

Relation: A Software Tool for Exploring the Relation between Diagnostic Accuracy and Measurement Uncertainty

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1. Purpose/Problem

Although diagnostic accuracy is fundamental to clinical decision making and measurement uncertainty is critical to quality and risk management in laboratory medicine, there has been very limited research on their relation.

2. Description of the Program

For this reason, the interactive program *Relation* was developed for calculating, optimizing, plotting and comparing various diagnostic accuracy measures and the corresponding risk of diagnostic or screening tests measuring a normally distributed measurand with different measurement uncertainties, applied at a single point in time in non-diseased and diseased populations [1].

3. Outcomes

The program demonstrates the relation between the diagnostic accuracy measures and the measurement uncertainty, for differing prevalence of the disease, mean and standard deviation of the measurand, diagnostic threshold, standard measurement uncertainty of the tests and expected loss (see Fig. 1 and 2). Furthermore, it provides calculators for the calculation of the effects of measurement uncertainty on the diagnostic accuracy measures and corresponding risk and for calculating the diagnostic threshold optimizing objective and loss functions. (see Fig. 3).

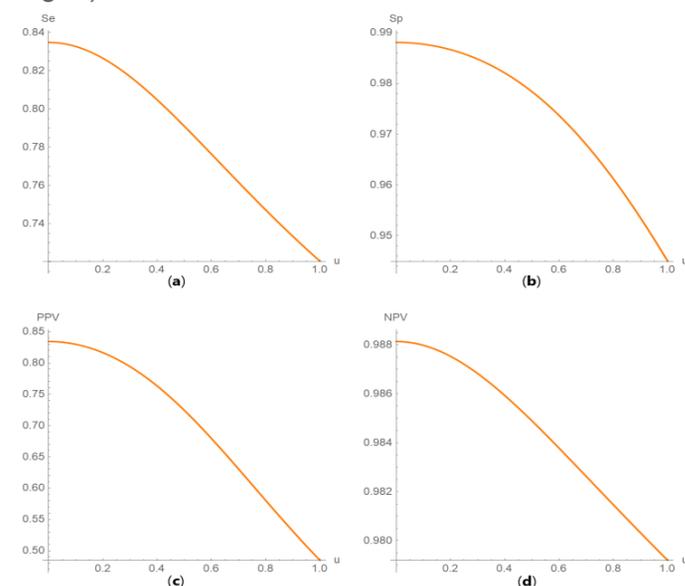
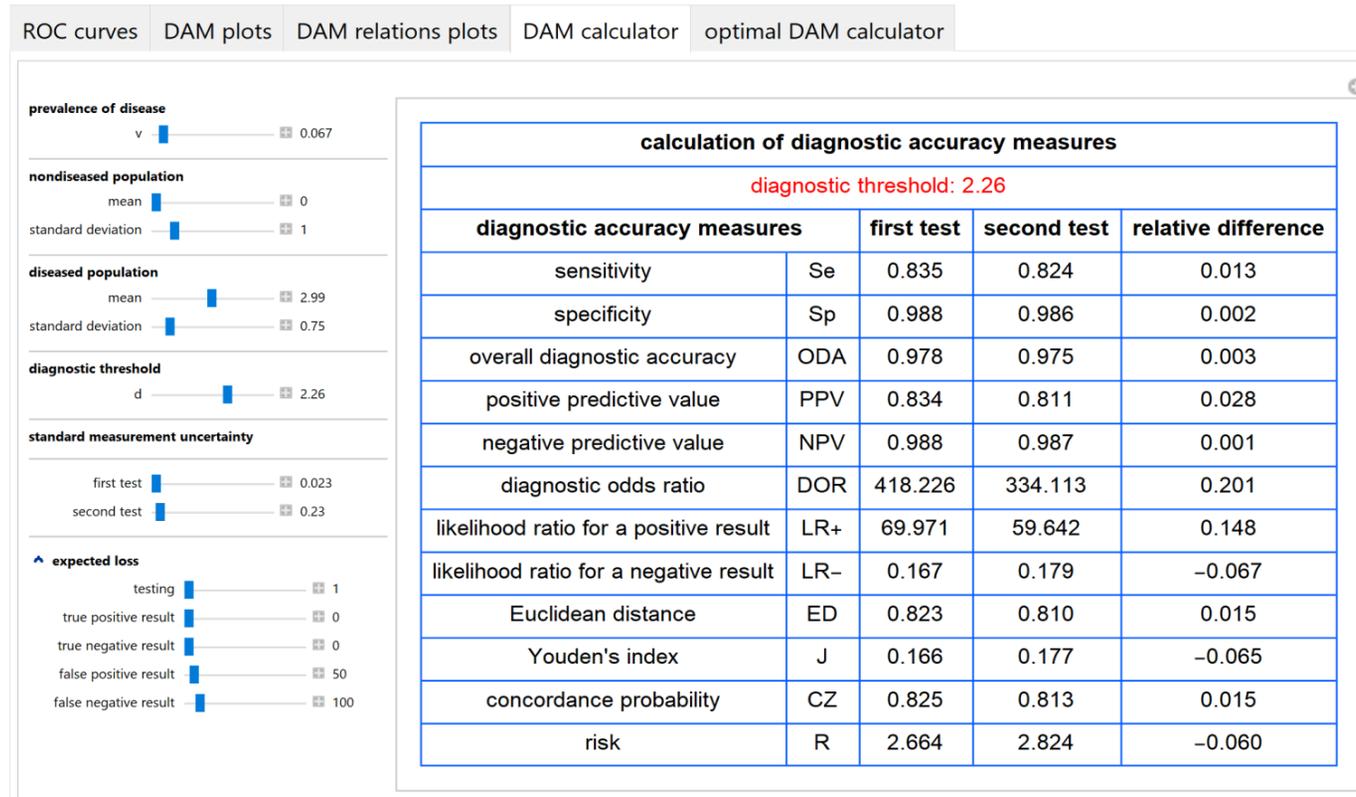
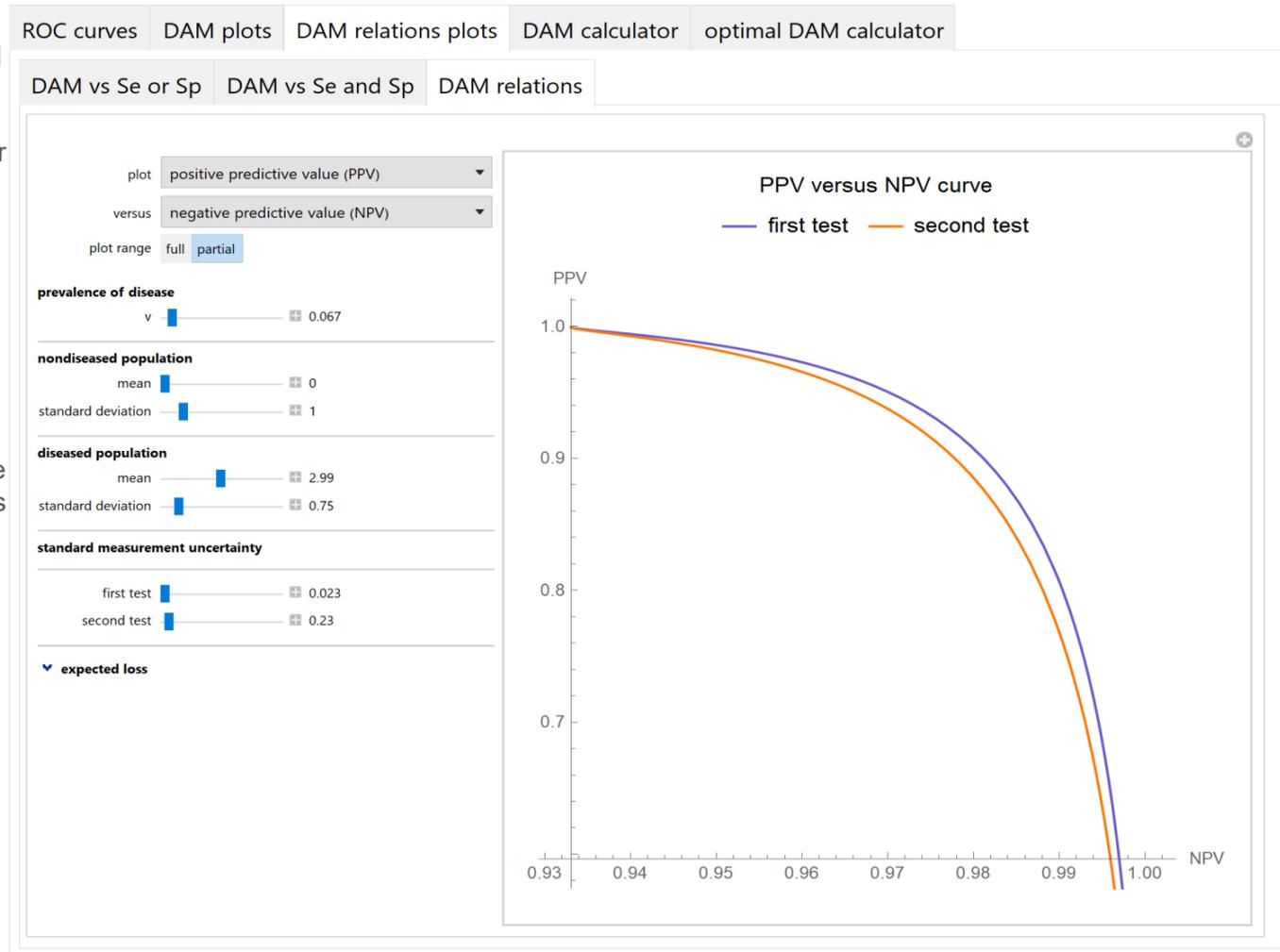


Figure 1. Plots of (a) sensitivity (Se), (b) specificity (Sp), (c) positive predictive value (PPV) and (d) negative predictive value (NPV) against standard measurement uncertainty (u)



4. Discussion

The freely available program *Relation* provides 269 different types of plots of diagnostic accuracy measures, many of which are novel. To the best of my knowledge, this is the only program to provide this range of plots without advanced statistical programming.

Figure 2. Positive predictive value (PPV) of two screening or diagnostic tests measuring the same measurand with different uncertainties, against negative predictive value (NPV) curves plot, with the settings at the left.

5. Significance

The program *Relation* is user-friendly and can be used as an educational and research tool in medical decision-making, to explore the relation between measurement uncertainty and diagnostic accuracy.

6. References

- Chatzimichail T, Hatjimihail AT. A Software Tool for Exploring the Relation between Diagnostic Accuracy and Measurement Uncertainty. *Diagnostics* 2020, 10(9), 610. DOI: [10.3390/diagnostics10090610](https://doi.org/10.3390/diagnostics10090610)

7. Supplementary Materials

The program *Relation* is freely available at:

<https://www.hcsl.com/Tools/Relation/>



Figure 3. Calculated diagnostic accuracy measures of two screening or diagnostic tests measuring the same measurand with different uncertainties and their relative differences, with the settings at the left.

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