6.2.A ABCD2 Score
The ABCD2 Score was developed to estimate the risk of stroke in patients after a transient ischemic attack (TIA, a brief period of neurological symptoms due diminished blood flow to the brain).{Johnston, 2007 #1078}

For your information, here is how the ABCD2 score is calculated.

	Risk Factor	**Points**
Age		
	≥ 60 years	**1**
Blood Pressure		
	Systolic ≥ 140 mm Hg or Diastolic ≥ 90 mm Hg	**1**
Clinical features of the TIA		
	Unilateral weakness (with or without speech impairment)	**2**
	Speech impairment without unilateral weakness	**1**
Duration		
	TIA duration ≥ 60 minutes	**2**
	TIA duration 10-59 minutes	**1**
Diabetes		
	Diabetes diagnosed by a physician	**1**
	Total ABCD2 Score	**0 – 7**

The 2-day risk of stroke by ABCD2 score is shown below:

Score	**% of TIA Patients**	**2-day Stroke Risk**
0-3	34%	1.0%
4-5	45%	4.1%
6-7	21%	8.1%

One of the main reasons for hospitalizing a patient after TIA is to enable rapid treatment with thrombolytics (to dissolve blood clots) if the patient has a subsequent stroke in the next 2 days.

a) Assume you are willing to admit 25 patients to the hospital for 2 days unnecessarily in order to avoid discharging one from the emergency department who goes home to have a stroke in the next 2 days. What is your ABCD2 score cutoff for hospitalization?

Using terminology from Chapter 2, 25C=B, so the treatment threshold of C/(C+B) = 1/26 = 3.8%. Based on the table above, a safe and reasonable answer would be to admit when the score is ≥ 4 and the 2-day stroke risk is 4.1%.

Extra credit answer: With 4 and 5 grouped together it's not possible to tell for sure, but it seems likely that a score of 4 would have a risk <4.1% and a score of 5 would have a risk of >4.1%, because the combined 4 and 5 group has a risk of 4.1%. If that's the case, it might be reasonable to admit when the score is ≥ 5, since it is probably <3.8% if it is 4.1%.

b) The above table of 2-day stroke risks can be converted into an ROC table and an ROC curve. Without doing any calculations, what do you expect the AUROC to be?

   i) < 0.5
   ii) 0.5 - 0.74
   iii) 0.75 - 0.89
   iv) 0.9 - 1

The correct answer is (ii). The ABCD2 score has some discriminatory value, so the AUROC > 0.5. But the lowest risk group, does not have a risk of 0%, and the highest risk group does not have a risk of 100%. If fact, the highest risk group only has a risk of 8.1%.

So the AUROC isn't going to be very much greater than 0.5.

We will convert the table of 2-day risks above into an ROC table and calculate the area under it.

First, order the results from most to least abnormal:

Score	**% of TIA Patients**	**2-day Stroke Risk**
6-7	21%	8.10%
4-5	45%	4.10%
0-3	34%	1.00%

Next, calculate the individual cell percentages. To get the D+ column, we multiply the proportion of patients in each risk stratum by the 2-day stroke rate in that stratum. Thus, e.g. if we had 10,000 patients, 21% (=2100) would have a score of 6-7 and 8.1% of those 2100 = 170 would have a stroke. So the top D+ cell would be 170/10,000 = 1.70%.

Score	D+	D-	% of TIA Patients
6-7	1.70%	19.30%	21%
4-5	1.85%	43.16%	45%
0-3	0.34%	33.66%	34%
Total	3.89%	96.11%	100.00%

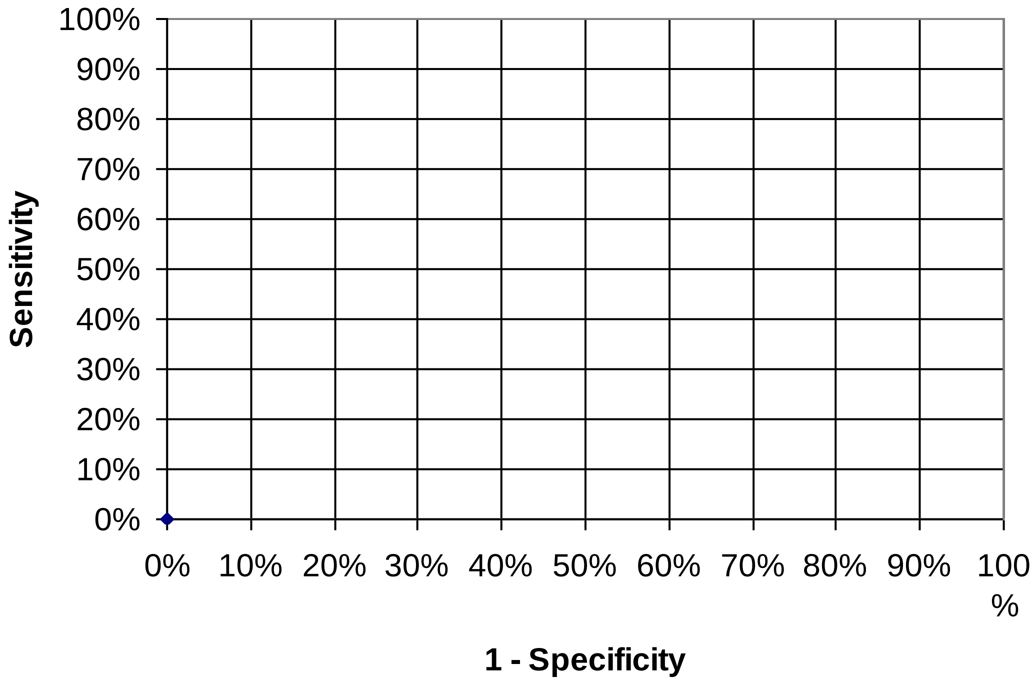
Then, calculate the column percentages. For example, for the top D+ cell, 1.70%/3.89% = 43.77%.

Score	D+	D-
6-7	43.77%	20.08%
4-5	47.48%	44.90%
0-3	8.75%	35.02%
Total	100.00%	100.00%

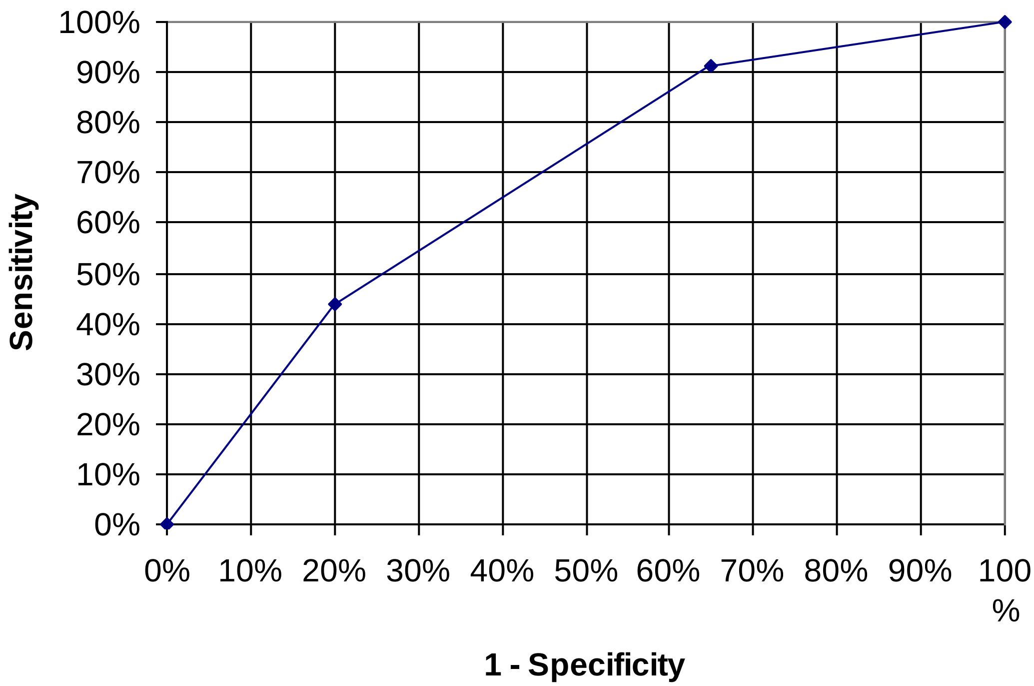
Finally, change them to cumulative percentages.

Score	D+	D-
≥ 6	43.77%	20.08%
≥ 4	91.25%	64.98%
≥ 0	100.00%	100.00%

c) Use the above ROC Table to plot the ROC curve on the grid below.



ANSWER:



AUROC = 0.68

d) If you didn't admit any TIA patients ("No Treat"), what proportion would have a stroke within 2 days? (In part (h) below, we will refer to this as P, overall risk, i.e. the proportion of the population who ultimately develop the outcome within the specified time period.)

3.89% From the second table after part B.

e) If you admitted all TIA patients ("Treat All"), what proportion would you admit unnecessarily?

100% - 3.89% = 96.11%

Remember that an unnecessary admission of a TIA patient who doesn't have a stroke in the next 2 days is 1/25 as bad as failing to admit someone who does have a stroke in the next 2 days.

f) Calculate the Net Benefit of the **Treat All** strategy relative to treat none. Recall Net Benefit = (Patients Treated Appropriately – C/B × Patients Treated Unnecessarily)/(All Patients) and explain in words what it means.

.0389% - (1/25).0911% = =0.000456, about 0.05%. (The net benefit of "treat none" would be zero: no patients treated appropriately and no patients treated unnecessarily.)

The low net benefit of 0.05% for treating all means that the harms of unnecessary treatment are almost as great as the benefits of treatment in this case.
This is not surprising because the 2-day incidence of stroke (3.89%) was very close to our treatment threshold of 1/26=3.85%, so we know that the expected utility of treating all and treating none will be very similar. It means for every 1/.05% = 2000 patients we would admit, our benefit would the equivalent of treating one patient who needs treatment without treating anyone who does not.

g) Calculate the Net Benefit of a hospitalization strategy using the ABCD2 cutoff in (a). Is it higher or lower than the NB of the "Treat All" strategy?

If we use the cutoff in part (a), according to the ROC table above, we will appropriately treat 91.25% of the 3.89% destined to have a stroke, so the left half of the net benefit calculation is *91.25% × 3.89% = 3.55%.* We will unnecessarily treat 64.98% of the (100% – 3.89%=) 96.11% of the subjects destined not to have a stroke, a total of 62.45%, or 0.6245. That's only 1/25 as bad, so we'll multiply by C/B= 1/25 to get .6245/25=2.50%. So our net benefit is 3.55% -2.5% = 1.05%.

This is higher than the treat all strategy, but it's still only about 1/100th as good as being able to admit someone destined to get a stroke without having to admit anyone unnecessarily.