

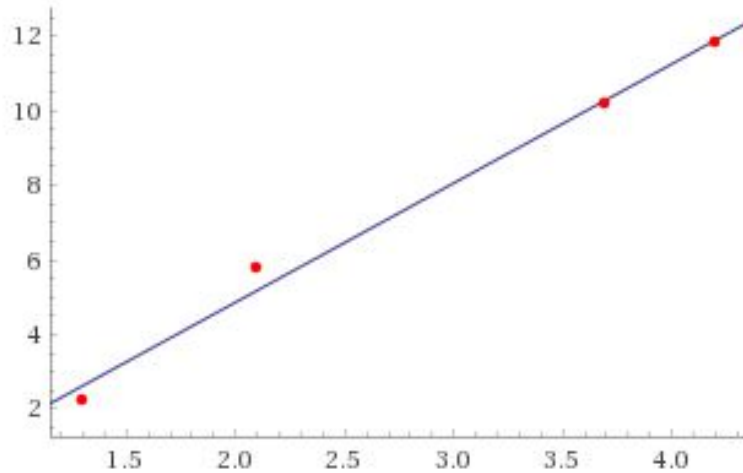


# Visual Representation of Spatial Relationships in Higher Dimensions

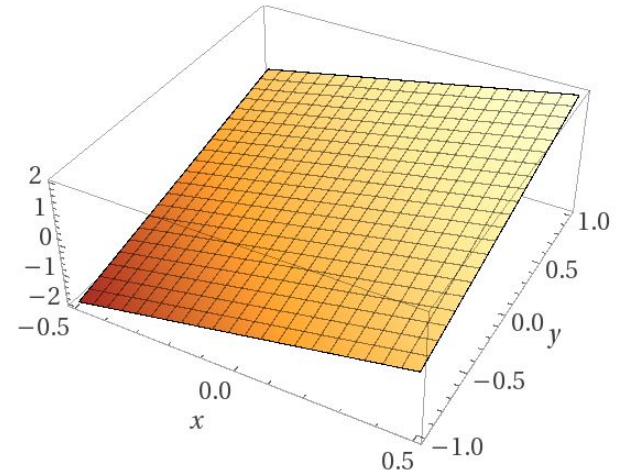
James Weichert | HL Math IA - June, 2018

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# The Problem:

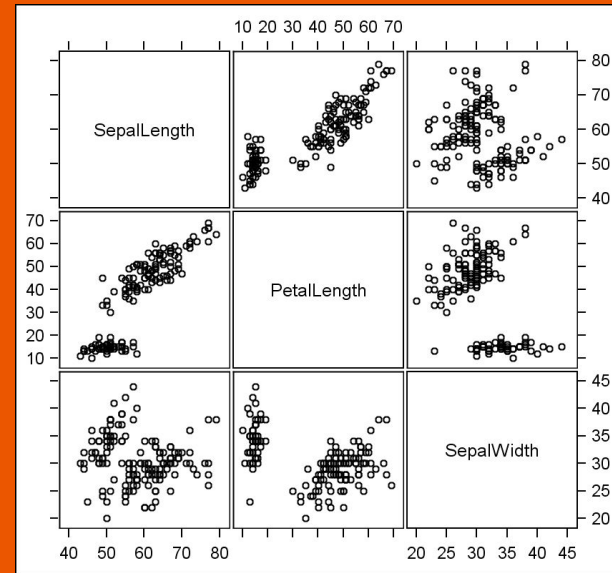
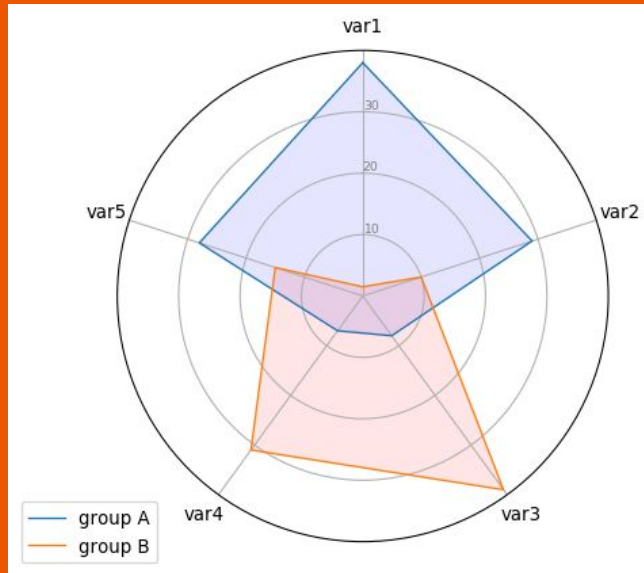
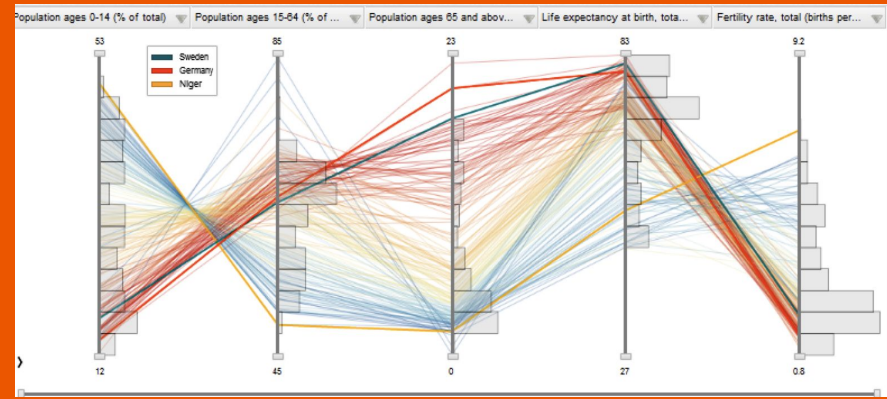


Computed by Wolfram|Alpha

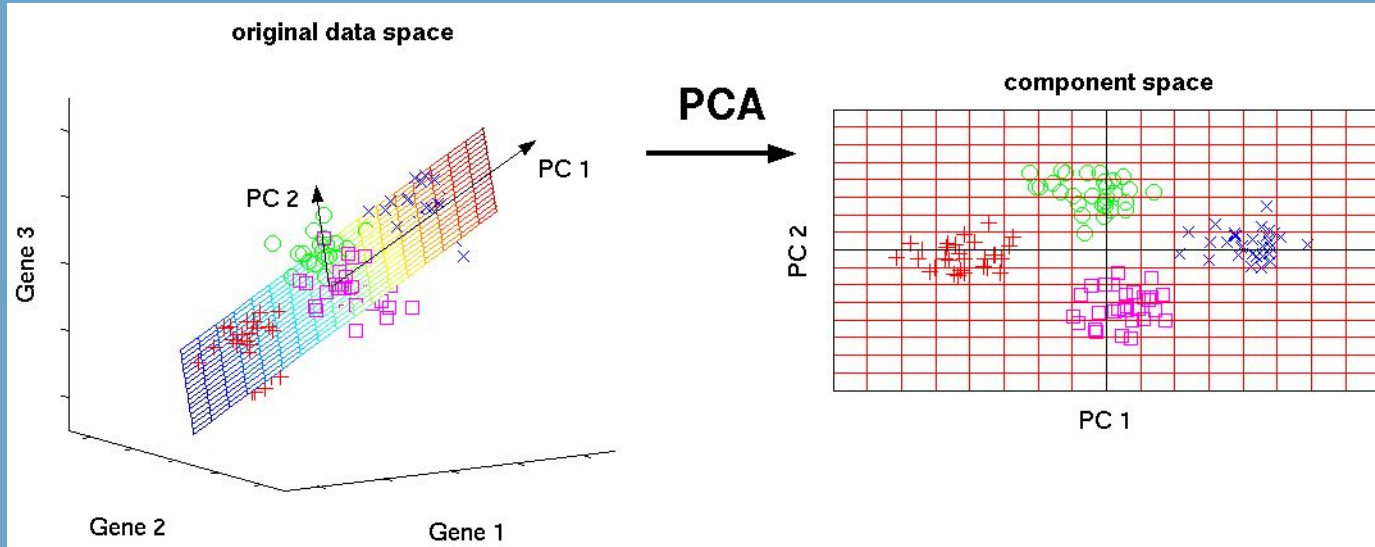


Computed by Wolfram|Alpha

# The Solutions:



# The *Better* Solutions:

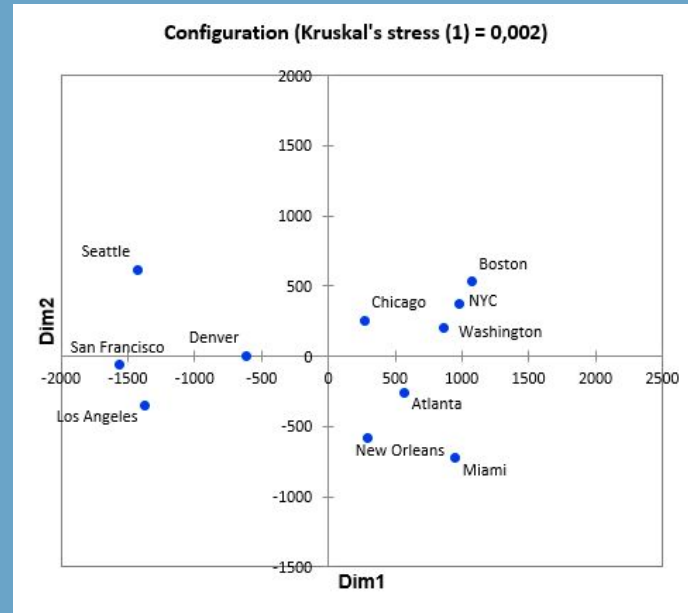


$$W = \frac{1}{n} \sum_{i=1}^n X^T X$$

$$T_r = W_r X$$

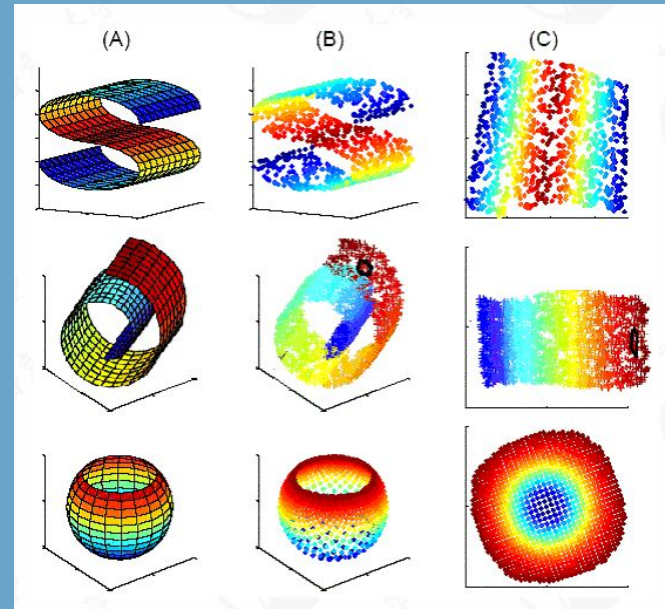
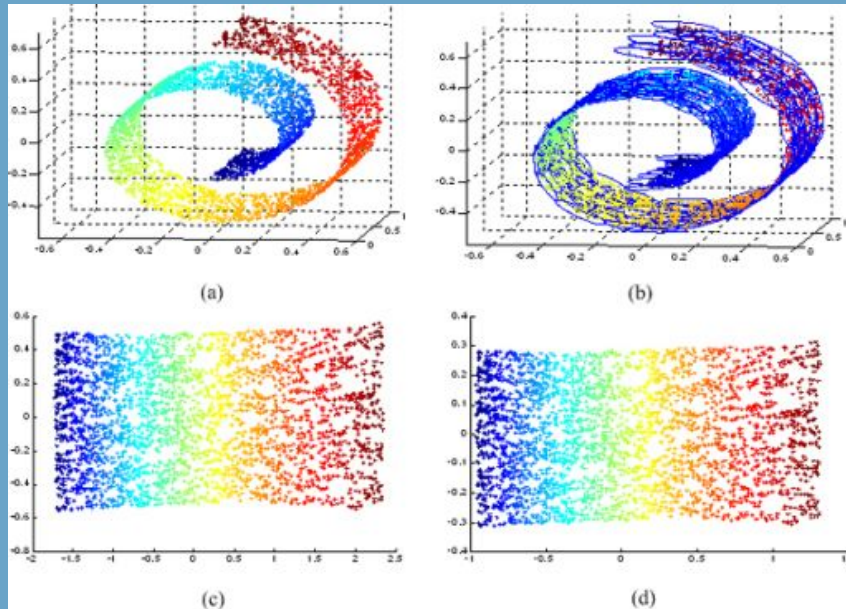
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# The *Better* Solutions:



$$Stress(x_1, x_2, \cdots, x_N) = \sum_{j=1}^{N-1} \sum_{i=1}^{N-1} (||x_i - x_j||_2 - d_{ij})^2$$

# The *Better* Solutions:



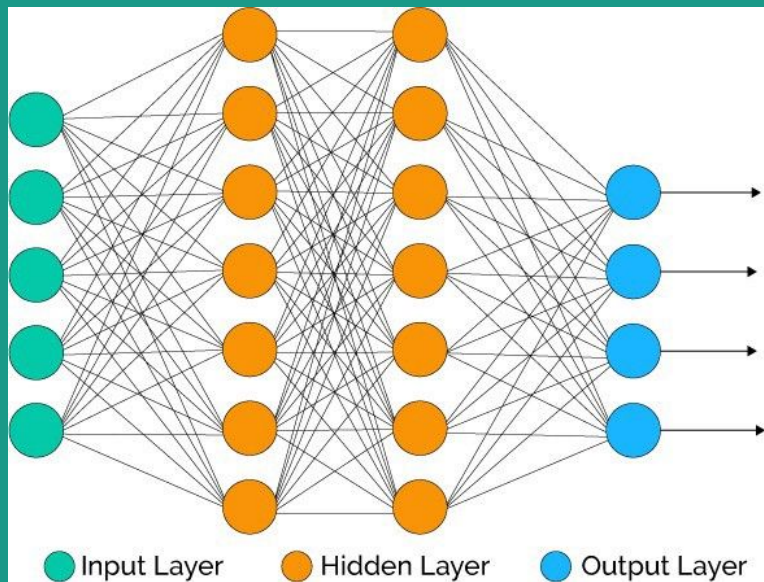


$$Stress(x_1, x_2, \cdots, x_N) = \sum_{j=1}^{N-1} \sum_{i=1}^{N-1} (||x_i - x_j||_2 - d_{ij}^G)^2$$

$$\varepsilon(W) = \sum_{i=1}^N ||x_i - \sum_{j=1}^k W_{ij} x_j||^2$$

$$\phi(y) = \sum_{i=1}^N ||y_i - \sum_{j=1}^N W_{ij} y_j||^2$$

# Why It Matters:



[illegible]