Grid search versus Model Averaging versus Hybrid

Contents

Experiment Summary

Here, I compare the results across 100 trials of 3 methods of hyperparameter specification; grid search, model averaging, and hybrid. Hybrid averages across the value of the π grid while grid searching for σ^2 and σ^2_β.

There are two experiements; I use a smaller π grid for the first which is nested inside the larger π grid for the second. In each, I present the sensitivity and specificity for each of the three methods. Additionally, I present the relative sensitivity and specificity for model averaging and hybrid. These are defined as:

$$\text{rel. sens., hybrid} = \frac{\text{grid sens. - hybrid sens.}}{\text{grid sens.}} \qquad \text{rel. sens., averaging} = \frac{\text{grid sens. - averaging sens.}}{\text{grid sens.}}$$

$$\text{rel. spec., hybrid} = \frac{\text{hybrid spec. - grid spec.}}{\text{grid spec.}} \qquad \text{rel. spec., averaging} = \frac{\text{averaging spec. - grid spec.}}{\text{grid spec.}}$$

Small grid

Marginal grids

The small grid was defined as the Cartesian product of the following marginal grids:

```
## $pip
##  [1] 0.00001 0.00010 0.00100 0.01000 0.02000 0.03000 0.04000 0.05000 0.10000
## [10] 0.15000 0.20000
##
## $ssq
##  [1] 1.0e-05 1.0e-04 1.0e-03 1.0e-02 2.0e-02 3.0e-02 4.0e-02 5.0e-02 1.0e-01
## [10] 1.5e-01 2.0e-01 3.0e-01 4.0e-01 5.0e-01 6.0e-01 7.0e-01 8.0e-01 9.0e-01
## [19] 1.0e+00 1.5e+00 2.0e+00 2.5e+00 3.0e+00 5.0e+00 1.0e+01
##
## $sbsq
##  [1] 1.0e-05 1.0e-04 1.0e-03 1.0e-02 2.0e-02 3.0e-02 4.0e-02 5.0e-02 1.0e-01
## [10] 1.5e-01 2.0e-01 3.0e-01 4.0e-01 5.0e-01 6.0e-01 7.0e-01 8.0e-01 9.0e-01
## [19] 1.0e+00 1.5e+00 2.0e+00 2.5e+00 3.0e+00 5.0e+00 1.0e+01
```

Specificity

Grid search

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.5235  0.6119  0.6391  0.6251  0.6459  0.6787
```

Model averaging

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.5787  0.6455  0.6459  0.6507  0.6653  0.6787
```

Hybrid

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.5639  0.6378  0.6459  0.6437  0.6598  0.6787
```

Sensitivity

Grid search

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.4476  0.4476  0.5321  0.5316  0.5905  0.7333
```

Model averaging

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.3881  0.4476  0.4655  0.4993  0.5560  0.7333
```

Hybrid

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.4048  0.4476  0.4976  0.5140  0.5679  0.7333
```

Relative specificity difference

Model averaging

```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
## 0.000000 0.005063 0.036863 0.043210 0.066229 0.218163
```

Hybrid

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## 0.00000 0.00245 0.02862 0.03107 0.04446 0.15971
```

Relative sensitivity difference

Model averaging

```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
## 0.000000 0.002679 0.038403 0.058950 0.092503 0.312727
```

Hybrid

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## 0.00000 0.00000 0.01628 0.03253 0.05311 0.14865
```

Large

Marginal grids

The large grid was defined as the Cartesian product of the following marginal grids:

```
## $pip
##  [1] 0.00001 0.00010 0.00100 0.01000 0.02000 0.03000 0.04000 0.05000 0.10000
## [10] 0.15000 0.20000 0.30000 0.40000 0.50000 0.60000 0.70000 0.80000 0.90000
## [19] 0.99000 0.99900 0.99990 0.99999
##
## $ssq
##  [1] 1.0e-05 1.0e-04 1.0e-03 1.0e-02 2.0e-02 3.0e-02 4.0e-02 5.0e-02 1.0e-01
## [10] 1.5e-01 2.0e-01 3.0e-01 4.0e-01 5.0e-01 6.0e-01 7.0e-01 8.0e-01 9.0e-01
## [19] 1.0e+00 1.5e+00 2.0e+00 2.5e+00 3.0e+00 5.0e+00 1.0e+01
##
## $sbsq
##  [1] 1.0e-05 1.0e-04 1.0e-03 1.0e-02 2.0e-02 3.0e-02 4.0e-02 5.0e-02 1.0e-01
## [10] 1.5e-01 2.0e-01 3.0e-01 4.0e-01 5.0e-01 6.0e-01 7.0e-01 8.0e-01 9.0e-01
## [19] 1.0e+00 1.5e+00 2.0e+00 2.5e+00 3.0e+00 5.0e+00 1.0e+01
```

Specificity

Grid search

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.1694  0.1716  0.3426  0.3511  0.4683  0.6672
```

Model averaging

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.3836  0.5526  0.5751  0.5702  0.6123  0.6672
```

Hybrid

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.2219  0.3765  0.4372  0.4352  0.4936  0.6109
```

Sensitivity

Grid search

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.4476  0.5875  0.6702  0.6452  0.7333  0.7333
```

Model averaging

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.4476  0.5321  0.5940  0.5877  0.6399  0.7333
```

Hybrid

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##  0.4476  0.5786  0.6179  0.6158  0.6595  0.7333
```

Relative specificity difference

Model averaging

```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
## -0.01651  0.20806  0.65315  1.01320  1.78118  2.81290
```

Hybrid

```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
## -0.32533 -0.06218  0.21584  0.49872  0.95593  2.01935
```

Relative sensitivity difference

Model averaging

```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
## -0.09574  0.00000  0.05432  0.08089  0.15300  0.33096
```

Hybrid

```
##     Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
## -0.22872  0.00000  0.01222  0.03595  0.09746  0.23843
```