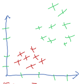
Application of inverse function In Data Science

1) Normalization And Standardization

Example: House prices Dataset → different units

Independet feactures			Dependent feature
Carpet Area	Number of rooms	Area(gaft)	Price
1500	4	1800	50
1800	3	2100	60

Same scale



[0 – 1]

CA, NR, A → ML Model → O/P ⇒ Price

Scale normalization { Matematical Operation } → convert
→ to quickly
→ optimization

1800 X 1500
or
1.5 x 1.5

Standardization => Data feature => feature => $\mu = 0$ & $\sigma = 1$
↓
standard Normal distribution

No of Rooms

$$\begin{bmatrix}1\\2\\3\\4\end{bmatrix} \in \mathbb{R} \Rightarrow \text{Standardization Transformation} \Rightarrow Z = \frac{x_i - \mu}{\sigma}$$

No of room

$$\begin{bmatrix}1\\2\\3\\4\end{bmatrix} \in \mathbb{R} \underset{f^{-1}(x)}{\overset{f(n)}{\rightleftarrows}} \begin{bmatrix}-1.5/2\\-0.5/2\\0.5/2\\1.5/2\end{bmatrix}$$

$$z_1 = \frac{1-\mu}{\sigma}$$

$$z_1 = \frac{1-2.5}{2} = \frac{-1.5}{2}$$

$$\mu = \frac{1+2+3+4}{4} = 2.5 \qquad \sigma = 2$$

Original Transformation $Z = \frac{x-\mu}{\sigma}$

Inverse Transformation $X = Z\sigma + \mu$

$$x = \frac{-1.5}{2}(2) + 2.5$$

$$x = 1$$

$\mu = 0$, $\sigma = 1$

→ Standard Scaling → ML Model → O/p

[Scaled Data] 2.5
↓ SK
↓ inverse Scaling

New Test Data → Standard Scaling

Inverse Scaling

Price y

Use Case:
After training a machine learning model on standardized data, the predictions are often rescaled back to the original scale to interpret the result in a meaningful way. For instance, if house price were standardized the inverse transformation would convert the standardized predictions back to the original price scale.

f1 f2 f3 O/p
↓
standard Scaling
↓ ↓ ↓
Price O/p → Model train → O/p [Scaled O/p]
New I/p
⇓ Inverse Scaling
Normal O/p

Normalization

Feacture scaling with min, max normalization

--> Original Transformation: $Z = \frac{x - \min(x)}{\max(x) - \min(x)}$

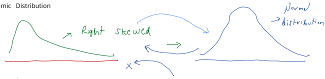
↳ $T: x \rightarrow y$

--> Inverse Transformation: $X = Z(\max(x) - \min(x)) + \min(x)$

↳ $T^{-1}: y \rightarrow X$

Distribution of Data

Logarithmic Distribution



Original transformation $y = \log(x)$

Inverse Transformation $x = e^y$

Use Case:

In financial data analysis, income or sales data often exhibit skewness. Applying a log transformation can stabilize the variance and make patterns more visible, After model prediction, the inverse log transformation is applied to interpret the results on the original scale.

Data encryption and decryption

Encryption function: E(p) = c (Where p is plaintext and c is Ciphertext)

Decryption function: D(c) = p

Use case:
Sensitive data like personal information, financial records, and medical data are encrypted before storage or transmission.
Decryption is applied to retrieve the original information.