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CS 677

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Homework 1, Written Answers

For homework 1, my selected stock symbol was PFE (Pfizer, Inc).

**Question 1.**

1.1 – see code in japarker\_hw1\_1.py.

1.2 – The tables for the five years of summarized data are:

2016

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Day | mean(R) | sd(R) | |R| | mean(R-) | sd(R-) | |R-| | mean(R+) | sd(R+) | |R+| |
| 'Monday' | -0.0367 | 1.055016 | 46 | -0.82737 | 0.584685 | 24 | 0.865172 | 0.72079 | 21 |
| 'Tuesday' | 0.160529 | 1.063518 | 51 | -0.84459 | 0.726628 | 20 | 0.864785 | 0.656129 | 29 |
| 'Wednesday' | 0.166947 | 1.493943 | 51 | -0.79536 | 0.572483 | 24 | 1.061652 | 1.555312 | 26 |
| 'Thursday' | -0.10296 | 1.109196 | 50 | -0.73031 | 0.668298 | 29 | 0.763386 | 1.009214 | 21 |
| 'Friday' | 0.007666 | 1.043055 | 50 | -0.84169 | 0.652008 | 23 | 0.759316 | 0.716259 | 26 |

2017

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Day | mean(R) | sd(R) | |R| | mean(R-) | sd(R-) | |R-| | mean(R+) | sd(R+) | |R+| |
| 'Monday' | -0.0513 | 0.599673 | 45 | -0.57056 | 0.377857 | 21 | 0.439701 | 0.317141 | 22 |
| 'Tuesday' | -0.04895 | 0.773826 | 50 | -0.54693 | 0.3907 | 28 | 0.612687 | 0.673556 | 21 |
| 'Wednesday' | 0.113818 | 0.749923 | 51 | -0.4449 | 0.451281 | 26 | 0.694881 | 0.522669 | 25 |
| 'Thursday' | 0.081769 | 0.662218 | 50 | -0.47527 | 0.399786 | 21 | 0.541123 | 0.501835 | 26 |
| 'Friday' | 0.148651 | 0.67707 | 50 | -0.35249 | 0.284305 | 21 | 0.549438 | 0.654572 | 27 |

2018

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Day | mean(R) | sd(R) | |R| | mean(R-) | sd(R-) | |R-| | mean(R+) | sd(R+) | |R+| |
| 'Monday' | -0.01905 | 1.309449 | 47 | -1.06303 | 1.205998 | 21 | 0.857133 | 0.564456 | 25 |
| 'Tuesday' | -0.05789 | 1.181725 | 50 | -0.82563 | 0.829546 | 27 | 0.969862 | 0.842433 | 20 |
| 'Wednesday' | 0.120345 | 1.295721 | 49 | -0.9427 | 0.826258 | 22 | 1.024475 | 0.901207 | 26 |
| 'Thursday' | 0.084017 | 1.182171 | 50 | -0.92946 | 1.073619 | 21 | 0.847125 | 0.527403 | 28 |
| 'Friday' | 0.347583 | 1.252398 | 50 | -0.96162 | 0.96989 | 15 | 0.935395 | 0.886763 | 34 |

2019

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Day | mean(R) | sd(R) | |R| | mean(R-) | sd(R-) | |R-| | mean(R+) | sd(R+) | |R+| |
| 'Monday' | -0.16474 | 1.209867 | 47 | -1.21591 | 0.950418 | 21 | 0.711645 | 0.54391 | 25 |
| 'Tuesday' | -0.04448 | 1.446374 | 51 | -1.09622 | 1.288027 | 24 | 0.924652 | 0.782161 | 26 |
| 'Wednesday' | -0.13706 | 1.071649 | 50 | -0.86601 | 0.784022 | 28 | 0.790697 | 0.539186 | 22 |
| 'Thursday' | 0.038917 | 1.140203 | 49 | -0.98727 | 0.816724 | 21 | 0.808556 | 0.626657 | 28 |
| 'Friday' | 0.204926 | 0.950124 | 50 | -0.89899 | 0.49681 | 17 | 0.797783 | 0.528409 | 32 |

2020

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Day | mean(R) | sd(R) | |R| | mean(R-) | sd(R-) | |R-| | mean(R+) | sd(R+) | |R+| |
| 'Monday' | 0.115881 | 2.792201 | 47 | -1.74203 | 2.069084 | 25 | 2.333194 | 1.823751 | 21 |
| 'Tuesday' | 0.038124 | 2.015202 | 51 | -1.30974 | 0.983817 | 28 | 1.679001 | 1.709517 | 23 |
| 'Wednesday' | 0.195493 | 2.144936 | 51 | -1.31523 | 1.581883 | 25 | 1.785454 | 1.503806 | 24 |
| 'Thursday' | -0.4717 | 2.269651 | 50 | -1.48568 | 1.781663 | 34 | 1.683003 | 1.588973 | 16 |
| 'Friday' | 0.332597 | 1.995838 | 48 | -1.16898 | 1.077109 | 21 | 1.500493 | 1.749722 | 27 |

1.3 – Overall, there are 621 days with positive gains and 587 days with negative losses over the five years.

1.4 – Over the five years, the average gain on any day is $0.063 higher than lost, so no the stock does not lose more on a down day than it gains on an up day

1.5 – Interestingly, no. The stock tends to lose $0.04 on Mondays and gain $0.19 on Wednesdays, while the difference between gains and losses on Thursday is less than a penny ($0.007).

**Question 2.**

2.1 – The general pattern is that prices are down on Monday and up on Wednesday, but this is not absolute (see 2019).

2.2 – The only obvious pattern for any day of the week across years is the number of trading days (they are about the same).

2.3 – Well, from the above observations, it’s best to buy on Monday (when prices are down) and sell on Wednesday (when prices are up).

2.4 – The only variations for PFE were Mondays in 2020 (average positive) and Wednesdays in 2019 (average negative).

**Question 3.**

PFE, all years

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Day | mean(R) | sd(R) | |R| | mean(R-) | sd(R-) | |R-| | mean(R+) | sd(R+) | |R+| |
| 'Monday' | -0.03359 | 1.576533 | 236 | -1.08274 | 1.278875 | 115 | 1.013801 | 1.125727 | 115 |
| 'Tuesday' | 0.018852 | 1.361223 | 257 | -0.92059 | 0.926603 | 128 | 1.005574 | 1.050187 | 122 |
| 'Wednesday' | 0.096953 | 1.429245 | 256 | -0.8687 | 0.967154 | 126 | 1.065684 | 1.159189 | 126 |
| 'Thursday' | -0.08 | 1.397631 | 253 | -0.97528 | 1.193692 | 128 | 0.864422 | 0.914855 | 121 |
| 'Friday' | 0.210181 | 1.261894 | 252 | -0.82759 | 0.791229 | 99 | 0.911464 | 1.038692 | 148 |

SPY, all years

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Day | mean(R) | sd(R) | |R| | mean(R-) | sd(R-) | |R-| | mean(R+) | sd(R+) | |R+| |
| 'Monday' | 0.050952 | 1.391235 | 236 | -0.87012 | 1.484976 | 98 | 0.720711 | 0.847547 | 135 |
| 'Tuesday' | 0.121188 | 1.148669 | 257 | -0.67076 | 0.693665 | 112 | 0.753694 | 1.060217 | 141 |
| 'Wednesday' | 0.09591 | 1.110491 | 256 | -0.73192 | 1.016161 | 105 | 0.671551 | 0.751527 | 151 |
| 'Thursday' | 0.00724 | 1.160276 | 253 | -0.69937 | 1.239279 | 116 | 0.605541 | 0.63639 | 137 |
| 'Friday' | 0.060291 | 1.110959 | 252 | -0.72224 | 0.848379 | 110 | 0.671203 | 0.890725 | 141 |

3.1 – The best day to trade based on average returns for PFE is to buy on Monday and Sell on Friday. For SPY the best trading days are to buy on Thursday (minimum gain) and sell on Tuesday (maximum gain).

3.2 – No, the days are not the same for PFE and the S&P 500.

**ASSUMPTIONS FOR THE ORACLE TRADING QUESTIONS**

When answering questions 4 – 6, my understanding of the questions and implementation of the code were as follows (also commented in the code):

* The trading oracle provides insight into the adjusted closing price of the CURRENT TRADING DAY.
  + If the price will close up, SELL to realize a gain.
  + If the price will go down, BUY to capture a lower price.
  + If the change is zero, hold (do not buy or sell).
* We cannot purchase fractional shares.
  + We must have enough cash on hand to purchase AT LEAST ONE SHARE.
* For question 6, I understood the question to be specific to the trading oracle providing incorrect information for the N days targeted.
  + For part 1 – we “miss” the 10 best days so DO NOT SELL.
  + For part 2 – we “realize” the 10 worst days, so we SELL when the price is down.
  + For part 3 – combine part 1 and 2, but for the five best and worst days.

**Question 4.**

4.1 – At the end of 2020, for PFE we will have $116.17.

4.2 - For SPY we will have only $100 because the stock is never at a price low enough to purchase even one share (see assumptions above about fractional shares).

**Question 5.**

5.1 – For the buy and hold strategy, PFE will end the five years with $145.32 total while SPY will have $100 (again, can’t buy a fractional share).

5.2 – The result for PFE is a good amount better than in question 4 (+25%).

**Question 6.**

6.1 – For each of the Oracle deception strategies, the final amounts are:

|  |  |  |
| --- | --- | --- |
| Strategy | PFE | SPY |
| A – miss best days | $ 113.40 | $ 100.00 |
| B – realize worst days | $ 116.17 | $ 100.00 |
| C - mix | $ 108.25 | $ 100.00 |

6.2 – We gain more by realizing the worst days, but this is given the assumptions laid out at the beginning of questions 4 – 6.

6.3 – Interestingly, the results for the realizing the worst days strategy are identical to the results from question 4.