3rd Homework Report

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(a)
Downloaded the SPY and VIX from Yahoo Finance, and saved them as "SPY.csv" and "^VIX.csv".

(b)
The autocorrelation of SPY is: -0.0444, and the autocorrelation of VIX is: 0.9809.
I found strong evidence of autocorrelation in VIX. I would expect VIX to be more auto-correlated.

(c)
Computed the correlation of the S&P and its implied volatility (using VIX as a proxy):

table c1: the correlation on daily basis

|	SPY	VIX
SPY	1.0000	-0.1784
VIX	-0.1784	1.0000

table c2: the correlation on monthly basis

	SPY	VIX
SPY	1.0000	-0.4763
VIX	-0.4763	1.0000

The correlation is negative, and more significant on a monthly basis.
The implication is that the assumption of BS model that the volatility is constant doesn't hold, as the price of underlying asset is moving.
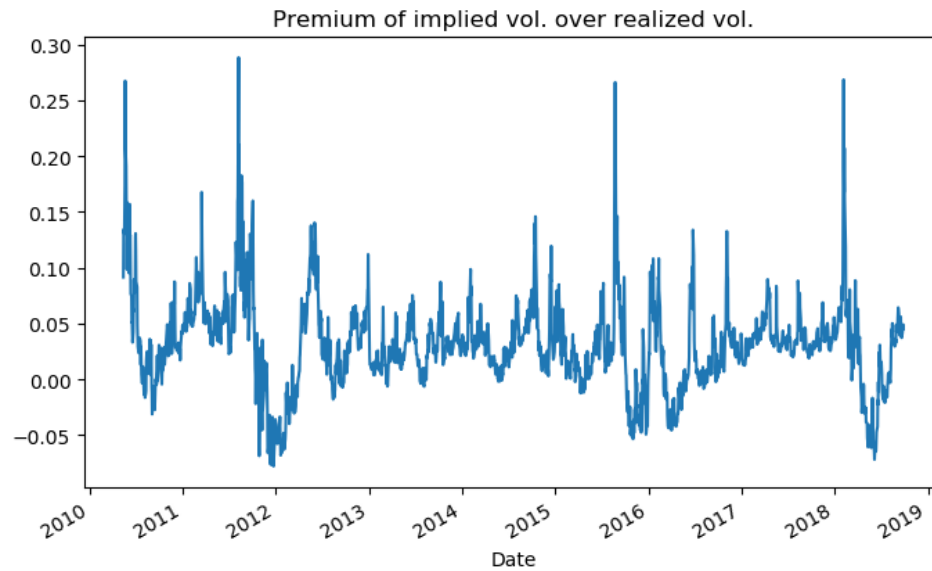
(d)
As it's shown in the picture, correlation deviates the most from long-run average in year 2018.

90-day correlatons of SPY and VIX
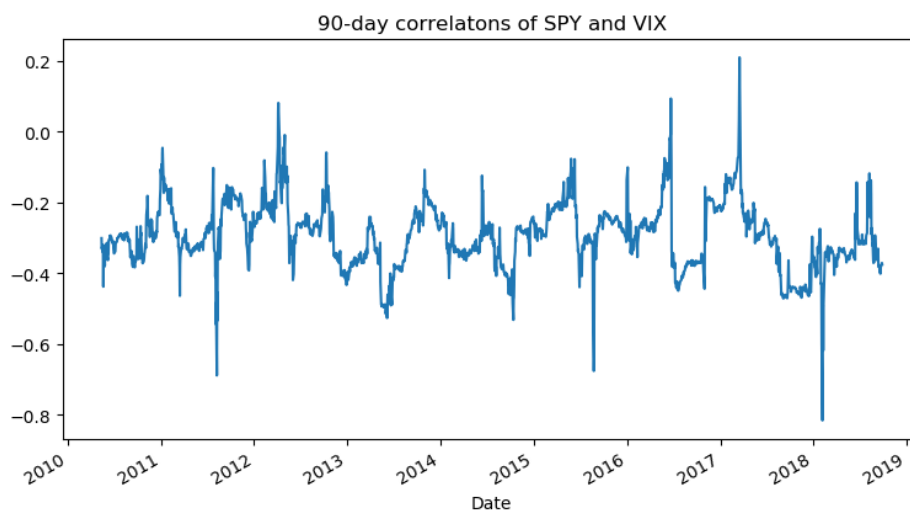
(e)
The premium is generally positive. Both of the highest and the lowest premium are in year 2011.

Premium of implied vol. over realized vol.

(f)
Constructed a portfolio that buys a 1M at-the-money straddle every day in historical period. The prices of straddles are shown in the picture.

(g)
Calculated the payoffs of these 1M straddles at expiry by looking at the historical 1M changes in the S&P. Calculated and plot the P&L as well.
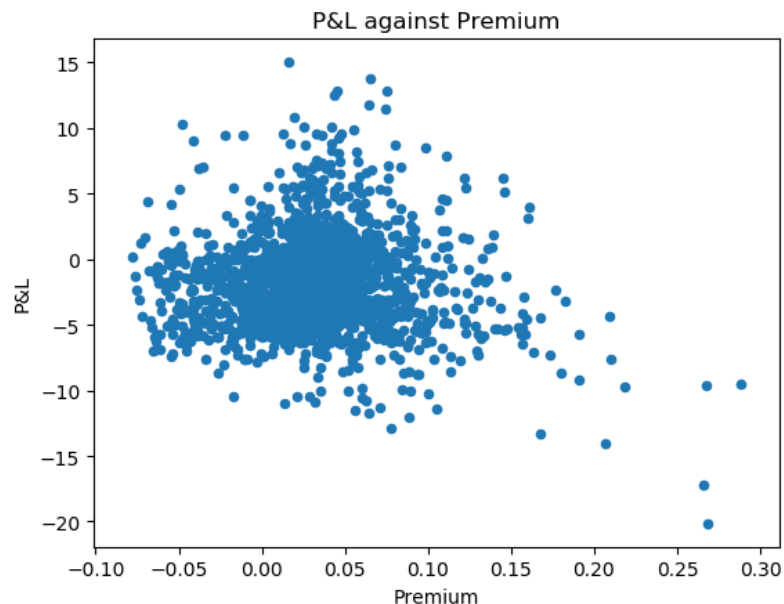

Price of straddle by BS model

Payoff of straddle

P&L
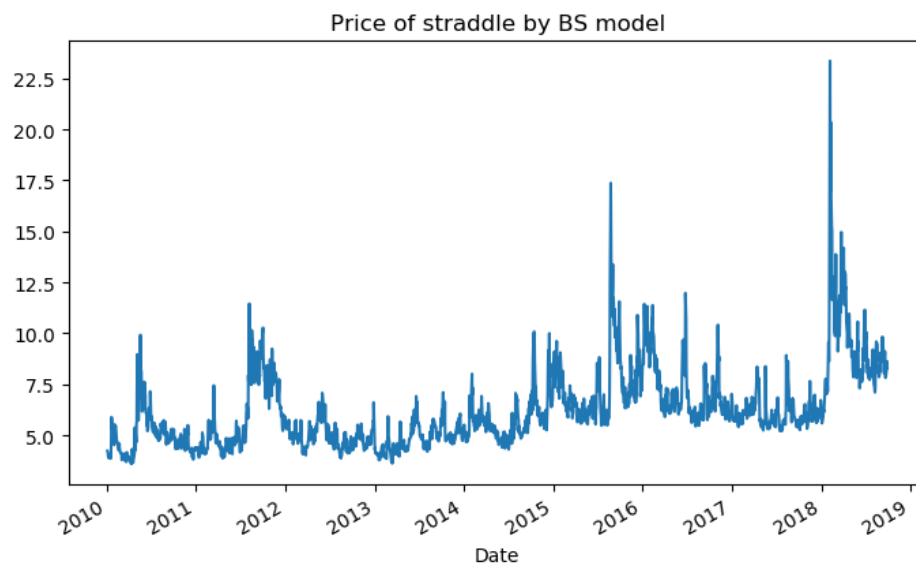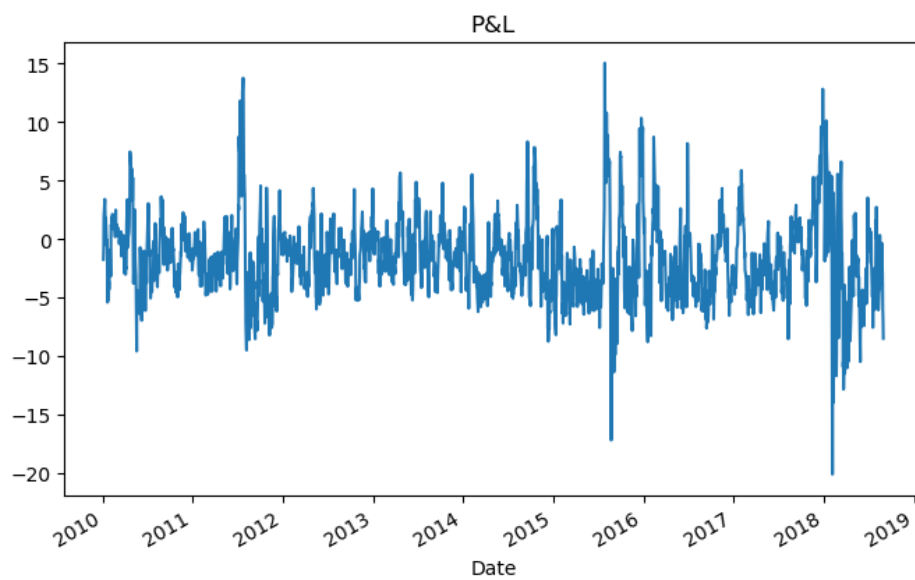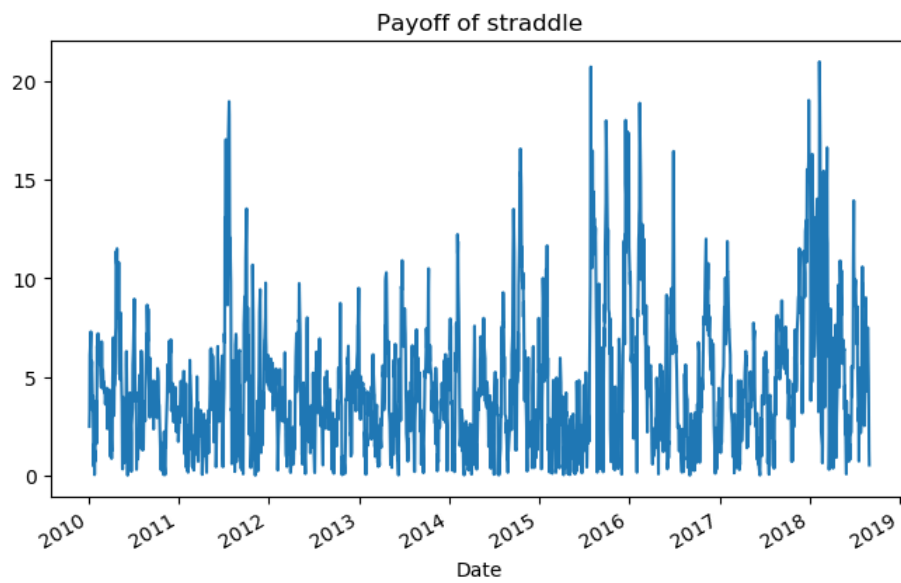
The average of P&L is: -1.7417

(h)
Made a scatter plot of this P&L against the premium between implied and realized volatility.

P&L against Premium

There is no strong relationship. I would expect little relationship between P&L and Premium because according to effective market theorem, investors can not make profit from given historical information.

Actually I observed a regular positive volatility premium on the option market. I think this is the major reason causing the P&L of straddle portfolio to be generally negative. Especially, this premium could be so high sometimes, causing the P&L to be strongly negative, which means some kind of overreaction, which could be spotted at the right-bottom part of the scatter. So I would not suggest anyone buying such a straddle when the premium is too high.

Using VIX to feed BS model is kind of problematic, as it's shown by the regular negative profit-making results. The 1M real volatility is somewhat "smaller" than the implied one. The premium might be explained by other reasons other than the traditional meaning of option pricing.