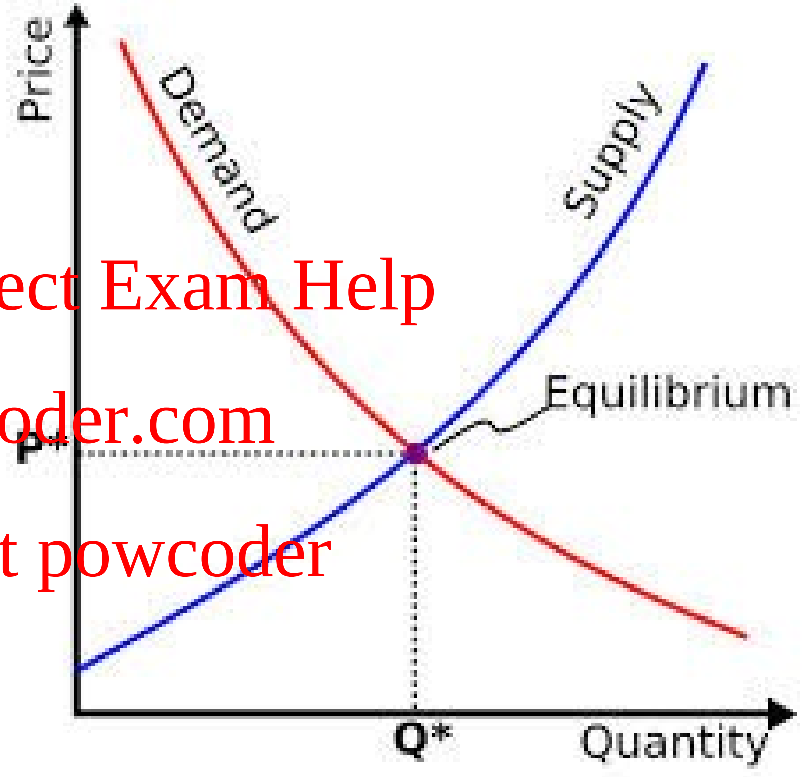
Equities

Agenda

What is a Market?

Traditional Markets

- Stock Markets
- Bond Markets
- Housing/Mortgages
- Commodities – gold/silver etc
- Crop Futures – corn/soybean
- Consumer Credit
- …



A market is one of the many varieties of systems, institutions, procedures, social relations and infrastructures whereby parties engage in exchange. Traditional markets are often regulated, have defined trading norms/rules, and have been in existence for some time.

Securities Trading can be distilled into 4 categories

Belief Based Investing

The intrinsic value of a company is appealing regardless of market & financial factors. As a result, intrinsic value changes trigger buy/sell action.

I like Wonder bread, so I bought stock in Flower Foods (FLO) since they make it.

https://www.steadygo.digital/blog/terrible-stock-photos/

Securities Trading can be distilled into 4 categories

Financial Fundamentals Investing

Traditional financial performance indicators trigger an action regardless of sector, or company product.

www.shutterstock.com · 39495199

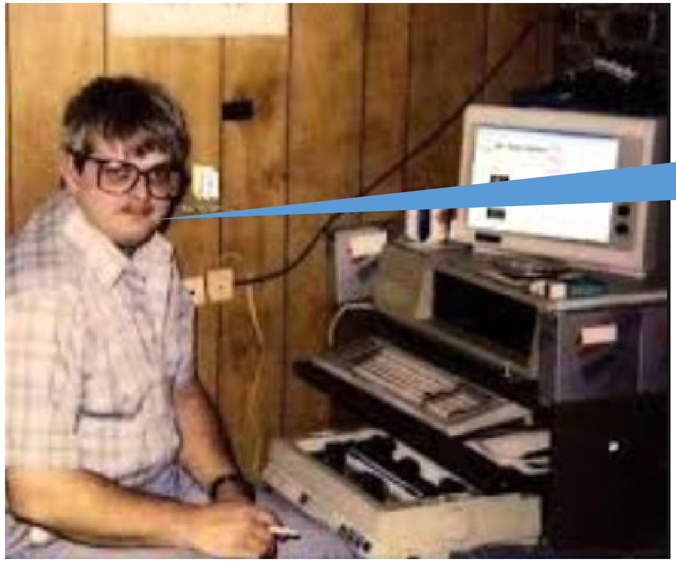
Monsanto (MON) makes genetically modified food, I don't care if it is safe. I bought the stock because the EPS is good.

Securities Trading can be distilled into 4 categories

Technical Trading

Trade based on “indications”. Uses non-financial mathematical indicators to quantify risk/reward, or trigger buy/sell

- “Algorithmic Trading” – using algorithms to identify an equity action
- Momentum – Recognize prices moving up/down at thresholds to trigger action
- “Charting” – Visual chart patterns trigger actions (crossovers, head & shoulders)



The MACD crossover pattern for Smith & Wesson (AOBC) is positive so now is a good time to buy.

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Securities Trading can be distilled into 4 categories

High Frequency Trading

Extremely technical trading executed without a human that can trigger thousands of actions measured in nano-seconds. “scalping” small profits thousands of times per minute.

1001100100...

Knight

*Although HFT uses algorithms:
>There is no human in the loop
>Primary profits derive from market making

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Speaking of Knight Cap

What happened to them?

Keep in mind for trading…

In the short term the market is a NEGATIVE sum transaction. Market “makers” make money on the transactions. Retail investors pay a commission/fee for the trade or for their account.

Be careful & be sure to test your methods!

What type?

The Stochastic Momentum Indicator (SMI), a formula for measuring momentum, crossed over to positive territory. I think I will buy Google (Alphabet).

- **Belief Based** – some intrinsic value of the company is appealing and triggers a buy/selling action.
- **Fundamental Trading** - traditional financial indicator triggers an action regardless of sector, or company product.
- **Technical Trading** – trade based on "indications" or "algo trading"
- **High Frequency Trading** – "scalping" small profits repeatedly

What type?

Our PhD physicist wrote an algorithm that trades apple stock 10,000 per minute.

- **Belief Based** – some intrinsic value of the company is appealing and triggers a buy/selling action.
- **Fundamental Trading** - traditional financial indicator triggers an action regardless of sector, or company product.
- **Technical Trading** – trade based on “indications” or “algo trading”
- **High Frequency Trading** – “scalping” small profits repeatedly

What type?

I won’t buy firearm companies.

- **Belief Based** – some intrinsic value of the company is appealing and triggers a buy/selling action.
- **Fundamental Trading** - traditional financial indicator triggers an action regardless of sector, or company product.
- **Technical Trading** – trade based on “indications” or “algo trading”
- **High Frequency Trading** – “scalping” small profits repeatedly

What type?

In our workshop we modeled the probability of risk using a decision tree and it looks like buying a consumer loan is a good investment.

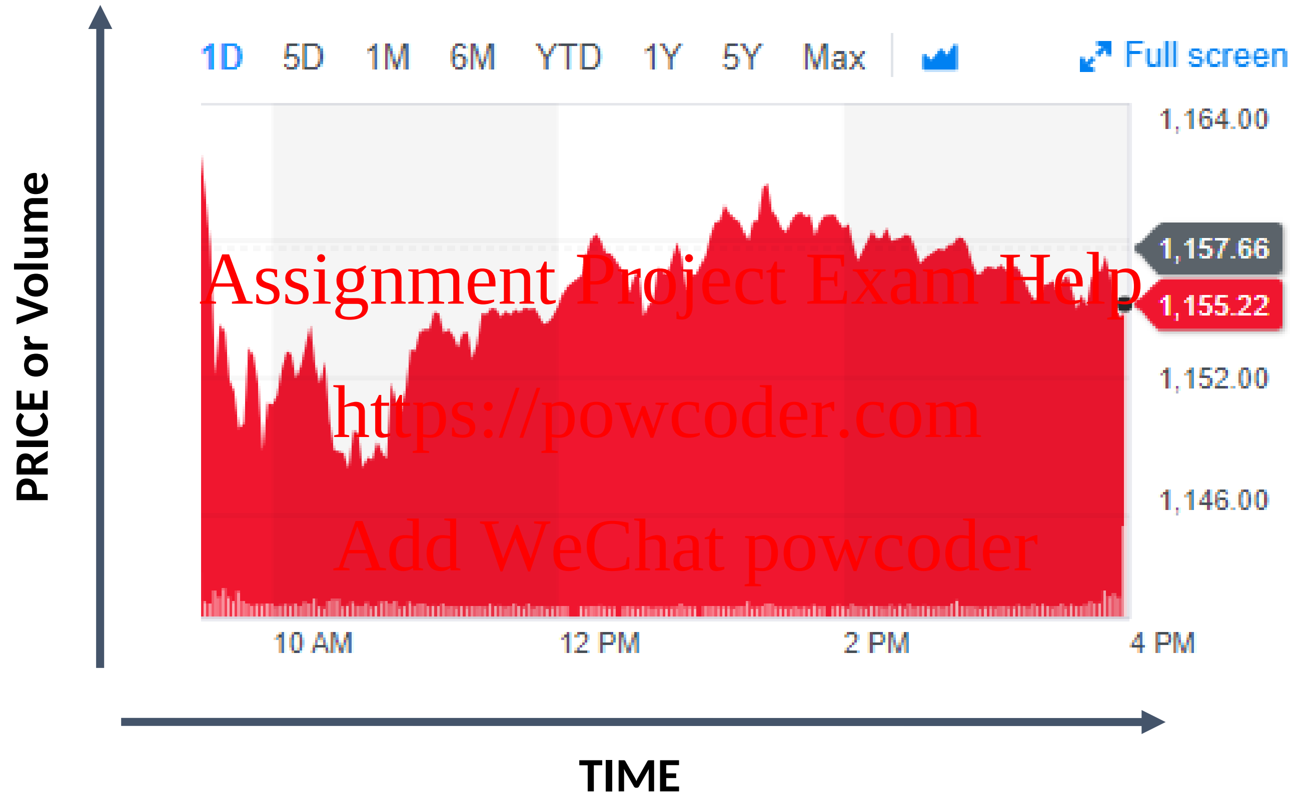
- **Belief Based** – some intrinsic value of the company is appealing and triggers a buy/selling action.
- **Fundamental Trading** - traditional financial indicator triggers an action regardless of sector, or company product.
- **Technical Trading** – trade based on “indications” or “algo trading”
- **High Frequency Trading** – “scalping” small profits repeatedly

What type?

Google's quarterly ad revenue is improving, so I am going to buy some shares.

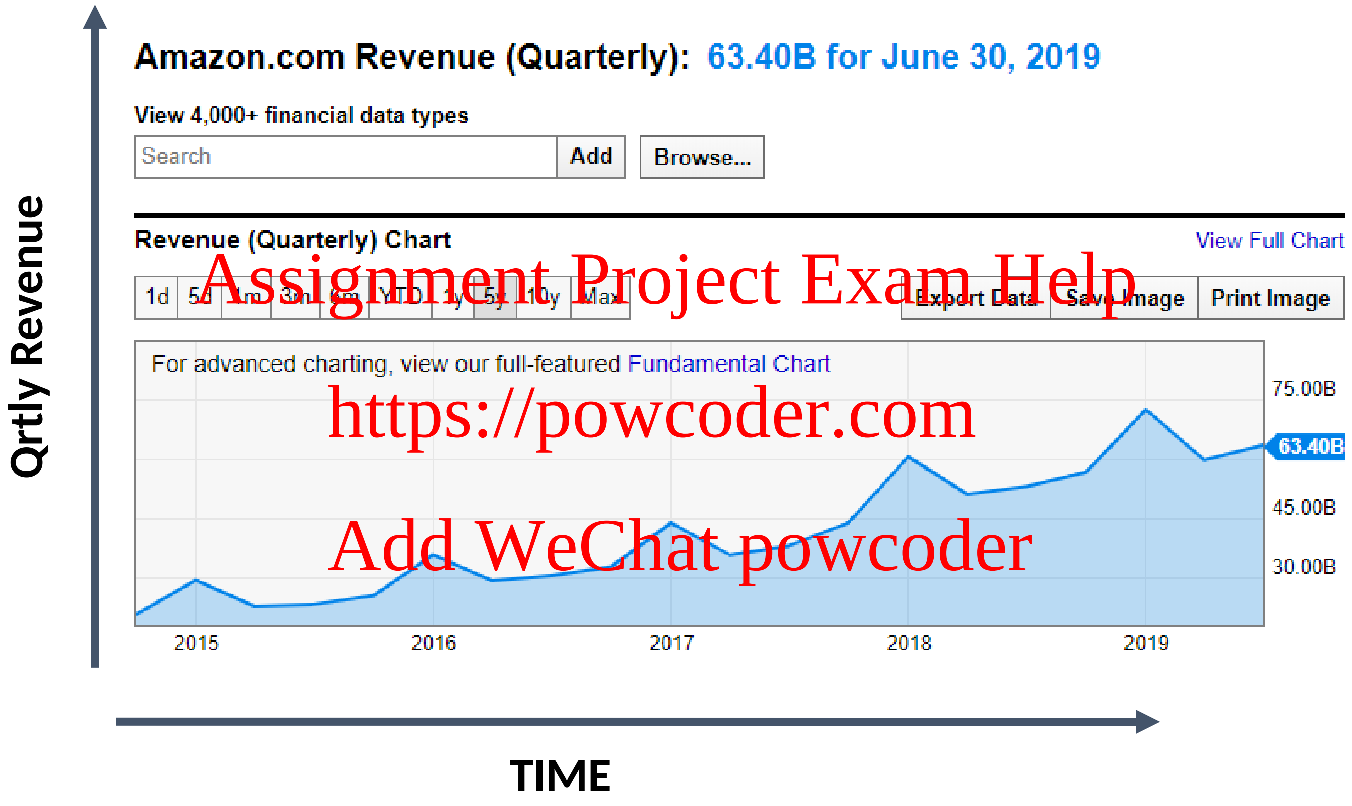
- **Belief Based** – some intrinsic value of the company is appealing and triggers a buy/selling action.
- **Fundamental Trading** - traditional financial indicator triggers an action regardless of sector, or company product.
- **Technical Trading** – trade based on "indications" or "algo trading"
- **High Frequency Trading** – "scalping" small profits repeatedly

Stock Prices represent a time series



Stock price of US Steel

Not all times series can be forecasted

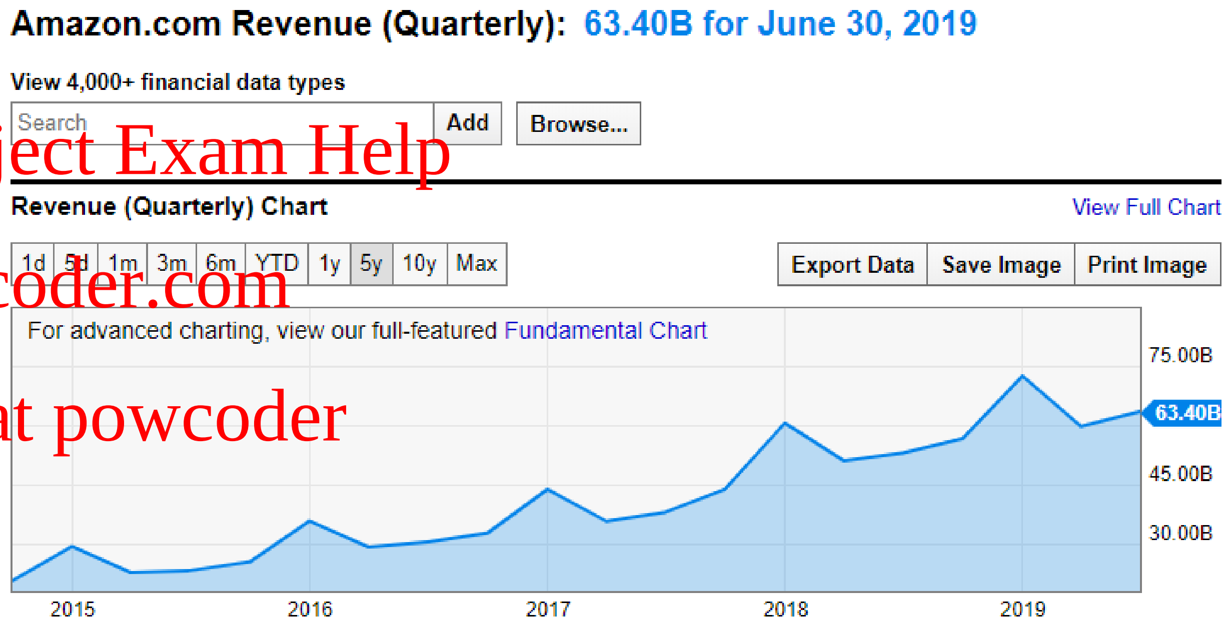


https://ycharts.com/companies/AMZN/revenues

This time series has a trend and seasonality so a traditional forecasting method like Holt Winters could be used.

Stock Prices represent a time series

Random Walk vs. **Predictable Patterns (non-stock)**



From a forecasting perspective stock prices are often considered a "random walk" meaning traditional econometric forecasting techniques do not apply.

Why can’t you forecast the time series?

Daily Chart

U.S. Steel

Q1 Jan/Feb/Mar plus ~30 days for reporting
4/25/17 Close : $31
4/26/17 Close: $22
4/26/17 Volume spike

What other forces can impact US Steel?

Weekly Chart

U.S. Steel

4/25/17 Close : $31
4/26/17 Close: $22
4/26/17 Volume spike

Missed Qrtly Earnings

5/15/17: ~$20
2/26/18: ~$45

What other forces can impact US Steel?

Weekly Chart

U.S. Steel

4/25/17 Close : $31
4/26/17 Close: $22
4/26/17 Volume spike
5/15/17: ~$20
2/26/18: ~$45
4/16/18: ~$36
6/16/18: ~36

Missed Qrtly Earnings

Steel tariffs

What other forces can impact US Steel?

Weekly Chart

U.S. Steel

4/25/17 Close : $31
4/26/17 Close: $22
4/26/17 Volume spike

Missed Qrtly Earnings

5/15/17: ~ $20
2/26/18: ~ $45

Steel tariffs

4/16/18: ~ $36
6/16/18: ~ $36

Retaliatory Auto tariffs

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So forecasting (pattern recognition) methods won't work.

Weekly Chart

U.S. Steel

- Missed quarterly earnings (self inflicted)
- Steel Tariffs (political/macro)
- Auto Tariffs (out of sector performance)

External factors remove pattern recognition that econometric forecasts seek.

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Meanwhile, US Steel was… producing steel.




A belief investor would not have bought or sold.

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Meanwhile, US Steel was… producing steel.



A fundamental investor would have sold after the quarterly earnings report waiting for another financial indicator to buy again (next quarter).

Meanwhile, US Steel was… producing steel.




A technical investor may have gotten out after the price drop but back in as positive moment based on steel tariffs occurred only to sell again after the momentum faded based on automotive tariffs

Meanwhile, US Steel was… producing steel.

An HFT would have been in and out many times per second and minute making money no matter the direction, they work only with speed as an advantage.

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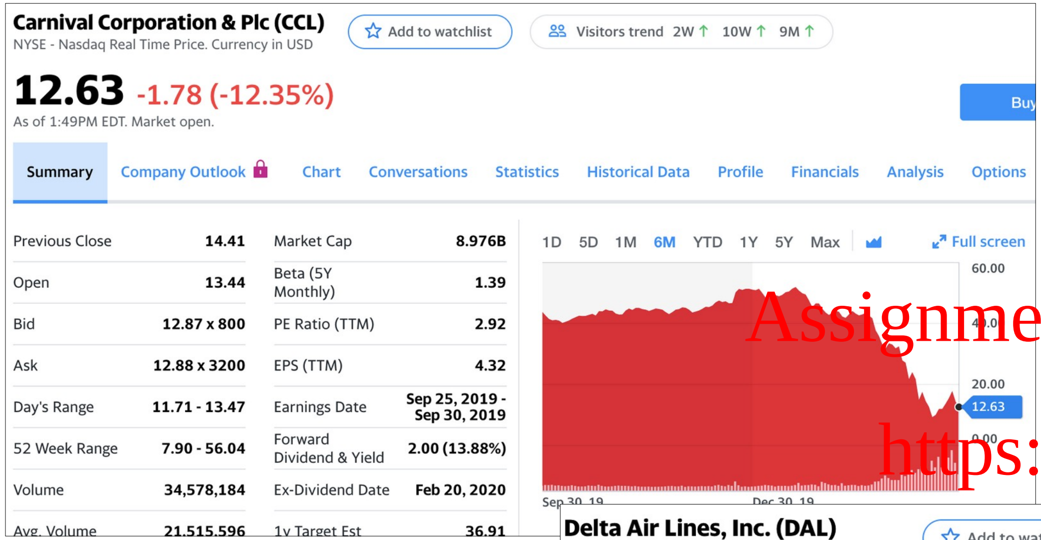
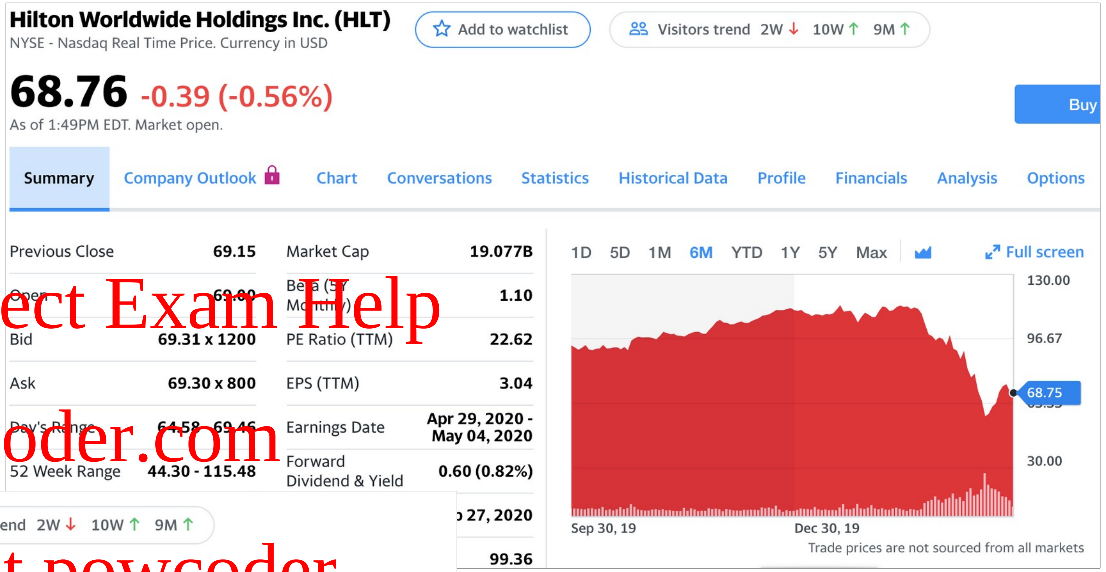
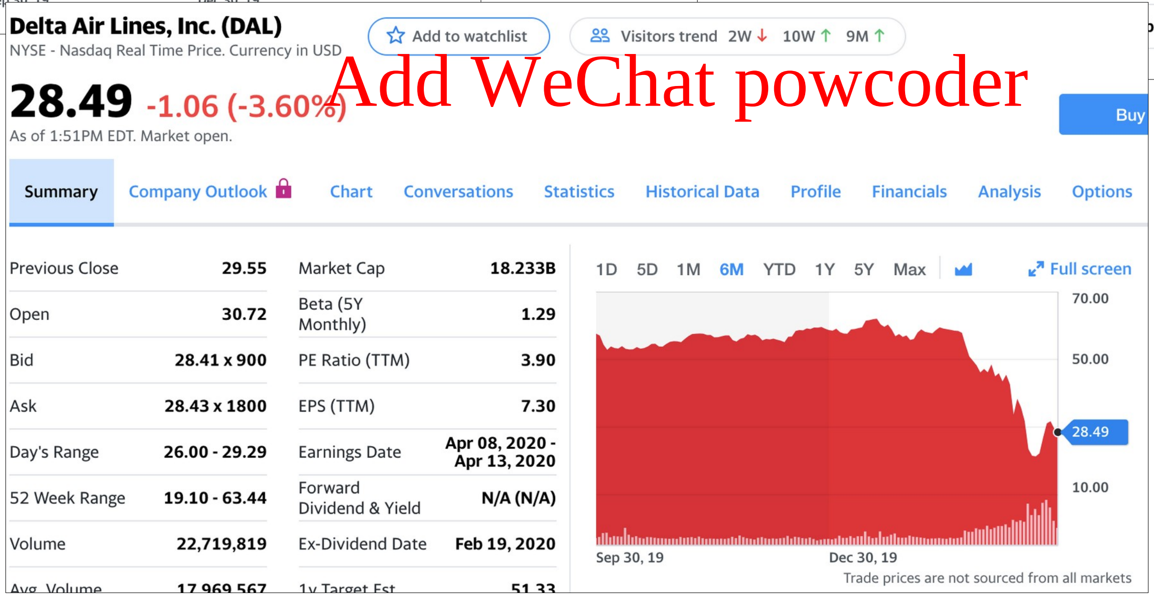
What is an example of a stock that has been impacted by macroeconomic forces?

What is an example of a stock that has been impacted by macroeconomic forces?





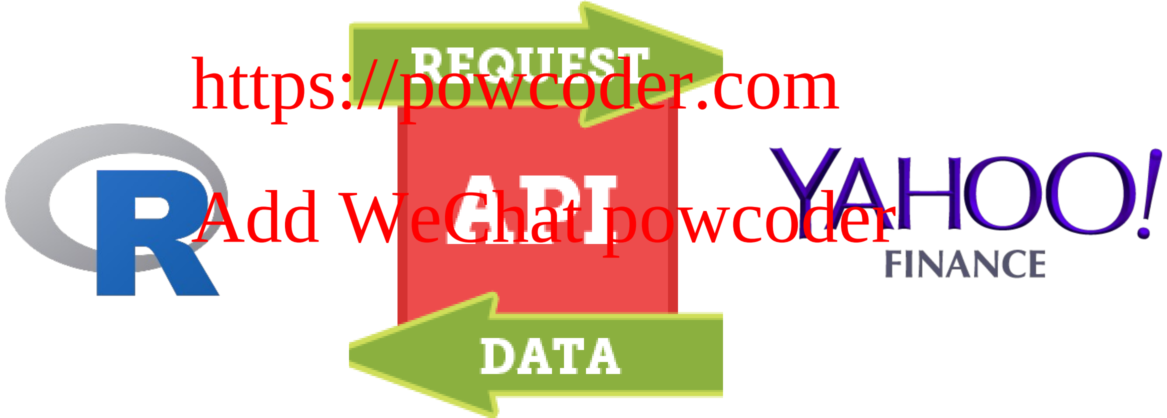


Agenda

Topic I
Obtaining Stock Data & Basic Visualization • What is the financial market? Types of investing strategies. • **What is an API? API access to stock data in R** • Manipulate a time series object TTR_A.R

R has many API related libraries.

Quantmod handles the request & organizing data to a time series object.



Rather than code requests & parse responses ourselves we use the quantmod package.

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Agenda

Topic I
Obtaining Stock Data & Basic Visualization • What is the financial market? Types of investing strategies. • What is an API? API access to stock data in R • **Manipulate a time series object TTR, A.R**

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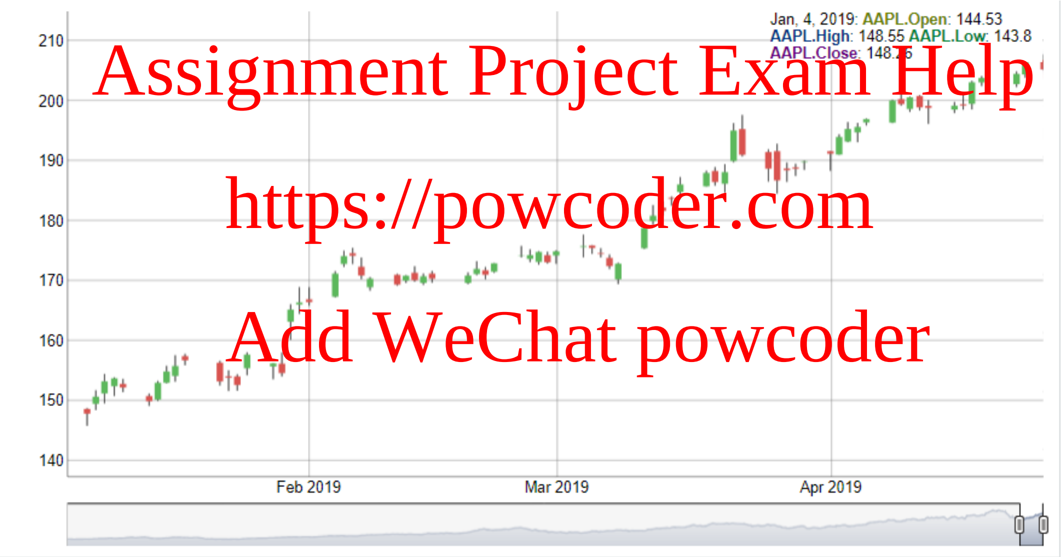
Interpreting a Candlestick Chart

Down Day



Up Day

Let’s Practice! Open TTR_A.R

<u>Learning Objective:</u>

- Get real stock data
- Subset an xts object
- Plot the time series dynamically

Agenda

Topic II
Creating the first indicator • **Explain what a technical trading rule/indicator is** • Learn what a lagged simple moving is • Calculate & Visualize 3 SMAs to understand the "smoothing" effect on time series data TTR_B.R

Technical traders use “indicators” to trigger actions.

1. Indicator:
If the daily Boris Johnson quotes of “Brexit” is greater than 5, then buy (or hold) WLTW (Willis Towers Watson) the next day.

2. Back-testing:
In the last 180 days, this indicator has yielded a 6% return [fictitious]

3. In Production:
Set up a script to monitor Boris’ Brexit quotes and buy if the number is greater than 5.

4. Execution:
In any given day that has quotes > 5 buy WLTW otherwise have no position.

5. Continual Monitor:
If you are in WLTW and quotes is < 5, then sell and vice versa.

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Technical Trading Assumptions

- “what” > “why”
  - Price action > reasons for move (non-explanatory)

Technical traders don’t necessarily care why a price changes.

Technical Trading Assumptions

- “what” > “why”
  - Price action > reasons for move (non-explanatory)

- Known information is *already* reflected in the price.

Technical traders believe tradeable information is immediately embedded in the price (not worth the effort to “scalp” i.e. trade based on speed, acting on info before others).

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Technical Trading Assumptions

- “what” > “why”
  - Price action > reasons for move (non-explanatory)
- Known information is *already* reflected in the price.
- Buyers & sellers trade based on emotion.
  - Fear & greed are powerful forces

Technical traders realize that some amount of trades occur due to emotion. Technical traders are unemotional when trading thereby exploiting the emotional traders.

Technical Trading Assumptions

- "what" > "why"
  - Price action > reasons for move (non-explanatory)
- Known information is *already* reflected in the price.
- Buyers & sellers trade based on emotion.
  - Fear & greed are powerful forces
- Markets fluctuate.

For technical traders to be successful, there needs to be pricing volatility.

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Let’s zoom into Technical Trading Rules (TTR)

Our learning goal is to use and understand some of the common technical indicators which affect you as a saver, pension holder, stock trader etc.
Further research is needed to be successful.

Our learning goal is NOT to make you a trader or convince you that you are now qualified to be a technical trader.

Agenda

Topic II
Creating the first indicator • Explain what a technical trading rule/indicator is • **Learn what a lagged simple moving is** • Calculate & Visualize 3 SMAs to understand the "smoothing" effect on time series data TTR_B.R

In addition to quantmod we will use TTR (technical trading rules)

```
library(TTR)
```



```
SMA()  #simple moving average
MACD() #moving avg convergence/divergence
RSI()  #Relative Strength Index
```

For expediency we will cover simple indicators but there are many more and you could even develop your own.

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What is a moving average?

vec[1:15]

```
[1,] -11.070657
 [2,]   3.774292
 [3,]  11.844412
 [4,] -22.456977
 [5,]   5.291247
 [6,]   6.060559
 [7,]  -4.747400
 [8,]  -4.466319
 [9,]  -4.644520
[10,]  -7.900378
[11,]  -3.771927
[12,]  -8.983864
[13,]  -6.762539
[14,]   1.644588
[15,]  10.594941
```

```
> mean(vec[1:5])
[1] -2.523537
```

```
> mean(vec[2:6])
[1] 0.9027066
```

```
> mean(vec[3:7])
[1] -0.8016318
```


A smoothing technique reducing noise in a data series. Takes the average over “n” number of periods.

What is a moving average?

```
vec[1:15
]
 [1,] -11.070657
 [2,]   3.774292
 [3,]  11.844412
 [4,] -22.456977
 [5,]   5.291247
 [6,]   6.060559
 [7,]  -4.747400
 [8,]  -4.466319
 [9,]  -4.644520
[10,]  -7.900378
[11,]  -3.771927
[12,]  -8.983864
[13,]  -6.762539
[14,]   1.644588
[15,]  10.594941
```

```
> mean(vec[1:5])
[1] -2.523537
```

```
> mean(vec[11:15])
[1] -1.45576
```



```
TTR::SMA(vec[1:15],
n=5)
 [1,]         NA
 [2,]         NA
 [3,]         NA
 [4,]         NA
 [5,] -2.5235367
 [6,]  0.9027066
 [7,] -0.8016318
 [8,] -4.0637779
 [9,] -0.5012865
[10,] -3.1396115
[11,] -5.1061087
[12,] -5.9534017
[13,] -6.4126457
[14,] -5.1548241
[15,] -1.4557603
```

A smoothing technique reducing noise in a data series. Takes the average over “n” number of periods.

So how does SMA become an Indicator?

Red Card! We need to lag the trading rule to ensure the signal is realistic. Calculations are not real time, but at the day's close so you need to adjust the results to emulate a real scenario.

Why Lag?

- Day 1 you have a closing price at 4:00pm EST
- Day 2 you have a closing price at 4:00pm EST
- Day 3 you have a closing price at 4:00pm EST
- Day 4 you have a closing price at 4:00pm EST
- Day 5 you have a closing price at 4:00pm EST

Now you have 5 complete data points to calculate the moving average

- Day 6 at 9:30AM is the earliest you could trade using the 5 day MA.

As a result you have to move the results of the calculation ”down” 1 day because that is when you would have it for use.

*setting aside futures/after hours

This is a “centered” moving average

```
vec[1:15
]
[1,] -11.070657
 [2,]   3.774292
 [3,]  11.844412
 [4,] -22.456977
 [5,]   5.291247
 [6,]   6.060559
 [7,]  -4.747400
 [8,]  -4.466319
 [9,]  -4.644520
[10,]  -7.900378
[11,]  -3.771927
[12,]  -8.983864
[13,]  -6.762539
[14,]   1.644588
[15,]  10.594941
```

```
> mean(vec[1:5])
[1] -2.523537
```


A centered moving average uses information from the future (days ahead) which is unrealistic.

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The data must be lagged so the value is known during trading time.

```
vec[1:15
]
[1,] -11.070657
 [2,]   3.774292
 [3,]  11.844412
 [4,] -22.456977
 [5,]   5.291247
 [6,]   6.060559
 [7,]  -4.747400
 [8,]  -4.466319
 [9,]  -4.644520
[10,]   7.900378
[11,]  -3.771927
[12,]  -8.983864
[13,]  -6.762539
[14,]   1.644588
[15,]  10.594941
```

Lagged 2 days but can be any appropriate “n”

```
> mean(vec[1:5])
[1] -2.523537
[1] 0.9027066
[1] -0.8016318
```


The calculation is lagged so the information is presented on a day you could actually make a trading decision.

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Agenda

Topic II
Creating the first indicator • Explain what a technical trading rule/indicator is • Learn what a lagged simple moving is • **Calculate & Visualize 3 SMAs to understand the "smoothing" effect on time series data TTR_B.R**

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Open TTR_B.R

Learning Objective:

- Get real stock data
- Subset an xts object
- Create three simple moving averages and plot to see the smoothing effect

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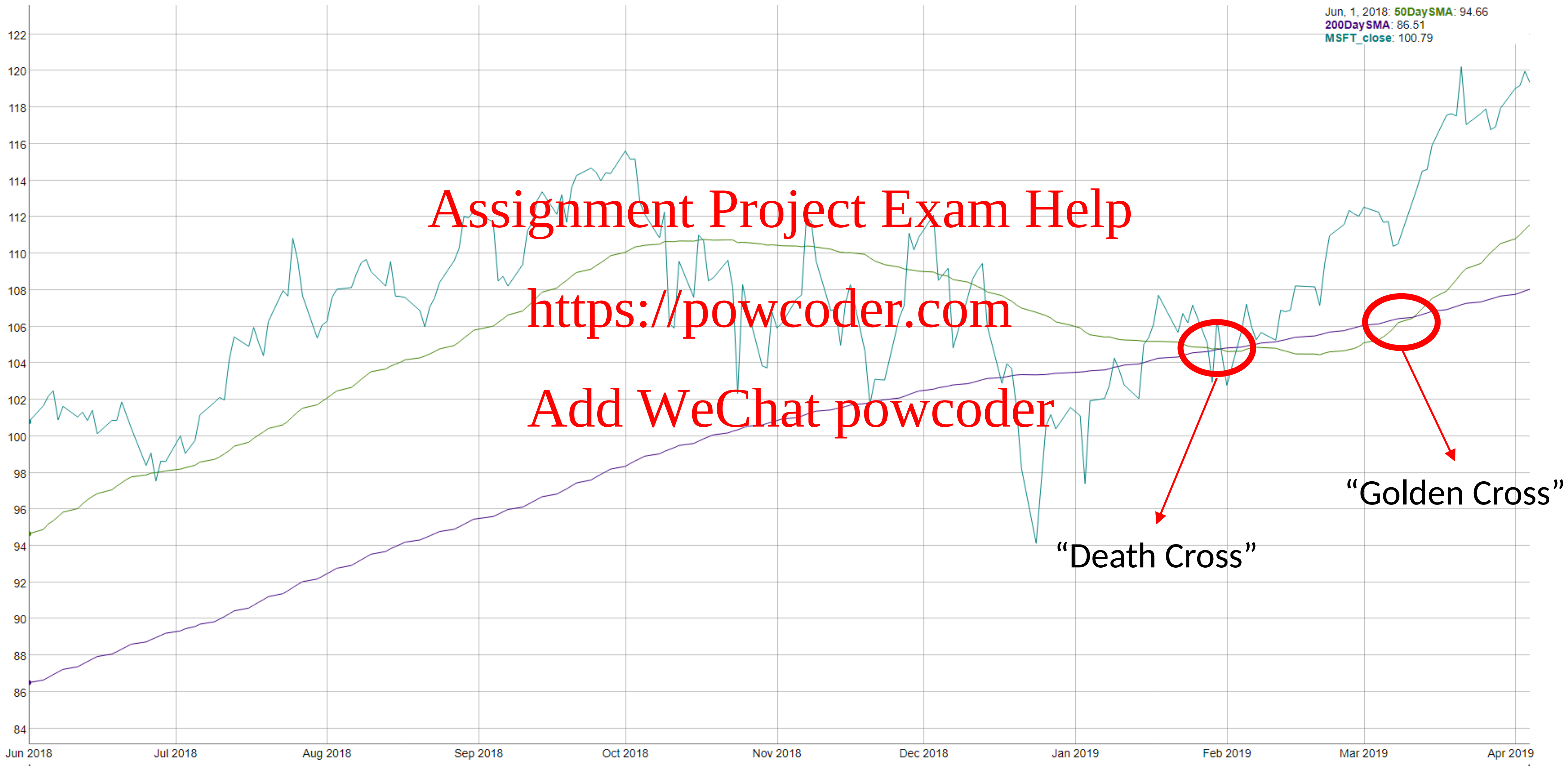
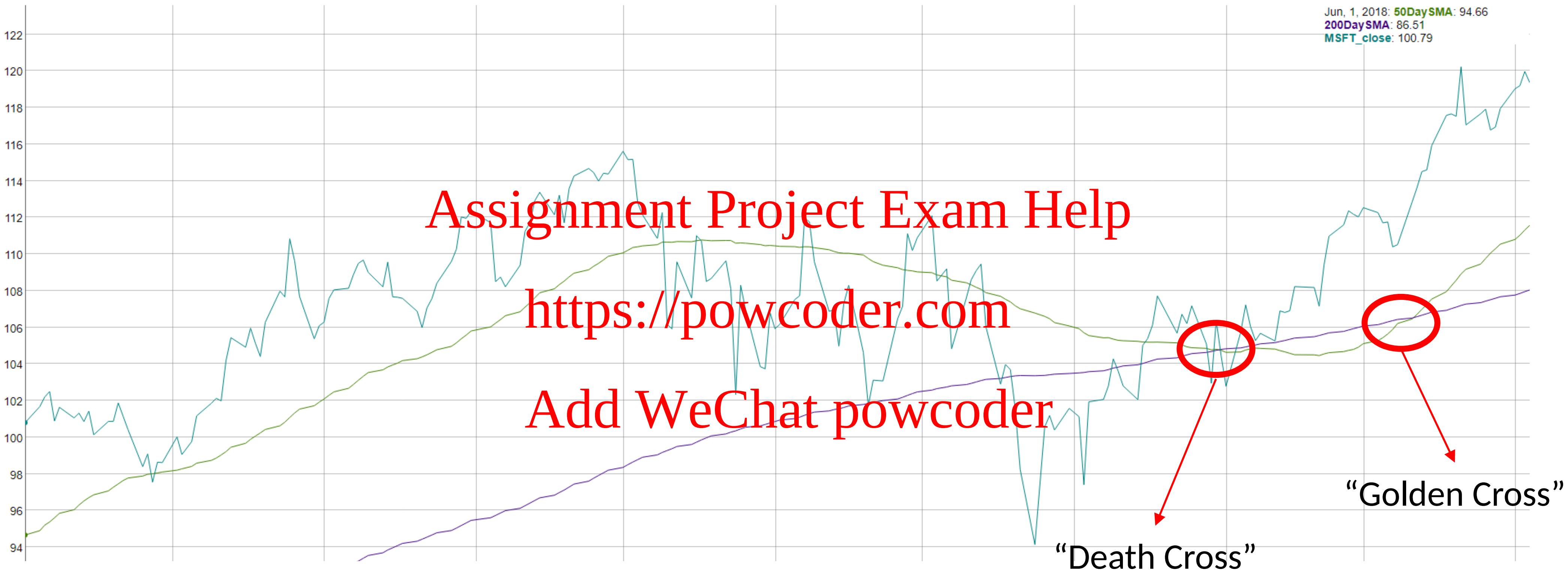
Agenda

Topic III
Applying the SMA Indicator • **50 & 200 day as a trading indicator** • Calculate the investment return with SMAs "death" and "golden" cross pattern • Explain what a back-test is for evaluating an indicator • Visualize the historical performance using a back-test TTR_C.R • Q&A • Break (5 minutes)

How does SMA become an indicator? MSFT 50 & 200 day SMA



How does SMA become an indicator? MSFT 50 & 200 day SMA



200 day: 9.5 months of trading
50 day: ~2.4 months of trading

Indicator Information

If the 50day average is > than the 200day then money is moving into the stock. Converse is True.

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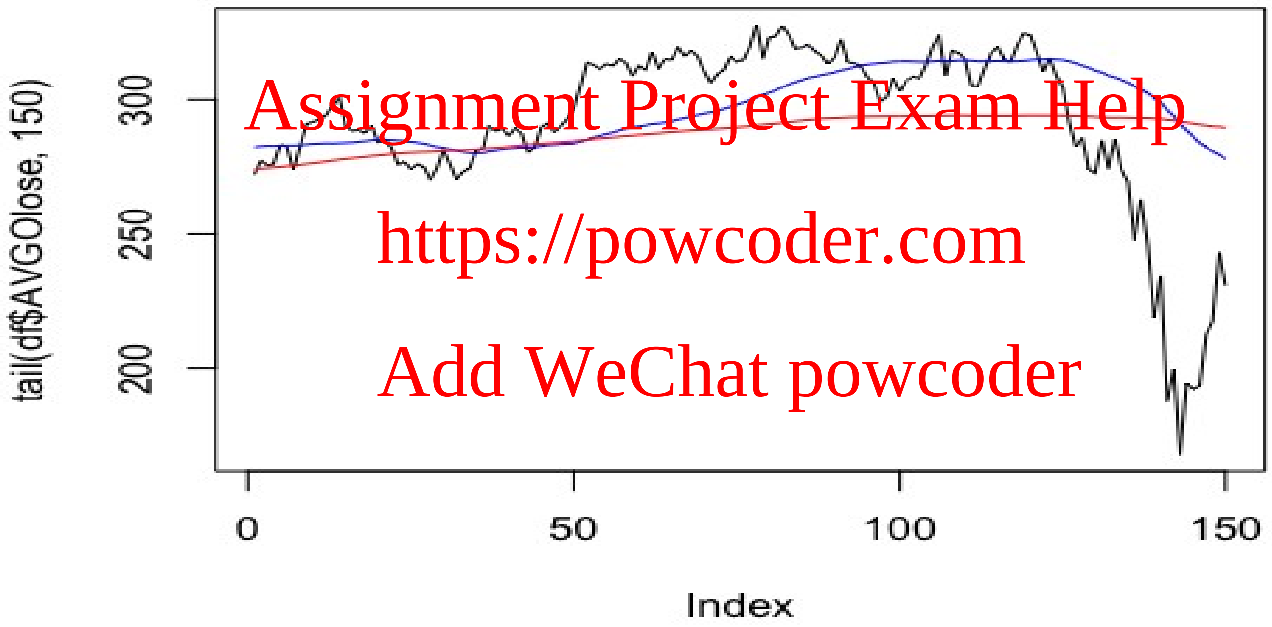
Do people really use SMA?



Mar 27 Article
https://finance.yahoo.com/news/moving-average-crossover-alert-broadcom-121912414.html

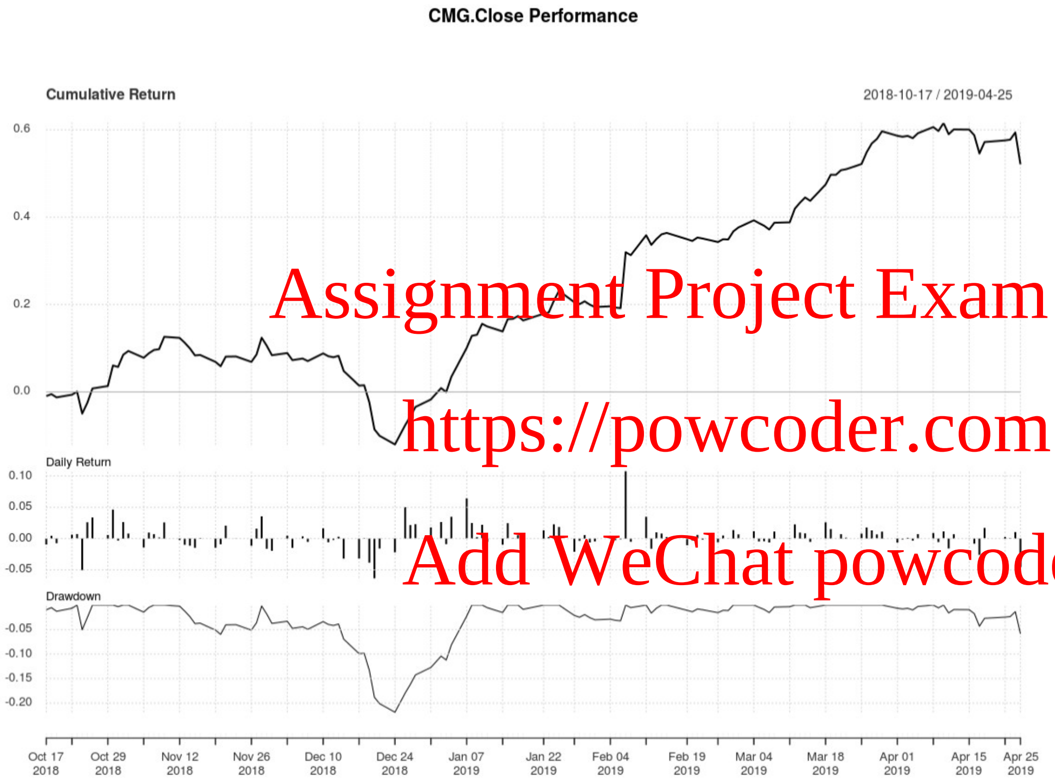
Agenda

Topic III
Applying the SMA Indicator • 50 & 200 day as a trading indicator • Calculate the investment return with SMAs “death” and “golden” cross pattern • **Explain what a back-test is for evaluating an indicator** • Visualize the historical performance using a back-test TTR_C.R • Q&A • Break (5 minutes)

Once you have an indicator you must test it.

An investor can "backtest" the strategy to find an acceptable "n" in case 50/200 doesn't work. Once the best "n" is found, an investor can look for "crosses" to indicate buy/sell.

Interpreting the Rate of Change (ROC)



Total Cumulative Return using the rule.

Day to Day Return
Important if rule is sub one day periodicity.

Peak to trough % change, used to understand volatility.

SMA as an Indicator for CMG as shown in a performance chart.

Agenda

Topic III
Applying the SMA Indicator • 50 & 200 day as a trading indicator • Calculate the investment return with SMAs "death" and "golden" cross pattern • Explain what a back-test is for evaluating an indicator • **Visualize the historical performance using a back-test TTR_C.R** • Q&A • Break (5 minutes)

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Open TTR_C_50Day_200Day_SMA.R

Learning Objective:

- Get real stock data
- Subset an xts object
- Calculate SMA 50 & 200
- Create a trading indicator (rule)
- Lag the Rule
- Back-test the lagged rule to see cumulative returns
- Switch a single character in the rule & back-test again to see the impact like Knight Capital

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Agenda

Topic III
Applying the SMA Indicator • 50 & 200 day as a trading indicator • Calculate the investment return with SMAs “death” and “golden” cross pattern • Explain what a back-test is for evaluating an indicator • Visualize the historical performance using a back-test TTR_C.R • **Q&A** • **Break (5 minutes)**

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Break!


YO DAWG, I HEARD YOU WANTED A BREAK FROM WORKING ON THE COMPUTER.
SO I OPENED FACEBOOK SO YOU CAN TAKE A BREAK FROM YOUR COMPUTER ON YOUR COMPTUER
quickmeme.com

Agenda

Topic IV
Creating the MACD Indicator • **Walk through the moving avg convergence divergence indicator** • Manually calculate a standard moving average • Apply the MACD signal as an indicator • Visualize the stock & MACD in a dynamic plot TTR_D.R • Debrief on MACD visuals & back-test • Q&A

Moving Average Convergence Divergence

By measuring *the moving average of two moving averages with different time frames*, an investor hopes to capture when momentum is building or receding.

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Moving Average Convergence Divergence

Money is moving into a stock…let's jump on the upswing!

Money is moving away from a stock…let's sell!

Moving Average Convergence Divergence

Instead of SMA's "n":

- nFast(12) – the smaller window to measure (12 periods)
- nSlow(26)- the longer window to measure (26 periods)
- nSig(9)- the number of periods used to measure the avg difference "signal"

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Moving Average Convergence Divergence

Instead of SMA's "n":

- nFast(12) – the smaller window to measure (12 periods)
- nSlow(26)- the longer window to measure (26 periods)
- nSig(9)- the number of periods used to measure the avg difference "signal"

1. **Calculate the 12 (nFast) day & 26 (nSlow) day moving averages.**
2. **Calculate the <u>difference</u> between averages from #1**
3. **Calculate the 9 day Moving Avg (nSig) of #2**

Moving Average Convergence Divergence

Instead of SMA's "n":

- nFast(12) – the smaller window to measure (12 periods)
- nSlow(26)- the longer window to measure (26 periods)
- nSig(9)- the number of periods used to measure the avg difference "signal"

1. **Calculate the 12 (nFast) day & 26 (nSlow) day moving averages.**
2. **Calculate the difference between averages from #1 (in R it's the MACD column)**
3. **Calculate the 9 day Moving Avg (nSig) of #2**

When MACD output of #2 > Signal, the price is accelerating, positive momentum/money is coming to the equity which represents a buying opportunity. Converse is true.

Agenda

Topic IV
Creating the MACD Indicator • Walk through the moving avg convergence divergence indicator • **Manually calculate a standard moving average** • **Apply the MACD signal as an indicator** • **Visualize the stock & MACD in a dynamic plot TTR_D.R** • Debrief on MACD visuals & back-test • Q&A

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Open TTR_D.R

<u>Learning Objective:</u>

- Get real stock data
- Subset an xts object
- Calculate MACD
- Plot a dynamic graph of the closing & MACD indicator
- Visually inspect the results of buy/sell actions
- Calculate cumulative return for the indicator

Agenda

Topic IV
Creating the MACD Indicator • Walk through the moving avg convergence divergence indicator • Manually calculate a standard moving average • Apply the MACD signal as an indicator • Visualize the stock & MACD in a dynamic plot TTR_D.R • **Debrief on MACD visuals & back-test** • **Q&A**

As a momentum indicator…

- MACD captures when the market is moving positively or negatively towards an equity. When emotional sentiment is positive or negative.

- MACD does not "Buy Low & Sell High" It's buy high and sell higher!

- MACD will not identify the market low point or high point exactly. So the returns will never be 100% of the possibility.

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Agenda

Topic V
Creating & Applying the RSI Indicator • Learn what a relative strength indicator is • Interpret RSI as an indication • Construction & visualization of RSI in dynamic plot with TTR_E.R

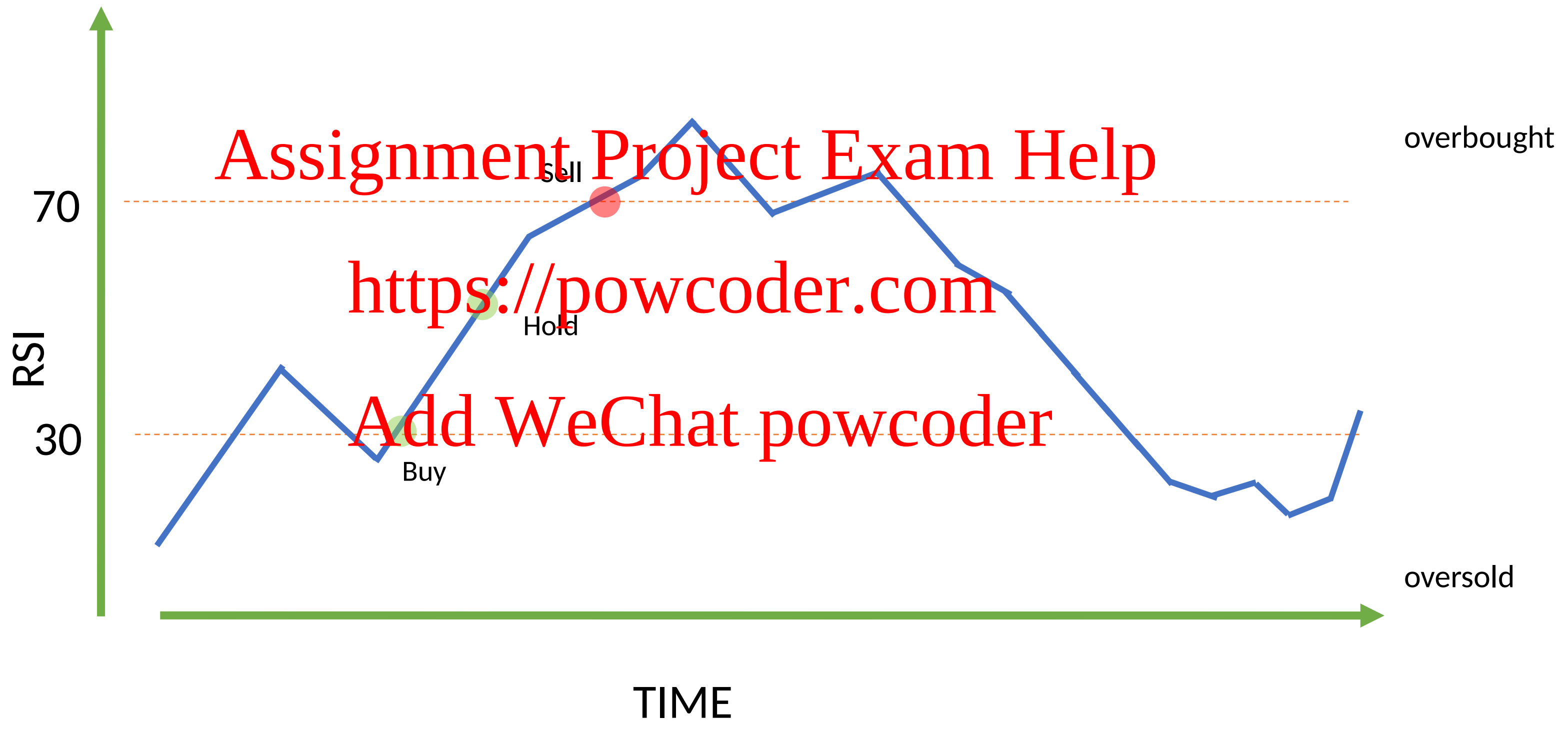
Relative Strength Index (RSI)

Momentum Oscillator

- Index between 0-100
- Compares average gains and losses in 14 day periods (“n”)
- Usually interpreted as an overbought/oversold (over 70 / below 30)

** Usually uses EMA but we will do SMA.*

Creates a control chart.



When the RSI dips below a threshold (30) the stock is considered “oversold” meaning the market has overreacted indicating a buying opportunity. RSI greater than 70 indicates the market is over buying the stock so it may be good to exit your position.

First the Relative Strength

RS = Avg Gain / Avg Loss

Avg Gain = For “up” days, total number of points up / number of “up” days (14 trading days)
Avg Loss = For “down” days, total number of points down / number of “down” days (14 trading days)

Calculating the RSI

RSI = 100 - (100 / 1+RS)

Where RS:

RS = Avg Gain / Avg Loss

Avg Gain = For “up” days, total number of points up / number of “up” days (14 trading days)
Avg Loss = For “down” days, total number of points down/ number of “down” days (14 trading days)

Open TTR_E.R

<u>Learning Objective:</u>

- Get real stock data
- Calculate RSI
- Plot a dynamic graph of the closing & RSI indicator
- Visually inspect the results of buy/sell actions

Housekeeping

- Homework help, use the script "1_REVISED_TTR_homework.R"
- Labs will end early if no one shows up after 15min. You can still email for additional help or request a 1x1 session.

- CHANGES TO GRADING
  - **Participation is now 20% not 10%.** You can get participation points for being on piazza, and engaged not just attending classes "live"
  - **Ethics Paper is now 10% EXTRA CREDIT**. It is optional.

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