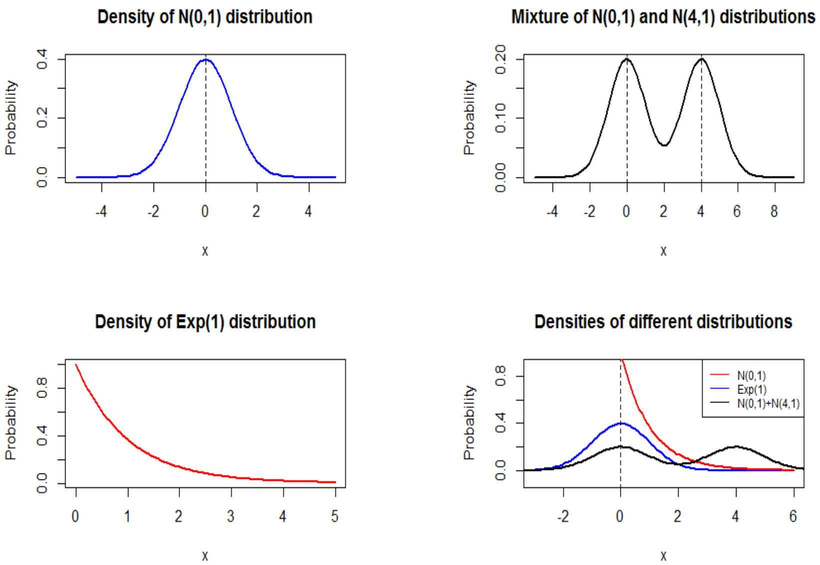
Displaying Uncertainty with Shading

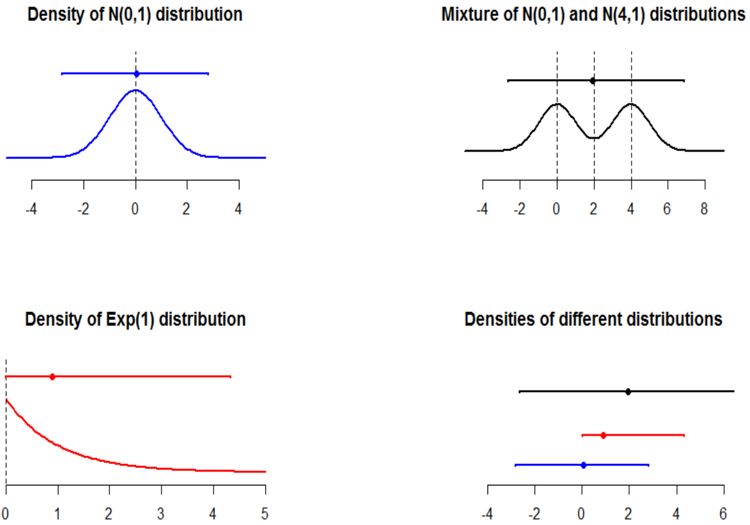
Marta Sommer

15th October 2014

Example 1


Density of N(0,1) distribution
Probability
0.0
0.2
0.4
-4
-2
0
2
4
x
Mixture of N(0,1) and N(4,1) distributions
Probability
0.00
0.10
0.20
-4
-2
0
2
4
6
8
x
Density of Exp(1) distribution
Probability
0.0
0.4
0.8
0
1
2
3
4
5
x
Densities of different distributions
Probability
0.0
0.4
0.8
N(0,1)
Exp(1)
N(0,1)+N(4,1)
-2
0
2
4
6
x

Example 1 – Point and Probability Region



Example 1 – Point and Probability Region

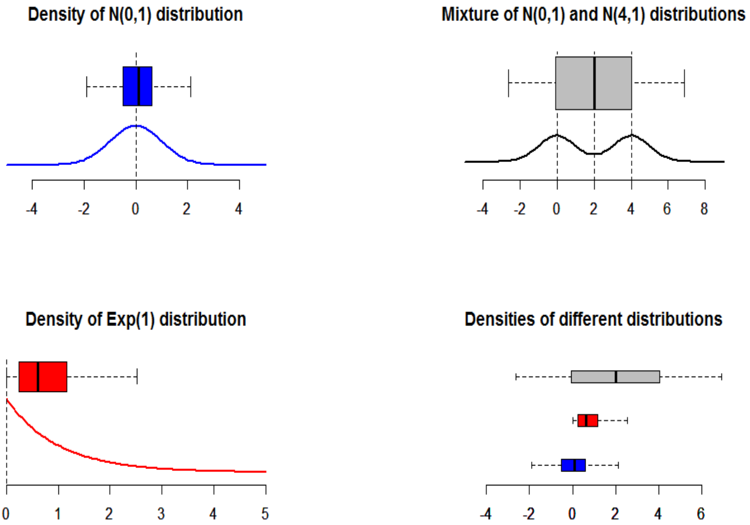
Advantages:

1. easy to draw and understand,
2. space-efficient - one dimension.

Disadvantages:

1. hides information, e.g. the peaks of the mixtures of normal distributions,
2. gives the perception that the data supports all points within the interval equally.

Example 1 – Boxplot



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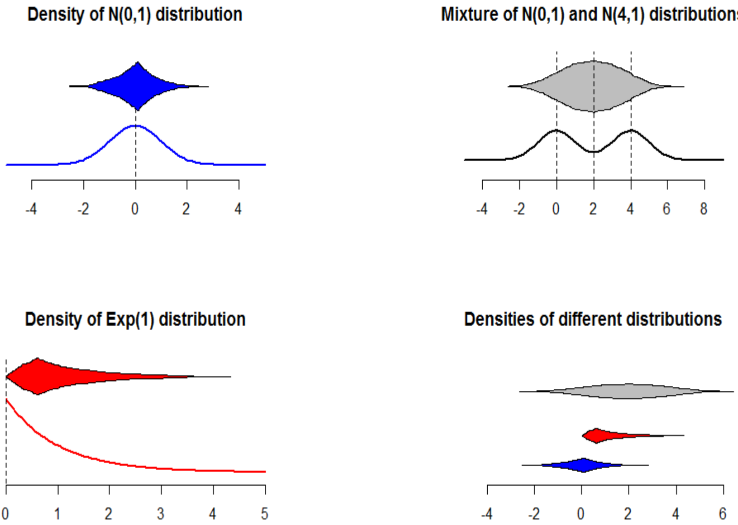
Example 1 – Box-Percentile Plot



Example 1 – Box-Percentile Plot

Advantages:

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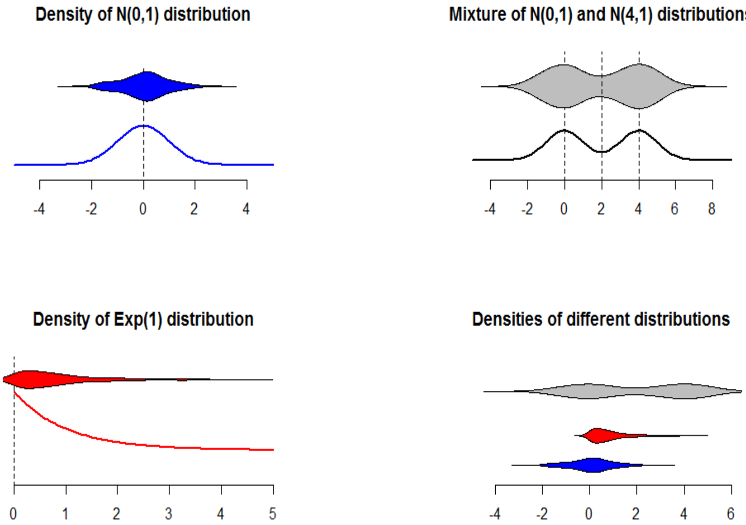
Example 1 – Varying-Width Strips



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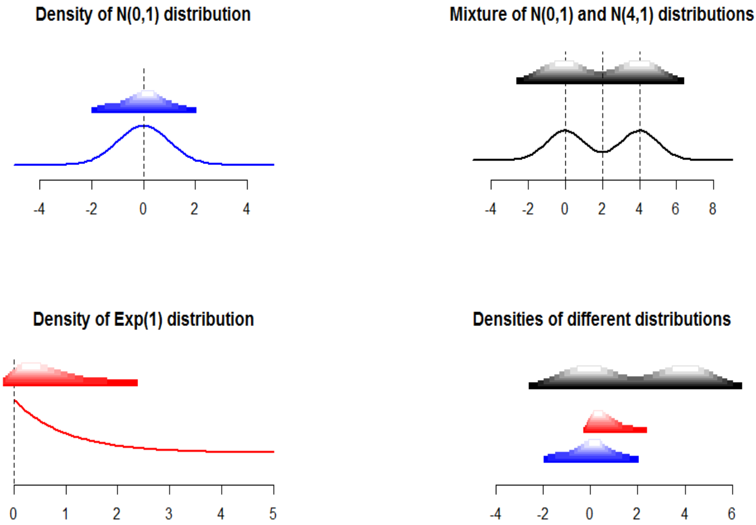
Example 1 – Sectioned Density Plots



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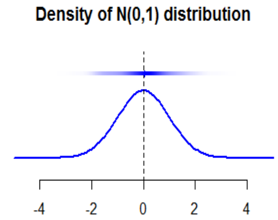

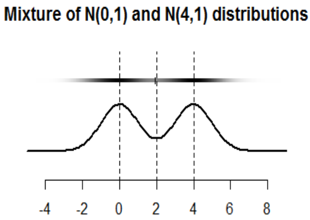

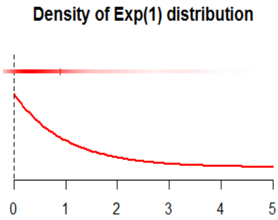

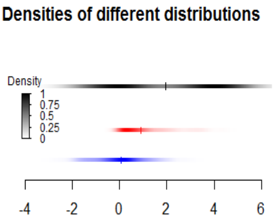

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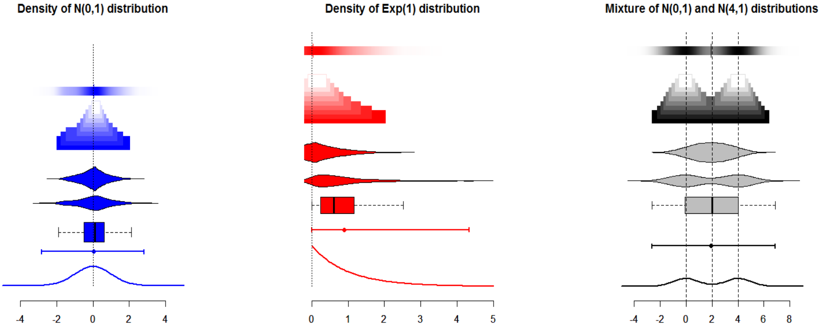
Example 1 – Summary



How to Draw Density Strips?

RGB – red - green - blue model

$R, G, B \in \{0, \ldots, 255\}$

$(0, 0, 0)$ – black

$(255, 255, 255)$ – white

Shades of grey have equal levels of red, green and blue.

How to Draw Density Strips?

Grey level for a density $f()$ at point x is the nearest integer to:

$$\left(1 - \frac{f(x)}{f(x_0)}\right) \cdot 255,$$

where x_0 is the mode.

If color display is available, then:

$$p \times (c_R, c_G, c_B) + (1 - p) \times (255, 255, 255),$$

where $p = \dfrac{f(x)}{f(x_0)}$ and (c_R, c_G, c_B) is a certain dark colour chosen for the maximum density.

How to Draw Density Strips?

Once again:

$$p \times (c_R, c_G, c_B) + (1 - p) \times (255, 255, 255),$$

where $p = \dfrac{f(x)}{f(x_0)}$, $p \in [0, 1]$.

<u>Gamma correction:</u>

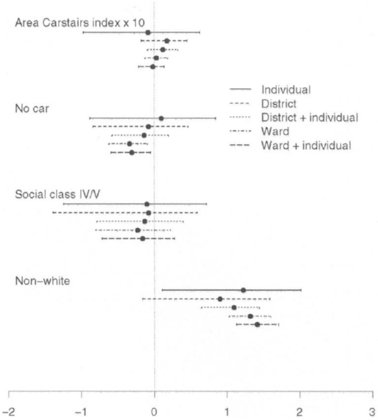
$$p^{\gamma} \times (c_R, c_G, c_B) + (1 - p^{\gamma}) \times (255, 255, 255),$$

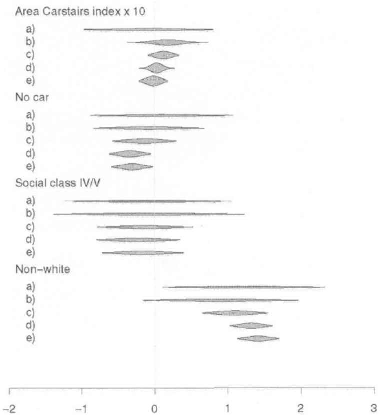
where $\gamma > 0$.

Setting $\gamma < 1$ will darken the tails of the distribution.

Setting $\gamma > 1$ will shorten the black area around the peak.

Example 2 – Multiple Regression





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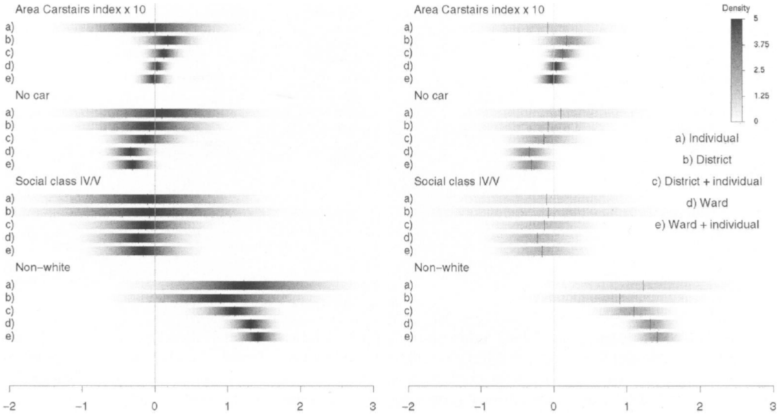
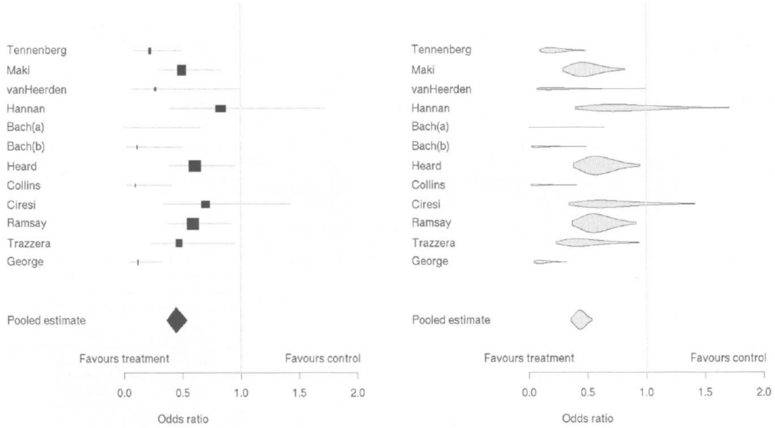


Example 3 – Meta-Analysis



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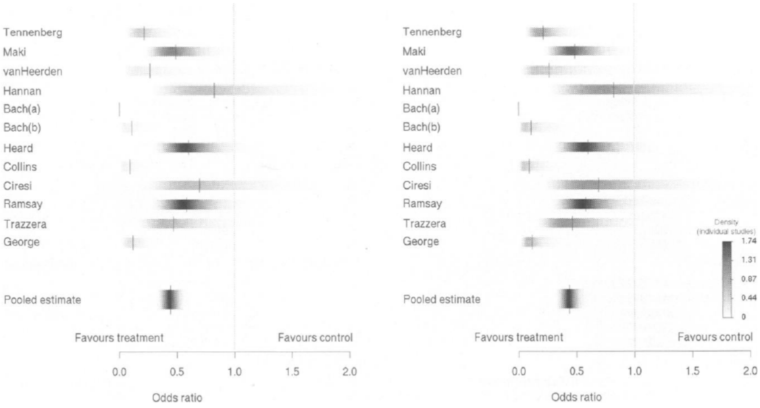
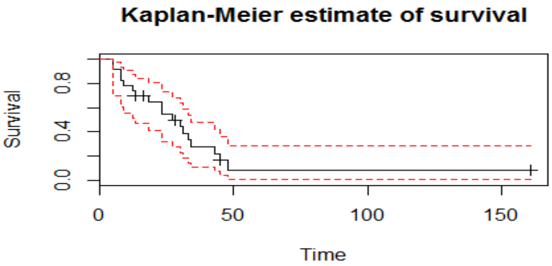
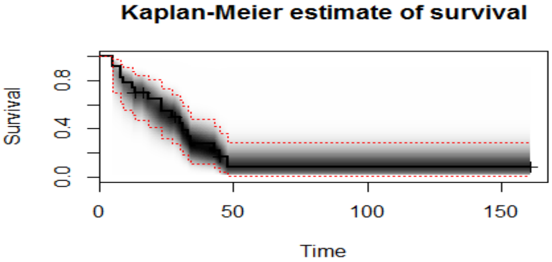
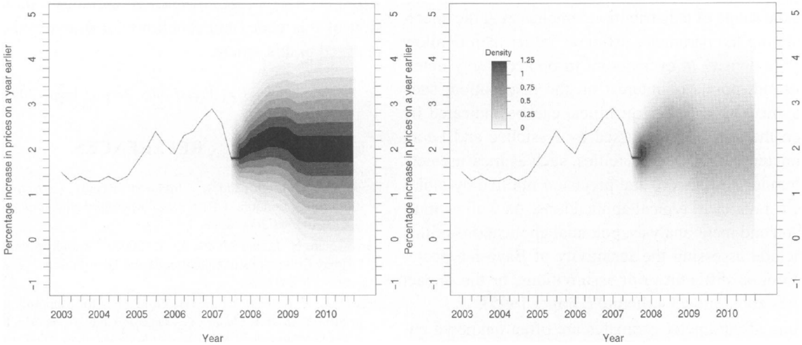


Example 4 – Survival Analysis





Example 5 – Forecasting



Implementation in R

R package $\boxed{\texttt{denstrip}}$.

Functions:

1. `cistrip()`
2. `vwstrip()`
3. `bpstrip()`
4. `sectioned.density()`
5. `denstrip()`

References

Jackson, Christopher H. Displaying Uncertainty with Shading, *The American Statistician* 2008, no. 62, p. 340–347.

http://CRAN.R-project.org/package=denstrip