

Did B737 MAX Crisis Handed AIRBUS a Stock Gain?

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Context

The Skies' Fierce Rivalry: BOEING-AIRBUS

- AIRBUS and BOEING (**leading aircraft manufacturers**), have made substantial contributions to developing the global aviation industry.
- AIRBUS has revolutionized the industry by introducing wide-body aircraft.
- BOEING, renowned for its engineering excellence, has a rich legacy of delivering iconic aircraft.
- In 2019, **AIRBUS displaced BOEING** as the largest aerospace company **by revenue** due to the BOEING 737 MAX **groundings**.
[Flight Global, 2020]

Context

What are we considering?

- “The past few months have seen a marked turnaround in **oil prices** accompanied by a strong increase in implied price volatility” .
[E.C.Bank, 2019]
- “Nothing is more important to us than safety. We are determined to restore the **trust we lost in 2019**. We’ll do it one airplane, one flight, one customer at a time.” [BOEING Annual Report, 2019]
- BOEING **accidents** and aftermath.

All the used data are reliable and come from official sources.

- BOEING Annual Financial Report [BOEING Annual Report, 2019]
- AIRBUS Annual Financial Report [AIRBUS Annual Report, 2019]
- Yahoo Finance
 - AIRBUS prices
 - BOEING prices
 - Oil prices¹
- Official News Reports²

¹AIRBUS introduced usage of SAF

²Research based on BOEING volume outliers.

BOEING Events

Date	Event
29.10.2018	First B737 MAX crash , Lion Air, flight 610
10.03.2019	Second B737 MAX crash , Ethiopian Airlines flight 302
19.03.2019	The United States Department of Transportation requested the Office of the Inspector General to conduct an audit of the certification process for the 737-MAX series.
4.04.2019	Boeing official Statement On Ethiopian Airlines Flight 302 Investigation Preliminary Report
7.05.2019	Boeing Chairman, President and Chief Executive Officer speaks at the Bernstein Strategic Decisions Conference
18.09.2019	Boeing may have 'unknowingly' misled regulators about crash-linked software
23.12.2019	Key events leading up to the firing of Boeing's CEO over the 737 MAX investigation.

- Data from October 2018 (1st B737 MAX accident) to December 2019.
- Weekdays (Monday to Friday)³

³Stocks market values only during weekdays and U.S. day hours

Feature Engineering

Our target variable

- **Close price of AIRBUS**
 - European market⁴
 - Units → €

⁴Because stocks were performing similar in the NYSC market.

- **Categorical variables** → Date and Day of the Week
- **Dynamic variables** → Using return of stocks from both companies, different variables were computed.
 - Daily returns for BOEING and AIRBUS
 - Open and close change of BOEING and AIRBUS
 - Percentage open and close change of BOEING and AIRBUS
 - Binary variables → Performances of BOEING and AIRBUS
- **Numerical variables**
 - Open and close prices of BOEING
 - Open prices of AIRBUS
 - Event time span
 - Volumes for BOEING and AIRBUS

Feature Engineering

Shape of the dataframe

- Rows → Every daily observation.
- Columns → Each of the variables considered for both companies and common-ones.

1st Model

Equation

$$\begin{aligned} \text{Close}_{\text{AIRBUS}} \sim & \beta_0 + \beta_1 \text{DayoftheWeek} + \beta_2 \text{Close}_{\text{BOEING}} + \beta_3 \text{Volume}_{\text{AIRBUS}} + \\ & + \beta_4 \text{Volume}_{\text{BOEING}} + \beta_5 \text{Performance}_{\text{BOEING}} + \beta_6 \text{Performance}_{\text{AIRBUS}} \\ & + \beta_7 \text{Change}_{\text{BOEING}} + \beta_8 \text{Change}_{\text{AIRBUS}} + \beta_9 \% \text{Change}_{\text{BOEING}} + \\ & \beta_{10} \% \text{Change}_{\text{AIRBUS}} + \beta_{11} \text{PriceOil} + \beta_{12} \text{Count}_{\text{Events}} + \\ & + \text{marginal effects} \end{aligned}$$

1st Model

Model Summary

```
Call:
lm(formula = target ~ ., data = train_set)

Residuals:
    Min       1Q   Median       3Q      Max
-13.141  -4.542   0.886   4.759  12.860

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  5.829e+01  5.800e+00  10.050  < 2e-16 ***
dayOfWeek    9.870e-02  2.741e-01   0.360  0.719043
Close_BA     1.117e-01  1.503e-02   7.431  1.54e-12 ***
Volume_BA    3.544e-07  1.006e-07   3.522  0.000505 ***
Volume_AIR   -3.964e-06  7.707e-07  -5.143  5.31e-07 ***
Performance_BA 4.572e-01  1.124e+00   0.407  0.684499
Performance_AIR -9.675e-01  1.135e+00  -0.853  0.394544
Change_BA    -2.572e-02  1.133e-01  -0.227  0.820632
Change_AIR    7.354e-01  5.212e-01   1.411  0.159474
X.Change_BA  -1.270e+01  3.093e+01  -0.411  0.681776
X.Change_AIR  -3.964e+00  4.775e+01  -0.083  0.933903
Price        -8.717e+00  1.750e+01  -0.498  0.618763
Count        1.405e-01  4.833e-03  29.068  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 6.263 on 261 degrees of freedom
Multiple R-squared:  0.8121,    Adjusted R-squared:  0.8035
F-statistic: 94.02 on 12 and 261 DF,  p-value: < 2.2e-16
```

3rd Model

Equation

Dropping the variables that drive the target with less than 1% of probability.

The model now looks like:

$$\text{Close}_{\text{AIRBUS}} \sim \beta_0 + \beta_1 \text{Close}_{\text{BOEING}} + \beta_2 \text{Volume}_{\text{BOEING}} + \beta_3 \text{Volume}_{\text{AIRBUS}} + \beta_4 \text{Count}_{\text{Events}} + \text{marginal effects}$$

3rd Model

Model Summary

Call:

```
lm(formula = target ~ ., data = train_set)
```

Residuals:

Min	1Q	Median	3Q	Max
-13.4080	-4.5757	0.5688	4.7616	13.3009

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)	
(Intercept)	5.850e+01	5.603e+00	10.440	< 2e-16	***
Close_BA	1.114e-01	1.466e-02	7.594	5.13e-13	***
Volume_BA	3.549e-07	9.123e-08	3.890	0.000126	***
Volume_AIR	-3.962e-06	7.505e-07	-5.279	2.68e-07	***
Count	1.400e-01	4.756e-03	29.437	< 2e-16	***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 6.228 on 269 degrees of freedom

Multiple R-squared: 0.8085, Adjusted R-squared: 0.8057

F-statistic: 284 on 4 and 269 DF, p-value: < 2.2e-16

2024 Blown Out window stock consequence prediction

1st prediction

Testing the trained model from 2019 with the data from last week event (8th January,2024 and next 3 days).⁵

Target	Fitted value
143.20	135.9533
143.12	128.9140
144.04	127.3262
143.88	125.7921
	☹️

Table: 1st Prediction

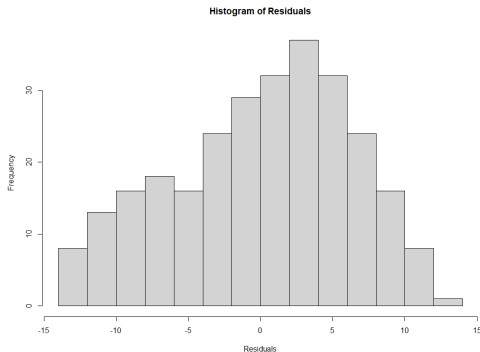
Residuals tests

Jarque-Bera test

Residuals follow a normal distribution?

Jarque-Bera test

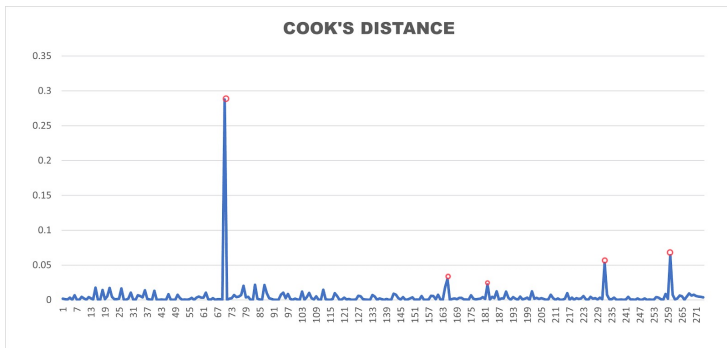
- Jarque-Bera $\rightarrow 10.6$
- p-value $\rightarrow 0.005$
- Skewness $\rightarrow -0.2923$
- Kurtosis $\rightarrow -0.7796$



Residuals tests

Cook's distance test

Influence of independent observations in the model itself.



After dropping the observations with higher Cook's distance we could observe these results.

Target	Fitted value
143.20	136.2078
143.12	128.8574
144.04	127.0940
143.88	125.5992
	☹️

Table: 2nd Prediction

Our model still doesn't fit the data, it can be further improved...

2024 Event prediction

Improved data frame model

After training our 3rd model taking everything mentioned into account...

```
Call:
lm(formula = target ~ ., data = train_set)

Residuals:
    Min       1Q   Median       3Q      Max
-10.8562  -2.6544   0.2903   2.6934  10.0207

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  1.239e+02  6.648e+00  18.643  <2e-16 ***
Close_BA    -2.859e-02  1.673e-02  -1.709  0.0890 .
Volume_BA    1.737e-08  6.938e-08   0.250  0.8026
Volume_AIR  -1.547e-06  6.916e-07  -2.237  0.0265 *
Count         6.205e-02  5.895e-03  10.526  <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 4.244 on 189 degrees of freedom
Multiple R-squared:  0.4857,    Adjusted R-squared:  0.4749
F-statistic: 44.63 on 4 and 189 DF,  p-value: < 2.2e-16
```

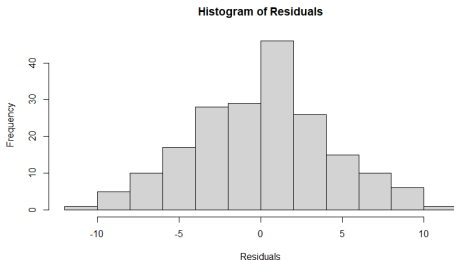
Residuals tests

Jarque-Bera test

Residuals follow a normal distribution?

Jarque-Bera test

- Jarque-Bera $\rightarrow 0.636$
- p-value $\rightarrow 0.7276$
- Skewness $\rightarrow -0.005$
- Kurtosis $\rightarrow -0.3083$



Our model shows the AIRBUS gain stock of last week!

- On 5th of January BOEING had a stock price of 249\$ and AIRBUS had 139.70€
- Alaska Airlines incident on B737 MAX happened during Friday night.

Target	Fitted value
143.20	134.8802
143.12	134.8019
144.04	134.9852
143.88	134.8946

😊

Table: 2nd Prediction

Conclusions

- Need of **Feature Engineering** to have low-correlated quality variables to feed the regression model.
- Residuals do NOT follow a normal distribution.
- **Skewness** and **Kurtosis** is present on our residuals.
 - There is a period of time in the time span of our data, where BOEING does not follow our initial assumptions of the model.
 - Some outliers observations influence the model in a higher manner based on the Cook's distance.
- **Workflow** through the project.
- Models helped us to predict when there is a negative event for the model B-737MAX, AIRBUS will show a **stock gain**.

- **Improve** our model
 - Cleaning data
 - Changing predictors
- **Change** of model (?)
- Feed with **more quality variables** affecting AIRBUS stock prices
 - Effect of currency change
 - Effect of inflation
 - Effect of the gap in the predictions
- Time series analysis (?)
- The Random Walk Behaviour of Stock Prices [A. Cooray, 2003]

References



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Recent developments in oil prices

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The Random Walk Behaviour of Stock Prices: A Comparative Study [ISSN 1443-8593 - ISBN 1 86295 130 6]

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Did B737 MAX Crisis Handed BOEING a Stock Gain?

Research Paper studing the impact of BOEING events to AIRBUS stock prices

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<https://www.overleaf.com/read/mcbrghybnsfy#f2a09a>

Thank you for your attention!
Questions?

Influence of the Events Count to the target

If we do not take into account our main assumption based on BOEING reports, i.e. 2019 was a bad year for BOEING

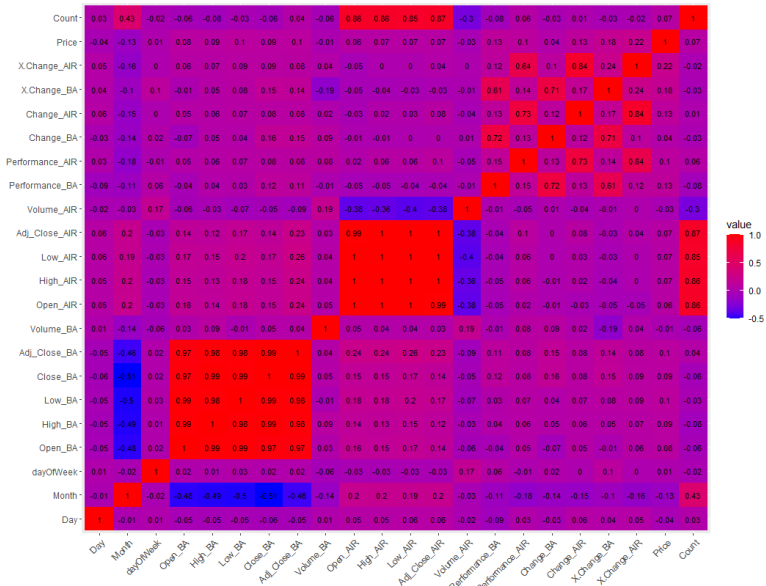
```
Call:
lm(formula = stocks_AIR ~ ., data = train_set)

Residuals:
    Min       1Q   Median       3Q      Max
-32.579  -6.875  -1.160   8.880  25.474

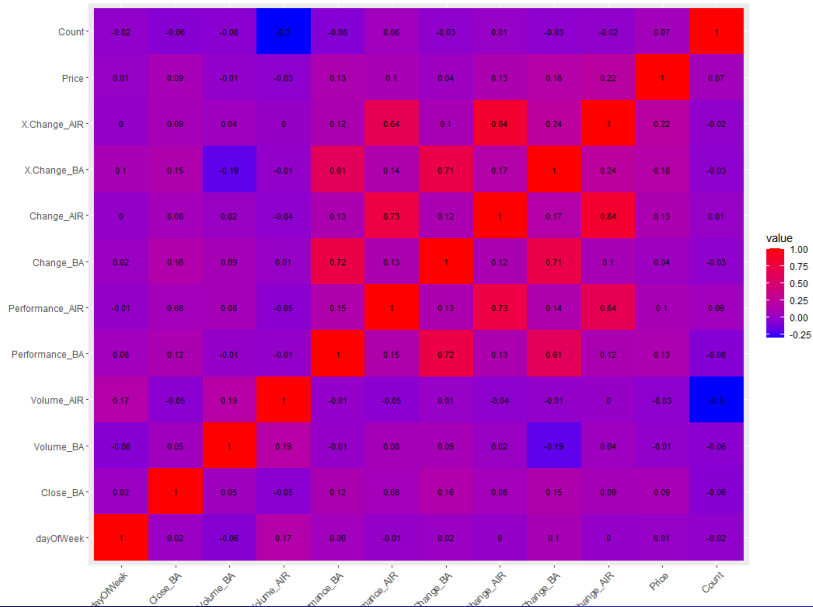
Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  2.634e+01  8.418e+00   3.129  0.00186 **
Month        1.617e+00  1.544e-01  10.473 < 2e-16 ***
Close_BA     2.213e-01  2.215e-02   9.993 < 2e-16 ***
Volume_BA    7.110e-07  1.489e-07   4.775 2.42e-06 ***
Volume_AIR   -7.282e-06  8.360e-07  -8.710 < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 10.94 on 466 degrees of freedom
Multiple R-squared:  0.4242,    Adjusted R-squared:  0.4192
F-statistic: 85.82 on 4 and 466 DF,  p-value: < 2.2e-16
```

Correlation matrix 1



Correlation matrix 2



2nd Model

Equation

The model now looks like:

$$\begin{aligned} \mathbf{Close}_{\text{AIRBUS}} \sim & \beta_0 + \beta_1 \text{Close}_{\text{BOEING}} + \beta_2 \text{Volume}_{\text{BOEING}} + \\ & + \beta_3 \text{Volume}_{\text{AIRBUS}} + \beta_4 \text{Change}_{\text{AIRBUS}} + \beta_5 \text{Count}_{\text{Events}} + \\ & + \text{marginal effects} \end{aligned}$$

2nd Model

Model Summary

```
Call:
lm(formula = target ~ ., data = train_set)

Residuals:
    Min       1Q   Median       3Q      Max
-12.9304  -4.4787   0.5767   4.5848  12.5532

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  5.913e+01  5.590e+00  10.579 < 2e-16 ***
Close_BA     1.094e-01  1.464e-02   7.475 1.10e-12 ***
Volume_BA    3.521e-07  9.084e-08   3.876 0.000134 ***
Volume_AIR   -3.918e-06  7.476e-07  -5.240 3.25e-07 ***
Change_AIR   4.415e-01  2.411e-01   1.831 0.068212 .
Count        1.400e-01  4.735e-03  29.573 < 2e-16 ***
---
signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 6.201 on 268 degrees of freedom
Multiple R-squared:  0.8109,    Adjusted R-squared:  0.8074
F-statistic: 229.8 on 5 and 268 DF,  p-value: < 2.2e-16
```