Poincaré, Probab. Stat. 44, No. 3, 447–474 (2008; Zbl 1274.62129)], we have provided the limiting distributions for these extreme sample eigenvalues. In this paper, we extend this theory to a generalized spiked population model where the base population covariance matrix is arbitrary, instead of the identity matrix as in Johnstone’s case. As the limiting spectral distribution is arbitrary here, new mathematical tools, different from those in [Baik and Silverstein, loc. cit.], are introduced for establishing the almost sure convergence of the sample eigenvalues generated by the spikes.

MSC:

62H05 Characterization and structure theory for multivariate probability distributions; copulas
60B20 Random matrices (probabilistic aspects)
60F15 Strong limit theorems
60F05 Central limit and other weak theorems

Keywords:

sample covariance matrices; spiked population model; central limit theorems; largest eigenvalue; extreme eigenvalues

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References:


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