Price
110
105
115
120
110
130
150
100
105

* Perform the mentioned techniques :

☑ Normalization

☑ Standardization

☑ Log Transformation

☑ Robust Scaler

☑ Maximum Absolute Scaler

☑ **Normalization:**

$$x_{new} = \frac{x_i - min(x)}{max(x) - min(x)}$$

Here, $min(x) = 100$
$max(x) = 150$

$\therefore max(x) - min(x) = 150 - 100 = 50$

After scaling = (using Normalization) the scaled price will be :

Price	Price_scaled
110	0.2
105	0.1
115	0.3
120	0.4
110	0.2
130	0.6
150	1
100	0
105	0.1

Standardization :

$$x_{new} = \frac{x_i - x_{mean}}{Standard\ Deviation}$$

Standard Deviation : $\sigma = \sqrt{\dfrac{\Sigma(x_i - \mu)^2}{N}}$

Now, mean of the sample $= \dfrac{110+105+115+120+110+130+150+100+105}{y}$

$$= 116.11$$

Table for calculations :

price (x_i)	mean (μ)	$x_i - \mu$	$(x_i-\mu)^2$	S.D	price_scaled
110		−6.11	37.33		−0.42
105		−11.11	123.43		−0.76
115		−1.11	1.23		−0.08
120	116.11	3.89	15.13		0.26
110		−6.11	37.33	14.68	−0.42
130		13.89	192.93		0.95
150		33.89	1148.53		2.31
100		−16.11	259.53		−1.02
105		−11.11	123.43		−0.76

☑ Log Transformation:

To avoid value zero or close-to-zero value in the logarithm function, let's add 1 to every value of the feature and then calculate $\log_e (1+x)$ which are the scaled values of the price column.

Price x	1+x	price_scaled $\log_e (1+x)$
110	111	4.71
105	106	4.66
115	116	4.75
120	121	4.80
110	111	4.71
130	131	4.88
150	150	5.02
100	101	4.62
105	106	4.66

☑ Robust Scaler :

Given the prices are : $110, 105, 115, 120, 110, 130, 150, 100, 105$

Now, ✸ Sort the values in ascending order, we get,

$$100, 105, 105, 110, 110, 115, 120, 130, 150$$

From here,

the first quantile, q_1 = the value below which 25% of the data falls

$$= 105$$

The second quantile (also the median), q_2 = The middle value of the data set

$$= 110$$

the third quantile, q_3 = The value below which 75% of the data falls

$$= 120$$

Now, the interquartile difference, $IQR = q_3 - q_1$

$$= 120 - 105$$

$$= 15$$

Formula :

$$x_{scale} = \frac{x_i - q_2}{IQR}$$

Now, calculating the scaled price and placing them into a table:

price (x_i)	$x_i - q_2$	price _ scaled
110	0	0
105	-5	-0.33
115	5	0.33
120	10	0.67
110	0	0
130	20	1.33
150	40	2.67
100	-10	-0.67
105	-5	-0.33

☑ Max Absolute Scaler:

Formula:

$$x_{scale} = \frac{x}{max(x)}$$

Table for calculations:

price (x_i)	max(x)	price_scaled $\dfrac{x}{max(x)}$
110		0.73
105		0.7
115		0.7
120		0.80
110	150	0.73
130		0.87
150		1
100		0.67
105		0.7