Pixel-Based Analysis
of Information Dashboard Attributes

Jiří Hynek, Tomáš Hruška

Brno University of Technology, Faculty of Information Technology
Božetěchova 1/2, 612 66 Brno - Královo Pole
ihynek@fit.vut.cz, hruska@fit.vut.cz

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- ***a visual display*** *of **the most important** information*
- *arranged **comprehesively on a single screen** .*
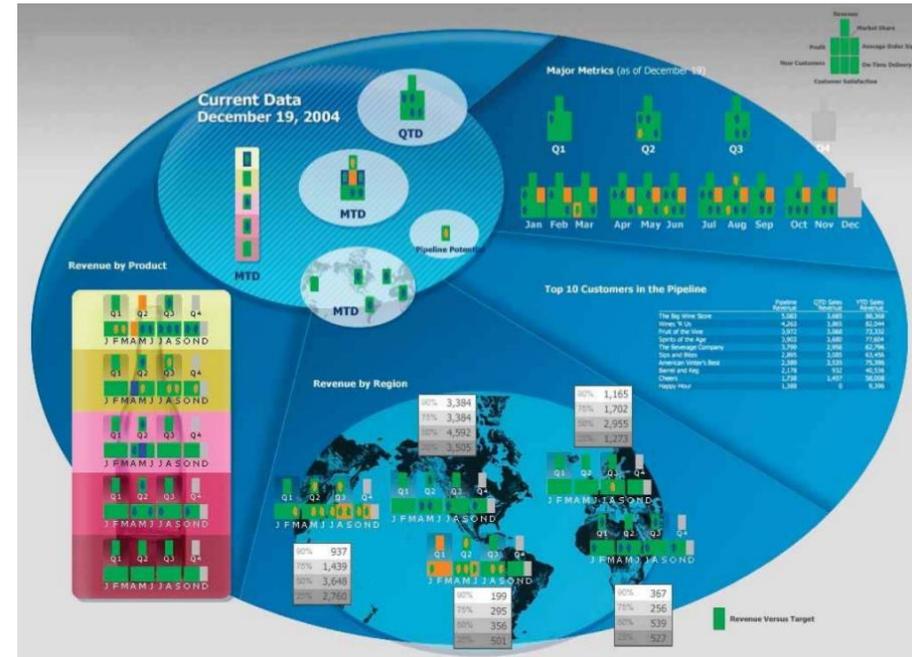
*Examples of 2 sales dashboards: **Stephen Few** – Information Dashboard Design*

- *How good is a dashboard?*
  - *(aesthetics, usability, simplicity, …)*
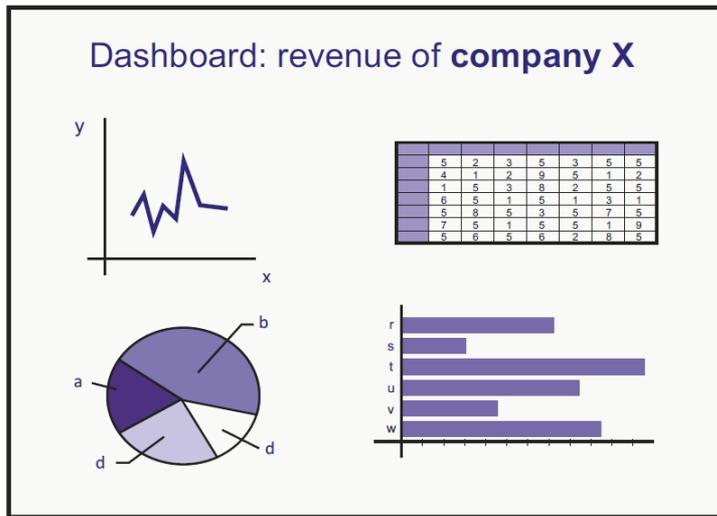
## 1. Dashbord

## 2. Internal representation

3. Attributes

4. Classification


```html
<html>
    <title>
    </title>
    <body>
        ...
    </body>
</html>
```
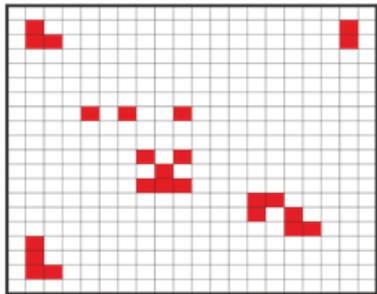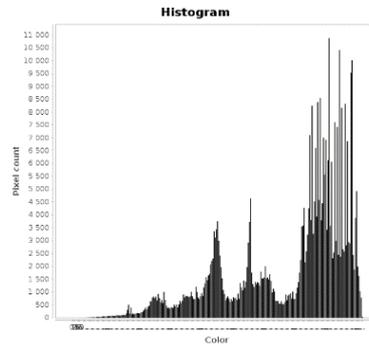
```
element:
    type: CHART
    x: 10
    y: 25
    width: 100
    height: 50
```

```
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. Dashbord   **2. IR**   **3. Attributes**   **4. Classification**
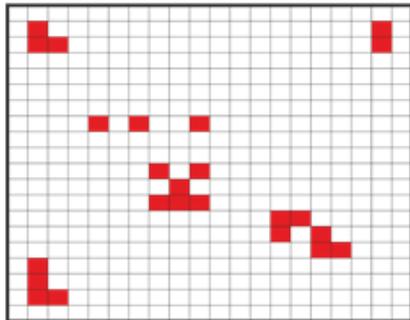
- HSB,
- CIE Lch,
- RGB
- Gray-scale
- B&W

?

Well-designed?
(according to SF)

1. Well-designed dashboards
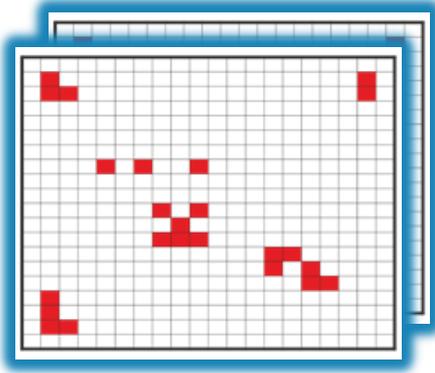
Stephen Few
40 (10 × 4)

→ measuring → mean μ_1
stdev σ_1

comparison

...*for each metric*

2. Randomly picked dashboards
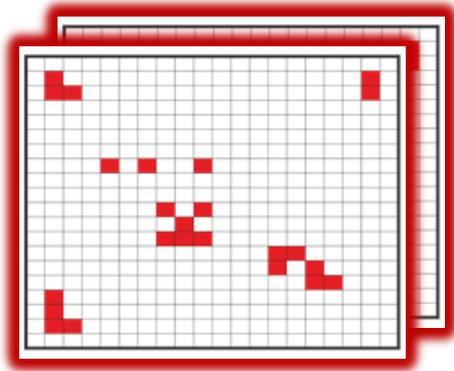

Google images
120

→ measuring → mean μ_2
stdev σ_2

- diversity and intensity of used colors
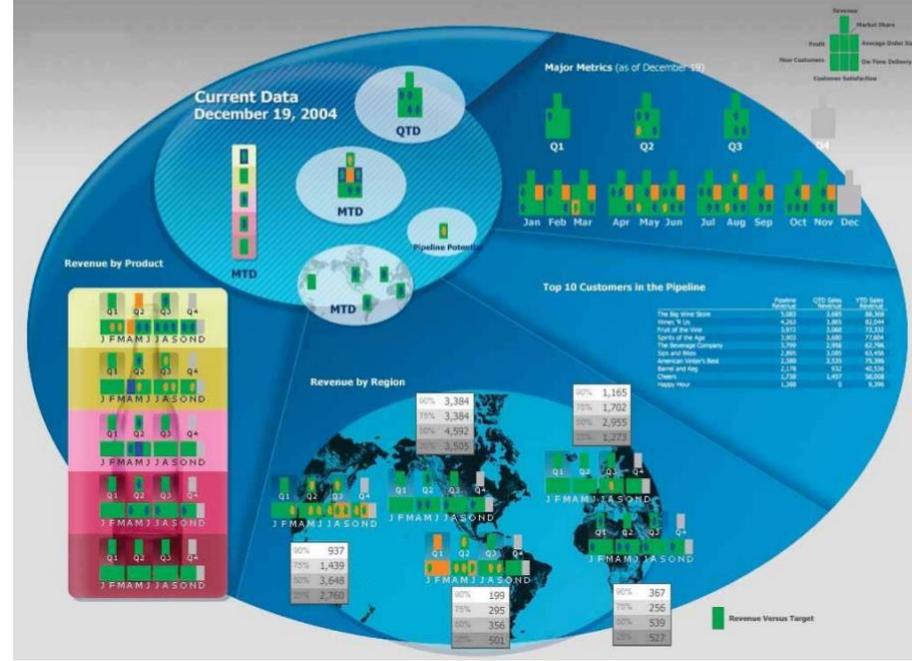
S. Few – Information Dashboard Design

- = **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

$$C_i = X_i + \sigma_i$$
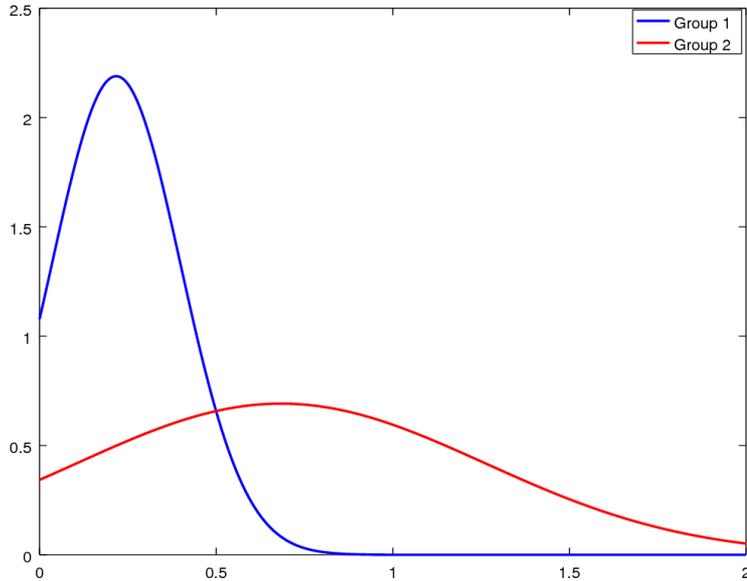
CIE saturation
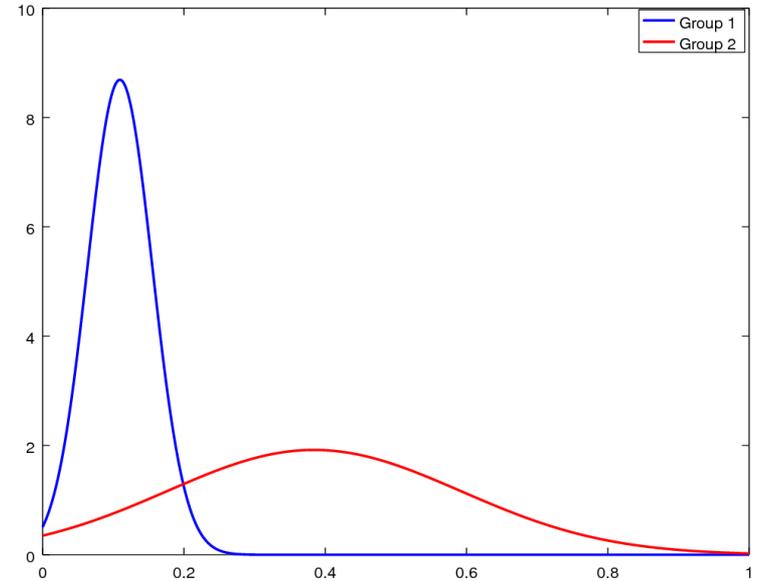
$$\mu_1 = 0.217 \; \sigma_1 = 0.182$$
$$\mu_2 = 0.684 \; \sigma_2 = 0.577$$

HSB saturation

$$\mu_1 = 0.109 \; \sigma_1 = 0.046$$
$$\mu_2 = 0.384 \; \sigma_2 = 0.208$$

HSB hue

HSB brightness
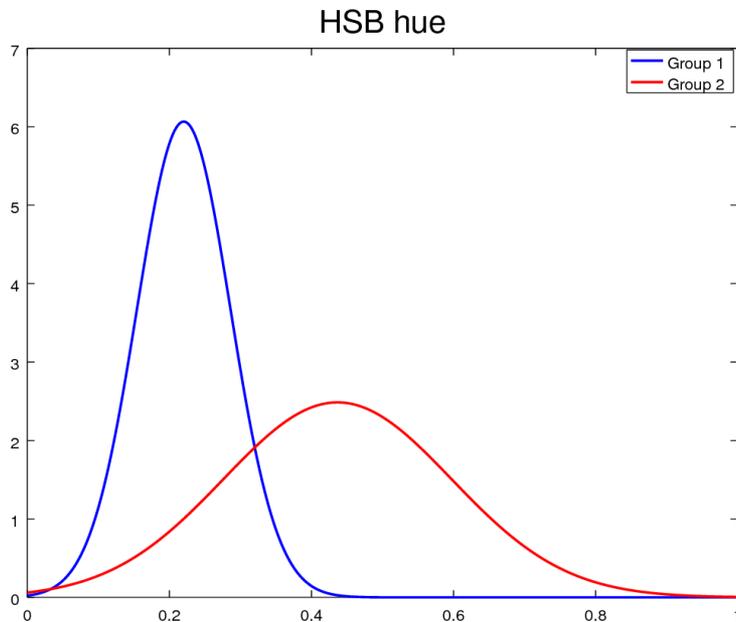
$$\mu_1 = 0.220 \; \sigma_1 = 0.066$$
$$\mu_2 = 0.437 \; \sigma_2 = 0.161$$
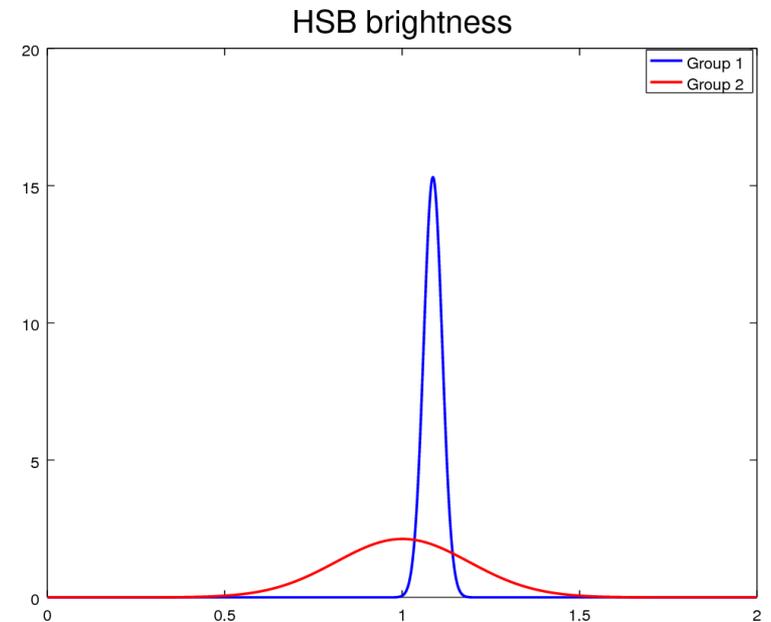
$$\mu_1 = 1.086 \; \sigma_1 = 0.026$$
$$\mu_2 = 1.001 \; \sigma_2 = 0.188$$

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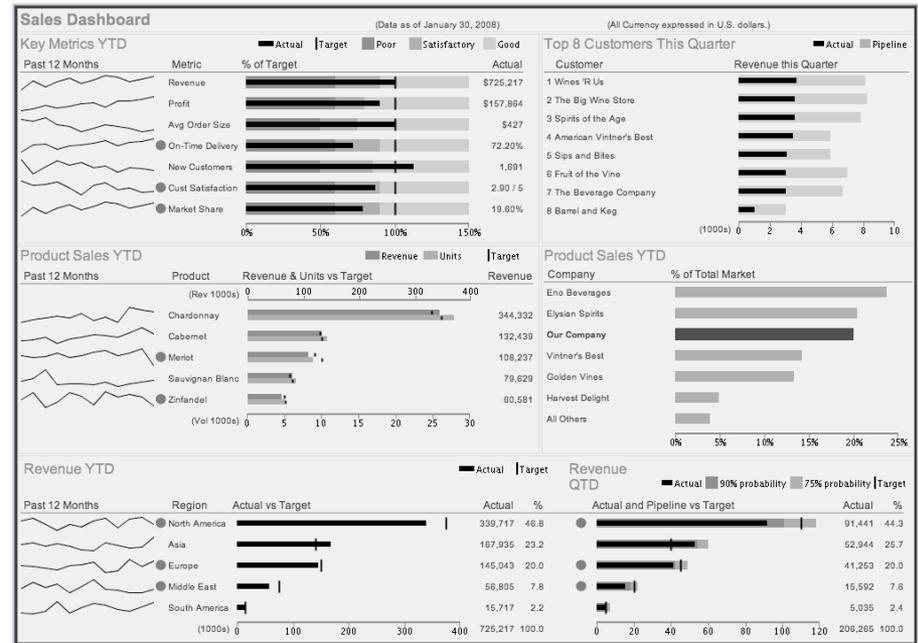

- share of background, color gradients, color diversity

$C_i = 0.16$

$C_i = 0.92$

$C_i = 0.70$
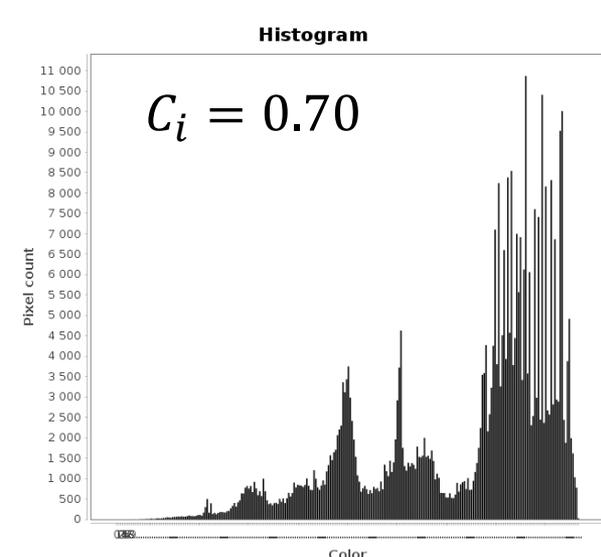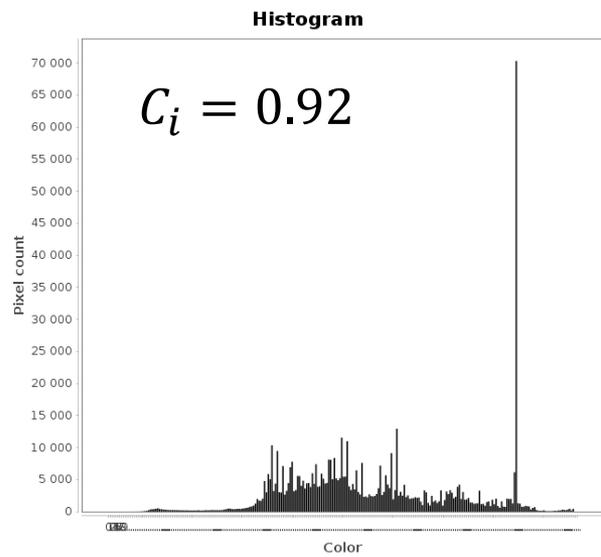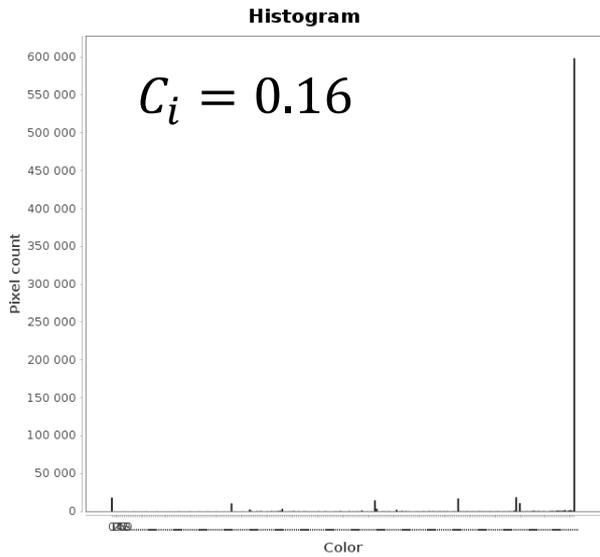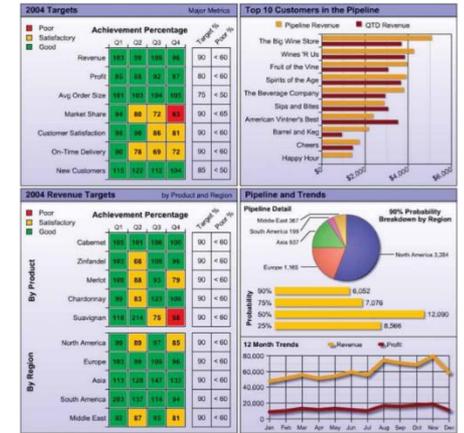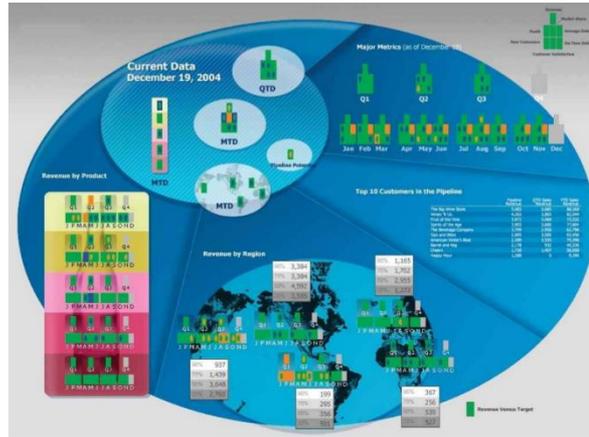
## 4-bit Gray-Scale
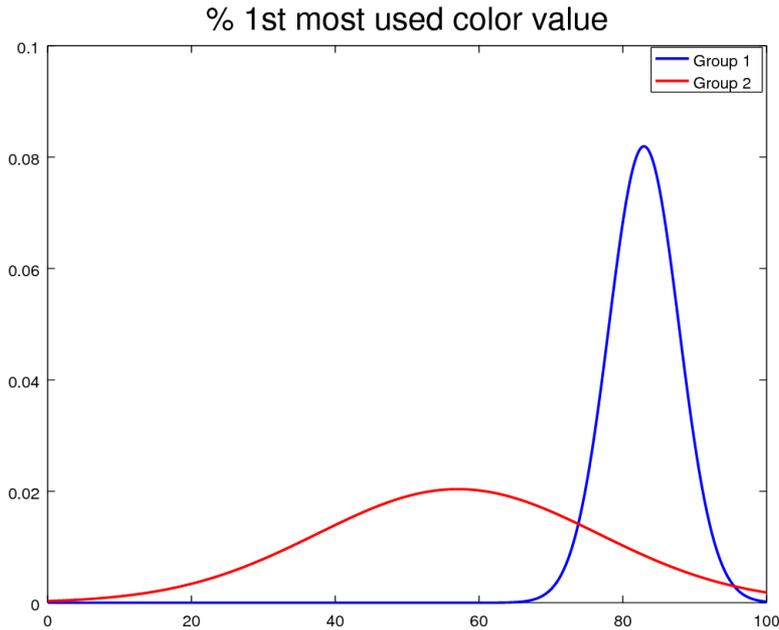
$$\mu_1 = 82.94\% \; \sigma_1 = 4.87\%$$
$$\mu_2 = 57.06\% \; \sigma_2 = 19.57\%$$
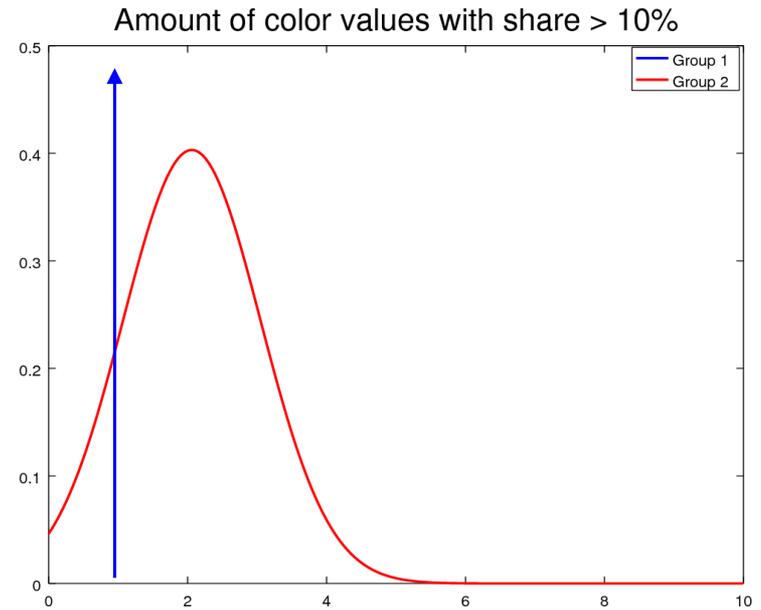
$$\mu_1 = 1.00 \; \sigma_1 = 0.00$$
$$\mu_2 = 2.06 \; \sigma_2 = 0.99$$

Share of black color value
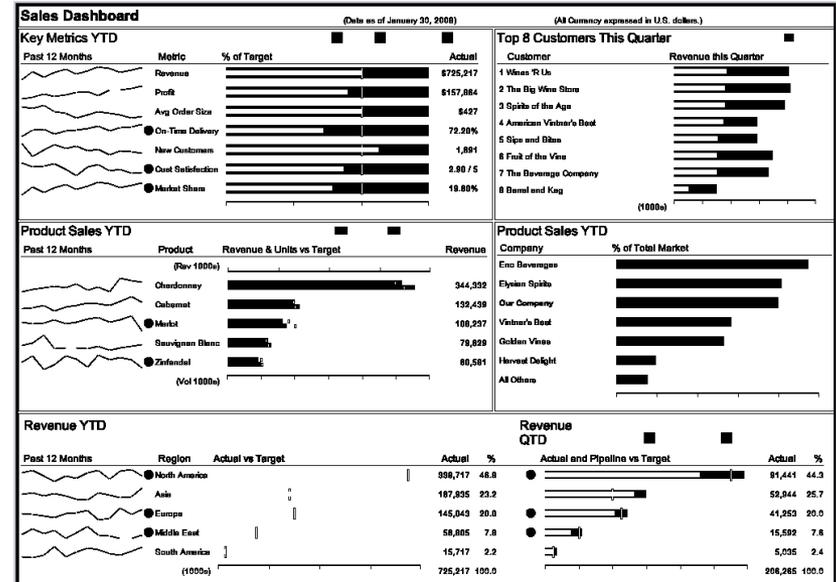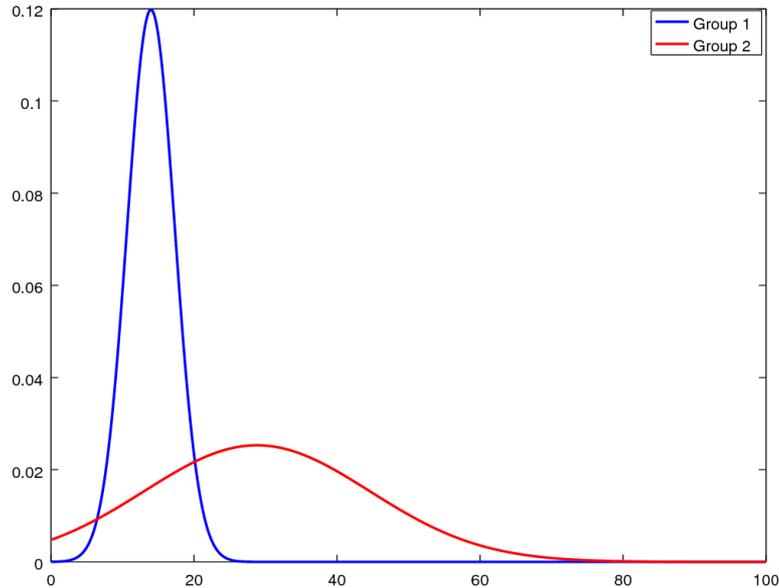
$\mu_1 = 13.98\% \; \sigma_1 = 3.33\%$

$\mu_2 = 28.80\% \; \sigma_2 = 15.77\%$

- adaptive thresholding *[Bradley and Roth]*

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

a)

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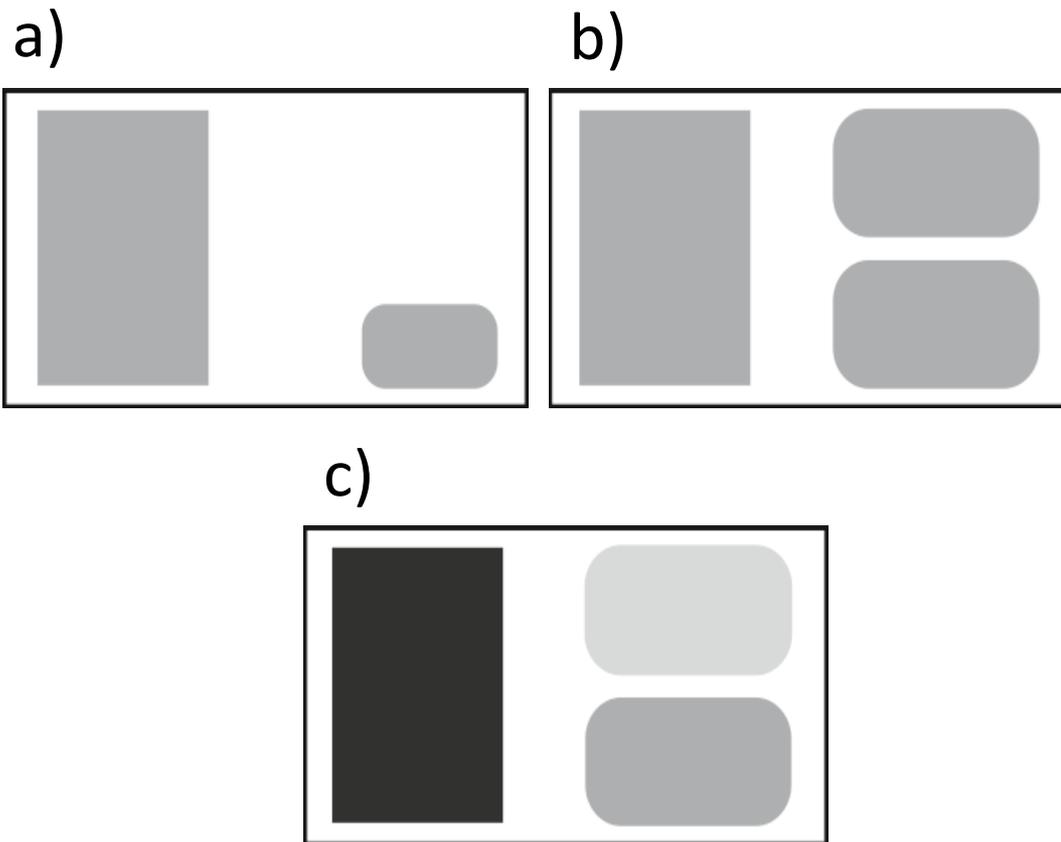
$$BM = \frac{|BM_v| + |BM_h|}{2}$$

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

c)

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

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

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

a)

b)

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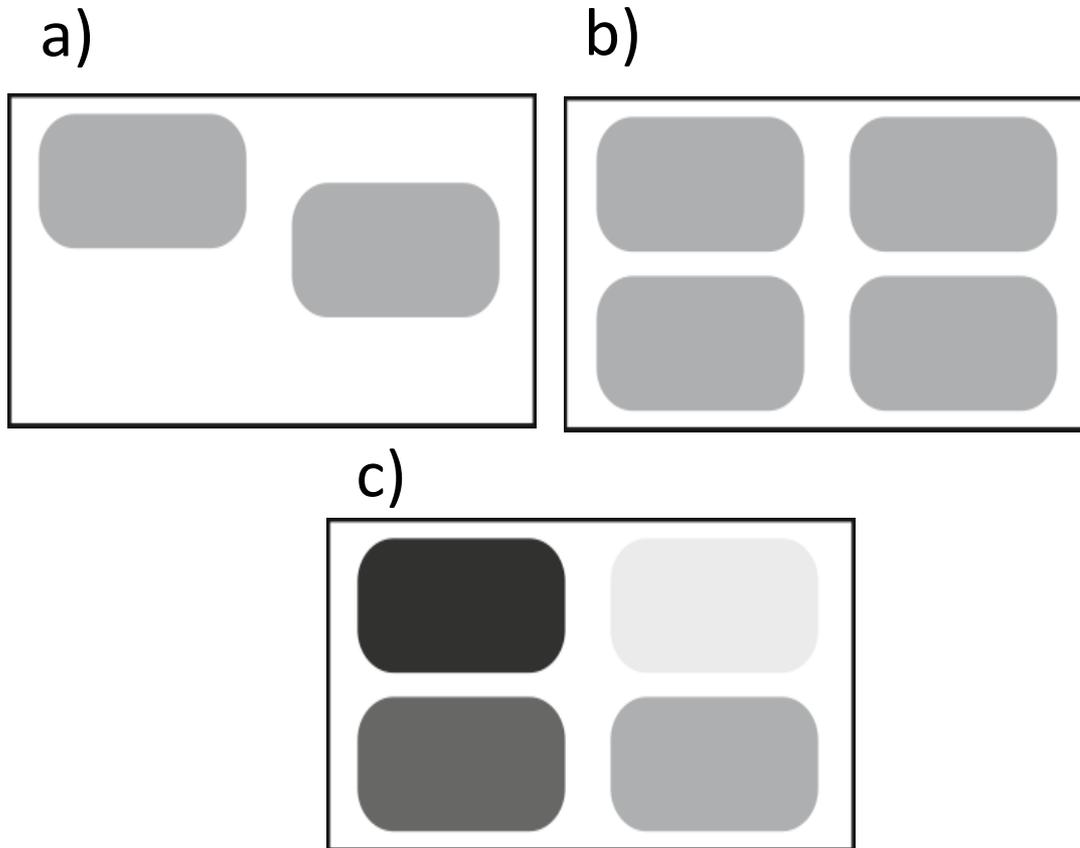
$$SM = \frac{|SM_v| + |SM_h|}{2}$$

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

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

$$miss = 1 - hit$$
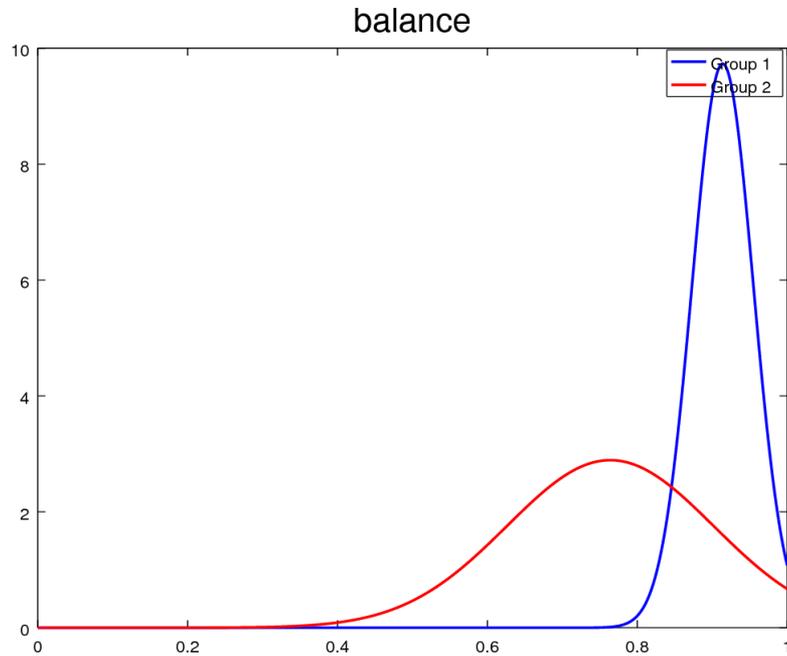
balance

symmetry

$$\mu_1 = 0.220 \; \sigma_1 = 0.066$$
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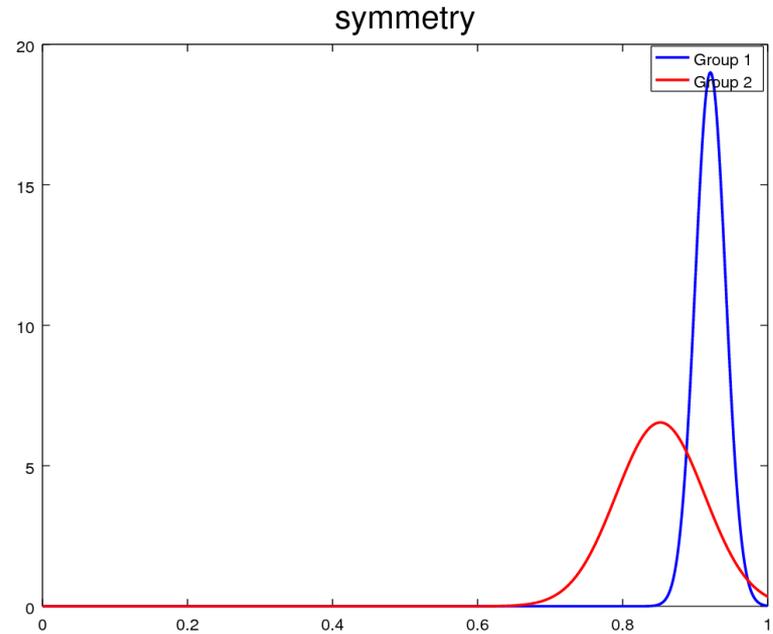
$$\mu_1 = 1.086 \; \sigma_1 = 0.026$$
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- suitable metrics found:

    - **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

Dashboard Analyzer Application
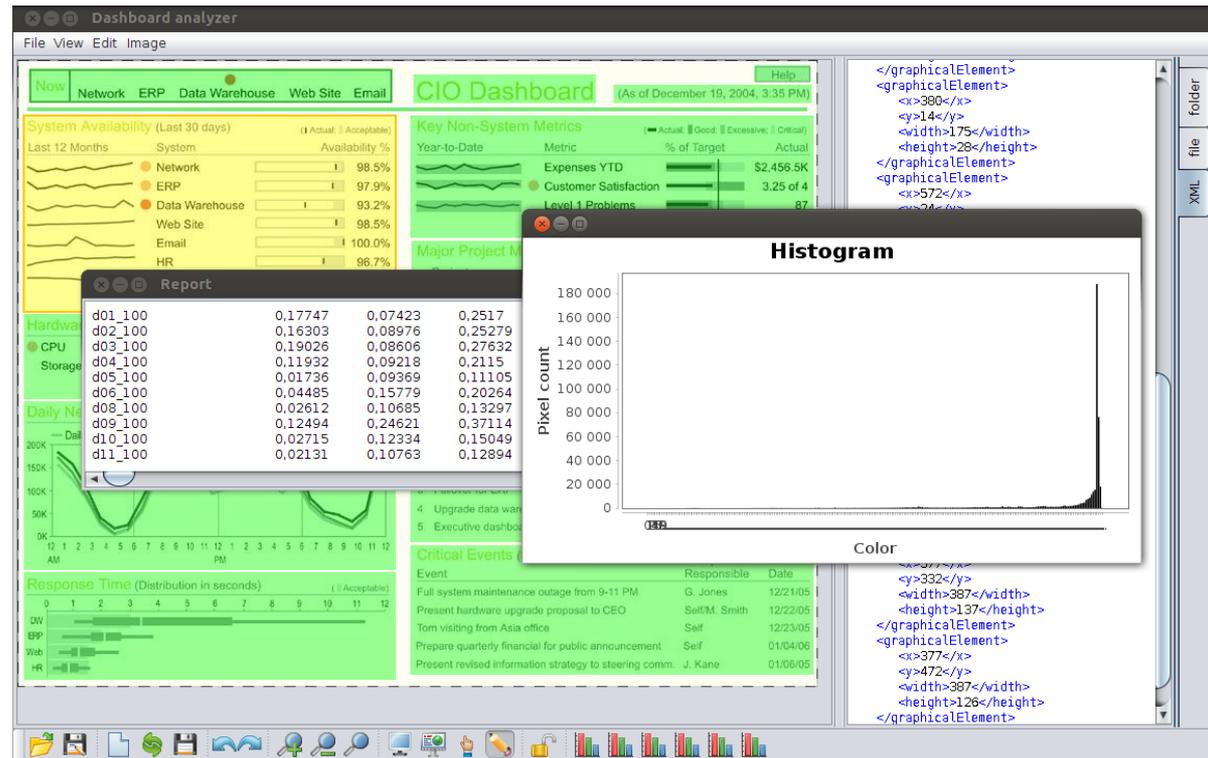
Thank You For Your Attention !