CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Jacob A. Braun

Project Number
J1301

Project Title
Chance or Design?

Abstract

Objectives/Goals
The objective of the project is to determine if evolution is mathematically probable by looking at the probability of amino acids forming a given polypeptide chain (a precursor to proteins) from a pool of amino acids under optimal circumstances.

Methods/Materials
Twenty Scrabble game tiles, labeled A through T, which represent the 20 standard amino acids in the human body, were set aside. Next, using each of the selected Scrabble tiles only once, a specific desired sequence of letters (representing a hypothetical protein needed for life) was written down. This single protein, identified with the letters BAGFJPONESTKCLDRHIQM, was chosen in order to simplify the experiment, since proteins found in the human body average in excess of 300 amino acids in length.

The 20 Scrabble letters were then placed in a bag, which was shaken for five seconds, and all 20 Scrabble tiles were then drawn out of the bag, one at a time, in order to see if the specific desired sequence of letters could be drawn. This process was repeated thirty times.

Results
The desired sequence of letters was never drawn. In fact, only 2 of the 30 draws even began with the same first letter as the sequence, and none of the draws contained the first two letters in the specific desired sequence.

Conclusions/Discussion
In conclusion, evolution tested to be mathematically improbable. The odds, using only 20 Scrabble tiles to draw the specific sequence for the hypothetical protein, are 1 in 2.433x10^18 (or in excess of 2 billion, billion), which is more seconds than there are in 70 billion years.

With proteins in the human body averaging in excess of 300 amino acids in length (and assuming the same mathematical probabilities as applied in my experiment), the likelihood of random chance properly assembling a single protein comprised of 300 amino acids is 1 in 300! or 3.0606 x 10^614 (which is 1 with 614 zeroes behind it). Mathematicians consider anything with odds greater than 1 in 10^50 to be effectively impossible. Moreover, in order to put the odds in perspective, the number of known electrons in the entire known universe is only 10^69.

I would like to further investigate the nature of amino acids and proteins.

Summary Statement
My project is designed to test whether or not evolution is mathematically probable by testing the aspect of evolution known as "random chance".

Help Received
Mother helped organize and proof read my board; Father helped with some of the mathematical concepts and research.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Stephen J. Chen

Project Number
J1302

Project Title
The Orientations of Dice

Abstract

Objectives/Goals
My objective was to find out whether the orientation of a die would affect the outcome of the roll. I believed that it would in a positive manner; i.e. one number would come up significantly more than any other.

Methods/Materials
Methods
1. Assemble some LEGO pieces into the LEGO Dice-Dropper-Thing-A-Ma-Jig.
2. Place the d4 dice onto the "Dice Platform" of the Dice-Dropper-Thing-A-Ma-Jig with the value "1" facing up.
3. Pull the ratchet of the Dice-Dropper-Thing-A-Ma-Jig back to allow the "Dice Platform" to swivel down and drop the dice.
4. Level the "Dice Platform" of the Dice-Dropper-Thing-A-Ma-Jig to allow for next testing.
5. Record result in spreadsheet on computer.
6. Repeat steps 2-5 999 times.
7. Repeat steps 2-5 1000 times, but with the value "2" facing up.
8. Repeat steps 2-5 1000 times, but with the value "3" facing up.
9. Repeat steps 2-5 1000 times, but with the value "4" facing up.
Materials: 1. One(1) LEGO Dice-Dropper-Thing-A-Ma-Jig[Made of various LEGOs]; 2. One(1) d4 dice [Four-Sided Dice]; 3. One(1) Computer; 4. One(1) Microsoft Excel Software; 5. Paper; 6. One(1) Printer.

Results
The orientation of a die does affect the outcome of the roll, but negatively; i.e. one number came up significantly less than any other. That one number was different for each of the four different orientations of the die which would remove doubts about it being a weighted die.

Conclusions/Discussion
Although the results did indicate influence with orientation of the die, it was not as I expected. I originally thought that the die would turn up a specific number more often than others. Instead, it happened in the inverse: A specific number turned up less often than others. So orientation dropping does help if you want to avoid a specific number, but it doesn't really help if you want the outcome to be a specific number. Also, I had tested only a d4 dice, which means most of my results don't apply to any other types of dice. Someone will have to take the time and do that themselves.

Summary Statement
Does the orientation of a die affect the outcome of the roll?

Help Received
Brother helped record results

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Camille I. Davis

Project Number
J1303

Project Title
Awesome Algorithms

Abstract

Objectives/Goals
To test the efficiency of the three sorting algorithms that I selected, I had to create a random set of data for the algorithms to sort, and write a program to record how long it took for the algorithm to sort the data. One of the problems that I encountered was that some of the algorithms codes that I used could not be compiled because of multiple errors. I also had to find a code that would record how long it took for the algorithm to sort that data.

Methods/Materials
Computer System: Operating System: Microsoft Windows XP Professional; Model: Dell Latitude C840; Processor: 2.00 GHz Mobile Intel Pentium 4; Memory: 1.0 GB RAM. Programming Language/Compiler: Java SDK 1.5.0_09; Java 2 Runtime Environment, Standard Edition 1.5.0_09-b03; Java VM 1.5.0_09-b03. Editor: TextPad 4.7.3.
1. Obtain Java code examples of the sorting algorithms (BubbleSort, QuickSort, MergeSort, and HeapSort) from the world wide web. The Java code for each algorithm is compiled in a separate program, a program representing each algorithm.
2. Write a program (TestSort) to create the data, run each sort on the data and print the results to a file.
2.1. TestSort creates an array data structure that can store 10,000 records, 50,000 records, and 100,000 records. TestSort is recompiled each time the data structure size was changed.
2.2. The actual data simulated SAT scores that ranged from 1 to 2400. The data is generated using a random number generator (Math.random).
2.3. For each record set (10K, 50K, 100K) each sorting program runs to sort the data.
2.4. The data and the results from the sorting programs are printed out to a file.

Results
Overall, the heapsort algorithm sorted the data the fastest. My experiment was to examine the efficiency of sorting algorithms, which utilized the quicksort, heapsort, and mergesort algorithms. The results of my experiment demonstrated that the heapsort algorithm sorted the data most efficiently. My hypothesis was incorrect. The quicksort algorithm was the slowest algorithm I tested excluding the control.

Conclusions/Discussion
My hypothesis was incorrect. The quicksort algorithm was the slowest algorithm I tested excluding the control.

Summary Statement
My project is about the efficiency of sorting algorithms when it comes to sorting data.

Help Received
My father helped me write the Java programs.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Erin E. Gudger

Project Number
J1304

Project Title
Shuffle Scuffle

Abstract

Objectives/Goals
The purpose of this project is to find out how many shuffles you need to do to play a card game fairly. My question is #How many times do you have to shuffle to have a random deck of cards?# My hypothesis is I think that after seven shuffles I won't be able to detect any difference in randomness.

Methods/Materials
a deck of playing cards, my notebook, a pencil and a computer.
I shuffled various amounts of cards 10 times and recorded their order. I then used the computer to analyze the data for randomness.

Results
I found out that the results depended on the number of cards shuffled. For a smaller sized deck of cards it seemed like I needed fewer shuffles than a full sized deck of cards. For both cases, after 5 shuffles, the cards did not get much more random.

Conclusions/Discussion
It is true that after seven shuffles you will not be able to detect any difference in randomness. However, I found that for a standard deck of playing cards I could not detect any increase in randomness after five shuffles.

Summary Statement
The purpose of this project is to find out how many shuffles you need to do to play a card game fairly.

Help Received
My father helped me with the project and wrote the shuffling computer program I used.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Cole T. Holmlund

Project Number
J1305

Project Title
IPod Shuffle: How Random Is It?

Abstract

Objectives/Goals
To determine whether the shuffle feature in the iPod really plays songs randomly. I believe that it does not play songs truly randomly because it uses a pseudo-random number generator.

Methods/Materials
My iPod, a die, playing cards, and Microsoft Excel. I conducted three tests and one data analysis to test the uniformity and unpredictability of the iPod shuffle. Uniformity and Unpredictability are the two tests that a random number generator has to pass to be considered random. On my iPod I recorded my voice saying "1-2-3-4-5-6". I then compared the iPod shuffle to rolling a die and dealing playing cards, which represent true random events. I also went to www.random.org and got random numbers which are generated by atmospheric noise and compared those numbers to those generated by the iPod shuffle.

Results
From the testing, the iPod shuffle was as random as the true random events it was compared against; it was just as unpredictable and just as uniform as the true random events.

Conclusions/Discussion
Based on my testing, my hypothesis was proven incorrect; the iPod shuffle is random. I have learned a lot from this project about randomness and random number generators and how they are used.

Summary Statement
My project is about the shuffle feature of the iPod, and if the random number generator it uses plays songs in a truly random order.

Help Received
My dad took me to his work to interview experts in random number generation. One of the experts helped make graphs on the computer. My mom helped me with the display board.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Davit Javadian

Project Number
J1306

Project Title
How to Create Tens of Thousands of Colors Using a C Program

Abstract

Objectives/Goals
I hypothesize that by using a C program to increase or decrease the intensity of each one of the red, green, and blue LEDs and mixing the three colors, I can create tens of thousands of different colors.

Methods/Materials
Select a color from the Color Gamut. Then edit the C program to generate the color. Save the file and compile the C program. Program the PSoC chip. Place a color mixing chamber on top of the LEDs. Then run the program in the Demo Board. Repeat this process 6 times.

Results
It was found that in a C Program by varying the intensity of the red, green and blue LEDs one can produce tens of thousands of various colors in the color mixing chamber. The C program mixed proper amounts of each one of the three colors.

Summary Statement
Create different colors by changing and combining intensities of red, green, and blue LEDs using a C program.

Help Received
My father helped me with debugging the C program.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Bryce H. Kobrin

Project Number
J1307

Project Title
If Robert E. Lee Had a PC: Cracking the Vigenere Cipher

Abstract

Objectives/Goals
The Vigenere cipher is a substitution cipher used during the Civil War to encrypt messages with a keyword. The objective of this project is to determine how much text for a given key length is required to crack the Vigenere cipher.

Methods/Materials
I created a Visual Basic computer program to crack the Vigenere cipher using two different procedures, index of coincidence and frequency analysis. Index of coincidence identifies the key length and frequency analysis uses the key length to identify the key. Both procedures are based on the standard English letter frequencies. I tested both procedures on 10 different texts and 100 different keys with key lengths from 1 to 20 letters.

Results
The results for frequency analysis averaged 30 letters in the text for each letter in the key. The results for index of coincidence were more scattered than frequency analysis and averaged 400 letters of text regardless of key length.

Conclusions/Discussion
The results for index of coincidence did not follow any particular trend. I believe this is because index of coincidence is highly key and algorithm dependent. Once the key length is known, then frequency analysis can determine the key if the text is at least 30 letters long for each letter in the key.

Summary Statement
My project demonstrates how the Vigenere cipher can be cracked using a computer program.

Help Received
Father helped me debug the computer program; Mother showed me tricks in Excel.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Ravi Lonberg

Project Number
J1308

Project Title
A Pseudorandom Number Generator Based on a Suggestion by John von Neumann

Abstract

Objectives/Goals
The object of my project was to test John Von Neumann#s idea for a pseudo random number generator and try to modify it to improve the pseudo random number generator.

Methods/Materials
Von Neumann#s idea was written into a computer program (Visual Basic 2005) and tested using the Monte Carlo method. I used a computer (PC) with the program Visual Basic 2005, several Visual Basic reference books, and The Art of Computer Programming by Donald Knuth. I wrote two different computer programs to test two properties of random numbers. Those properties are:
I) A uniform distribution among the number sequence that was generated.
II) The independence of numbers from other numbers (preceding numbers) in the sequence.

Results
The random number generator turned out to be very dependent on the initial starting seed, which often led to unevenly distributed sequences. A big problem was the pseudo random number generator#s inability to recover from the appearance of zero in the sequence. I was able to contribute to John Von Neumann#s pseudo random number generator by reducing the program#s dependence on the initial starting seed and fixing the program#s inability to recover from zero. My final program was able to calculate a good first four digits of pi (through the Monte Carlo Method).

Conclusions/Discussion
The Von Neumann Algorithm was able to generate relatively uniformly distributed random number sequences. But the algorithm wasn#t completely random because numbers within the sequence were dependent on preceding numbers within the sequence. The Von Neumann pseudo random number generator worked, but definitely had some flaws and I was able to fix some of those flaws.

Summary Statement
To test John von Neumann's idea for a pseudo random number generator and modify it improve it.

Help Received
Dad taught computer program commands, Cousin helped arrange board, Mom proofread abstract

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Keegan M. Mann

Project Number
J1309

Project Title
Pseudo-Random Numbers

Abstract

Objectives/Goals
I analyzed the quality of several random number generation algorithms and tested which constants performed best in some of the algorithms. The quality of pseudo-random numbers is crucial to the accuracy of a Monte Carlo simulation and the security of encrypted documents.

Methods/Materials
In my experiment I generated and tested sequences from different algorithms with a program I created in Visual Basic. To evaluate the randomness, I calculated pi with the Monte Carlo method, found the length of the period until the sequence repeats, and I calculated the average. I also measured the effect of changing the constants of the algorithm on the output sequence.

Results
Blum Blum Shubwas best overall because it was best on the most important tests although it was fifth on the test of the average. I was wrong in my prediction that it would be best at all of the tests.
The several versions of the lagged Fibonacci generator performed differently. The exclusive-or version did worst on all of the tests. The multiplication version had repetition but did well on the Monte Carlo pi test and the mean test. The addition version had no repetition, did tolerable on the Monte Carlo pi test, and did well on the mean test. The subtraction version did satisfactory on all the tests although it was not the best.
The Middle square method is not very good, because it repeats, sometimes very quickly. The Linear Congruential algorithm is very bad because although it calculated close to pi and doesn't repeat quickly, when points are graphed from the random numbers, they create a non-random pattern.
My hypothesis was wrong in that the repetition did not always get consistently longer with larger values for M in the Blum Blum Shub formula. For powers of ten, the repetition period was five times larger than the previous power. I also found out that prime numbers seemed to do better than non-prime numbers even when they were close in value.
In the Middle Square formula, contrary to my hypothesis, the repetition length was not directly proportional to the number of digits in the output.

Conclusions/Discussion
Different tests gave different algorithms the varying ratings. I believe that the most important tests were the repetition test and the Monte Carlo value of pi test.

Summary Statement
I analyzed the quality of several random number generation algorithms and tested which constants performed best in some of the algorithms.

Help Received
I received no help

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Craig T. McHugh

Project Number
J1310

Project Title
Benford's Law: Fact or Fiction?

Abstract

Objectives/Goals
The goal of this experiment is to determine weather Benford#s Law is valid or not. Benford#s Law states that lower digits appear as the first digits of a number of a numerical data set more often than the higher digits.

Methods/Materials
Experimental Method: Collect data sources, Purchase data spreadsheets, Select data sources to test, Record occurrences of first number in a data spreadsheet, Create graphs/tables from data, Compare results to Benford's Law.

Materials: Data Pad Spreadsheets, Binder, The World Almanac 2007, The World Almanac 2007 for Kids, A reliable helper, Calculator, Access to Microsoft Excel.

Results
Of the 34 data sets tested to determine the actual occurrences of the numbers one through nine being the first significant digit or leading digit, the majority of the data sets yielded results consistent with the probability determined in Benford#s Law.
When the results for each data set used in this experiment were plotted and compared to the slope of the data sets used by Benford, 19 of the 34 data sets, or approximately 56%, were similar to the curve for Benford#s Law. Of the remaining 15 data sets, 14 of them had some relationship to Benford#s curve, but varied in that some of the numbers were either significantly higher or lower than Benford#s curve. Only one data set had results that yielded a curve that did not resemble Benford#s curve. For the numbers five through nine the tested results were extremely close to the probabilities in Bedford#s Law. The combined probability of numbers five through nine occurring as the first significant digit under Benford#s Law would be 30.3%. Of the 5,900 numbers tested the numbers five through nine appeared as the first digit 1,782 times or 30.2%,
just .1% less than Benford#s Law.
The curve for the combined totals for all 34 data sets was extremely close to Benford#s curve. The testing on the data sets that contained the most numbers had results that were the closest to Benford#s Law, and in evaluating the mean results for the total of all data sets, it was observed that as the number of sets tested increased, the results converged with Benford#s Law.

Conclusions/Discussion
My hypothesis was correct and Benford#s Law stands valid. Individually, some data sets did not exactly

Summary Statement
I was trying to test if Benford's Law was valid or not

Help Received
I would first like to thank my dad and mom because they were references to me if I didn#t understand something while I was doing research. They also taught me cool tricks on Microsoft Excel that quickened the process of making all my graphs, and they purchased my data sources for me.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)

Aaron J. McKinstry

Project Number

J1311

Project Title

Motor Learning in a Robot: Testing Competing Ideas from Neuroscience

Abstract

Objectives/Goals

Movements need to be accurate for humans and animals alike. Therefore, the method used by the nervous system to generate these movements is important. There are many aspects of motor control, such as direction, speed, and distance of movement. This experiment examines how to control the distance of a movement. Neuroscientists have proposed two possible methods for accurately controlling the motor commands used to generate the distance of a movement: timing and corollary discharge. The timing method uses timers in the brain to measure the amount of time from the start of a movement to determine when to stop. Alternately, the corollary discharge method uses a copy of its own motor command to estimate the distance traveled in a movement in order to decide when to stop.

Methods/Materials

In order to perform a realistic test of these two methods, I needed to 1) implement each method in a separate program to control a robot, and 2) test the programs in a challenging task. Each program was written in RCX code, and downloaded into the LMRIS 2.0 robot, called Roverbot. The challenging task was to make it learn from a single experience to stop before it hit an object. During the learning experience, the Roverbot traveled forward on a track until hitting a wall. During future trials, it traveled a distance that was based on the motor control method.

Results

After testing the two methods in a robot, I found that corollary discharge is a more consistent method than timing when there are random variations in the motor#s commanded speed.

Conclusions/Discussion

Although neuroscientists propose that both methods are used by the brain to control the distance of movements, this data supports the corollary discharge method by showing that movements would be more accurate if the brain used corollary discharge rather than timing. The data also suggests that corollary discharge would be helpful in building robotic devices and possibly prosthetic limbs.

Summary Statement

This project uses a robotic device to test the hypothesis that corollary discharge is more consistent than timing in controlling the distance of a movement where motor commands vary.

Help Received

Dad helped do background research and advised during program development; Mom helped put together board; Mr. Gardinier gave feedback on project ideas.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Joshua Navarette

Project Number
J1312

Project Title
The Nautilus Shell: Golden Mean or Logarithmic Spiral?

Abstract

Objectives/Goals
My objective for this project was to understand the mathematical nature of the growth pattern of the Nautilus shell. I wanted to determine if the growth pattern of the Nautilus shell in fact follows the Golden Mean or the Logarithmic Ratio. My hypothesis was that the Nautilus shell would follow the Logarithmic Ratio instead of the Golden Mean because during my research I found out that people often confuse the Logarithmic ratio with the Golden mean.

Methods/Materials
Materials
A 12 inch Ruler
A protractor
A number two pencil
A camera
2 Nautilus shells and 16 Nautilus shell photos
A calculator
An Apple Computer

Methods
I used 16 photos of unique Nautilus shells for my investigation. First, I found the center of a Nautilus shell and made an X and Y-axis through it. Then I rotated the photo 45 degrees and drew another X and Y-axis. This gave me a picture with 8 radii from the center of the shell to the edge of the last part of the spiral of the shell. I labeled every point where the radii intersected the Nautilus spiral. I then used a ruler to measure the line segments that were a part of each radius. Next I created ratios with neighboring line segments to see if they produced the Golden Mean. Finally, I recorded the given ratios into a list and plotted them on a scatter plot.

Results
In my graph it shows specifically where the Golden Mean (1.6) and Logarithmic Ratio (1.3) were located. In doing so it shows that only 6 of the ratios out of 212 fell on 1.6, and 13 fell on 1.3. But most of the ratios that are on the graph are below the 1.3 line. My hypothesis was supported by these results.

Conclusions/Discussion
In the end of my experimentation I found that Nautilus shells do not appear to follow the Golden Mean, but more likely the Logarithmic Ratio.

Summary Statement
I studied Nautilus shell growth patterns using line-segments created by radii that intersected the spiral of the shell, and calculated ratios to see if the shell grows according to the Golden Mean.

Help Received
My science teacher, Mr. Quintrell, helped me learn how to study the shells. My math teacher, Mr. Simonsen, helped edit the project and taught me about quadratics.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Mitchell A. Ness

Project Number
J1313

Project Title
PS2 vs. Xbox: Which System Will Load a Game Faster?

Abstract

Objectives/Goals
The purpose of my science project is to determine the speed of two different gaming systems. The reason I am doing this comparison is to evaluate what system to buy that doesn#t take so long to load.

Methods/Materials
The game systems I am using are Xbox and Playstation 2. The games tested for Playstation 2 and Xbox were: Flatout, Arena Football, and Tom Clancy#s Ghost Recon Advanced Warfighter. (Each game was made for the appropriate system.) Methods for my experiment consist of: 1. Opening the disc tray 2. Placing the game in the disc tray. 3. Properly closing the disc tray 4. When it is was thoroughly closed I started the timer 5.When I saw the advertisement on the game screen, I stoped the timer 6. Then I recorded my data 7. I repeated this procedure 10 times.

Results
The results on my comparison of game loading between the game systems, Xbox and Playstation 2, indicates that Xbox game system has a faster average loading time. My project has revealed that there is more to the game loading time than the system, the different types of memory in the game system is a vital component that needs further testing.

Conclusions/Discussion
The Xbox is a game system with a 733MHz Pentium lll CPU, 5 x DVD drive, and a custom-designed graphics processor. The Xbox was released on November 15th, 2001 it included 4 controller ports, Ethernet networking, and internet connectivity. The Playstation 2 is a 300MHz Emotion 128-bit CPU which exceeded the floating point performance of a 500MHz Pentium lll. The Playstation 2 had a significant amount of upgrades for its processors performance in subsequent years. Released in October 26, 2000. After completing my comparison I learned all about the Xbox and Playstation 2#s architectures, different types of cables, heating and the problems it causes, processors, and more.

Summary Statement
The purpose of my science project is to compare how fast an Xbox loads a game to how fast a Playstation 2 loads a game.

Help Received
My mother helped paste items on board; Cousin answered an interview; Teacher had science meetings,guided in each step, and printed items.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Camille M. Nygard

Project Number
J1314

Project Title
I Don't Appreciate Your Tone!

Abstract

Objectives/Goals
Examine the digital sampling of music by evaluating the Nyquist Theorem. My hypothesis was "If a recorded sound is sampled at a rate below the rate recommended by the Nyquist Theorem then the sound will be distorted." I further identified the smallest sampling rate required to reproduce a sound with no distortion. (Point of Indifference -POI)

Methods/Materials
I used a computer tone generator (NCH Tone Generator), a music editing program (Audacity), a computer, and a few people#s ears to sense the sound/distortion. I generated a fixed tone (440A) in the tone generator, adjusted the sampling rates in Audacity, and evaluated the quality of the tone with my ears. I kept track of my data collection in MS-Excel.

Results
I disproved my understanding of the Nyquist Theorem by determining that the POI was significantly higher than 2X the frequency. Then I found that a sampling rate of approximately 24 times the frequency of the tone was the point where an audible distortion began. For points below this sampling rate the audible distortion increased, for points above this sampling rate there was little if any change in the quality of the sound. I then confirmed the results a 440A test by evaluating a 360Hz tone with similar results.

Conclusions/Discussion
I identified a POI of approximately 24 times the sampled frequency for tones near 440Hz.

Summary Statement
Find the smallest sampling rate in order to reproduce a sound with no distortion

Help Received
Grandfather explained Nyquist theorem and helped understand wave forms; father helped type report and obtain / install software

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Nolan H. Poe

Project Number
J1315

Project Title
Can a Robot Balance on Two Wheels?

Abstract

Objectives/Goals
The objective of my project is to develop an algorithm to balance a two wheeled, one axle autonomous robot.

Methods/Materials
For my project, I used a vex robotics kit and the optional C programming kit. I also used a Sharp infrared distance sensor. I built the robot completely out of parts from the vex robotics kit, except for the infrared distance sensor. The distance sensor was mounted pointing down, on an arm, so that sensor output is a function of robot angle. I iteratively wrote programs to balance the robot based on the sensor output.

Results
The algorithm that corrected for angle and change in angle balanced the best. Its mean balance time is higher than any of the others, and its maximum balance time is almost double that of the runner-up algorithm. However, the minimum balance time of all algorithms is fairly constant; the same goes for the median balance time. This indicates significant room for improvement.

Conclusions/Discussion
The algorithm that balanced based on the angle and the change in angle worked the best. Nevertheless, some factors keep it from balancing for a significant amount of time. Possible reasons include loose gears and nonlinear motor behavior.

Summary Statement
The purpose of my project is to find the best algorithm to balance a two wheeled robot.

Help Received
Father helped with some robot construction and sensor selection; Mother helped in board layout.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Kaitlyn M. Sims

Project Number
J1316

Project Title
Let's Make a... Deal or No Deal

Abstract

Objectives/Goals
The goal of my science fair project was to mathematically calculate whether or not the #Monty Hall Theory# is applicable to the game show #Deal or No Deal.# My hypothesis was that the #Monty Hall Theory# would not be applicable to the game show #Deal or No Deal,# and that in the game #Deal or No Deal# staying with your original case would be in your best interest.

Methods/Materials
In my science fair project the materials I used were a laptop, the online #Deal or No Deal# game, StatDisk, and Excel spreadsheets. My methods were to go online and play the #Deal or No Deal# game 100 times. I then logged in an excel spreadsheet the case I chose in each game and the amount I won. I put this data on StatDisk and figured the mean, median, amount of losing and winning amounts won, and range for the data. I then played fifty games of #Deal or No Deal# on the website, this time logging the offers. I took all of the Offer 1#s, Offer 2#s, etc. and put each set of data on StatDisk. I found the mean, median, amount of losing and winning offers, and range for each set of data. I used the amount of offer sets that were always winners to calculate my conclusion.

Results
After the 100 games, I found that the median amount won was $750. I decided to use the median instead of the mean for my calculations to set up the winner/loser system. This is because a few high amounts would skew the data. If the winnings were over $750 they were considered a winner, and if they were equal to or below $750 they were considered a loser. I determined the winners by whether or not they were over $750. In the fifty games I logged all of the offers and put these in the offers sets. My results that I got from my experiment were that 6 out of nine 9 of the offer sets were always winners. I found this in my control that $750 was the median in my data. I found that the #Monty Hall Theory# could apply to #Deal or No Deal.#

Conclusions/Discussion
I found in my experiments that when playing the game #Deal or No Deal,# taking the deal will always be in your favor 66% of the time. This is the exact scenario the #Monty Hall Theory# predicts. My hypothesis was unsupported, and the #Monty Hall Theory# is applicable to the game #Deal or No Deal.#

Summary Statement
My science fair project was testing whether or not the #Monty Hall Theory,# a probability theory, would be applicable to the game show #Deal or No Deal.#

Help Received
Mother helped by providing college level textbooks, transportation, and teaching me how to use StatDisk.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Adam J. Stanford

Project Number
J1317

Project Title
Does the Length of, or the Character Type of, a Password Increase the Security for a Computer User?

Abstract

Objectives/Goals
I designed this experiment to test password security. I believe that this is an issue in out current time because every thing is going computerized and that means that we need passwords to protect our confidential content on the computer. The reason I chose this experiment is because i have had experience with my passwords getting hacked. I am very interested in finding a much more secure way to use passwords.

Methods/Materials
I will be using encrypted .zip files to test the password security. Also, I will be using a password recovery tool to "hack" the files' passwords to determine how strong the passwords are.

Results
According to my experiments, the length of the password makes a huge impact on how secure the password is. The character type was also a factor on how long it took to crack the passwords. It looks like the passwords with more letters or numbers were stronger. The mixed letters and numbers were the strongest in this experiment.The password with one to four characters were cracked in 170 seconds or less. The passwords with five to eight characters were cracked in 1,000 seconds or less. The nine to twelve plus were cracked in 10,000 seconds or less.

Conclusions/Discussion
My hypothesis is if a file is programmed with a password and a hacker tries to gain access, then a password containing a combination of three letters and three numbers will be more difficult to hack then a password with less. My results do support my hypothesis. It is more difficult to hack a password with a combination of 3 letters and 3 numbers then a password with fewer characters. I think the test I did went fine and I had no problems, except for the fact that some of the bigger passwords took very long to crack. An interesting future study might involve testing more passwords and maybe testing the passwords on different file types.

Summary Statement
My project tests encryted computer files to determine if character type or length of passwords affect security.

Help Received
Science teacher assisted with wording of project components. Family assisted by providing time and support for me to complete my project.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Kaelin A. Swift

Project Number
J1318

Project Title
There and Back Again: A Point's Tale: The Planar Isometries of a Regular Polygon

Abstract

Objectives/Goals
In this project, an analytic description of the counter clockwise rotations of regular polygons is obtained. This project is a continuum of last years project.

Methods/Materials
Aspects of trigonometry and complex numbers are combined with group theory to obtain the desired description.

Results
The rotations are described in terms of the cyclic group and the vertices of the polygon are shown to be roots of Zn-1.

Conclusions/Discussion
I extended my results from last years project and obtained an analytic description of the polygon's vertices.

Summary Statement
To obtain a description of the vertices of a regular polygon.

Help Received
Father helped prepare the display board.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
James J. Thomas

Project Number
J1319

Project Title
To Find a Generalized Equation to Determine a Stock's Optimal Trailing Stop Loss using Linear Regression

Abstract

Objectives/Goals
Trailing stop loss is a technology that provides investors with an exit strategy that can help to maximize profits. The purpose of this project was to find an equation in the form OTSL = m*(HPV) + b where OTSL is a stock's optimal trailing stop loss, and HPV is its historical price volatility over a one year period.

Methods/Materials
A template spreadsheet was set up to take the raw data of 20 stocks from 2004-07. The values were copied onto the spreadsheet, and it generated several other columns based on this initial data including absolute gain since simulated buying day (in 2004) and daily gain or loss as a percentage. A running maximum column was generated to show the highest stock price since buying day, and another called dip percentage showed by what percentage each day's price had dipped from the running maximum. Each stock's volatility was calculated by finding the standard deviation of the values in the day to day percentage gain/loss column from 2003-04 and multiplying that by the square root of 252. Each one's OTSL was calculated by finding the value in the dip percentage column that would allow that stock to ride for the amount of time that would give it the highest obtainable gain. The OTSL and HPV values obtained from the 20 tested stocks were entered into a regression table, generating a linear equation. The accuracy of this equation was checked by using back-testing - finding the HPVs of 10 stocks, entering them into the equation, and comparing the outputted OSTL of each stock to its actual OSTL. Real-time accuracy testing was also done by finding the HPVs of 10 stocks from 2006-07, getting their predicted OTSLs, and setting each stock with its generated OTSL using virtual trading. Resources used in this project were finance.yahoo.com, for its historical data; Microsoft Excel; and optionsxpress.com, for its virtual trading interface.

Results
The R^2 of the regression was 0.8, proving that OTSL and HPV are related. The back-testing used to check the equation was successful, as most of the generated OSTLs were within 1-3% of the actual OSTLs. The results of the real-time testing were good as well, with the ten stocks going up as a whole by an annualized 30%.

Conclusions/Discussion
It was discovered that there is indeed a solid relationship between a stock's OTSL and its HPV, and that it is possible to determine an accurate linear equation to predict a stock's OTSL based on its volatility.

Summary Statement
This project was about developing a generalized equation that could calculate a stock's optimal trailing stop loss using its historical price volatility.

Help Received
Father helped check abstract and board material; showed where to obtain stock data; helped with strategies to effectively utilize Excel

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Nathaniel C. Willy

Project Number
J1320

Project Title
A Mathematical Proof of a Relationship between Fibonacci and Lucas Numbers

Abstract

Objectives/Goals
Prove that [2L(n)+L(n-3)]/5 equals a Fibonacci number for all values of n.
In this expression, n is a sequential number in a series, and L(n) is the n^th Lucas number.

The equation above is a more complex relationship between Fibonacci and Lucas numbers posed as a challenge problem in The Fibonacci Quarterly.

Results
I proved that the stated equation relating Fibonacci and Lucas numbers was true using mathematical equations and algebraic manipulations. I also showed that the equation was valid using a chart populated with the Fibonacci and Lucas series numbers then graphically displayed results of the equation. In addition, I validated it in Microsoft Excel by plugging the appropriate Lucas numbers into this equation, and showed that it was true for the first 100 values of n.

I also demonstrated some more simple relationships between Fibonacci and Lucas numbers along with their numerical patterns and matching mathematical equations.

Conclusions/Discussion
Fibonacci numbers are a fascinating and famous series of numbers. The occurrence of the Fibonacci series is found throughout nature. There are also countless mathematical relationships between Fibonacci and Lucas numbers. While researching Fibonacci and Lucas numbers I became intrigued with these relationships and chose to focus my study on a mathematical analysis of these relationships. I thoroughly enjoyed this very interesting project.

Summary Statement
A mathematical proof of a relationship between Fibonacci and Lucas numbers using algebra.

Help Received
My father and my algebra teacher, Mr. Merle, went over my proof to make sure I didn't make any errors.

CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
Thomas T. Wooding

Project Number
J1321

Project Title
Flip of a Coin, Roll of a Die, Turn of a Door: Is It Fair? A Study on Probabilities

Abstract

Objectives/Goals

Coin- Mathematician Persi Diaconis used a machine to flip coins and he discovered that if a coin is flipped with heads starting out facing up it will land facing up. The objective of this experiment is to see if this is true if a human flips the coins,anddoes it apply on different surfaces.
Dice- the objective of this experiment is to determine if the shape of a die effects the fairness of the roll.
Door- the objective of this project is to determine if the probability of picking the right object is better by switching your initial choice with a variant of the shell game, where one choice that is for sure wrong is removed by the person in charge and shown to you after you make your first guess. Is it better to stay or switch?

Methods/Materials

Coin- I will flip a quarter starting heads up over the first surface and record the ending position. I will do this 200 times. I'll repeat this experiment again, except the quarter will start out with tails up. I will repeat this experiment using 5 different surfaces with various density and textures.
Dice- I will roll each polyhedral die 25 times per side (tetrahedron, cube, octrahedron, decahedron, dodecahedron, icosahedron). I'll make a non-isohedral pentahedral out of cardbord. I'll roll the non-isohedral die 25 times per side.
Door- I conducted 100 trial with a computer simulation of the three door variant.

Results

Coin- When a human flips a coin starting heads up it has a 50% chance of landing heads up,landing surface does not make a difference.
Dice- For all the die, except the non-isohedral pentahedral, the die landed within 10% of the expected value for each face. The expected value was the total number of rolls divided by the number of faces.
Door- Computer simulation showed that switching got the right door 65% of the time, while staying got it right 35% of the time.

Conclusions/Discussion

Coin- Diaconis found that when a machine tosses a coin it more likely to land the way it started, when a human tosses a coin it does not.
Dice- The tetrahedron, cube, octrahedron, decahedron, do decahedron and the icosahedron are fair dice. The experiment and the research showed this to be true based on Eulers Equation. Non-isohedral pentahedron isn't a fair die because the faces are not identical.
Door- Experiment showed that when there are three doors and one of the doors is eliminated that there is a

Summary Statement

This project investigates if different games of chance are fair.

Help Received