

Name:

Student ID:

Tutorial Section:

Is the Pope an Alien?

The chances that a randomly chosen human being is Pope John Paul II are about 1 in 6 billion, since the number of human beings on Earth is 1 billion. Some people might conclude that it follows that the probability that the Pope is human are about 1 in 6 billion. (Lawyers have used this trick – or made this mistake – when trying to convict people using statistical tests, like DNA fingerprinting.)

As pointed out by David MacKay of Cambridge University, Pope John Paul II is probably not an alien. In this quiz, you must prove this using Bayes rule.

1. The sample space. The random experiment consists of taking all creatures in the universe, and selecting one at random. Assuming the number of creatures in the universe is finite and equal to N , specify the sample space S using symbolic notation.

2. The probability model. Assuming that the outcomes are equally, specify the probabilities of the outcomes.

3. Events. We are interested in 3 events: H) That the creature is human; A) That the creature is an alien; J) That the creature is Pope John Paul II. Assuming that if a creature is not human, then it is alien, write down the probability of event H in terms of the probability of event A . Draw the Venn diagram for A and H .

4. Bayes Rule. We would like to compute the probability that the creature is an alien, given that it is Pope John Paul II. Write down Bayes rule for this conditional probability (using symbols – we'll substitute numbers later.)

5. Computing the probability that Pope John Paul II is an alien. Write down numbers for $P(H)$, $P(A)$, $P(J|H)$ and $P(J|A)$ and substitute them into the above formula to compute (approximately) the probability that Pope John Paul II is an alien. Justify your choice of numbers. Helpful assumptions: There are about 6 billion humans in the universe; Aliens account for 99% of all creatures in the universe. What is the probability the creature is John Paul II, given that the creature is an alien? You can select this number.