Continuous Assessment 3

Xiaoyi Long

November 2021

1 Hypothesis

In this experiment, I generate a hypothesis that ZIP[1] is more profitable than PRSH[2] in a simple dynamic market with fluctuating supply and demand curves. I consider it to be an interesting hypothesis is that PRSH is a relatively new and adaptive trading strategy in the automatic trading area. It is based on PRZI[3], which combines three different trading strategies: ZIC, SHVR and GVWY. So I'd like to see how much profit it can earn compared with ZIP, which outperformed human traders when it was developed in 1997. Furthermore, real world stock trading is continuously changing, so it is important to investigate the dynamic market. We can perform experiments to simulate the real-world stock trading in the BSE.

2 Experimental Methodology

I use the balanced-group tests in this experiment, here is the configuration of my experiment. First, trader specification. I set 15 ZIP traders and 15 PRSH traders for both buyers and sellers. Second, the supply and demand curves. I choose `jittered` mode to define the supply and demand schedules, which starts with a fixed stepmode but then randomly adjusts each order to simulate random noise. In order to simulate the dynamic market, I introduce two shocks, range1(50, 100, schedule_offsetfn) switches to range2(150, 200, offset_t) at 180 seconds and range2 switches back to range1 at 410 seconds during a market session. Furthermore, I use two offset functions `schedule\_offsetfn` and `offset\_t` to dynamically modify the ranges of supply and demand curves. Next, order schedule, it takes 15 seconds to cycle through all the traders and supply them with new orders, and I use `drip-jitter` mode to define that orders are delivered to traders one at a time, essentially at constant intervals but with some random noise added. Last, the market session part, it starts at 0 seconds, and each session lasts for 600 seconds. Based on the supply and demand schedules and order schedules defined above, I run this market session 500 times. Then we generate the the experiment data.

3 Visualisation

First, I use the `describe` function from `pandas` library to summary the sample statistics. The result shows in Figure 1

Second, I plot histograms with kernel density lines of PRSH and ZIP to generally observe the underlying distribution of these data. we can see that they look similar to Gaussian distribution because their distributions are unimodal and roughly symmetric around the mean.

	PRSH	ZIP
count	500.000000	500.000000
mean	68.837733	153.365600
std	18.194213	26.432003
min	23.100000	76.266667
25%	56.566667	136.025000
50%	69.033333	152.433333
75%	81.733333	170.991667
max	123.366667	236.766667

Figure 1: sample statistics

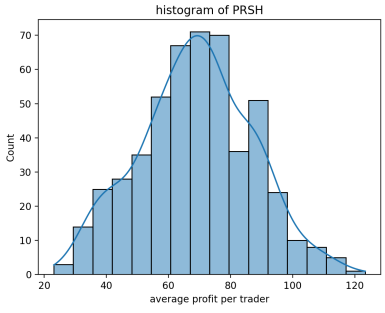

Figure 2: histogram of PRSH

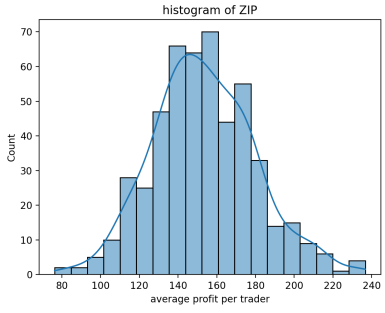

Figure 3: histogram of ZIP

Third, I use a boxplot to compare the distributions of the profit PRSH and ZIP. The confidence interval around the median is depicted by the box's notch, the green triangle shows the mean. As can be seen, average profit of ZIP is generally higher than PRSH, and their distributions cross. Last, the confidence interval around the mean is computed

and plotted. The sample size is 30 for both PRSH and ZIP in each trial. When sample size greater than or equal to 30 and Population standard deviation unknown, we can use a t-interval to compute confidence interval. so I use `t.interval` function from `scipy.stats` library to compute the confidence interval around the mean. We can observe that the confidence interval around the mean of ZIP is much larger than PRSH, and they have no intersection area.

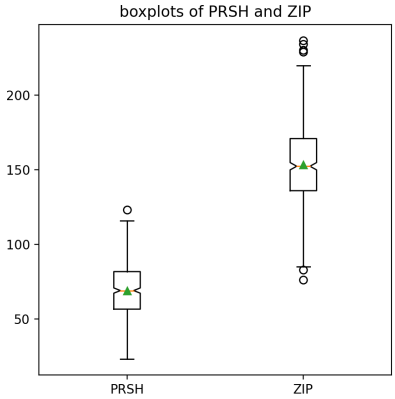

Figure 4: boxplots of PRSH and ZIP

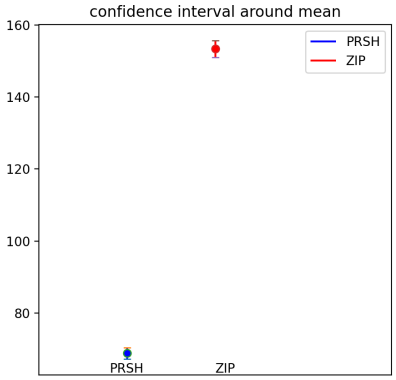

Figure 5: confidence interval around mean

4 Statistical Test

To check whether the data validate modelling assumptions for using a T-test, I use the `normaltest` function from the `scipy.stats` library to test whether it differs from a normal distribution and `|levene`function to test homoscedasticity. Results show that when alpha is 0.05, the p value of these two distribution is above the significant level, thus we can not reject the null hypothesis that they are normal distribution, however the result of `levene` test indicates that their variances are not equal.

In this case, the non parametric test is a better choice to test the hypothesis. To test my hypothesis, I employ the Mannwhitney U one-sided test. The null hypothesis is that each PRSH trader's average profit is no less than each ZIP trader's average profit, hence the alternative hypothesis is that each PRSH trader's average profit is less than each ZIP trader's average profit. To test the hypothesis, I use the `mannwhitneyu`function, with the `alternative` argument set to `less`. The null hypothesis is rejected since the p-value of this test is 3.38507811718986e-163, which is considerably below the significant level when alpha is 0.05. So we in favor of the alternative hypothesis that is each PRSH trader's average profit is statistically less than each ZIP trader's average profit.

5 Conclusion

In this experiment, first, I generate a hypothesis that ZIP is more profitable in a simple dynamic market with fluctuating supply and demand curves. Then, to observe the distribution of the data, I plot histograms, boxplots, and the confidence interval around the mean in a data set of size 500. We can observe that the average profit per ZIP trader is generally higher than the average profit per PRSH trader from these plots. Finally, I conduct the Mannwhitney U test, which reveals that average profit per PRSH trader is statistically considerably lower than average profit per ZIP trader when the significance is set to 0.05.

References

[1] Dave Cliff. Robot "ZIP". `https://github.com/davecliff/BristolStockExchange/wiki/3.05-Robot-%22ZIP%22`, 2021.

[2] Dave Cliff. Robot "PRSH". `https://github.com/davecliff/BristolStockExchange/wiki/3.11-Robot-%22PRSH%22`, 2021.

[3] Dave Cliff. Parameterised-response zero-intelligence traders, 2021.