**Time series:**

Time series is a sequence of data captured at an equally spaced period of time. While this type of data is nothing new in weather measurements, stock market and mobile data transmission, the police phone calls, exponential increase in the volume of data generated in recent years is driven by new technologies within the realm of Internet of Things (IoT) where data is continuously generated and recorded over time even during their idle state.

A quick look at a time series plot, for example, the representation of sound waves from a music clip may be very hard to interpret since the underlying pattern behind the jagged peaks and troughs are very cannot be easily detected in its raw form.

**How to Deal with Seasonality/Trends in Time Series:** The following is approaches on how to deal with seasonality and trends in time series.

1. **Decomposition:** we can decompose the underlying components of a time series using Statsmodel using its seasonal\_decompose function into its trend, seasonality, and residual elements. A trend that appears to follow a linear relationship may be modelled using a linear or logistic regression model, and while residual should be a random element, there are techniques out there such as ARCH model that could help in its prediction. For the seasonality component, if the underlying pattern behind it is still unclear as in the case above, we can approach the problem using Fourier transformation.
2. **Detrending using Fourier transform:** Use Fourier terms to model the time series. I believe that empirical results have shown that this performs better for long-term components, while performance degrades as the frequency increases. We can also detrend using Fourier terms and still use lags in order to further model any autocorrelations. In this way, we can just ignore the seasonality and directly model the time series. This includes lags of the target series.
3. Seasonal ARIMA models: Stationarity is a necessary condition before applying ARIMA. When seasonality is removed via seasonal differencing, we use ARIMA .

**Fourier analysis:** Our goal is to take this single-variable periodic time series and decompose it into simpler periodic functions. The method for expressing a function **as a sum of sines and/or cosines,** and for recovering the function from those components is called Fourier analysis. It does not matter if the function is non-sinusoidal. Any periodic time series is an infinite sum of sinusoidal components with coefficients. Fourier analysis is the process of obtaining the spectrum of frequencies H(f) comprising a time-series h(t) and it is realized by the Fourier Transform (FT).

## Diagram Description automatically generated

## Fourier transform? The Fourier transform allows you to transform a function of time and signal into a function of frequency and power. This tells you what frequencies make up your signal and how strong they are. The goal is to obtain the magnitude (frequency) and phase information (power).

.