Time Series Analysis and Seasonal Decomposition

Examine Periodicity in the Data

Here we are looking for some evidence that the time series has periodicity… in this case yearly cycles.

Analyze > Forecasting > Sequence Charts...
Variables: CO2
Time Axis Label: Date

Analyze > Forecasting > Autocorrelations...
Variables: CO2

Our version of SPSS does not have the correct modules to do seasonal decomposition automatically, so we must do it ourselves.

Steps in Additive Time Series Decomposition

1. Calculate the trend-cycle component (***Tt***) using moving averages.
2. Calculate a de-trended series by subtracting the trend from the observation (***yt–Tt***).
3. Estimate the seasonal component (***St***) for each period (e.g. month) by averaging the de-trended values for that period.
4. Calculate the remainder (error) component by subtracting both the seasonal and trend-cycle components from the observation (***Et= yt–St–Tt***).

Step 1: Create Seasonal (Trend Cycle) Component:

Transform > Create Times Series…
CO2, Center Moving Average
Span=12
Name = CO2_Trend

Note that centered moving average in SPSS removed observations from both the beginning and the end of the time series.

Step 2: Create the Detrended Series:

Transform > Compute Variable…
CO2_Detrend = CO2 – CO2_Trend

Step 3: Estimate the Seasonal Component:

Next you would compute the mean CO2_Detrend for each month and then copy the mean CO2_Detrend for each year. I have done this for you…CO2_Seasonal.

Data > Split File…
Organize Output Groups by: Mo

Analyze > Descriptive Statistics > Descriptives
Variables: CO2_Detrend

Data > Sort Cases
Variables: Date

Then you input for each month the monthly mean CO2_Detrend for the entire series. Copy and paste works here…

<u>Step 4: Calculate the Error Component:</u>

Transform > Compute Variable…

CO2_Error = CO2 – CO2_Trend – CO2_Seasonal

<u>Step 5: Generate Seasonality Plots</u>

Analyze > Forecasting > Sequence Charts...
Variables: CO2, CO2_Trend
Time Axis Label: Date

Analyze > Forecasting > Sequence Charts...
Variables: CO2_Seasonal, CO2_Error
Time Axis Label: Date

<u>Step 5: Determine if the Trend is Significant:</u>

Create a new variable called ***NumDate***.

Open a new syntax window and enter the command below:
formats NumDate(f1).

Copy the Date variable into the NumDate variable using ***Cut (ctrl V)*** and ***Paste (ctrl C)***.

> Note that the Julian date format has changed into a numeric format. These represent the numbers of seconds between the year 1582 and a given time on a given date, with each year being ***3155760*** seconds long.
>
> To calculate 1 year in the future, you will need to know the numeric last date in the time series and then use the following equation:
>
> New Date = Numeric Last Date in Time Series + Number of Years into the Future(31557600)
>
> For example: Determine the numeric date of Dec 1987
> Dec 1985 = 12721622400
>
> Dec 1987 = 12721622400 + 2(31557600) = 12784737600

Run the regression using NumDate as the independent variable and CO2_Trend as the dependent variable.

Remember that the regression equation is in terms of the number of seconds.