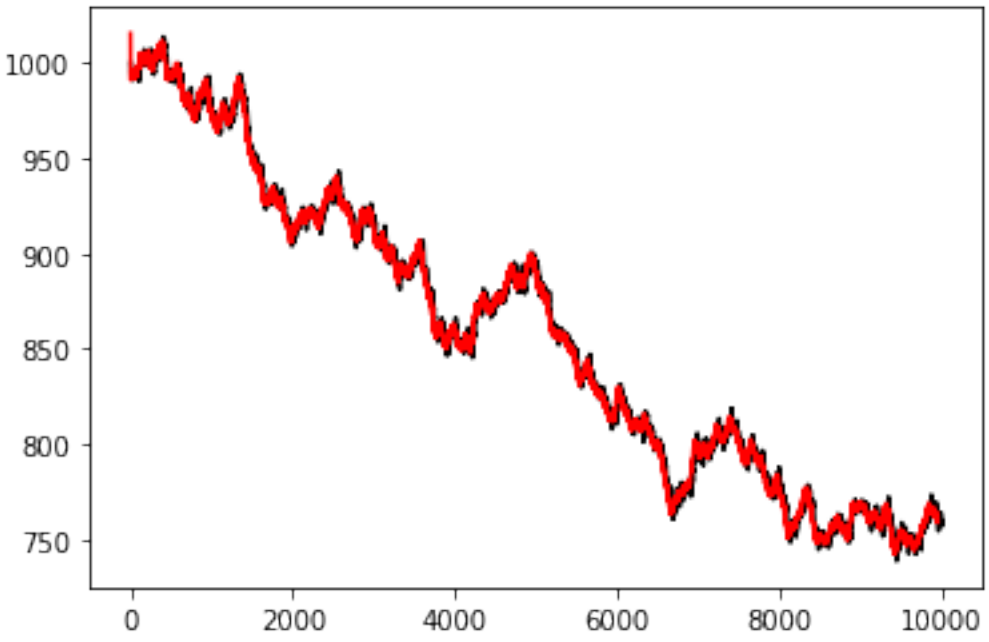
note-2-Robert

July 27, 2021

1 We consider a spot market and a TWAP for that market. Below the TWAP has a rolling window size of 50 data points.

[455]:
```
plt.plot(m.prices, c='k')
plt.plot(twaps, c='r')
```

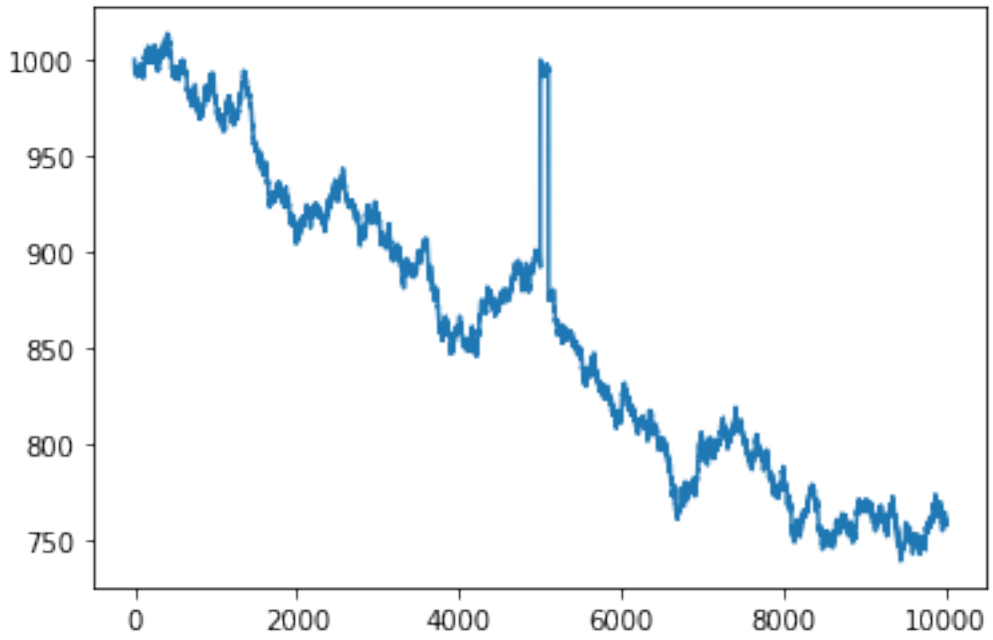
[455]:
```
[<matplotlib.lines.Line2D at 0x7ff438a437f0>]
```



2 The main concern is that the TWAP can be predicted. Let's see if this is the case – we artificially introduce a price shock

[499]:
```
prices_w_shock = m.prices.copy()
shock_block = 5000
for i in range(100):
    prices_w_shock[shock_block + i] = prices_w_shock[i]
plt.plot(prices_w_shock)
```

[499]: [<matplotlib.lines.Line2D at 0x7ff48fca5760>]

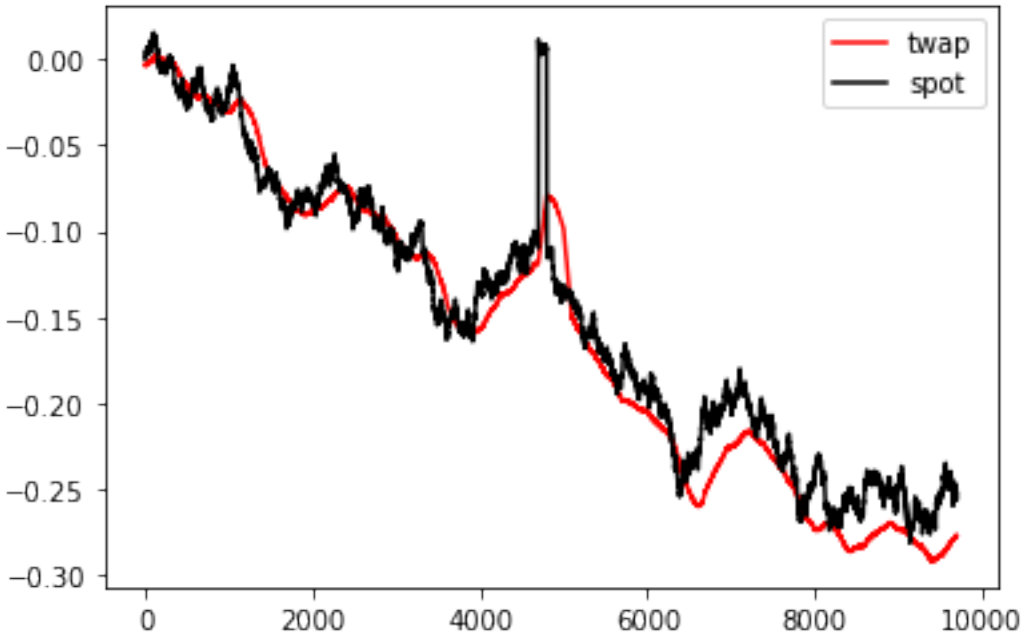


3 Now compute the TWAP as before

[519]:
```
twap_crets = np.cumsum(Shock.get_returns(Shock_twaps))
crets = np.cumsum(Shock.returns[window:])

plt.plot(twap_crets, c='r', label='twap')
plt.plot(crets, c='k', label='spot')
plt.legend()
```

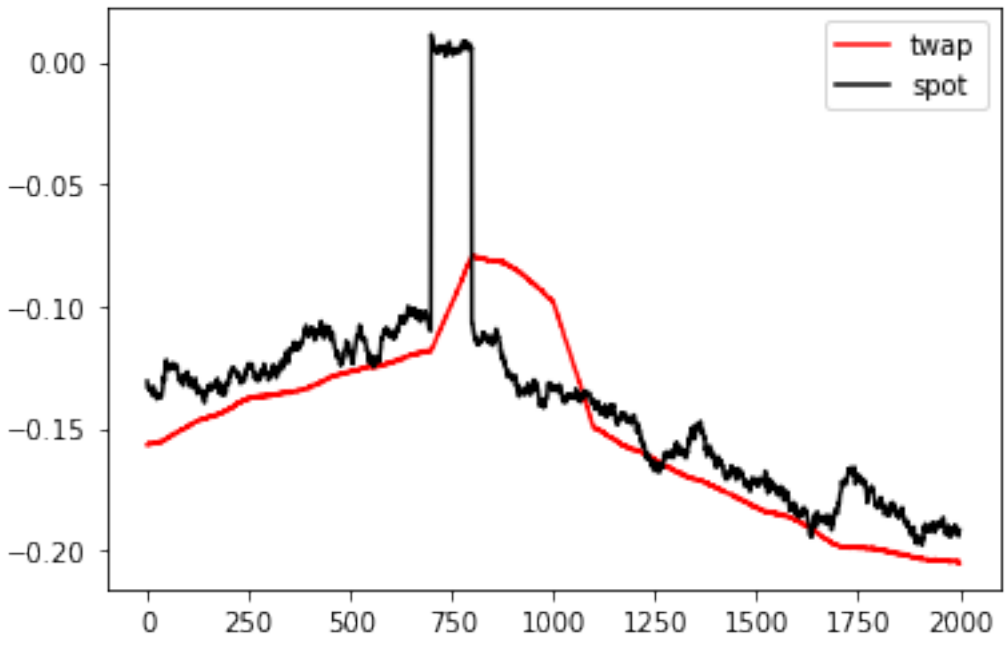
[519]: <matplotlib.legend.Legend at 0x7ff43a225640>



4 Zoom in

[505]:
```
plt.plot(twap_crets[4000:6000], c='r', label='twap')
plt.plot(crets[4000:6000], c='k', label='spot')
plt.legend()
```

[505]: <matplotlib.legend.Legend at 0x7ff45868d4f0>

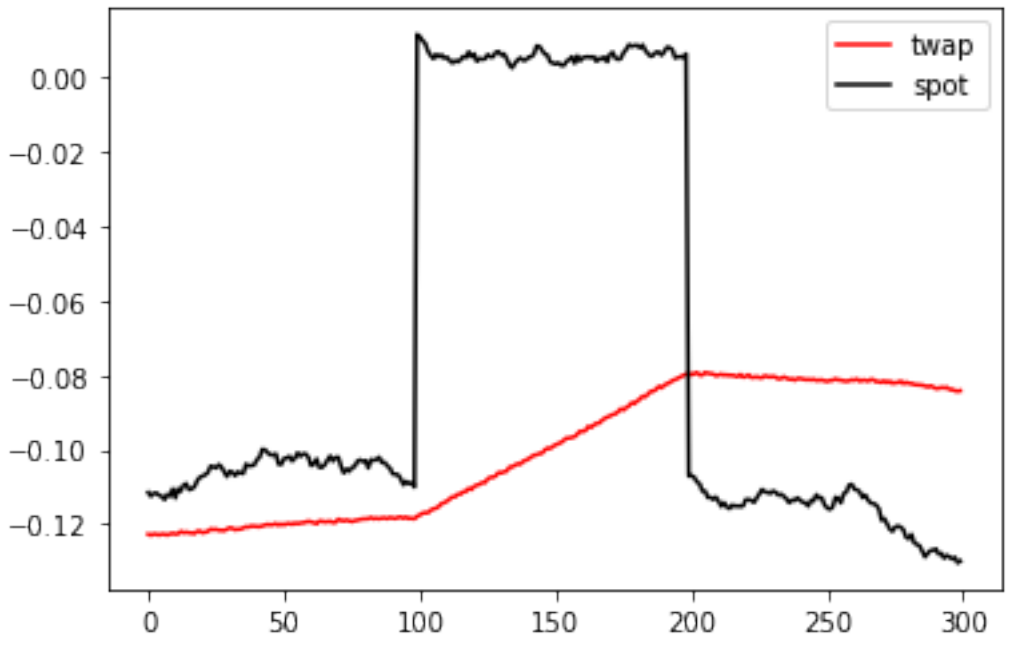


5 Zoom in

[506]:
```
shock_time = shock_block-window

plt.plot(twap_crets[shock_time-100:shock_time+100+100], c='r', label='twap')
plt.plot(crets[shock_time-100:shock_time+100+100], c='k', label='spot')
plt.legend()
```

[506]:
```
<matplotlib.legend.Legend at 0x7ff47fd35370>
```



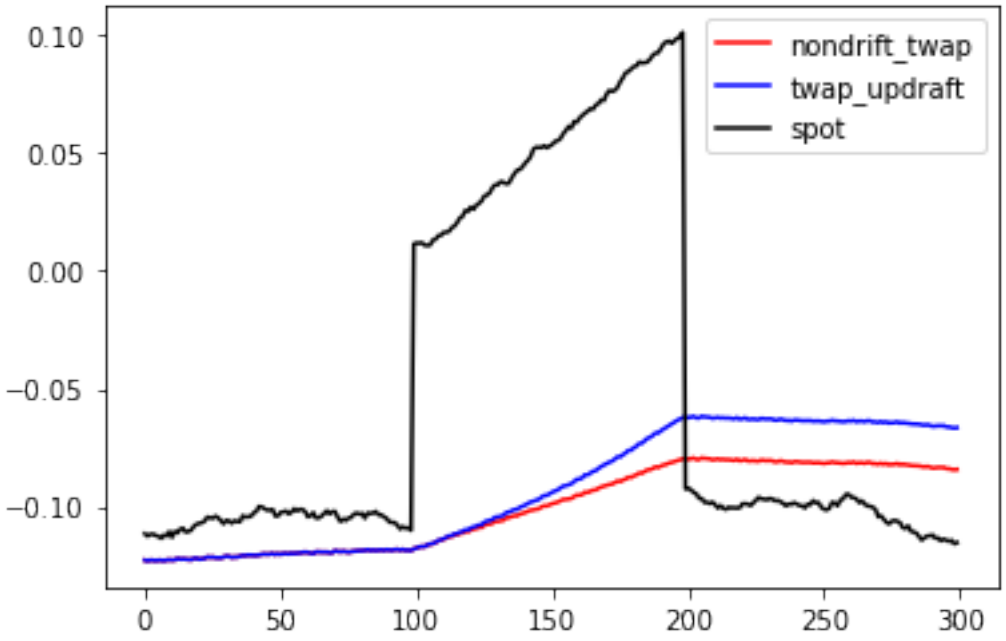
6 A 10% shock occuring instantaneously (1 block) and lasting for 100 blocks (20 minutes) leads to about 3.8% of free profit for anyone paying attention.

7 This result does not assume very much about the direction of future prices after the shock:

[524]:
```
shock_time = shock_block-window

plt.plot(twap_crets[shock_time-100:shock_time+100+100], c='r',␣
 ↪label='nondrift_twap')
plt.plot(twap_crets_up[shock_time-100:shock_time+100+100], c='b',␣
 ↪label='twap_updraft')
plt.plot(crets_up[shock_time-100:shock_time+100+100], c='k', label='spot')
plt.legend()
```

[524]:
```
<matplotlib.legend.Legend at 0x7ff49cdaab50>
```

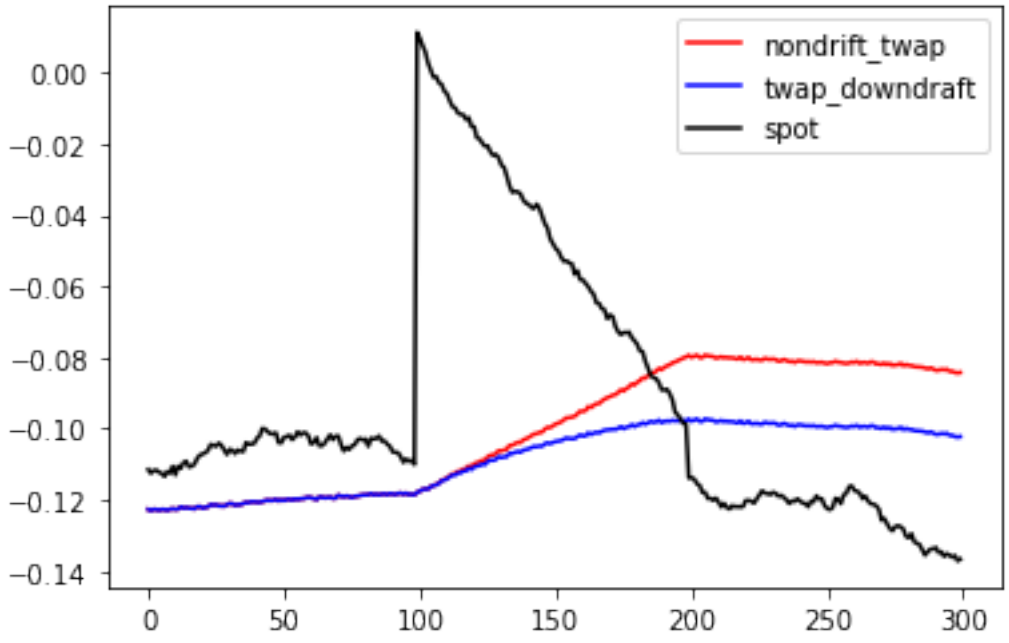


8 As expected, if prices keep going up, the trader makes even more money

[534]:
```
shock_time = shock_block-window

plt.plot(twap_crets[shock_time-100:shock_time+100+100], c='r',␣
 ↪label='nondrift_twap')
plt.plot(twap_crets_down[shock_time-100:shock_time+100+100], c='b',␣
 ↪label='twap_downdraft')
plt.plot(crets_down[shock_time-100:shock_time+100+100], c='k', label='spot')
plt.legend()
```

[534]:
```
<matplotlib.legend.Legend at 0x7ff43aba8100>
```



9 As expected, if price fades down, the trader still makes money (2%) just not as much

[ ]: