Hellenic Complex Systems Laboratory

Calculation of Diagnostic Accuracy Measures

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Calculation of Diagnostic Accuracy Measures

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Search Terms: sensitivity, specificity, diagnostic test, clinical accuracy, diagnostic accuracy, normal distribution, positive predictive value, negative predictive value, likelihood ratio, odds ratio, confidence intervals

Short Description of the Demonstration

This Demonstration shows calculations of point estimations and confidence intervals for various accuracy measures of a diagnostic test for a disease. This is done for differing negative and positive test results of nondiseased and diseased populations and differing *p*-values for the estimations of the lower and upper bounds of the confidence intervals. The calculated measures are the sensitivity, the specificity, the positive predictive value (PPV), the negative predictive value (NPV), the (diagnostic) odds ratio (OR), the likelihood ratio for a positive test result (LR+) and the likelihood ratio for a negative test result (LR−). The measures can be selected using the menu. The negative and positive test results of the nondiseased and diseased populations, along with the *p*-value, are chosen using the sliders.

nondiseased population
negative test result

▮——————— ⊞ 1054

positive test result

▮——————— ⊞ 235

diseased population
positive test result

▮——————— ⊞ 45

negative test result

▮——————— ⊞ 5

p–value

————————▮— ⊞ 0.95

measure

sensitivity ▾

population statistics	
total population	1339
nondiseased	1289
diseased	50
prevalence of disease	0.037341

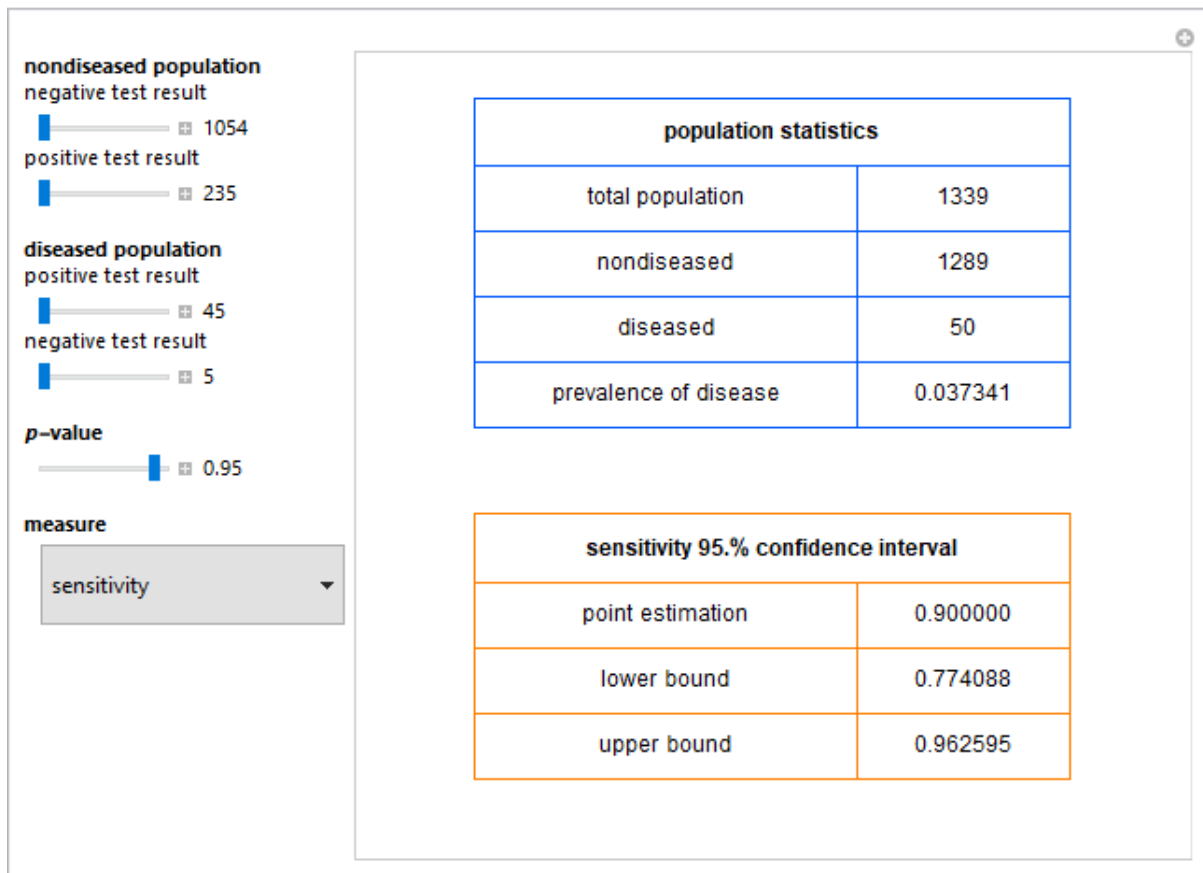| sensitivity 95.% confidence interval	
point estimation	0.900000
lower bound	0.774088
upper bound	0.962595

Figure 1: *Population statistics and the point estimation and the 95.0% confidence interval of the sensitivity of a diagnostic test, with the settings shown at the left.*
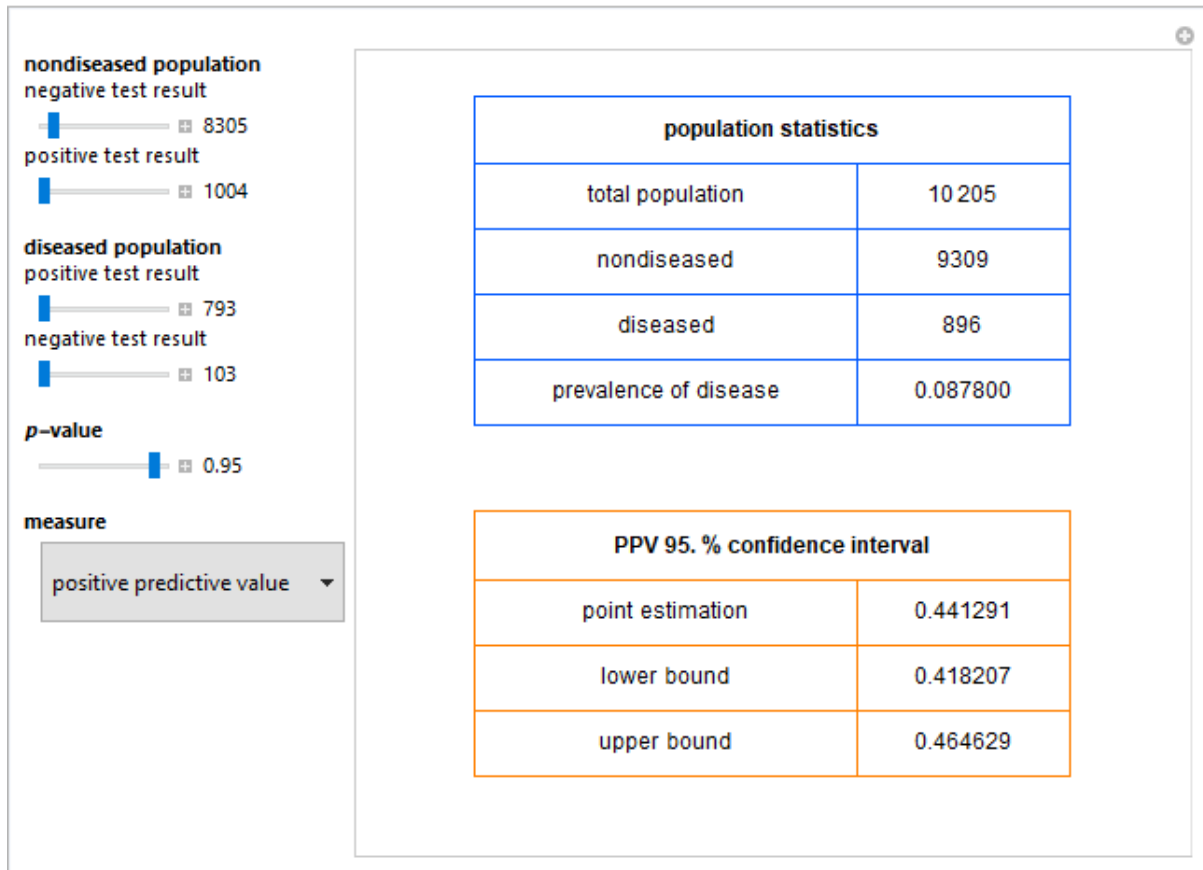
nondiseased population
negative test result
▮────── ⊞ 8305
positive test result
▮────── ⊞ 1004

diseased population
positive test result
▮────── ⊞ 793
negative test result
▮────── ⊞ 103

p–value
──────▮ ⊞ 0.95

measure
[positive predictive value ▾]

population statistics	
total population	10 205
nondiseased	9309
diseased	896
prevalence of disease	0.087800

PPV 95. % confidence interval	
point estimation	0.441291
lower bound	0.418207
upper bound	0.464629

Figure 2: *Population statistics and the point estimation and the 95.0% confidence interval of the positive predictive value of a diagnostic test, with the settings shown at the left.*
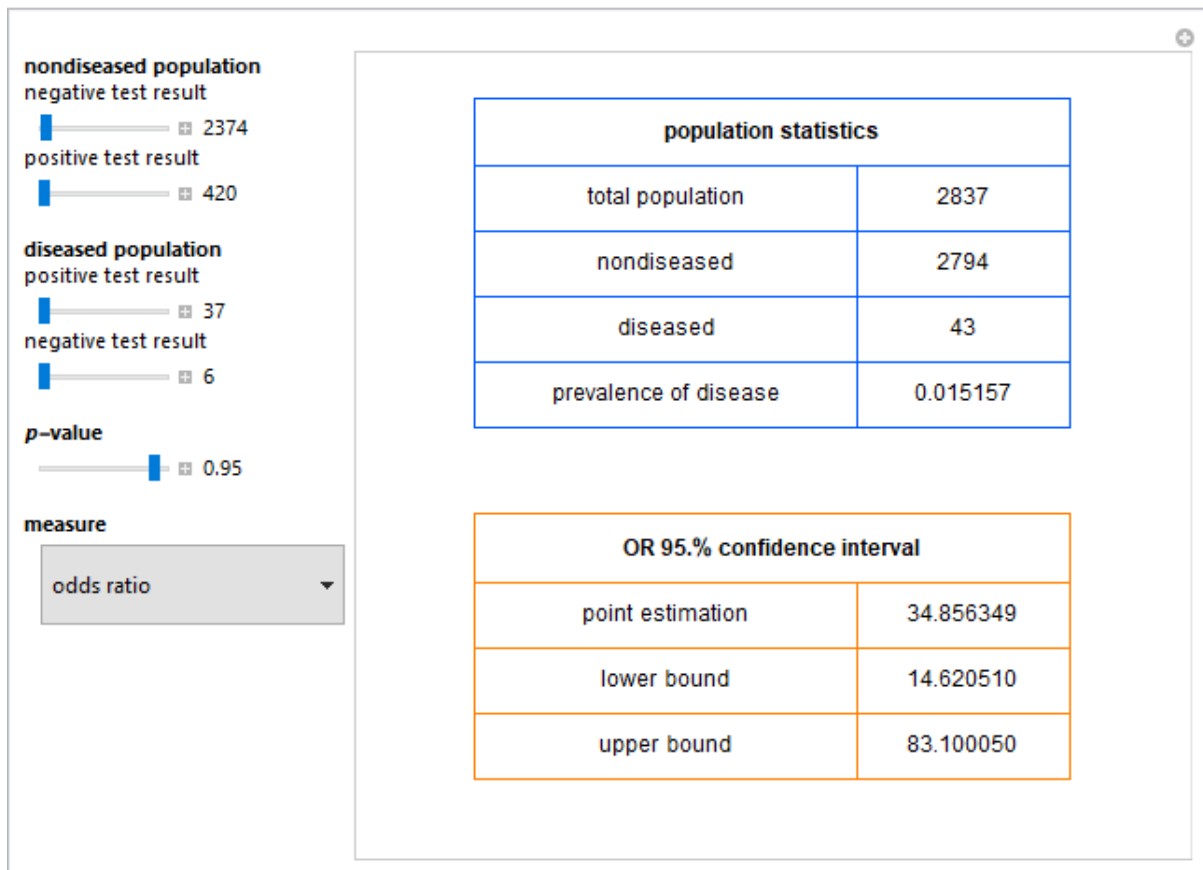
Figure 3: *Population statistics and the point estimation and the 95.0% confidence interval of the odds ratio of a diagnostic test, with the settings shown at the left.*
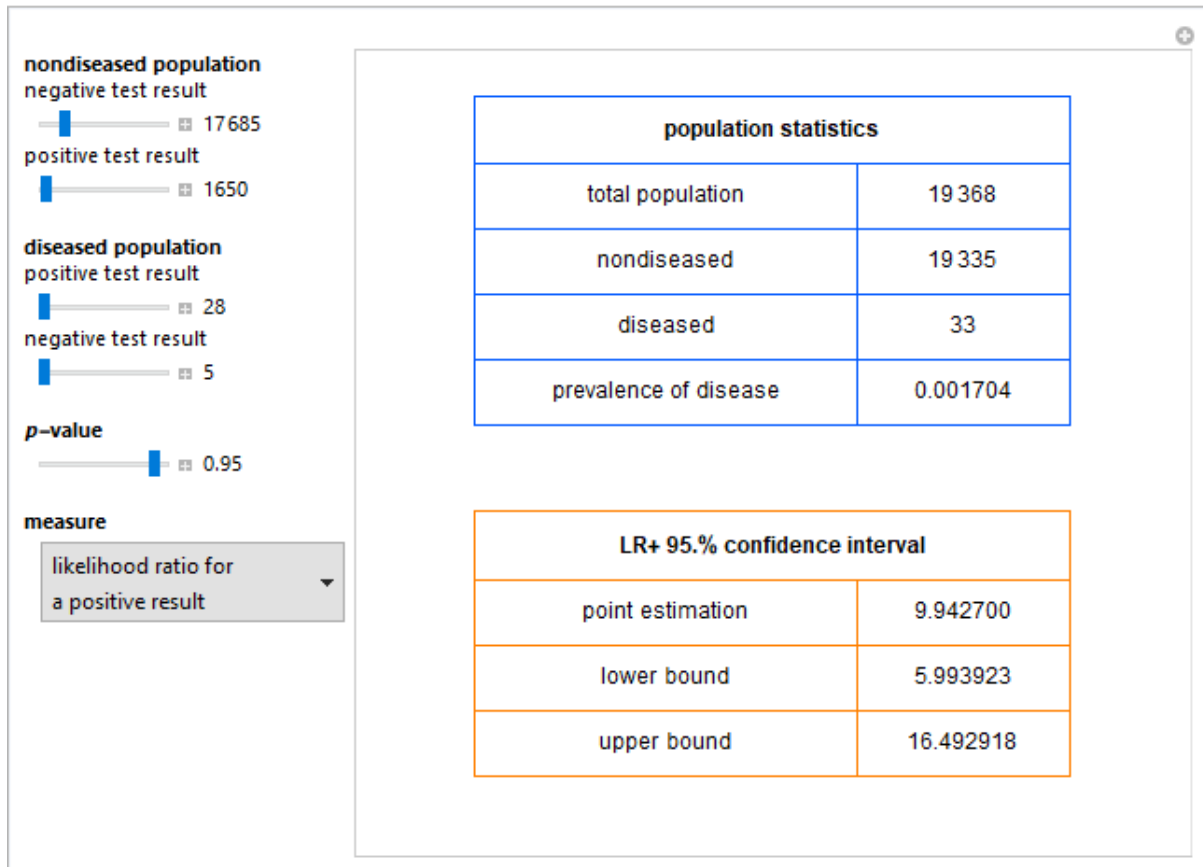
Figure 4: *Population statistics and the point estimation and the 95.0% confidence interval of the likelihood ratio for a positive test result of a diagnostic test, with the settings shown at the left.*

Details

Sensitivity refers to the fraction of the diseased population with a positive test result, while specificity is the fraction of the nondiseased population with a negative test result. Positive predictive value is the fraction of the population with a positive test result that is diseased, while negative predictive value is the fraction of the population with a negative test result that is not diseased. Prevalence of the disease is the ratio of the diseased population to the total (nondiseased and diseased) population. If we denote by *sens* the sensitivity, *spec* the specificity, and *pr* the prevalence, we have:

$$OR = \frac{\frac{sens}{1-sens}}{\frac{1-spec}{spec}}$$

$$LR+ = \frac{sens}{1-spec}$$

$$LR- = \frac{1-sens}{spec}$$

The Wilson score method with continuity correction is used [1] for calculating the confidence intervals of the sensitivity, the specificity, the positive predictive value and the negative predictive value.

For the calculation of the confidence intervals of the (diagnostic) odds ratio, the likelihood ratio for a positive test result and the likelihood ratio for a negative test result, it is assumed that their natural logarithms have asymptotically normal distributions [1].

This Demonstration is an extension of another Demonstration [2] and is appropriate as an educational and research tool.

References

[1] J. L. Fleiss, B. Levin and M. C. Paik. Statistical Methods for Rates and Proportions*, 3rd ed., Hoboken, NJ: J. Wiley, 2003.

[2] Chatzimichail T. Calculator for Diagnostic Accuracy Measures. Wolfram Demonstrations Project, Champaign: Wolfram Research, Inc., 2018. Available at:
http://demonstrations.wolfram.com/CalculatorForDiagnosticAccuracyMeasures/

Source Code

Programming language: Wolfram Language
Availability: The updated source code is available at:
https://www.hcsl.com/Tools/Demonstrations/CalculationOfDiagnosticAccuracyMeasures.nb

Software Requirements

Operating systems: Microsoft Windows, Linux, Apple iOS
Other software requirements: Wolfram Player®, freely available at: https://www.wolfram.com/player/ or Wolfram Mathematica®.

System Requirements

Processor: x86-64 compatible CPU.
System memory (RAM): 4GB+ recommended.

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https://demonstrations.wolfram.com/CalculationOfDiagnosticAccuracyMeasures/

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