830-ph1-report

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PHASE III - Response Optimization

Objective:

Our final goal is to build the second order model: $\eta = \beta_0 + \sum_{j=1}^{K'} \beta_j x_j + \sum_{j<l} \beta_{jl} x_j x_l + \sum_{j=1}^{K'} \beta_{jj} x_j^2$

This expression may be re-written in vector-matrix notation as $\widehat{\eta} = \widehat{\beta}_0 + \mathbf{x}^T \mathbf{b} + \mathbf{x}^T \mathbf{B} \mathbf{x}$

In phase 2, we have found the vicinity of optimum. Here we hope to find the stationary point and calculate the estimated minimum response. We used the Central Composite Designs in this phase.

The stationary point is $\mathbf{x}_s = -\frac{1}{2} \mathbf{B}^{-1} \mathbf{b}$

The optimal expected response for continuous response (like in this experiment) is $E[\bar{Y}] = \widehat{\eta}_s = \widehat{\beta}_0 + \frac{1}{2} \mathbf{x}_s^T \mathbf{b}$

Data

In CCD, we need to define our region to explore. For two-level factorial conditions and the center point condition, we used the result of vicinity of optimum in Phase 2.

For the axial conditions, to balance both practical and statistical concerns, we choose $a = \sqrt{2}$, then round the result to the reasonable value (i.e.: the natural unit should be integer).

The data visualization with both preview types can be seen below.
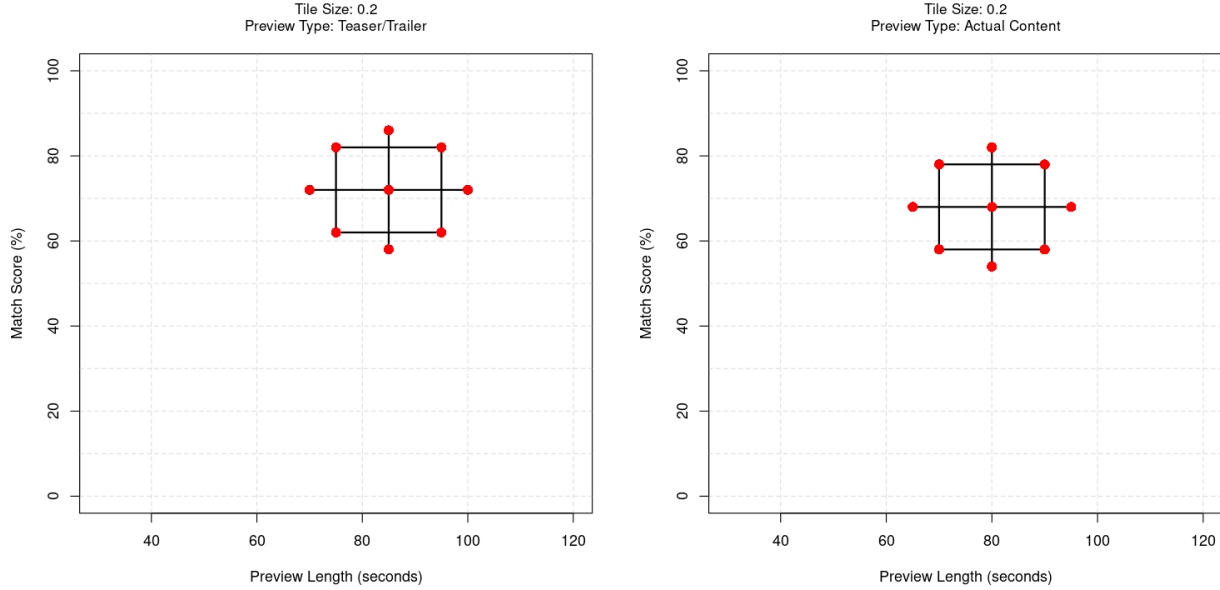
Experiment

First we explore when the preview type is teaser/trailer.

After doing the linear regression of the second order model, we can plot the contour plots of the fitted response surface.

The stationary point for this second order model is located (in coded units) at x1 = -1.3453, x2 = 0.5126.

The predicted browse time at this point is 10.2740 minutes, with a 95% prediction interval given by (10.1232,10.4249).

In the natural units, after doing the rounding, this corresponds to a preview length of 70 seconds (71.54665 before rounding) and a matching score of 77 (77.12676 before rounding). This achieves a predicted browse time of 10.29217 minutes with a 95% prediction interval given by (10.1151,10.46921).

We plot the stationary points using the red dots and the approximate rounded stationary points using the green dots.
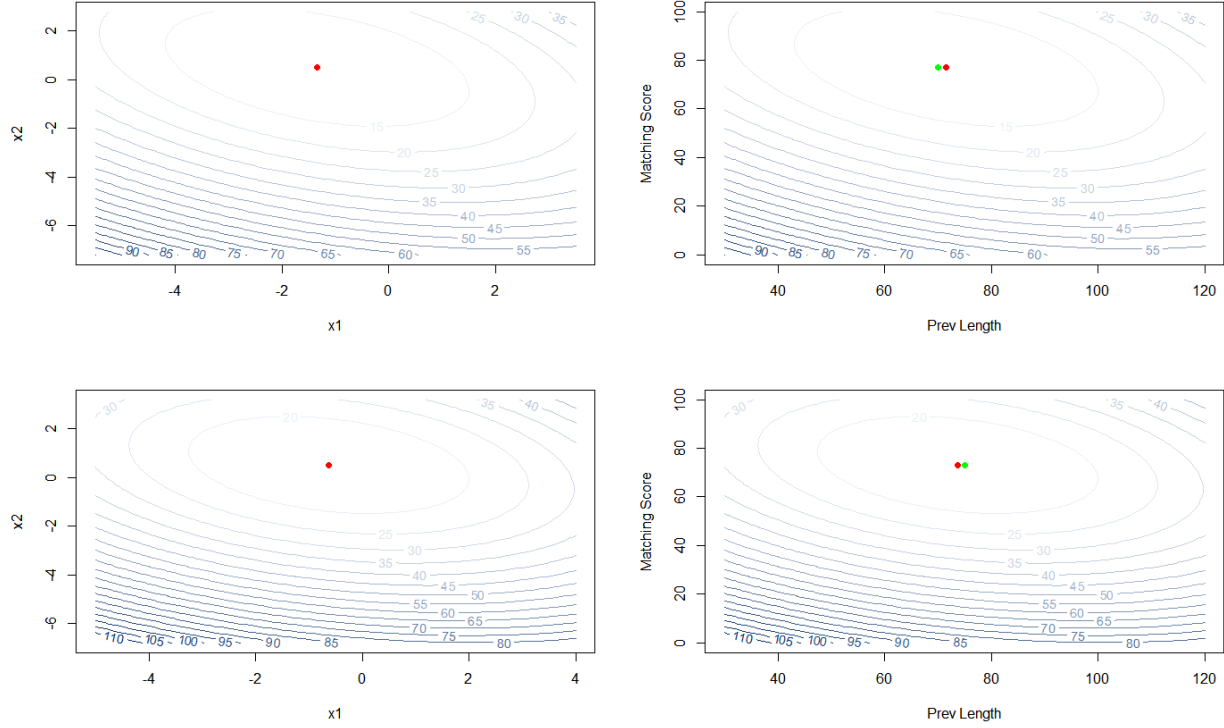
For preview type is actual content, the Response Optimization process is similar.

The stationary point for this second order model is located (in coded units) at x1 = -0.6287399, x2 = 0.5166630.

The predicted browse time at this point is 15.16203 minutes, with a 95% prediction interval given by (15.0156,15.30846).

In the natural units, after doing the rounding, this corresponds to a preview length of 75 seconds (73.7126 before rounding) and a matching score of 73 (73.16663 before rounding). This achieves a predicted browse time of 15.17383 minutes with a 95% prediction interval given by (15.01870,15.32895).

Clearly, among these two candidate surfaces, the one with preview type = TT has the most optimal optimum.

Conclusion

We finally obtain the estimated optimal operating conditions:

- Preview Length = 70 second

- Match Score = 77 percent

- This achieves a predicted browse time of 10.29217 minutes with a 95% prediction interval given by (10.1151,10.46921).

We made a bit modification of the optimum in phase 4.