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1 writing point

Beauty in Art, Mathematics, and Nature

On Wednesday October 3, 2001 Professor John Pastor presented a colloquium on the beauty in art, mathematics, and nature. Professor Pastor explained that he does field experiments and constructs mathematical models, while exploring the patterns in nature as well. Not only does Professor Pastor teach classes in Biological Illustration, Ecosystems Ecology, and Mathematical Ecology, he draws and paints his studies of nature.

Throughout Professor Pastor's lecture he illustrated the concept of beauty in various paintings of nature. He would put up a slide of one of his paintings, say a group of trees in a forest, and analyze how particular lines of tree trunks illustrated the beauty in the painting. The lines of the trunks would break up the painting into two rectangles, often how famous painters would do themselves, and just by this one line would create a beautiful work of art.

We can now tie beauty in art with math. Professor Pastor talked about how equations can be beautiful. He said that beautiful equations have the following characteristics: 1) symmetry, 2) economy of form, 3) interconnection with other sciences, 4) maximum of structure from a minimum of inputs, 5) emergence of unanticipated results, and 6) unbiased conformance with data. Therefore, we see in mathematics that there are many beautiful equations and with this we get balance. Much like the balance in a painting, beautiful equations are balanced in themselves.

My favorite concept of mathematics in nature that Professor Pastor talked about was the logarithmic spiral. This means that whatever radius you pick in the spiral, the

tangent always occurs at the same place in the spiral. This explains why many things in nature are in the spiral shape, because a spiral shape is the most efficient way for things to grow. An example of the logarithmic spiral in nature is in pinecones. If you look closely at a pinecone growing off of a branch of pine needles, the pinecone is slowly gaining the shape of the logarithmic curve. Now, the pinecone obviously does not closely resemble a spiral shape, but its growth pattern obviously mimics the logarithmic spiral pattern. The reason that a pinecone grows in this manner, and the seeds grow in a spiral also around the pinecone, is so that when the pinecone is spreading its seeds, maximum dispersal will occur. When seeds are being spread about, we wouldn't want the seeds bumping into each other and then not being dispersed, as we would like. A pine trees shape also mimics the logarithmic spiral in the growth of its branches. The branches at the bottom of the tree are longer and grow faster. This makes it easier for the tree to shed the heavy snow it may have on it, or it makes it easier for the tree to get more sunlight.

Lastly, Professor Pastor touched on the concept of May Flies and how if nitrogen 15 was placed in a stream a curve would result from the plotting of the data. But this curve for the adult May Flies had a strange drop and rise in the graph. After much experimenting, Professor Pastor figured out that if they looked ~~that the amount of~~ the ratio females to male May Flies that were ending upstream, this would explain the strange curve. They found out that since the females had to find mates, they would swim upstream to where the majority of the nitrogen 15 was. This made the graph increase at a negative distance (meaning above the site of the addition of nitrogen 15). This experiment with May Flies

is just another example of Professor Pastor's that shows mathematics in with nature and art.

I really was interested in how nature works in particular ways to make the best possible route occur. The growth of pine cones was really intriguing for me and I am interested in looking further into what other occurrences there are in nature that are mathematical. This would be a great project for my geometry students to study, because I am student teaching at Central High School right now. Students would be very interested in how math really does pertain to life and this would show why people need to learn math.

Professor Gallian's paper, "Who is the Greatest Hitter of Them All?" shows that the consensus top two hitters of all time were Babe Ruth and Ted Williams. After these two players, the rankings become much more difficult to decide on. The difficulty of ranking these players is brought about because of the multitude different offensive statistics, ballpark differences, and the differences in the playing era. I have decided to do a much-scaled down version of this study by answering the question, "Who has been the best hitter on the 2001 Minnesota Twins?" This comparison is much easier to do because all of the players chosen play in the exact same conditions and in the same era.

For this comparison, I have chosen ten of the Twins: Doug Mientkiewicz, Christian Guzman, A.J. Pierzynski, Corey Koskie, Brian Buchanan, Jacque Jones, Luis Rivas, Torii Hunter, David Ortiz, and Denny Hocking. Buchanan has the lowest number of at-bats in this group with 193. Therefore all other players with less than 193 at-bats were left out of this study, including regular players Chad Allen and Tom Prince. Matt Lawton was traded to the New York Mets in July, so he was left out of this study, even though he had 376 at-bats for the Twins this season.

A statistic that is considered a good indication that a player is a good hitter is batting average. The batting average is the percentage of times a player gets a hit in his at-bats. The batting averages for these ten players are as follows:

1	Mientkiewicz	.307
2	Guzman	.298
3	Pierzynski	.293
4	Koskie	.276
5	Buchanan	.275
6	Jones	.269
7	Rivas	.264
8	Hunter	.264
9	Ortiz	.243
10	Hocking	.235

The batting average is not a good indication of the best overall hitter because it counts a single as important as a home run. Players with exceptional speed, such as Guzman, can get hits easily by just putting a ball on the ground, where a power hitter, like Ortiz, needs to hit a home run to match an infield hit

To put more emphasis on power hitting, slugging percentage is used. Slugging percentage is the total bases achieved through hits divided by at-bats. A single counts for one base, a double for two, and so on. The statistic puts more emphasis on an extra-base hit. The slugging percentages for these ten players are as follows:

1	Koskie	.497
2	Mientkiewicz	.492
3	Buchanan	.486
4	Ortiz	.480
5	Guzman	.475
6	Hunter	.467
7	Pierzynski	.441
8	Jones	.404
9	Rivas	.366
10	Hocking	.322

This ranking shows that the more powerful hitters are at the top, and the singles hitter are more towards the bottom. This statistic is a good indicator of a good hitter, but it does not indicate how well a hitter can get on base.

Hitting for power is an important part of hitting, but the ability to draw walks is also important. If a player is patient at the plate, he has the ability to get on base no matter what, which allows a team to score runs. On-base percentage is the statistic used to show how often a player to get on base. The on-base percentages for these players are as follows:

1	Mientkiewicz	.387
2	Koskie	.360
3	Buchanan	.344
4	Guzman	.334
5	Pierzynski	.326
6	Jones	.324
7	Ortiz	.324
8	Rivas	.319
9	Hunter	.304
10	Hocking	.304

This statistic is similar to the batting average, because it equalizes a walk and a home run. Power and the ability to get on base can be put together in the OPS statistic, which is simply adding slugging and on-base percentage together. The OPS for these players are shown below:

1	Koskie	.857
2	Mientkiewicz	.854
3	Buchanan	.836
4	Ortiz	.819
5	Guzman	.809
6	Hunter	.784
7	Pierzynski	.768
8	Jones	.730
9	Rivas	.685
10	Hocking	.626

The OPS seems to be a good statistic to combine the importance of an overall hitter to be able to play big ball, as well as, small ball. Even though this statistic seems good, a power hitter would have a higher OPS than a small ball player. Slugging percentage is normally a higher number than the on-base percentage, even if the player is a singles hitter. Therefore a power hitter would have a top heavy OPS.

Another good statistic to use to find a good overall hitter is the offensive quotient, which is total bases plus walks divided by outs. This shows the total bases a player gets compared to outs the player creates. Offensive quotients for these Twins:

1	Mientkiewicz	.85
2	Koskie	.85
3	Buchanan	.81
4	Ortiz	.80
5	Guzman	.72
6	Hunter	.71
7	Pierzynski	.68
8	Jones	.66
9	Rivas	.59
10	Hocking	.54

The statistic puts all factors into finding a good, all-around hitter. Therefore, I decided to take the ranking of each player, in each of the five previous statistics. These rankings were averaged for each player to decide who is the best offensive player for the Minnesota Twins in 2001. The rankings are as follows:

1	Koskie	1.8
2	Mientkiewicz	2.2
3	Buchanan	3.2
4	Guzman	4.2
5	Ortiz	5.4
6	Pierzynski	5.8
7	Hunter	6.6
8	Jones	7.2
9	Rivas	8.4
10	Hocking	10.0

This final listing shows that Corey Koskie and Doug Mientkiewicz were the best offensive players in 2001. This can be easily agreed upon by looking at the five statistics and where the players usually fall on those lists.

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Can the use of concepts from introductory statistics yield stock market profits?

William J. Krossner, who ~~is presently~~ one was a book reviewer for the *Duluth New Tribune* and has been a psychology teacher, came in to give a talk on investing in the stock markets. He said that this is a great time to invest money in the stock market for several reasons. Some of these motives include, low buying prices of stocks, instant availability of information on stocks, streaming quotes and low brokerage commissions.

One of the reasons to invest in the stock market is because, according to Mr. Krossner, "Everyone lives up to their income." It doesn't matter if you're a doctor, you will spend all of your income and live paycheck to paycheck. He used an example of earning $70,000 fresh out of college, which after taxes and other paycheck deductions, comes to $3,200 a month.

He mentioned that America as a whole has a negative savings rate. Also, when each person subtracts his (her) liabilities from his (her) assets, the amount that is left over is a mere $2,000, on average. This is cutting it too close in case of a costly accident or other disaster. For these reasons, Mr. Krossner said investing in the stock market is a good thing to do early in life because $5,000 has a potential to earn $250,000 by the time you retire, if done correctly, using an annual compounded interest rate of 18%. This interest rate is not unrealistic because during the 1990s the average mutual fund growth was 40%!

Stocks market funds are liquid assets, which means that a quick phone call can free up your money and be available to you within a short period of time. This is not true of assets such as a house or car, which take a relatively longer amount of time to sell.

He addressed several factors that influence a person's decision to invest in a stock or mutual fund. One of the factors that play's a huge role in investing is risk. Of course, Enron was mentioned, as a company that has changed the way investors perceive risk. The University of Minnesota even lost $8.3 million from the Enron collapse.

Something that is often costly to investors ~~is~~ the stock market is the inability to admit that they were wrong. This is costly when an investor sees their stock going down, but they think it will go back up and hang on to it, only to lose more money. He added that when a stock drops 30%, it takes a 42% gain just to break even. From here, he went on to explain his successful methods for investing in the markets. 1 pt

For both methods Krossner used moving averages and went over the advantages and disadvantages of using them. He preferred the exponential formula better because it does not have as much lag as a normal moving average formula.

His first method for investing was based on a pdf of the S&P 500, which invests in the largest 500 stocks in the market. The way he chooses to invest in this is that he gathers data from the stock symbol SPY from past years and invests only when the stock is at the lowest 5%. Then, he puts a stop order out at 88% of the value of the previous high. Thus, if the stock drops below 88% of the highest market price, he does not lose much money and most of the time makes money off the investment because the stock usually goes up after being in the lowest 5% of its distribution.

Method two involves his favorite stock, the QQQ, or NASDAQ 100. The QQQ is made up of 68% tech stocks and various other big companies' stocks. This investment scheme is based on the Mann method and uses a formula he wrote in the programming

language Basic. He proved that the method is very good using a uniform prior distribution to show that his method works over half of the time. Over his past investment period, he has made money off of 9 successes and only 2 losses.

For his methods to work, he said that one need not be on the computer all day, in fact only two minutes are needed every day to check the stock's price. Also, only basic statistics principles are used.

Now, the only thing that I need to invest, is the money.

Ok
Good job

Colloquium Summary
Actuaries

The colloquium presented on actuaries on Dec. 6 was very interesting. It was presented by two recent UMD graduates that currently work as actuaries for the St. Paul Property and Liability Insurance Company. They showed a video that gave a general description of what an actuary is and what they do, then they discussed actuarial projects, where actuaries work, skills they need, and exams they are required to take.

Actuaries interpret statistics to develop theoretical projections. Most of them work for insurance companies, but other may work for companies such as consulting firms or colleges. According to the *Jobs Rated Almanac*, the actuarial profession is currently rated the fourth best job in America, and in previous editions has been rated the best job in America. The almanac rates occupations by environment, income, outlook, physical demands, security, and stress. Actuaries rank high in all of these criteria because they earn a good salary, have opportunities for advancement, require little physical demand, and have minimal stress on their job.

There are many types of actuarial projects. Financial planning, competitor analysis, and pricing are a few examples. Insurance companies may need to know how much homeowners should pay for insurance or how much money they should set aside to pay its claims in a given year, then actuaries would use statistics and models to provide them with an adequate projection. So actuaries not only need to have a strong math and statistics background, but they need to be good communicators to explain their projections to nonactuaries. This requires calculus, probability, and statistics courses, as well as

economics and communication courses. Also, computer and spreadsheet skills are necessary and are used on a day to day basis by actuaries.

Once hired as an actuary, a series of exams are required to advance in the profession. The exams measure mathematical, economic, and financial knowledge. They are very rigorous examinations. In fact, according to the Society of Actuaries, actuaries should spend 400 hours studying for each exam. When they are all completed, which may take up to fifteen years, actuaries are considered fully accredited and receive their Fellow of Society of Actuaries designation. Also, for every exam completed, actuaries receive a generous pay increase.

The two presenters of the colloquium suggested a website to visit for more information on actuaries. The website provides examples of actuarial projects, exact pay increases for each completed exam, updated jobs available for actuaries, tips to study for the preliminary examinations, and much more. Anything you wanted to know about actuaries or becoming an actuary is available at the website www.beanactuary.org. An interesting thing I enjoyed on the website was the interactive skills assessment quiz. It is a quiz to determine if you are suited for the career of an actuary. Some sample questions include, "Do you like solving complicated problems," and, "Are you interested in current issues on social or political topics?

Actuarial work seems to be a very rewarding and interesting occupation. They have the opportunity for advancement and are involved in a wide variety of projects. It is a great job for people with a strong mathematics background who also enjoy business and economics.