

Mathematica Genealogica

Shock! Horror! You've discovered that one of your ancestors married a first cousin! Do visions of genetic abnormalities start streaming through your mind? Read on and ease your mind...

Have no fear! The further back you go the more likely you are to find cousins marrying, perhaps even an ancestor or two who married a niece/nephew/aunt or uncle. If you've never really considered this before it can come as a bit of a shock, but if you think about the maths behind your ancestry it's obvious why this is in fact a given rather than odd or unusual.

Let's call yourself generation zero and your parents generation one. The number of ancestors you have in this generation is 2: Mum and Dad. Mathematically that's 2^1 , i.e. 2. If you go back another generation, each of your parents has a Mum and Dad too, so that's 2 times 2, or 2², which is 4 grandparents. This model continues with the number of your ancestors in each generation increasing as a power of 2: in the third generation back you have 8 (2³) great-grandparents, 16 (2⁴) great-great-grandparents in the 4th and so on. OK, that's pretty easy to understand - discounting the modern-day scientific possibilities of cloning, the number of individuals who contributed to your existence is always given by the rule that each ancestor had exactly two parents (even if you don't know who they were!).

So the number of your ancestors increases the further back you go. But at the same time the population of the world gets smaller the further back you go - all the way back to just two, Adam and Eve, if that's your thing... It has been estimated that in the year 1 AD the population of the entire world was about 150 million, rising to an expected 8 billion give or take by the year 2020(1).

The trouble is, of course, that these two formulas can't both be correct if every one of your ancestors was only represented exactly once because there is a point where the number of your ancestors in a generation is greater than the population of the entire world at that time! If you go back a mere 30 generations, let's say around 1000 years, a mind-blowing 230 or exactly 1,073,741,824 people had descendants who procreated in turn to result in just you. Well OK, you and your siblings. But more than a billion ancestors? That's some family tree! The population of the entire world at around the end of the first millennium AD is estimated to have been only about 220 million! And if your heritage is mainly European the number is much less than even that - according to one estimate the population of Europe in 1810 was less than 168 million(2).

The answer is that the further back you go, the higher the number of your ancestors who will be represented in your family tree an increasing number of times. Some sources indicate I can claim a link back to Charlemagne, Emperor of the Holy Roman Empire (AD 742-814), who appears in my ancestry no less than 111 times between 43 and 49 generations ago - his descendants must number well into the millions! What that means is that some of his descendants in the first 6 or so generations intermarried, reducing the number of ancestors "required" by the rule that every ancestor must have exactly two parents - they don't have to be unique!

This is also why modern-day scientists can trace your ancestry geographically, using DNA markers that might be present in all descendants of a common ancestor.

So the next time you find one of those relationships in your family tree that today might be frowned upon, remember that it was in the context of a different time and be thankful it happened, otherwise you wouldn't be you!

(1) Bleier, Ronald (ed); Demographic, Environmental and Security Issues Project, "Human Population through History 1 A.D. to 2020", available online at <http://desip.igc.org/populationmaps.html>, accessed 2 June 2009

(2) Burnham, Robert (ed); The Napoleon Series, "World Population: Europe 1810", available online at http://www.napoleon-series.org/research/abstract/population/world/c_world2.html, accessed 2 June 2009

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