Global Temperature Change prediction:

using Time series Forecasting Techniques

Motivation :

Global climate change is a very serious issue affecting the modern world with problems like global warming, shrinking of glaciers, change in climate patterns etc.

As a student of this course we have ability to forecast future temperature variations and influence the public opinion on climate change or say global warming that it needs urgent action, need to be educating people about necessary actions that needs to be taken.

Problem statement :

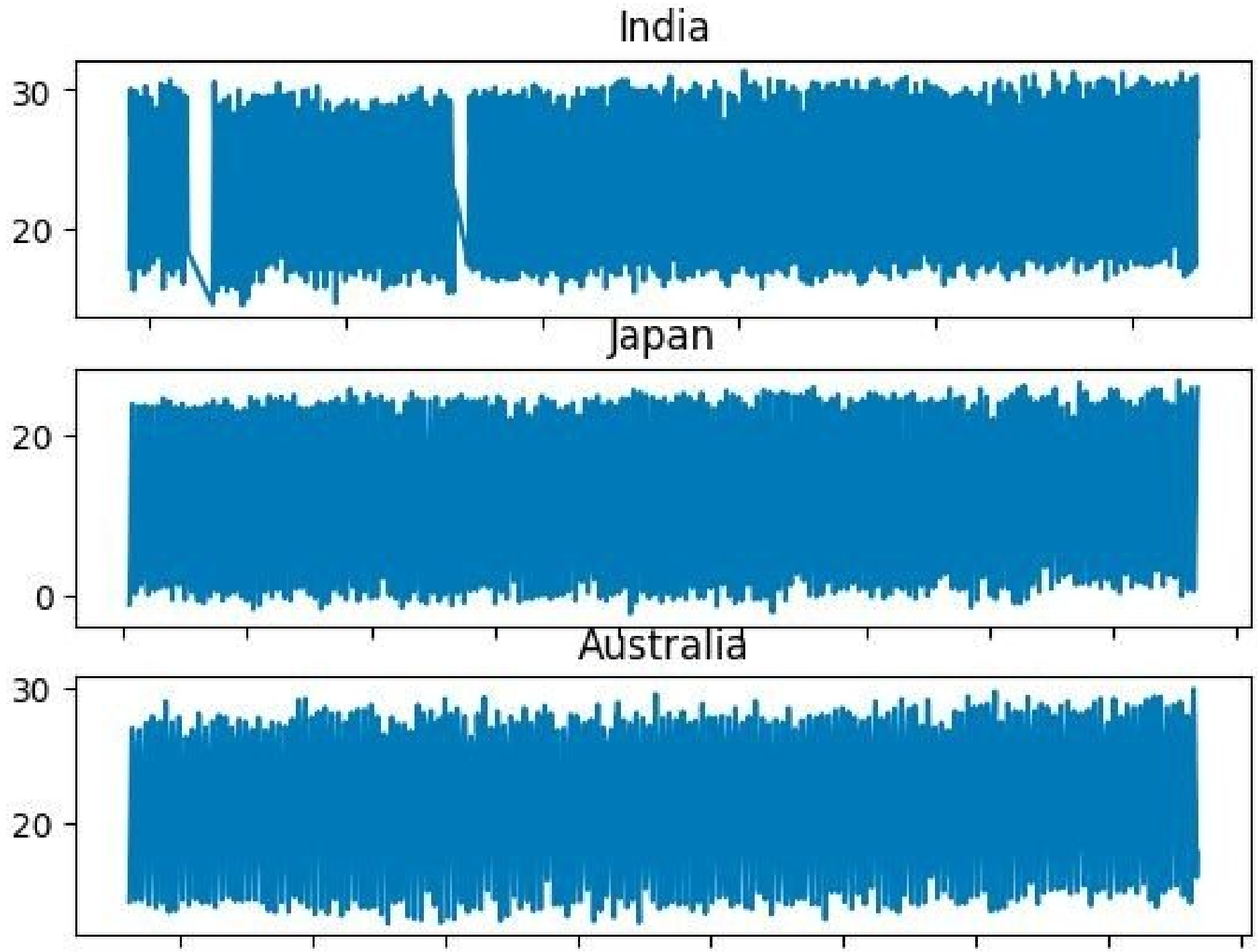
Understanding and predicting temperature variations is crucial for climate monitoring and informed decision-making Utilizing historical temperature data (18th century to 2013) on a monthly basis, we aim to predict temperature changes in India, Australia, USA, and Japan.

Data set used :

	dt	AverageTemperature	AverageTemperatureUncertainty	Country
0	1743-11-01	4.384	2.294	Åland
5	1744-04-01	1.530	4.680	Åland
6	1744-05-01	6.702	1.789	Åland
7	1744-06-01	11.609	1.577	Åland
8	1744-07-01	15.342	1.410	Åland
...	...	...	...	...
577456	2013-04-01	21.142	0.495	Zimbabwe
577457	2013-05-01	19.059	1.022	Zimbabwe
577458	2013-06-01	17.613	0.473	Zimbabwe
577459	2013-07-01	17.000	0.453	Zimbabwe
577460	2013-08-01	19.759	0.717	Zimbabwe

544811 rows × 4 columns

Avg. temperature over time for India, Australia and Japan :



Checking stationarity for data :

For checking the stationerrity in the data we have used the ADF(Augmented Dickey Fuller Test)

Australia

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ADF Stat: -4.715610985099344
p-value: 7.865030726922643e-05
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ADF Stat: -3.864063068749569
p-value: 0.0023158316592004026
```

Japan

India

```
ADF Stat: -4.558478434336369
p-value: 0.00015395077389037247
```

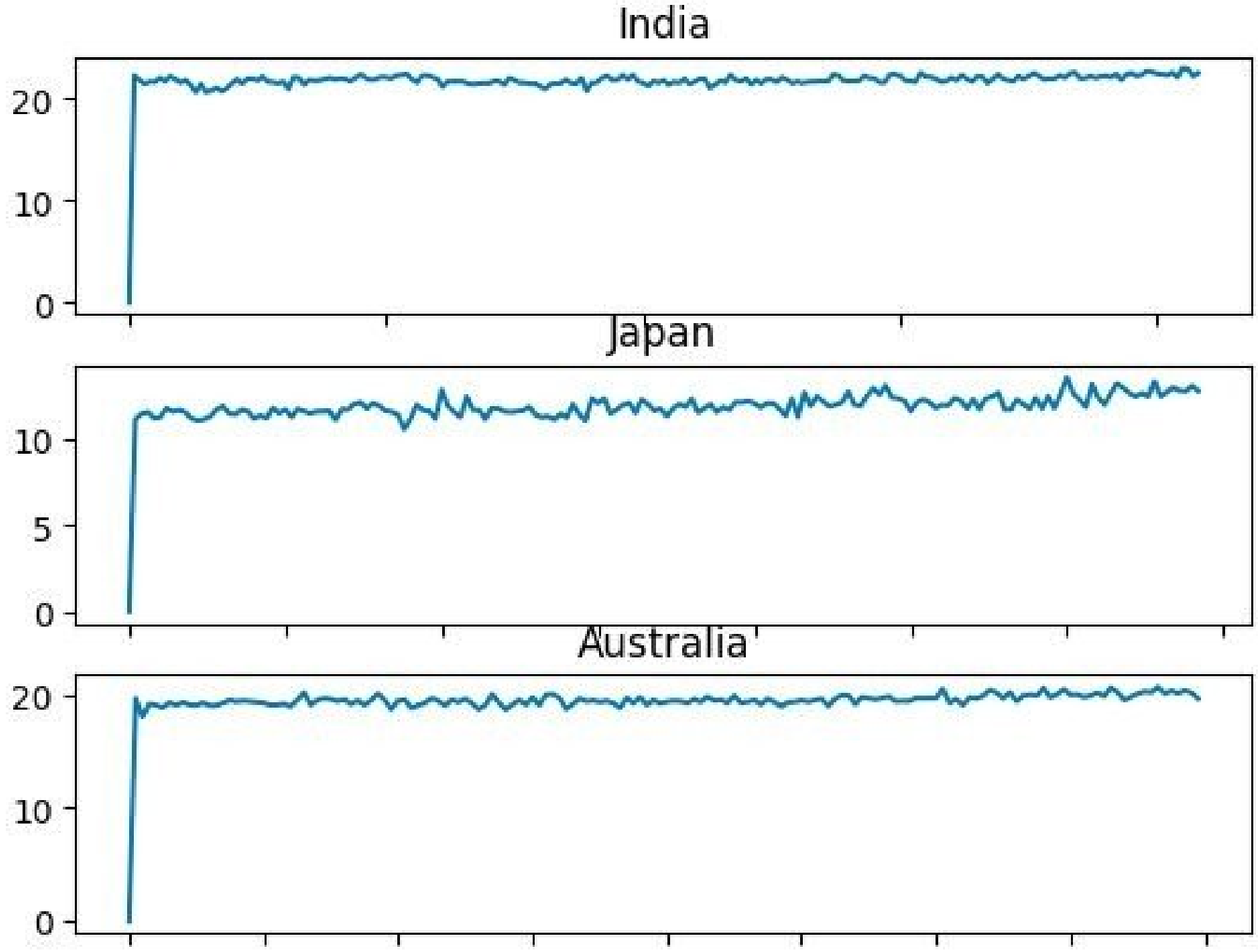
Does our data have trend :

- Firstly, we'll remove seasonality by averaging temperature values over a year, as seasonality assumes a sum of components over time is zero
- To determine if there's a significant trend in Global Temperature, we'll use linear regression.
- If the slope is close to zero, there's likely no trend; otherwise, we'll observe if it's increasing or decreasing

Japan ——————— **0.00975354**

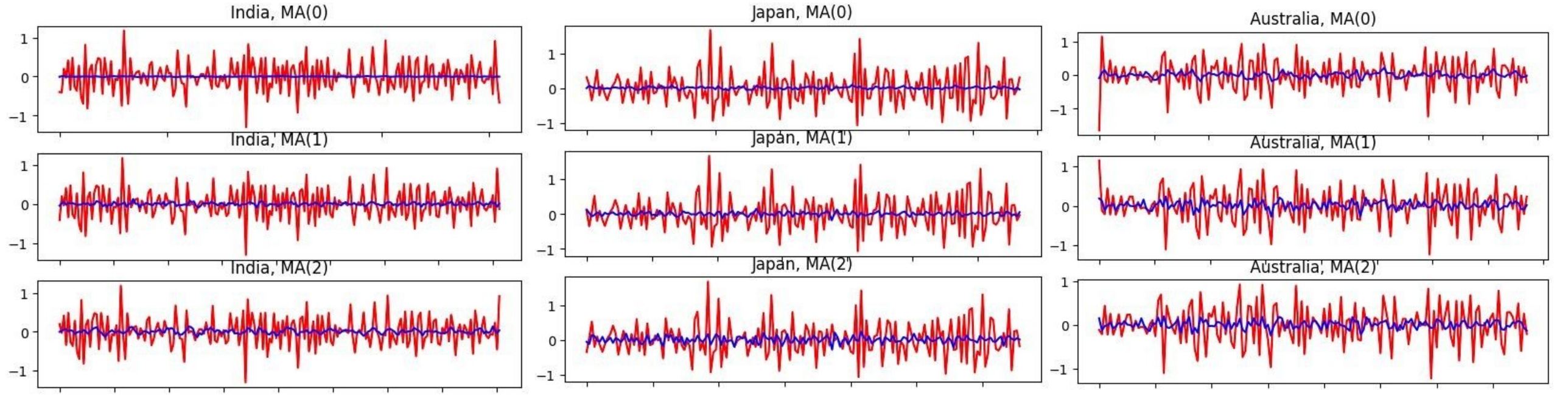
India ——————— **0.0061468**

Austarlia ——————— **0.010294**

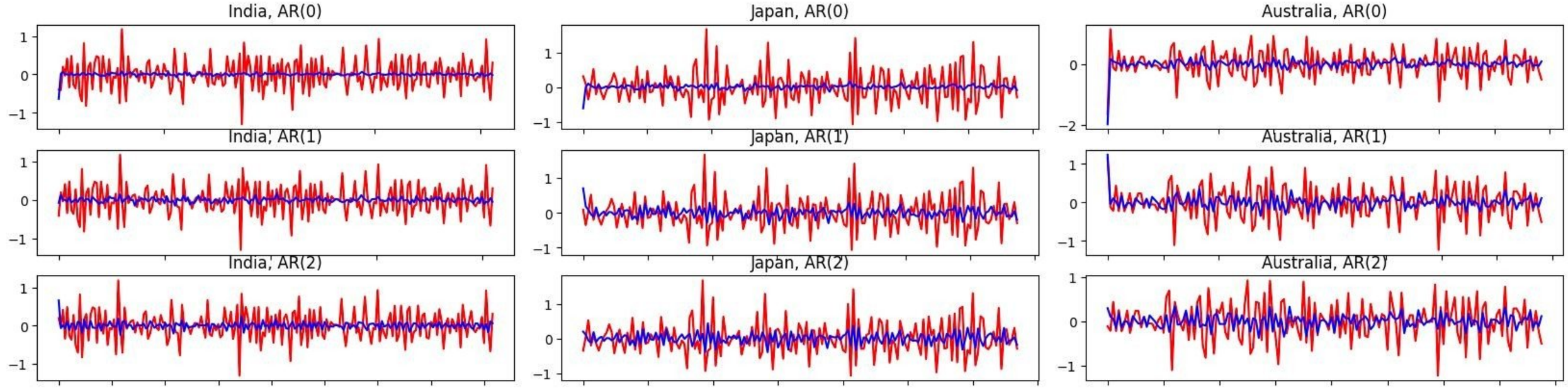


It is observed that for all the countries, the trend slope has a positive value ranging between 0.006 and 0.010. Which is bad news of course

Moving Average Model

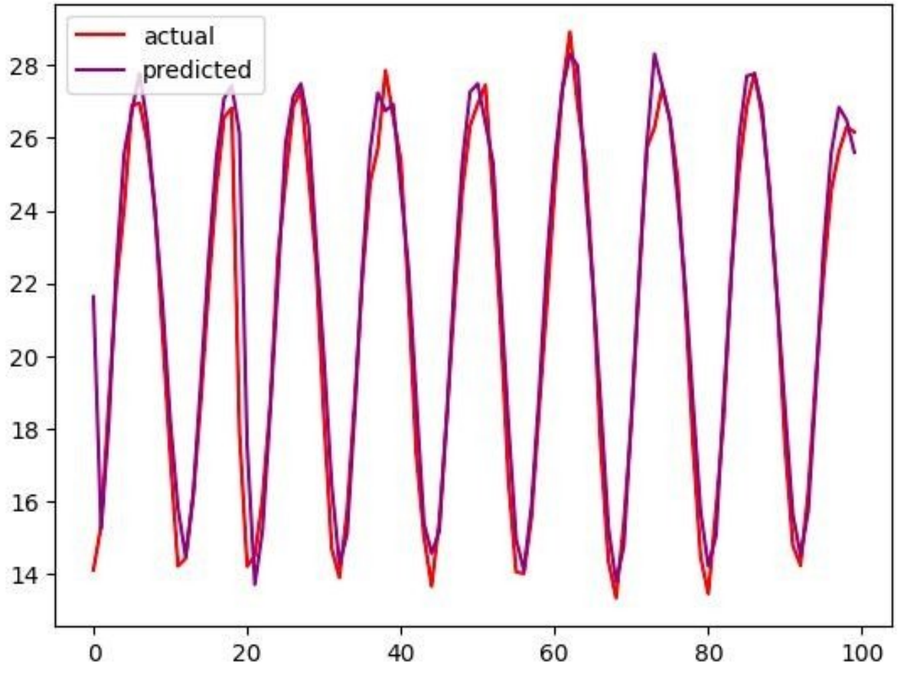


AR Model


India, AR(0)
Japan, AR(0)
Australia, AR(0)
India, AR(1)
Japan, AR(1)
Australia, AR(1)
India, AR(2)
Japan, AR(2)
Australia, AR(2)

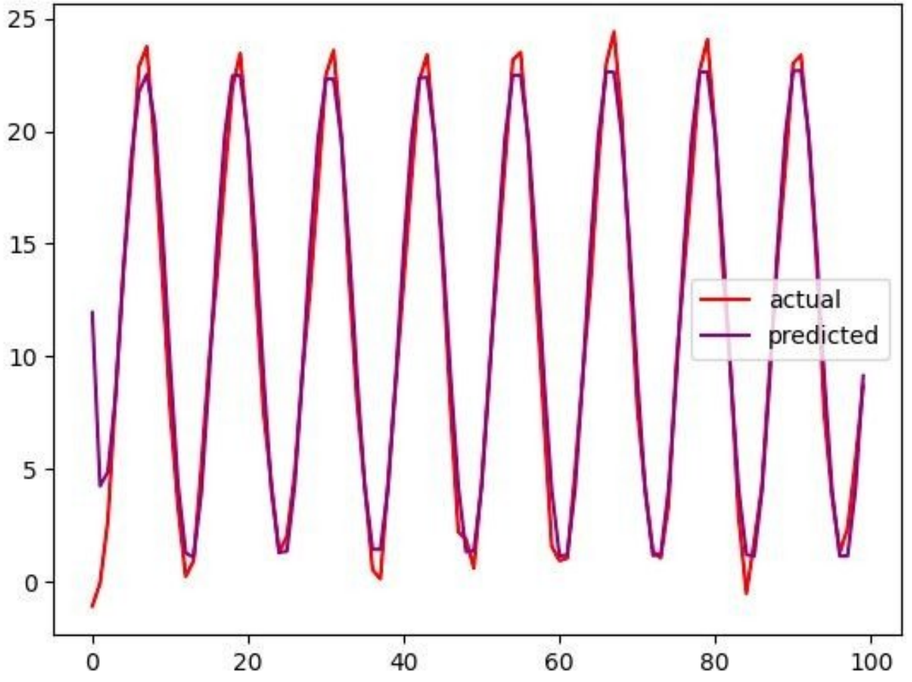
ARMA Model

In order to compare the results across combinations of p and q, we will use the Akaike and Bayesian Information Criteria. They are calculated as follows: For N samples of data points represented by x , with model M , let the maximum likelihood value be $\hat{L}$ =max$p(x|\theta,\hat{M})$ and let k be the number of parameters. Then, Akaike Information Score = $2k-2\ln(L)\hat{}$Bayesian Information Score = $k\ln(n)-2\ln(L)\hat{}$

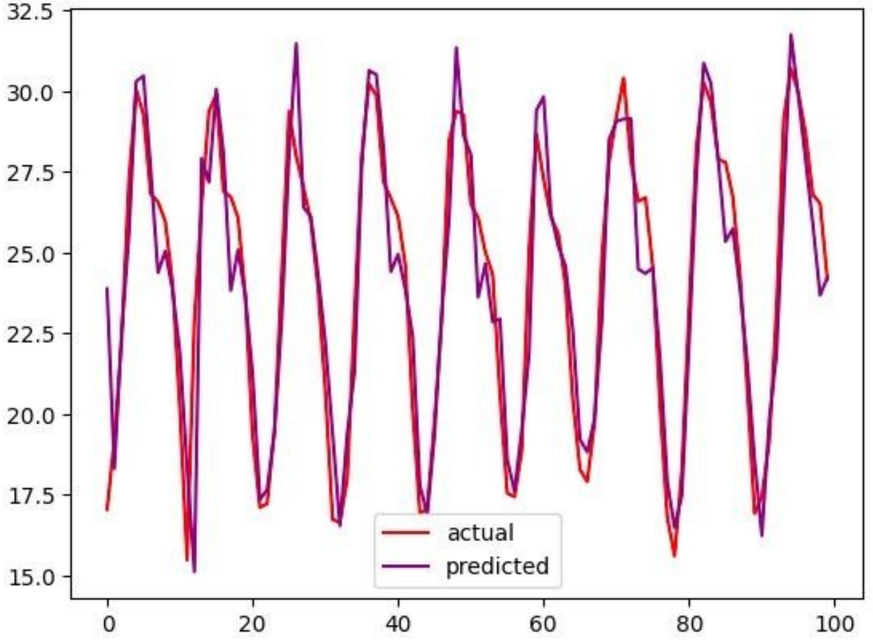


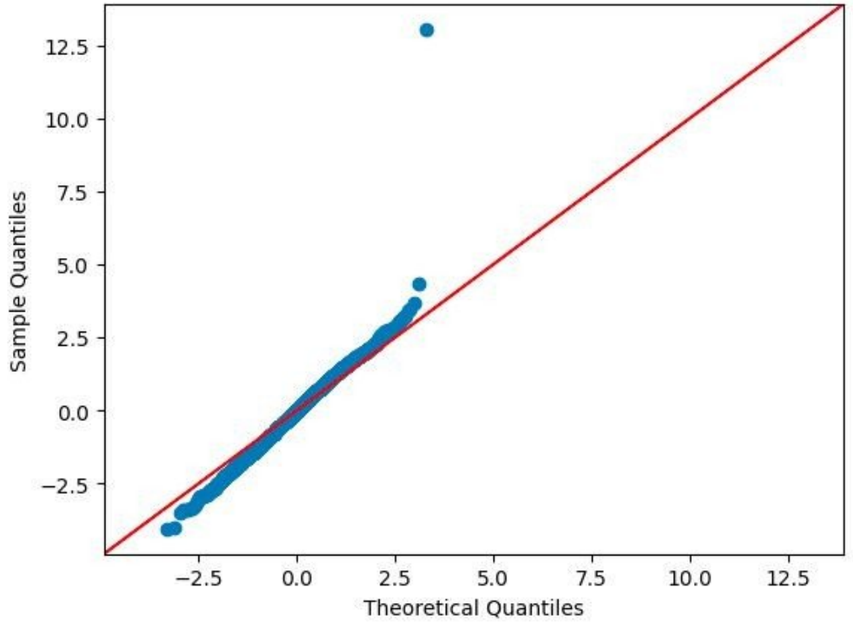
Australia

India

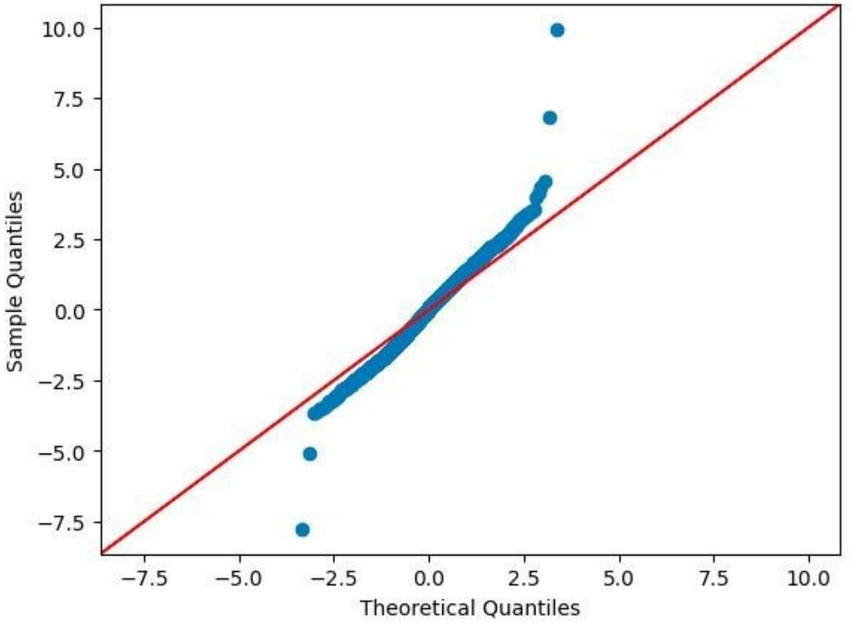


Japan



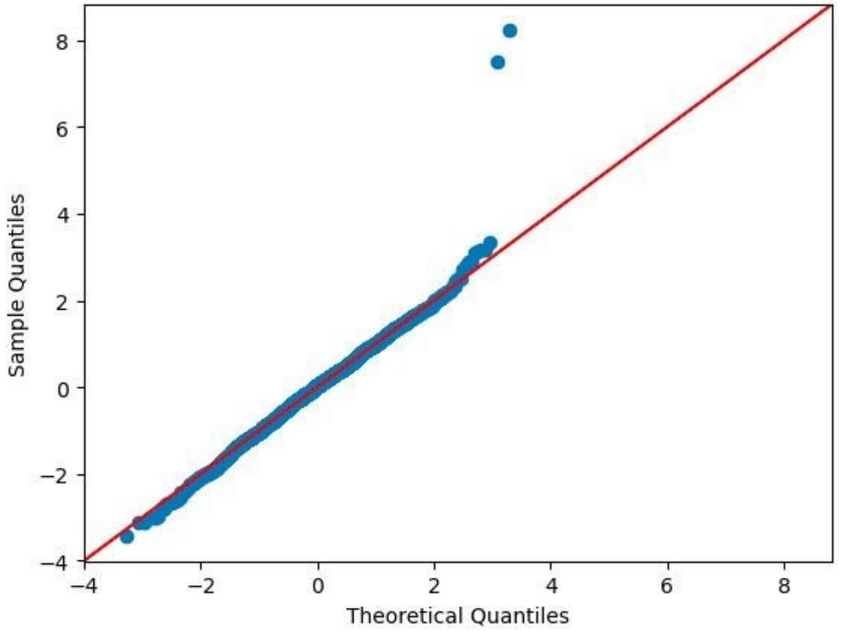


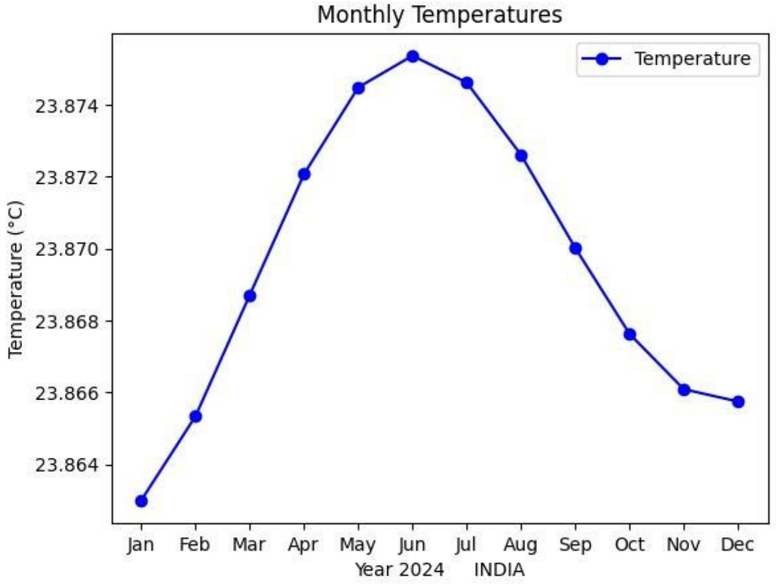
Australia

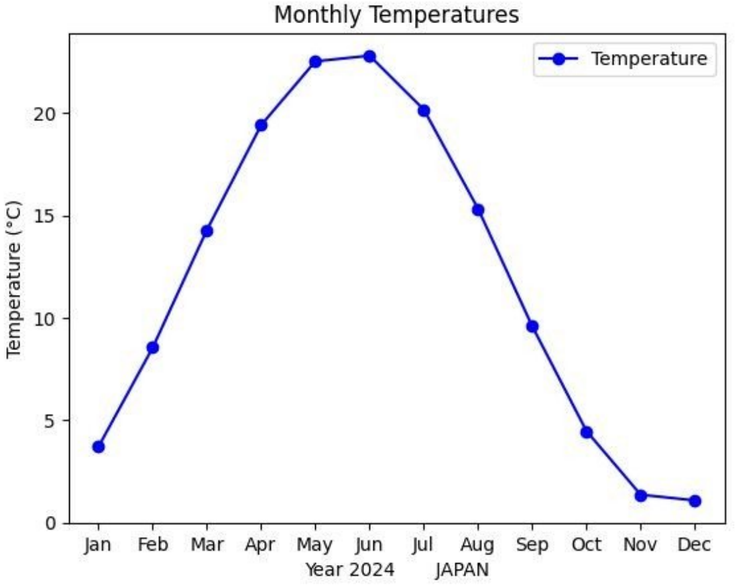


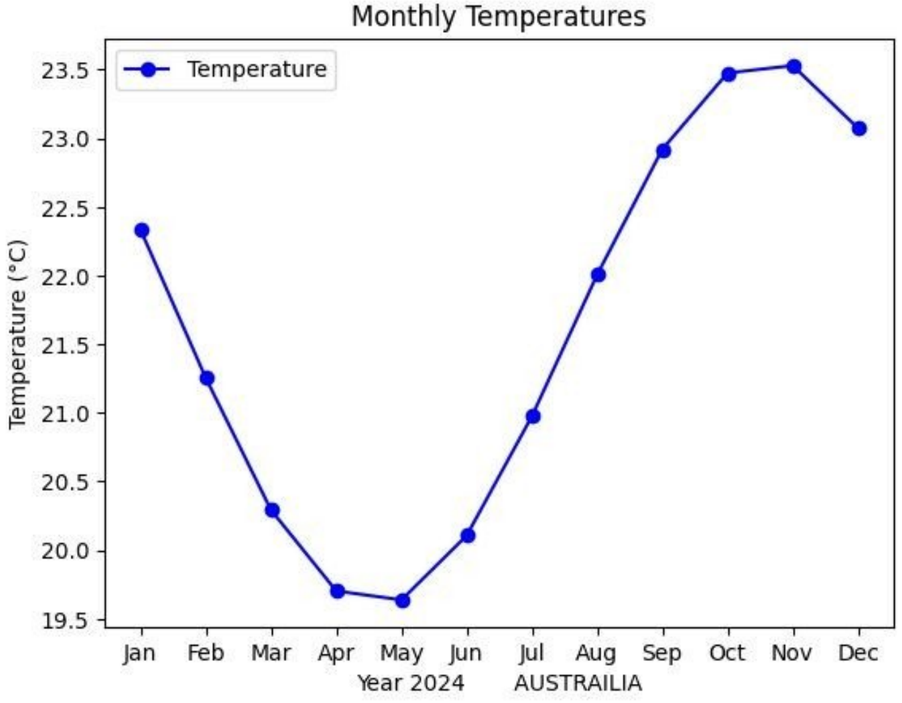
Japan

India




Monthly Temperatures
Temperature
23.874
23.872
23.870
23.868
23.866
23.864
Temperature (°C)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Year 2024 INDIA


Monthly Temperatures
Temperature
20
15
10
5
0
Temperature (°C)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Year 2024 JAPAN


Monthly Temperatures
Temperature
23.5
23.0
22.5
22.0
21.5
21.0
20.5
20.0
19.5
Temperature (°C)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Year 2024 AUSTRAILIA

Thanks!