We'll Name This Presentation Later...

FA542: Financial Econometrics and Time Series Analysis

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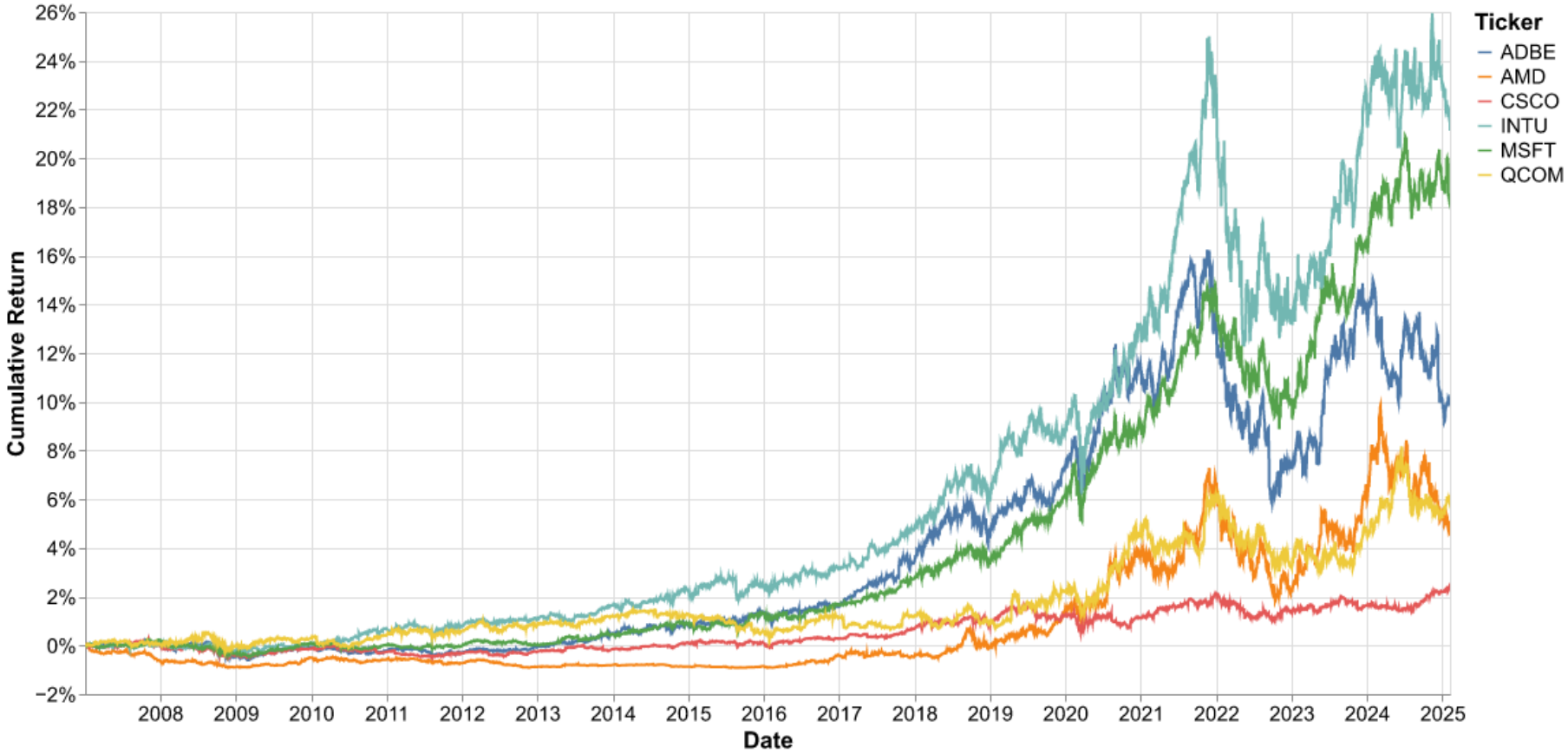
Motivation: Modeling Asset Prices in Tech

- Our analysis primarily focuses on the technology sector
- Tech stocks tend to have higher betas
- They’re more sensitive to information shocks in the market
- We also consider the growth aspect of the market (Macroeconomic Trends, Interest Rates, etc.

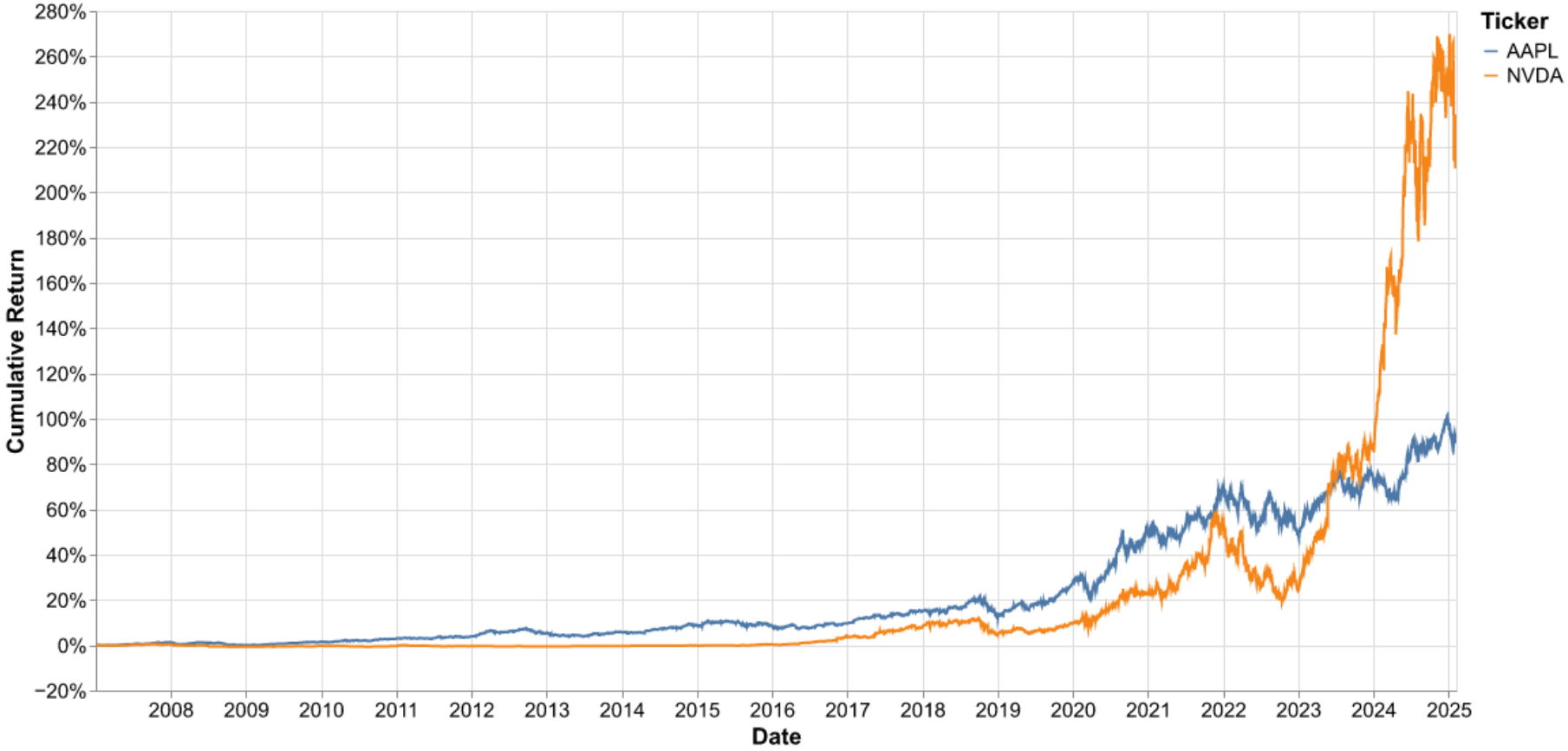
Our Sample Universe

Market Comparisons of Technology Stocks (as of 2/10/25)				
Company Name (Ticker)	Market Capitalization	Last Price	1D Pct Change	1M Pct Change
Apple Inc. (AAPL)	3.42T	227.65	0.01%	-3.88%
NVIDIA Corp (NVDA)	3.27T	133.57	2.87%	-1.72%
Microsoft Corp (MSFT)	3.06T	412.22	2.87%	-1.61%
Qualcomm Inc. (QCOM)	189.52B	171.36	2.02%	9.16%
Adobe Inc. (ADBE)	196.36B	451.1	4.16%	11.13%
Advanced Micro Device (AMD)	179.03B	110.48	2.71%	-4.79%
Cisco System Inc. (CSCO)	250.16B	62.81	0.87%	6.93%
Intuit Inc. (INTU)	164.27B	586.84	1.38%	-5.87%
Sample Average	**123.64B**	**269.50**	**2.11%**	**1.17%**

Our Sample Universe



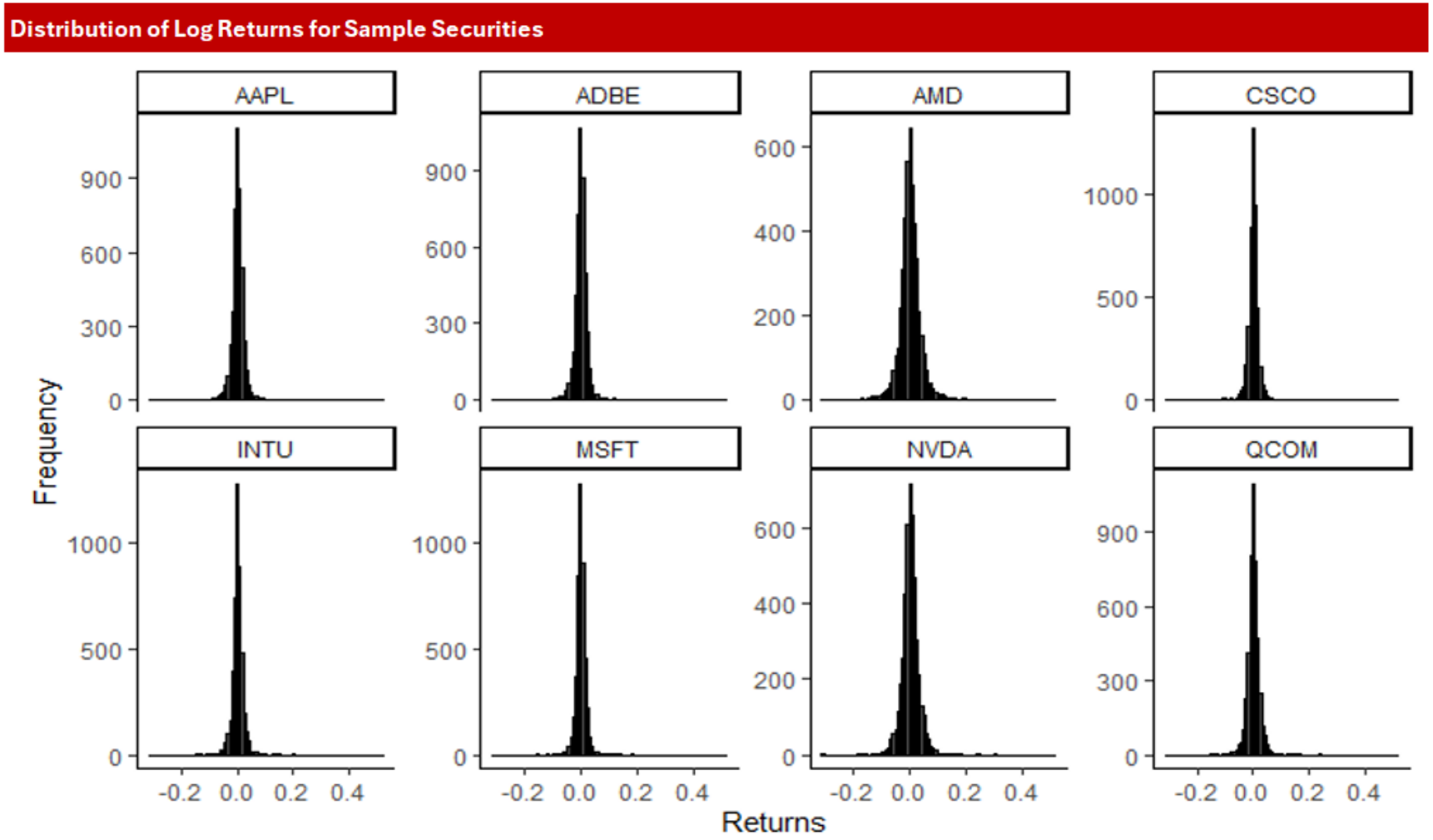
Our Sample Universe



Descriptive Statistics

Descriptive Statistics of Tech Stocks (Daily Simple Returns)						
Company Name (Ticker)	Mean (μ_x)	Std Dev (σ_x)	Skewness $(S(x))$	Kurtosis $(K(x))$	Min	Max
Apple Inc. (AAPL)	0.11	1.97	-0.11	5.96	17.91%	13.90%
NVIDIA Corp (NVDA)	0.16	3.11	0.13	7.69	-30.71%	29.80%
Microsoft Corp (MSFT)	0.07	1.76	0.27	9.17	-14.73%	18.60%
Qualcomm Inc. (QCOM)	0.05	2.17	0.27	9.53	-15.25%	23.20%
Adobe Inc. (ADBE)	0.07	2.16	-0.12	8.66	19.03%	17.71%
Advanced Micro Device (AMD)	0.1	3.66	0.78	12.39	-24.22%	52.29%
Cisco System Inc. (CSCO)	0.03	1.77	0.22	11.56	16.21%	15.95%
Intuit Inc. (INTU)	0.08	1.91	0.25	8.49	14.47%	20.08%

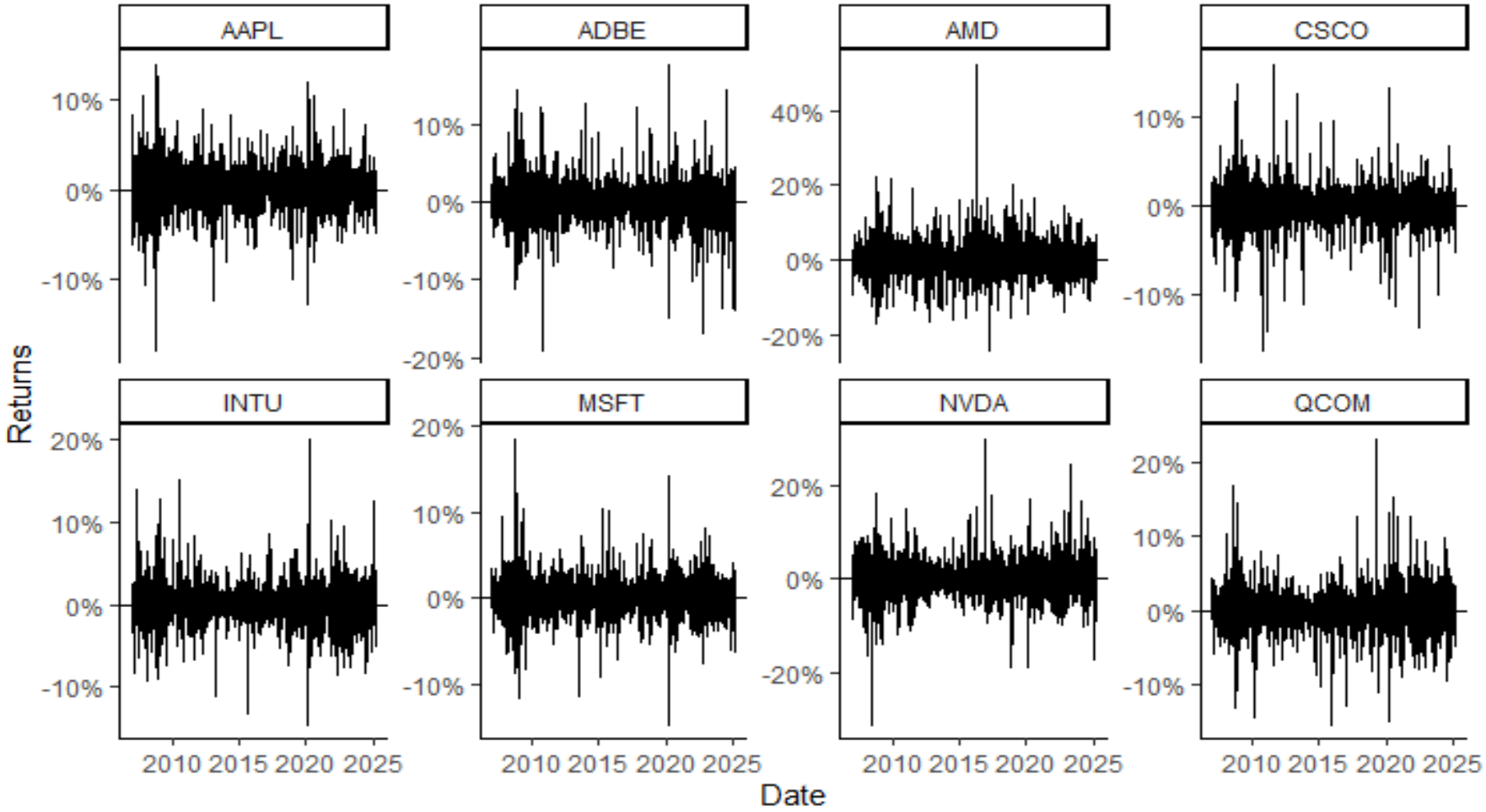
Test for Normality (Jarque-Bera Test)



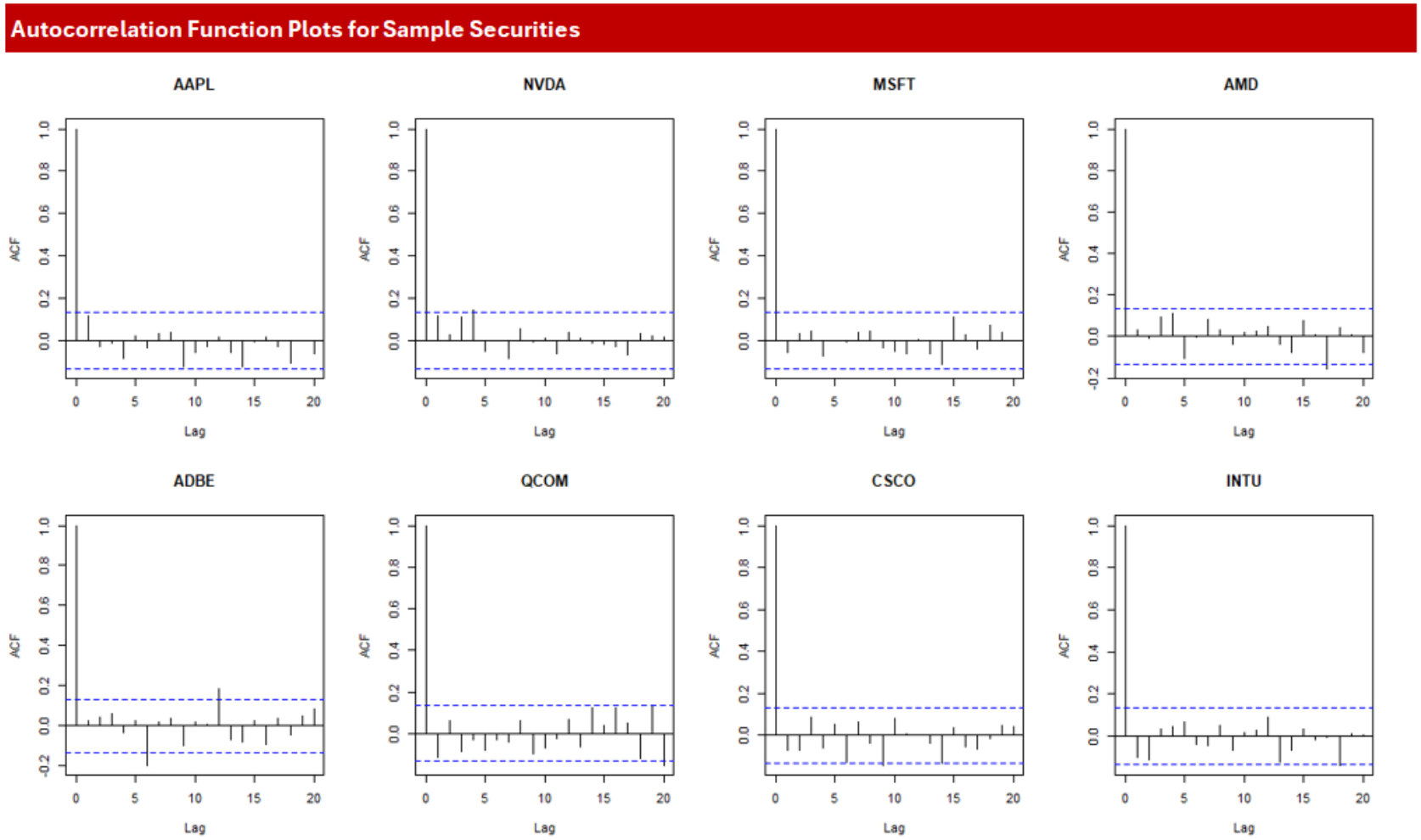
Test for Normality (Jarque-Bera Test)

Jarque-Bera Statistical Test for Normality for Log Daily Returns				
Company Name (Ticker)	**Skewness** $(S(x))$	**Kurtosis** $(K(x))$	**t-statistics** (x^2)	**p-values**
Apple Inc. (AAPL)	-0.11	5.96	6784.85	2.20E-16
NVIDIA Corp (NVDA)	0.13	7.69	12052.68	2.20E-16
Microsoft Corp (MSFT)	0.27	9.17	14325.07	2.20E-16
Qualcomm Inc. (QCOM)	0.27	9.53	14733.69	2.20E-16
Adobe Inc. (ADBE)	-0.12	8.66	16759	2.20E-16
Advanced Micro Device (AMD)	0.78	12.39	11128.07	2.20E-16
Cisco System Inc. (CSCO)	0.22	11.56	28331.08	2.20E-16
Intuit Inc. (INTU)	0.25	8.49	11128.07	2.20E-16

White Noise (Ljung-Box)



White Noise (Ljung-Box)



White Noise (Ljung-Box)

- The following shows the Ljung-Box Test for white noise (serial autocorrelation)
- $H_0: \rho_1 = \cdots = \rho_m = 0$ (White Noise), $H_a: \rho_i \neq 0$ (serial autocorrelation)

Ljung Box Test for Serial Autocorrelation									
Parameters	AMD Q(17)	ADBE Q(6)	ADBE Q(12)	QCOM Q(19)	QCOM Q(20)	CSCO Q(9)	CSCO Q(14)	INTU Q(9)	NVDA Q(4)
Ljung-Box Test Statistic	19.044	10.404	20.765	29.27	34.939	14.675	20.773	20.678	10.826
p-values	0.326	0.1086	0.05393	0.06185	0.02043	0.1003	0.1076	0.296	0.028

White Noise (Ljung-Box)

- We find that Qualcomm Inc. (QCOM) and NVIDIA Corp (NVDA) have significant lags, suggesting some lag dependence.
- For the remainder of the analysis, we turn our attention on these two assets.

Ljung Box Test for Serial Autocorrelation									
Parameters	AMD Q(17)	ADBE Q(6)	ADBE Q(12)	QCOM Q(19)	QCOM Q(20)	CSCO Q(9)	CSCO Q(14)	INTU Q(9)	NVDA Q(4)
Ljung-Box Test Statistic	19.044	10.404	20.765	29.27	34.939	14.675	20.773	20.678	10.826
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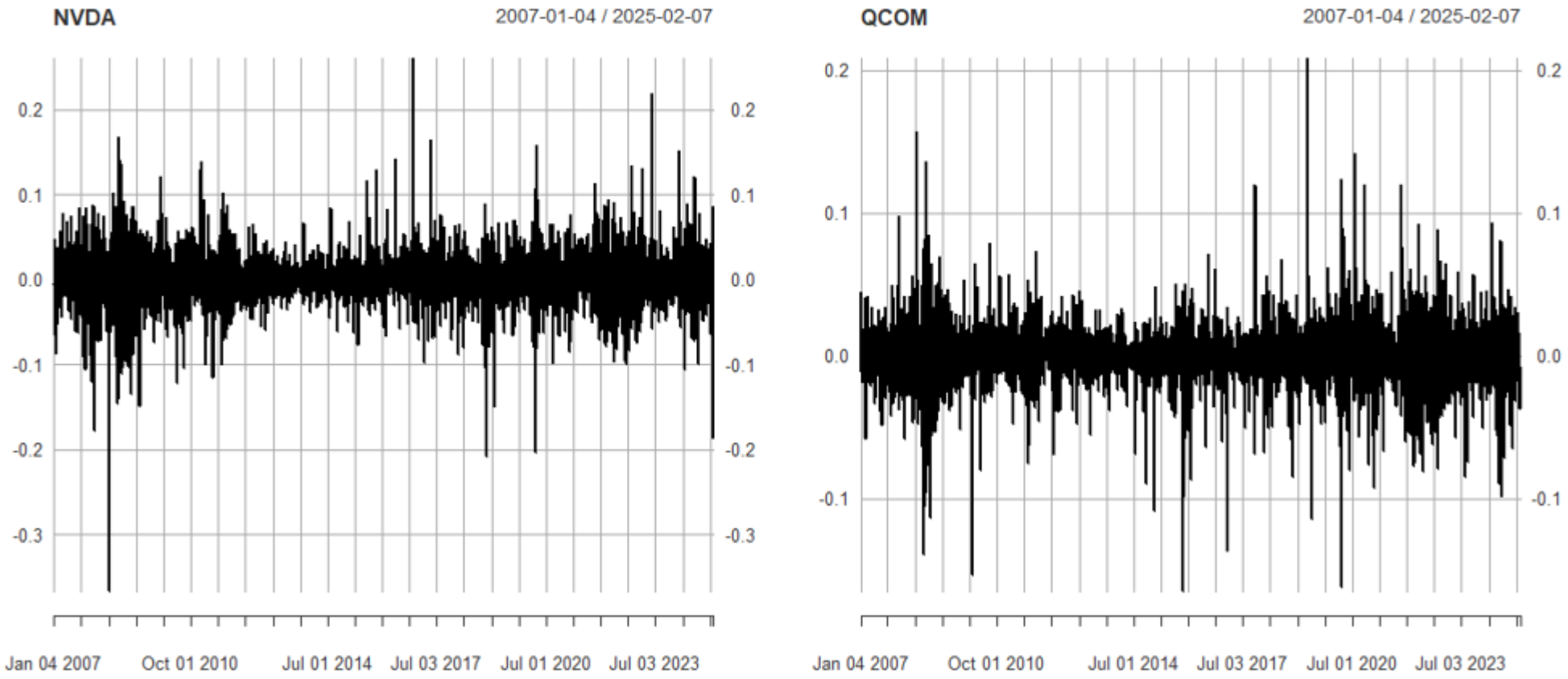
Stationarity (Augmented Dickey-Fuller Test)

Log Returns of Nvidia and Qualcomm



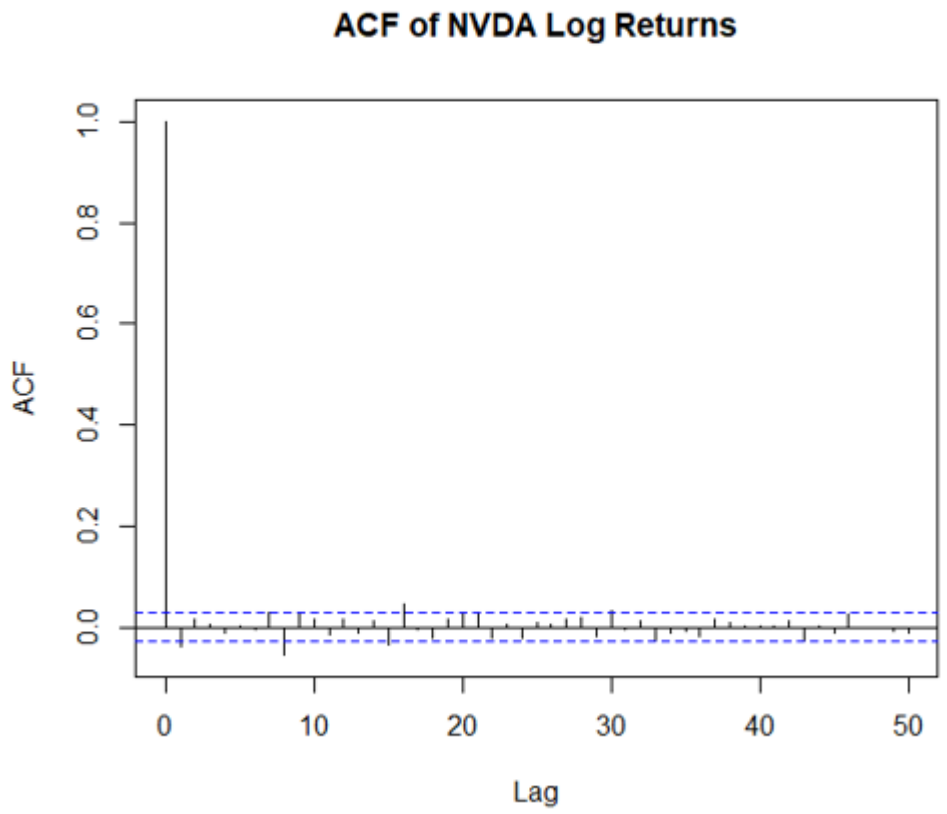
Stationarity (Augmented Dickey-Fuller Test)

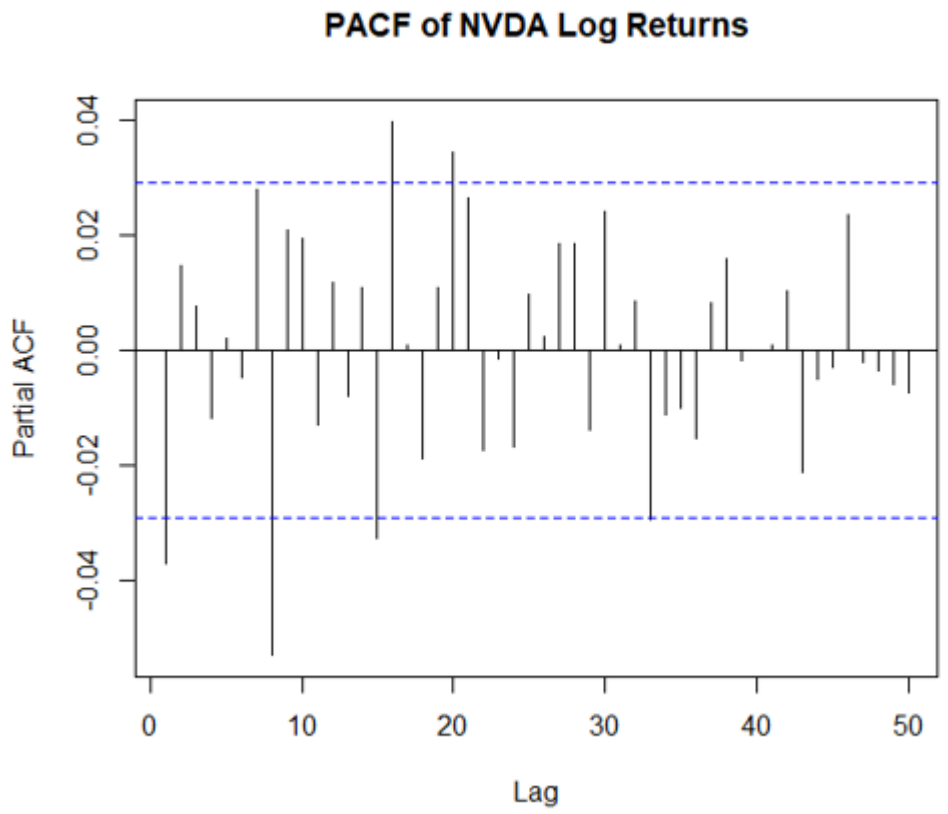
- The following shows the Augmented Dickey-Fuller Test for the log returns.
- $H_0: \gamma = 0$ (Unit Root), $H_a: \gamma < 0$ (Stationary)

Augmented Dickey-Fuller Test			
Stock	**Test Statistics**	**P-Value**	**Recommedation**
NVDA	-16.217	0.01	Test Statistic < critical value of -1.96 Sigificance level = 0.05 Reject null hypothesis Time Series is Stationary
QCOM	-16.254	0.01	Test Statistic < critical value of -1.96 Sigificance level = 0.05 Reject null hypothesis Time Series is Stationary

Model Selection

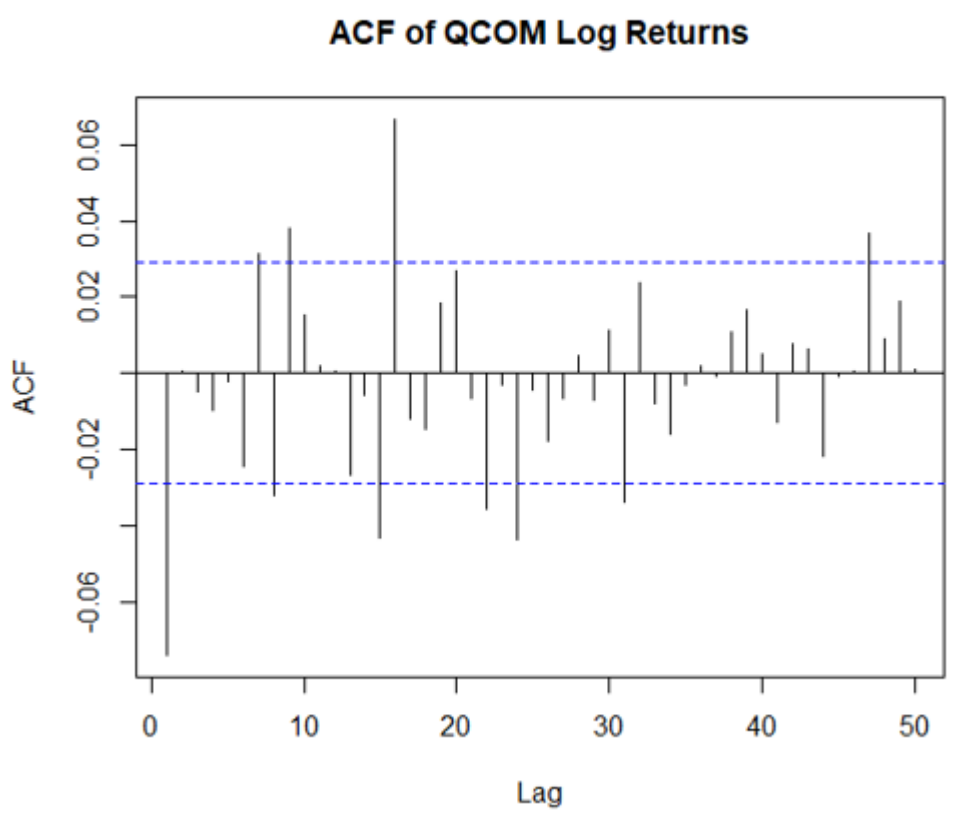
ACF/PACF Plots for Nvidia Corp

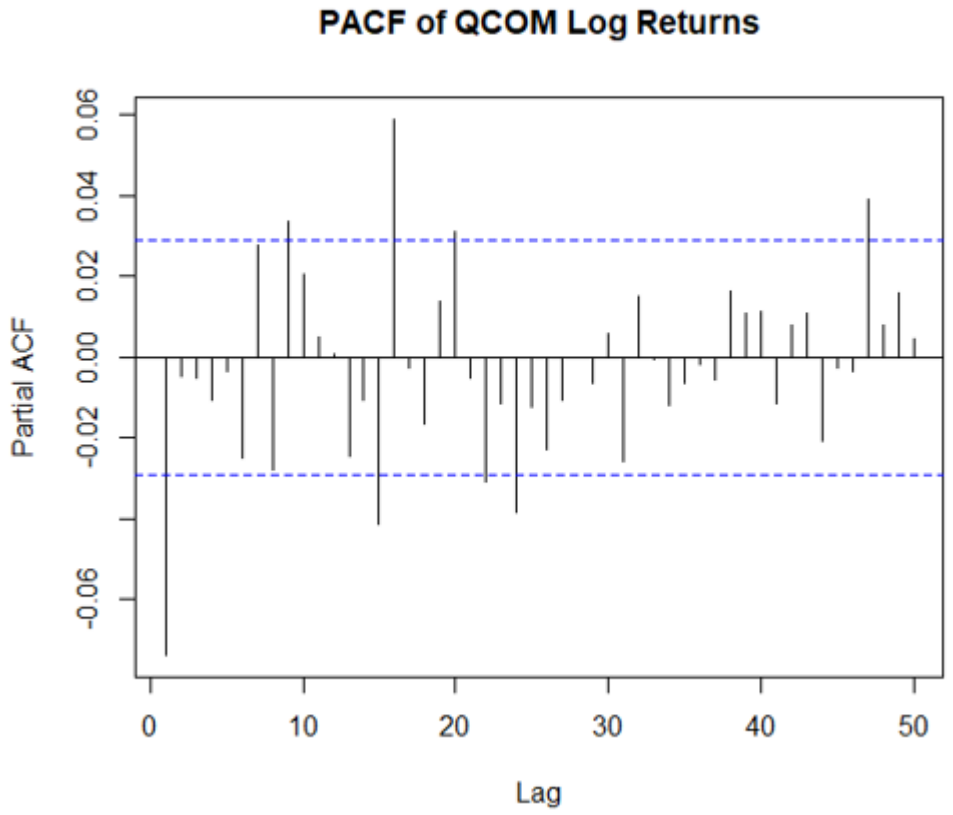




Model Selection

ACF/PACF Plots for Qualcomm Corp





Model Selection

EACF Plot for the Log Returns of Nvidia Corp.

p, q	MA(0)	MA(1)	MA(2)	MA(3)	MA(4)	MA(5)	MA(6)	MA(7)	MA(8)	MA(9)	MA(10)
AR(0)	x	o	o	o	o	o	o	x	o	o	o
AR(1)	x	o	o	o	o	o	o	x	x	o	o
AR(2)	x	x	o	o	o	o	o	o	o	o	o
AR(3)	x	x	x	o	o	o	o	o	o	o	o
AR(4)	x	x	x	x	o	o	o	o	o	o	o
AR(5)	x	o	x	x	o	o	o	o	o	o	o
AR(6)	x	x	x	x	x	x	o	o	o	o	o
AR(7)	x	x	x	x	x	x	x	o	o	o	o

Model Selection

AIC Plot for the Theoretical EACF for Nvidia ARIMA Model

p, q	MA(0)	MA(1)	MA(2)	MA(3)	MA(4)	MA(5)	MA(6)	MA(7)	MA(8)	MA(9)	MA(10)
AR(0)	-18655	-18658	-18658	-18656	-18654	-18653	-18651	-18651	-18660	-18661	-18660
AR(1)	-18658	-18657	-18656	-18654	-18652	-18651	-18649	-18656	-18659	-18659	-18658
AR(2)	-18658	-18656	-18654	-18652	-18652	-18651	-18649	-18660	-18663	-18658	-18661
AR(3)	-18656	-18654	-18652	-18672	-18650	-18649	-18652	-18666	-18664	-18660	-18665
AR(4)	-18654	-18652	-18650	-18650	-18658	-18647	-18645	-18664	-18656	-18666	-18674
AR(5)	-18652	-18650	-18651	-18661	-18648	-18660	-18660	-18674	-18660	-18669	-18658
AR(6)	-18650	-18648	-18646	-18647	-18646	-18660	-18677	-18675	-18673	-18673	-18678
AR(7)	-18652	-18657	-18662	-18665	-18664	-18666	-18675	-18676	-18676	-18677	-18679

Model Selection

EACF Plot for the Log Returns of Qualcomm Corp.

p, q	MA(0)	MA(1)	MA(2)	MA(3)	MA(4)	MA(5)	MA(6)	MA(7)	MA(8)	MA(9)	MA(10)
AR(0)	x	o	o	o	o	o	x	x	x	o	o
AR(1)	x	o	o	o	o	o	o	o	x	o	o
AR(2)	x	o	o	o	o	o	o	o	x	o	o
AR(3)	x	x	o	o	o	o	o	o	x	o	o
AR(4)	x	x	x	o	o	o	o	o	o	o	o
AR(5)	x	x	x	o	x	o	o	o	o	o	o
AR(6)	x	x	x	x	x	o	o	o	o	o	o
AR(7)	x	x	o	x	x	x	x	o	o	o	o

Model Selection

AIC Plot for the Theoretical EACF for Qualcomm ARIMA Model

p, q	MA(0)	MA(1)	MA(2)	MA(3)	MA(4)	MA(5)	MA(6)	MA(7)	MA(8)	MA(9)	MA(10)
AR(0)	-21936	-21959	-21957	-21955	-21954	-21952	-21951	-21953	-21953	-21957	-21956
AR(1)	-21959	-21957	-21955	-21953	-21952	-21950	-21955	-21954	-21953	-21956	-21954
AR(2)	-21957	-21955	-21953	-21951	-21950	-21948	-21966	-21952	-21952	-21956	-21952
AR(3)	-21955	-21953	-21951	-21950	-21950	-21965	-21948	-21963	-21960	-21954	-21952
AR(4)	-21954	-21952	-21950	-21949	-21970	-21948	-21963	-21975	-21962	-21953	-21968
AR(5)	-21952	-21950	-21948	-21963	-21976	-21965	-21977	-21975	-21961	-21970	-21972
AR(6)	-21952	-21957	-21966	-21950	-21969	-21977	-21976	-21975	-21967	-21976	-21974
AR(7)	-21954	-21956	-21954	-21963	-21977	-21975	-21975	-21981	-21977	-21977	-21971

ARIMA Models (Nvidia)

- The following outlines the models generated from our selection criteria.

$$\text{AR}(1):\ r_t = 0.0012 - 0.0371 r_{t-1} + \epsilon_t$$

$$\text{AR}(2):\ r_t = 0.0012 - 0.0365 r_{t-1} + 0.0146 r_{t-2} + \epsilon_t$$

$$\text{MA}(1):\ r_t = 0.0012 - 0.0360 \epsilon_{t-1} + \epsilon_t$$

$$\text{ARMA}(1,1):\ r_t = 0.0012 - 0.230 r_{t-1} + 0.1928 \epsilon_{t-1} + \epsilon_t$$

$$\text{ARMA}(1,\ 2):\ r_t = 0.0012 - 0.0179 r_{t-1} - 0.0187 \epsilon_{t-1} + 0.0161 \epsilon_{t-2} + \epsilon_t$$

ARIMA Models (Qualcomm)

- The following outlines the models generated from our selection criteria.

$$\text{AR}(1):\ r_t = 3e-04 - 0.0740 r_{t-1} + \epsilon_t$$

$$\text{AR}(2):\ r_t = 3e-04 - 0.0743 r_{t-1} - 0.0049 r_{t-2} + \epsilon_t$$

$$\text{MA}(1):\ r_t = 3e-04 - 0.0743 \epsilon_{t-1} + \epsilon_t$$

$$\text{MA}(2):\ r_t = 3e-04 - 0.0744 \epsilon_{t-1} - 0.0003 \epsilon_{t-2} + \epsilon_t$$

$$\text{ARMA}(1,\ 1):\ r_t = 3e-04 - 0.0374 r_{t-1} - 0.0371 \epsilon_{t-1} + \epsilon_t$$

Forecast

Forecast of Nvidia ARIMA(1,1,2) for T+10