Dear Editor,

In a recent letter to the Editor [1], it was pointed out that there exists a close relationship between the Youden index $J = P(T+ | D+) + P(T- | D-) - 1$, specificity plus sensitivity of a diagnostic test $T$ minus 1, and the likelihood ratio positive $LR^+ = P(T+ | D+)/P(T+ | D-)$, the ratio of sensitivity to the false positive rate of a diagnostic test $T$. Here $D$ stands for the disease of interest and +/- indicate the presence or absence of the condition. We note that $J = P(T+ | D+) - P(T+ | D-) = P(T+ | D+) - 1 - [P(T+ | D+) - 1] = J$.

However, the above result is only an approximation and the approximation will typically be good for values of sensitivity close to 1 and values of specificity close to 0, and it is the latter which we would like to see taking much higher values in practice. A better view of the situation is provided in Figure 1 which shows the difference between the log-likelihood ratio positive and Youden’s index as function of sensitivity and false positive rate (FPR = 1 – specificity). The best agreement is achieved along the diagonal which corresponds to the lower bound of diagnostic accuracy. Mostly we would be interested in the region close to the upper left corner where the diagnostic accuracy is high. Here the agreement between both measures is poor. In addition, sensitivity and specificity are typically inversely related as Figure 2 shows for two normal background populations (healthy and diseased). Hence only certain pathways in the sensitivity – false positive rate diagram are possible: the so-called ROC curves which typically path through areas of low agreement between log likelihood ratio and Youden index. Fin-
ally, we point out a further important difference between the two measures.

Whereas Youden’s index performs well in finding a “best” cut-off value (maximizing Youden’s index as a function of the cut-off), the log-likelihood ratio positive is less useful as it frequently leads to clinically improper “best” cut-offs. This is shown in Figure 3 and Figure 4. In particular, Figure 4 shows that the largest value of the log-likelihood positive would be reached on the boundary which is clinically useless. This point has been emphasized in [2].

In summary, although there are certain similarities between Youden’s index and the log-likelihood positive, important differences remain and these can play a considerable role depending on the scenario in which either index is used.

**References**
