VGK ARMA-X Analysis

Contents

	Model 1
ar1	0.9844***
	(0.0025)
ma1	−0.7428***
	(0.0075)
ma2	−0.1699***
	(0.0087)
ma3	−0.0270***
	(0.0072)
intercept	0.0003***
	(0.0001)
dummy_lag_0	0.0000*
	(0.0000)
dummy_lag_1	0.0000
	(0.0000)
dummy_lag_2	0.0000
	(0.0000)
AIC	−200264.8032
AICc	−200264.7942
BIC	−200193.6858
Log Likelihood	100141.4016
Num. obs.	19969

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

Table 1: ARMAX Model Results

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Here we try various specifications with multiple variables to see what comes out.

Tweet Dummy as Exogenous

```
#auto.armax selects the lowest AIC value given r (exogenous variable lags)
res1 = auto.armax(data$VGK_vol,xreg=data$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$VGK_vol, xreg=data$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$VGK_vol, x=data$dummy,
                  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	0.2612***
	(0.0071)
ar2	0.0243***
	(0.0073)
ar3	0.0306***
	(0.0073)
ar4	0.0391***
	(0.0073)
ar5	0.0471***
	(0.0071)
intercept	0.0003***
	(0.0000)
dummy_lag_0	0.0000**
	(0.0000)
dummy_lag_1	0.0000
	(0.0000)
dummy_lag_2	0.0000
	(0.0000)
AIC	−199889.4166
AICc	−199889.4056
BIC	−199810.3972
Log Likelihood	99954.7083
Num. obs.	19969

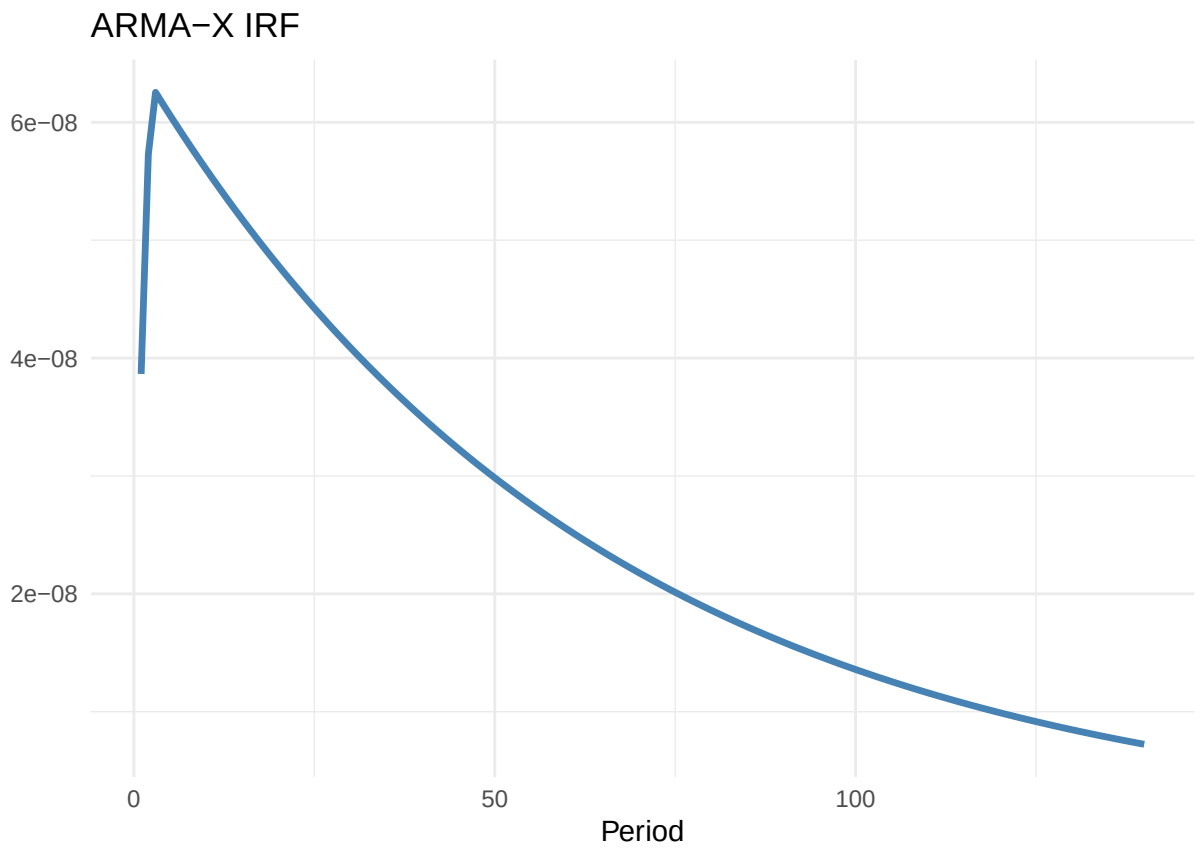
***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Table 2: ARMAX Model Results

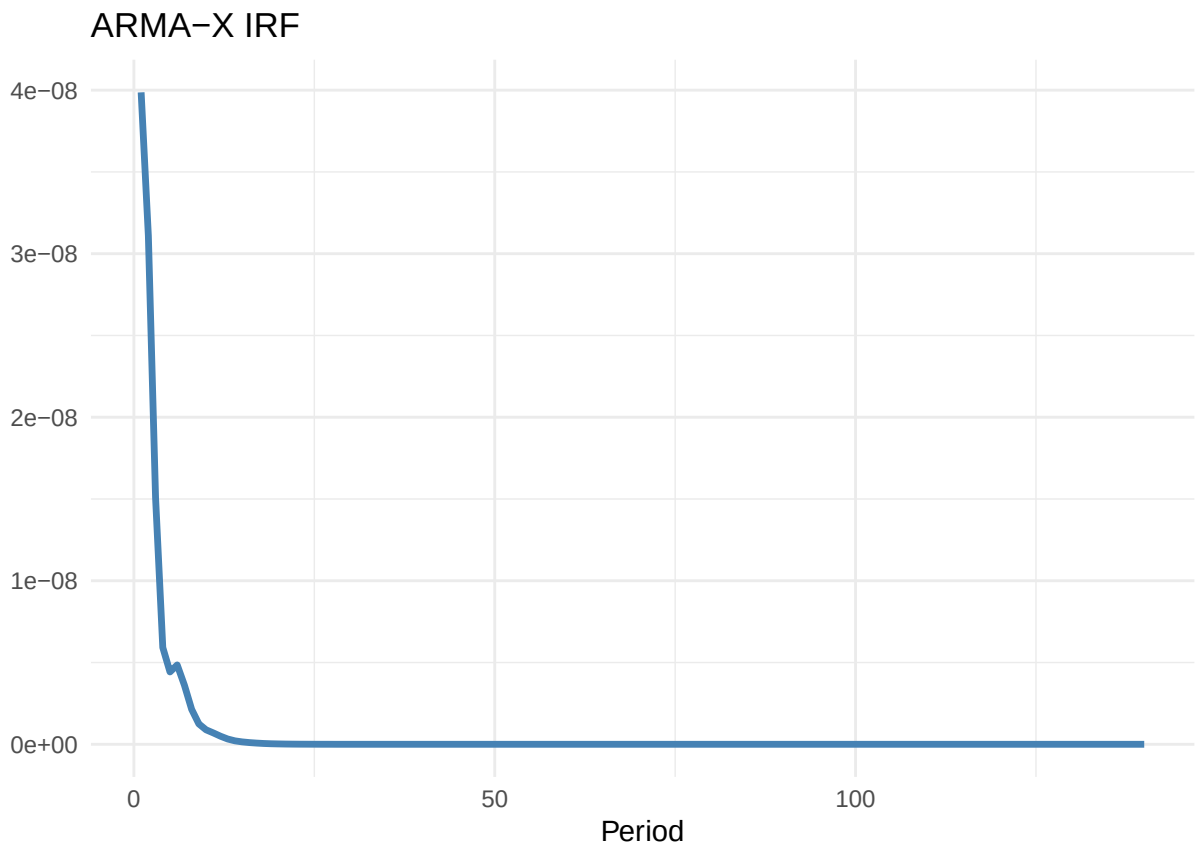
	Model 1
ar1	0.9843***
	(0.0025)
ma1	−0.7428***
	(0.0075)
ma2	−0.1703***
	(0.0087)
ma3	−0.0265***
	(0.0072)
intercept	0.0004
dummy_lag_0	0.0000
AIC	−200279.9599
AICc	−200279.9543
BIC	−200224.6457
Log Likelihood	100146.9800
Num. obs.	19971

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

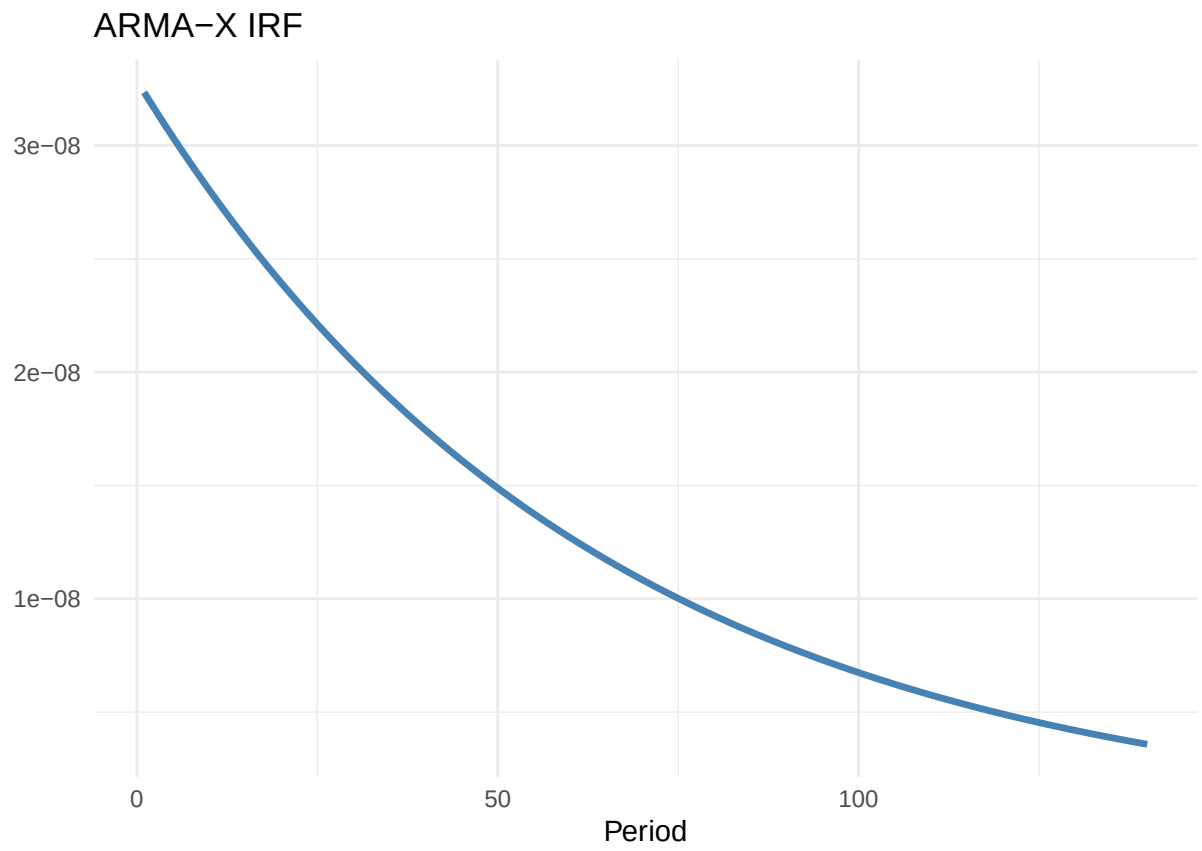
Table 3: ARMAX selected by AIC




```
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$VGK_vol,xreg=data$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$VGK_vol, xreg=data$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$VGK_vol, x=data$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	0.2611***
	(0.0071)
ar2	0.0237**
	(0.0073)
ar3	0.0309***
	(0.0074)
ar4	0.0395***
	(0.0073)
ar5	0.0466***
	(0.0071)
intercept	0.0004***
	(0.0000)
N_lag_0	0.0000
	(0.0000)
N_lag_1	0.0000
	(0.0000)
N_lag_2	0.0000
	(0.0000)
AIC	−199875.0009
AICc	−199874.9899
BIC	−199795.9815
Log Likelihood	99947.5004
Num. obs.	19969

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

Table 4: ARMAX Model Results

	Model 1
ar1	0.2611***
	(0.0071)
ar2	0.0237**
	(0.0073)
ar3	0.0309***
	(0.0074)
ar4	0.0395***
	(0.0073)
ar5	0.0466***
	(0.0071)
intercept	0.0004***
	(0.0000)
N_lag_0	0.0000
	(0.0000)
N_lag_1	0.0000
	(0.0000)
N_lag_2	0.0000
	(0.0000)
AIC	−199875.0009
AICc	−199874.9899
BIC	−199795.9815
Log Likelihood	99947.5004
Num. obs.	19969

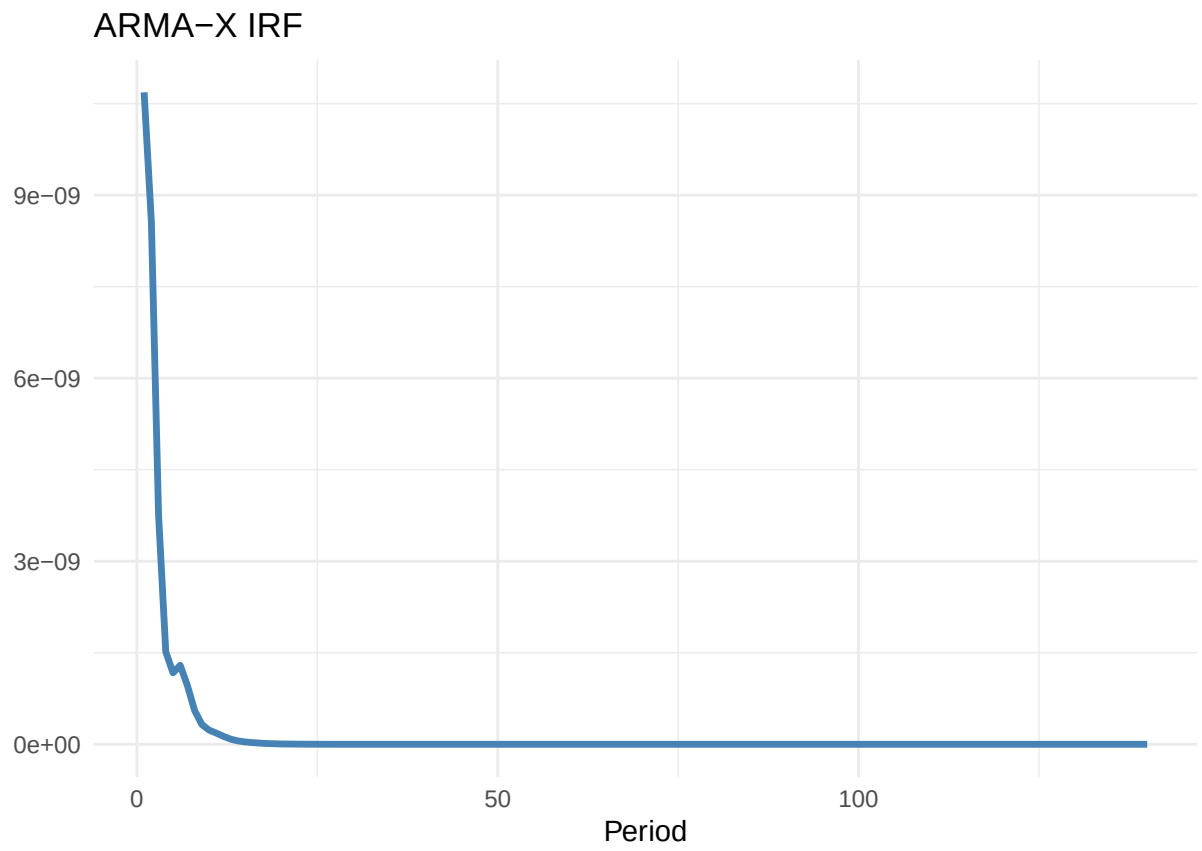
$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 5: ARMAX Model Results

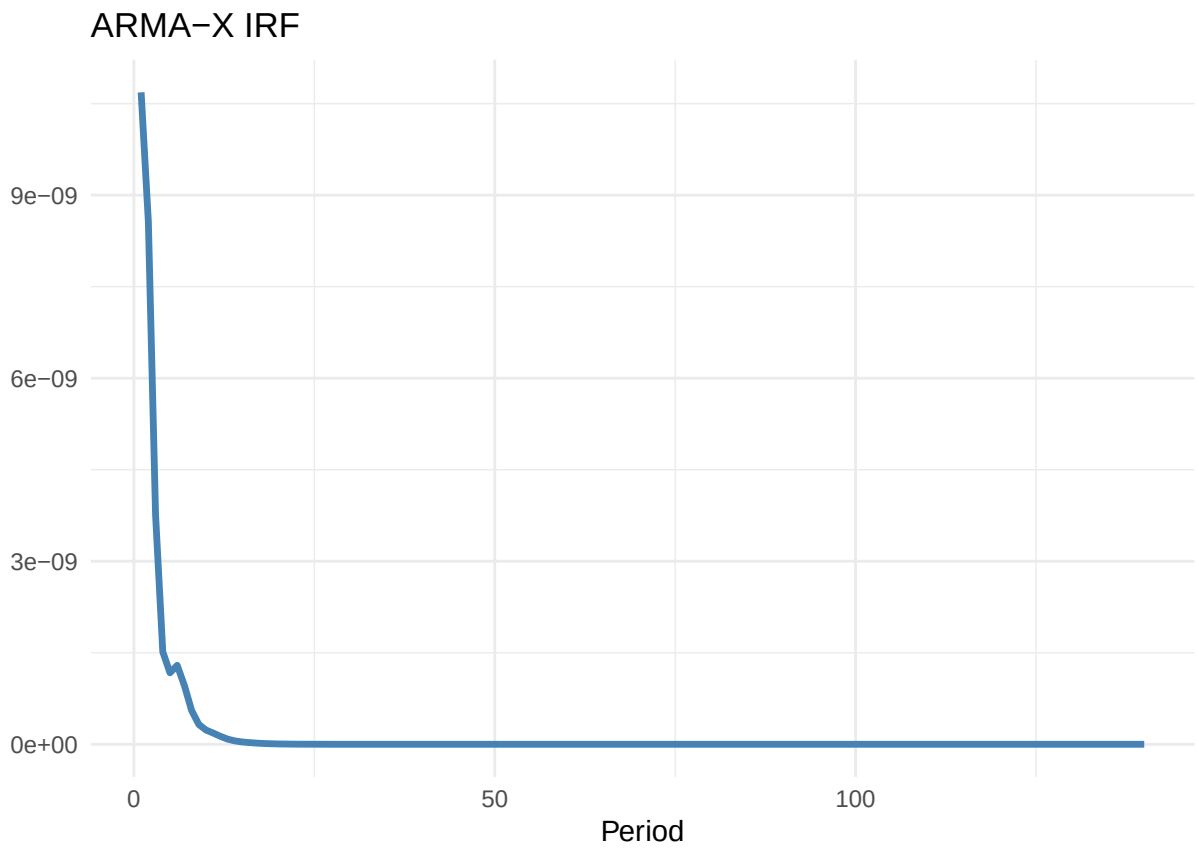
	Model 1
ar1	0.9843***
	(0.0025)
ma1	−0.7427***
	(0.0075)
ma2	−0.1708***
	(0.0087)
ma3	−0.0260***
	(0.0072)
intercept	0.0004
N_lag_0	0.0000
AIC	−200269.0091
AICc	−200269.0035
BIC	−200213.6949
Log Likelihood	100141.5046
Num. obs.	19971

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

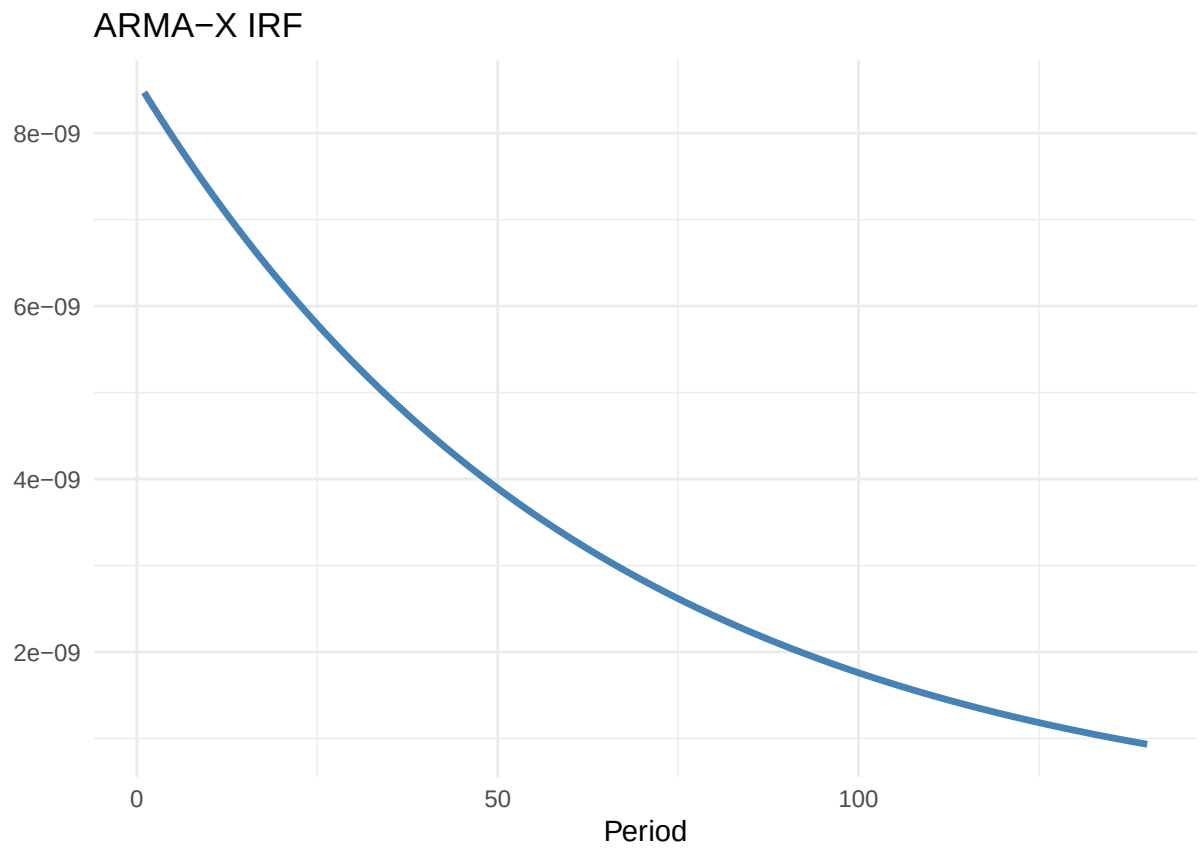
Table 6: ARMAX selected by AIC




```
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$VGK_vol,xreg=data$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$VGK_vol, xreg=data$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$VGK_vol, x=data$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	1.1886***
	(0.0089)
ar2	−0.2208***
	(0.0111)
ar3	0.0049
	(0.0110)
ar4	0.0131
	(0.0075)
ma1	−0.9477***
	(0.0054)
intercept	0.0004***
	(0.0000)
tariff_lag_0	0.0000
	(0.0000)
tariff_lag_1	0.0002***
	(0.0000)
tariff_lag_2	0.0001*
	(0.0000)
AIC	−200247.2535
AICc	−200247.2424
BIC	−200168.2341
Log Likelihood	100133.6267
Num. obs.	19969

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

Table 7: ARMAX Model Results

	Model 1
ar1	0.2606***
	(0.0071)
ar2	0.0232**
	(0.0073)
ar3	0.0284***
	(0.0073)
ar4	0.0376***
	(0.0073)
ar5	0.0461***
	(0.0071)
intercept	0.0004***
	(0.0000)
tariff_lag_0	0.0001
	(0.0000)
tariff_lag_1	0.0002***
	(0.0000)
tariff_lag_2	0.0001**
	(0.0000)
AIC	−199877.9797
AICc	−199877.9687
BIC	−199798.9603
Log Likelihood	99948.9898
Num. obs.	19969

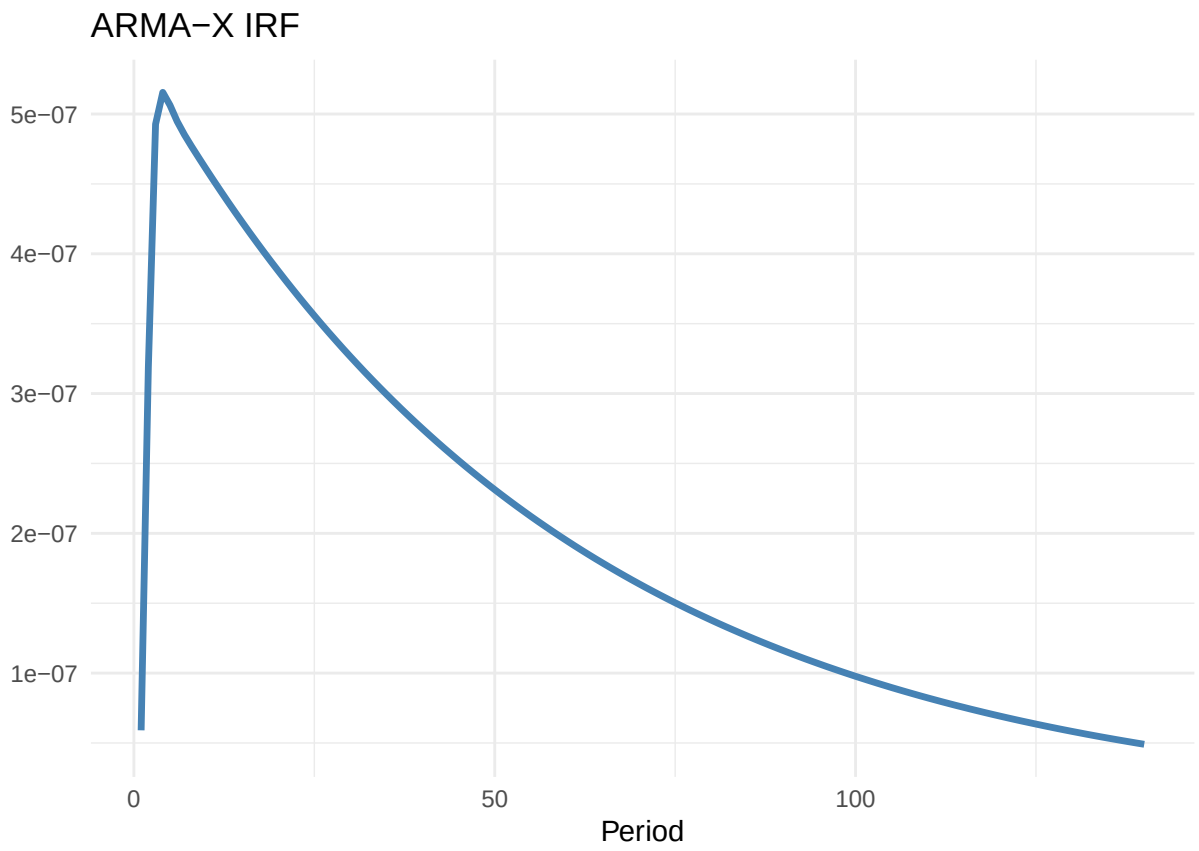
$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 8: ARMAX Model Results

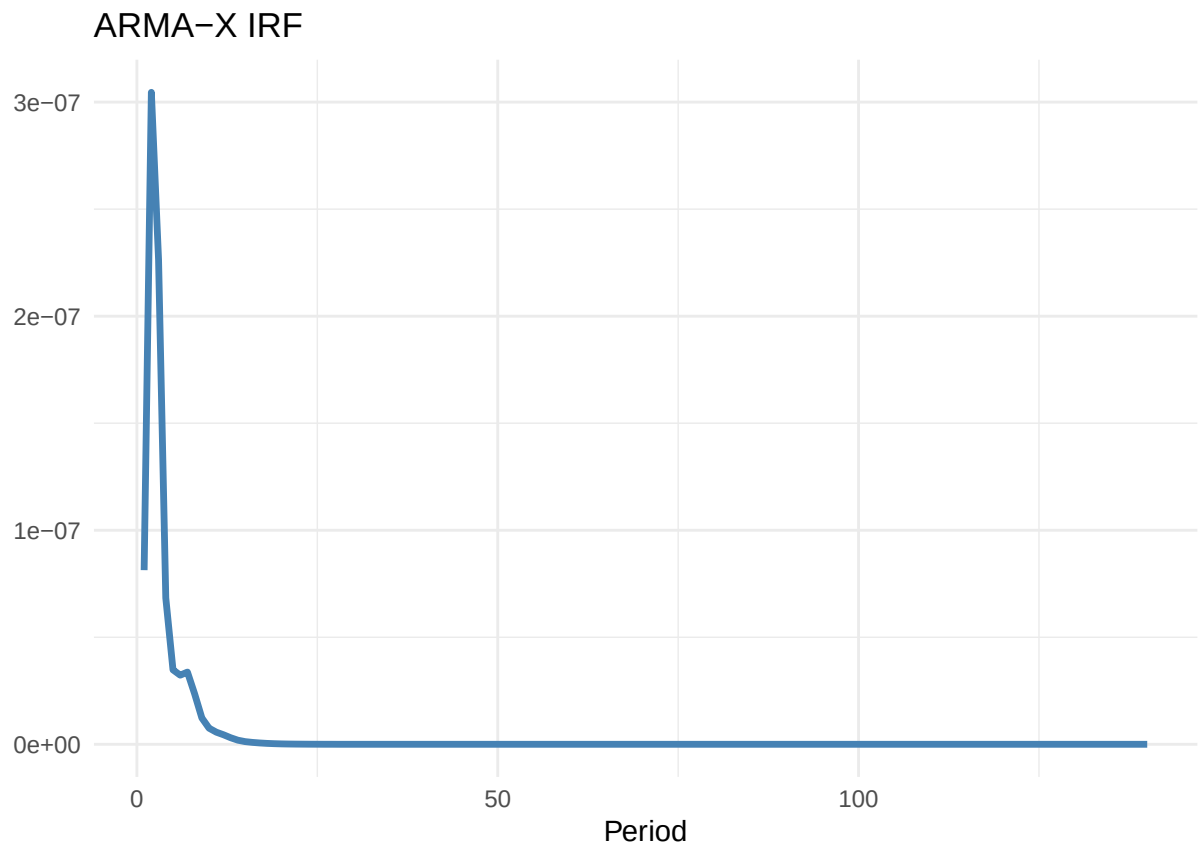
	Model 1
ar1	0.9844***
	(0.0025)
ma1	−0.7432***
	(0.0075)
ma2	−0.1701***
	(0.0087)
ma3	−0.0270***
	(0.0073)
intercept	0.0004***
	(0.0000)
tariff_lag_0	0.0000
	(0.0000)
tariff_lag_1	0.0001***
	(0.0000)
AIC	−200253.6847
AICc	−200253.6775
BIC	−200190.4688
Log Likelihood	100134.8424
Num. obs.	19970

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

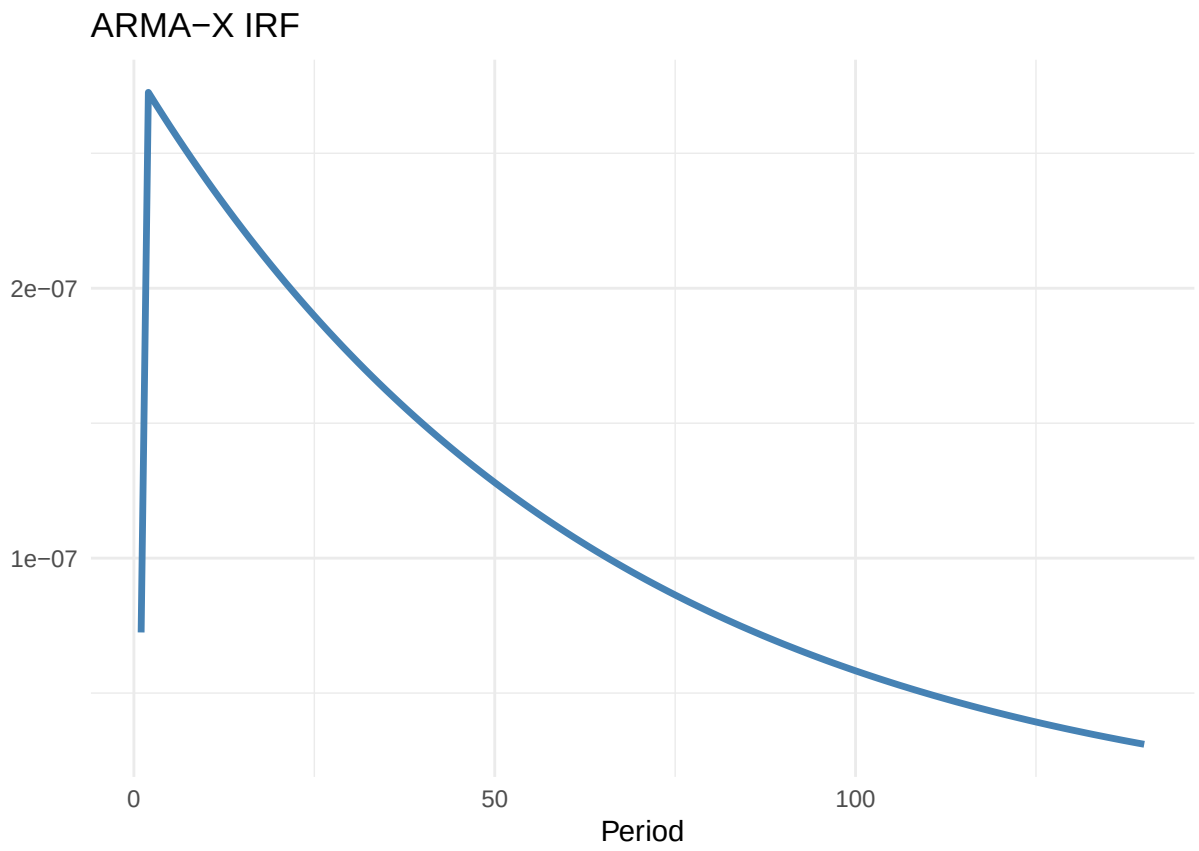
Table 9: ARMAX selected by AIC




```
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$VGK_vol,xreg=data$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$VGK_vol, xreg=data$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$VGK_vol, x=data$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	0.9844***
	(0.0025)
ma1	−0.7425***
	(0.0075)
ma2	−0.1709***
	(0.0087)
ma3	−0.0266***
	(0.0072)
intercept	0.0004***
	(0.0000)
trade_lag_0	−0.0000
	(0.0000)
trade_lag_1	0.0000
	(0.0000)
trade_lag_2	0.0001
	(0.0000)
AIC	−200224.4642
AICc	−200224.4552
BIC	−200153.3468
Log Likelihood	100121.2321
Num. obs.	19969

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

Table 10: ARMAX Model Results

	Model 1
ar1	0.2615***
	(0.0071)
ar2	0.0232**
	(0.0073)
ar3	0.0298***
	(0.0073)
ar4	0.0386***
	(0.0073)
ar5	0.0458***
	(0.0071)
intercept	0.0004***
	(0.0000)
trade_lag_0	−0.0000
	(0.0000)
trade_lag_1	0.0000
	(0.0000)
trade_lag_2	0.0001
	(0.0000)
AIC	−199846.8393
AICc	−199846.8283
BIC	−199767.8200
Log Likelihood	99933.4197
Num. obs.	19969

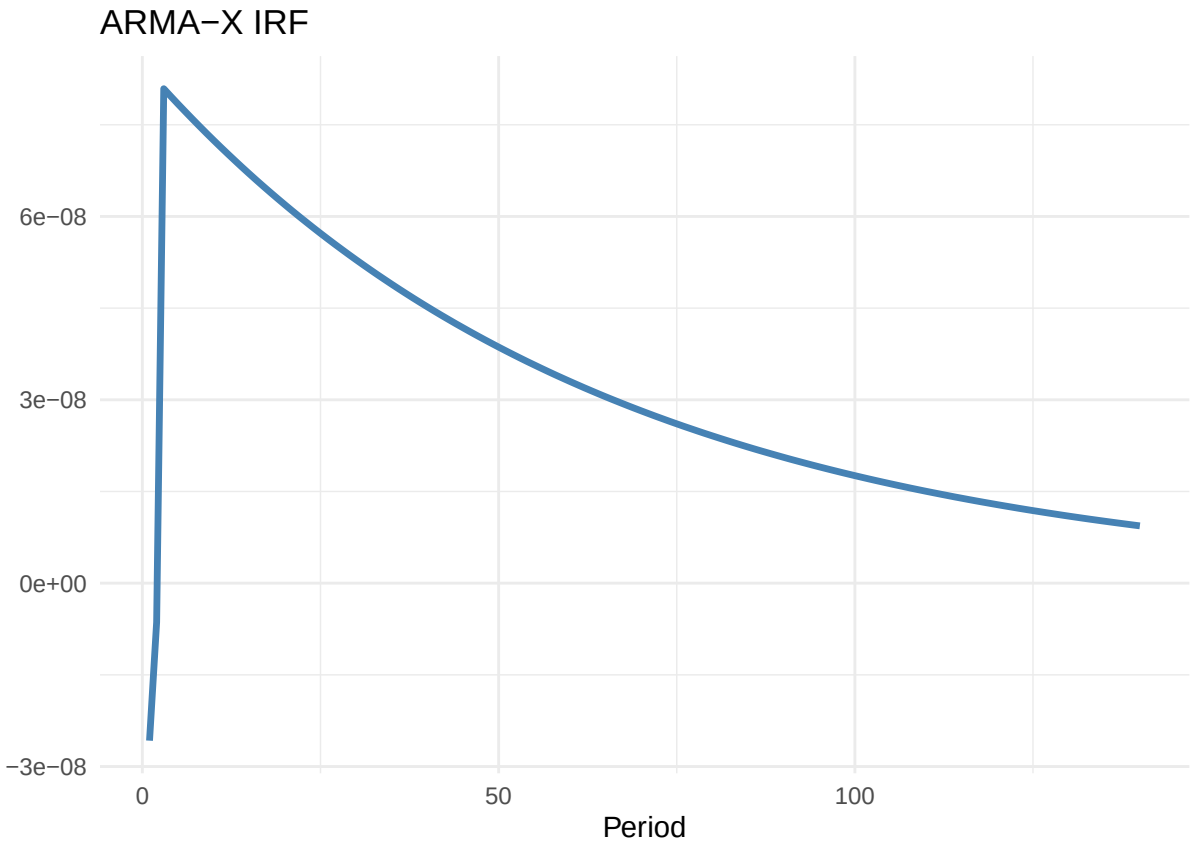
***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Table 11: ARMAX Model Results

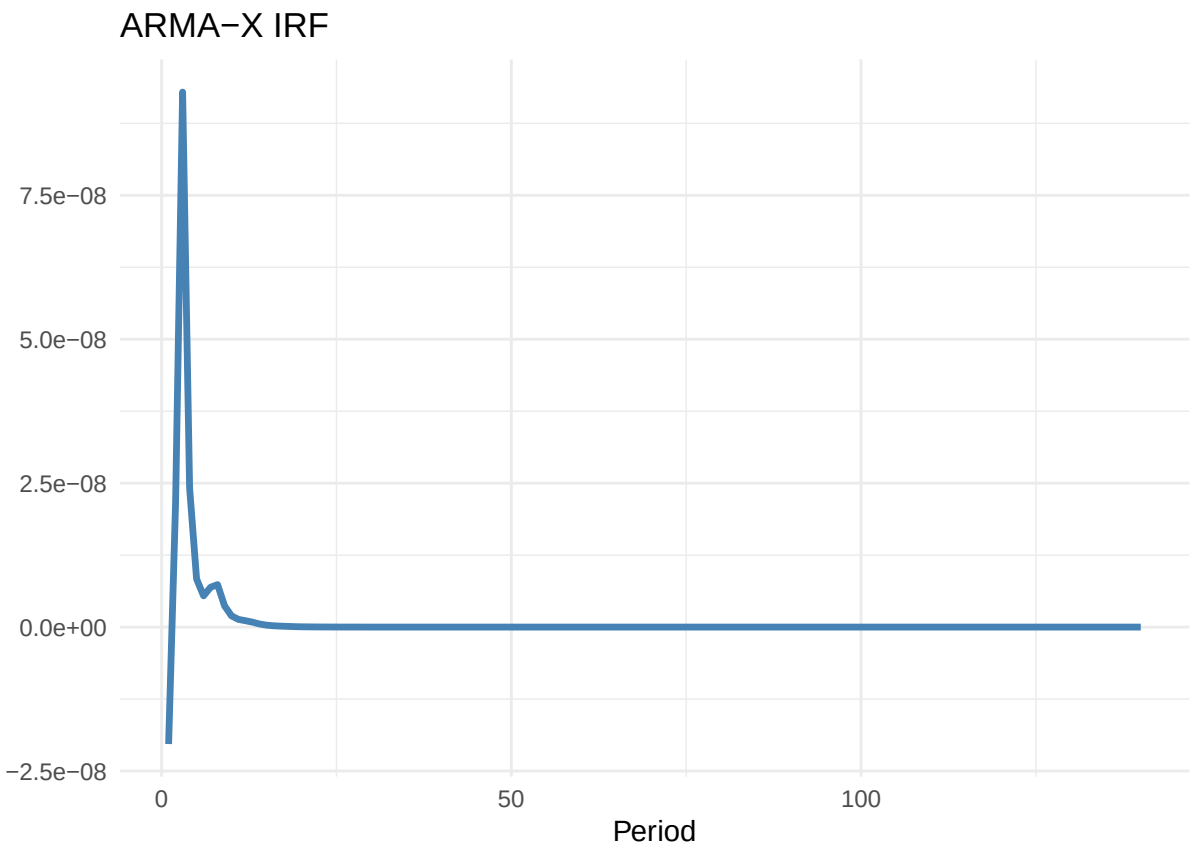
	Model 1
ar1	0.9843***
	(0.0025)
ma1	−0.7424***
	(0.0075)
ma2	−0.1706***
	(0.0087)
ma3	−0.0267***
	(0.0072)
intercept	0.0004***
	(0.0000)
trade_lag_0	−0.0000
	(0.0000)
AIC	−200248.5095
AICc	−200248.5039
BIC	−200193.1952
Log Likelihood	100131.2548
Num. obs.	19971

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

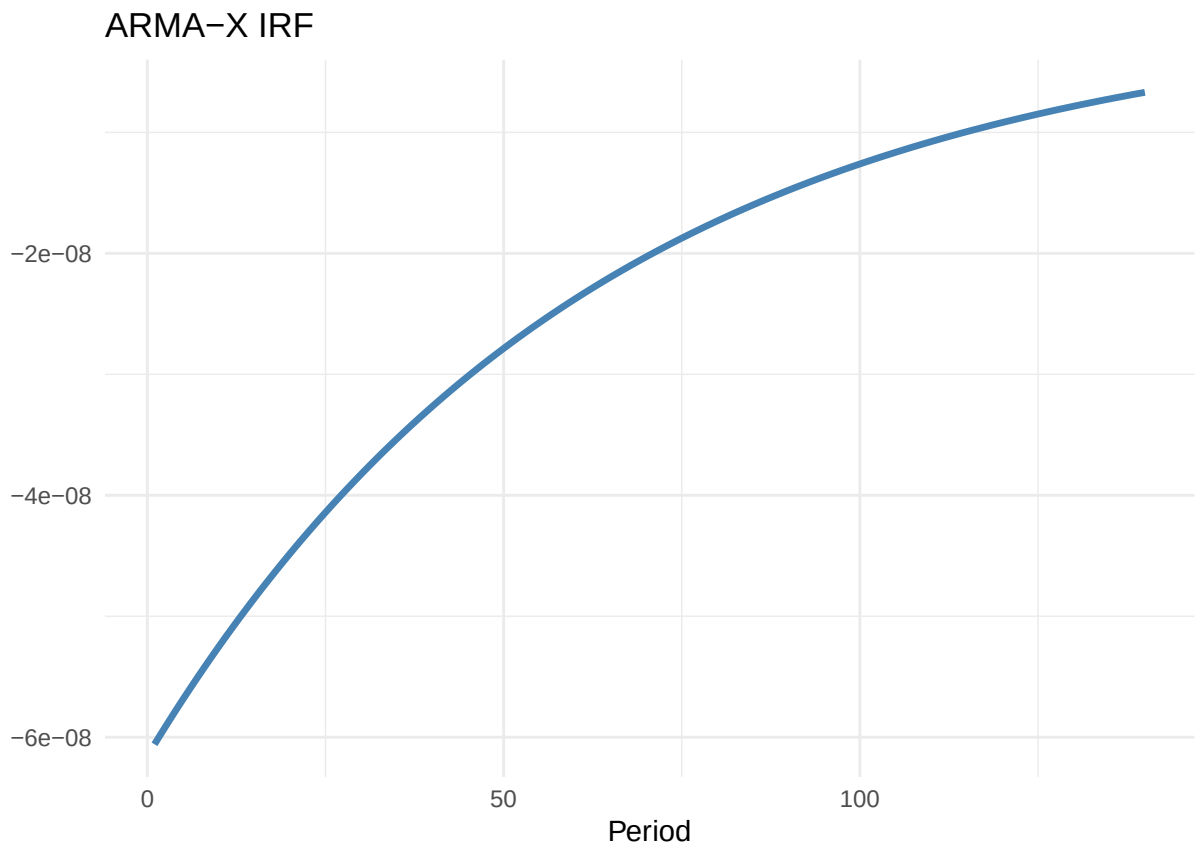
Table 12: ARMAX selected by AIC



```
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$VGK_vol,xreg=data$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$VGK_vol, xreg=data$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$VGK_vol, x=data$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	1.1894***
	(0.0088)
ar2	−0.2214***
	(0.0111)
ar3	0.0064
	(0.0110)
ar4	0.0119
	(0.0075)
ma1	−0.9482***
	(0.0053)
intercept	0.0004***
	(0.0000)
china_lag_0	0.0001*
	(0.0000)
china_lag_1	0.0001*
	(0.0000)
china_lag_2	0.0000
	(0.0000)
AIC	−200232.3259
AICc	−200232.3148
BIC	−200153.3065
Log Likelihood	100126.1629
Num. obs.	19969

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

Table 13: ARMAX Model Results

	Model 1
ar1	0.2610***
	(0.0071)
ar2	0.0232**
	(0.0073)
ar3	0.0300***
	(0.0073)
ar4	0.0389***
	(0.0073)
ar5	0.0460***
	(0.0071)
intercept	0.0004***
	(0.0000)
china_lag_0	0.0001*
	(0.0000)
china_lag_1	0.0001**
	(0.0000)
china_lag_2	0.0000
	(0.0000)
AIC	−199856.3346
AICc	−199856.3236
BIC	−199777.3152
Log Likelihood	99938.1673
Num. obs.	19969

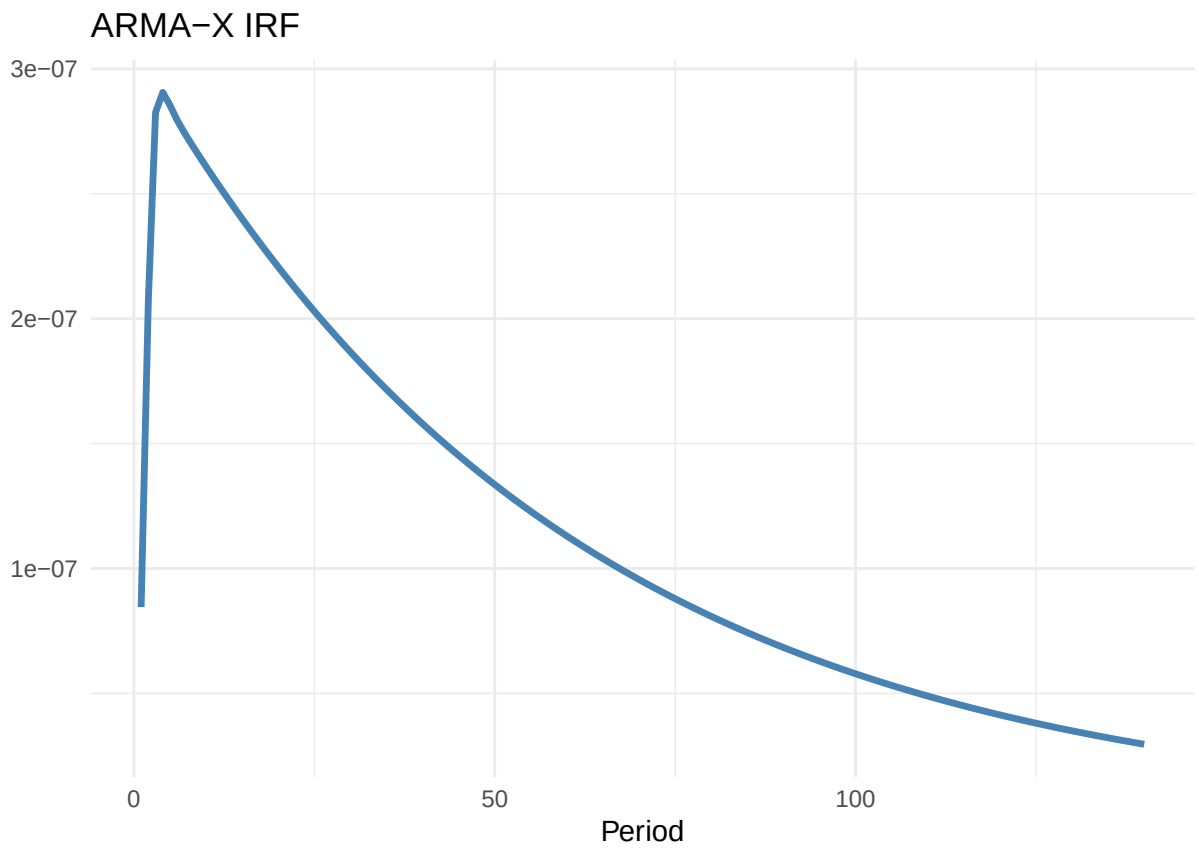
***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Table 14: ARMAX Model Results

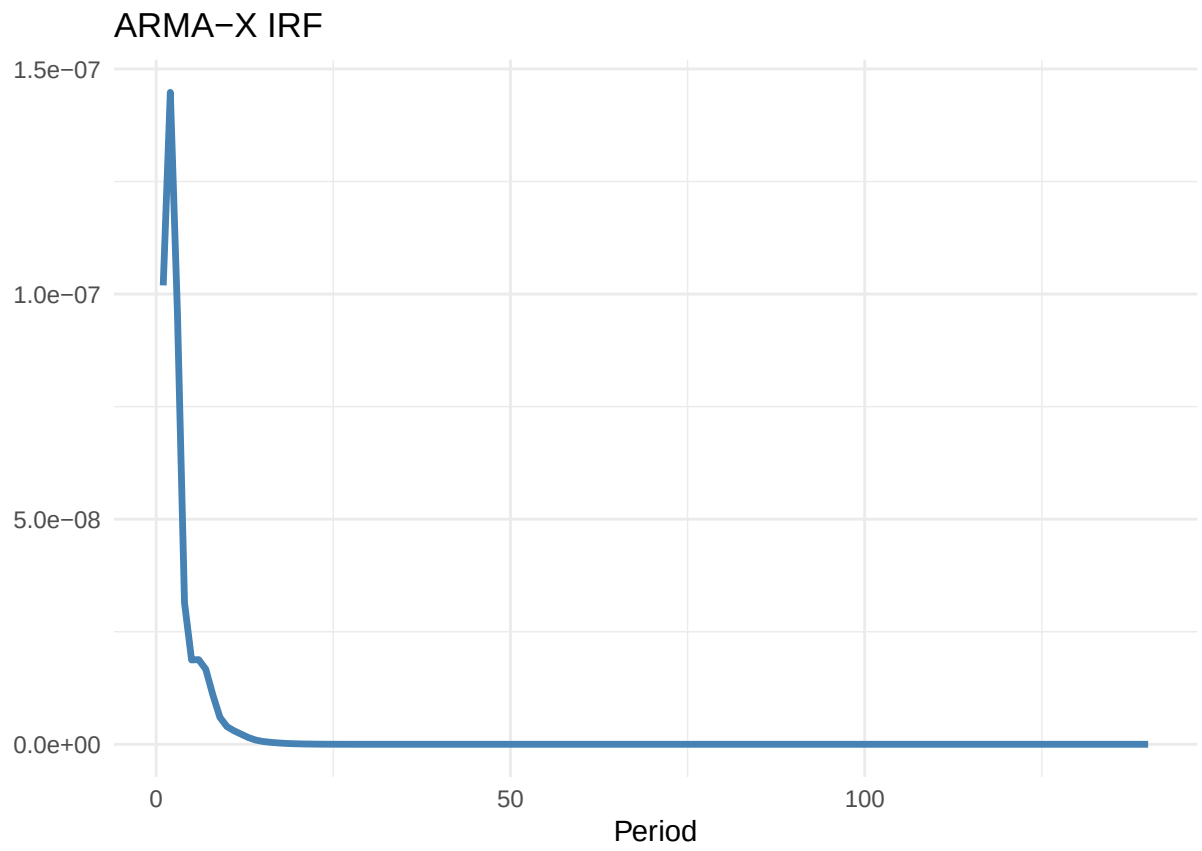
	Model 1
ar1	0.9843***
	(0.0025)
ma1	−0.7427***
	(0.0075)
ma2	−0.1708***
	(0.0087)
ma3	−0.0261***
	(0.0072)
intercept	0.0004***
	(0.0000)
china_lag_0	0.0000
	(0.0000)
AIC	−200251.1835
AICc	−200251.1779
BIC	−200195.8692
Log Likelihood	100132.5917
Num. obs.	19971

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

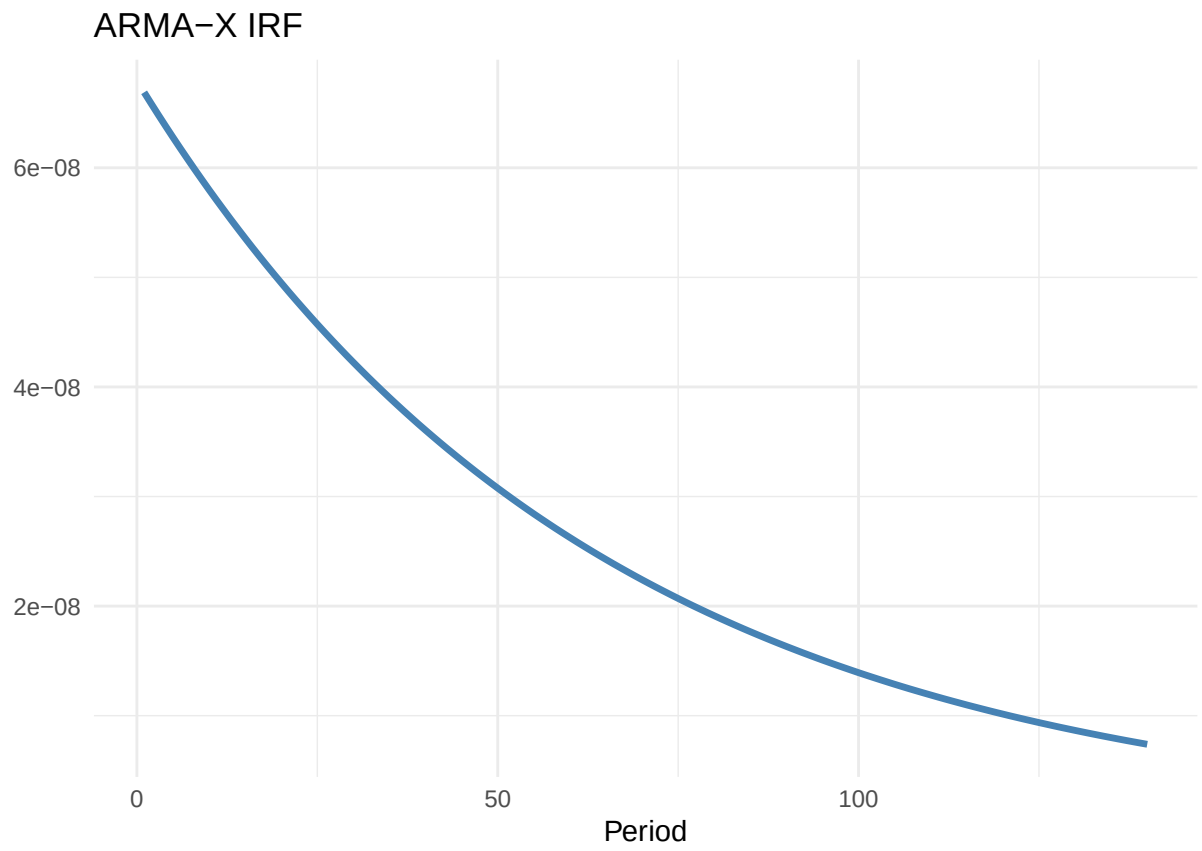
Table 15: ARMAX selected by AIC




```
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$VGK_vol,xreg=data$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$VGK_vol, xreg=data$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$VGK_vol, x=data$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	1.1896***
	(0.0088)
ar2	−0.2216***
	(0.0111)
ar3	0.0068
	(0.0110)
ar4	0.0116
	(0.0075)
ma1	−0.9483***
	(0.0053)
intercept	0.0003***
	(0.0000)
prop_positive_lag_0	0.0001**
	(0.0000)
prop_positive_lag_1	0.0001
	(0.0000)
prop_positive_lag_2	0.0000
	(0.0000)
AIC	−200235.6804
AICc	−200235.6694
BIC	−200156.6611
Log Likelihood	100127.8402
Num. obs.	19969

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

Table 16: ARMAX Model Results

	Model 1
ar1	0.2612***
	(0.0071)
ar2	0.0233**
	(0.0073)
ar3	0.0304***
	(0.0073)
ar4	0.0392***
	(0.0073)
ar5	0.0465***
	(0.0071)
intercept	0.0003***
	(0.0000)
prop_positive_lag_0	0.0001***
	(0.0000)
prop_positive_lag_1	0.0001
	(0.0000)
prop_positive_lag_2	0.0000
	(0.0000)
AIC	−199857.8911
AICc	−199857.8800
BIC	−199778.8717
Log Likelihood	99938.9455
Num. obs.	19969

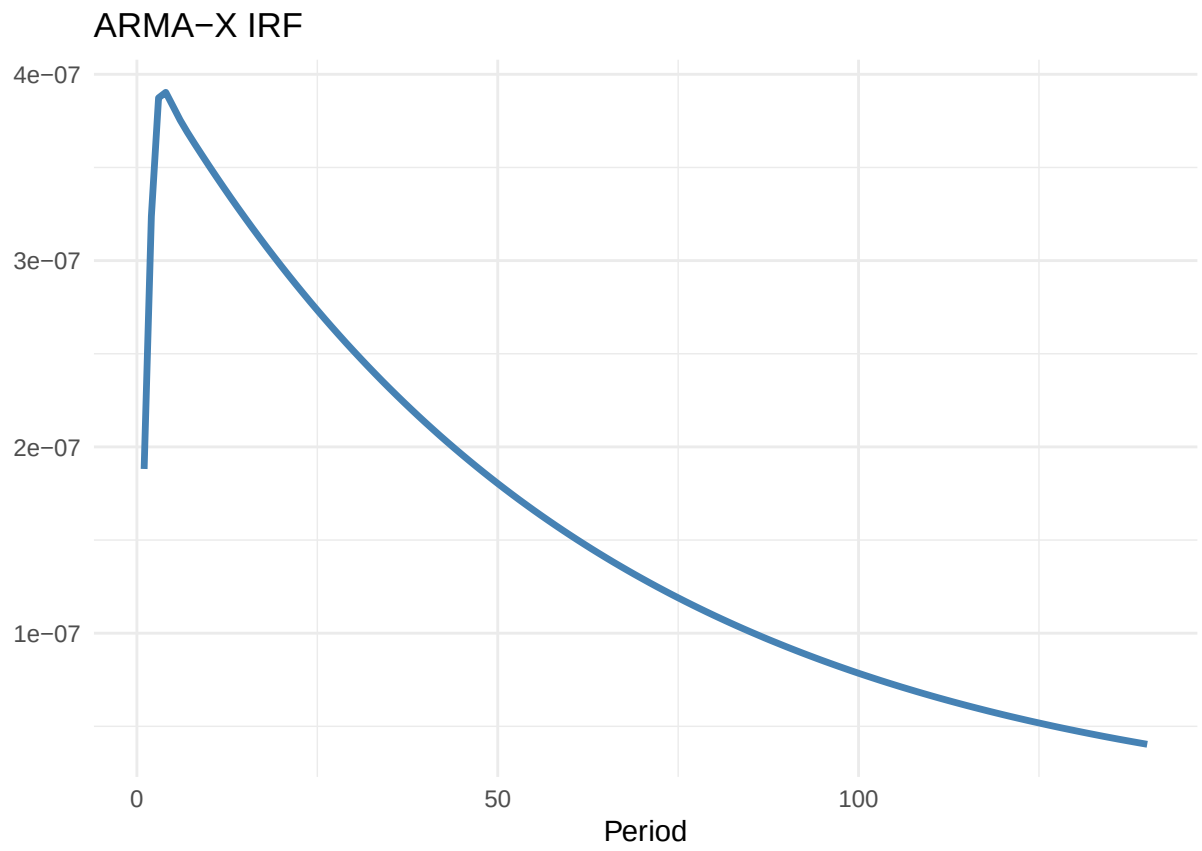
***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Table 17: ARMAX Model Results

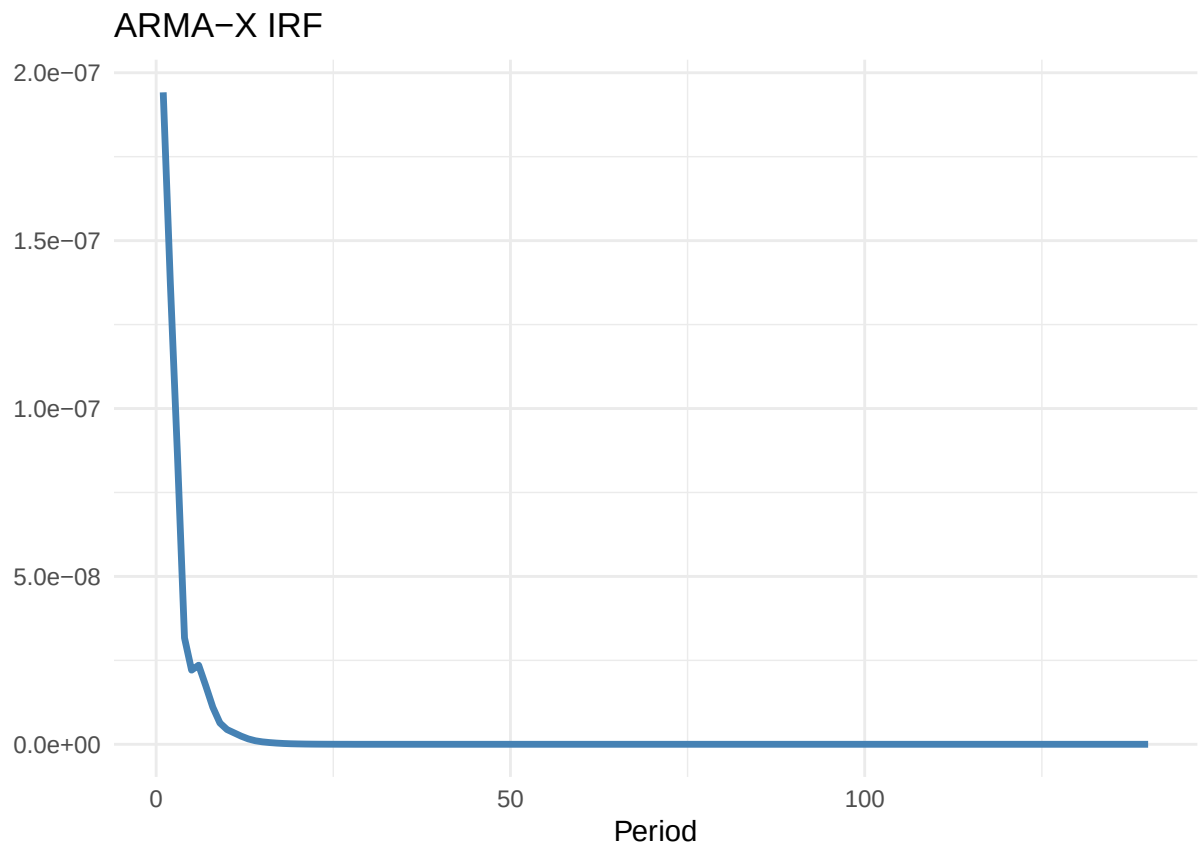
	Model 1
ar1	0.9843***
	(0.0025)
ma1	−0.7426***
	(0.0075)
ma2	−0.1708***
	(0.0087)
ma3	−0.0262***
	(0.0072)
intercept	0.0004***
	(0.0000)
prop_positive_lag_0	0.0001**
	(0.0000)
AIC	−200258.3763
AICc	−200258.3707
BIC	−200203.0620
Log Likelihood	100136.1881
Num. obs.	19971

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

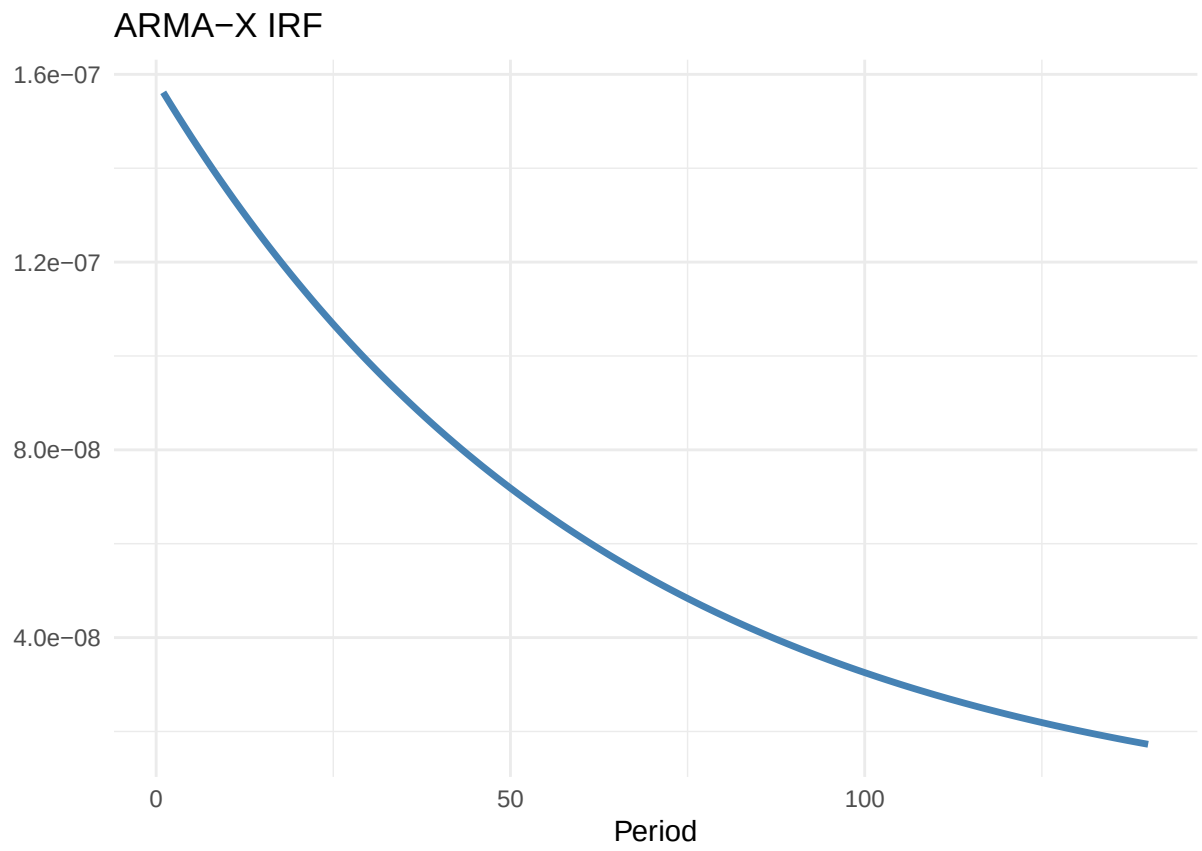
Table 18: ARMAX selected by AIC




```
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$VGK_vol,xreg=data$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$VGK_vol, xreg=data$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$VGK_vol, x=data$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	1.1897***
	(0.0088)
ar2	−0.2216***
	(0.0111)
ar3	0.0063
	(0.0110)
ar4	0.0119
	(0.0075)
ma1	−0.9482***
	(0.0053)
intercept	0.0004***
	(0.0000)
prop_negative_lag_0	0.0001
	(0.0000)
prop_negative_lag_1	0.0001
	(0.0000)
prop_negative_lag_2	0.0000
	(0.0000)
AIC	−200224.5140
AICc	−200224.5030
BIC	−200145.4947
Log Likelihood	100122.2570
Num. obs.	19969

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

Table 19: ARMAX Model Results

	Model 1
ar1	0.2614***
	(0.0071)
ar2	0.0233**
	(0.0073)
ar3	0.0301***
	(0.0073)
ar4	0.0389***
	(0.0073)
ar5	0.0459***
	(0.0071)
intercept	0.0004***
	(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	−199846.3333
AICc	−199846.3223
BIC	−199767.3140
Log Likelihood	99933.1667
Num. obs.	19969

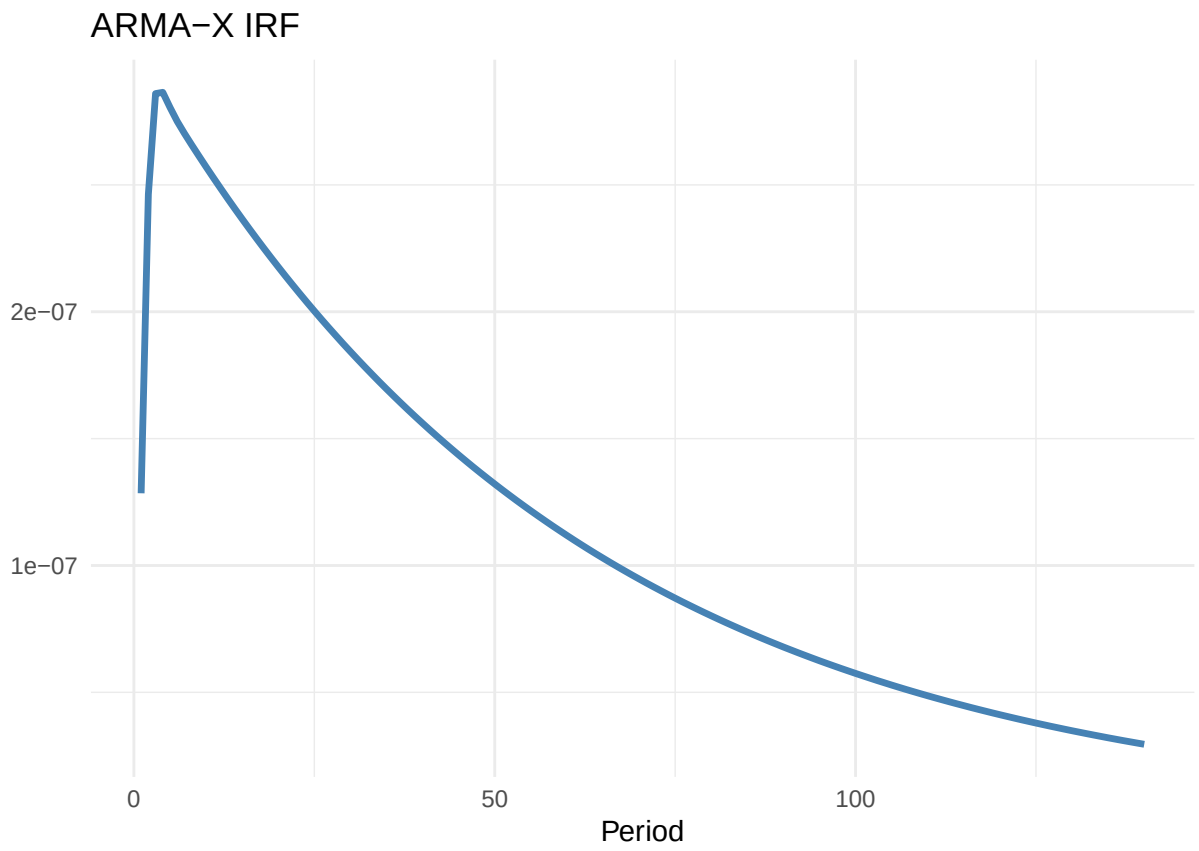
$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Table 20: ARMAX Model Results

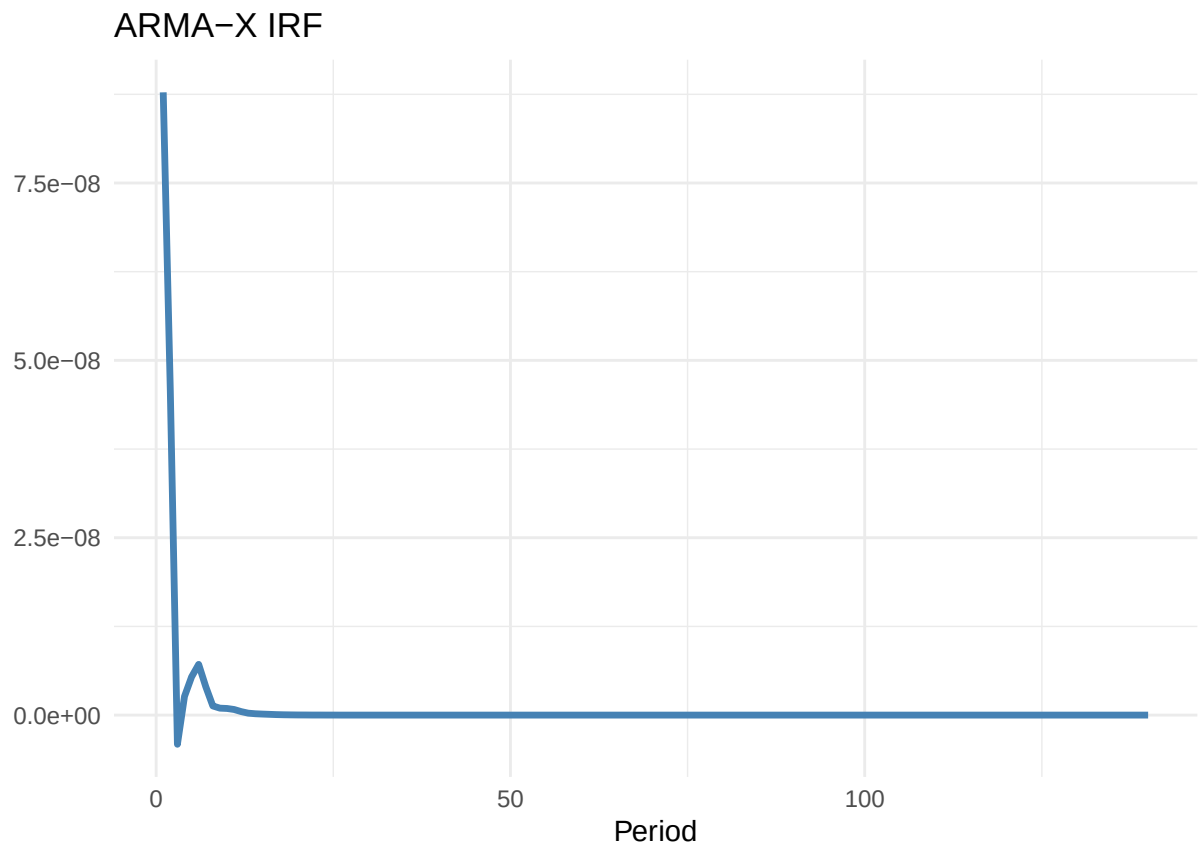
	Model 1
ar1	0.9843***
	(0.0025)
ma1	−0.7425***
	(0.0075)
ma2	−0.1707***
	(0.0087)
ma3	−0.0265***
	(0.0072)
intercept	0.0004***
	(0.0000)
prop_negative_lag_0	0.0001
	(0.0000)
AIC	−200250.1442
AICc	−200250.1386
BIC	−200194.8300
Log Likelihood	100132.0721
Num. obs.	19971

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

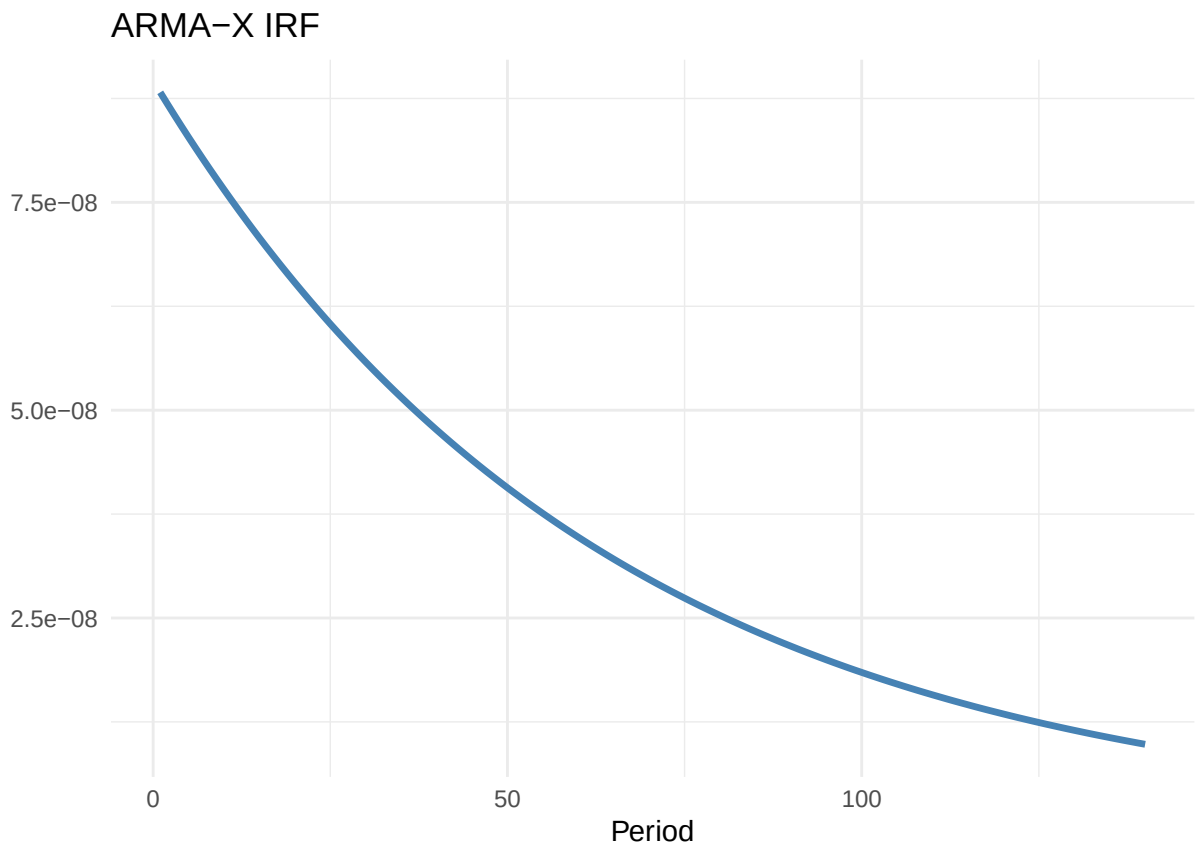
Table 21: ARMAX selected by AIC




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




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


ARMA−X IRF
7.5e−08
5.0e−08
2.5e−08
0
50
100
Period