

# Graph presentations for moments of noncentral Wishart distributions and their applications

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**Abstract** We provide formulas for the moments of the real and complex noncentral Wishart distributions of general degrees. The obtained formulas for the real and complex cases are described in terms of the undirected and directed graphs, respectively. By considering degenerate cases, we give explicit formulas for the moments of bivariate chi-square distributions and  $2 \times 2$  Wishart distributions by enumerating the graphs. Noting that the Laguerre polynomials can be considered to be moments of a noncentral chi-square distributions formally, we demonstrate a combinatorial interpretation of the coefficients of the Laguerre polynomials.

**Keywords** Kibble's bivariate gamma distribution · Laguerre polynomial · Noncentral Stirling number of the first kind