Time Series HW8

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Import the necessary libraries

```
library(sarima)
```

```
## Loading required package: stats4
```

```
library(forecast)
```

```
## Registered S3 method overwritten by 'quantmod':
##   method            from
##   as.zoo.data.frame zoo
```

III. For the following models, simulate 400 observations, estimate the model, obtain 1-step ahead to 12-step ahead predictions and their standard errors, and plot the last 24 observed observations with the predictions and their 95% confidence intervals.

1. $(x_t - 20) = -0.7(x_{t-1} - 20) + \epsilon_t, \epsilon_t \sim N(0, 5^2)$

```
set.seed(123)
sim1 <- arima.sim(model=list(order=c(1,0,0), ar=c(-0.7)), n=400, sd = 5)+20
model1 <- arima(sim1, order=c(1,0,0))
model1.pred <- predict(model1, n.ahead=12)
```

Predictions for model 1

```
model1.pred$pred
```

```
## Time Series:
## Start = 401
## End = 412
## Frequency = 1
##  [1] 22.61501 18.21987 21.20547 19.17736 20.55505 19.61919 20.25492 19.82307
##  [9] 20.11642 19.91715 20.05251 19.96056
```

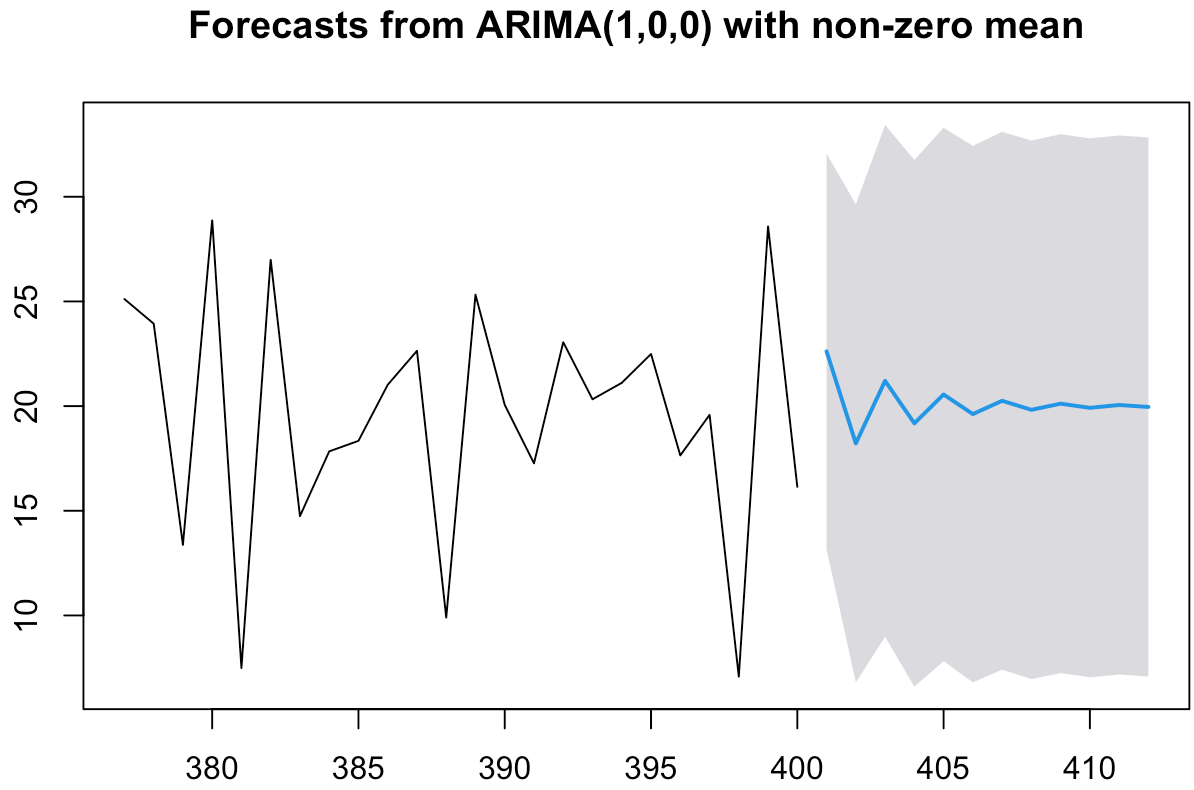
Standard errors for model 1 predictions

```
model1.pred$se
```

```
## Time Series:
## Start = 401
## End = 412
## Frequency = 1
##  [1] 4.821014 5.828133 6.238277 6.418704 6.500273 6.537569 6.554708 6.562601
##  [9] 6.566240 6.567919 6.568693 6.569051
```

Plot last 24 observations with 95% confidence intervals for predictions

```
plot(forecast(model1,h=12, level=0.95), include=24)
```



2. $(1 - 1.4B + 0.48B^2)(x_t - 20) = (1 + 1.2B + 0.35B^2)\epsilon_t, \epsilon_t \sim N(0, 5^2)$

```
set.seed(123)
sim2 <- arima.sim(model=list(order=c(2,0,2),ar=c(1.4,-0.48), ma=c(1.2,0.35)), n=400,
sd=5)+20
model2 <- arima(sim2, order=c(2,0,2))
model2.pred <- predict(model2, n.ahead=12)
```

Model 2 predictions

```
model2.pred$pred
```

```
## Time Series:
## Start = 401
## End = 412
## Frequency = 1
##  [1] 65.05035 54.46571 45.90735 39.25102 34.23000 30.53848 27.88528 26.01794
##  [9] 24.73006 23.85973 23.28400 22.91196
```

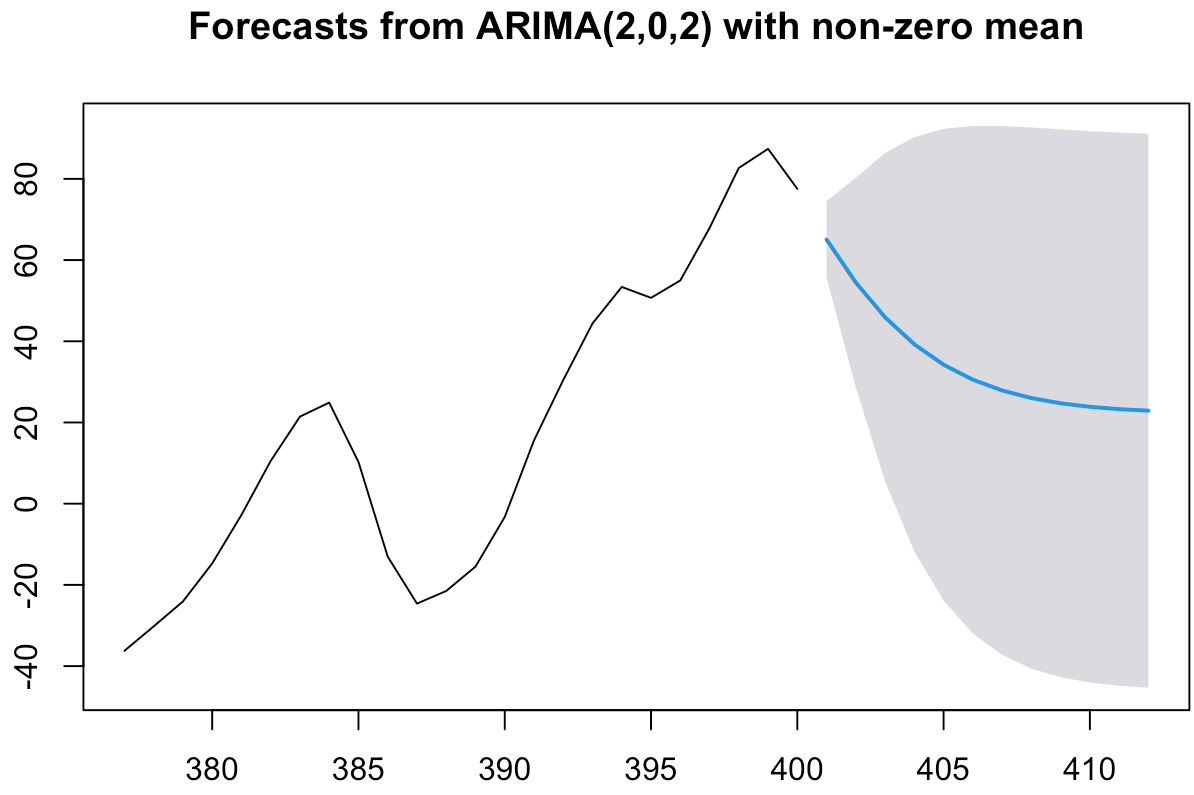
Standard errors for model 2 predictions

```
model2.pred$se
```

```
## Time Series:
## Start = 401
## End = 412
## Frequency = 1
##  [1]  4.82509 13.17455 20.63327 26.03732 29.63439 31.89041 33.23671 34.00483
##  [9] 34.42500 34.64576 34.75729 34.81150
```

Plot last 24 observations with 95% confidence intervals for predictions

```
plot(forecast(model2,h=12, level=0.95), include=24)
```



3. $(1 - 0.8B)\Delta x_t = (1 + 0.6B)\epsilon_t, \epsilon_t \sim N(0, 5^2)$

```
set.seed(123)
sim3 <- arima.sim(model=list(order=c(1,1,1),ar=c(0.8), ma=c(0.6)), n=400, sd=5)
model3 <- arima(sim3, order=c(1,1,1))
model3.pred <- predict(model3, n.ahead=12)
```

Model 3 predictions

```
model3.pred$pred
```

```
## Time Series:
## Start = 402
## End = 413
## Frequency = 1
##  [1] 283.0256 299.3452 311.1959 319.8014 326.0503 330.5881 333.8833 336.2761
##  [9] 338.0136 339.2754 340.1916 340.8570
```

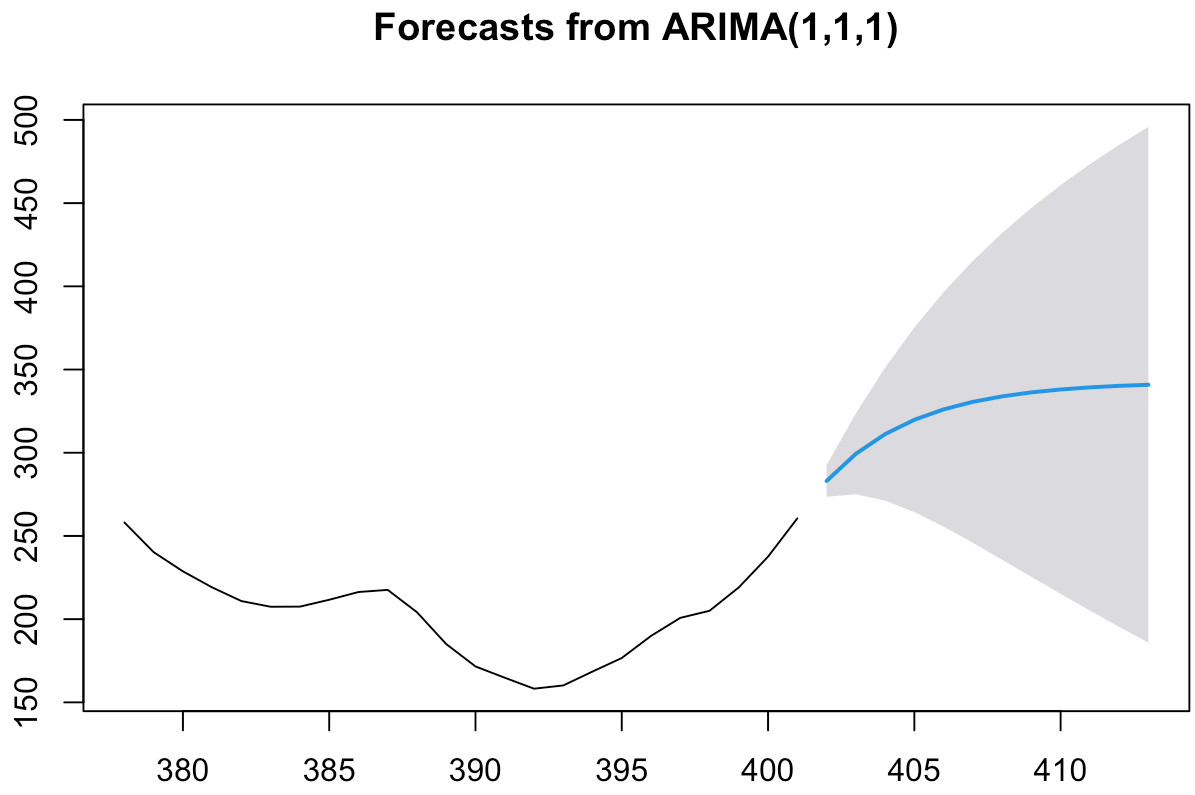
Standard errors for model 3 predictions

```
model3.pred$se
```

```
## Time Series:
## Start = 402
## End = 413
## Frequency = 1
##  [1]  4.837976 12.392390 20.380972 28.307836 35.951017 43.219673 50.088131
##  [8] 56.563335 62.667865 68.430860 73.883155 79.054761
```

Plot last 24 observations with 95% confidence intervals for predictions

```
plot(forecast(model3,h=12, level=0.95), include=24)
```



4. $(1 - B^{12})x_t = (1 + 0.8B)(1 + 0.8B^{12})\epsilon_t, \epsilon_t \sim N(0, 5^2)$.

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

```
set.seed(123)
sim4 <- sim_sarima(model=list(siorder=1, ma=c(0.8), sma=c(0.8), nseasons=12), n=400,
sd=5)

model4 <- arima(sim4, order=c(0,0,1), seasonal=list(order=c(1,0,1), period=12))

model4.pred <- predict(model4, n.ahead=12)
```

Model 4 predictions

```
model4.pred$pred
```

```
## Time Series:
## Start = 401
## End = 412
## Frequency = 1
##  [1] -3.3739258  5.7240993 18.3386909  4.5111090  7.2202443 10.6474639
##  [7] -1.0901893 -7.5589013 -9.5697695 -3.6018103  0.5235469 -4.4363520
```

Standard errors for model 4 predictions

```
model4.pred$se
```

```
## Time Series:
## Start = 401
## End = 412
## Frequency = 1
##  [1] 0.944145 1.219792 1.219792 1.219792 1.219792 1.219792 1.219792 1.219792
##  [9] 1.219792 1.219792 1.219792 1.219792
```

Plot last 24 observations with 95% confidence intervals for predictions

```
plot(forecast(model4,h=12, level=0.95), include=24)
```