

Mathematical Transformations

Tuesday 14 May 2024 9:41 PM

→ Transform then scale

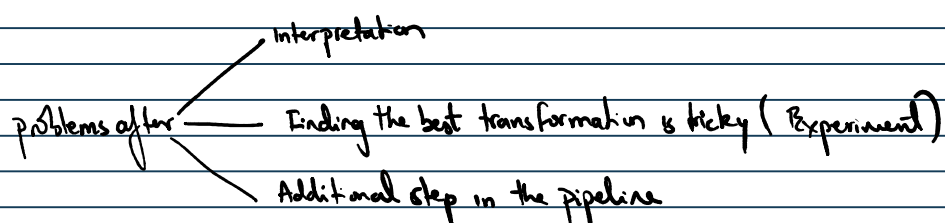
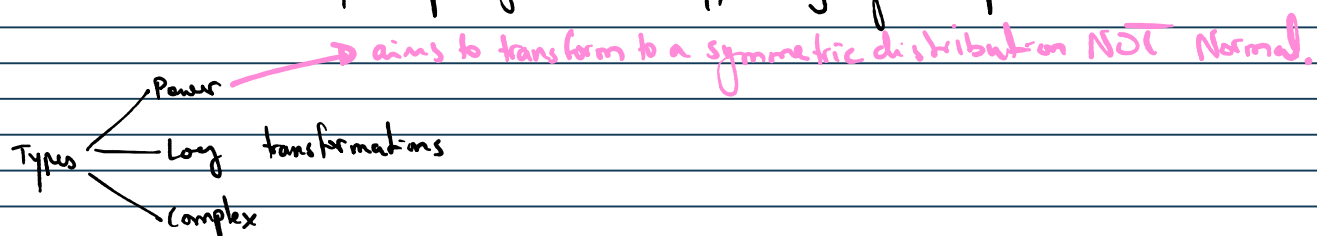
→ To improve model performance → transformations conform to model assumptions & which in turn amplifies model's predictive power.

- even out variance
- make feature more normal
- reduce the skew
- linearize the relationship b/w feature & target
- Reduce the impact of outliers

parametric → assumptions about data models

→ Mathematical operations to modify the original data features in a way that enhances their representation for ML Models.

→ These transformations can help in improving model accuracy, meeting algo assumptions.



1) Log transformation

large value → more compression

- use
- Right skewed data [moderate] ≈ 1.3 or 4
 - data contains outliers [RobustScaler or LogitMixMax/standardScaler]
 - Reduces Heteroskedasticity

- Don't use
- ve or 0 values
 - normal or uniform distribution already
 - Interpretation \approx [unit → % change]
↑ Research

→ Invertible

2) Square Root transformation

$\sqrt{x} \approx \log$

- log is extreme version of sqrt in compression of larger values
- mild right skewed data [0-1]

3) Square transformations

→ mild left skewed data $[-1, 0]$

→ linearize non-linear relationships
↳ polynomial features

4) Reciprocal Transformation

Dont use → left skewed with outlier close to 0

use → Strong Right skewed ($x > 1$) → $y \in [0, 1]$
[> 4]

↳ linearize relationship b/w feature & target

→ Strong left skewed → reflect → shift (Now treat this a right skewed distribution)
 $(-)$ → $(\text{Max} + 1) - x$

5) Box-Cox transform

$$Y'(\lambda) = \begin{cases} \frac{Y^{-\lambda} - 1}{-\lambda} & \text{if } \lambda \neq 0 \\ \log(Y) & \text{if } \lambda = 0 \end{cases} \quad \lambda \in [-5 \text{ to } 5] \text{ MLE + optimization}$$

use

- handle skewness
- handle non-normal data
- Heteroscedasticity
- general case to many other transformations

Don't use

- ve values
- Interpretability
- Data already normally distributed
- Categorical Data

6) Yeo Johnson transformation

→ improvement on Box-cox can handle -ve values also.

Yeo-Johnson transformation [\[edit\]](#)

The Yeo-Johnson transformation^[15] allows also for zero and negative values of y . λ can be any real number, where $\lambda = 1$ produces the identity transformation. The transformation law reads:

$$y_i^{(\lambda)} = \begin{cases} ((y_i + 1)^\lambda - 1)/\lambda & \text{if } \lambda \neq 0, y \geq 0 \\ \ln(y_i + 1) & \text{if } \lambda = 0, y \geq 0 \\ -((-y_i + 1)^{(2-\lambda)} - 1)/(2-\lambda) & \text{if } \lambda \neq 2, y < 0 \\ -\ln(-y_i + 1) & \text{if } \lambda = 2, y < 0 \end{cases}$$