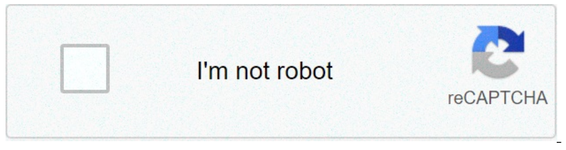


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# Mathematical applications in agriculture pdf

Though economics is technically a social science, students pursuing this field receive a firm foundation in math. Determining how resources are allocated requires a mathematical understanding of how to calculate those resources, the cost of distribution and assessing other quantitative measures. Thus, the field of economics is riddled with mathematical equations and applications. The types of math used in economics are primarily algebra, calculus and statistics. Algebra is used to make computations such as total cost and total revenue. Calculus is used to find the derivatives of utility curves, profit maximization curves and growth models. Statistics allows economists to make forecasts and determine the probability of an occurrence. Therefore, many students take at least a year of calculus, statistics and forecasting courses called econometrics in pursuit of a bachelor's degree in economics. Economists are hired to determine the risk or probable outcome of an event. For example, hospitals want to know what the risks are of dying from an operation and if the benefits are worth it. The National Institutes of Health explains the relationship between litigation pressure and rates of C-sections and VBACs. Because of the increased risk of litigation, some states ban vaginal birth after C-section, or VBACs. This policy was likely made after an economist assessed what the statistical risk was to the mother and weighed it against the cost of a malpractice lawsuit based on this number. Thus, the decision is an economic one. Economists working for pharmaceutical companies make similar math computations to assess if the risk of taking a drug outweighs its potential benefits. Economists use their math skills to find ways to save money, even in counter-intuitive ways. Using a profit maximization graph, economists might advise a venue to sell only 75 percent of the available tickets instead of 100 percent to make the most money. If the company lowers the price of tickets to attract additional concert-goers and fill the stadium to capacity, it might make less money than selling only 75 percent of the tickets at a much higher price. Economists also use math to determine a business' long-term success, even when some factors are unpredictable. For instance, an economist working for an airline uses statistical forecasting to determine the price of fuel two months from now. The company uses this data to lock in fuel prices, or to hedge fuel. Bijan Vasigh, author of the book "Introduction to Air Transport Economics" explains that Southwest gained a financial advantage over other carriers due to its fuel hedging strategy. Economists perform mathematical calculations with imperfect information. Their economic models are rendered useless in times of natural disasters, union strikes or any other catastrophic event. Additionally, math can seldom help economists predict irrational human behavior. A fundamental assumption of economics is that humans act rationally. However, humans often make irrational decisions based on fear or love. These two factors cannot be accounted for in an economic model. Economists are revising the way calculations are performed to account for intangible effects like pollution. Economists currently do not calculate the effects of rain forest depletion or water pollution into things like profit maximization or business costs, for example. Quentin Grafton and Wiktor Adamowicz, authors of "The Economics of the Environment and Natural Resources," explain that economic standards such as GDP are inadequate when measuring the health of the economy. A new field is emerging called "natural resource accounting," which attempts to attribute a dollar value to these costs. Agricultural economics goes back to the days of the Old Testament. When Joseph tells Pharaoh that seven years of famine will follow seven years of good harvests, they work out a plan to store excess grain so Egypt won't go hungry. That's what agricultural economists do: figure out the best way to manage farmers' resources and price agricultural products. The agricultural economics definition is the field studies issues related to farming, from how farmers can manage resources effectively to ways farmers can adapt to changing market demand. It seeks to give farmers practical economic advice and not just theories. Farmers have always had to worry about economics. At what price can they sell their produce? Will buying new dairy cows pay off in having more milk to sell? What's the going rate for farm labor? However, agricultural economics, meaning establishing general principles and scientific rules to answer such questions, didn't develop until the late 19th or early 20th century. While some economists focus on theory, the importance of agricultural economics is that it's an applied discipline, not just academic. Farmers need information that helps them stay afloat financially, and the various types of agricultural economics tackle the relevant issues. What are the production costs of agriculture? How can farmers manage them successfully? How can farmers use their land and their workforce most effectively? Do the costs of buying equipment outweigh the profits of greater mechanized efficiency? As demands change, such as the growing interest in organic produce, is it necessary or profitable for farmers to change what they grow or how they produce it? How can society balance the needs of farmers with those of hikers, dirt bikers and other outdoor-recreation enthusiasts? How do we balance the needs of farmers with the needs of the environment? What should government farm policy entail? Farming has always had an element of risk: One bad harvest or a crop blight can ruin a farm. However, the economics have changed over the centuries. At one time, increasing farm production was done entirely by expanding the amount of agricultural land: double the size of the farm, double the yields. Now, however, land is harder to come by, so farmers rely more on high-yield crops, machinery and the use of fertilizer. Another change is that governments in the 20th century became much more involved in controlling prices for produce. Agricultural prices fluctuate due to yield, supply and demand, so stabilizing prices and ensuring that farmers stay in business became a government priority. Like many economic disciplines, the agricultural economics definition stretches to a wide variety of fields and career paths. Agribusiness addresses issues in marketing, farm management, agricultural finance and trade. Policy analysts look at the effect of government agricultural policy on farms. Market researchers study market conditions to gauge the sales potential of different farm products. Rural development and regional economics Supply chain study and management Natural resource economics, which studies how farmers can get the maximum use out of their land and other resources Risk analysis Two centuries ago, farming was the heart of the American economy. As the country has grown and prospered, farming has dropped in importance. Fewer people work in farming, and the price of food consumes less of our budget than it did for past generations. Farming is concentrated in relatively few areas, so the agricultural industry directly involves only a small portion of the country. All the same, agriculture is still a big deal, which explains the importance of agricultural economics. Agriculture is the source of the world's food. Without the farm industry, we go hungry. Although agriculture only makes up 1% of the gross domestic product, it indirectly contributes much more than 1% to the GDP. Agriculture is the foundation for many industries: food, beverage, tobacco, textile, leather, restaurant and bar, for example. Agriculture provides 11% of U.S. domestic employment. Food manufacturing provides another 1%, including poultry and meat plants and bakeries. Rolling dice to determine an outcome seems like the epitome of chance, right? Well, that's true in many ways, but according to Karen Bell, associate professor at the State University of New York at New Paltz, the mathematical principle of probability actually plays a major role in Parcheesi and dice play in general.In a study she conducted on the use of Parcheesi to teach math, Bell and her students calculated the probability of rolling any given combination of numbers on a pair of six-sided dice during a turn. Rather than just looking at each roll as an unknown, players can use these calculations to anticipate opponents' moves and to plan their own several turns in advance [source: Bell]. Parents and teachers can mimic Bell's lessons to help teach concepts of probability.Also, the Parcheesi board itself is designed to encourage strategic play. In general, if you land on a space already occupied by an opposing pawn, you bump that pawn back to its home circle. However, each player's home row is safe, as are a few other spots on the board (usually marked by color or by circles within the spaces), including each player's pawn-entry space. While a pawn is on a safe space, it cannot be taken off the board by an opponent -- unless it's on an opponent's pawn-entry space and that opponent moves a pawn onto the board.The exception to the bumping rule is when two of your own pieces land on the same spot. In this case, the pieces form what's called a blockade, which prohibits pawns from passing. This can allow you to move your other pawns ahead unencumbered -- an effective strategic move in a game that's all about being the first to reach the finish line. However, it's important to remember that no pieces, the blockading player's included, can pass a blockade.So it's not all just a roll of the dice; Parcheesi is set up so that every move involves important strategic questions. Do I use the combined or individual numbers on the dice? Which pawn do I move? What are my priorities -- safety, blockading or bumping another player?So where did Parcheesi's intricate rule and strategy sets come from? Agricultural products are always in demand in a growing world population. Jupiterimages/Comstock/Getty Images Agriculture is subject to steady, though cyclical, demand. People need to eat, and the population is growing. Investing in agriculture can be simple or complicated, depending on how direct you want your exposure to be. Investing through the stock market is easy through agriculture exchange traded funds, or ETFs, which are similar to mutual funds. A more direct investment comes from the much more complex commodity futures market. Step 1Learn about the global agricultural market and how it is affected by both worldwide and local issues. Wheat, corn and soy are a few of the most heavily traded futures, and despite the global focus of the market, some crops are focused on geographic areas. Corn is an international crop, but it is heavily grown in North America, and local issues there, such as drought or an early winter, can affect the price internationally. Prices also tend to be higher earlier in the harvest season for the crop and more expensive later as the supply dwindles. If a crop is widespread in both the Northern and Southern Hemispheres, there can be a year-round harvest because the seasons are reversed. Rice is mostly a Northern Hemisphere crop that is grown extensively in East Asia and India, while sugar is grown extensively in both hemispheres. Prices of different crops can diverge based on time or specific events in the growing areas. For example, rice requires a considerable amount of water, while wheat tends to be more hardy. While the prices of both might move together during normal conditions, rice might rise higher if there is a drought. Keep in mind the political risks involved in growing countries as well. Both India and China are major producers of rice, and widespread civil unrest or poor political policy there might have an impact on the price of rice around the globe. Step 2Research ETFs that invest in agriculture. Reconcile the research into the specific movements of crops with the ETFs you find. You need to learn how the spot price affects the price of the ETF and the timing of movements in relation to the underlying asset. DBA is an example of a broad-based agriculture ETF that invests in many crops. CORN invests in only corn. These ETFs trade futures contracts to mimic the spot price of the crop. An individual can trade the futures themselves, but ETFs simplify the process. Step 3Buy the ETF you like best, but monitor it closely. Agriculture does not easily lend itself to a buy-and-hold strategy and should be watched almost daily. You should be familiar with the common causes of fluctuations, as well as being aware that unique situations, such as governmental collapse, might occur that are completely unexpected. All the research done to understand the global agricultural market should be considered when monitoring your investment. Step 1Apply for futures-trading privileges in your broker account, or open a new account with another firm. Be aware of capital requirements, fees and any other restrictions that can differ between brokerages. Step 2Learn how to trade futures because they differ from stocks. There is also a different schedule. Agriculture futures are traded 17:00-14:00 Central Time Sunday to Friday. A futures contract is an actual trade that will be carried out at a certain time in the future, with the price negotiated beforehand. Those trades need to be backed by capital, and each contract is for a fixed number of units. This means substantial capital is required to trade in commodities. Step 3Begin trading only when you are comfortable with the process. You do not want to accidentally initiate an erroneous trade, considering how much capital can be at stake, so master the online broker interface to avoid errant trades. How do populations grow? How do viruses spread? What is the trajectory of a glider? Many real-life problems can be described and solved by mathematical models. This course will introduce you to the modelling cycle which includes: analyzing a problem, formulating it as a mathematical model, calculating solutions and validating your results. All models are (systems of) ordinary differential equations, and you will learn more about those by watching videos and reading short texts, and more importantly, by completing well-crafted exercises. You will learn how to implement Euler's method in a (Python) program, and finally, you will learn how to write about your findings in a scientific way (with LaTeX). In the verified track of this course you will additionally: Consolidate the new theoretical skills with graded problem sets about five real-life applications. Work on your own modelling project (individually or in a team). Because mathematical modelling is only learned by doing it yourself, you complete your own modelling project on a self-defined real-life problem. You will be guided through the project by completing a list of smaller tasks. This course is aimed at Bachelor students from Mathematics, Engineering and Science disciplines. The course is for anyone who would to use mathematical modelling for solving real world problems, including business owners, researchers and students. To follow the process of the mathematical modelling cycle: formulate a real-life problem, construct an appropriate mathematical model, calculate solutions and validate the results. More about (systems of) ordinary differential equations. Solve the ordinary differential equations and implement Euler's method in a (Python) program. Write a scientific report (with LaTeX). In the Verified Track, you will additionally: Consolidate your new skills by completing well-crafted problem sets on several interesting real-life applications. Learn the skill of mathematical modelling in the only way possible: by doing your own modelling project. Module 1: Introduction to the cycle of mathematical modelling. We will start describing a population of fish by a differential equation. Verified Track: Two practice problems with other real-life applications to consolidate the theory learned. You start your personal modelling project. You can choose to work in a team of two. Module 2: Complete more modelling cycles by improving on the model and evaluating the consequences. Euler's method is introduced for solving ordinary differential equations. You will run Python simulations. Verified Track: A new application to practice the theory. For your project you specify a real-life problem. You implement a 1-dimensional model. Module 3: Predator fish are added to the model. How do the populations interact? Systems of differential equations. You also learn how to write about your project in a scientific report. You get an introduction to scientific and mathematical writing. You will learn how to write a preliminary report about mathematical modelling in LaTeX. Verified Track: One more practice problem to consolidate the theory learned about systems. You do more simulations with your own mathematical model and complete the modelling cycle several times. You apply your writing skills by writing a scientific report about your modelling project. You submit both a preliminary version of the report and the final version. Both are peer reviewed.Receive an instructor-signed certificate with the institution's logo to verify your achievement and increase your job prospectsAdd the certificate to your CV or resume, or post it directly on LinkedInGive yourself an additional incentive to complete the courseedX, a non-profit, relies on verified certificates to help fund free education for everyone globally"Why do I need mathematics is no longer a question for me. So many phenomena and problems can be modelled using mathematics. I really enjoyed making a model to describe how the virus we studied spread. Every engineering or science student should take this course!" "This course is excellent! I am an engineer, but have been working in another field for almost 2 decades, totally away from calculus, and this is exactly what I was looking for in order to brush up. I loved the videos and the questions as well. They are crafted in a very clever way to sediment concepts just learned."LICENSEThe course materials of this course are Copyright Delft University of Technology and are licensed under a Creative Commons Attribution-NonCommercial-ShareAlike (CC-BY-NC-SA) 4.0 International License.