Linear Tranformation in Pandas

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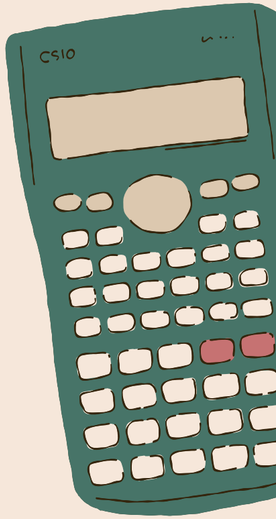
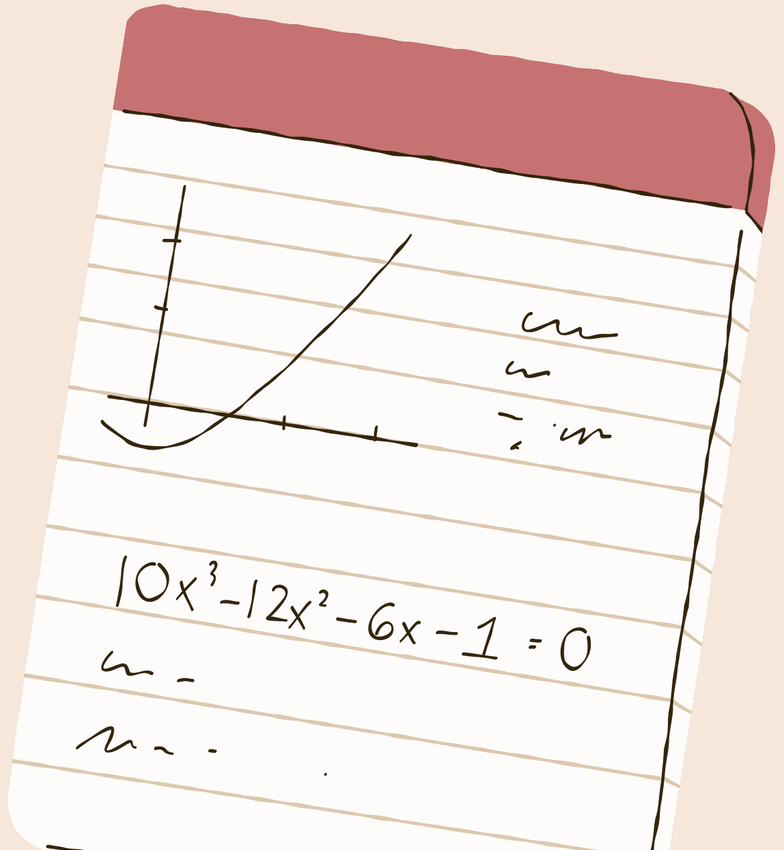
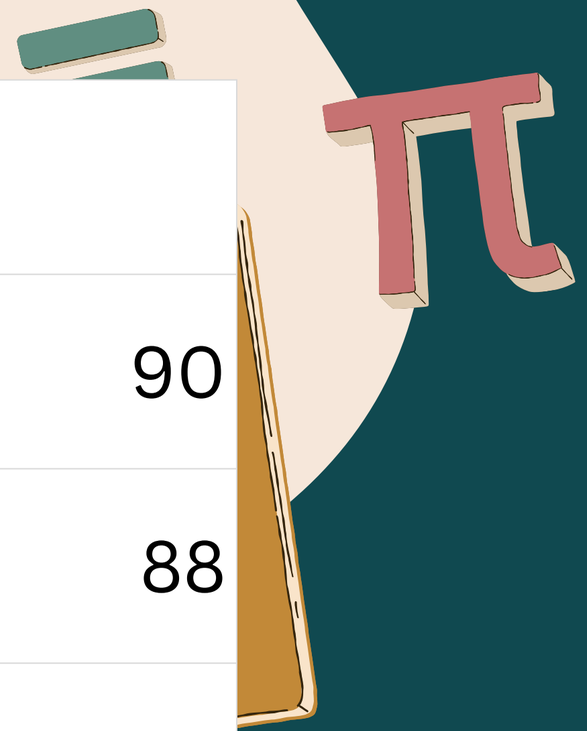




Dataset

Nama	Matematika	Bahasa	IPA
Abel	80	75	90
Angella	70	85	88
Cella	75	75	80

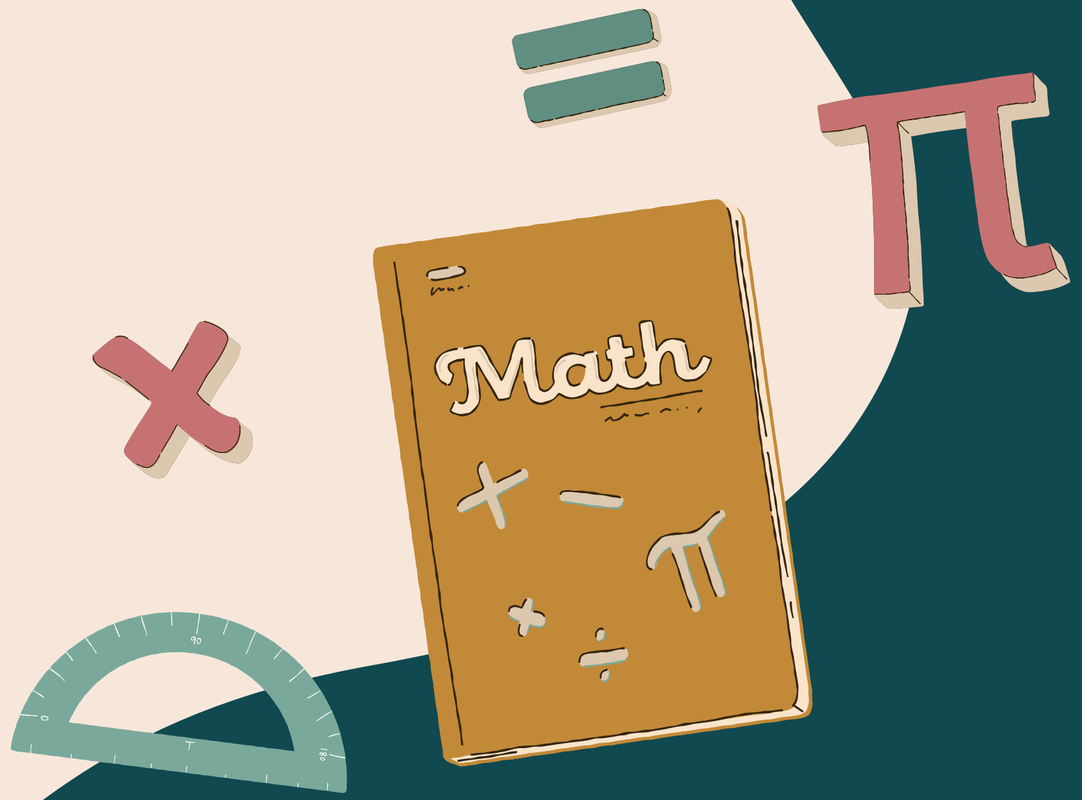


Kombinasi Linear

```
df['Skor_Akhir'] = (
    0.5 * df['Matematika'] +
    0.3 * df['Bahasa'] +
    0.2 * df['IPA'])

print(df[['Nama','Skor_Akhir']])
```

Skor Akhir=0.5 · Matematika+0.3 · Bahasa+0.2 · IPA

	Nama	Skor_Akhir
0	Abel	80.5
1	Angella	78.1
2	Cella	76.0

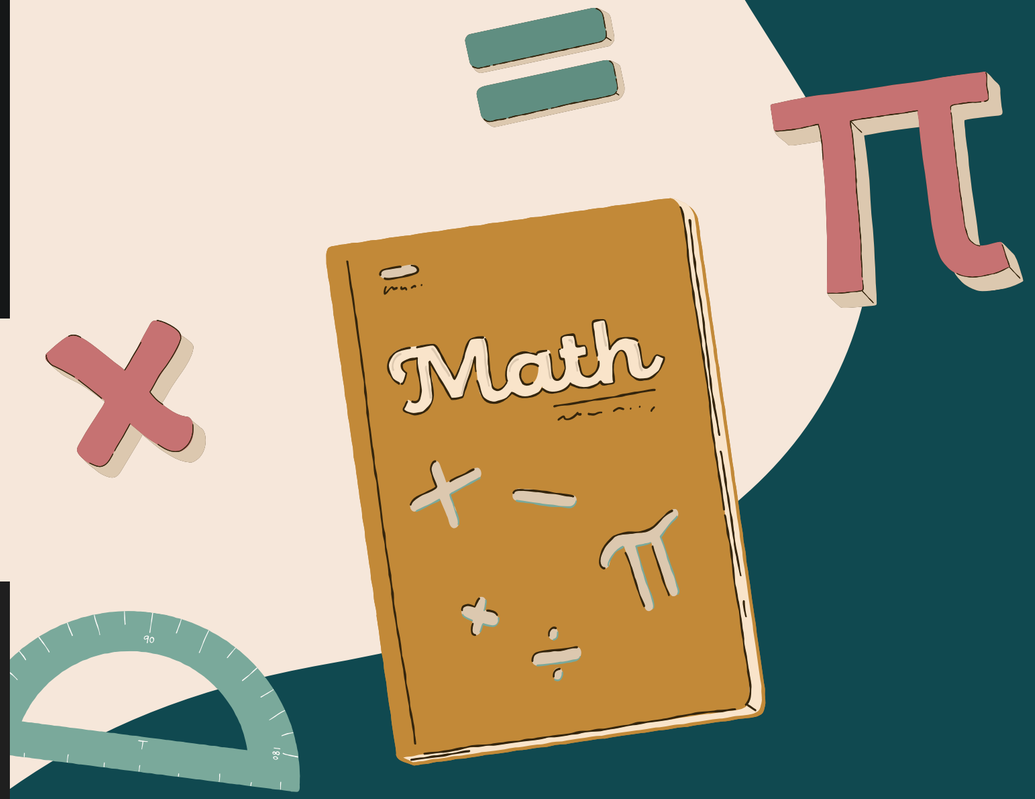


Transformasi Skalar

```python
for col in ['Matematika', 'Bahasa', 'IPA']:
    mean = df[col].mean()
    std = df[col].std()
    df[f'{col}_zscore'] = (df[col] - mean) / std

print(df[['Nama','Matematika_zscore','Bahasa_zscore','IPA_zscore']])
```

$$x' = \frac{x - \mu}{\sigma}$$

	Nama	Matematika_zscore	Bahasa_zscore	IPA_zscore
0	Abel	1.0	-0.577350	0.755929
1	Angella	-1.0	1.154701	0.377964
2	Cella	0.0	-0.577350	-1.133893

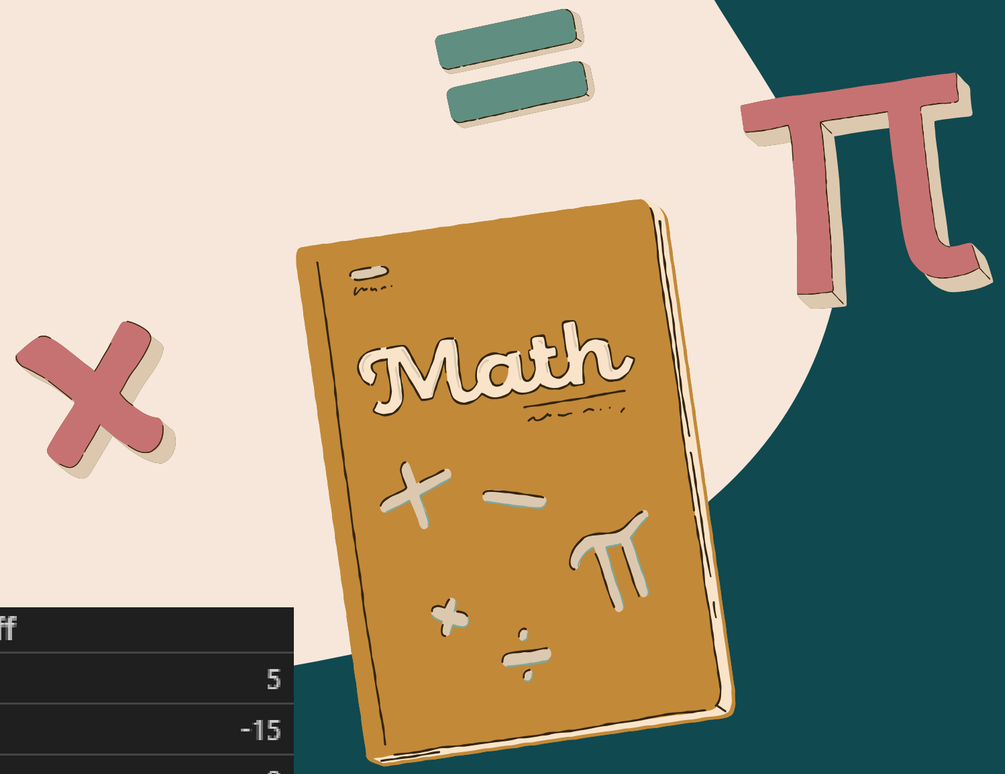


Proyeksi Linear

```
df['proj_sum'] = df['Matematika'] + df['Bahasa']
df['proj_diff'] = df['Matematika'] - df['Bahasa']

df[['Nama','proj_sum','proj_diff']]
```

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix} \cdot \begin{bmatrix} \text{Matematika} \\ \text{Bahasa} \end{bmatrix}$$

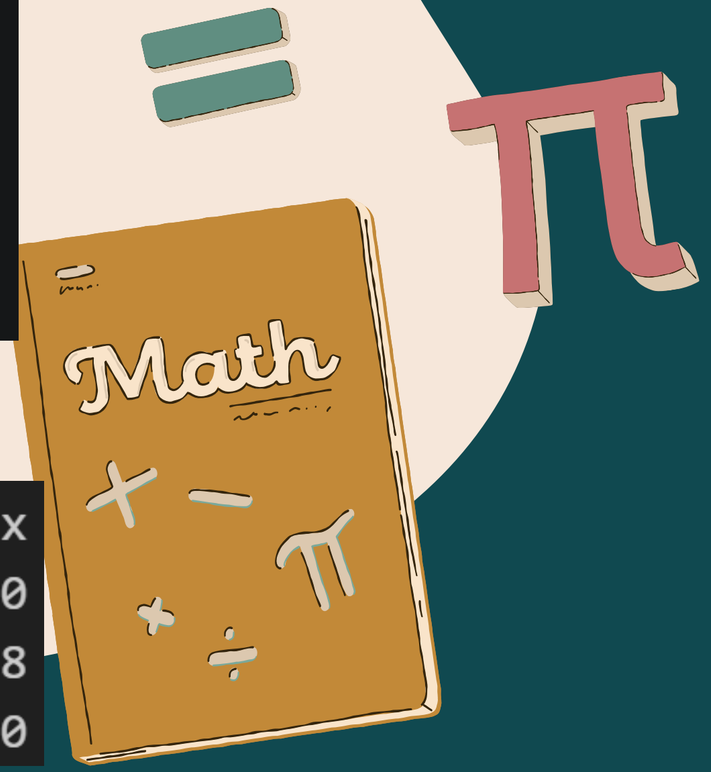
	Nama	proj_sum	proj_diff
0	Abel	155	5
1	Angella	155	-15
2	Cella	150	0



Normalisasi Min-Max

```python
for col in ['Matematika', 'Bahasa', 'IPA']:
    min_val = df[col].min()
    max_val = df[col].max()
    df[f'{col}_minmax'] = (df[col] - min_val) / (max_val - min_val)

print(df[['Nama','Matematika_minmax','Bahasa_minmax','IPA_minmax']])
```

```
    Nama  Matematika_minmax  Bahasa_minmax  IPA_minmax
0   Abel                1.0            0.0         1.0
1  Angella              0.0            1.0         0.8
2   Cella               0.5            0.0         0.0
```

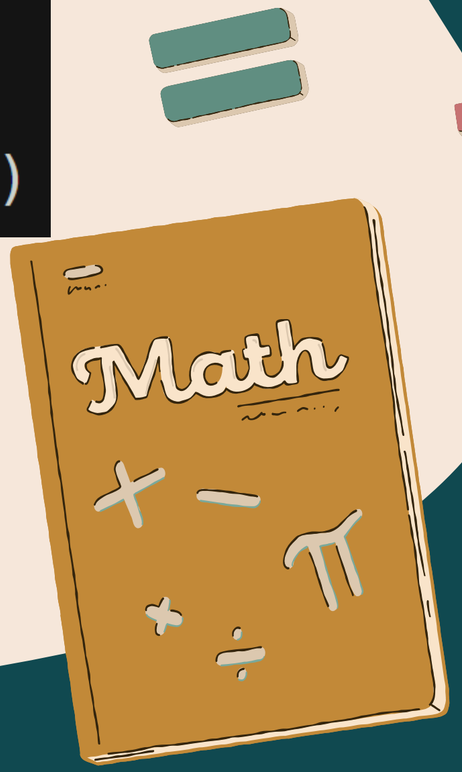


Shift

Membuat nilai lampau (lag), perbandingan antar waktu

```
df['Shifted Bahasa'] = df['Bahasa'].shift(1)
```

$$T(x)_t = x_{t-1}$$




```
Hasil transformasi linier:
      Nama  Matematika  Bahasa  IPA  Shifted Bahasa
0     Abel          80      75   90             NaN
1  Angella          70      85   88            75.0
2    Cella          75      75   80            85.0
```

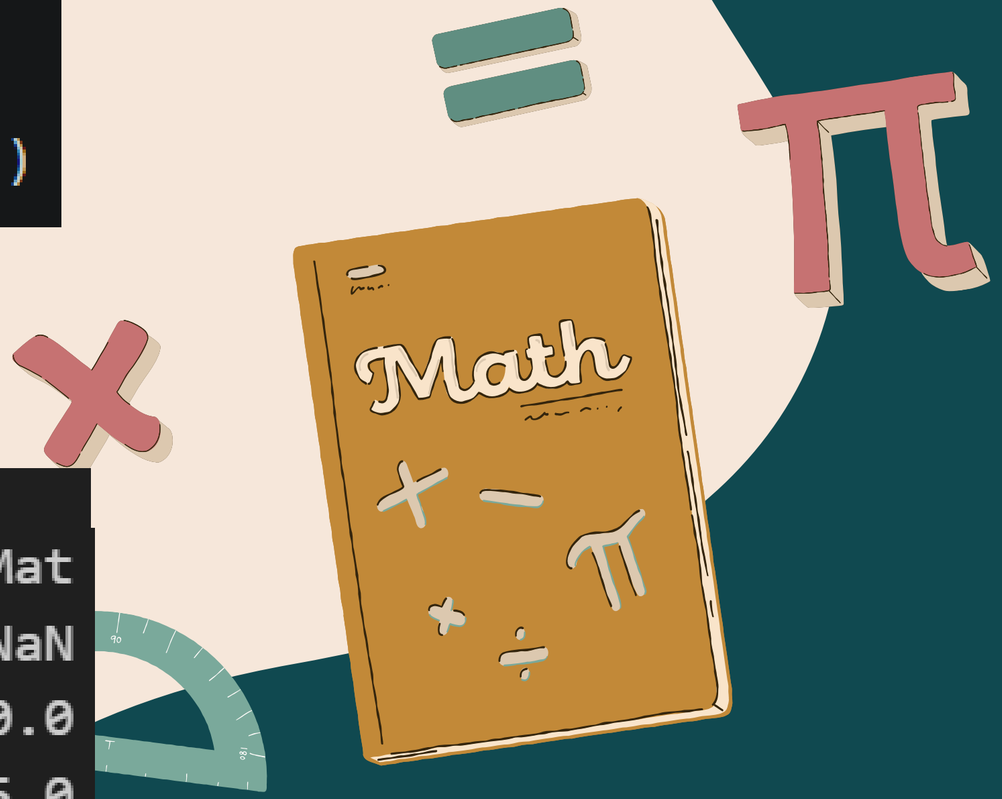
Difference

Tujuan: Menghitung perubahan antar waktu (growth, delta)

```
df['Diff Mat'] = df['Matematika'].diff()
```

$$T(x)_t = x_t - x_{t-1}$$

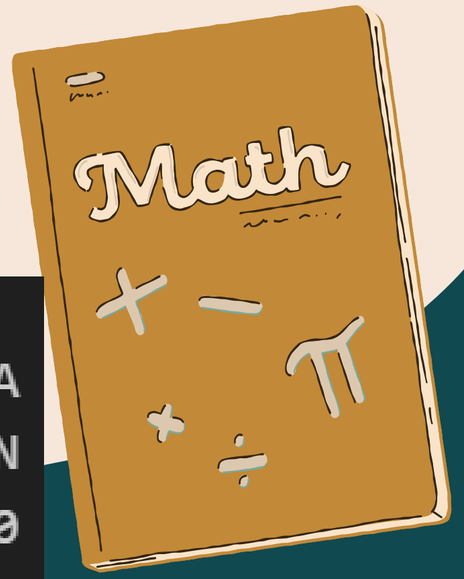
```
Hasil transformasi linier:
      Nama  Matematika  Bahasa  IPA  Diff Mat
0     Abel          80      75   90       NaN
1  Angella          70      85   88     -10.0
2    Cella          75      75   80       5.0
```



Rolling Mean

```
df['Rolling Mean IPA'] = df['IPA'].rolling(window=2).mean()
```

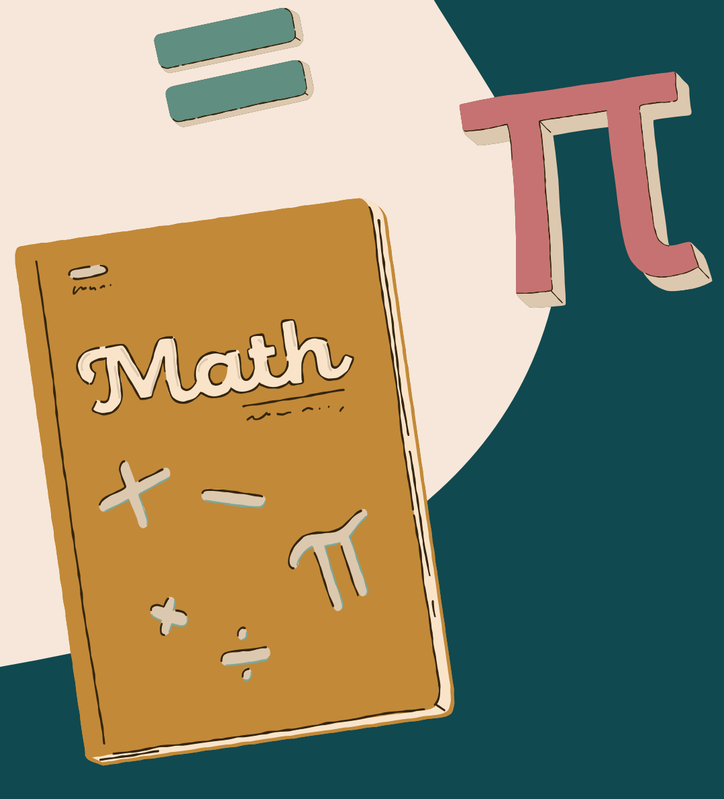
$$T(x)_t = \frac{x_t + x_{t-1}}{2}$$




```
Hasil transformasi linier:
      Nama  Matematika  Bahasa  IPA  Rolling Mean IPA
0     Abel          80      75   90              NaN
1  Angella          70      85   88             89.0
2    Cella          75      75   80             84.0
```

Model

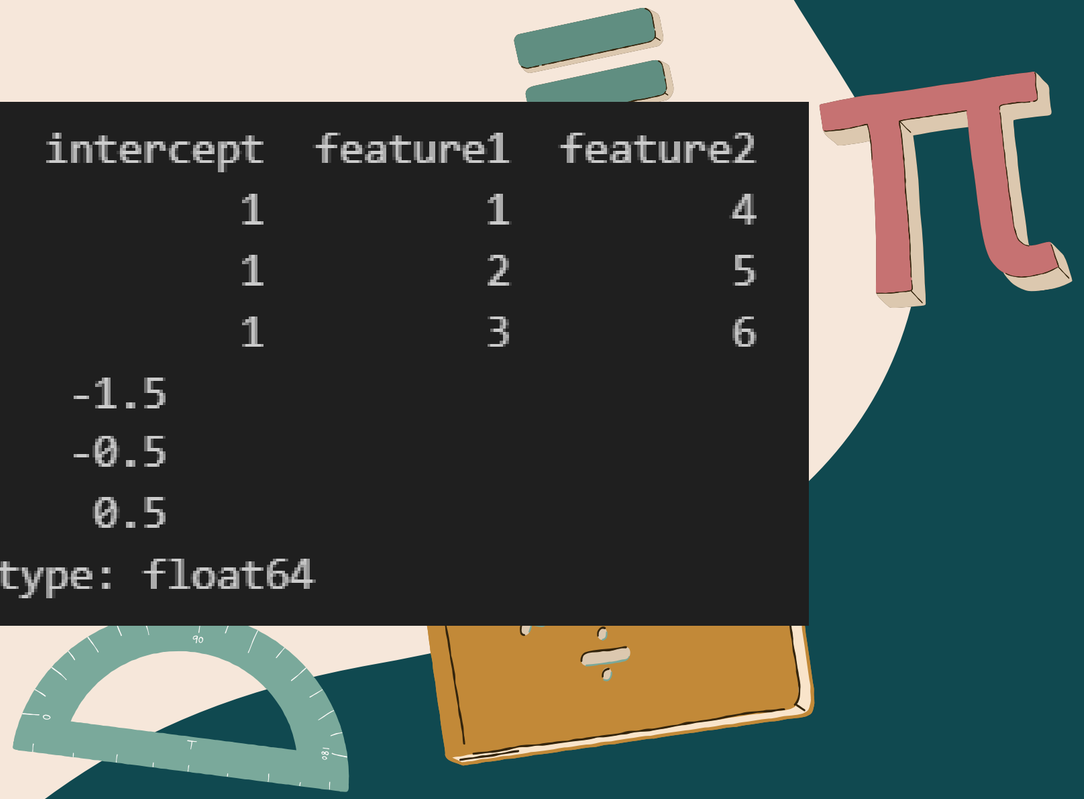
intercept	feature1	feature2
1	1	4
1	2	5
1	3	6



Dot

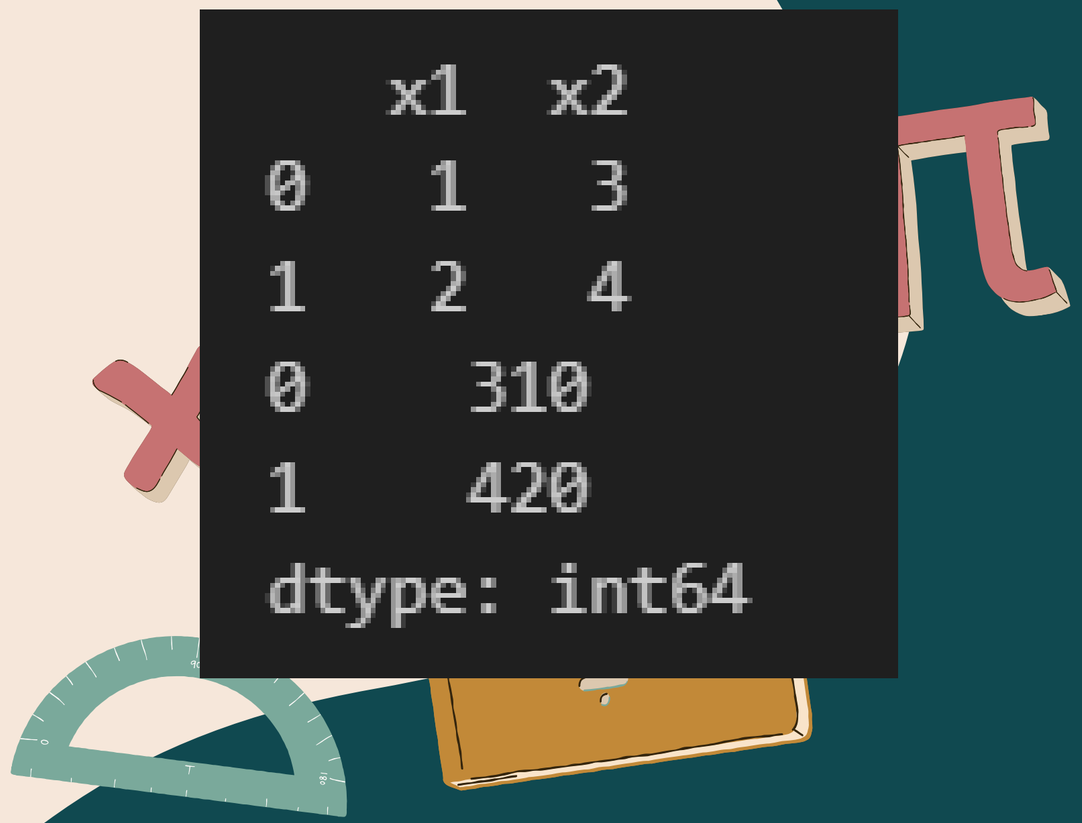
```python
X = pd.DataFrame({
    'intercept' : 1,
    'feature1' : [1,2,3],
    'feature2' : [4,5,6]
})
print(X)

beta = pd.Series({
    'intercept' : 0.5,
    'feature1' : 2.0,
    'feature2' : -1.0
})

y_pred = X.dot(beta)
print(y_pred)
```

```
   intercept  feature1  feature2
0          1         1         4
1          1         2         5
2          1         3         6
0   -1.5
1   -0.5
2    0.5
dtype: float64
```



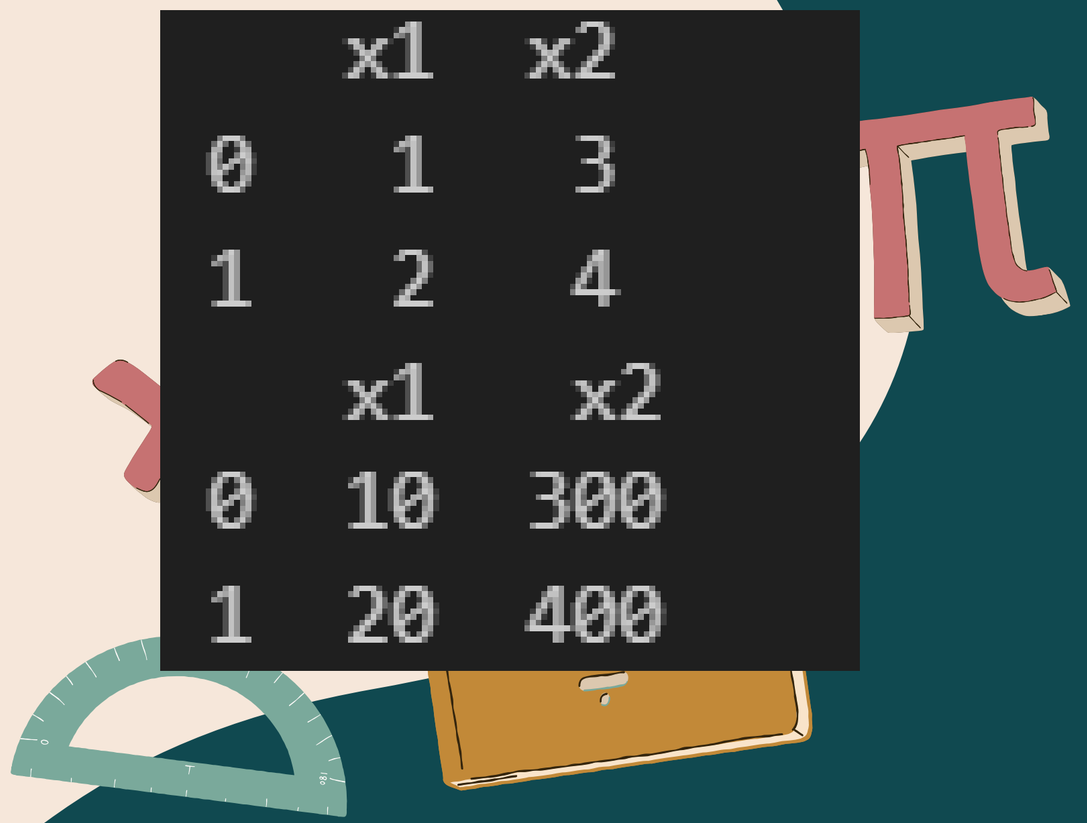
Dot Product

```python
# DataFrame (matriks X)
df = pd.DataFrame({
    'x1': [1, 2],
    'x2': [3, 4]
})
print(df)

# Series (vektor w)
w = pd.Series([10, 100], index=['x1', 'x2'])

# Dot product (X @ w)
result = df.dot(w)
print(result)
```



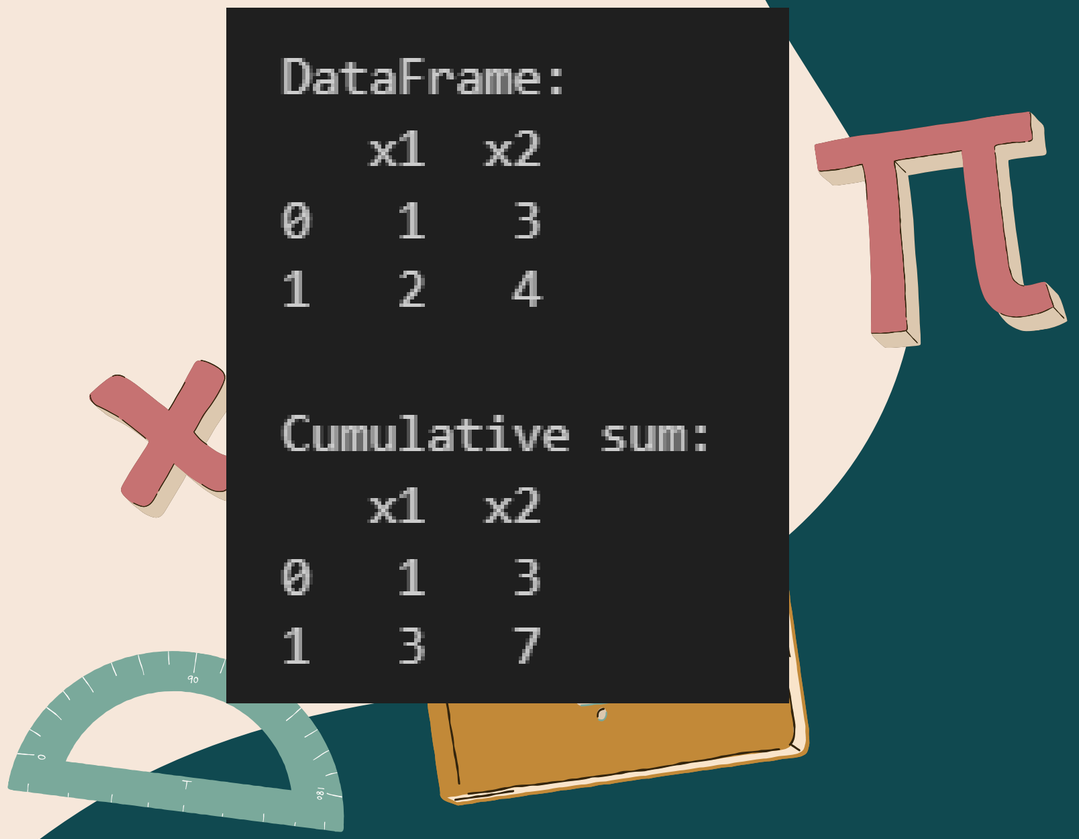
Multiply

```python
# DataFrame (matriks X)
df = pd.DataFrame({
    'x1': [1, 2],
    'x2': [3, 4]
})
print(df)

# Series (vektor w)
w = pd.Series([10, 100], index=['x1', 'x2'])

# Dot product (X @ w)
result = df.mul(w,axis=1)
print(result)
```



Cumulative Sum

```python
import pandas as pd

# DataFrame (matriks X)
df = pd.DataFrame({
    'x1': [1, 2],
    'x2': [3, 4]
})
print("DataFrame:")
print(df)

# Series (vektor bobot w)
w = pd.Series([10, 100], index=['x1', 'x2'])

# Step 3: Cumulative sum dari hasil dot product baris
cumulative = df.cumsum()
print("\nCumulative sum:")
print(cumulative)
```

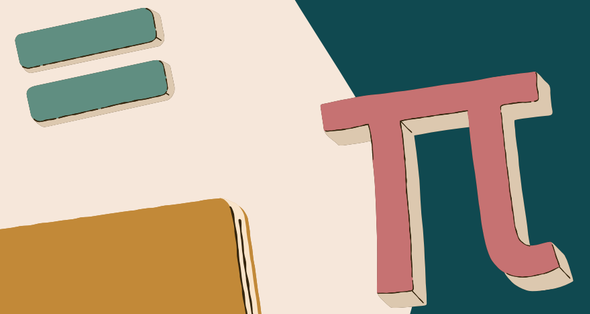


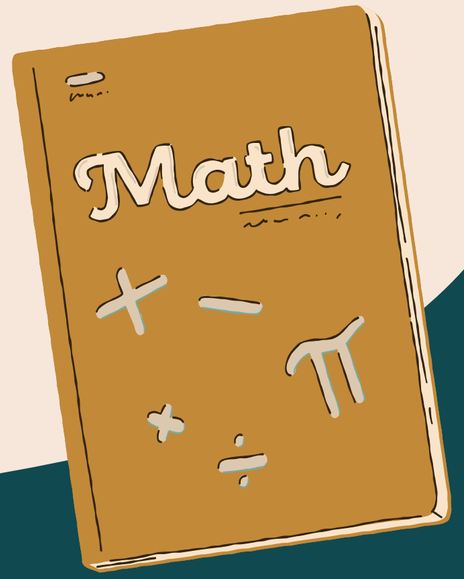
Sifat Transformasi Linear

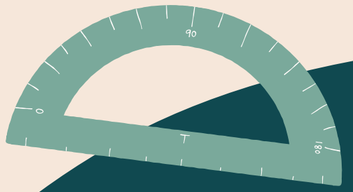
Homogenitas

```python
import numpy as np

# Matriks transformasi A
A = np.array([[2, 0],
              [0, 3]])

# Vektor x
x = np.array([1, 2])

# Skalar a
a = 5

# T(a·x)
T_ax = A @ (a * x)

# a·T(x)
a_Tx = a * (A @ x)

print("T(a·x):", T_ax)
print("a·T(x):", a_Tx)
print("Sama? :", np.allclose(T_ax, a_Tx))
```

```
...   T(a·x): [10 30]
      a·T(x): [10 30]
      Sama? : True
```



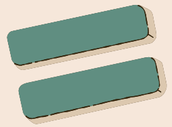


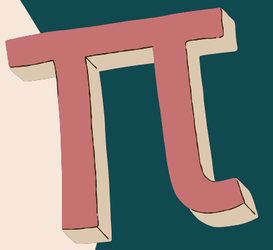


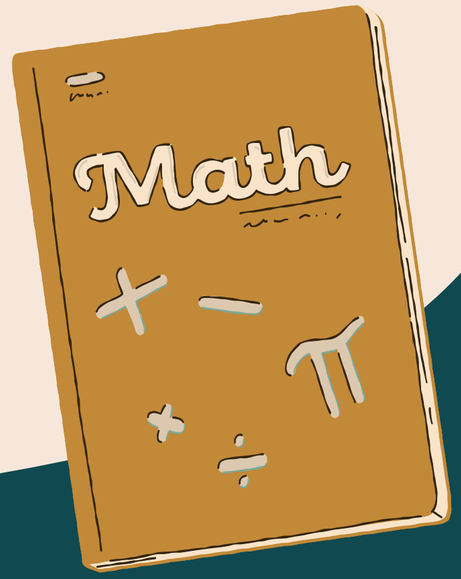
Sifat Transformasi Linear
Additivitas

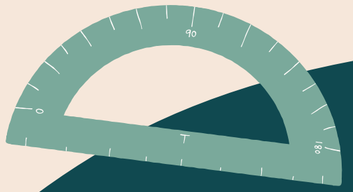
```python
# Dua vektor
x = np.array([1, 2])
y = np.array([3, 4])

# T(x + y)
T_x_plus_y = A @ (x + y)

# T(x) + T(y)
T_x = A @ x
T_y = A @ y
T_x_plus_T_y = T_x + T_y

print("T(x + y):", T_x_plus_y)
print("T(x) + T(y):", T_x_plus_T_y)
print("Sama?     :", np.allclose(T_x_plus_y, T_x_plus_T_y))
```

```
...   T(x + y): [ 8 18]
      T(x) + T(y): [ 8 18]
      Sama?     : True
```









Thank you for listening

Saranghae <3