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By**

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**OPTIMAL LINEAR COMBINATION OF CONTINUOUS DIAGNOSTIC
MEASUREMENTS WHEN GOLD STANDARD IS CONTINUOUS
— AN OBUCHOWSKI'S θ BASED APPROACH**

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Abstract. Effectively combining many classification instruments or diagnostic measurements together to improve the classification accuracy of individuals is a common idea in disease diagnosis or classification. These ensemble type diagnostic methods can be constructed with respect to different kinds of performance criterions. Among them, the receiver operating characteristic (ROC) curve is the most popular criterion, which, together with some indexes derived from it, are commonly used for evaluating and summarizing the performance of a classification instrument, such as a bio-marker or a classifier. However, the usefulness of ROC curve and its related indexes rely on the existence of a binary label for each individual subjects. In many disease diagnosis situations, such a binary variable may not exist, but only the continuous measurement of the true disease status is available. This true disease status is often referred to as the “gold standard”. The modified area under ROC curve (AUC) type measure of Obuchowski (2006) is one the methods proposed to accommodate such a situation. However, there is still a lack of a method for finding optimal combination of diagnostic measurements, with respect to such an index, in order to have better diagnostic power than that of each individual measurements. In this paper, we propose an algorithm for finding the optimal combination with respect to such an extended AUC type measure such that the diagnostic power can be improved. The performance of our algorithm is illustrated using some synthesized data and a diabetes data set.

Key words and phrases. Area under curve, combination of markers, continuous gold standard, ROC curve.