

MA40189 - Question Sheet Zero

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<https://people.bath.ac.uk/masss/ma40189.html>

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Set: Problems class, Thursday 10th February 2022.

Task: Question 1 will be discussed in the problems class and forms a revision of the basic means of utilising Bayes' theorem.

1. Whether certain mice are black or brown depends upon a pair of genes, each of which is either B or b . If both members of the pair are alike, the mouse is said to be homozygous, and if they are different it is said to be heterozygous. The mouse is brown only if it is homozygous bb . The offspring of a pair of mice have two such genes, one from each parent, and if the parent is heterozygous, the inherited gene is equally likely to be B or b . Suppose that a black mouse results from a mating between two heterozygotes.

- (a) What are the probabilities that this mouse is homozygous and that it is heterozygous?

Now suppose that this mouse is mated with a brown mouse, resulting in seven offspring, all of which turn out to be black.

- (b) Use Bayes' Theorem to find the probability that the black mouse was homozygous BB .
- (c) Recalculate the same probability by regarding the seven offspring as seven observations made sequentially, treating the posterior after each observation as the prior for the next.
- (d) What is the probability that an eighth offspring is also black.

(Source: Peter M. Lee, Bayesian Statistics: an introduction, Fourth Edition, 2012)