**BLOSSOMS VIDEO LESSON TRANSCRIPT**

**Why Pay More? (The Concept of Multiple Regression Analysis)**

Assalammualaikum (peace upon you)

Hi everyone

I am Associate Professor Dzurllkanian Daud

from Universiti Teknologi Malaysia.

I teach Property Management

Valuation, Mass Appraisal and

Property Taxation at the

Faculty of Geoinformation and Real Estate.

I am going to talk about

Multiple Regression Analysis

or in short, MRA.

MRA is a mathematical concept

which is applicable in many fields

when looking at the relationship between

one variable - called the dependent variable –

with multiple other variables – called independent variables.

MRA is used in numerous activities

in our daily lives

from simple concepts such as

the calculation of our Body Mass Index

to the application of intricate calculations

such as analyzing the strategies used by

big retail stores to calculate factors which

could increase their sales.

I will explain Multiple Regression Analysis

from the perspective of a property valuer.

In property valuation

MRA is primarily used to determine

the property value, especially

in cases where many properties need to be valued,

for example, for the purpose of property taxation.

MRA is an advanced technique which provides

standardized,

efficient, uniform,

and fair method of property valuation

for taxation purposes.

Some important key terms

that you should know

are property value,

building value,

land value,

building area,

factors affecting value,

price, market value.

In most countries,

every property is subject to property tax.

This tax is used by the local authorities

to provide and maintain basic infrastructures,

facilities, and services to the public.

Therefore, If you own a property,

you need to pay property tax.

The question is how is this tax

determined by the local authority? How is it calculated?

Let's take a look at this situation.

These people seem to have a problem at hand.

Can you help them answer these two basic questions?

What factors determine the property tax?

What factors determine property value?

Disscuss the answers with your friends.

In most countries, and especially here in Malaysia,

There are five basic methods of property valuation.

They are the comparison method,

the investment method,

the profit method,

the cost method

and the residual method.

To have a better understanding of these concepts,

please read handout provided by your teacher.

These 5 methods are

considered as traditional methods

of property valuation.

Of all the 5 methods,

the comparison method is the main

and most commonly used in practice.

In property tax valuation,

local authorities are still using

these traditional methods which have been

proven to be too costly and time consuming.

To overcome this problem,

an advanced technique of valuation using MRA

has started to be more widely used

and practiced by assessors.

The basic formula for property valuation

using MRA is basic algebra equation.

Let us consider a simple equation,

an equation which all of you are familiar with.

First equation,

 2x + 3y = 19

equation 2,

2x + 5y = 29

Now find the solution values of x and y.

Your teacher will assist you

if you have problems.

I will give you 5 minutes to

solve these simple problems.

I’ll see you later to discuss the answer.

Do you have your answer ready?

Compare your answers to mine.

Did you and your class also agree on this answer?

If not, you may want to go back

and check your calculations.

Now let me show you a more realistic situation.

Consider we have two houses,

House A

and House B

with the same land area of

22 feet width

and 70 feet depth.

Thus, the land area is equal to 1,540 square feet.

Meanwhile,

the built up area of house A is

22 feet by 45 feet

with two floors.

Thus the built up area is 1,980 square feet.

House B is also 22 feet by 45 feet with two floors.

But it has an extended kitchen of 22 feet X 10 feet.

Thus the built up area is 2,200 square feet.

The price of House A is RM235,400

and the price of House B is RM253,000.

These problems can be expressed

in mathematical formulas.

For house A,

we can write

1,540 L plus 1,980 B equals RM235,400.

For house B,

we can write

1,540 L plus 2,200 B equals RM253,000.

What is the value of L

and what is the value of B?

By using the similar previous process,

we can solve these problems.

First,

equation (2) minus equation (1).

Thus, you’ll get

220 B equals to RM17,600.

Thus,

B equals to RM80

Image: B=RM80

Insert

B equals to RM80 into the first equation.

1,540 L plus RM158,400 equals to RM235,400.

1,540 L equals to RM235,400 minus RM158,400.

Thus L equals RM50 per square foot.

So, what is the price of:

The land (L) per square foot?

Where L is land upon which the building is erected.

And the built up area (B)

per square foot?

Where B is built up area of the house

Now, figure out how much

is the price of House C

with land area of 1,540 sq. ft.

and a built up area of 2,400 sq. ft.

To solve this problem,

you will need to form the equations

based on the information given.

I’ll give you five minutes to solve this problem.

Now, you have the property value

based on 2 variables,

land and building.

you should get B = 80

and L = 50

and the value of House C = RM269,000.

If you got a different answer,

you may want to go back and check your calculations.

Now I understand the basic concept of property valuation.

But these two variables are not enough.

Surely there are other factors.

Of course,

the other factors or variables

in addition to land area and build up area

include surrounding facilities

and renovation works on the property

and many others.

Yes, I think this is where

we need to use Multiple Regression Analysis.

Yes, Mustafa is correct.

We need to use MRA

for many multiple variables.

To understand the basic MRA,

here, you can see 7 properties.

ABCDEF and SP.

SP is the subject property which we

want to value based on the prices of 6

comparable properties (ABCDEF).

These properties have different features.

Property A features House+Car porch+Pool, the price is 820,000

Property B features House+Car porch, the price is 720,000

Property C features House+pool+Studio, the price is 900,000

Property D features House+Studio+garage, the price is 870,000

Property E features House+Garage+Tennis Court, the price is 930,000

Property F features House+Pool, the price is 780,000

The Subject Property features House+Car porch+Pool+Garage

Given the figure as such,

what is the value of each feature?

Discuss the answer with your friends.

By comparing the prices

of property A and B,

we will get the price of each

utility or component by decomposing

each property into its separate components.

Decomposing here means

separating the components of the property

into its individual price.

For example,

for properties A and B,

we know that property A which is

made up of the house,

carporch, and pool

is priced at 820,000 Malaysian Ringgit.

While property B

which is made up of only

a house and carporch,

is priced at 720,000 Malaysian Ringgit.

Therefore, the price of the pool would be

820,000 – 720,000 = 100,000 Malaysian Ringgit.

By using the same similar process,

we will be able to calculate the price

of the other components of the properties.

Thus, by cleverly using successive substitutions,

the price of the components of the properties

are as follows:

From A and B we will get the price of pool equal to 100,000

From A and F we will get the price of car porch equal to 40,000

From C and F we will get the price of studio equal to 120,000

From A, B and F we will get the price of house equal to 680,000

From A, B, C and D we will get the price of garage equal to 70,000

From 4, 5, and E we will get the price of tennis court equal to180,000

What I have just demonstrated was

the use of paired comparison method

to calculate the prices of the components

of the properties.

There are three steps in paired comparison method.

Step 1

This approach is used to find,

by deduction, the value attributable

to each major different property feature

exhibited by a target property

in relation to the various sale properties.

The assumption behind this is that

if there is one major difference

in the features like size, facilities, fittings etc,

of two properties which have been sold,

then the difference in price between

the two represents the value

of the single different feature.

Step 2

If there are several differences

then we will need several sales

to be able to isolate the value differences,

and we may have to go through

quite a long process of elimination

in order to eventually account

for all the different value differences.

Assume that we have information

on the following sales,

properties A to F,

each of which is different

from the others in one or more features.

We then carry out

A simple subtractive process

to identify the value of each feature

To arrive at the value

of the subject property,

we need to add up the price

of all components that make up

the subject property.

This is step 3 Subject Property (SP)

What is the value of SP which includes

a house, carporch, pool and garage?

Using the result from the inference process, we can estimate the value of the Subject Property which consists of House, Carporch, Pool and Garage.

ESTIMATION OF SUBJECT PROPERTY:

SP = House + Carporch + Pool + Garage = ?

SP = 680,000 + 100,000 + 70,000 + 40,000

SP = RM 890,000

This means that the more components

present in a property, the more it

contributes to the property value

and this will increase the tax imposed.

Ghazali now understands why

his tax is higher than the neighbors.

The higher the value, the higher the tax is.

Up to this point

we have learned to solve linear equations

in order to determine

the value of properties.

The activities that we have done

were simple demonstrations towards

the understanding of MRA.

In real world case,

it involves more complex calculations

due to more factors,

which need to be taken into consideration

in determining property value.

It also involves a huge number of properties

to be analyzed thus further

complicating the inference process.

Due to this,

we need to employ MRA

which is capable to analyze

a huge number of data.

A statistical tool like

Statistical Package for Social Scientist (SPSS)

can be used to run MRA.

SPSS makes using MRA much easier,

performing the necessary calculations

quickly and accurately.

However,

the real property market is not

as simple as that.

Property market is imperfect.

Refer back to the

previous equations from Segment 3

1540 L + 1980 B = RM235,400 ------------(1)

1540 L + 2200 B = RM 253,000------------(2)

In Real property market,

the equations might be as follows

1540 L + 1980 B = RM235,400 ------------(1)

 = RM250,000

 = RM240,000

 = RM260,000

 = RM270,000

1540 L + 2200 B = RM 253,000------------(2)

 = RM 265,000

 = RM 275,000

 = RM 280,000

 = RM 250,000

Meaning that,

with the same variables,

the price of the house varies between each other,

depends on how much each buyer

is willing to pay for that particular house.

The calculation for multiple variables

requires the use of

Multiple Regression Analysis.

MRA determines the statistical

relationship between Y (property value)

and several independent variables X1, X2,..Xn as follows:

Y = b0 + b1X1 + b2X2 + b3X3 +…+ bnXn

This is the regression equation

to be estimated in determining

the property values.

Where Y is the dependent variable

(property value), b0, b1……bn

are the parameters that are estimated.

X1,X2 ,X3……Xn are independent variables

(all important property characteristics)

which is X1 is Land area,

X2 is Building area,

X3 is Carporch,

X4 Number of bedrooms,

X5 is Ensuite,

X6 is Repairs etc.

Other variables might be Gated,

Guarded, Extension Kitchen,

Extension Car porch,

Site location (Intermediate lot, End lot or Corner lot)

Distance to school,

Distance to Shopping Complex,

Distance to Playing ground and so on.

Variables X1 to Xn may be numeric or categorical.

Property values can be estimated

using regression model based on

a sample of previously sold properties.

We can predict a value for the

dependent variable (property value)

based on the known value of the causal

(independent) variables,

or more critically,

MRA also estimates the individual components

of value e.g. value of garage,

value of car porch

and other important components.

The point is that the influence on

property value of each independent variables

will be estimated by the model,

and thus, not subject to human error.

As a example,

with respect to the Building Area (X2),

every additional square feet of the building,

will result additional amount in property value (y).

This relationship can be easily and

accurately measured by using MRA.

From the regression result,

the estimated value of the subject property

can be determined by multiplying

each coefficient estimated (b0, b1……bn )

from the equation with the subject property’s

respective characteristics.

As a result,

Regression models produce average,

or typical values,

consistent with the definition of market value.

So, it is similar to the paired sale analysis

and should produce the same result as

traditional methods of valuation.

There is a great deal of similarity between

MRA and traditional methods,

when appraisers use a weighted average

to arrive a final value estimate

they are effectively applying the assumption

of the regression to the mean.

You can learn more about this concept

by reading Handout A

The aim of this video is to make it easier

for tertiary students to understand

the concept of Multiple Regression Analysis.

It is through our experience that

Malaysian tertiary students find this

concept a bit difficult to understand.

In order to facilitate their understanding,

we introduced a scaffolding method

whereby students are first exposed

to basic equations

which they have learned in secondary school.

Then, students will be introduced to the concept

of variables, teaching them to calculate property

value based only 2 variables.

Exposing them to multiple variables related

to valuation of property further

enhances their understanding.

Finally, they are asked to calculate property

value and property tax based on multiple variables.

To make the video interesting,

dramatization is employed to drive home the points.

Furthermore, this video will also make heavy

use of animations during the professor’s

explanation of the topic.

For property valuation students,

a prerequisite needed before learning

this lesson is the

Sales Comparison Method in valuation.

For other students such as those in

business or social science fields,

an understanding of basic statistics

such as total, average, mod, mean,

and median is necessary before

starting this lesson.

The suggested activities are the

activities stated in the activity section

of this concept and architecture paper.

MRA can also be applied in other areas

as well such as medicine

MRA can be used to predict

the height of a child which can

depend on the height of the mother,

father, nutrition, and environmental factors.

Social science MRA can be used in many

research situations where there will be a

lot of independent variables to be considered.

For example to analyze the relationship

between economic development and its

impact to property value.

Business MRA can be used by a real estate

agent to sell houses.

The selling price of a house

can depend on the location,

the number of bedrooms,

the number of bathrooms,

the year the house was built,

the square footage of the lot,

and a number of other factors.

There is a limitation in regression analysis.

Regression result only gives average

value for all the variables.

But in real world,

it could be difference value.

For example,

not all square footage in a house

is created equal as produces by

regression analysis.

So, as with all mathematical techniques

applied to real world situations,

the user must be careful to know

the method’s applicability and its limitations.

Finally, the professor challenges the students

to investigate other possible

application of MRA in real life.

Can you think of other

possible applicatIon of MRA in real life?

Discuss with your friends and your teacher.

BYE-BYE FOR NOW…

AND GOOD DAY TO ALL OF YOU.

ASSALAMUALAIKUM, WRH. WBTH.