HW2

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If a test has sensitivity = 80% and specificity 80% and the prevalence of the disease is 9/100,000, what is the positive predictive value (aka "precision") of the test?

We know that sensitivity $= \frac{TP}{TP+FN}$ and specificity $= \frac{TN}{TN+FP}$. Meanwhile, prevalence $= \frac{TP+FN}{TP+FN+FN+FP}$.

precision $= PPV = \frac{TP}{TP+FP} = \frac{(sensitivity \times prevalence)}{sensitivity \times prevalence + (1-specificity) \times (1-prevalence)} = \frac{0.8 \times 0.00009}{0.8 \times 0.00009 + (1-0.8) \times (1-0.00009)} = 0.0003599 = 0.03599\%$

Suppose sensitivity = specificity. What would they have to be to achieve positive predictive value = 50% when prevalence is 9/100,000?

Using the formula above, let sensitivity = specificity = x.

$0.5 = \frac{(sensitivity \times prevalence)}{sensitivity \times prevalence + (1-specificity) \times (1-prevalence)} = \frac{x \times 0.00009}{x \times 0.00009 + (1-x) \times (1-0.00009)}$

$\therefore x = 1 - 0.00009 = 0.99991$

Comment on these results in relation to the precision values provided in Table 2 of Wang et al. (2019)

For results in table 2, the authors claimed that they have achieved pretty high AUC scores, indicating an excellent prediction performances. From the cases above, we can see that if we have close sensitivity and specificity, and if the disease is not highly prevalent, then we need sensitivity and specificity to be almost perfect to just get 0.5 precision, which means that for each detected positive, there could be a 50% chance of incorrect prediction. The high AUC can just implicate an accurate detection of true negatives, which may not be in our best interest.

When we have about 80% sensitivity and specificity above, we have computed a super low precision. Though they also had similar stats in one of their cases shown in the table, they did achieve about 0.57 precision. This then indicates a high prevalence in their sample, which was true from their description about the data. However, it leads to a question whether their sample was representative of the population of interest and whether their prediction model was truly powerful. Other metrics, for instance, F1 score should be included to assess the model performance.