

Hellenic Complex Systems Laboratory

Correlation of Positive and Negative Predictive Values of Diagnostic Tests

Technical Report XII

Theodora Chatzimichail
4-5-2018



Correlation of Positive and Negative Predictive Values of Diagnostic Tests

Theodora Chatzimichail ^a

^a Hellenic Complex Systems Laboratory

Search Terms: sensitivity, specificity, diagnostic test, clinical accuracy, diagnostic accuracy, normal distribution, positive predictive value, negative predictive value

Abstract

This Demonstration examines the correlation of the negative predictive value (NPV) and the positive predictive value (PPV) of a diagnostic test for normally distributed nondiseased and diseased populations. Differing levels of prevalence of the disease are considered. The mean and standard deviation of the populations, measured in arbitrary units, are used.

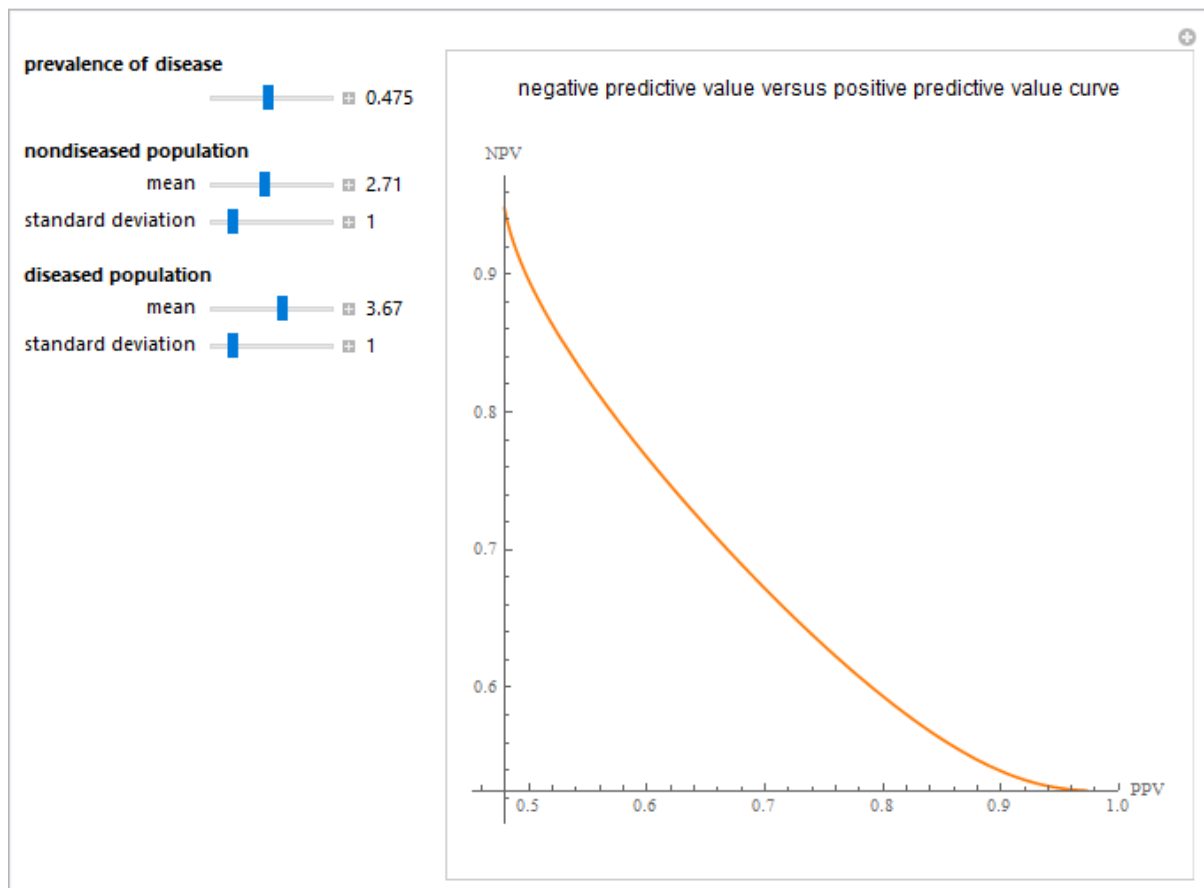


Figure 1: Negative predictive value versus positive predictive value curve plot of a diagnostic test. Prevalence of disease: 0.475, mean and standard deviation of the nondiseased population: 2.71 and 1.00 units respectively, mean and standard deviation of the diseased population: 3.67 and 1.00 units respectively.

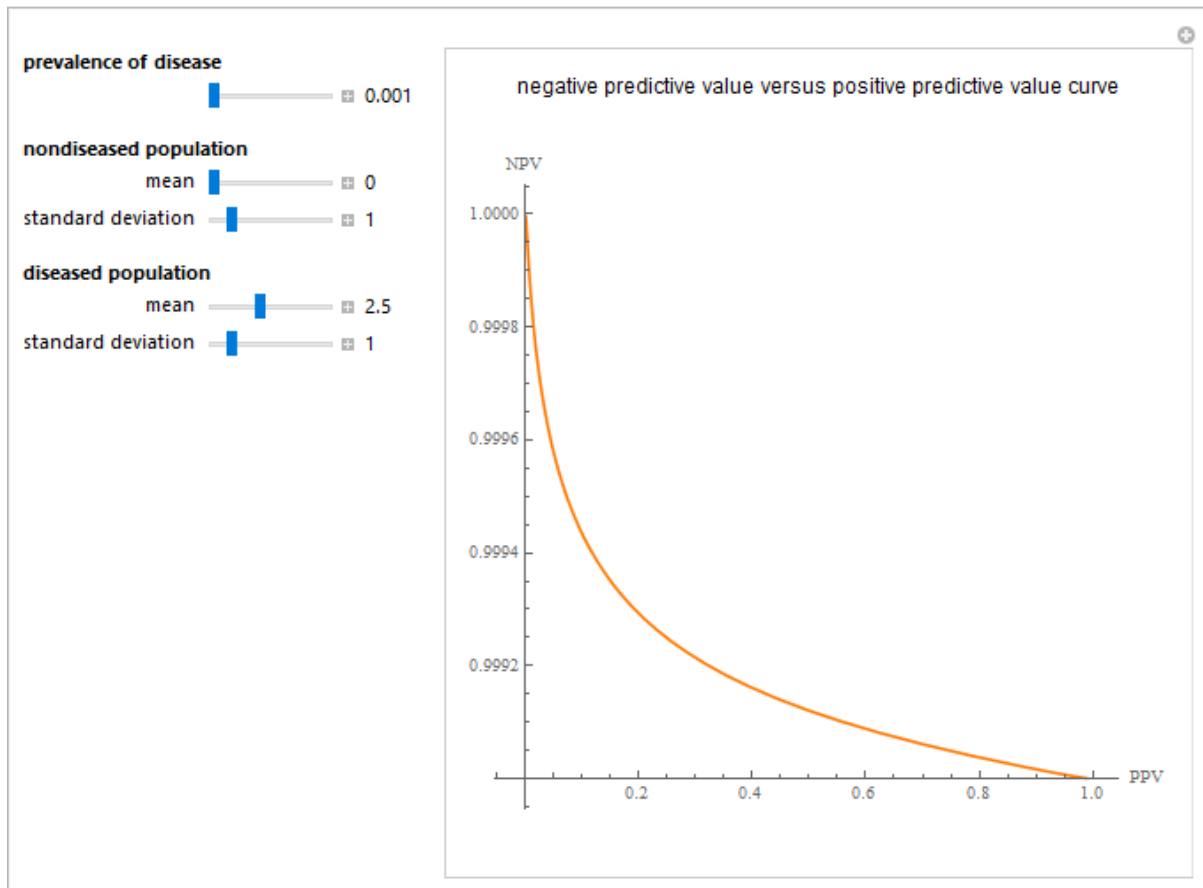


Figure 2: Negative predictive value versus positive predictive value curve plot of a diagnostic test. Prevalence of disease: 0.001, mean and standard deviation of the nondiseased population: 0.00 and 1.00 units respectively, mean and standard deviation of the diseased population: 3.50 and 1.00 units respectively.

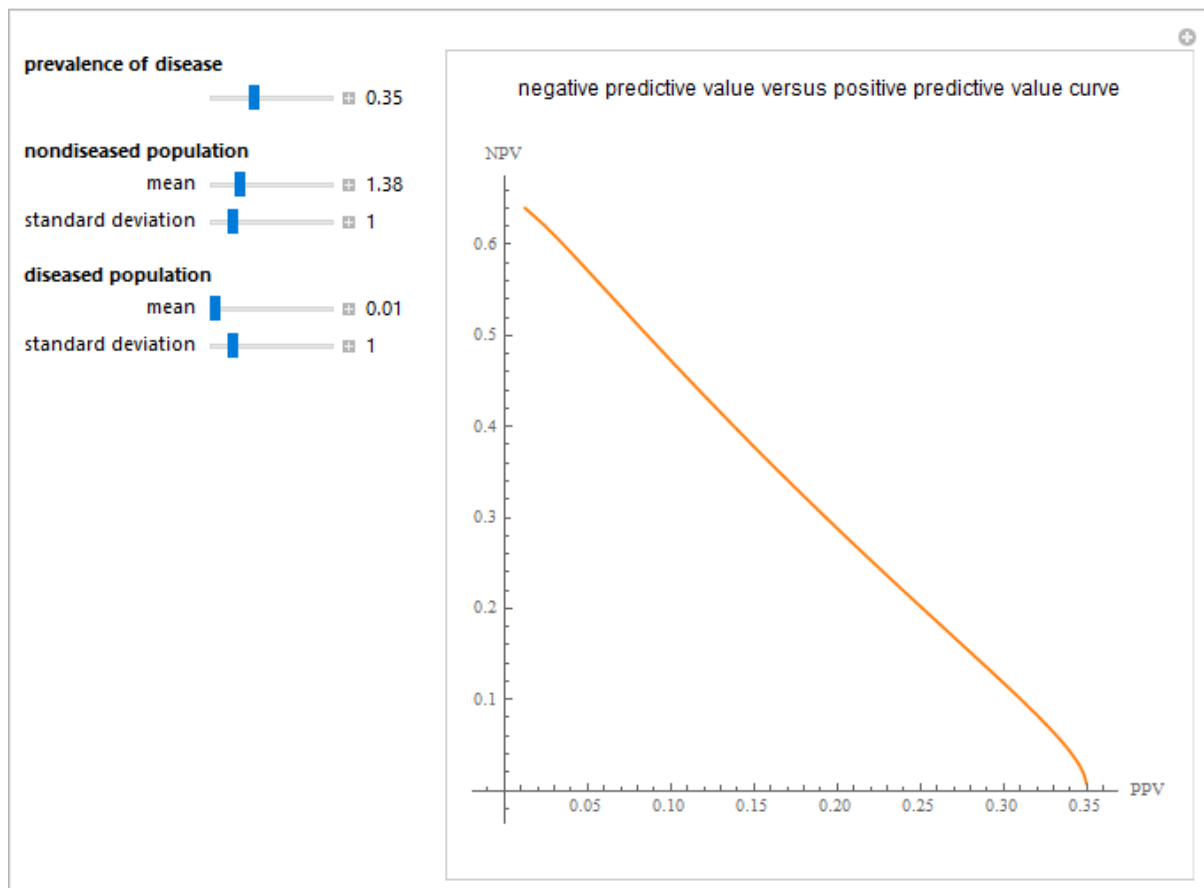


Figure 3: Negative predictive value versus positive predictive value curve plot of a diagnostic test. Prevalence of disease: 0.35, mean and standard deviation of the nondiseased population: 1.38 and 1.00 units respectively, mean and standard deviation of the diseased population: 0.01 and 1.00 units respectively.

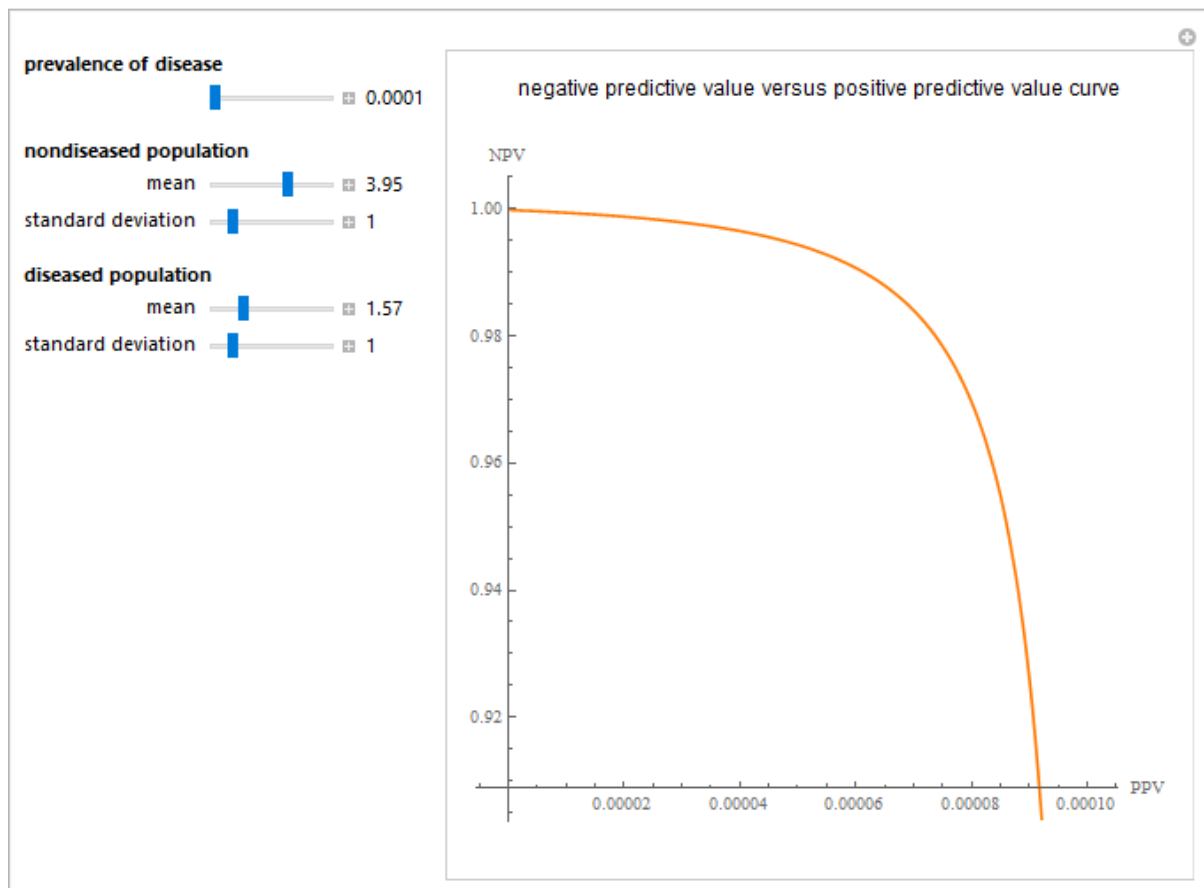


Figure 4: Negative predictive value versus positive predictive value curve plot of a diagnostic test. Prevalence of disease: 0.001, mean and standard deviation of the nondiseased population: 3.95 and 1.00 units respectively, mean and standard deviation of the diseased population: 1.57 and 1.00 units respectively.

Details

The PPV and NPV that are used in the evaluation of the clinical accuracy of a diagnostic test applied to a diseased or nondiseased population can be calculated given the sensitivity and specificity of the test. 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. If we denote by *sens* the sensitivity, *spec* the specificity, and *pr* the prevalence, then:

$$PPV = \frac{sens \times pr}{sens \times pr + (1 - spec)(1 - pr)}$$

$$NPV = \frac{spec (1 - pr)}{spec (1 - pr) + (1 - sens) pr}$$

Given a diseased and a nondiseased population, the specificity can be defined as a function of sensitivity; therefore, we can plot PPV versus NPV (a parametric plot).

The population data in the figures describes a bimodal distribution of serum glucose measurements in nondiabetic and diabetic populations [1].

This Demonstration is based on [2].

References

[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. doi:10.2337/diacare.25.12.2212.

[2] A. T. Hatjimihail. Uncertainty of Measurement and Diagnostic Accuracy Measures. Wolfram Demonstrations Project, Champaign: Wolfram Research, Inc., 2009. Available at: <http://demonstrations.wolfram.com/UncertaintyOfMeasurementAndDiagnosticAccuracyMeasures/>

Source Code

The updated Wolfram Mathematica® source code is available at:

<https://www.hcsl.com/Tools/CorrelationOfPositiveAndNegativePredictiveValuesOfDiagnostic-author.nb>

Permanent Citation:

Chatzimichail T. Correlation of Positive and Negative Predictive Values. Wolfram Demonstrations Project, Champaign: Wolfram Research, Inc., 2018. Available at: <http://demonstrations.wolfram.com/CorrelationOfPositiveAndNegativePredictiveValuesOfDiagnostic/>

Published: April 5 2018