Why I don't have a girlfriend:
An application of the Drake Equation to love in the UK

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The Drake equation is used to estimate the number of highly evolved civilizations that might exist in our galaxy. The equation was developed in 1961 by Dr. Frank Drake at the National Radio Astronomy Observatory in Green Bank, West Virginia.

The equation is generally specified as:

$$G = R \cdot f_P \cdot n_e \cdot f_l \cdot f_i \cdot f_e \cdot L$$

where,

G = The number of civilizations capable of interstellar communication

R = The rate of formation of stars capable of supporting life (stars like our Sun)

n_e = The average number of planets similar to Earth per planetary system

f_l = The fraction of the Earth-like planets supporting life of any kind

f_i = The fraction of life-supporting planets where intelligent life develops

f_c = The fraction of planets with intelligent life that are capable of interstellar communication (those which have electromagnetic technology like radio or TV)

L = The length of time such communicating civilizations survive

Using this equation Prof Drake estimated that 10,000 communicative civilizations probabilistically exist in the Milky Way alone. Astronomers estimate that there are between 200 and 400 billion stars in the Milky Way. Let's call it 300 billion. This makes the probability of a star chosen at random supporting life capable of interstellar communication 3.333e-08 or 0.000003%.

Another way to think about this is that this is the probability of the conditions necessary for us to communicate with an alien civilization being satisfied. These seem like slim odds at best, but the probability is positive (There *is* a chance!) and this approach is widely accepted by astronomers (This *isn't* a science fiction!). The idea that there could be 10,000 civilizations that we are capable of communicating with is very exciting indeed.

While extraterrestrial civilizations may be rare, there is something that is seemingly rarer still: A girlfriend. For me. What might the approach employed in

[1] I would like to thank Ian L. Johnson and an anonymous volunteer referee for comments and suggestions concerning this paper. Others have applied the Drake equation in the same way. See: 'Singles in SF', 'This American Life, Raymond Francis's paper and 'The Big Bang Theory'. Links to all of these are available on my website.

the estimation of the number of alien civilizations tell us about the number of potential girlfriends for me? A somewhat less scientific question, I admit, but one of substantial personal importance.

The parameters are re-defined as follows with the values in parentheses:

G = The number of potential girlfriends.

> One can easily substitute boyfriends in here but as I am mostly a heterosexual male I will focus on the search for a girlfriend.

R = The rate of formation of people in the UK (i.e. population growth).

> This is about 150,000 people per year over the last 60 years.[2]

f_W = The fraction of people in the UK who are women.

> See the above clarification. (0.51)

f_L=The fraction of women in the UK who live in London.

> I would like my girlfriend to be nearby so that we can see each other. This makes it easier to get to know each other, avoids the difficulties of a long distance relationship and saves me the train fare. (0.13)

f_A = The fraction of the women in London who are age-appropriate.

> I am nearly 31 years old (Thank you, I know I don't look it). I would like my girlfriend to be near my own age. I don't want to feel older than I am by not being able to keep up with a spritely 20 year old, or because I haven't read *Twilight* and I don't know who the Jonas Brothers are. Nor do I want to fall prey to a voracious cougar or to be regaled with stories of the war. Lets say I am looking for a woman between 24 and 34 years of age. (0.20)

f_U = The fraction of age-appropriate women in London with a university education.

> I am not trying to be an elitist or anything, but I would like my girlfriend to have a university education. I think we would have more in common and I would like someone I could discuss my work with sometimes. I know that there are many intelligent people who don't go to university, so don't get all righteously indignant. Everyone has preferences. How many women out there have dated men shorter than themselves? I rest my case. (0.26)

[2] http://www.statistics.gov.uk/cci/nugget.asp?ID=950

f_B = The fraction of university educated, age-appropriate women in London who I find physically attractive.

> Physical attractiveness is important. It is often the first thing people notice about each other and it makes sex easier. Not that my potential girlfriend need be considered attractive by anyone else, but it is important that I find her attractive. This is a tough parameter to estimate. Let's be generous and say I find 1 in 20, or 5% of age-appropriate women in London with a university education physically attractive. (0.05)

L = The length of time in years that I have been alive thus making an encounter with a potential girlfriend possible.

> Good lord, I am old. (31)

We can simplify the above specification by recognizing that the number of people who have ever lived in the UK is related to the population growth rate by

$$N = \int_0^T R(t)dt$$

where T is the age of the UK. If we assume that R is constant over the period T than $N = R \cdot T$. While this simplification is often used for the Drake Equation's intended purpose, it is not a good assumption when adapting the equation for our purposes here. Instead we use N*, the population of the UK as of 2007, where

N^*=60,975,000.[3]

With this simplification we can re-specify the Drake equation as:

$$G = N^* \cdot f_W \cdot f_L \cdot f_A \cdot f_U \cdot f_B$$

If we plug in the above values we get:

$$G = 60{,}975{,}000 \cdot 0.51 \cdot 0.13 \cdot 0.20 \cdot 0.26 \cdot 0.05$$

or

G=10,510

So, what this means is that there are 10,510 people in the UK that satisfy these most basic criteria for being my girlfriend. That is 0.017% of the UK and 0.14%

[3] http://www.statistics.gov.uk/cci/nugget.asp?ID=950

of Londoners, which doesn't seem so bad. On a given night in London, there is greater than a 1 in 1000 chance that I will meet an attractive woman between the ages of 24 and 34 with a university degree. Of course this does not take into account the fraction of these women that will find me attractive (depressingly low), the fraction of these women who will be single (falling with age) and, perhaps most importantly, the fraction of these women who I will get along with. Including such factors would greatly reduce the above figure of 10,510. A rough estimate puts the number of potential girlfriends accounting for these three additional criteria (1 in 20 of the women find me attractive, half are single and I get along with 1 in 10) at 26. That's correct. There are 26 women in the UK with whom I might have a wonderful relationship. So, on a given night out in London there is a 0.00034% chance of meeting one of these special people, about 100 times better than finding an alien civilization we can communicate with. That's a 1 in 285,000 chance. Not great.

Make of this what you will. It might cheer you up, it might depress you. I guess it depends on what you thought your chances were before reading this.