Hellenic Complex Systems Laboratory

Receiver Operating Characteristic Curves and Uncertainty of Measurement

Technical Report V

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WOLFRAM Demonstrations Project

Receiver Operating Characteristic Curves and Uncertainty of Measurement

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Search Terms: receiver operating characteristic curves, ROC curves, uncertainty of measurement, sensitivity, specificity, diagnostic test, clinical accuracy, diagnostic accuracy, permissible uncertainty, normal distribution, area under ROC curves

Short Description of the Demonstration

This Demonstration compares two receiver operating characteristic (ROC) plots of two diagnostic tests (first test: blue plot, second test: orange plot) measuring the same measurand. The comparisons are for normally distributed nondiseased and diseased populations, for various values of the mean and standard deviation of the populations, and of the uncertainty of measurement of the tests. A normal distribution of the uncertainty is assumed. The ratio of the areas under the ROC curves of the two diagnostic tests is calculated. The six parameters that you can vary using the sliders are measured in arbitrary units.

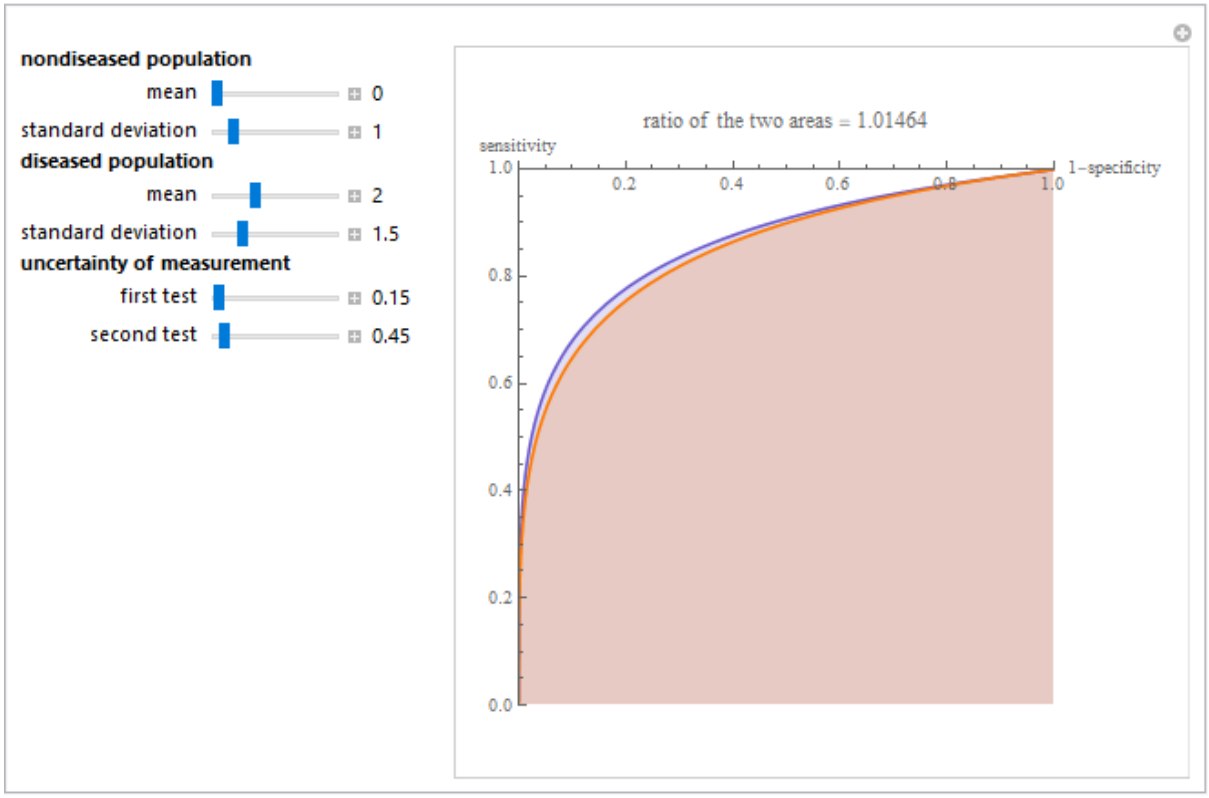

Figure 1: *Receiver operating characteristic (ROC) plots of two diagnostic tests (first test: blue plot, second test: orange plot), and the ratio of the respective areas under the curves, with the settings shown at the left.*

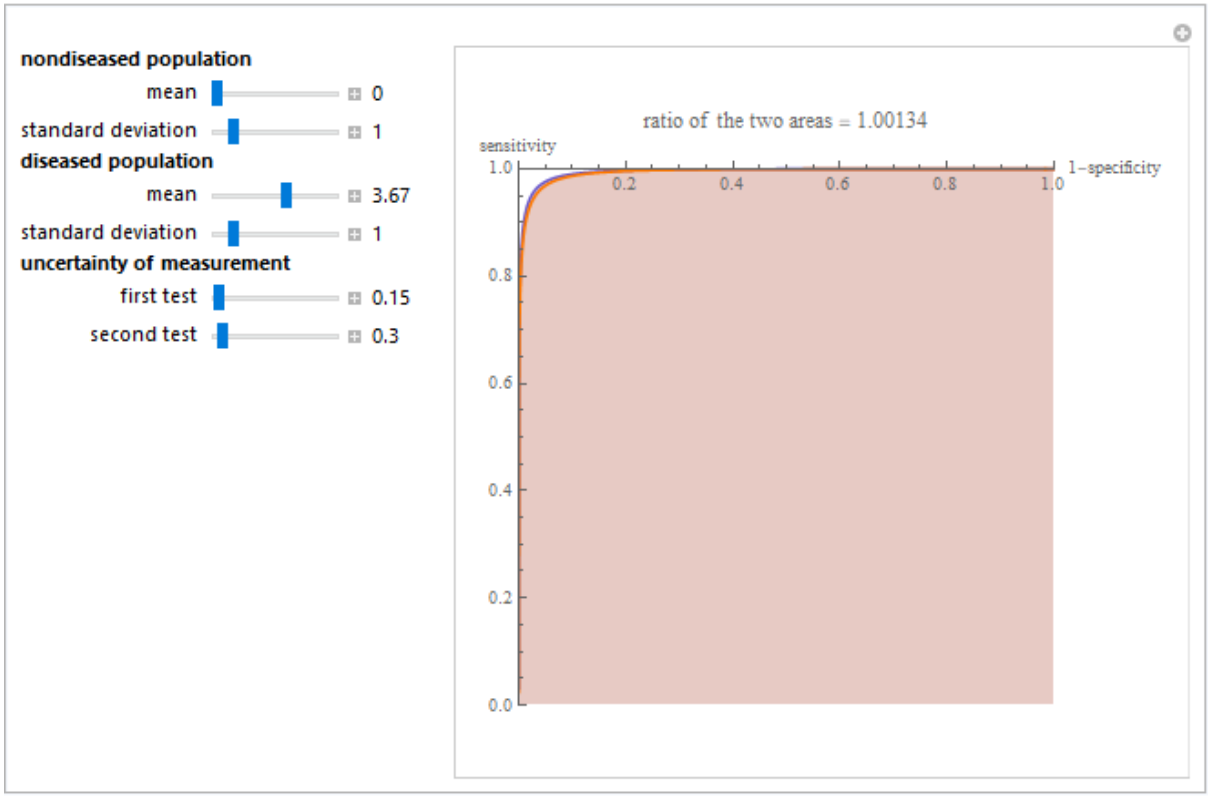

Figure 2: *Receiver operating characteristic (ROC) plots of two diagnostic tests (first test: blue plot, second test: orange plot), and the ratio of the respective areas under the curves, with the settings shown at the left.*

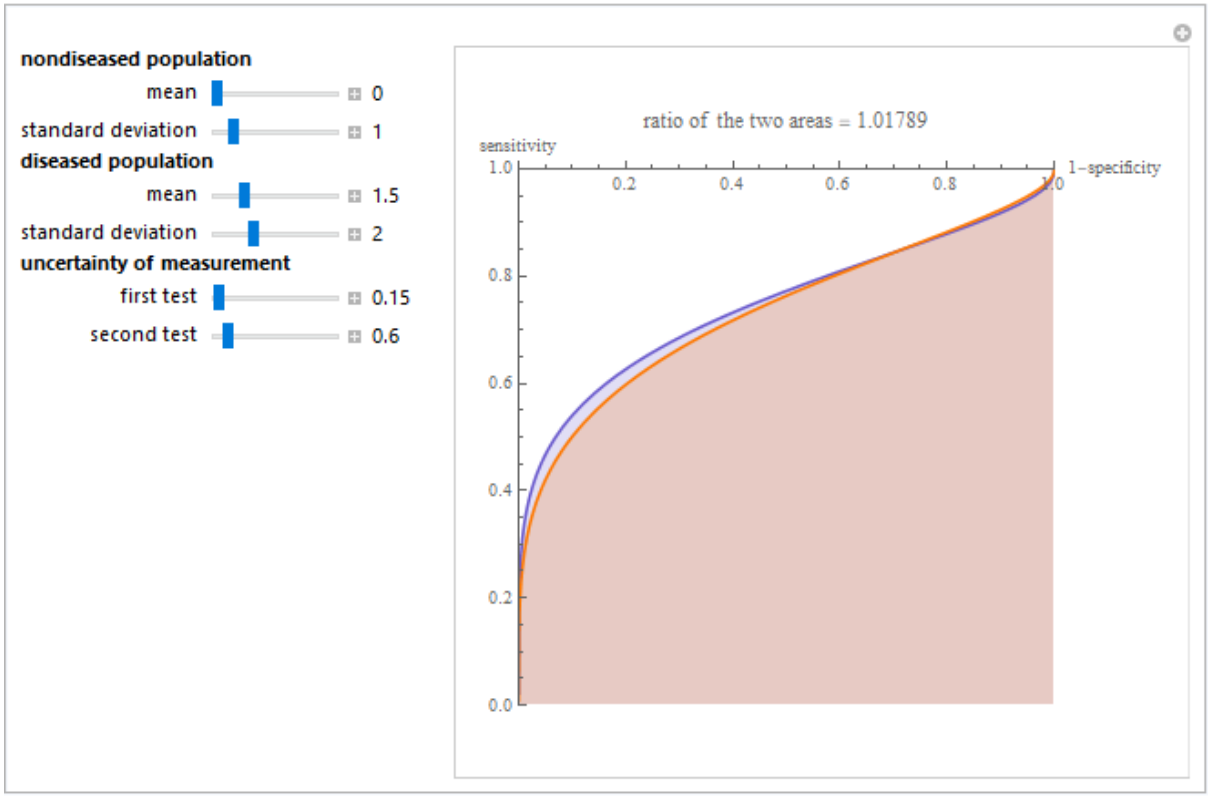

Figure 3: *Receiver operating characteristic (ROC) plots of two diagnostic tests (first test: blue plot, second test: orange plot), and the ratio of the respective areas under the curves, with the settings shown at the left.*

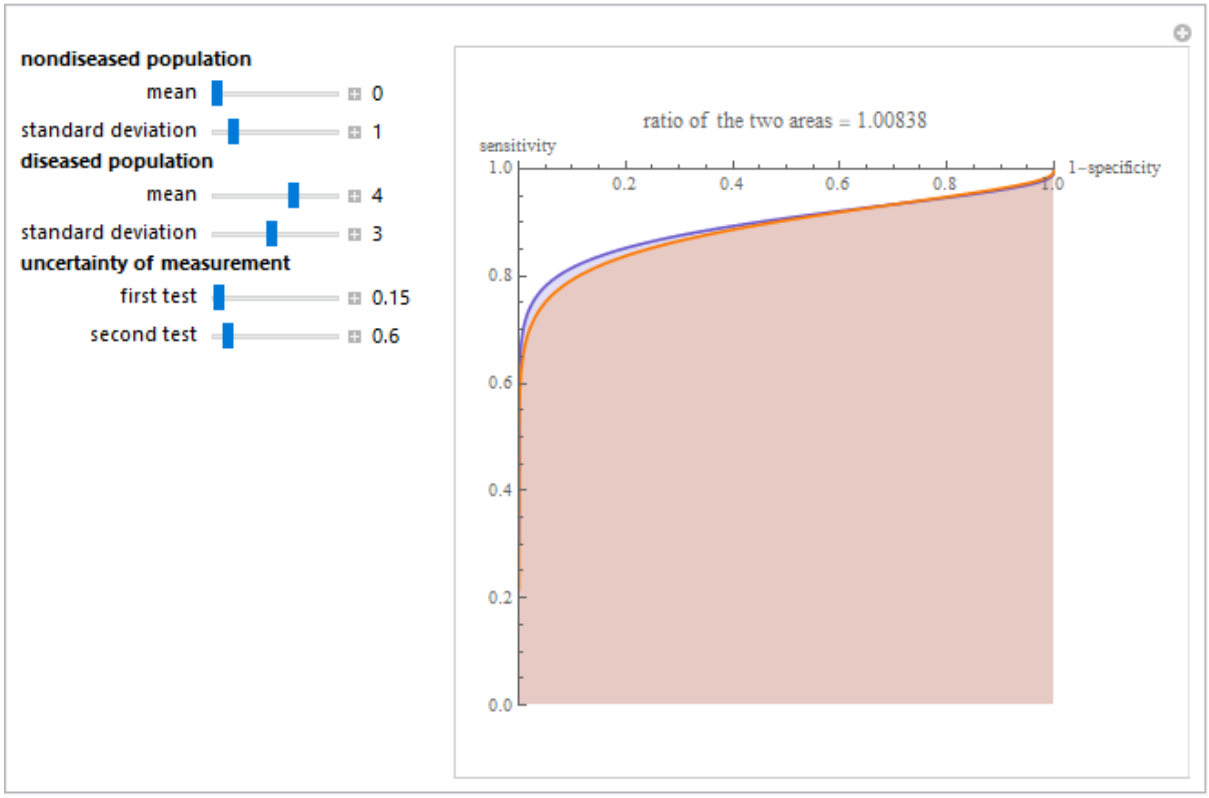

Figure 4: *Receiver operating characteristic (ROC) plots of two diagnostic tests (first test: blue plot, second test: orange plot), and the ratio of the respective areas under the curves, with the settings shown at the left.*

Details

The ROC plots are used in the evaluation of the clinical accuracy of a diagnostic test applied to a diseased and a nondiseased population. They display the sensitivity of the test versus 1-specificity. Sensitivity is the fraction of the diseased population with a positive test, while specificity is the fraction of the nondiseased population with a negative test. Therefore, the ROC plots display the true positive fraction versus the false positive fraction. Furthermore, the area under a ROC curve is used as an index of the diagnostic accuracy of the respective test.

This Demonstration could be useful in exploring ROC curves and evaluating the maximum medically permissible uncertainty of measurement of a diagnostic test. For example, in the second figure the population data describes a bimodal distribution of serum glucose measurements with a non-diabetic and a diabetic population [1].

Reference

[1] T. O. Lim, R. Bakri, Z. Morad, and M. A. Hamid. Bimodality in Blood Glucose Distribution: Is It Universal? *Diabetes Care,* **25**(12), 2002 pp. 2212–2217.

Source Code

The updated Wolfram Mathematica© source code is available at:
https://www.hcsl.com/Tools/Demonstrations/ReceiverOperatingCharacteristicCurvesAndUncertaintyOfMeasure.nb

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https://demonstrations.wolfram.com/ReceiverOperatingCharacteristicCurvesAndUncertaintyOfMeasure/

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