Due Dec. 7th

Evaluating the Drake Equation

1 Introduction

The Drake equation provides a means of estimating the number of communicable civilizations (N) that exist in our galaxy today.

$$N = R_* \times f_p \times n_e \times f_l \times f_i \times f_c \times L.$$

where

- R_* = starformation rate (number of stars born per year)
- f_p = fraction of stars with planets
- n_e = number of Earth-like planets around each star
- f_l = fraction of planets where life emerges
- f_i = fraction of life-bearing planets where intelligent species emerge
- f_c = fraction of planets where intelligent life has the technology, resources and desire to communicate over interstellar distances
- L = average lifetime of a communicable civilization (in years)

2 Questions

1. Combining your own intuition with what you have learned in class and elsewhere, estimate each of the seven parameters on the right-hand side of the Drake equation. Enter your estimates of the parameters on the accompanying table (Table 1). Provide a brief explanation of how you arrived at your estimates.

2. Evaluate the Drake equation using your estimates. Enter the result in Table 1.

3. Assuming there are 4×10^{11} stars in our galaxy, how many stars would you need to survey before you are likely to find another communicable civilization?

4. What is your estimated birthrate for:

   (a) planets with life?

   (b) planets with intelligent life?

   (c) planets with communicable civilizations?

5. If you were on a starship with a mission to catalog life forms on other planets, how much more likely is it that you would find planets with microbial life than planets with communicable civilizations?

R_*	f_p	n_e	f_l	f_i	f_c	L	N

Table 1: Parameters of the Drake Equation

6. Using the equations in the E.T. text and your value for N, estimate the average distance between communicable civilizations in the Milky Way galaxy.
   page 138: $r = 5 \times 10^4 \, ly / N^{1/2}$

7. As we discussed in lecture, radio provides both the fastest and cheapest way we know of to communicate between the stars. Using a large array of antennae (such as is envisioned with Project Cyclops), assume we can detect an alien beacon after "listening" toward a star in ~10 seconds. Using your answer from (3), estimate how many years it would take to find the nearest communicable civilization.

8. Write a couple of paragraphs on why you might search for extra-terrestrial intelligence.

9. Assume it takes 10 million dollars a year to keep the SETI program going. What will be the total expenditure on the program before it is likely to result in a positivie detection of another civilization?

10. Do you think such expenditures in time and money are justified? (Explain.)