Null hypothesis: "Inhibitory interneurons receive dense, convergent input from nearby excitatory neurons with widely varying preferred stimulus orientation."

Two Potential Null Models:

(i) No dependence on distance or preferred stimulus orientation: $SBM_n^k(\vec{\rho}, \vec{\beta})$, where $\vec{\rho}$ are regions and $\vec{\beta}$ are the connectivity probabilities in each region, in this case Bernoulli p's associated with each region k: $\vec{\rho} \in \Delta_k$, $\vec{\beta} \in (0,1)^{k \times k}$; Ex: $SBM_4^2(\vec{\rho}, \vec{\beta})$, $\vec{\rho} \in \Delta_2$, $\vec{\beta} \in (0,1)^{2\times 2}$, where $k = 1$ is cluster of excitatory neurons, $k = 2$ is cluster of inhibitory interneurons, $\beta(1,1) = p_{11}$, $\beta(1,2) = p_{12}$, $\beta(2,1) = p_{21}$, $\beta(2,2) = p_{22}$.

(ii) Dependence on distance and no dependence on preferred stimulus orientation: Ex: $SBM_4^2(\vec{\rho}, \vec{\beta}(\vec{x}))$, $\vec{\rho} \in \Delta_2$, $\vec{\beta}(\vec{x})$, where $\vec{x} \in \mathbb{R}^3$, is either a function of neuron location $\vec{x}$ (connectivity probability between each cluster) or Bernoulli p's, i.e. $\in (0,1)$, (connectivity probability within each cluster), where $\beta(1,1) = p_{11}$ (apply Bernoulli), $\beta(1,2)_{ij} = Ke^{-d(E_i,I_j)}$ (apply thresholding), $\beta(2,1)_{ij} = Ke^{-d(E_i,I_j)}$ (thresholding), $\beta(2,2) = p_{22}$ (Bernoulli), where $d(E_i, I_j)$ is distance (Euclidean or Mahalanobis) between excitatory neuron E_i and inhibitory interneuron I_j, $k = 1$ is cluster of excitatory neurons, $k = 2$ is cluster of inhibitory interneurons, and K is some scale factor.

Two Corresponding Alternate Models:

(i) No dependence on distance but dependence on preferred stimulus orientation: $SBM_4^2(\vec{\rho}, \vec{\beta}(z_{ij}))$, $\vec{\rho} \in \Delta_2$, $\vec{\beta}(z_{ij})$, where $z_{ij} \in (0, 2\pi)$, is either a function of preferred stimulus orientation z_{ij} (connectivity probability between each cluster) or Bernoulli p's, i.e. $\in (0,1)$, (connectivity probability within each cluster), where $\beta(1,1) = p_{11}$, $\beta(1,2)_{ij} = Ke^{-d(z_{ij}, z_{\neq i,j})}$ given some $E_{\neq i}$ and I_j already have a connection, $\beta(2,1)_{ij} = Ke^{-d(z_{ij}, z_{\neq i,j})}$ given some $E_{\neq i}$ and I_j already have a connection (threshold), $\beta(2,2) = p_{22}$, where $d(z_{ij}, z_{\neq i,j})$ is some cosine distance between preferred orientation angles of E_i and $E_{\neq i}$ for some I_j, $k = 1$ is excitatory neuron cluster, $k = 2$ is inhibitory neuron cluster, and K is scale factor.

(ii) Dependence on distance and dependence on preferred stimulus orientation: $SBM_4^2(\vec{\rho}, \vec{\beta}(\vec{x}, z_{ij}))$, $\vec{\rho} \in \Delta_2$, $\vec{\beta}(\vec{x}, z_{ij})$, where $\vec{x} \in \mathbb{R}^3$ and $z_{ij} \in (0, 2\pi)$, is either a function of neuron location $\vec{x}$ and preferred stimulus orientation z_{ij} (connectivity probability between each cluster) or Bernoulli p's, i.e. $\in (0,1)$, (connectivity probability within each cluster), where $\beta(1,1) = p_{11}$, $\beta(1,2)_{ij} = Ke^{-d(E_i,I_j)}e^{-d(z_{ij}, z_{\neq i,j})}$ given some $E_{\neq i}$ and I_j already have a connection, $\beta(2,1)_{ij} = Ke^{-d(E_i,I_j)}e^{-d(z_{ij}, z_{\neq i,j})}$ given some $E_{\neq i}$ and I_j already have a connection, $\beta(2,2) = p_{22}$, where $d(E_i, I_j)$ is distance (Euclidean or Mahalanobis) between excitatory neuron E_i and inhibitory interneuron I_j and $d(z_{ij}, z_{\neq i,j})$ is some cosine distance between preferred orientation angles of E_i and $E_{\neq i}$ for some I_j, $k = 1$ is cluster of excitatory neurons, $k = 2$ is cluster of inhibitory interneurons, and K is some scale factor.