Applying mathematics takes 'friendship paradox' beyond averages

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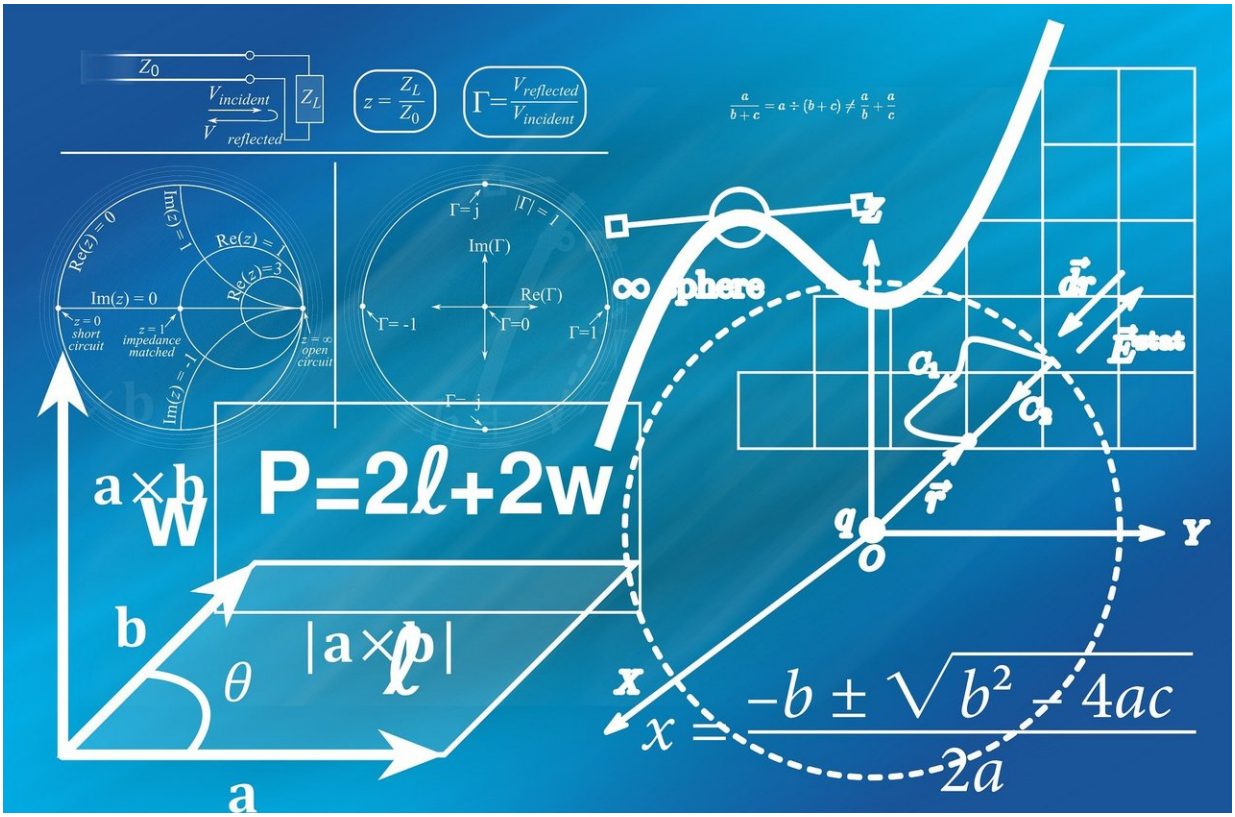

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The friendship paradox is the observation that the degrees of the neighbors of a node within any network will, on average, be greater than the degree of the node itself. In other words: your friends probably have

more friends than you do.

While the standard framing of the friendship paradox is essentially about averages, significant variations occur too.

In the *Journal of Complex Networks*, Santa Fe Institute and University of Michigan researchers George Cantwell, Alec Kirkley, and Mark Newman address this by developing the mathematical theory of the friendship paradox.

Some people have lots of friends, while others have only a few. Unless you have good reason to believe otherwise, it's reasonable to assume you have roughly an average number of friends.

But if you compare yourself to your friends, you may see a different picture. In fact, a simple calculation—provided by Scott L. Field's 1991 paper entitled "Why your friends have more friends than you do"—shows it's likely many of your friends are more popular than you.

Almost by definition, your friends are likely to be the sorts of people that have lots of friends. Perhaps worse, this effect means your friends might not only be more popular than you but also more wealthy and more attractive.

These kinds of friendship paradoxes have been explored by network scientists for 30 years.

"Standard analyses are concerned with average behavior, but there's a lot of heterogeneity among people," says Cantwell. "Could the average results, for example, be skewed by a few outliers? To get a fuller picture, we studied the full distribution describing how people compare to their friends—not simply the average."

The researchers found that applying mathematics to real-world data reveals a slightly more nuanced picture. For example, popular people are more likely to be friends with one another, whereas less popular people are more likely to be friends with less popular people.

Conversely, some people have just one or two friends, while others have hundreds. "This has a tendency to magnify the effect," says Cantwell. "While there are surely other effects at play, around 95% of the variation within social networks can be explained by just these two."

We should all "simply be wary of impressions we get about our success and social status from looking at the people around us because we get a distorted view," Cantwell adds. "In the offline social world, the bias is partially mitigated by the fact we tend to end up around similar others. On online social media, however, the effect can be exacerbated—there's virtually no limit on the number of people who can follow someone online and no reason to only look at 'similar' people."

More information: George T Cantwell et al, The friendship paradox in real and model networks, *Journal of Complex Networks* (2021). DOI: 10.1093/comnet/cnab011

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