For this assignment, you are requested to download the **Forecast** package in R. The package contains methods and tools for displaying and analyzing univariate time series forecasts including exponential smoothing via state space models and automatic ARIMA modelling. Explore the **gas** (Australian monthly gas production) dataset in Forecast package to do the following:

- Read the data as a time series object in R. Plot the data **(5 marks)**
- What do you observe? Which components of the time series are present in this dataset? **(5 marks)**
- What is the periodicity of dataset? **(5 marks)**
- Is the time series Stationary? Inspect visually as well as conduct an ADF test? Write down the null and alternate hypothesis for the stationarity test? De-seasonalise the series if seasonality is present? **(20 marks)**
- Develop an ARIMA Model to forecast for next 12 periods. Use both manual and auto.arima (Show & explain all the steps) **(20 marks)**
- Report the accuracy of the model **(5 marks)**

Australian monthly gas production

- Read the data as a time series object in R. Plot the data
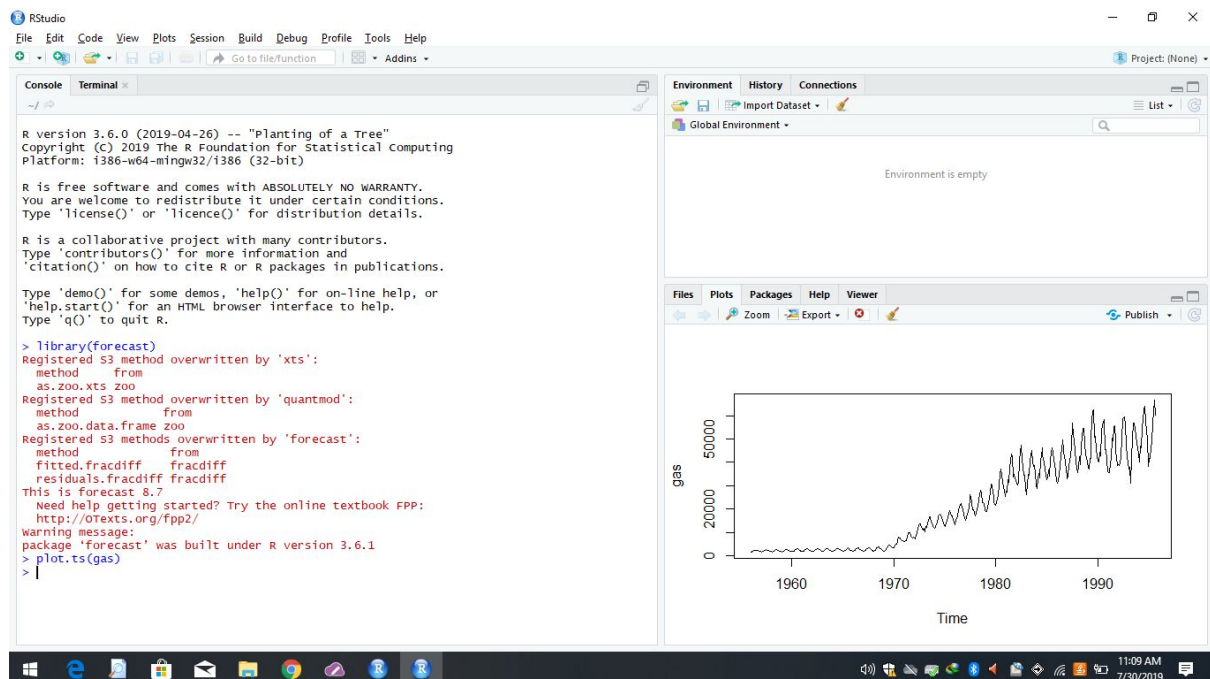
- What do you observe? Which components of the time series are present in this dataset?

From the plot my observation is,x-axis indicates year from 1960 till 1990 and y-axis indicated amount of gas produced.

Till 1970,the gas production was low and stagnant but after 1970 the gas production has become extremely variable.

And while decomposing the time series,we can find the components such as seasonality,trend,random..

- What is the periodicity of dataset? **(5 marks)**

Periodicity is nothing but the frequency of the data which can be found using findfrequency() function.Here the output is 12 which is data is taken every month.

```
 16770 16805 17094 17109 17243 17293 17339 17592 17777 18137 18276 18284 18471 18488
     1     1     1     1     1     1     1     1     1     1     1     1     1     1
 18737 18839 18892 19157 19619 19627 19795 19819 19969 20226 20750 20823 20903 20983
     1     1     1     1     1     1     1     1     1     1     1     1     1     1
 21398 21433 21930 22001 22212 22337 22369 22404 22804 22813 22886 23328 23768 23854
     1     1     1     1     1     1     1     1     1     1     1     1     1     1
 24503 25076 25248 25479 25885 25905 26025 26138 26323 26762 26776 26884 27424 27730
     1     1     1     1     1     1     1     1     1     1     1     1     1     1
 28038 28305 28729 28801 29275 30228 30234 30400 30605 30611 30715 30745 31043 31239
     1     1     1     1     1     1     1     1     1     1     1     1     1     1
 31306 31366 31451 31793 32142 32261 32445 32494 32684 32791 33034 33181 33308 33480
     1     1     1     1     1     1     1     1     1     1     1     1     1     1
 33827 34206 34221 34355 34502 34514 34549 34607 34879 34951 34962 34984 35018 35294
     1     1     1     1     1     1     1     1     1     1     1     1     1     1
 35308 35567 35592 35677 35901 36016 36068 36805 37059 37060 37277 37328 37459 37541
     1     1     1     1     1     1     1     1     1     1     1     1     1     1
 37696 37913 37958 37963 38109 38180 38410 38608 38690 38698 38963 39128 39137 39269
     1     1     1     1     1     1     1     1     1     1     1     1     1     1
 39331 39606 39792 39857 39864 39975 39995 40249 40295 40387 40459 40478 40592 40797
     1     1     1     1     1     1     1     1     1     1     1     1     1     1
 40943 40980 41020 41060 41281 41304 41310 41471 41600 41666 41712 41761 41778 41805
     1     1     1     1     1     1     1     1     1     1     1     1     1     1
 41851 42145 42155 42269 42319 42355 42398 42430 42528 42545 42697 42869 43168 43225
     1     1     1     1     1     1     1     1     1     1     1     1     1     1
 43519 43558 43736 44133 44147 44350 44435 44503 45022 45387 45500 45547 45622 45627
     1     1     1     1     1     1     1     1     1     1     1     1     1     1
 45731 46098 46137 46147 46173 46251 46287 46895 47062 47321 47387 48073 48516 49013
     1     1     1     1     1     1     1     1     1     1     1     1     1     1
 49058 49129 49397 49568 49616 50145 50354 50366 50380 50610 50820 51116 51367 52306
     1     1     1     1     1     1     1     1     1     1     1     1     1     1
 52561 53231 54435 54457 54634 55011 55066 55671 55988 56572 56624 56709 56807 56858
     1     1     1     1     1     1     1     1     1     1     1     1     1     1
 56977 57784 57793 57799 58164 58363 59035 59408 60054 61739 61884 62400 62450 63896
     1     1     1     1     1     1     1     1     1     1     1     1     1     1
 66600
     1
> findfrequency(gasts)
[1] 12
>
```
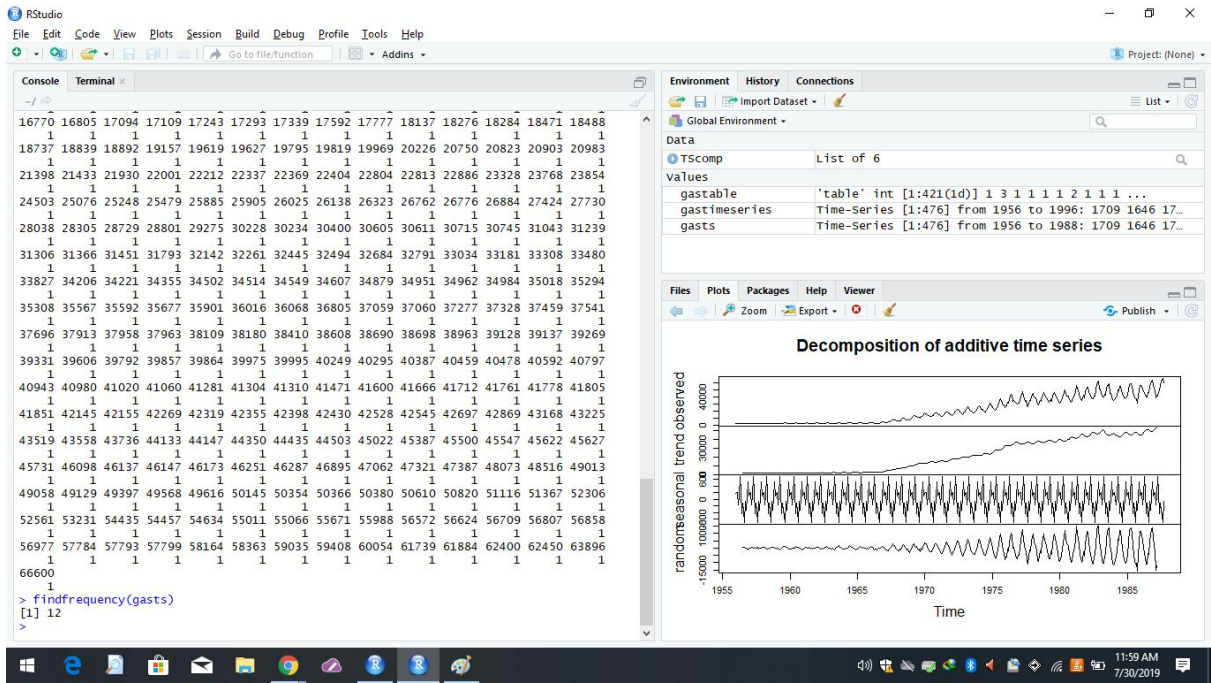
Decomposition of additive time series

- Is the time series Stationary? Inspect visually as well as conduct an ADF test? Write down the null and alternative hypothesis for the stationarity test? De-seasonalise the series if seasonality is present?

By Visualising the plot, it is very clear that the data is non-stationary series.

ADF test can be used to check this.if P value <0.05 then Time series is stationary.But the P-value we got here is 0.2764(as in the image below).Hence the time series is non-stationary(Null hypothesis is accepted).

But.from the image below,ADF test confirms that time series is stationary(alternate hypothesis) with P value 0.2764
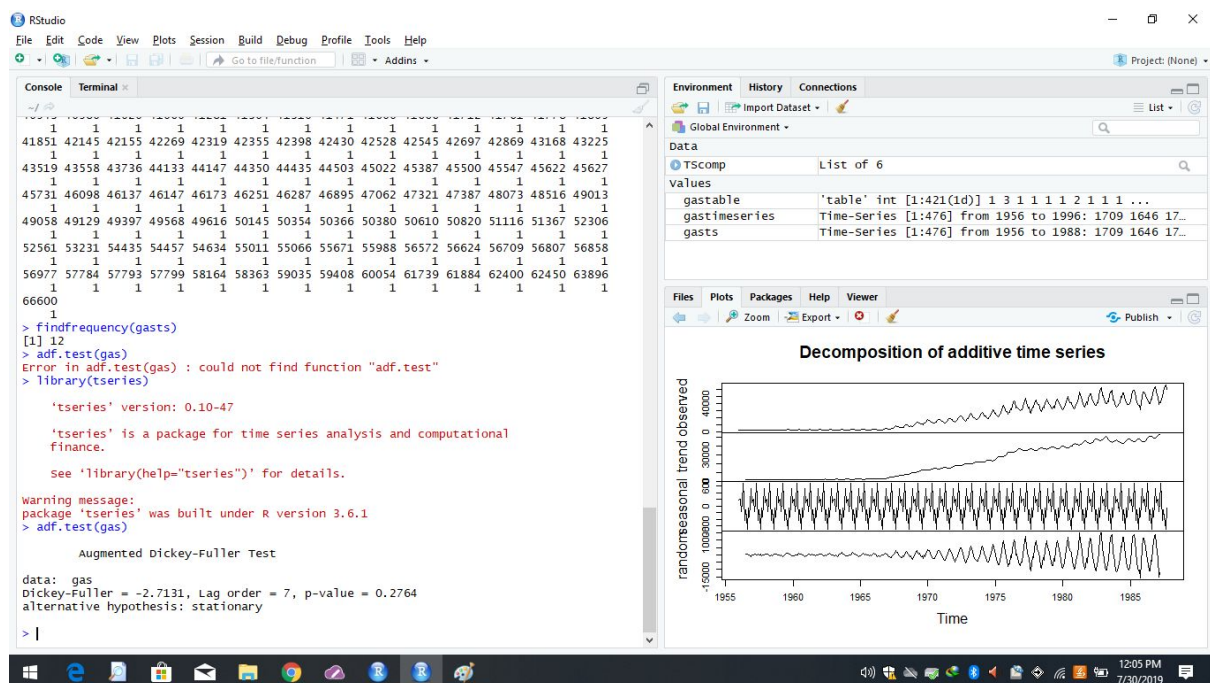
Here the **Null hypothesis is time series is non-stationary,i.e P-value>0.05**

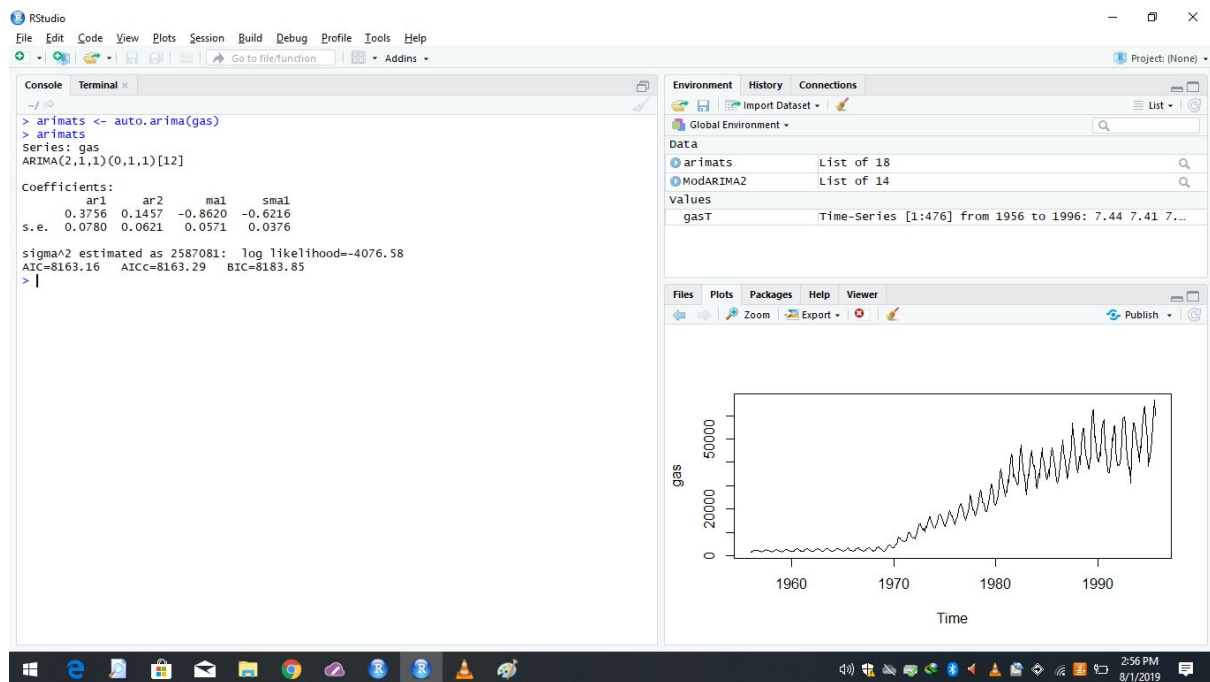**Alternate hypothesis is time series is stationary.i.e P-value is <=0.05**

Deseasonalise:

- Develop an ARIMA Model to forecast for next 12 periods. Use both manual and auto.arima (Show & explain all the steps)
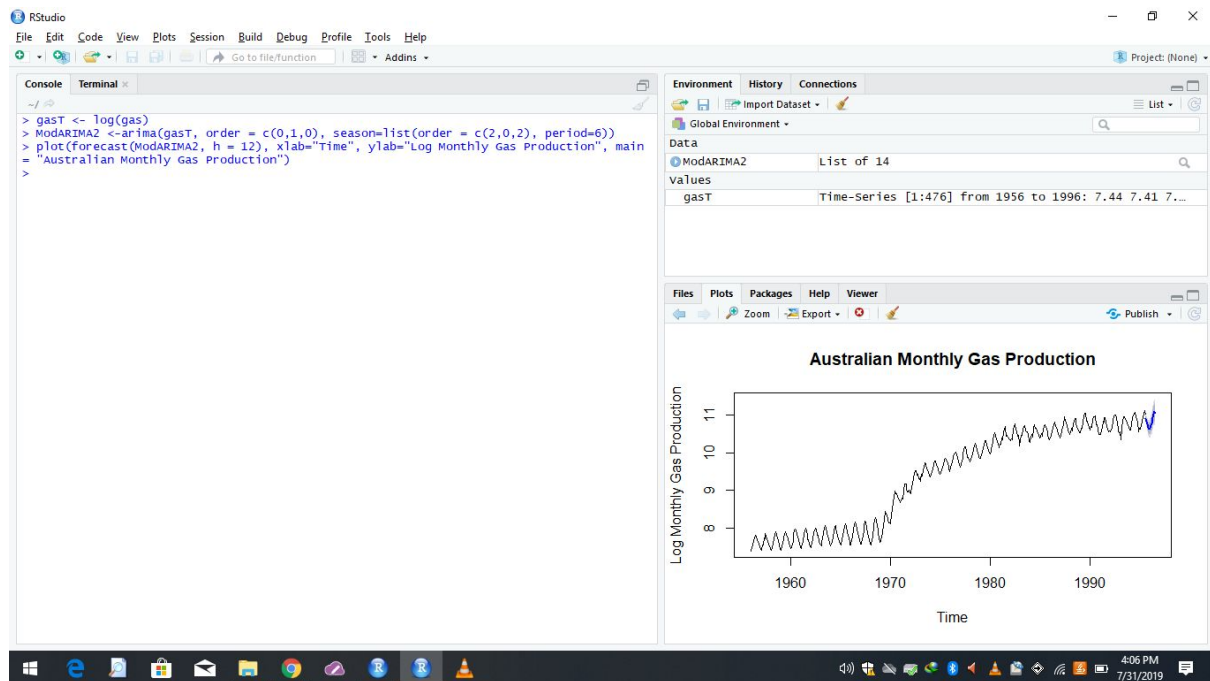
The above graph shows a similar pattern develops in the next 12 months.

Auto arima

- Report the accuracy of the model