

PHY408

Time Series Analysis

January 11, 2023

Signal and System

Signal: Something conveys information, description of a physical system, mathematically, functions of one or more variables, e.g. $f(t)$, $g(x, y)$.



Audio signals



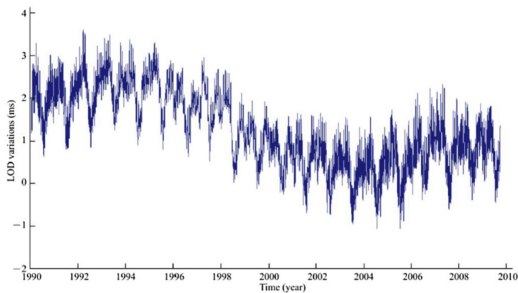
Images

Example: Time Series



source: tradingeconomics.com

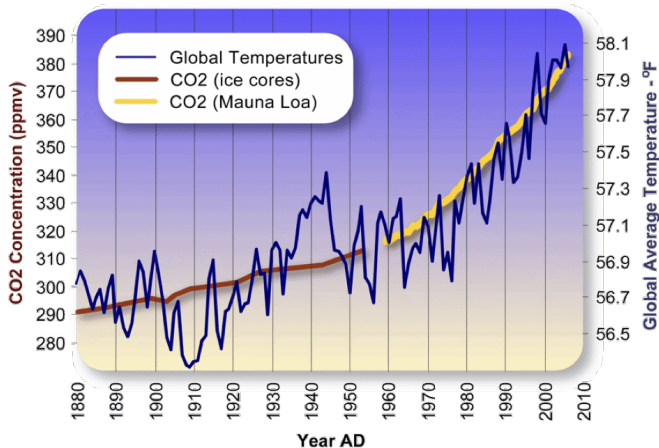
Example: Time Series



[Yu et al., 2015]

Example: Time Series

Global Average Temperature and Carbon Dioxide Concentrations, 1880 - 2006



Data Source Temperature: ftp://ftp.ncdc.noaa.gov/pub/data/anomalies/annual.land_and_ocean.90S.90N.df_1901-2000mean.dat

Data Source CO2 (Siple Ice Cores): <http://cdiac.esd.ornl.gov/ftp/trends/co2/siple2.013>

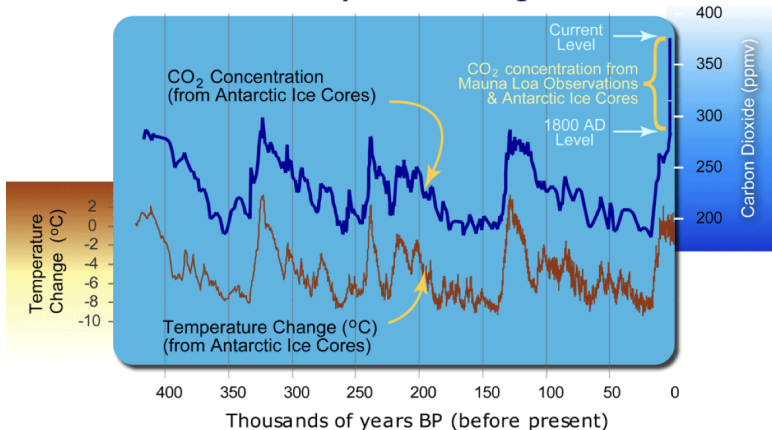
Data Source CO2 (Mauna Loa): <http://cdiac.esd.ornl.gov/ftp/trends/co2/maunaloa.co2>
& http://www.esrl.noaa.gov/gmd/webdata/ccgg/trends/co2_mm_mlo.dat

Graphic Design: Michael Ernst, The Woods Hole Research Center



Example: Time Series

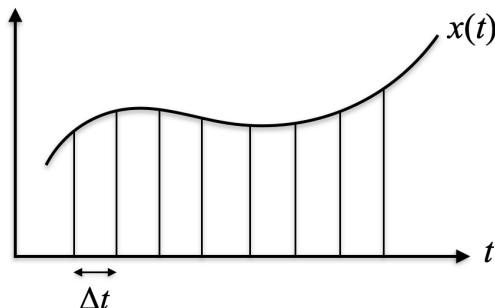
400 Thousand Years of Atmospheric Carbon Dioxide Concentration and Temperature Change



Data Source CO₂: <http://cdiac.ornl.gov/pub/trends/co2/vostok.icecore.co2>
Data Source Temp: <http://cdiac.esd.ornl.gov/ftp/trends/temp/vostok/vostok.1999.temp.dat>

Graphic: Michael Ernst, The Woods Hole Research Center



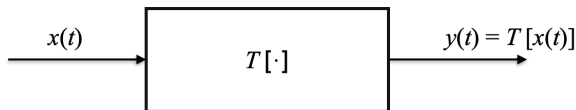


- **Continuous-time signal:** $x(t)$ represented by a continuous independent variable.
- **Discrete-time signal:** x_k , the independent variable has discrete values

$$x_k = x(k\Delta t) \quad k = 0, 1, 2, \dots, N \quad (1)$$

where Δt is the sampling interval.

System



A system maps an input signal $x(t)$ onto an output signal $y(t)$.