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Correction

Correction to: Fluctuations of the Free Energy of the Spherical Sherrington–Kirkpatrick Model with Ferromagnetic Interaction

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In Theorem 1.4 (iii) of the original article, we stated that

$$\sqrt{N}(F_N - F(\beta)) \Rightarrow \mathcal{N}(0, \alpha_2) \tag{1}$$

in the ferromagnetic regime $J > 1$ and $\beta > \frac{1}{2J}$. The proof is based on Theorem 1.5 (iii), which we proved in the paper, and a known random matrix theory result, given in the second part of (1.19) which reads

$$N^{1/2}\left(\mu_1 - \left(J + \frac{1}{J}\right)\right) \Rightarrow \mathcal{N}\left(0, 2\left(1 - \frac{1}{J^2}\right)\right) \tag{2}$$

for $J > 1$.

However, (2) holds only when W_3 (the third moment of A_{ij}) vanishes. (See Definition 1.1 of the original article.) For a general case, Theorem 2.14 (and Remark 2.19) of [2] and Theorem 1.3 of [4] show that

$$N^{1/2}\left(\mu_1 - \left(J + \frac{1}{J}\right)\right) \Rightarrow \mathcal{N}\left(\frac{W_3(J^2-1)}{J^4}, 2\left(1 - \frac{1}{J^2}\right)\right). \tag{3}$$

See also Theorem 1.5 of [3] and Theorem 3.4 of [1]. Together with Theorem 1.5 (iii) of the original article, (3) implies that

$$\frac{1}{\beta - \frac{1}{2J}}\sqrt{N}(F_N - F) \Rightarrow \mathcal{N}(f_2', \alpha_2') \tag{4}$$

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where

$$f_2' = \frac{W_3(J^2-1)}{J^4}, \qquad \alpha_2' = \frac{2(J^2-1)}{J^2}.$$

We note that, if $W_3 = 0$, the result in (4) coincides with (1). Hence, the results in the original article are valid with an additional assumption $W_3 = 0$.

We remark that the structure of the perturbation matrix of Wigner has an effect on the limiting distribution of the outlier, as discussed in [4]. In particular, the nonzero mean case we consider corresponds to the case where the eigenvector of the non-trivial eigenvalue of the perturbation matrix is delocalized.

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