How Much Gas Should I Buy This Week?

Abstract

Gasoline is the necessary consumable in the families with car, and it has been playing a more and more role in people’s daily life. Two models are built in this paper: Gasoline Price ARIMA Model and Integer Program Model.

Firstly, based on the history price of gasoline in last ten years, we find that the gasoline’s price showed the trending of changing periodically. Due to the financial crisis or the business revival the gasoline’s price is not so regular. To avoid the disturbing, according to the time series analysis, we built the Gasoline Price ARIMA Model, to forecast the cycle-changing price of gasoline in the future. The arma model can predict stationary random process with white noise. So in the assumption that the price of oil and gasoline varied smoothly and there is no sudden change and disturb on global economy .We derive the arima model to simplify the problem .In the arima model ,we get the AR factor and MA factor and get the prediction using this model.

Then, to reduce the cost of gasoline, let the tank’s volume and weekly consumption as constraints, while the total cost as the goal, we built the Integer Program Model, to determine how to purchase the gasoline each week, after knowing the daily price. With the forecast price of 2012 comes from the ARIMA model, via calculation, the total price is 731.5 dollars, when weekly mileage is 100miles; while the total price is 1479.9 dollars, when weekly mileage is 200miles. After that, we compared our plan with the best plan on the true weekly price, found that the distinct between them is no more than.

We also proved that there are some upper binds on “mileage drove” that changes the decision for buying weekly gasoline. So it’s important to decide your mileage driven. Finally we developed our model in San Francisco, and found that a man should pay 1557.1dollars for his car in 2012.

Keywords: ARIMA Model; Integer Programming; Gasoline;

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# Introduction

* Background

Integrated multi-trophic aquaculture (IMTA) provides the by-products, including waste, from one aquatic species as inputs for another. Farmers combine fed aquaculture with inorganic extractive and organic extractive aquaculture to create balanced systems for environment remediation, economic stability and social acceptability.

* Related Work

Max Troell had discussed IMTA in marine offshore systems[1]. DW Zheng had used Lotka-Volterra model to describe a soil food webs and ecosystem process[2]. He used the theory of carbon dynamics at the ecosystem level and food web theory to link the different species.

* Our Work

We trying to lead-in the classic model--- Lotka-Volterra model to IMTA, and use this model to simulate the ecosystem and its balance and change in the process of IMTA. After that we use our model to get the balance point of both single-species ecosystem and multi-species ecosystem, which allows the coral reef growing. Furthermore, we considered the economic value of different species in the multi-species ecosystem, and find the way maximize the profits while keeping the coral reef grow healthy.

# Before Fishfarming ---- Single-Species Ecosystem Model

## Conventions

* Using subscript to denote interact between species. For example, suppose anddenote different species, denotes a factor of a kind of interact, than the symbol denotes the influence  from  to.

## Assumption

* Simplify Assumption: There is no sudden change and pound on the stability of global economies;
* Completeness Assumption: The development of economy is random.

## Notation

Table Notation for Single-Species Model

|  |  |  |
| --- | --- | --- |
| Symbols | Definitions | Units |
|  | The compete factor in a species |  |
|  | The predation factor whileis predator |  |
|  | The relative amount of species |  |
|  | The algae |  |
|  | The siganus doliatus |  |
|  | The crab |  |
|  | The urchin |  |
|  | The milkfish |  |
|  | The excrete |  |
|  | The oyster |  |

## Single-Species Ecosystem Modeling

First of all we need to consider the relationship between the different species. For example, the algae can absorb sunlight and grow. Meanwhile the algae will die or disappear because of the discipline of the nature. So the growth rate which can also be called intrinsic rate of group growth is defined as the input food subtracts the death rate without the interference of the outside world. So we can defined the intrinsic formula as



The algae can absorb the sunlight as the input of energy but other animals such as the herbivores and the carnival can’t get input energy without any other species. So except the algae, can’t be larger than 1. The position of an animal in the food web decides its accurate value of r. In general, we assume the algae have an instinct growth rate of 2, while the herbivores have a rate of 0.5 and the predator has as 0.2.

So if the herbivores and the predator don’t live of other parts of the food web. They will finally become extinct and disappear. Now we assume there are only one of the predator and one of the herbivores. According to the function we can deduce the following differential equation as follows:



In the equation, we describe  as the number of **plants**, **herbivores** and **predator**. The parameter stands for the hunting skills of different species. In this particular question, we can plot a graph to illustrate the relationship between different species:



Figure 1 Species Relationship Graph

Based on the convention before and function, we can get the **Single-Species Ecosystem Modeling**:



Solving the model we can get the variation trending of different species.

# What if the milkfish introduced in?

## Part A’s Discuss: Only milkfish and algae

After removing all the herbivores and crustacean and molluscs, the system will only contain algae and milkfish. Sunlight can provide energy to algae as the input of the system, while milkfish doesn't eat algae so the only material feeding milkfish is the feeding materials. The graph of the whole ecosystem can be described as the following:



Figure 2 Relationship Between Milkfish and Algae

According to the problem we can know that, the water quality is depending on four factors: Bacteria, Particulate, ChlorophyII, Algae, and those factors are depending on some other things. As a conclusion, the factors influencing water quality can be described in the following graph:



Figure 3 How Water Quality Was Influenced

From the paragraph, it’s seen clearly that milkfish eat feeding material for growing. So the growth function of the milkfish can be an equibrium between the input feedstuff and the death rate of the milkfish. We can rewrite the volterra function in the form of the logistic format:



From the format and the nature of Logistic, will converge to a certain value of. depends on how much forage is given to the milkfish.

However, No matter how much forage is given **there will not be a stable solution** because of the logistic formula, because molluscs have a population of zero. **The Excretes will increase continually**. Finally excretes will burst out and destroy the ecosystem. Too much mineral will make the algae grow too fast. Too much algae will choke the coral reef and make it difficult to grow and the ecosystem will not be stable because of the lack of species in the ecosystem. Although the milkfish and algae can arrive at an equilibrium in the end. However, excretes will accumulate too much making the coral reef difficult to survive. **So no matter what the constant term is, the ecosystem can’t maintain equilibrium and keep stable**.

Even if got the gasoline’s price every week, we can hardly find the best decision by simple consider. By no mean the decision such as that ’You should keep tank full if the price next week is higher …’ can always get best result.

To solve the problem, a Integer Program Model was developed.

## Part B’s Discuss: Other species were added

### Conventions

* In this part we use the same symbol system with the **Single-Species Ecosystem Modeling**.

### Assumption

* Simplify Assumption: the consumption of a consumer each week is the same.
* Simplify Assumption: the tank can only be half or full.
* Simplify Assumption: at the beginning the tank is empty.

### Notations

Table 2: Notations for this part

|  |  |  |
| --- | --- | --- |
| Symbols | Definitions | Units |
|  | The feeding factor |  |

### Model Modified

If the famer feed milkfish using forage and don’t harm the other creatures’ living. The equation can be substituted and replaced. The forage is an input energy of the milkfish. After revising the differential equation of the milkfish, we can have a differential equation in the following form:



# Is there an Upper Bound

# An Example in San Francisco

# Strength and Weakness

## Strength

* ARIMA can predict the random process very precisely.
* can precisely calculating the planning that reduce the cost mostly;

## Weakness

* ARMA model requires the stationary process which is hard to acquire and test.
* depend on the forecast strongly;

# Letter to San Francisco local people

I am very glad to introduce our gas model to you. I believe that everyone can get benefit from it.

You can save money by use the guide picture above to decide whether buy a tank of gas or a half tank of gas.

As we can see in the picture, the x-axis means the weeks and the y-axis mean the quantity of gas you supposed to buy.

Enjoying our method, and we all very happy to know that you save your money. Please tell your friends around you about it.

# Reference

[1]<http://www.eia.gov/dnav/pet/pet_pri_gnd_a_epmr_pte_dpgal_w.htm>

[2]<http://www.eia.gov/dnav/pet/pet_pri_spt_s1_w.htm>