UNIT - III

Multidimensional Scaling, Huge Multidimensional Data Visualization, Multivariate Visualization by Density Estimation, Structured Sets of Graphs, Structural Adaptive Smoothing by Propagation– Separation Methods, Smoothing Techniques for Visualization.

UNIT — DATA VISUALIZATION NOTES

---

1. Multidimensional Scaling (MDS)

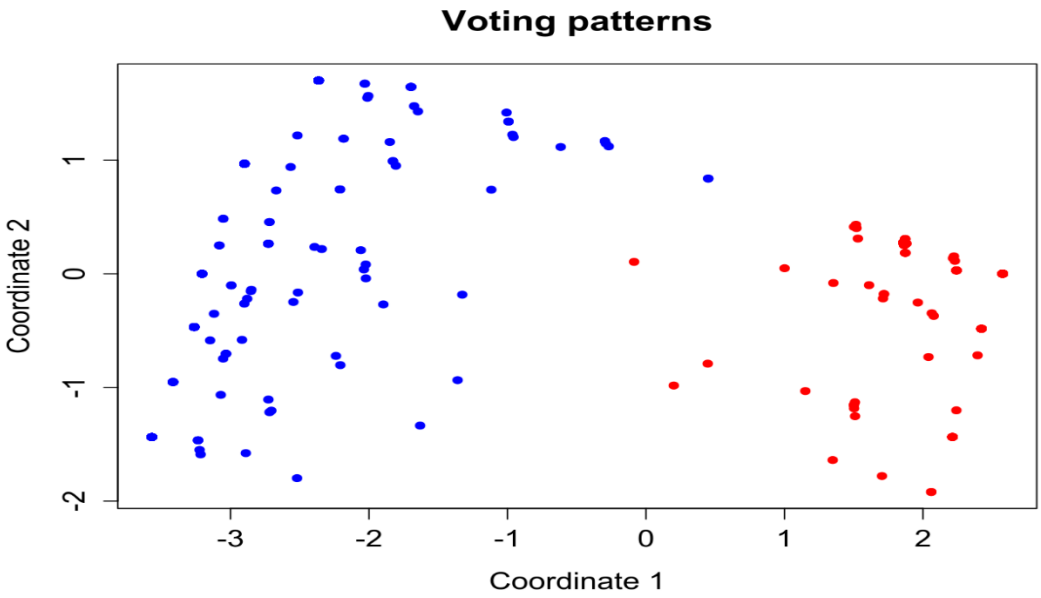
Multidimensional Scaling (MDS) is a technique used to visualize similarity or distance between data points in lower dimensions (2D or 3D).

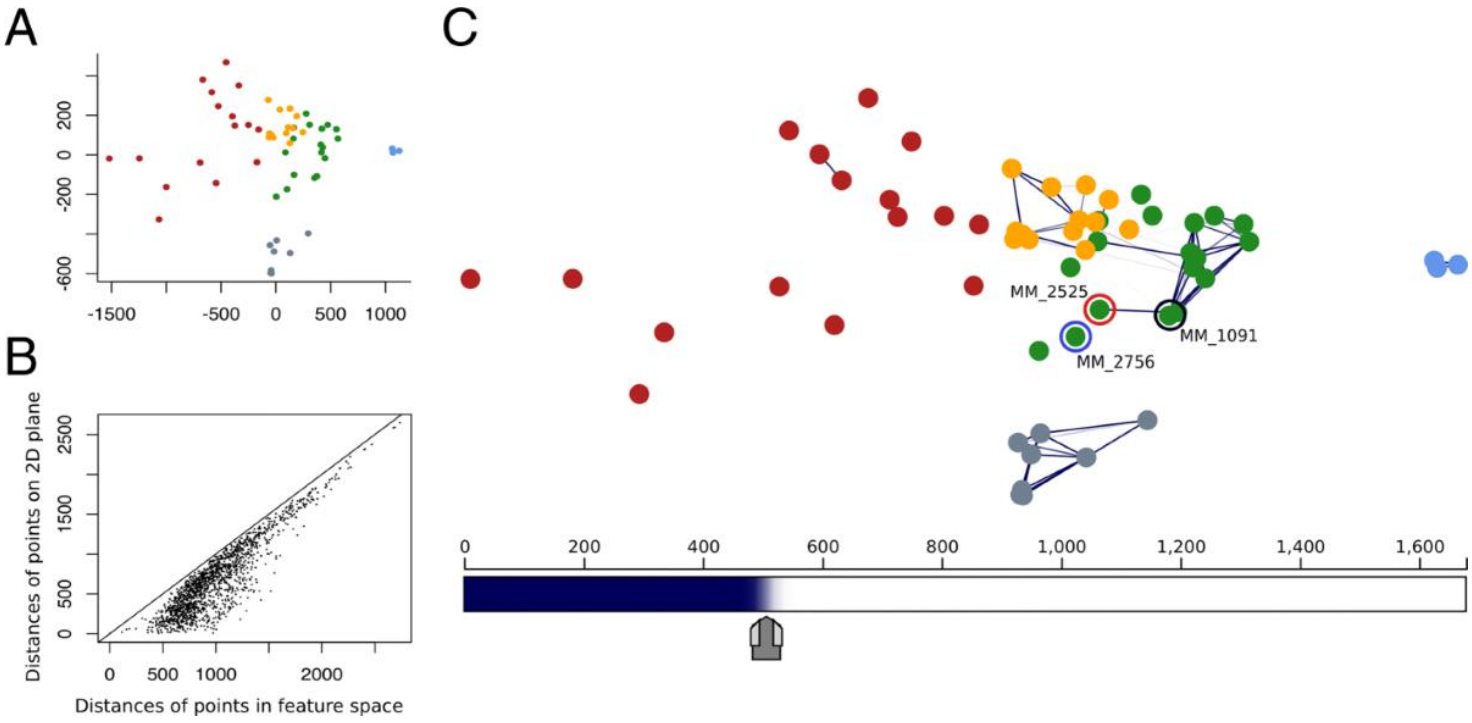
It converts high-dimensional data into a 2D map while preserving distances between points.

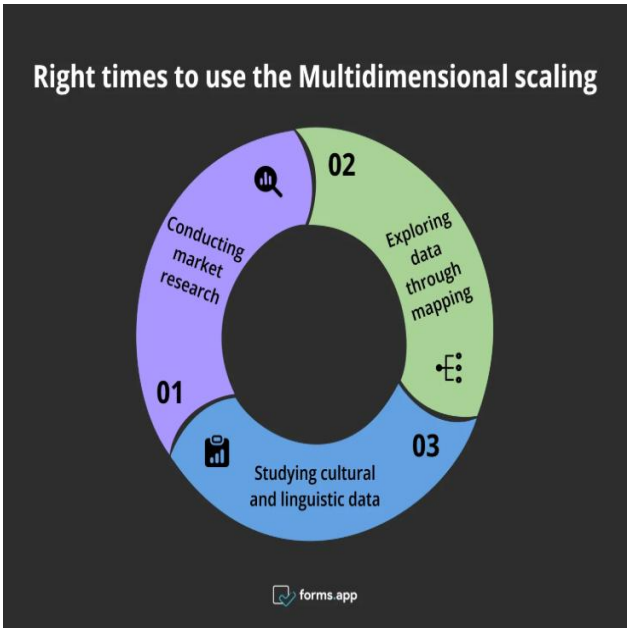
Uses:

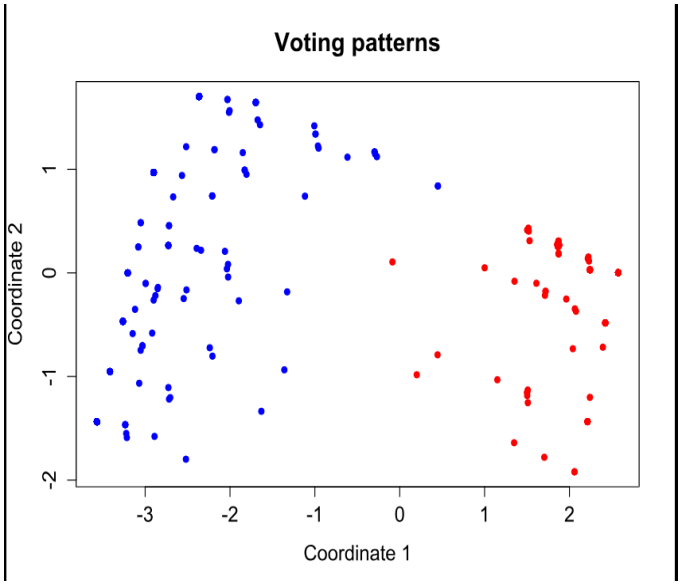
- **Pattern recognition**
- **Clustering analysis**
- **Market research**
- **Machine learning visualization**

Example:
Students with similar marks appear closer together on a plot.


Voting patterns
Coordinate 2
Coordinate 1
-3
-2
-1
0
1
2
-2
-1
0
1


A
B
C
-1500
-500
0
500
1000
200
0
-200
-600
Distances of points on 2D plane
Distances of points in feature space
0
500
1000
2000
2500
1500
MM_2525
MM_1091
MM_2756
0
200
400
600
800
1,000
1,200
1,400
1,600





---

2. Huge Multidimensional Data Visualization

Huge multidimensional data visualization deals with very large datasets containing many variables.

Since large data is difficult to visualize directly, special methods are used.

Techniques:

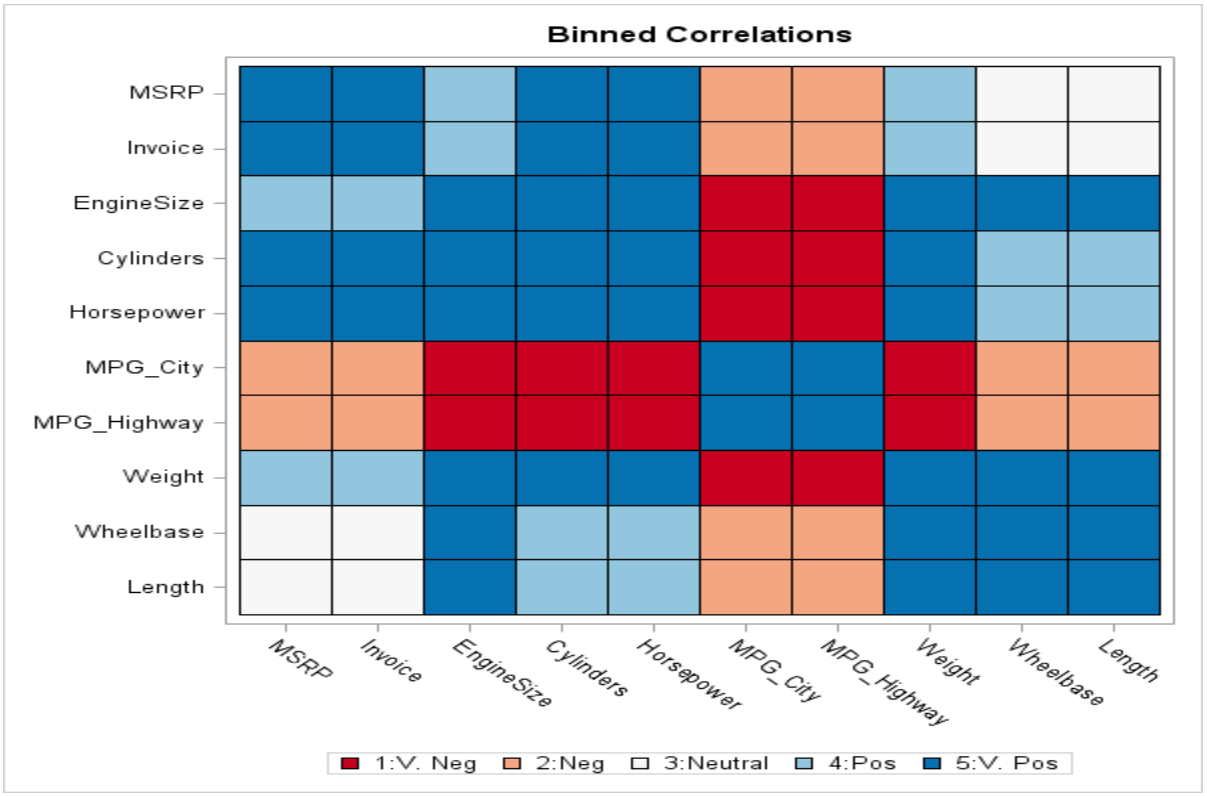
- **Data sampling**
- **Clustering**
- **Dimensionality reduction**
- **Heat maps**

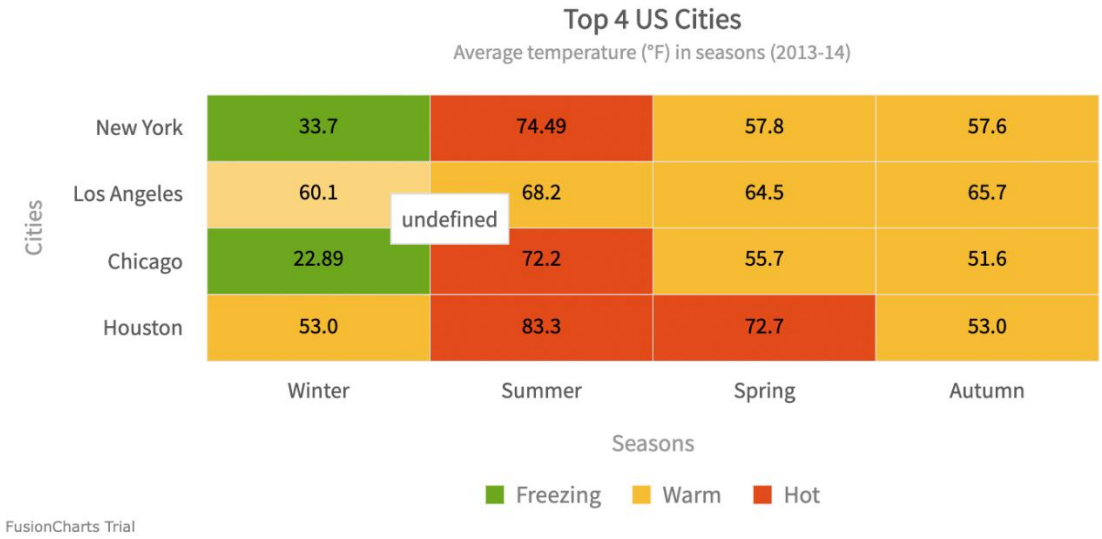
Applications:

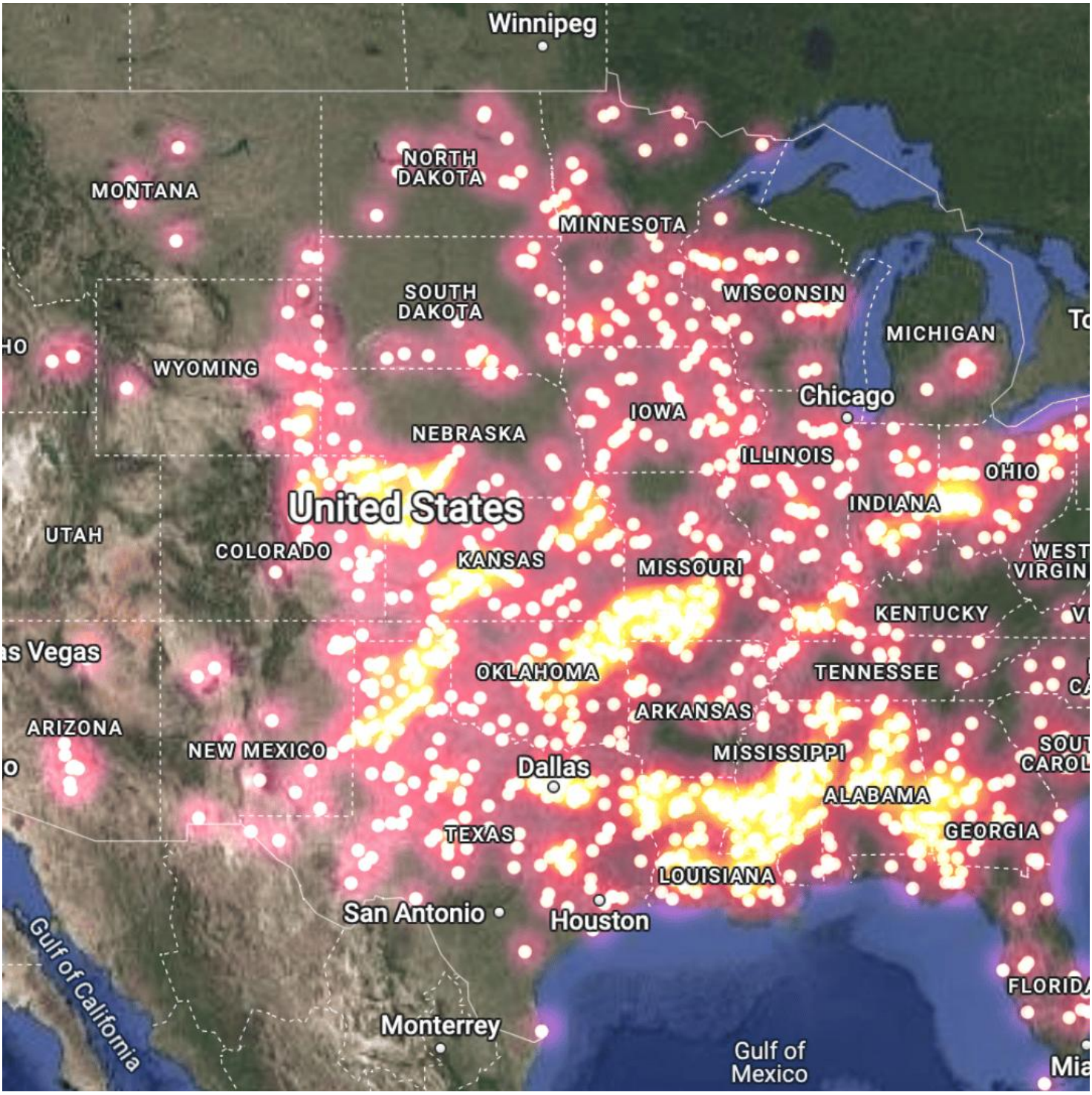
- **Big data analytics**
- **Scientific research**
- **Business intelligence**

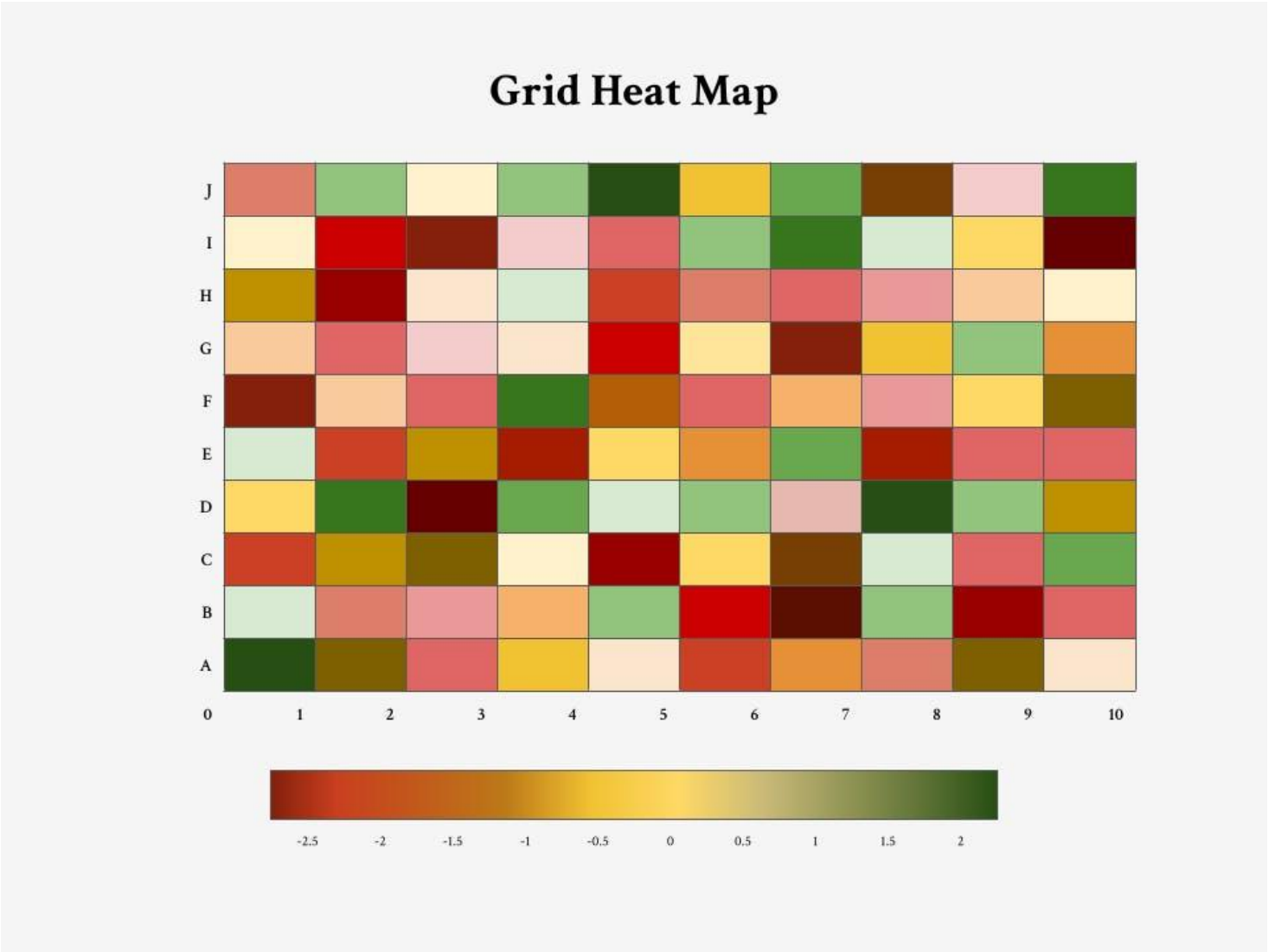
Example:

Visualizing millions of customer records using a heat map.






Winnipeg
MONTANA
NORTH DAKOTA
MINNESOTA
SOUTH DAKOTA
WISCONSIN
MICHIGAN
WYOMING
Chicago
IOWA
NEBRASKA
ILLINOIS
OHIO
United States
INDIANA
UTAH
COLORADO
KANSAS
MISSOURI
KENTUCKY
OKLAHOMA
TENNESSEE
ARKANSAS
ARIZONA
NEW MEXICO
Dallas
MISSISSIPPI
ALABAMA
TEXAS
GEORGIA
LOUISIANA
San Antonio
Houston
Gulf of California
Monterrey
Gulf of Mexico



---

3. Multivariate Visualization by Density Estimation

Density estimation visualization shows how data points are distributed in space.

It helps identify clusters, patterns, and concentration areas.

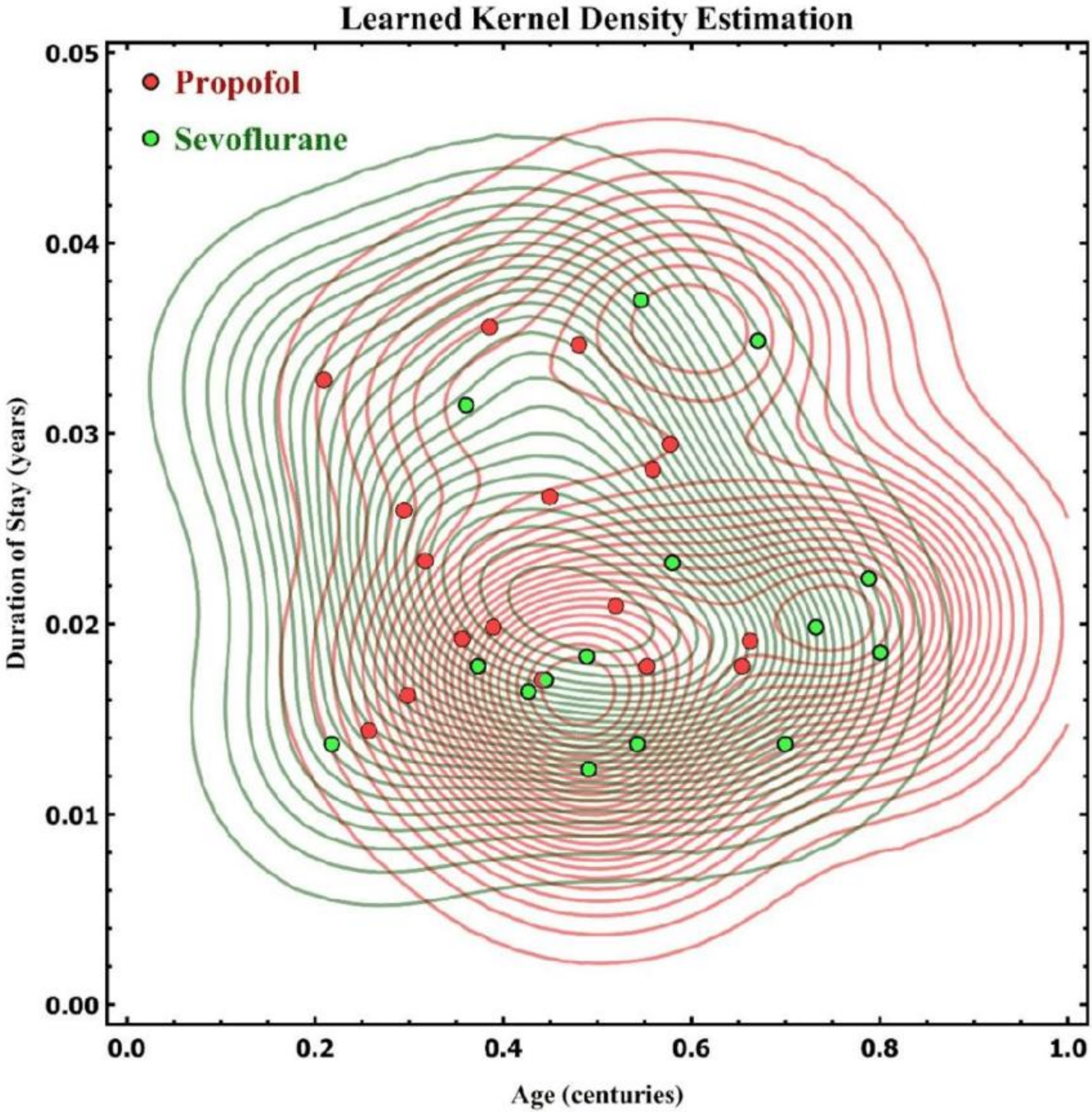
Common methods:

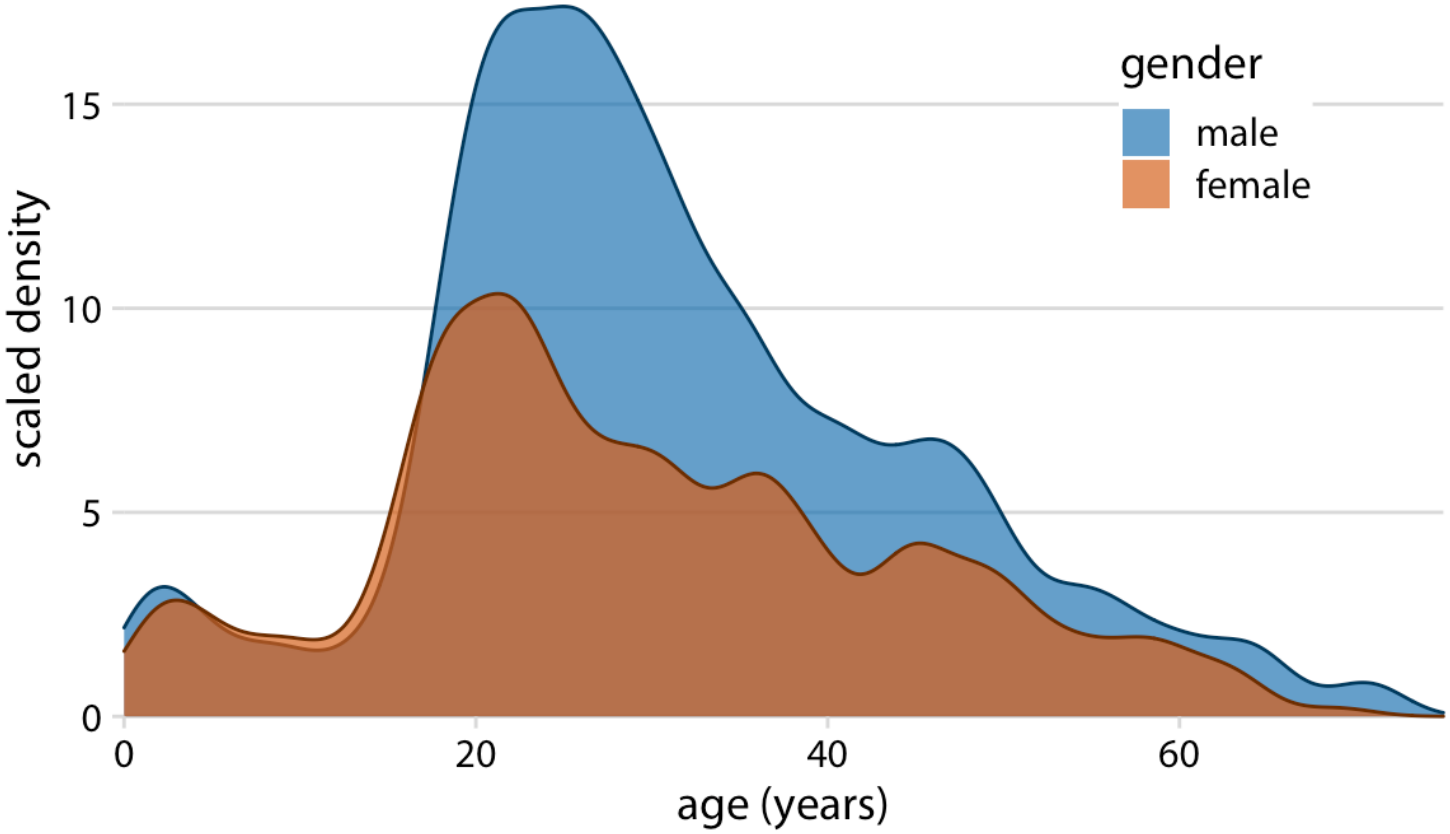
- **Kernel Density Estimation (KDE)**
- **Contour plots**
- **Density maps**

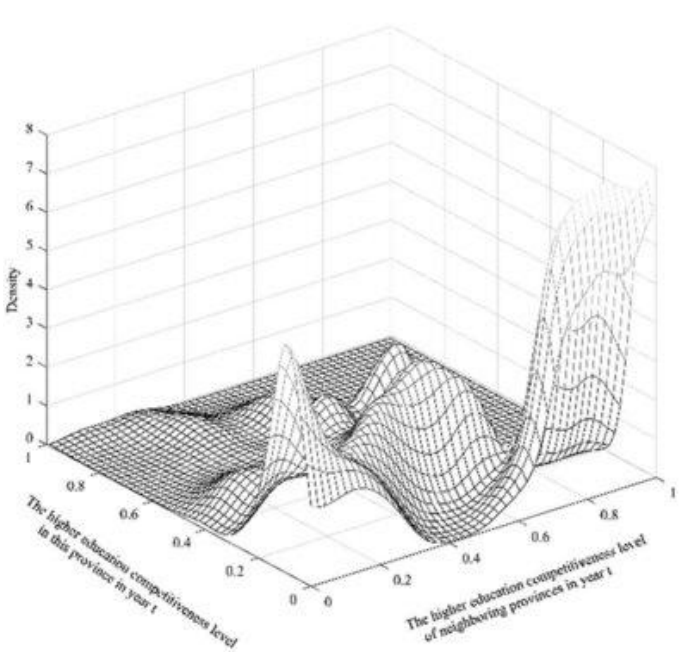
Example:

Population distribution in a city shown using a density map.

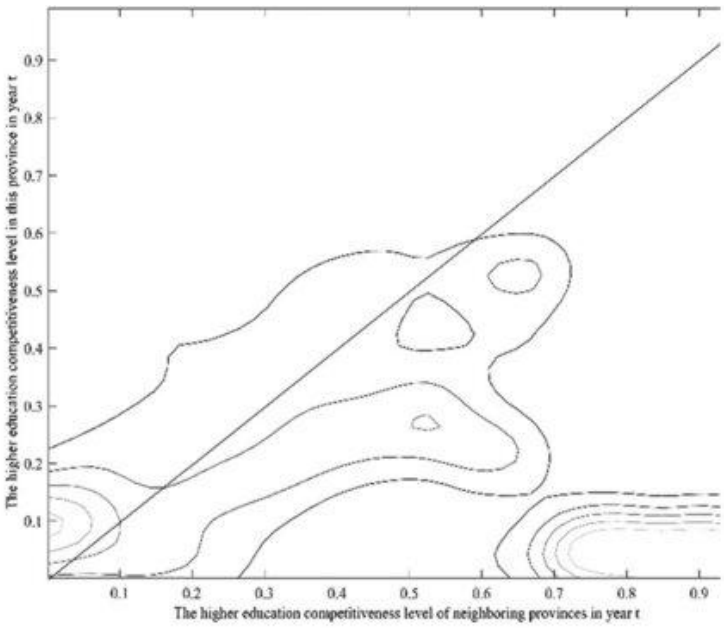
Diagram to draw




gender
male
female
scaled density
15
10
5
0
0
20
40
60
age (years)


Density
The higher education competitiveness level in this province in year t
The higher education competitiveness level of neighboring provinces in year t

(a)


The higher education competitiveness level in this province in year t
The higher education competitiveness level of neighboring provinces in year t

(b)

4. Structured Sets of Graphs

Structured sets of graphs mean multiple graphs organized together to represent related data.

They help compare information across datasets.

Examples:

- **Dashboard charts**
- **Small multiple graphs**
- **Panel plots**

Advantages:

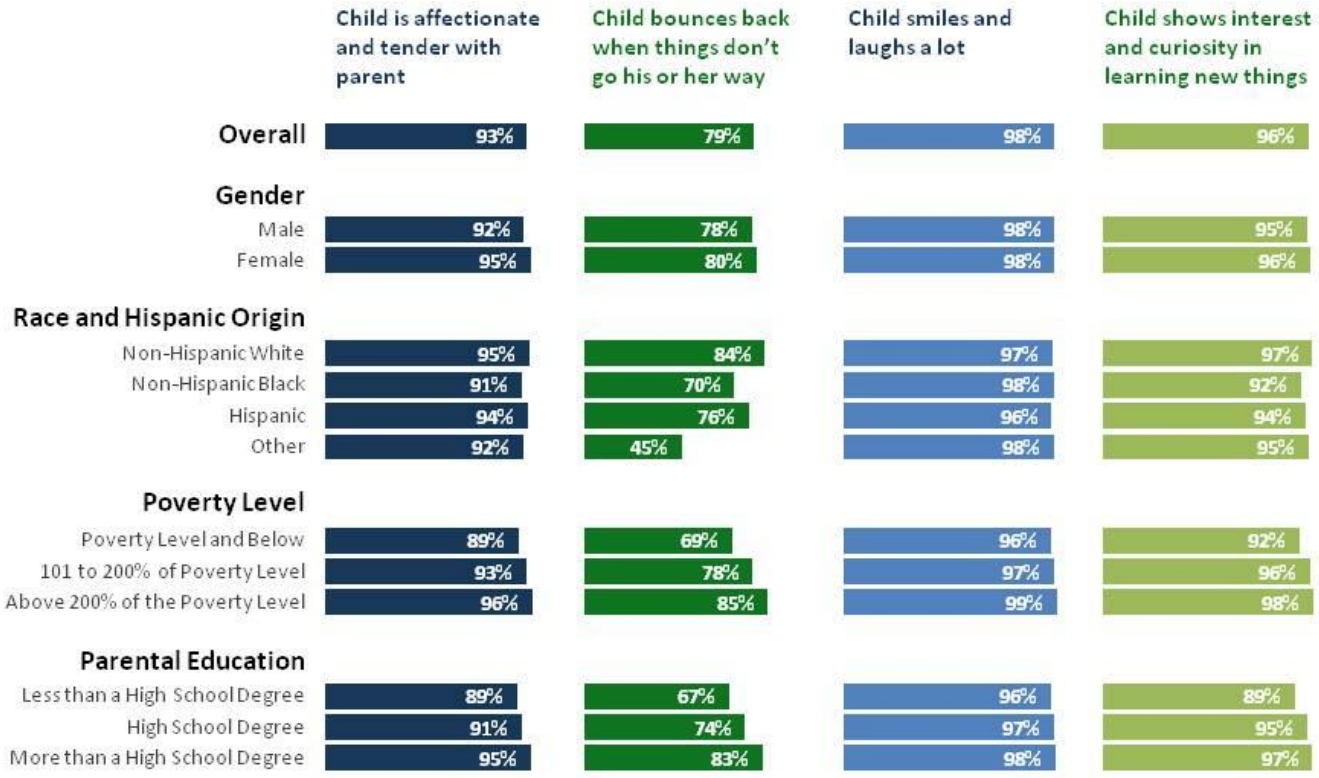
- **Easy comparison**
- **Organized visualization**
- **Better analysis**

Example:
Monthly sales shown in multiple small bar charts.

Diagram to draw

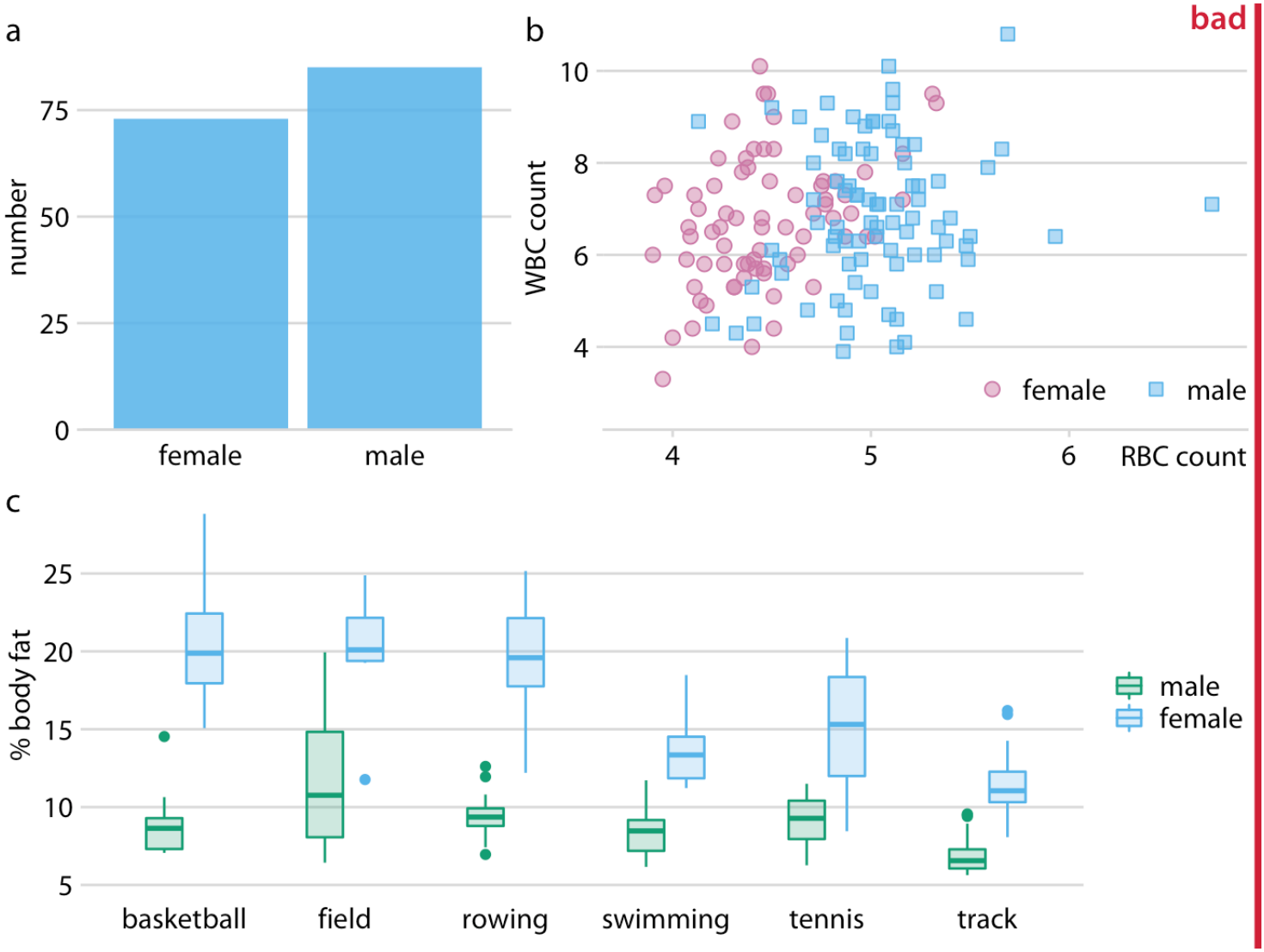
Measures of Flourishing

Percentage of children, ages six months through five years, whose parents indicated they "usually" or "always" showed selected "flourishing" behaviors

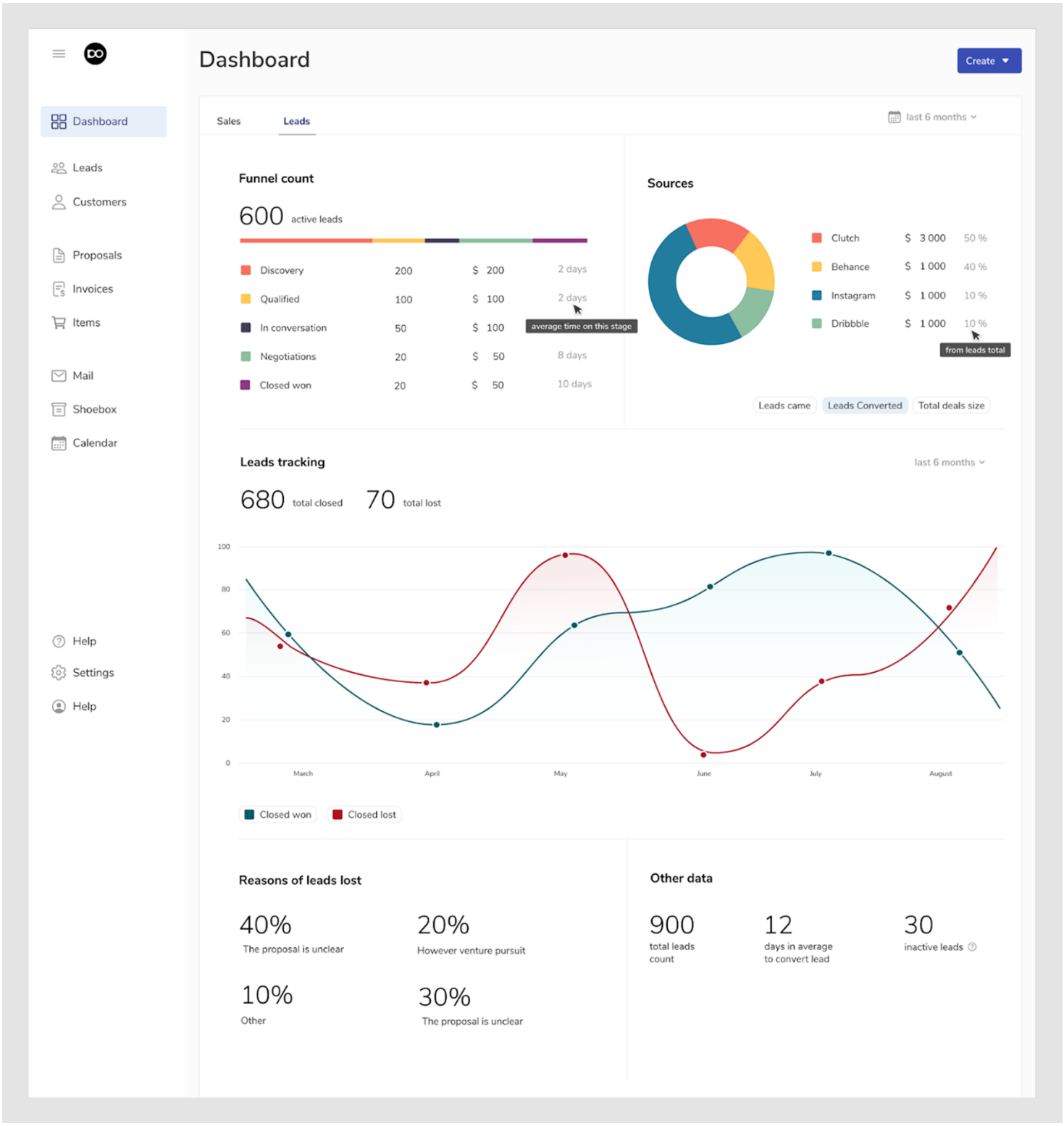


Data source: http://www.childtrends.org/wp-content/uploads/2013/07/125_Flourishing_Measures.pdf

Visualization by Ann K. Emery


a
number
75
50
25
0
female
male
b
WBC count
10
8
6
4
4
5
6
RBC count
female
male
bad
c
% body fat
25
20
15
10
5
basketball
field
rowing
swimming
tennis
track
male
female


AMBASSADORS GROUP
PURCHASE, INVENTORY & SALES EXECUTIVE SUMMARY
Customer Metrics
Sales & Quantity (Tons) Metrics
$5.31M
Sales
$4.09K
Avg Sales
Purchases| Customers | Qty (Tons) Metrics
Inv Tons | Order Timeline Metrics
Quantity Received
58.29K
Tons
Received Order
35.98
Avg Days
Customer Bill
16.09
Avg Days
PO Issuing
49.12
Avg Days
Top 5 Purchased Material (Tons) by Month
Weekly Average Qty (Tons) | Above Average



5. Structural Adaptive Smoothing by Propagation–Separation Methods

This method is used to smooth noisy data while preserving important structures.

It works by:

- **Propagating information across nearby data points**
- **Separating regions with different patterns**

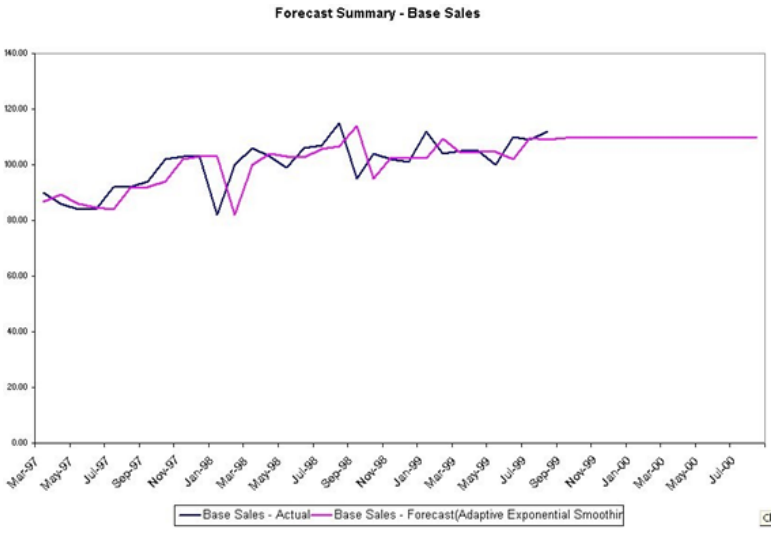
Purpose:

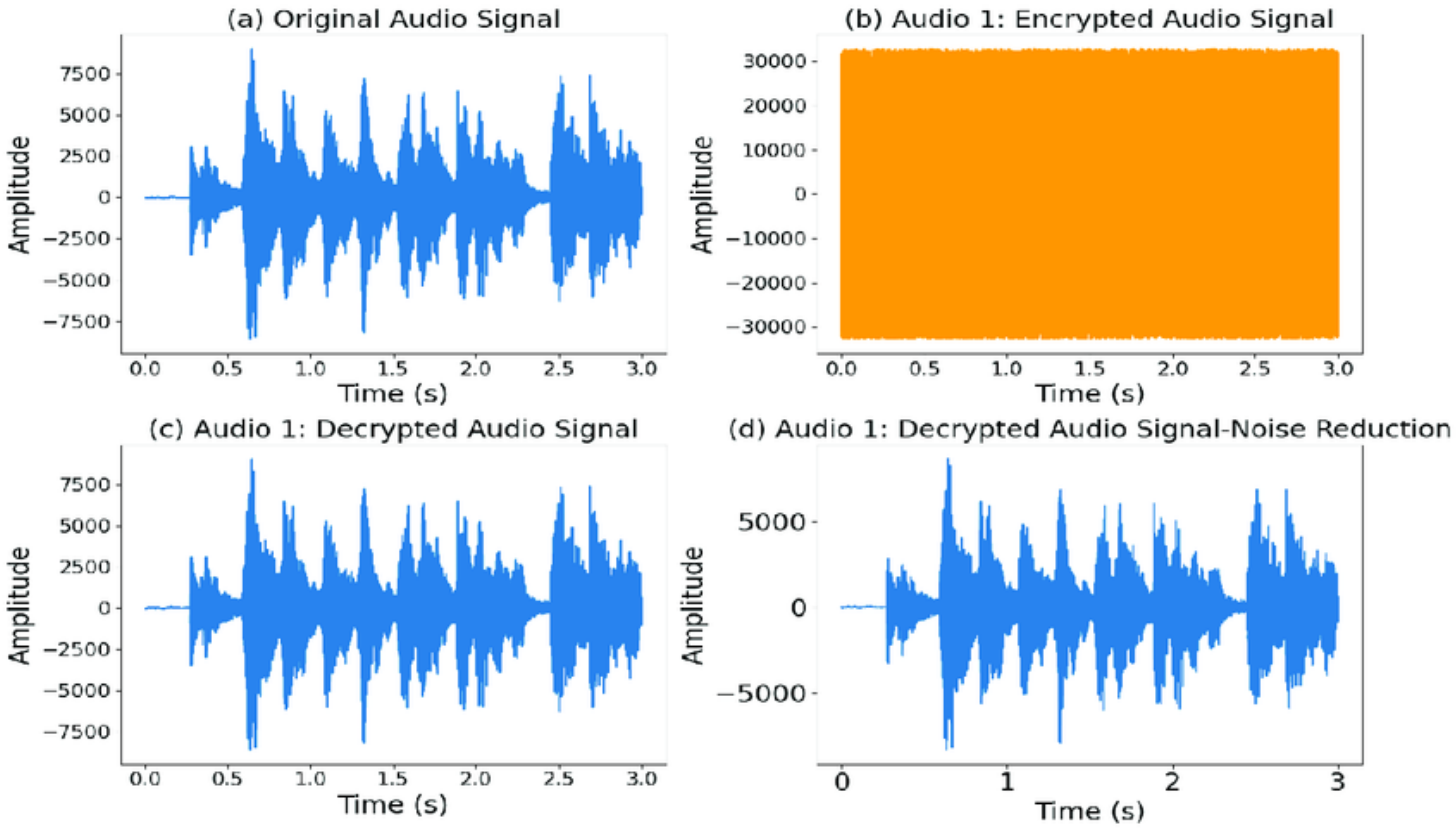
- **Reduce noise**
- **Maintain data boundaries**
- **Improve visualization clarity**

Applications:

- **Image processing**
- **Medical imaging**
- **Scientific data analysis**

Example:
Smoothing noisy image data without losing edges.





---

6. Smoothing Techniques for Visualization

Smoothing techniques remove noise and irregular variations from data to show trends clearly.

Common smoothing methods:

- **Moving average**
- **Regression smoothing**
- **Gaussian smoothing**
- **Kernel smoothing**

Advantages:

- **Shows trends clearly**
- **Reduces noise**
- **Improves readability**

Example:

Stock price data smoothed using a moving average line.

Diagram to draw