Identifiability of Gaussian Mixtures from their sixth moments

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I give a partial answer to an identifiability question from algebraic statistics: When do the truncated moments of a Gaussian mixture distribution uniquely determine the parameters (means and covariance matrices)? We will see that generically, a mixture of at most $m = \theta(n^4)$ Gaussian distributions in n variables is uniquely determined by its moments of degree 6. The proof relies on recent advances in both the theory of secant varieties and on Fröberg's conjecture, which jointly allow to reduce identifiability to a simple combinatorial problem. I show that the resulting Gaussian Moment variety of degree 6 is identifiable up to rank $m = \theta(n^4)$, which asymptotically matches the bound from counting parameters, with the constant hidden in the O-notation being optimal.