Information Theory — Tutorial 4

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1. **Review:** are there any previous tutorial exercises, or parts of the notes, that you would have trouble explaining to another MSc student? If so, please ask *specific* questions on NB, attached to the relevant tutorial answers, or notes. Ideally do this task before the day of your tutorial so we can discuss any good questions.

2. **Inference and prediction:** Solve MacKay Ex 3.1 (p47) *and* work out the probability that the next outcome is a 1, given the sequence that you have observed. If you needed to look at the answer or otherwise needed help, also do Ex 3.2.

3. **Past exam question:** A set of positive values $\{x_1, x_2, \ldots, x_N\}$ has arithmetic mean A, and geometric mean G, where by definition:

$$A = \frac{1}{N}\sum_{n=1}^{N} x_n\,, \qquad \text{and} \qquad G = \exp\left(\frac{1}{N}\sum_{n=1}^{N} \log_e x_n\right).$$

   Prove that, for all sets of positive values, either $G \leq A$ or $G \geq A$. State for which sets the geometric mean is equal to the arithmetic mean.

   Hint: you may wish to rewrite the geometric mean as a function of an expectation.

   If you have trouble getting started, solve MacKay Ex 2.25 (p37), which we already looked at in class.

4. **More inference and prediction:** MacKay Ex. 3.12 and Ex. 3.14, p58.