Research on Application of Mathematical Model in Cost Fuzzy Control

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Abstract. The main goal of mathematical modeling is to deal with the problems of economic and ecological environment, daily life, etc., and to extract real problems and abstract them into mathematical models, and then to obtain the solution of the model, verify the scientificity of the model, and use the answers obtained by this model. Explain real problems. Through a series of related studies, this article guides the internal work of many real-world organizations, such as saving costs, reducing wood, and improving economic efficiency.

1. Introduction
The theory of "mathematical modeling" has been developed for a long time, and it has begun to enter all parts of social life. If you want to use mathematical methods to deal with different fields, especially economic problems, you need to create mathematical models. In other words, mathematical modeling is aimed at promoting economic development and transforming society. It uses equations or inequality created by letters, numbers, and other mathematical symbols to describe the characteristics of real things and their essential relationships Characterization of mathematical structure. Especially the prediction of the future has a positive impact on the popularization of mathematical theory and the sustainable development of the economy.

2. Application of "elastic" model in cost fuzzy control
In the competitive development, the price of a product will be adjusted independently, which promotes the demand and supply of this product to remain balanced. In order to conduct in-depth research and explain the newly discovered impact phenomenon by agronomists, the following method needs to be used at this time: elastic definition. Resilience is an indicator that evaluates the fierce response of both buyers and sellers to market changes. It prompts us to accurately study supply and demand. When analyzing how an event or policy affects the real market, we not only analyze the influence of fir trees but also Need to analyze specific sizes. Elasticity is an important mathematical definition. It expresses the relative rate of change. Using proportional analysis, it is the percentage of the change in the prisoner variable caused by a 1% change in the independent variable. Therefore, elasticity does not rely on the measurement of other units, which is dimensionless. Let x and Y be different variables, and the elasticity of Y to X be \( \frac{E_y}{E_x} \). When \( y = y(x) \) is differentiable, its calculation formula is:

\[
\frac{E_y}{E_x} = \frac{x \; dy}{y \; dx}
\]
Obviously, suppose the market demand for a certain commodity is $Q$. The price is $P$, and the demand function $Q = Q(p)$ is differentiable. Then the elasticity of demand for this product (that is, demand elasticity) is $\frac{EP}{EQ} = \frac{P}{Q} \frac{dQ}{dP}$. Because the demand function $Q = Q(p)$ usually decreases monotonously, the demand for price elasticity is generally negative.

For example, suppose the demand $Q$ of a certain product is a monotonically decreasing function of price $P$: $Q = Q(p)$, the return function is $R$, and its demand elasticity $\eta = \frac{2P^2}{192 - P^2} > 0$. Assume that at $P = 6$, since $\frac{ER}{EP} = \frac{P}{R} \frac{dR}{dP} = \frac{P}{PQ} Q(1 - \eta) = 1 - \eta = 1 - \frac{2P^2}{192 - P^2} = \frac{192 - 3P^2}{192 - P^2}$, then $\frac{ER}{EP} = \frac{192 - 3 \times 6^2}{192 - 6^2} = \frac{7}{13} = 0.54$, the economic meaning it represents is: at $P = 6$, for every 1% increase in price, the comprehensive income will increase by 0.54%.

In the actual operation period, using in-depth market investigation and information collection, and using the above-mentioned research and statistics, to allow decision makers to adjust production and sales programs on time, it is possible to comprehensively monitor and regulate the market. The key definition of the key has important influences in estimating market results and studying changes in the market when it is intervened. It is an important research tool for company management to use mathematical methods to make decisions. Therefore, we can know that "elasticity" is the core of regulating the relationship between supply and demand.

3. Application of "Malthusian" population model

The population problem is a worldwide problem, and it is also a realistic problem that deserves attention at present. It is a problem that most countries currently attach importance to. At present, the global population is constantly increasing, and the control and estimation of the number of people has become an important sociological problem. Population size is a very important indicator in the current regional planning and comprehensive land use plan. Whether the population size is appropriate will not only affect regional economic and social progress in the future, but also affect the long-term and stable development of the regional ecological environment. Therefore, accurately predicting the future population development trend, and revising and improving the efficient and effective population plan and layout plan, have shown important theoretical and practical value.

In the above model, consider that the total number of all living things is a positive integer $N(x)$, which is a step function of time $X$, when the total number of populations is large (such as the number of people in a country, the number of fish in a certain sea area), Individual changes and totals within the population are relatively small. Therefore, at this time, it can be regarded as $N(x)$, and the time $X$ can be slightly changed with time. Malthus pointed out that the population growth rate at $X$ is proportional to the current total population:

$$ \frac{dN(x)}{dx} = aN(x)(*) $$

At this time, $a > 0$, which is related to social conditions. According to the above situation, we can know that the population case exponential growth:

$$ N(x) = N_0 e^{ax} $$
Malthus used the following axioms in creating his own population model: firstly, food is needed for human life, and secondly, the population shows a natural growth trend. It pointed out that because of the influence of the declining law of labor compensation, population growth has always exceeded the increase in means of living, so the population is always saturated, leading to the suspension of social development. The main topic is the idea that population growth has a higher tendency than food supply. In his earlier article, Malthus used a more rigorous way of expressing the above point, pointing out that the population has a geometric growth trend, of which the food supply is only an arithmetic growth trend. In his own book, Malthus once again reiterated his personal point of view in a non-critical way, only showing that the population will grow indefinitely, up to the maximum limit of food supply. The main result from the books he wrote is that most people definitely want to survive poverty and hunger. Based on a long-term analysis, all technological advances cannot change the above trend, and the increase in food supply will be subject to certain constraints. Among them, "the population index is infinitely large. The earth is an index of substances produced by humans." It is obviously not in line with the actual situation. Later, the experts modified the above model and pointed out that a in the formula is not a constant, it is a higher-order linear function. Because it is to be regarded as a constant, it does not analyze most social survival factors. Therefore, revising a to *a N(x)*, the latter is not as large as the former, that is, N (x) continues to increase, because of the effects of the resources of the living environment, etc., the growth rate of N (x) to X will become slower. So, here comes:

\[
\frac{dN(x)}{dx} = [a - bN(x)] \quad (4)
\]

When N (x) is larger, \(-bN(x)\) must be taken seriously. We use the method of solving ordinary differential equations, and use the initial value condition \(N(x) = N_p\). Integrate the left and right sides of the above formula to obtain:

\[
N(x) = \frac{aN}{bN + (a - bN)e^{-a(\tau - t0)}} \quad (5)
\]

When \(t \to +\infty\), \(N(x) \to +\frac{a}{b}\), which means that after a certain period of time, the total population will remain at a saturated value.

Based on China's multiple demographic data, we can see that the fitted values of a and b, then the population forecast value and saturation value for a certain year. Since the middle of the twentieth century, the world has gradually used differential models to deal with ecological population problems, especially population problems, and has also achieved good results.

4. Applying the Lagrangian Multiplier Method to Solve Optimization Problems

For the function \(u = f(x, y, z)\), the problem of finding the maximum or minimum value under the condition of \(m(x, y, z) = 0, n(x, y, z) = 0\), that is, the problem of conditional extreme value. For example, the profit of a factory is determined by its wood production and price and other related factors. This includes many prisoners such as personnel expenditure costs, electricity costs, garbage disposal costs, etc., so there is no calculation that directly uses the sale price minus the cost. With the result, you need to create a mathematical model for processing. In the above replacement, the conditional extreme value model appeared. Therefore, we need to create helper functions: \(F(x, y, z, \lambda, \mu) = f(x, y, z) + \lambda m(x, y, z) + \mu n(x, y, z)\).
Then solve the system of equations:

\[
\frac{\partial F}{\partial x} = \frac{\partial f}{\partial x} + \lambda \frac{\partial m}{\partial x} + \mu \frac{\partial n}{\partial x} = 0 \\
\frac{\partial F}{\partial y} = \frac{\partial f}{\partial y} + \lambda \frac{\partial m}{\partial y} + \mu \frac{\partial n}{\partial y} = 0 \\
\frac{\partial F}{\partial z} = \frac{\partial f}{\partial z} + \lambda \frac{\partial m}{\partial z} + \mu \frac{\partial n}{\partial z} = 0 \\
\frac{\partial F}{\partial \lambda} = m(x, y, z) = 0 \\
\frac{\partial F}{\partial \mu} = n(x, y, z) = 0
\]

Then solve the system of equations:

\[
\frac{\partial F}{\partial x} = \frac{\partial f}{\partial x} + \lambda \frac{\partial m}{\partial x} + \mu \frac{\partial n}{\partial x} = 0 \\
\frac{\partial F}{\partial y} = \frac{\partial f}{\partial y} + \lambda \frac{\partial m}{\partial y} + \mu \frac{\partial n}{\partial y} = 0 \\
\frac{\partial F}{\partial z} = \frac{\partial f}{\partial z} + \lambda \frac{\partial m}{\partial z} + \mu \frac{\partial n}{\partial z} = 0
\]

In the solution \((x, y, z, \lambda, \mu)\) that satisfies all the equations, \((x, y, z)\) is a possible extreme point under the condition \(m(x, y, z) = 0, n(x, y, z) = 0\), and finally the maximum or minimum point is obtained from the possible extreme points, which has the optimization function.

For example, if a factory manufactures products of categories A and B, the comprehensive income when the output of the above products is \(x\) and \(y\) is:

\[
R(x, y) = 42x + 27y - 4x^2 - 2xy - y^2 \tag{6}
\]

The composite log function is \(C(x, y) = 36 + 8y + 12y\). In addition, for the production of A and B products, an additional 20,000 yuan and 10,000 yuan in sewage charges will have to be paid for each ton. At present, it can be analyzed: when the total amount of sewage charges is 80,000 yuan, what is the total profit of the two products of A and B, and what is the specific value?

When the total amount of pollutant discharge expenses is stipulated to be 80,000 yuan, it is necessary to calculate the maximum value of the comprehensive profit function \(L(x, y)\) under the constraint condition \(2x + y = 8\), that is, \(2x + y - 8 = 0\). The Lagrangian multiplier method is used, so \(F(x, y, \lambda) = L(x, y) + \lambda(2x + y - 8)\).

To find the stagnation point of \(F(x, y, \lambda)\), let:

\[
F_x' = L_x' + 2\lambda = 32 - 8x - 2y + 2\lambda = 0 \\
F_y' = L_y' + \lambda = 14 - 2x - 2y + \lambda = 0 \\
F_{\lambda}' = 2x + y - 8 = 0
\]

At present, the first two formulas can be used to obtain \(2x - y - 2 = 0\), and then the third type can be used to obtain the unique stagnation point \((2, 5, 3)\). Because the stagnation point is unique, the above practical problems will definitely have the highest profit. The statistical results show that When the requirement is 80,000 yuan, the total profits of A and B products are 2.5 (tons) and \(y = 3\) (tons) when the total profit is the maximum, and the profit is \(\text{max } L = L(2,5,3) = 37\) (10,000 yuan). Planning production in this way is more scientific and can yield the highest profits.

5. Conclusion
At present, the development of the domestic economic and ecological environment has gradually achieved good results. Whether it is to analyze at the macro level or to analyze at the micro level, the development of economics must be assisted by appropriate mathematical modeling. The model has
also brought positive effects to the sustainable development of the country's society and economy. This article studies the impact of mathematical modeling on economic development, and discusses the real cases of the elastic model and Malthus's population model in the field of economics. I hope that the analysis in this article can promote the public to pay more attention to mathematical modeling, improve the overall level, and further accelerate the domestic society's economic development.

References
[1] Dai Xiaoqin. Differential Cultivation of College Students’ Mathematical Modeling Ability and Modular Teaching Practice [J]. Educational Forum, 2017 (25): 160-163.
[2] Huang Qingqun. Application of optimization method in mathematical modeling [J]. Journal of Higher Education, 2016 (21): 118-120.
[3] Chen Ying. Analysis on the combination of mathematical modeling and applied mathematics [J]. Smart City, 2017, 3 (05): 130 + 132.