Hello Alien!

How many extraterrestrial civilizations are there in our galaxy with which we might communicate?

Dr. Drake split the problem into 7 smaller problems:

1. How many new stars are created in our galaxy each year?
2. What percentage of these new stars have planets?
3. For each such star, how many planets can support life?
4. What percentage of these planets which can support life actually develop life?
5. What percentage of developed life will produce a civilization?
6. What percentage of civilizations will be able and willing to communicate with us?
7. How many years will such a civilization last?

Let A(1) be the answer to problem 1; A(2) be the answer to problem 2, etc. Of course these answers are very difficult to establish.

Here are some estimates:

Answer	Low Estimate	High Estimate	Comments
A(1)	9/year	11/year	Astronomers are pretty sure about this number.
A(2)	25%	75%	Even if we cannot see planets orbiting distant stars, we can sometimes see the stars wobble because of their planets. If you were to view our sun from far away over a hundred years, you would see its path wobble mostly due to the rotation of Jupiter.
A(3)	0.1	2	In our solar system, Mars is the planet most likely to be able to support life. However, Europa, one of Jupiter's moons, may also be hospitable, so we should include a planet if one of its moons can support life. On the negative side, the lifetime of our sun will be about 12 billion years. Of this time, the earth will only be able to support bacterial life for several billion years, and more complex life for only about 1 billion years.* Because of this, I have chosen a lower low estimate than others.
A(4)	20%	60%	Based on the time required for life to evolve on earth, the availability of carbon, and being a safe distance from exploding supernovae Charles Lineweaver and Tamara Davis suggest this value. *Science*(vol 303, p59)
A(5)	10^{-5}%	1%	New predictions about high levels of radiation on most other planets have caused this number to fall from Drake's original estimate of 0.01
A(6)	1%	10%	Gigglet lives far far away in our galaxy. She wants to communicate with us, but finds it difficult to use a keyboard.
A(7)	68 years	100,000 years	Our civilization has been capable of communicating with Aliens since 1938. So one estimate is 2006-1938 = 68. Michael Shermer estimated* A(7) as 420 years based on the average life span of earths civilizations. Still others would argue that even if we destroyed our civilization, another with similar technologies would rise from the ashes so they would favour a much higher number.
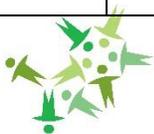
Choose the high estimates for all of the above properties; How many communicative civilizations are there in our galaxy?

Choose the low estimates for all of the above properties; How many communicative civilizations are there in our galaxy?

Extensions:

Critique the Drake equation or critique the estimates.

If you magically knew that either the low or high estimate was correct in each of the above cases, what is the fewest number of civilizations?

The Andromeda galaxy is a little larger than our galaxy, the Milky Way.

The Math in This Problem:

In this investigation, students are challenged to combine research analysis along with mathematical statistics to arrive at an appropriate solution to this extraterrestrial civilization problem.