ASHR ARMA-X Analysis

Contents

	Model 1
ar1	0.9820***
	(0.0029)
ma1	−0.8749***
	(0.0088)
dummy_lag_0	0.0000**
	(0.0000)
dummy_lag_1	0.0000
	(0.0000)
dummy_lag_2	0.0000
	(0.0000)
AIC	−255919.4761
AICc	−255919.4719
BIC	−255872.0645
Log Likelihood	127965.7380
Num. obs.	19969

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Table 1: ARMAX Model Results

Stationarity

```
adf.test(data$ASHR_vol)

adf.test(data$N)
adf.test(data$tariff)
adf.test(data$china)
```

CSI 300 China Univariate ARMA-X Models

Tweet Dummy as Exogenous

```
#auto.armax selects the lowest AIC value given r (exogenous variable lags)
res1 = auto.armax(data$ASHR_vol,xreg=data$dummy,nb.lags=2,
                latex=T,max.p = 6, max.q = 6, max.d=0)
```

```
#armax enables a custom armax specification with p,q,r
res2 = armax(data$ASHR_vol, xreg=data$dummy, nb.lags=2,
                   p=5, q=0, d=0, latex=T)
```

```
#auto.armax.r selects the lowest AIC checking all 3 p,q,r values
res3 = auto.armax.r(data$ASHR_vol, x=data$dummy,
                max_p = 3, max_q = 3, max_r = 3, criterion = "AIC", latex=T)
```

	Model 1
ar1	0.2927***
	(0.0071)
ar2	0.0828***
	(0.0073)
ar3	0.0534***
	(0.0073)
ar4	0.0684***
	(0.0073)
ar5	0.0909***
	(0.0073)
intercept	0.0001
dummy_lag_0	0.0000***
	(0.0000)
dummy_lag_1	0.0000
	(0.0000)
dummy_lag_2	0.0000
	(0.0000)
AIC	−255731.1908
AICc	−255731.1798
BIC	−255652.1715
Log Likelihood	127875.5954
Num. obs.	19969

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

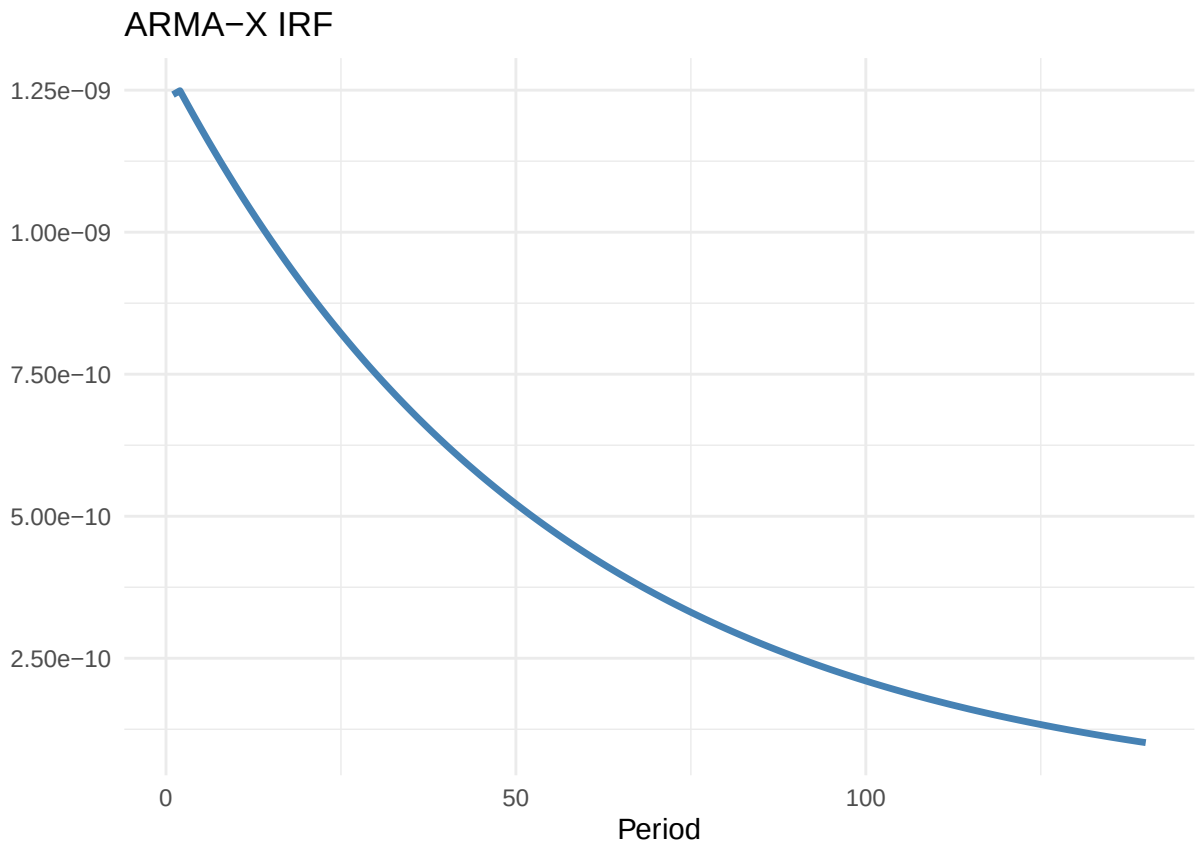
Table 2: ARMAX Model Results

	Model 1
ar1	0.9910***
	(0.0014)
ma1	−0.7445***
	(0.0072)
ma2	−0.1387***
	(0.0088)
ma3	−0.0470***
	(0.0072)
intercept	0.0001
dummy_lag_0	0.0000
AIC	−256599.7623
AICc	−256599.7567
BIC	−256544.4480
Log Likelihood	128306.8811
Num. obs.	19971

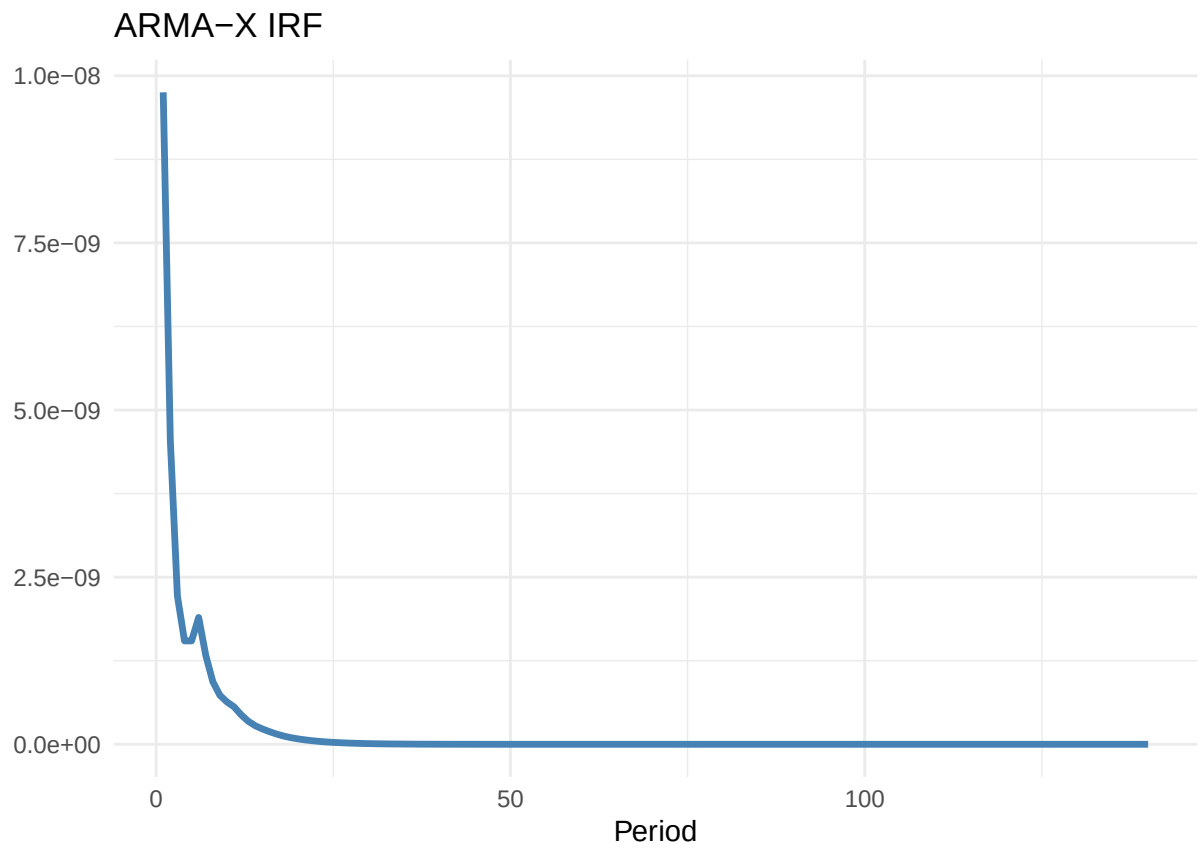
$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 3: ARMAX selected by AIC

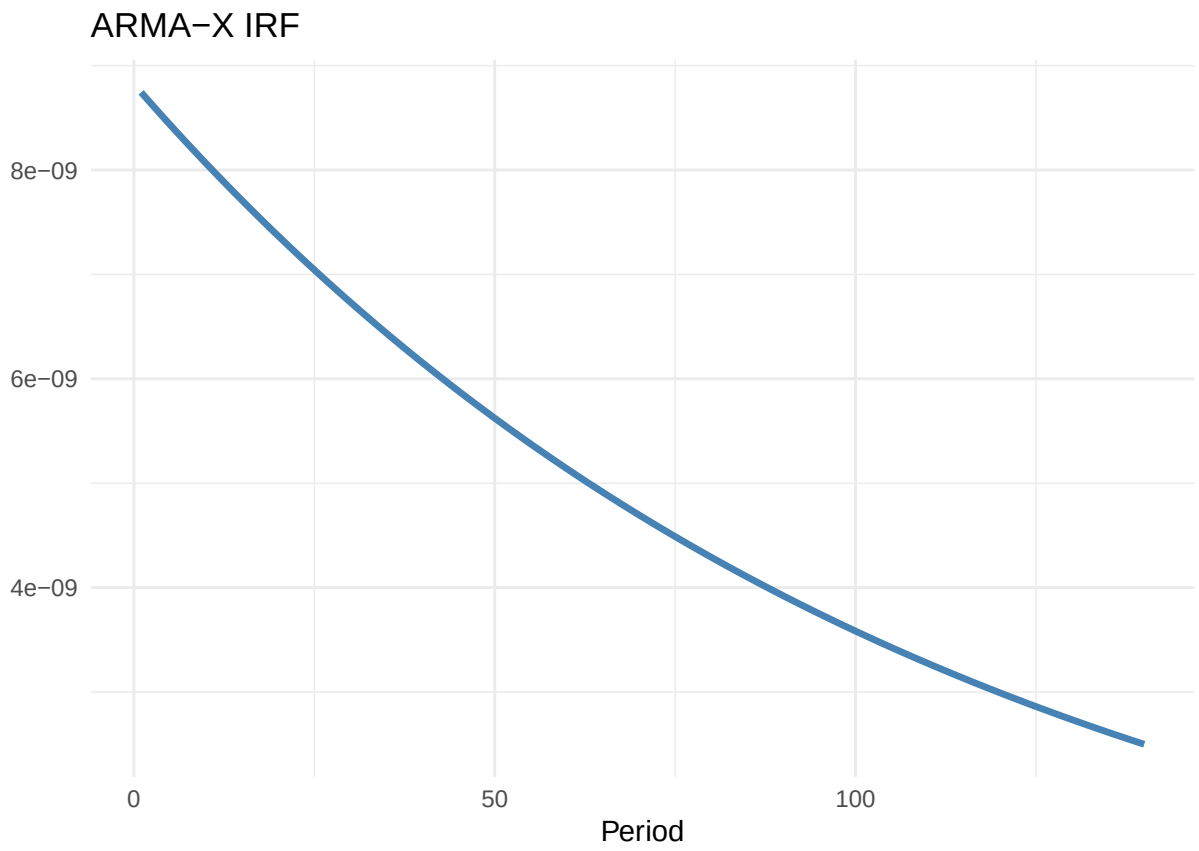
```r
#we want to plot the IRFs of these models
nb.periods = 7 * 20

irf.plot(res1,nb.periods)
```




```r
irf.plot(res2,nb.periods)
```




```
irf.plot(res3$model,nb.periods)
```



Tweet Count as Exogenous

```
#auto.armax selects the lowest AIC value given r (exogenous variable lags)
res1 = auto.armax(data$ASHR_vol,xreg=data$N,nb.lags=2,
                  latex=T,max.p = 6, max.q = 6, max.d=0)
```

```
#armax enables a custom armax specification with p,q,r
res2 = armax(data$ASHR_vol, xreg=data$N, nb.lags=2,
                    p=5, q=0, d=0, latex=T)
```

```
#auto.armax.r selects the lowest AIC checking all 3 p,q,r values
res3 = auto.armax.r(data$ASHR_vol, x=data$N,
                  max_p = 3, max_q = 3, max_r = 3, criterion = "AIC", latex=T)
```

```
#we want to plot the IRFs of these models
nb.periods = 7 * 20

irf.plot(res1,nb.periods)
```

	Model 1
ar1	0.3092***
	(0.0075)
ar2	0.0926***
	(0.0074)
ar3	0.0657***
	(0.0075)
ar4	0.0809***
	(0.0073)
ar5	0.1049***
	(0.0065)
N_lag_0	0.0000
	(0.0000)
N_lag_1	0.0000
	(0.0000)
N_lag_2	0.0000
	(0.0000)
AIC	−255345.1057
AICc	−255345.0966
BIC	−255273.9882
Log Likelihood	127681.5528
Num. obs.	19969

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 4: ARMAX Model Results

	Model 1
ar1	0.2931***
	(0.0080)
ar2	0.0802***
	(0.0076)
ar3	0.0535***
	(0.0077)
ar4	0.0680***
	(0.0073)
ar5	0.0907***
	(0.0118)
intercept	0.0001
N_lag_0	0.0000
	(0.0000)
N_lag_1	0.0000
	(0.0000)
N_lag_2	−0.0000
	(0.0000)
AIC	−255638.6089
AICc	−255638.5979
BIC	−255559.5895
Log Likelihood	127829.3044
Num. obs.	19969

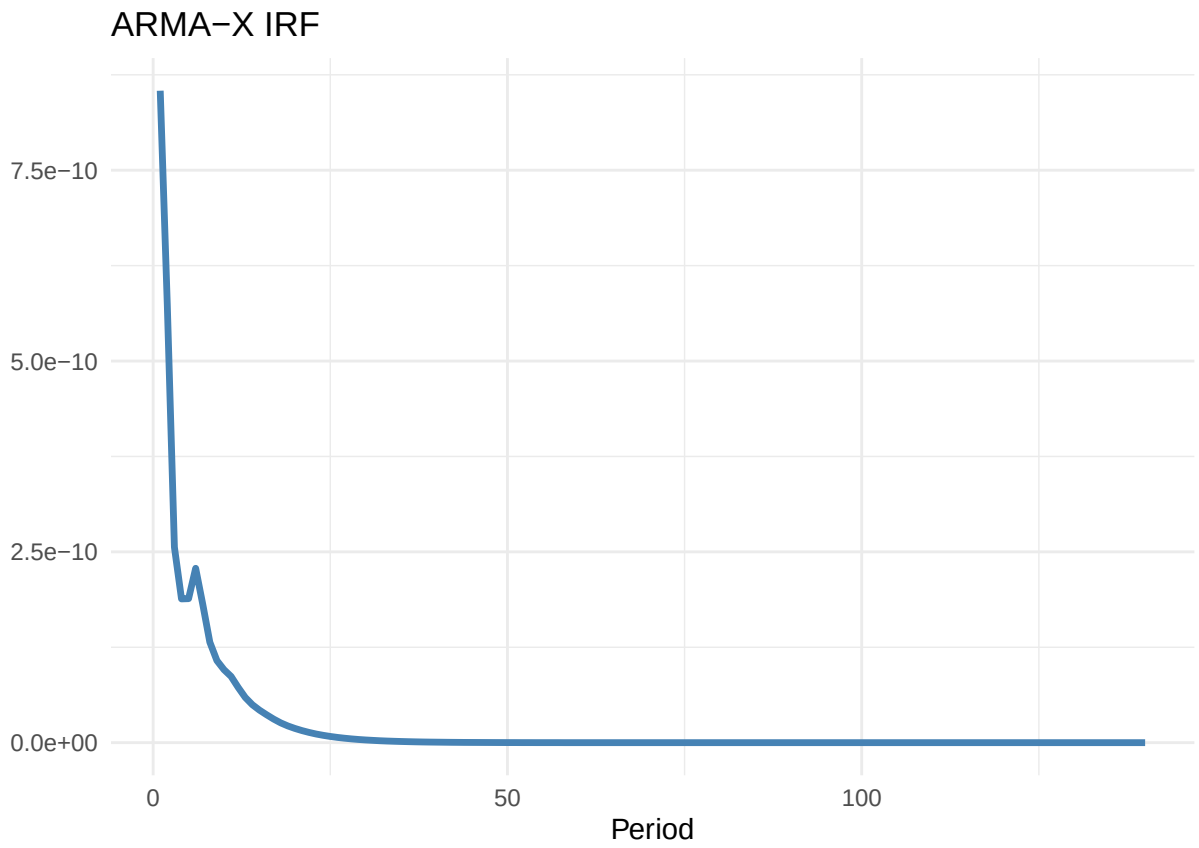
$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 5: ARMAX Model Results

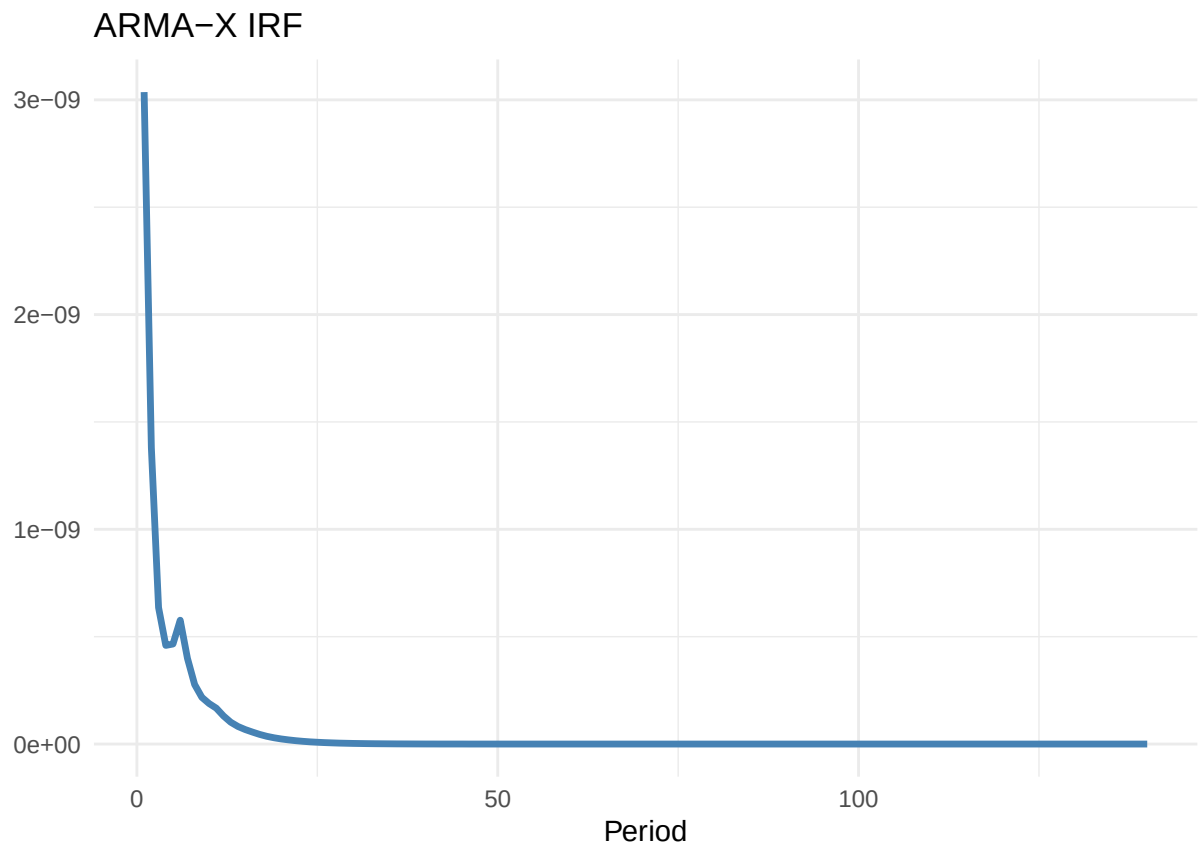
	Model 1
ar1	0.9909***
	(0.0014)
ma1	−0.7439***
	(0.0072)
ma2	−0.1410***
	(0.0087)
ma3	−0.0452***
	(0.0072)
intercept	0.0001
N_lag_0	0.0000
AIC	−256508.5319
AICc	−256508.5263
BIC	−256453.2176
Log Likelihood	128261.2659
Num. obs.	19971

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

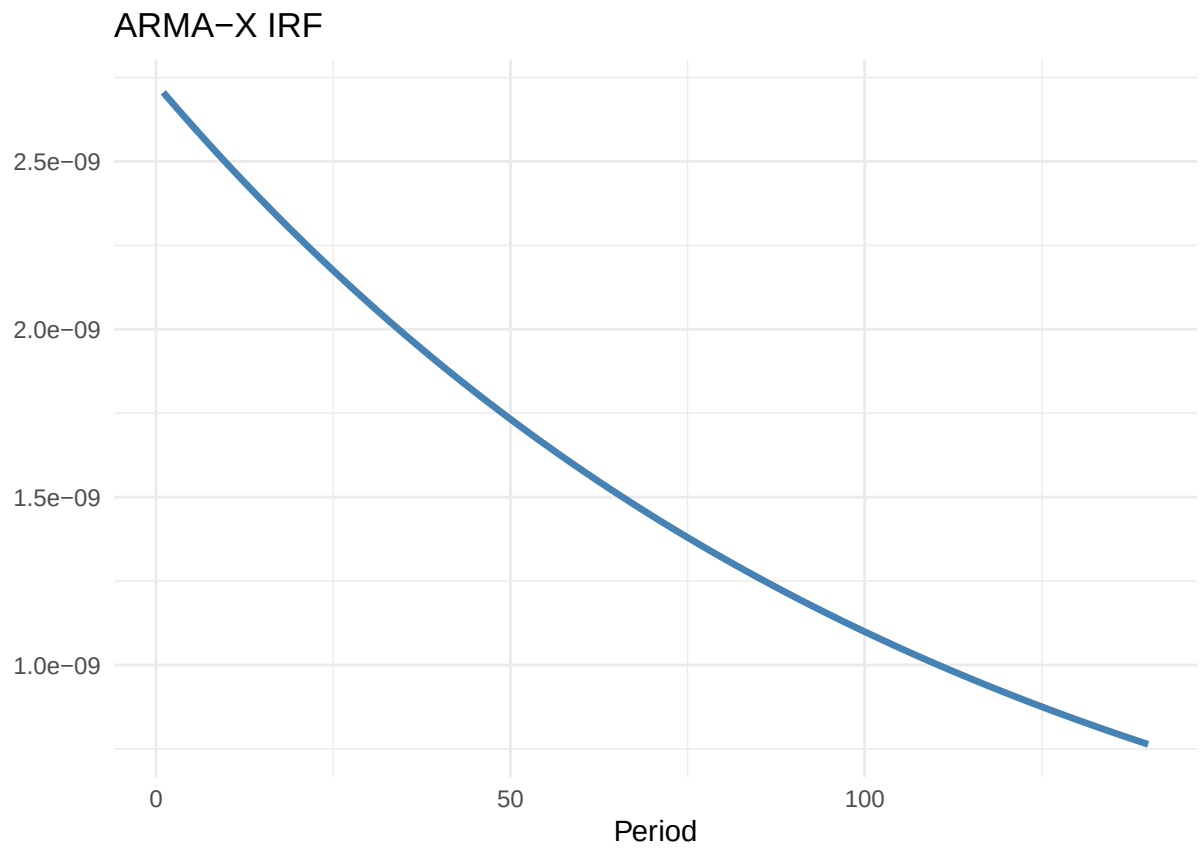
Table 6: ARMAX selected by AIC



```
irf.plot(res2,nb.periods)
```




```
irf.plot(res3$model,nb.periods)
```



Tariff as Exogenous

```
#auto.armax selects the lowest AIC value given r (exogenous variable lags)
res1 = auto.armax(data$ASHR_vol,xreg=data$tariff,nb.lags=2,
                latex=T,max.p = 6, max.q = 6, max.d=0)
```

```
#armax enables a custom armax specification with p,q,r
res2 = armax(data$ASHR_vol, xreg=data$tariff, nb.lags=2,
                   p=5, q=0, d=0, latex=T)
```

```
#auto.armax.r selects the lowest AIC checking all 3 p,q,r values
res3 = auto.armax.r(data$ASHR_vol, x=data$tariff,
                max_p = 3, max_q = 3, max_r = 3, criterion = "AIC", latex=T)
```

```
#we want to plot the IRFs of these models
nb.periods = 7 * 20

irf.plot(res1,nb.periods)
```

	Model 1
ar1	0.9900***
	(0.0015)
ma1	−0.7563***
	(0.0070)
ma2	−0.1692***
	(0.0069)
intercept	0.0002***
	(0.0000)
tariff_lag_0	0.0000
	(0.0000)
tariff_lag_1	0.0000
	(0.0000)
tariff_lag_2	−0.0000
	(0.0000)
AIC	−255927.0698
AICc	−255927.0626
BIC	−255863.8543
Log Likelihood	127971.5349
Num. obs.	19969

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Table 7: ARMAX Model Results

	Model 1
ar1	0.2907***
	(0.0070)
ar2	0.0796***
	(0.0073)
ar3	0.0507***
	(0.0073)
ar4	0.0651***
	(0.0073)
ar5	0.0887***
	(0.0070)
intercept	0.0002***
	(0.0000)
tariff_lag_0	0.0000
	(0.0000)
tariff_lag_1	0.0000
	(0.0000)
tariff_lag_2	0.0000
	(0.0000)
AIC	−255036.7200
AICc	−255036.7090
BIC	−254957.7006
Log Likelihood	127528.3600
Num. obs.	19969

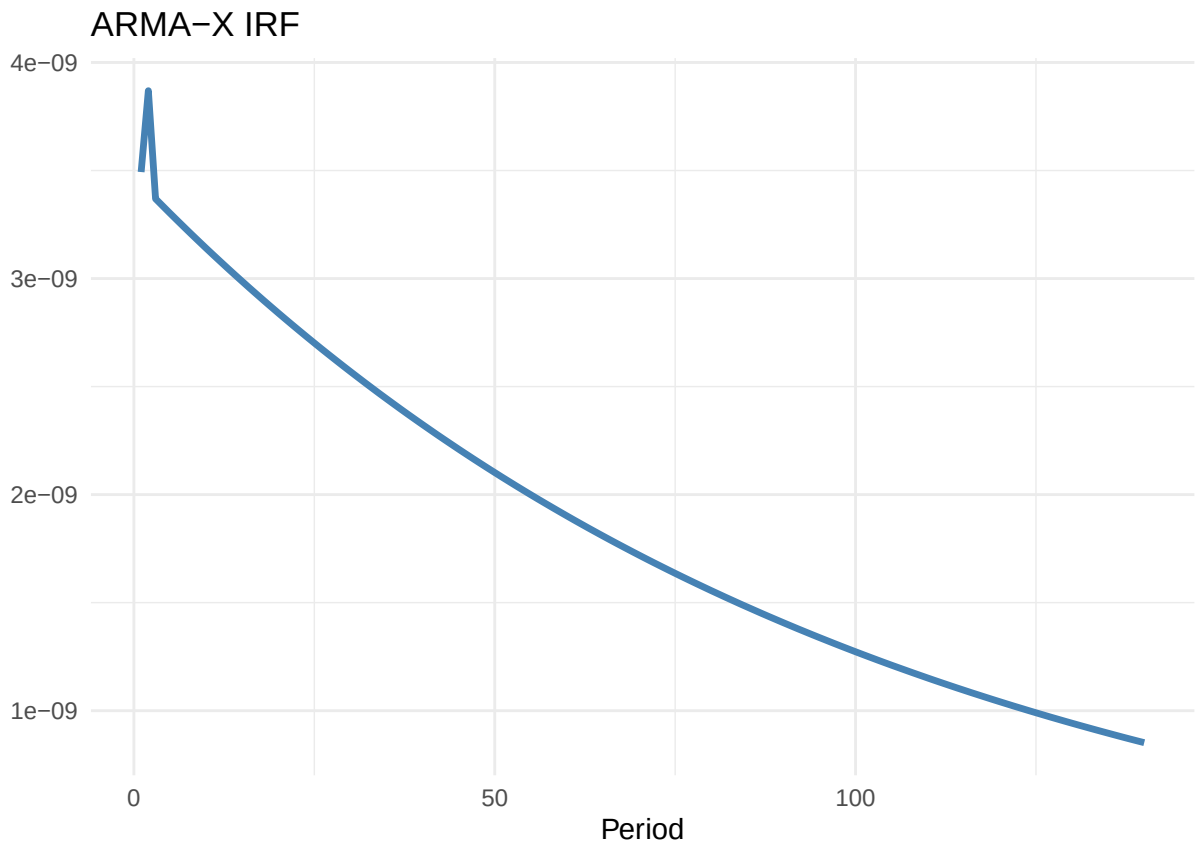
***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Table 8: ARMAX Model Results

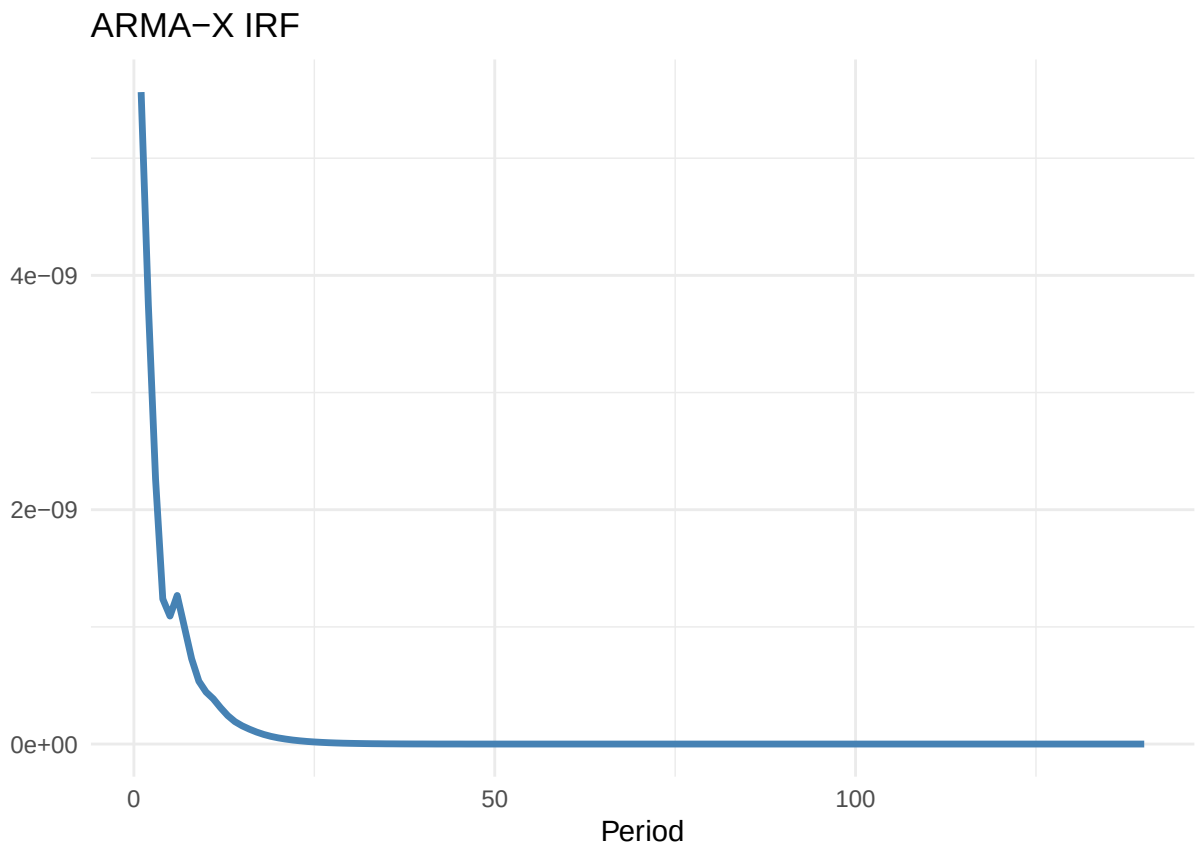
	Model 1
ar1	0.9913***
	(0.0013)
ma1	−0.7508***
	(0.0072)
ma2	−0.1387***
	(0.0088)
ma3	−0.0429***
	(0.0073)
intercept	0.0002***
	(0.0000)
tariff_lag_0	0.0000
	(0.0000)
AIC	−255990.0623
AICc	−255990.0567
BIC	−255934.7481
Log Likelihood	128002.0312
Num. obs.	19971

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

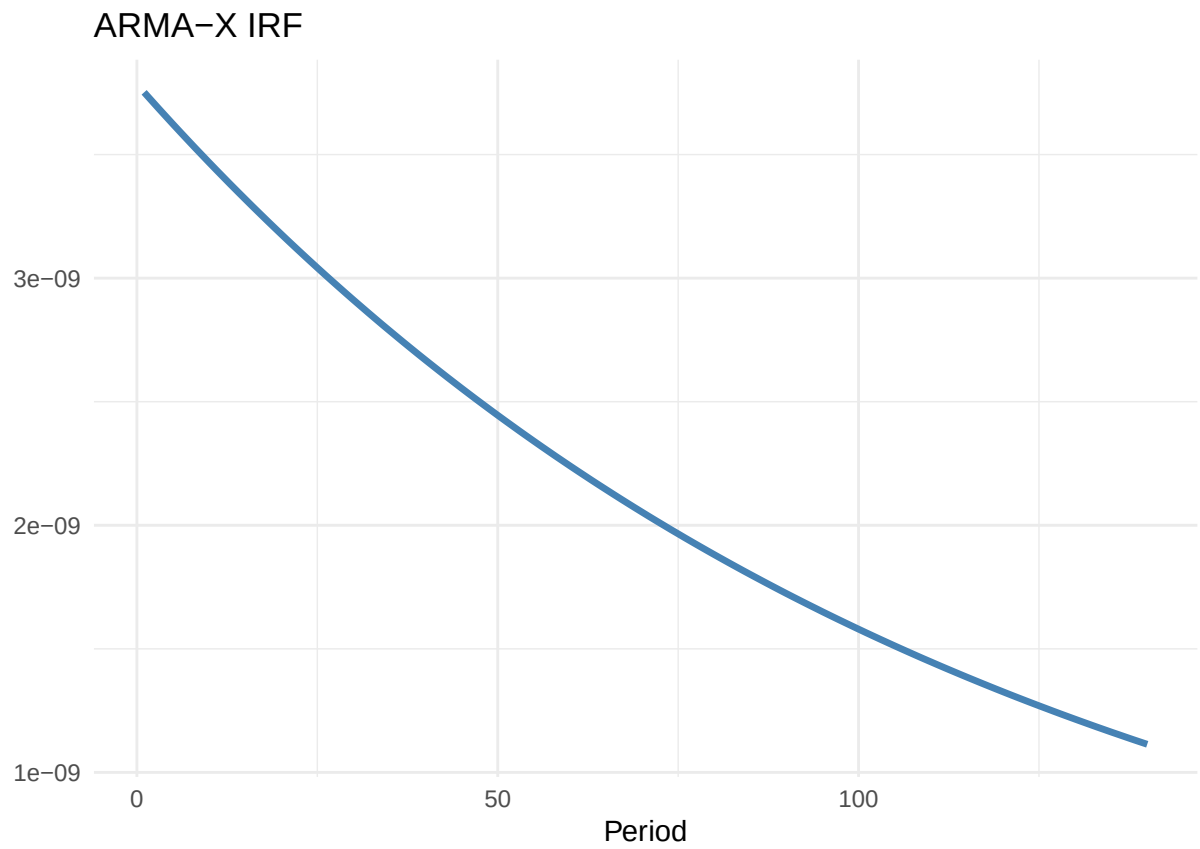
Table 9: ARMAX selected by AIC



```
irf.plot(res2,nb.periods)
```




```
irf.plot(res3$model,nb.periods)
```



Trade Mention as Exogenous

```
#auto.armax selects the lowest AIC value given r (exogenous variable lags)
res1 = auto.armax(data$ASHR_vol,xreg=data$trade,nb.lags=2,
                  latex=T,max.p = 6, max.q = 6, max.d=0)
```

```
#armax enables a custom armax specification with p,q,r
res2 = armax(data$ASHR_vol, xreg=data$trade, nb.lags=2,
                    p=5, q=0, d=0, latex=T)
```

```
#auto.armax.r selects the lowest AIC checking all 3 p,q,r values
res3 = auto.armax.r(data$ASHR_vol, x=data$trade,
                  max_p = 3, max_q = 3, max_r = 3, criterion = "AIC", latex=T)
```

```
#we want to plot the IRFs of these models
nb.periods = 7 * 20

irf.plot(res1,nb.periods)
```

	Model 1
ar1	0.9900***
	(0.0015)
ma1	−0.7555***
	(0.0070)
ma2	−0.1703***
	(0.0069)
intercept	0.0002***
	(0.0000)
trade_lag_0	0.0000**
	(0.0000)
trade_lag_1	−0.0000
	(0.0000)
trade_lag_2	0.0000
	(0.0000)
AIC	−255946.3538
AICc	−255946.3466
BIC	−255883.1383
Log Likelihood	127981.1769
Num. obs.	19969

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Table 10: ARMAX Model Results

	Model 1
ar1	0.2916***
	(0.0070)
ar2	0.0787***
	(0.0073)
ar3	0.0502***
	(0.0073)
ar4	0.0661***
	(0.0073)
ar5	0.0881***
	(0.0071)
intercept	0.0002***
	(0.0000)
trade_lag_0	0.0000**
	(0.0000)
trade_lag_1	−0.0000
	(0.0000)
trade_lag_2	0.0000
	(0.0000)
AIC	−255055.5611
AICc	−255055.5501
BIC	−254976.5418
Log Likelihood	127537.7806
Num. obs.	19969

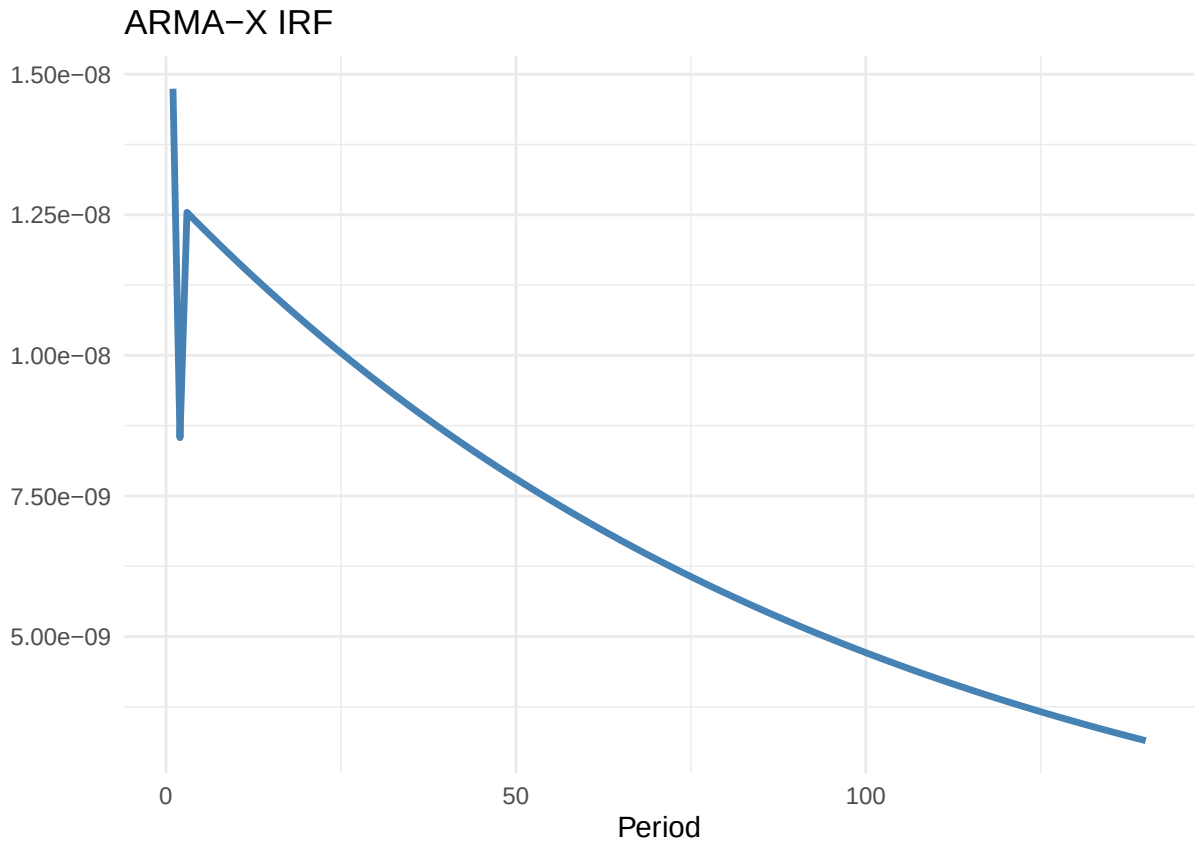
***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Table 11: ARMAX Model Results

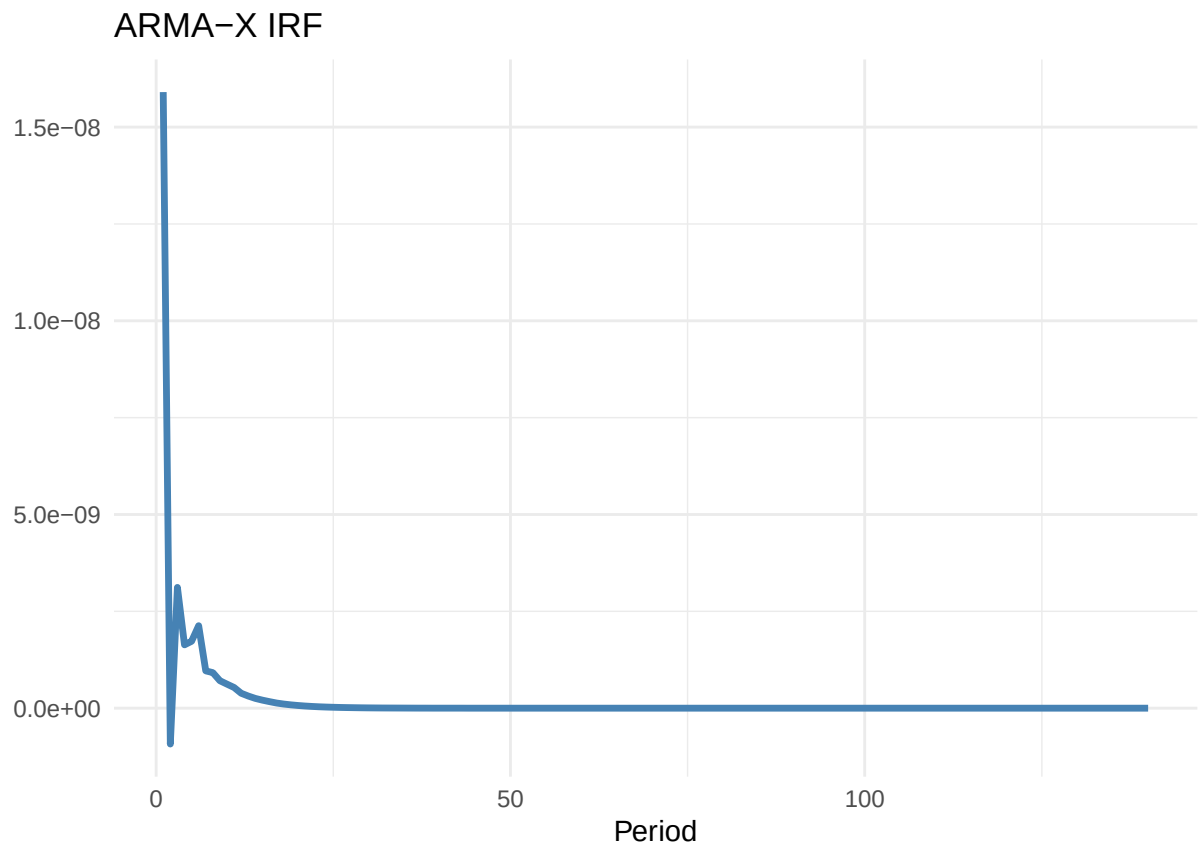
	Model 1
ar1	0.9914***
	(0.0013)
ma1	−0.7494***
	(0.0072)
ma2	−0.1406***
	(0.0087)
ma3	−0.0427***
	(0.0073)
intercept	0.0002***
	(0.0000)
trade_lag_0	0.0000**
	(0.0000)
AIC	−256004.3080
AICc	−256004.3024
BIC	−255948.9937
Log Likelihood	128009.1540
Num. obs.	19971

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

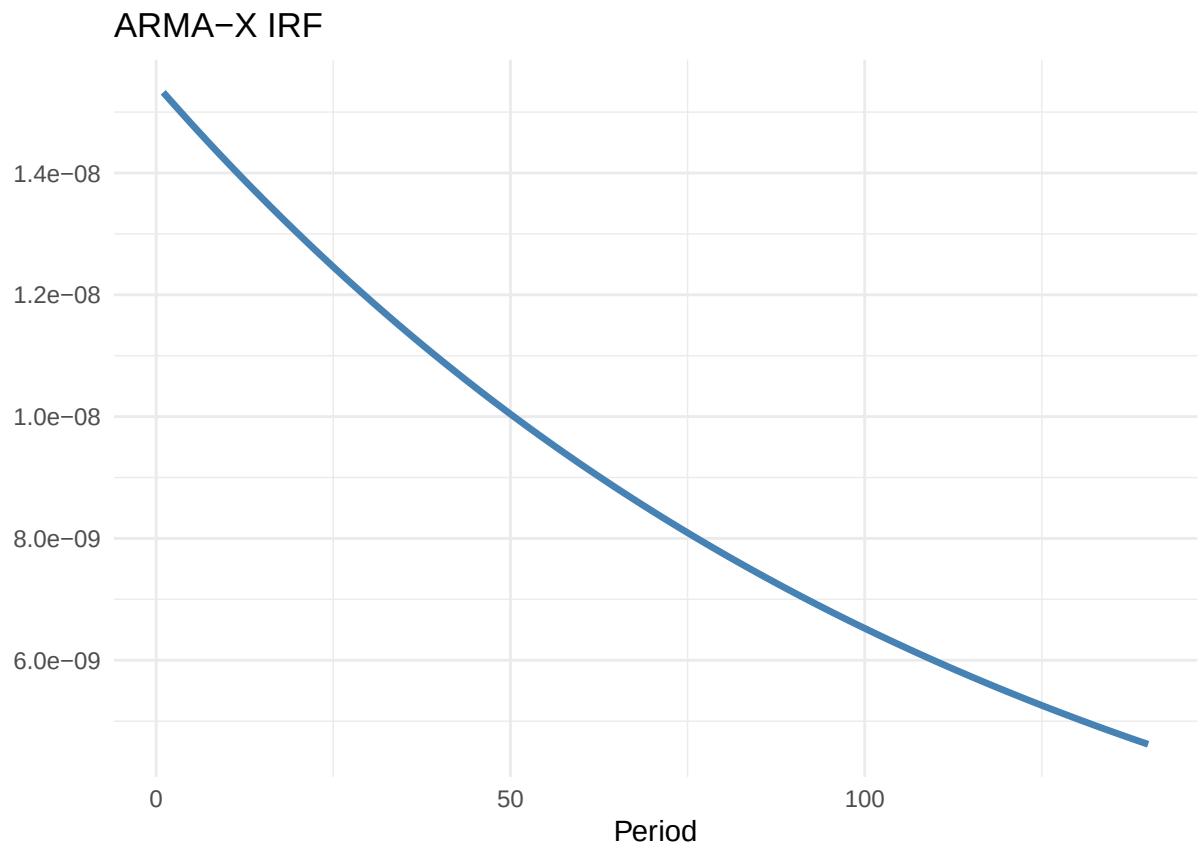
Table 12: ARMAX selected by AIC



```
irf.plot(res2,nb.periods)
```




```
irf.plot(res3$model,nb.periods)
```



China Mention as Exogenous

```
#auto.armax selects the lowest AIC value given r (exogenous variable lags)
res1 = auto.armax(data$ASHR_vol,xreg=data$china,nb.lags=2,
                  latex=T,max.p = 6, max.q = 6, max.d=0)
```

```
#armax enables a custom armax specification with p,q,r
res2 = armax(data$ASHR_vol, xreg=data$china, nb.lags=2,
                    p=5, q=0, d=0, latex=T)
```

```
#auto.armax.r selects the lowest AIC checking all 3 p,q,r values
res3 = auto.armax.r(data$ASHR_vol, x=data$china,
                  max_p = 3, max_q = 3, max_r = 3, criterion = "AIC", latex=T)
```

```
#we want to plot the IRFs of these models
nb.periods = 7 * 20

irf.plot(res1,nb.periods)
```

	Model 1
ar1	0.9900***
	(0.0015)
ma1	−0.7563***
	(0.0070)
ma2	−0.1697***
	(0.0069)
intercept	0.0002***
	(0.0000)
china_lag_0	0.0000**
	(0.0000)
china_lag_1	0.0000
	(0.0000)
china_lag_2	0.0000
	(0.0000)
AIC	−255947.4425
AICc	−255947.4352
BIC	−255884.2270
Log Likelihood	127981.7212
Num. obs.	19969

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Table 13: ARMAX Model Results

	Model 1
ar1	0.2909***
	(0.0070)
ar2	0.0795***
	(0.0073)
ar3	0.0507***
	(0.0073)
ar4	0.0655***
	(0.0073)
ar5	0.0889***
	(0.0071)
intercept	0.0002***
	(0.0000)
china_lag_0	0.0000**
	(0.0000)
china_lag_1	0.0000
	(0.0000)
china_lag_2	−0.0000
	(0.0000)
AIC	−255054.9774
AICc	−255054.9663
BIC	−254975.9580
Log Likelihood	127537.4887
Num. obs.	19969

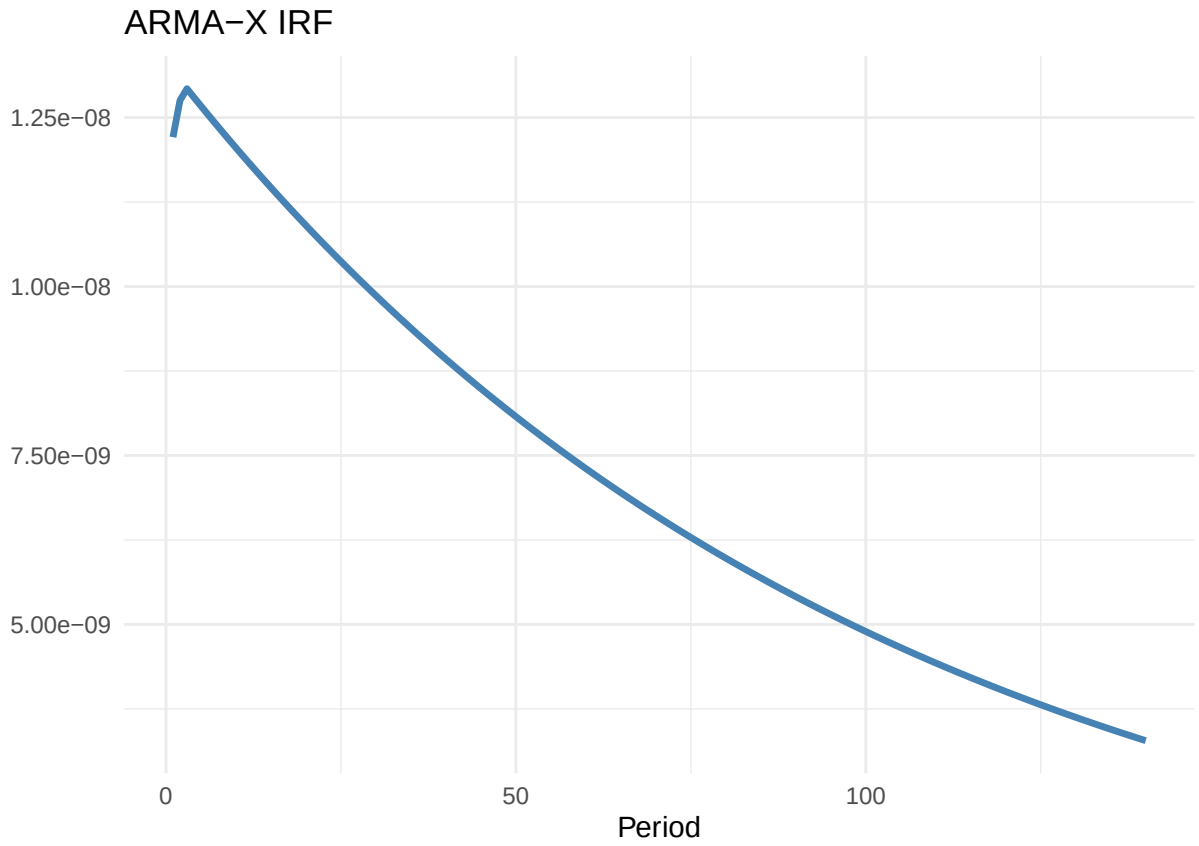
***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Table 14: ARMAX Model Results

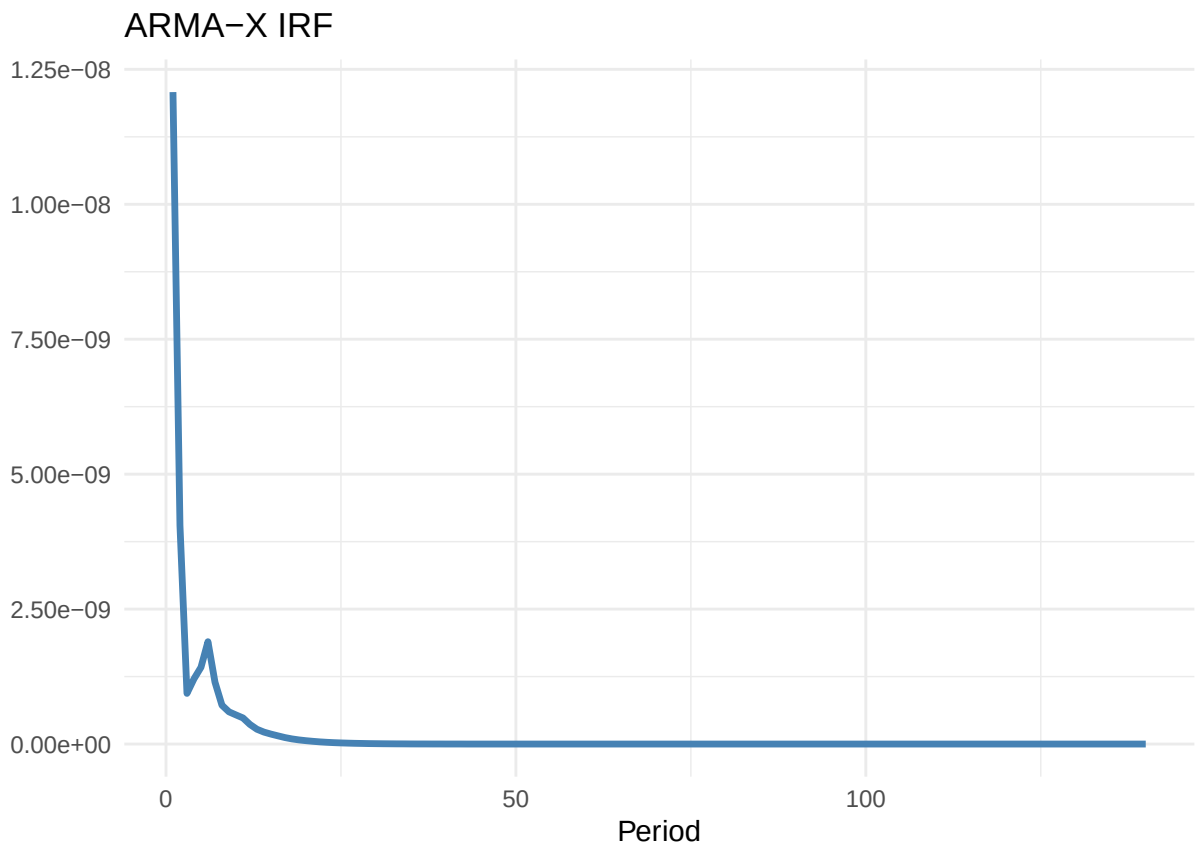
	Model 1
ar1	0.9915***
	(0.0013)
ma1	−0.7509***
	(0.0072)
ma2	−0.1383***
	(0.0088)
ma3	−0.0434***
	(0.0073)
intercept	0.0002***
	(0.0000)
china_lag_0	0.0000**
	(0.0000)
AIC	−256010.2273
AICc	−256010.2217
BIC	−255954.9130
Log Likelihood	128012.1137
Num. obs.	19971

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

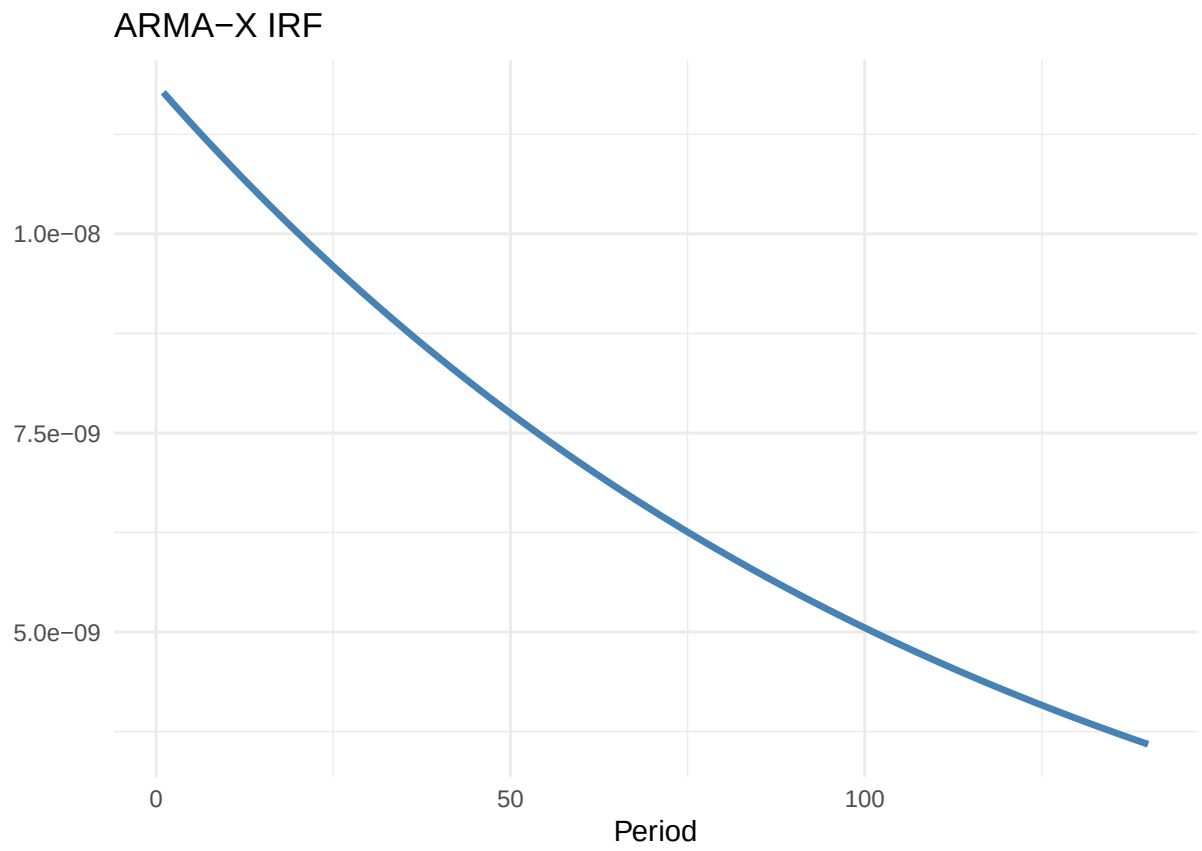
Table 15: ARMAX selected by AIC



```
irf.plot(res2,nb.periods)
```




```
irf.plot(res3$model,nb.periods)
```



Positive Vibe as Exogenous

```
#auto.armax selects the lowest AIC value given r (exogenous variable lags)
res1 = auto.armax(data$ASHR_vol,xreg=data$prop_positive,nb.lags=2,
                  latex=T,max.p = 6, max.q = 6, max.d=0)
```

```
#armax enables a custom armax specification with p,q,r
res2 = armax(data$ASHR_vol, xreg=data$prop_positive, nb.lags=2,
                    p=5, q=0, d=0, latex=T)
```

```
#auto.armax.r selects the lowest AIC checking all 3 p,q,r values
res3 = auto.armax.r(data$ASHR_vol, x=data$prop_positive,
                  max_p = 3, max_q = 3, max_r = 3, criterion = "AIC", latex=T)
```

```
#we want to plot the IRFs of these models
nb.periods = 7 * 20

irf.plot(res1,nb.periods)
```

	Model 1
ar1	0.9892***
	(0.0016)
ma1	−0.7522***
	(0.0070)
ma2	−0.1708***
	(0.0070)
intercept	0.0001***
	(0.0000)
prop_positive_lag_0	0.0001***
	(0.0000)
prop_positive_lag_1	0.0000*
	(0.0000)
prop_positive_lag_2	0.0000
	(0.0000)
AIC	−256149.5460
AICc	−256149.5387
BIC	−256086.3305
Log Likelihood	128082.7730
Num. obs.	19969

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Table 16: ARMAX Model Results

	Model 1
ar1	0.2915***
	(0.0070)
ar2	0.0787***
	(0.0073)
ar3	0.0505***
	(0.0073)
ar4	0.0668***
	(0.0073)
ar5	0.0882***
	(0.0071)
intercept	0.0001***
	(0.0000)
prop_positive_lag_0	0.0001***
	(0.0000)
prop_positive_lag_1	0.0000***
	(0.0000)
prop_positive_lag_2	0.0000
	(0.0000)
AIC	−255318.5205
AICc	−255318.5095
BIC	−255239.5012
Log Likelihood	127669.2603
Num. obs.	19969

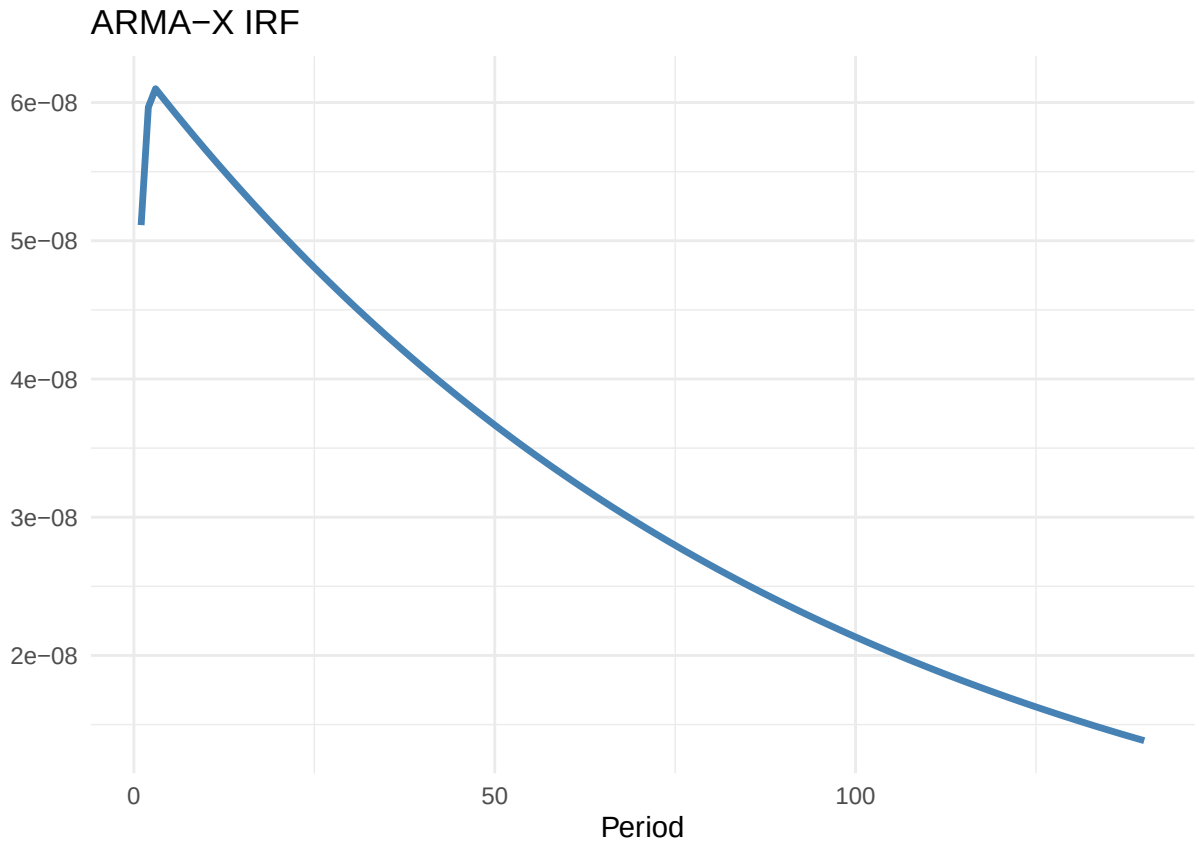
***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Table 17: ARMAX Model Results

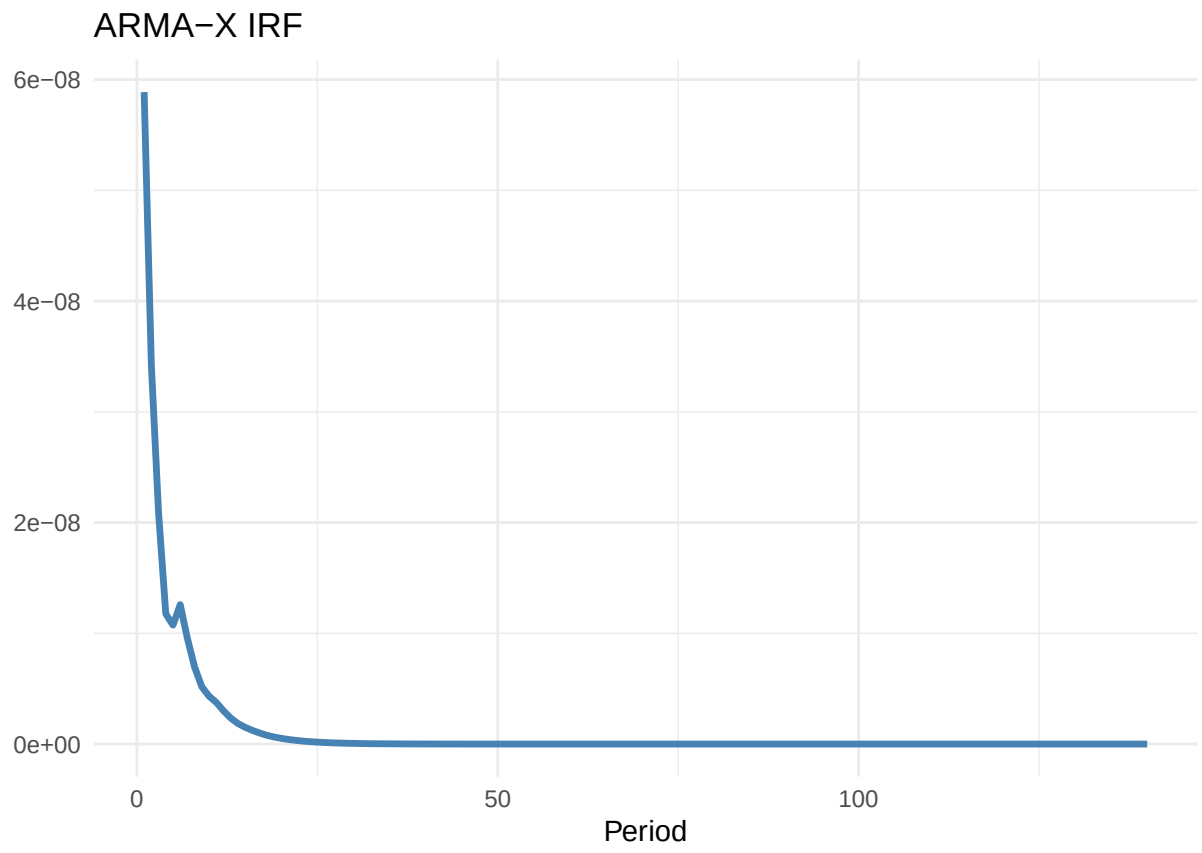
	Model 1
ar1	0.9910***
	(0.0014)
ma1	−0.7463***
	(0.0072)
ma2	−0.1410***
	(0.0087)
ma3	−0.0438***
	(0.0073)
intercept	0.0001***
	(0.0000)
prop_positive_lag_0	0.0001***
	(0.0000)
AIC	−256208.9107
AICc	−256208.9050
BIC	−256153.5964
Log Likelihood	128111.4553
Num. obs.	19971

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

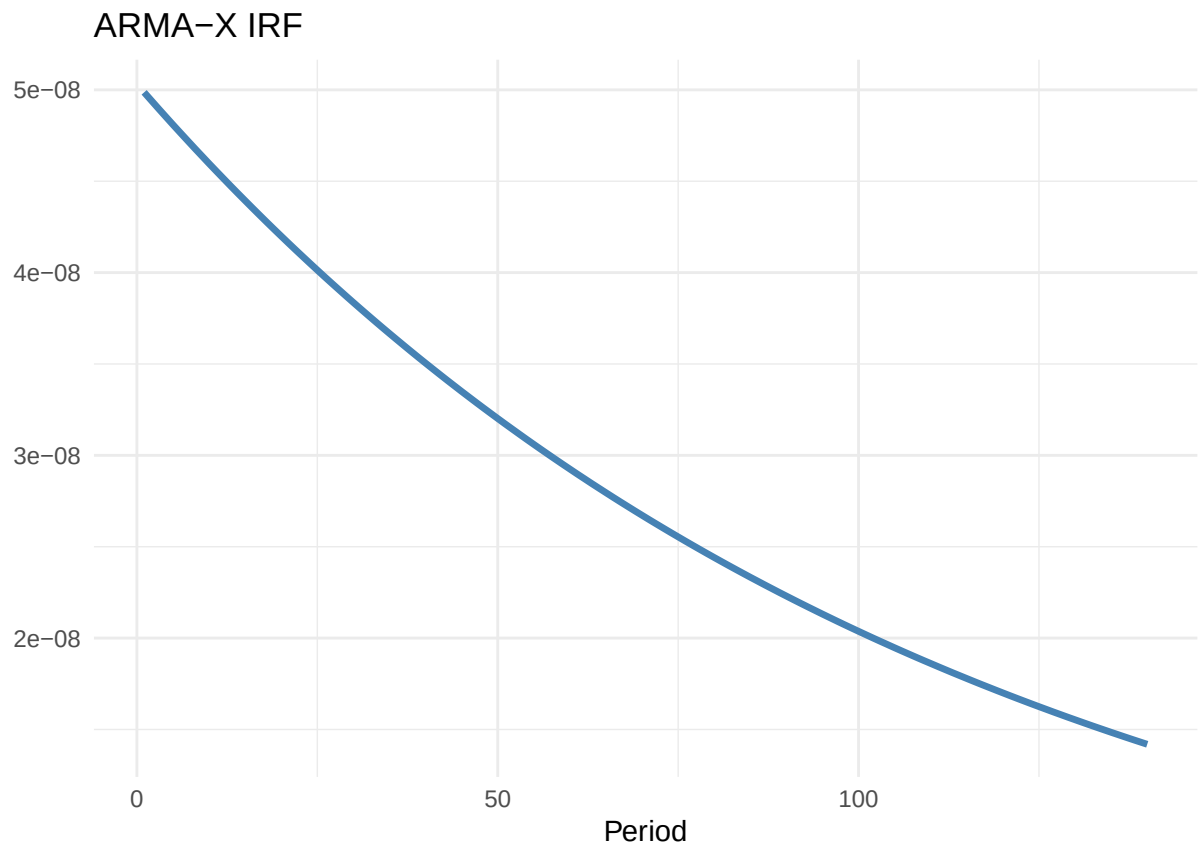
Table 18: ARMAX selected by AIC



```
irf.plot(res2,nb.periods)
```




```
irf.plot(res3$model,nb.periods)
```



Negative Vibe as Exogenous

```
#auto.armax selects the lowest AIC value given r (exogenous variable lags)
res1 = auto.armax(data$ASHR_vol,xreg=data$prop_negative,nb.lags=2,
                  latex=T,max.p = 6, max.q = 6, max.d=0)
```

```
#armax enables a custom armax specification with p,q,r
res2 = armax(data$ASHR_vol, xreg=data$prop_negative, nb.lags=2,
                    p=5, q=0, d=0, latex=T)
```

```
#auto.armax.r selects the lowest AIC checking all 3 p,q,r values
res3 = auto.armax.r(data$ASHR_vol, x=data$prop_negative,
                  max_p = 3, max_q = 3, max_r = 3, criterion = "AIC", latex=T)
```

```
#we want to plot the IRFs of these models
nb.periods = 7 * 20

irf.plot(res1,nb.periods)
```

	Model 1
ar1	0.9901***
	(0.0015)
ma1	−0.7551***
	(0.0070)
ma2	−0.1707***
	(0.0069)
intercept	0.0001***
	(0.0000)
prop_negative_lag_0	0.0001***
	(0.0000)
prop_negative_lag_1	0.0000
	(0.0000)
prop_negative_lag_2	0.0000
	(0.0000)
AIC	−256009.0491
AICc	−256009.0419
BIC	−255945.8336
Log Likelihood	128012.5245
Num. obs.	19969

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Table 19: ARMAX Model Results

	Model 1
ar1	0.2925***
	(0.0070)
ar2	0.0804***
	(0.0073)
ar3	0.0506***
	(0.0074)
ar4	0.0650***
	(0.0073)
ar5	0.0900***
	(0.0071)
intercept	0.0001***
	(0.0000)
prop_negative_lag_0	0.0001***
	(0.0000)
prop_negative_lag_1	0.0000
	(0.0000)
prop_negative_lag_2	−0.0000
	(0.0000)
AIC	−255118.7457
AICc	−255118.7346
BIC	−255039.7263
Log Likelihood	127569.3728
Num. obs.	19969

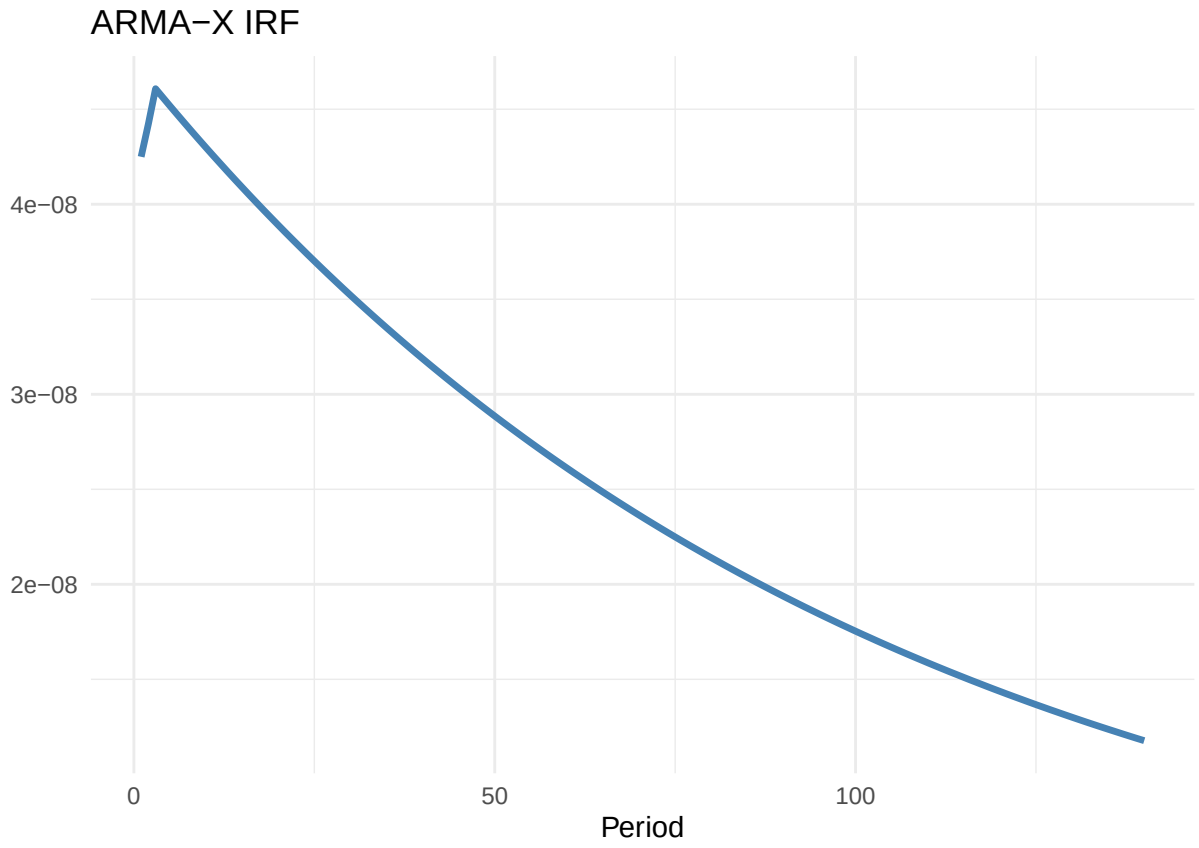
***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Table 20: ARMAX Model Results

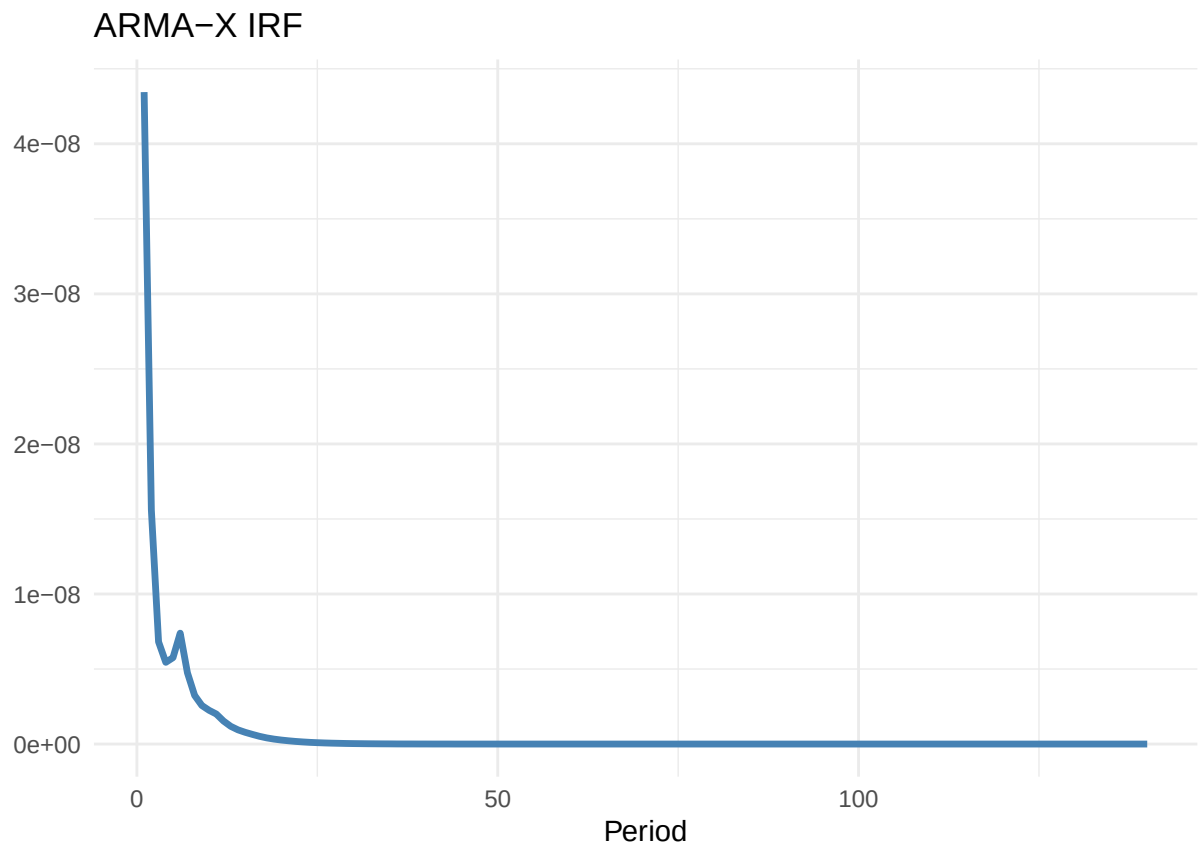
	Model 1
ar1	0.9915***
	(0.0013)
ma1	−0.7488***
	(0.0072)
ma2	−0.1400***
	(0.0087)
ma3	−0.0440***
	(0.0073)
intercept	0.0001***
	(0.0000)
prop_negative_lag_0	0.0001***
	(0.0000)
AIC	−256073.7682
AICc	−256073.7625
BIC	−256018.4539
Log Likelihood	128043.8841
Num. obs.	19971

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

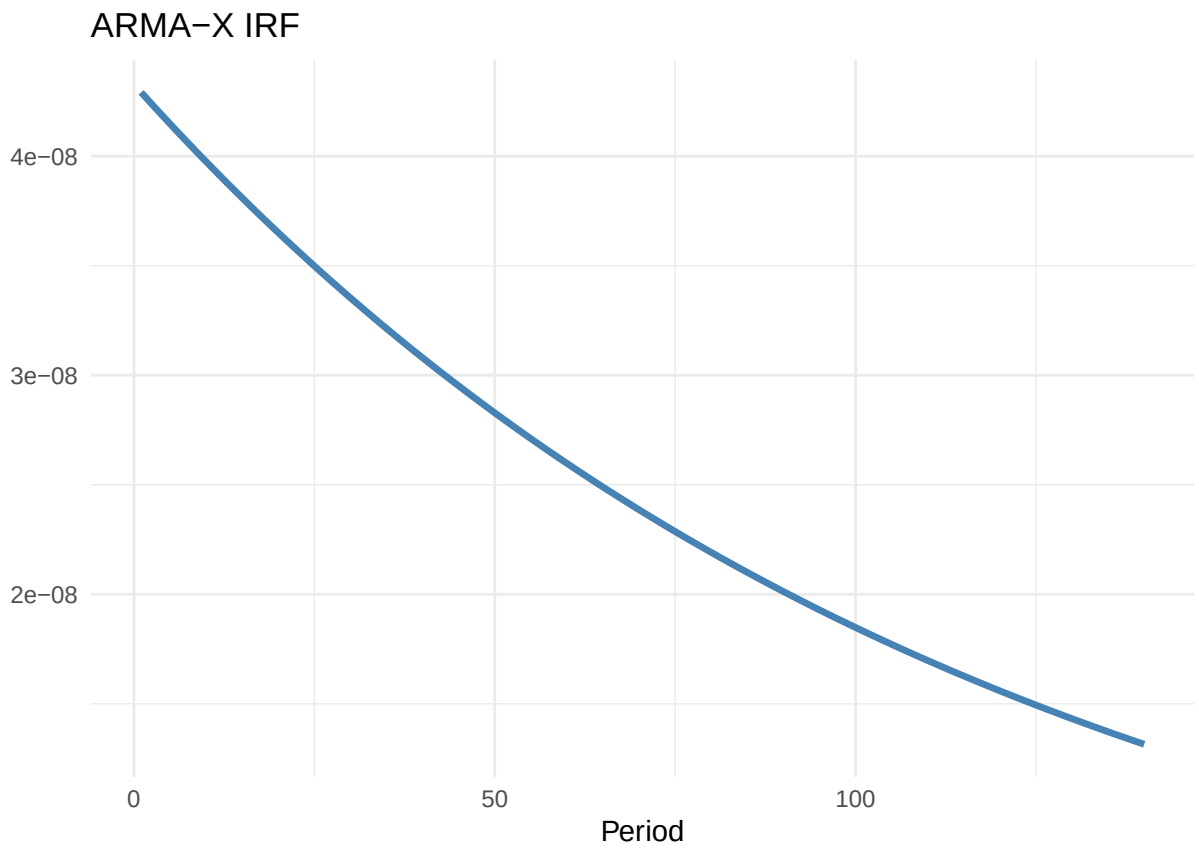
Table 21: ARMAX selected by AIC



```
irf.plot(res2,nb.periods)
```




```
irf.plot(res3$model,nb.periods)
```


ARMA−X IRF
4e−08
3e−08
2e−08
0
50
100
Period