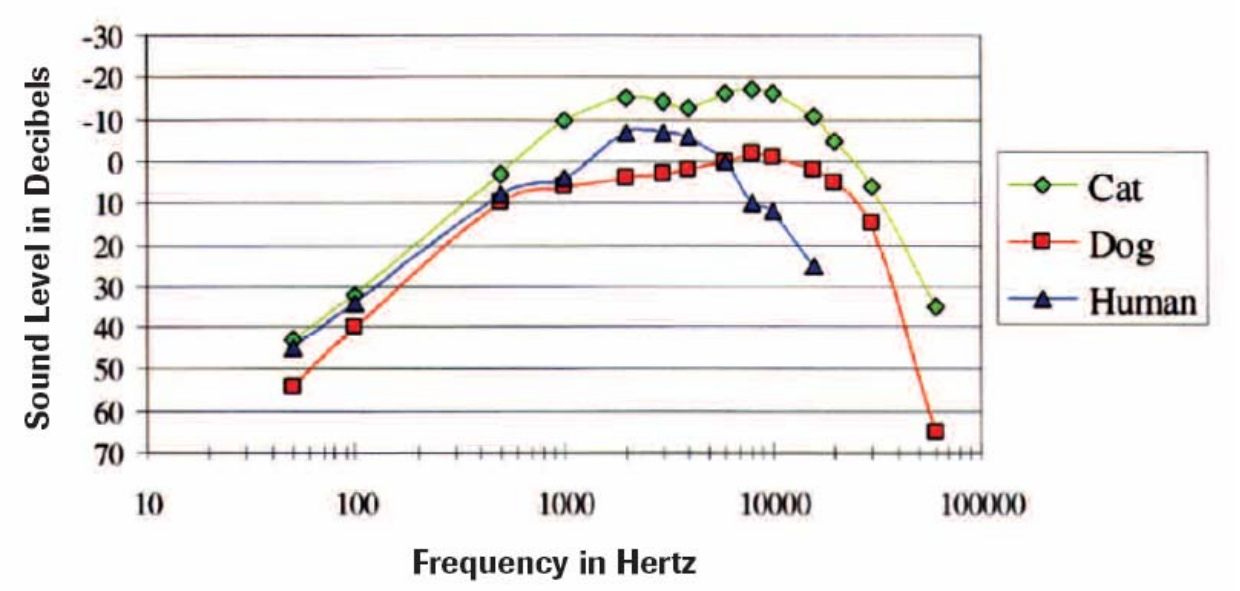
Astronomy A345H

Astronomical Data Analysis I: Example Sheet 5

1. Below is a graph showing audible sound levels, as a function of frequency, for human, dog and cat hearing.



Use this graph to estimate the digital sampling rate of music recorded on a compact disc.

2. Show that equation (6.4) of your notes may be re-written as $h(t) = \sum_{k=-\infty}^{+\infty} h_k \frac{\sin[\pi(t-k\Delta)/\Delta]}{\pi[(t-k\Delta)/\Delta]}$

3. Consider the periodic function $x(t) = \cos(2\pi f t)$. Assuming that $f = 1\,\text{Hz}$, sketch a graph of the function, for $t = 0$ to $t = 4$ seconds.

   Suppose the function is sampled at a rate of 1 sample every 2/3 seconds, starting at $t = 0$. Show that these sampled values are *also* consistent with a periodic signal with $f = 0.5\,\text{Hz}$. (This is an example of the effect of aliasing).

4. In filming a Western, a 35mm movie camera which films 24 frames per second is used. The camera films the wheels of a stagecoach, the spokes of which are all painted white except for one which is black. What will be the *apparent* rotation speed of the stagecoach wheel (i.e. the apparent rotation speed of the black spoke) if the actual rotation speed of the wheel is:

   a) 4 revolutions per second
   b) 12 revolutions per second
   c) 18 revolutions per second
   d) 24 revolutions per second