Homework 1.

Due at the Beginning of Class
Wednesday January 21, 2015

Wharton junior Owen Thomas (40), a six-foot-two, 240-pound defensive end, was a second-team All-Ivy player in 2009. He recorded 29 tackles and finished second in the league with six sacks.
Wharton Junior Found Dead Monday Afternoon
By Darina Shtrakhman
April 26, 2010, 8:41 pm

Wharton junior Owen Thomas was found dead at his off-campus residence around 2 p.m. Monday afternoon, University spokeswoman Lori Doyle and Director of Athletic Communication Mike Mahoney confirmed. He was a member of the football team.

Cause of death has not yet been determined, but “no foul play is suspected,” according to Doyle. Thomas, who played defensive end for the Quakers, was recently voted a captain of the football team.

Suicide Reveals Signs of a Disease Seen in N.F.L.
By Alan Schwarz
September 13, 2010

ALLENTOWN, Pa. — A brain autopsy of a University of Pennsylvania football player who killed himself in April has revealed the same trauma-induced disease found in more than 20 deceased National Football League players, raising questions of how young football players may be at risk for the disease.

Owen Thomas, a popular 6-foot-2, 240-pound junior lineman for Penn with no previous history of depression, hanged himself in his off-campus apartment after what friends and family have described as a sudden and uncharacteristic emotional collapse. Doctors at Boston University subsequently received permission from the family to examine Thomas’s brain tissue and discovered early stages of chronic traumatic encephalopathy, a disease linked to depression and impulsive control primarily among N.F.L. players, two of whom also committed suicide in the last 10 years.

Thomas is the youngest and first amateur football player to be found with clear C.T.E.
And the two Penn neuro-ophthalmologists testing King-Divick—Steven Galetta and Laura Balcer—are starting to draw attention for their work.

Lanky, loping, contagiously affable Galetta, 54, and his energetically serious 46-year-old colleague Balcer are new to this hard-hitting world of concussions, and surprisingly engaging. Neuro-ophthalmologists are considered the dorks of neurology, Galetta explains: "If you walk into the second base of the field and the sports concussion research he's entered as dominated by 'expert opinion, the lowest form of medical evidence.'"

Laura Balcer was Steve Galetta's resident at HUP (where, among other jobs, he runs the neurology residency program) and rose in the department as his protégée. Kristin Galetta— daughter of Steve—is a medical student at Penn and was lead author on both papers on the King-Divick research.

A big part of the reason the research has been done at Penn and the Haverford School is that Galetta played on a football team at Penn, and is a longtime adviser to the university's athletic program.
Table 1: The effects of concussion during the playing season on K-D scores.

<table>
<thead>
<tr>
<th>K-D Result</th>
<th>Positive</th>
<th>Negative</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>909</td>
<td>1</td>
<td>910</td>
</tr>
<tr>
<td>Negative</td>
<td>206</td>
<td>206</td>
<td>207</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>10</td>
<td>207</td>
</tr>
</tbody>
</table>

Sensitivity = 9/10 = 0.90
Specificity = 206/207 = 1.00

The King-Devick Test (K-D Test) is used in many school athletic programs. The test is also used at the professional level in the National Hockey League (NHL), Major League Soccer (MLS), Major League Lacrosse and professional arena football.
Problems with the Study

• Small numbers
• Players with concussions were tested on the sidelines immediately after injury, but players without concussions were tested only at the end of the season

Revised Operating Characteristics
Estimated from the Confidence Intervals

Sensitivity = (0.54 + 0.97)/2 = 0.76
Specificity = (0.98 + 1.00)/2 = 0.99
Using the King‐Devick Test to Evaluate High School and College Football Players for Concussion

Background
Recent developments have established that high school and college football players are at risk for chronic traumatic encephalopathy, which can have devastating consequences. Most clinicians believe that recognizing concussion is an important step in preventing chronic traumatic encephalopathy. Research has demonstrated that certain methods, and most take over 12 months using game simulations. The King‐Devick test is short enough to be used during game conditions and has been utilized in over 200 college athletes. 1

Problem
Assume that the sensitivity of the King‐Devick test is 0.7 and the specificity is 0.8. Use assume that when a team suspect a football player might have a concussion, half of the players mentally have a concussion and half have a concussion and half are doing an exercise due to a high school or college concussion. There are at least 50 players during a game who they suspect might have a concussion and then refer all these players to a neurologist for further evaluation.

1. What is the probability that a football player will eventually have a concussion confirmed if the King‐Devick test result is negative?

2. What is the probability that a football player will eventually have a concussion confirmed if the King‐Devick test result is negative?

3. If the King‐Devick test yields a negative, should the player be allowed to continue playing? Why or why not?

Reference