Let's Get the Number ~~Right~~ Close!

Thomas Hockey, University of Northern Iowa

The means and opportunity to observe a total eclipse of the Sun [TSE] is rare. This is one of the reasons we do not want people to miss the 8 April TSE, which will pass over a large population in North America. To make our point, it is tempting to say something like, "Only [F] people see a TSE is their lifetime. " But what is the fraction F? Google provides an answer, and that answer is something like "one out of ten thousand" (without attribution). If our goal is merely order-of-magnitude, then a simple calculation shows that this cannot be correct.

Let,

F = fraction of people who observe a TSE
P = human population
H = average human lifetime

L = average TSE path length
W = average TSE path width
T = average number of TSEs per year (converges to)

E = surface area of the Earth
C = average global cloud cover

Assumptions:

- Eclipse path overlaps are ignored.
- Latitude and longitude effects, which would turn straightforward algebra into a problem in spherical trigonometry, are ignored.
- I realize that P includes, for instance, infants. However, the portion of a human lifetime during which a person is physically incapable of observing a TSE is usually small.
- The number of people who stay home to observe a TSE is much greater than the number who travel in order to do so.
- While it is possible to see a TSE through thin clouds, I take "cloudy" equal to "cannot see."
- This is key: The mean population density of the Earth is 13.1 per square kilometer. (An argument can be made for using the median, a less accessible figure.) The number who observe a TSE in the oceans—most of the Earth's area—is very close to zero. Still, I feel that it is legitimate to say that at least one person per square kilometer wants to observe a TSE, is not precluded from doing so by circumstance, and is healthy enough to do so. You may disagree, but remember: This is an order-of-magnitude calculation.

So, what is F?

$$F = TLWHC/EP$$

$$F = \frac{(2/3\ y^{-1})(15{,}000\ km)(480\ km)(73.4y)(2/3)}{(5.10 \times 10^{8}\ km^{2})(8.0 \times 10^{9})}$$

$$F \sim 10^{-10} \quad !$$

What if I have erred by as much as an order of magnitude in each of my estimations for the more approximate variables, say L, W, and C? And have done so that the error increases F? I still cannot reach 10^{3}. The chance to observe a TSE from one's backyard, school, place of work, or community gathering spot is very fortuitous. Spread the word!