

3.6 A. CALFRAST

A quick screening test for hearing loss is the Calibrated Finger Rub Auditory Screening Test (CALFRAST). The examiner with arms extended stands facing the patient and rubs her fingers together strongly and asks if the patient can hear the rubbing sound on each side. Because this strong stimulus is presented about 70 cm from the patient's ear, it is called CALFRAST Strong 70. If the patient can hear the finger rubbing, the examiner repeats the test at the quietest level the examiner can hear (CALFRAST Faint 70). Torres-Russotto et al [1] reported test characteristics for the CALFRAST, using audiometry as the gold standard, with normal hearing defined as < 25 decibel loss at 1000, 2000 and 4000 Hz.

Results from a consecutive sample of consenting patients are summarized below, adapted and corrected from Table 2 of that study and reprinted with permission are shown below:

	Hearing Loss			
CALFRAST Strong 70 result	Yes	No	Total	
Positive (Rubbing NOT heard)	90	0	90	PPV=10%
Negative (Rubbing heard)	61	291	352	NPV=83%
Total	151	291	442	
	Sens = 60%	Spec = 100%		
	Hearing Loss			
CALFRAST Faint 70 result	Yes	No	Total	
Positive (Rubbing NOT heard)	149	73	222	PPV = 67%
Negative (Rubbing heard)	2	218	220	NPV= 99%
Total	151	291	442	
	Sens = 99%	Spec = 75%		

From Torres-Russotto D, Landau WM, Harding GW, Bohne BA, Sun K, Sinatra PM. Calibrated finger rub auditory screening test (CALFRAST). Neurology. 2009;72(18):1595-600. <https://www.ncbi.nlm.nih.gov/pubmed/19414727>

Consider the CALFRAST-70 as a single multi-level test where Strong-70 and Faint-70 are two results for the same test. (Not hearing a strong stimulus is a more abnormal result than not hearing a faint stimulus.) Draw and label an ROC curve that summarizes the accuracy of the CALFRAST Strong 70 and Faint 70 results summarized above as a single test. This is challenging, but you should be able to do it!

Answer:

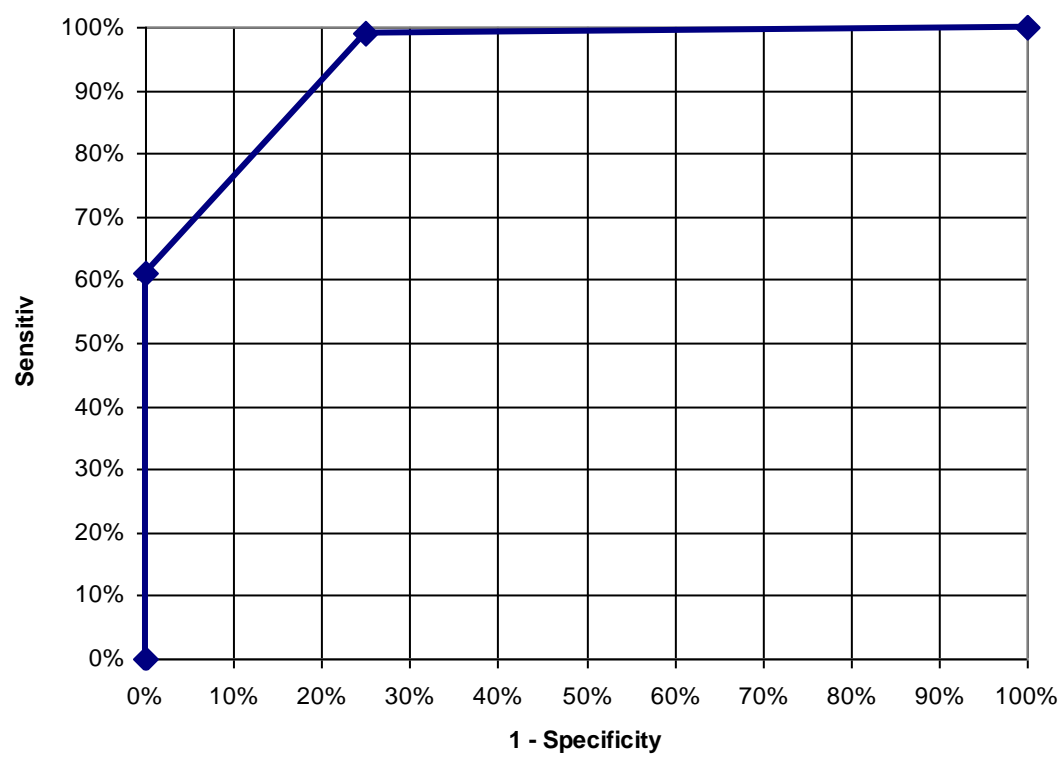
You can use the sensitivities and specificities above to create an ROC table like the one below.

Cutoff	Sensitivity	Specificity	1 - Specificity
<i>Origin</i>	0%	100%	0%
<i>Can't hear strong</i>	61%	100%	0%
<i>Can't hear weak</i>	99%	75%	25%

Upper right corner	100%	0%	100%
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Then you can use that to draw an ROC curve:

Answer:



The study also examined the patient's self-assessment of hearing compared with the same gold standard, as shown in the continuation of Table 2 below.

	Hearing Loss			
Subject's self assessment	Yes	No	Total	
Hearing abnormal	91	41	132	PPV = 69%
Hearing normal	60	250	310	NPV = 81%
Total	151	291	442	
	Sens = 60%	Spec = 86%		

b. You are seeing a patient similar to those included in this study whose self-assessment is that his hearing is normal. What would be that patient's prior probability (before the CALFRASST) of ≥ 25 dB hearing loss?

Remember this was a consecutive sample, so we can go horizontally in the 2×2 table. Of the 310 subjects who thought their hearing was normal, 60 (19%) had hearing loss. You could also just look at $1 - NPV = 1 - 81\% = 19\%$.

c. Suppose a patient with a 20% prior probability of hearing loss can hear the strong stimulus, but not the weak stimulus. What is your best estimate that he has significant (at least 25 decibels) hearing loss?

We'll need his prior odds and LR. He has an intermediate result on the test: he can hear the strong but not the weak stimulus. The probability of this result in a D+ patient is 99% - 61% = 38%. The probability of this result in a D- patient is 100% - 75% = 25%. So the LR for this result is 38%/25% ≈ 1.5

Prior prob=20%, so prior odds = 1:4. So posterior odds = 1.5:4, and posterior probability = 1.5/5.5 = 27%.

(Note with less rounding error the result would be 1.56/5.56 = 28%; see below.)

CALFRAS ^T RESULT	Hearing Impairment				LR
	Impairment		No Impairment		
	N	%	N	%	
Can't hear strong stimulus	90	60%	0	0%	Infinity
Can hear strong but not weak	59	39%	73	25%	1.56
Can hear weak stimulus	2	1%	218	75%	0.02
	151		291		

1. Torres-Russotto D, Landau WM, Harding GW, Bohne BA, Sun K, Sinatra PM. Calibrated finger rub auditory screening test (CALFRAS^T). *Neurology*. 2009;72(18):1595-600.