

**Worksheet: genetic diversity and half-life**

Math 102 Section 102

Oct. 31, 2018

**(Genetic diversity)** 1. Entropy and other information theory approaches are used to quantify how genetically diverse a population is. The (Shannon) entropy represents the amount of uncertainty in the information. A given gene can be either on with probability  $0 \leq x \leq 1$ , or off with probability  $0 \leq y \leq 1$ . The Shannon entropy for the gene is

$$H = -x \log x - y \log y$$

Find  $x$  and  $y$  so that the genotype is the most unpredictable.

(*hint*: It amounts to finding when the Shannon entropy is the greatest. Make sure you understand why this is the case.)

**(Half-life and carbon dating)** 2. Researchers at Charlie Lake in BC have found some artifacts. For instance, a butchered bison bone that contains 0.25 mg of  $^{14}\text{C}$  isotope. A comparable bone of a bison alive today contains about 1 mg of  $^{14}\text{C}$ . We know that the half-life of  $^{14}\text{C}$  is 5730 years. How many years ago could human habitation be dated back to in this region?