The likelihood ratio scatterplot

Diagnostic meta-analysis at a glance

An ICE Project

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The Problem

Senseless diagnostic tests significantly contribute to the annual health care budget world–wide

Clinicians are frequently not aware that some tests are simply superfluous

Where's the best evidence? There are far more less systematic reviews of diagnostic studies than of RCT!

Questions remaining

We like to do meta-analyses of diagnostic test research, but how should we pool the data?

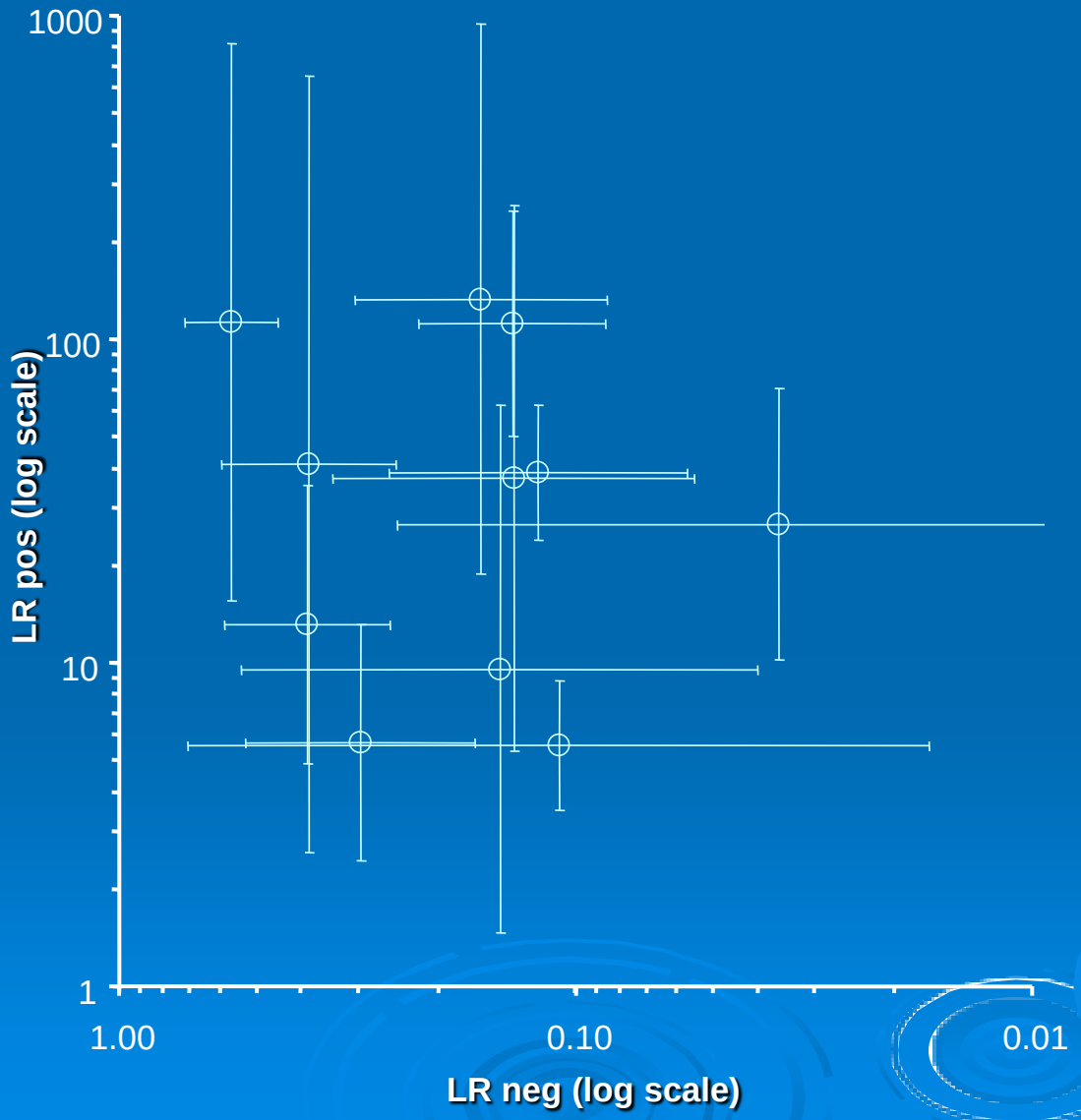
Sensitivity? Specificity? Accuracy? The "diagnostic odds ratio"? Pooled ROC curves?

Why not using likelihood ratios?

Worked example: trauma ultrasound

Study	n	SN	SP	prior	LR+	LR–
Akgür F (1997)	208	0.83	0.99	0.25	88.33	0.17
Froelich JW (1982)	26	0.84	0.88	0.62	6.75	0.18
Förster R (1993)	140	0.95	0.96	0.21	23.64	0.05
Goletti O (1994)	73	0.85	0.97	0.42	25.08	0.15
Healey MA (1996)	796	0.88	0.98	0.07	37.30	0.13
Katz S (1996)	121	0.88	0.83	0.10	5.25	0.15
Krupnick AS (1997)	64	0.62	0.98	0.52	41.00	0.38
McGahan JP (1997)	121	0.63	0.95	0.32	11.73	0.39
McKenney KL (1998)	884	0.86	0.99	0.13	102.58	0.14
Röthlin MA (1993)	313	0.44	0.99	0.18	75.54	0.57
Singh G (1997)	73	0.74	0.86	0.49	5.22	0.31

A bi-dimensional forest plot



How to obtain a summary estimate

Remember: likelihood ratios are ratios of odds!

LR+ = post-test odds given a positive result / pre-test odds

LR– = post-test odds given a negative result / pre-test odds

We can immediately apply established meta-analytic methods to calculate a common LR

Some calculus

Θ — common LR+ or LR–

θ_i — LR of the *i*th individual study

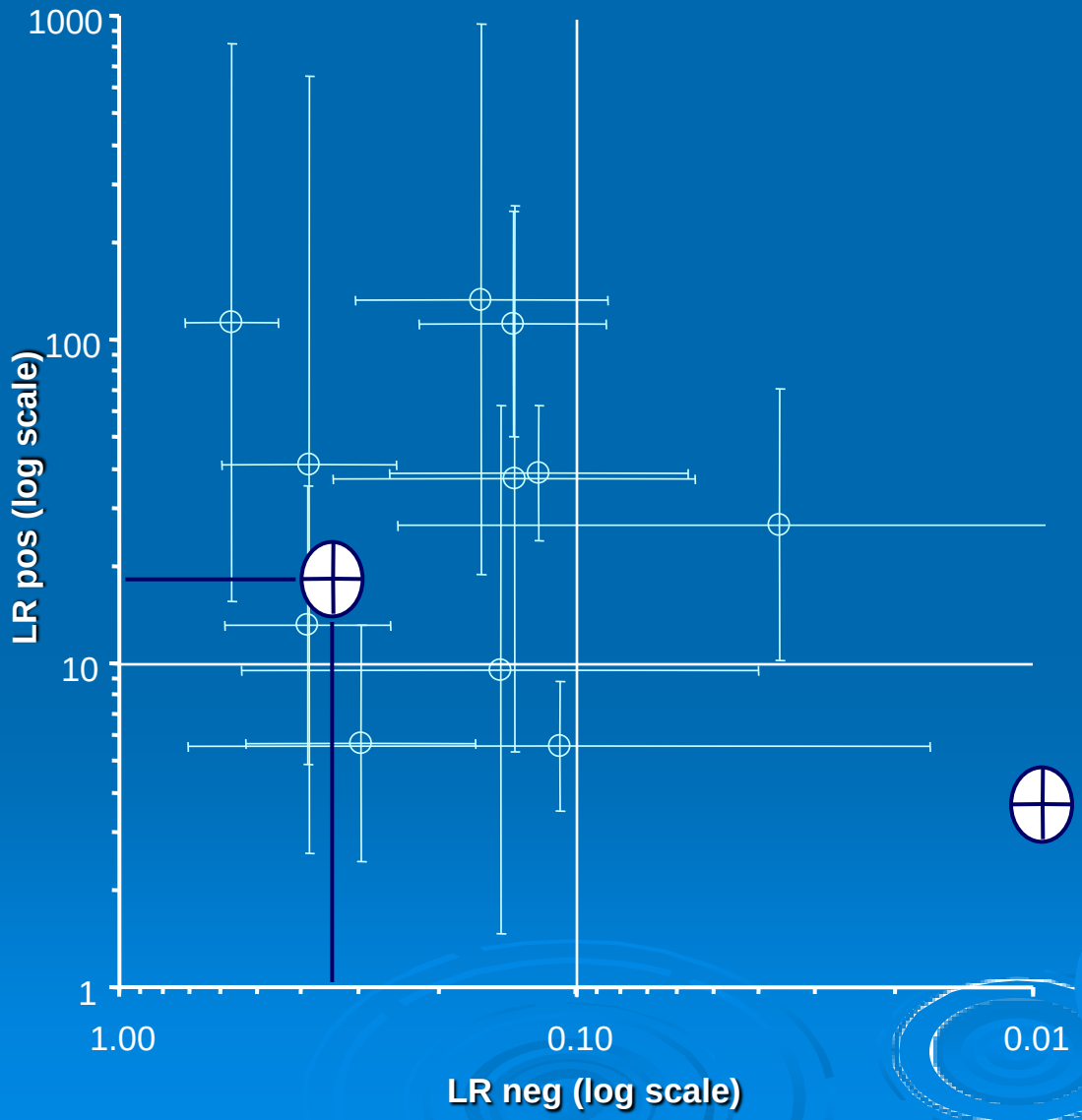
$\omega_i = 1 / \text{variance}(\theta_i)$ — weight of the *i*th individual study

General inverse variance method

$$\ln(\Theta) = \Sigma [\omega_i \quad \ln(\theta_i)] / \Sigma \omega_i$$

Alternatively: use constant-only meta-regression (e.g., STATA's metareg procedure)

Range of data and common LR



Pooled results
Fixed effects
LR+ 18.26 (95% CI 14.14, 23.58)
LR– 0.34 (95% CI 0.29, 0.40)

Test for heterogeneity
Cochran's *Q*+ 73.88 (*df*=10)
Cochran's *Q*+ 58.31 (*df*=10)

Advantages

Clinicians are familiar with forest plots of therapeutic meta-analyses

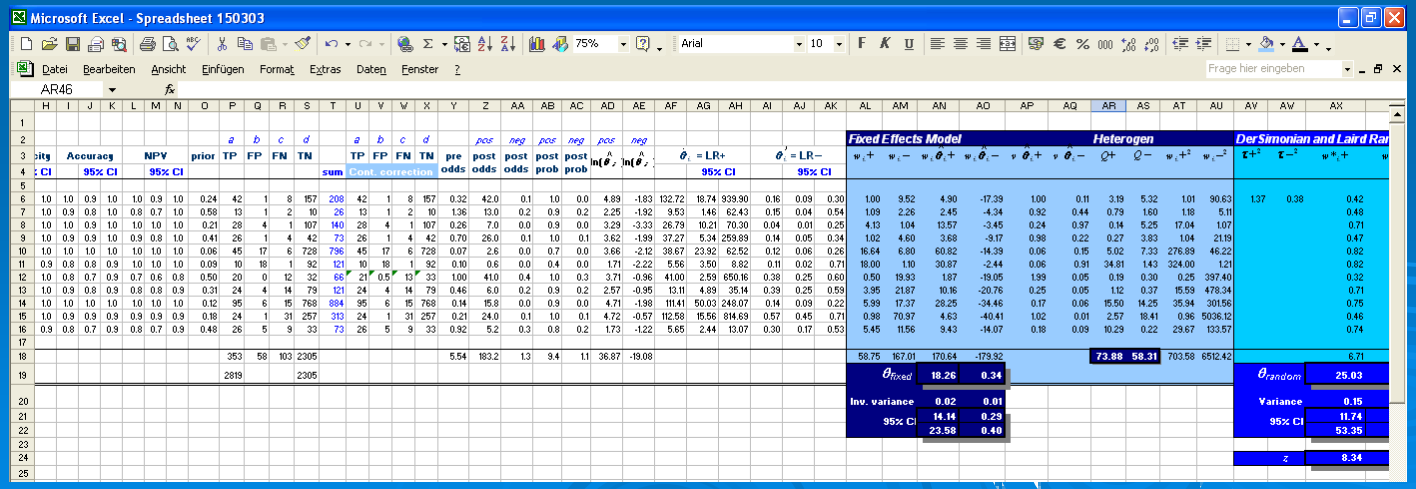
Accepted threshold values for LRs (0.1 and 10) to distinguish between valuable and useless tests

Computational simple

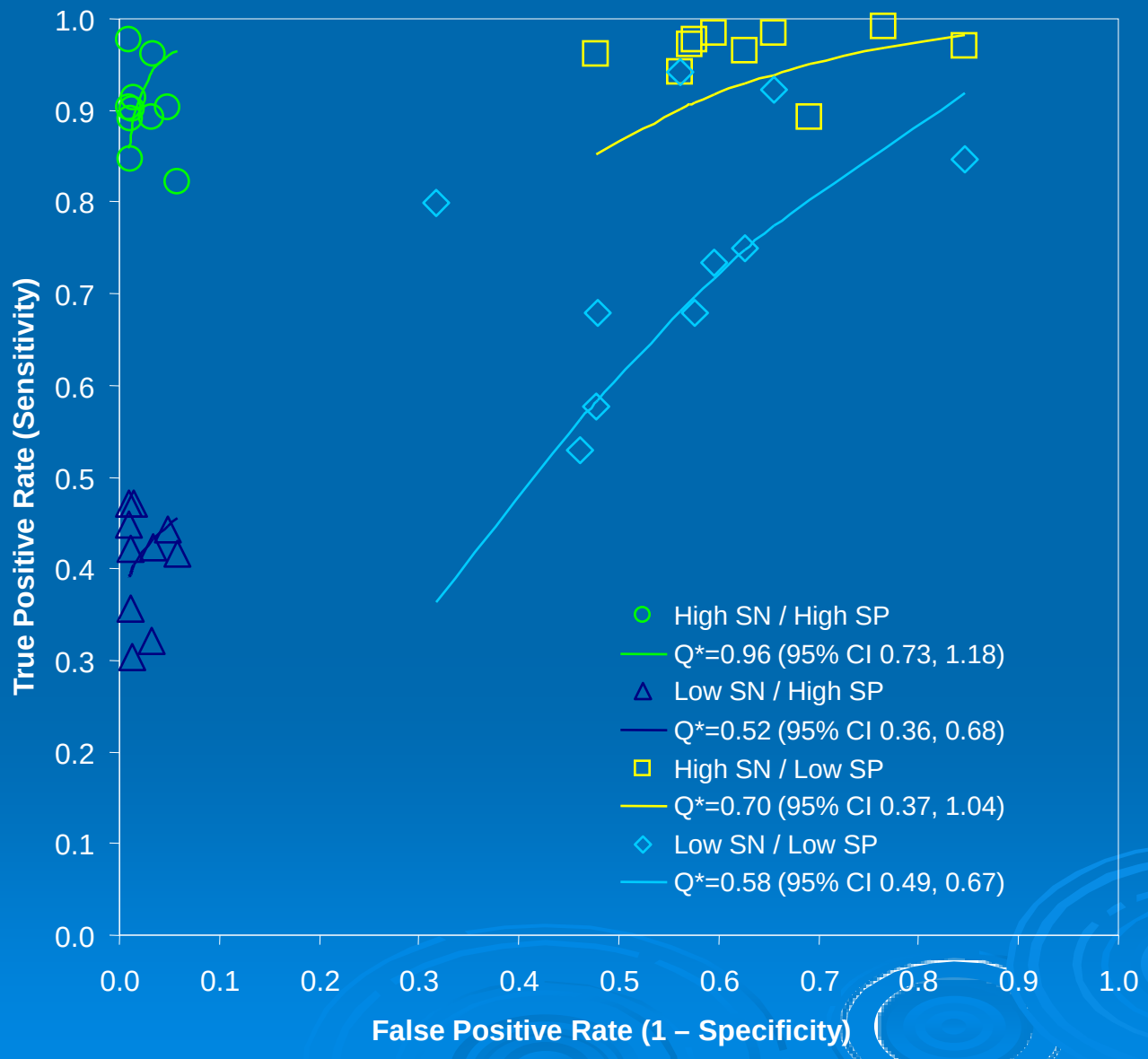
Disadvantages

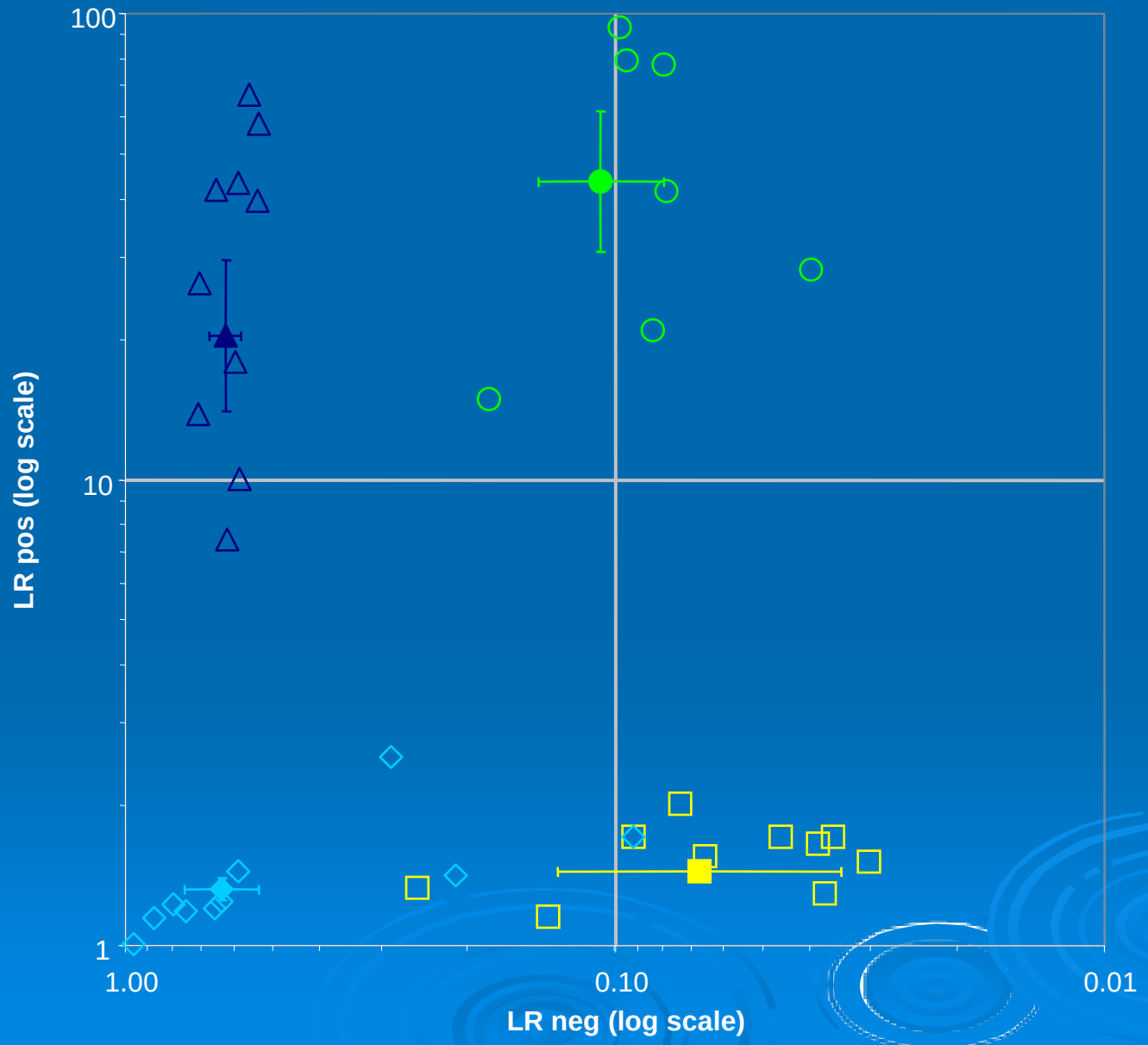
Confusing if a large number of trials is enrolled (possible solution: refrain from presenting the 95% confidence intervals of individual studies)

No commercial software available



Thank you!


True Positive Rate (Sensitivity)
False Positive Rate (1 – Specificity)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
High SN / High SP
Q*=0.96 (95% CI 0.73, 1.18)
Low SN / High SP
Q*=0.52 (95% CI 0.36, 0.68)
High SN / Low SP
Q*=0.70 (95% CI 0.37, 1.04)
Low SN / Low SP
Q*=0.58 (95% CI 0.49, 0.67)


100
10
1
LR pos (log scale)
1.00
0.10
0.01
LR neg (log scale)