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# Introduction to Time Series Analysis

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# What is time series?

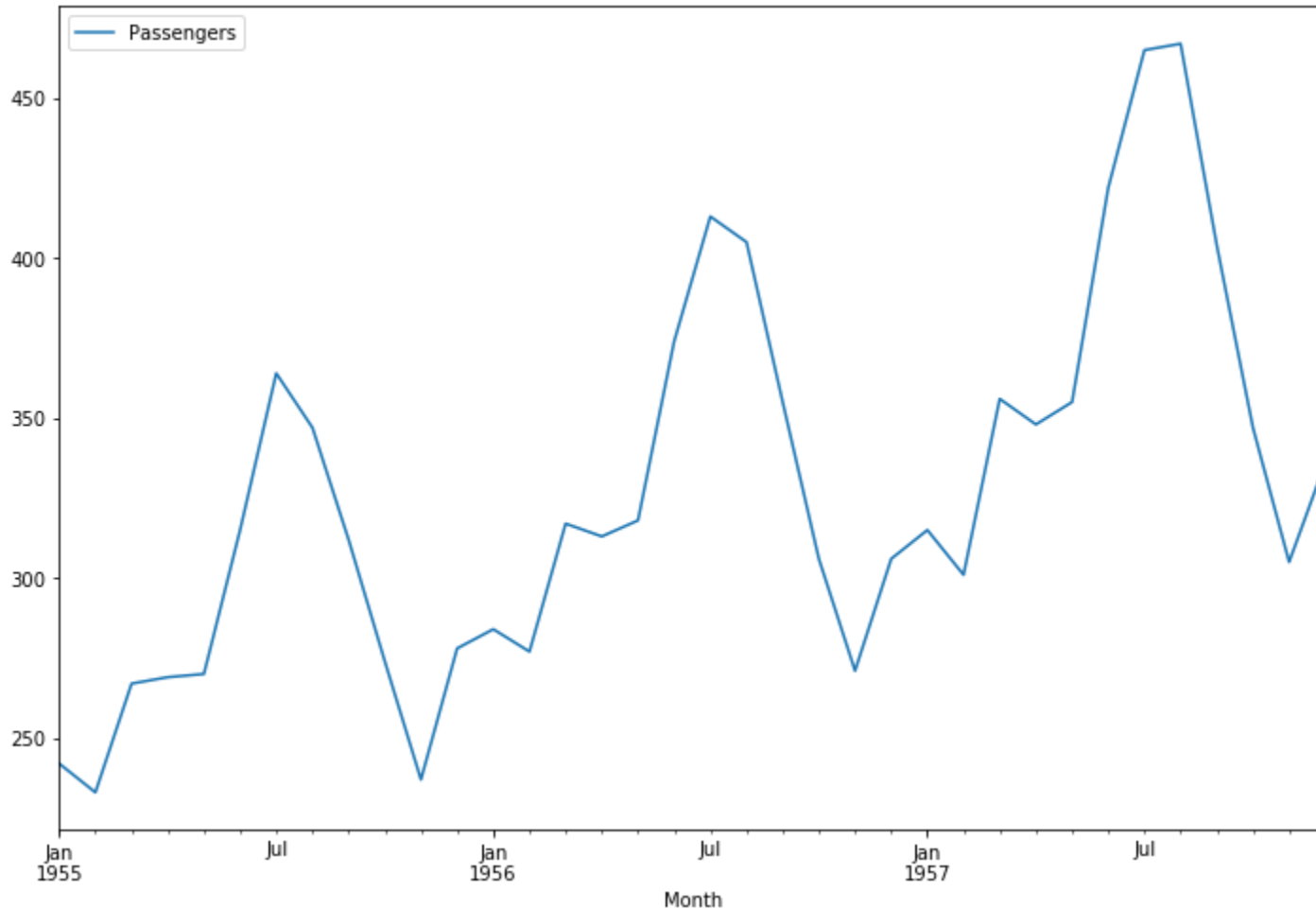
- The data points are not time dependent
- The sequence of the data points is not important

	mpg	cylinders	displacement	horsepower	weight	acceleration	model_year	origin	car_name
0	18.0	8	307.0	130.0	3504.0	12.0	70	1	chevrolet chevelle malibu
1	15.0	8	350.0	165.0	3693.0	11.5	70	1	buick skylark 320
2	18.0	8	318.0	150.0	3436.0	11.0	70	1	plymouth satellite
3	16.0	8	304.0	150.0	3433.0	12.0	70	1	amc rebel sst
4	17.0	8	302.0	140.0	3449.0	10.5	70	1	ford torino

# What is time series?

- A time series is a sequence of observations ordered by time
- The data points are observations that take place in a given period of time
- Collected or measured in regular interval
  - millisecond, sec, min, hour, day, week, ... month, year, ...

# What is time series?



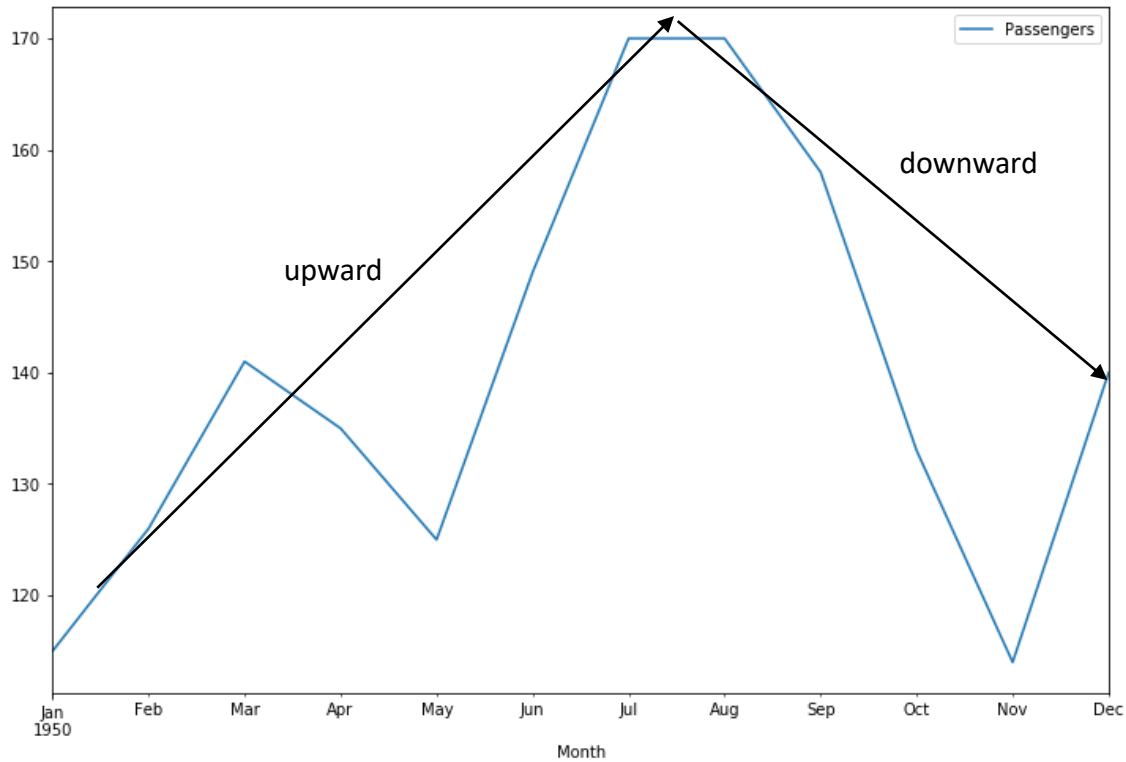
# Components of Time Series

- Trend
- Seasonal Variations
- Cyclic Variations
- Irregular Variations

# Trend

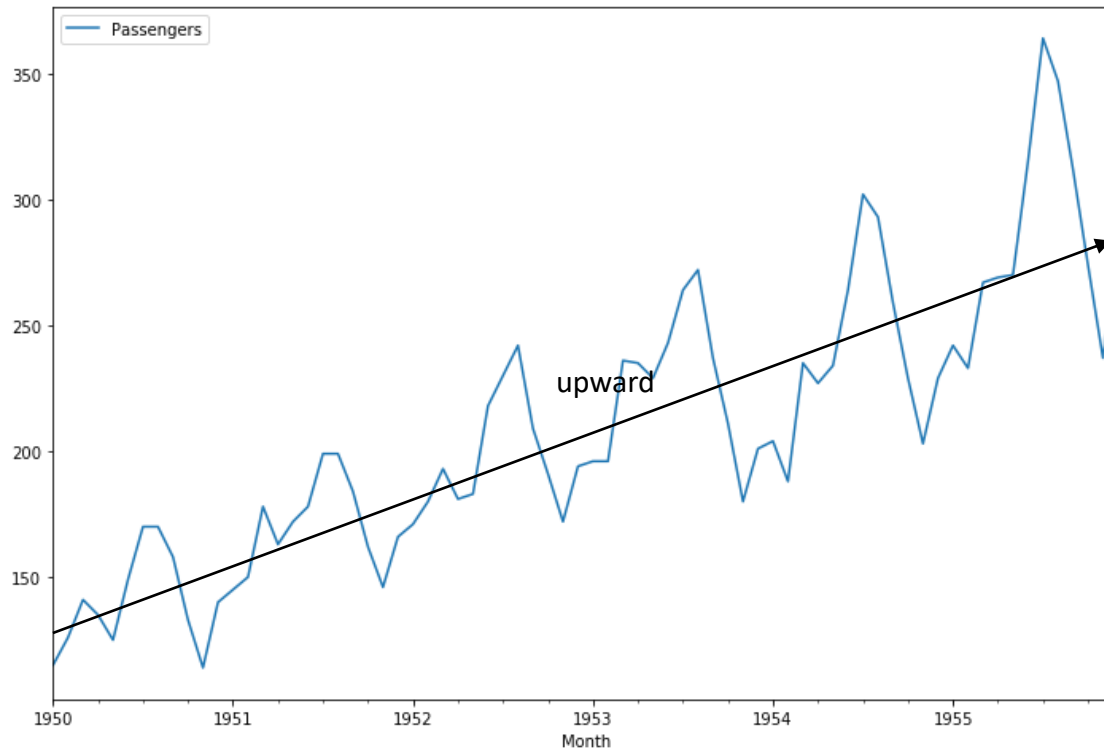
- The general tendency of the data to increase or decrease during a **long period of time**
- The general, long-term and average tendency
- Tendencies may increase or decrease or stable in different section of time
  - Overall trend must be upward, downward or stable

# Trend



Tendency within 1 year is **upward** (Jan – Jul) and **downward** (Jul – Dec)

# Trend



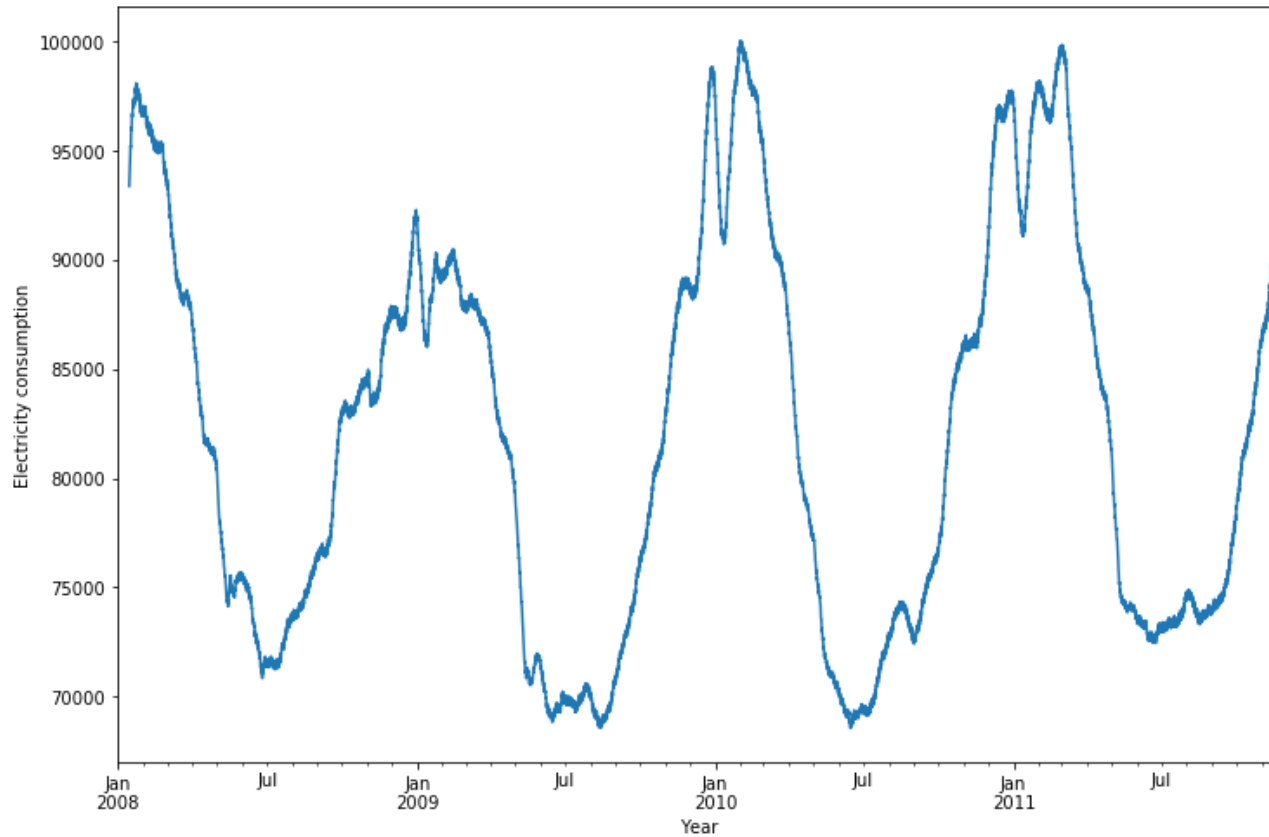
The long-term tendency is **upward**



# Seasonal Variations

- A regular fluctuation (periodic manner) over a span of less than a year
- Hourly, daily, weekly, monthly or quarterly

# Seasonal Variations

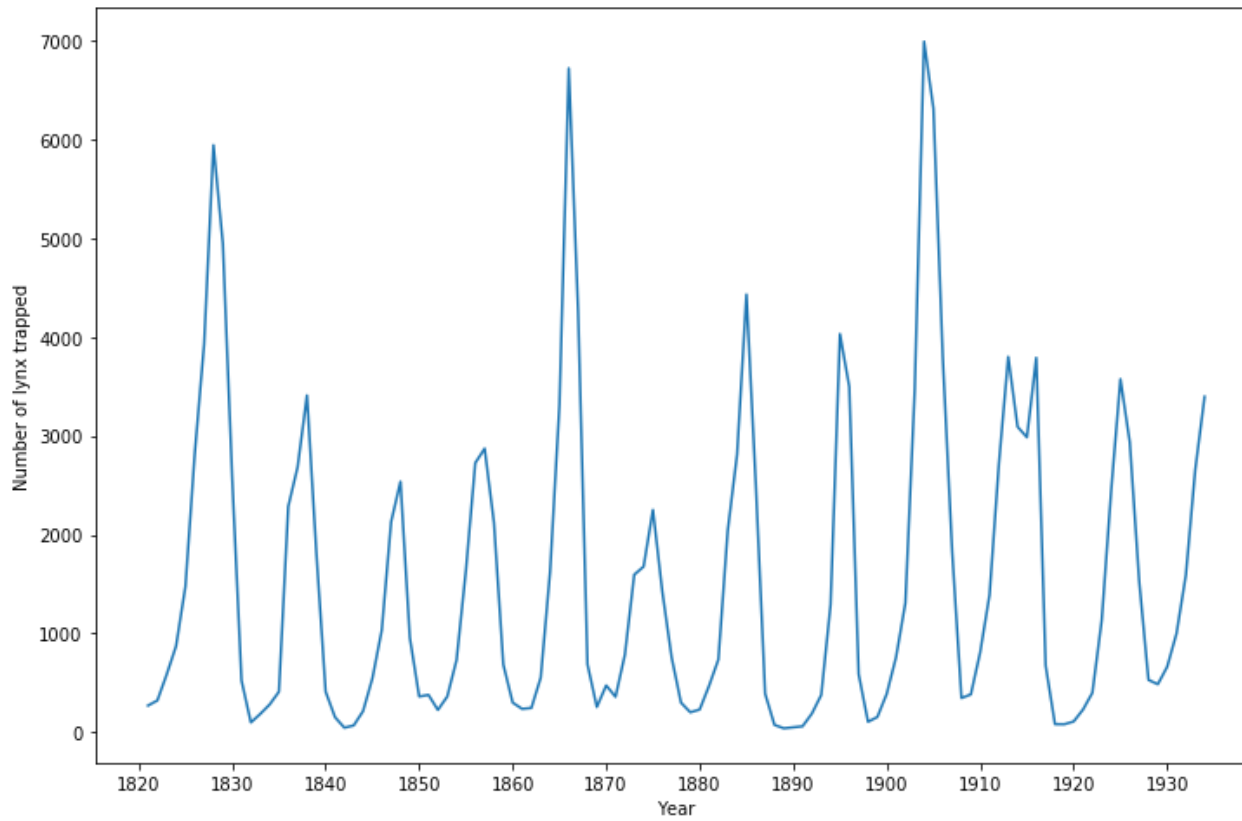


**Peak** during January and at **minimum** during July within each year

# Cyclic Variations

- Fluctuations that are not of fixed period
- Duration is of more than 1 year

# Cyclic Variations



The cycles **are not of fixed length** – some last 8 or 9 years and others last longer than 10 years.

# Seasonal Variations vs Cyclic Variations

- If the fluctuations are not of fixed period then they are cyclic
- If the period is unchanging and associated with some aspect of the calendar, then the pattern is seasonal
- The average length of cycles is longer than the length of a seasonal pattern
- The magnitude of cycles tends to be more variable than the magnitude of seasonal patterns

# Irregular Variations

- Variations other than the trend, seasonal and cyclic (residual)
- The unpredictable component (random)
- The variations occur due to sudden causes or accidental or erratic fluctuations e.g. a rise in prices of steel due to strike in the factory, pandemic, accident due to flooding, earthquake etc.

End