Mantel Test

$$X = \begin{bmatrix} 0 & x_{12} & x_{13} & \dots & x_{1N} \\ x_{21} & 0 & x_{23} & \dots & x_{2N} \\ x_{31} & x_{32} & 0 & \dots & x_{2N} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ x_{N1} & x_{N2} & x_{N3} & \cdots & 0 \end{bmatrix}$$

$$Y = \begin{bmatrix} 0 & y_{12} & y_{13} & \cdots & y_{1N} \\ y_{21} & 0 & y_{23} & \cdots & y_{2N} \\ y_{31} & y_{32} & 0 & \cdots & y_{2N} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ y_{N1} & y_{N2} & y_{N3} & \cdots & 0 \end{bmatrix}$$

The Mantel Test

$$Z = \sum_{i=1}^{N} \sum_{j=1}^{N} x_{ij} y_{ij}$$