On Nvidia Share Prices

BUSINESS ECONOMIC AND FINANCIAL DATA

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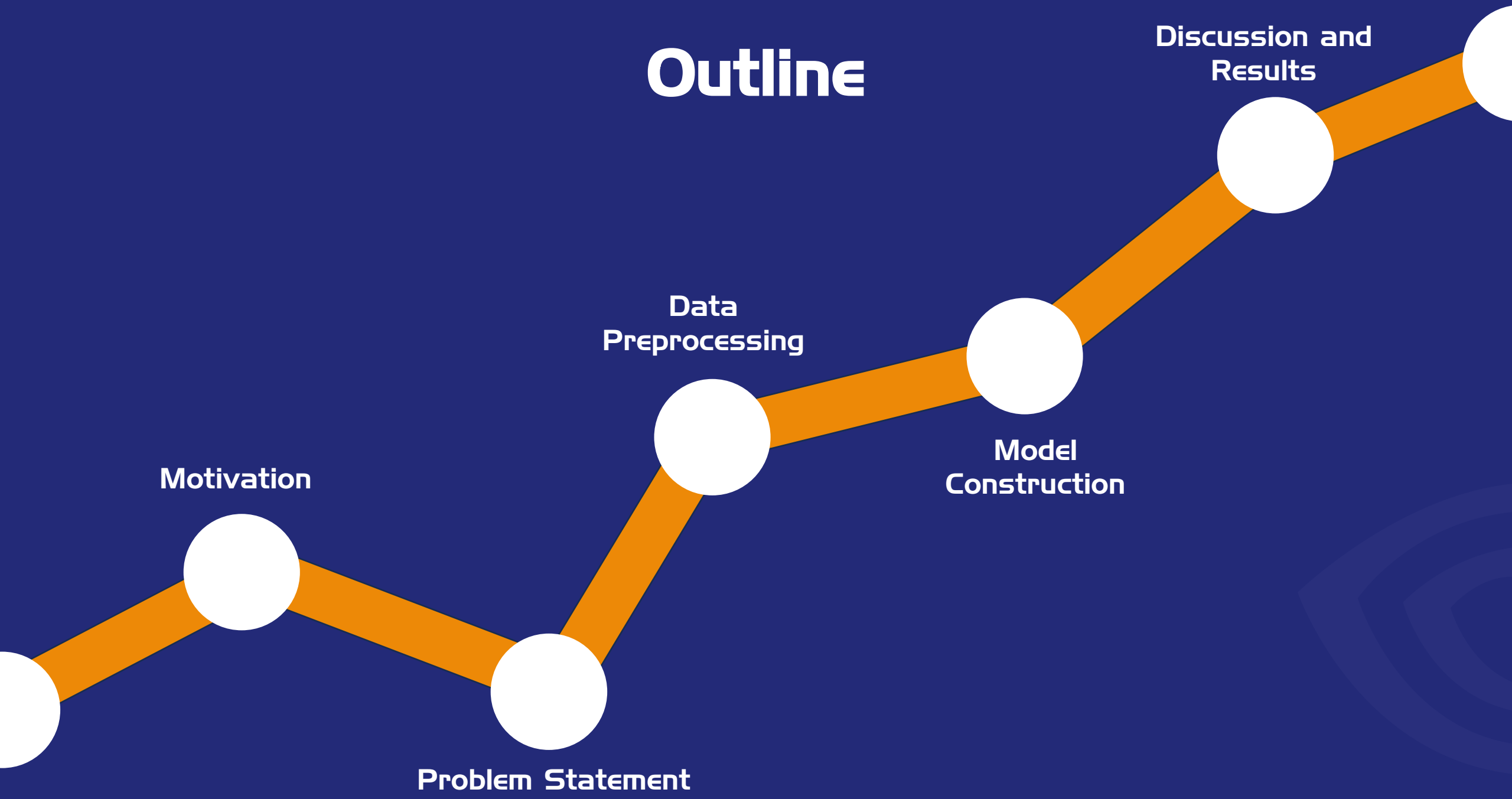
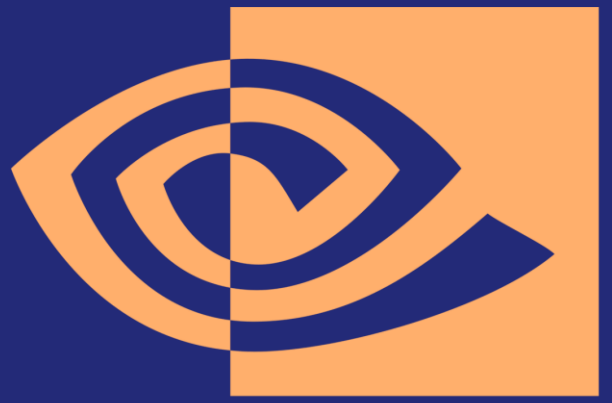
Outline


Discussion and Results
Data Preprocessing
Model Construction
Motivation
Problem Statement

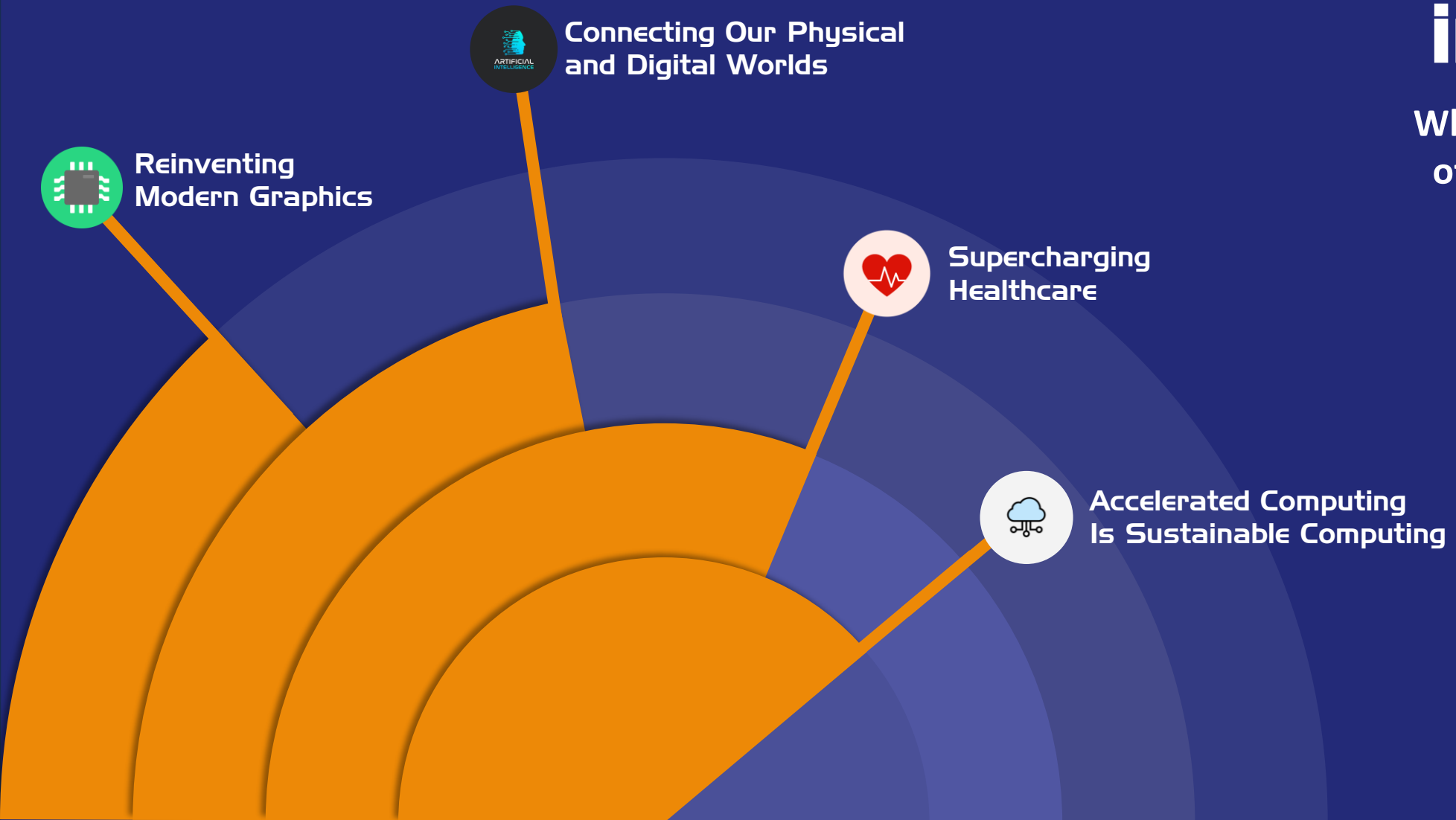
Nvidia is the Engine of AI

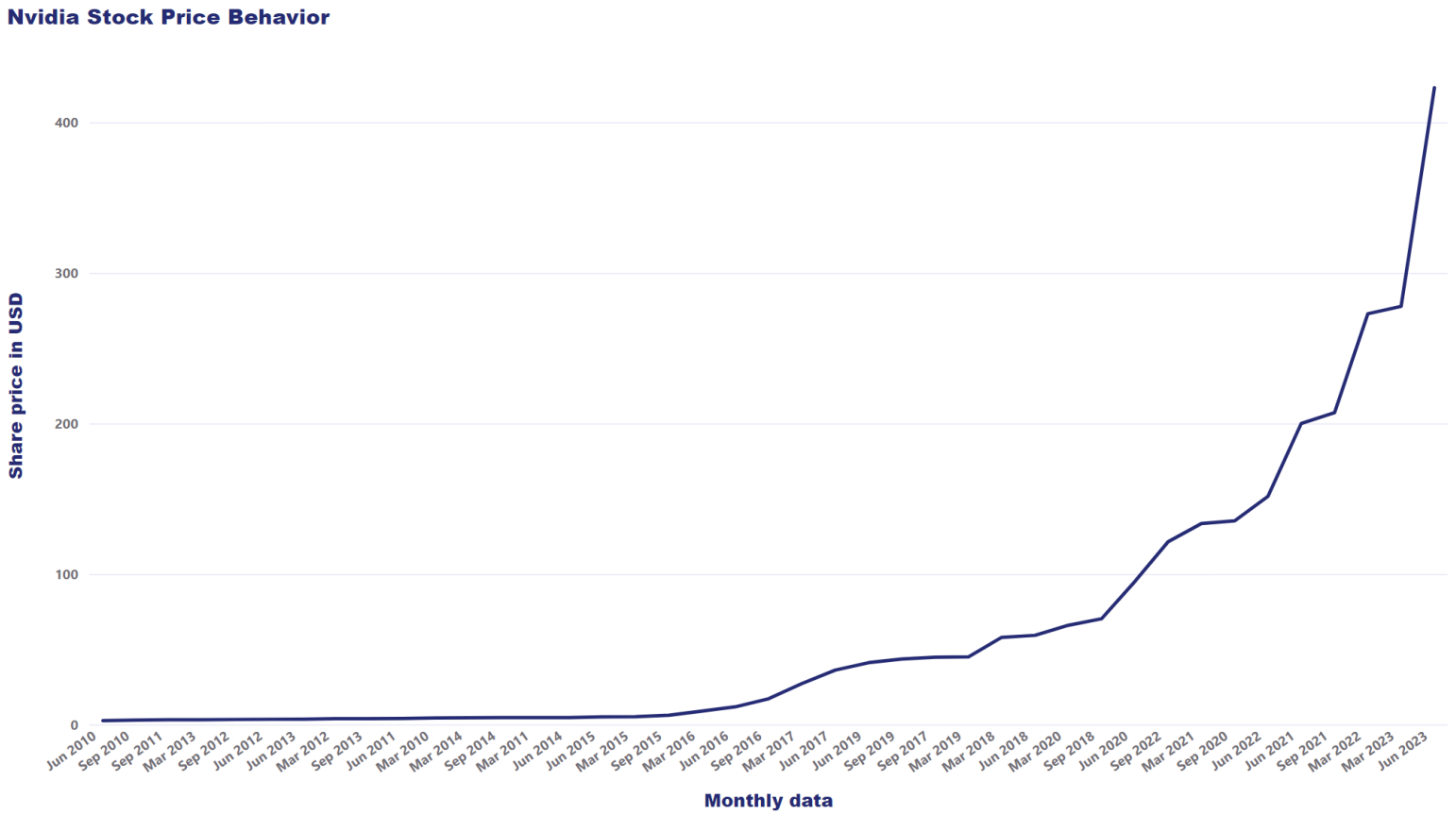
NVIDIA engineers the most advanced chips, systems, and software for the AI factories of the future. We build new AI services that help companies create their own AI factories.



Worlwide impact

What is the impact of this company?





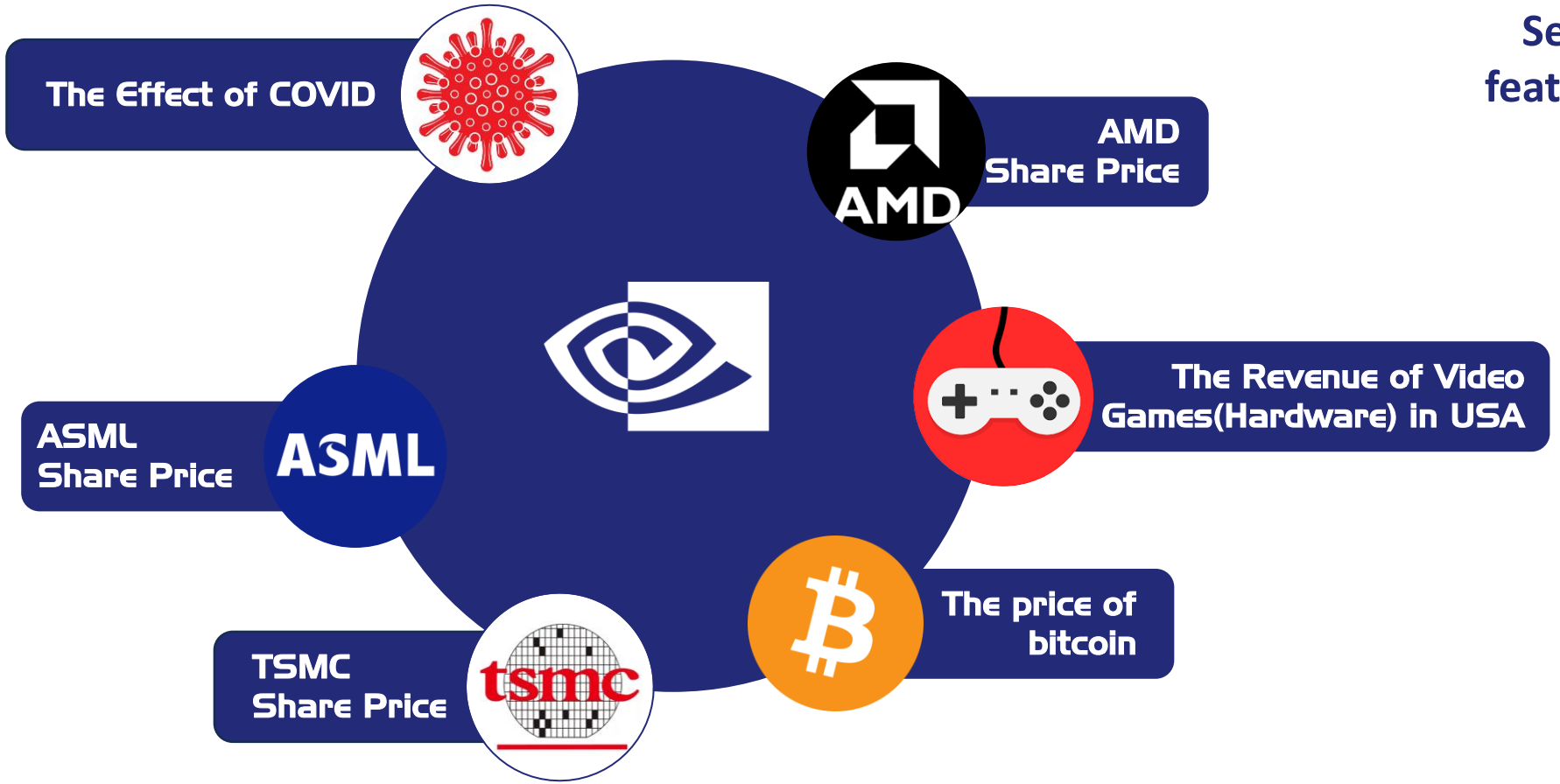
NVIDIA SHARE PRICE

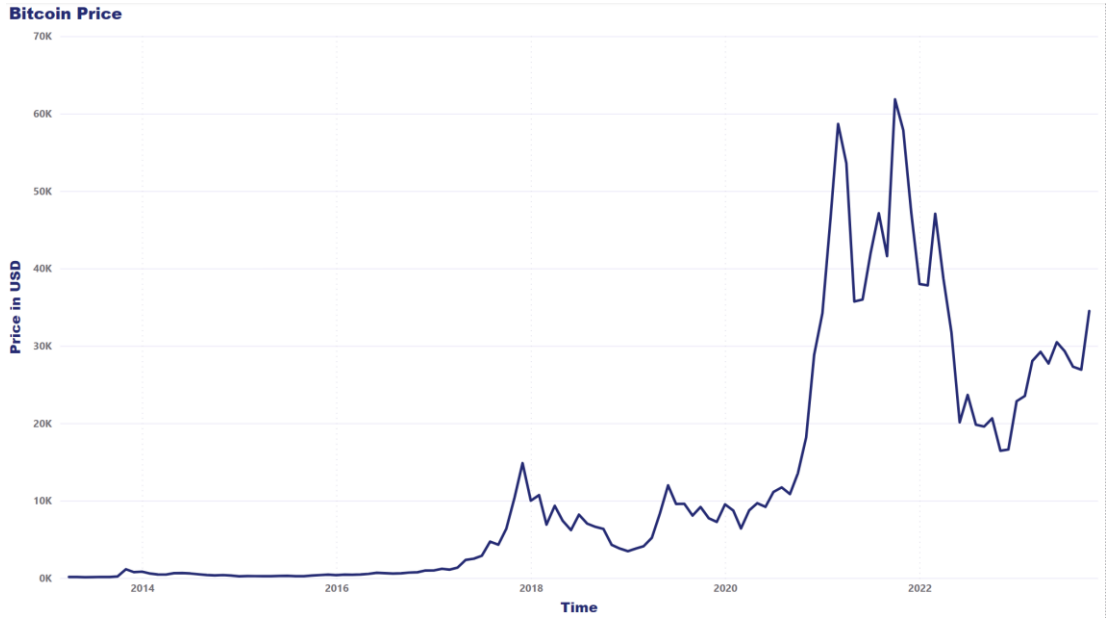
Monthly data taken from 2010-2022 period

163 data points

Features

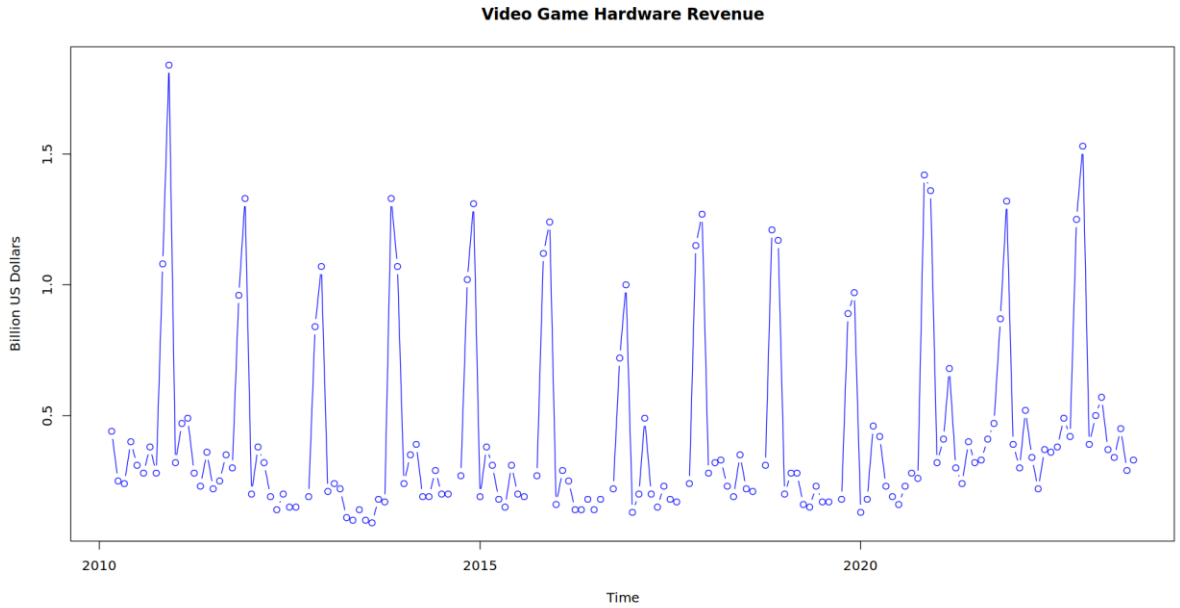
Selected 6 different features for forecasting.





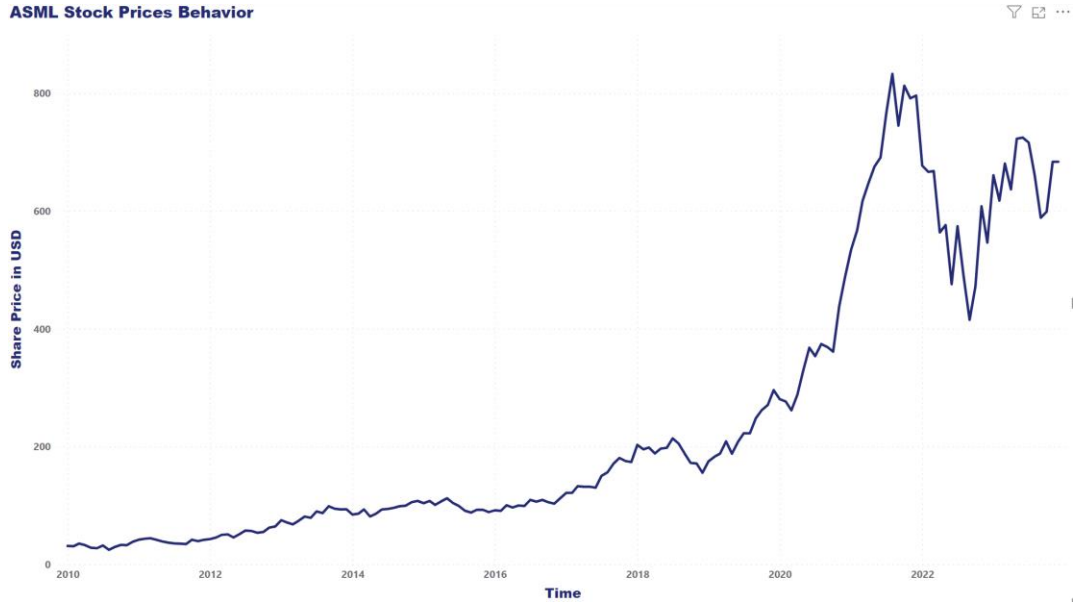
Bitcoin Price

Monthly data taken from 2013-2023 period



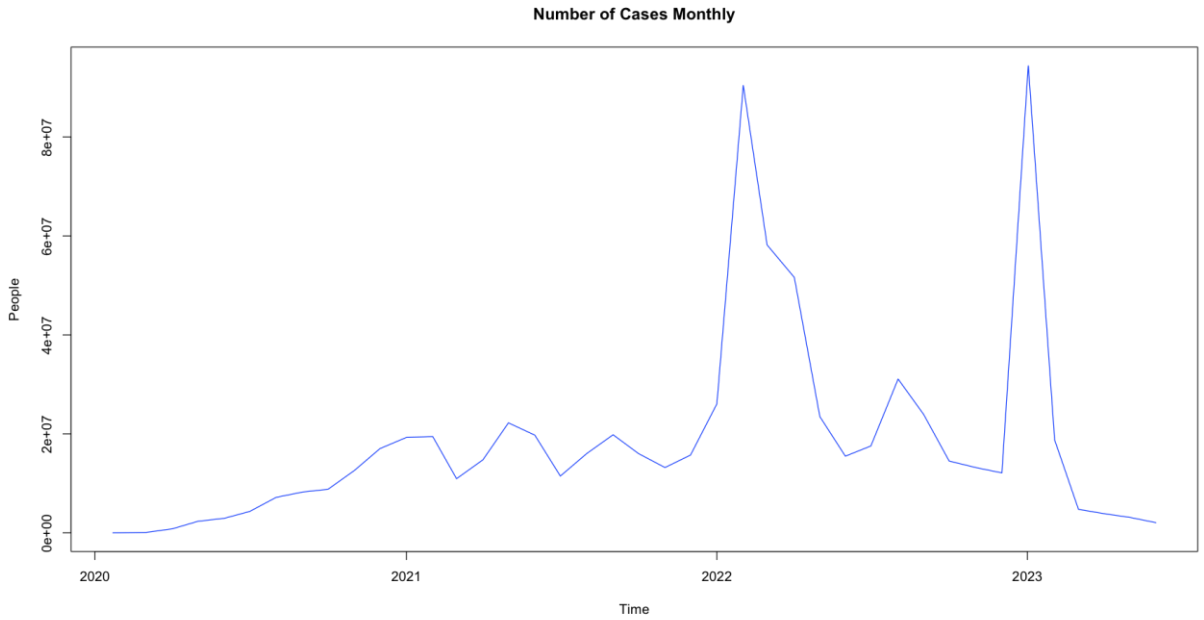
Video Game Hardware

Monthly data taken from 2010-2023 period.



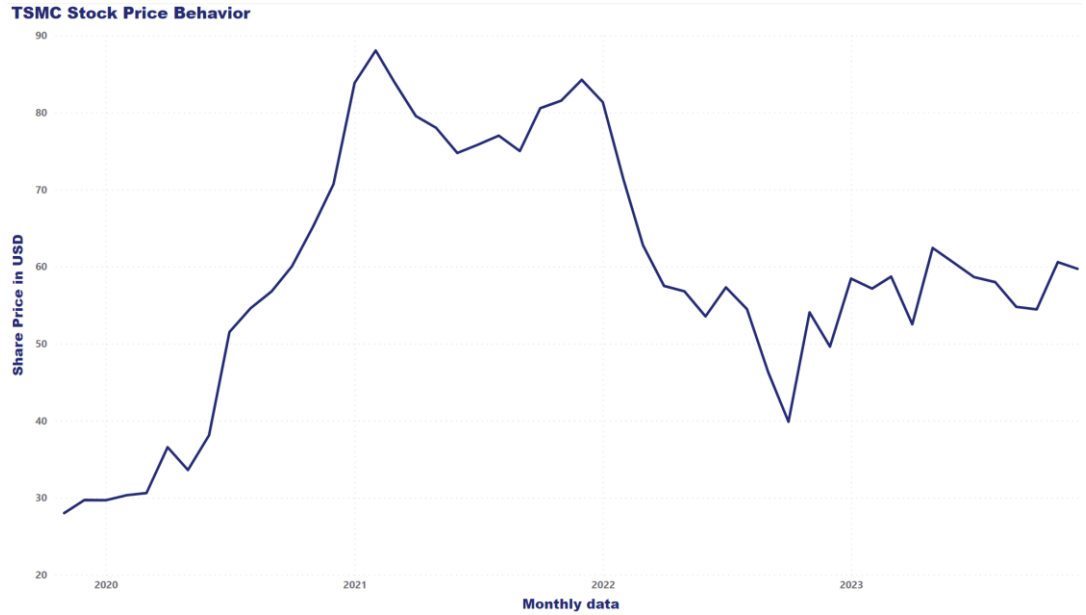
AMD SHARE PRICE

Monthly data taken from 2010-2023 period



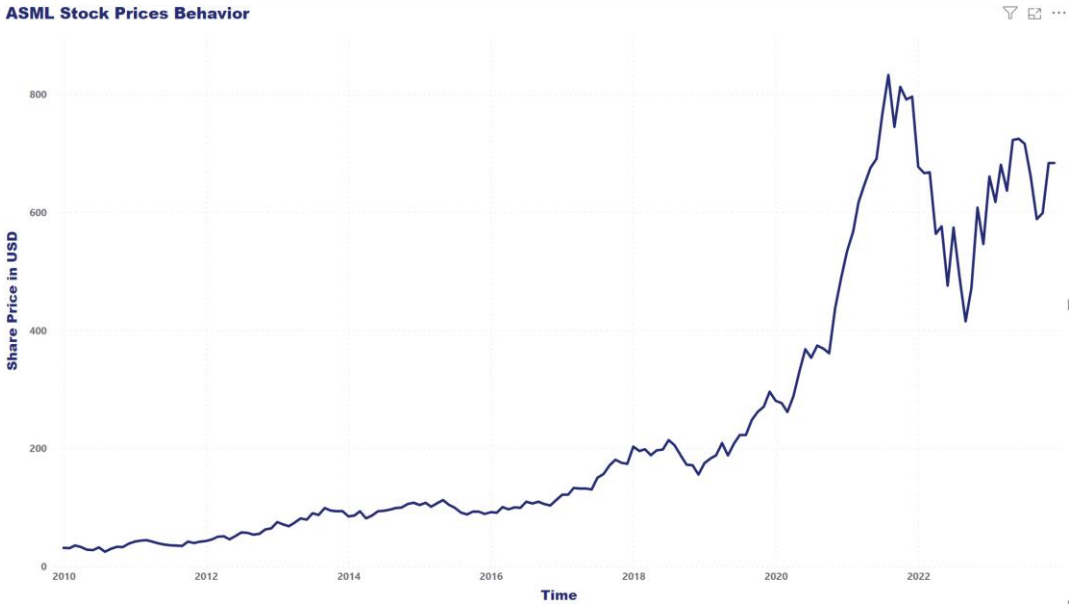
COVID CASES

Monthly data taken from 2020-2023 period.



ASML and TSMC

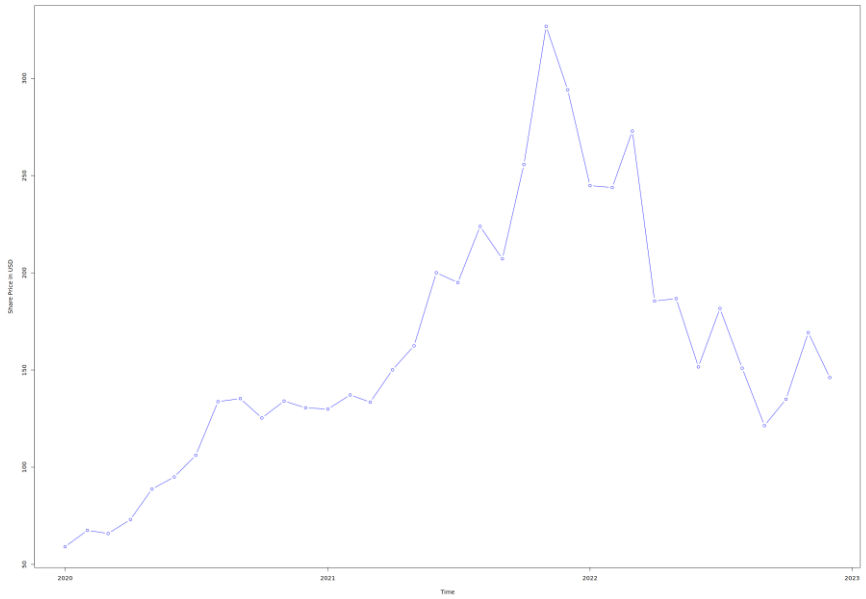
Monthly data taken from 2010-2023 period.



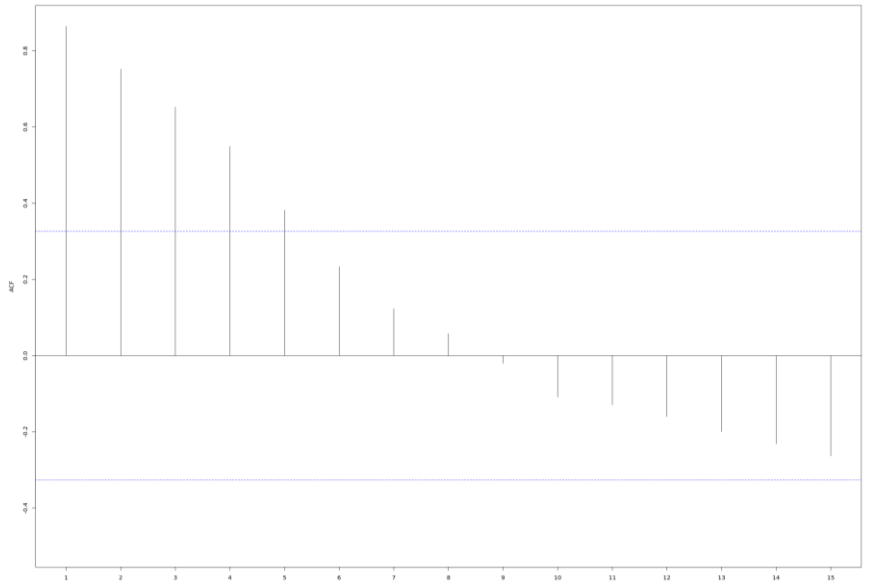
TSMC SHARE PRICE

Monthly data taken from 2020-2023 period.

Nvidia share price (sliced)



ACF-nvidia

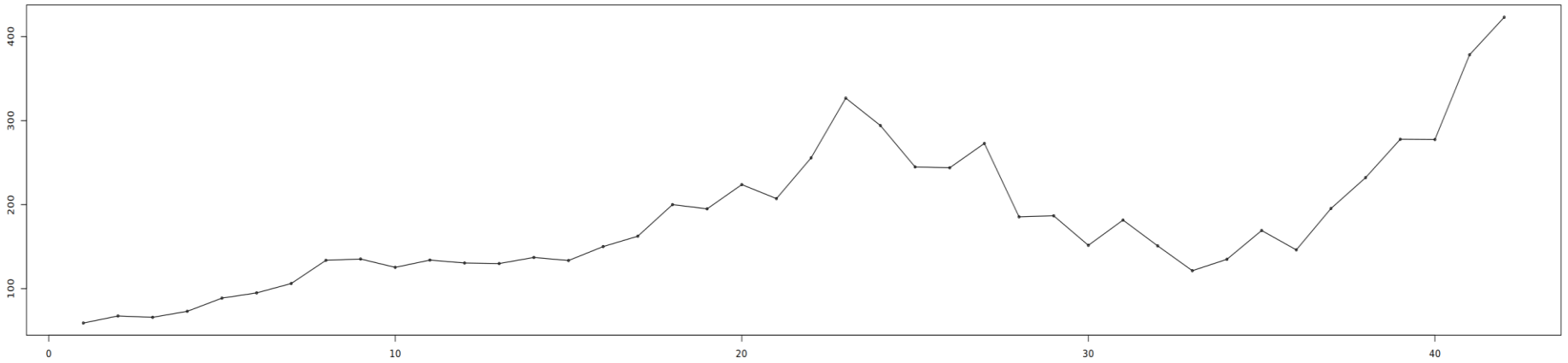


PACF-nvidia

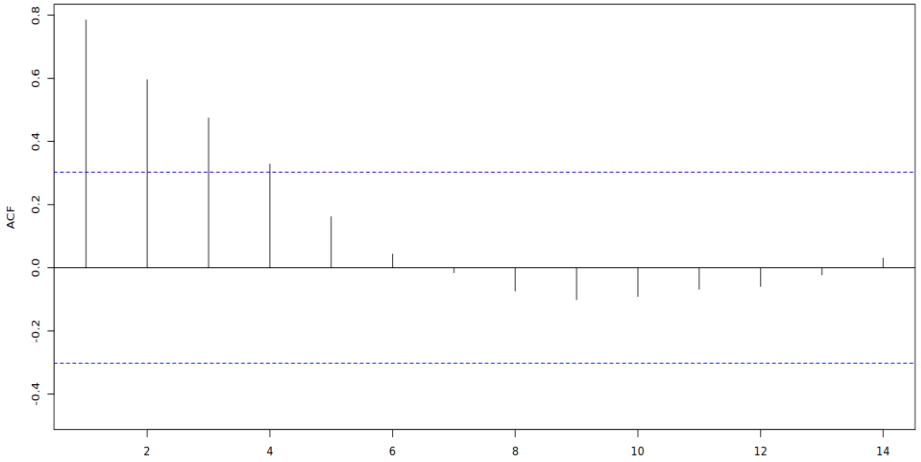
Slicing Data

NVIDIA DATA

Nvidia share price (sliced)

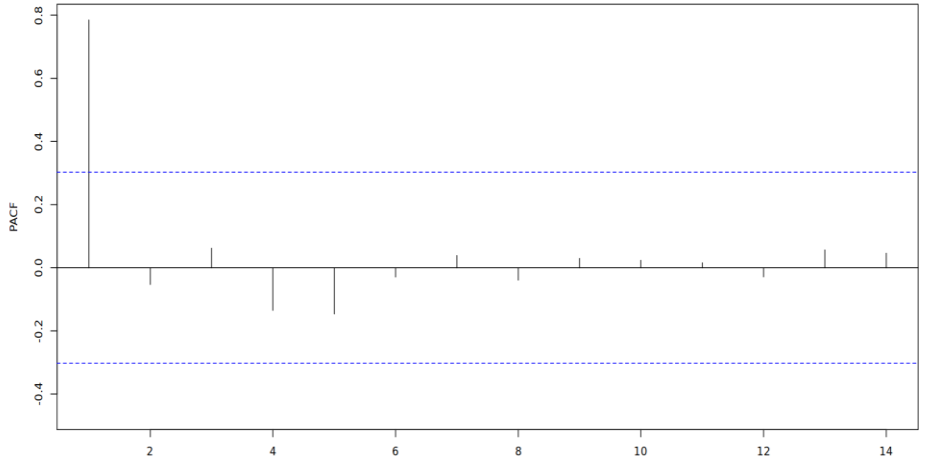


ACF-nvidia



lag

PACF-nvidia

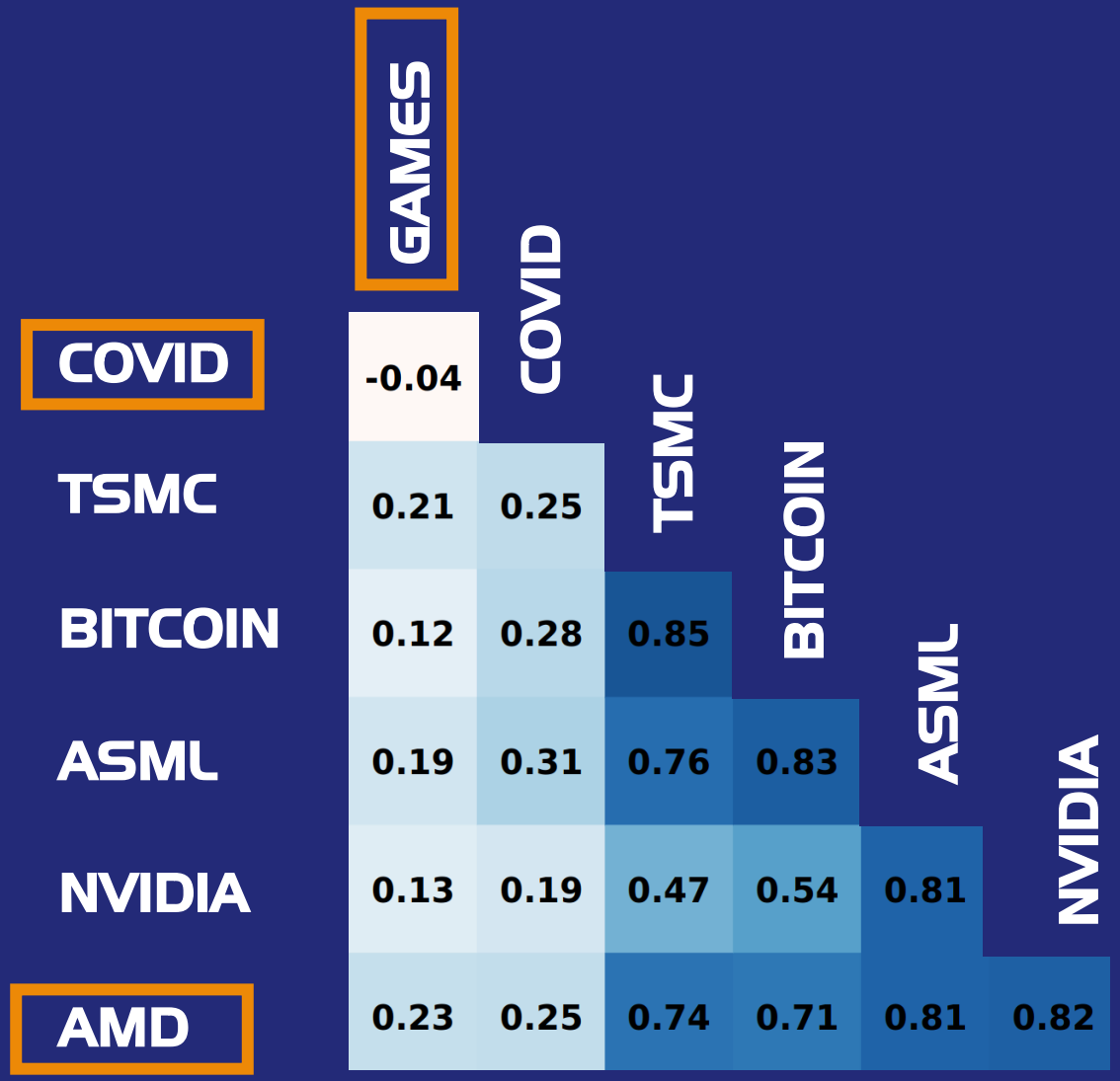


lag

```
Call:
tslm(formula = nvidia_ts ~ trend + season + AMD_ts + vidgame_ts +
    ASML_ts + TSMC_ts + bitcoin_ts + covid_ts)

Residuals:
     Min       1Q   Median       3Q      Max
-0.27188 -0.09424  0.01762  0.05377  0.42805

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.27099    0.13479  -2.010  0.05315 .
trend        0.01098    0.00320   3.431  0.00172 **
season2      0.04861    0.06547   0.742  0.46339
season3     -0.04869    0.07476  -0.651  0.51965
season4     -0.04977    0.07337  -0.678  0.50262
AMD_ts       1.03725    0.15600   6.649 1.96e-07 ***
vidgame_ts  -0.04811    0.04908  -0.980  0.33463
ASML_ts      0.52690    0.25530   2.064  0.04748 *
TSMC_ts     -0.44001    0.20565  -2.140  0.04037 *
bitcoin_ts  -0.03583    0.12275  -0.292  0.77231
covid_ts    -0.07476    0.03509  -2.131  0.04114 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1506 on 31 degrees of freedom
Multiple R-squared:  0.899,     Adjusted R-squared:  0.8664
F-statistic:  27.6 on 10 and 31 DF,  p-value: 1.073e-12
```

TSML+ FEATURES+ TREND

Correlation Matrix and TSLM



STEPS

Slice data
Scale data
Apply TS
Get Correlation Matrix
Choose explanatory variables

STEPS

TSLM

Apply Backward Elimination
Get R2 Values

$a\text{-}R^2$	0.8545	0.8401	0.4508	0.836	0.8271
Model Combination	*AMD*** COVID* GAMES* TREND****	*AMD*** COVID* TREND****	*COVID GAMES TREND****	*AMD*** GAMES TREND****	*AMD*** TREND****

Detailed results

TREND + AMD + COVID

```
Residuals:
     Min       1Q   Median       3Q      Max
-0.25590 -0.10252 -0.00578  0.08739  0.54506

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.336937   0.092983  -3.624 0.000847 ***
trend        0.016286   0.002361   6.897 3.39e-08 ***
AMD_ts       0.986244   0.102520   9.620 9.91e-12 ***
covid_ts    -0.075315   0.036928  -2.040 0.048394 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1648 on 38 degrees of freedom
Multiple R-squared:  0.8518,    Adjusted R-squared:  0.8401
F-statistic: 72.78 on 3 and 38 DF,  p-value: 8.232e-16
```

TREND + AMD

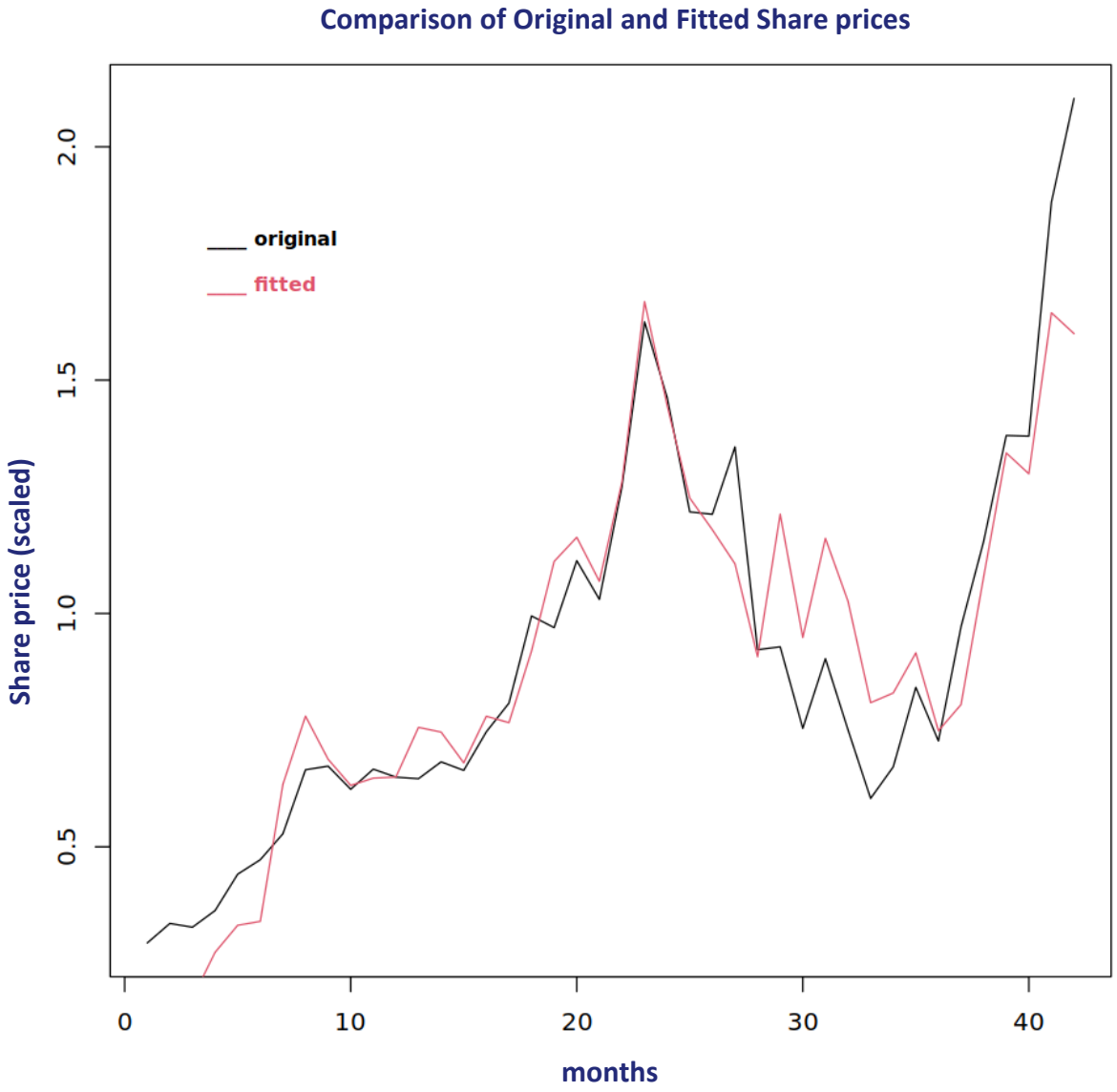
```
Residuals:
     Min       1Q   Median       3Q      Max
-0.27847 -0.12031 -0.02589  0.09839  0.62290

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.332480   0.096649  -3.440   0.0014 **
trend        0.015037   0.002371   6.342 1.74e-07 ***
AMD_ts       0.957541   0.105583   9.069 3.78e-11 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1713 on 39 degrees of freedom
Multiple R-squared:  0.8355,    Adjusted R-squared:  0.8271
F-statistic: 99.07 on 2 and 39 DF,  p-value: 5.169e-16
```

TREND + AMD + GAMES

```
Residuals:
     Min       1Q   Median       3Q      Max
-0.29780 -0.08022 -0.01361  0.09935  0.59782

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.308059   0.095133  -3.238   0.0025 **
trend        0.015572   0.002329   6.686 6.55e-08 ***
AMD_ts       0.988468   0.104303   9.477 1.49e-11 ***
vidgame_ts  -0.081517   0.046139  -1.767   0.0853 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1668 on 38 degrees of freedom
Multiple R-squared:  0.848,     Adjusted R-squared:  0.836
F-statistic: 70.68 on 3 and 38 DF,  p-value: 1.319e-15
```

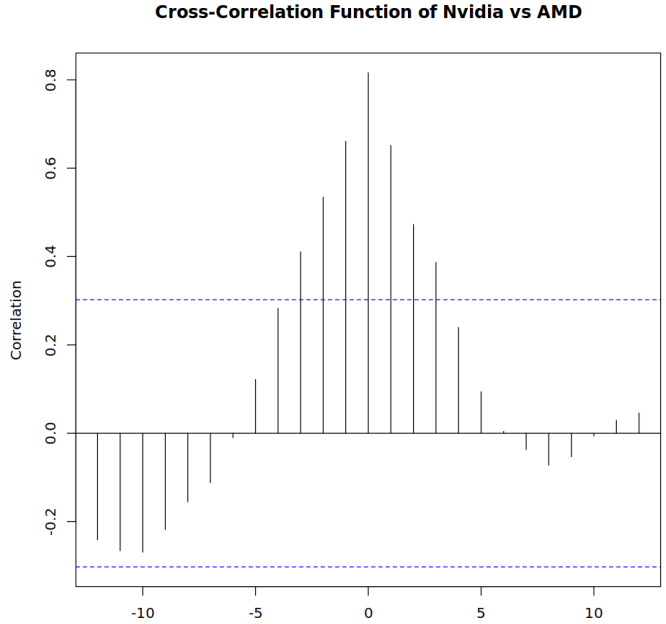
TREND + COVID + GAMES

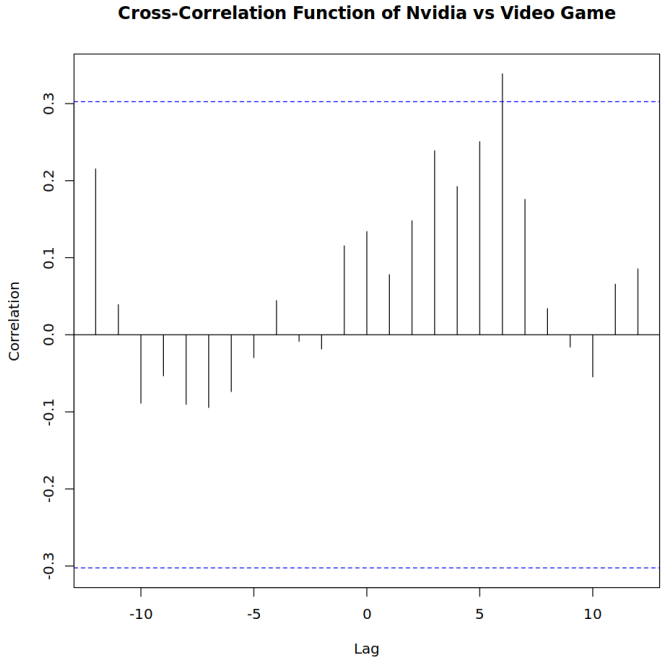
```
Residuals:
     Min       1Q   Median       3Q      Max
-0.56868 -0.14183 -0.03294  0.13633  0.69128

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.408972   0.109789   3.725 0.000633 ***
trend        0.024147   0.004231   5.707 1.44e-06 ***
covid_ts    -0.027665   0.068224  -0.405 0.687385
vidgame_ts  -0.012009   0.083785  -0.143 0.886781
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.3053 on 38 degrees of freedom
Multiple R-squared:  0.491,     Adjusted R-squared:  0.4508
F-statistic: 12.22 on 3 and 38 DF,  p-value: 9.638e-06
```

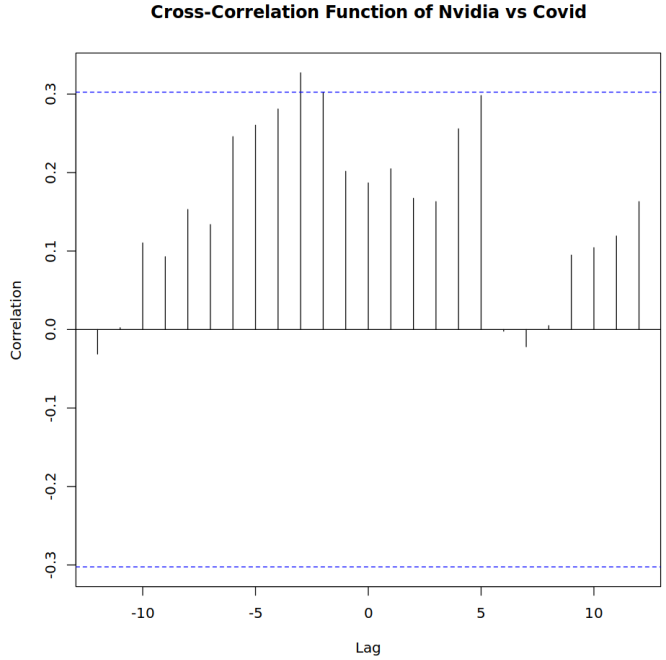


Best model

```
Call:
tslm(formula = nvidia_ts ~ trend + AMD_ts + covid_ts + vidgame_ts)

Residuals:
     Min       1Q   Median       3Q      Max
-0.28417 -0.07136 -0.00907  0.07957  0.50404

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.308687   0.089542  -3.447  0.00143 **
trend        0.017100   0.002281   7.498 6.21e-09 ***
AMD_ts       1.027027   0.099449  10.327 1.89e-12 ***
covid_ts    -0.086292   0.035546  -2.428  0.02018 *
vidgame_ts  -0.096468   0.043862  -2.199  0.03418 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.157 on 37 degrees of freedom
Multiple R-squared:  0.8689,    Adjusted R-squared:  0.8547
F-statistic: 61.31 on 4 and 37 DF,  p-value: 8.089e-16
```







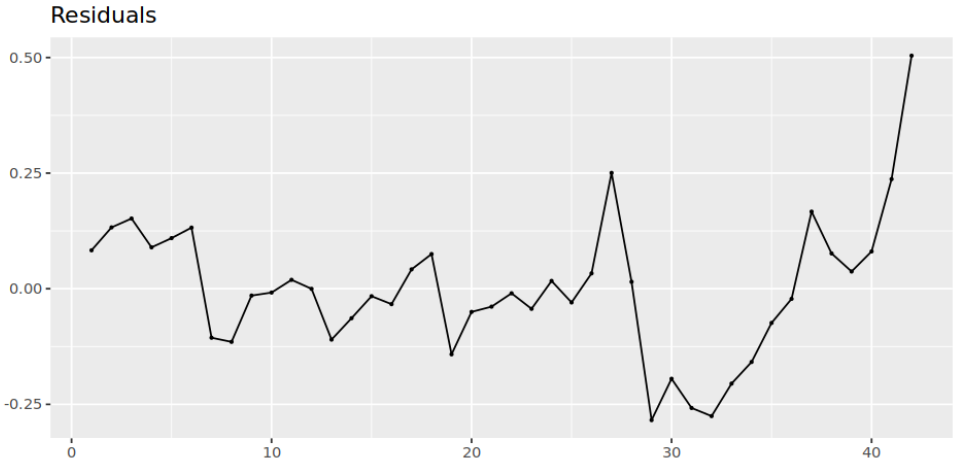

```
Call:
tslm(formula = adjust_nvidia ~ trend + adjust_amd + adjust_cov +
    adjust_vidgame)

Residuals:
     Min       1Q   Median       3Q      Max
-0.31146 -0.06497 -0.01611  0.03777  0.45604

Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)    -0.353436   0.104788  -3.373  0.00187 **
trend           0.020032   0.002617   7.654 6.76e-09 ***
adjust_amd      1.056293   0.103348  10.221 6.65e-12 ***
adjust_cov     -0.093724   0.038376  -2.442  0.01995 *
adjust_vidgame -0.092032   0.043725  -2.105  0.04278 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1557 on 34 degrees of fre
Multiple R-squared:  0.8596,    Adjusted R-squared:  0.8431
F-statistic: 52.03 on 4 and 34 DF,  p-value: 5.01e-1
```

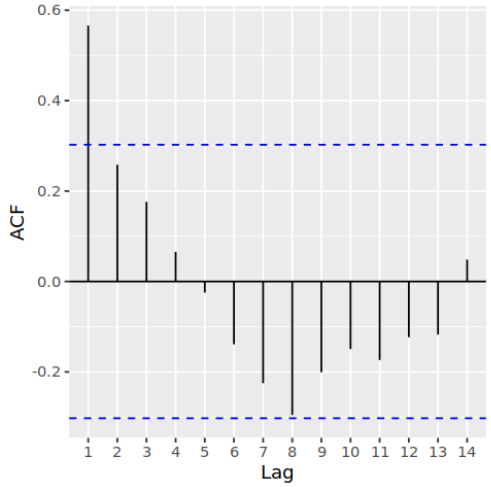
Lagged variables

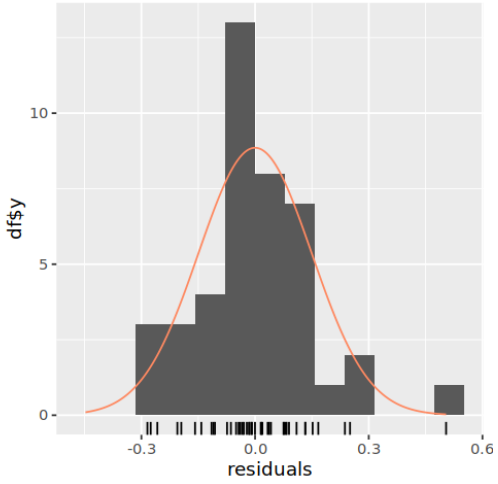
Analyse AMD, GAMES and COVID for lagged variables.

AMD = 0
Games = 0
Covid = -3

AMD + COVID + GAMES + TREND







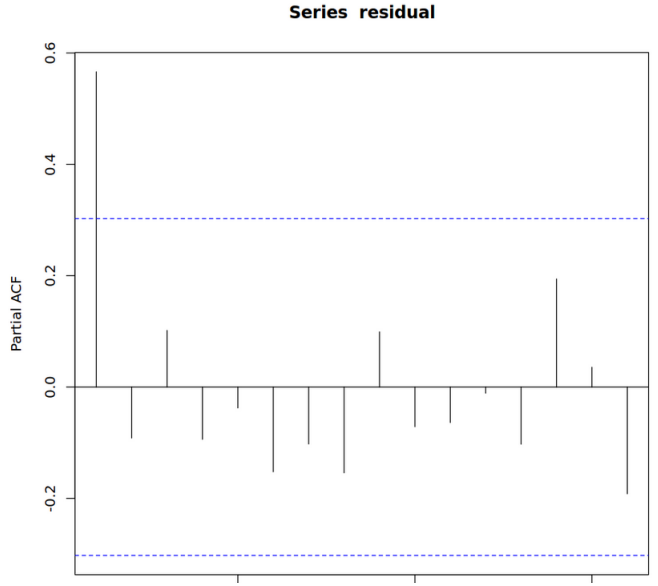
Ljung-Box test

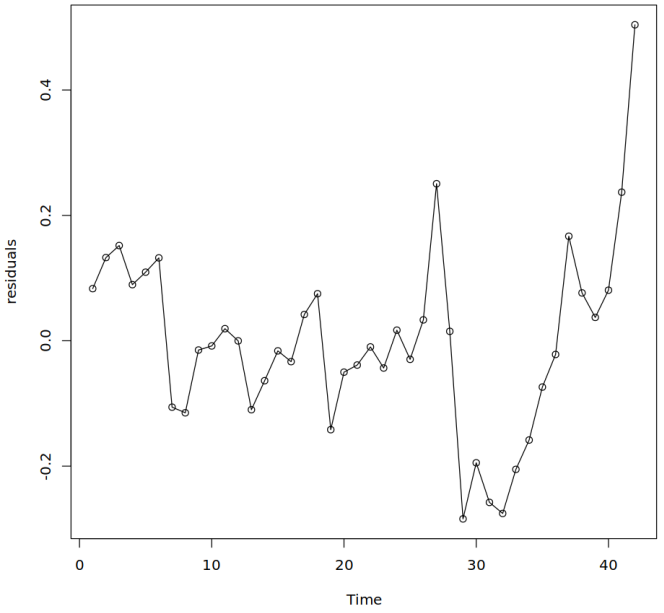
data: Residuals
Q* = 27.635, df = 8, p-value = 0.000549

Model df: 0. Total lags used: 8

Durbin-Watson test

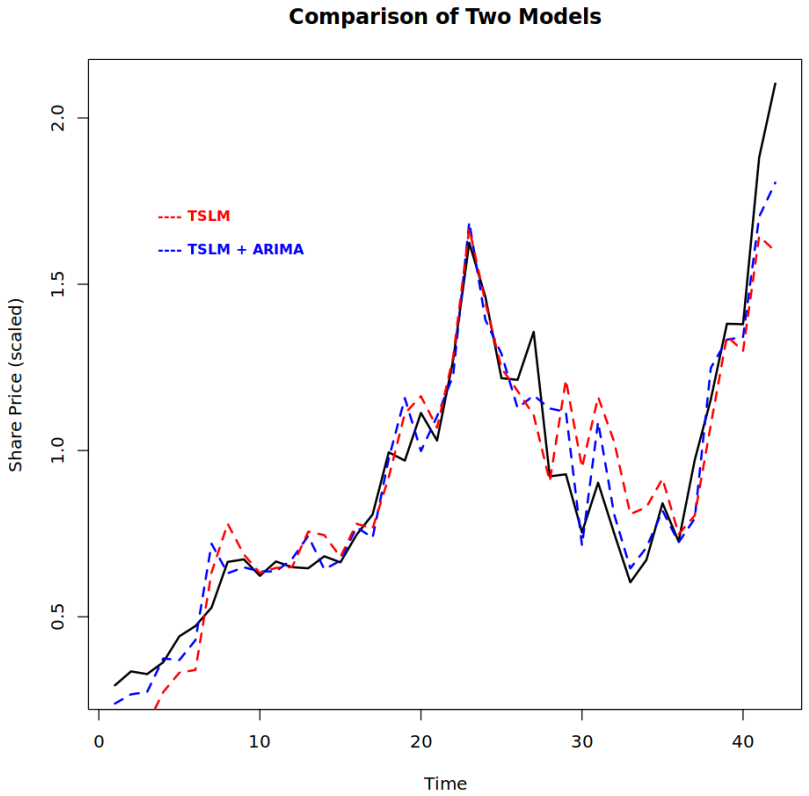
data: fit.tslm_AVC
DW = 0.58176, p-value = 2.504e-09
alternative hypothesis: true autocorrelation is not 0

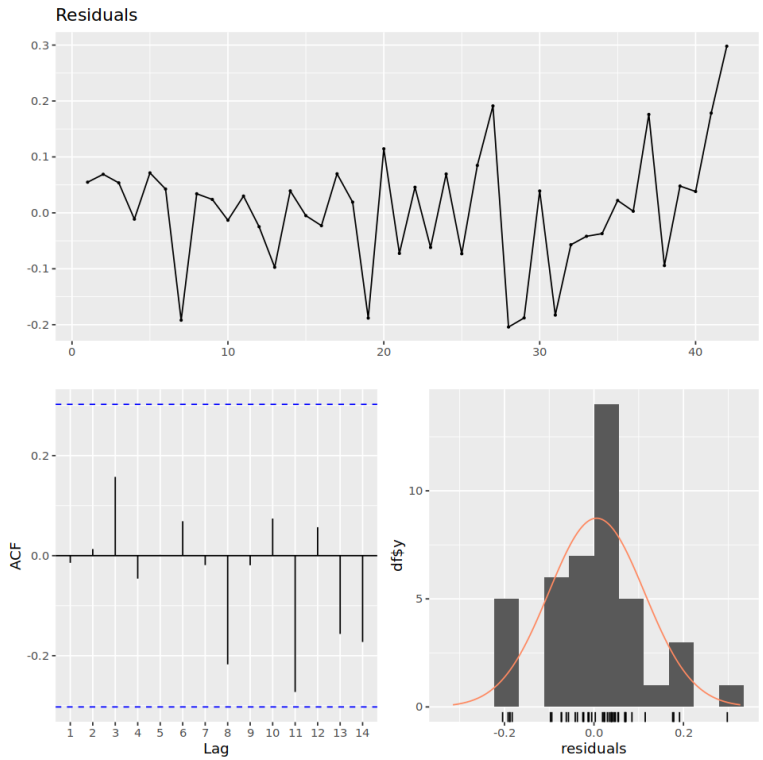




Residuals check

There's still autocorrelation in the residuals





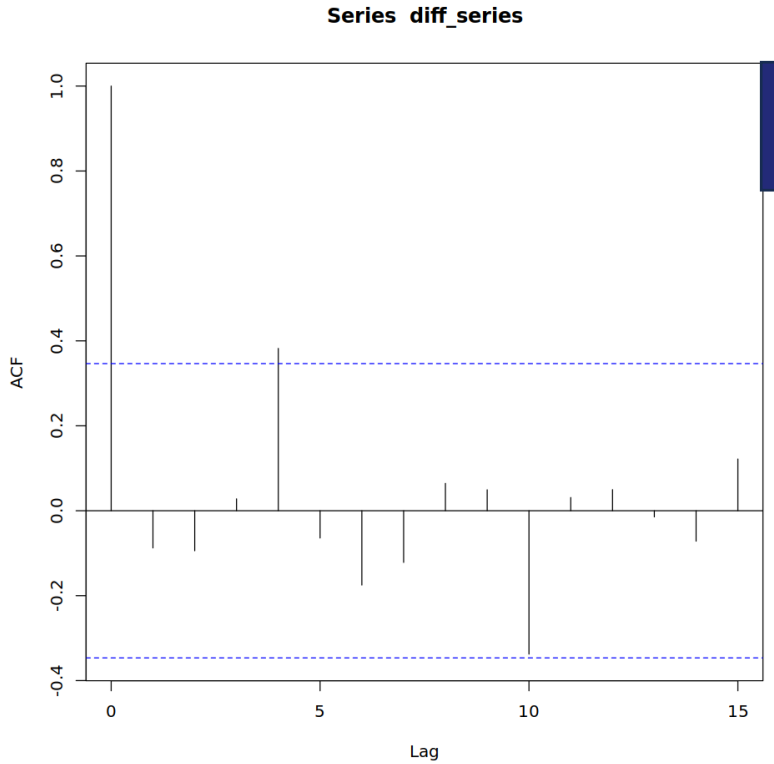

```
Series: residual
ARIMA(1,0,1) with zero mean

Coefficients:
         ar1     ma1
      0.4874  0.5075
s.e.  0.2350  0.2396

sigma^2 = 0.01178:  log likelihood = 34.18
AIC=-62.37   AICc=-61.74   BIC=-57.16
```

```
        Ljung-Box test

data:  Residuals
Q* = 4.1238, df = 8, p-value = 0.8458

Model df: 0.   Total lags used: 8
```

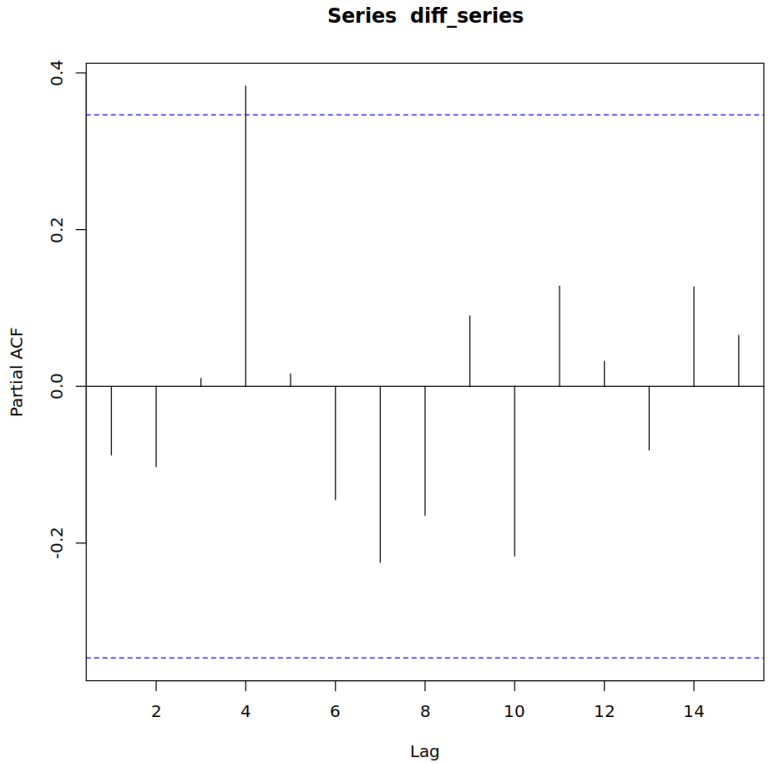
Arima For Residuals

Error TSLM + ARIMA -> 0.4713
Error TSLM -> 0.91233

AMD + COVID + GAMES + TREND + ARIMA (1,0,1)



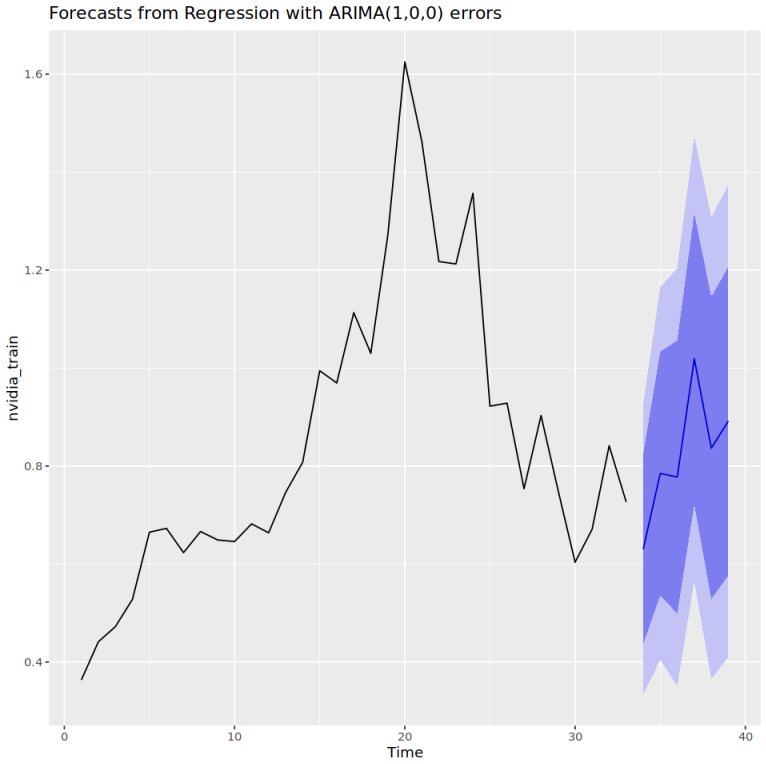
Diff 1

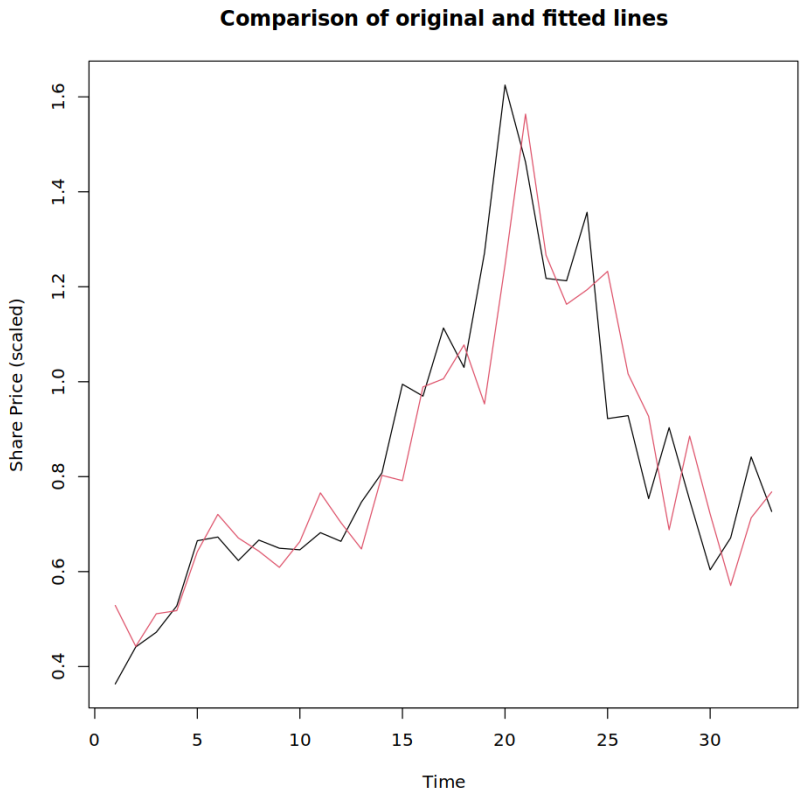


Forecasting

STEPS

Slice data
Training set -> Jan 2020 – Dec 2020
Testing set -> Jan 2023 – Jun 2023
Apply Models



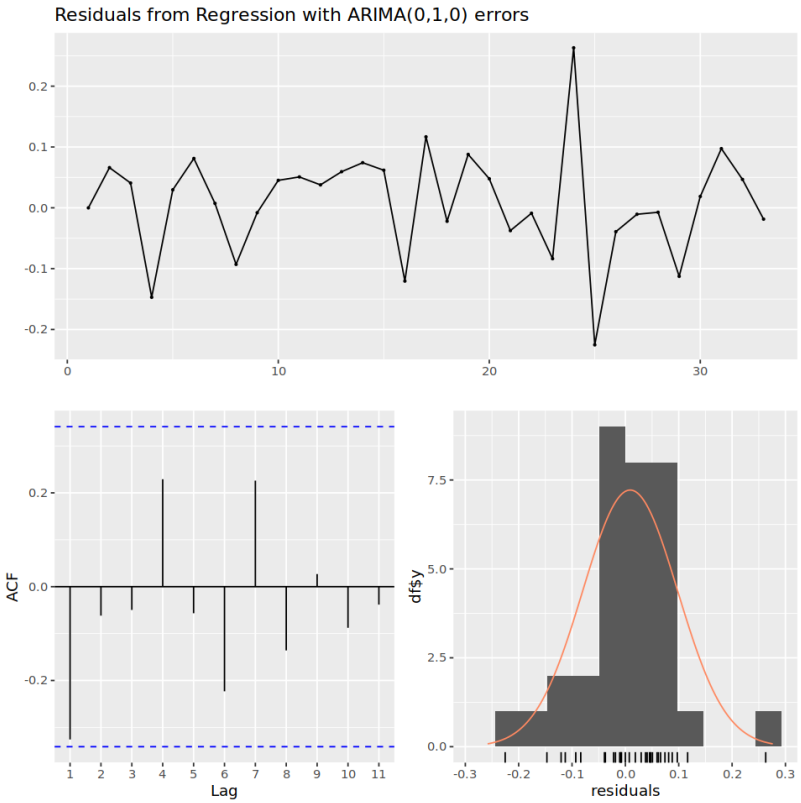



```
Series: nvidia_train
Regression with ARIMA(1,0,0) errors

Coefficients:
         ar1  intercept  AMD_train  covid_train  vidgame_train
      0.8077     0.5601     0.2763       0.0651        -0.0698
s.e.  0.1299     0.2186     0.2188       0.0536         0.0453

sigma^2 = 0.02276:  log likelihood = 17.77
AIC=-23.55   AICc=-20.32   BIC=-14.57

Training set error measures:
                     ME      RMSE       MAE       MPE     MAPE      MASE
Training set 0.01034969 0.1389623 0.1026449 -1.178406 11.93352 0.9054515
                    ACF1
Training set 0.001621722
```

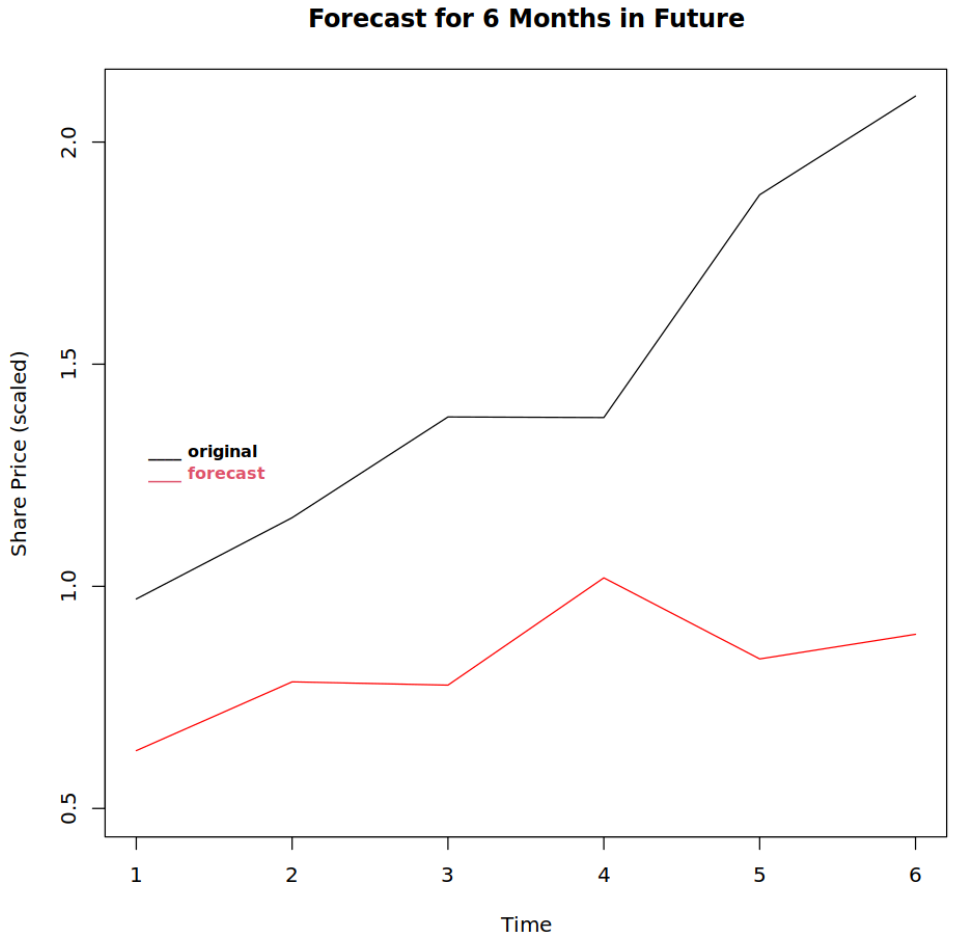
Auto-ARIMA (1,0,0)

Xreg -> AMD + COVID + GAMES

Forecasting




```
        Ljung-Box test

data:  Residuals from Regression with ARIMA(0,1,0) errors
Q* = 10.692, df = 7, p-value = 0.1526

Model df: 0.   Total lags used: 7
```



Conclusions

Best performance:
Trend + AMD + Games + Covid +
ARIMA (1,0,1) [0.4713]

Forecasting:
Auto-Arima (1,0,0)
Xreg -> AMD + Games + Covid