

Love is fantastic, love is complex, love can be painful and love is full of patterns. This is what the mathematician Hannah Fry has poured her love into, in order to show what mathematics can explain about the secrets of long-lasting relationships.

From your chances of seeking The One to the way game theory shows the best pick-up strategy, these chapters will explain the beauty of math and love, and the way they inform one another.

**We can calculate our probabilities of finding a partner;
however, we shouldn't be overly picky.**

Sometimes we can become hopeless when looking for romantic love as if the odds are not in our favor. An example of such discouraged bachelor was Peter Backus who was a mathematician. Back in 2010, Backus went really far just to prove that there were more intelligent alien civilizations in the world than there were possible girlfriends for him!

His result was based on calculations led by the following questions:

How many women live close to him? In his case, he stays in London so there were four million.

How many of them are likely to be of the right age range? His result was 20% or 800,000 women.

How many of them are single? About 50% of them which is 400,000 women.

How many of them have a university degree? There were about 26% or 104,000 women.

How many of them are likely to be attractive? He calculated this at 5% or 5,200 women.

How many of them are likely to find him attractive? This was also calculated at 5% or 260 women.

Finally, how many of them am I likely to get along well with? He calculated this to be 10% or 26 women.

Therefore, Backus was only left with only 26 women to date. On the other hand, scientists currently estimate that there are approximately 10,000 intelligent alien civilizations in our world.

However, if Backus had been a little bit picky and calm with his standard a little, he would have had a huge number of potential partners. For instance, he presumed that he would just get along with one in ten women he met. However, if he increased this to about 20% and if he also increased the percentage of those he found attractive to 20% as well as if increased the percentage of women who would consider him attractive to 20%; therefore he would have been left with a more optimistic number of 832 potential partners.

In love, it is good to be reasonably flexible with your standards.

As luck, or maybe math, would have it, Backus finally got married in 2014.

Some mathematical terms are related to beauty; however, the golden ratio is not part of them.

We all know the popular saying of beauty is in the eye of the beholder; however, there are a few numbers of people whose faces are really attractive that they appear to be almost unquestionably beautiful or handsome. Hence, there must be a few basic criteria for the beauty that we all agree on.

Some people consider beauty to be encoded in a mathematical term called the golden ratio, which has been continuously applied to human attractiveness. The golden ratio is a number that is approximately equal to 1.61803399 and it is regularly represented by the Greek letter phi or Φ . Nevertheless, the theory doesn't hold up very well.

For instance, you might have heard that the perfect face should have a mouth that is 1.618 times bigger than the base of the nose, eyebrows that are 1.618 times wider than the eyes, and so forth.

However, the issue with applying the golden ratio is that if you're looking for a pattern, it's very likely that you will find one, particularly if you're ready to be somewhat lax with your definitions. For example, how do you define where the beginning of your ear is, or exactly the point at which your nose ends?

Apart from the golden ratio, there are other mathematical concepts that are related to beauty. One example of such a concept is our preference for average face shape. It has been long known by researchers that overlaying images of several faces from a given ethnic group leads to an average face that is widely accepted as attractive.

The theory behind this preference is that when we are finding a partner, we have a habit of loathing unusual face shapes as they might show a genetic mutation in which we don't want to pass on to our children.

An essential factor for attractiveness is facial symmetry, and people who have more symmetrical faces regularly score highly on attractiveness surveys.

The math says it isn't usually the best option to choose the most attractive person; however, you should hold the initiative anyway.

If you're single and you're at a party; should you sit back and just wait for someone to walk up to you, or waltz up to the most attractive party-goer, talk to them and risk being rejected?

According to the Nash Equilibrium, it is not the best idea to make a beeline for the person you are most attracted to.

You might have seen the movie *A Beautiful Mind*, which explains the story of a well-known mathematician named John Nash.

One of the popular scenes was where Nash and three of his male friends sight a group of five women in a bar which consisted of four brunettes and one very beautiful blonde.

The men were instantly attracted to the blonde woman; however, instead of tripping over each other to get to her, Nash proposes an approach based on mathematics that accommodates the best interests of all of them.

His theory of equilibrium states that if they all approached the blonde lady, they'd block one another, which will result in neither of them going to bed with her. But, if none of them approached the blonde woman, they wouldn't block each other's way and they wouldn't insult the other four women by making them feel like the second choice. Then they concluded that they would approach the four brunettes.

Though, sometimes it helps to approach the person you've selected. At a party, if you do the approaching, hence risking being rejected all the time, you end up better than the people who just sit back and wait for people to approach them.

If you begin at the top of the list of people you'd like to connect with and work your way down, you'll end up with the best person who accepts your advances. However, if you just sit back and wait for people to approach you, you'll wind up with the least preferable person who approaches you.

Algorithms on dating websites are elegant however it cannot perfectly predict compatibility.

A lot of parties at once can really sap your energy for meeting possible partners, therefore what about online dating?

Dating websites use algorithms to calculate how compatible people are with each other. An example is OkCupid which is a free site created by a group of mathematicians and is based on a specifically elegant algorithm that creates a score to show how well two people fit. The key elements are your answers to a questionnaire, the replies you'd like a partner to give, and how significant the questions are to you.

The rates in which you can allocate to your questions are as follows: Not at all important = one, A little important = ten, somewhat important = 50, Very important = 100 and Compulsory = 250.

Let's illustrate this with two fictional characters Harry and Hermione; with two questions: "Do you like quidditch?" and "Are you good at defeating dark wizards?"

First, the algorithm calculates how good a match Hermione is for Harry as follows: for instance if Harry answered the first question "Yes" and he rates it as "A little important." Let's say Hermione replied this question with a "Yes" too. This shows that she gets ten out of ten probable points. However, let's say she answered the second question with "No," although Harry wanted his match to reply with a "yes" and had rated the question as "Very important." She would then get zero out of 100 possible points for that particular question.

What was the result? Hermione's total match percentage for Harry would be $(10+0) / (10+100) = 10/110 = 9.1$ percent. Finally, the algorithm would calculate Harry's match percentage for Hermione and these percentages would be averaged.

However, even elegant algorithms regularly fail to predict precisely our compatibility with each other. Clearly, if the internet were the main matchmaker, there wouldn't be a lot of us still struggling through terrible dates. The mistake is that most times it doesn't work when you use individual information to predict how well they will get along: two people may both love the Harry Potter movies, however, that doesn't say anything whether they would enjoy watching them together.

The game theory shows how men can be persuasive in order to make women sleep with them and the reason why complacent women don't get married.

Are there any mathematical rules that can enable you to get what you want when you meet a person and sparks are flying? Consider trying the game theory.

Game theory is best applied to men who just have one thing on their minds. Therefore, if you're a man that doesn't know how to persuade women to sleep with you, mathematicians Peter Sozou and Robert Seymour can assist you with that.

The method of both Sozou and Seymour's assumes that you have a variety of offerings at your hand like flowers or a candlelit dinner. Then, your tactic should be to choose the gifts that are very likely to get you what you want without attracting women who only want the gifts.

The woman is seen as an opponent in game theory and her job is to win the best man through sex which is a means of bargaining. This is how the method works: in order to impress the woman, you have to select gifts that have great value; however it has to be shared to have meaning. Therefore, a great choice would be a candlelit dinner, a fancy firework or pulling up to her house in a Ferrari. Buying her a piece of jewelry wouldn't work.

Also, Game theory suggests that women shouldn't get complacent when looking for a partner. Dating can be seen as the mathematical equivalent to auctions, where bidders submit bids. Now, it may look like the strong bidder which is the most attractive woman in this case has the highest opportunity of winning the man.

However, it is usually the bidder in the weaker position who comes out on top. Why? This is because when a weak bidder meets a man she likes, she does everything possible just to gain his attention. However, a confident bidder is less likely to make an effort; hence, she is less likely to get the man.

The number of people we are sleeping with isn't random, and mathematics can help us understand the spread of sexually transmitted diseases.

Immediately you've found someone you connect with romantically, the next step is likely to be the bedroom. Fortunately, mathematics can also give us some handy tips there, too!

Interestingly, the number of sexual partners we have is not completely random. In 1999, Fredrik Liljeros who is a Swedish sociologist and a team of mathematicians found a formula that can really determine the number of sexual partners we're expected to have over our lifetime.

A lot of us would assume that this falls under the normal bell curve distribution like height or IQ, however, the formula instead follows what is called the power-law distribution.

The power-law distribution can really be understood by the way we form networks on Twitter. A lot of people on Twitter have nearly the same number of followers; however, for some people, they have a lot of followers. An example would be Katy Perry who has 57 million followers and it is the largest hub in the Twitter network.

As with Twitter followers, most people have approximately the same number of sexual partners, however, there are some people who have a huge number of followers.

Therefore, what do we do with this type of information? Well, a mathematical understanding of sexual networks can show us how sexually transmitted diseases are spread.

People who have a lot of sexual partners form focus points in the sexual network and these are the vital players in the spread of disease. However, how can we find such people?

Let's go back to Katy Perry's Twitter presence for a minute. If we choose a single person at random from the 500 million people on Twitter, we'd have a paltry one in 500 million-odd of finding Katy. However, if we select a person at random and requested them to lead us to the most famous person they follow, it would bring us to Katy 57 million times. Therefore, we'd have approximately a 10% chance of finding her.

This handy rule has been used to determine the spread of epidemics.

Mathematics can tell the number of potential partners you should reject before you get the perfect one.

Maybe you've been dating for a while now and you want to settle down. The question is, how can you select the perfect person to settle down with if you can't reject potential partners that you have yet to meet?

Again, this is where mathematics can assist you. In this case, math knows the number of potential partners you should reject until you find the person you are ready to commit to. This is called the optimal stopping theory and it works as follows: if you're meant to date like ten people in your whole life, the formula dictates that you have the highest opportunity of finding The One if you reject your first four partners. Therefore, by doing this, the likelihood of your fifth partner being The One stands at a fairly realistic percentage of 39.87%.

For instance, if you have more partners, let's say 20, then you should stop after your first eight partners. At this point, the probability of finding Mr. or Miss right stands at 38.42%.

Have you seen an error in this calculation? Except you're a member of the English royal family in the 1500s, your potential suitors won't be patiently waiting outside your chamber prepared to be dated. Therefore, there is definitely no way to know the number of people you'll date during your lifetime.

However, there is still hope in this model, and it depends on the number 37. Fortunately, it is okay to only determine how long you wish to date in your life. Therefore, let's say you start dating when you are 15 years old with the mindset of settling down at the age of 40; then you should turn down everyone in the first 37% of your dating window till you turn 24. This makes you have one in three chance of getting your perfect match!

Mathematics can assist you in optimizing your wedding planning.

Let's say you found The one and you have to plan for the wedding. However, before you go into all the unavoidable stress, let's look at how mathematics can help you.

Guestlist is near the top of everyone's list of stressors and making a reasonable list of invitees can be terrifying. Budgetary constraints and venue size can force you into sticky circumstances, and definitely not everyone you invite will eventually show up on that day.

Again, mathematics can help you in determining more precisely the number of people who will show up at your wedding.

First of all, write down all possible invitees who are categorized as couples or families. Also, you can put this list into a spreadsheet, with the name of the category in the first column, and the number of people in that category in the second column.

Afterward, determine how possible it is that each category will show up if they were invited. For instance, your best friend from home has probably a 95% chance of attending, thus they and their category would jointly get a score of 0.95. Put this score into the third column of your spreadsheet.

Then multiply the second column which is the number of people in each category with their score in the third column. Then this will give you a number for a fourth column which contains the expected number of people who will accept the invitation.

As you work down the list, keep a running total of the expected number of guests in a fifth column. With this approach, you will, on average, invite the accurate number of people to your wedding, hence lessening one of the biggest headaches of wedding planning.

Mathematics is able to predict how likely a marriage is to last.

One of life's greatest pleasures is finding the one you want to settle down with; unfortunately, a lot of marriages don't last. Wouldn't it be nice to know how to act in a long-term relationship so you can be able to maintain your wedded bliss? You might have guessed that there's a formula for this.

There is actually a formula for predicting how positively or negatively marriage partners will act when it's their turn to speak during a conversation. When we consider arguments, the way couples argue varies greatly and can be useful for predicting their long-term happiness.

John Gottman who is a Psychologist actually found an approach to score how positively or negatively a couple can behave towards one another. Surprising, the Gottman's scoring approach was precise, predicting divorces with up to 90% accuracy just by observing how couples talk to each other.

However, it wasn't until Gottman teamed up with James Murray a mathematician that he explained how spirals of negativity in conversations are formed.

Murray formulated two similar formulas for the husband and wife. These formulas enable us to calculate how positive or negative the husband and the wife will be in the next thing they say.

For instance, the wife's answer can be influenced by her general mood, her mood when she is with her husband, and the impact her husband has on her. For instance, let's say the husband act a little negatively, maybe interrupting her when she is speaking, he will negatively influence his wife.

Using this formula we can be able to know the point at which the husband is sufficiently negative to tip the mood of his wife, leading to a likely break-up.

Quite fascinating, Murray's equations have also been used to successfully show what happens between two countries during an arms race.

The Mathematics of Love: Patterns, Proofs, and the Search for the Ultimate Equation by Hannah Fry Book Review

From online dating to understanding the spread of sexually transmitted diseases, mathematics offers understandings that can solve some of the mysteries of love and give us the best opportunity of finding The One we want.

Make them hate you or love you.

When people select their profile pictures for online dating, they have a habit of hiding characteristics and traits that might make them unattractive, for instance, by cropping out some part. However, we should be doing the opposite of this.

The people who are extremely beautiful are continuously going to be flooded with several messages, while the rest of us would do better to share view than to aim to look as charming as possible. It has been proven by statistical analysis that people who share different opinions about their looks end up being very popular on internet dating sites than people whom everyone agrees is just “quite cute.”

Therefore, when choosing your profile picture, play up to whatever makes you stand out as well as the things that some people might consider as really off-putting!

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