6. Epistemic uncertainty

Bayes’ paper - 1763

LII. An Essay towards solving a Problem in the Doctrine of Chances. By the late Rev. Mr. Bayes, F. R. S. communicated by Mr. Price, in a Letter to John Canton, A. M. F. R. S.

Bayes’ probability - 1763

5. The probability of any event is the ratio between the value at which an expectation depending on the happening of the event ought to be computed, and the value of the thing expected upon it’s happening.

6. By chance I mean the same as probability.

- Suppose I get £1 if X occurs
- I am willing to bet 60p on X
- Then my probability is 60/100 = 0.6
- Nothing to do with ‘frequency’ or ‘randomness’ – reasonable betting odds

Flipping coins

Two types of uncertainty

Aleatory
- chance, unpredictable
  (can’t know)

Epistemic
- lack of knowledge, ignorance
  (don’t know)

(A rather simplistic)

Aleatory or epistemically?

- Lottery
- Scratchcards
- Gender of a foetus
- Current sexual behaviour
- Whether you will live to 100
Bayes’ horrible notation

Laplace’s 1774 beautiful notation, almost identical to now

Quantifying your ignorance

- Think whether you prefer (A) or (B) for each question
- Then think of how confident you are with your answer
- Give your confidence a number 5 to 10
- Score yourself when you hear the correct answer
- The ‘scoring rule’ is designed to encourage you to be honest

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<tr>
<th>Your 'confidence' in your answer</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
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<tbody>
<tr>
<td>Score if you are right</td>
<td>0</td>
<td>9</td>
<td>16</td>
<td>21</td>
<td>24</td>
<td>25</td>
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<td>Score if you are wrong</td>
<td>0</td>
<td>-11</td>
<td>-24</td>
<td>-39</td>
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1. Which university was founded first? A) Cambridge or B) Oxford?
A) Cambridge (1209 vs 1096)
B) Oxford

2. Which is bigger, A) Venus B) Earth?
B) Earth (6051 vs 6371 km radius)

3. Who died first, A) Beethoven or B) Jane Austen?
B) Beethoven (1827 vs 1817)

4. Which college came higher in the Tompkins Table 2014?
A) Kings or B) St. Johns?
A) Kings (14th vs 16th)

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1. Who is older, A) Prince William or B) Kate, Duchess of Cambridge?
B) Kate (9/1/82 vs 21/6/82)

2. Which is bigger, A) Croatia or B) Czech Republic?
B) Czech Republic (77,000 vs 56,000 sq km)

3. Who is taller, A) the Eiffel Tower or B) Shard London Bridge?
A) Eiffel Tower (324m vs 310m)

4. In the IMDb rankings (5/2/2015), which film comes higher, A) Toy Story or B) Alien?
B) Alien (104th vs 51st)