### 3.05 A Grim Reaper's Walking Speed

To estimate the walking speed of the Grim Reaper, Stanaway et al[1] studied walking speed as a predictor of mortality in 1705 Australian men at least 70 years old. Of the 1705, 266 died during follow up, so 1705 – 266 = 1439 survived. They treated walking speed (in meters/sec) as a continuous diagnostic test and created the ROC Curve for mortality below: Slower walking speed was a predictor of higher mortality in this study.
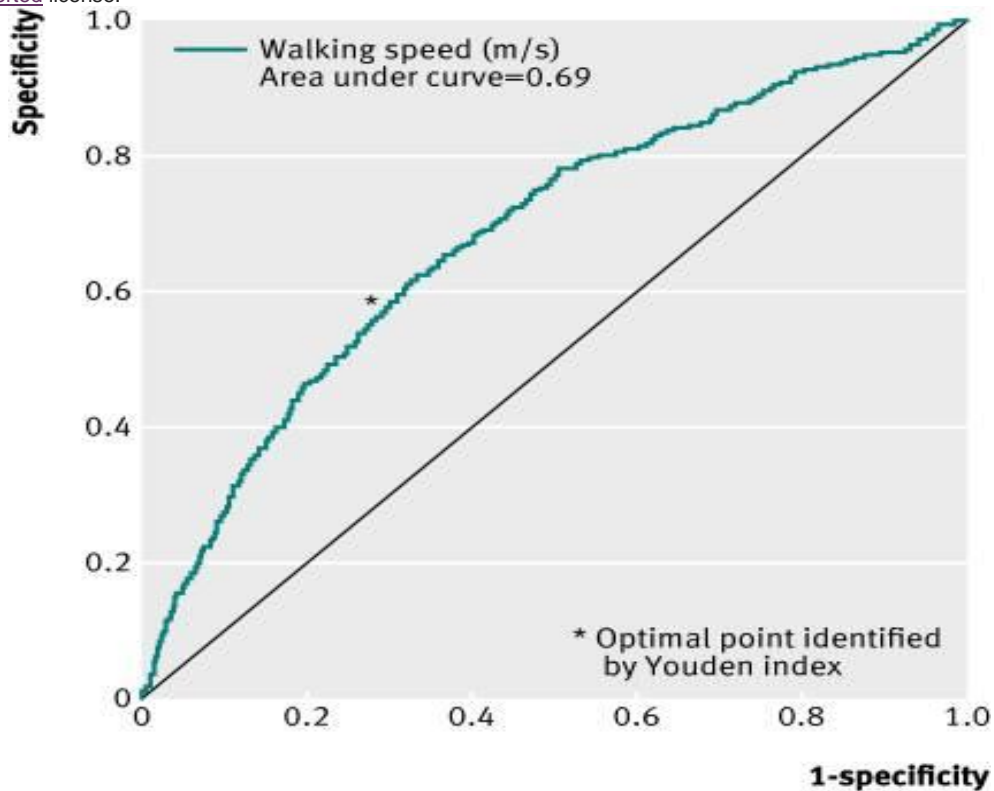
a) What are two errors in the labeling of this figure?

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Answer: The Y-axis is mislabeled "Specificity;" it should be "Sensitivity." Also, the "optimal" cut point should be on the ROC curve. Another possible answer is stating that the green ROC curve represents "Walking speed (m/s)". Each point on the curve does represent a specific walking speed cutoff below which we would consider the test positive. You know that the (0, 0) point corresponds to a cutoff below the lowest walking speed observed in the study, and the (1,1) point corresponds to a walking speed > the highest walking speed observed in the study. But we can't read any particular cutoff from the plot.

b) What part of the ROC curve refers to the slowest walking speeds?

ANSWER: The slowest walking speeds are the most abnormal, so they would be at the lower left of the graph.

The authors found that although there were 266 deaths during follow-up, no one in the cohort who walked faster than 1.36 m/sec (about 3 miles per hour) died. They proposed the following explanation: "This supports our hypothesis that faster speeds are protective against mortality because fast walkers can maintain a safe distance from the Grim Reaper."

c) (Extra Credit) About how many men walked faster than 1.36 m/sec? (Again, of the 1705, 266 died during follow up, so 1705 – 266 = 1439 survived.)

Answer: The part of the ROC curve with 100% sensitivity is a little tiny horizontal line segment at the upper right. It looks like it starts at 1-specifcity of about 0.985. So about 1.5% of those who didn't die (=1.5% × (1705-266) = (.015)(1439) = 22) and none of those who did die walked faster than 1.36 m/sec. In fact, this number can also be found if you read the paper.

1.   Stanaway FF, Gnjidic D, Blyth FM, Le Couteur DG, Naganathan V, Waite L, et al. How fast does the Grim Reaper walk? Receiver operating characteristics curve analysis in healthy men aged 70 and over. BMJ. 2011;343:d7679.

In Problem 3.4 we reviewed a study suggesting that the Grim Reaper's walking speed was less than 1.36 meters/second because none of the 22 men in the cohort who was able to walk that fast died during the follow-up, which averaged about 5 years. Setting aside the problem that this hypothesis clearly was generated from the data and the low prior probability that the Grim Reaper approaches his victims on foot (as opposed to e.g., driving an SUV) if the observed mortality was 0/22, use the shortcut in the chapter to

estimate the upper limit of the 95% confidence interval for mortality among men able to walk > 1.36 meters/second at baseline.