Medical Diagnosis Example

(Corrected from erroneous version in Week 8)

Diagnosing Meningitis

S : stiff neck M : have meningitis

Given probability model:

Prior probability $P(M) = 0.0001$, $P(S) = 0.1$

Causal model $P(S|M) = 0.8$

Probability of meningitis if having a stiff neck:

$P(M|S) = P(S|M)\ P(M) / P(S) = 0.8 \times 0.0001 / 0.1$

$= 0.0008$

$P(\neg M|S) = 1 - P(M|S) = 0.9992$

Alternative Model

Given probability model:

P(M) and P(S|M) are as before,

but instead of P(S) we are given P(S|¬M) = 0.05

Probability of meningitis if having a stiff neck:

$$P(M|S) = P(S|M)P(M) / P(S)$$
$$= P(S|M)P(M) / [P(S,M) + P(S,\neg M)]$$
$$= P(S|M)P(M) / [P(S|M)P(M) + P(S|\neg M)P(\neg M)]$$
$$= 0.8 \times 0.0001 / [0.8 \times 0.0001 + 0.05 \times 0.9999]$$
$$= 0.0016$$
$$P(\neg M|S) = 1 - P(M|S) = 0.9984$$

Conclusion

- We have a different answer in each case, because we are given different background knowledge
- Sometimes we are given P(symptom)
- Sometimes we are given P(symptom|¬cause)
- But we wouldn't be given both!!
- See Section 13.5.1 in the textbook for more details