

Note 1:

$$\hat{p}_N(x) = \frac{1}{Nh} \sum_{i=1}^N K\left(\frac{x_i - x}{h}\right)$$

$$\hat{p}_N(x, y) = \frac{1}{Nh^2} \sum_{i=1}^N K\left(\frac{x_i - x}{h}\right) K\left(\frac{y_i - y}{h}\right)$$

$$\int y \hat{p}_N(x, y) dy = \frac{1}{Nh^2} \sum_{i=1}^N K\left(\frac{x_i - x}{h}\right) \int y K\left(\frac{y_i - y}{h}\right) dy$$

$$\begin{aligned} \frac{1}{h} \int y K\left(\frac{y_i - y}{h}\right) dy &= \int \frac{y - y_i}{h} K\left(\frac{y_i - y}{h}\right) dy + y_i \int K\left(\frac{y_i - y}{h}\right) dy \\ &= -h \int u K(u) du + y_i \int K(u) du \end{aligned}$$

considering a kernel such that

$$\int K(u) du = 1, \quad \int u K(u) du = 0$$

we have

$$\frac{1}{h} \int y K\left(\frac{y_i - y}{h}\right) dy = y_i$$

Therefore

$$\hat{f}(x) = \frac{1}{Nh \hat{p}(x)} \sum_{i=1}^N y_i K\left(\frac{x_i - x}{h}\right) = \frac{\sum_{i=1}^N y_i K\left(\frac{x_i - x}{h}\right)}{\sum_{i=1}^N K\left(\frac{x_i - x}{h}\right)}$$

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