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Appendix

Nine measurements

Several measurements are used to evaluate the prediction performance of the regularized random forest. Assume we have true PMI, the response variable $Y=(y_1,y_2,...,y_n)$ where n is the sample size, and predicted value $\hat{Y}=(\hat{y}_1,\hat{y}_2,...,\hat{y}_n)$ The difference between Y and $\hat{Y}$ is called residual, i.e., $r_i=y_i-\hat{y}_i, i=1,2,...,n.$. We compute the following measurements:

Mean Squared Error (MSE): $MSE=\frac{1}{n}\sum_{i-1}^{n}r_i^2$

Median Absolute Deviation (MAD): $MAD=median_i\left(\left|r_i-median_j\left(r_j\right)\right|\right)$

Mean Absolute Percentage Error (MAPE): $MAPE=\begin{Bmatrix}\frac{1}{n}\sum_{i=1}^{n}\left|\frac{r_i}{y_i}\right| if\ y_i\neq 0\\ \frac{1}{n}\sum_{i=1}^{n}\left|\frac{r_i+1}{y_i+1}\right| if\ y_i=0\end{Bmatrix}$

Root Mean Squared Relative Error (RRMSE): $RRMSE=\begin{Bmatrix}\sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(\frac{r_i}{y_i}\right)^2} if\ y_i\neq 0\\ \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(\frac{r_i+1}{y_i+1}\right)^2} if\ y_i=0\end{Bmatrix}$

Symmetric Mean Absolute Percentage Error (SMAPE): $SMAPE=\frac{1}{n}\sum_{i=1}^{n}\frac{2\times|r_i|}{|y_i|+|\hat{y}_i|}$

The Average relative Error (AVGRE): $AVGRE=\begin{Bmatrix}\frac{1}{n}\sum_{i=1}^{n}\frac{|r_i|}{y_i} if\ y_i\neq 0\\ \frac{1}{n}\sum_{i=1}^{n}\frac{|r_i+1|}{y_i+1} if\ y_i=0\end{Bmatrix}$

The Maximum Relative Error (MAXRE): $MAXRE=\begin{Bmatrix}\max_i\left(\frac{|r_i|}{y_i}\right) if\ y_i\neq 0\\ \max_i\left(\frac{|r_i+1|}{y_i+1}\right) if\ y_i=0\end{Bmatrix}$

The Total Variation Distance (DTV): $DTV=\frac{1}{2}\sum_{i=1}^{n}|r_i|$

The Average absolute error or the Mean Difference: $MeanDiff=\frac{1}{n}\sum_{i=1}^{n}|r_i|$