

1 ALGORITHM - WEIGHTED AVERAGE

With the objective of improving the accuracy of predictions, we previously developed a simple average method for the predictions of all questions and got an accuracy score of 86%. The goal is to compare the performance of the model that is trained with the algorithm with performance of the baseline model that takes the last trade as the predicted value. To achieve a better accuracy for the predictions, the proposed algorithm considers weights for aggregating the predictions. Distribution of weights gives the interpretations about the user's performance and impact of time on the accuracy of the predictions. Notation of the weight is given as below:

$$w_{ij}(t) = A_{ij}B_j(t) \quad (1)$$

where i denotes the user and j denotes the category of the questions that user made trades.

Weighted average model learns weights per user based on category from 2 factors:

- Timeline of the resolution: $B_j(t)$
- Historical accuracy of the user per category: A_{ij}

1.1 TIMELINE OF THE RESOLUTION

Assumption for this model is that the predictions get better as question timeline gets closer to the resolution time.

- Plotted all the average probability estimates of all the trades to see if they follow a pattern that monotonically increasing or decreasing or flat.
- Although the aggregated plot is cluttered, the the individual plots of the probability estimates for question from a random sample likely showed that the above assumption is not invalid.
- Weights B_j are calculated for time t using the exponential distribution.

$$B_j(t) \sim \exp(k)$$

1.2 HISTORICAL ACCURACY OF THE USER PER CATEGORY

Here the algorithm learns the weights for the user based on the questions they answered per category.

- Gets the data of trades made by user.
- For each question, the error is calculated as the absolute difference between the user's trade and the actual(settled) value
- Aggregate the error per category and update the weights across each user. Aggregate function used is mean.

Notation is as below:

$$A_{ij} = \frac{1}{K} \sum_{k=1}^K E_{ijk} \quad (2)$$

where A_{ij} is the average error rate per user i user for K questions that belong to a category j and E_{ijk} is the absolute error of the user i for a question k that belongs to j

$$\begin{aligned} E_{ijk} &= |t_{jk} - p_{ijk}| \\ E_{ijk} &\in [0, 1] \end{aligned} \quad (3)$$

t_{jk} and p_{ijk} are the settled and predicted values for the question respectively

Once the weights are trained using the algorithm, the final predictions per category can be calculated by aggregating the predictions of the user and over the time as below:

$$\frac{\sum_{i,t}^K A_{ij} B_j(t) P_{ijk}(t)}{\sum_{i,t} A_{ij} B_j(t)} \quad (4)$$