

Pixel-Based Analysis of Information Dashboard Attributes

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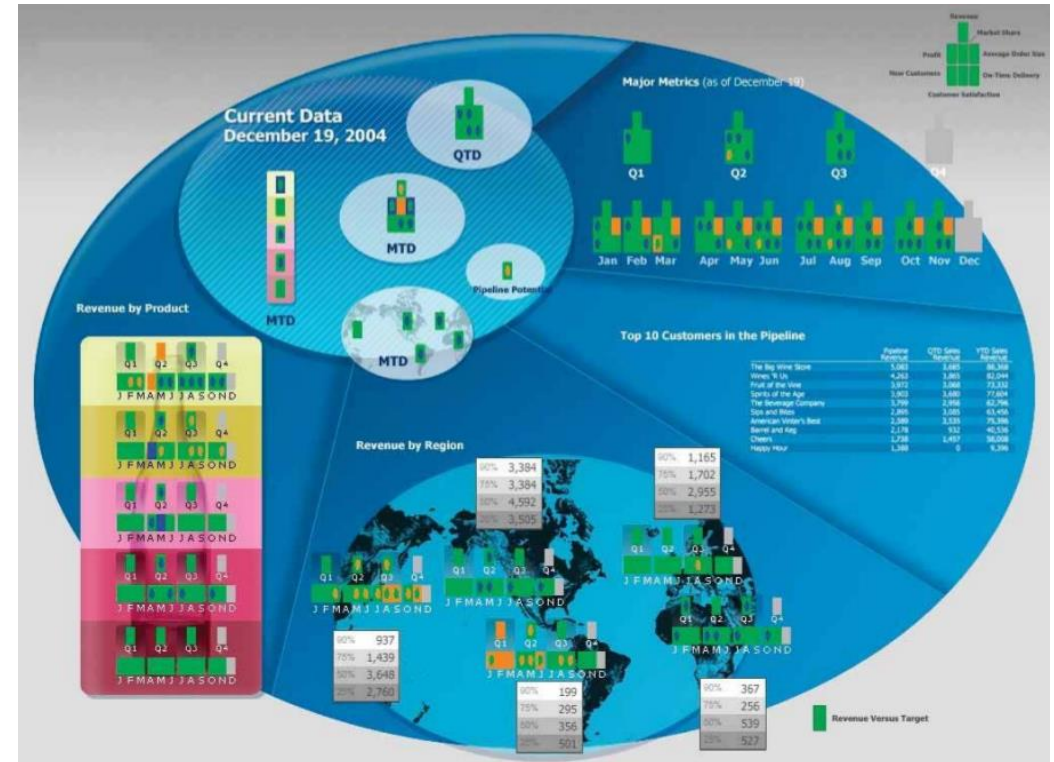
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ADBIS 2016, Prague



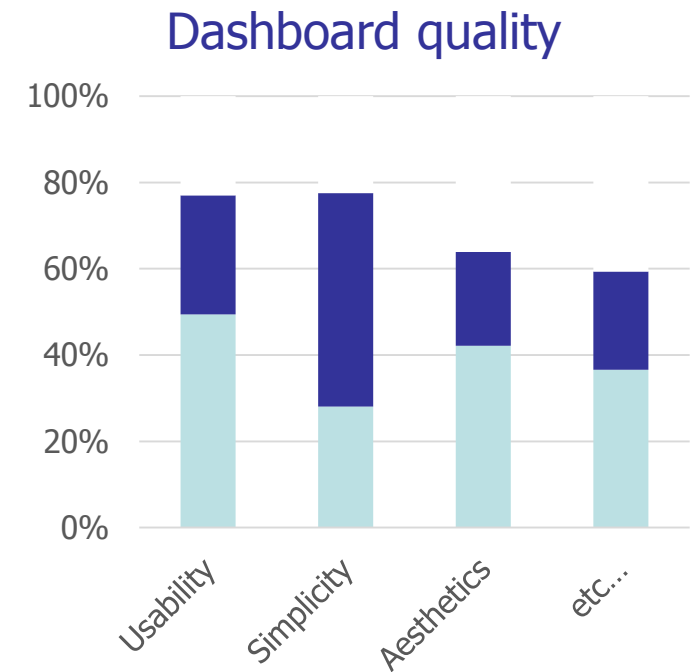
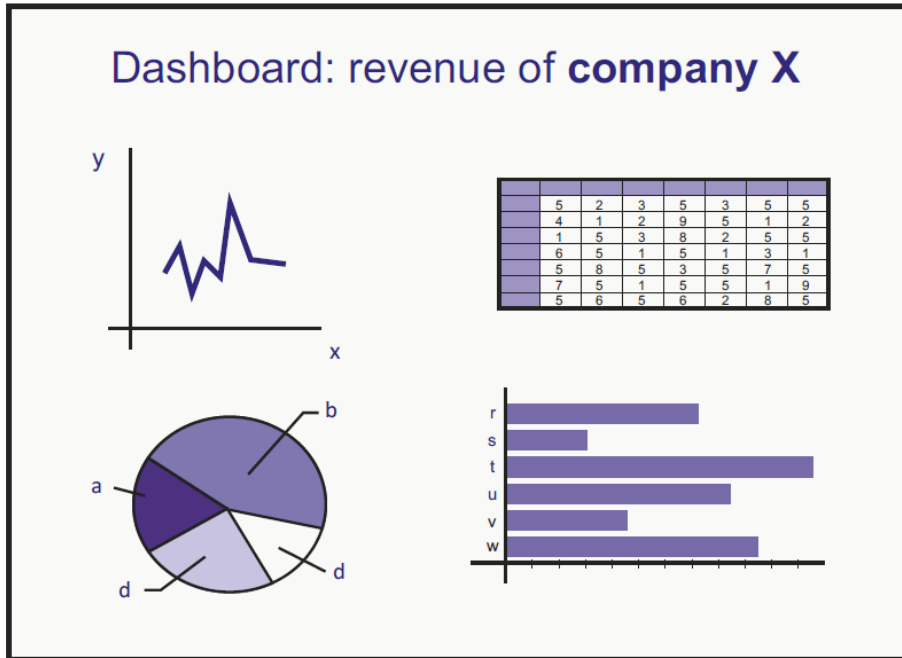
29.08.2016

- a visual display of the most important information
- arranged comprehensively on a single screen .



Examples of 2 sales dashboards: **Stephen Few** – Information Dashboard Design

- *How good is a dashboard?*
 - *(aesthetics, usability, simplicity, ...)*

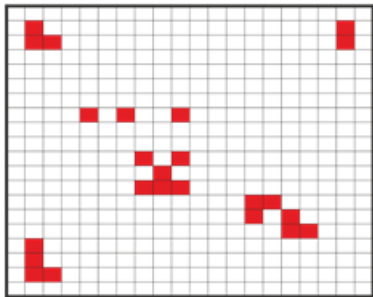


1. Dashboard

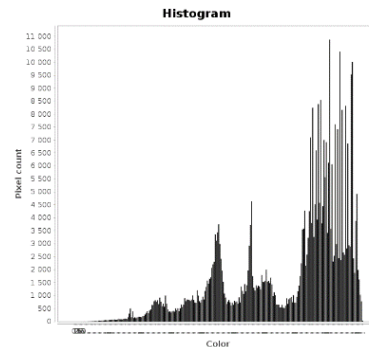
2. Internal representation

3. Attributes

4. Classification



```
<html>
  <title>
</title>
  <body>
    ...
  </body>
</html>
```



```
element:
  type: CHART
  x: 10
  y: 25
  width: 100
  height: 50
```

```
colorfulness = 0.25
balance = 0.92
symmetry = 0.85
...
```

Group 1:
Well-designed

Group 2:
Poorly
designed

Group 3:
...

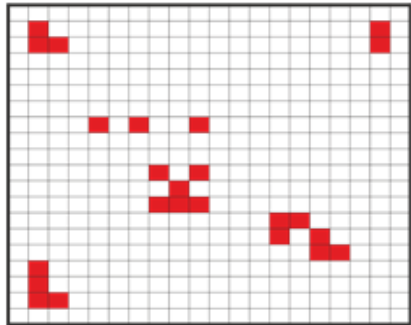
- Find suitable **pixel-based** metrics

1. Dashboard

2. IR

3. Attributes

4. Classification

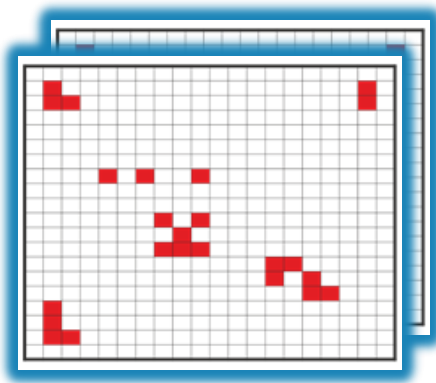


- HSB,
- CIE Lch,
- RGB
- Gray-scale
- B&W



Well-designed?
(according to SF)

1. Well-designed dashboards



Stephen Few
40 (10 × 4)



measuring



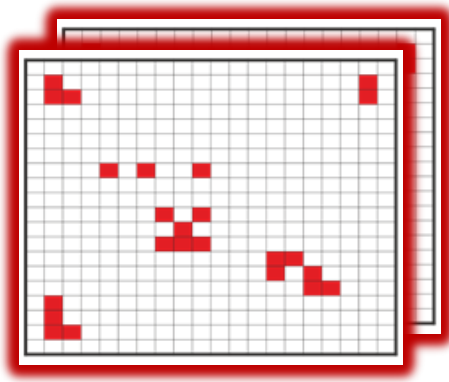
mean μ_1
stdev σ_1



comparison

...for each metric

2. Randomly picked dashboards



Google images
120



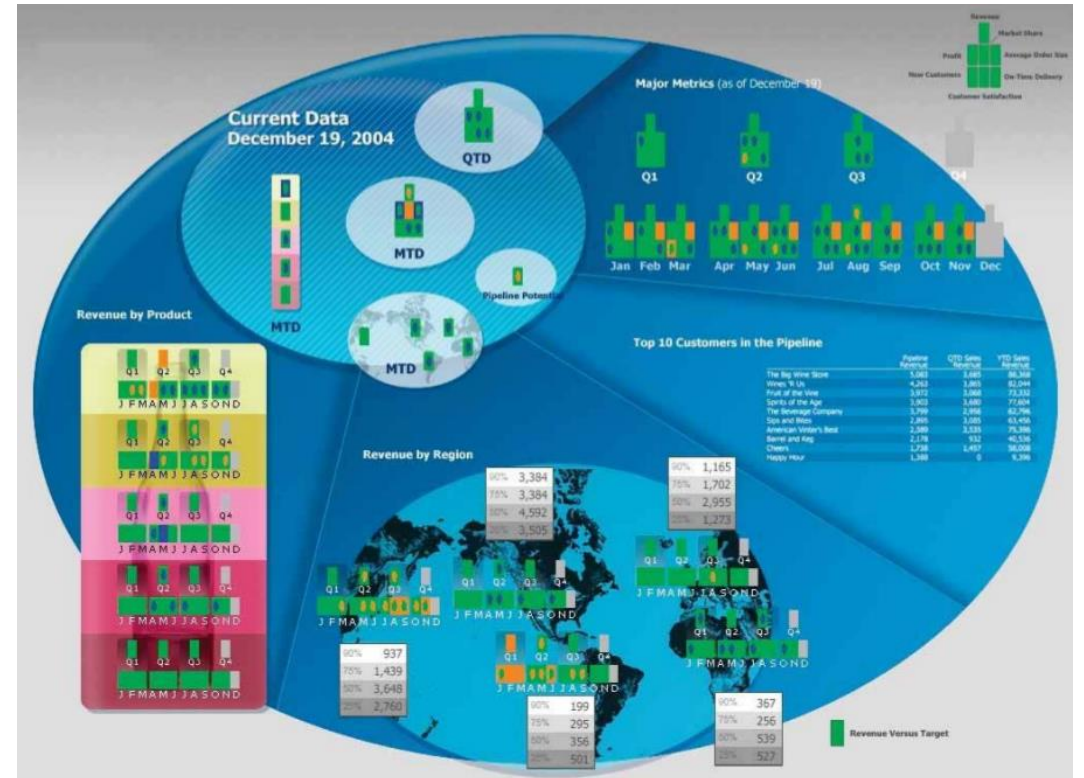
measuring



mean μ_2
stdev σ_2



- diversity and intensity of used colors



S. Few – Information Dashboard Design

- = **saturation in CIE Lab color space**
 - saturation = chroma / lightness
 - *[Yendrikhovskij, 1998], [Reinecke, 2013]*

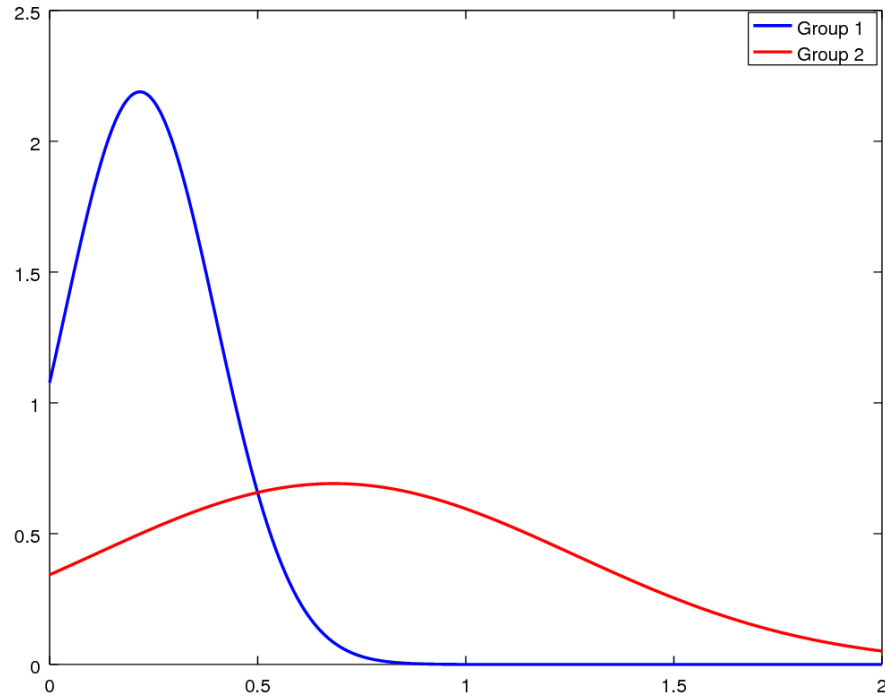
$$C_i = S_i + \sigma_i$$

$$C_i \approx 2 \quad (\text{highly colorful})$$

- We also used this equation for other color features of **HSB** and **CIE Lch** model

$$C_i = X_i + \sigma_i$$

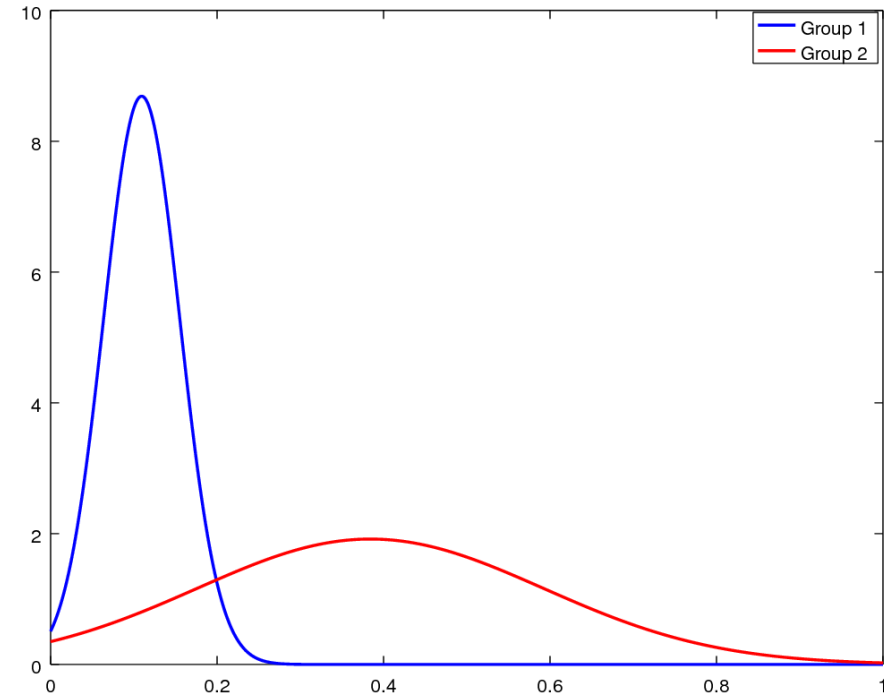
CIE saturation



$$\mu_1 = 0.217 \quad \sigma_1 = 0.182$$

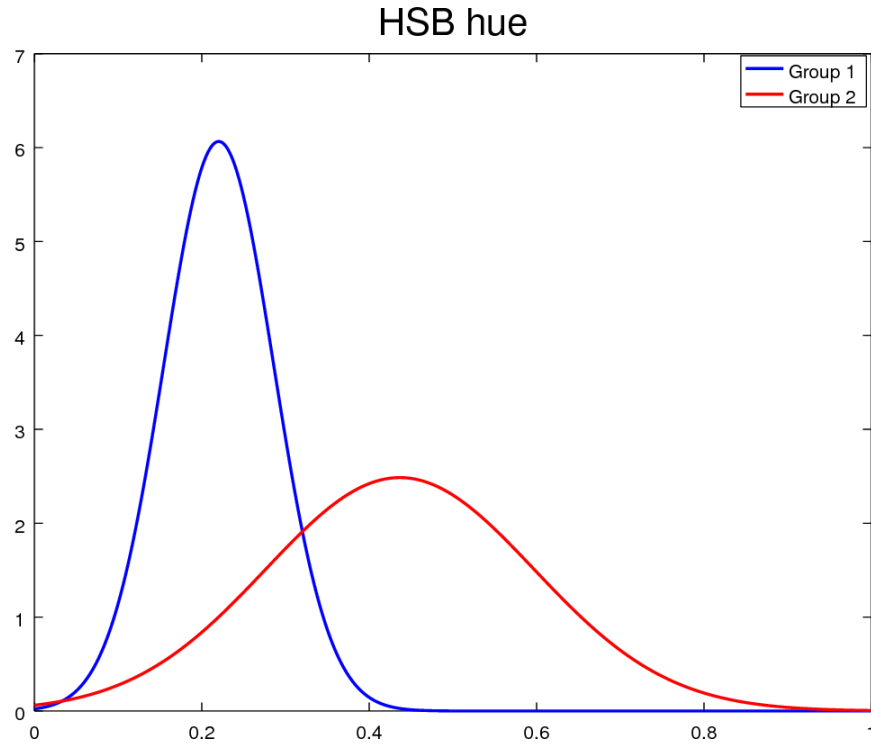
$$\mu_2 = 0.684 \quad \sigma_2 = 0.577$$

HSB saturation

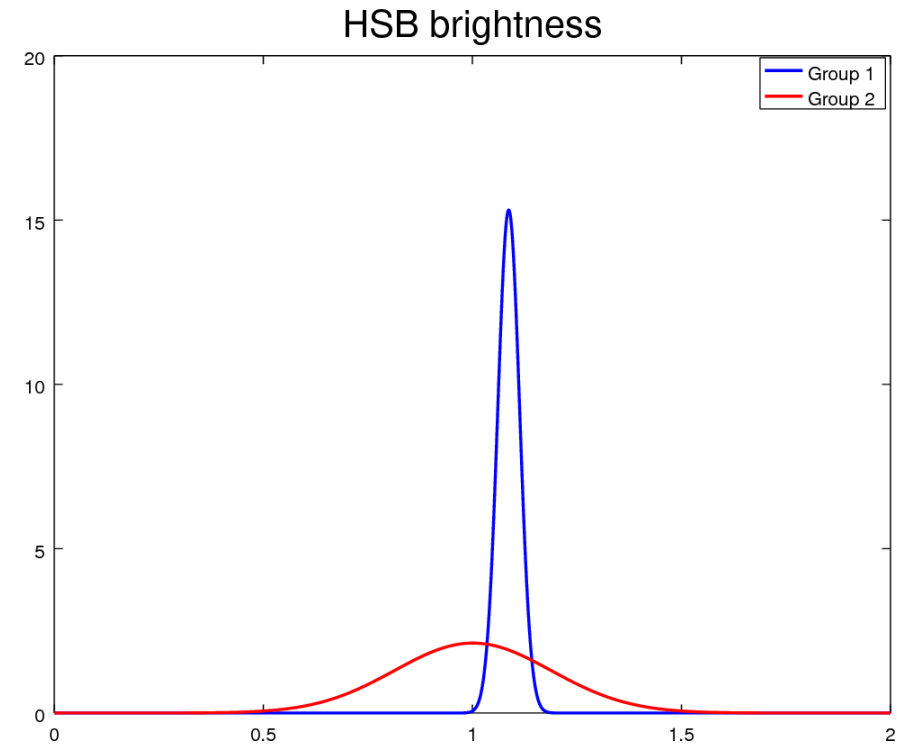


$$\mu_1 = 0.109 \quad \sigma_1 = 0.046$$

$$\mu_2 = 0.384 \quad \sigma_2 = 0.208$$

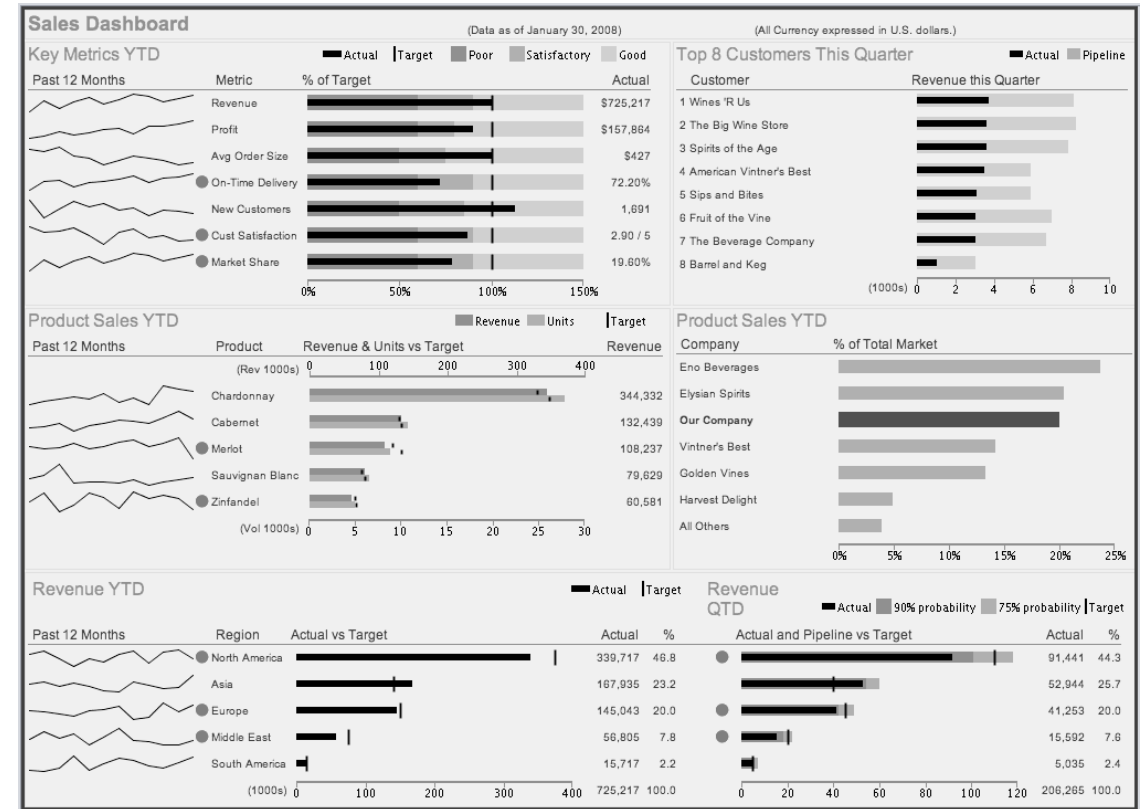
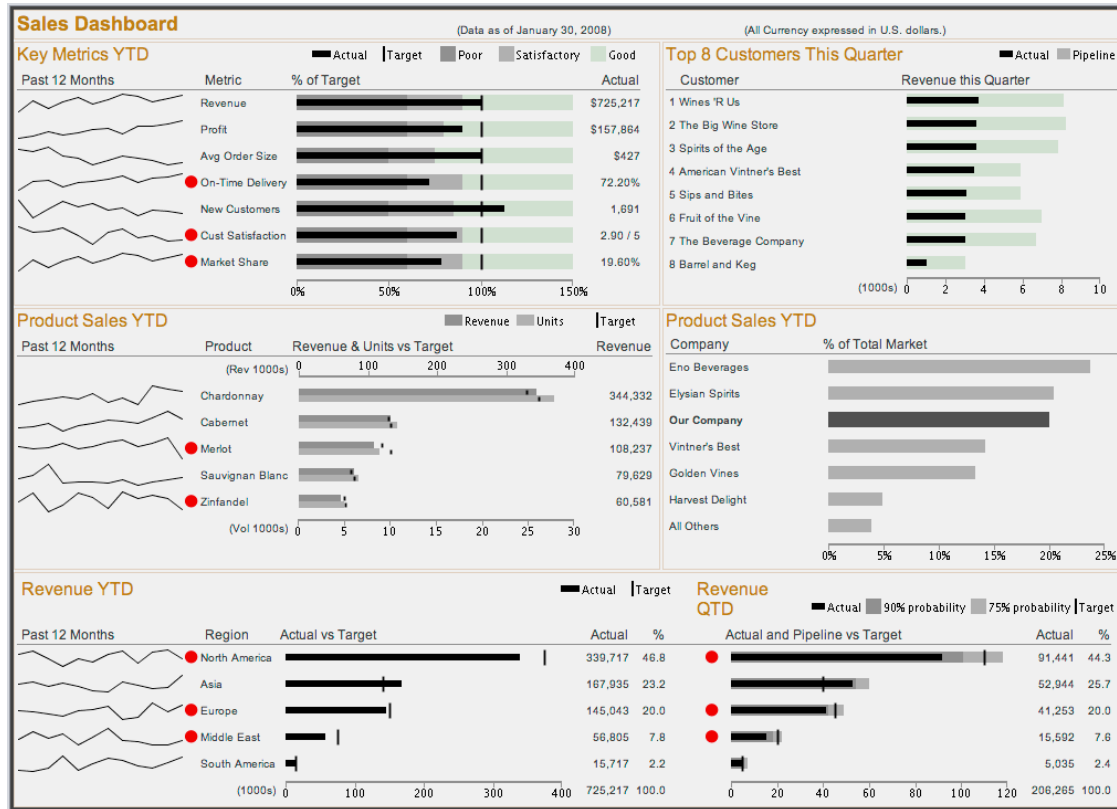


$$\mu_1 = 0.220 \quad \sigma_1 = 0.066$$
$$\mu_2 = 0.437 \quad \sigma_2 = 0.161$$



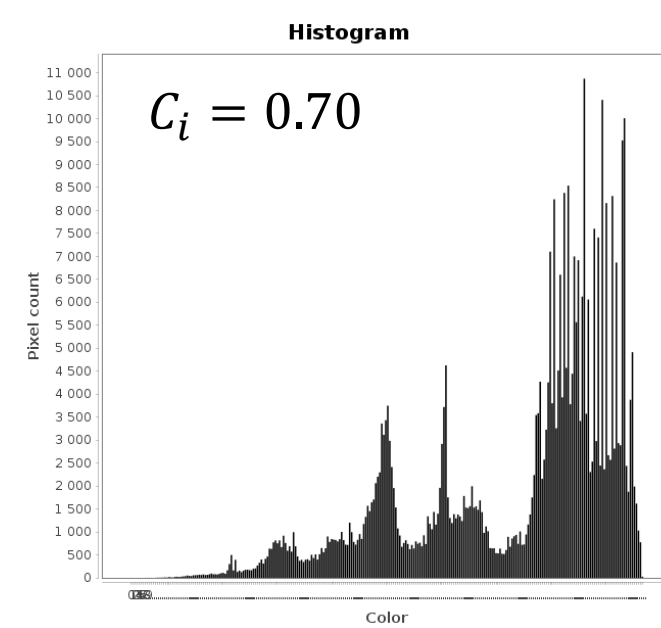
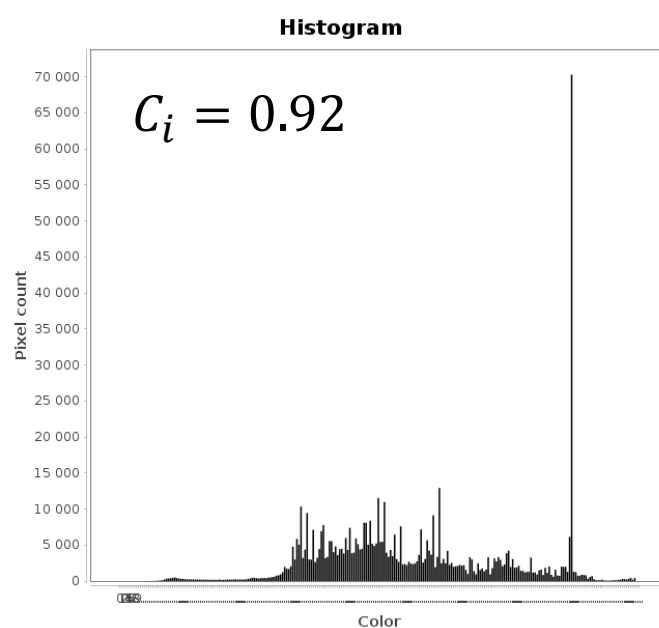
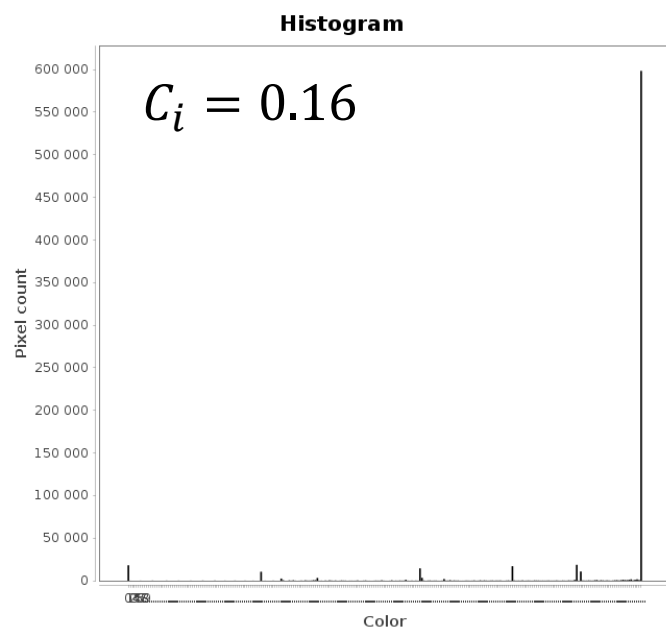
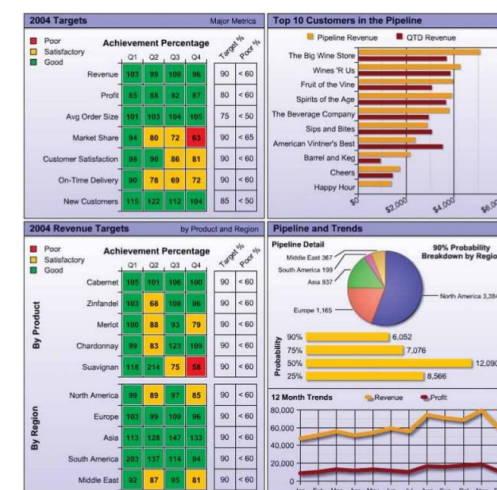
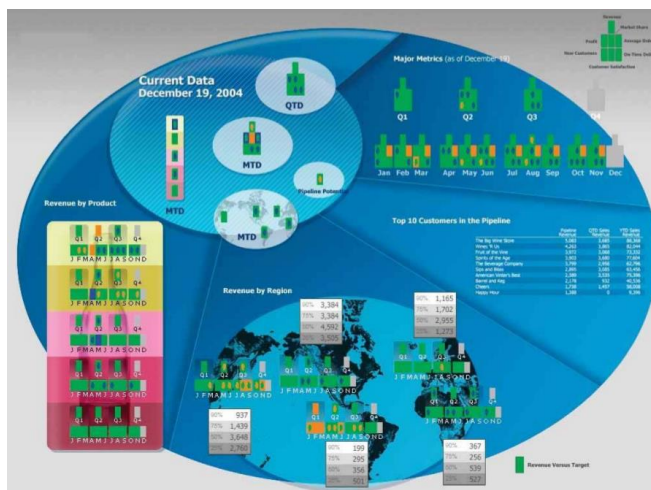
$$\mu_1 = 1.086 \quad \sigma_1 = 0.026$$
$$\mu_2 = 1.001 \quad \sigma_2 = 0.188$$

- reduction of color amount – *model conversions, posterization, thresholding*

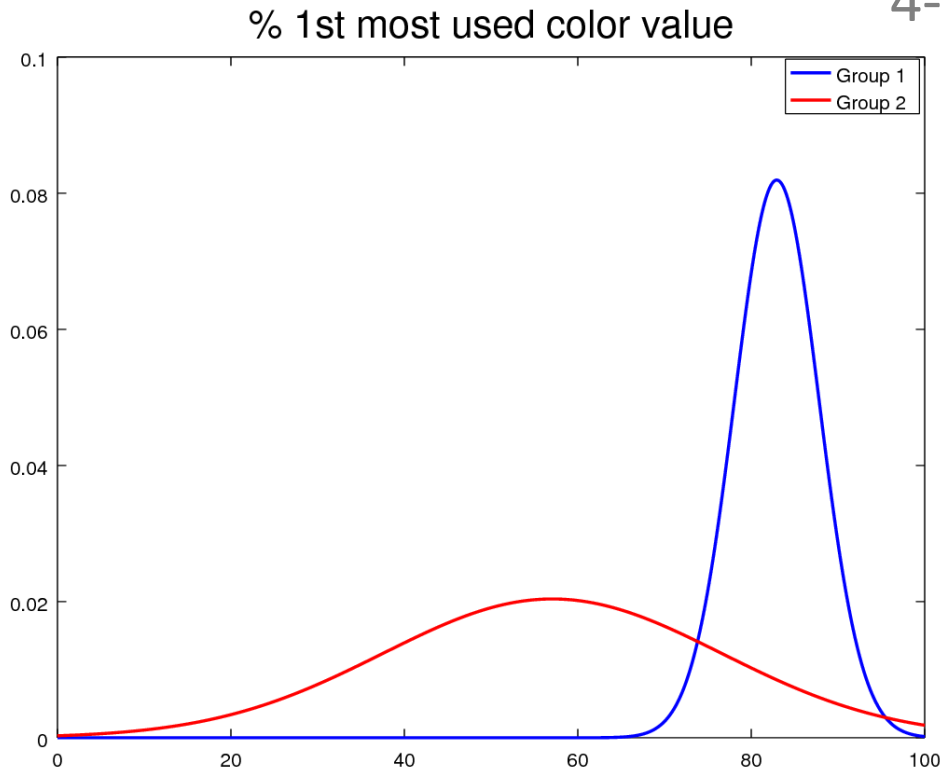


- share of background, color gradients, color diversity

Amount and share of color values: histogram analysis

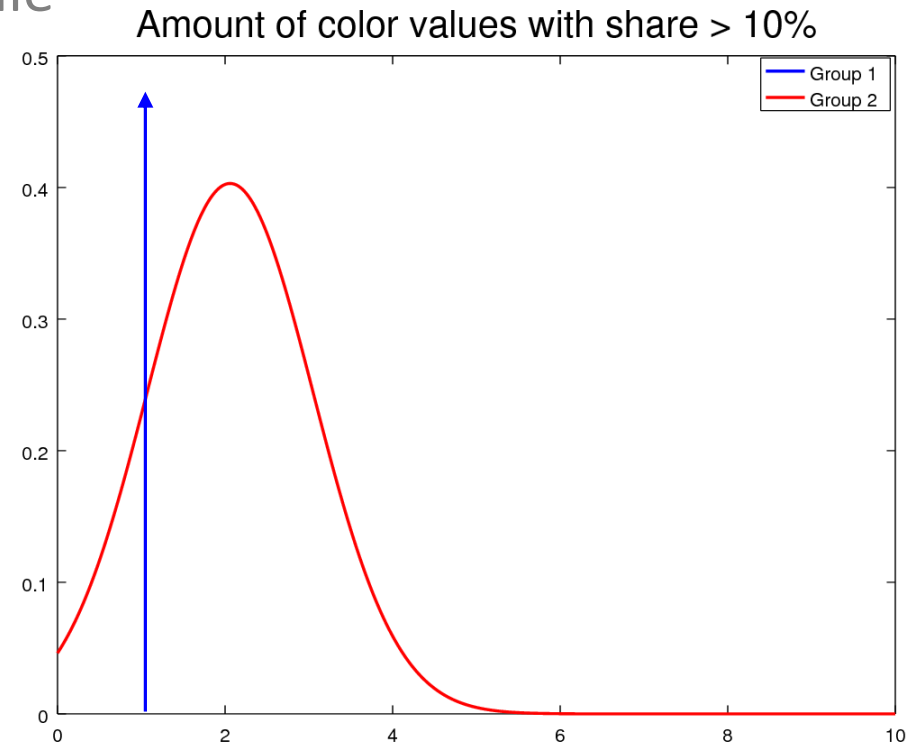


4-bit Gray-Scale



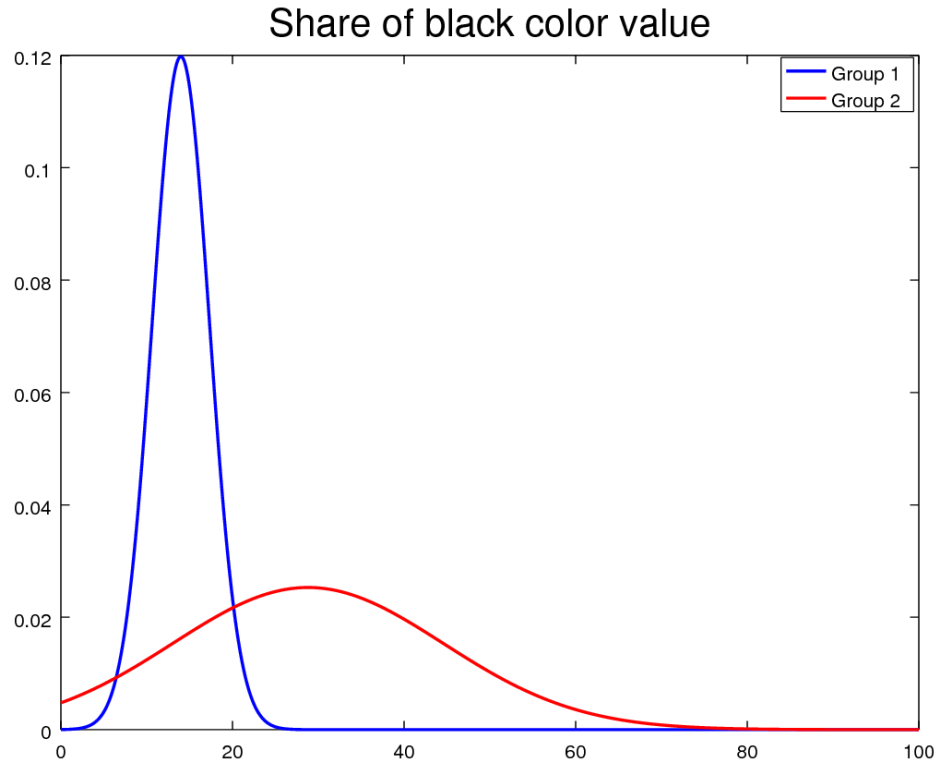
$$\mu_1 = 82.94\% \quad \sigma_1 = 4.87\%$$

$$\mu_2 = 57.06\% \quad \sigma_2 = 19.57\%$$

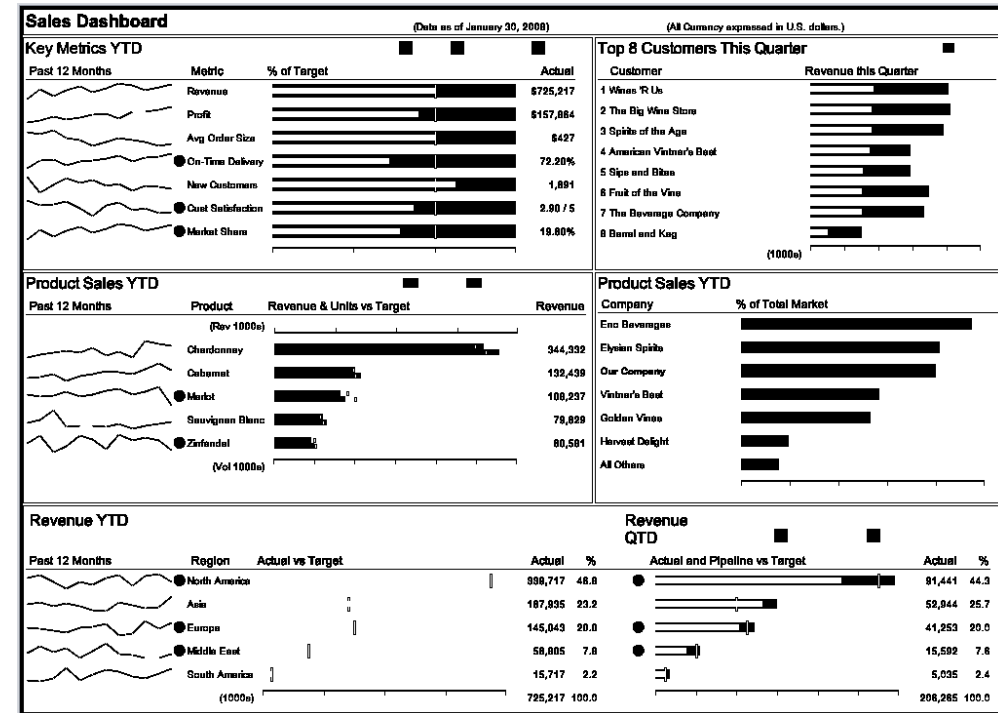


$$\mu_1 = 1.00 \quad \sigma_1 = 0.00$$

$$\mu_2 = 2.06 \quad \sigma_2 = 0.99$$

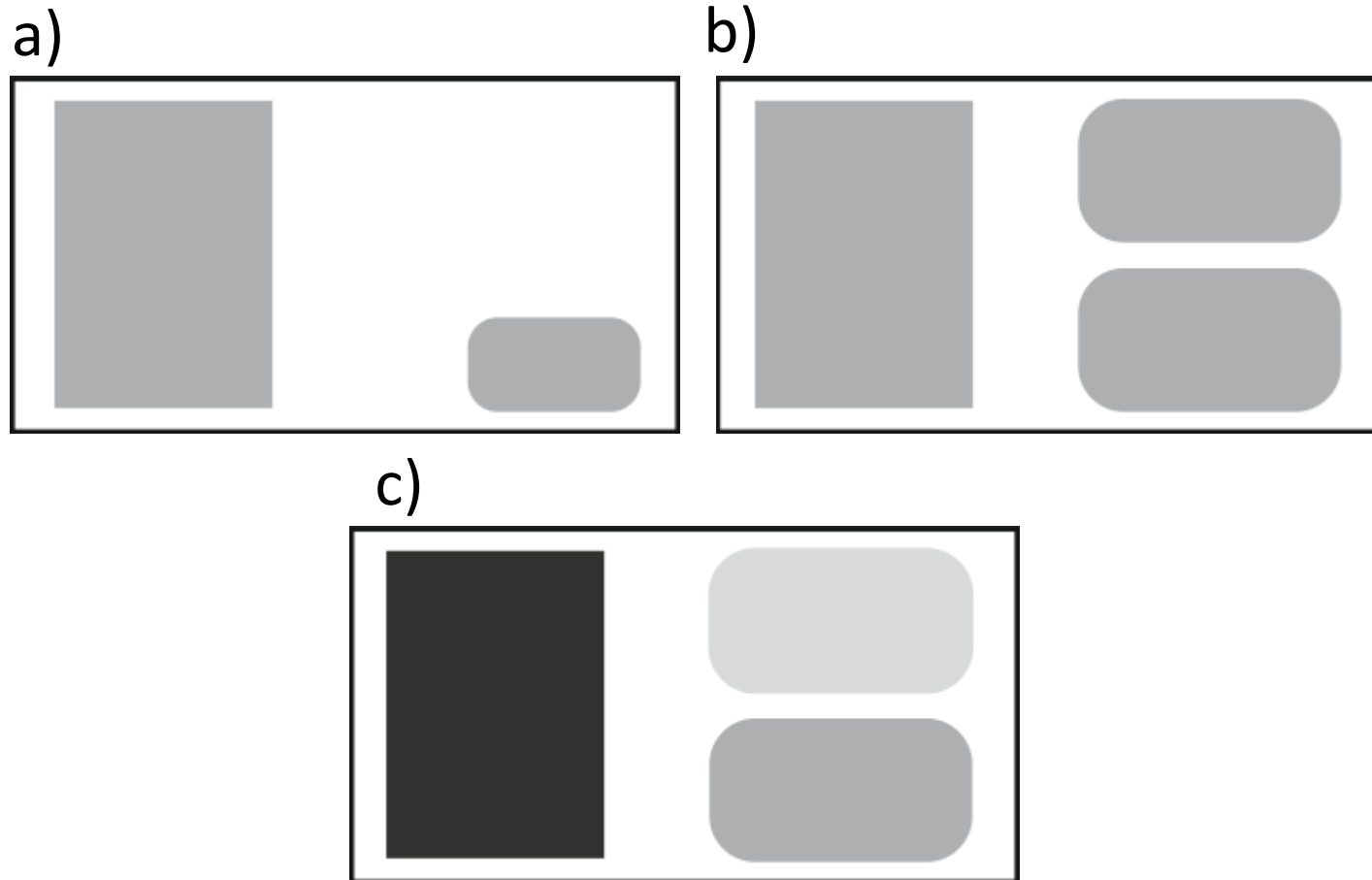


$\mu_1 = 13.98\%$ $\sigma_1 = 3.33\%$
 $\mu_2 = 28.80\%$ $\sigma_2 = 15.77\%$



- adaptive thresholding
[Bradley and Roth]

- **Balance:** distribution of an optical weight in a picture along a vertical or horizontal axis [Vanderdonckt], [Ngo]



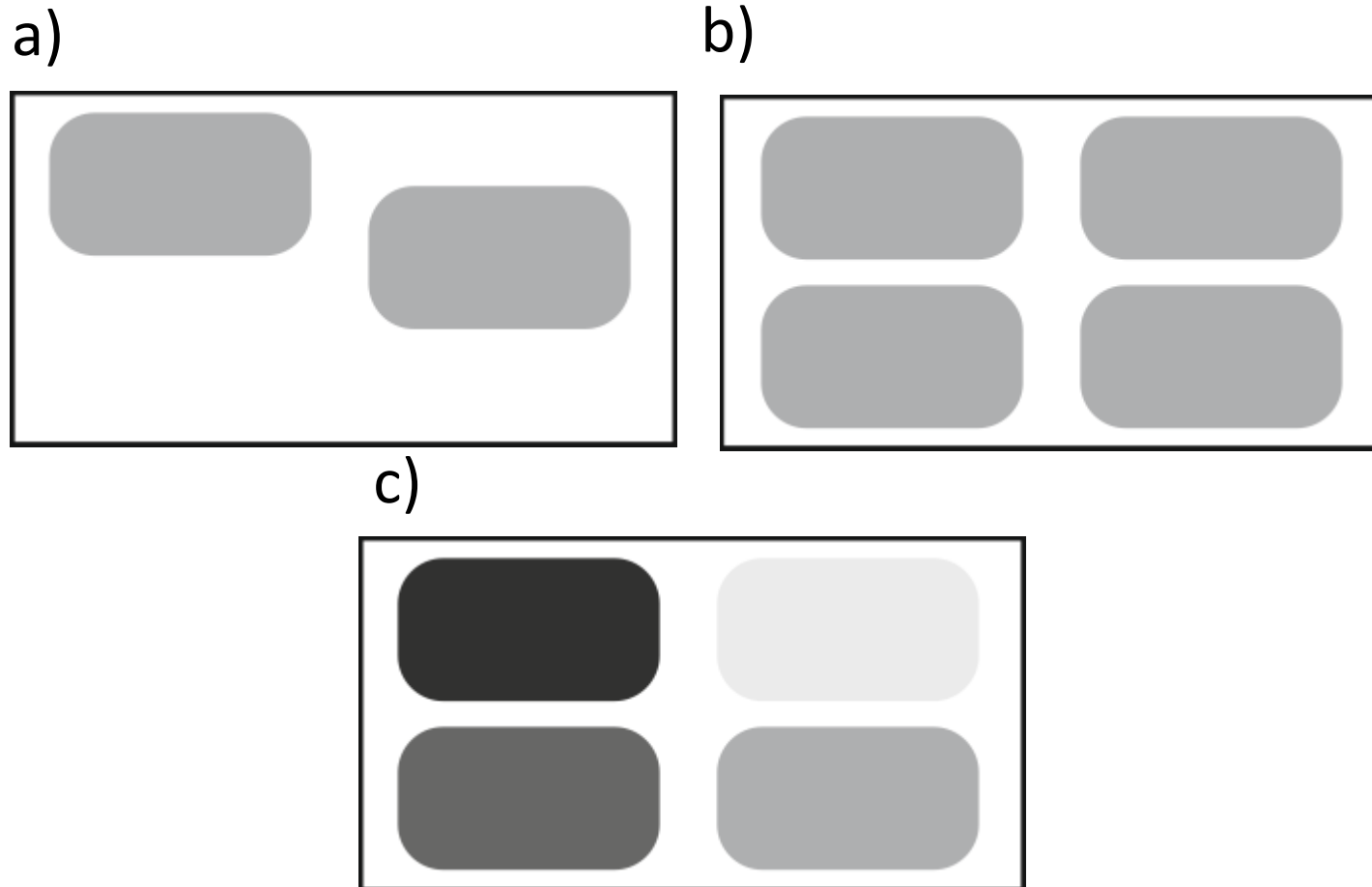
$$BM = \frac{|BM_v| + |BM_h|}{2}$$

$$BM_x = \frac{|w_{sideA}| - |w_{sideB}|}{\max(w_{sideA}, w_{sideB})}$$

$$w_X = \sum_{i \in X} (1 - val_i) * f(d)$$

$f(d) = \text{distance from center}$

- **Symmetry:** rate of axial duplication of a visual image of graphical elements along the horizontal and vertical axes [Vanderdonckt], [Ngo]

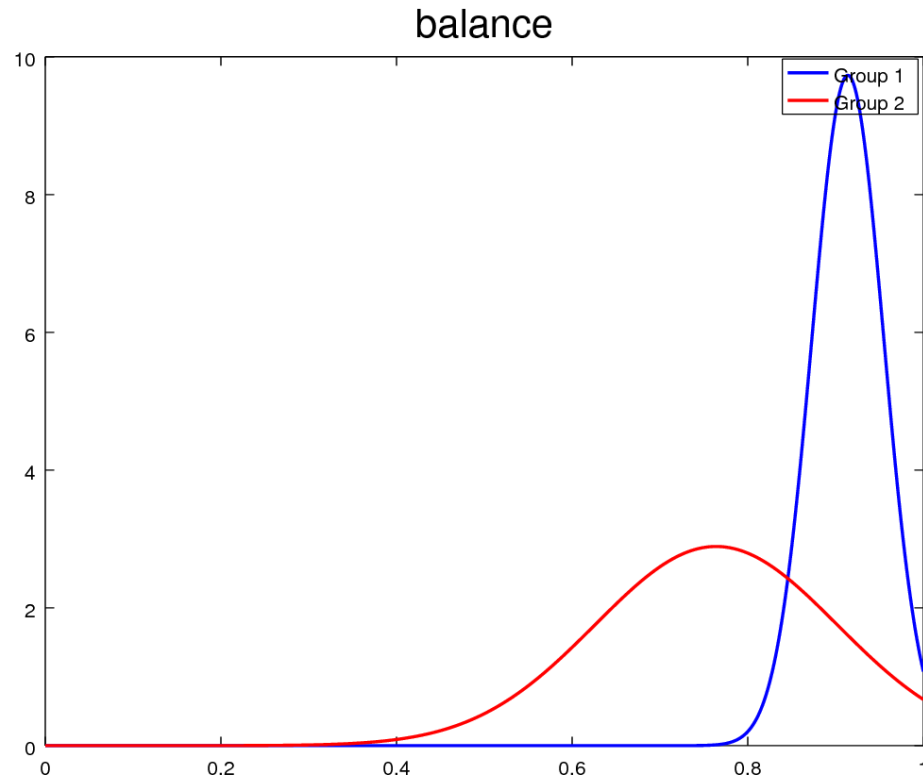


$$SM = \frac{|SM_v| + |SM_h|}{2}$$

$$SM_x = \frac{hit_x}{hit_x + miss_x}$$

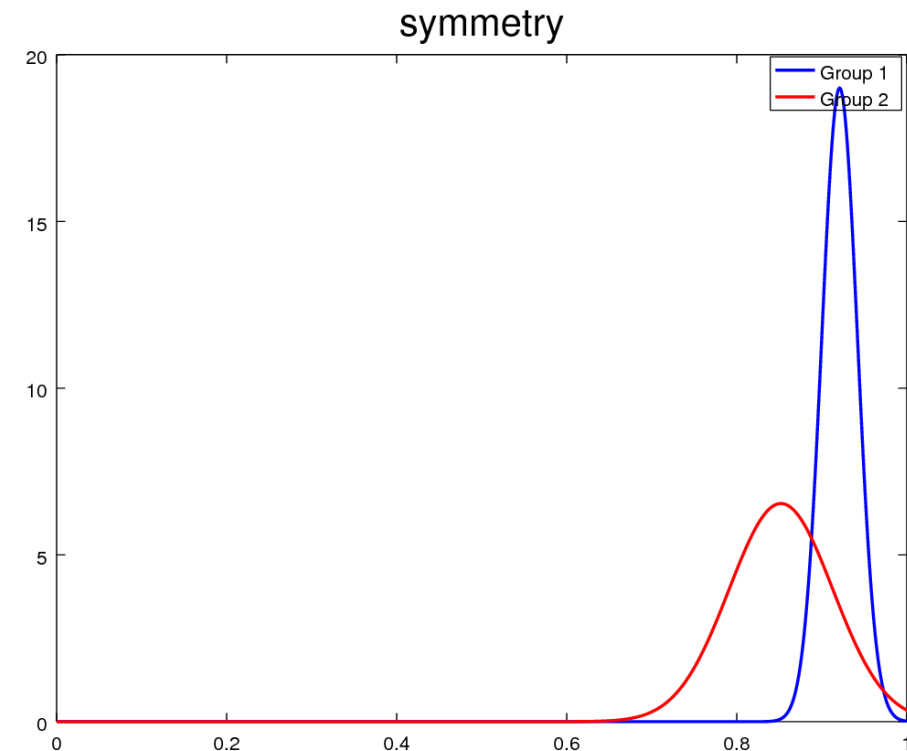
$$hit_x = \sum_{sym. i, j} |val_i - val_j|$$

$$miss = 1 - hit$$



$$\mu_1 = 0.220 \quad \sigma_1 = 0.066$$

$$\mu_2 = 0.437 \quad \sigma_2 = 0.161$$

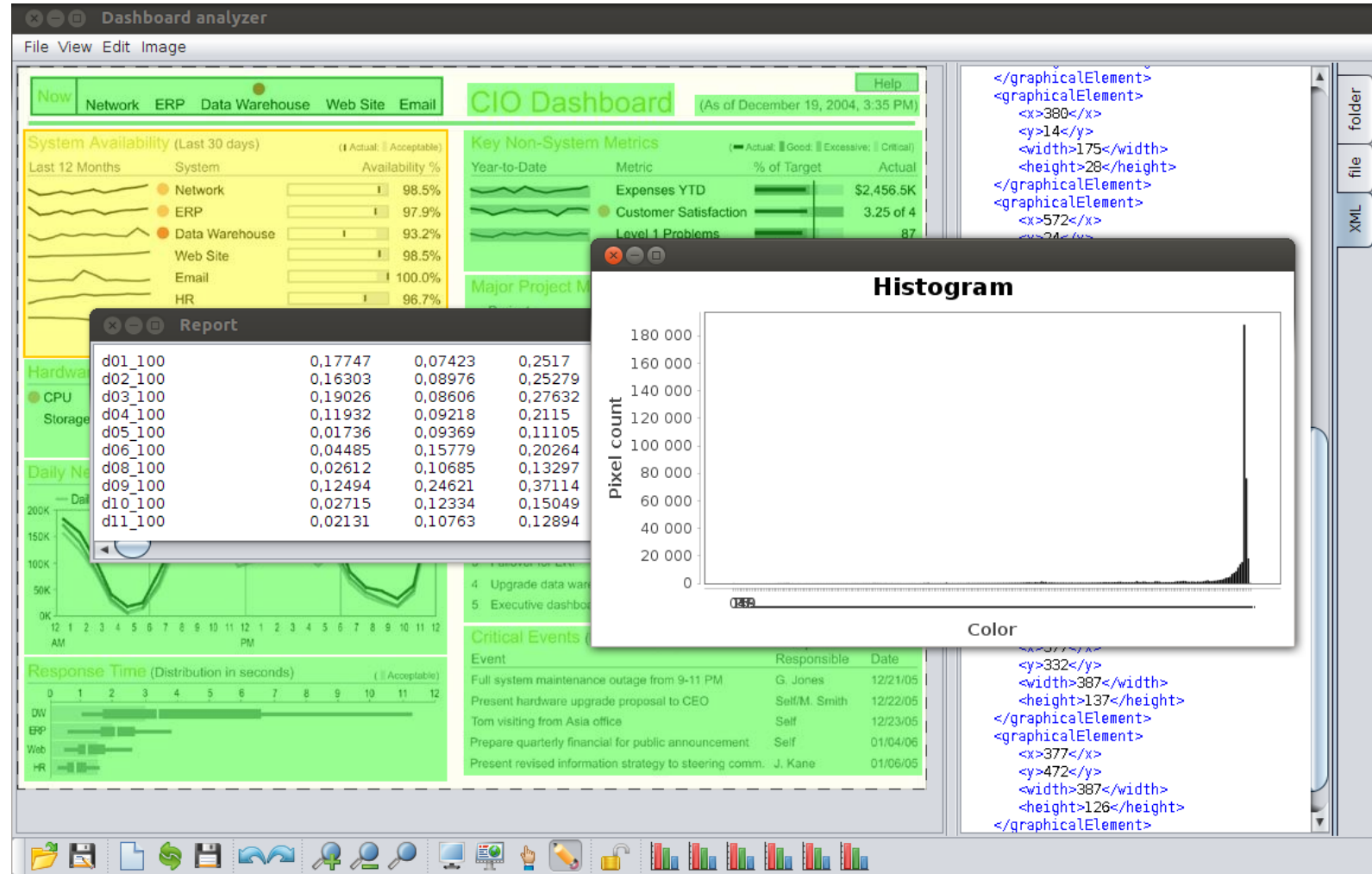


$$\mu_1 = 1.086 \quad \sigma_1 = 0.026$$

$$\mu_2 = 1.001 \quad \sigma_2 = 0.188$$

- suitable metrics found:
 - **Colorfulness** (HSB color saturation, hue)
 - **Share of the most used color** (12 bit RGB, 4-bit Gray-Scale)
 - **Share of black color value** (adaptive thresholding)
 - **Balance**
 - **Symmetry**

- widget-based metrics
- training of classification algorithms
- integration with a real dashboard design tool



Thank You For Your Attention !