```
In [1]: import pandas as pd
        import numpy as np
        import matplotlib.pyplot as plt
        import seaborn as sns
        import warnings
        warnings.filterwarnings('ignore')
```

```
In [2]: df = pd.read_csv("AirPassengers.csv")
        df.head()
```
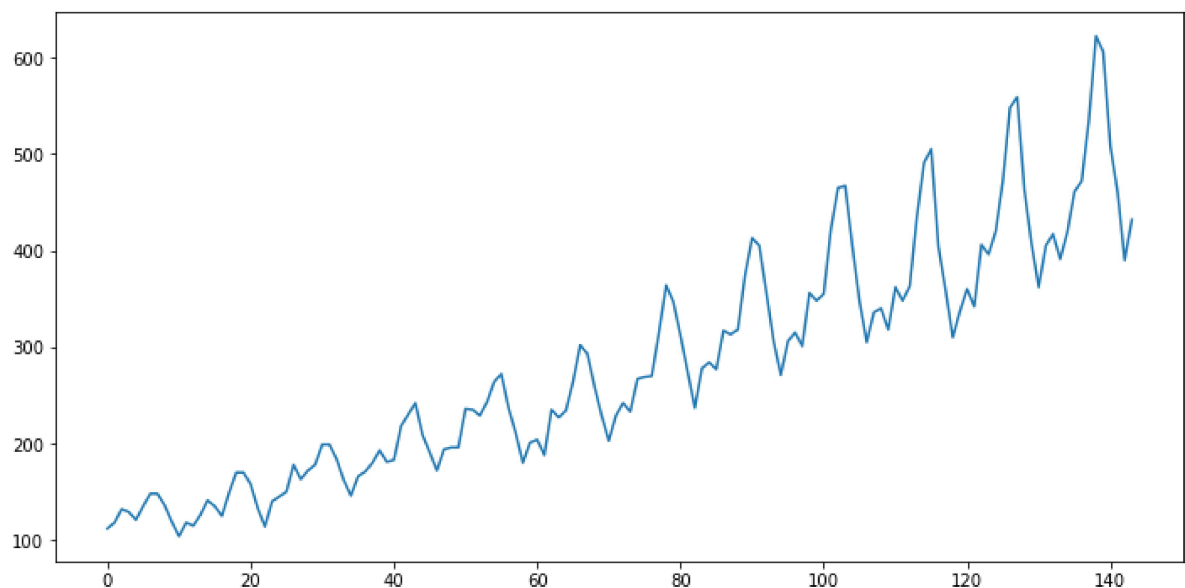
Out[2]:

	Month	#Passengers
0	1949-01	112
1	1949-02	118
2	1949-03	132
3	1949-04	129
4	1949-05	121

```
In [3]: df.rename(columns={'#Passengers':'Passengers'},inplace = True)
```

```
In [4]: plt.rcParams.update({'figure.figsize':(12,6)})
        df['Passengers'].plot()
```

Out[4]: <AxesSubplot:>

Moving Averages

1. Simple Moving Average (SMA)
2. Cumulative Moving Average (CMA)
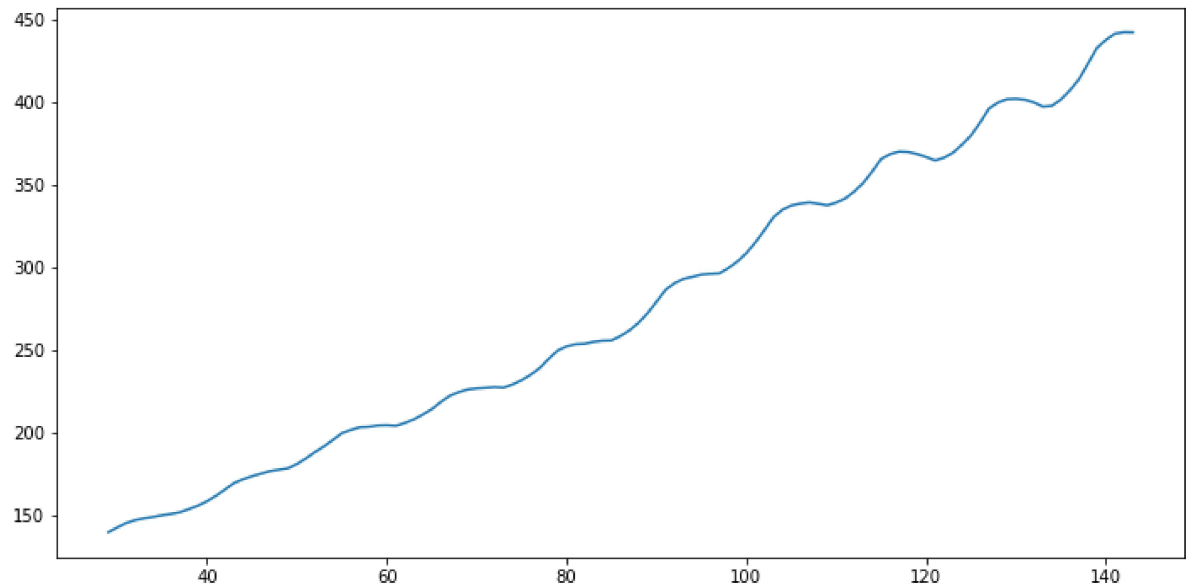3. Exponential Moving Average (EMA) / Exponential Weighted Moving Average (EWMA)

SMA/ Rolling Mean

$$SMA_t = \frac{x_t + x_{t-1} + x_{t-2} + \ldots + x_{t-n}}{n}$$

In [5]:
```python
df['SMA_30']=df['Passengers'].rolling(window = 30).mean()
```
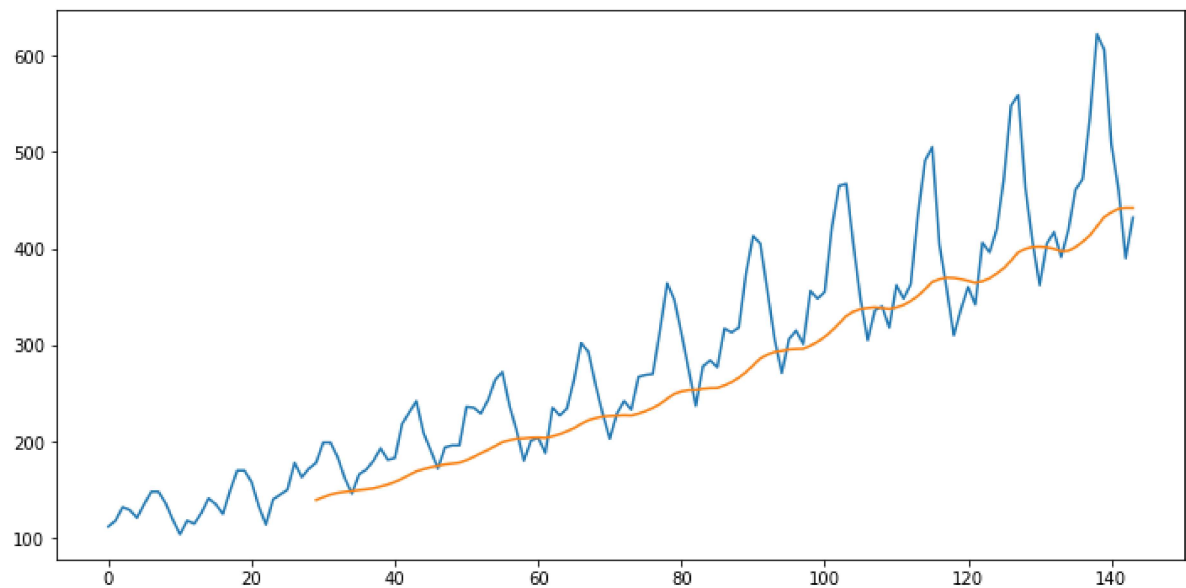
In [6]:
```python
df['SMA_30'].dropna().plot()
```

Out[6]: <AxesSubplot:>

In [7]:
```python
df['Passengers'].plot()
df['SMA_30'].dropna().plot()
```

Out[7]: <AxesSubplot:>

In [ ]:

Conclusion: Passenger column has uptrend/increasing trend(Pattern)

CMA

$$CMA_t = \frac{x_1 + x_2 + \ldots + x_n}{n}$$

In [8]:
```python
df['CMA']=df['Passengers'].expanding().mean()
```

In [9]:
```python
df
```

Out[9]:

	Month	Passengers	SMA_30	CMA
0	1949-01	112	NaN	112.000000
1	1949-02	118	NaN	115.000000
2	1949-03	132	NaN	120.666667
3	1949-04	129	NaN	122.750000
4	1949-05	121	NaN	122.400000
...	...	...	...	...
139	1960-08	606	432.566667	275.514286
140	1960-09	508	437.433333	277.163121
141	1960-10	461	441.200000	278.457746
142	1960-11	390	442.100000	279.237762
143	1960-12	432	442.000000	280.298611

144 rows × 4 columns

```
In [10]: df['Passengers'].plot()
         df['CMA'].plot()
```

```
Out[10]: <AxesSubplot:>
```
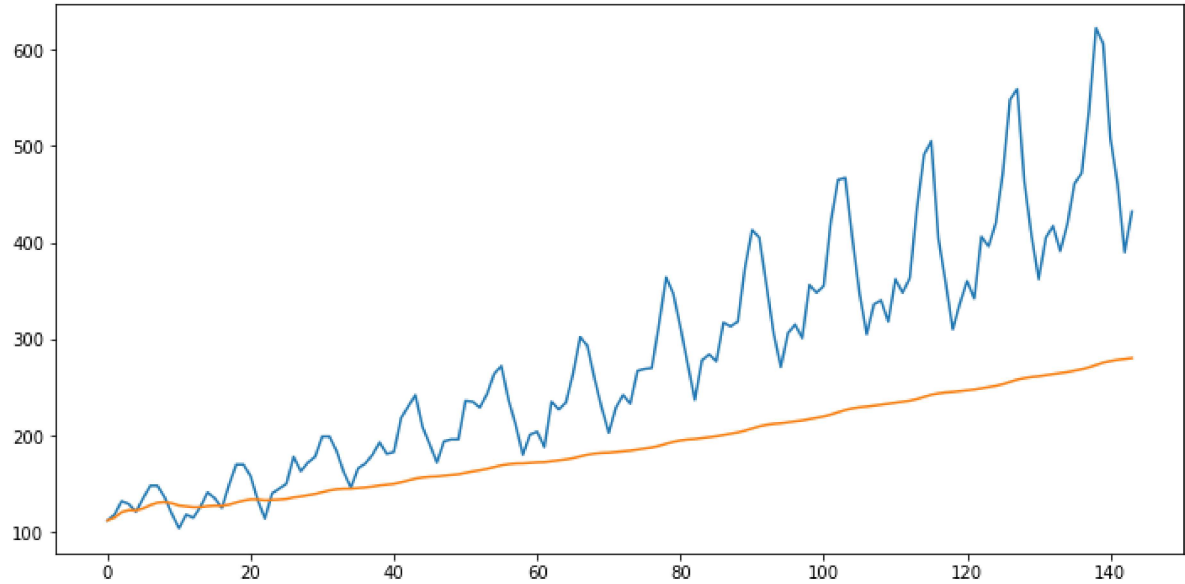


```
In [ ]:
```

EMA / EWMA

$$EMA_t = \alpha * x_t + (1 - \alpha) * EMA_{t-1}$$
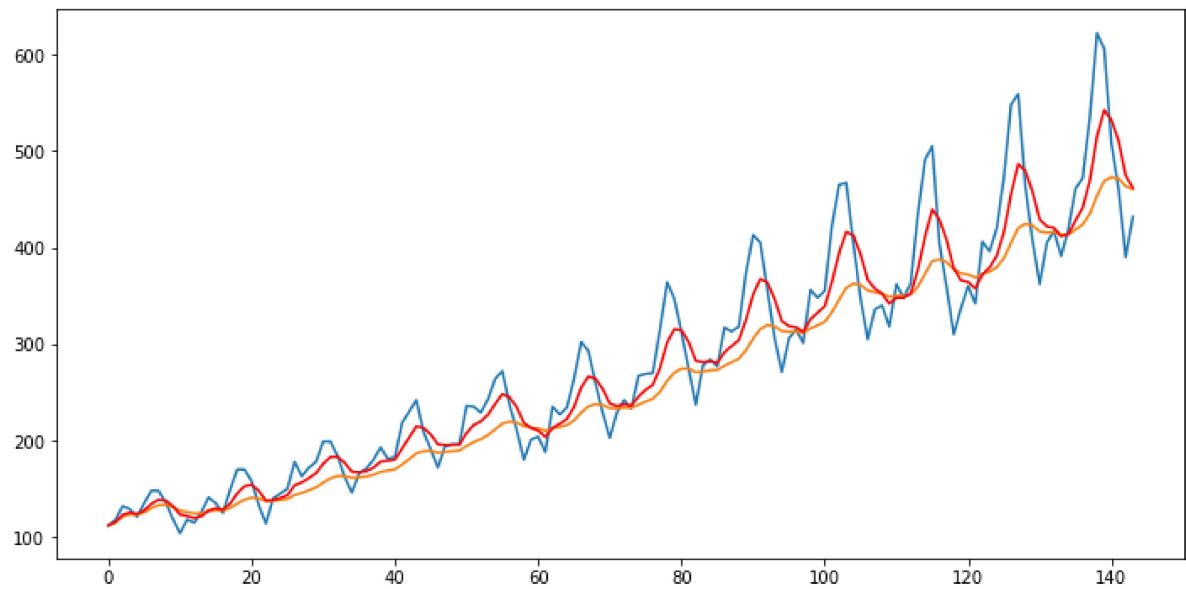
alpha is smoothing factor

Range of alpha is between 0 to 1

```
In [11]: # df['EMA']=df['Passengers'].ewm(span=4, adjust=False).mean()
         df['EMA_0.1']=df['Passengers'].ewm(alpha = 0.1).mean()
         df['EMA_0.3']=df['Passengers'].ewm(alpha = 0.3).mean()
```

In [12]:
```python
df['Passengers'].plot()
df['EMA_0.1'].plot()
df['EMA_0.3'].plot(color='r')
```

Out[12]: <AxesSubplot:>

In [ ]: