



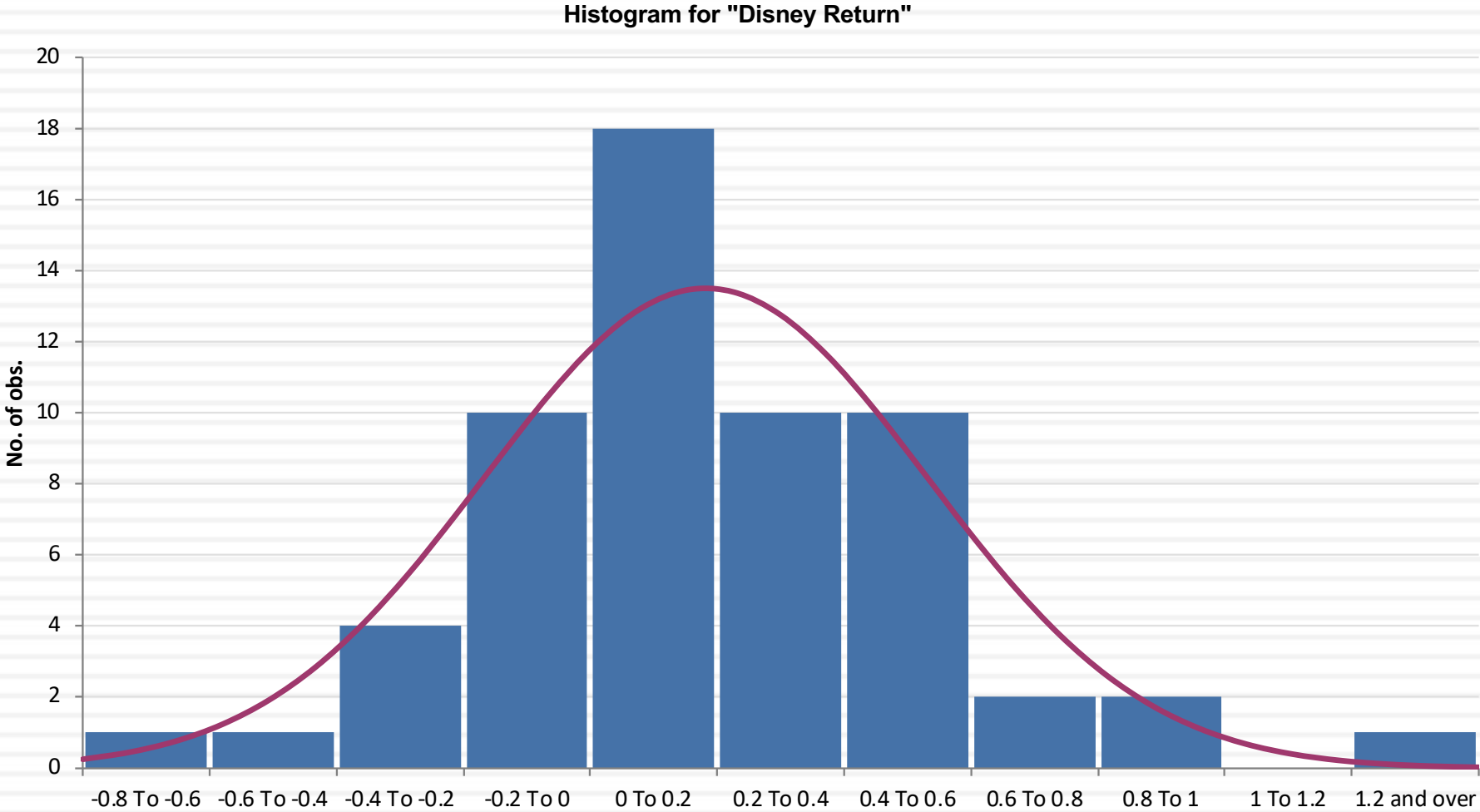
SESSION 4A: DATA DISTRIBUTIONS IN FINANCE

Session 4
Accounting & Statistics

The Normal Distribution in Finance

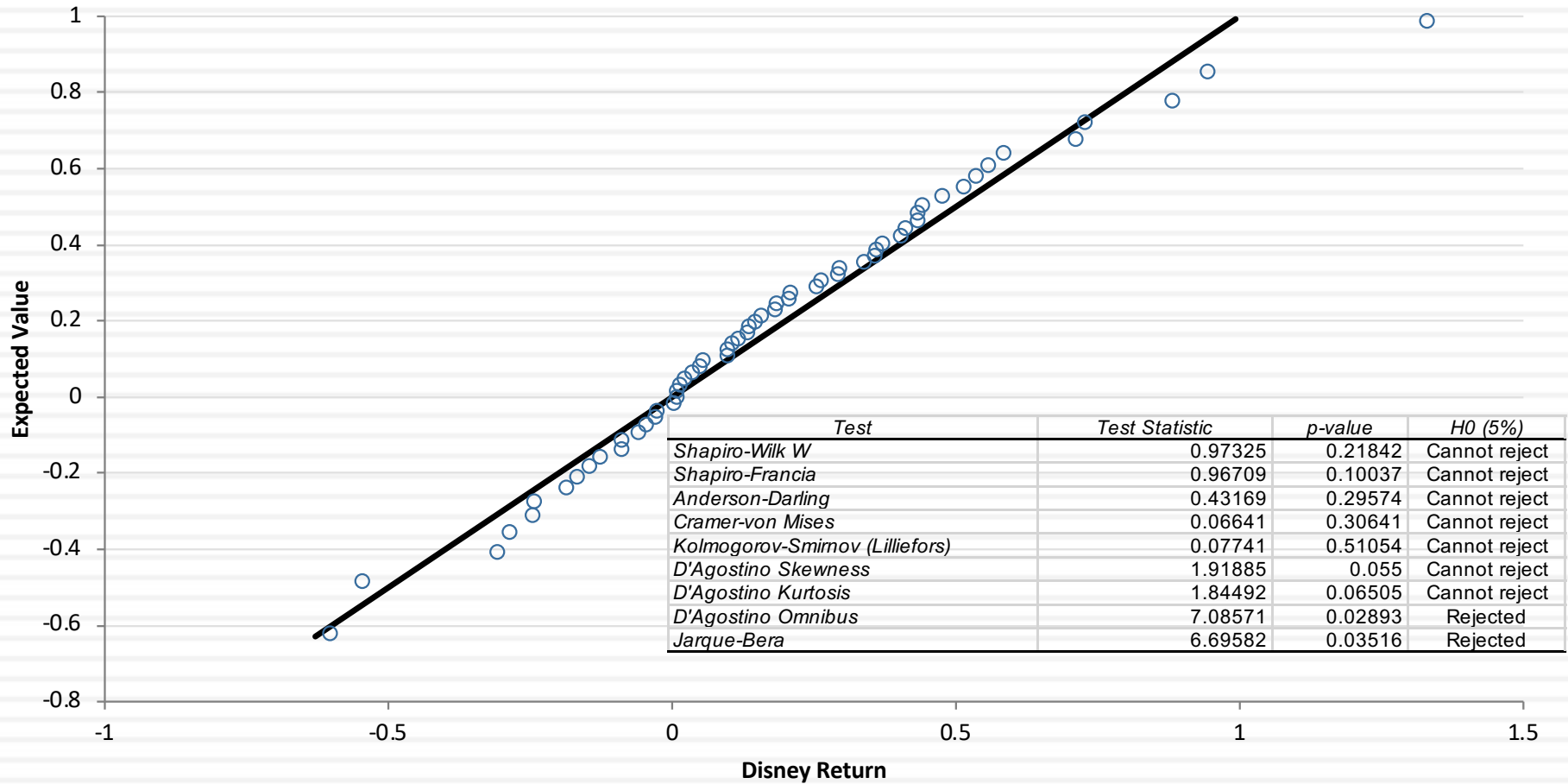
- One of the critiques of finance is its dependence on the normal distribution in both developing theory and in empirical tests.
- The reason for that dependence is two-fold:
 - ▣ The normal distribution has properties that make it easy to work with, both in theory and in practice.
 - ▣ In financial markets, we have had access to large amounts of data (we had big data, before the rest of the world even discovered it), and with it came the temptation to use the normal distribution on almost every aspect of finance.
- The normal distribution assumption comes into play especially when it comes to returns that you can earn on investments (and stock prices).

An Individual Stock: Annual Returns on Disney from 1962 - 2021



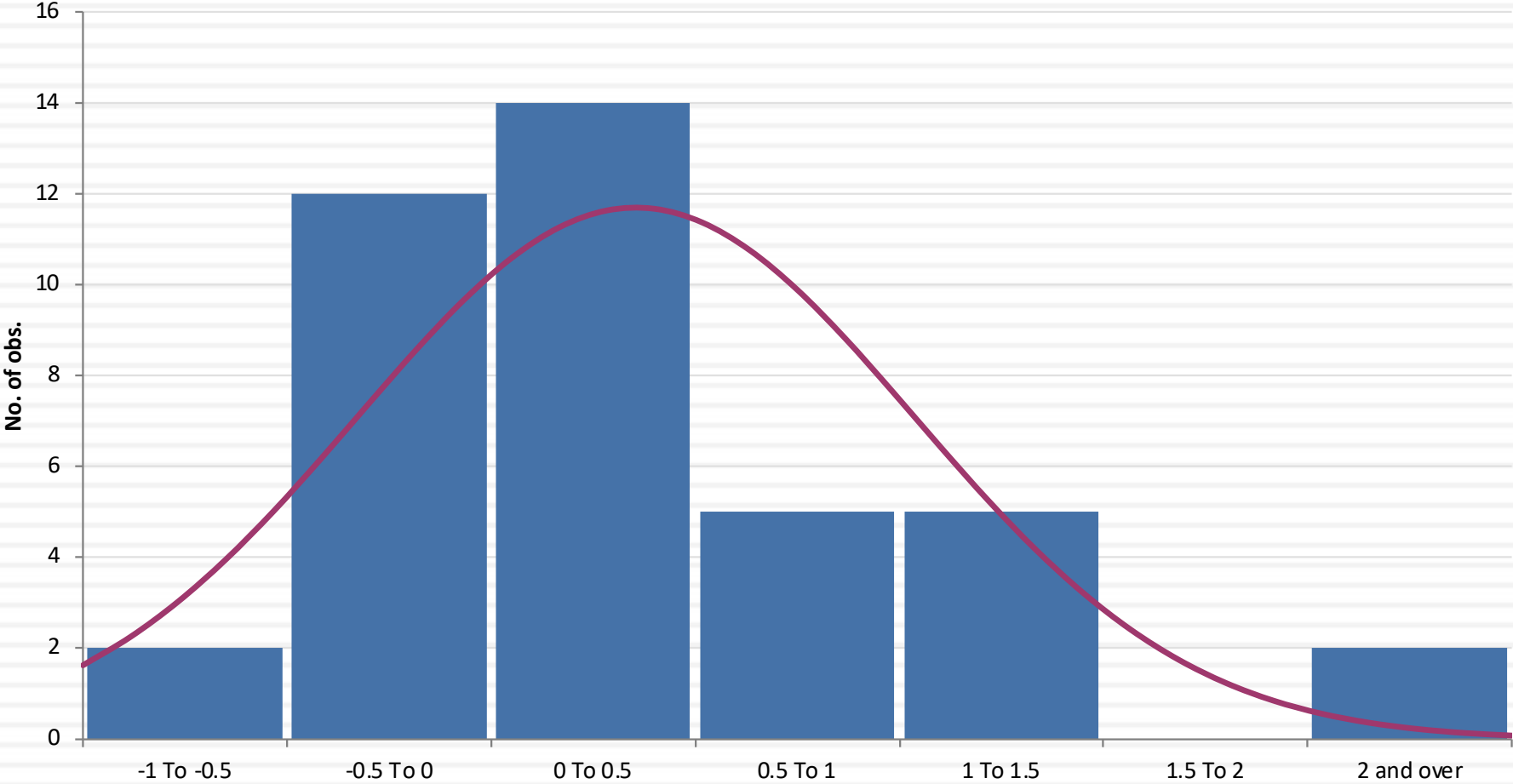
Testing for Normality

Normal Q-Q Plot - Disney Return



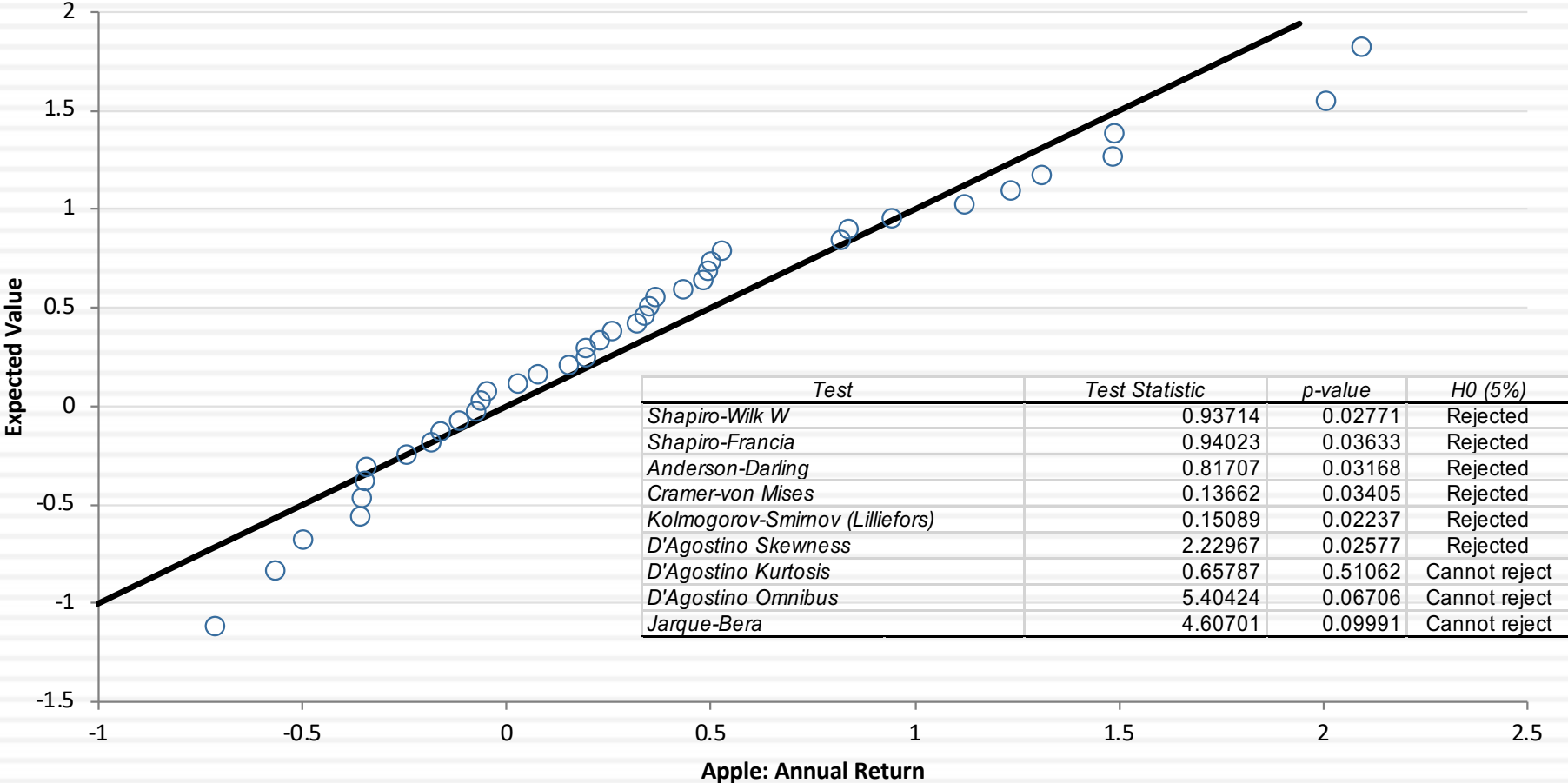
Another Individual Stock: Annual Returns on Apple from 1981 to 2020

Histogram for "Apple: Annual Return"



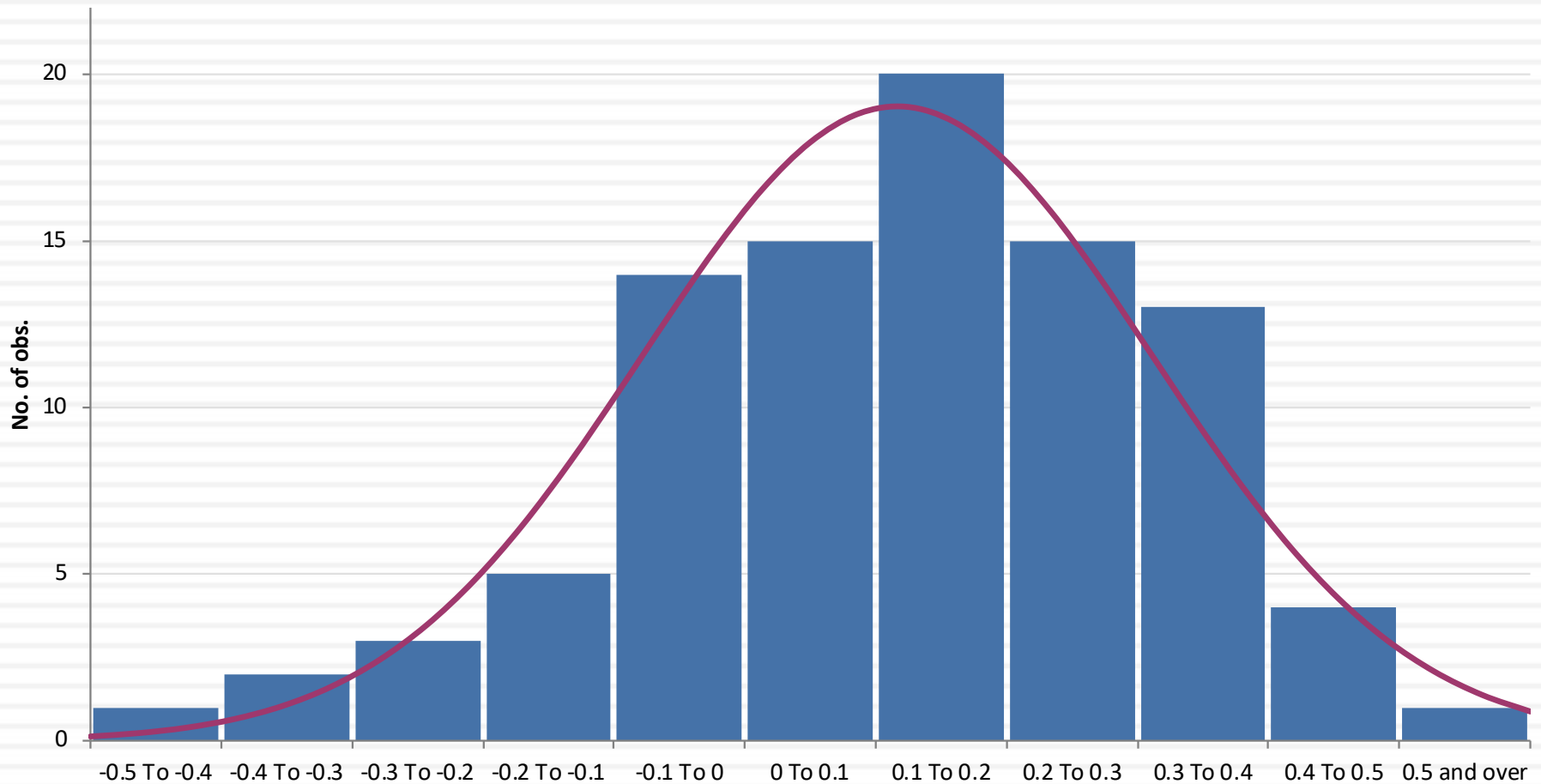
Testing for Normality

Normal Q-Q Plot - Apple: Annual Return



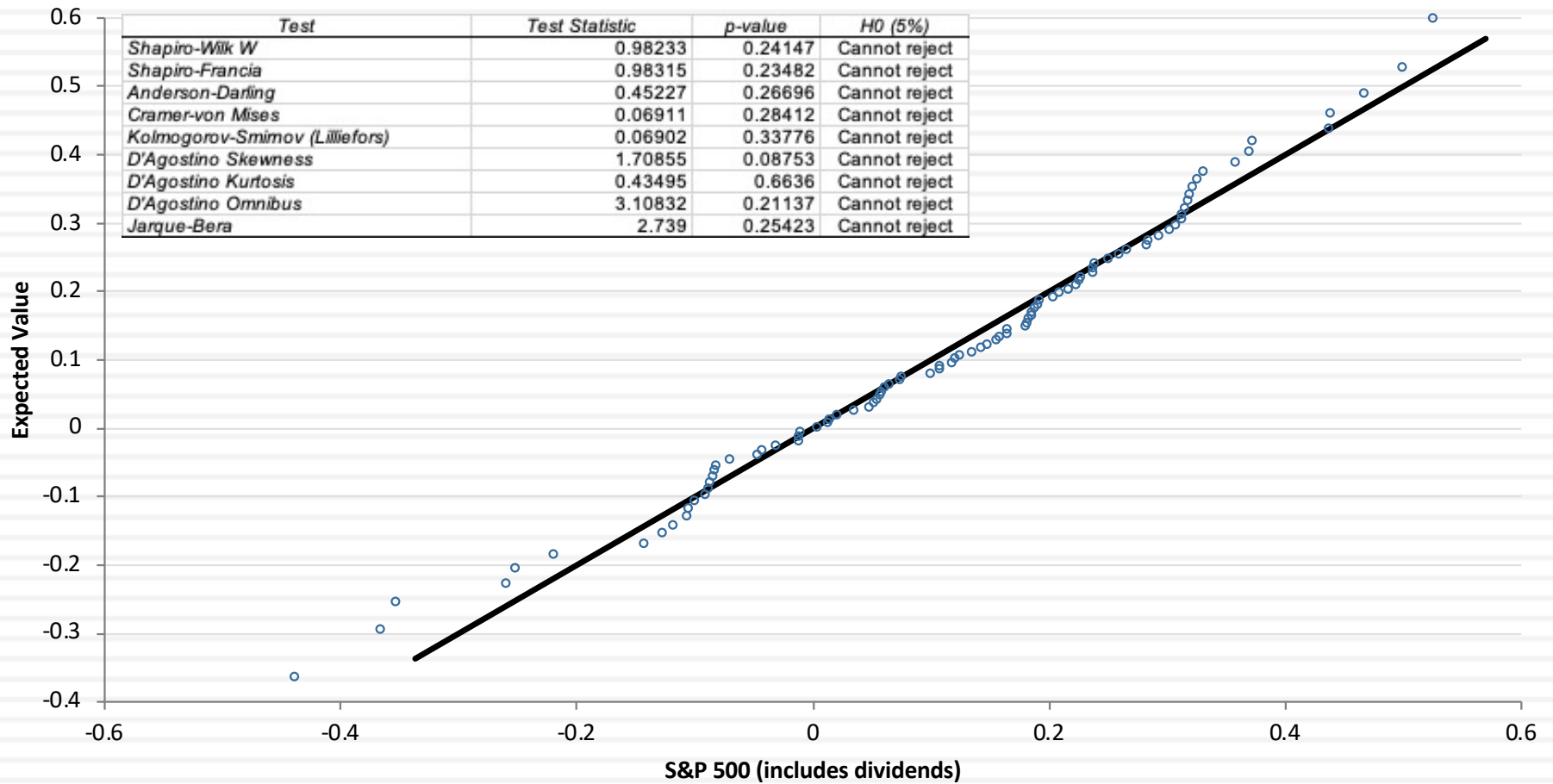
Returns on S&P 500: Annual Returns from 1928 to 2020

Histogram for "S&P 500 (includes dividends)"

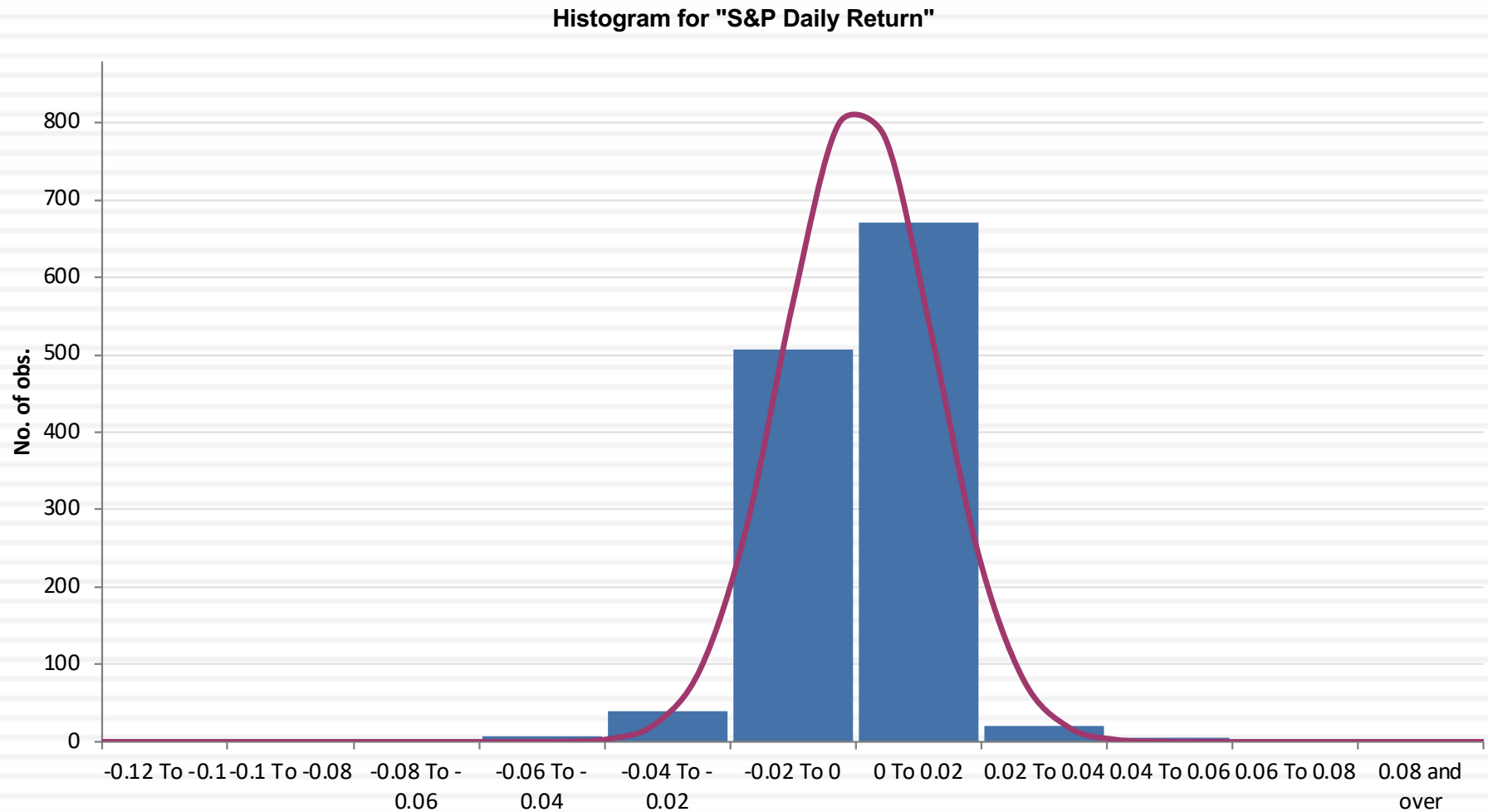


Testing for Normality

Normal Q-Q Plot - S&P 500 (includes dividends)

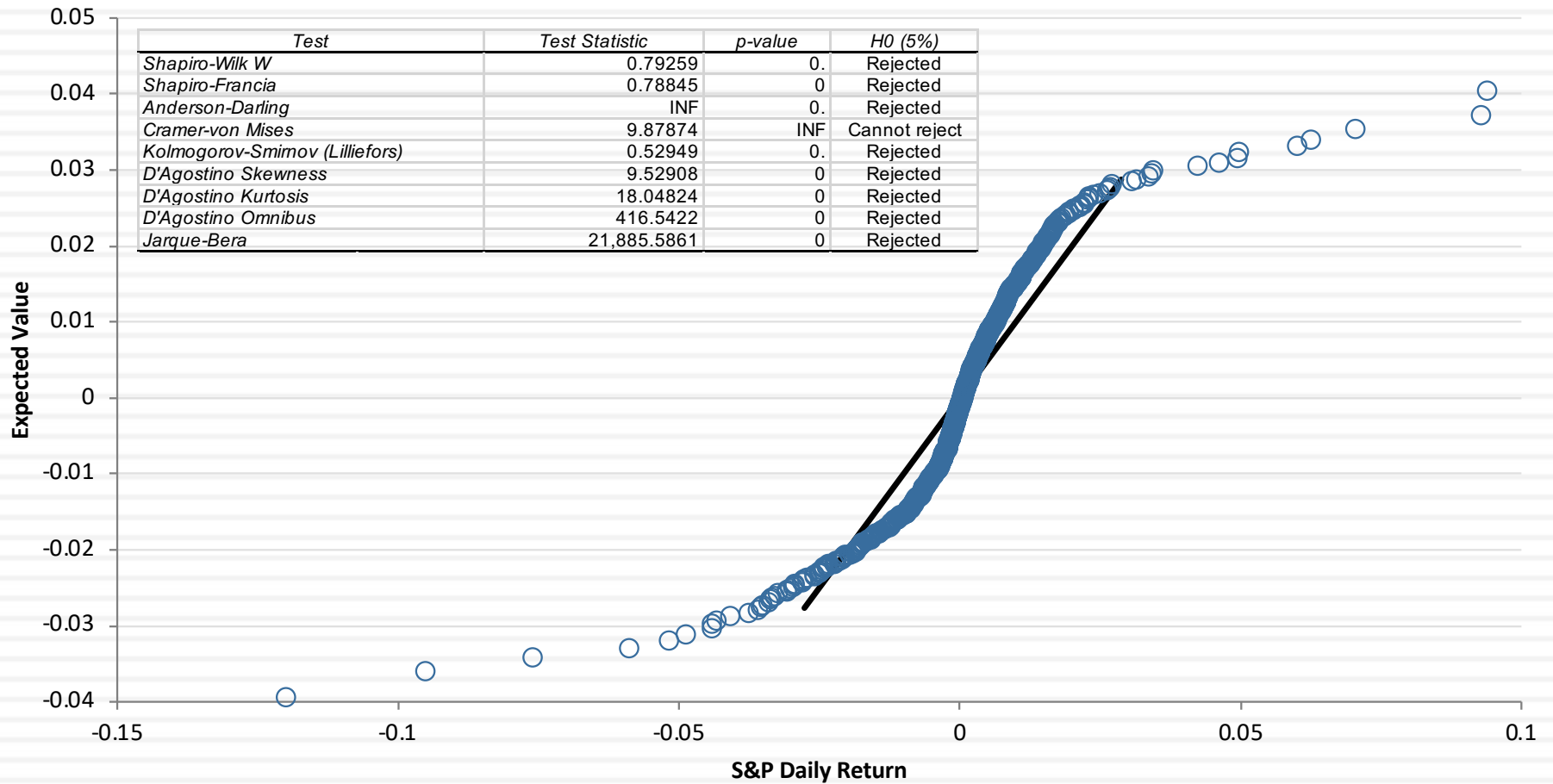


Returns on the S&P 500: Daily from 2016 to 2020



Testing for Normality

Normal Q-Q Plot - S&P Daily Return

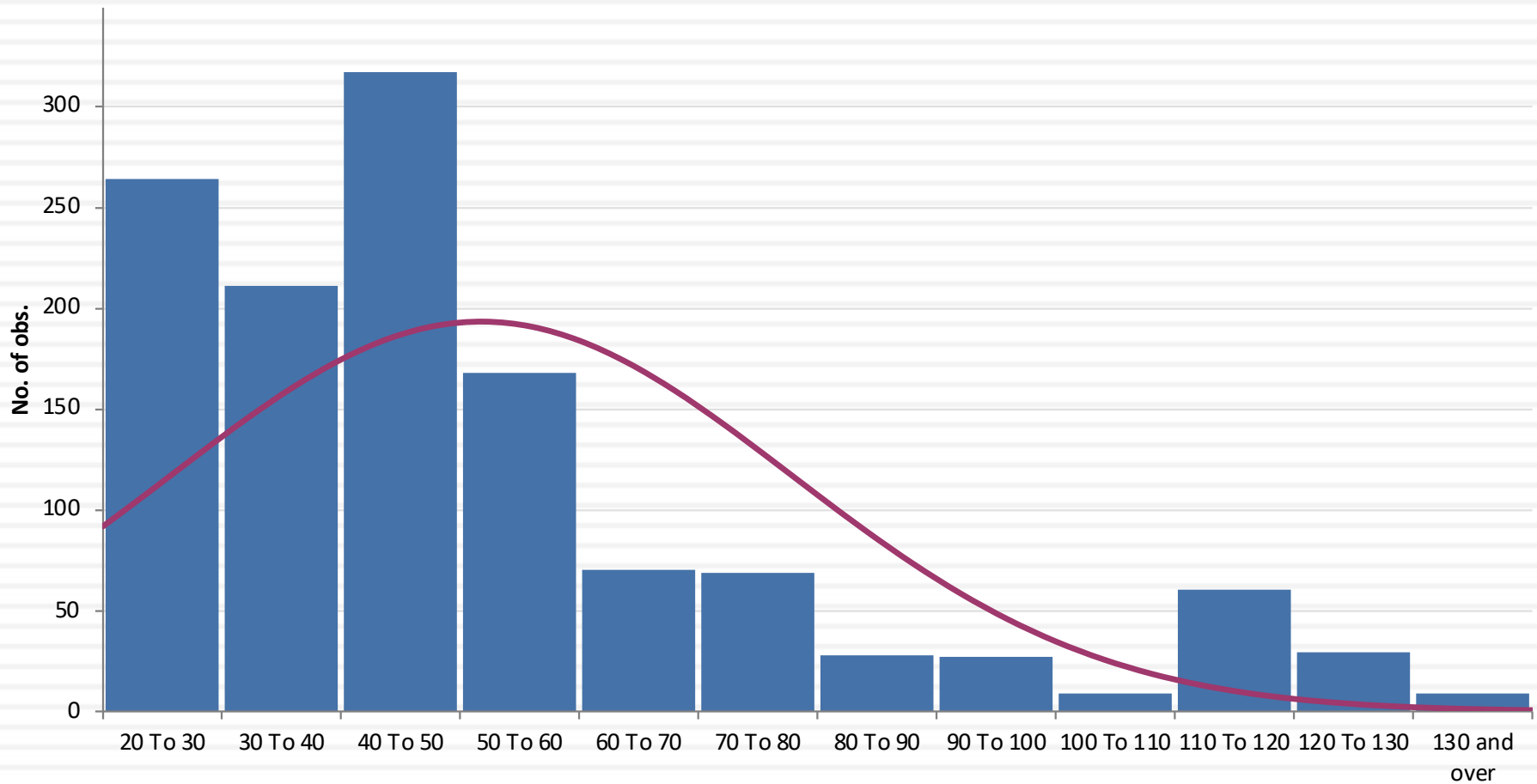


The perils of assuming normality, when the data is not...

- If returns follow a normal distribution, it is extremely unlikely that you will see returns that deviate more than two or three standard deviations from the average.
- Stock returns, especially for short term (daily, weekly) and on individual stocks (as opposed to portfolios) have fatter tails than you would expect to see in a normal distribution.
 - Simply put, you are going to see returns that can fall four, five or even six standard errors from the mean.
 - If your investment and risk management strategies are based upon normality, you will find yourself surprised (with catastrophic consequences), when this happens.

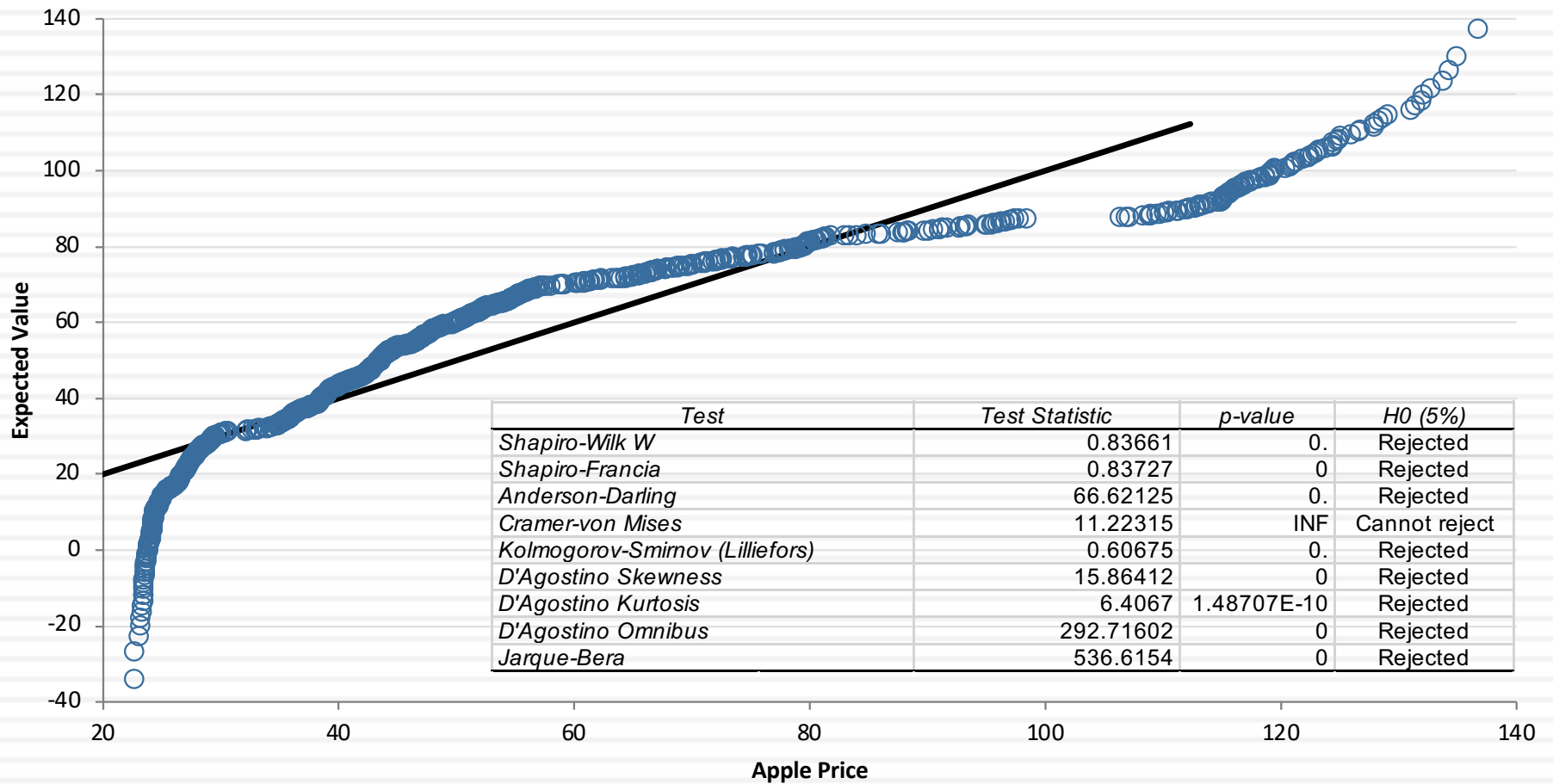
Stock prices are definitely not normally distributed... Apple Daily Stock Prices

Histogram for "Apple Price"

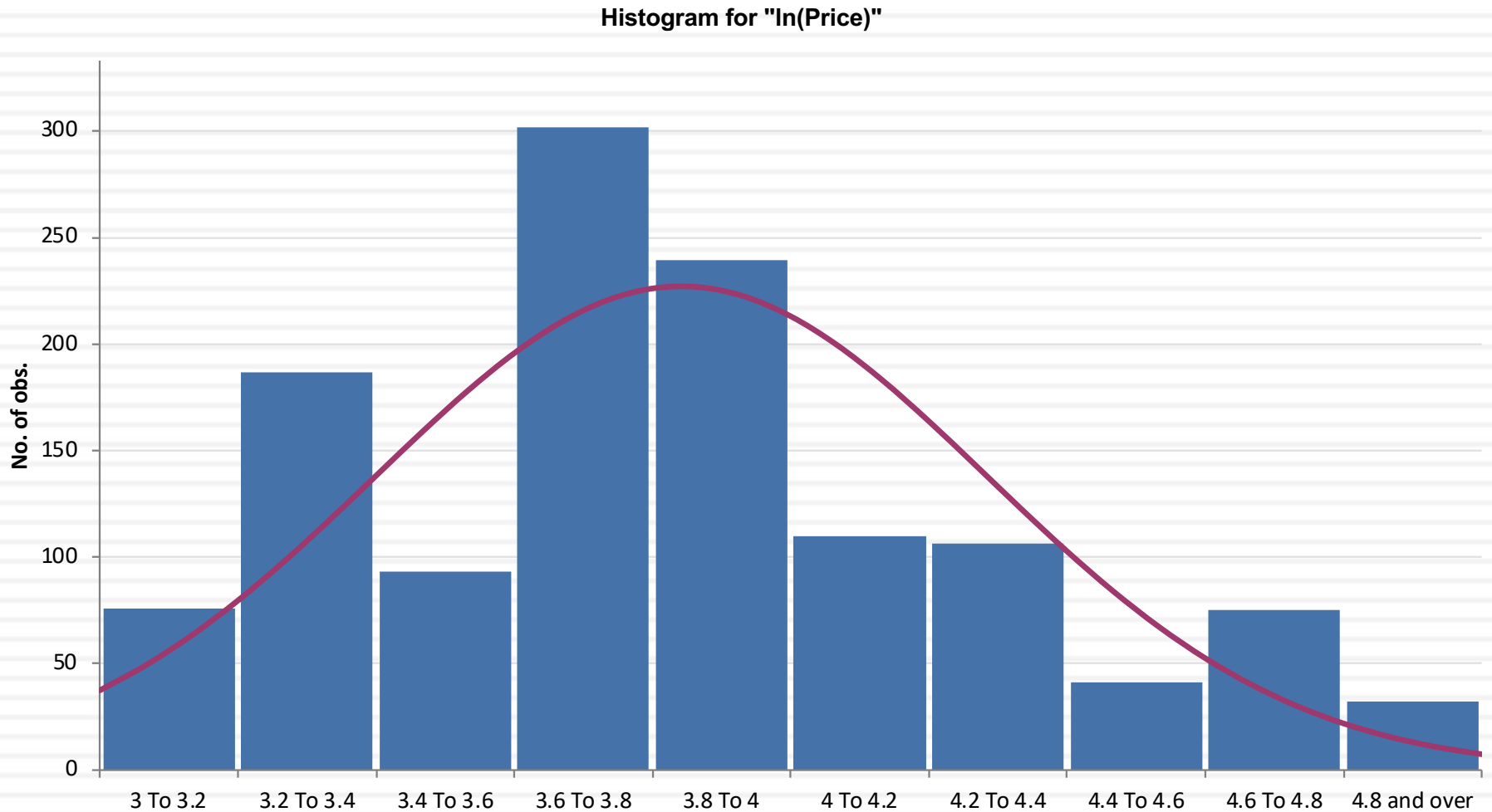


Normality Test

Normal Q-Q Plot - Apple Price



A Transformation: In(Apple) Daily



And normality tests...

Normal Q-Q Plot - ln(Price)

