A Report on "Combining Mixture Components for Clustering" by Baudry et al.

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BIC is defined as

$$\text{BIC}(K) = \log p(\mathbf{x}|K, \widehat{\theta_K}) - \frac{\nu_K}{2} \log(n)$$

wherea

$$\begin{aligned}
\nu_K &= \dim \mathcal{M}_K \\
&= \dim \theta_K \\
&= \dim (p_1, \dots, p_{K-1}, \mathbf{a}_1, \dots, \mathbf{a}_K) \\
&= \dim (p_1, \dots, p_K) + \dim (\mathbf{a}_1, \dots, \mathbf{a}_K) \\
&= K - 1 + K \dim(\mathbf{a}_1) \\
&= K - 1 + K (\dim (\mu_1, \Sigma_1)) \\
&= K - 1 + K [m + m(m+1)/2]
\end{aligned}$$