Supporting Information for *Non-random network connectivity comes in pairs*

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SI1

Solving

$$\mu = px + (1-p)y \tag{1}$$

for p gives

$$p = \frac{\mu - y}{x - y}, \tag{2}$$

which, plugged into

$$\varrho = \frac{px^2 + (1-p)y^2}{\mu^2}, \tag{3}$$

yields

$$\begin{aligned}
\varrho &= \frac{\left(\frac{\mu-y}{x-y}\right)x^2 + \left(1 - \frac{\mu-y}{x-y}\right)y^2}{\mu^2} && (4)\\
&= \frac{\left(\frac{\mu-y}{x-y}\right)(x^2 - y^2) + y^2}{\mu^2} && (5)\\
&= \frac{(\mu - y)(x+y) + y^2}{\mu^2} && (6)\\
&= \frac{x+y}{\mu} - \frac{xy}{\mu^2}. && (7)
\end{aligned}$$

SI2

Solve

$$p = \frac{\mu - y}{x - y} \tag{8}$$

for y and since $x \geq \mu$,

$$y = \frac{\mu - px}{1-p} \leq \frac{\mu - p\mu}{1-p} = \mu. \tag{9}$$

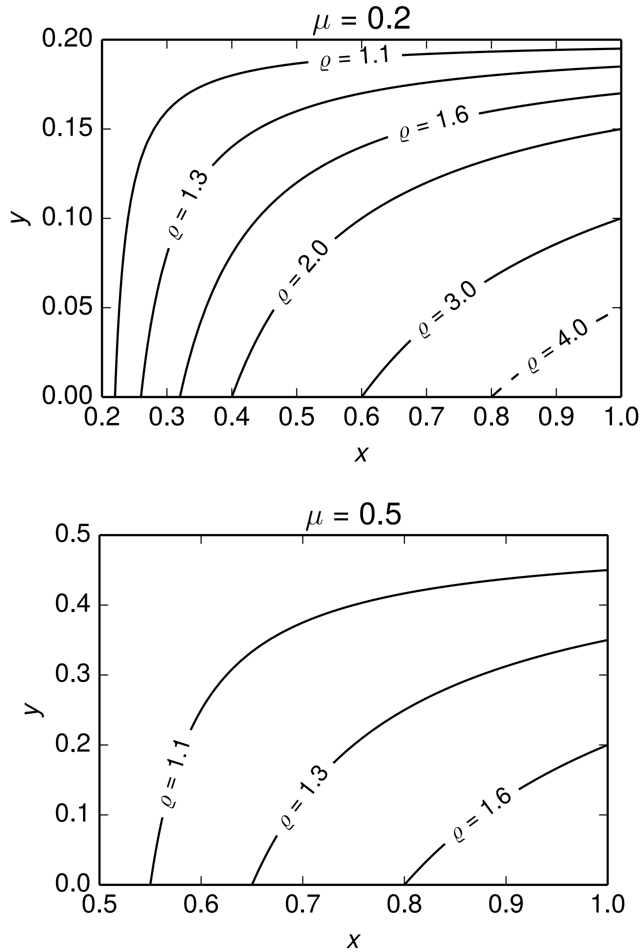

Figure S1: Relative overrepresentation ϱ of bidirectional connections in networks with a fraction of pairs connected with a high probability x and the rest of the pairs connected with a low probability y. **Top** Overall connection probability in the network $\mu = 0.2$ **Bottom** $\mu = 0.5$