

Types of variable normalization formulas

A. Variable (column) normalization

Variable (column) normalization can be applied to any data matrix.

1	Selection of objects and variables	data matrix $[x_{ij}]$		
2	Variable scale level	Ratio	Ratio	Interval
	Selection of variable normalization formula	n6 – quotient transformation n6a – positional quotient transformation n7 – quotient transformation n8 – quotient transformation n9 – quotient transformation n9a – positional quotient transformation n10 – quotient transformation n11 – quotient transformation	n1 – standardization n2 – positional standardization n3 – unitization n3a – positional unitization n4 – unitization with zero minimum n5 – normalization in range $[-1, 1]$ n5a – positional normalization in range $[-1, 1]$ n12 – normalization n12a – positional normalization	n1 – standardization n2 – positional standardization n3 – unitization n3a – positional unitization n4 – unitization with zero minimum n5 – normalization in range $[-1, 1]$ n5a – positional normalization in range $[-1, 1]$ n12 – normalization n12a – positional normalization
	Transformed variable scale level	Ratio	Interval	Interval

$$(n1) \quad z_{ij} = (x_{ij} - \bar{x}_j) / s_j$$

$$(n2) \quad z_{ij} = (x_{ij} - med_j) / mad_j$$

$$(n3) \quad z_{ij} = (x_{ij} - \bar{x}_j) / r_j$$

$$(n3a) \quad z_{ij} = (x_{ij} - med_j) / r_j$$

$$(n4) \quad z_{ij} = \left[x_{ij} - \min_i \{x_{ij}\} \right] / r_j$$

$$(n5) \quad z_{ij} = (x_{ij} - \bar{x}_j) / \max_i |x_{ij} - \bar{x}_j|$$

$$(n5a) \quad z_{ij} = (x_{ij} - med_j) / \max_i |x_{ij} - med_j|$$

$$(n6) \quad x_{ij} / s_j$$

$$(n6a) \quad z_{ij} = x_{ij} / mad_j$$

$$(n7) \quad x_{ij} / r_j$$

$$(n8) \quad x_{ij} / \max_i \{x_{ij}\}$$

$$(n9) \quad x_{ij} / \bar{x}_j$$

$$(n9a) \quad z_{ij} = x_{ij} / med_j$$

$$(n10) \quad x_{ij} / \sum_{i=1}^n x_{ij}$$

$$(n11) \quad x_{ij} / \sqrt{\sum_{i=1}^n x_{ij}^2}$$

$$(n12) \quad z_{ij} = \frac{x_{ij} - \bar{x}_j}{\sqrt{\sum_{i=1}^n (x_{ij} - \bar{x}_j)^2}}$$

$$(n12a) \quad z_{ij} = \frac{x_{ij} - med_j}{\sqrt{\sum_{i=1}^n (x_{ij} - med_j)^2}}$$

where: x_{ij} (z_{ij}) – i -th observation on j -th variable (i -th normalized observation on j -th variable),

\bar{x}_j (s_j) – mean (standard deviation) for j -th variable,

med_j (mad_j) – median (median absolute deviation) for j -th variable,

$r_j = \max_i \{x_{ij}\} - \min_i \{x_{ij}\}$.

B. Object (row) normalization

The same normalization procedures can be applied as for variable (column) normalization. Object (row) normalization makes sense only when all variables are expressed in the same unit. This is often the case for instance with structural data.

References

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