



Growth Curves and Descriptive Statistics

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This dataset contains historical daily stock prices for Apple (since 1980) and Microsoft (since 1986), adjusted for stock splits and dividends. The columns represent Opening, High, Low, and Closing prices for each trading day. The dataset follows a daily periodicity, excluding weekends and market holidays. The adjustments for stock splits and dividends ensure that past stock prices remain comparable to present-day values.

Sheet 1: Combined Data of Apple and Microsoft Historical Annual Stock Price Data

AJ23	Date	Apple_Open	App_High	App_Low	App_Close	Mic_Open	Mic_High	Mic_Low	Mic_Close
1	12/12/1980	0.0991	0.0995	0.0991	0.0991				
2	12/15/1980	0.0944	0.0944	0.0939	0.0939				
3	12/16/1980	0.0874	0.0874	0.087	0.087				
4	12/17/1980	0.0892	0.0896	0.0892	0.0892				
5	12/18/1980	0.0918	0.0922	0.0918	0.0918				
6	12/19/1980	0.0974	0.0978	0.0974	0.0974				
7	12/22/1980	0.1021	0.1025	0.1021	0.1021				
8	12/23/1980	0.1064	0.1068	0.1064	0.1064				
9	12/24/1980	0.112	0.1125	0.112	0.112				
10	12/26/1980	0.1223	0.1228	0.1223	0.1223				
11	12/29/1980	0.1241	0.1245	0.1241	0.1241				
12	12/30/1980	0.1215	0.1215	0.121	0.121				
13	12/31/1980	0.118	0.118	0.1176	0.1176				
14	1/2/1981	0.1189	0.1198	0.1189	0.1189				
15	1/5/1981	0.1167	0.1167	0.1163	0.1163				
16	1/6/1981	0.1116	0.1116	0.1111	0.1111				
17	1/7/1981	0.1068	0.1068	0.1064	0.1064				
18	1/8/1981	0.1047	0.1047	0.1043	0.1043				
19	1/9/1981	0.1099	0.1103	0.1099	0.1099				
20	1/12/1981	0.1099	0.1099	0.109	0.109				
21	1/13/1981	0.1056	0.1056	0.1051	0.1051				
22	1/14/1981	0.1056	0.106	0.1056	0.1056				
23	1/15/1981	0.1077	0.1086	0.1077	0.1077				
24	1/16/1981	0.1073	0.1073	0.1068	0.1068				
25	1/19/1981	0.1133	0.1137	0.1133	0.1133				
26	1/20/1981	0.1103	0.1103	0.1099	0.1099				
27	1/21/1981	0.112	0.1129	0.112	0.112				
28	1/22/1981	0.1133	0.1142	0.1133	0.1133				
29	1/23/1981	0.1133	0.1137	0.1129	0.1129				
30	1/26/1981	0.1116	0.1116	0.1111	0.1111				
31	1/27/1981	0.1111	0.1111	0.1103	0.1103				
32	1/28/1981	0.1073	0.1073	0.1068	0.1068				
33	1/29/1981	0.1034	0.1034	0.1029	0.1029				

Sheet 2: Apple and Microsoft Historical Annual Stock Price Data for Year 1986-2025

	A	B	C	D	E	F	G	H	I	J	K	L
1	Date	Apple_Open	App_High	App_Low	App_Close	Mic_Open	Mic_High	Mic_Low	Mic_Close			
2	3/13/1986	0.0853	0.0862	0.084	0.0853	0.0548	0.0628	0.0548	0.0602			
3	3/14/1986	0.0853	0.0905	0.0853	0.09	0.0602	0.0634	0.0602	0.0623			
4	3/17/1986	0.0896	0.0896	0.0874	0.0896	0.0623	0.0639	0.0623	0.0634			
5	3/18/1986	0.0896	0.0939	0.0892	0.0926	0.0634	0.0639	0.0612	0.0618			
6	3/19/1986	0.0926	0.0939	0.0909	0.0913	0.0618	0.0623	0.0602	0.0607			
7	3/20/1986	0.0965	0.1021	0.0965	0.0974	0.0607	0.0607	0.0585	0.0591			
8	3/21/1986	0.0974	0.0991	0.0948	0.0952	0.0591	0.0602	0.0564	0.0575			
9	3/24/1986	0.0952	0.0952	0.0909	0.0922	0.0575	0.0575	0.0553	0.0559			
10	3/25/1986	0.0922	0.0961	0.0922	0.0961	0.0559	0.0569	0.0553	0.0569			
11	3/26/1986	0.0961	0.0991	0.0961	0.0974	0.0569	0.0591	0.0564	0.0585			
12	3/27/1986	0.0974	0.0999	0.0974	0.0974	0.0585	0.0596	0.0585	0.0596			
13	3/31/1986	0.0974	0.0982	0.0965	0.0974	0.0596	0.0596	0.058	0.0591			
14	4/1/1986	0.0974	0.0974	0.0931	0.0939	0.0591	0.0591	0.0585	0.0585			
15	4/2/1986	0.0939	0.0943	0.0905	0.0939	0.0585	0.0602	0.0585	0.0591			
16	4/3/1986	0.0939	0.0952	0.0926	0.0931	0.0596	0.0612	0.0596	0.0596			
17	4/4/1986	0.0931	0.0931	0.0917	0.0922	0.0596	0.0602	0.0596	0.0596			
18	4/7/1986	0.0922	0.0918	0.0905	0.0929	0.0596	0.0602	0.0575	0.0585			

< > ≡ COMBINED DATA 1986 1987 YEARLY AVG OF HIGH +

Sheet 3: Apple and Microsoft Historical Annual Stock Price Data for Year 1987-2025

	A	B	C	D	E	F	G	H	I	J	K
1	Date	Apple_Open	App_High	App_Low	App_Close	Mic_Open	Mic_High	Mic_Low	Mic_Close		
2	1/2/1987	0.1392	0.1417	0.1383	0.1409	0.1037	0.1047	0.1021	0.1026		
3	1/5/1987	0.1422	0.1491	0.1413	0.1482	0.1026	0.1096	0.1021	0.1085		
4	1/6/1987	0.1486	0.1516	0.1469	0.1508	0.1085	0.1107	0.108	0.1101		
5	1/7/1987	0.1512	0.1547	0.1504	0.1542	0.1101	0.116	0.1101	0.116		
6	1/8/1987	0.1542	0.1555	0.1534	0.1542	0.1166	0.1209	0.1166	0.1198		
7	1/9/1987	0.1542	0.1577	0.1529	0.1564	0.1198	0.1252	0.1192	0.1246		
8	1/12/1987	0.1568	0.1577	0.1542	0.1568	0.1246	0.1337	0.1235	0.1327		
9	1/13/1987	0.1555	0.1564	0.1538	0.1538	0.1316	0.1316	0.1268	0.1289		
10	1/14/1987	0.1538	0.1663	0.1534	0.1659	0.1289	0.1295	0.1262	0.1289		
11	1/15/1987	0.1663	0.1771	0.1654	0.1719	0.1289	0.1391	0.1289	0.1359		
12	1/16/1987	0.1723	0.1723	0.1646	0.168	0.1359	0.1359	0.13	0.1327		
13	1/19/1987	0.168	0.1831	0.165	0.1831	0.1327	0.1375	0.13	0.1375		
14	1/20/1987	0.1896	0.1921	0.1775	0.1779	0.1375	0.1429	0.137	0.1397		
15	1/21/1987	0.1754	0.1762	0.1689	0.1689	0.1397	0.1493	0.137	0.1456		
16	1/22/1987	0.1685	0.1814	0.1671	0.1809	0.1456	0.1606	0.1413	0.1601		
17	1/23/1987	0.1809	0.1827	0.1732	0.1732	0.1601	0.1665	0.145	0.145		
18	1/26/1987	0.1723	0.174	0.1706	0.1715	0.1461	0.1493	0.1413	0.1477		
19	1/27/1987	0.1723	0.1831	0.1719	0.1818	0.1477	0.1558	0.1477	0.1536		
20	1/28/1987	0.1827	0.1921	0.1797	0.1909	0.1536	0.1563	0.1493	0.1542		
21	1/29/1987	0.1926	0.1973	0.184	0.1866	0.1542	0.1558	0.1445	0.1477		
22	1/30/1987	0.1861	0.1926	0.1814	0.1913	0.1477	0.1574	0.1456	0.1571		

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Sheet 4: Computed Yearly Average of Apple and Microsoft Historical Annual Stock Price Data for Year 1987-2025

	A	B	C	D	E	F	G	H	I	J	K	L
1	Date	App_High	Mic_High									
2	1987	0.274751779	0.216171146									
3	1988	0.292598419	0.242229644									
4	1989	0.296201984	0.273538492									
5	1990	0.270529249	0.543626482									
6	1991	0.382317787	1.010239921									
7	1992	0.401413386	1.573443701									
8	1993	0.304388142	1.636894862									
9	1994	0.256800397	2.005896525									
10	1995	0.308953571	3.256146429									
11	1996	0.191434646	4.716894882									
12	1997	0.138256917	9.475640711									
13	1998	0.235465476	15.45019683									
14	1999	0.445082143	27.49420437									
15	2000	0.711846825	24.10655238									
16	2001	0.312775806	19.6807625									
17	2002	0.294050794	17.17066032									
18	2003	0.283759524	16.41669048									
19	2004	0.542671825	17.33535079									
20	2005	1.424959127	18.26685317									
21	2006	2.167471713	18.81385976									
22	2007	3.919049004	22.12796295									
23	2008	4.371849012	19.80841423									
24	2009	4.473271429	17.39958373									
25	2010	7.903578571	20.82975437									
26	2011	11.06824048	20.5343									
27	2012	17.5697456	24.1147628									
28	2013	14.71404008	27.08275794									
29	2014	20.54252778	36.40954881									
30	2015	27.23344524	41.19555317									
31	2016	24.17119444	49.9946619									
32	2017	35.36933227	66.61744622									
33	2018	45.29915857	95.7896506									
34	2019	50.55474167	124.9398905									
35	2020	94.22270277	188.0003482									
36	2021	139.6829897	269.9959738									
37	2022	154.8247163	266.7279522									
38	2023	172.584828	313.218734									
39	2024	208.4705742	422.0614639									
40	2025	236.3963815	427.8018222									
41												

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...
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S.J.A.M

< > ⏷ COMBINED DATA 1986 1987 YEARLY AVG OF HIGH

Reading CSV file

The screenshot shows the RStudio interface. The left pane displays an R script named 'Untitled3.R' with the following code:

```
1 #AMAT 132 Exercise 2
2 #Growth Curves and Descriptive Statistics
3
4
5 #installing the packages
6 install.packages("ggplot2")
7 install.packages("dplyr")
8 install.packages("readr")
9
10
11 # Load necessary libraries
12 library(ggplot2)
13 library(dplyr)
14 library(readr)
15
16 # Read CSV file (Ensure correct file path)
17 df <- read_csv("C:/Users/saint/Documents/AMAT132/AMAT_132.csv")
18
19
20 # Display first few rows
21 head(df)
22
23 # Clean column names (Replace spaces with underscores, and handle other special characters -)
24 colnames(df) <- make.names(colnames(df)) # More robust than gsub
25
26 # Convert necessary columns to numeric. Handle potential errors
27
```

The right pane shows the Data View with a table named 'df' containing 39 observations of 3 variables.

Console output:

```
R - R.4.4.2 - ~/Desktop/Untitled3.R
> # Read CSV file (Ensure correct file path)
> df <- read_csv("C:/Users/saint/Documents/AMAT132/AMAT_132.csv")
Rows: 39 Columns: 3
── Column specification ──────────────────────────────────────────────────
Delimiter: ","
dbl (3): Date, App_High, Mic_High

i use `spec()` to retrieve the full column specification for this data.
i specify the column types or set `show_col_types = FALSE` to quiet this message.
>
```

Displaying first few rows

The screenshot shows the RStudio interface. The left pane displays an R script named 'Untitled3.R' with the following code:

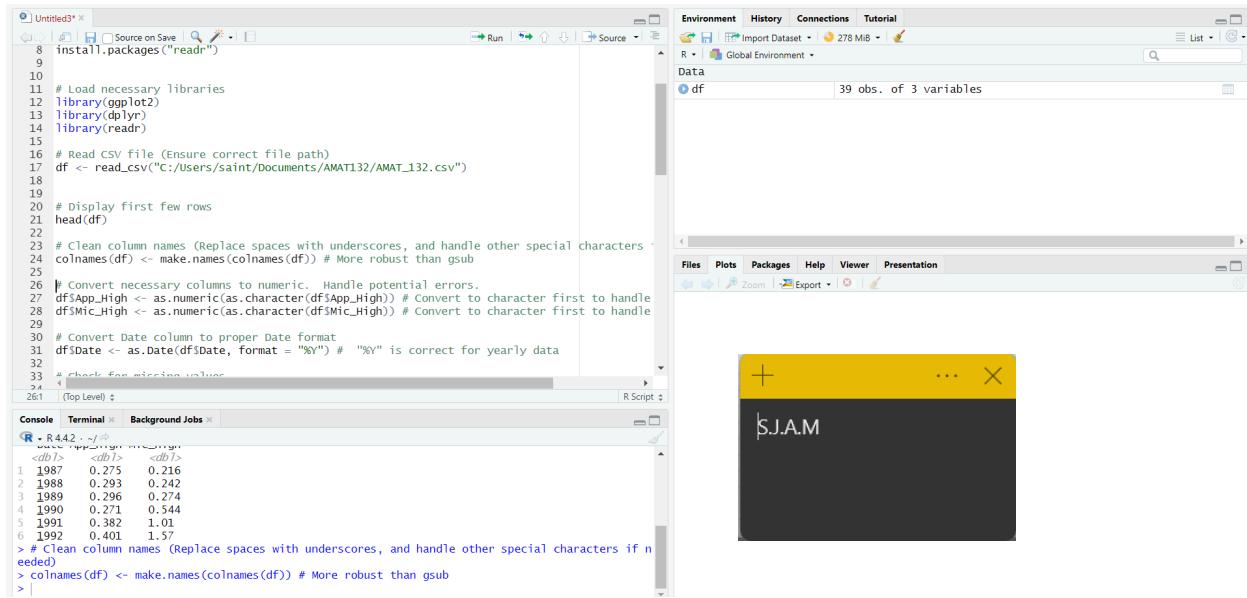
```
1 #AMAT 132 Exercise 2
2 #Growth Curves and Descriptive Statistics
3
4
5 #installing the packages
6 install.packages("ggplot2")
7 install.packages("dplyr")
8 install.packages("readr")
9
10
11 # Load necessary libraries
12 library(ggplot2)
13 library(dplyr)
14 library(readr)
15
16 # Read CSV file (Ensure correct file path)
17 df <- read_csv("C:/Users/saint/Documents/AMAT132/AMAT_132.csv")
18
19
20 # Display first few rows
21 head(df)
22
23 # Clean column names (Replace spaces with underscores, and handle other special characters -)
24 colnames(df) <- make.names(colnames(df)) # More robust than gsub
25
26 # Convert necessary columns to numeric. Handle potential errors
27
```

The right pane shows the Data View with a table named 'df' containing 39 observations of 3 variables.

Console output:

```
R - R.4.4.2 - ~/Desktop/Untitled3.R
> head(df)
# A tibble: 6 × 3
  Date App_High Mic_High
  <dbl>    <dbl>    <dbl>
1 1987     0.275   0.216
2 1988     0.293   0.242
3 1989     0.296   0.274
4 1990     0.271   0.544
5 1991     0.382   1.01
6 1992     0.401   1.57
```

Clean column names (Replace spaces with underscores, and handle other special characters if needed)



The screenshot shows the RStudio interface with the following details:

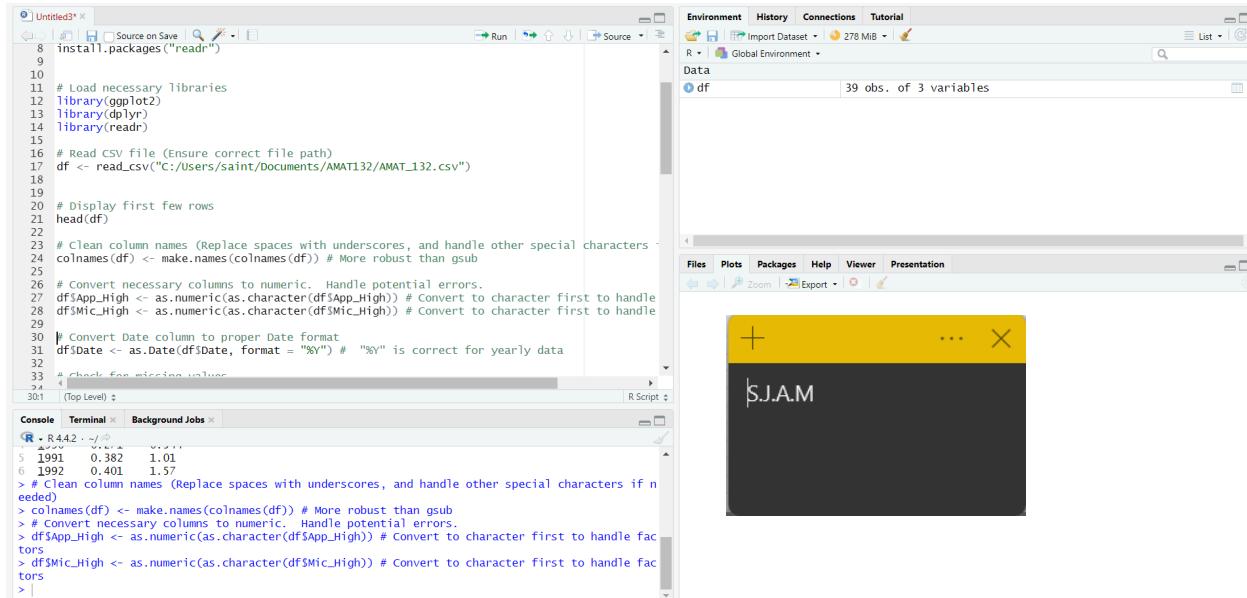
- Code Editor:** An R script titled "Untitled3" containing code to install packages, load libraries, read a CSV file, display the first few rows, clean column names, convert columns to numeric, and convert the Date column to a proper date format.
- Environment View:** Shows a dataset named "df" with 39 observations and 3 variables.
- Console View:** Displays the output of the R script, including the data frame structure and the first few rows of the "df" dataset.

```
8 install.packages("readr")
9
10 # Load necessary libraries
11 library(ggplot2)
12 library(dplyr)
13 library(readr)
14
15 # Read CSV file (Ensure correct file path)
16 df <- read_csv("C:/Users/saint/Documents/AMAT132/AMAT_132.csv")
17
18
19 # Display first few rows
20 head(df)
21
22
23 # Clean column names (Replace spaces with underscores, and handle other special characters - colnames(df) <- make.names(colnames(df)) # More robust than gsub
24
25 # Convert necessary columns to numeric. Handle potential errors.
26 df$App_High <- as.numeric(as.character(df$App_High)) # Convert to character first to handle
27 df$Mic_High <- as.numeric(as.character(df$Mic_High)) # Convert to character first to handle
28
29
30 # Convert Date column to proper Date format
31 df$date <- as.Date(df$date, format = "%Y") # "%Y" is correct for yearly data
32
33 # Check for missing values
34
35
```

> |

Year	App_High	Mic_High
1987	0.275	0.216
1988	0.293	0.202
1989	0.296	0.274
1990	0.273	0.544
1991	0.382	1.01
1992	0.401	1.57

Convert necessary columns to numeric. Handle potential errors.



The screenshot shows the RStudio interface with the following details:

- Code Editor:** An R script titled "Untitled3" containing code to install packages, load libraries, read a CSV file, display the first few rows, clean column names, convert columns to numeric, and convert the Date column to a proper date format.
- Environment View:** Shows a dataset named "df" with 39 observations and 3 variables.
- Console View:** Displays the output of the R script, including the data frame structure and the first few rows of the "df" dataset.

```
8 install.packages("readr")
9
10 # Load necessary libraries
11 library(ggplot2)
12 library(dplyr)
13 library(readr)
14
15 # Read CSV file (Ensure correct file path)
16 df <- read_csv("C:/Users/saint/Documents/AMAT132/AMAT_132.csv")
17
18
19 # Display first few rows
20 head(df)
21
22
23 # Clean column names (Replace spaces with underscores, and handle other special characters - colnames(df) <- make.names(colnames(df)) # More robust than gsub
24
25 # Convert necessary columns to numeric. Handle potential errors.
26 df$App_High <- as.numeric(as.character(df$App_High)) # Convert to character first to handle
27 df$Mic_High <- as.numeric(as.character(df$Mic_High)) # Convert to character first to handle
28
29
30 # Convert Date column to proper Date format
31 df$date <- as.Date(df$date, format = "%Y") # "%Y" is correct for yearly data
32
33 # Check for missing values
34
35
```

> |

Year	App_High	Mic_High
1991	0.382	1.01
1992	0.401	1.57

Convert Date column to proper Date format

The screenshot shows the RStudio interface with the following details:

- Code Editor:** An R script titled "Untitled3.R" containing code to read a CSV file, clean column names, convert numeric columns to character, and convert date columns to proper Date format.
- Data View:** Shows a dataset named "df" with 39 observations and 3 variables.
- Console:** Displays the R session history, including the execution of the script's commands.
- Environment:** Shows the global environment with the "df" object.
- Plots:** A small window titled "S.J.A.M" is visible in the background.

```
12 library(ggplot2)
13 library(dplyr)
14 library(readr)
15
16 # Read CSV file (Ensure correct file path)
17 df <- read_csv("C:/Users/saint/Documents/AMAT132/AMAT_132.csv")
18
19
20 # Display first few rows
21 head(df)
22
23 # Clean column names (Replace spaces with underscores, and handle other special characters - colnames(df) <- make.names(colnames(df)) # More robust than gsub
24
25
26 # Convert necessary columns to numeric. Handle potential errors.
27 df$App_High <- as.numeric(as.character(df$App_High)) # Convert to character first to handle
28 df$Mic_High <- as.numeric(as.character(df$Mic_High)) # Convert to character first to handle
29
30 # Convert Date column to proper Date format
31 df$date <- as.Date(df$date, format = "%Y") # "%Y" is correct for yearly data
32
33 # Check for missing values
34 sum(is.na(df$App_High))
35 sum(is.na(df$Mic_High))
36
37
38
39
40
41
```

Check for missing values

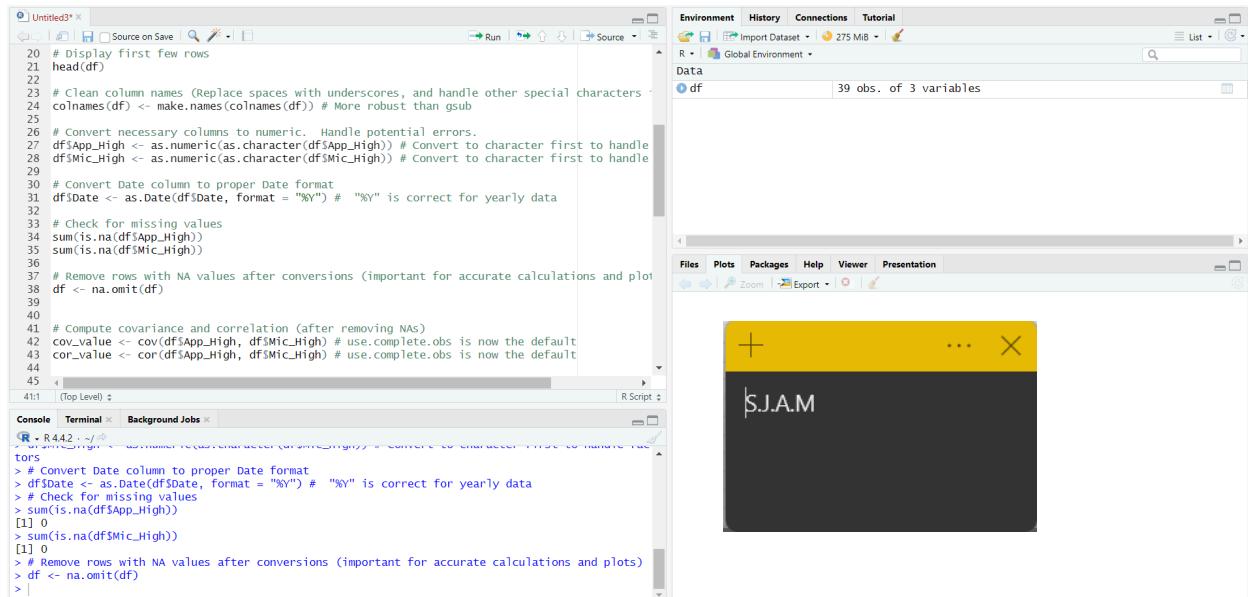
The screenshot shows the RStudio interface with the following details:

- Code Editor:** An R script titled "Untitled3.R" containing code to read a CSV file, clean column names, convert numeric columns to character, convert date columns to proper Date format, and check for missing values.
- Data View:** Shows a dataset named "df" with 39 observations and 3 variables.
- Console:** Displays the R session history, including the execution of the script's commands.
- Environment:** Shows the global environment with the "df" object.
- Plots:** A small window titled "S.J.A.M" is visible in the background.

```
16 # Read CSV file (Ensure correct file path)
17 df <- read_csv("C:/Users/saint/Documents/AMAT132/AMAT_132.csv")
18
19
20 # Display first few rows
21 head(df)
22
23 # Clean column names (Replace spaces with underscores, and handle other special characters - colnames(df) <- make.names(colnames(df)) # More robust than gsub
24
25
26 # Convert necessary columns to numeric. Handle potential errors.
27 df$App_High <- as.numeric(as.character(df$App_High)) # Convert to character first to handle
28 df$Mic_High <- as.numeric(as.character(df$Mic_High)) # Convert to character first to handle
29
30 # Convert Date column to proper Date format
31 df$date <- as.Date(df$date, format = "%Y") # "%Y" is correct for yearly data
32
33 # Check for missing values
34 sum(is.na(df$App_High))
35 sum(is.na(df$Mic_High))
36
37 # Remove rows with NA values after conversions (important for accurate calculations and plots)
38 df <- na.omit(df)
39
40
41
```

```
[1] 0
> sum(is.na(df$App_High))
[1] 0
> sum(is.na(df$Mic_High))
[1] 0
> |
```

Remove rows with NA values after conversions (important for accurate calculations and plots) df <- na.omit(df)



The screenshot shows the RStudio interface with the following details:

- Code Editor:** An R script titled "Untitled3.R" containing the provided R code for data cleaning and removing NA values.
- Environment View:** Shows the global environment with a data frame named "df" containing 39 observations and 3 variables.
- Console View:** Displays the R session history, showing the execution of the code and the resulting output, including the removal of rows with NA values.
- Plots View:** A small plot window titled "S.J.A.M." is visible.

```

20 # Display first few rows
21 head(df)
22
23 # Clean column names (Replace spaces with underscores, and handle other special characters)
24 colnames(df) <- make.names(colnames(df)) # More robust than gsub
25
26 # Convert necessary columns to numeric. Handle potential errors.
27 df$App_High <- as.numeric(as.character(df$App_High)) # Convert to character first to handle
28 df$Mic_High <- as.numeric(as.character(df$Mic_High)) # Convert to character first to handle
29
30 # Convert Date column to proper Date format
31 df$date <- as.Date(df$date, format = "%Y") # "%Y" is correct for yearly data
32
33 # Check for missing values
34 sum(is.na(df$App_High))
35 sum(is.na(df$Mic_High))
36
37 # Remove rows with NA values after conversions (important for accurate calculations and plots)
38 df <- na.omit(df)
39
40
41 # Compute covariance and correlation (after removing NAs)
42 cov_value <- cov(df$App_High, df$Mic_High) # use.complete.obs is now the default
43 cor_value <- cor(df$App_High, df$Mic_High) # use.complete.obs is now the default
44
45 <
46
47
48
49 <
50
51
52
53
54
55
56
57
58
59
59 <
60
61
62
63
64
65
66
67
68
69
69 <
70
71
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74
75
76
77
78
79
79 <
80
81
82
83
84
85
86
87
87 <
88
89
90
91
92
93
94
95
95 <
96
97
98
99
99 <
100
101
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137 <
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147
147 <
148
149
150
151
152
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Printing results for covariance and correlation

The screenshot shows the RStudio interface with the following details:

- Code Editor:** The left pane displays R code for data cleaning, covariance calculation, and scatter plot creation.
- Console:** The bottom-left pane shows the R command-line interface with the R version (R 4.4.2) and the current working directory (~/Desktop).
- Environment:** The top-right pane shows the global environment with a data frame named "df" containing three variables: cor_value (0.994910940822693) and cov_value (7112.37286388347).
- Plots:** A scatter plot titled "S.J.A.M" is displayed in the bottom-right pane, showing the relationship between Apple High and Microsoft High prices.

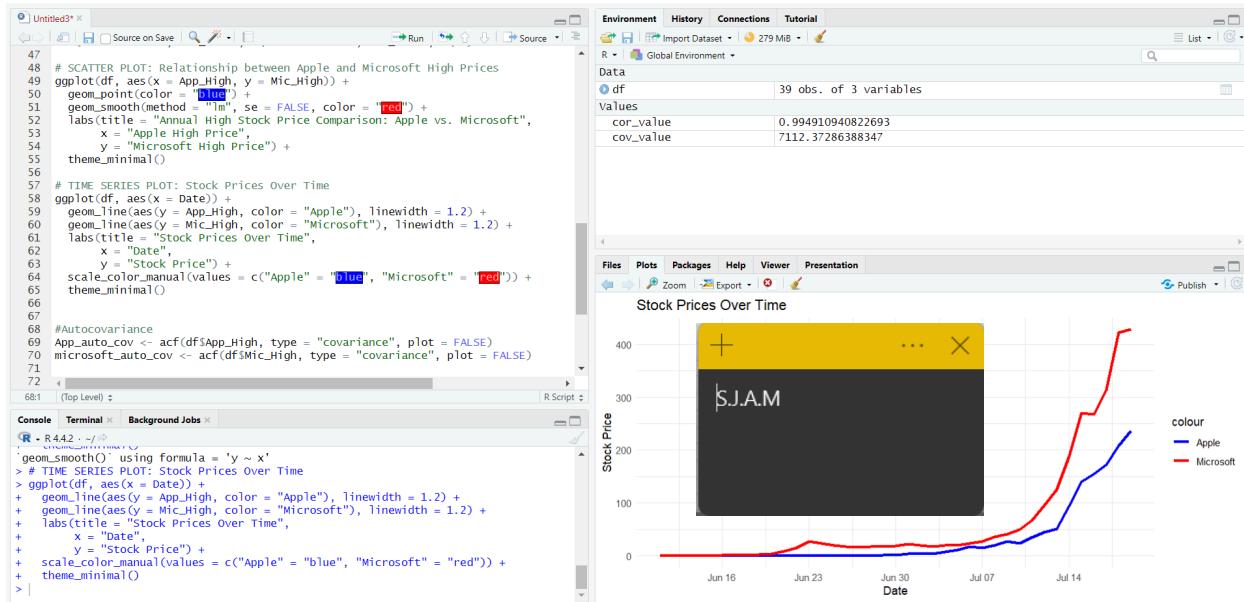
SCATTER PLOT: Relationship between Apple and Microsoft High Prices

The figure shows a screenshot of the RStudio interface. On the left, the code editor displays R code for calculating covariance and correlation between Apple and Microsoft stock prices, followed by a scatter plot command. The console window at the bottom shows the execution of the code and the resulting correlation value (0.9949109). The main workspace shows a scatter plot titled "Annual High Stock Price Comparison: Apple vs. Microsoft". The x-axis is labeled "Apple High Price" and ranges from 0 to 200. The y-axis is labeled "Microsoft High Price" and ranges from 0 to 400. Blue dots represent Apple data points, and red dots represent Microsoft data points. A solid red line shows a strong positive linear trend. The top right corner features a yellow header bar with the text "S.J.A.M".

The scatter plot shows how the high stock prices of Apple and Microsoft relate to each other, and it reveals a strong positive correlation. This means that when Apple's stock price goes up, Microsoft's tends to rise as well. You can see this trend in the upward slope of the data points, which aligns closely with the red regression line. This line indicates a linear relationship between the two companies' stock prices. There are a few points that stand out as outliers, indicating moments when one company's stock behaved differently—these could be due to specific market factors at play. Overall, the plot suggests

that Apple and Microsoft's stock prices generally move in tandem, likely influenced by larger market trends or conditions in the tech industry.

TIME SERIES PLOT: Stock Prices Over Time

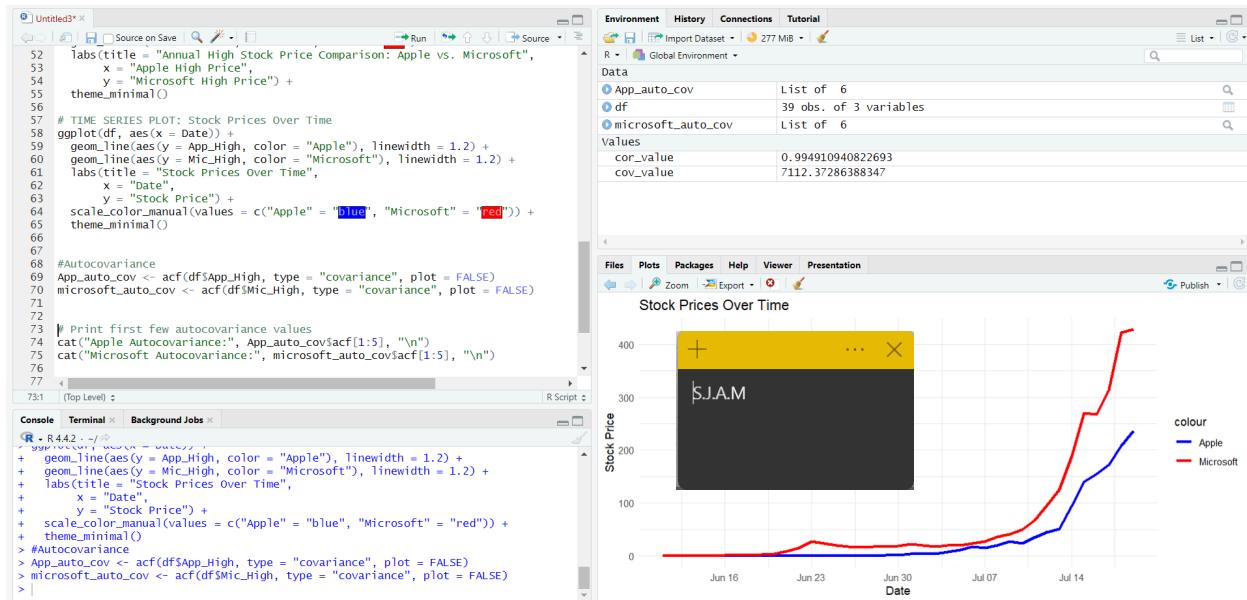


The time series plot offers a snapshot of Apple and Microsoft's stock prices over time. At first, both stocks show a fairly steady trend with just a few ups and downs. However, things take off dramatically in early July. During this spike, Microsoft (shown by the red line) has a more significant surge compared to Apple (shown by the blue line), which suggests that Microsoft is experiencing stronger growth or perhaps more volatility.

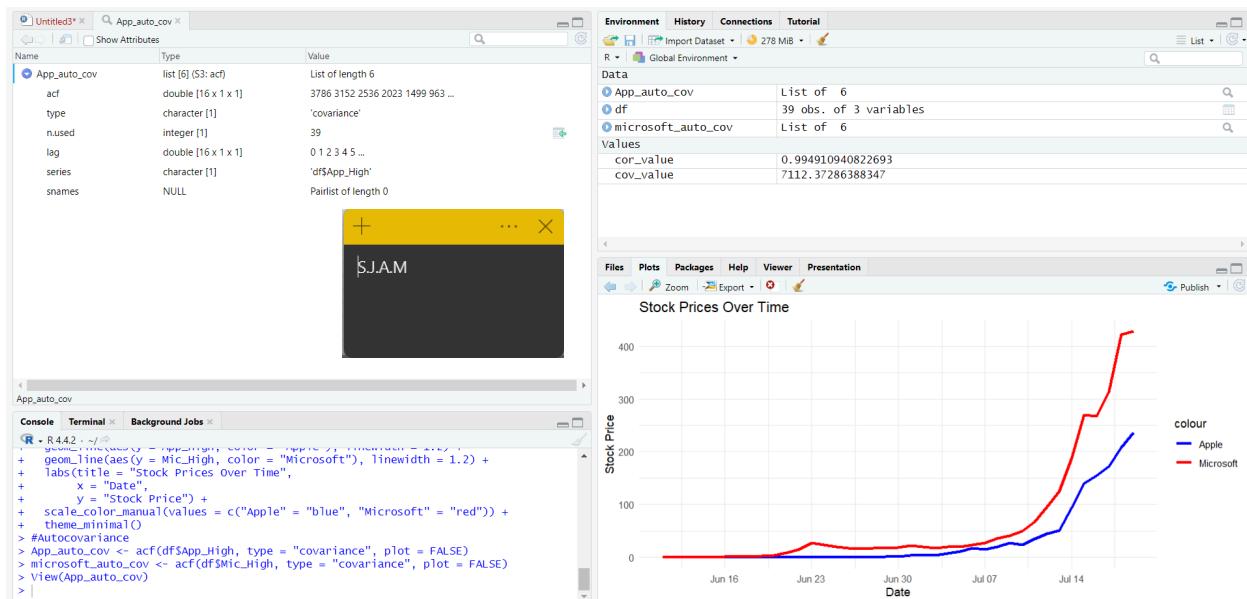
Interestingly, both companies share a similar upward trend, indicating that their stock prices are likely responding to similar market influences. However, it's clear that Microsoft's stock is climbing at a quicker pace. This pattern might be due to various external factors, like earnings reports, developments within their industries, or broader market movements that are impacting both tech giants.

Exercise 2.b Interpret Results

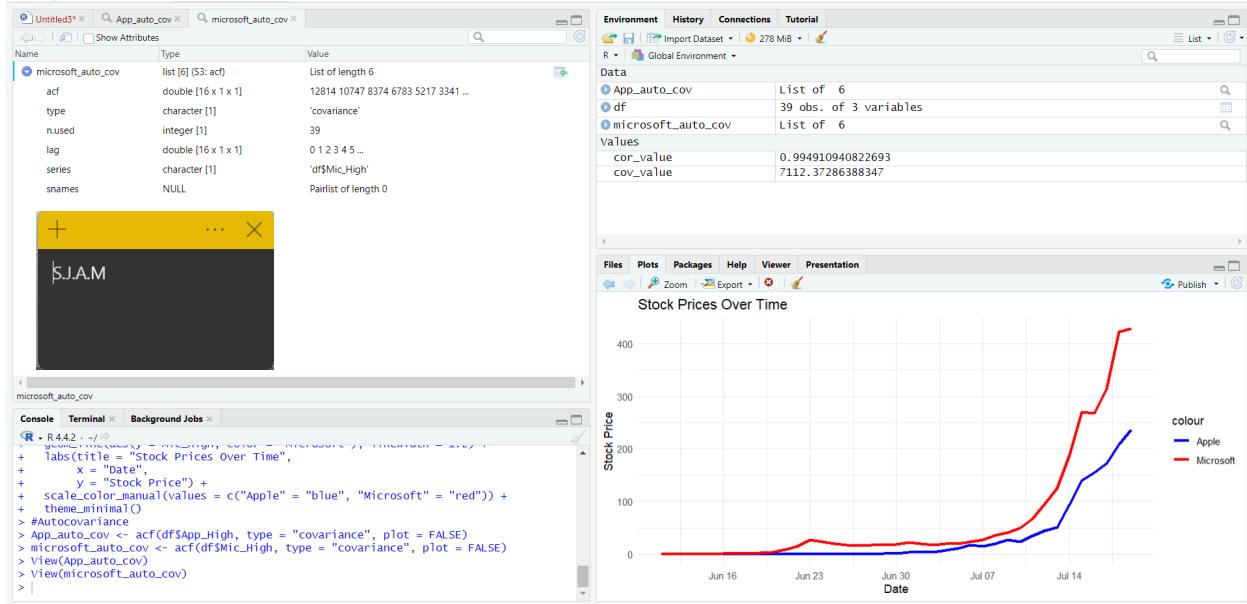
Compute the autocovariance (per lag) for each time series and plot the Autocorrelation Function (ACF) using the code below. Edit the field names when necessary. Interpret results.



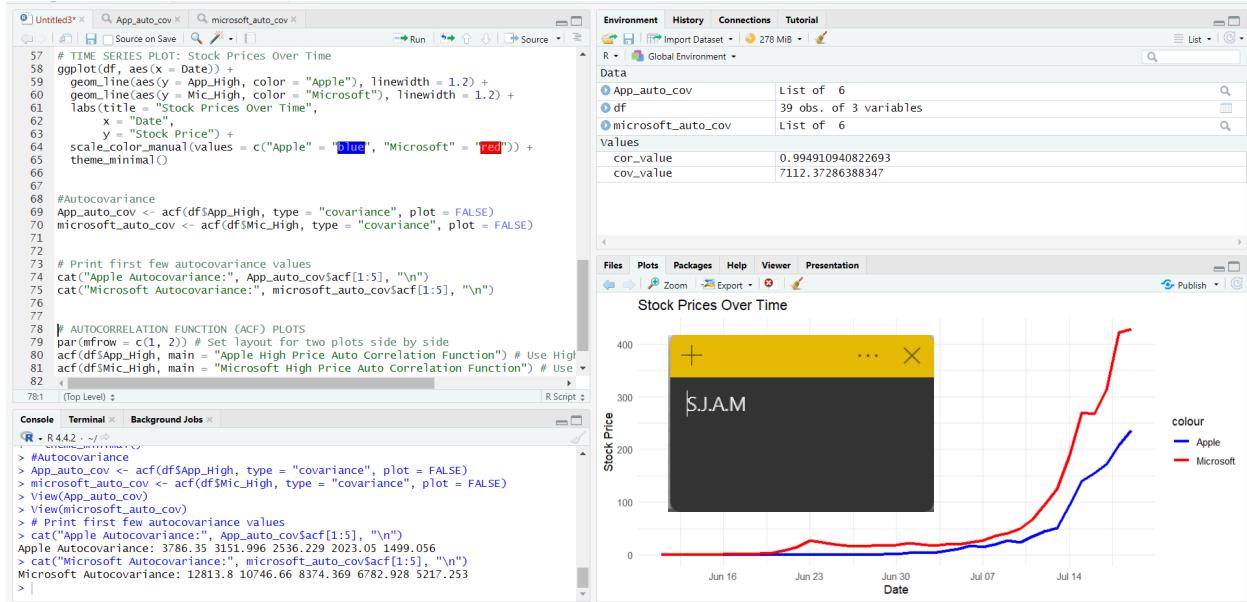
Apple auto covariance



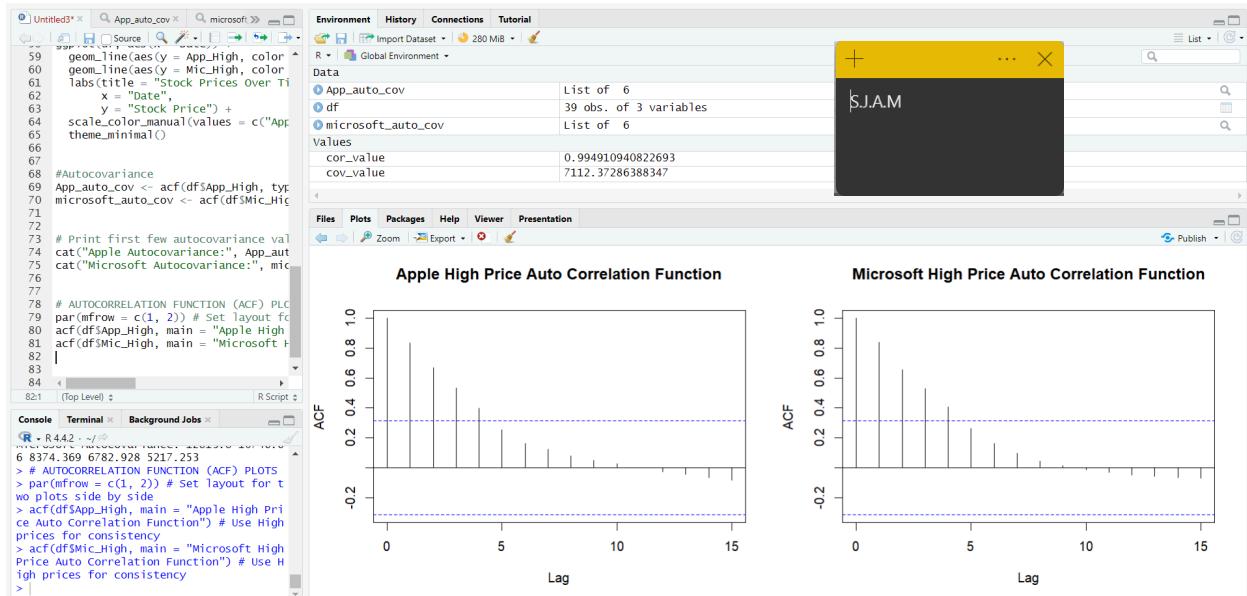
Microsoft auto covariance



Print first few autocovariance values



AUTOCORRELATION FUNCTION (ACF) PLOTS



The **Autocorrelation Function (ACF)** plots for the high stock prices of Apple and Microsoft reveal an interesting connection between past and future prices over time. Starting at a high positive value close to 1 at lag 0, the ACF for both stocks gradually decreases as the lag increases. This means there's a strong relationship between the current stock prices and their recent past values, showing that what happened before significantly affects future prices. However, this influence does weaken over time. The decreasing bar heights suggest that while past prices still play a role in shaping future prices, their impact diminishes as time goes on.

The dashed blue lines you see represent confidence intervals, and any ACF values that fall outside of these lines are statistically significant. For both Apple and Microsoft, the ACF values are significant up to around lag 5, after which they taper off toward zero. This indicates that both stocks have a sort of short-term memory—past prices influence future prices for a few time periods before their effects fade away.

In addition, both stocks have a rising trend, with Microsoft's stock price growing at a more rapid pace than Apple's, especially in the later dates. Both stocks initially stayed relatively consistent at lower price points, but as time went on, the prices of Microsoft rose more rapidly than those of Apple.

With respect to **autocovariance**, the study shows that both Microsoft and Apple stock prices are highly dependent on their immediate past values, as shown by high autocovariance at low lags. Microsoft's autocovariance values are, however, significantly higher than those of Apple, implying higher volatility and price fluctuations. As the lag gets larger, the autocovariance values decrease slowly, showing that past stock prices have decreasing effects on future prices for longer lags. This implies that although both shares exhibit short-term momentum, price movements of Microsoft are stronger and indicate greater general price swings.