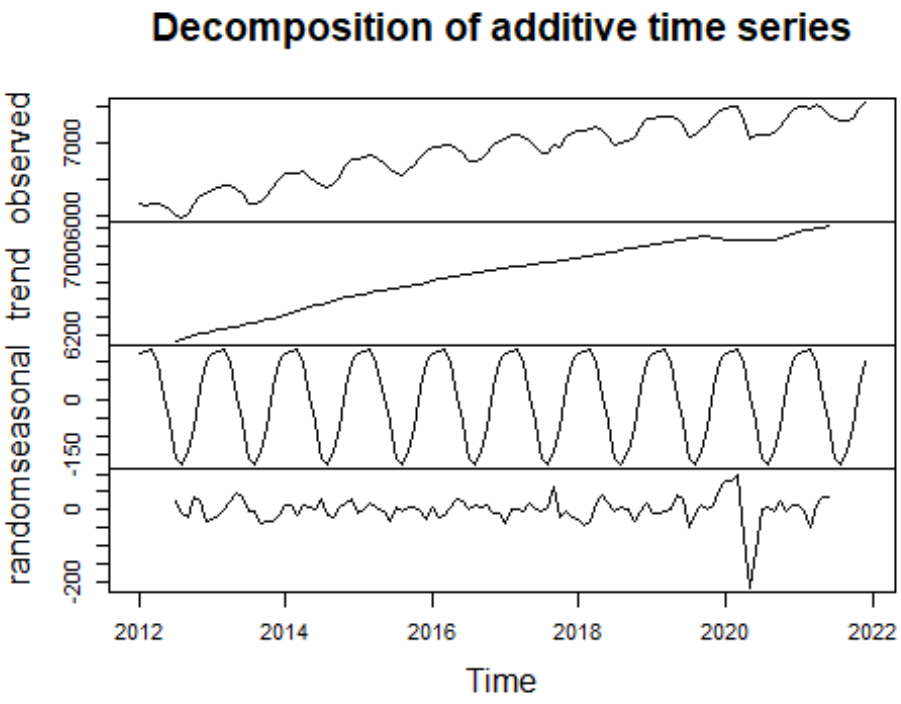
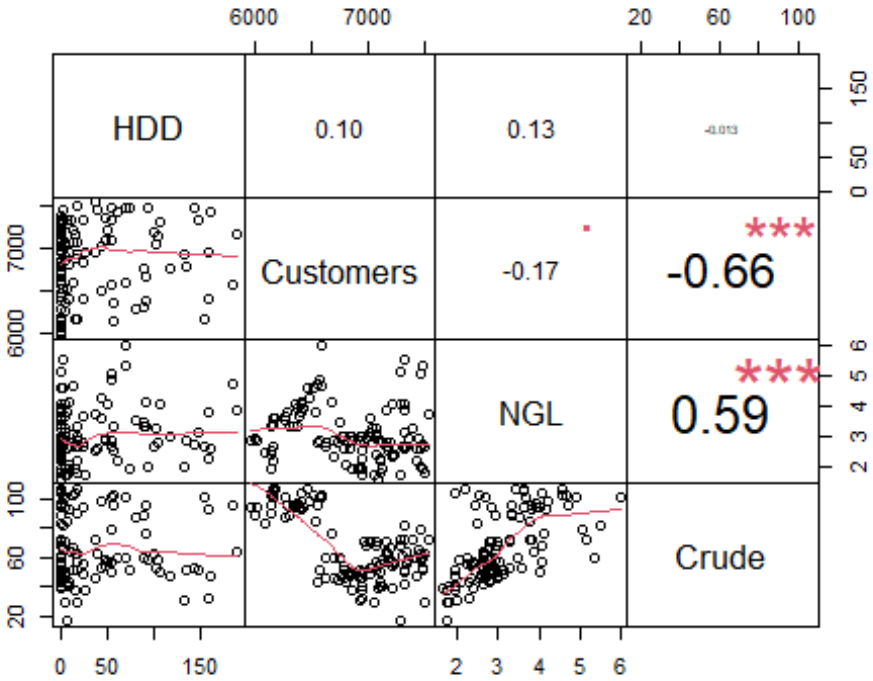
Commercial Customer Count Forecast

Overall Commercial Customers Forecast Analysis

Customer Time-Series Decomposition



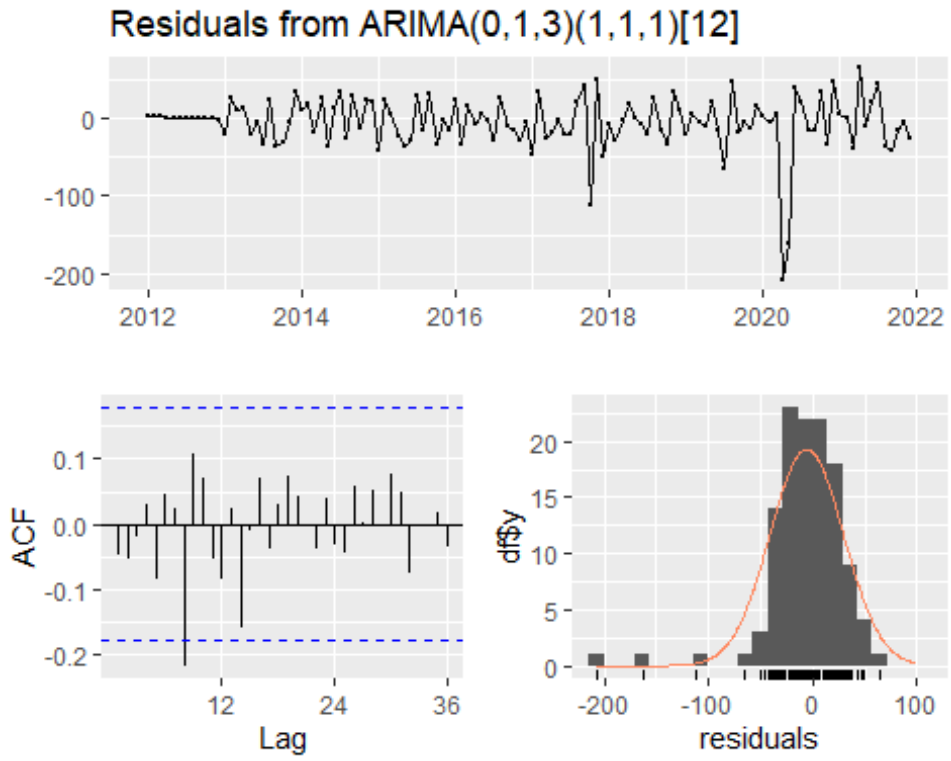


ARIMA Model: Expected Accuracy

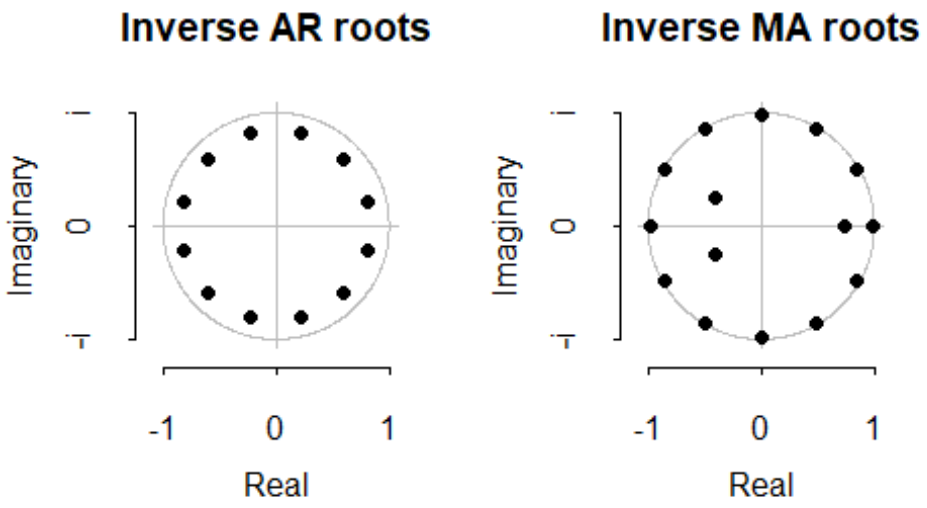
```
                      ME RMSE MAE
Forecast Horizon  1   -2   26  20
Forecast Horizon  2    0   28  22
Forecast Horizon  3   -1   28  23
Forecast Horizon  4   -7   44  30
Forecast Horizon  5  -17   76  41
Forecast Horizon  6  -24   87  48
Forecast Horizon  7  -27   89  51
Forecast Horizon  8  -31   94  56
Forecast Horizon  9  -37  100  60
Forecast Horizon  10 -43  103  66
Forecast Horizon  11 -45  106  69
Forecast Horizon  12 -48  110  73
Forecast Horizon  13 -52  114  79
Forecast Horizon  14 -54  115  80
Forecast Horizon  15 -58  119  84
Forecast Horizon  16 -59  121  89
Forecast Horizon  17 -62  121  91
Forecast Horizon  18 -66  119  91
Forecast Horizon  19 -67  115  89
Forecast Horizon  20 -68  115  89
Forecast Horizon  21 -73  120  95
Forecast Horizon  22 -77  122  99
Forecast Horizon  23 -79  122  99
Forecast Horizon  24 -84  124 101
```

ARIMA Model: Diagnostics

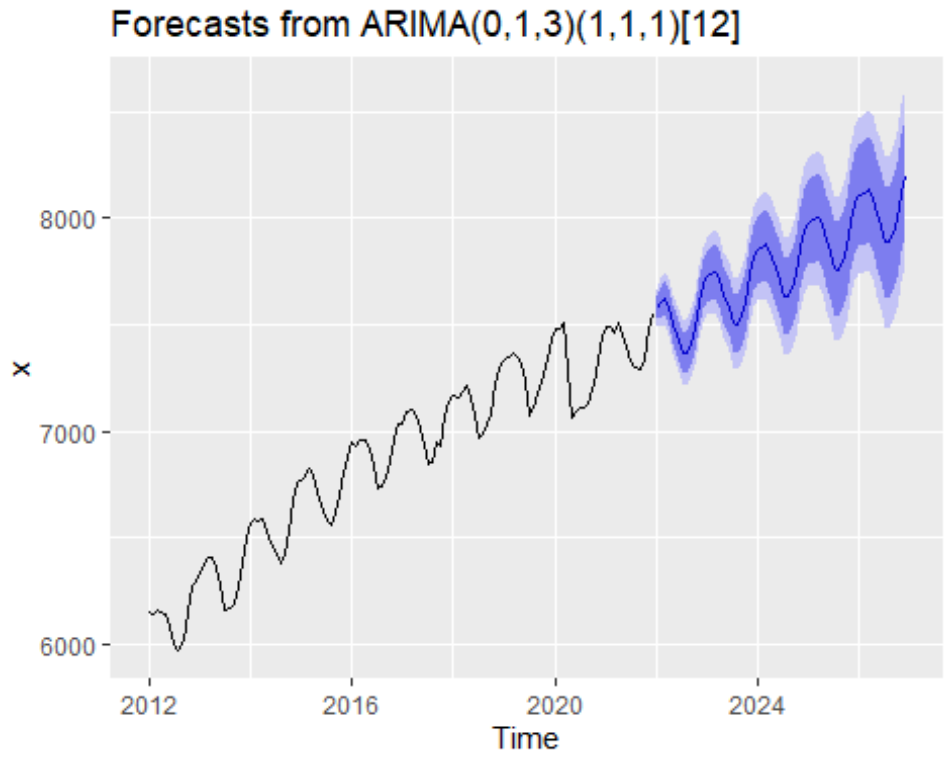
```
Series: x
ARIMA(0,1,3)(1,1,1)[12]

Coefficients:
         ma1      ma2      ma3     sar1     sma1
      0.0742  -0.3654  -0.1624  -0.1281  -0.8283
s.e.  0.1053   0.0841   0.1085   0.1572   0.2179

sigma^2 estimated as 1500:  log likelihood=-548.66
AIC=1109.33   AICc=1110.17   BIC=1125.36

Training set error measures:
                    ME     RMSE      MAE          MPE     MAPE      MASE
Training set -6.049582 35.70541 23.40443 -0.08616574 0.336943 0.1517032
                    ACF1
Training set -0.04888767
```



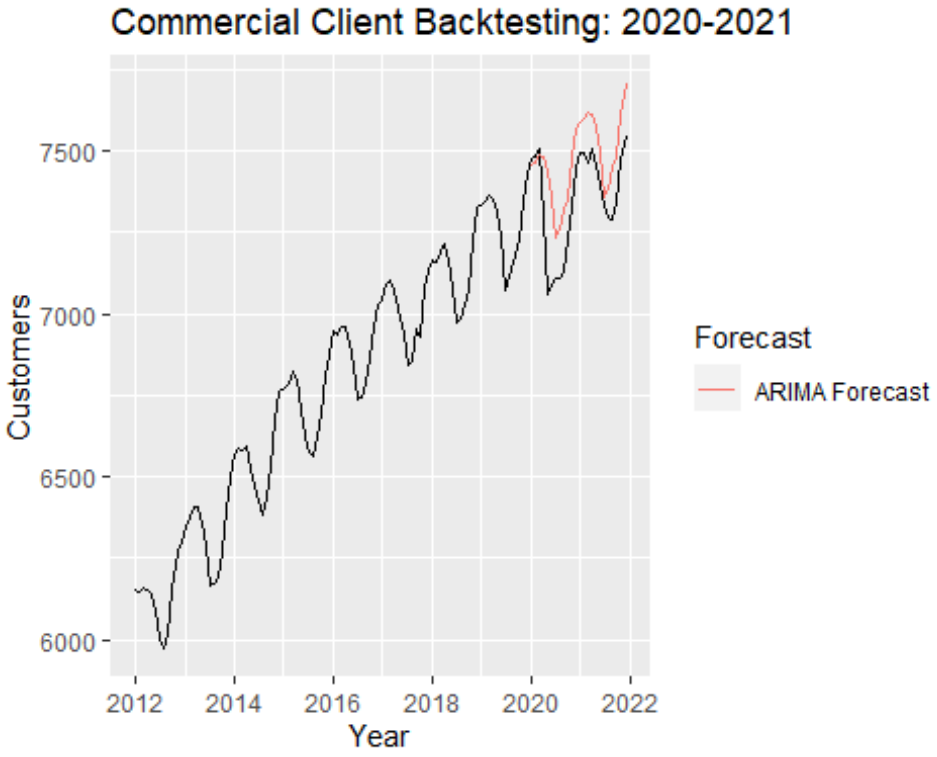

```
 Ljung-Box test

data:  Residuals from ARIMA(0,1,3)(1,1,1)[12]
Q* = 18.359, df = 19, p-value = 0.4986

Model df: 5.   Total lags used: 24
```



ARIMA Model: 5 Year Forecast



Back-Testing



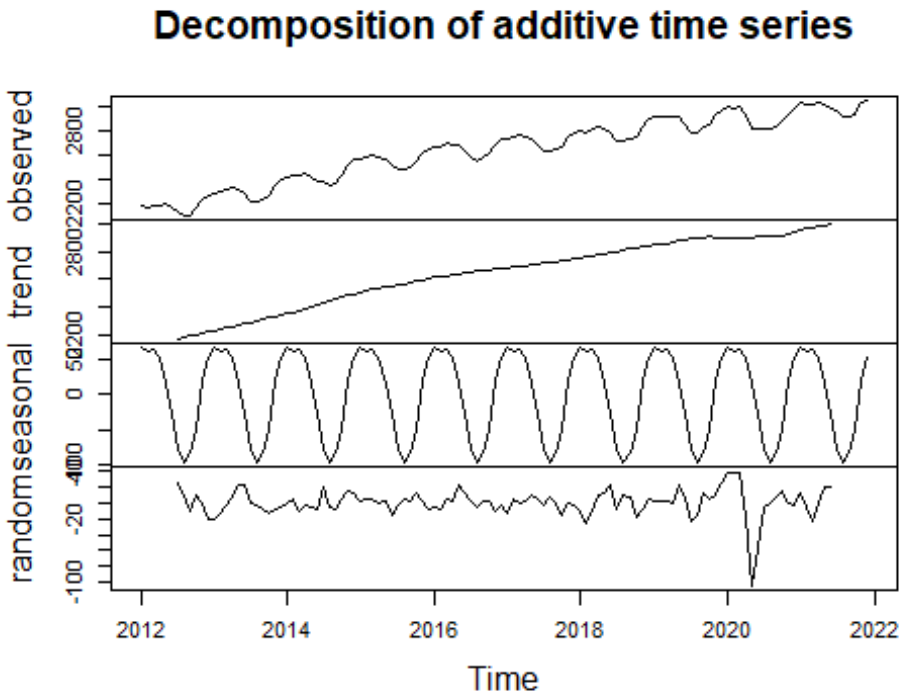
Test Results

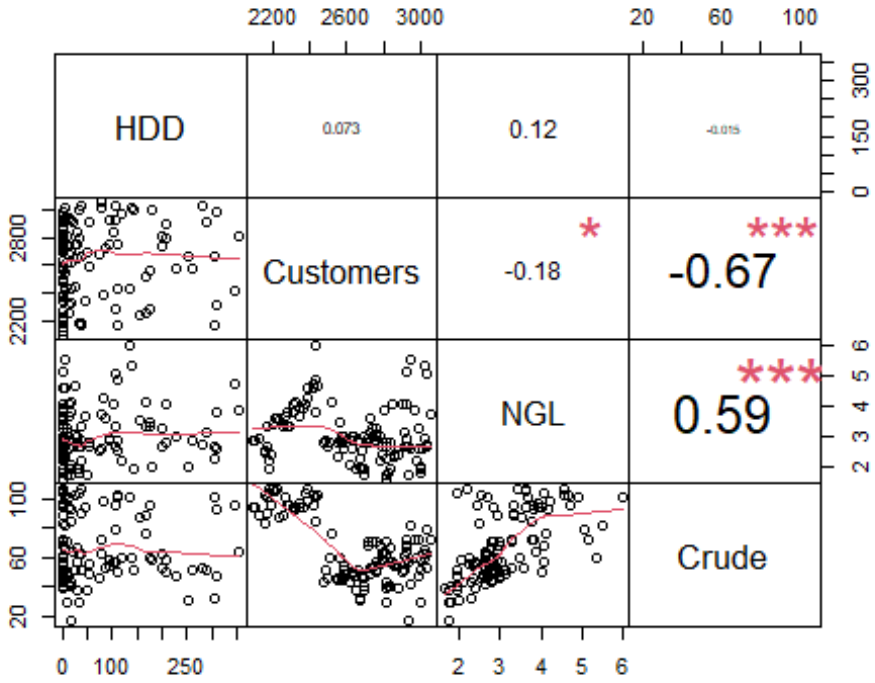
Below we see that the model performs roughly as expected for a “normal” year of 2019, and continues to have a high degree of accuracy in 2020 and 2021.

```
[1] "Overall MAE: 131.69"

[1] "Overall Accuracy: 98.19"

         Actual Forecast Absolute_Error Accuracy
Jan 2020   7478     7455          23.39     99.7
Feb 2020   7482     7462          19.91     99.7
Mar 2020   7505     7485          19.65     99.7
Apr 2020   7293     7482         189.10     97.4
May 2020   7061     7436         375.23     94.7
Jun 2020   7092     7358         265.68     96.3
Jul 2020   7112     7234         121.93     98.3
Aug 2020   7108     7255         147.46     97.9
Sep 2020   7130     7319         188.97     97.3
Oct 2020   7225     7349         123.76     98.3
Nov 2020   7332     7484         152.40     97.9
Dec 2020   7444     7571         127.13     98.3
Jan 2021   7492     7589          97.01     98.7
Feb 2021   7492     7597         105.06     98.6
Mar 2021   7466     7620         154.26     97.9
Apr 2021   7508     7615         107.31     98.6
May 2021   7456     7574         117.64     98.4
Jun 2021   7392     7495         102.65     98.6
Jul 2021   7332     7358          26.22     99.6
Aug 2021   7298     7386          87.55     98.8
Sep 2021   7287     7449         161.79     97.8
Oct 2021   7336     7484         148.01     98.0
Nov 2021   7478     7615         137.16     98.2
Dec 2021   7544     7705         161.32     97.9
```

FPUC General Service 2 (FPU-GS2 & FPU-GST2)

Customer Time-Series Decomposition





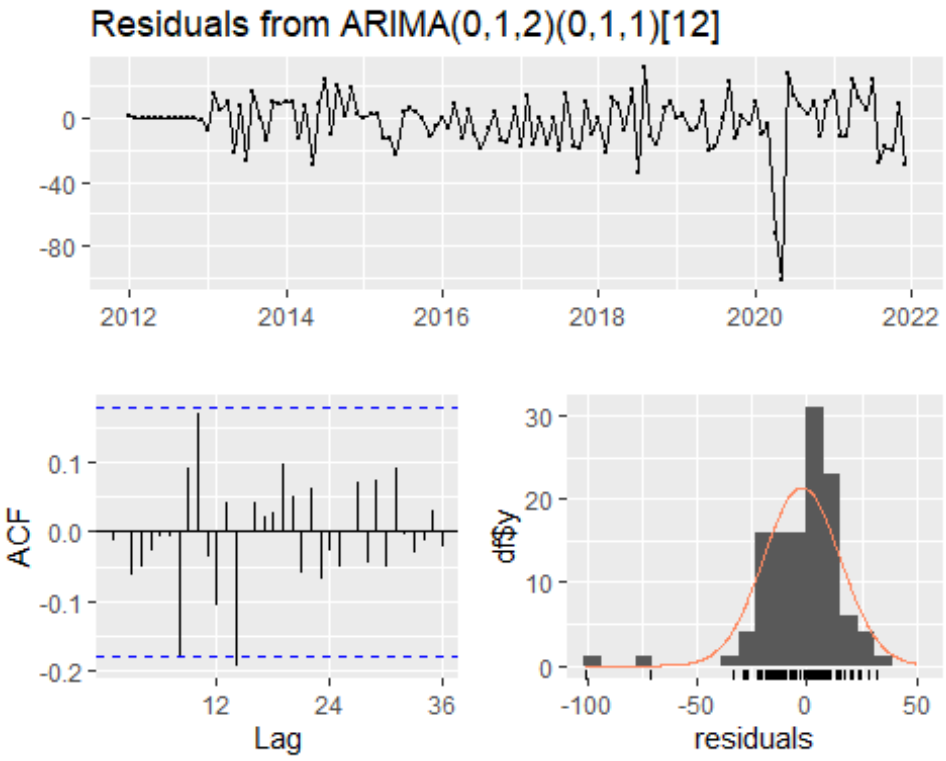
ARIMA Model: Expected Accuracy

		ME	RMSE	MAE
Forecast Horizon	1	1	15	13
Forecast Horizon	2	2	16	12
Forecast Horizon	3	1	17	14

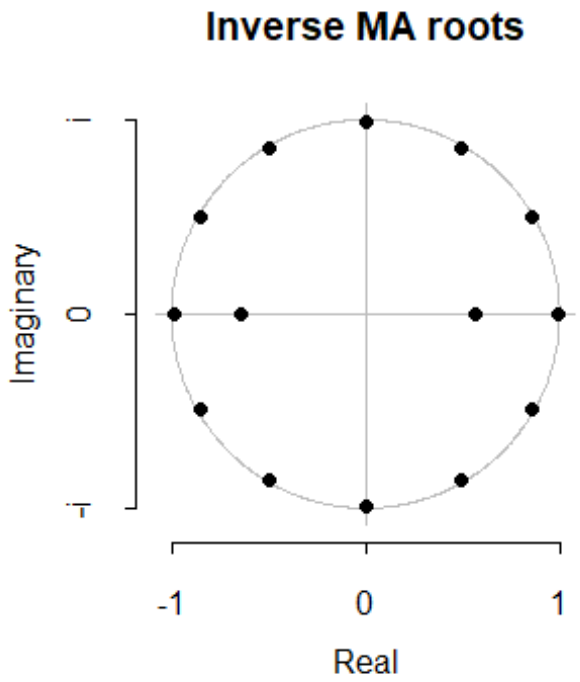
```
Forecast Horizon  4    0   20  16
Forecast Horizon  5   -5   35  21
Forecast Horizon  6   -8   41  26
Forecast Horizon  7  -10   42  28
Forecast Horizon  8  -11   43  27
Forecast Horizon  9  -13   44  31
Forecast Horizon  10 -14   47  33
Forecast Horizon  11 -15   49  34
Forecast Horizon  12 -16   51  35
Forecast Horizon  13 -17   53  39
Forecast Horizon  14 -17   56  41
Forecast Horizon  15 -18   60  42
Forecast Horizon  16 -19   62  44
Forecast Horizon  17 -20   63  48
Forecast Horizon  18 -20   63  48
Forecast Horizon  19 -20   64  49
Forecast Horizon  20 -21   65  51
Forecast Horizon  21 -23   65  52
Forecast Horizon  22 -25   66  55
Forecast Horizon  23 -25   69  56
Forecast Horizon  24 -27   68  56
```

ARIMA Model: Diagnostics

```
Series: x
ARIMA(0,1,2)(0,1,1)[12]

Coefficients:
         ma1      ma2     sma1
      0.0754  -0.3622  -0.8704
s.e.  0.0969   0.1025   0.1547

sigma^2 estimated as 354.3:  log likelihood=-472.54
AIC=953.08   AICc=953.48   BIC=963.78

Training set error measures:
                     ME   RMSE      MAE         MPE      MAPE      MASE
Training set -2.472999 17.524 11.89993 -0.08808673 0.4423596 0.1253357
                     ACF1
Training set -0.01260262
```

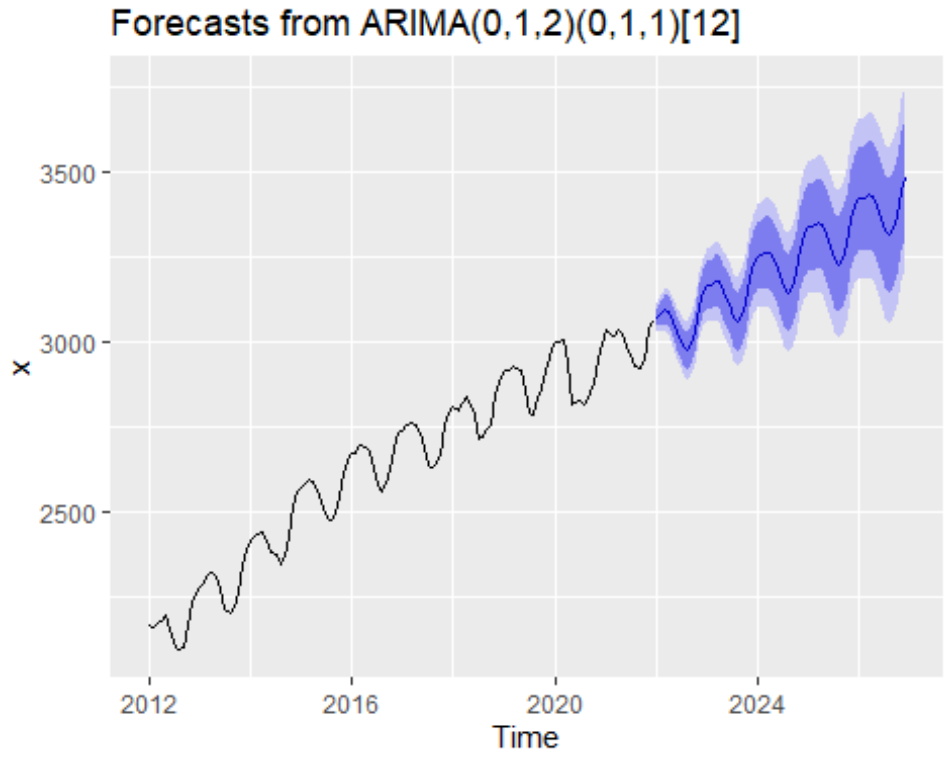



```
 Ljung-Box test

data:  Residuals from ARIMA(0,1,2)(0,1,1)[12]
Q* = 21.503, df = 21, p-value = 0.4286

Model df: 3.   Total lags used: 24
```

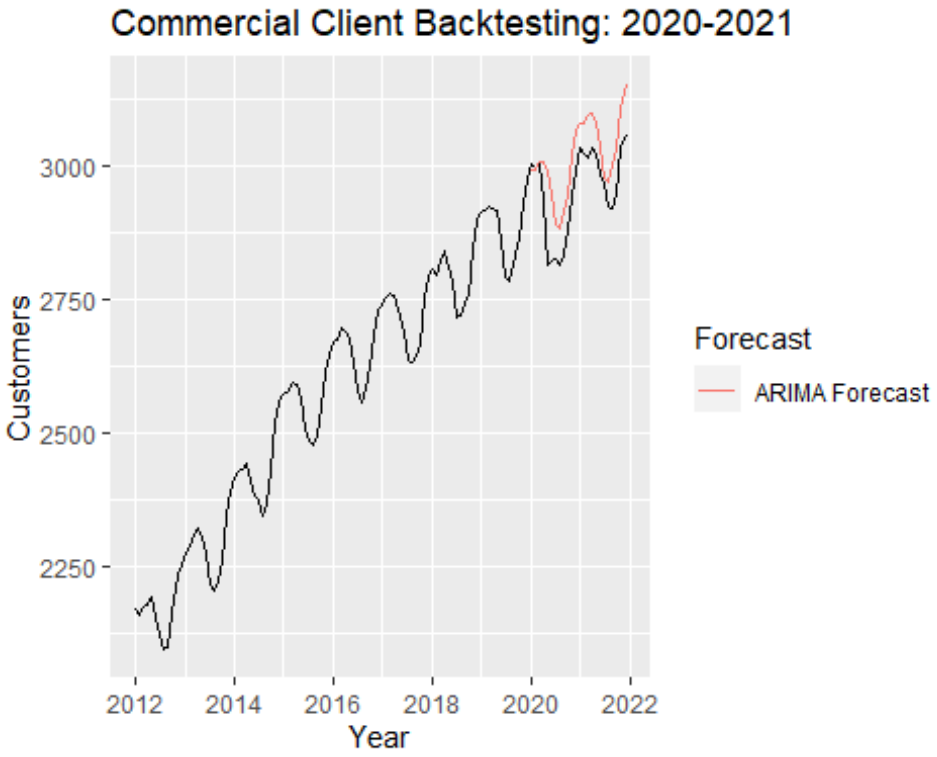


ARIMA Model: 5 Year Forecast

Below we fit & forecast 60 months into the future using an ARIMA (0,1,2)(0,1,1) model. This model only uses 1 difference,1 Seasonal Moving Average, 1 Seasonal Difference, and is expected to be extremely accurate as previously shown. In the graph below we see the 80% and 95% Prediction Intervals bounding our forecast.



Back-Testing



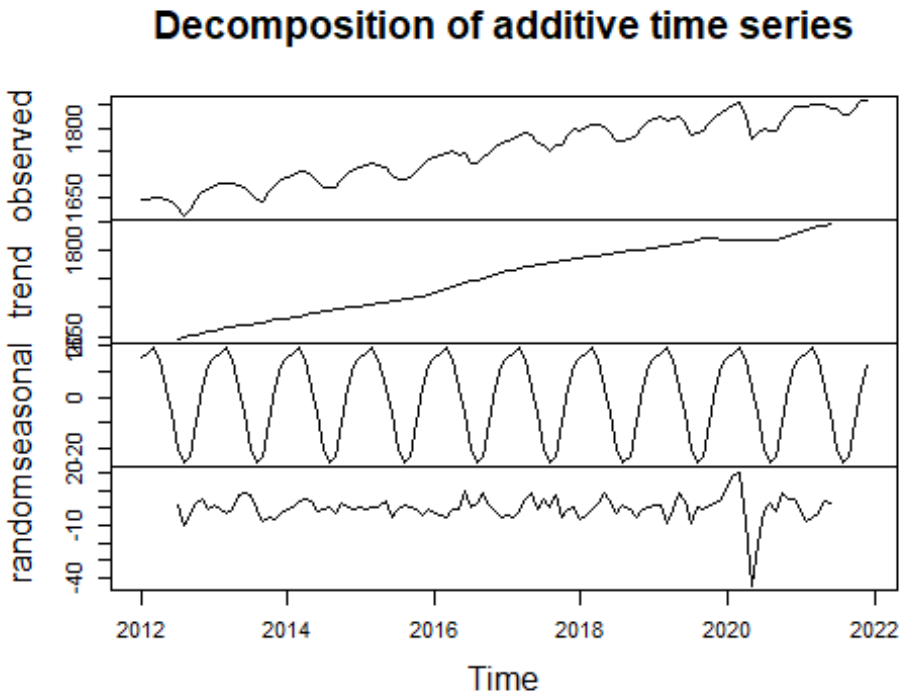
Test Results

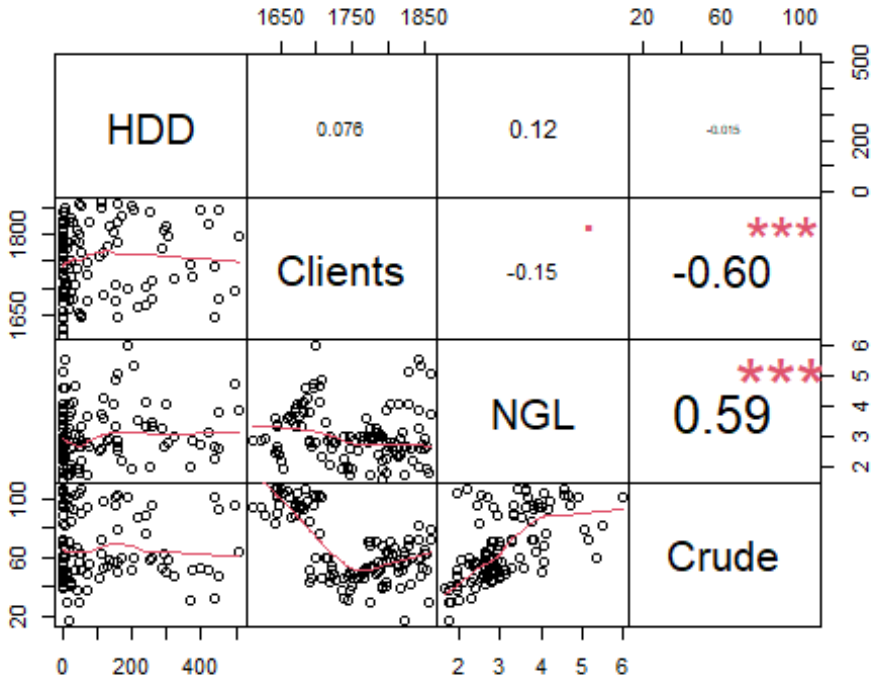
Below we see that the model performs roughly as expected for a “normal” year of 2019, and continues to have a high degree of accuracy in 2020 and 2021.

```
[1] "24Month Mean Absolute Error (MAE): 65.17"

[1] "24Month Mean Accuracy: 97.77"

         Actual Forecast Absolute_Error Accuracy
Jan 2020   3002     2991          11.04     99.6
Feb 2020   2997     2992           4.79     99.8
Mar 2020   3004     3007           2.82     99.9
Apr 2020   2937     3009          71.79     97.6
May 2020   2815     2993         178.46     93.7
Jun 2020   2820     2948         128.31     95.4
Jul 2020   2825     2889          63.66     97.7
Aug 2020   2813     2883          70.14     97.5
Sep 2020   2834     2913          79.30     97.2
Oct 2020   2880     2943          62.77     97.8
Nov 2020   2945     3019          73.88     97.5
Dec 2020   2992     3063          71.20     97.6
Jan 2021   3033     3079          46.16     98.5
Feb 2021   3021     3080          59.41     98.0
Mar 2021   3016     3095          79.02     97.4
Apr 2021   3036     3097          60.99     98.0
May 2021   3024     3082          57.67     98.1
Jun 2021   2986     3037          50.51     98.3
Jul 2021   2965     2977          11.86     99.6
Aug 2021   2925     2971          46.34     98.4
Sep 2021   2919     3002          82.51     97.2
Oct 2021   2947     3031          83.98     97.2
Nov 2021   3035     3107          72.08     97.6
Dec 2021   3056     3151          95.41     96.9
```

FPUC Large Volume Services (LVS, LVTS,LVTS2)

Customer Time-Series Decomposition





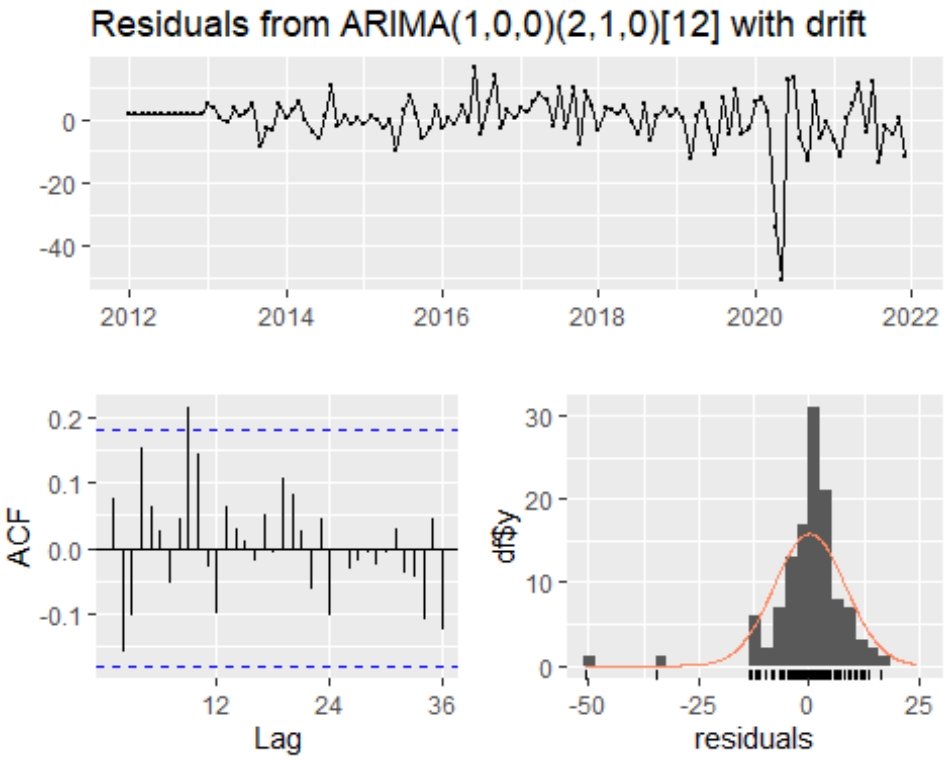
ARIMA Model: Expected Accuracy

		ME	RMSE	MAE
Forecast Horizon	1	-1	6	4
Forecast Horizon	2	-1	6	5
Forecast Horizon	3	-1	7	5

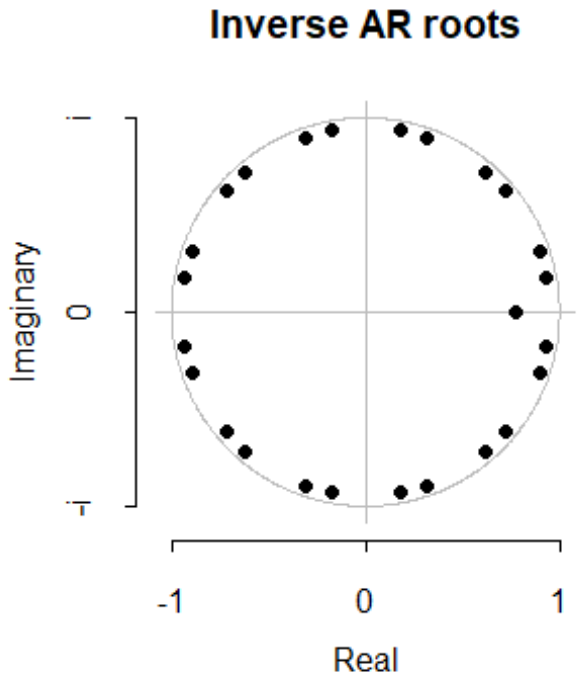
```
Forecast Horizon  4   -2    7   6
Forecast Horizon  5   -4   14   8
Forecast Horizon  6   -6   16  10
Forecast Horizon  7   -6   16  10
Forecast Horizon  8   -7   15  10
Forecast Horizon  9   -8   16  10
Forecast Horizon  10 -10   17  12
Forecast Horizon  11 -10   18  12
Forecast Horizon  12 -11   18  12
Forecast Horizon  13 -12   17  13
Forecast Horizon  14 -13   18  13
Forecast Horizon  15 -13   20  15
Forecast Horizon  16 -14   20  15
Forecast Horizon  17 -15   20  16
Forecast Horizon  18 -16   21  17
Forecast Horizon  19 -16   21  17
Forecast Horizon  20 -16   22  18
Forecast Horizon  21 -17   22  17
Forecast Horizon  22 -18   22  18
Forecast Horizon  23 -18   23  18
Forecast Horizon  24 -19   24  19
```

ARIMA Model: Diagnostics

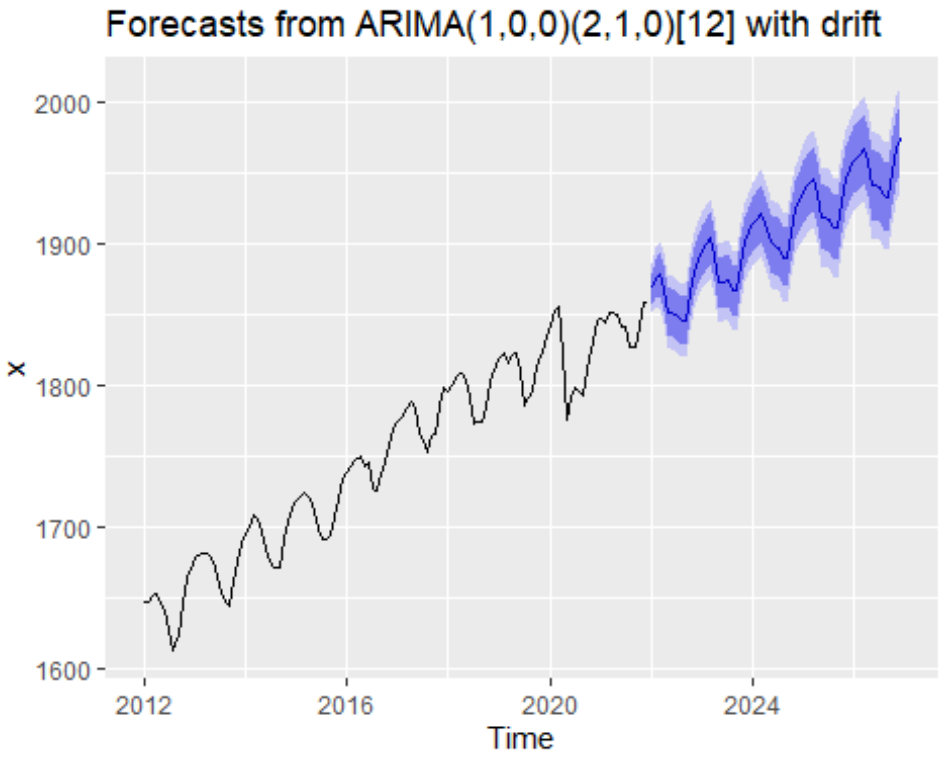
```
Series: x
ARIMA(1,0,0)(2,1,0)[12] with drift

Coefficients:
         ar1     sar1     sar2   drift
      0.7700  -0.6788  -0.2845  1.8258
s.e.  0.0637   0.0994   0.1264  0.1568

sigma^2 estimated as 74.61:  log likelihood=-387.25
AIC=784.49   AICc=785.08   BIC=797.9

Training set error measures:
                     ME     RMSE      MAE         MPE      MAPE      MASE
Training set 0.1976991 8.041368 5.113355 0.01287257 0.2889195 0.2148803
                    ACF1
Training set 0.07471428
```



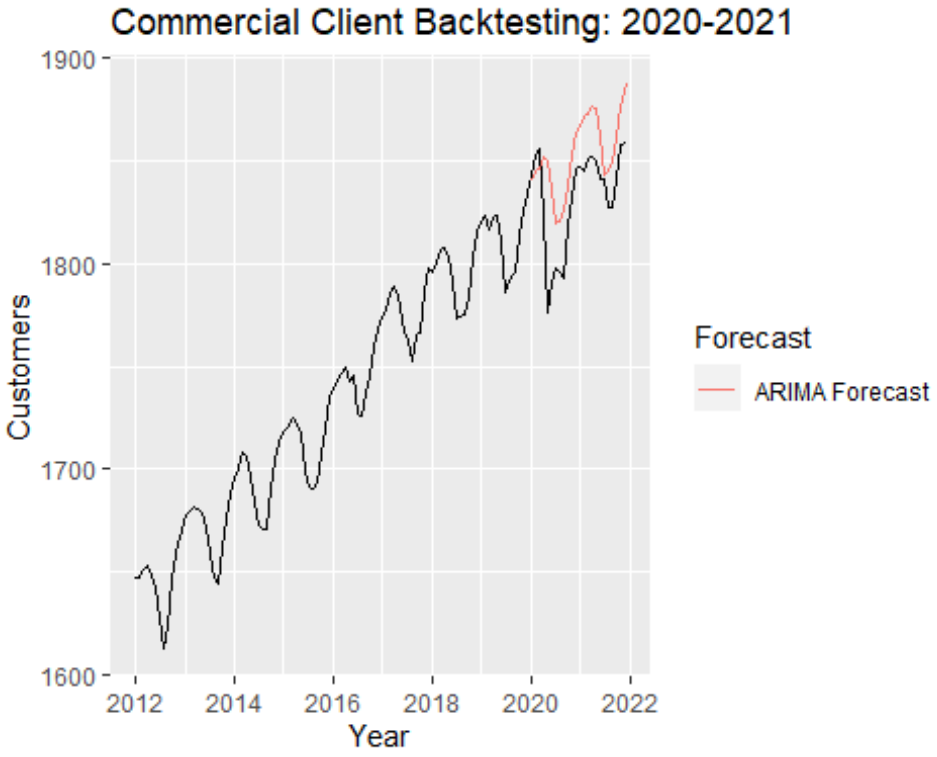

```
 Ljung-Box test

data:  Residuals from ARIMA(1,0,0)(2,1,0)[12] with drift
Q* = 25.879, df = 20, p-value = 0.1699

Model df: 4.   Total lags used: 24
```



ARIMA Model: 5 Year Forecast



Back-Testing



Test Results

Below we see that the model performs roughly as expected for a “normal” year of 2019, and continues to have a high degree of accuracy in 2020 and 2021.

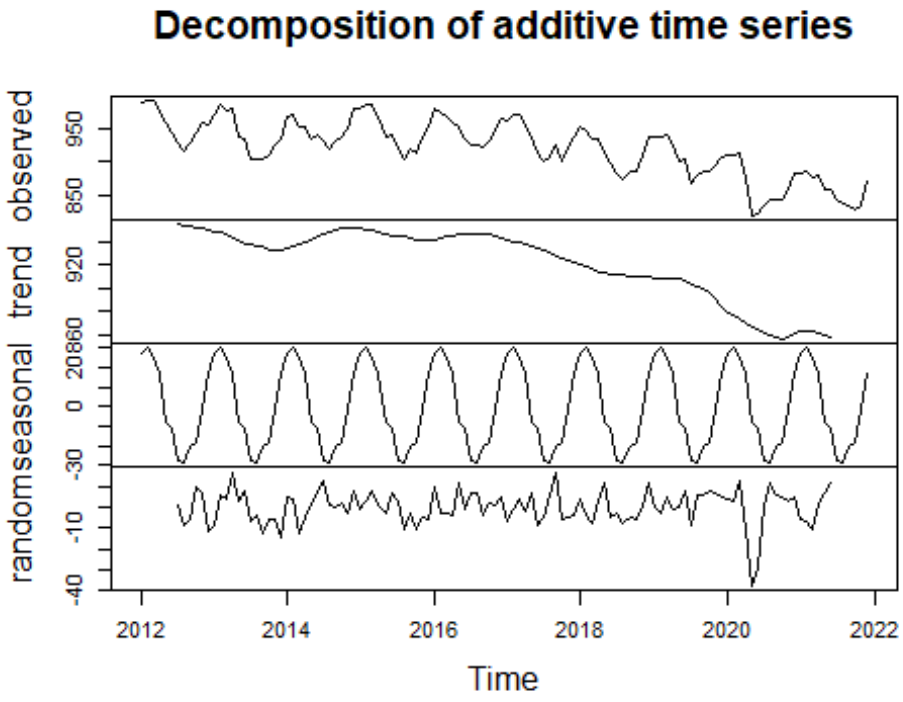
```
[1] "24Month Mean Absolute Error (MAE): 22.88"

[1] "24Month Mean Accuracy: 98.75"
```

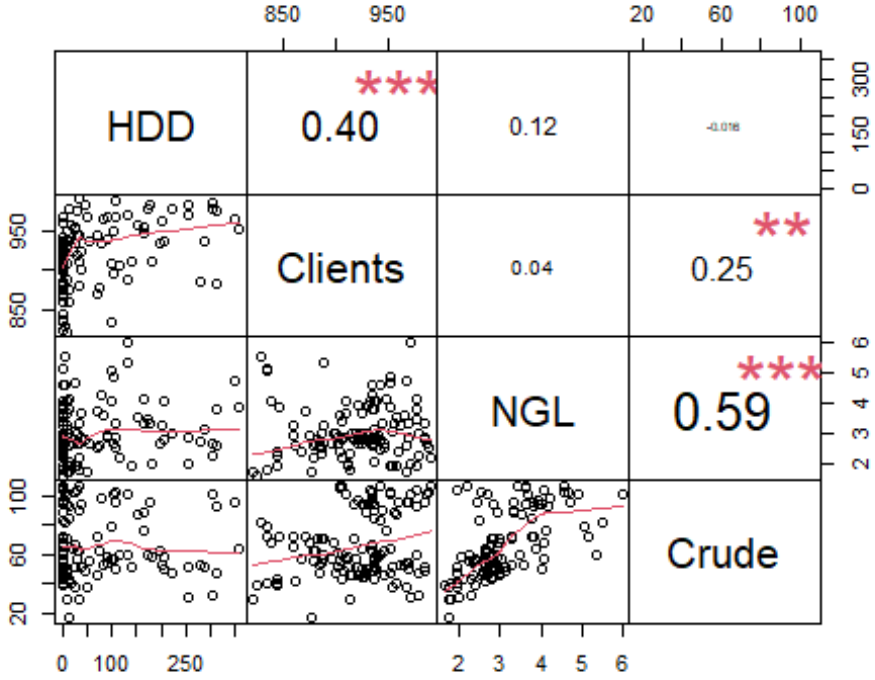
	Actual	Forecast	Absolute_Error	Accuracy
Jan 2020	1843	1840	2.77	99.8
Feb 2020	1853	1845	7.87	99.6
Mar 2020	1856	1846	9.98	99.5
Apr 2020	1823	1851	28.29	98.4
May 2020	1776	1850	74.14	95.8
Jun 2020	1791	1836	45.33	97.5
Jul 2020	1798	1819	21.33	98.8
Aug 2020	1796	1820	24.15	98.7
Sep 2020	1793	1826	33.13	98.2
Oct 2020	1818	1837	19.02	99.0
Nov 2020	1832	1853	20.72	98.9
Dec 2020	1846	1863	17.20	99.1
Jan 2021	1847	1867	19.79	98.9
Feb 2021	1845	1871	26.40	98.6
Mar 2021	1851	1872	21.42	98.8
Apr 2021	1852	1877	24.56	98.7
May 2021	1850	1875	24.95	98.7
Jun 2021	1841	1862	20.53	98.9
Jul 2021	1841	1843	1.99	99.9
Aug 2021	1827	1845	17.79	99.0
Sep 2021	1827	1849	21.93	98.8
Oct 2021	1841	1860	19.35	98.9
Nov 2021	1858	1876	18.38	99.0
Dec 2021	1859	1887	28.05	98.5

FPUC General Services1 (GS-1 & GSTS1)

Fort Meade customers excluded.

Customer Time-Series Decomposition





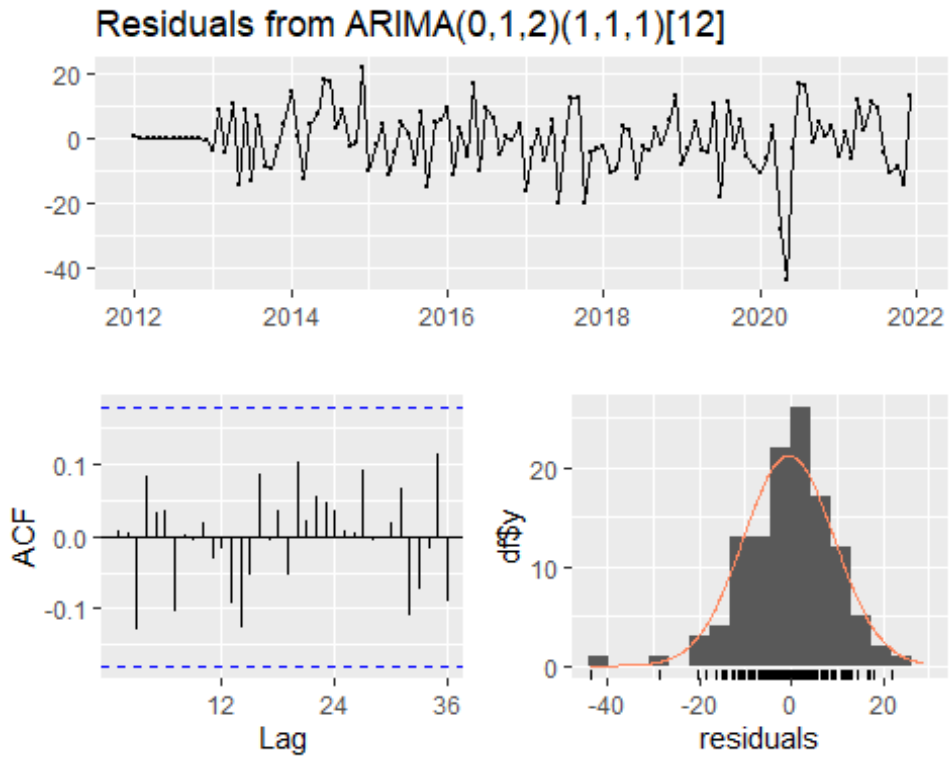
ARIMA Model: Expected Accuracy

		ME	RMSE	MAE
Forecast Horizon	1	-2	10	8
Forecast Horizon	2	-3	11	9
Forecast Horizon	3	-4	12	10
Forecast Horizon	4	-5	13	11
Forecast Horizon	5	-8	18	14
Forecast Horizon	6	-10	22	17
Forecast Horizon	7	-11	23	17
Forecast Horizon	8	-11	23	18
Forecast Horizon	9	-12	24	19
Forecast Horizon	10	-14	25	20
Forecast Horizon	11	-15	26	21
Forecast Horizon	12	-16	26	22
Forecast Horizon	13	-17	27	23
Forecast Horizon	14	-18	27	23
Forecast Horizon	15	-19	28	24
Forecast Horizon	16	-19	28	24
Forecast Horizon	17	-20	28	24
Forecast Horizon	18	-20	27	24
Forecast Horizon	19	-20	26	23
Forecast Horizon	20	-20	25	22
Forecast Horizon	21	-20	25	21
Forecast Horizon	22	-21	25	22
Forecast Horizon	23	-22	26	22
Forecast Horizon	24	-22	26	23

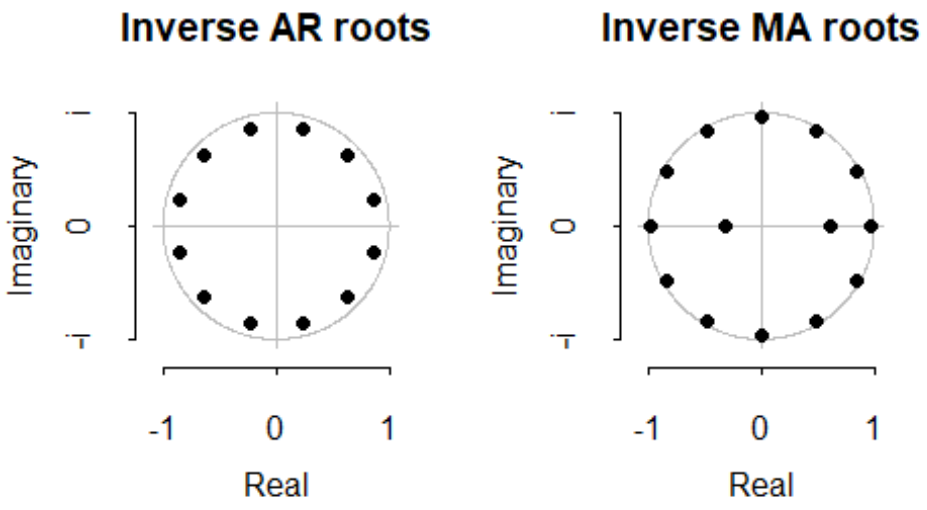
ARIMA Model: Diagnostics

In this section we evaluate the diagnostics of the ARIMA Model. Below we see that the model fails the Ljung-Box Test and therefore we can determine the data is independently distributed. In addition, we see from the graphs that the lagged values are not auto-correlated with one another, and the residuals are normally distributed.

```
Series: x
ARIMA(0,1,2)(1,1,1)[12]

Coefficients:
          ma1      ma2     sar1     sma1
      -0.3040  -0.1908  -0.2488  -0.7001
s.e.   0.0939   0.0871   0.1580   0.1755

sigma^2 estimated as 113.5:  log likelihood=-409.33
AIC=828.65   AICc=829.25   BIC=842.02

Training set error measures:
                     ME    RMSE      MAE         MPE      MAPE      MASE
Training set -0.5066976 9.86858 7.364808 -0.06322886 0.8106228 0.3883785
                    ACF1
Training set 0.008085022
```

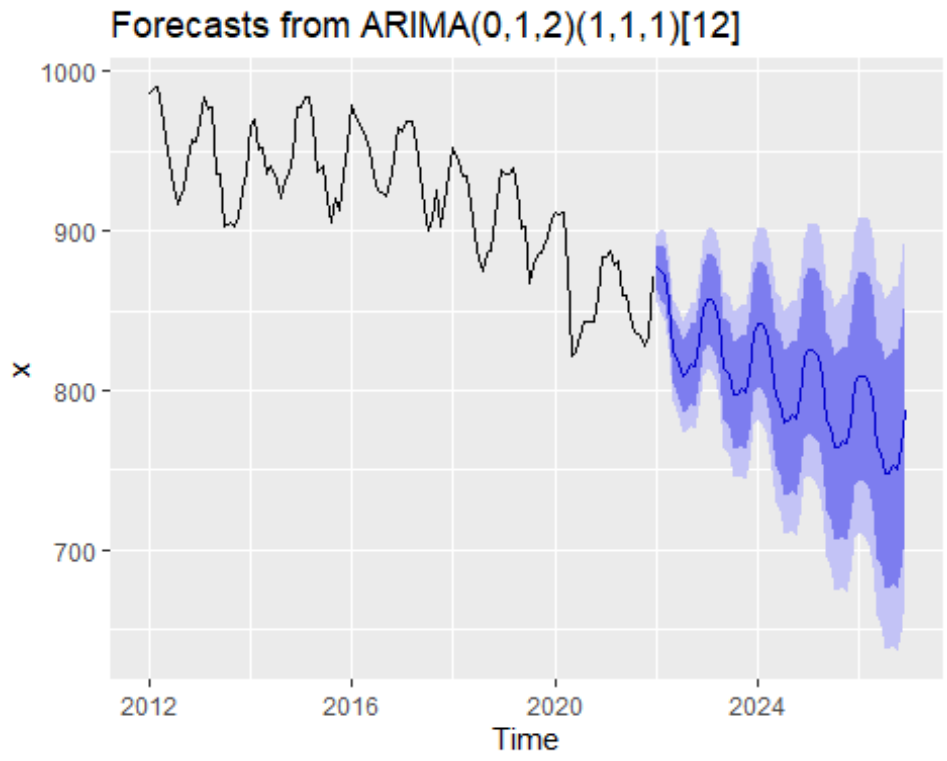



```
 Ljung-Box test

data:  Residuals from ARIMA(0,1,2)(1,1,1)[12]
Q* = 13.029, df = 20, p-value = 0.8761

Model df: 4.   Total lags used: 24
```

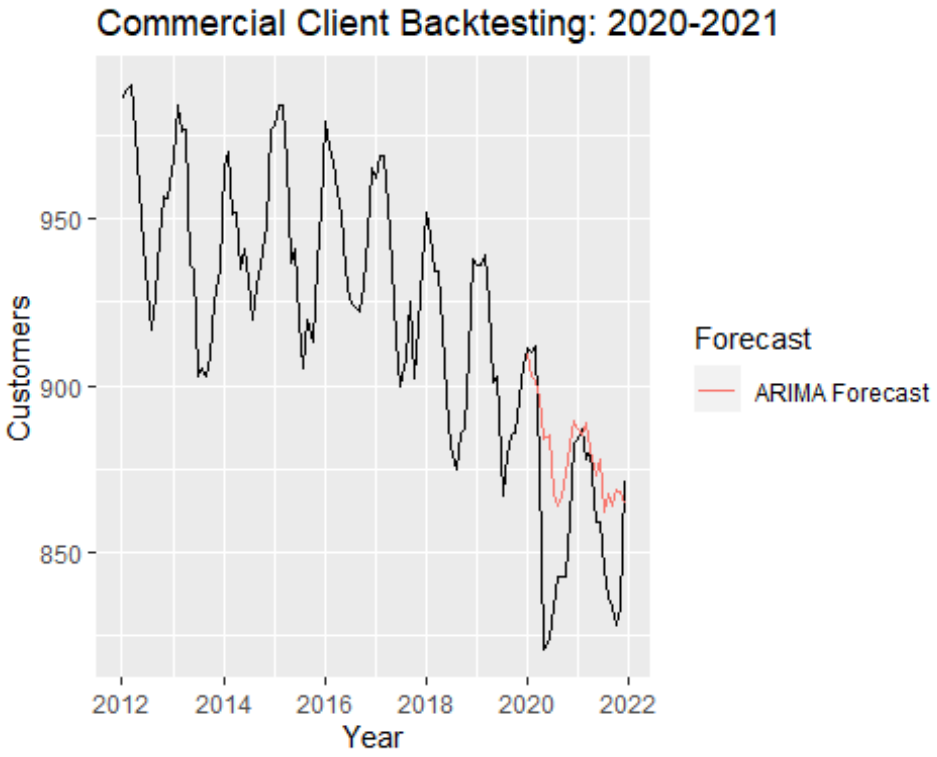


ARIMA Model: 5 Year Forecast

Below we fit & forecast 60 months into the future using an ARIMA (0,1,2)(1,1,1) model.



Back-Testing



Test Results

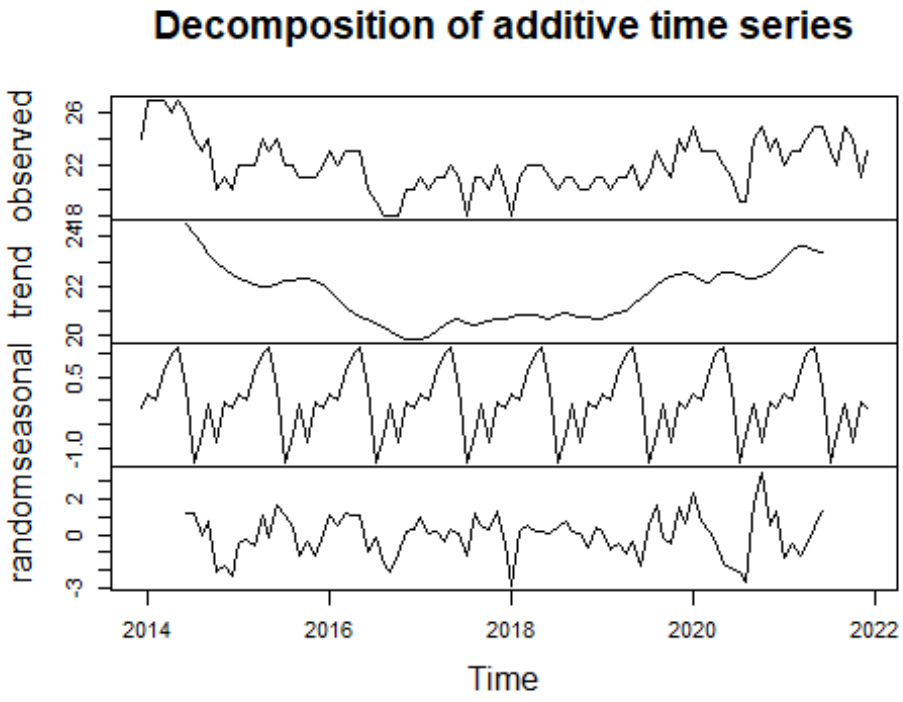
Below we see that the model performs roughly as expected for a “normal” year of 2019, and continues to have a high degree of accuracy in 2020 and 2021.

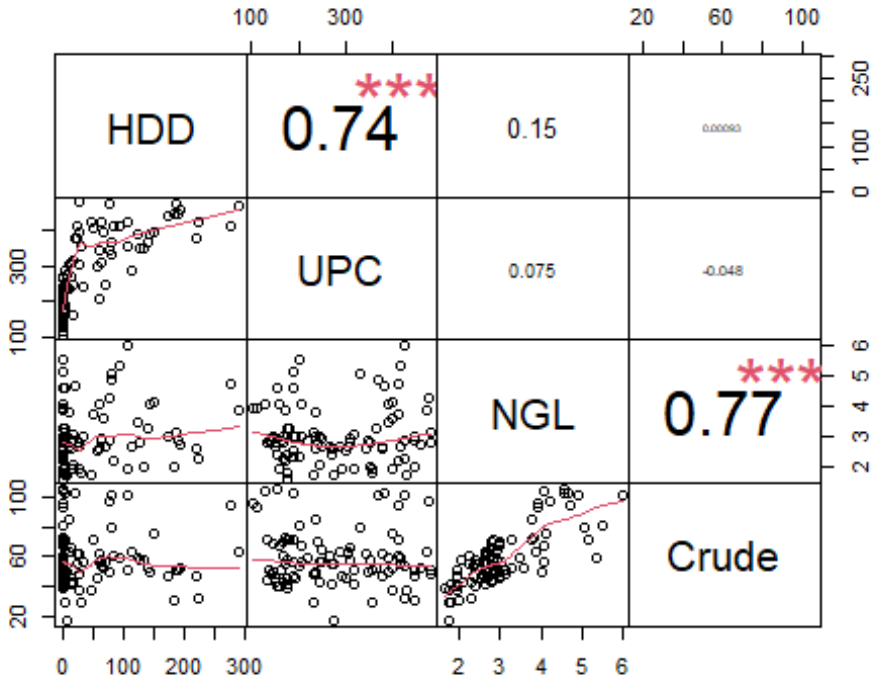
```
[1] "24Month Mean Absolute Error (MAE): 21.28"

[1] "24Month Mean Accuracy: 97.47"

         Actual Forecast Absolute_Error Accuracy
Jan 2020    911      909           1.75     99.8
Feb 2020    910      903           7.12     99.2
Mar 2020    912      902          10.38     98.9
Apr 2020    876      897          20.78     97.6
May 2020    821      884          63.10     92.3
Jun 2020    824      885          61.33     92.6
Jul 2020    834      868          33.82     95.9
Aug 2020    843      864          21.24     97.5
Sep 2020    843      867          23.83     97.2
Oct 2020    843      874          30.67     96.4
Nov 2020    860      882          21.96     97.4
Dec 2020    883      889           6.27     99.3
Jan 2021    884      887           3.31     99.6
Feb 2021    887      885           1.98     99.8
Mar 2021    878      889          10.89     98.8
Apr 2021    881      881           0.26    100.0
May 2021    859      873          14.31     98.3
Jun 2021    859      878          18.92     97.8
Jul 2021    845      862          17.01     98.0
Aug 2021    837      868          30.73     96.3
Sep 2021    834      864          29.84     96.4
Oct 2021    828      869          40.68     95.1
Nov 2021    834      868          34.17     95.9
Dec 2021    871      865           6.34     99.3
```

Fort Meade General Services1 (GS-1 & GSTS1)

Fort Meade customers only

Customer Time-Series Decomposition





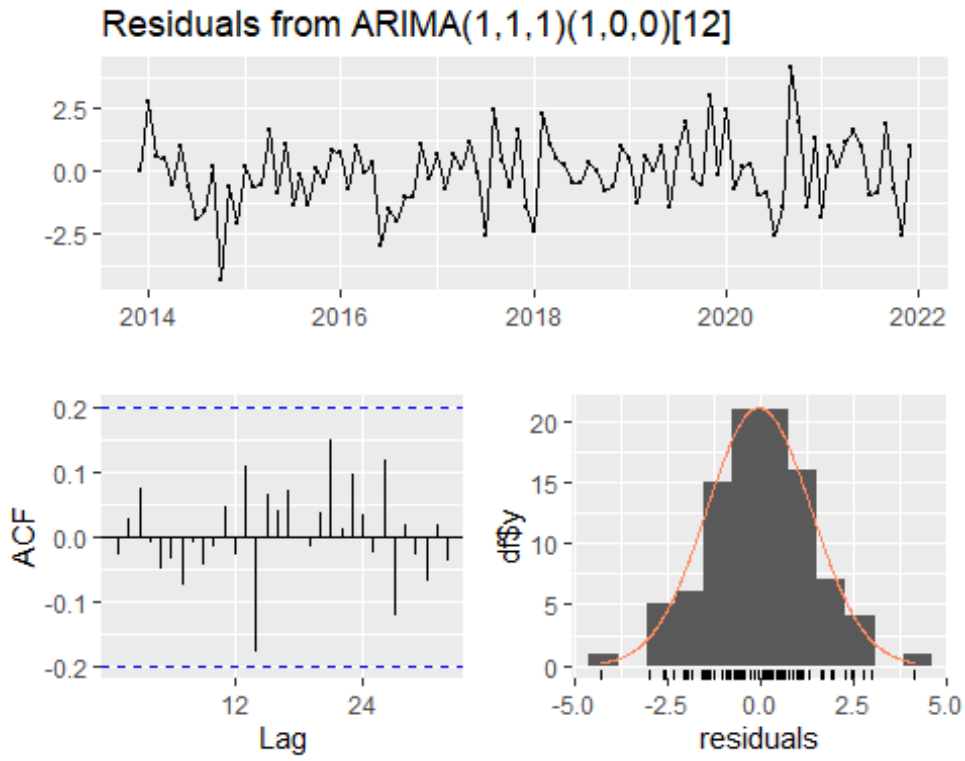
ARIMA Model: Expected Accuracy

		ME	RMSE	MAE
Forecast Horizon	1	0	2	1
Forecast Horizon	2	1	2	1
Forecast Horizon	3	1	2	1
Forecast Horizon	4	1	2	1
Forecast Horizon	5	1	2	2
Forecast Horizon	6	1	2	1
Forecast Horizon	7	1	2	2
Forecast Horizon	8	1	2	2
Forecast Horizon	9	1	2	2
Forecast Horizon	10	1	2	2
Forecast Horizon	11	1	2	2
Forecast Horizon	12	1	2	2
Forecast Horizon	13	1	2	2
Forecast Horizon	14	1	2	2
Forecast Horizon	15	1	3	2
Forecast Horizon	16	2	3	2
Forecast Horizon	17	2	3	2
Forecast Horizon	18	2	3	2
Forecast Horizon	19	2	3	2
Forecast Horizon	20	2	3	2
Forecast Horizon	21	2	3	2
Forecast Horizon	22	2	3	2
Forecast Horizon	23	2	3	2
Forecast Horizon	24	2	3	2

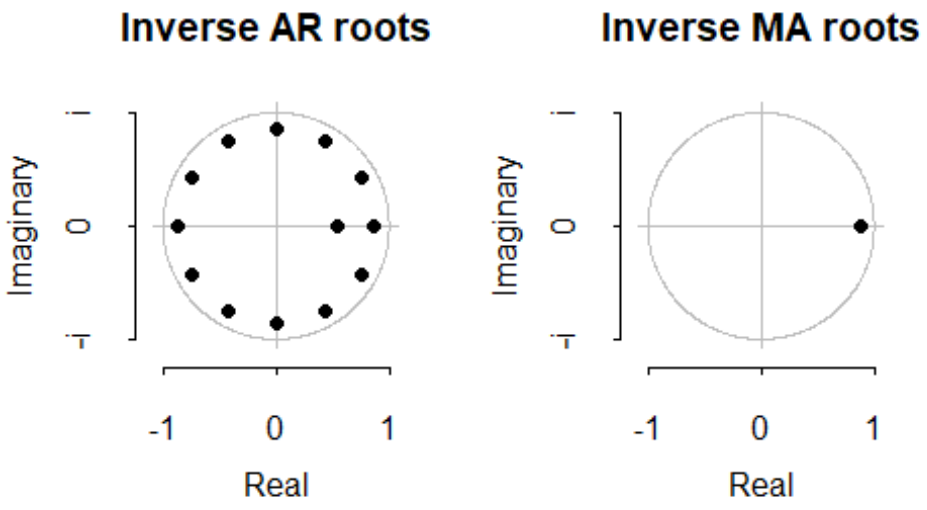
ARIMA Model: Diagnostics

In this section we evaluate the diagnostics of the ARIMA Model. Below we see that the model fails the Ljung-Box Test and therefore we can determine the data is independently distributed. In addition, we see from the graphs that the lagged values are not auto-correlated with one another, and the residuals are normally distributed.

```
Series: x
ARIMA(1,1,1)(1,0,0)[12]

Coefficients:
         ar1      ma1    sar1
      0.5450  -0.8785  0.1712
s.e.  0.1309   0.0738  0.1134

sigma^2 estimated as 2.043:  log likelihood=-169.4
AIC=346.8   AICc=347.24   BIC=357.06

Training set error measures:
                     ME     RMSE      MAE        MPE     MAPE     MASE
Training set -0.053021 1.399699 1.095254 -0.5677927 5.052239 0.589219
                     ACF1
Training set -0.02706726
```

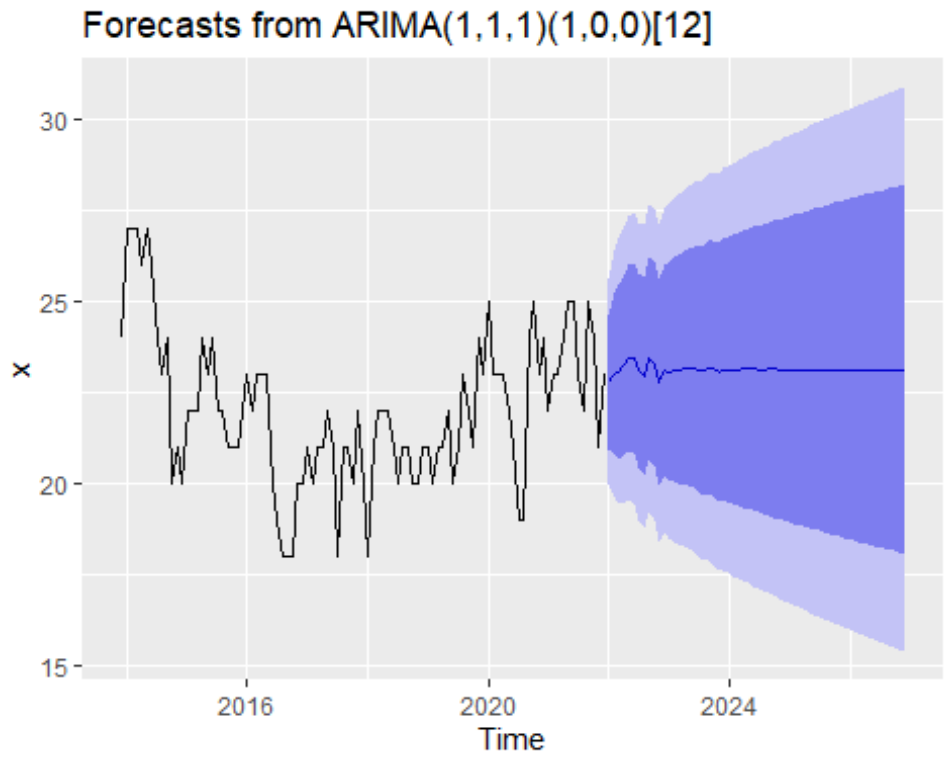



```
 Ljung-Box test

data:  Residuals from ARIMA(1,1,1)(1,0,0)[12]
Q* = 8.6502, df = 16, p-value = 0.9271

Model df: 3.   Total lags used: 19
```

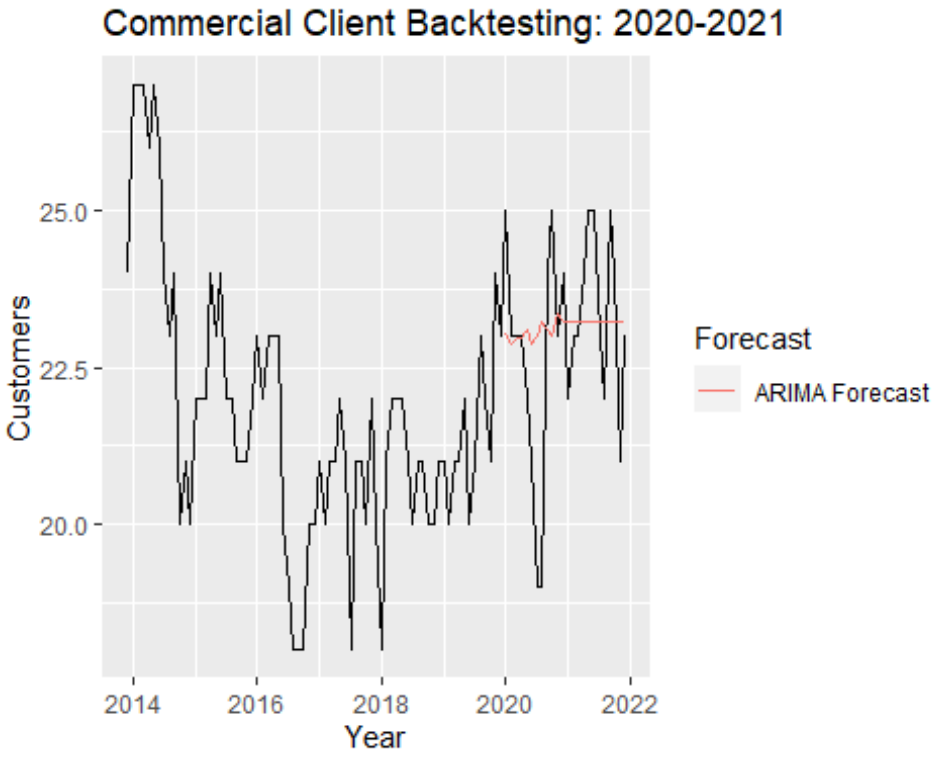


ARIMA Model: 5 Year Forecast

Below we fit & forecast 60 months into the future using an ARIMA (1,1,1)(1,0,0) model.



Back-Testing



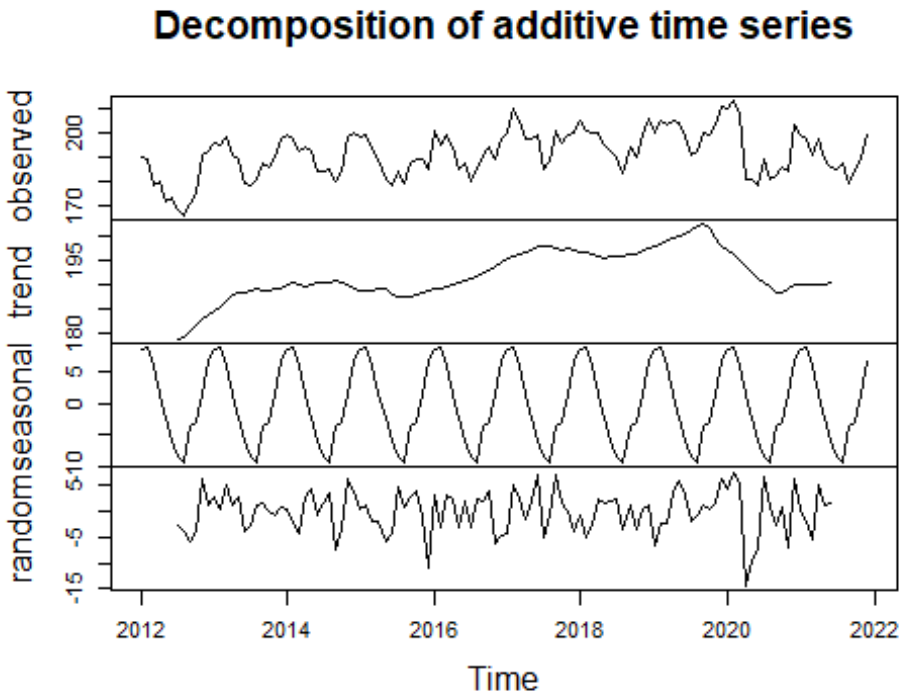
Test Results

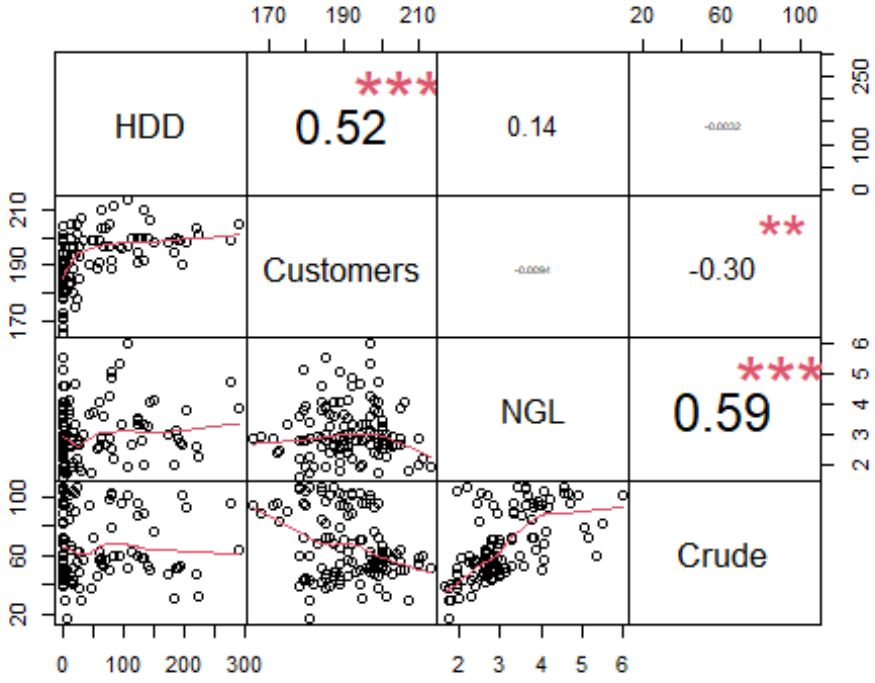
Below we see that the model performs roughly as expected for a “normal” year of 2019, and continues to have a high degree of accuracy in 2020 and 2021.

```
[1] "24Month Mean Absolute Error (MAE): 1.24"

[1] "24Month Mean Accuracy: 94.34"

         Actual Forecast Absolute_Error Accuracy
Jan 2020     25       23           1.97     92.1
Feb 2020     23       23           0.13     99.4
Mar 2020     23       23           0.02     99.9
Apr 2020     23       23           0.02     99.9
May 2020     22       23           1.09     95.0
Jun 2020     21       23           1.88     91.0
Jul 2020     19       23           4.00     78.9
Aug 2020     19       23           4.22     77.8
Sep 2020     24       23           0.90     96.2
Oct 2020     25       23           2.00     92.0
Nov 2020     23       23           0.34     98.5
Dec 2020     24       23           0.79     96.7
Jan 2021     22       23           1.21     94.5
Feb 2021     23       23           0.21     99.1
Mar 2021     23       23           0.21     99.1
Apr 2021     24       23           0.79     96.7
May 2021     25       23           1.79     92.8
Jun 2021     25       23           1.79     92.8
Jul 2021     23       23           0.21     99.1
Aug 2021     22       23           1.21     94.5
Sep 2021     25       23           1.79     92.8
Oct 2021     24       23           0.79     96.7
Nov 2021     21       23           2.21     89.5
Dec 2021     23       23           0.21     99.1
```

CFG Firm Transportation Services (FTS-1)

Customer Time-Series Decomposition





ARIMA Model: Expected Accuracy

In this section we evaluate the expected accuracy of a Seasonal ARIMA Model using cross-validation. ARIMA is an acronym for 'Autoregressive Integrated Moving Average' which is a widely using Time-Series forecasting model that utilizes the recent values to predict outward.

Here we evaluate model accuracy by using cross-validation and rolling forecasts throughout the time-series to determine our expected accuracy over a 24 Month period.

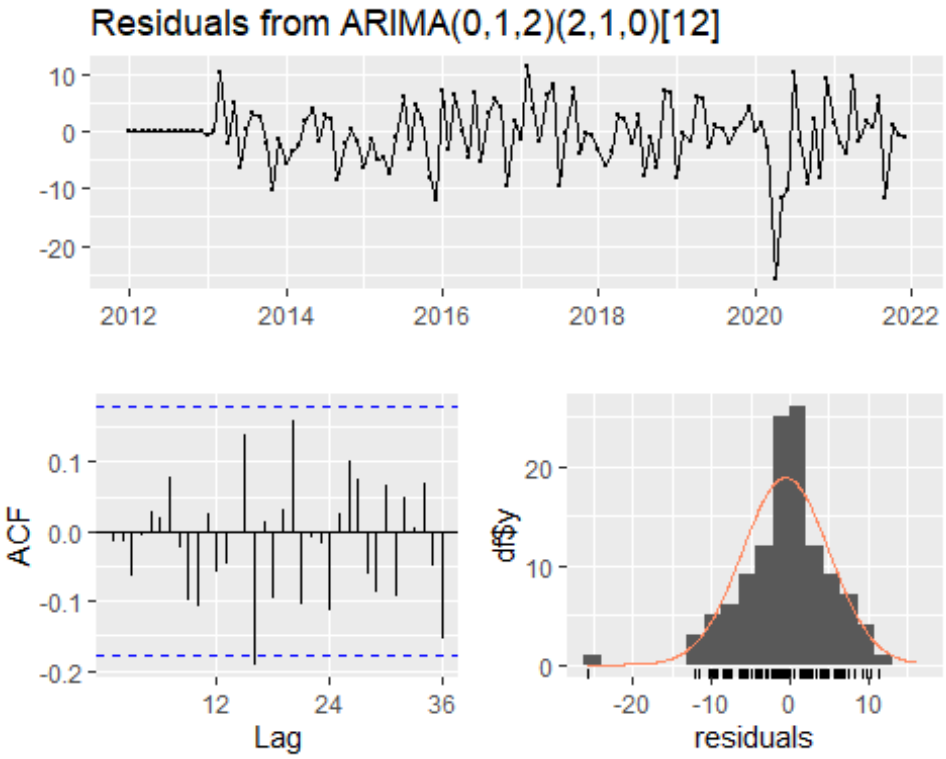
```
                     ME RMSE MAE
Forecast Horizon  1   0    5   4
Forecast Horizon  2   1    5   4
Forecast Horizon  3   0    4   4
Forecast Horizon  4   0    6   4
Forecast Horizon  5  -1    7   5
Forecast Horizon  6  -1    8   5
Forecast Horizon  7  -2    8   5
Forecast Horizon  8  -2    8   5
Forecast Horizon  9  -3    9   6
Forecast Horizon  10 -3    9   6
Forecast Horizon  11 -4    9   7
Forecast Horizon  12 -4    9   7
Forecast Horizon  13 -4   10   7
Forecast Horizon  14 -5   10   7
Forecast Horizon  15 -5   10   8
Forecast Horizon  16 -5   10   8
Forecast Horizon  17 -6   10   8
Forecast Horizon  18 -6   10   8
Forecast Horizon  19 -6   10   8
Forecast Horizon  20 -7   10   8
Forecast Horizon  21 -7   11   9
Forecast Horizon  22 -7   11   9
Forecast Horizon  23 -8   12   9
Forecast Horizon  24 -8   12   9
```

ARIMA Model: Diagnostics

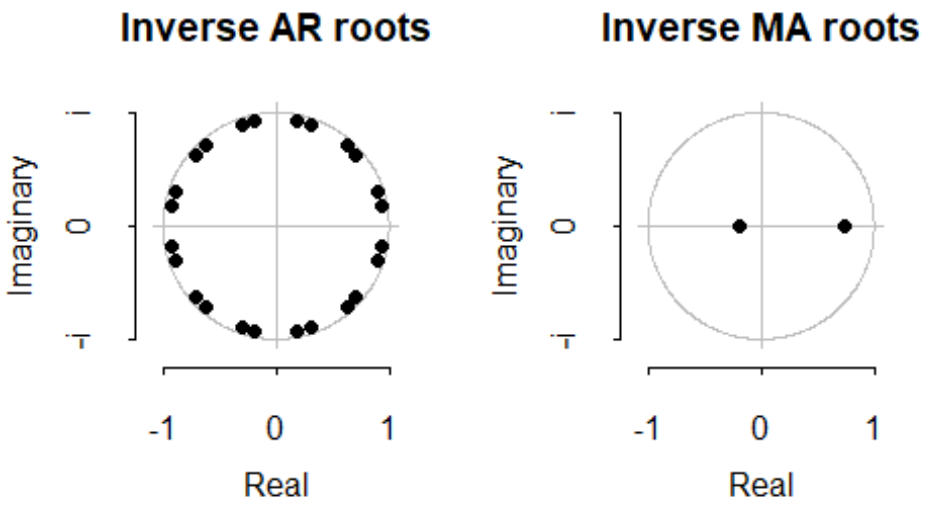
In this section we evaluate the diagnostics of the ARIMA Model. Below we see that the model fails the Ljung-Box Test and therefore we can determine the data is independently distributed. In addition, we see from the graphs that the lagged values are not auto-correlated with one another, and the residuals are normally distributed.

```
Series: x
ARIMA(0,1,2)(2,1,0)[12]

Coefficients:
          ma1      ma2     sar1     sar2
      -0.5312  -0.1461  -0.7304  -0.2622
s.e.   0.0941   0.0932   0.0976   0.1097

sigma^2 estimated as 35.66:  log likelihood=-344.57
AIC=699.15   AICc=699.74   BIC=712.51

Training set error measures:
                     ME     RMSE      MAE        MPE     MAPE      MASE
```

```
Training set -0.5663027 5.532242 3.975449 -0.3420511 2.082338 0.5561509
                     ACF1
Training set -0.01412129
```

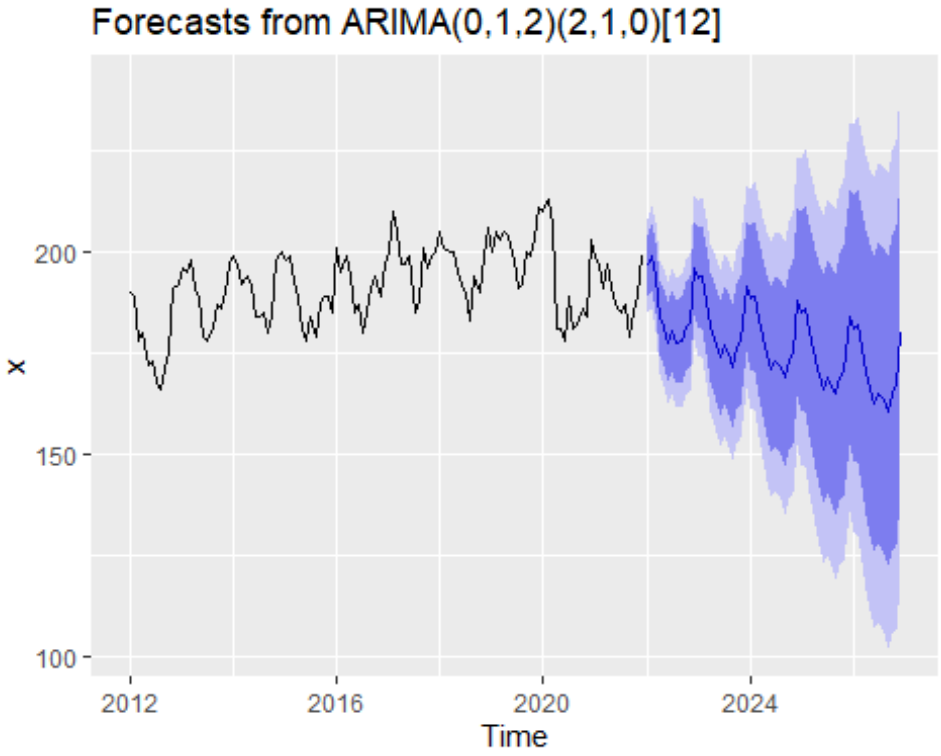



```
 Ljung-Box test

data:  Residuals from ARIMA(0,1,2)(2,1,0)[12]
Q* = 22.143, df = 20, p-value = 0.3328

Model df: 4.   Total lags used: 24
```

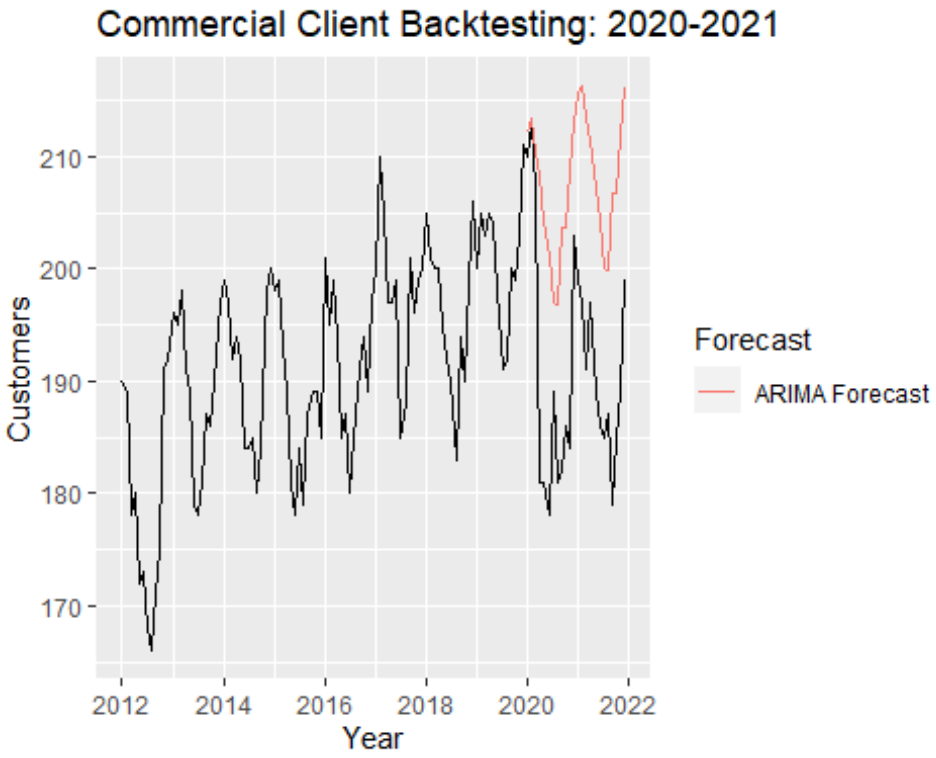


ARIMA Model: 5 Year Forecast

Below we fit & forecast 60 months into the future using an ARIMA (0,1,2)(2,1,0) model. In the graph below we see the 80% and 95% Prediction Intervals bounding our forecast.



Back-Testing



Test Results

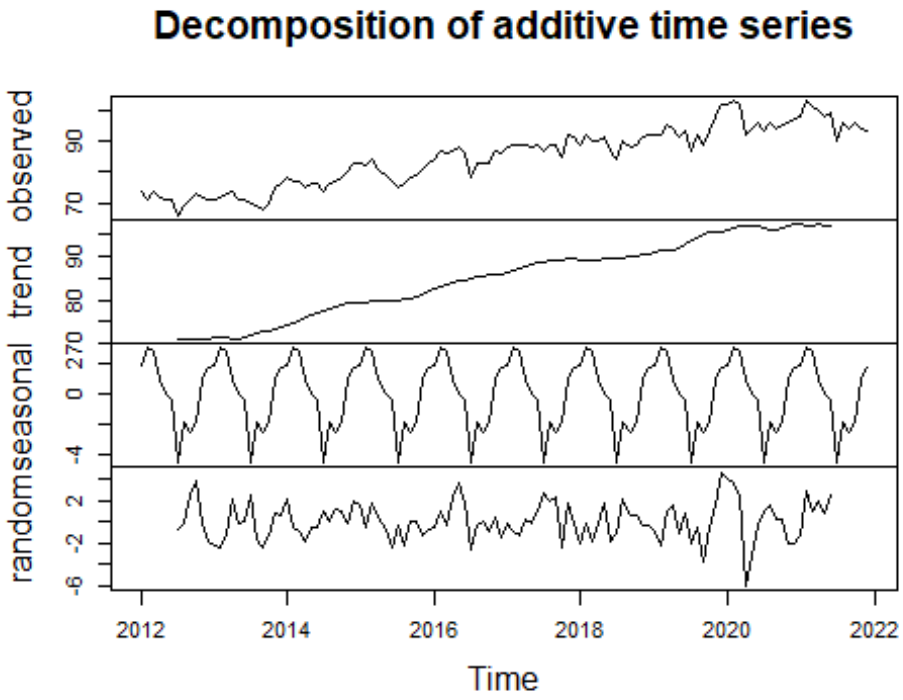
Below we see that the model performs roughly as expected for a "normal" year of 2019, and continues to have a high degree of accuracy in 2020 and 2021.

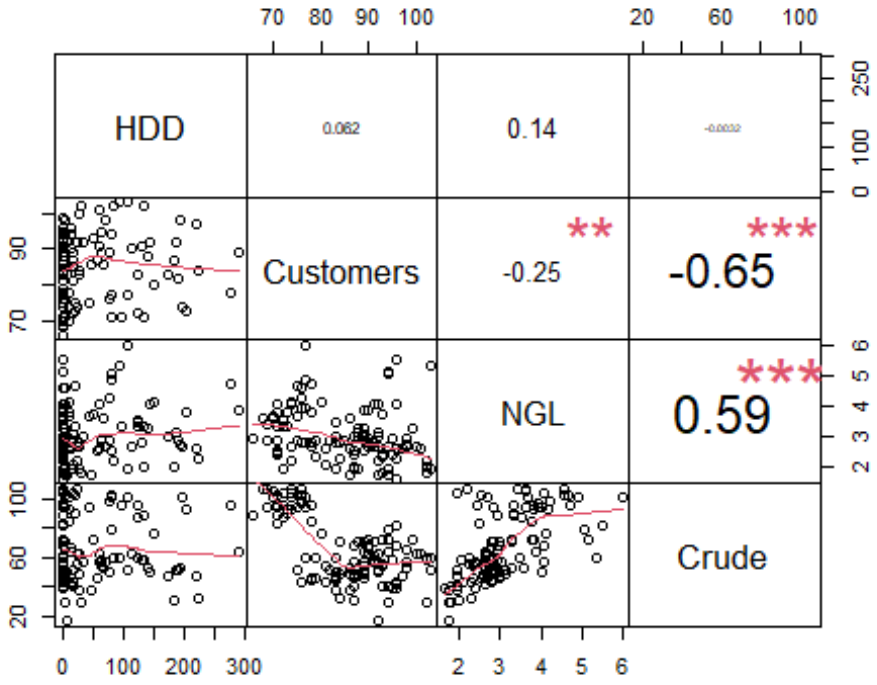
```
[1] "24Month Mean Absolute Error (MAE): 16.84"

[1] "24Month Mean Accuracy: 90.99"

         Actual Forecast Absolute_Error Accuracy
Jan 2020    210      212           2.13     99.0
Feb 2020    213      213           0.32     99.8
Mar 2020    207      210           3.39     98.4
Apr 2020    181      208          27.36     84.9
May 2020    181      204          23.16     87.2
Jun 2020    178      201          23.10     87.0
Jul 2020    189      197           7.96     95.8
Aug 2020    181      197          15.75     91.3
Sep 2020    182      204          21.71     88.1
Oct 2020    186      204          17.61     90.5
Nov 2020    184      209          24.95     86.4
Dec 2020    203      213          10.01     95.1
Jan 2021    199      216          16.62     91.6
Feb 2021    197      216          19.26     90.2
Mar 2021    191      214          22.53     88.2
Apr 2021    197      211          14.42     92.7
May 2021    189      207          18.25     90.3
Jun 2021    186      204          18.18     90.2
Jul 2021    185      200          15.05     91.9
Aug 2021    187      200          12.83     93.1
Sep 2021    179      207          27.80     84.5
```

Oct 2021	185	207	21.69	88.3
Nov 2021	189	212	23.03	87.8
Dec 2021	199	216	17.10	91.4

CFG Firm Transportation Services (FTS-2)

Customer Time-Series Decomposition





ARIMA Model: Expected Accuracy

In this section we evaluate the expected accuracy of a Seasonal ARIMA Model using cross-validation. ARIMA is an acronym for 'Autoregressive Integrated Moving Average' which is a widely using Time-Series forecasting model that utilizes the recent values to predict outward.

Here we evaluate model accuracy by using cross-validation and rolling forecasts throughout the time-series to determine our expected accuracy over a 24 Month period.

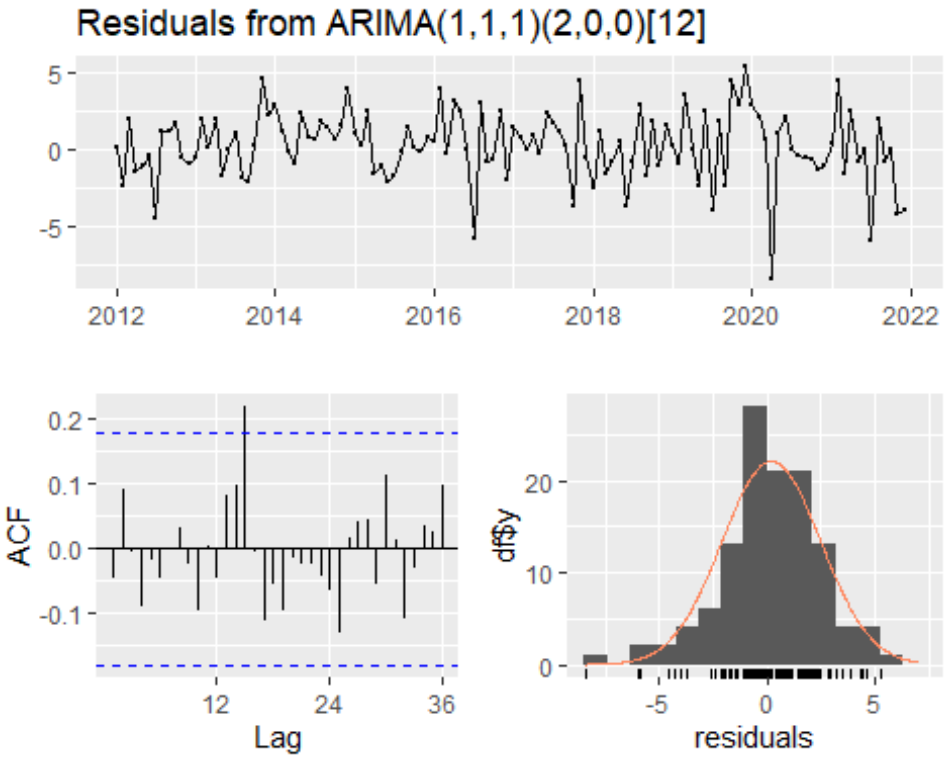
```
                     ME RMSE MAE
Forecast Horizon  1   0    2   2
Forecast Horizon  2   0    3   2
Forecast Horizon  3   0    3   3
Forecast Horizon  4   0    4   3
Forecast Horizon  5   0    4   3
Forecast Horizon  6   0    4   3
Forecast Horizon  7  -1    4   3
Forecast Horizon  8  -1    4   3
Forecast Horizon  9  -1    4   3
Forecast Horizon  10 -1    4   3
Forecast Horizon  11 -1    4   3
Forecast Horizon  12 -1    4   3
Forecast Horizon  13 -1    4   3
Forecast Horizon  14 -1    3   3
Forecast Horizon  15 -1    3   3
Forecast Horizon  16 -1    3   3
Forecast Horizon  17 -1    3   3
Forecast Horizon  18 -1    3   3
Forecast Horizon  19 -1    3   3
Forecast Horizon  20 -1    4   3
Forecast Horizon  21 -2    4   3
Forecast Horizon  22 -2    3   3
Forecast Horizon  23 -2    4   3
Forecast Horizon  24 -2    4   3
```

ARIMA Model: Diagnostics

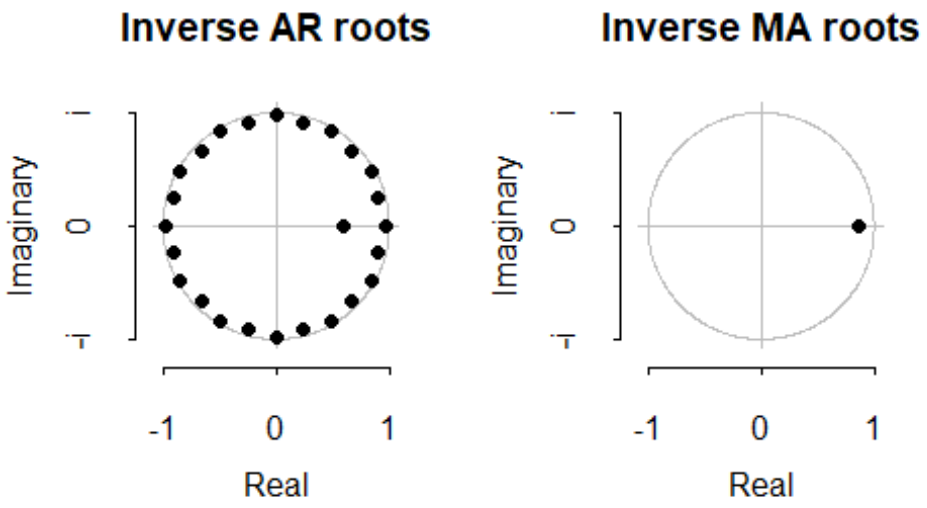
In this section we evaluate the diagnostics of the ARIMA Model. Below we see that the model fails the Ljung-Box Test and therefore we can determine the data is independently distributed. In addition, we see from the graphs that the lagged values are not auto-correlated with one another, and the residuals are normally distributed.

```
Series: x
ARIMA(1,1,1)(2,0,0)[12]

Coefficients:
         ar1      ma1    sar1    sar2
      0.5954  -0.8705  0.2882  0.3367
s.e.  0.1236   0.0741  0.0912  0.0980

sigma^2 estimated as 5.481:  log likelihood=-270.87
AIC=551.74   AICc=552.27   BIC=565.63

Training set error measures:
                    ME     RMSE      MAE       MPE     MAPE      MASE
```

```
Training set 0.1866313 2.291785 1.736264 0.1824327 2.041302 0.4845389
                     ACF1
Training set -0.04640503
```

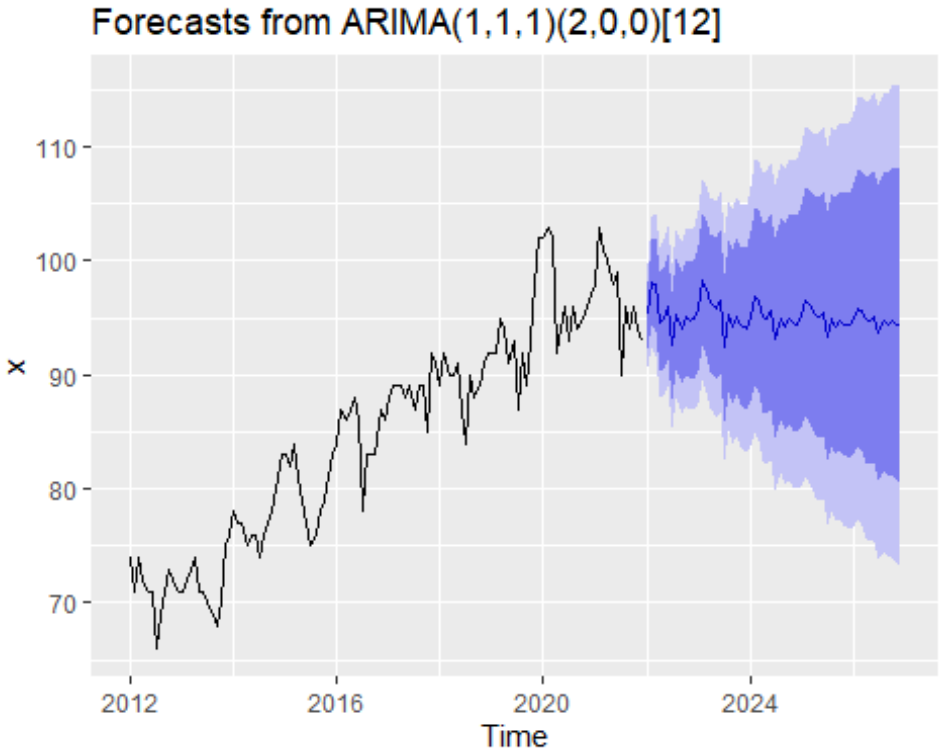



```
 Ljung-Box test

data:  Residuals from ARIMA(1,1,1)(2,0,0)[12]
Q* = 17.899, df = 20, p-value = 0.594

Model df: 4.   Total lags used: 24
```

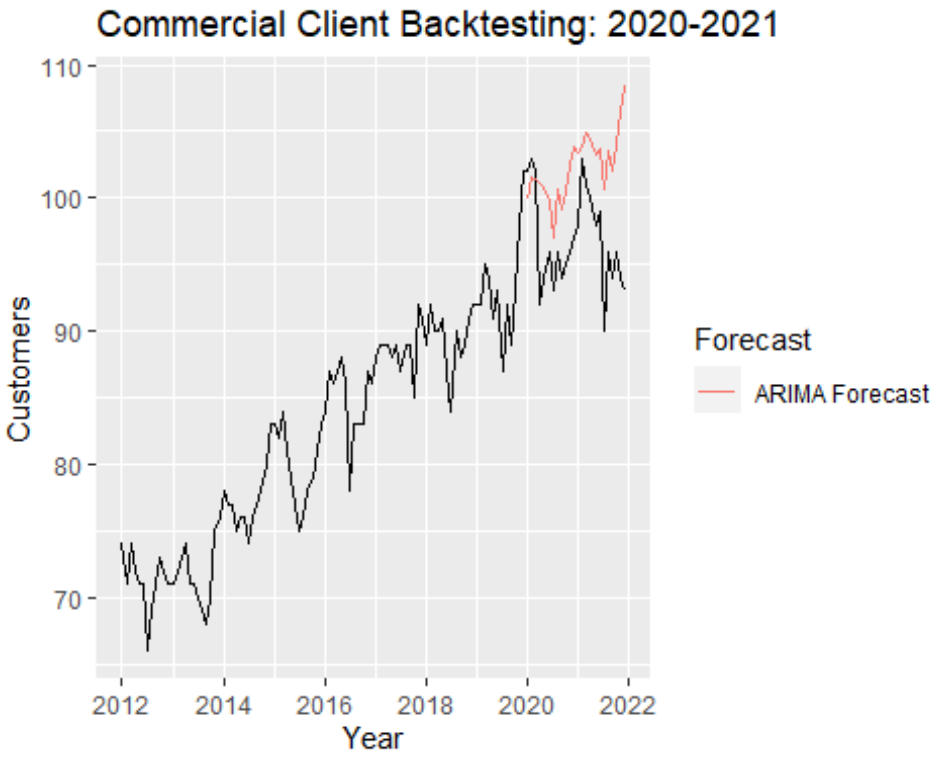


ARIMA Model: 5 Year Forecast

Below we fit & forecast 60 months into the future using an ARIMA (1,1,1)(2,0,0) model. In the graph below we see the 80% and 95% Prediction Intervals bounding our forecast.



Back-Testing



Test Results

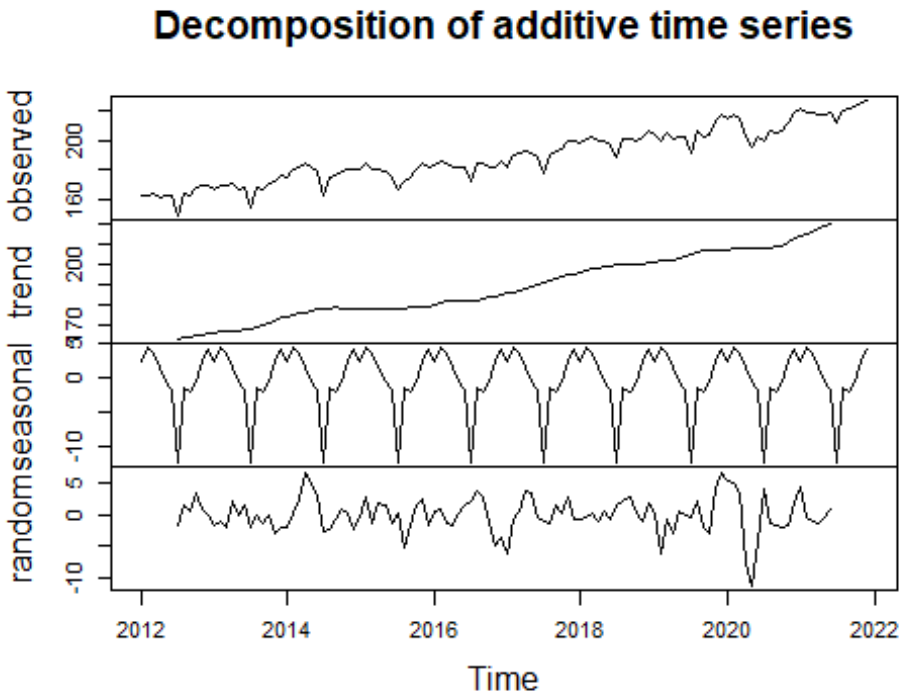
Below we see that the model performs roughly as expected for a "normal" year of 2019, and continues to have a high degree of accuracy in 2020 and 2021.

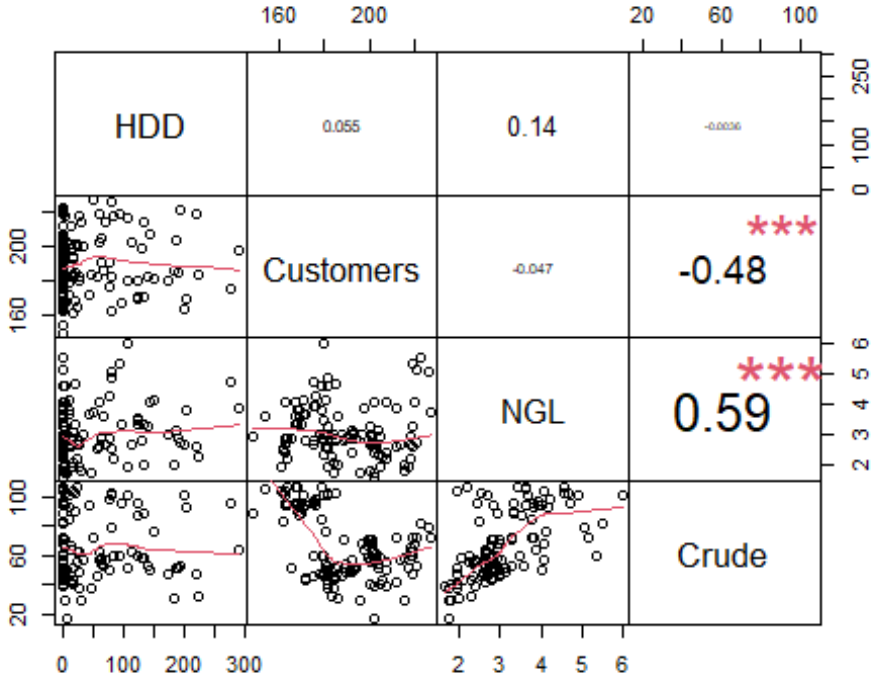
```
[1] "24Month Mean Absolute Error (MAE): 5.96"

[1] "24Month Mean Accuracy: 93.74"

         Actual Forecast Absolute_Error Accuracy
Jan 2020    102      100           2.03     98.0
Feb 2020    103      102           1.46     98.6
Mar 2020    102      101           0.64     99.4
Apr 2020     92      101           9.15     90.1
May 2020     94      101           6.81     92.8
Jun 2020     96      100           3.68     96.2
Jul 2020     93       97           4.01     95.7
Aug 2020     96      101           4.65     95.2
Sep 2020     94       99           5.11     94.6
Oct 2020     95      100           5.49     94.2
Nov 2020     96      103           6.52     93.2
Dec 2020     97      104           6.90     92.9
Jan 2021     98      103           5.40     94.5
Feb 2021    103      104           0.79     99.2
Mar 2021    101      105           3.96     96.1
Apr 2021    100      105           4.50     95.5
May 2021     98      103           5.20     94.7
Jun 2021     99      104           4.74     95.2
Jul 2021     90      101          10.66     88.2
Aug 2021     96      104           7.57     92.1
Sep 2021     94      102           7.98     91.5
```

Oct 2021	96	104	7.94	91.7
Nov 2021	94	106	12.46	86.7
Dec 2021	93	108	15.41	83.4

CFG Firm Transportation Services 2.1 (FTS-2.1)

Customer Time-Series Decomposition





ARIMA Model: Expected Accuracy

In this section we evaluate the expected accuracy of a Seasonal ARIMA Model using cross-validation. ARIMA is an acronym for 'Autoregressive Integrated Moving Average' which is a widely using Time-Series forecasting model that utilizes the recent values to predict outward.

Here we evaluate model accuracy by using cross-validation and rolling forecasts throughout the time-series to determine our expected accuracy over a 24 Month period.

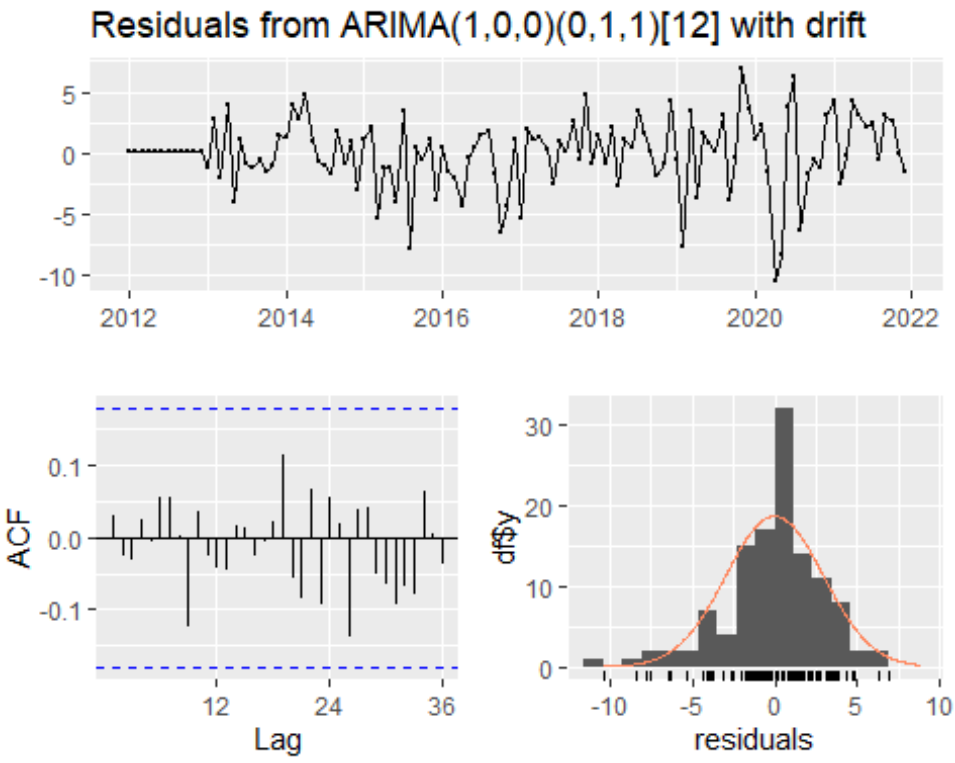
```
                     ME RMSE MAE
Forecast Horizon  1   1    3   2
Forecast Horizon  2   1    4   3
Forecast Horizon  3   2    5   4
Forecast Horizon  4   2    5   4
Forecast Horizon  5   1    6   5
Forecast Horizon  6   1    6   5
Forecast Horizon  7   1    6   5
Forecast Horizon  8   1    6   6
Forecast Horizon  9   1    7   6
Forecast Horizon  10  1    7   6
Forecast Horizon  11  1    7   6
Forecast Horizon  12  0    6   5
Forecast Horizon  13  1    6   5
Forecast Horizon  14  1    7   6
Forecast Horizon  15  1    7   6
Forecast Horizon  16  1    8   5
Forecast Horizon  17  1    8   6
Forecast Horizon  18  1    8   6
Forecast Horizon  19  1    8   6
Forecast Horizon  20  1    8   6
Forecast Horizon  21  1    8   6
Forecast Horizon  22  1    8   6
Forecast Horizon  23  1    8   7
Forecast Horizon  24  1    8   6
```

ARIMA Model: Diagnostics

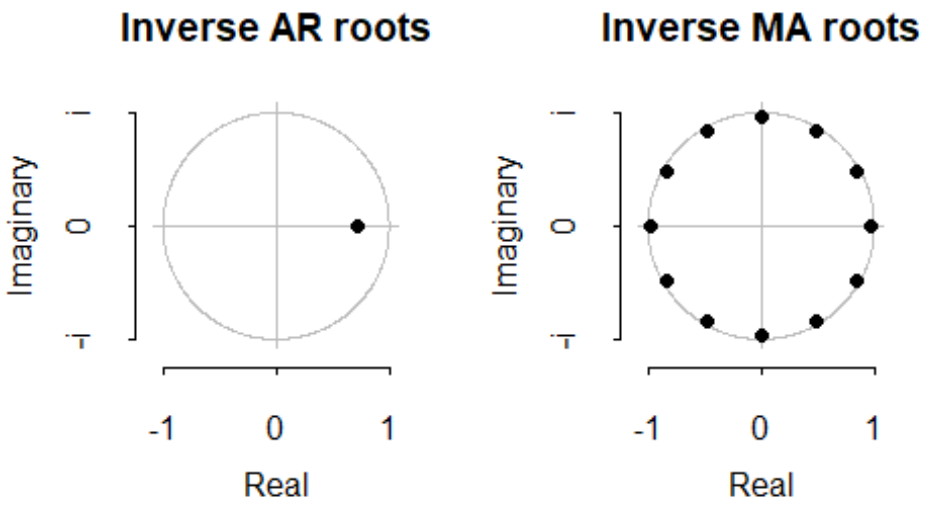
In this section we evaluate the diagnostics of the ARIMA Model. Below we see that the model fails the Ljung-Box Test and therefore we can determine the data is independently distributed. In addition, we see from the graphs that the lagged values are not auto-correlated with one another, and the residuals are normally distributed.

```
Series: x
ARIMA(1,0,0)(0,1,1)[12] with drift

Coefficients:
         ar1     sma1   drift
      0.7114  -0.6852  0.5050
s.e.  0.0671   0.0977  0.0353

sigma^2 estimated as 9.806:  log likelihood=-279.13
AIC=566.26   AICc=566.65   BIC=576.99

Training set error measures:
                     ME     RMSE      MAE         MPE     MAPE      MASE
```

```
Training set -0.02500651 2.929146 2.142987 -0.03690567 1.116374 0.3098294
                     ACF1
Training set 0.03029662
```

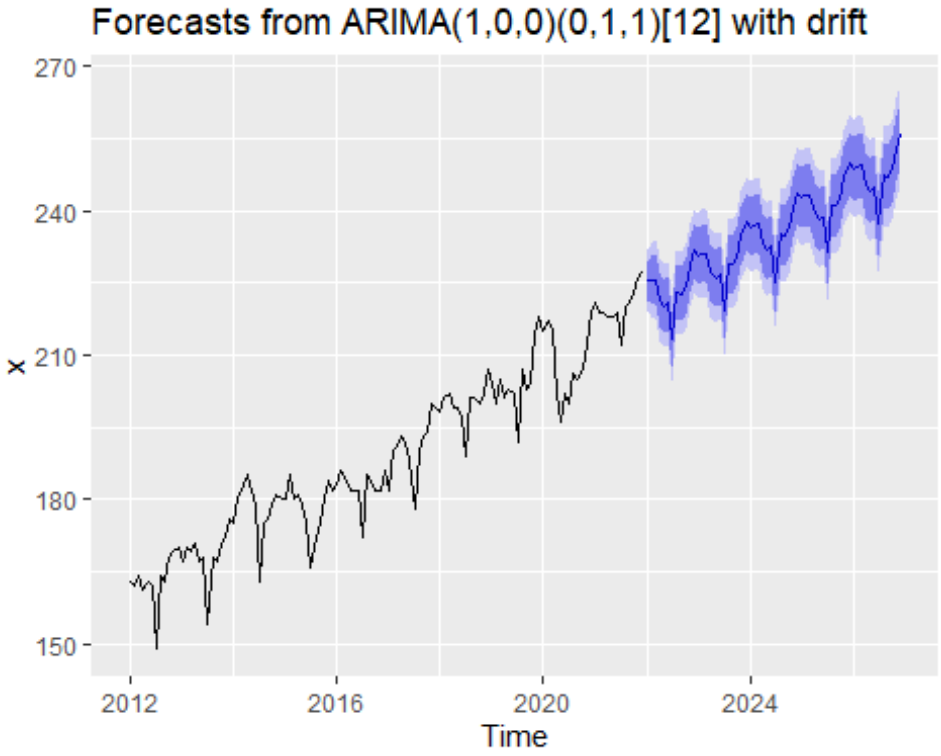



```
 Ljung-Box test

data:  Residuals from ARIMA(1,0,0)(0,1,1)[12] with drift
Q* = 10.142, df = 21, p-value = 0.977

Model df: 3.   Total lags used: 24
```

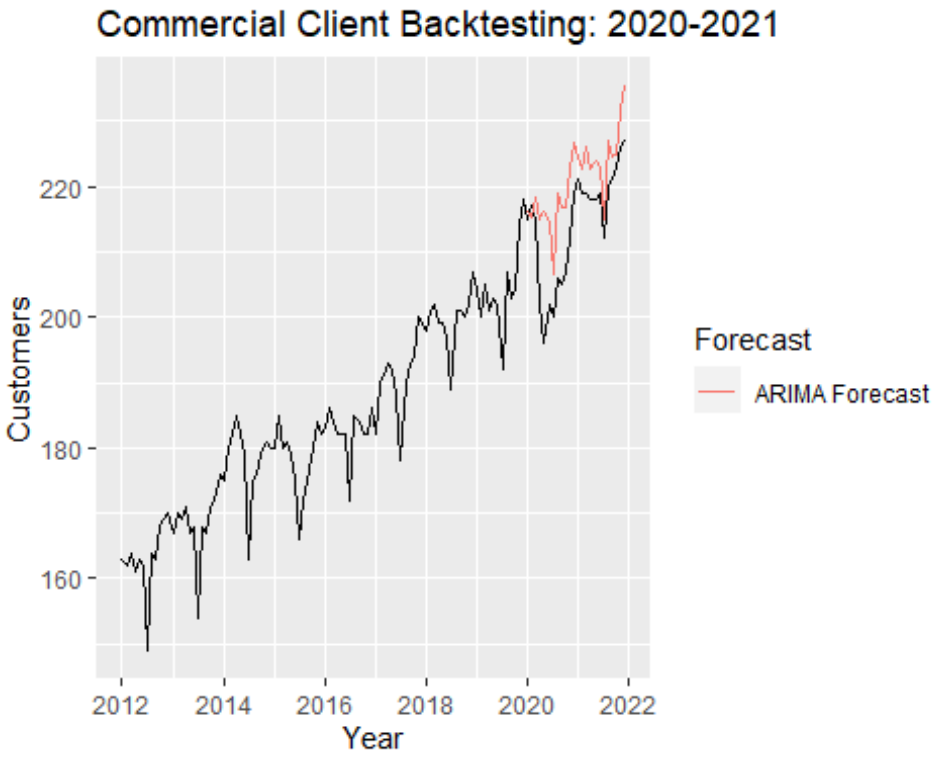


ARIMA Model: 5 Year Forecast

Below we fit & forecast 60 months into the future using an ARIMA (1,0,0)(0,1,1) model. In the graph below we see the 80% and 95% Prediction Intervals bounding our forecast.



Back-Testing



Test Results

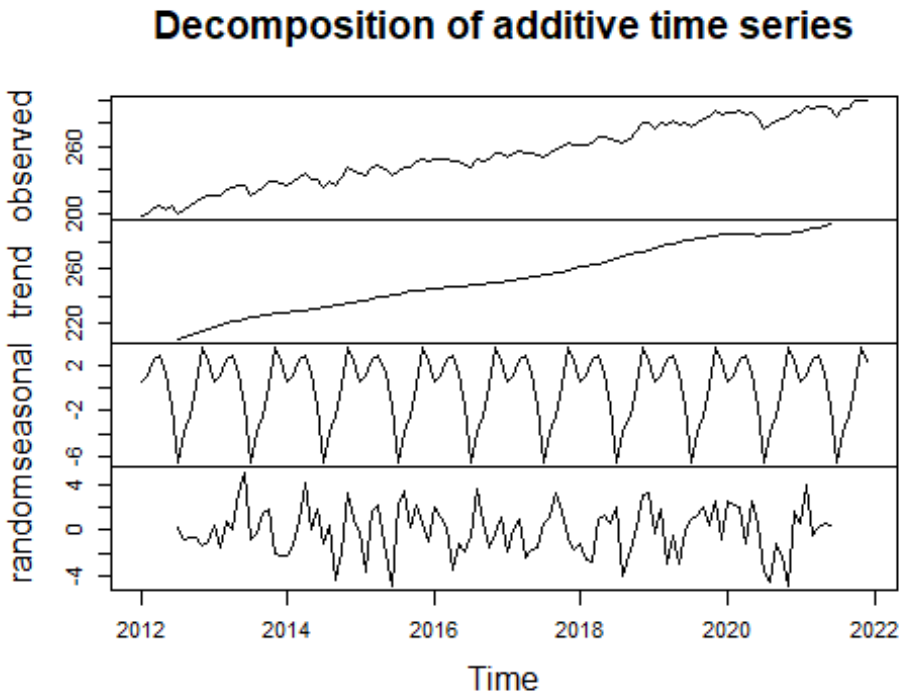
Below we see that the model performs roughly as expected for a "normal" year of 2019, and continues to have a high degree of accuracy in 2020 and 2021.

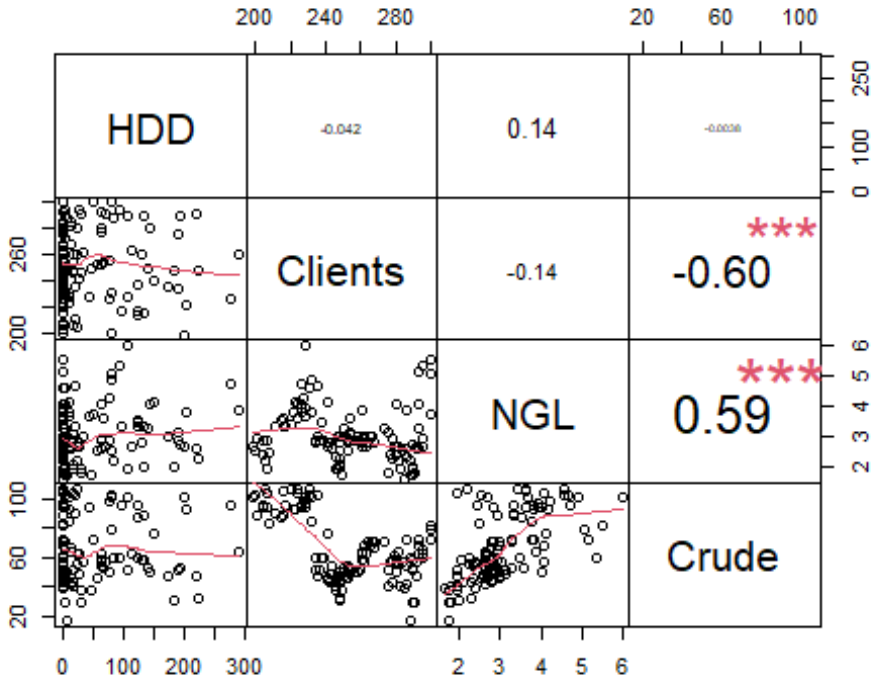
```
[1] "24Month Mean Absolute Error (MAE): 7.07"

[1] "24Month Mean Accuracy: 96.63"

         Actual Forecast Absolute_Error Accuracy
Jan 2020    215      216           1.12     99.5
Feb 2020    217      215           1.64     99.2
Mar 2020    215      218           3.23     98.5
Apr 2020    202      215          13.05     93.5
May 2020    196      216          20.03     89.8
Jun 2020    202      215          12.73     93.7
Jul 2020    200      207           6.58     96.7
Aug 2020    206      219          12.81     93.8
Sep 2020    205      217          11.84     94.2
Oct 2020    207      217           9.93     95.2
Nov 2020    212      223          10.66     95.0
Dec 2020    219      227           7.64     96.5
Jan 2021    221      225           3.51     98.4
Feb 2021    219      223           3.52     98.4
Mar 2021    219      226           6.95     96.8
Apr 2021    218      223           4.77     97.8
May 2021    218      224           6.06     97.2
Jun 2021    219      223           4.02     98.2
Jul 2021    212      215           2.97     98.6
Aug 2021    220      227           7.04     96.8
Sep 2021    221      224           3.46     98.4
```

Oct 2021	223	225	1.90	99.1
Nov 2021	226	232	5.76	97.5
Dec 2021	227	235	8.34	96.3

CFG Firm Transportation Services 3 (FTS-3)

Customer Time-Series Decomposition





ARIMA Model: Expected Accuracy

In this section we evaluate the expected accuracy of a Seasonal ARIMA Model using cross-validation. ARIMA is an acronym for 'Autoregressive Integrated Moving Average' which is a widely using Time-Series forecasting model that utilizes the recent values to predict outward.

Here we evaluate model accuracy by using cross-validation and rolling forecasts throughout the time-series to determine our expected accuracy over a 24 Month period.

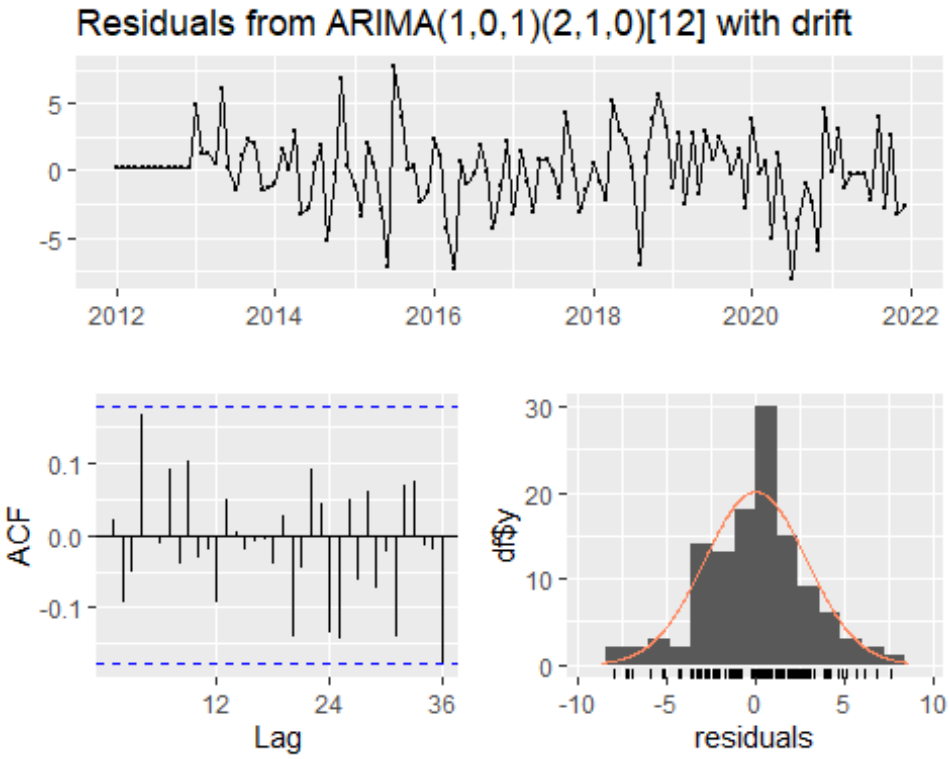
```
                     ME RMSE MAE
Forecast Horizon  1   1    3   3
Forecast Horizon  2   2    4   2
Forecast Horizon  3   2    4   3
Forecast Horizon  4   2    4   3
Forecast Horizon  5   2    4   3
Forecast Horizon  6   2    5   4
Forecast Horizon  7   2    5   4
Forecast Horizon  8   2    6   5
Forecast Horizon  9   2    6   5
Forecast Horizon  10  2    7   6
Forecast Horizon  11  1    8   6
Forecast Horizon  12  1    8   7
Forecast Horizon  13  2    9   8
Forecast Horizon  14  2    9   8
Forecast Horizon  15  2    9   9
Forecast Horizon  16  2   10   9
Forecast Horizon  17  2   10   9
Forecast Horizon  18  2   10   9
Forecast Horizon  19  2   10   9
Forecast Horizon  20  1   10   9
Forecast Horizon  21  1   10   9
Forecast Horizon  22  1   10   9
Forecast Horizon  23  1   10   9
Forecast Horizon  24  1   10   9
```

ARIMA Model: Diagnostics

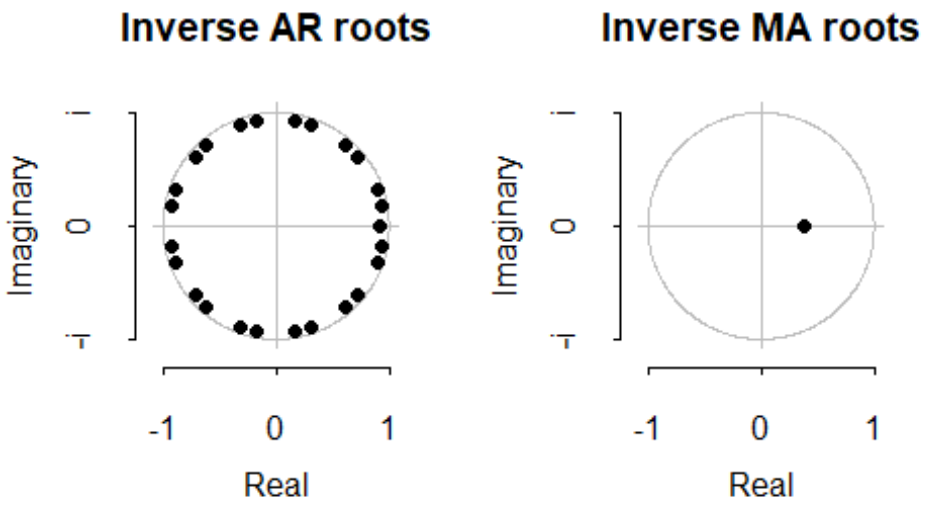
In this section we evaluate the diagnostics of the ARIMA Model. Below we see that the model fails the Ljung-Box Test and therefore we can determine the data is independently distributed. In addition, we see from the graphs that the lagged values are not auto-correlated with one another, and the residuals are normally distributed.

```
Series: x
ARIMA(1,0,1)(2,1,0)[12] with drift

Coefficients:
         ar1      ma1     sar1     sar2   drift
      0.9156  -0.3765  -0.5894  -0.2462  0.8140
s.e.  0.0534   0.1190   0.0944   0.1056  0.0951

sigma^2 estimated as 9.539:  log likelihood=-275.07
AIC=562.15   AICc=562.98   BIC=578.24

Training set error measures:
                     ME     RMSE      MAE           MPE      MAPE      MASE
```

```
Training set -0.01527597 2.861378 2.119481 -3.072475e-05 0.8255929 0.2119481
                     ACF1
Training set 0.02237732
```

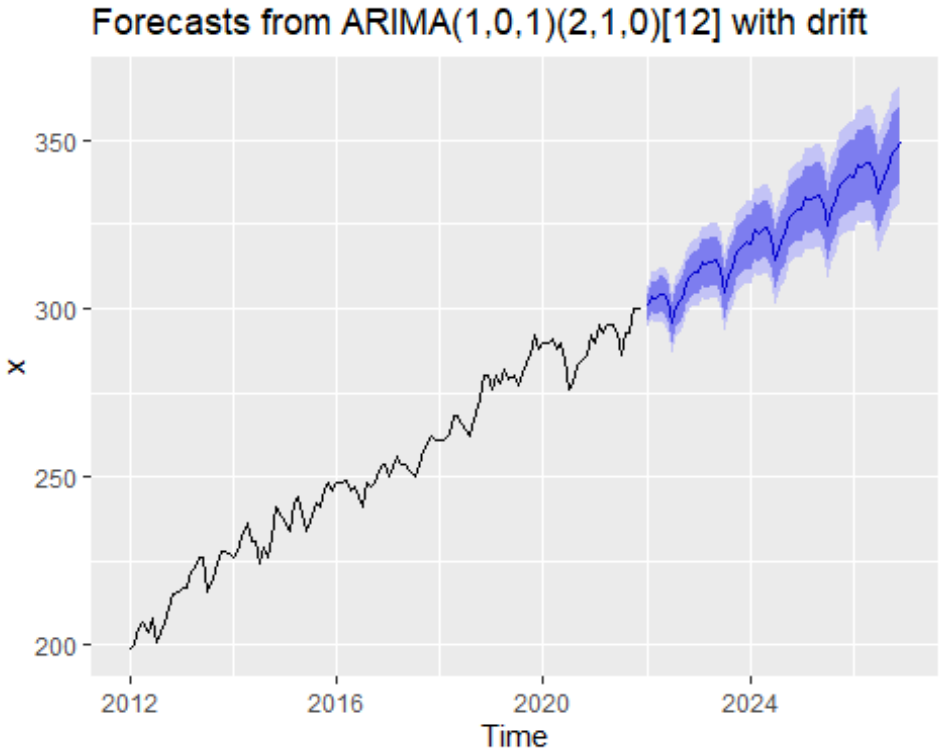



```
 Ljung-Box test

data:  Residuals from ARIMA(1,0,1)(2,1,0)[12] with drift
Q* = 17.588, df = 19, p-value = 0.5501

Model df: 5.   Total lags used: 24
```

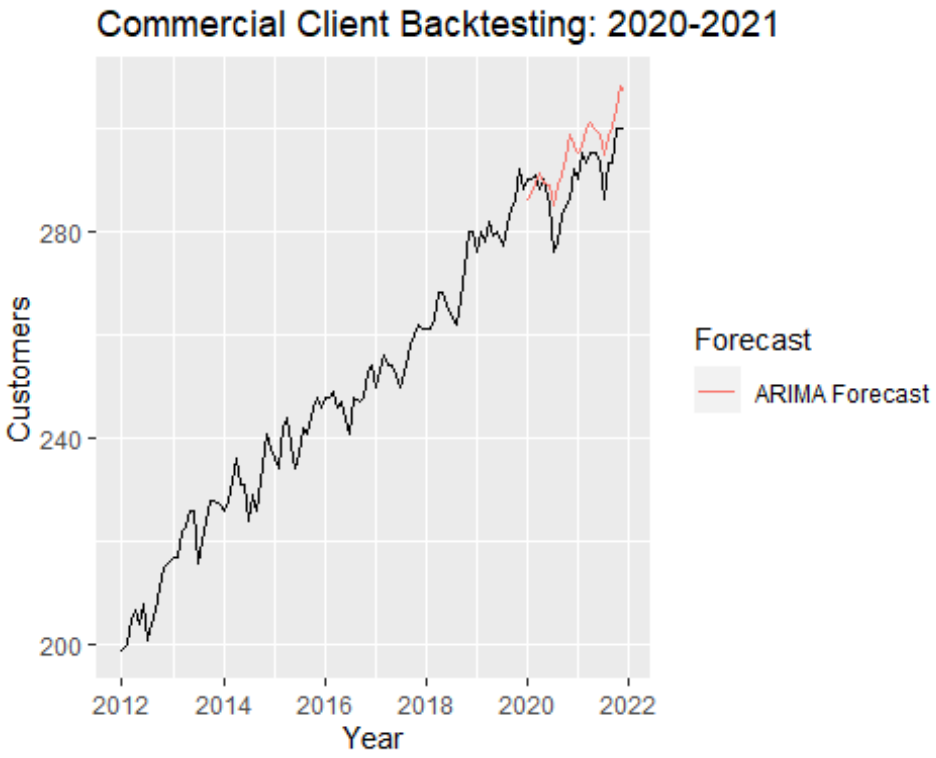


ARIMA Model: 5 Year Forecast

Below we fit & forecast 60 months into the future using an ARIMA (1,0,1)(2,1,0) model. In the graph below we see the 80% and 95% Prediction Intervals bounding our forecast.



Back-Testing



Test Results

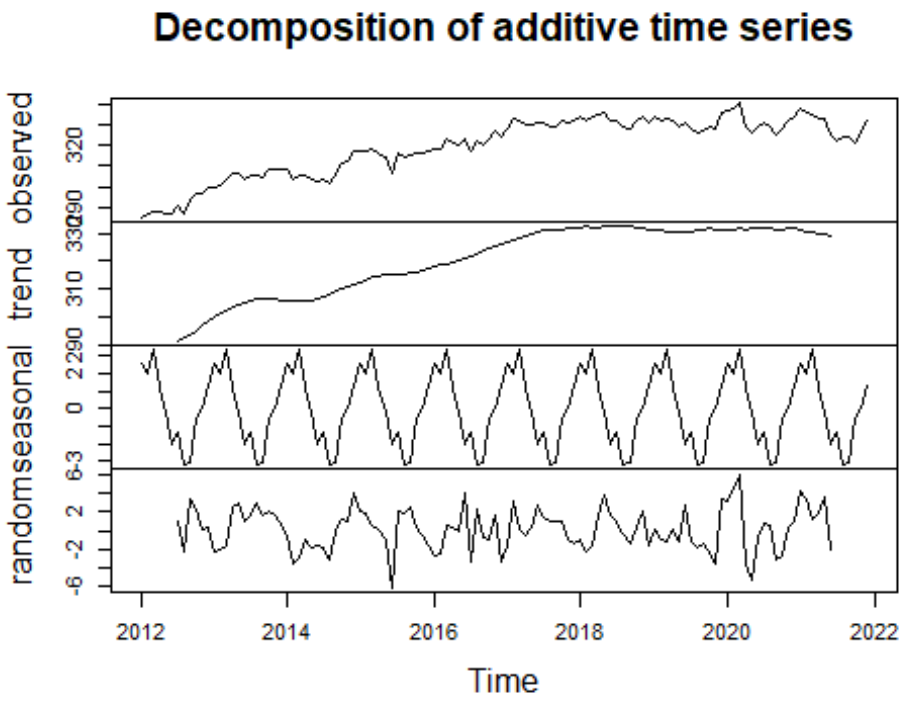
Below we see that the model performs roughly as expected for a "normal" year of 2019, and continues to have a high degree of accuracy in 2020 and 2021.

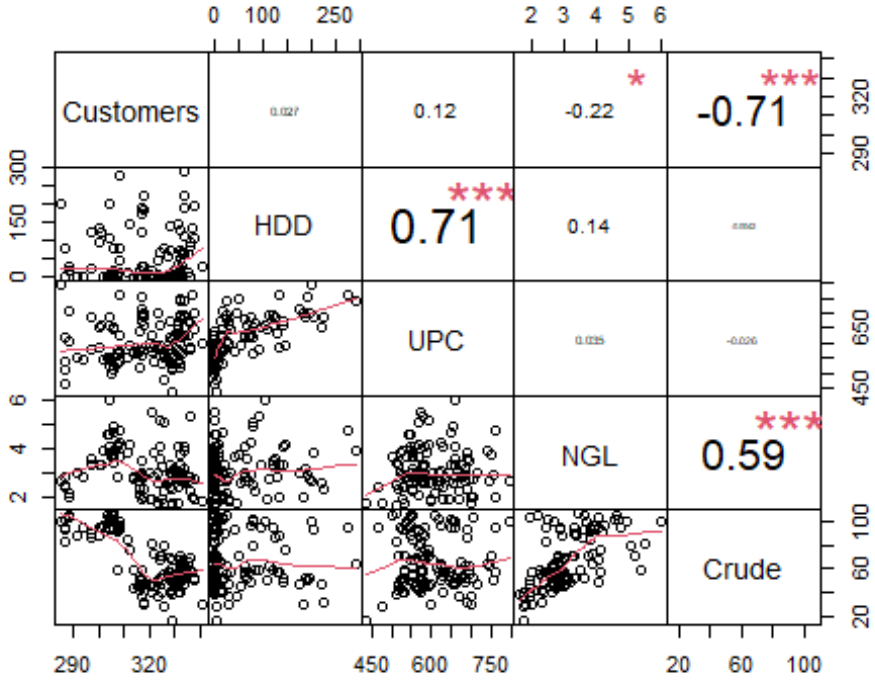
```
[1] "24Month Mean Absolute Error (MAE): 5.76"

[1] "24Month Mean Accuracy: 98.01"

         Actual Forecast Absolute_Error Accuracy
Jan 2020    290      286           4.17     98.6
Feb 2020    290      287           2.80     99.0
Mar 2020    291      289           1.63     99.4
Apr 2020    288      291           3.26     98.9
May 2020    290      289           0.68     99.8
Jun 2020    285      289           3.83     98.7
Jul 2020    276      285           8.98     96.7
Aug 2020    278      289          10.83     96.1
Sep 2020    283      291           7.69     97.3
Oct 2020    285      294           8.99     96.8
Nov 2020    286      299          12.51     95.6
Dec 2020    292      297           4.73     98.4
Jan 2021    290      295           5.21     98.2
Feb 2021    295      296           1.24     99.6
Mar 2021    293      299           6.32     97.8
Apr 2021    295      301           5.96     98.0
May 2021    295      299           4.33     98.5
Jun 2021    293      299           5.58     98.1
Jul 2021    286      295           8.64     97.0
Aug 2021    293      298           5.37     98.2
Sep 2021    293      300           7.10     97.6
```

Oct 2021	300	304	3.70	98.8
Nov 2021	300	308	8.01	97.3
Dec 2021	300	307	6.68	97.8

CFG Firm Transportation Services 3.1 (FTS-3.1)

Customer Time-Series Decomposition





ARIMA Model: Expected Accuracy

In this section we evaluate the expected accuracy of a Seasonal ARIMA Model using cross-validation. ARIMA is an acronym for 'Autoregressive Integrated Moving Average' which is a widely using Time-Series forecasting model that utilizes the recent values to predict outward.

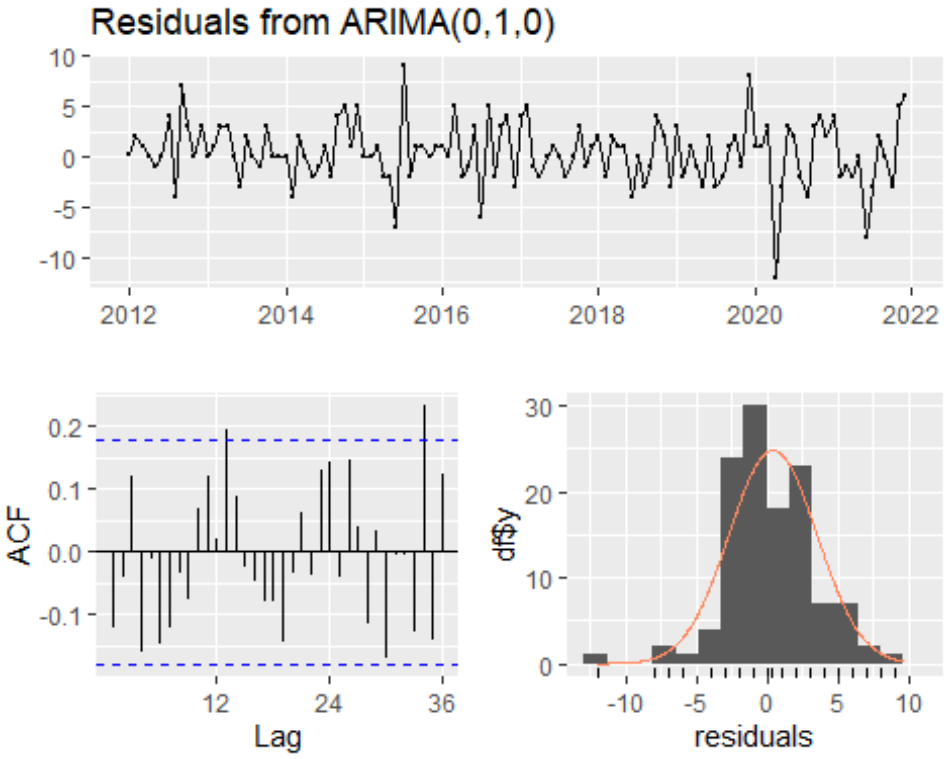
Here we evaluate model accuracy by using cross-validation and rolling forecasts throughout the time-series to determine our expected accuracy over a 24 Month period.

		ME	RMSE	MAE
Forecast Horizon	1	0	3	2
Forecast Horizon	2	0	4	3
Forecast Horizon	3	0	4	4
Forecast Horizon	4	-1	5	4
Forecast Horizon	5	-1	6	5
Forecast Horizon	6	-2	6	5
Forecast Horizon	7	-2	6	5
Forecast Horizon	8	-3	5	4
Forecast Horizon	9	-3	5	4
Forecast Horizon	10	-4	6	5
Forecast Horizon	11	-4	6	5
Forecast Horizon	12	-5	6	5
Forecast Horizon	13	-5	7	6
Forecast Horizon	14	-5	8	7
Forecast Horizon	15	-6	9	8
Forecast Horizon	16	-6	10	9
Forecast Horizon	17	-6	11	10
Forecast Horizon	18	-7	11	10
Forecast Horizon	19	-8	11	10
Forecast Horizon	20	-9	11	9
Forecast Horizon	21	-9	11	9
Forecast Horizon	22	-10	11	10
Forecast Horizon	23	-10	12	10
Forecast Horizon	24	-11	13	11

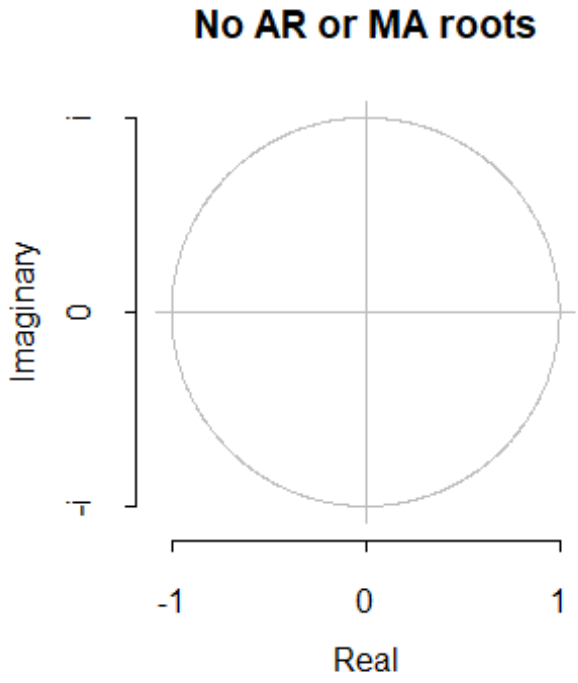
ARIMA Model: Diagnostics

In this section we evaluate the diagnostics of the ARIMA Model. Below we see that the model fails the Ljung-Box Test and therefore we can determine the data is independently distributed. In addition, we see from the graphs that the lagged values are not auto-correlated with one another, and the residuals are normally distributed.

```
Series: x
ARIMA(0,1,0)

sigma^2 estimated as 9.824:  log likelihood=-304.8
AIC=611.6   AICc=611.63   BIC=614.38

Training set error measures:
                     ME     RMSE      MAE       MPE      MAPE      MASE
Training set 0.3940417 3.121273 2.327375 0.1232868 0.7268457 0.3825822
                    ACF1
Training set -0.1205972
```

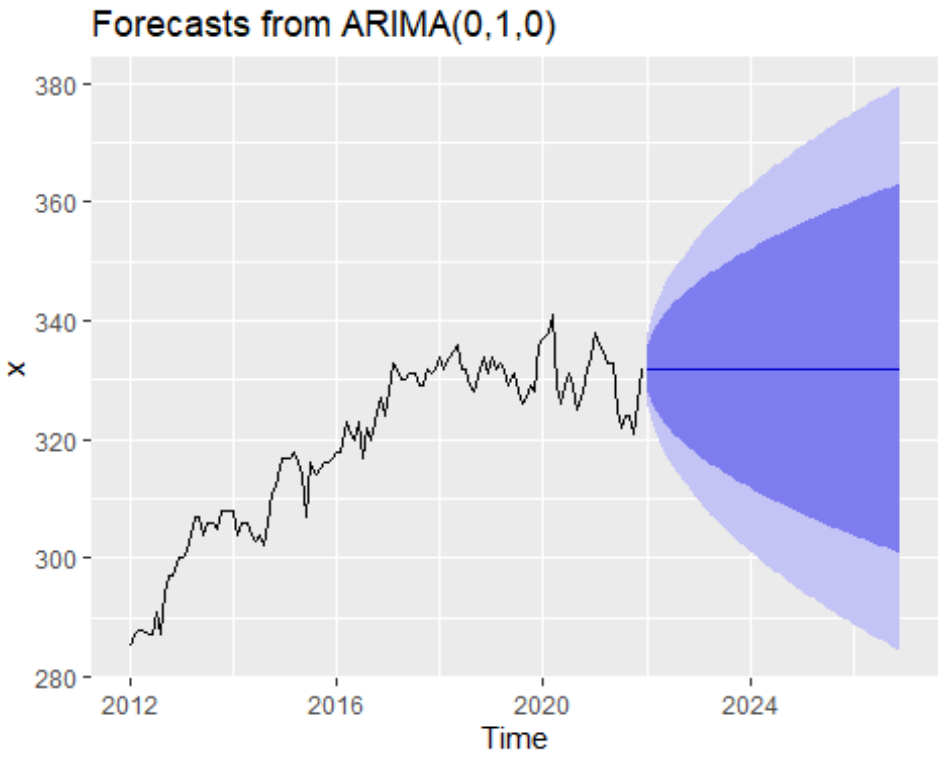



```
 Ljung-Box test

data:  Residuals from ARIMA(0,1,0)
Q* = 33.497, df = 24, p-value = 0.09401

Model df: 0.   Total lags used: 24

Warning in plot.Arima(arima_fit): No roots to plot
```

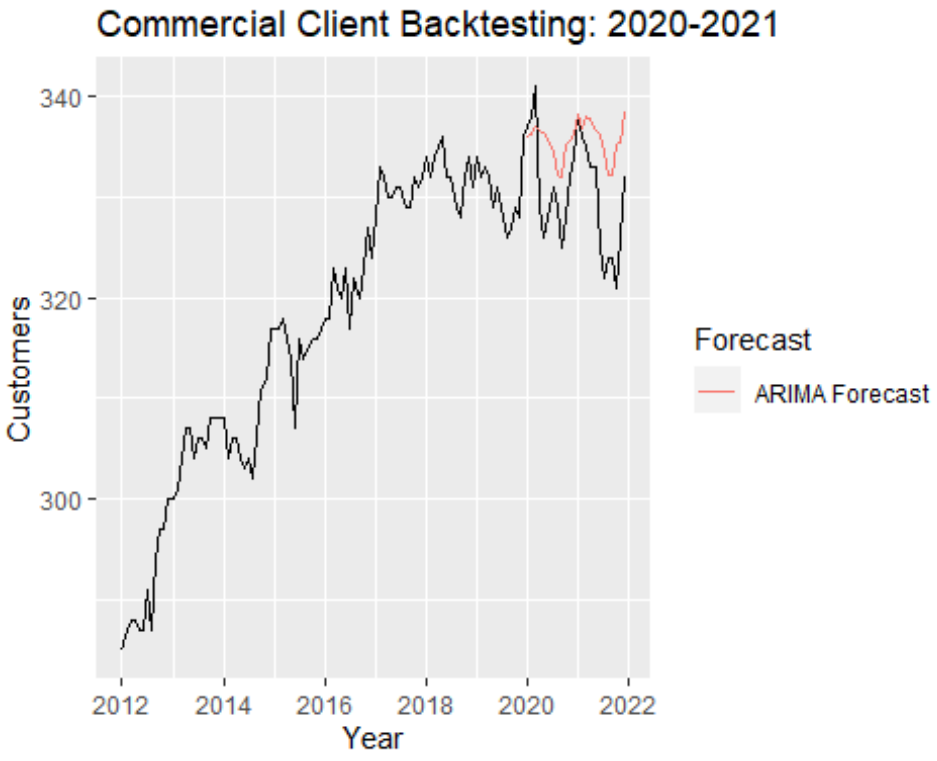


ARIMA Model: 5 Year Forecast

Below we fit & forecast 60 months into the future using an ARIMA (0,1,0) model. In the graph below we see the 80% and 95% Prediction Intervals bounding our forecast.



Back-Testing



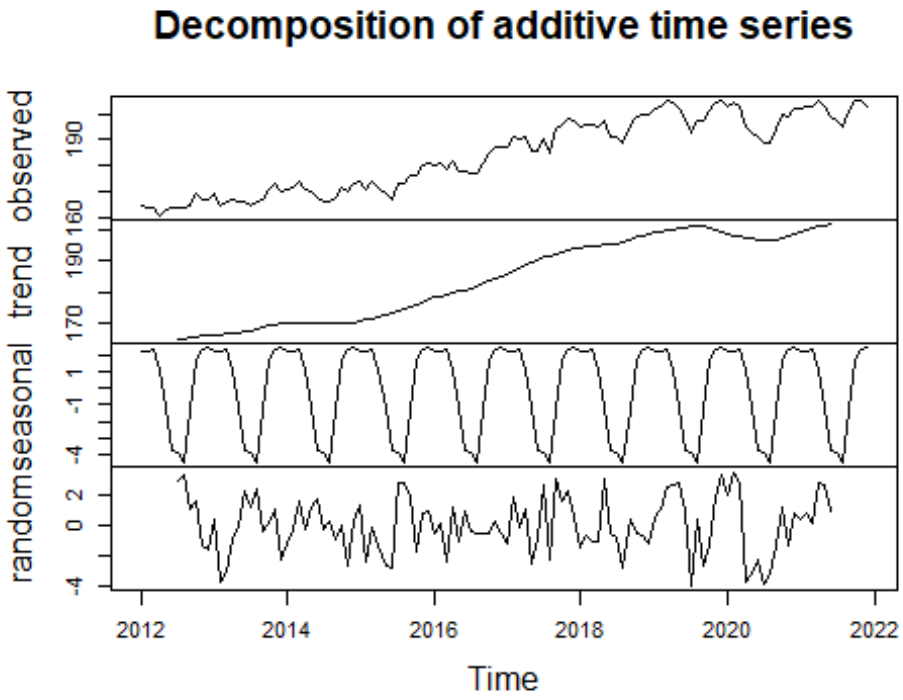
Test Results

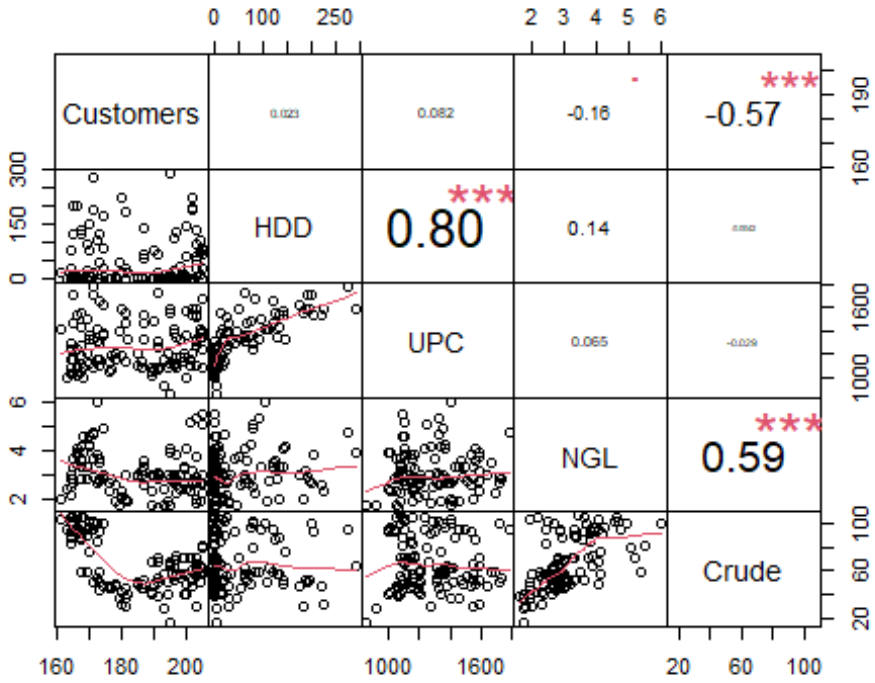
Below we see that the model performs roughly as expected for a “normal” year of 2019, and continues to have a high degree of accuracy in 2020 and 2021.

```
[1] "24Month Mean Absolute Error (MAE): 5.86"

[1] "24Month Mean Accuracy: 98.22"

         Actual Forecast Absolute_Error Accuracy
Jan 2020    337      336           1.03     99.7
Feb 2020    338      336           1.84     99.5
Mar 2020    341      337           4.00     98.8
Apr 2020    329      337           7.62     97.7
May 2020    326      336          10.42     96.8
Jun 2020    329      335           6.31     98.1
Jul 2020    331      335           3.65     98.9
Aug 2020    329      332           3.18     99.0
Sep 2020    325      332           6.94     97.9
Oct 2020    328      335           7.18     97.8
Nov 2020    332      336           3.58     98.9
Dec 2020    334      336           2.27     99.3
Jan 2021    338      338           0.28     99.9
Feb 2021    336      337           0.77     99.8
Mar 2021    335      338           3.05     99.1
Apr 2021    333      338           4.81     98.6
May 2021    333      337           3.68     98.9
Jun 2021    325      336          11.12     96.6
Jul 2021    322      335          12.57     96.1
Aug 2021    324      332           8.16     97.5
Sep 2021    324      332           8.25     97.5
Oct 2021    321      335          14.16     95.6
Nov 2021    326      335           9.40     97.1
Dec 2021    332      338           6.34     98.1
```

CFG Firm Transportation Services 4 (FTS-4)

Customer Time-Series Decomposition





ARIMA Model: Expected Accuracy

In this section we evaluate the expected accuracy of a Seasonal ARIMA Model using cross-validation. ARIMA is an acronym for 'Autoregressive Integrated Moving Average' which is a widely using Time-Series forecasting model that utilizes the recent values to predict outward.

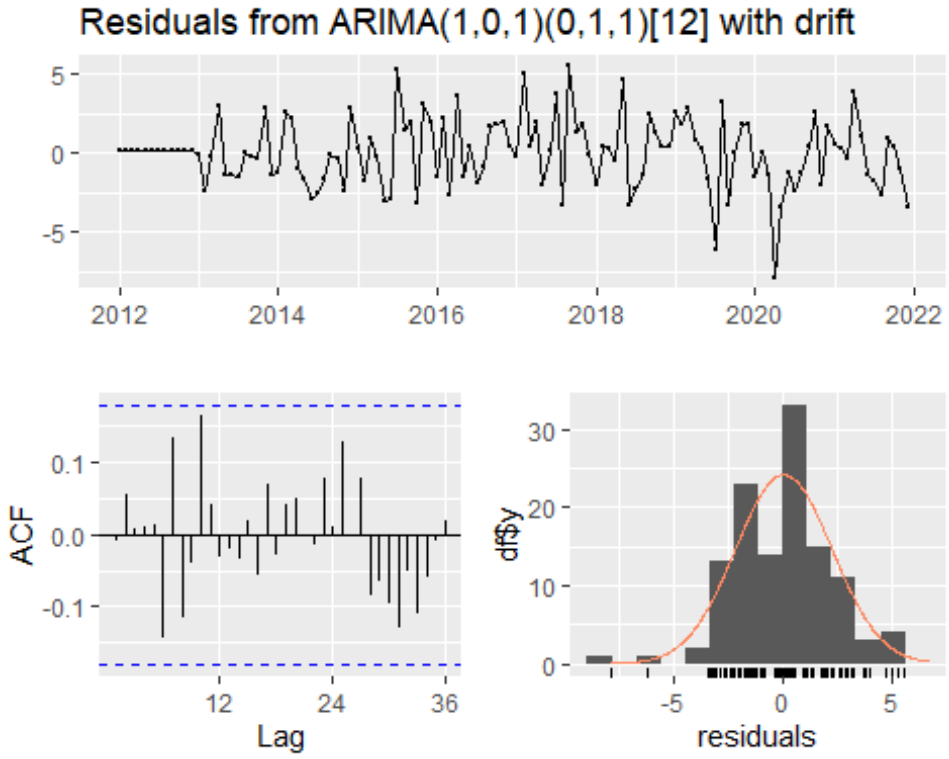
Here we evaluate model accuracy by using cross-validation and rolling forecasts throughout the time-series to determine our expected accuracy over a 24 Month period.

```
                     ME RMSE MAE
Forecast Horizon  1   0    3   2
Forecast Horizon  2  -1    3   2
Forecast Horizon  3  -1    3   3
Forecast Horizon  4  -1    4   3
Forecast Horizon  5  -2    5   4
Forecast Horizon  6  -2    5   4
Forecast Horizon  7  -3    5   4
Forecast Horizon  8  -3    6   5
Forecast Horizon  9  -3    6   5
Forecast Horizon  10 -4    7   5
Forecast Horizon  11 -4    7   5
Forecast Horizon  12 -5    7   6
Forecast Horizon  13 -5    8   6
Forecast Horizon  14 -6    8   6
Forecast Horizon  15 -6    8   7
Forecast Horizon  16 -6    9   7
Forecast Horizon  17 -7    9   7
Forecast Horizon  18 -7    9   7
Forecast Horizon  19 -7    9   7
Forecast Horizon  20 -8    9   8
Forecast Horizon  21 -8   10   9
Forecast Horizon  22 -8   10   9
Forecast Horizon  23 -9   11  10
Forecast Horizon  24 -9   11  10
```

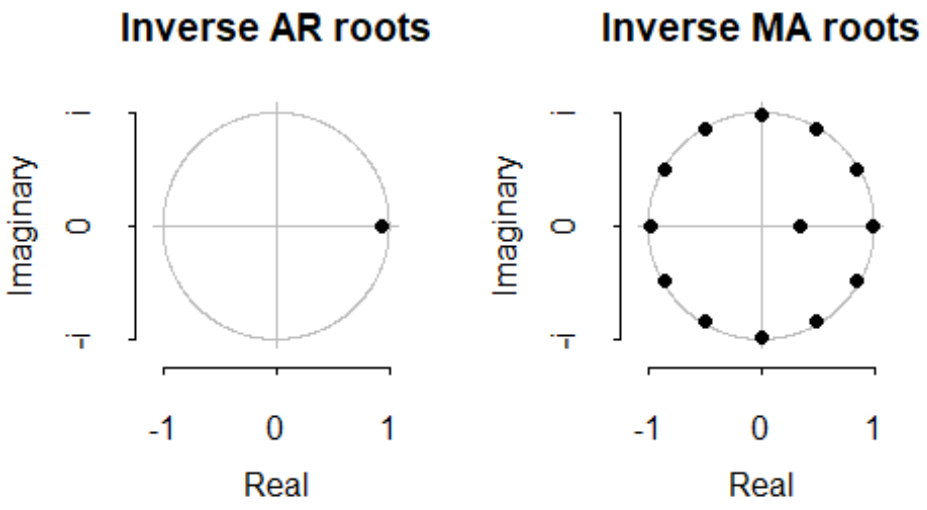
ARIMA Model: Diagnostics

In this section we evaluate the diagnostics of the ARIMA Model. Below we see that the model fails the Ljung-Box Test and therefore we can determine the data is independently distributed. In addition, we see from the graphs that the lagged values are not auto-correlated with one another, and the residuals are normally distributed.

```
Series: x
ARIMA(1,0,1)(0,1,1)[12] with drift

Coefficients:
         ar1      ma1     sma1   drift
      0.9423  -0.3365  -0.7736  0.3495
s.e.  0.0388   0.0996   0.1133  0.0650

sigma^2 estimated as 5.605:  log likelihood=-250
AIC=509.99   AICc=510.58   BIC=523.4

Training set error measures:
                     ME     RMSE      MAE          MPE     MAPE      MASE
Training set 0.01367694 2.204091 1.668164 -0.003418302 0.898286 0.3205725
                     ACF1
Training set -0.008318769
```

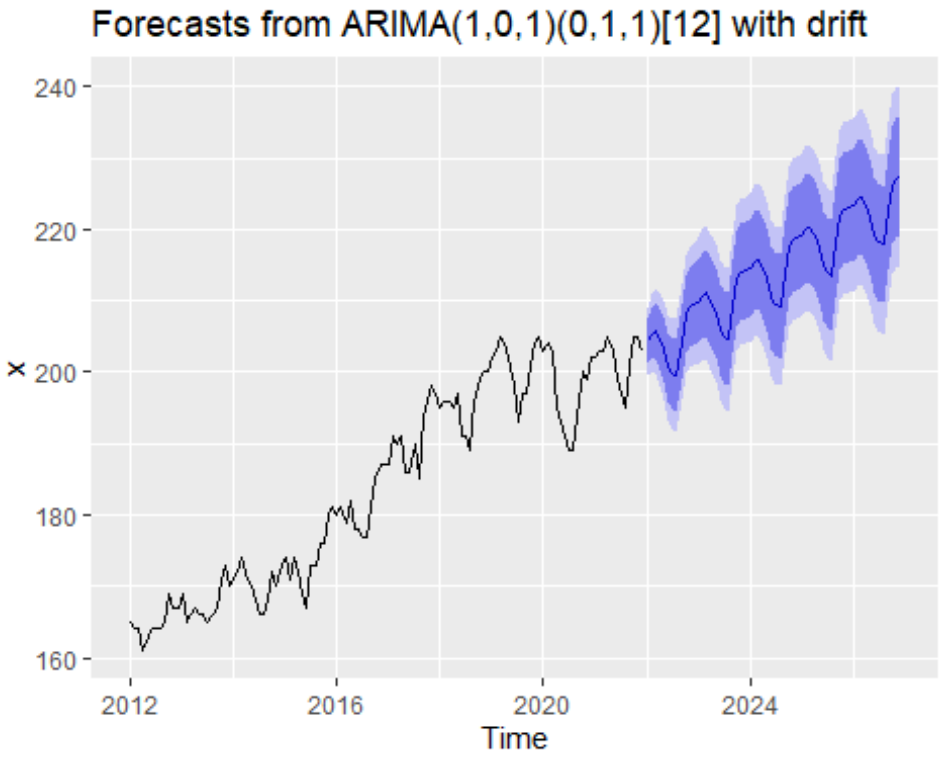



```
 Ljung-Box test

data:  Residuals from ARIMA(1,0,1)(0,1,1)[12] with drift
Q* = 14.616, df = 20, p-value = 0.7979

Model df: 4.   Total lags used: 24
```

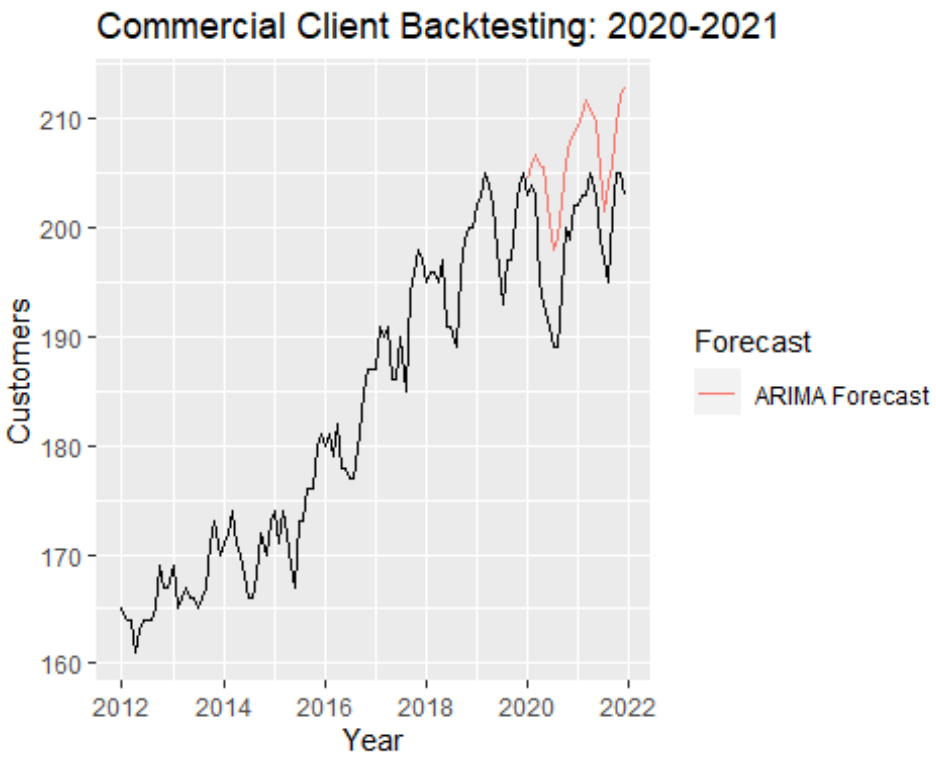


ARIMA Model: 5 Year Forecast

Below we fit & forecast 60 months into the future using an ARIMA (1,0,1)(0,1,1) model. In the graph below we see the 80% and 95% Prediction Intervals bounding our forecast.



Back-Testing



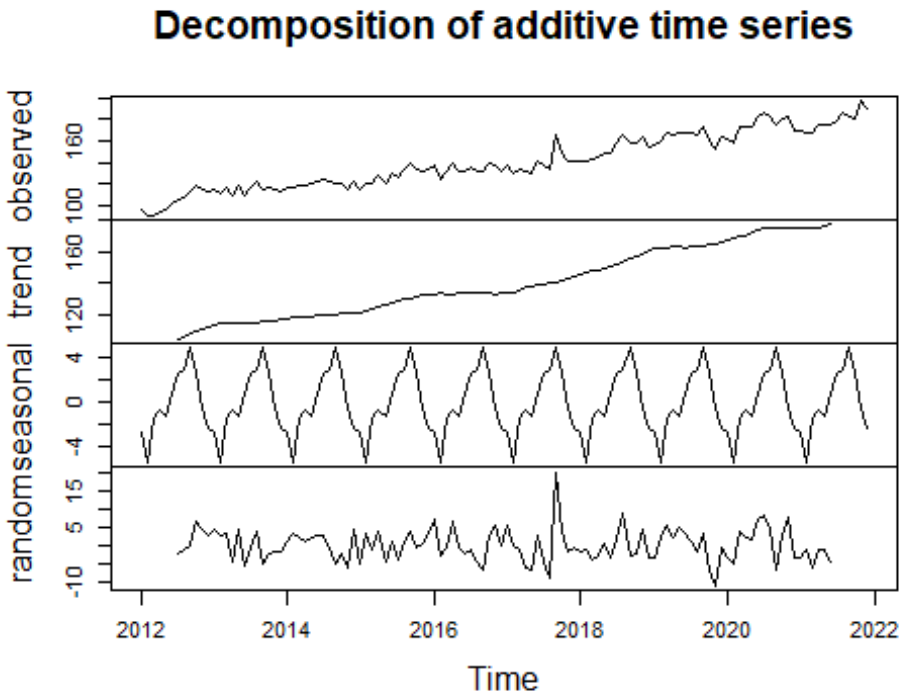
Test Results

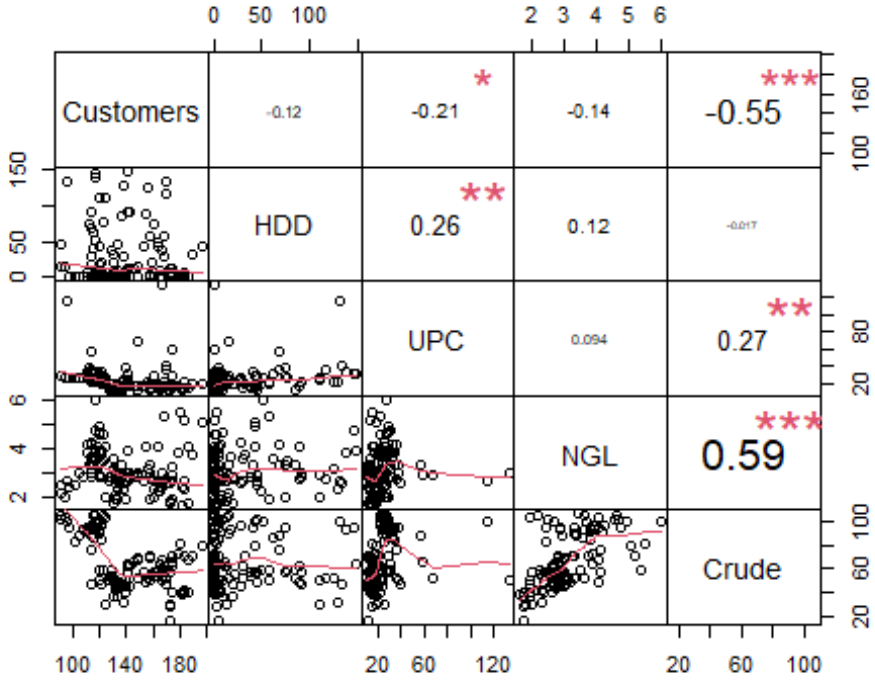
Below we see that the model performs roughly as expected for a “normal” year of 2019, and continues to have a high degree of accuracy in 2020 and 2021.

```
[1] "24Month Mean Absolute Error (MAE): 7.15"

[1] "24Month Mean Accuracy: 96.38"

         Actual Forecast Absolute_Error Accuracy
Jan 2020    203      204           1.43     99.3
Feb 2020    204      206           1.74     99.1
Mar 2020    203      207           3.65     98.2
Apr 2020    195      206          10.72     94.5
May 2020    193      206          12.58     93.5
Jun 2020    191      201           9.65     94.9
Jul 2020    189      198           9.00     95.2
Aug 2020    189      199          10.17     94.6
Sep 2020    194      202           8.48     95.6
Oct 2020    200      206           6.01     97.0
Nov 2020    199      208           9.06     95.4
Dec 2020    202      209           6.59     96.7
Jan 2021    202      209           7.23     96.4
Feb 2021    203      210           7.40     96.4
Mar 2021    203      212           8.82     95.7
Apr 2021    205      211           5.86     97.1
May 2021    203      210           6.84     96.6
Jun 2021    199      205           6.35     96.8
Jul 2021    197      202           4.59     97.7
Aug 2021    195      204           9.10     95.3
Sep 2021    201      206           4.84     97.6
Oct 2021    205      210           4.59     97.8
Nov 2021    205      212           7.09     96.5
Dec 2021    203      213           9.84     95.2
```

Commercial Standby Generator Service (CS-GS)

Customer Time-Series Decomposition





ARIMA Model: Expected Accuracy

In this section we evaluate the expected accuracy of a Seasonal ARIMA Model using cross-validation. ARIMA is an acronym for 'Autoregressive Integrated Moving Average' which is a widely using Time-Series forecasting model that utilizes the recent values to predict outward.

Here we evaluate model accuracy by using cross-validation and rolling forecasts throughout the time-series to determine our expected accuracy over a 24 Month period.

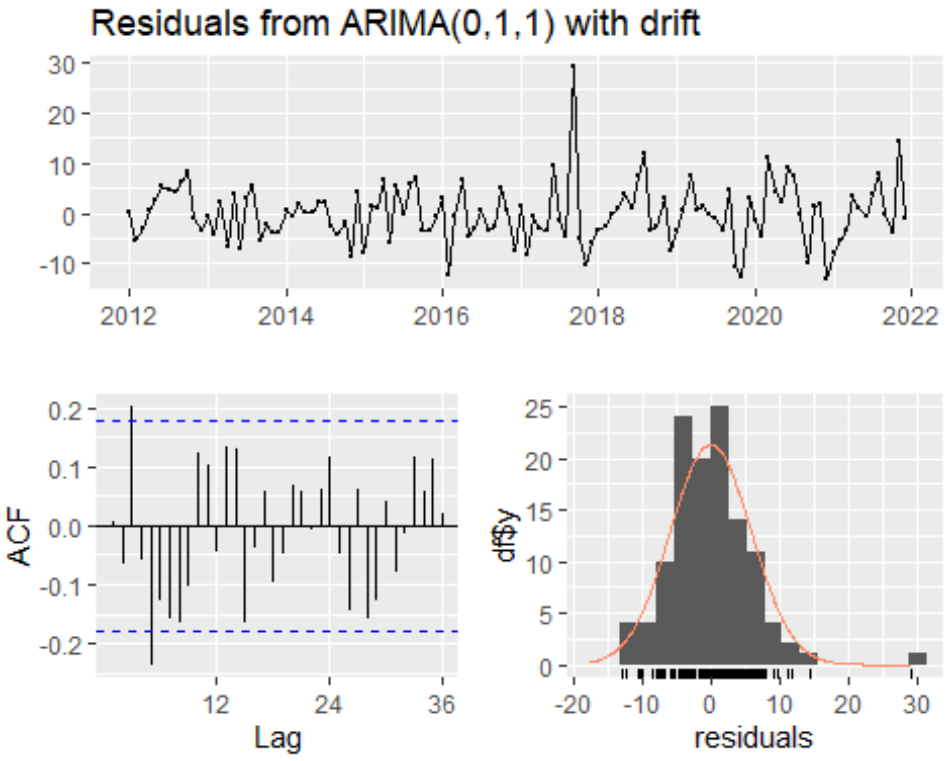
```
                     ME RMSE MAE
Forecast Horizon  1   1    8   5
Forecast Horizon  2   0    9   7
Forecast Horizon  3   1    9   7
Forecast Horizon  4   2   10   8
Forecast Horizon  5   2   11   8
Forecast Horizon  6   3   11   8
Forecast Horizon  7   4   11   9
Forecast Horizon  8   5   11   9
Forecast Horizon  9   5   11   8
Forecast Horizon  10  5   10   8
Forecast Horizon  11  5   11   9
Forecast Horizon  12  6   12   9
Forecast Horizon  13  6   12   9
Forecast Horizon  14  6   13  11
Forecast Horizon  15  6   14  11
Forecast Horizon  16  7   14  11
Forecast Horizon  17  7   14  11
Forecast Horizon  18  7   14  12
Forecast Horizon  19  8   14  12
Forecast Horizon  20  8   14  12
Forecast Horizon  21  8   14  12
Forecast Horizon  22  8   14  12
Forecast Horizon  23  8   15  13
Forecast Horizon  24  9   16  14
```

ARIMA Model: Diagnostics

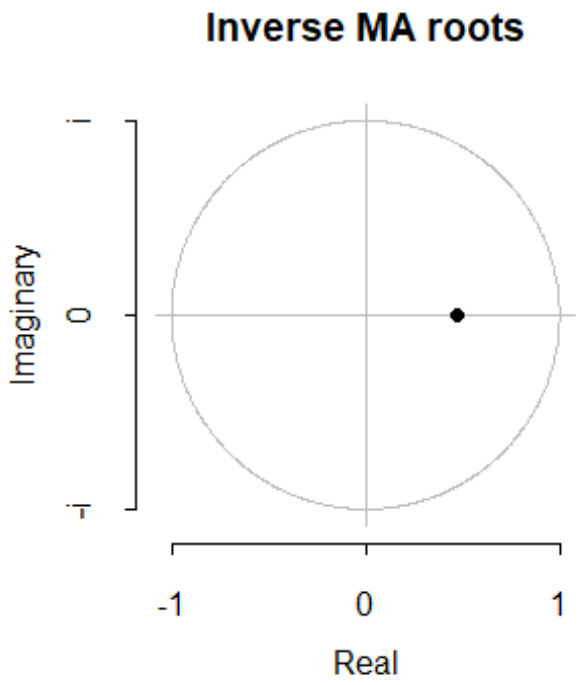
In this section we evaluate the diagnostics of the ARIMA Model. Below we see that the model fails the Ljung-Box Test and therefore we can determine the data is independently distributed. In addition, we see from the graphs that the lagged values are not auto-correlated with one another, and the residuals are normally distributed.

```
Series: x
ARIMA(0,1,1) with drift

Coefficients:
          ma1   drift
      -0.4687  0.8146
s.e.   0.0859  0.2893

sigma^2 estimated as 35.37:  log likelihood=-380.14
AIC=766.27   AICc=766.48   BIC=774.61

Training set error measures:
                     ME     RMSE      MAE        MPE     MAPE      MASE
```

```
Training set -0.0239026 5.872354 4.328385 -0.1464874 3.084861 0.4512216
                     ACF1
Training set 0.006491761
```

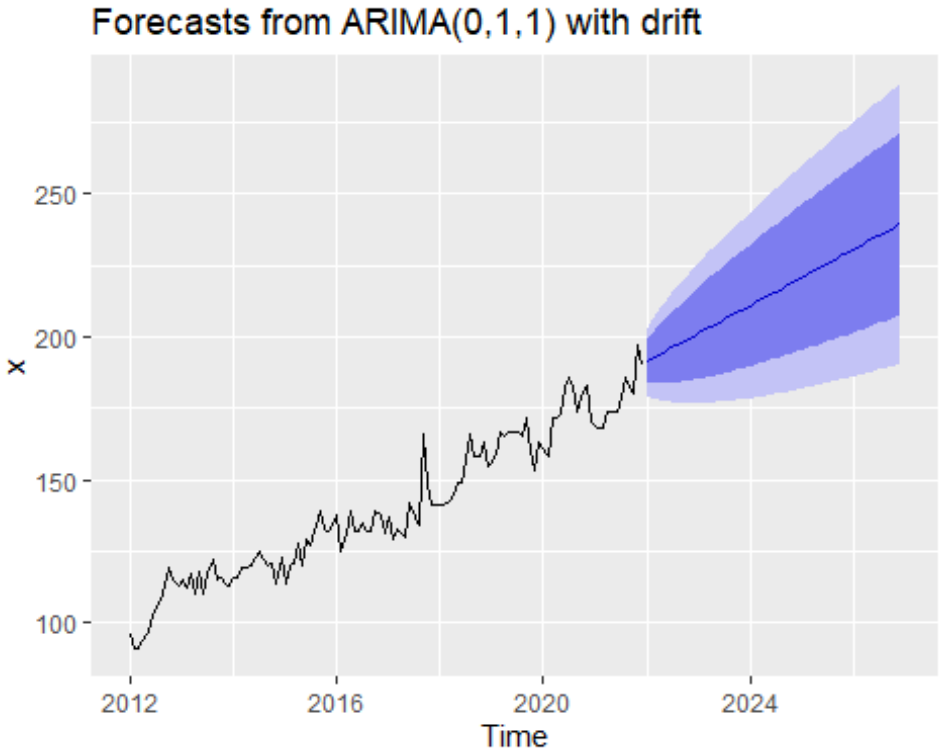



```
 Ljung-Box test

data:  Residuals from ARIMA(0,1,1) with drift
Q* = 41.998, df = 22, p-value = 0.006254

Model df: 2.   Total lags used: 24
```

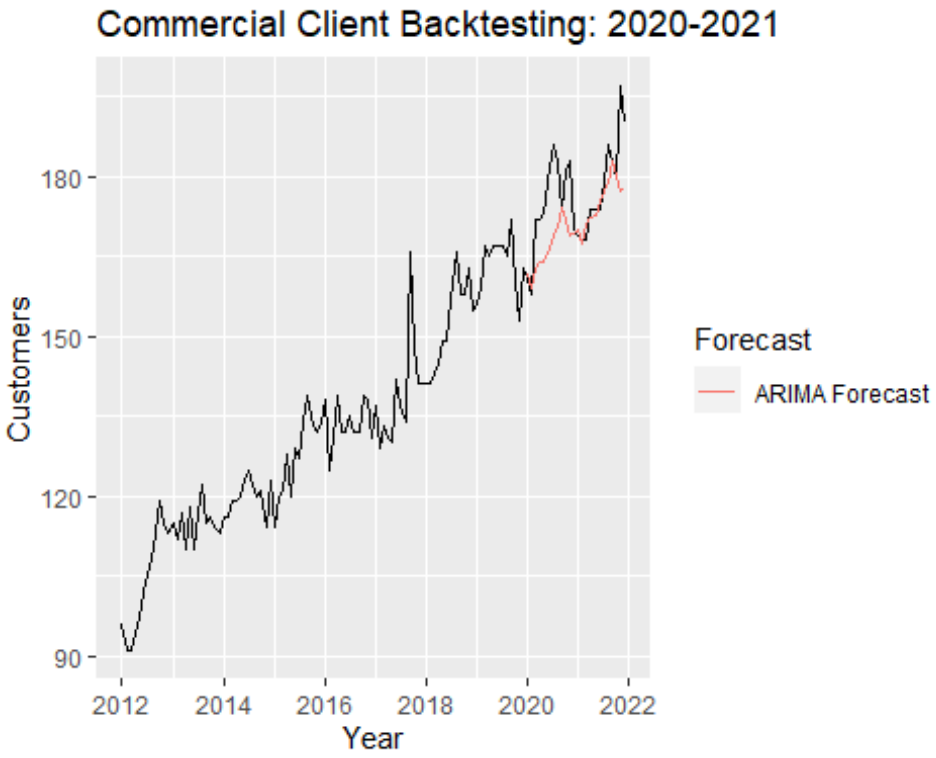


ARIMA Model: 5 Year Forecast

Below we fit & forecast 60 months into the future using an ARIMA (0,1,1) model. In the graph below we see the 80% and 95% Prediction Intervals bounding our forecast.



Back-Testing



Test Results

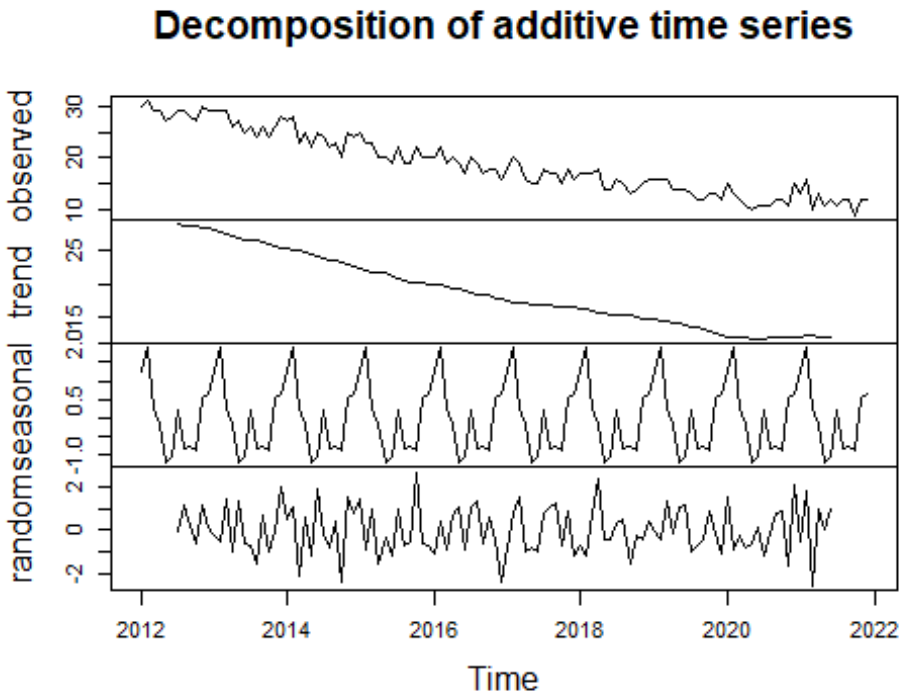
Below we see that the model performs roughly as expected for a "normal" year of 2019, and continues to have a high degree of accuracy in 2020 and 2021.

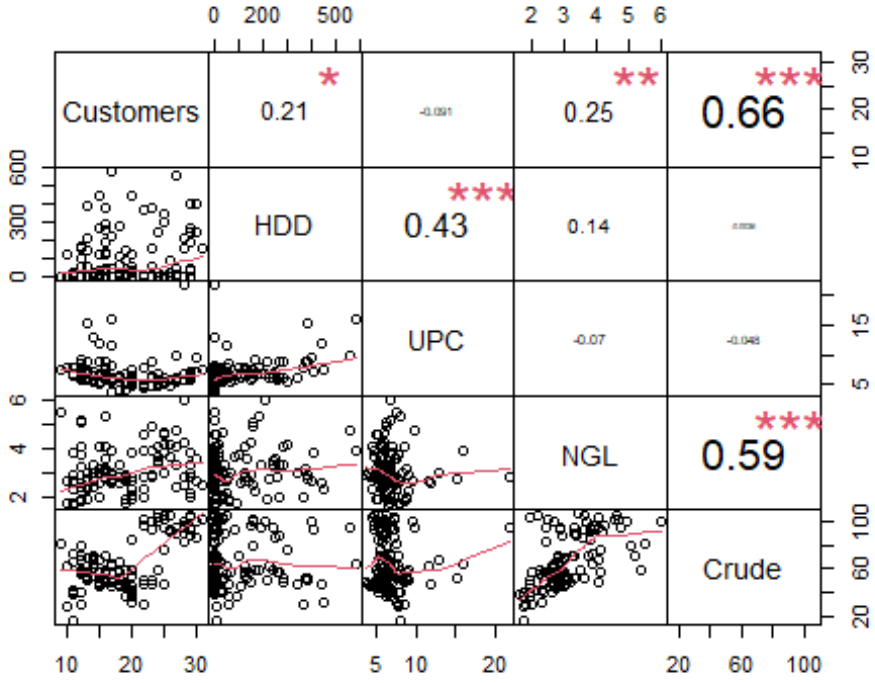
```
[1] "24Month Mean Absolute Error (MAE): 6.18"

[1] "24Month Mean Accuracy: 96.6"

         Actual Forecast Absolute_Error Accuracy
Jan 2020    161      162           0.65     99.6
Feb 2020    158      159           1.15     99.3
Mar 2020    172      163           9.23     94.6
Apr 2020    172      164           8.10     95.3
May 2020    173      164           8.85     94.9
Jun 2020    182      167          15.23     91.6
Jul 2020    186      169          17.23     90.7
Aug 2020    183      170          12.60     93.1
Sep 2020    174      174           0.40     99.8
Oct 2020    181      172           9.23     94.9
Nov 2020    183      169          14.23     92.2
Dec 2020    170      169           0.85     99.5
Jan 2021    169      170           1.07     99.4
Feb 2021    168      168           0.43     99.7
Mar 2021    168      171           3.19     98.1
Apr 2021    174      172           1.68     99.0
May 2021    174      173           1.43     99.2
Jun 2021    174      175           1.19     99.3
Jul 2021    179      177           1.81     99.0
Aug 2021    186      179           7.18     96.1
Sep 2021    183      183           0.18     99.9
```

```
Oct 2021    180       180          0.19      99.9
Nov 2021    197       177         19.81      89.9
Dec 2021    190       178         12.43      93.5
```

Firm Transporation Service (FTS-A & FTS-B)

Customer Time-Series Decomposition





ARIMA Model: Expected Accuracy

In this section we evaluate the expected accuracy of a Seasonal ARIMA Model using cross-validation. ARIMA is an acronym for 'Autoregressive Integrated Moving Average' which is a widely using Time-Series forecasting model that utilizes the recent values to predict outward.

Here we evaluate model accuracy by using cross-validation and rolling forecasts throughout the time-series to determine our expected accuracy over a 24 Month period.

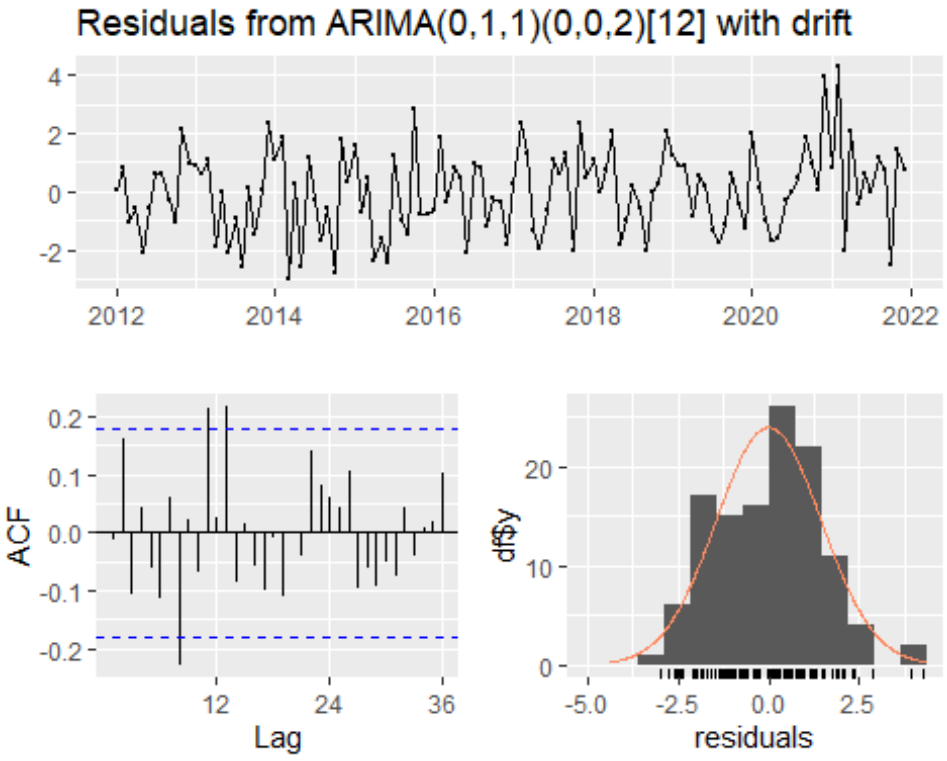
```
                     ME RMSE MAE
Forecast Horizon  1   0    1   1
Forecast Horizon  2   0    1   1
Forecast Horizon  3   0    1   1
Forecast Horizon  4   0    1   1
Forecast Horizon  5   0    1   1
Forecast Horizon  6   0    1   1
Forecast Horizon  7   0    1   1
Forecast Horizon  8   0    2   1
Forecast Horizon  9   0    1   1
Forecast Horizon  10  0    2   1
Forecast Horizon  11 -1    2   1
Forecast Horizon  12  0    2   1
Forecast Horizon  13  0    2   1
Forecast Horizon  14  0    2   2
Forecast Horizon  15 -1    2   2
Forecast Horizon  16 -1    2   2
Forecast Horizon  17 -1    2   2
Forecast Horizon  18 -1    2   2
Forecast Horizon  19 -1    2   2
Forecast Horizon  20 -1    2   2
Forecast Horizon  21 -1    2   2
Forecast Horizon  22 -1    2   2
Forecast Horizon  23 -1    2   2
Forecast Horizon  24 -1    2   2
```

ARIMA Model: Diagnostics

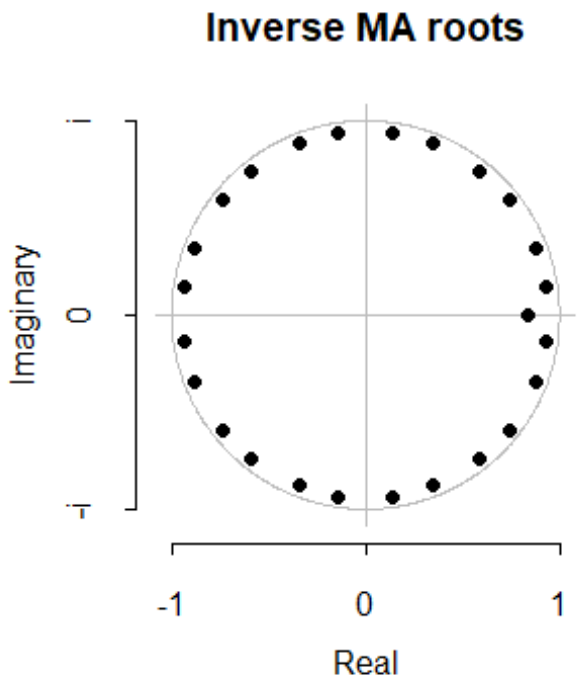
In this section we evaluate the diagnostics of the ARIMA Model. Below we see that the model fails the Ljung-Box Test and therefore we can determine the data is independently distributed. In addition, we see from the graphs that the lagged values are not auto-correlated with one another, and the residuals are normally distributed.

```
Series: x
ARIMA(0,1,1)(0,0,2)[12] with drift

Coefficients:
          ma1    sma1    sma2    drift
      -0.8361  0.2333  0.2618  -0.1511
s.e.   0.0572  0.0956  0.0907   0.0325

sigma^2 estimated as 2.184:  log likelihood=-214.92
AIC=439.83   AICc=440.37   BIC=453.73

Training set error measures:
                      ME     RMSE      MAE        MPE     MAPE      MASE
```

```
Training set -0.01183897 1.446572 1.176106 -0.3366003 6.840653 0.5405083
                     ACF1
Training set -0.01405601
```

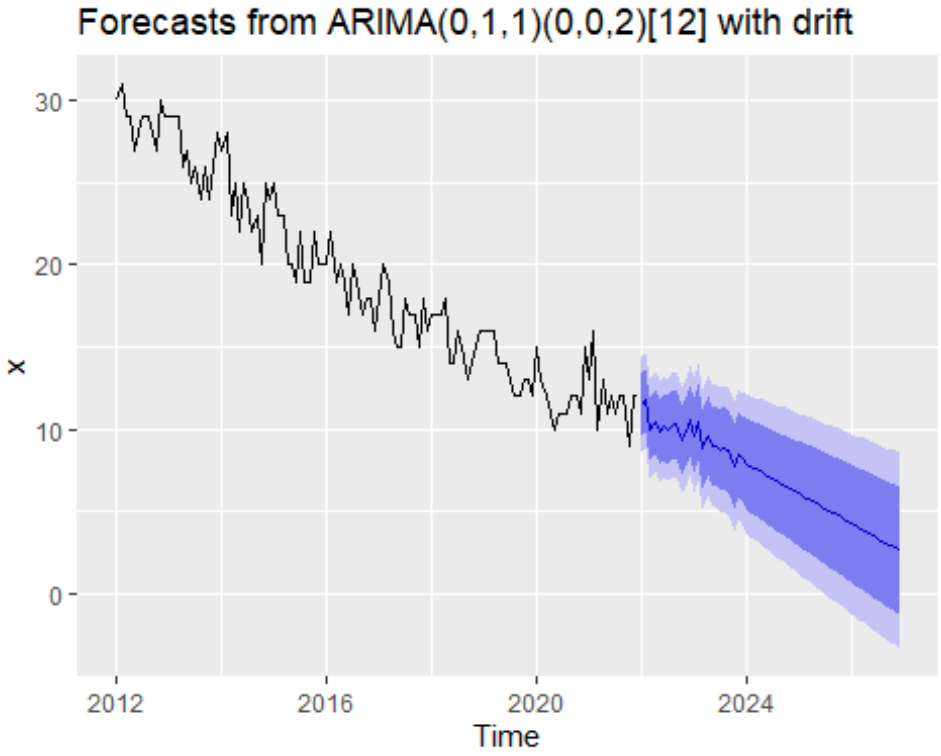



```
 Ljung-Box test

data:  Residuals from ARIMA(0,1,1)(0,0,2)[12] with drift
Q* = 37.008, df = 20, p-value = 0.01168

Model df: 4.   Total lags used: 24
```

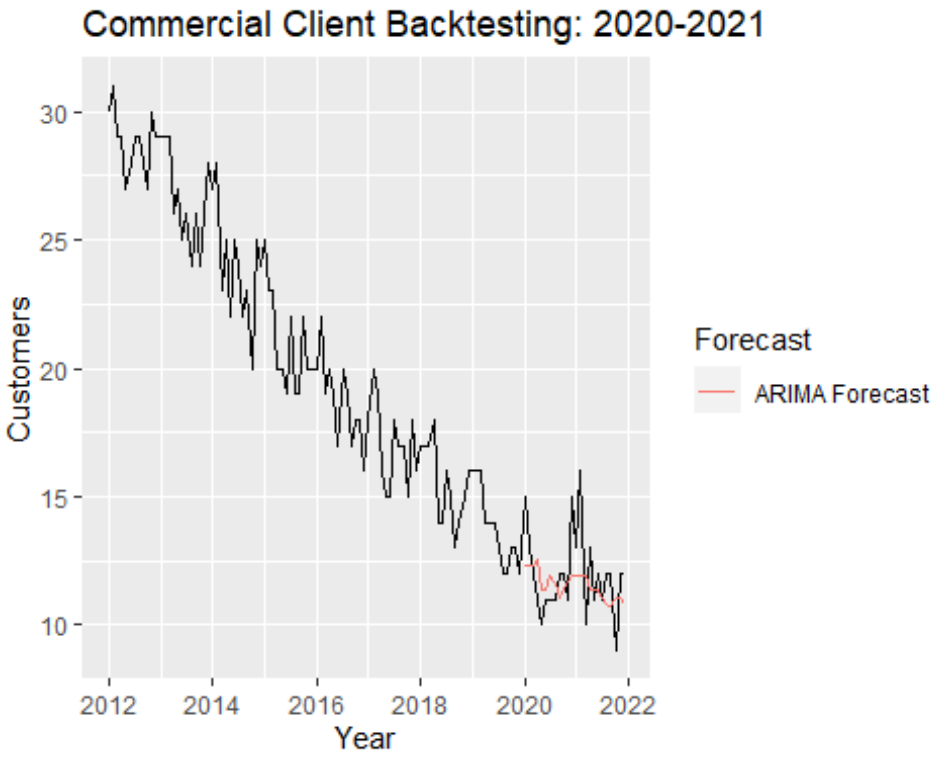


ARIMA Model: 5 Year Forecast

Below we fit & forecast 60 months into the future using an ARIMA (0,1,1)(0,0,2) model. In the graph below we see the 80% and 95% Prediction Intervals bounding our forecast.



Back-Testing



Test Results

Below we see that the model performs roughly as expected for a "normal" year of 2019, and continues to have a high degree of accuracy in 2020 and 2021.

```
[1] "24Month Mean Absolute Error (MAE): 1.26"

[1] "24Month Mean Accuracy: 89.71"

         Actual Forecast Absolute_Error Accuracy
Jan 2020     15       12           2.72     81.9
Feb 2020     13       12           0.72     94.5
Mar 2020     12       12           0.28     97.7
Apr 2020     11       13           1.53     86.1
May 2020     10       11           1.39     86.1
Jun 2020     11       11           0.39     96.5
Jul 2020     11       12           0.94     91.5
Aug 2020     11       12           0.64     94.2
Sep 2020     12       11           0.93     92.2
Oct 2020     12       11           0.63     94.8
Nov 2020     11       12           0.66     94.0
Dec 2020     15       12           3.07     79.5
Jan 2021     13       12           1.07     91.8
Feb 2021     16       12           4.07     74.6
Mar 2021     10       12           1.93     80.7
Apr 2021     13       11           1.63     87.5
May 2021     11       11           0.34     96.9
Jun 2021     12       11           0.66     94.5
Jul 2021     11       11           0.07     99.4
Aug 2021     12       11           1.22     89.8
Sep 2021     12       11           1.23     89.8
```

Oct 2021	9	11	2.06	77.1
Nov 2021	12	11	0.94	92.2
Dec 2021	12	11	1.22	89.8