TIME SERIES ASSIGNMENT

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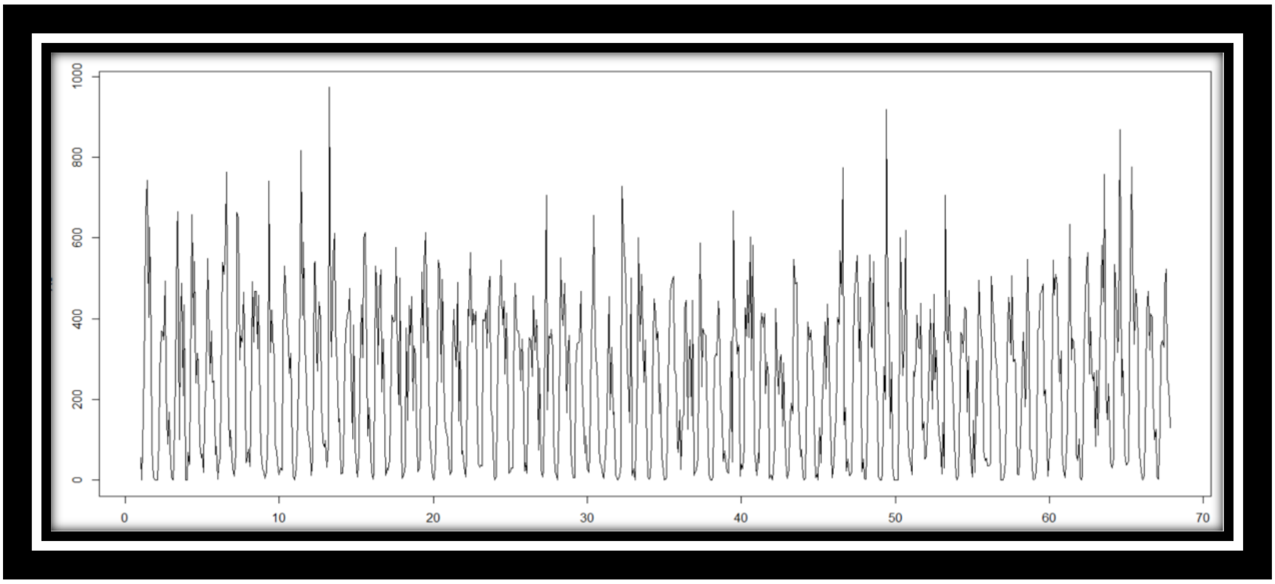
My data was on monthly rainfall in Andaman for last 67 years. Clearly it should be having a seasonal component where S=12.

Before doing any further calculations we made the following plot:

CODE:

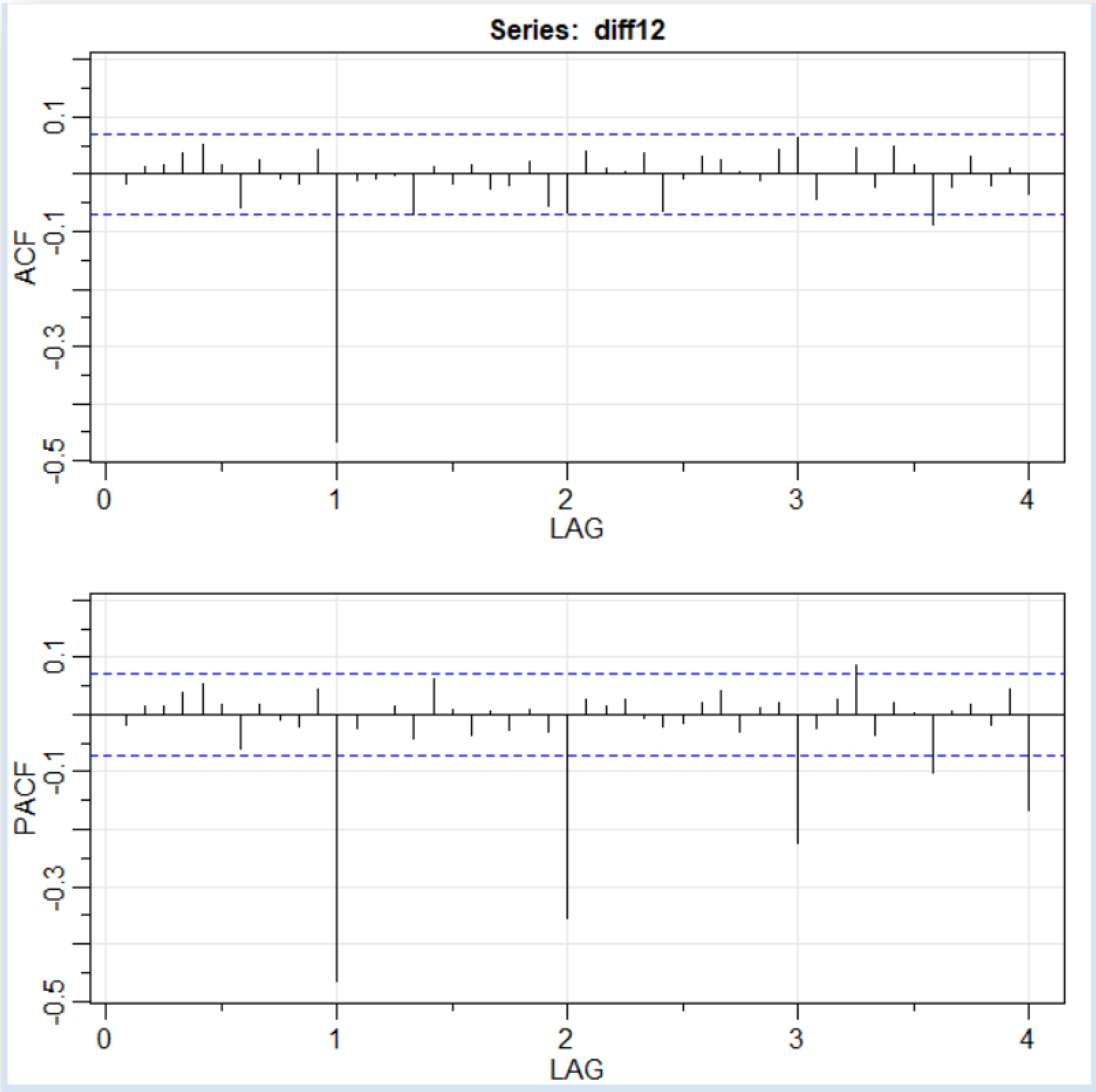
```
x=ts(x,freq=12)
plot(x)
```

OUTPUT:



SEASONAL PART:

Now we introduced a variable diff12=diff(x,12) and plotted the first 48 ACFs and PACFs. The plot of diff12 almost gave a random plot showing no trend.



The seasonal part is clearly an MA 1 model with a spike in ACF at lag 12 and tapering spikes in PACF at lags 12,24,36,48. But the non-seasonal part is not very clear. So I tried to decompose the model and analyse the random part.

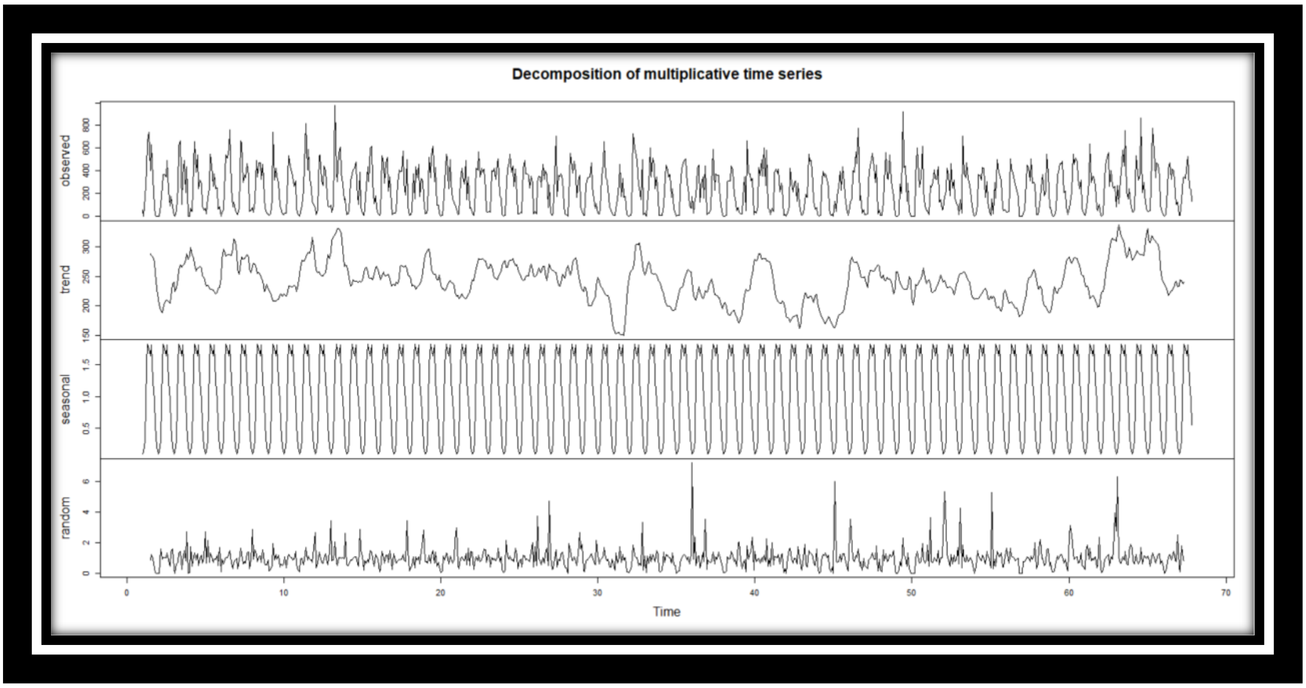
NON-SEASONAL PART:

First we have to decompose the model.

CODE:

```
plot(decompose(x,type="multiplicative"))
```

OUTPUT:

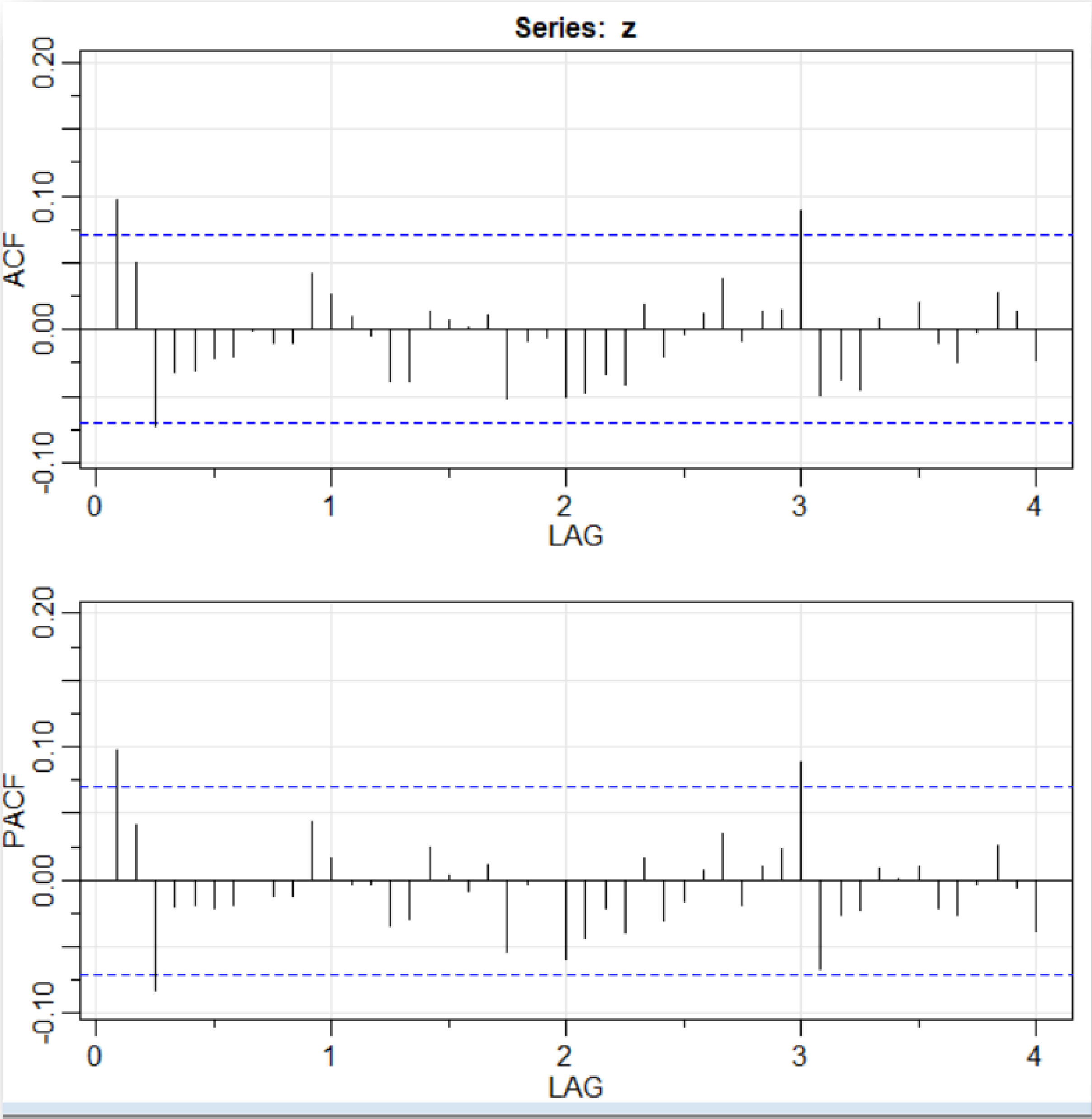


Now we try to plot ACF and PACF of the random part free from seasonality and trend.

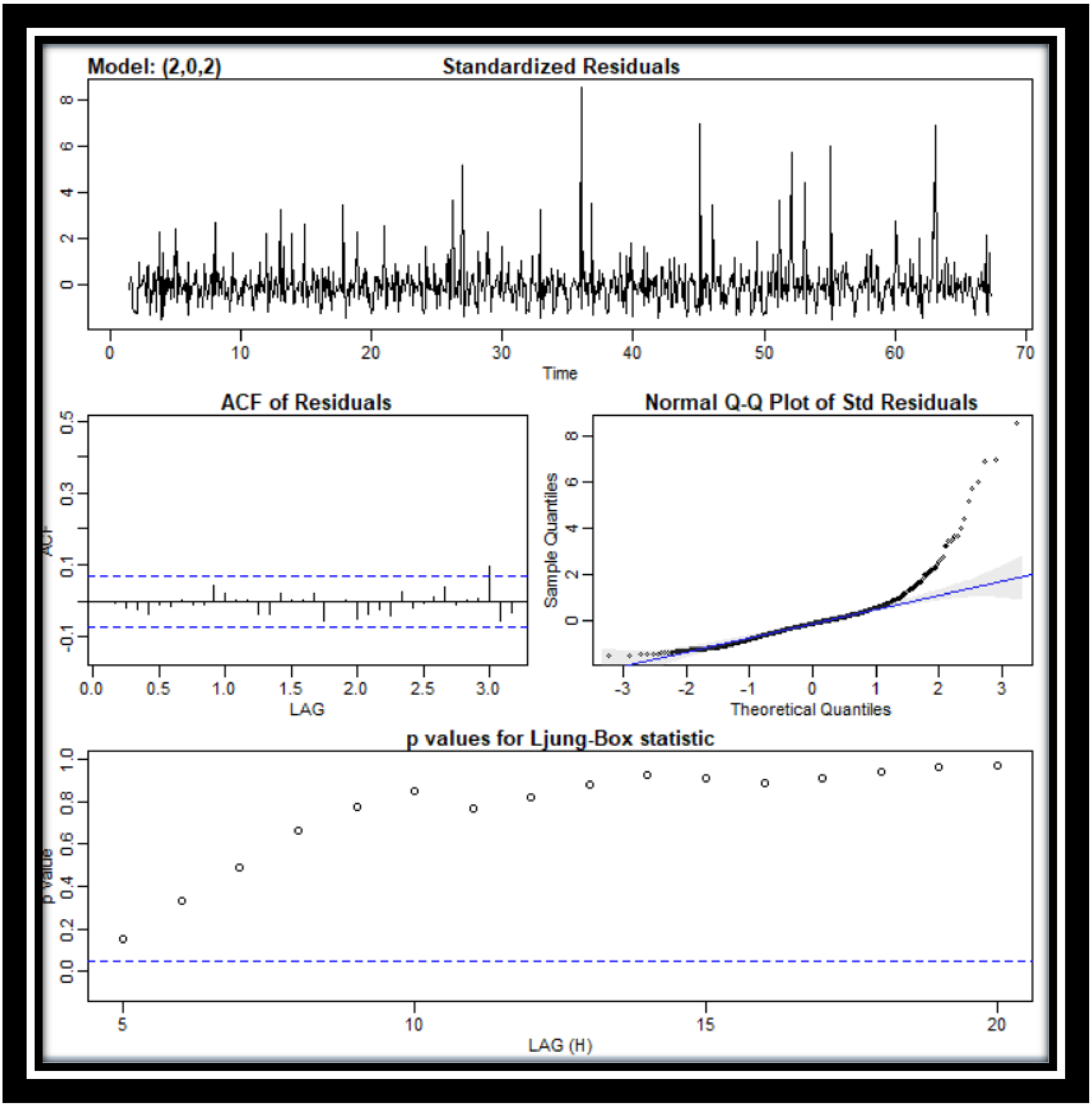
CODE:

```
y=decompose(x,type="multiplicative")
z=y$random
acf2(z,48)
```

OUTPUT:



The plot has initial spikes in both ACF and PACF. This shows that there is most probably components of both AR and MA model. So I tried fitting ARMA(1,0,1), ARMA(1,0,2) , ARMA(2,0,2) , ARMA(2,0,1).The best result was obtained from ARMA(2,0,2).

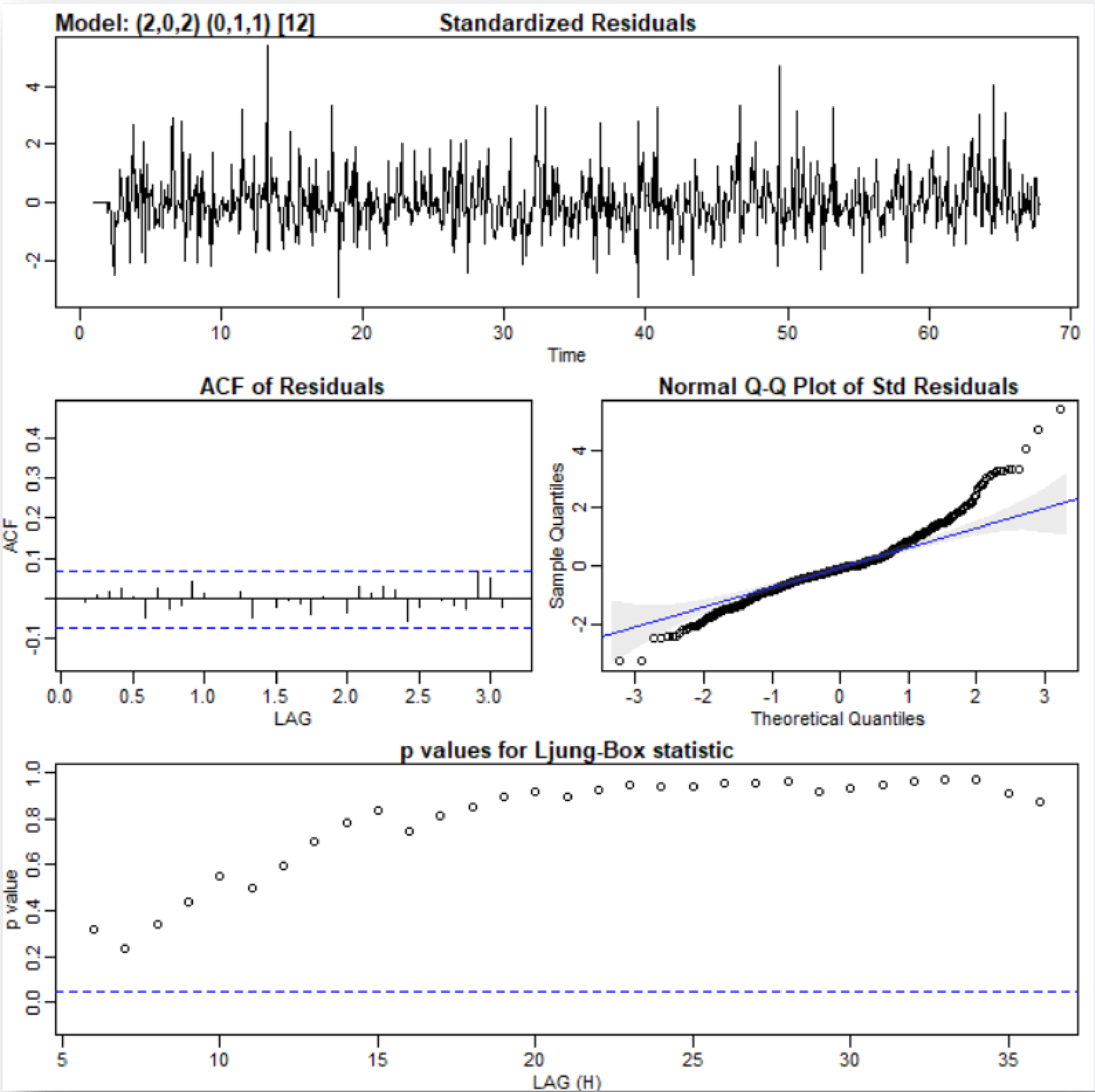


So now we can conclude our model is ARIMA(2,0,2)*(0,1,1)(12).Now I tried fitting the model to my data and the result was quite satisfactory(plot given below).

The coefficients are as follows:

```
Coefficients:
         ar1     ar2      ma1      ma2     sma1  constant
      0.1824  0.7617  -0.1700  -0.7389  -0.9844   -0.0223
s.e.  0.7255  0.7019   0.7269   0.6895   0.0370    0.0285
```

FITTING SARIMA(X,2,0,2,0,1,1,12):



THE FINAL MODEL IN ALGEBRAIC FORM :

ARIMA $(2,0,2) * (0,1,1)_{12}$

$$Z_t = (1 - B^{12})\, X_t$$

Non-Seasonal Comp

AR: $\phi(B) = 1 - \phi_1 B - \phi_2 B^2$

MA: $\theta(B) = 1 + \theta_1 B + \theta_2 B^2$

Seasonal Comp

AR: $\Phi(B^{12}) = 1$

MA: $\Theta(B^{12}) = 1 + \Theta_1 B^{12}$

$$\Phi(B^{12})\, \phi(B)(Z_t - \mu) = \Theta(B^{12})\, \theta(B)\, \omega_t$$

where μ is the mean of z_t.

$\phi_1 = 0.1824$, $\phi_2 = 0.7617$

$\theta_1 = -0.17$, $\theta_2 = -0.7389$

$\Theta_1 = -0.9844$, $\mu = -0.0223$

Final Model: $(1 - \phi_1 B - \phi_2 B^2)(Z_t - \mu) = (1 + \Theta_1 B^{12}) \times (1 + \theta_1 B + \theta_2 B^2)\, \omega_t$