Neyman-Pearson testing.
Signal detection

6.011, Spring 2018
Lec 23
Likelihood ratio test (LRT) implementation of MAP rule

\[
\Lambda(r) = \frac{p_1 \cdot f_{R|H}(r | H_1)}{p_0 \cdot f_{R|H}(r | H_0)}
\]

\[
\begin{align*}
\text{‘} H_1 \text{’} & > \frac{p_0}{p_1} = \eta \\
\text{‘} H_0 \text{’} & < \frac{p_0}{p_1} = \eta
\end{align*}
\]
Terminology

• prevalence \( (p_1) \)

• (conditional) probability of detection, sensitivity, true positive rate, recall

• specificity, true negative rate

• (conditional) probability of false alarm, false positive rate \( (= 1 – \text{specificity}) \)

• (conditional) probability of a miss, false negative rate \( (= 1 – \text{sensitivity}) \)

• positive predictive value, precision

• negative predictive value
Testing for diabetes

Table 4. Performance of Serial Combination Screening for Undiagnosed Diabetes in the Australian AusDiab study populations

<table>
<thead>
<tr>
<th></th>
<th>Risk assessment alone</th>
<th>Plus FPG 5.5-6.9 mmol l(^{-1})</th>
<th>Plus HbA(_{1c}) (^{3}) 5.3%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensitivity (%)</strong></td>
<td>87</td>
<td>78</td>
<td>68</td>
</tr>
<tr>
<td><strong>Specificity (%)</strong></td>
<td>48</td>
<td>75</td>
<td>93</td>
</tr>
<tr>
<td><strong>PPV + (%)</strong></td>
<td>7</td>
<td>13</td>
<td>31</td>
</tr>
<tr>
<td><strong>PPV – (%)</strong></td>
<td>99</td>
<td>99</td>
<td>98</td>
</tr>
<tr>
<td><strong>% population requiring OGTT</strong></td>
<td>53</td>
<td>25</td>
<td>8</td>
</tr>
</tbody>
</table>

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For clinically significant cancer, MP-MRI was more sensitive (93%) than TRUS-biopsy (48%) and less specific (41%) for MP-MRI vs 96% for TRUS-biopsy. 5.9% of 740 patients reported serious adverse events, including 8 cases of sepsis.

Ahmed et al., Lancet Feb 2017