

## IS THERE INTELLIGENT LIFE OUT THERE?

“Intelligent life evolved here and there are zillions of planets like ours out there, so the universe must be teeming with civilizations just waiting to make contact.”

Wrong: we may well be alone in the Universe. Why? Because the argument above has an (implicit) error, well-known in probability under varying names such as the self-sampling effect. Yes, intelligent life happened here, yes there are zillions of planets like ours out there. Yes, if  $p$  is the probability that life evolved on earth and  $N = \text{zillions}$  then  $Np$  is the expected number of planets like ours with life on them, and so  $e^{-Np} = \text{tinynumber}$  is the probability that none of these other planets have intelligent life. The problem is the implicit assumption involved about  $p$  – that because there is intelligent life on earth  $p$  can’t be too small. However all that really matters is that intelligent life evolved in the universe at least once – which of the zillions of actual earth-like planets we happen to find ourself on is irrelevant. So  $p$ , the probability of life evolving on any one of these planets (including earth) could be very very tiny, and  $Np$  could be about 1. It’s like the person who wins a big lottery falsely concluding that because he won, and so many people bought tickets, there must be many others who won, because if the chance of winning was too tiny we wouldn’t have won in the first place. So what is the probability of intelligent life elsewhere in the Universe (given that there it exists at least in one place)? It is simply the conditional Poisson probability (i.e.  $\mathbb{P}(X \geq 2|X \geq 1)$ ) given by:

$$\frac{1 - e^{-\lambda} - \lambda e^{-\lambda}}{1 - e^{-\lambda}},$$

where  $\lambda = Np$ . Of course this can vary from 1 to 0 depending on  $\lambda$ . For example if  $Np = 1$  then the probability of intelligent life elsewhere in the Universe would be just  $(1 - 2e^{-1})/(1 - e^{-1}) = 42\%$ . Maybe Douglas Adams was onto something...