

# Dimensionality reduction

## Types of statistical analysis

### Univariate

- One variable

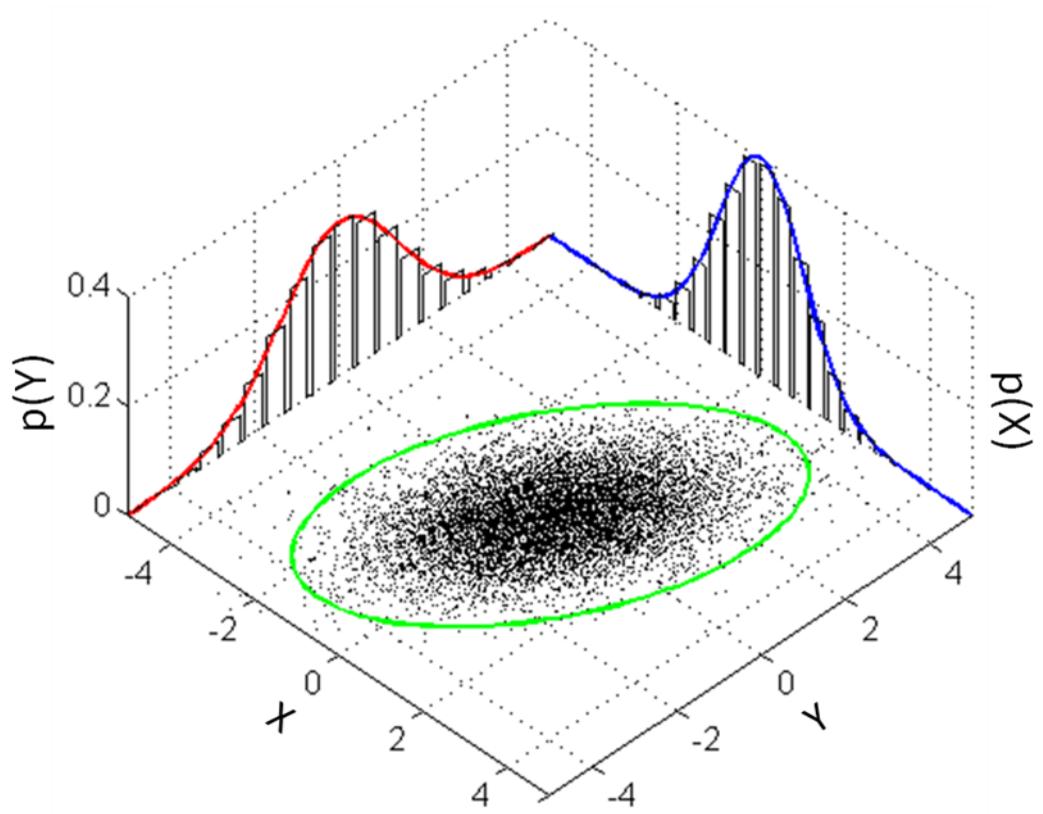
### Bivariate

- Two variables ( $x$  and  $y$ )

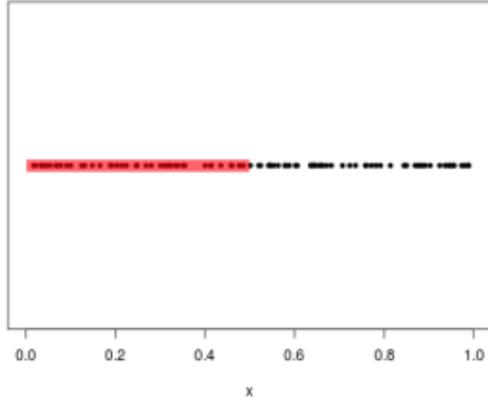
### Multivariate

also **multidimensional**

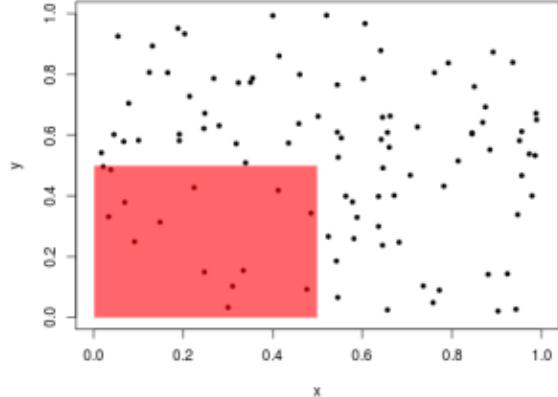
- Many variables



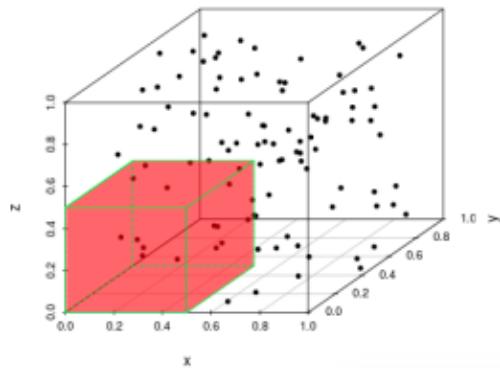
1-D: 42% of data captured.



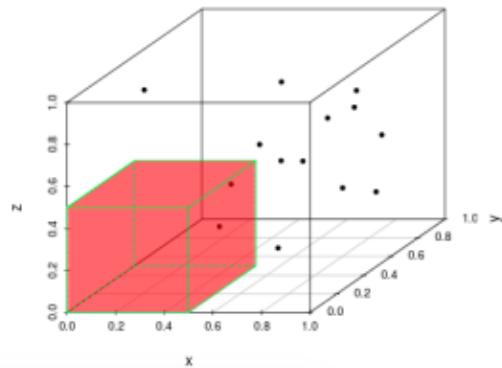
2-D: 14% of data captured.



3-D: 7% of data captured.



4-D: 3% of data captured.



$t = 0$

## The curse of higher dimensions

- Computational ineffectivity.
- Low data density in higher dimensions.
- Problematic visualization, human brain does not easily cope with more than 3D.
- Difficult interpretation.

→ Dimensionality reduction

## Dimensionality reduction techniques

### Principal component analysis (PCA)

- Numeric (continuous) data.

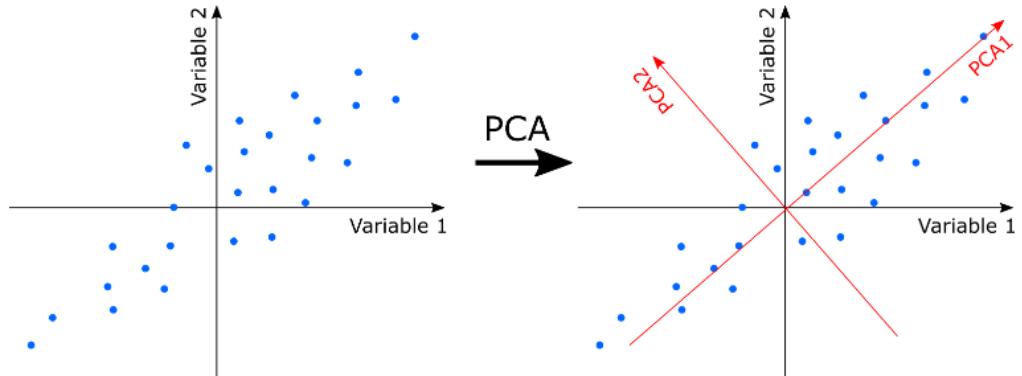
### Correspondence analysis (CA)

- Categorical data.

### Principal component analysis

The goal of PCA is to find **low-dimensional representation** of the observations that explain a good fraction of the original variation.

- First principal component is a **direction** that **maximizes the variance** of the projected data.
- Second PC is **orthogonal** to the previous one.



### Biplot