

Exercise walk-through

12.4

Diagnostic tests

University Medicine

Diagnostic tests: columns vs rows

- 1 **Columns** $Se = a/(a+c)$, $Sp = d/(b+d)$ - 90 % each in the worked example.
- 2 **Rows** 10 % prevalence: $PPV\ 90/180 = 50\%$, $NPV\ 810/820 = 98.8\%$; at 1 %, $PPV\ 9/108 = 8.3\%$.
- 3 **Portable** $LR+ = Se/(1-Sp) = 0.9/0.1 = 9$ - multiplies pre-test odds anywhere.

The 2×2 table and its natural-frequency tree

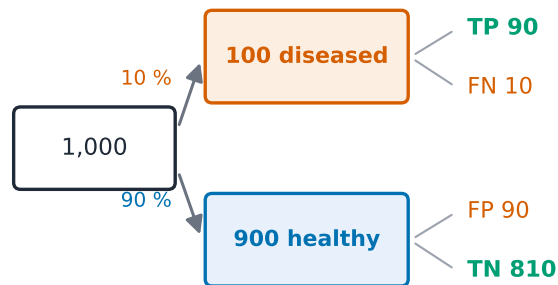
the 2×2 table

diseased | healthy

test +	a = 90 TP	b = 90 FP
test -	c = 10 FN	d = 810 TN

Se = $90/100 = 90\%$ · Sp = $810/900 = 90\%$
columns: test properties

natural-frequency tree: 1,000 people, 10 % prevalence



rows: population properties

PPV $90/180 = 50\%$ · NPV $810/820 = 98.8\%$
at 1 % prevalence: PPV $9/108 = 8.3\%$
LR+ = $Se/(1-Sp) = 0.9/0.1 = 9$ — travels with you

Sensitivity and **specificity** live in the columns; predictive values live in the rows.

Exercises 2.1-2.3

2.1 Which cell pair defines sensitivity?

[3]

2.2 Se 90 %, Sp 80 % – LR+?

[3]

2.3 Why does NPV rise as prevalence falls?

[3]

Exercises 2.1·2.3

2.1 Which cell pair defines sensitivity? [3]

2.1

- a and c: TP among the diseased – $a/(a+c)$ ✓.

2.2 Se 90 %, Sp 80 % – LR+? [3]

2.2

- $LR+ = 0.90/0.20 = 4.5$ ✓.

2.3 Why does NPV rise as prevalence falls? [3]

2.3

- Fewer diseased → fewer false negatives; the negatives are nearly all truly well ✓.

Exercise 3.1

3.1 A synthetic new test evaluated against a reference standard: among 200 diseased, 160 test positive; among 800 healthy, 120 test positive.

Compute Se ($160/200 = 80\%$), Sp ($680/800 = 85\%$) and LR+ ($0.80/0.15 \approx 5.3$) ✓.
Then build the natural-frequency tree for this test at a clinic prevalence of 25 % among 1,000 people and compute the PPV and NPV ✓. [8]

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3.1

- Se = $160/200 = 80\%$; Sp = $680/800 = 85\%$ ✓.
- LR+ = $0.80/(1-0.85) = 5.3$ ✓.
- At 25 %: 250 diseased → 200 TP, 50 FN; 750 healthy → 112.5 FP, 637.5 TN ✓.
- PPV = $200/312.5 = 64\%$; NPV = $637.5/687.5 = 92.7\%$ ✓.

Exercise 3.2

3.2 The same test is used in a low-prevalence screen (2 %).

Predict the direction of PPV (falls sharply) and NPV (rises toward its ceiling) and explain both with the tree (false positives scale with the healthy majority) ✓. State one consequence for a screening programme (most positives are false; confirmatory testing required) ✓.

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3.2

- PPV falls: at 2 %, 20 diseased $\rightarrow$ 16 TP; 980 healthy $\rightarrow$ 147 FP $\rightarrow$ $PPV = 16/163 \approx 9.8\%$ ✓.
- NPV rises: false negatives shrink with the diseased minority $\rightarrow$ $NPV \approx 833/837 \approx 99.5\%$ ✓.
- Programme consequence: most screen positives are false – a confirmatory (more specific) test is needed ✓.