Algorithm Effectiveness Report

Abstract

This report focuses on the effectiveness of the Mira app algorithm, including dynamic threshold, and prediction of ovulation day. The users' historical predictive data were collected by retrospective.

The PPV of the dynamic threshold is 83.69%, and TPR is 98.66%. Compared with the traditional calendar method, the accuracy to predict the ovulation day is improved by 1.5X by the Mira fertility wand improves, while the Mira fertility plus wand improves by 6X.

Materials and methods

The users who use the V.4 app and whose cycles are regular and perform the test following the recommended test day were screened. The total number of users is 20,827 and the total number of cycles is 89,388. The time of data collection is 2022-05-23.

The dynamic threshold is based on the LH Surge detected in the actual cycle. In terms of predicting ovulation day, the users are divided into three groups by retrospective:

1) Traditional calendar method
2) Only use the Mira fertility wand
3) Use Mira fertility plus wand

Results

According to the dynamic threshold to determine whether the current LH value is LHSurge, if the LH value is greater than the threshold then the prediction is true, conversely, it's false. The number of LH Data is 1,015,164. Among them, TP (True Positive, predicted to be true and actually true) was 146,002, FP (False Positive, predicted to be true and actually false) was 28,444, TN (True Negative, predicted to be false and actually false) was 838,743, and FN (False Negative, predicted to be false and actually true) was 1,975. So it can be calculated: PPV(PPV= TP /(TP + FP)): 83.69% ; TPR (TPR = TP/(TP+ FN)): 98.66%. The following image is the confusion matrix:
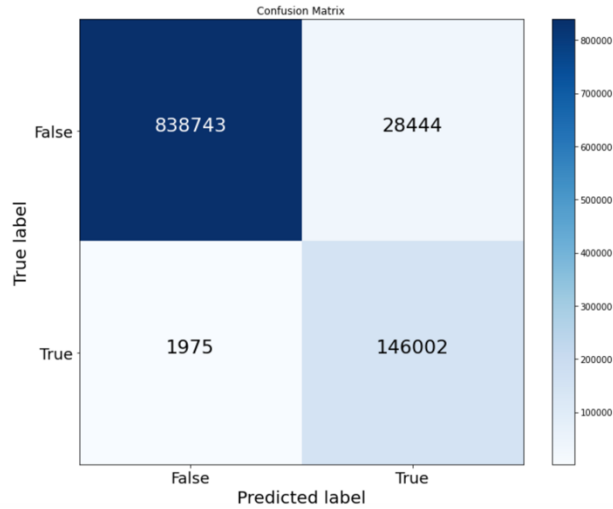
Figure 1. Confusion matrix for the prediction of LH surge.

Data based on real user hormone data were retrospected and users were divided into three groups:

A: Traditional calendar method

B: Only use the Mira fertility wand to test LH

C: Use Mira fertility plus wand to test LH and E3G

The following table shows the distribution of the accuracy of predicting ovulation day with the index of ovulation day.

"**Index of Ovulation**" means the number of days before the ovulation date, and "**errorIn0Ratio**" means the accuracy of the predicted ovulation day (the number of absolute errors between the predicted value and the real value which is zero / the number of predictions). "**errorIn1Ratio**" predicts the accuracy of ovulation day within one day (the number of absolute error between the predicted and true values which is less than or equal to one / number of predictions), "**errorIn2Ratio**" predicts the accuracy of ovulation day within two days (the number of absolute error between the predicted and true values which is less than or equal to two / number of predictions)

Table 1. The distribution of the accuracy of predicting ovulation day with the index of ovulation day.

Group	Index of Ovulation	errorIn0Ratio	errorIn1Ratio	errorIn2Ratio
A	None	0.0916	0.2975	0.5292
B	-1	0.138	0.6329	0.7551
B	-2	0.1039	0.6096	0.7491
B	-3	0.0982	0.2958	0.5935
B	-4	0.1012	0.2926	0.5167

B	-5	0.0883	0.2927	0.4442
B	-6	0.0937	0.2672	0.4177
B	-7	0.0917	0.2597	0.42
C	-1	0.5522	0.7356	0.9316
C	-2	0.4944	0.7189	0.8743
C	-3	0.2716	0.5743	0.8351
C	-4	0.2341	0.4654	0.7889
C	-5	0.1984	0.4341	0.5146
C	-6	0.1868	0.3467	0.5003
C	-7	0.1901	0.3433	0.4992

The following chart shows the "**errorIn0Ratio**" comparison of the improvement in different groups :
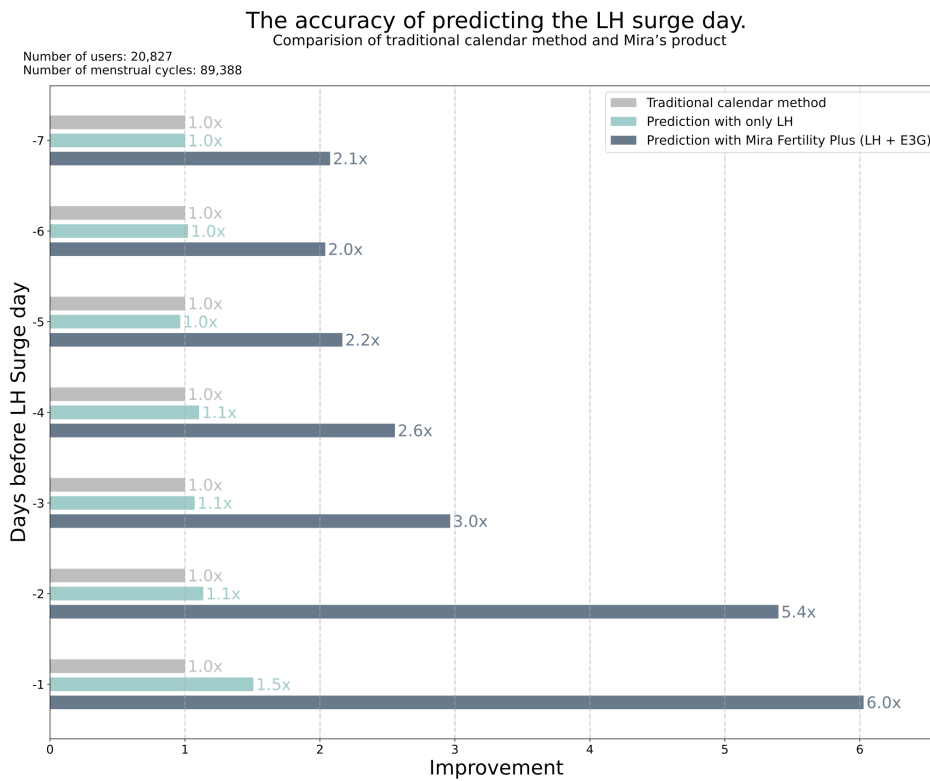

Figure 2. The accuracy of predicting the LH surge day.

Conclusion

The TPR of the dynamic threshold is high, which means that the user can be easy to detect the LH surge, and the PPV means that the probability of detected LH surge is actually LH surge is relatively high.

When calculating the error was at 0 days, the accuracy rate of group B users (Only using the Mira fertility wand) improved by 1.0x~1.5x compared with group A users (Traditional calendar method), especially 2 days before ovulation day, and the accuracy rate of group C users (Use Mira fertility plus wand) improved by 2.1x~6x compared with group A users (Traditional calendar method). Group C users have a larger improvement in ovulation prediction.

Claims

Compared with the calendar method, the Mira fertility wand improves 1.5X the accuracy to predict the ovulation day, while the Mira fertility plus wand improves 6X the accuracy to predict the ovulation day.

Along with the day near the ovulation day, the accuracy increases. From 7 days before the ovulation day to 1 day before the ovulation day, the prediction accuracy of Mira fertility increased to 1.5X from 1X, and Mira fertility plus wand increased to 6X from 2.1X.

Mira wands can detect 98.66% of the true LH surge, and the probability that the determined LH surge is actually true is 83.69%.

Disclaimer

The cycle of the user is regular.

They perform the test following the recommended test day.

This is a retrospective study.