Method of Steepest Descent

After factor screening, I ended up with 2 factors, preview length and match score, that I had found to significantly influence browsing time.

I then wanted to roughly determine the optimal levels for these 2 factors.

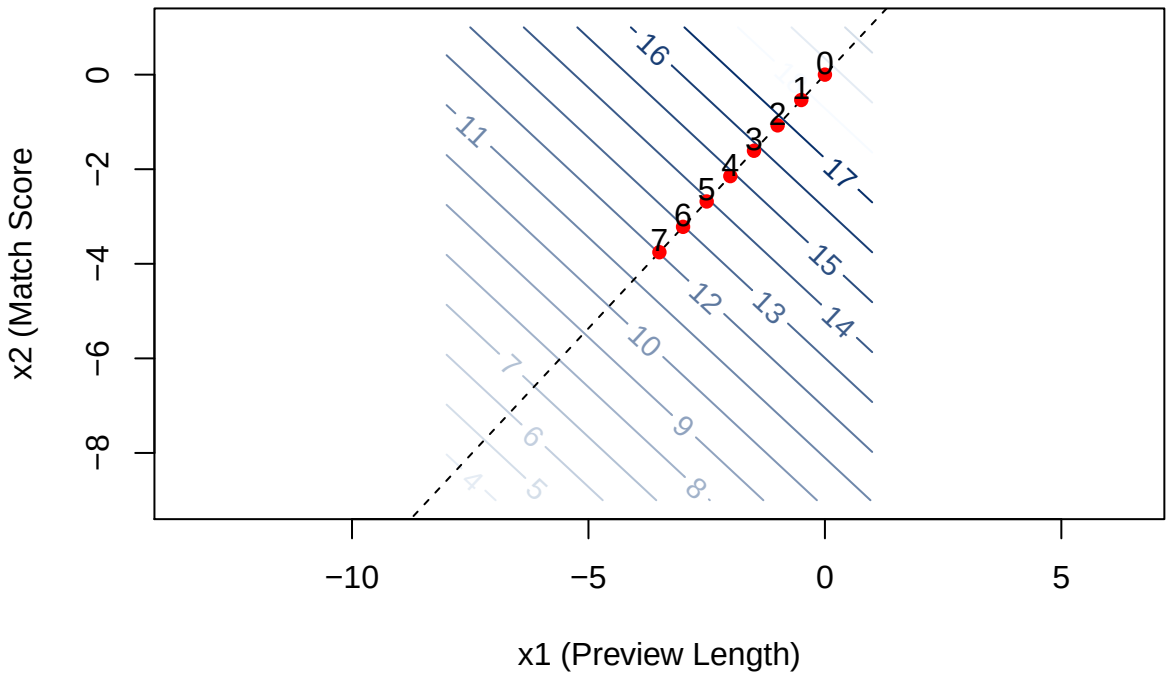
I began with a 2^2 factorial experiment with a center point condition. The initial region of experimentation was the area in which my factor screening took place. Thus, the high level for preview length was 120 and low level for it was 100. The high level for match score was 100 and low level was 80.

I first simulated the data for the center point and combined it with previously simulated data and then performed a curvature test in order to determine whether the initial region was already in the vicinity of the optimum.

I found that although β_{PQ} was significantly different from 0, since its p-value was much lower than 0.01, its size was much larger relative to the other p-values. Thus, there was likely not a pure quadratic curvature in this area and so the initial region was not likely to be in the vicinity of the optimum.

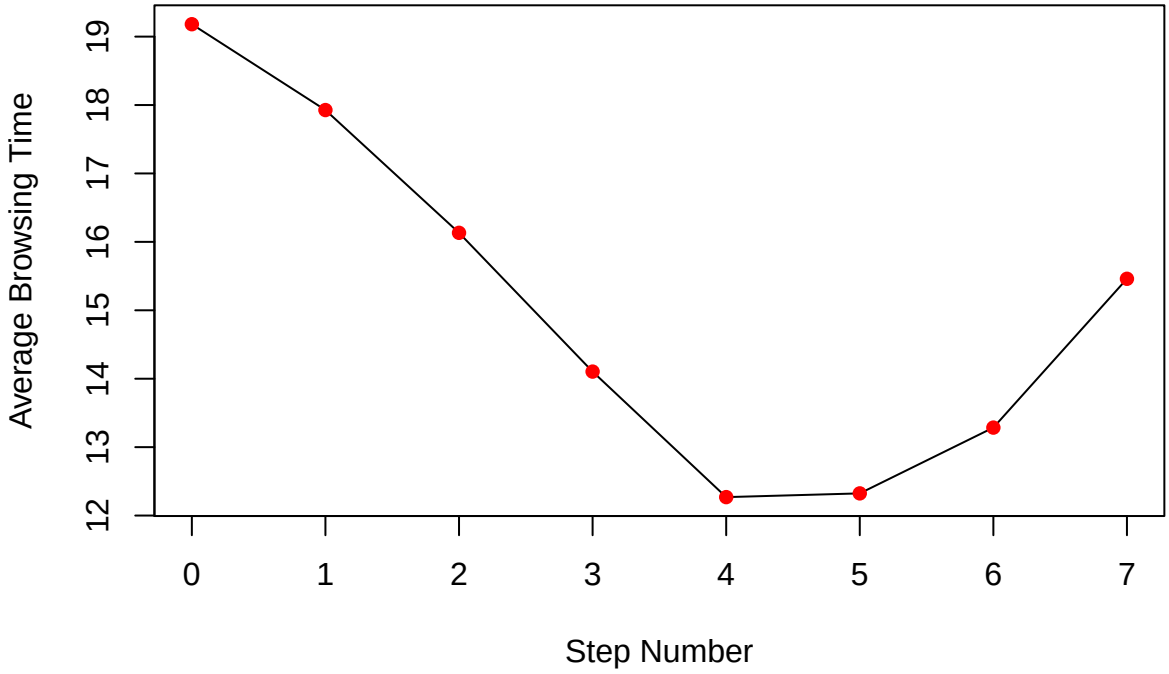
My next step was to use the method of steepest descent in order to determine roughly where in the x-space the optimum was lying.

I first fitted the first order model to determine the direction of the path of the steepest descent. I also found the 2D contour plot, with the gradient on it and we see that the starting point is (0,0).



Since preview length can only be changed in increments of 5, I decided that the steps should be 5 seconds long in preview length. I then converted it from natural units to coded units. I got that $\Delta x_1 = 0.5$ and so $\lambda = \frac{0.5}{\hat{\beta}_1} = 0.5661741$.

I took one step at a time, until I found the lowest observed average browsing time, and then I took a few more to make sure that I had found the lowest, since the following steps ended up with higher average browsing time.



I found that step 4 corresponded to the lowest observed average browsing time. It corresponded to a preview length of 90 seconds and match score of 70%.

In order to determine if I reached the vicinity of the optimum, I decided to perform another test of curvature in this region. I ran another 2^2 factorial experiment with a center point and simulated the data. My new high level for preview length was 100, and low level was 80. My new high level for match score was 80, and low level was 60.

This time, β_{PQ} was significantly different from 0 and the p-value for the pure quadratic was <2e-16 < 0.01, so I rejected the null hypothesis that the pure quadratic was 0. Thus, I concluded that I was in the vicinity of the optimum. The optimal browsing time was somewhere in the vicinity of 90 seconds for preview length, and 70% for match score.