

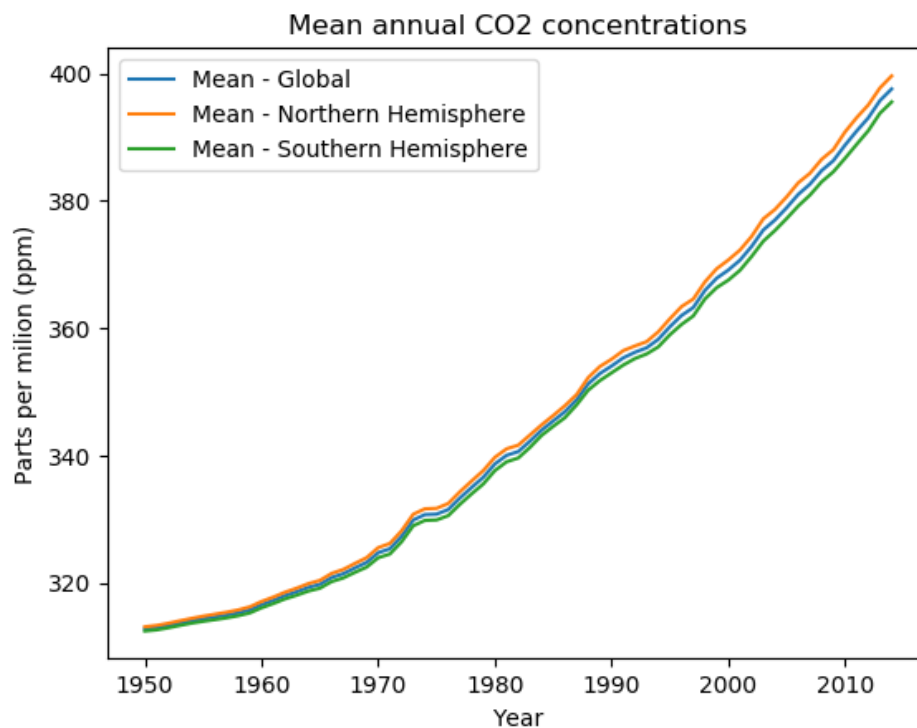
Link to Github: <https://github.com/MatornenSinera/BDA-2ndSemester/tree/master/3rd-semester/Monographic%20Lecture%20In%20Mathematics>

Dataset: co2.csv – measurement of CO₂ concentration in Earth's atmosphere.
Analysis of data beginning from year 1950:

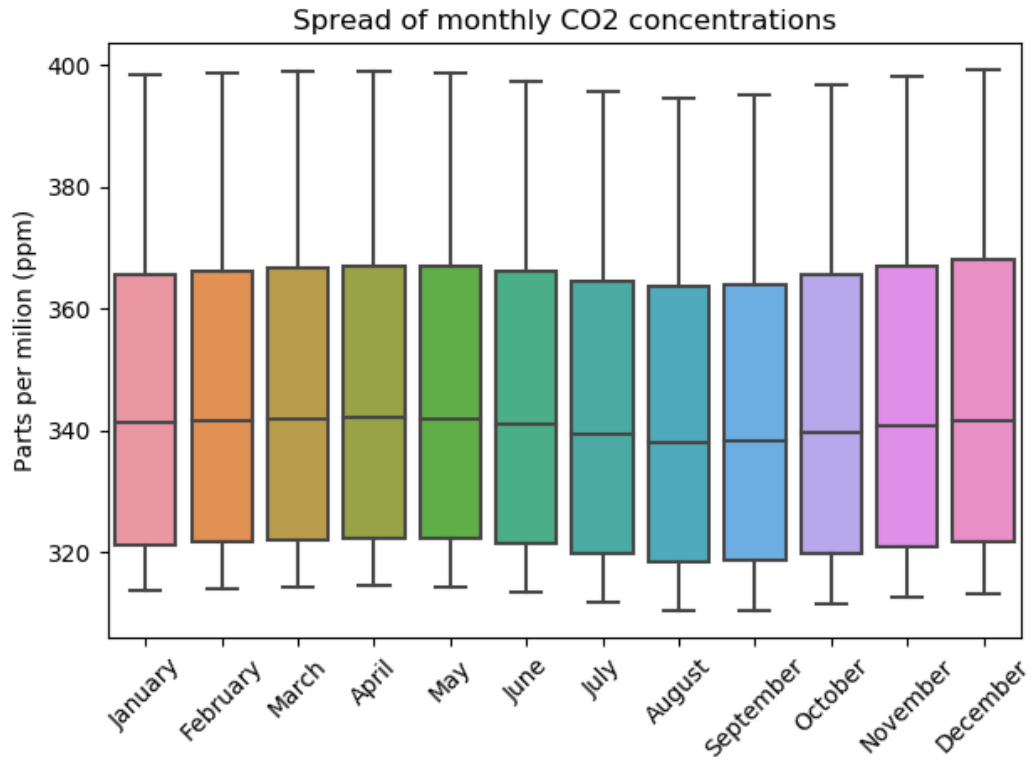
date	data_mean_global	data_mean_nh	data_mean_sh
1950-01-15	313.597898	314.751334	312.444461
1950-02-15	313.968034	315.402500	312.533568
1950-03-15	314.274349	315.997671	312.551026
1950-04-15	314.468454	316.441488	312.495420
1950-05-15	314.310746	316.134174	312.487318
...
2014-08-15	394.573461	393.376544	395.770379
2014-09-15	395.026810	394.318661	395.734959
2014-10-15	396.668760	397.456653	395.880867
2014-11-15	398.189074	400.321220	396.056929
2014-12-15	399.179692	402.195088	396.164296

[780 rows x 3 columns]

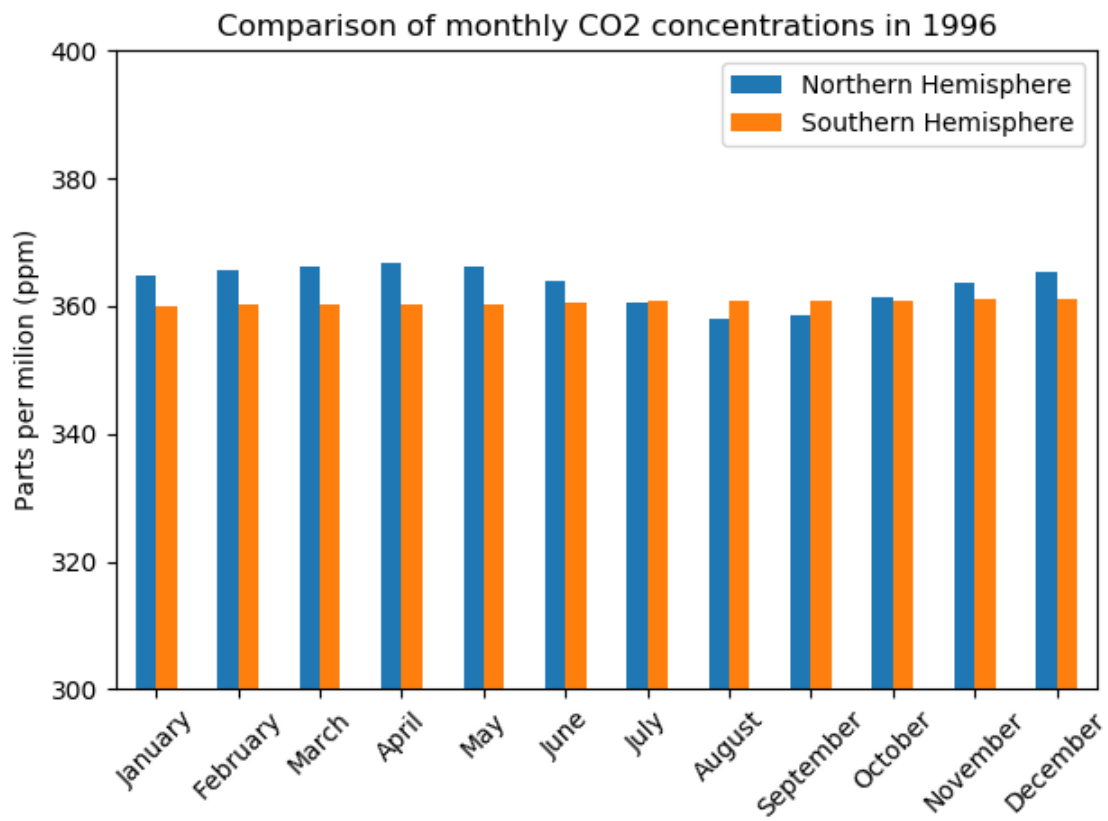
Exercise 2. Mean annual CO₂ concentrations.



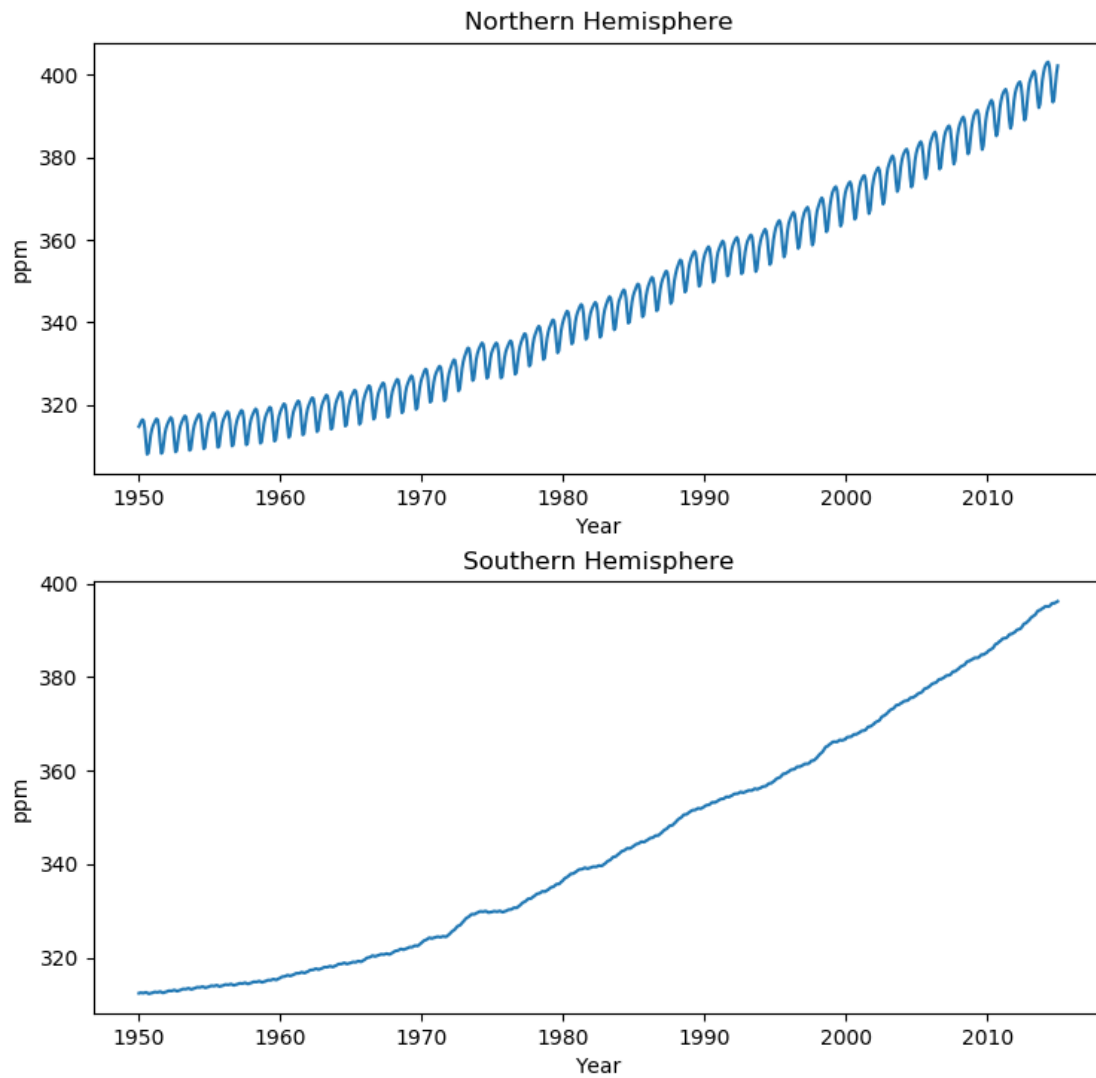
Exercise 3. Mean annual CO₂ concentrations.



Exercise 4. Comparison of monthly CO₂ concentrations in chosen year.

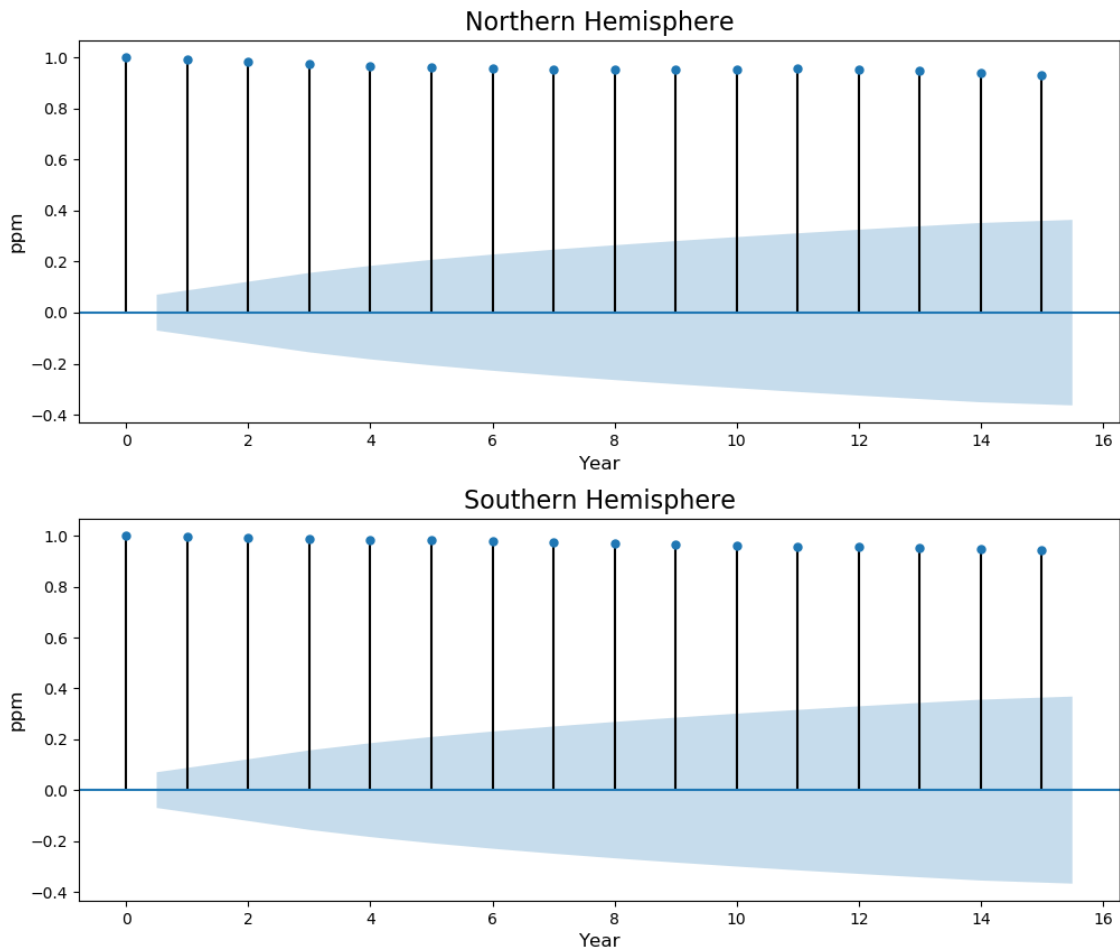


Exercise 5. Monthly CO₂ concentration on both hemispheres.



Autocorrelation Function – lags up to 15.

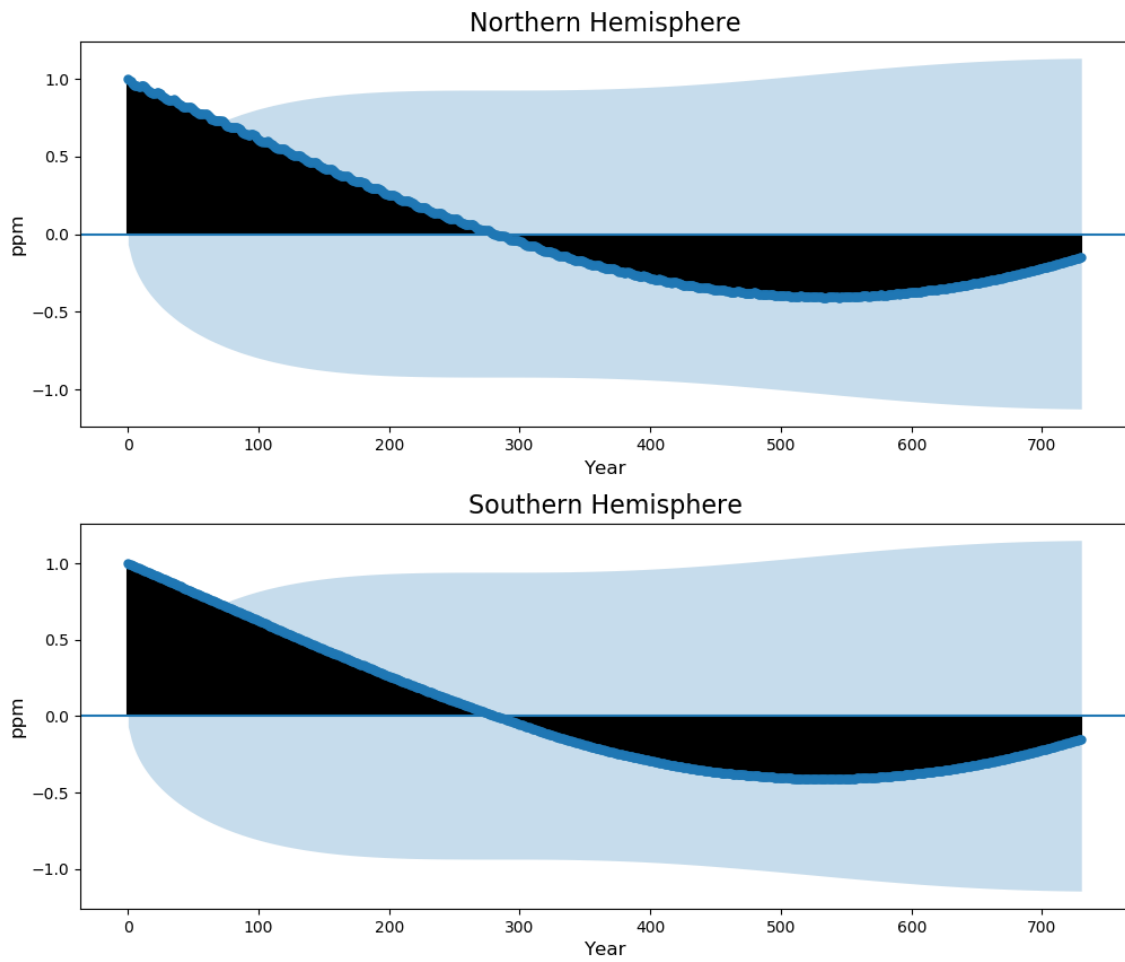
Autocorrelation Function



Commentary: Strong correlation of series with itself, which is more visible when describing whole graph with lags up to maximum value (730 entries). Both hemispheres show quick, almost linear growth.

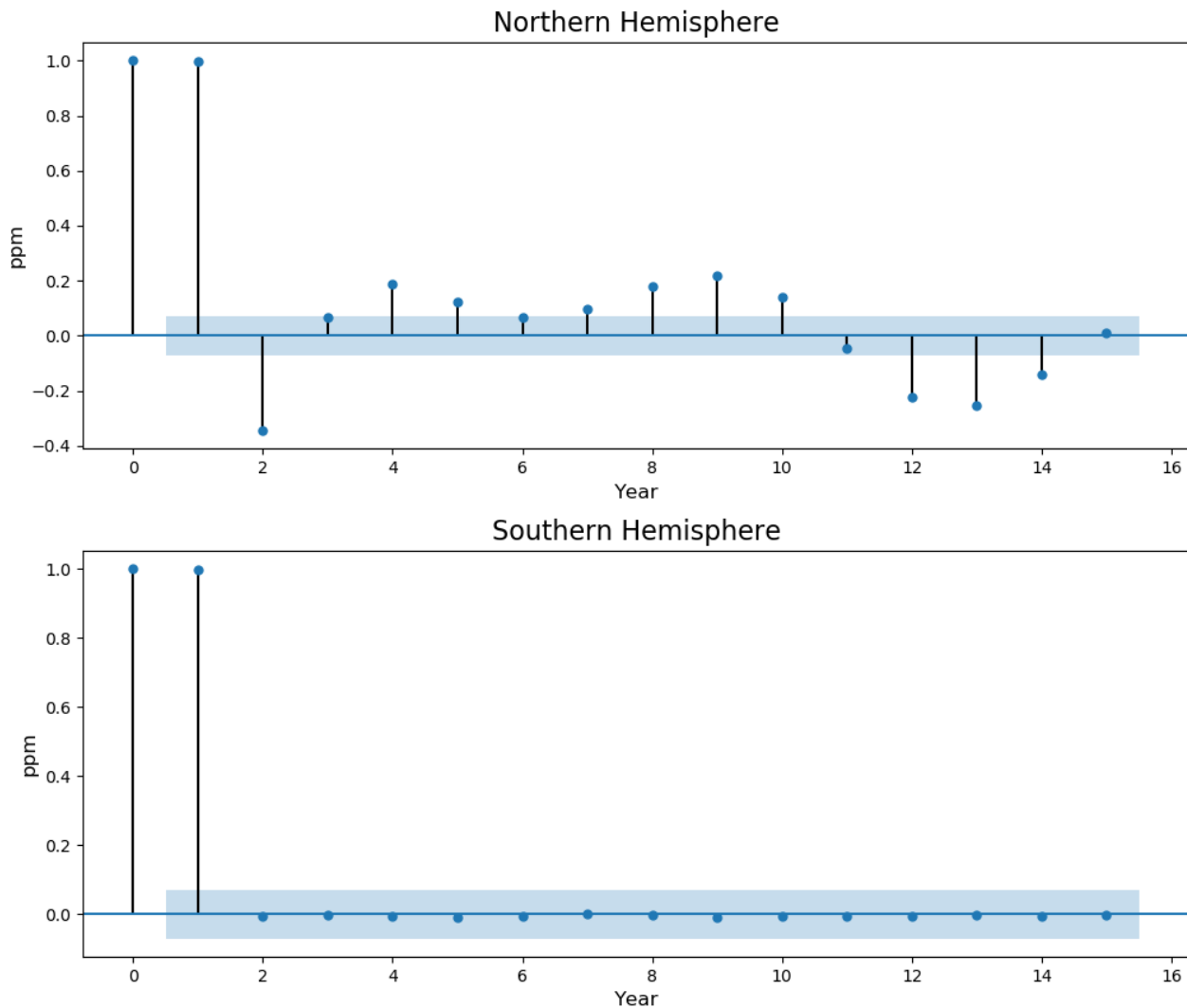
Autocorrelation Function – lags up to 730.

Autocorrelation Function



Partial Autocorrelation Function – lags up to 15

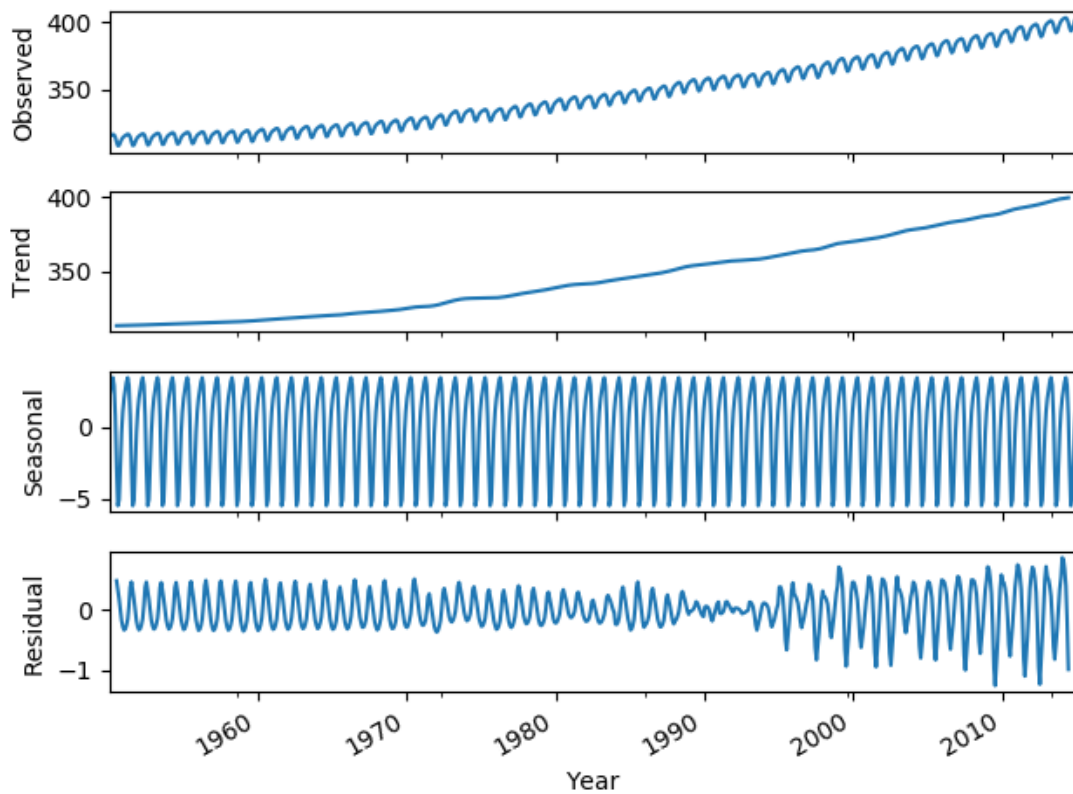
Partial Autocorellation Function



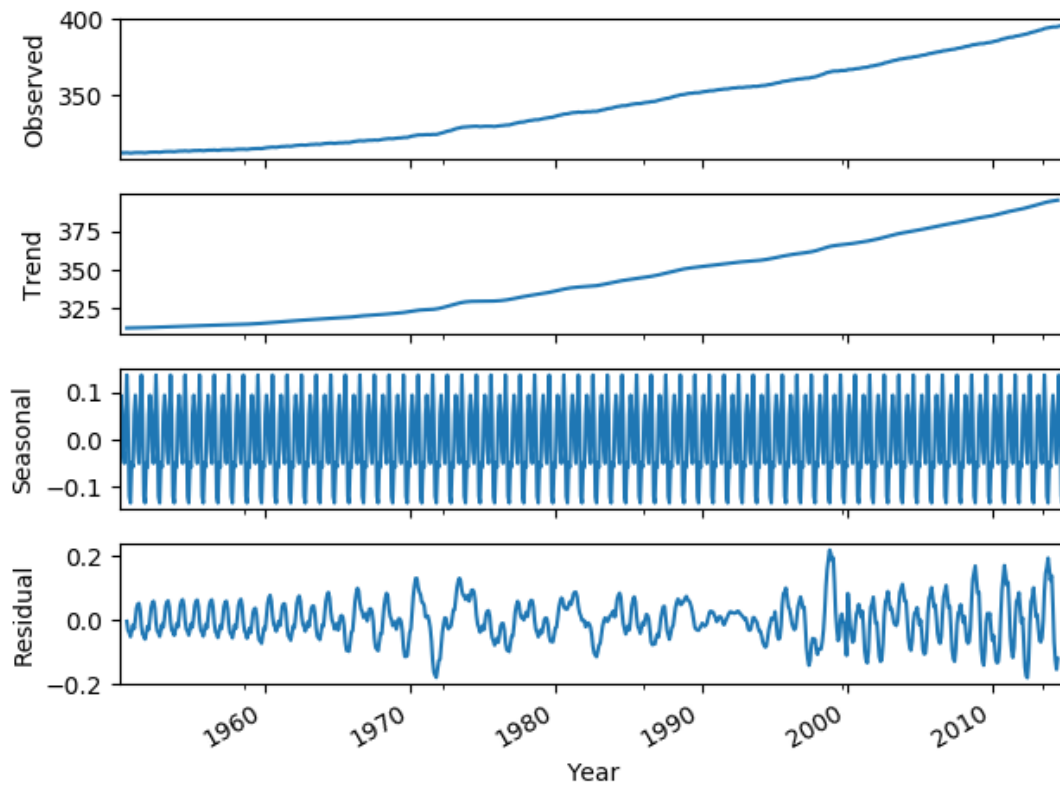
Commentary: Upon removal of linear dependence of function on itself, the differences in both hemispheres tend to appear. Southern Hemisphere depicts almost not existent change month to month. In Northern Hemisphere CO₂ concentration diverges on monthly basis, with visible time periods equal to one year.

Exercise 6. Seasonal decomposition – Additive Model and Multiplicative Model

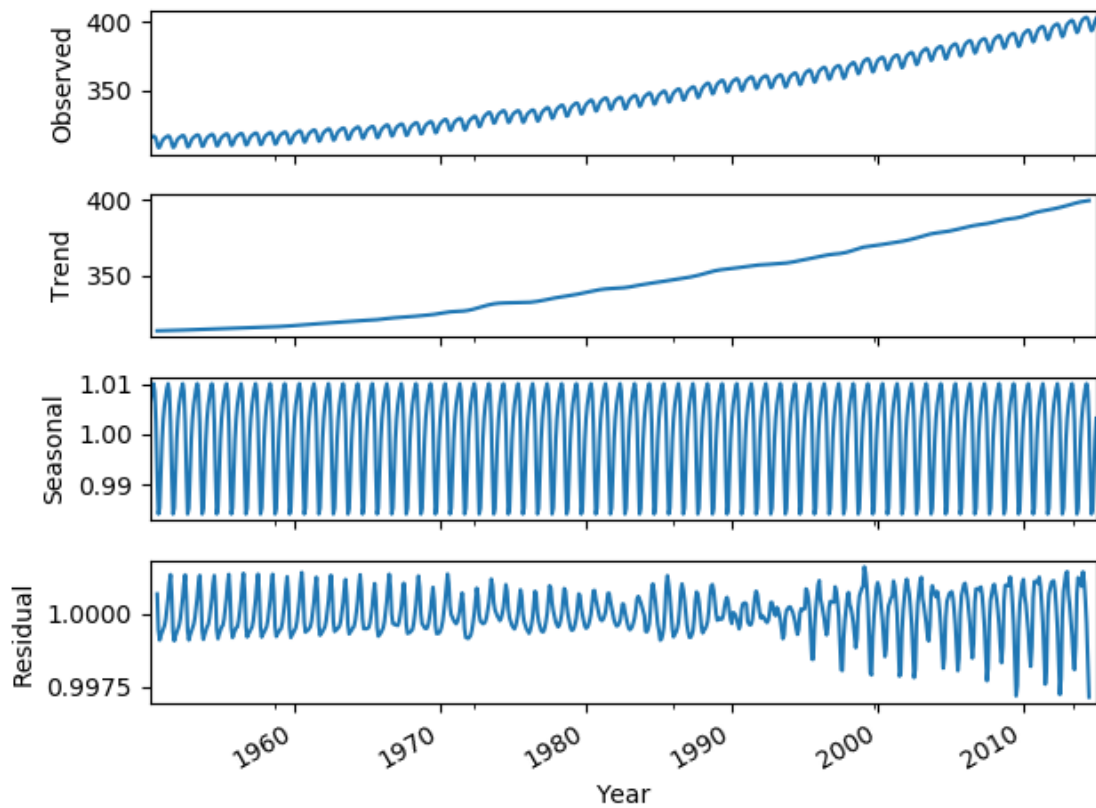
Additive Model – Northern Hemisphere



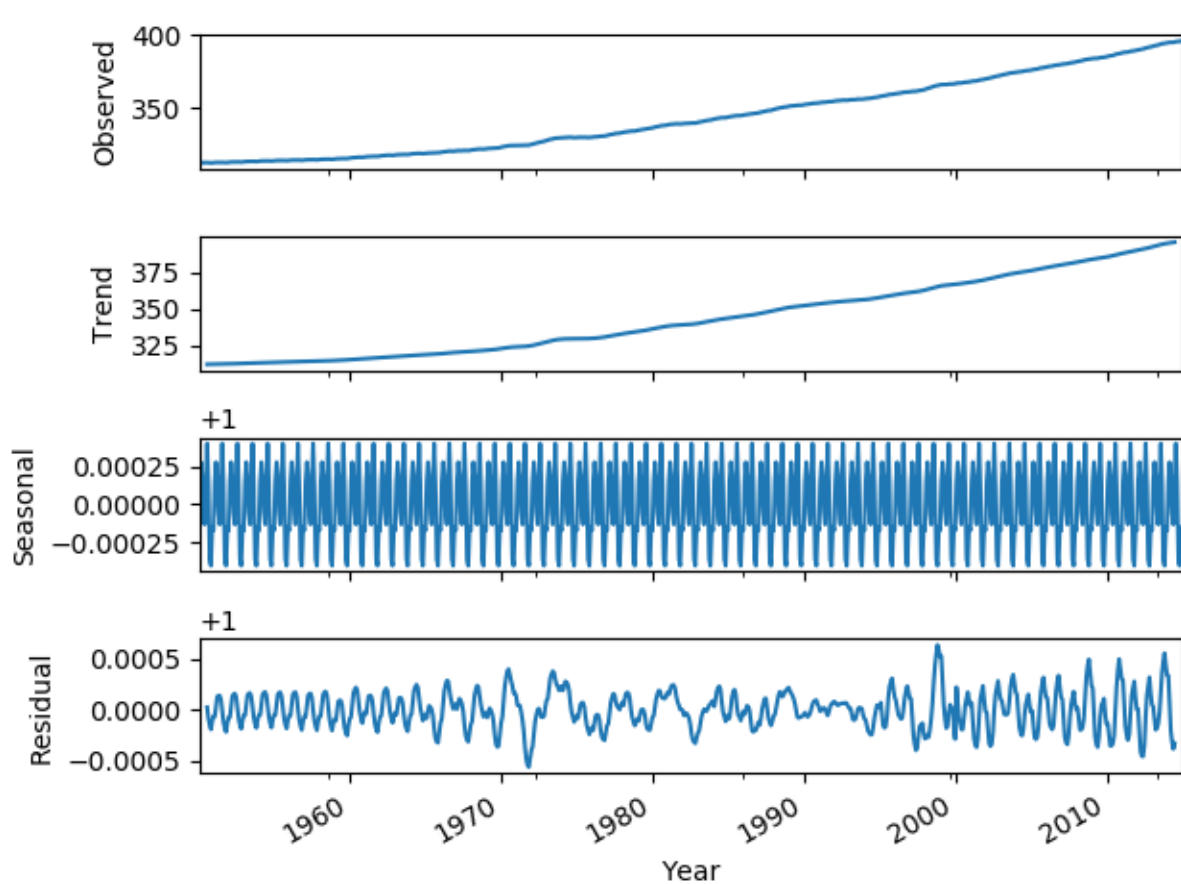
Additive Model – Southern Hemisphere



Multiplicative Model – Northern Hemisphere



Multiplicative Model – Southern Hemisphere



Commentary: We are able to distinguish a visible trend in Northern Hemispheres that has a similar shape to a trend shown in Southern Hemisphere, but also consists of visible seasonal and residual components, which in comparison are nearly nonexistent in analysis derived from Southern Hemisphere.

There are no major differences between additive and multiplicative models in both examples, except for values of seasonal and residual components, which have always higher altitudes in Northern Hemispheres example.