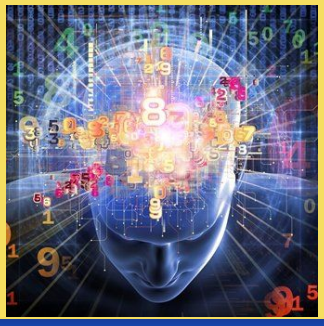
2018 / Volume 1 / Issue 1



Mathematics Applications

A REVIEW OF RECENT LITERATURE ON THE APPLICABILITY OF MATHEMATICS TO REAL LIFE

BY THE HOLTON-ARMS ALGEBRA CLASSES

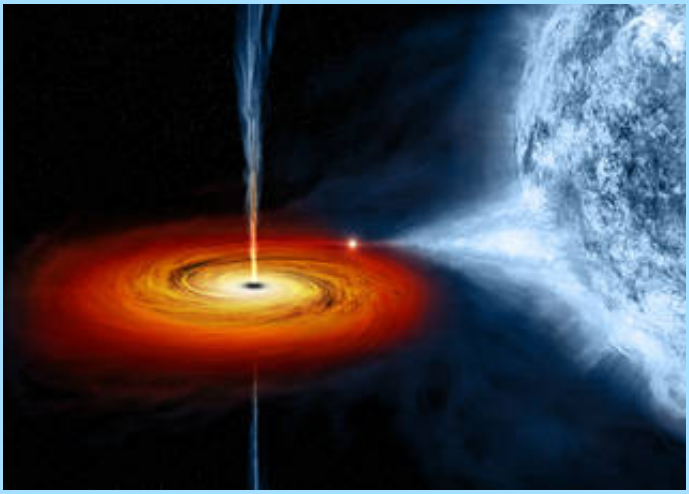
Features:

Alg 1 H M1 students

Alg 1 H M6 students

In the Shell of a Black Hole

By: Divya D.



We may all be living in a holographic mirage from another dimension.

The universe appears to exist in 3 dimensions. This is our universe, what we know as a three-dimensional universe. However, in this theory, our world is a holographic mirage from a world that has 4 spatial dimensions. In our world, we have 3 of these: length, width, and height. However, in this universe, there may be a fourth. So to explain further, in this theory our own universe came into existence because of a stellar implosion in this super-universe. The explosion that may have happened, created a 3D shell around a 4D black hole.

That shell is our universe. Although the idea may sound absurd, it's actually grounded firmly in the same mathematics that explains time, space, and matter. Over the last few decades, mathematicians have developed and discovered math that allows them to convert descriptions of events in one dimension to the physics of another dimension. Scientists and researchers can use these equations, then substitute them into a much more complex system.An example of this is the dynamics of a 3D black hole. Technically, the 2 descriptions of the black hole using the two formulas for the two dimensions are interchangeable, serving as a perfect representation for this black hole. This is what holography is, and how scientists think our universe is made up.So this leads to the conclusion that the rules of the cosmos may, in fact, be written in another dimension, then translated into the mathematical language of ours. Our personal experiences may have led us to believe that the world is 3D, but we will only be able to perceive the universe completely when we understand what it truly is. Another reason that this is entirely a possibility and is not just an absurd idea is, that this could further our understanding about the origins of the cosmos, because there isn't much support behind any theories today. Modern cosmology considers the "Big Bang" to be the start of the universe. Theories about this state, that this was followed by an inflation that increased the volume of our known universe at a factor of 1078 or more. But, this theory can provide no insight into the cause of this explosion. The black hole theory, however, gives an explanation grounded in mathematics about the ultimate mystery: Where did the universe come from? Scientists could research this by studying Cosmic Microwave Background Radiation, which are radio waves left over from the beginnings of the universe. If they show that they are older than the universe is believed to be, then the existence of a 4D universe is an even greater possibility. The investigations into this theory came from the difficulty scientists have had while contemplating the existence of our 3D universe. The cosmology of the modern day has astounded most people, but it still holds many complex mysteries. Cosmologists today can describe the universe from a fraction of a second after the big bang to the modern day using just a few equations, (many of which were developed by Albert Einstein) and 5 numbers. These are known as parameters. These include the densities of dark matter and dark energy, as well as quantum fluctuations in the early universe. These parameters can describe the cosmos, which is 10 billion light years across, but they cannot answer the most fundamental questions about our universe, such as how the Big Bang happened. The bigger problem than this is that scientists simply don't understand the 5 parameters. There's no origin for these 5 numbers, and they constantly fluctuate as well since the universe keeps expanding. In addition to this, researchers never know what they will discover next. Until only a few decades ago, scientists assumed the universe was chiefly made from visible matter. However, Nobel-Prize winning scientists have disproved this. 25% of the universe consists of dark matter, which is different from regular matter. It has different properties, and we do not have the tools to study it on Earth. Dark energy makes up another 70%. Dark energy is an energy that counteracts with the force of gravity. Visible matter makes up no more than 5% of the universe. There are 2 other problems with the Big Bang theory.The first one is, that scientists don't completely understand inflation and do not know whether it occurred or not. They also don't understand how a natural end to inflation is possible.The second is, that scientists don't understand how it all began. Since the ideas of space, matter, and time didn't exist before the Big Bang, scientists have a hard time imagining how it could've happened if there was no driving force. Every explosion across the universe has a cause, but if space, matter, and time didn't exist, what could've caused the Big Bang?The universe is said to have come from a singularity, which is an unimaginably and bizarre thing. It's a point where space and time curve in on themselves, and make it impossible to distinguish the past from the future. This is where all laws of physics break down. Thus, researchers have no reason to think that a universe, as ordered as the one we see, came from a singularity.

Comments:

If the 4D universe is real, and we are living in the shell of a black hole, then the possibilities are endless.There may be 4D galaxies, stars, and black holes. There may be an infinite number of universes that exist inside of it, all of them as the shell of various four-dimensional black holes. However, this raises a few more questions while answering several others: Where did this 4D universe's parent universe come from? Is there a five-dimensional universe with five-dimensional black holes?Are there an infinite number of universes that are three-dimensional? If so, is there one exactly like ours, where all events occur exactly the same?Does this mean that there is a two-dimensional universe that is the shell of every black hole in our 3D one?And are there infinitely more one dimensional universes as the shells of black holes in two-dimensional ones?Just how many universes are there?

Link:

https://www.express.co.uk/news/science/726632/big-bang-universe-black-hole-singularity

Interns Use Math to Understand Health, Well-being, and Life-threatening Ailments

Summary by Phoebe S.

Eric Palmer learned due to the premature birth of his son that the lungs are the last organ that babies develop, his son needed medicine to lubricate his lungs to be able to breathe. His thesis was to develop mathematical models that use computational fluid dynamics to recreate lung mucus performance. Needing better resources, tools and opportunities Palmer turned to the National Science Foundation's Mathematical Graduate Internship program (MSGI), which led him to research multiphase flow in Berkeley, California. Multiphase flow is the simultaneous movement of matter or materials in different phases or states. Working with mentors Andy Nonaka and Ann Almgren he was able to explore both fluid flow simulation and particle movement in a single model showing how particles affect fluid performance. He focused on element particle tracking methods by analyzing mathematical equations and making software prototypes to lead him to implementing a discovered solution. These experiments led to a final method which provided a step towards improving modeling methods. Also his research became part of the U.S. Department of Energy's Exascale Computing Project, improving multiphase flow models.

Hang Deng used his MSGI program to make cervical cancer easier to avoid. Deng analyzed Norwegian women's health Data working towards creating personalized policies for cervical screening. Pap smear tests are recommended every 1-3 years for ages 20-65, based on patient records medical screening is not needed this often. They started with an approach using the long-short term memory (LSTM) neural network model by inserting lots of data to train a model specifically to cervical cancer. The model was personally tailored to certain women by inputting previous screening or test results. This resulted in a convenient and affordable way to avoid cervical cancer.

James Brunner used the MSGI program, to work with other biologists to research microbiomes. A microbiomes is a population of microorganisms in a certain environment. Along side mentors, Patrick chain and Karen Davenport he was able to research the network interference plus analysis involved in microbiomes. Together they worked to find out how microbial networks can help improve taxonomic classification, they also found genetic material samples from microbiomes to discover the differences from microbiomes and microbial communities. This research and improving understanding contributes to diagnostic tools which help detect pathogens from clinical samples.

Eric palmer (top left), Hang Deng (top right) and James Brunner (bottom right) with the program logo (bottom left)

https://sinews.siam.org/Details-Page/interns-use-math-to-understand-health-well-being-and-life-threatening-ailments

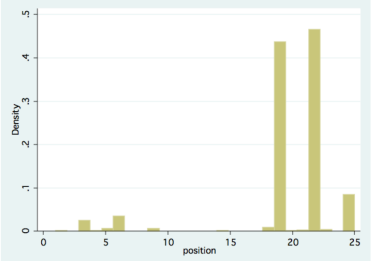
A Field Guide to Deception

MIT Technology Review, January, 2018

Summary by: Tomisin S.

Lying is a very interesting psychological topic that interests many researchers and scientists. Hélène Barcelo from the Mathematical Sciences Research Institute in Berkeley and Valerio Capraro from the Middlesex University Business School in London performed an experiment to test how often people lie and whether lying is intuitive. The results show that when it comes to lying people are divided into three categories: good, angry, and bad. The decision whether to lie or not is not just binary, it involves a calculation to weigh the personal benefit from lying and the risk one might endure if they are caught. Barcelo and Capraro's experiment is special because it tells people to lie and lets them lie in different ways that change their personal gain. Participants in the experiment are show a list of numbers. The values of those numbers range between 1 and 90. Simultaneously, the participants are show a number. This number represents a position on the list. The participants are told to find the number and they will be payed that in cents. Half of the participants are asked to find the number in the 19th position, which is 16. The other half are supposed to find the number in the 22nd position, which is 71. The first half of participants are unlucky. However, they could easily improve their fate by choosing a number on either side, 63 or 50. That is considered stretching the truth and not actually lying. Or the participants could just go for the highest payout with 85 cents. The participants asked to find 71 are much luckier. There is less incentive to lie because the payout is closer to 85. 800 people were experimented on. 50% of the people were unconditionally honest. They are honest no matter the payout. Interestingly, not know of the participants merely stretches the truth. There are two groups of liars. Conditional and unconditional. Some people always lie, and some only lie after weighing their options. The conditional liars make up 35% of the group. The unconditional liars make up about 15% of the group. The researchers also found that women are more honest than men in self-serving positions. In conclusion, this experiment shows that being dishonest takes more time making it a more reflective than intuitive process.

This graph shows the distribution of answers.



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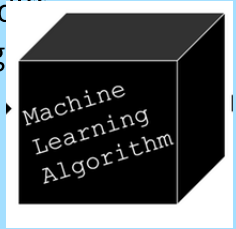
This March Madness, We're Using Machine Learning to Predict Upsets

The Conversation, March 12, 2018

Summary By: Jules F.

https://theconversation.com/this-march-madness-were-using-machine-learning-to-predict-upsets-91618

When March comes around, there's one thing on everyone's minds: March Madness. One of America's favorite thing to do is create their bracket and make predictions about who will win the championship. In 2017, 18.8 million brackets were submitted. Out of those 18 million, only 164 had a perfect 1st round. That's less than 0.001%! Throughout the tournament there are upsets, or times when lower seeded teams beat the favored team. There are at least eight upsets per year. One of the reasons people get their brackets completely wrong, is recency bias. Recency bias is a decision making fallacy where people use their most recent observations to make a decision. In this case, the decision about which teams to select. Other biases people have are biases towards their home team, favorite player, etc. These things impacts brackets in a negative way, they make people choose a team because of their feelings rather than the facts about who is the better team. Two college students decided to use machine learning to predict the upsets in March Madness. Statisticians, mathematicians, and computer scientists program machines to make predictions by "learning" from past data. They used classification algorithms that will determine and provide the probability of whether a game would be an upset or not. Logistic regression, random forest models and k-nearest neighbors went into the process. Stats from 2001-2017 1st round team winners were compiled to find data. They tested the algorithm with the 2017 1st round data and got a 75% success rate! The upsides to this machine is that it is more accurate, efficient and correct than when people fill out brackets by themselves. The downside is that since it relies on past data, if the first deed loses in the first round, the machine wouldn't be able to predict it since that has never happened before. Also, the machine works best with thousands or millions of examples, so since there is only 544 1st round games since 2001, the predictions won't be 100% accurate. People are continuing to use machine learning for many d
things including marketing, medicine and sports. It's also becoming
and easier to use so more people are finding interest in it!



This is a picture of a machine learning technique

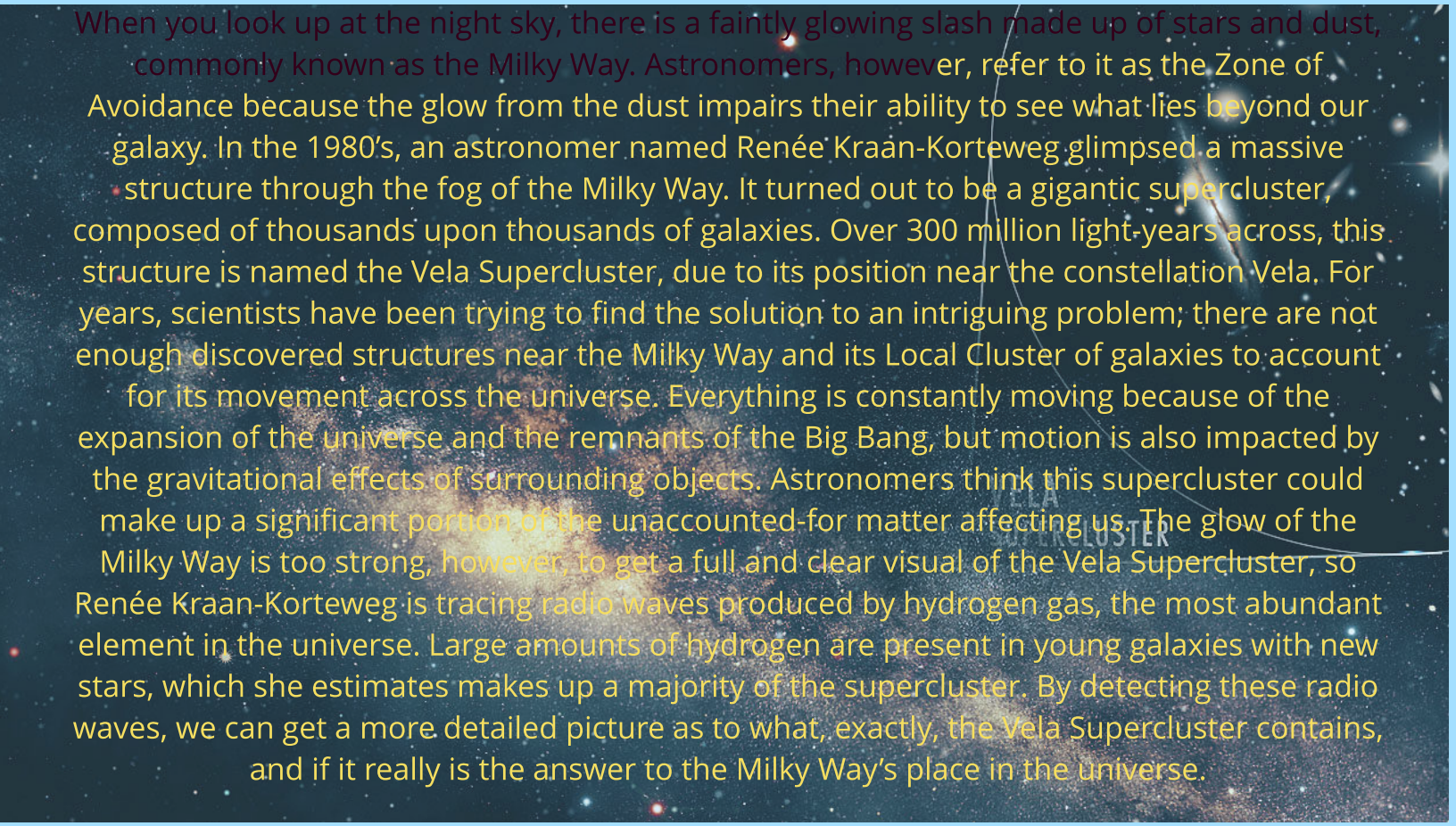
that they used in this project called Black Box.

Hidden Supercluster Could Solve Milky Way Mystery

(Original article by QuantaMagazine)

https://www.quantamagazine.org/hidden-supercluster-could-solve-milky-way-mystery-20171121/

Summary by Sukhmani K.



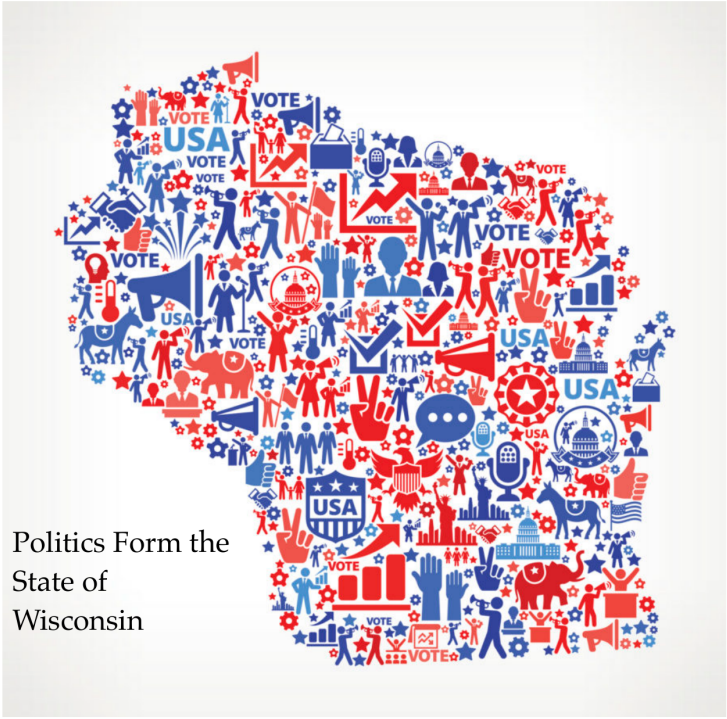
When you look up at the night sky, there is a faintly glowing slash made up of stars and dust, commonly known as the Milky Way. Astronomers, however, refer to it as the Zone of Avoidance because the glow from the dust impairs their ability to see what lies beyond our galaxy. In the 1980's, an astronomer named Renée Kraan-Korteweg glimpsed a massive structure through the fog of the Milky Way. It turned out to be a gigantic supercluster, composed of thousands upon thousands of galaxies. Over 300 million light-years across, this structure is named the Vela Supercluster, due to its position near the constellation Vela. For years, scientists have been trying to find the solution to an intriguing problem; there are not enough discovered structures near the Milky Way and its Local Cluster of galaxies to account for its movement across the universe. Everything is constantly moving because of the expansion of the universe and the remnants of the Big Bang, but motion is also impacted by the gravitational effects of surrounding objects. Astronomers think this supercluster could make up a significant portion of the unaccounted-for matter affecting us. The glow of the Milky Way is too strong, however, to get a full and clear visual of the Vela Supercluster, so Renée Kraan-Korteweg is tracing radio waves produced by hydrogen gas, the most abundant element in the universe. Large amounts of hydrogen are present in young galaxies with new stars, which she estimates makes up a majority of the supercluster. By detecting these radio waves, we can get a more detailed picture as to what, exactly, the Vela Supercluster contains, and if it really is the answer to the Milky Way's place in the universe.

I really enjoyed reading this article, and was amazed by the extremely complex math involved behind the scenes of this discovery. Although math was not directly referenced, the sheer amount of calculations required to even be able to see the Vela Supercluster, much less figure out the contents of it, are enormous. I performed some background research to further my understanding of this complicated concept, and discovered pages upon pages of math and calculations required to interpret the radio waves emitted from hydrogen atoms, calculate distances in light-years, and build the devices needed for each. This article opened my eyes to the fact that math truly is everywhere. Without it, the amazing discoveries we have made would be impossible. Even though I cannot understand a large amount of this concept (yet!), I found it interesting, informative, and awe-inspiring.

How Computers Turned Gerrymandering Into a Science

The New York Times, October 6, 2017

Summary by Lily M



Politics Form the State of Wisconsin

Jordan Ellenberg discusses how gerrymandering has evolved over time into the "science" it is today. The results of the Wisconsin state assembly election in 2017 were surprising to many. Even though the state of Wisconsin generally has equal numbers of Democrats and Republicans, the Republicans seem to hold a surprisingly big majority- 65% of the seat of the state assembly. The United States Supreme Court is reviewing this dilemma in Gill vs. Whitford to see if gerrymandering, in this case, is constitutional.

Some believe that gerrymandering is part of the fierce game of politics, yet others question the ethics behind it. Regardless, gerrymandering involves lots of math and technology to render a map to favor one party. This computer based analysis is the "science" Ellenberg refers to. In Wisconsin, maps are made and tested through computer algorithms to see if the map meets the goal of the Republican party. The mapping program has special features that can result in the election favoring the Republicans, even with an electorate of more Democrats.

Republicans defend their actions by saying that because more Democrats typically live in cities than in rural areas they are "gerrymandering themselves." If Democrats live in major cities, like Milwaukee and Madison, those districts will have a large Democratic win but more districts outside the cities will have a medium Republican win. This tactic is how many gerrymanders win the election, for better or for worse. As Ellenberg says, "As a mathematician, I'm impressed. As a Wisconsin voter, I feel a little ill." The Supreme Court case is a monumental decision and will create a precedent about gerrymandering for years to come. A ruling on the case will come out in June of 2018. As Ellenberg stated, "It's not math versus democracy; it's math versus math, with democracy at stake."

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https://www.nytimes.com/2017/10/06/opinion/sunday/computers-gerrymandering-wisconsin.html

“You’re all ‘math people,’ but you just didn’t know it” - San Francisco Chronicle, September 2017

Summary by Josephina W.

Article URL:

https://www.sfchronicle.com/opinion/article/You-re-all-math-people-you-just-12236409.php

A lot of people claim that they aren’t “math people” but no matter what they think, everyone is a math person. These non-believers seem to think that math only lives in class, textbooks, or people who are so called “math people”. But they are wrong and missing out on the real, accurate truth. For example, when you are dividing a fraction, you are told to just invert and multiply, and not to question why. However, how would you know that that strategy is correct? You could ask a question of the same meaning, one that makes you have to understand the problem. Like how many times can the divisor go into the dividend? Or how many half cups will fit into x amount of cups? These questions change the problem from strictly mathematical to personal. When you look at a math problem personally and creatively, you develop a better understanding of the problem. And when you understand how something works, you’re more likely to remember how it works, which makes math easier in the future. People who do not classify themselves as math people are totally oblivious to the fact that math is everywhere. Everybody solves math problem everyday, whether they know it or not. So math is not just confined to classrooms, books, or the brains of ‘math people”. For example, if you’re in a taxi, the amount of money that you pay is determined by the distance. And distance is a function of speed and time. Even if you’re eating a pizza with friends and you need to divide equal portions for everyone. It can be as simple as that. However, there are excuses that come along with “non-math” people. Turns out, a fear of math can be passed along from person to person. But math is not about the answer, it’s about the process, and the “journey of discovery”. So the next you find yourself coming up with the solution to some math problem that came up in life, remember, you are a math person, and you’re not the only one.

An “example” of math in everyday life, and the supermarket is a great place to do math, like finding the best deal, or calculating your total cost.

Fractions: Where It All Goes Wrong - Scientific American, November 2017

Summary by Ayleen A.

Original Article: https://www.scientificamerican.com/article/fractions-where-it-all-goes-wrong/

Fractions are one of the hardest fundamentals of mathematics to learn and comprehend. Fractions are difficult to learn because students must know the inherent and culturally contingent difficulties. Inherent difficulties are those that come from the nature of fractions. Understanding how and why a fraction is written as “a/b” is a type of inherent problem. These inherent difficulties make it hard for students to understand the concepts of fractions. Culturally contingent problems are those that can lessen or worsen the inherent difficulties of learning fractions. Statistics show that when asked to solve a simple problem like, “If 12/13 + 7/8 was closest to 1, 2, 19, or 21” only 24% out of 20,000 American eighth graders answered correctly. However this data is from forty years ago. Many would expect that teachers, researchers, and government workers would’ve worked to make a positive difference, but the percentages have only increased from 24% to 27% correct answers. Fraction addition, subtraction, multiplication, and division problems also cause difficulties for many middles schoolers. Some studies show that even community college students have poor performances when dealing with fractions. In a survey given to 1,000 Algebra 1 teachers from the US, fractions were rated as the second greatest obstacle keeping students from mastering Algebra. In addition, students’ knowledge of fractions were rated as “poor.” Children in many countries of Europe and Asia do very well with fractions, when many American students do not. Language can be a culturally-contingent factor because of the way numbers are expressed. Furthermore, many U.S. textbooks have little challenging problems with fractions, whereas in countries like China and Korea, textbooks have more challenging fraction problems. Learning a better understanding of fractions and teaching challenging problems can help students learn more effectively. There are also programs to help students creatively learn how to work with fractions that have proven to be very productive. Educational systems in countries like, the United States, should focus on how to improve their teaching, especially when dealing with fractions because others around the world perform exceptionally well.

Fraction Face Off! A twelve week program designed to help students improve their fraction knowledge.

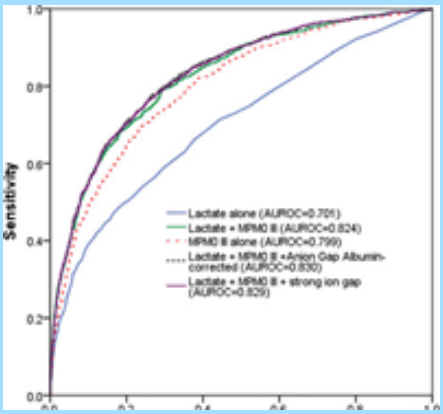
Comment: This article was an interesting read because it surprised me. I didn’t expect that so many people in America do not know how to apply or comprehend fractions. I have a little trouble with fractions so it was interesting to learn that in other parts of the world it is being taught better than in America.

This Cat Sensed Death. What if Computers Could, Too?-NY Times, January 3, 2018

Summary by Eve M.

Two-year old Oscar, of the Steere House nursing home is Rhode Island could predict death better than most doctors could. In 2007, The New England Journal of Medicine wrote that when Oscar would sniff the air, crane his neck, and cuddle up next to a patient, the doctors would call in families for their last visit. Over the course of a couple years, Oscar predicted 50 death, and he wasn't wrong a single time. No one could really figure out how Oscar could tell the future. Theories included that the dying cells of patients released chemicals that he could smell. Maybe he could pick up on other signs that doctors could not. However, professionals have a record of under or overestimating the death of patients by nearly three months, according to a study done at the University College London. It's clearly not a strong suit of the field. But what if an algorithm could be created to replicate Oscar's prophetic skills? In late 2016 a graduate student at Stanford's computer science department, named Anand Avati, was able to "teach" an algorithm that may help solve this problem. Avati, with the help of a team from the medical school, was able to find a way to identify a three to twelve month window in which the patients were most likely to die. Avati took information such as a patient's diagnosis, the number of scans ordered, the amount of time spent in the hospital, the kinds of procedures done, and the prescriptions written. He then fed these inputs into a "neural network", a kind or software that loosely mimics the organization of neurons in the brain. The neural network took this input and weighted each piece of information to produce a probability score that a patient would die in the next three-twelve months. Avati and his team found 200,000 possible patients to try the "death algorithm" on. The algorithm used the information from the first 160,000 patients to teach itself how to operate. The remaining 40,000 patients were used for testing. The algorithm performed extraordinarily well on these patients, nine out of ten predicted to die within the window did. In time, this program will be able to take inputs like doctor's notes, even patient's complaints and self-diagnoses to produce outputs with even more accuracy. The algorithm is still young and hard to understand, and often it cannot to answer the question "why" and explain how it arrived at its answer. Nevertheless, this program is a huge advancement in medicine and it will help many people.

Original article: https://nyti.ms/2DXqzyd



A graph of inputs in the "Improving Palliative Care With Deeper Learning" software

Run, STEM, Run! , Siam News, September 27, 2017

https://sinews.siam.org/Details-Page/run-stem-run

Summary by Alanna F.

Do you run track? Do you run for leisure? SIAM Journal on Applied Mathematics News conducted groundbreaking running research lead by Amandine Aftalion. You will be interested to learn about this fascinating research, especially if you enjoy running track or for leisure.

People often say “Cross the Finish Line strong!” Or in other words, “Spirit and expend all your energy in order to cross the finish line fast.” Amandine Aftalion found that when athletes sprint short distances, they cross the finish line much slower than they started. Interestingly enough, she found that it is the opposite for longer sprints/ distance running. If you are running a distance longer than 400 meters, you are more likely to cross the finish line faster than you began the race. Aftalion found that with an initial strong acceleration in short distances followed by a deceleration to the finish line is the “best use of a person’s body resources.” She tested her findings with a mathematical model. Aftalion’s rather complex model describes the evolution of velocity, the anaerobic energy, the propulsive force using a system of ordinary differential equations. “The system of equations is coupled to the condition of optimizing the time to run a fixed distance, and factors in Newton’s second law and energy conservation”. Newton’s second law of motion directly correlates to this model because it states “ The acceleration of an object produces a change of speed in the object.” The intake of oxygen is seen to increase quickly then decrease suddenly with short distance running. For long distance, oxygen uptake increases then decreases, mimicking the flow of the runners pace. Aftalion verified her mathematical model by using data from real races. The time splits recorded for 100m, 400m, and 800 meter races show that the curves match very well with her model.

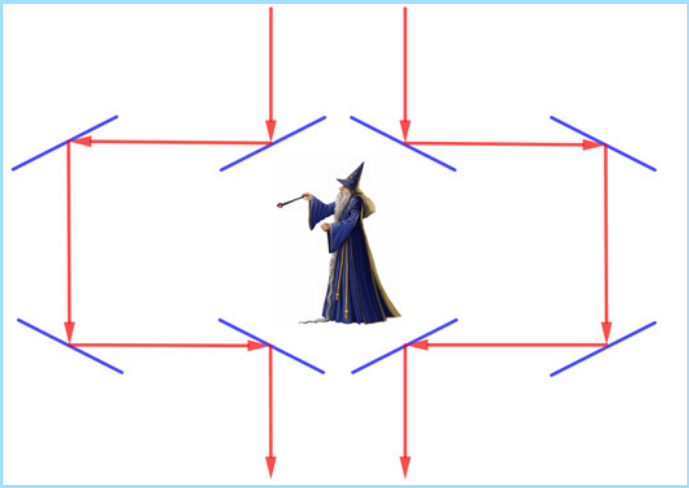
Amandine Aftalion’s research provides insight on how athletes can better their time in races. Her findings provide a new perspective on the impact that velocity and oxygen intake have on running.

Maybe this sloth wonders why he cannot cross the finish line, (other than the fact that he is a sloth) …. His oxygen intake has slowed down exponentially! He crossed the finish line slower than he began!

Invisibility Cloaks

Summary By: Zoe K.

Have you ever wondered what is would be like to be invisible? The idea of an actual invisibility cloak sounds like a fantasy, and while it can't be achieved through magic, scientists might have an alternative. Early invisibility devices used lenses and mirrors that were placed at specific angles so that they bended the light around an object, displaying an image of the background. However, these devices only work when the viewer stays in one spot, not from all around. The reason why we can see an object is because the lights rays that hit it get obscured. US researchers developed a cloaking device that calculates the direction and position of the light rays that hit an object, and then shows an image of the background. This allows the image to change as the point of view shifts, keeping the object effectively cloaked. The cloaks themselves are made of meta-materials, which affect both the electric and magnetic components of light, rather than affecting only the electric parts like natural materials. This feature, along with the lattice-like weave of the cloak, allows the material to bend the light around an object. Modern science and technology is allowing scientists to create things that were previously thought of as fiction.



This is a diagram that shows how early invisibility devices worked. The incoming light rays (red arrows) are reflected at different angles by the mirrors (blue lines). The result is an image of the area behind the wizard.

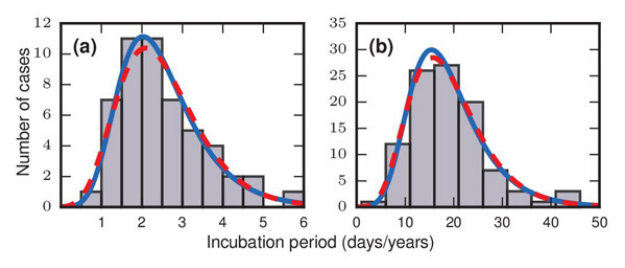
I believe that invisibility cloaks could be huge assets in many fields, and researchers are much closer to developing them than most people think. Cloaking devices would completely change how wars are fought, or even avoided. However, like many other examples of modern technology, they could be used for bad purposes. Invisibility devices would make it much easier to steal and break the law, so they would have to be regulated to ensure safety.

Article : https://plus.maths.org/content/invisibility-cloak

Spaghetti, Chance, and Typhoid- Plus Magazine, January 2018

Summary by Emi H.

On March 17, 1914, a woman made spaghetti for a large crowd at church. The spaghetti, unknowingly by the woman, had typhoid fever bacteria inside. The woman who made the spaghetti did not become sick, but the 93 who ate it did. A question arose from this, why did the time for the 93 people to become sick vary so much? Some people who were infected took 3 days to develop symptoms, and some took 3 weeks. Biologists didn't know why this variation occurred, but there are similar variation patterns with other diseases like measles. There was a peak in time where most people are sick, then the amount of cases drop. There are multiple possibilities of variation one of which is people eating different portions of the spaghetti. Then, mathematician Steven Strogatz and his colleagues created a model that shows how the disease infects the body. It shows how the incubation period of a disease varies because of chance and probability. The model represents healthy resident cells fighting against the invader bacteria cells. All the cells are connected to make "neighbors". The invaders can influence their healthy neighbors, infecting them with the disease. Once all healthy cells are infected, the disease has successfully infected the person. A number "r" represents the person's fitness, or fighting power. The incubation period starts off with only one invader, and one cell is chosen at random to be infected with a probability proportional to the fitness number. The invader's offspring infects the neighbor by killing and replacing it. The neighbor being infected is chosen at random, and they all have the same probability of of being picked. The incubation period is the number of times this process has to be repeated to have all cells invaded. Eventually the whole network will be infected, but the invaders will be slowed down because of probability. Invaders can not only infect healthy residents, but they can infect other invaders. By killing invaders, this slows down the whole process. In the beginning it is easier to only infect residents, but as the number of residents goes down, it is harder to infect only them. The chance of infecting a resident goes down as the number of invaders grow. This wait for all residents to be infected is what makes incubation periods longer. The sooner all cells are infected, the sooner symptoms will show. All in all, the incubation period of the disease varies because of chance and probability. I thought is was really interesting how we can use math to find explanations for things going on in the world.



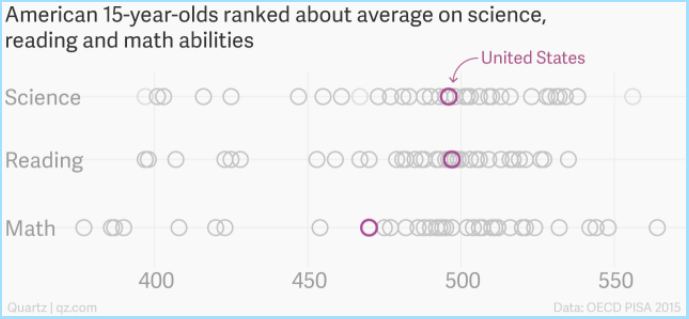
The grey bars represent the number of people who developed symptoms after a period of time. In graph a, time is measured in days, and it was after a streptococcal outbreak. In graph b, time is measured in years, and it was after a study of dye factory workers getting bladder tumors. The dashed red line and blue line represent probability distributions of the diseases. The graphs indicate that the incubation period might follow this pattern for many diseases.

https://plus.maths.org/content/beware-spaghetti

“US Students Aren’t Bad at Math-- They’re Just Not Motivate” - Quartz November 2017

Summary by Madeline F.

American students are just average at math based on the PISA test, but according to a recent study, their motivation might be the culprit for their sub-par scores. The Program for International Students Assessment is a test given to thousands of fifteen year olds in seventy five different countries, every three years. During the 2015 assessment Americans scored less than average on the Math test. Researchers then wondered why the American’s scores were suffering and wondered if the reason was their motivation. The researchers gave students in the US and China twenty five questions, and they gave some students, from both countries, money for each question they got correct. The results were expected. The American students who had the cash for every question correct scored undoubtedly better than the Americans without the cash offer. The Chinese scored were effected little to none. If the cash bonuses were added in 2012, then the Americans would have scored 19th in the PISA, then their low 36th. This study shows that the American students were not showing their full abilities on this test. Which means American teens are smarter than you think, just less motivated.



American scores on the 2015 PISA test from:

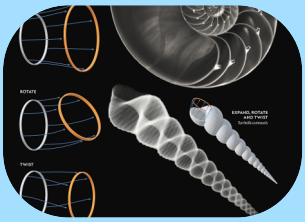
https://qz.com/1130505/us-students-arent-bad-at-math-theyre-just-not-motivated/

Comment: This article shows how Americans are portrayed as dumb and self-absorbed, especially the younger generations, but we may actually be smart. Lots of peoples lifestyles in America are very busy, and you need to work hard to be good. Everything is ultra-competitive, like sports, academics, and social lives. If its so hard to succeed, and people are already stressed about everything, when you throw a test in front of them that means nothing, how will they respond? They will be told to “try their best” but if they already are doing their “best” in many other activities, why will they go full out on this test. The cash advantage changed this because they had something to gain, money, which is one of the most important things in our society. I think Americans are not motivated on

“How Seashells Take Shape”

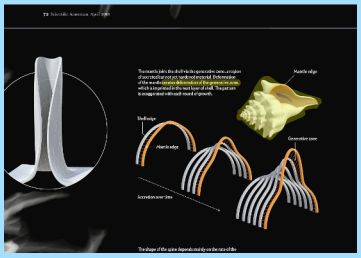
A Summary by Genevieve S.

The article “How Seashells Take Shape” is about how seashells are made, how some seashells form spines or ribs and the mathematical modeling they used to figure out how these patterns form. The mathematical modeling they used was Physics-based mathematical modeling which used differential geometry, the study of curves and surfaces. For seashells to be made the mollusk’s mantle has to secrete layers of a substance that is rich in calcium carbonate at the aperture, which is the opening, of the shell. To create the shell pattern, there are three rules the mollusk has to follow. Rule number one is to expand, the mollusk deposits more of the substance which creates a slightly larger aperture as it mores along. This creates a cone from an initial circle. Rule number two is to rotate, by the mollusk depositing more material on one side of the aperture it achieves rotation of the aperture, similar to a donut shape. Rule number three is to twist, by rotating the points of deposition and this creates a nonplaner, helicospiral shell. If the mollusk only expands and rotates then the mollusk will have a planospiral shell similar to a nautilus’s shell. To know how a spine is made it is important to know the mechanical system. First there is the generative zone which is a region of secreted but not yet calcified material and then the mantle which is attached to the shell by the generative zone. For a spine to form there has to be a mismatch between the mantle and the aperture that will lead to a physical stress in the mantle. So if the mantle is too small for the aperture then it will have to stretch, if the mantle is too large then it will have to compress, and if the generative zone is deformed as a result of the stresses then the secreted material will solidify in the deformed shape. The spine is formed during a growth spurt in which the mantle develops so quickly that it cannot align itself with the aperture and this causes the mantle to buckle slightly. And when the mantle secretes more material it will take the buckled shape. And this continued buckling pattern creates the spines. The best way to see ribs is to use the shells of ammonites, which is a group of extinct mollusks. In ammonite the aperture is pretty much circular. And if the mantle radius is larger than the aperture the mantle will compress, however not to the degree of elastic instability needed to create spines. The compressed mantle pushes outward and the shell radius has become larger. Yet the outward motion is opposed by the calcifying generative zone. The effect produce by the two opposing forces is an oscillating system; the shell radius increasing but causing state of tension from the stretched mantle; then stretched mantle pulls inward creating state of compression. And this continued pattern of this morphomechanical oscillator creates ribs.



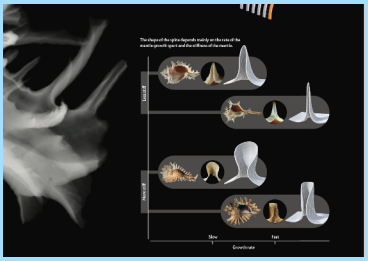
Caption 1:

How seashells are made



Caption 2:

How seashell spines are made



Caption 3:

How the speed of growth affects the type of spine

Caption 4:

How seashell ribs are made

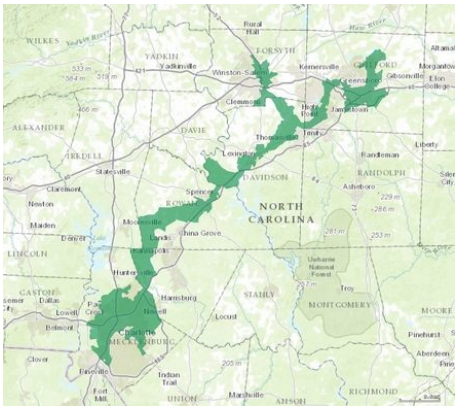
Mathematicians Invent a Tool to Judge when Voting Maps have been Unfairly Drawn

Annie B-F

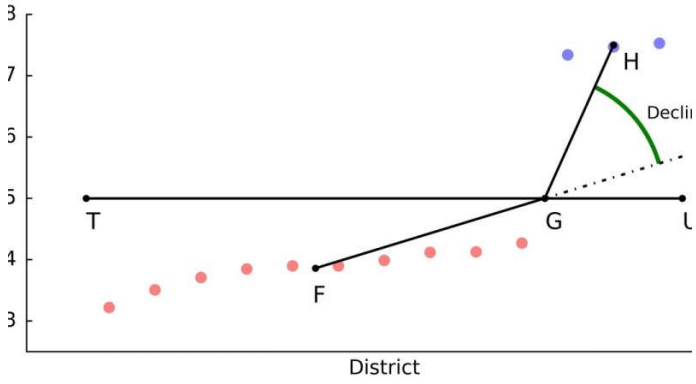
https://phys.org/news/2018-03-mathematicians-tool-voting-unfairly-drawn.html

The article, "Mathematicians invent tool to judge when voting maps have been unfairly drawn," explains the phenomenon of gerrymandering and how to best detect for certain when it has taken place. In our current voting system, states have to be divided into districts of equal population in order to count votes for political elections. Gerrymandering is when districts are drawn to favor a political party. Politicians utilize gerrymandering to influence elections to their party's advantage, especially in swing states like Pennsylvania and Ohio. Greg Warrington, a University of Vermont mathematician, has been working on the best way to determine if gerrymandering has occurred. There is no single way to test for gerrymandering because there is no exact standard of what it is. Warrington's method uses three major techniques to decide when gerrymandering has occurred: focus on 50%, shift from shape, and packing and cracking. Focusing on 50% looks at how large a percentage each district won by. For example, if districts have been drawn fairly for both parties, then plotting the district's voters from least to greatest for each party would form a straight line. If plotting the points causes "a sudden turn at 50%" then this can be a warning that districts have been gerrymandered. Shifting from shape refers to the fact that in the past, districts have been suspected of being gerrymandered if they had odd shapes. Warrington says that we should move away from looking at shape and compactness as a major factor because some districts have been drawn in non-traditional shapes so minorities can have representation. He also says that a district could have been gerrymandered even if it has a regular shape. The third way to detect gerrymandering is though packing and cracking. This means that members of a party who are underrepresented are "packed," or concentrated, as much as possible into a few districts, and then "cracked"' or spread, in smaller numbers across the opposite-party districts, which would then win by being just over the 50% majority. This way, most of the districts would still go to the gerrymandered party by a small amount. Warrington believes that if the Supreme Court were to decide that partisan gerrymandering is unconstitutional, with the additional use of these methods, a standard that could be used in court cases could be created.

I really enjoyed reading this article because I think it is important to solve the problem of gerrymandering so that everyone's vote counts and so our politicians are an accurate representation of the countries political views. The methods that the researcher came up with seemed like they would be good ways to detect gerrymandering.



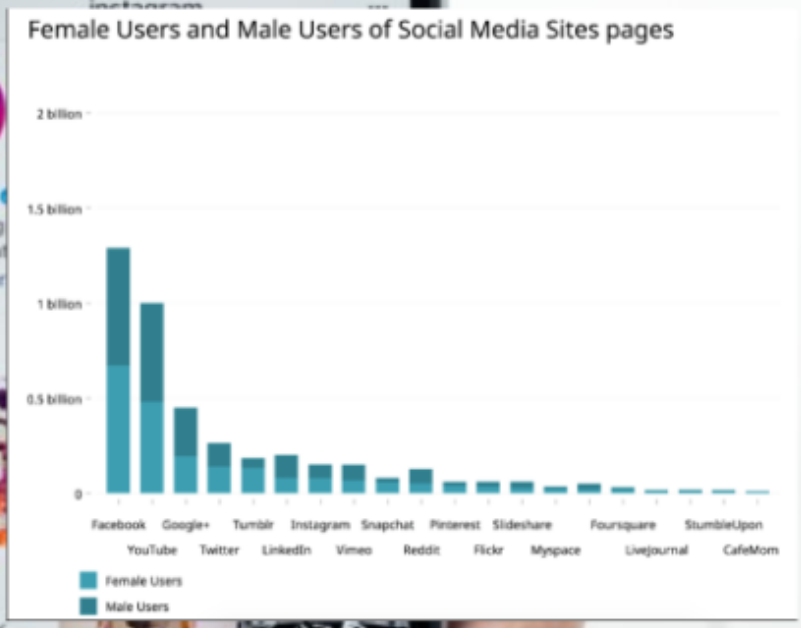
North Carolina's much debated twelfth district, said to give minorities representation



Graph of what percentage each district won by from a most-likely gerrymandered state

"How social networking sites may discriminate against women"
ScienceDaily, April 20, 2018

In this article, Columbian researchers are testing to see if social media sites can discriminate against women with just one loose algorithm. Homophily is a network effect where similar people are grouped together. By doing an experiment on Instagram in 2014, they were able to conclude that algorithms that run free on a network with homophily were more likely to be gender biased, but because they are amplifying the slight divide that was already there. Women were already less likely to get as many likes or comments as men did, but once the algorithms came in, the divide widened even more. One of the main points of their research was to show how certain algorithms can pick up patterns, and how this may create a disadvantage. Although there were more female users than male, the data showed that male users tended to receive more responses on their posts than women. The data also showed that homophily had an influence on it as well; men were 1.2 times more likely to comment on another man's post than a woman's. On the other hand, women were 1.1 times more likely to comment on other women's posts than men's posts. When using two common recommendation algorithms, they found that the amount of women recommended to at least 10 other users fell by more than 10%. When letting the algorithms (all of them, not only the recommendation ones) turn loose, researchers found that women's visibility dropped dramatically. As Augustine Ghaintreau - the study's senior author - said, "Algorithms pick up subtle patterns and amplify them". In other words, it was picking up on something that was already there, and amplifying it. It just goes to show how a social network can be influenced in the long term, just from an algorithm. So far researchers have been learning more about what not to do to promote these types of things, but are still looking for solutions. In summary, these algorithms that run on the assumption of homophily put women at a further disadvantage because they deepen the discrimination that was already there.



This visual shows the amount of each gender using each social media site

https://www.sciencedaily.com/releases/2018/04/180420170621.htm

“Sharpening that Competitive Edge” - UDaily, December 2017

Summary by - Amelie W-B

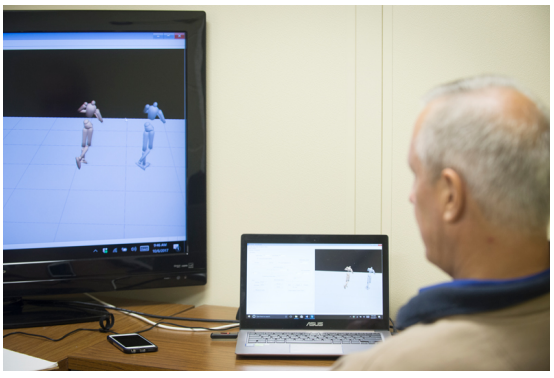
Throughout the past decade, an increasing number of young skaters have made their way to the University of Delaware ice arenas. Why? Many of these skaters include the top United States’ competitors, and they’re here for one reason - the magic of biomechanics analysis. The biomechanics analysis, lead by Jim Richards, distinguished professor of kinesiology and applied physiology in the College of Health Sciences, starts with placing ten cameras around the ceiling of the rink. Small markers covered with retro-reflective tape are attached to the skater, and the cameras capture the light that is reflected from the skater during the jump. The camera only collects a grouping of red dots, but these dots provide the data necessary to create the computer models. The data collected shows the skater’s precise air position, time, and speed. The first three-dimensional computer model shows the skater’s original jump using the data collected by the cameras. The second computer model is a mathematics-based model, which is created to show what the jump would look like if certain modifications were made, such as if a skater tucked in their arm more. Jumps like triple axels and quads require 3–3 ½ rotations in the air, which is 1,080-1,260 degrees of rotation (360 multiplied by the number of rotations). Anything from improper air position to an incorrect take-off will cost a skater rotation speed, and this reflects in the data that the cameras collect. Jumps require rotational energy and angular momentum, which many of the tested skaters have enough of. Under-rotated jumps are common problem in many figure skaters who attempt these difficult jumps, even at the highest levels, but it is possible that a change in arm position could be the only modification that is necessary to fully rotate the jump - and UD’s biomechanics analysis will show this.

Article Link: http://www.udel.edu/udaily/2017/december/figure-skating-biomechanics-olympics/

Video Link: https://m.youtube.com/watch?v=hD87AbzjilY

Personal comment:

This article caught my attention right away, because it includes figure skating and physics, which are two things I’m really interested in. I also enjoyed this article because I can relate to it a lot. As a figure skater working on triple jumps myself, I find it interesting that so many things can be a factor during a jump, and that mathematics based models can actually show you the jump of you made certain modifications. I know that things like height and rotation speed are the two most valued factors in a jump, but some of the other factors get overlooked. For instance, I have very fast rotation speed and good height, but if my air position isn’t exactly how it should be, it costs me a lot of air time, which leads to either under-rotated or downgraded jumps, which affect competition scores greatly. I know this article has not only taught me more about mathematical applications and physics, but also valuable information I can take with me to the rink.



The computer takes the data points and turns them into 3D models, one showing the actual jump, and the other showing the jump with certain modifications.

THE SUPREME COURT IS ALLERGIC TO MATH

SHAILA B.

In this article Oliver Roeder explores the roots behind the Supreme Court's aversion to the use of mathematics in their cases. There are many instances in which the Supreme Court have, in the words of Ryan Enoch, a political scientist at Harvard, "dismissed evidence based on sweeping statements, gut reactions, and logical fallacies". The justices have ignored and misinterpreted quantitative evidence multiple times, and Roeder speculates how this is tied into the outcome of the cases the court takes on.

In a recent case involving gerrymandering, the justices argued the use of the efficiency gap for the process. The efficiency gap is a simple mathematical equation in which you record the number of "wasted votes" (votes for the losing part and votes for the winning party that go beyond what was needed to win) and divide that by the total number of votes. It is an extremely simple equation that would provide a more accurate solution for the gerrymandering situation, yet the justices objected. They described that using the math would be "unwieldy", "complicated", "newfangled", "baloney", and in an interview with Chief Justice Roberts, he used the phrase "sociological gobbledygook". The infamous g-word had not been used often in the history of the court, so when he applied the term to this concept he felt very strongly about the matter.

The logic of other political scientists was that the more complicated a process is, the more math needed to identify it, the less likely the court will be able to find it unconstitutional, therefore opposing the majority opinions of the justices. In conclusion, Roeder speculates the court's future and suggests considering to have them hire trusted staff or social scientist to "pursue empirical arguments", to have the courts alter their norms and social standards regarding the consideration of statistical evidence, and to take the math more seriously in general.

I agree with Mr.Roeder on this matter, as having quantitative evidence to back up an argument will make cases stronger and will provide more backup for a more efficient and effective process.

Maths in a minute: Dark matter

Plus Magazine, March 27, 2018

Summary by - Daniella N.

Physicists around the world presume that 82% of all the matter in the universe cannot be seen. This presumed matter is called “dark matter”, and cannot be seen because it does not interact with light - more specifically, electromagnetic radiation. Although we cannot see it, it is theorized that dark matter exists because of science and calculations made in math. Evidence of dark matter was first introduced in the 1930s, but was only taken seriously in the 1970s. Evidence shows that galaxies seem to be held together by the pull of gravity of more materials than can be seen. By observations made of galaxies in groups, scientists calculated the amount of gravity holding these galaxies together. Using these calculations, scientists were able to predict that if this supposed dark matter were not present, and therefore none of its gravitational pull, these observed galaxies would fly apart into space. In a nutshell, if there were no dark matter present, objects in orbit would not have enough gravitational pull to keep them in orbit, and they would fly off into space. In the 19th century, scientists came to reason that another planet must exist because “the orbit of Uranus was deviated by the pull of a more distant unseen object”. These scientists were right, and this planet soon came to be known as Neptune. The same reasoning was sed to predict the A galaxy, which contains abundant dark matter. The existence of Neptune is the reasoning used in the theory of dark matter: the way that stars and galaxies move show that something unable to be seen would have to be applying gravitational pull for these objects to move the way they do. This invisible source of gravitational pull is thought to be dark matter. Along with these two pieces of evidence, the observations of motions of objects in space show that these objects (ei. planets) are moving at a surprisingly fast rate. These objects are moving too fast to be balanced by only the gravity of the stars and gases that are visible around them. The only feasible explanation for the extraordinary speed of these objects is dark matter. Physicists have many theories as to what dark matter could be made of, and although we cannot see it, much evidence points to its existence, and more information is still being gathered on this mysterious dark matter today.

https://plus.maths.org/content/maths-minute-dark-matter

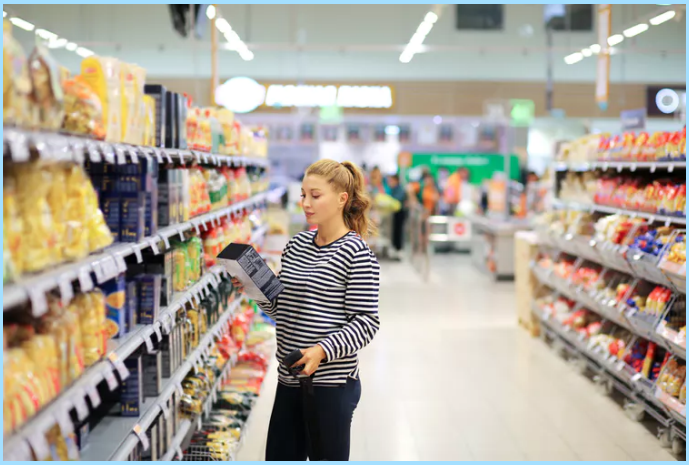
High Number Of Adults Unable To Do Basic Mathematical Tasks- The Conservation, March 2018

SUMMARY BY- EMME P.

https://theconversation.com/high-number-of-adults-unable-to-do-basic-mathematical-tasks-92858

If three apples cost US$3.75, how much would one apple cost? Although this question may seem like it is very easy to solve, a large number of adults across the world struggle to find answers to simple problems like this, even if given a calculator. (The answer is US$1.25) Data compiled from the OCED and the PIAAC show that when asked a simple financial question, many adults are unable to find the answer. Even in the highest ranking countries, Lithuania, Austria, and Slovakia, 1 in 4 adults failed to give the correct answer. In other countries the numbers were much worse. In the USA, 4 in every 10 adults failed to give the correct answer. Of course, this is based on the whole country, not specific groups. While compiling the data, it was found that men tended to perform slightly better than women, and that younger people performed better than older people. In addition, the amount of education a person had received greatly affected how well they could solve simple financial problems. Because so many adults fail to do basic mathematical tasks, it is important for stores to make prices as simple and straightforward as possible, so that people know how much they are spending. If not, a large portion of the population of the world is at a high risk of making major financial errors.

This article was interesting, informational, and laid out very well. The topic is an interesting concern for our economy, and the title grabs readers. The text is highly informational, including statistics and a graph to prove the points stated. Finally, the story is laid out very nicely. The story is easy to follow and understand. Overall, the Conservation did a very good job on this published article.



The Math Behind Flu Season

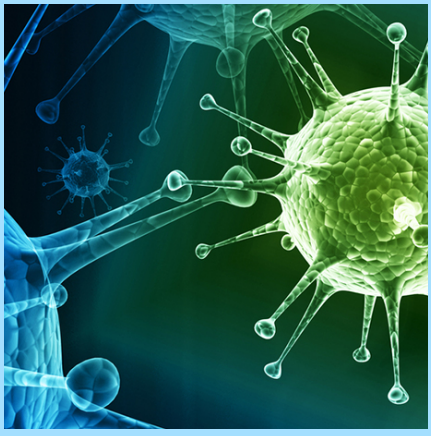
The Wall Street Journal, February 23, 2018

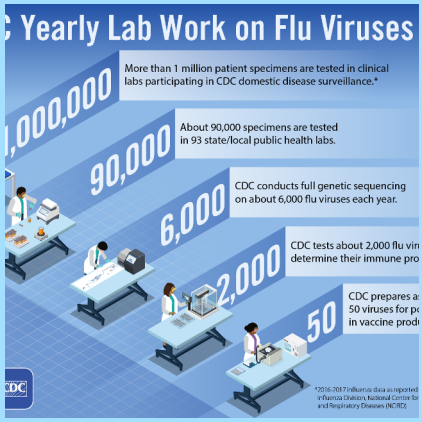
Summary by Gloria K.

Every flu-season people get their vaccines and hope not to fall under the wrath of the relentless flu but many people don't know about the math that goes into estimating and analyzing the impact of the disease. Every flu-related doctor's visit, lab conformation of influenza, and death due to the flu in hospitals is recorded and sent to CDC. There are five age categories that all types of hospital visits regarding the flu fall under, which are less than 5 years old, 5 to 17, 18 to 49, 50 to 64, and 65 and over. Since only a certain number of people affected by the flu visit hospitals, the CDC sends out a medical survey to see how many of those affected visited the doctor. The CDC then uses the percentage of people who said they have consulted a doctor about the flu and multiplies that by the amount of people hospitalized to find the amount of people who had the flu but were not recorded by hospitals. Furthermore, the CDC finds the number of deaths related to the flu by using influenza-positive rates from lab tests which help determine if the death was related to the flu or another illness. Deaths related to the flu are somewhat more difficult to calculate than people who fall under the flu because the flu can lead to other types of illnesses that can contribute to death like pneumonia. Since death has so many variables, researchers aren't always certain whether the death was related to influenza so their data of mortality is not as accurate as of people who have contracted the flu making it hard to infer the amount of people who will die in the following year due to the flu. The CDC uses all of it's data to try to make more effective vaccines for the following year. The data gathered and analyzed by the CDC helps us understand influenza better making us one step closer to complete prevention of the vile flu. Moreover, the article is very informative but I wish it had more information of prior flu seasons for more background of the relentless virus. More background information would have helped the understanding of how important math is to helping lessen the affects of influenza for readers.

Link to Original Article:

https://www.wsj.com/articles/the-math-behind-flu-season-1519390800





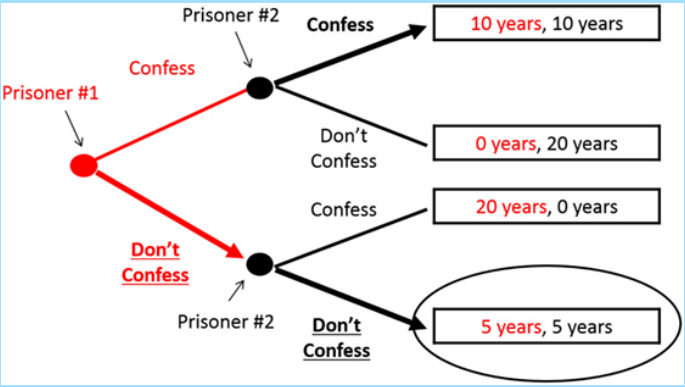
Game Theory and Cooperation: How Putting Others First Can Help Everyone -- Frontiers, December 18th, 2017

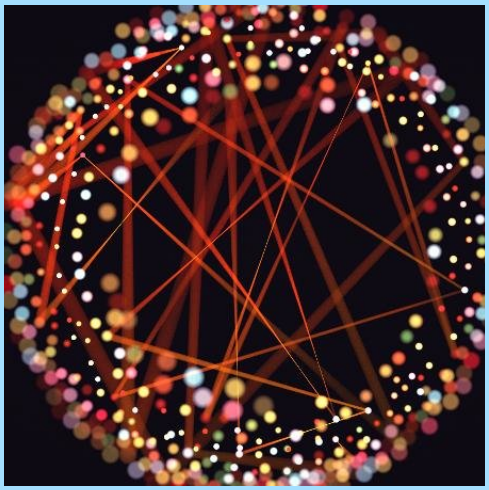
Summary by Iman S.

https://kids.frontiersin.org/article/10.3389/frym.2017.00066

In Game Theory, a game is when people's decisions affect one another and 2 or more people have to make a decision. Game theory is used to predict how people will act in a specific situation. Almost anything that someone does is a game. The prisoners' dilemma (PD) is a popular game created by Albert Tucker, a Princeton mathematician, which explains that sometimes being selfish will make everyone worse of. In the PD, the police have arrested two criminals—P1 and P2—on a charge which carries a prison term for five years. The police, however, suspect that the two criminals also committed armed robbery, which carries a term of up to 20 years. The two criminals are placed into different cells, and each are told, "if only you confess, you get to leave jail today. If neither of you confess, you'll both spend five years in jail. If both of you confess, you'll spend ten years in jail. And if you are the one that doesn't confess, you'll spend 20 years in jail." In this situation, it is predicted that both prisoners will confess and spend ten years in jail. The reason why is that P1 and P2 both are better off confessing so they both are likely to confess. In this scenario, the prisoners confessing is an example of a dominant strategy, or the action that gives an individual the greatest reward no matter what the other people choose to do. While this may not seem to apply to real life, it actually does. For instance, when there is a bully, most kids will decide not to stand up to them. The reason being is because each individual is better off not standing up to the bully because the bully likely will go after whoever stands up. So each kid follows the dominant strategy of never standing up, and the bully is never stopped. In this game, everyone ends up worse if they do what is individually best for themselves. Therefore, in order to prevent a worse outcome, people need to either change other people's motives or make a promise. In the PD, suppose P2 told P1 that if P1 didn't confess, P2 wouldn't. They then both end up with five years in jail instead of ten. So, game theory proves that being nicer does benefit everyone.

In my eyes, the article was a good read. It explains game theory, which is kinda complex, in a simple and easy-to-understand way.





Artistic depiction of an incredibly complex protein network within a cell

"Math Sheds Light on How Living Cells 'Think'"- Phys.org, May 2018

Summary by- Robin H.

Cells are tiny but almost unimaginably complex. They have numerous systems to complete tasks imperative to maintaining homeostasis in the body, performing mitosis and meiosis, and allowing us to sleep, breathe, and eat. But how do they know how to do all of these things? Dr. Robyn Araujo, a researcher at the Queensland University of Technology, unlocked the mystery of perfect adaptation by using mathematics.

Perfect adaptation is how a cell (or system), after long periods of exposure to a stimulus, can 'reset,' or return to base level or activity. A common example of this is smell. If you enter a room and it smells bad, you'll notice the smell at first, but after a while the smell will just fade into the background. This allows for cells to keep base activity normal to maintain homeostasis.

Dr. Araujo realized that all networks that experience RPA (robust perfect adaptation) can be sorted into two classes. These two classes show the shape of all networks that are capable of RPA and they show that evolutionary processes can be carried out by simple design principles, even if the networks that perform RPA can become extremely large and complex. Using this information, Dr. Araujo was able to create an algebraic equation that accounts for all networks capable of RPA.

The equation that Dr. Araujo found relies on three complicated factors: the route factor (the pathway through the network is unbroken), circuit products (feedback loops), and kinetic multipliers (a cycle could be composed of one node).

This equation could help scientists modify cell networks more efficiently, which could advance cancer therapy. It could also help us understand our immune defenses, hormone system, and brain neuron signaling adaptation. Without math, none of this would be possible.

This article was really interesting to read, and also relates to what we're learning about in science this year. The article was a summary of a study written by Dr. Araujo and a colleague. Along with reading this article, I referred to the study to get more in-depth information about certain parts of the concept. It was really cool to see how mathematics can be used to explain a complicated scientific concept, and how both math and science were used in making this discovery.

Article Link: https://phys.org/news/2018-05-math-cells.html

Study Link: https://www.nature.com/articles/s41467-018-04151-6

This Episode of "Arthur" Gets Basically Everything Right About Math- dy/dan, December 2017
Summary by - Maya A.

https://blog.mrmeyer.com/2017/this-episode-of-arthur-gets-basically-everything-right-about-math/

"Arthur" is a children's television program that teaches kids lessons about life. In the episode "Sue Ellen Adds It Up", the show teaches kids three important truths about math. The first lesson that the episode teaches is that everyone is a "math person". When Sue Ellen is convinced that she isn't a "math person", her friend Prunella convinces her that everyone is a math person, but people can also be interested in other areas such as art. The next lesson that the episode teaches is that though formal mathematics isn't necessarily always used in the real world, it is very helpful to know, and people often use their math skills in real world situations without realizing it. Sue Ellen says that she and her family have never needed to use math anywhere outside of school. She claims that they rely on estimating and using the guess-and-check system, but what she doesn't realize is that these methods are just different ways of doing math. Prunella points this out to Sue Ellen, and shows her that math is everywhere. The last truth about math that is shown in this episode is that even if it may seem like formal math isn't useful in everyday scenarios, there are limits to what informal math can be helpful with. For example, Sue Ellen creates a painting to go on a certain wall in her house, but due to her lack of measurement, she accidentally makes a painting that is too big for the space she wants to use. She is forced to use calculation and measurement to crop her picture into a size that fits the space, but still preserves the important parts of the painting.

I thought that this was a really well written article, and it had some very good points about how this episode of "Arthur" teaches lessons about math. While this is true, I don't necessarily agree that the episode gets everything right about math. Overall, I still think that it was a good article and it was very interesting to read.

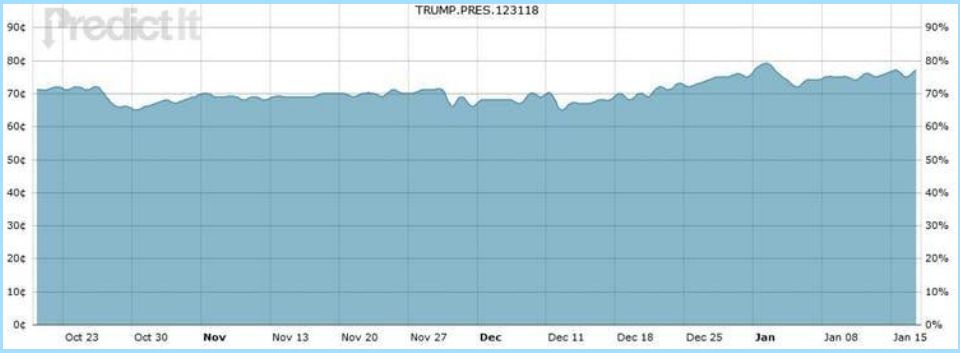
The Conversation

January 2018

Naomi F.

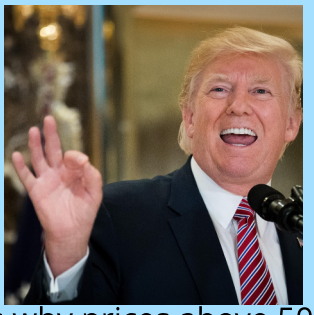
What are the odds of Trump surviving 2018 in office? An expert crunches the numbers

Donald Trump's presidency has been very chaotic compared to past presidencies which sparks controversy over whether Trump should remain in office or be impeached. In Fire and Fury, Bannon says that Trump only has a 33.3% chance of completing his term in January 2021. While forecasting experts have their thoughts and opinions, betting and prediction markets have been proven to be more dependable. A prediction market is a financial market which allows people to bet on a future outcome.



(Chances of Trump staying as president for 2018 over 90 days)

For example, if the market asks "Will Donald Trump be president at year-end 2018", the yes asset will pay 100 cents if he is in office and 0 if he isn't. The asset price is between 0 and 100 cents, exactly like a probability is. Research has demonstrated that betting markets are good predictors for future outcomes. For example, whenever the asset price is 60 cents, 60% of the time, the outcome does happen, etc. proving that prices often correspond to probabilities.



Other studies find that assets due in over half a year could have a bias, which is why prices above 50 cents tend to be larger than actual probabilities. Currently in the Trump case, the yes asset trades at around 77 cents, saying that there's 77% or less chance that Trump stays in office this year. Out of the 57 US presidential terms, nine ended early which means 84% of terms were fulfilled. The expectation for him to make it to next year (77%-not even the whole term) is lower than the historical average. Although there are many threats to his presidency including but not limited to; the Mueller investigation and early stage dementia rumors, the crowd still believes that Trump will have more of a chance of surviving 2018 as president than being impeached. Another market asks "Will Trump be president at year-end 2019". Obviously, the probability is lower because he cannot continue to be president in 2019 if he was removed from office in 2018. Currently, the trading cost for the yes asset is 62 cents. All in all, Trump is more expected to continue in office till year-end 2018, but in comparison to past presidents, he has significantly lower chances of staying in office.

Link to article:
https://theconversation.com/what-are-the-odds-of-trump-surviving-2018-in-office-an-expert-crunches-the-numbers-90047

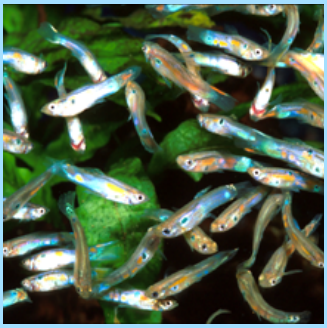
"Many Animals Can Count, Some Better Than You"

The New York Times Feb 5th 2018

Summary by Cate G.

Many of us as humans think of our brains and smarts as leaps and bounds apart from other animals, and while we are right in some ways, math is not one of them. One example of an animal's sense of number is the túngara frog. The male túngara frog in Central America will let out its call for breeding with "a long downward sweep" and a "brief, twangy,... chuck", nntil another male frog lets out its breeding call. Then the frog will add two chucks to his call. They go back and forth adding on until they reach the limit of six or seven. The female frogs are counting the chucks and will mate with the frog with the highest number. Their brains are able to do this because they are able to count the pulses. Another example of number sense in animals is in small fish. Small fish are likelier to survive in schools. So they are able to head count the amount of fish in a school to deduce which school has a larger amount of fish. Guppies have a "contrast ratio of .8" so they are able to decide with very close accuracy. Another animal that can keep track of numbers is an orb weaving spider. These spiders are able to keep count of the prey they have in their web. Scientists tried to remove one of their prey and the spider kept searching. This sense of numbers is not only prominent in animals and educated humans. When people are born they have a strong sense of numbers. Numbers less than five are closely related among many different languages. One scientist claims that a Neanderthal would be able to understand you if you said one and pointed to yourself. Humans have been using numbers for a long time and scientists have discovered the leg bone of a hyena with nine notches which is probably a number system. I think humans discredit many other animals brains so it is good to have research like this. We think math is something the applies only to us but it applies to everything.

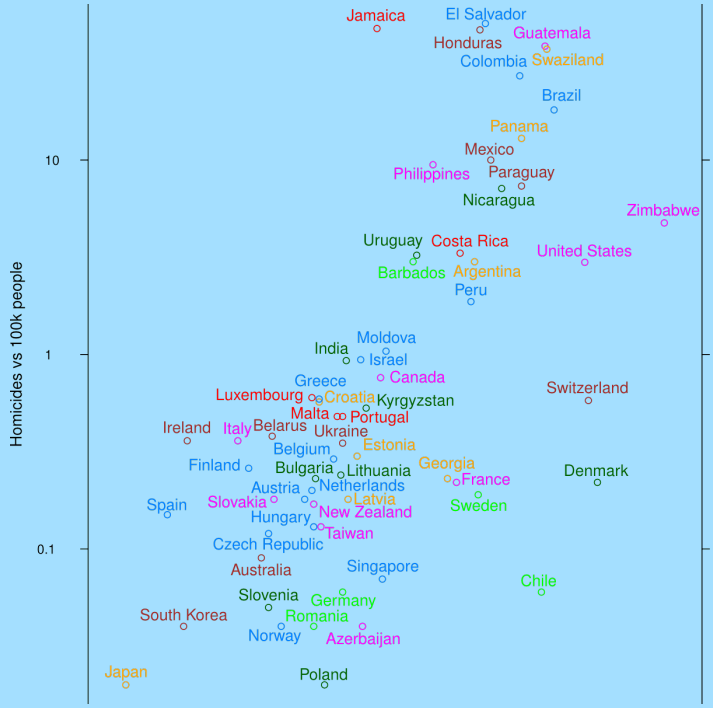
Guppies

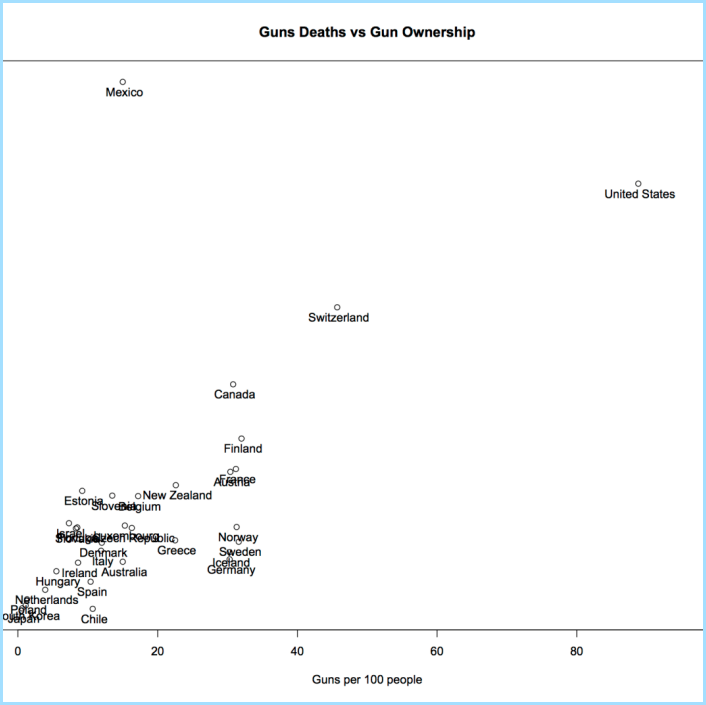


Some Math About Guns— AMS Blogs, March 2018
Summary by — Abigail S.
https://blogs.ams.org/blogonmathblogs/2018/03/12/some-math-about-guns/

Lately, a very controversial topic has been discussed throughout our country - gun control. With all of the school shootings and overall violence with or without guns, it has become clear that the government has to make some changes in order to make our country a safer place. It turns out that math has actually been used to figure out some statistics about guns and gun use all around the world. Research shows that the United States has the most guns out of many of the world's biggest countries (~90 guns per 100 people). Also, there have been 9 deaths per 100,000 people in the United States, the 2nd largest number after Mexico. It has also been found that in places with less money, there is an increased amount of violence. It is also true that people who are planning mass shootings have multiple weapons equipped. This adds to the number of guns owned by people in the United States. The United States has had 29.7 homicides by guns per 1 million people, the most in the whole world. That's six times as many as Canada and nearly 16 times as many as Germany. One of the reasons that the United States has these numbers is because of the Second Amendment. The Second Amendment allows all Americans the right to bear arms which is the right to own and use guns. The United States is one of the few countries that still has this law in place. Although it is legal to own guns in the United States, not all guns are legal. The amount of accessible illegal guns in the United States is more than any other country. Although America is not too big of a country and only holds 4.4% of the world's population, almost half of the civilian-owned guns are owned by Americans. There are approximately 644 million civilian-owned guns in the world and 42% of those guns are in the United States. On an average day in America there is a mass shooting. In 2015 there were 355 mass shootings within just 365 days and since then the amount has continued to increase rapidly. For example, since the Sandy Hook mass shooting in 2012, there have been over 1,600 mass shootings. This remains to be a topic widely discussed because while some people strongly encourage gun ownership, other people are strongly against it.

I found this math to be very intriguing because I am very passionate about gun control. Finding out all these statistics made me realize how bad the issue of guns is not only in our country but in a lot of other countries even if the problem is not as bad in other places.





“Simple Math Shows How Many Space Aliens May Be Out There” NBC News, January 2018

Summary by Catherine B.

In an article by Seth Shostak, the idea of finding an alien society is explored through math. Using simple equations, he finds how many intelligent civilizations are out there, and how close they are to us on Earth. In 1961, astronomer Frank Drake made the Drake Equation, an equation composed of seven terms relevant to finding how many intelligent societies existed in the Milky Way and if they were broadcasting radio signals. Seth Shostak used similar reasoning to figure out how many alien civilizations there are, using simple mathematics. First, they found that research shows that 1 in 6 stars has a planet where life could potentially form. They assumed that at least half of all of these planets do have life, since not all planets that could necessarily do. Estimating that 1 in 100 planets with life have life that is intelligent, the math reveals that about 100 million stars have intelligent life. Though we know it is extremely likely that there are alien societies out there, actually reaching them would be extremely difficult. The average distance between stars is 4.2 light years away, so the nearest aliens are probably 1 or 2 thousand light years away from Earth. The fastest rocket we have today would take at least 20 million years to get there. Since much of this math is estimations and assumptions, we can’t know for certain how close we are to finding another intelligent society like ours. Aliens could be much closer or much farther away then we know, but this basic math he used gives us a good look at the approximate distance from a society of space aliens. His use of math in the article demonstrates how math is used in science and to learn things that interest us. Most people, even if math is not their favorite subject, are curious about another planet that hosts intelligent life. It is unlikely that we will be able to communicate with real space aliens anytime soon, but we can keep trying.

I thought that the article gave me an idea of around how many alien civilizations are out there and what our chances of reaching them are. I was surprised to see how many societies are thought to exist. I wish the math in the article had been clearer and he had shown us exactly what he did instead of just telling the reader his answers. I also think the article would have been better if I understood where some of his estimations were coming from. Despite this, I thought the article was overall fairly easy to understand and well written.

Link to the article:
https://www.nbcnews.com/mach/science/simple-math-shows-how-many-space-aliens-may-be-out-n

How Math Helps Fight Cancer
Ava vP.

Mathematics can be utilized and applied in many different ways to real life. One example of this is finding a technique to overcome cancer. Cancer is the second highest cause of death on Earth, but will hopefully decrease, using the application of mathematics. Cancer is a disease in which cells do not follow regular and healthy growth patterns. One of the major difficulties doctors have faced when trying to combat the disease, is avoiding resistance and relapse in chemotherapy. Standard treatments for cancer have been surgery, radiation therapy, and chemotherapy, which prevents cancer cell growth, however it can cause mutations that are able to withstand the treatment, making it ineffective.

At the University of Waterloo, the Mathematical Medicine Group has been using mathematical and computational skills to attempt to get a good grasp of cancer, how it works, and how to control it. They are working with biologists and oncologists to pull together all their knowledge and comprehension of how cancer functions and how to put an end to it. The team has created models in order to find drug combinations to defeat cancer cells' resistance to chemotherapy. They have attained theories concerning the spreading of cancer cells and how different characteristics can force treatment to be more complex. One theory, "clonal evolution", states that tumors appear on account of genetic shifts overtime. The second theory, "cancer stem cell hypothesis", believes that cancer is caused by a sub-population of "cancer-initiating cells". The "clonal evolution" theory has been disproved by mathematicians and scientists who discovered that chemotherapy was the direct cause of the resistance in cancer cells. They have concluded that a lethal combination of drugs placed in a nanoparticle, is a necessity in the process of stopping resistance and relapse.

Mathematicians have exploited their skills in making models and experiments, which ultimately led to their further understanding of why chemotherapy is not always effective, therefore pushing scientists and doctors toward a solution to cancer treatment. I believe the extensive work will eventually prove an essential role in curing cancer.

Detecting Tsunamis

https://phys.org/news/2018-01-tsunamis.html

January 24, 2018

Summary by: Sophia T.

Tsunamis are extremely dangerous because they are hard to track. Underwater Earthquakes happen when tectonic plates on the ocean floor shift. Earthquakes are also the main cause of tsunamis. Currently, earthquakes are measured by seismic sensors. These devices are very good at tracking when an earthquake is going to happen and the strength of the quake, but they can't tell whether or not a tsunami will follow it. The current technology for detecting tsunamis is relatively inconvenient. Scientists have invented a dart buoy which is a floating detector that senses pressure changes in the ocean. Tsunamis create these pressure changes but the only problem is that the waves cannot be detected before the tsunami hits. These devices don't give enough preparation time before the waves hit the shore and cause destruction. Also, dart buoys are only effective if they are placed around all of the oceans and that can become very expensive. But gladly, scientists have discovered a new technology called a hydrophone that can detect AGWs (acoustic gravity waves) which lead to tsunamis. They can extend from tens to hundreds kilometers in length. These waves are found deep underwater and they occur after large triggering events like an earthquake. Acoustic gravity waves are 10 times stronger than the tsunami itself. Their strength causes plankton and other aquatic animals to follow the current because they can't swim against the current. The waves also spread out in all different directions from the center of the fault so they are easy to find and measure. Once the fault is found, figuring out the amplitude and the level of destructive force can be difficult. But with new science and math, this will be easy to figure out soon.