**Q1.1**

See the output of the python file. Table is too large to print out in word.

**Q1.2**

P star for D is: 0.5397877984084881

P star for SPY is: 0.5543766578249337

**Q1.3**

After seeing all down days:

For stock D:

For k = : 1

The probability of seeing a upday over a downday is: 0.5317919075144508

For k = : 2

The probability of seeing a upday over a downday is: 0.5864197530864198

For k = : 3

The probability of seeing a upday over a downday is: 0.6119402985074627

For stock SPY:

For k = : 1

The probability of seeing a upday over a downday is: 0.5952380952380952

For k = : 2

The probability of seeing a upday over a downday is: 0.5955882352941176

For k = : 3

The probability of seeing a upday over a downday is: 0.6363636363636364

**Q1.4**

After seeing all up days:

For stock D:

For k = : 1

The probability of seeing a upday over a downday is: 0.5454545454545454

For k = : 2

The probability of seeing a upday over a downday is: 0.536036036036036

For k = : 3

The probability of seeing a upday over a downday is: 0.5210084033613446

For stock SPY:

For k = : 1

The probability of seeing a upday over a downday is: 0.5203836930455635

For k = : 2

The probability of seeing a upday over a downday is: 0.5023041474654378

For k = : 3

The probability of seeing a upday over a downday is: 0.46788990825688076

**Q2**

Please see python output. There are probably more efficient ways to identify the pattern other than mapping it to a semi-hash value. But this is by far way easier to implement XD

The total predicted labels are way too many to fit in word

**Q2.2**

For Stock D:

Accuracy (%) when w=2: 54.76190476190476

Accuracy (%) when w=3: 55.15873015873016

Accuracy (%) when w=4: 54.166666666666664

For Stock SPY:

Accuracy (%) when w=2: 58.53174603174603

Accuracy (%) when w=3: 58.53174603174603

Accuracy (%) when w=4: 57.53968253968254

**Q2.3**

Best W value for D: 3

Best W value for SPY: tied, 2 or 3

**Q3.1**

Again, labels are way too many to show

**Q3.2**

Accuracy (%) for ensembled (D) : 54.56349206349206

Accuracy (%) for ensembled (SPY) : 58.92857142857143

**Q3.3**

**Conclusion for D: not really, it’s more like the middle of the road, better than some w values and worse than the best W**

For D:

Ensembled accuracy for '-': 0.5227272727272727

w: 2

Accuracy predicting '-': 0.52

w: 3

Accuracy predicting '-': 0.5636363636363636

w: 4

Accuracy predicting '-': 0.5172413793103449

**Conclusion for SPY: yes there’s definitely improvement. Especially considering that when w=2, the predicted labels are all “+”**

For SPY:

Ensembled accuracy for '-': 0.5208333333333334

w: 2

No negative predicated, acturacy = 0%

w: 3

Accuracy predicting '-': 0.5

w: 4

Accuracy predicting '-': 0.4778761061946903

**Q3.4**

**Conclusion for D: no real improvement. It’s only better then when w=3**

For D:

Ensembled accuracy for '+': 0.5504807692307693

w: 2

Accuracy predicting '+': 0.5567282321899736

w: 3

Accuracy predicting '+': 0.5501113585746102

w: 4

Accuracy predicting '+': 0.5448430493273543

**Conclusion for SPY: no, it’s worse than not using ensemble**

For SPY:

Ensembled accuracy for '+': 0.5504807692307693

w: 2

Accuracy predicting '+': 0.5853174603174603

w: 3

Accuracy predicting '+': 0.6053921568627451

w: 4

Accuracy predicting '+': 0.6035805626598465

**Q4**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| W | Ticker | TP | FP | TN | FN | Accuracy% | TPR | TNR |
| 2 | SPY | 295 | 209 | 0 | 0 | 58.53 | 1 | 0 |
| 3 | SPY | 247 | 161 | 48 | 48 | 58.53 | 0.8373 | 0.2297 |
| 4 | SPY | 236 | 155 | 54 | 59 | 57.54 | 0.8 | 0.2584 |
| Ensemble | SPY | 272 | 184 | 25 | 23 | 58.93 | 0.922 | 0.1196 |
| 2 | D | 211 | 168 | 65 | 60 | 54.76 | 0.7786 | 0.279 |
| 3 | D | 247 | 202 | 31 | 24 | 55.16 | 0.9114 | 0.133 |
| 4 | D | 243 | 203 | 30 | 28 | 54.17 | 0.8967 | 0.1288 |
| Ensemble | D | 229 | 187 | 46 | 42 | 54.65 | 0.845 | 0.1974 |

Noticeable result:

For SPY when w = 2, we predicted no “-”.

Ensemble generally yields a moderate result between the best and worst W.

The hit rate (TPR) is relatively high while the TNR is very low in comparison. It seems to be easier to predict positive than negative overall. Which make sense considering that overall the stock prices are going up, so one would be more likely to be correct when predicting “+”

**Q5**

A graph of a stock market

Description automatically generated with medium confidence

**Red**: Buy and hold **Blue**: Best W **Green**: Ensembled

**Q5.2 (next page)**

There’s a huge dip in the market around 300 days (by the end of 2019, covid)

Before that, the predictions are pretty close to each other. When there are large **sudden unexpected** changes in stock prices, it hurts way more if you predict wrong than just hold on and try to ride it out.

When there’s not too much unexpected changes such as covid, the three methods seems to be share similar patterns.

(Year 4 the three have similar yields, year 5 they are much different due to the starting point changes due to covid)