

Sys-Computational Finance

Final Project

Quan Zhou GTID: 903163827

1. Problem Description

Topic 1: Gamma Scalping Trading Strategy

Design a C++ or a Python program to implement the Gamma scalping trading strategy involving one underlying stock and two at-the-money (ATM) options (one Call and one Put).

2. Code Structure Description

Class Name	Description
CsvReader	Read data from csv files.
SignalGen	Generate entry and exit signals based on σ_{Entry} σ_{Exit} and MA_t
GammaScalping	Generate trading instructions. When open a position, buy K shares of call option and K shares of put option. Check position delta every day during the trading period and trade on stocks to make delta neutral if position delta exceeds a threshold.
Portfolio	Record position information. Number of shares, total position value and total wealth.
Evaluation	Evaluate a given sequence of portfolio value. Analyze it's average return, Sharpe Ratio and maximum drawdown.
OptionData	Data structure. Manipulating option data.

3. In-sample backtest

The following 9 parameters were tested during in sample backtest. The runtime of each set of parameter is approximately 6-7 seconds. Considering the total runtime must be less than 1 hour. Each parameter is only tested with two values. So the estimated runtime is " $2^9 * 7s = 3584s$ ", which is almost one hour.

Parameter	Values	Description
SigmaEntry	[0.24, 0.28] if using implied vol, [0.3, 0.4] if using historical vol	MA_t lower than SigmaEntry indicates starting a trading period.
SigmaExit	[0.32, 0.36] if using	MA_t higher than SigmaExit indicates

	implied vol, [0.5, 0.6] if using historical vol	ending a trading period.
w	[5, 10]	Days of calculating moving average
m	[5, 10]	Days of price used to calculate historical standard deviation.
e	[2, 20]	The days to expiration of the holding option less than e is an exit signal.
Volatility Measure	[Historical, Implied]	Use either historical volatility or implied volatility given by Black-Scholes Model
DeltaT	[0.1, 0.2]	Tolerance of position delta. If position delta exceeds deltaT, trade some shares of stocks to keep delta-neutral.
Tmin	[40, 80]	Minimum days to expiration when choosing which option to hold.
Tmax	[100, 140]	Maximum days to expiration when choosing which option to hold.

During the back test, security was set to GOOG, initial cash was set to 1 million, transaction cost was set to 0.001 and K was set to 1, meaning hold 1 share of call option and 1 share of put option during one trading period.

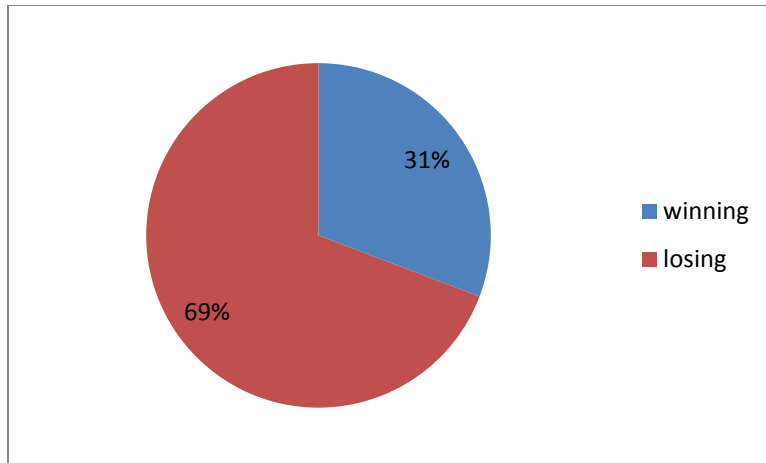
The set of parameters that gave the best Sharpe ratio is marked as red in the above table. The maximum Sharpe Ratio was 1.88 with annualized average daily return of 1.7% and standard deviation of 0.93%.

However, using the parameters given by in sample backtest, during out-of-sample period, no trade was done because the overall implied volatility during out-of-sample period is much higher than in the in-sample period. This is exactly one potential problem of technical strategy which is the results mainly depends on what time period we are using if the sample size is not large enough.

4. Performance

Using another set of parameters, the following results were generated.

Security=GOOG, Use implied Vol, SigmaEntry=0.3, SigmaExit=0.5, w=5, m=5, e=2, deltaT=0.15, tmin=60, tmax=120.



Totally 13 trades were made and only 31% of them had a positive return. However, the average return per trade was 11.2%. This suggests that the losing trades didn't lose as much as the winning trades gained.

The total portfolio value over the trading period is shown as below. The cumulative growth rate was approximately 1.2%.

