Number: Name:

Exercise 8 (no submission required)

1) We would like to reproduce the quantum-mechanical result in Eq. (268) using a hidden variable theory. Assume that the hidden variable is discrete, $i = 1, 2, 3, 4$, and define the probability distribution and the expectation value by

$$p_i = \rho(i), \qquad \sum_{i=1}^{4} p_i = 1, \qquad C(\boldsymbol{n}, \boldsymbol{m})_{\mathrm{HV}} = -\sum_{i=1}^{4} p_i N(\boldsymbol{n}, i) N(\boldsymbol{m}, i),$$

where the relation in Eq. (273) has been used. For each value of i, let

$$\begin{aligned} &N(\boldsymbol{n}, 1) = +1, \qquad N(\boldsymbol{m}, 1) = +1, \qquad N(\boldsymbol{n}, 2) = +1, \qquad N(\boldsymbol{m}, 2) = -1, \\ &N(\boldsymbol{n}, 3) = -1, \qquad N(\boldsymbol{m}, 3) = +1, \qquad N(\boldsymbol{n}, 4) = -1, \qquad N(\boldsymbol{m}, 4) = -1. \end{aligned}$$

This assignment satisfies the marginal distribution condition (264). Give one example of $\{p_i\}$ that reproduces Eq. (268).

2) Consider a continuous hidden variable $\lambda \in [0, 1]$ with a uniform distribution, $\rho(\lambda) = 1$. Choose

$$N(\boldsymbol{n}, \lambda) = \begin{cases} +1, & 0 \le \lambda < \frac{1}{2}, \\ -1, & \frac{1}{2} \le \lambda \le 1. \end{cases}$$

This choice satisfies the marginal distribution condition (264). Give one example of $N(\boldsymbol{m}, \lambda)$ that reproduces

$$C(\boldsymbol{n}, \boldsymbol{m})_{\mathrm{HV}} = -\int d\lambda\, \rho(\lambda) N(\boldsymbol{n}, \lambda) N(\boldsymbol{m}, \lambda) = -\cos\theta.$$
