

## FIND NORMALIZING TRANSFORMATIONS

The idea (very sketchy) behind the “Find Normalizing Transformations” command (on the “Transformations” menu on scatterplot matrix):

(See pp. 332 – 324 and 329 – 330 for a little more detail.)

This command will look for appropriate “scaled power transformations” – that is, functions

$$v^{(\lambda)} = \begin{cases} \frac{v^\lambda - 1}{\lambda} & \text{if } \lambda \neq 0 \\ \log(v) & \text{if } \lambda = 0 \end{cases}.$$

(Recall that these are the functions that we saw earlier on the transformation slidebars.)

One possible idea: e.g., if  $v = y$ , look for  $\lambda$  to minimize  $\text{RSS}(\lambda) =$  the RSS from regressing  $y^{(\lambda)}$  on the terms.

This has a problem: The units of  $\text{RSS}(\lambda)$  will be different for different  $\lambda$ 's; that is, the different  $\text{RSS}(\lambda)$ 's are not in the same scale.

A possible remedy: Instead consider “modified scaled power transformations”:

$$z^{(\lambda)} = y^{(\lambda)}[\text{GM}(y)]^{1-\lambda},$$

where

$$\begin{aligned} \text{GM}(y) &= \text{geometric mean of } y_1, y_2, \dots, y_n \\ &= (y_1 y_2 \dots y_n)^{1/n}. \end{aligned}$$

Note that  $\text{GM}(y)$  has the same units as  $y$ , so  $z^{(\lambda)}$  also has the same units as  $y$ .

To handle several variables simultaneously: Minimize an analogous function of the matrix of sums of squares and cross products (analogues of  $\text{SXX}$ ,  $\text{SXY}$ , etc.)

*Note:* This is a tool to try; it is not guaranteed to work in all cases.

e.g., it is impossible to transform an indicator variable for a categorical variable to normality.

However, using the tool gives a better chance that regression techniques will apply.

*Example:* Big Mac