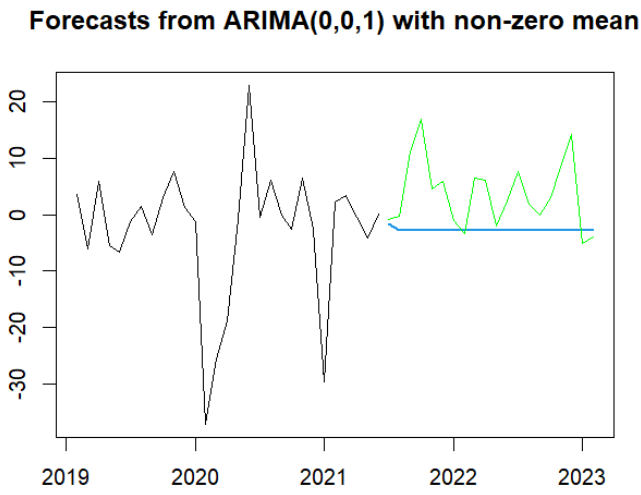
Reach Conclusion

In this study, we mainly selected three representative tourist cities, Bangkok, Chiangmai and Chonburi, and analyzed the three indicators of hotel occupancy rate, tourist number and tourism net profit in the three cities.

The first is the three indicators of Chonburi.

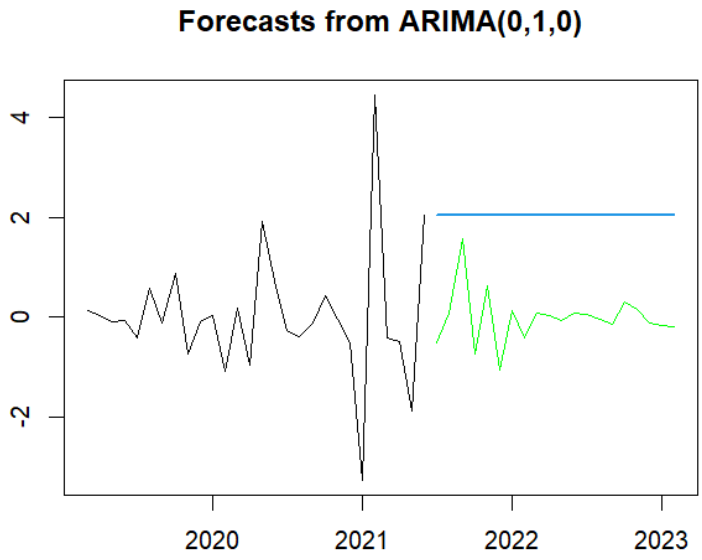
1. Occupancy rate

```
> accuracy(linear.lm.pred.season1)
                      ME      RMSE       MAE        MPE      MAPE
MASE      ACF1

Training set 1.441902e-16 27.26454 25.4701 -506.4164 543.3196
0.6684327 0.9201807

> accuracy(quadratic.lm.pred.season1)
                         ME      RMSE       MAE        MPE      MAPE
   MASE       ACF1
Training set -1.296324e-15 11.99539 9.229535 -198.2706 214.7823
0.2422183 0.67624
> accuracy(arima1)
                      ME      RMSE       MAE         MPE      MAPE
  MASE       ACF1

Training set -0.1441264 9.507311 6.43747 196.4665 246.6431 0.5550319
0.01292051
```



2. Net Profit

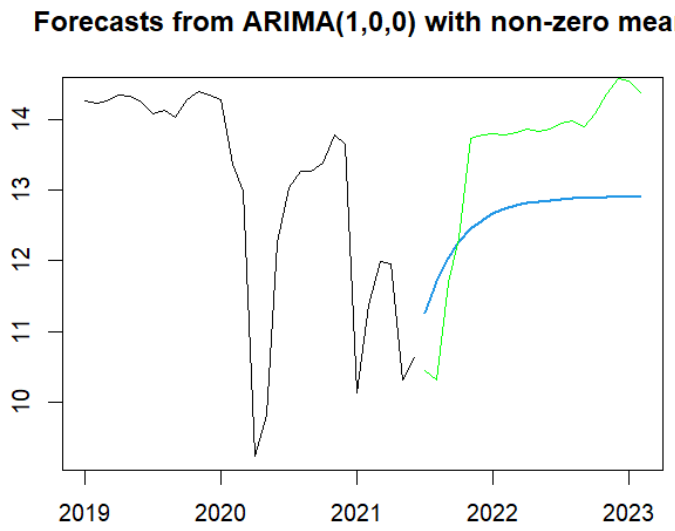
```
> accuracy(linear.lm.pred.season2)  #1.479454
                      ME      RMSE       MAE        MPE      MAPE
MASE      ACF1
Training set 5.324734e-17 1.479454 1.269046 -
4.114058 17.47562 0.5836318 0.880876
> accuracy(quadratic.lm.pred.season2) #0.9034827
                         ME      RMSE       MAE        MPE      MAPE
   MASE      ACF1
Training set -3.550762e-17 0.9034827 0.7499888 -
1.772736 10.14263 0.3449183 0.7064459
> accuracy(arima2)  #0.7556289
                       ME      RMSE       MAE         MPE      MAPE
  MASE       ACF1
Training set -0.01139841 0.7556289 0.4234124 -
0.8244412 6.375995 0.1947265 0.07662258
```



3. Tourist

```
> accuracy(linear.lm.pred.season3)  #1.324548
                      ME      RMSE       MAE        MPE      MAPE
 MASE      ACF1
Training set -7.102392e-17 1.324548 1.052942 -
1.203455 8.660632 0.5756022 0.7976605
> accuracy(quadratic.lm.pred.season3) #0.9490133
                      ME      RMSE       MAE         MPE      MAPE
    MASE      ACF1
Training set -3.551196e-17 0.9490133 0.7730783 -
0.6597469 6.292316 0.4226116 0.6177829
> accuracy(arima3)  #0.8926509
```

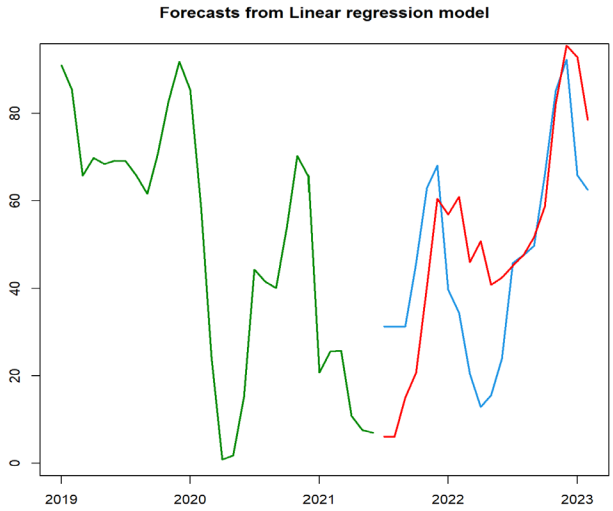
```
                      ME       RMSE       MAE       MPE      MAPE
MASE      ACF1
Training set -0.0219576 0.8926509 0.4908888 -
0.771892 4.284318 0.2683496 0.124683
```



Then there are the three indicators for Chiangmai.

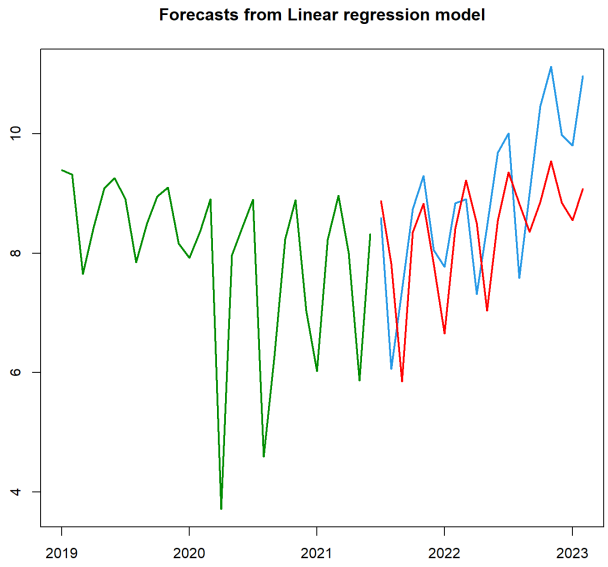
1. Occupancy rate

```
> accuracy(predict_line_occupancy)
              ME      RMSE       MAE        MPE      MAPE       MASE
Training set  0 21.22669 18.44047 -169.0438 197.5982 0.6009038
                  ACF1
Training set 0.8760137
> accuracy(predict_nonlinear_occupancy)
                        ME     RMSE       MAE        MPE      MAPE
Training set 5.328724e-16 12.1902 10.40683 -103.6789 122.6228
                   MASE      ACF1
Training set 0.3391184 0.6735608
> accuracy(predict_arima_ChiangMai_occupancy)
                    ME     RMSE       MAE        MPE      MAPE       MASE
Training set 1.093677 12.1911 8.394615 -60.03949 91.37578 0.2735481
                   ACF1
Training set 0.1743643
```



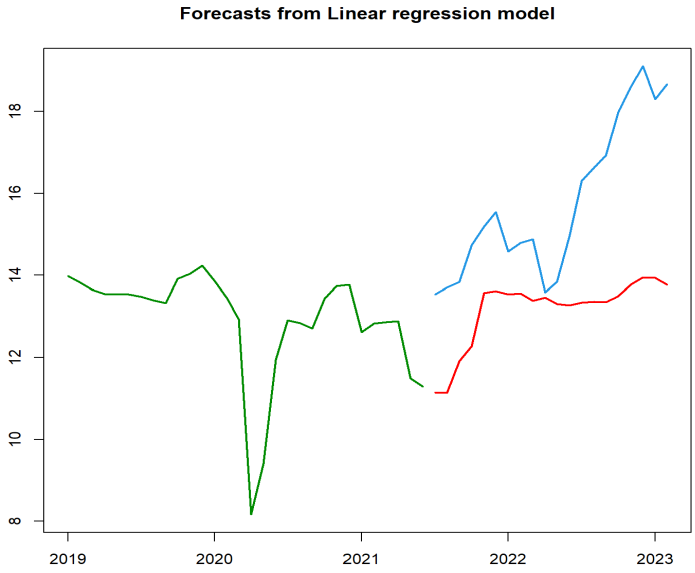
2. Net Profit

```
> accuracy(predict_line_profit)
                         ME      RMSE       MAE        MPE     MAPE
Training set -5.324951e-17 1.004784 0.7394051 -2.409881 10.90629
                    MASE      ACF1
Training set 0.6559822 0.1950246
> accuracy(predict_nonlinear_profit)
                         ME      RMSE       MAE        MPE     MAPE
Training set -1.774839e-17 0.8405172 0.5971661 -1.830352 8.86177
                    MASE       ACF1
Training set 0.5297912 -0.1065541
> accuracy(predict_arima_ChiangMai_profit)
                        ME      RMSE       MAE        MPE     MAPE
Training set -0.04321887 1.160345 0.8086366 -3.735592 12.35599
                    MASE      ACF1
Training set 0.7174027 0.1215264
```



3. Tourist

```
> accuracy(predict_line_tourist)
                      ME       RMSE        MAE         MPE      MAPE
Training set 7.101849e-17 0.9659936 0.6674755 -0.7385931 5.692294
                   MASE      ACF1
Training set 0.5615434 0.6837551
> accuracy(predict_nonlinear_tourist)
             ME      RMSE        MAE         MPE      MAPE    MASE
Training set  0 0.8344299 0.5808907 -0.5810061 4.925267 0.4887
                   ACF1
Training set 0.5704997
> accuracy(predict_arima_ChiangMai_tourist)
                      ME       RMSE        MAE         MPE      MAPE
Training set 0.02103759 0.9360489 0.5260736 -0.1692823 4.506591
                   MASE       ACF1
Training set 0.4425828 0.02021196
```

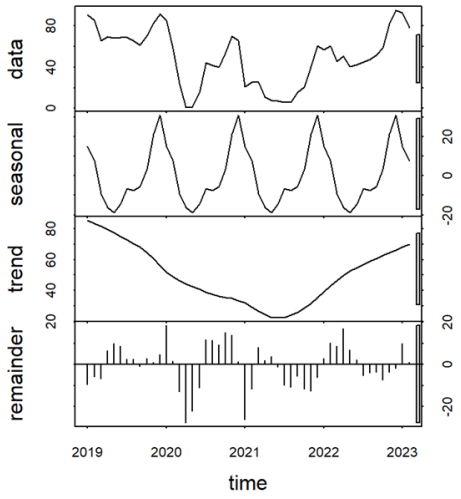


As can be seen from the above accuracy results, ARIMA model has the best performance in the prediction of hotel occupancy rate, tourism net profit and total number of tourists in Chonburi; In Chiangmai, the nonlinear trend model has the best performance in the prediction of hotel occupancy rate, tourism net profit and total number of tourists. The picture shows the best models and divides the training set and test set to make predictions.

Through the pictures of the two places, we further compare and analyze, Chiang Mai's profit margin fluctuates year by year, while Chonburi fluctuates up and down at 0, indicating that the profitability is not strong in this period of time. We further infer the reasons: Chiang Mai is the largest city except the capital Bangkok, with mature urban facilities and developed tourism

industry, and the occupancy rate and number of tourists are also good, so it has the potential to make further profits in the tourism industry in the future; Chonburi was originally a fishing village and is now an industrial and commercial city. Compared with Chiang Mai, the tourism industry is less developed, and the overall urban level and economic level are lower. Therefore, the above factors may have a certain negative effect on the profit of tourism.

In the process of implementation, special analysis and supplementary explanation of data processing for a special city are required: When the ARIMA difference is performed on the data in Chiang Mai, the ndiff result of the non-seasonal term is 0, but it fails the ADF test, so the first-order difference is performed on the seasonal term. However, after this step, the ndiff result is 1, which fails the ADF test, so the first-order difference processing is performed on the non-seasonal term. The results passed the unit root test ($p = 0.04<0.05$). The reason for this is mainly because the seasonal term in Chiang Mai fluctuates more than that in Bangkok and Chonburi. (as shown in the picture). In the final value of Auto Arima model, season terms are added: ARIMA(0,1,0)(1,1,0)[12].




```
> ADF1

        Augmented Dickey-Fuller Test

data:  ChiangMai_occupancy.ts
Dickey-Fuller = -2.1703, Lag order = 3, p-value = 0.506
alternative hypothesis: stationary
```

```r
ndiffs(ChiangMai_occupancy.ts) #The result is 0 but does not pass the ADF unit root test
ADF1 <- adf.test(ChiangMai_occupancy.ts)
# So make a first-order difference for the seasonal term
nChiangMai_occupancy.ts<-diff(ChiangMai_occupancy.ts,12)
nChiangMai_occupancy.ts<-diff(nChiangMai_occupancy.ts,1)
ndiffs(nChiangMai_occupancy.ts)
## Run the unit root test on the data again
```

```
ADF2 <- adf.test(nChiangMai_occupancy.ts)
#p=0.04<0.05, so the null hypothesis is rejected, there is no unit
root, and the time series is stationary after first difference
```

Therefore, we think that among the three cities, only the optimal model of three indicators in Chiang Mai is a nonlinear model. First, it may be that ARIMA has stronger ability to process data with weak seasonality, while the accuracy of ARIMA decreases due to the strong seasonality in Chiang Mai. Second, the data range and circumstances may be special, which will affect the judgment of the optimal model.