Pricing Test Part 2

I compared a frequentist and Bayesian technique to determine the time to switch pricing strategies. The frequentist approach being the traditional method employed by most companies today, which is to track the p value over time or to set fixed time horizons for their t-tests ahead of time. A Bayesian approach provides a lot of flexibility in that it can tell you the probability that A or B is larger at any given time. A t-test tells you whether or not you can reject the null hypothesis A Bayesian approach is much more becoming in a business setting as there may be circumstances that will require a company to make a decision immediately.

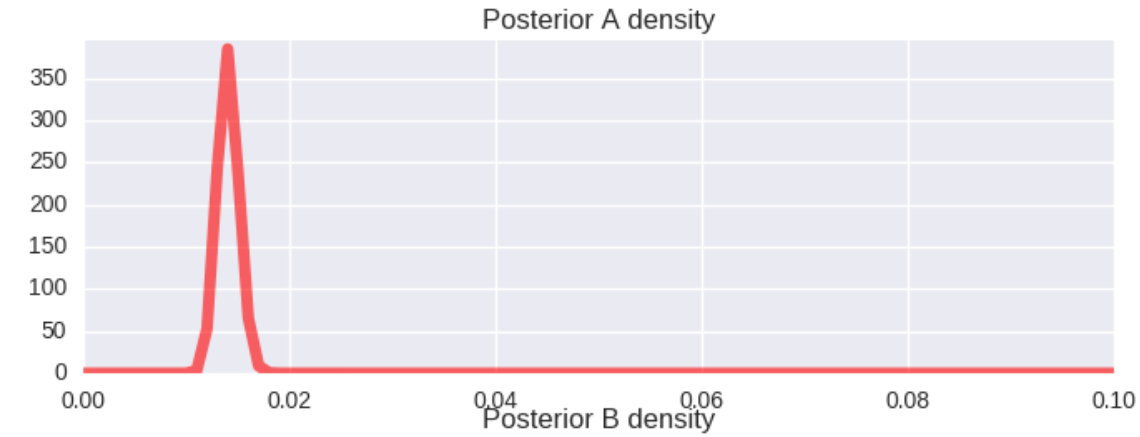
The script I used to run the t-test Is in price_test_frequentist.py. For both the Bayesian and frequentist approach I multiplied group A by the price ratio between group A and B so the two groups could be compared directly.

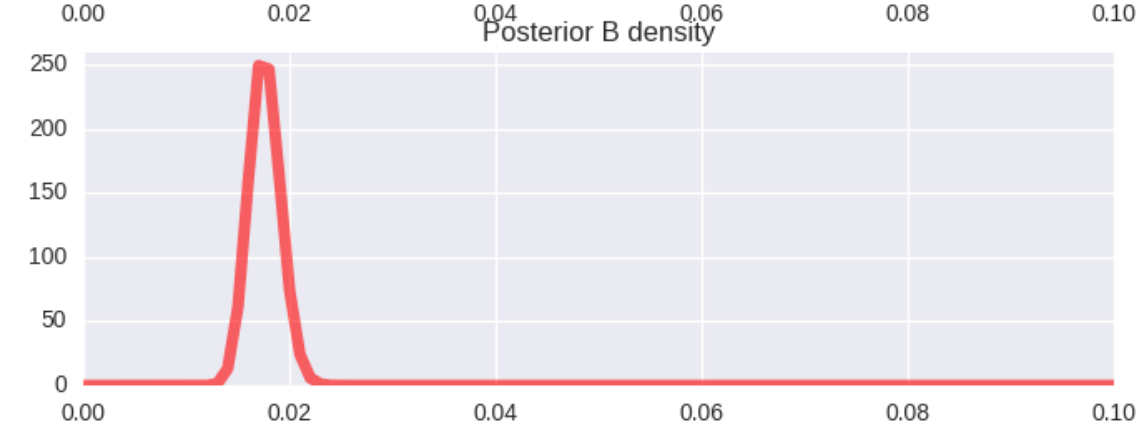
This graph is an output of the price_test_frequentist.py script. The green line is the threshold I chose to indicate the null hypothesis could be rejected. The t-test goes below .05 on the sixth day. This would indicate fairly strong evidence for a switch in price to 59 being a good business decision.

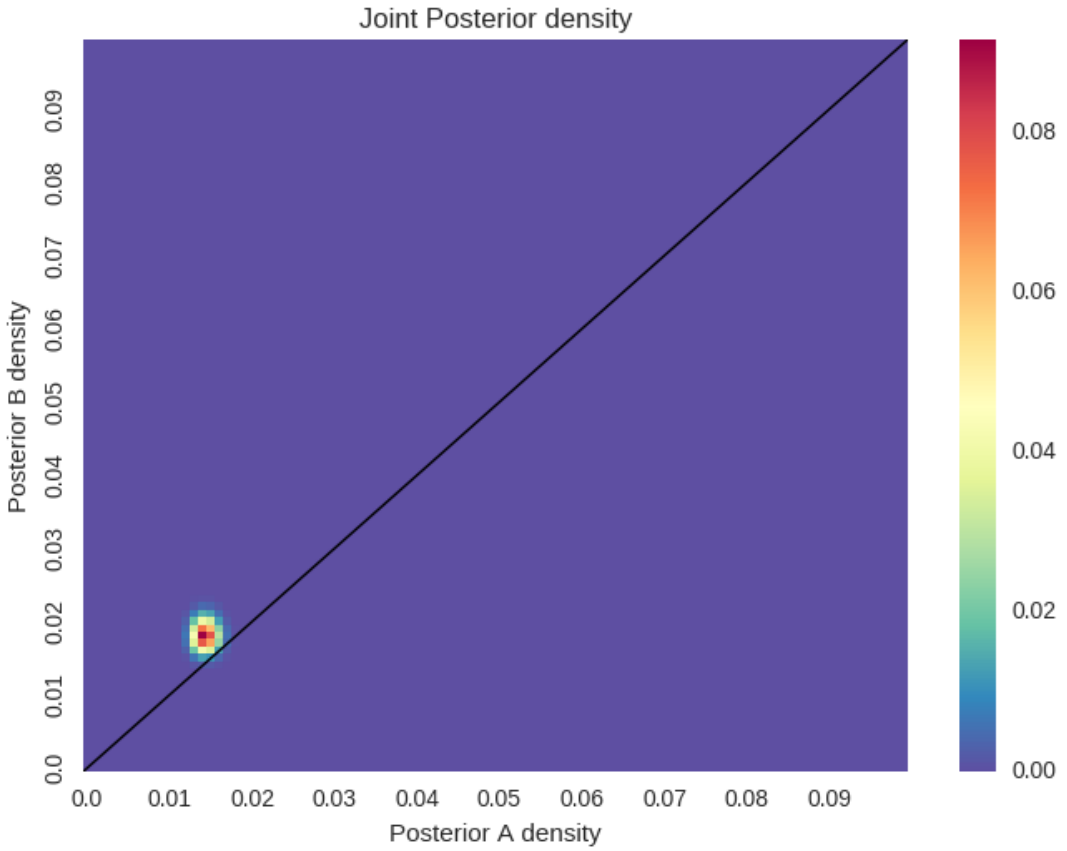
The scripts used for the Bayesian method are price_test.py and bayesian_ab.py. The script bayesian_ab.py calculates the posteriors, probability, and error and price_test.py prepares the data and calls the bayesian test function for each day.

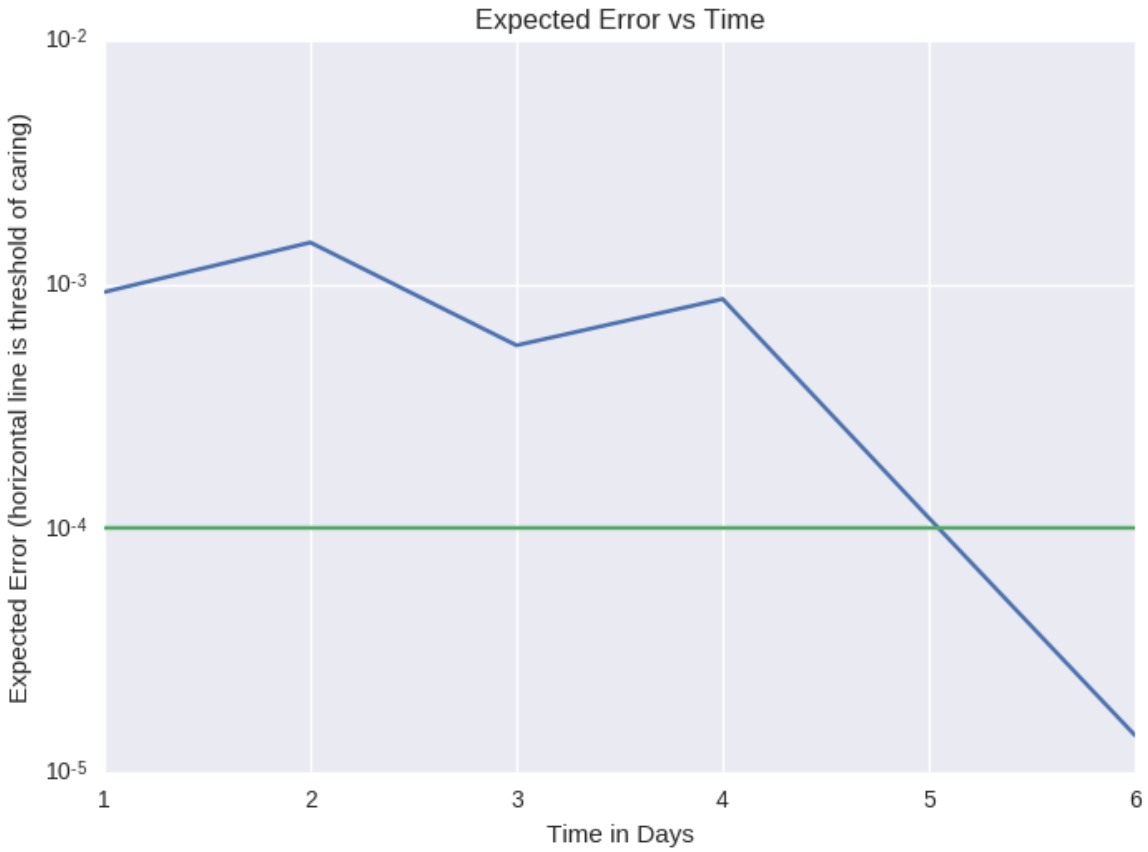
Output:

```
Day:  1
Probability that version B is larger is 0.755777987651
Continue test. Expected error was 0.000930978265757 > 0.0001
Day:  2
Probability that version B is larger is 0.593403600363
Continue test. Expected error was 0.0014866413223 > 0.0001
Day:  3
Probability that version B is larger is 0.790838100997
Continue test. Expected error was 0.000563248013636 > 0.0001
Day:  4
Probability that version B is larger is 0.653515976747
Continue test. Expected error was 0.000872204621567 > 0.0001
Day:  5
Probability that version B is larger is 0.924984580313
Continue test. Expected error was 0.000110496987474 > 0.0001
Day:  6
Probability that version B is larger is 0.988204622332
Terminate test. Choose version B. Expected error is 1.42040512354e-05
```


Posterior A density
350
300
250
200
150
100
50
0
0.00
0.02
0.04
0.06
0.08
0.10


Posterior B density
250
200
150
100
50
0
0.00
0.02
0.04
0.06
0.08
0.10


Joint Posterior density
Posterior B density
0.0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
Posterior A density
0.0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.08
0.06
0.04
0.02
0.00



From the posteriors graphs you can see posterior b clearly has a large probability to be much larger than posterior A. The joint posterior heat map shows almost the entire joint posterior in posterior B territory. The two posterior territories, A and B, is demarcated by the black line with a slope of 1.

Text output summarizes the actual probability and expected error. The Bayesian test reaches conclusion on the same day as the frequentist test, on day 6. There is a difference however in the speed that it converges to this result. On day 5 and 6 the p value is .21 and .041 respectively. The Bayesian test concludes on day 5 and 6 that B is larger by a 92% and ~99% respectively. This could make a difference of a couple days or more in other tests which could mean a difference of thousands or more in potential revenue.