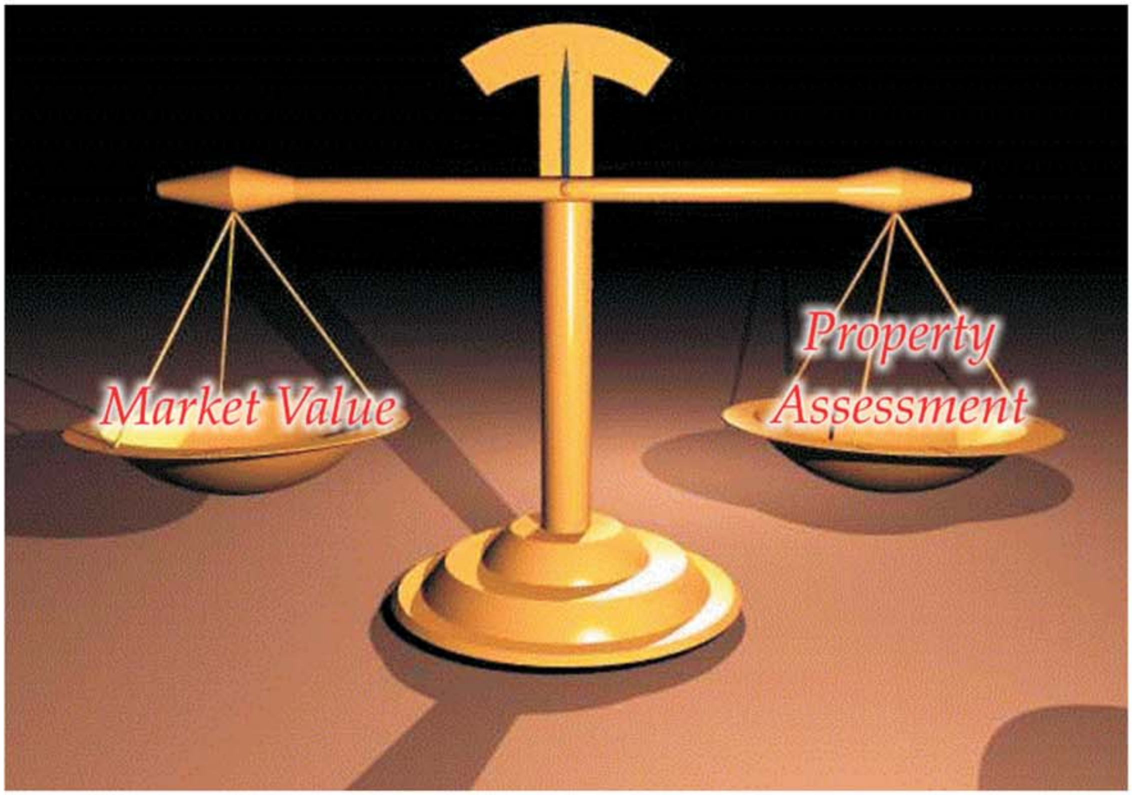


Spatial Assessment

Computer Assisted Mass Appraisal

NOVA SCOTIA
Service Nova Scotia & Municipal Relations

Centre of Geographic Sciences

Planning: Land Information Technology
Andrew M. J. Bell

COMPUTER ASSISTED MASS APPRAISAL

Spatial Assessment

Table of Contents

TABLE OF CONTENTS

EXECUTIVE SUMMARY

I am enrolled in the second and final year of the Planning: Land Information Technology program at the centre of Geographic Sciences which entitles me to complete a research project for an outside organization as a requirement before graduation. After working with the Bridgewater Assessment team during the summer of 2004, I took an interest in property assessment and the theoretical concepts that affect market value. Since the research project had to be related to GIS (Geographic Information Systems) I investigated software companies that create software for the purpose of calculating land value. I learned that there are several companies across North America that produce Computer Assisted Mass Appraisal Systems, and also that Service Nova Scotia and Municipal Relations does not have a CAMA system installed in their assessment office. I was eager to pursue this aspect of assessment further so I contacted Teth Cleveland, the GIS coordinator for Service Nova Scotia to ask him about a potential project. Teth thought this would be a good opportunity for me to research a topic of my interest while providing useful information to Service Nova Scotia and Municipal Relations.

I proposed to create an application that will run through ArcMap9.0 with the purpose of creating land values for an entire Neighborhood. Teth and I consulted frequently to discuss the idea and what data would be needed to get started. By December of 2004 I had the data and had already started the research.

The application is called Spatial Assessment, the values generated by it are not meant to be an exact reflection of market value because the Spatial Assessment tool uses the average value per square foot of land for a neighborhood to generate values, but the values provide a good beginning point where more advanced calculations can be made. Generating a base value for every property is a good starting point because more advanced calculation can be made to reflect things that affect individual properties. This report explains the data table used, the way I approached this project, and the results I arrived at. The research I have completed could potentially lead to the development of a

CAMA system by using the Base Rate function as the foundation of the system, and then using the theories I have included in the report to further develop the application.

The application uses recent transactions in an assessment neighborhood to generate an average value per square foot of land that reflects market value. The average value generated by recent transactions can be used to generate property value for lots that have not recently sold by applying the average value per square foot to the square footage of every lot. The values that are generated will reflect both the size of the lot and the average desirability of the neighborhood. The values do not reflect things that affect individual lots, things like proximity to water, proximity to dumps, and oddly shaped properties that place limitations the type of development on the land.

The Spatial Assessment Tool could be further developed to reflect these variables through the use of buffers which allow the user to select lots that fall within a specified distance of a feature. The buffer theory will be explained in the report.

If you have any questions or comments after reviewing this binder, please contact me for more information.

Andrew Bell
andybell@canada.com

Section

1.1

COMPUTER ASSISTED MASS APPRAISAL

Spatial Assessment

Formalized Proposal

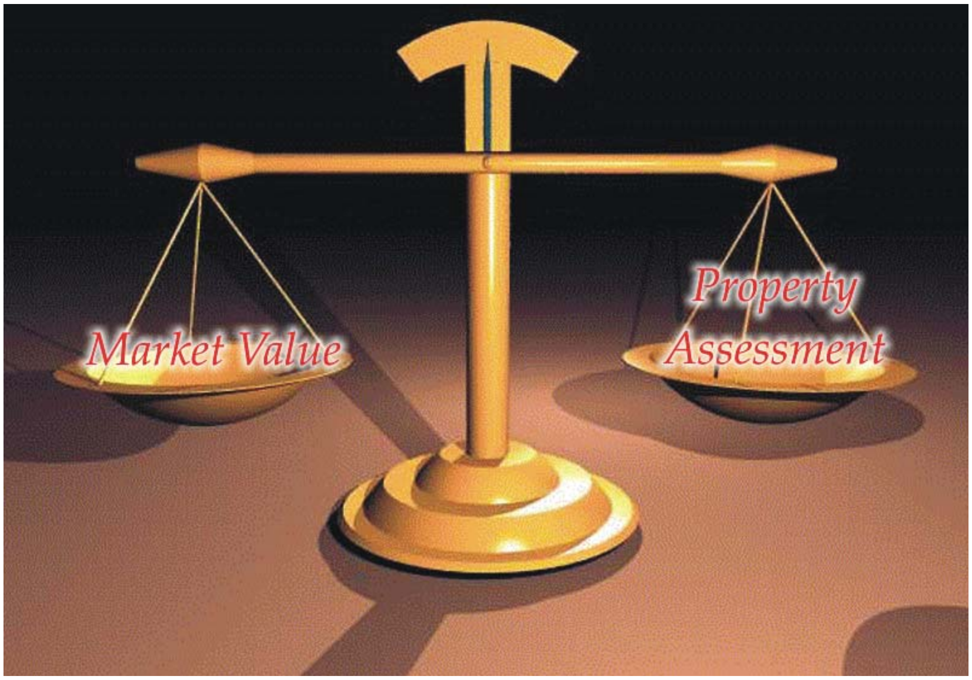
CENTRE OF GEOGRAPHIC SCIENCES

PLANNING: LAND INFORMATION AND GIS TECHNOLOGY

ANDREW BELL

RESEARCH PROJECT PRELIMINARY PROPOSAL

COMPUTER ASSISTED MASS APPRAISAL



Project Completed By Andrew Bell

2005

SPATIAL ASSESSMENT

Spatial Assessment is a tool I purpose to build that will run as an application through a geographical representation program produced by ESRI, the piece of software is known as ArcMap 9.0. The purpose of this application is to calculate an average, base rate value for every property in an assessment neighborhood.

PROJECT BACKGROUND

Assessment Offices throughout Canada are taking advantage of GIS technology to build Computer Assisted Mass Appraisal (CAMA) systems. These systems are capable of creating accurate property values based on characteristics of a property, its proximity to natural and man made features, and the type of land use actively present on the lot. This means that property values can be created within seconds for large study areas. The assessed values are generated based on relevant factors that affect market value, thus providing defendable property appraisals in the event of an appeal.

To perform an accurate property assessment in Nova Scotia a property assessor has to review each property parcel individually and occasionally visit the location in person to determine its true market value. The process currently being used in Nova Scotia is very time consuming and leaves room for human error.

Service Nova Scotia and Municipal Relations considers integration of GIS (spatial data) into the process of determining market value a priority, but has not actively experimented with using CAMA software. Service Nova Scotia does not have adequate staff to experiment with CAMA systems and most property assessors do not have the computer skills necessary to operate one. This creates a good opportunity for me to research a topic of my interest while providing useful information to Service Nova Scotia.

PROJECT CLIENT

Teth Cleveland, the GIS coordinator for Service Nova Scotia, will be both my client and technical advisor for this project. His office is located in Halifax.

Teth Cleveland:

CLEVELTE@gov.ns.ca

Phone: 902-424-5666

Fax: 902- 424-0587

PROJECT DESCRIPTION

The variables that affect market value are either spatial or can be modeled spatially. I purpose to build an application using GIS software with the main focal point for Spatial Assessment will be the sale price of lots that have had a transaction within the last three years.

Essentially, what I will be working with is a data table containing the characteristics of every property within a neighborhood (Table 1.1). The table I have displayed to the right is a small section of the data table I'll be working with for the Kingsburg study area. I will create tools that can be used to generate property values that reflect the current market value of a neighborhood. Depending on the location of the study area, more than one tool might be needed to create accurate values. The tools will be designed to be user friendly; however, computer skills will be required to use the tools most effectively. The user should also have a good foundation of knowledge in property assessment so they can property interpolate the results.

Table 1.1 *Example of a Spatial Data Table*

Attributes of Kingsburg2005

OBJECTID*	PID*	JURI	MU	AAN	SITUS_CITY
1	60193356	13	75	05202582	UNKNOWN
2	60189123	13	75	04986571	ROSE BAY
3	60193356	13	75	05202582	UNKNOWN
4	60460995	13	75	04986571	ROSE BAY
5	60193331	13	75	03643735	ROSE BAY
6	60193307	13	75	02111578	ROSE BAY
7	60193208	13	75	05049628	ROSE BAY
8	60460987	13	75	04986571	ROSE BAY
9	60189065	13	75	02254379	ROSE BAY
10	60189057	13	75	03819655	ROSE BAY
11	60189008	13	75	03332713	ROSE BAY
12	60456563	13	75	09323678	ROSE BAY
13	60193752	13	75	00984604	UNKNOWN
14	60186806	13	75	00908835	ROSE BAY
15	60189081	13	75	03665283	ROSE BAY
16	60188950	13	75	03642828	ROSE BAY
17	60455607	13	75	04752309	ROSE BAY
18	60189156	13	75	04809947	ROSE BAY
19	60456548	13	75	04752309	ROSE BAY
20	60493343	13	75	03642828	ROSE BAY
21	60467040	13	75	04779592	UNKNOWN

Record: 1 Show: All Selected Records (0 out of 1399 Selected.)

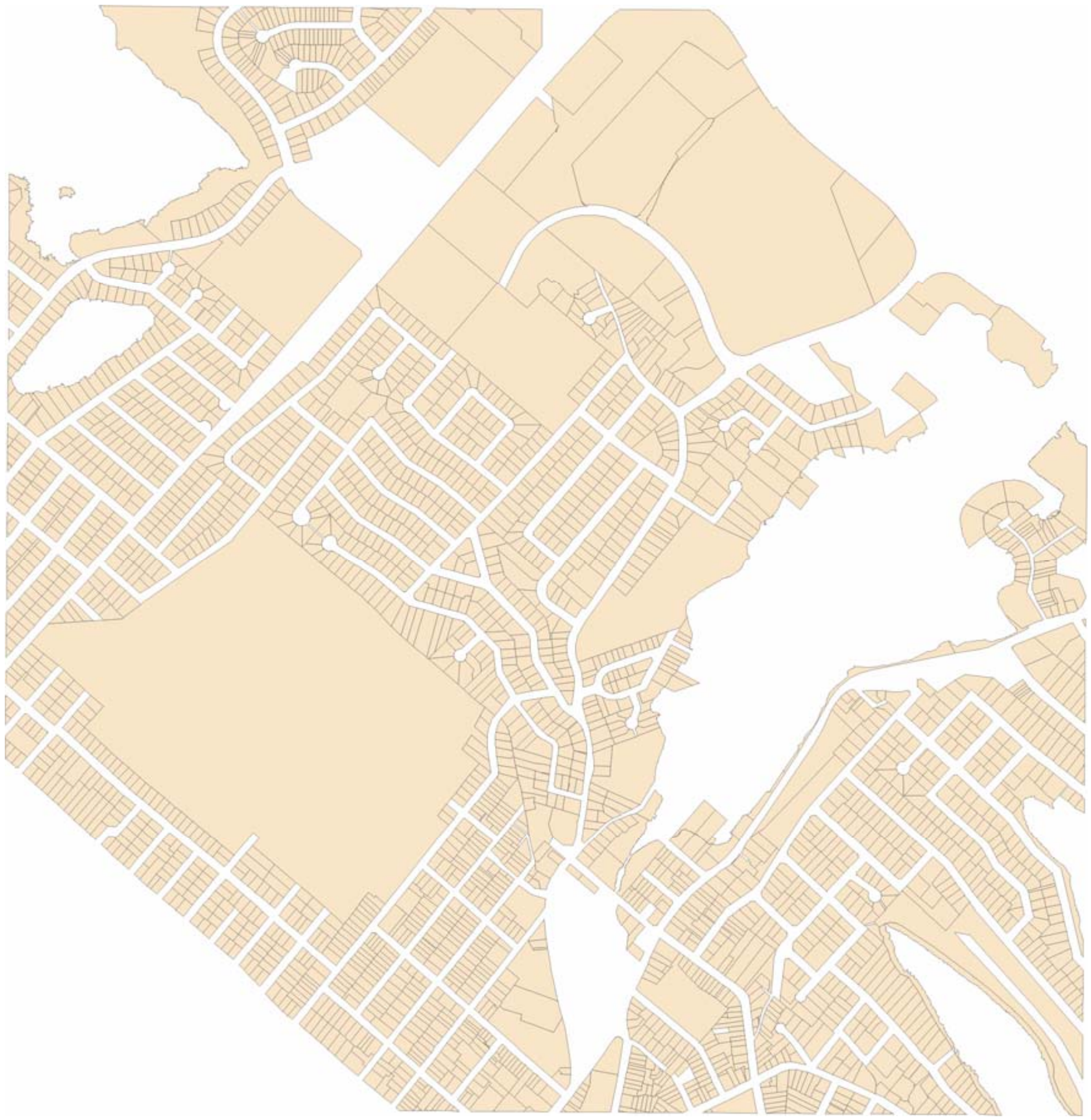
PROJECT RESULTS

Upon completion of this project, Service Nova Scotia and Municipal Relations will be provided with all of the tools I create. The tools will be saved in a .mxt document (ArcMap project document). Even if the prototype is a failure, he will still receive an organized binder containing seven month of research and all the difficulties I encounter. This information could be used by another GIS professional or technician to prevent them from encountering the same difficulties and errors. My goal is to produce a somewhat accurate application that shows potential for improvement with the support of a technical and theoretical team. The most important aspect of this application is the concepts used, not the computer programming involved. My objective is to produce something that supports theoretical assessment concepts.

PROJECT STUDY AREA

There will be two study areas and a total of 15 neighborhoods. A section of Dartmouth will be used as the urban study area and the rural study area will be a section of Kingsburg.

TOPOGRAPHIC VIEW OF THE DARTMOUTH STUDY AREA



TOPOGRAPHIC VIEW OF THE KINGSBURG STUDY AREA

Section

2.1

COMPUTER ASSISTED MASS APPRAISAL

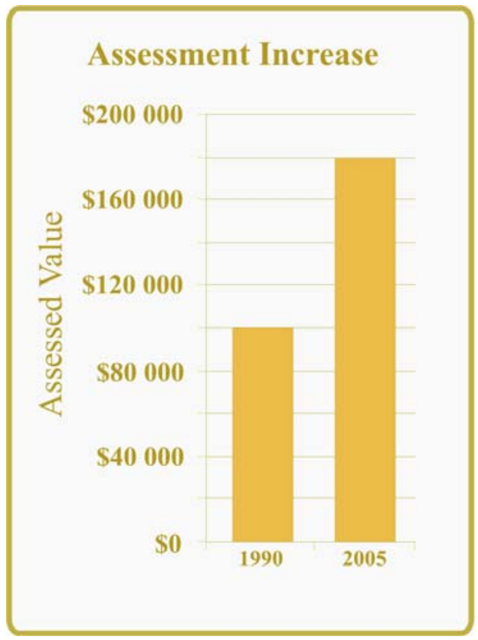
Spatial Assessment

Final Report

The job of a property assessor is complex and very important to Canada's economy. However, it is difficult to maintain accurate property values as market value fluctuates over time. Figure 1 displays an example of how an assessment has increased over the duration of 15 years.

The local government of an area collects property taxes annually and uses the money to improve the standard of living for Canadian citizens through improved infrastructure, maintenance of parks, plowing streets, etc. The amount of money a property owner pays in taxes each year is based on their property assessment. The accuracy of assessment data is crucial to ensure the property owner is paying the correct amount of money in taxes. If a neighborhood is under-assessed it could lead to thousands of dollars in lost revenue. The market value of a property fluctuates when the desirability factor of an area changes. Keeping up with market value is a never-ending battle for assessors. It is an extremely time consuming process for assessors to review neighborhoods and visit individual properties on a regular basis to make adjustments.

Figure 1 *Assessment Increase*

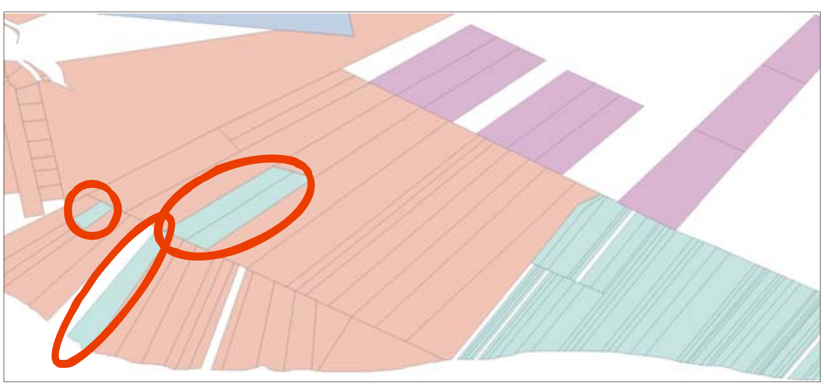


Source: Created in Corel Draw 11

Property assessments are determined by experienced property assessors who make comparisons between common trends in a neighborhood and applying those trends to recent transactions in the surrounding area. There are different classifications of land, ranging from developed residential land to municipal taxable exempt land. Every classification of land is assessed differently. It would make sense that a residential lot with water frontage would be worth more on the open market than a piece of undeveloped bulk land. Provincial assessors determine what each type of land would be worth per acre if it were to be sold as of a specified date. Bulk land in one area of Nova Scotia may be worth much less than bulk land in other parts of the province. It all depends on the location of the assessment neighborhood and what services are offered in the relative area.

An assessment neighborhood is an area that shares similarities from an assessment perspective. One thing that is taken in to consideration when determining neighborhood boundaries is the sale price of lots. All of the lots sold in a neighborhood should sell for similar values. Another thing that is considered is the location of the area and the services offered. Considerable effort has been spent on the alteration of neighborhood boundaries but there is still an issue where properties are classified under the wrong neighborhood. One possible reason for this could be clerical error when inputting data into the assessment database. To the right you'll find a section of Kingsburg that has been displayed by assessment neighborhood. This is an example of where four properties have been assigned to the wrong neighborhood *(Figure 2).*

Figure 2 *A section of Kingsburg displayed by assessment neighborhood*



Source: Created in ArcMap9.0

As mentioned above, there are many different types of land. All of the different types of land are classified under one of three classifications. The classifications are based on a property's use and whether it meets the requirements for the class as specified by the Assessment Act. The three main assessment classes are:

1. ***Residential*** *-- includes single-family residences, multi-family residences, duplexes, apartments, condominiums, nursing homes, seasonal dwellings, manufactured homes, and some vacant land.*
2. ***Commercial*** *-- includes all property or part thereof except residential property and resource property. This includes forest property owned by a person who owns fifty thousand acres or more.*
3. ***Resource*** *-- includes farm property (land and building used for agricultural purposes), land of a municipal water utility, excluding the structure, community fisherman's service building occupied and used by boat owners who are licensed commercial fishermen and the land used in connection. Retrieved May 08, 2005 from http://www.gov.ns.ca/snsmr/asmt/ps/value/types.asp*

It is also possible for one property to fall under more than one classification. If a 10 acre lot in a rural part of Nova Scotia is used partly for residential use, and the remaining portion is used for farming, then the lot would have two different classifications. In this case, a field assessor would visit the lot and determine what portion of the land is used for residential use and what portion is used for farming. The lot would be assessed differently for each type of land use and the assessed value applied to the lot as a whole would depend on what percentage of the lot is actively being used for farming and what portion is occupied by the residential structure.

MARKET VALUE

A property assessment is approached from a market value perspective. This is the most widely used method and most equitable way of determining a property assessment. This approach is used by every province in Canada, as do most assessment jurisdictions in the United States. Market value is widely accepted for the following reasons:

1. It is easily understood by most property owners.
2. It is a transparent process, allowing property owners to test fairness.
3. It is objectively determined and equitably applied to property owners.

"Market value is the amount of money that probably would be arrived at through fair negotiations between a willing buyer and a willing seller. Consideration is also given to the uses the property may be put. The following characteristics of market value should be noted:

1. *is the most probable price, not the highest, lowest or average price.*
2. *is expressed in terms of money.*
3. *implies a reasonable time to be exposed to the market.*
4. *implies that both the buyer and seller are informed of the uses to which the property may be put.*
5. *assumes an arm's-length transaction in the open market.*
6. *assumes a willing buyer and a willing seller with no advantage being taken by either buyer or seller.*
7. *recognizes both the present use and the potential use of the property."*

Valuing Property: Why Market Value? Retrieved April 21, 2005 from *http://www.gov.ns.ca/snsmr/asmt/ps/value/market.asp*

There are many variables that affect market value. Some of the most predominant variables are things like lot size, the land use actively present on the lot, a lots proximity to natural and man made features, and the most defendable variable of all would be recent transactions. In the event of an appeal a layer representing an assessment office would probably present the sale price of similar estates to help defend the assessment in question.

CAMA SYSTEMS

A CAMA system is a software package that helps simplify the job of a property assessor by providing functions that an assessor would normally have to do manually in the run of a day. They also make it possible to visualize the results of their data to make it more comprehensive to a property owner who may have questions about their assessment.

There are currently about twenty companies across North America that market a CAMA system. The capabilities of CAMA systems are increasing every day with the same goals in mind: generating reliable, accurate, and defendable property values. The systems are capable of producing property values that accurately reflect market value.

"In the 1980's, with the assistance of experienced appraisers and technical advisers, Govern's personnel were instrumental in developing a CAMA system that is presently installed in several jurisdictions across North America. Govern's goals are to provide the best solution to client needs, prompt support, and long term satisfaction with a cost effective and easy to use CAMA system that uses the most advanced tools in software and hardware technologies.

The system has been specially designed to satisfy the requirements needed by the assessor. The system will accomplish the primary objective of an assessor that is to arrive at values that are reliable, accurate, equitable and defensible." Valuing Property: Mass Appraisal, Retrieved April 21, 2005 from http://www.governsoftware.com/Mass_Appraisal.htm

A CAMA system utilizes digital tables that contain property information to calculate a value which is supported by documentation. The digital tables contain facts about the neighborhood such as lot size and proximity to natural and man made features, (Rivers, Schools, Parks). When a CAMA produces a value it produces an output table containing all of the factors that were considered when generating the assessment value. In the event of an appeal, the output table would provide cold hard facts about a property and how the CAMA arrived at the value. All property information, values, and tables are saved annually allowing government employees to retrieve property information exactly as they appear on the tax role. A CAMA system can refine previously determined values to calculate more up to date ones.

CAMA systems run primarily on facts and policies that have been input in to the system when it was originally developed. The values generated by a CAMA system are rarely ever wrong and remove the subjective human error variable from an assessment.

GIS TOOLS USED IN NOVA SCOTIA

Computer based applications have been introduced to Nova Scotia, but nothing that compares to the capabilities of a CAMA system. One of the web-based applications used by assessment offices in Nova Scotia is called Akanda. This application enables assessors to access assessment accounts from anywhere they log in. Akanda's database is expanding every day as assessment offices upload pictures acquired from field inspections. Akanda also offers a topographic view of lots, and has a printing option that centers the map on an 8.5 by 11 inch page for easy printing. This application is an excellent way to store data, and the public version allows assessment account holders to view their assessment information online.

Another tool very common in assessment offices is a program called Oasis. Oasis is an old program with a dos interface and is used to organize assessment account information. In the Oasis program you can search for assessment accounts by the property owner, Property Identification (PID), or Assessment Account Number (AAN). When a query is submitted there is a list of AAN's that match the search criteria. All of the information contained in an AAN is displayed in a layout called a PR20. When an assessor is reviewing an assessment account they will most likely print a PR20 because it contains all of the information about a property and the structures on the lot. The length of a PR20 depends on the amount of information a property has, (ex. A property with 3 structures on it will have a larger PR20 than a property with only 1 structure).

Akanda and Oasis are the two most commonly used GIS tools used in Nova Scotia at this time leaving a huge portion of the work to field assessors. Assessment Nova Scotia has recently shown interest in taking advantage of today's technology to create a mass appraisal system but have not taken steps to consider the analytical process. I think we'll see big changes in the next five years as Assessment Nova Scotia finds ways to maintain and improve effective public relations.

I think introducing new GIS tools to assessment offices would improve the accuracy of assessments, help organize data, and also improve the work ethic of assessors. It is my understanding that Akanda has proven to improve public relations, and I think expanding the GIS environment in assessment offices would continue to do so in the future.

DATA SET

There are two datasets made available to me by Service Nova Scotia and Municipal Relations. One data set contains the assessment information for a section of Dartmouth and the other dataset contains information for a section of Kingsburg.

The data set I'll be working with for the Kingsburg study area is very simple. It contains 50 fields and 1020 records. The attribute table could be generalized substantially because the Spatial Assessment tool only uses 10 of the 50 fields. ArcMap uses some of the remaining 40 fields for spatial referencing purposes. Every property in the study area contains one record in the table. Each record has 50 fields that pertain to a specific lot. Not all 50 fields will have entries though; only the fields that reflect the lot will have entries. (ex. There are six fields for structure assessments; if there are only two structures on the lot than only two of the six fields will have entries.) Here is a list of the principle fields I'll be working with and what they display:

AREA: The area field is used to show the area of each property parcel.

SALEYMD: This field stands for Sale Year Month Day and contains the date of transaction if a transaction has every taken place.

SALEPRICE: This field contains the sale price of the transaction.

PBLDG 1 – PBLDG 6: These six fields contain the assessments of every structure on a lot. If there are only two structures on a lot than only two of the six fields will have entries. The other four fields would have a value of zero. It is common to see upwards of two structures on a lot in rural areas, but very rare to see more than two in an urban area.

Others: There are other fields contained in the data table but they are not needed for the Spatial Assessment Tool. Some of the more predominant fields to an assessor are: **AAN**, which stands for assessment account number and **PID**, which stands for property identification. Every property with an assessment should have both a PID and an AAN associated with it, there are problems in Nova Scotia where an AAN does not have a PID match. This is common when a property owner owns multiple properties in various locations.

INTRODUCTION TO THE SPATIAL ASSESSMENT TOOL

The Spatial Assessment tool is an application that creates an average lot value that reflects the lot size and also the desirability of the neighborhood. The base rates are created using transactions that have taken place within the last three years and compares the sale price to the square footage of the lots. The base rate function will calculate the average lot size of every lot with a transaction greater than one dollar and a transaction after the year 2002. I will go in to more detail as to why I select only these properties later. Spatial Assessment will then find the average sale price of those lots. The next step of the base rate function is to divide the average sale price by the average lot size to get a value per square foot. The average value per square foot is then multiplied to the square footage of every lot in the neighborhood. The base rate values produced are not meant to be exact because they reflect the average market value of an assessment neighborhood, but it provides a good starting point where more advanced calculations can be made to reflect things that affect individual lots rather than the study area as a whole.

The base Rate function is the only Spatial Assessment tool I have successfully completed. Additional functions could be explored if the development of this tool were to be continued in the future. Using buffers to perform proximity analysis would be a function that could be integrated in to this tool. Here is an example of how a buffer would work for waterfront and water view lots. By using muli-ring buffers we could use the coastline as a starting point for the buffer. Having the first buffer ring 500 meters wide would allow us to select properties that fall within 500 meters of the coastline. Then having another buffer that extends an additional 500 meters would allow us to select properties that fall between 500 and 100 meters of the coastline *(Figure 3).* All of the lots selected from the first buffer ring would be considered water front lots and have a certain percentage of their base rate value added to their base rate. The other lots that are selected from the second buffer ring would be considered water view lots and have a smaller percentage of their base rate value added to their base rate. Again, I will go in to more detail about the base rate value later. The width of the buffers would vary depending on the study area. In rural areas where long lots are common, a wider buffer would be needed to select lots with water frontage. The percentage of the base rate value added to the base rate would also vary depending on the desirability of the area.

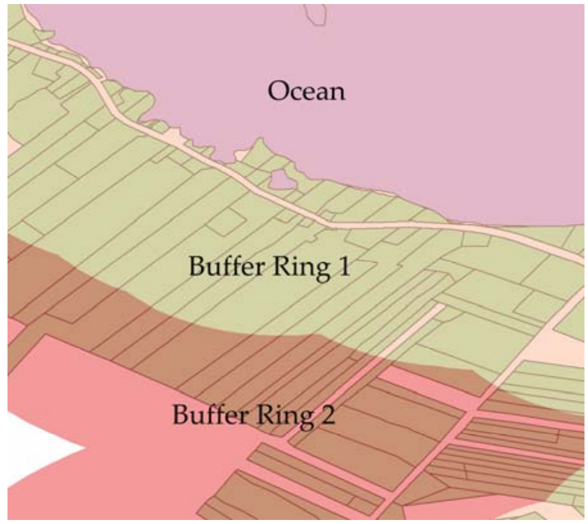


Figure 3: Created in ArcMap9.0

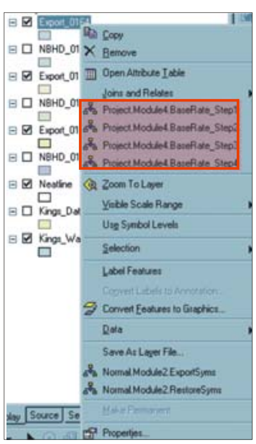
As mentioned in the proposal, a large portion of this project is turning theoretical concepts into tools that will run on spatial data. With more advanced VBA script writing the technical side could be simplified to make this application more user-friendly. My goal is to focus on the values being produced rather than the user-friendliness of the application.

The purpose of the base rate function is to calculate a base rate for every property in an assessment neighborhood by using recent transactions to calculate a value that can be applied to lots that have never had a registered transaction from one property rights holder to another.

ArcMap 9.0 is the software package used as the foundation for this application. ArcMap is created and released by ESRI, one of the most advanced GIS companies in the world. There are a total of **four scripts* for the base rate function. The scripts have been created to run on any table with residential lots. All of the scripts are context sensitive, meaning they will appear in the context menu when you right click on the neighborhood in which you wish to work on *(Figure 4).* All four scripts have to be run before a base rate can be created. With more advanced VBA script writing, all four scripts could be reduced in to one large script, or a call command could be added to the end of each script to automatically run the next script until all four scripts have been ran in consecutive order.

****Four Scripts:** The four scripts are named: Base Rate Script I, Base Rate Script II, Base Rate Script III, Base Rate Script IV. The functionality of these four scripts will be explained in detail later.*

Figure 4 *Context Menu*

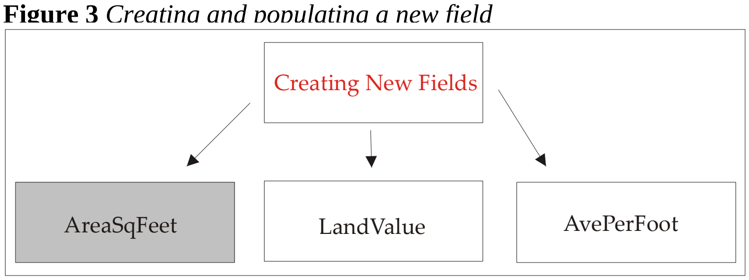


Source: Screen Capture from ArcMap9.0

The attribute table for the Dartmouth and Kingsburg study areas that have been provided to me by Service Nova Scotia contains useful information, but in its current form it is useless for this application. In order to create base rate vales an additional 7 fields will have to be created and populated. The 7 fields are created based on calculations made in the original table. As mentioned above, there are four scripts; I'll break the base rate function down in to four sections, one section for each script.

Base Rate Script I: The first script creates 3 of the additional 7 fields. The first field created is an "AreaSqFeet" field that displays the area of every lot in square feet *(Figure5).*

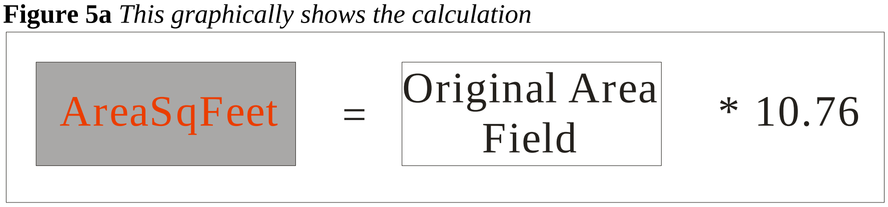
Figure 3 *Creating and populating a new field*



Source: Created in Corel Draw 11

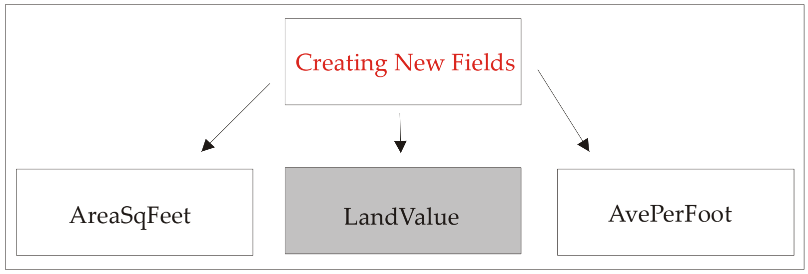
The original data table I received has an area field but the values are represented in map units. When spatial data is projected to it proper location on earth the area field will be displayed in map units. This is a default setting in ArcMap. The values represented in map units can be converted to area per square foot by multiplying each value by 10.76 *(Figure 5a).*

Figure 5a *This graphically shows the calculation*



Source: Created in Corel Draw 11

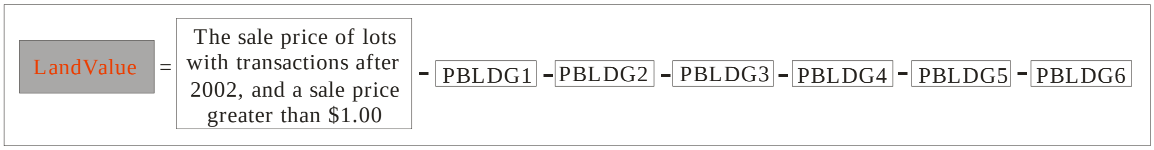
Figure 6 *Creating and populating a new field*



The second field created in the first script is a “LandValue” field *(Figure 6).* To populate this field we use the sale price of lots that have had a transaction within the last three years and a sale price greater than $1.00. The table has transactions dating back as far as 1978. Market value has changed so much since then that values dating back before 2002 are not considered within ‘arms length’ of the current market value. The only problem with the SALEPRICE field is that it contains the sale price of both the land and the structures on the lot. To remove the sale price of the structures we look at the six fields pertaining to structural assessments. These fields are labeled PBLDG1 – PBLDG6. If a property has two permitted structures present on the lot, than PBLDG1 and PBLDG2 will have entries, the other 4 fields will have a value of 0 because there can’t be a value for a structure that does not exist. Subtracting the assessed value of all the structures from the sale price was the only way to remove the structures from the sale price. The value remaining is roughly what the land is worth. I did run into a few anomalies where the assessed value for the house was greater than the sale price of the house and property rights together. The resulting land value was a negative. These negative values pose a problem later in the base rate function. There were also a few problems with lots that have transactions dating back to 2002. The structure assessments available to me are 2005 assessments. The transactions may have taken place two or three years before 2005, this means that the land value may be slightly lower than its true value because the assessed value of the house may have increased since the transaction date. The difference between the true land value and the land value calculated is equal to the difference between the assessed value of the house at the date of transaction and the assessed value of the house now. Since I didn’t have structure assessments for the 2003 base year I was unable to correct this problem.

The accuracy of this application will vary from neighborhood to neighborhood depending on the accuracy of the assessments in that area. Neighborhoods that are regularly reviewed by assessors will produce more accurate results because the structural assessments will be up-to-date. The calculation for the LandValue field is graphically shown below *(Figure6a)*.

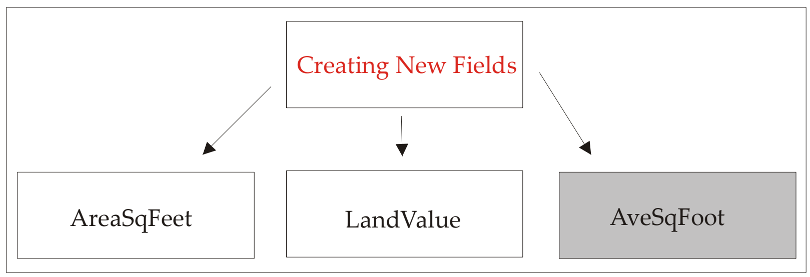
Figure 6a



Source: Created in Corel Draw 11

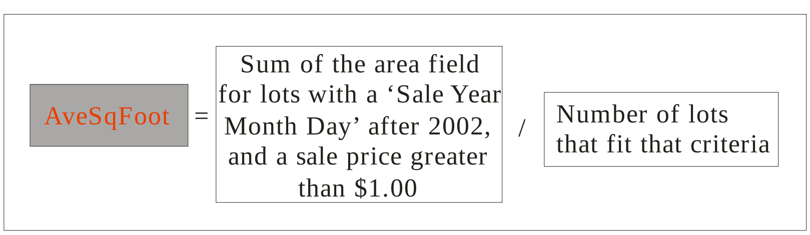
The third field created is an "aveSqFeet" field where we calculate the average square footage for the lots that have a transaction after 2002 and a sale price greater than 1 dollar *(Figure 7)*. I had to exclude the lots that have sold for 1 dollar because they do not reflect market value. The lot was sold for one dollar simply to switch the rights to a new owner. This is common when land is sold within a family. This average per square foot field will be used in the third script where we make a comparison between the average lot size and the average sale price.

Figure 7 *Creating and populating a new field*



<u>The Base Rate Script 1 can be found in the appendix.</u> The script will make sense to GIS analysts who understand VBA scripting. The green text is commentary I have added to explain the various steps in each procedure. Below is a graphic showing the 'AveSqFoot' calculation *(Figure 7a)*.

Figure 7a



Source: Created in Corel Draw 11

In *Figure 8* you may notice that there are values of "0" showing. This is because the date of transaction was older than 2002 or there hasn't been a transaction. The calculations can be found in the appendix under the Base Rate Script I section. Scan through the green text to find the section of the script that applies to the 'calculating variables'.

Figure 8 *New fields created in Base Rate Script 1*

aveSqFeet	LandValue	LandAve	AreaSqFeet
115303.925122	26000	194996.548673	18948.469584
115303.925122	26000	194996.548673	11797.486535
115303.925122	8000	194996.548673	57603.595526
115303.925122	38506	194996.548673	5186.586084
115303.925122	121002	194996.548673	10362.533439
115303.925122	45800	194996.548673	16295.025748
115303.925122	38506	194996.548673	5821.450236
115303.925122	38506	194996.548673	3611.207143
115303.925122	265502	194996.548673	255837.011912
115303.925122	27200	194996.548673	15391.246593
115303.925122	54302	194996.548673	16499.791421
115303.925122	38506	194996.548673	8155.732732
115303.925122	45800	194996.548673	26788.369817
115303.925122	155100	194996.548673	7544.256027
115303.925122	499002	194996.548673	44287.296663
115303.925122	22600	194996.548673	10168.587844
115303.925122	190002	194996.548673	108276.431313
115303.925122	190002	194996.548673	44354.962641
115303.925122	5400	194996.548673	47920.083691
115303.925122	265002	194996.548673	44506.158518
115303.925122	169602	194996.548673	1103527.24463
115303.925122	38506	194996.548673	443302.049669
115303.925122	10002	194996.548673	48014.961031

Source: Screen capture from ArcMap9.0

Base Rate Script II: The second script creates 1 more of the 7 new fields. This field is called "LandAve" *(Figure 9 & 10).* To find the average sale price for lots that have recently sold we find the total of the "LandValue" field that was created and populated in Base Rate Script I and divide by the number of entries greater than 0 dollars. I have to filter out all the negative values because the assessed value of the house was more than the sale price of the house and lot together. We touched on this issue in section I. Now we have an average sale price and an average sq footage for the same lots. (The average sq footage field was created and populated in the first script.) The next script does a calculation based on these two fields to find an average value per sq foot of land. The Base Rate Script 2 can also be found in the appendix.

Figure 9 *Creating a new field*

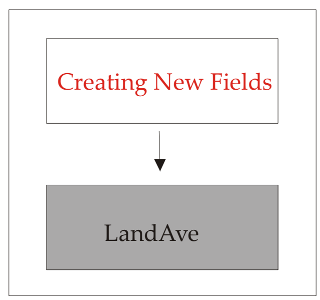


Figure 10 *LandAve Field*

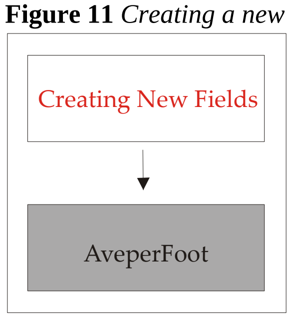
LandAve
0
258782.71875
258782.71875
258782.71875
258782.71875
0
258782.71875
258782.71875
258782.71875
258782.71875
258782.71875
258782.71875
258782.71875
258782.71875
258782.71875

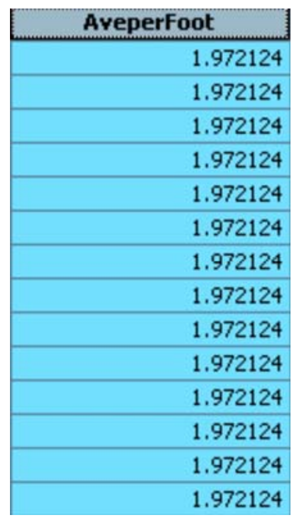
Below is a graphic showing the 'LandAve' calculation *(Figure 10a)*.

Figure 10a

Source: Created in Corel Draw 11

Figure 11 *Creating a new field*





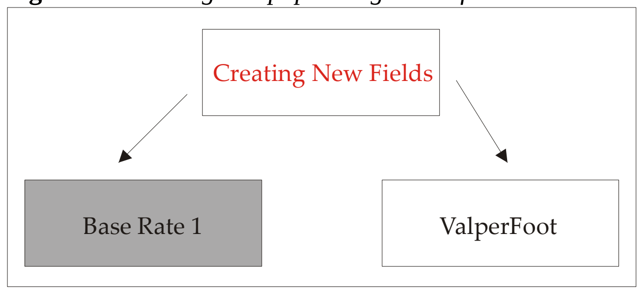
AveperFoot
1.972124
1.972124
1.972124
1.972124
1.972124
1.972124
1.972124
1.972124
1.972124
1.972124
1.972124
1.972124
1.972124
1.972124

Base Rate Script III: This script was by far the most complex because it contains 6 variables to arrive at an average value per square foot of land. The average square footage field and the average sale price field were divided by each other to find an average value per square foot of land *(Figure 11)*. Now we have an average land value for one square foot of land, and also a square footage field, which was created in section I *(Figure 12)*. The Base Rate Script 3 can be found in the appendix. Below is a graphic showing the calculation for the 'AveperFoot' field *(Figure 12a)*.

Figure 12a

Source: Created in Corel Draw 11

Figure 13 *Creating and populating a new field*

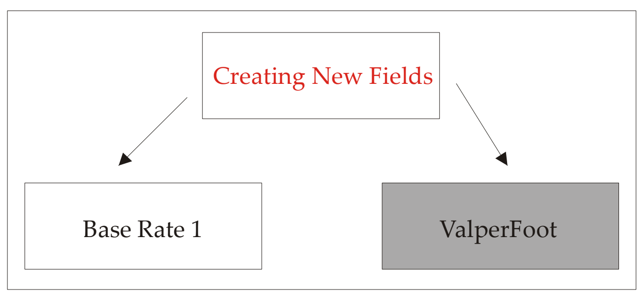


Base Rate Script IV: The fourth and final script is where the base rate is generated for all of the lots in the study area *(Figure 13)*. The average value per square foot is multiplied to the square footage of every lot in the study area. The average value per square foot was generated based on lots that have had recent transactions and uses that value to apply values to the remaining lots that have not had transactions. *Figure 13a* displays the calculation made for 'BaseRate1'.

Figure 13a

Source: Created in Corel Draw 11

Figure 14 *Creating and populating a new field*



This script also adds a field that shows the value per square foot of every lot with recent transactions *(Figure 14)*. By creating this field we can identify lots or areas of the neighborhood that have sold for much more or much less than the average value. By identifying these areas, an assessor could make inquires to find out why the lots are so far from the average value per square foot of land for different sections of the neighborhood. An example of an area with a high value per square foot would be coastal areas. By identifying the 'outliers', adjustments could be made to the surrounding properties to reflect the fluctuation of market value in that section of the neighborhood. <u>The Base Rate Script 4 can be found in the appendix.</u>

Figure 15

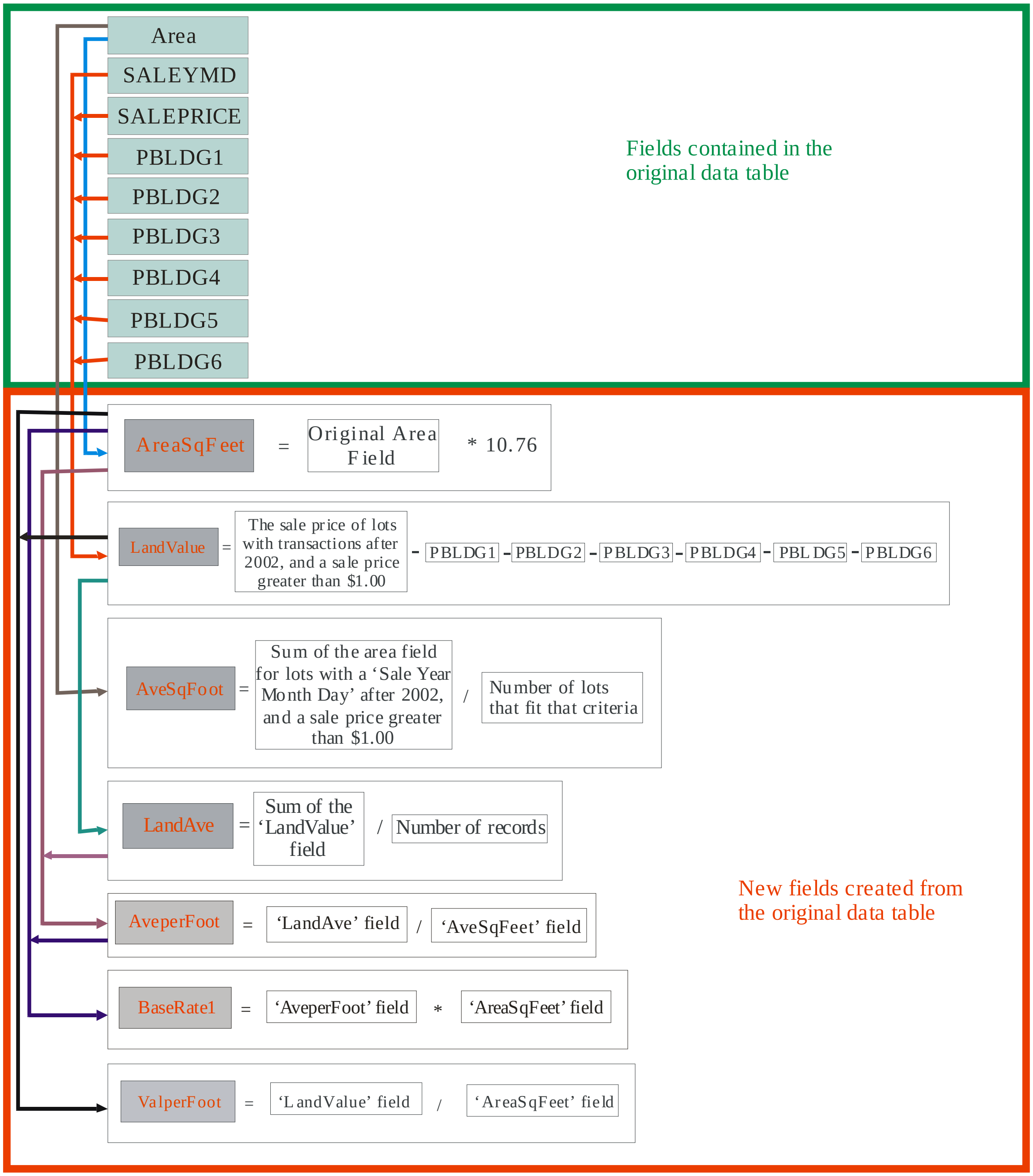
BaseRate1	ValperFoot
32044.756219	1.372142
19951.351656	2.203859
97416.478293	0.138880
8771.309257	7.424151
17524.626799	11.676874
27557.377410	2.810674
9844.961505	6.614503
6107.102848	10.662916
432659.463177	1.037778
26028.948817	1.767238
27903.667438	3.291072
13792.58974	4.721342
45303.224962	1.709697
12758.489236	20.558687
74896.583011	11.267385
17196.635174	2.222531
183111.983276	1.754786
75011.016514	4.283669
81040.180740	0.112688
75266.711835	5.954277
1866233.12121	0.153691
749691.475059	0.086862
81200.632812	0.208310
149914.546857	1.410097
261071.625473	0.226086

Figure 15a shows the calculation made for the ‘ValperFoot’ field.

Figure 15a

Source: Created in Corel Draw 11

That is how the base rate function works. I think it has potential to be improved with more time and a team of trained assessors and GIS technicians. One thing that may be possible to do is to create a formula that adjusts old transactions to reflect current market value. The more records this application has to work with the more accurate the results will be.


Area
SALEYMD
SALEPRICE
PBLDG1
PBLDG2
PBLDG3
PBLDG4
PBLDG5
PBLDG6
Fields contained in the original data table
AreaSqFeet = Original Area Field * 10.76
LandValue = The sale price of lots with transactions after 2002, and a sale price greater than $1.00 - PBLDG1 - PBLDG2 - PBLDG3 - PBLDG4 - PBLDG5 - PBLDG6
AveSqFoot = Sum of the area field for lots with a 'Sale Year Month Day' after 2002, and a sale price greater than $1.00 / Number of lots that fit that criteria
LandAve = Sum of the 'LandValue' field / Number of records
AveperFoot = 'LandAve' field / 'AveSqFeet' field
BaseRate1 = 'AveperFoot' field * 'AreaSqFeet' field
ValperFoot = 'LandValue' field / 'AreaSqFeet' field
New fields created from the original data table

The following section is about an extension that can be added to the ArcMap 9.0 interface. This extension could be used to visualize in 3D common trends in an assessment neighborhood and potentially create land values based on the trends present in the surrounding area. Preliminary research into this technique looks promising for creating land value for lots that have not recently sold. There is an issue with lot size that will be discussed in the next section.

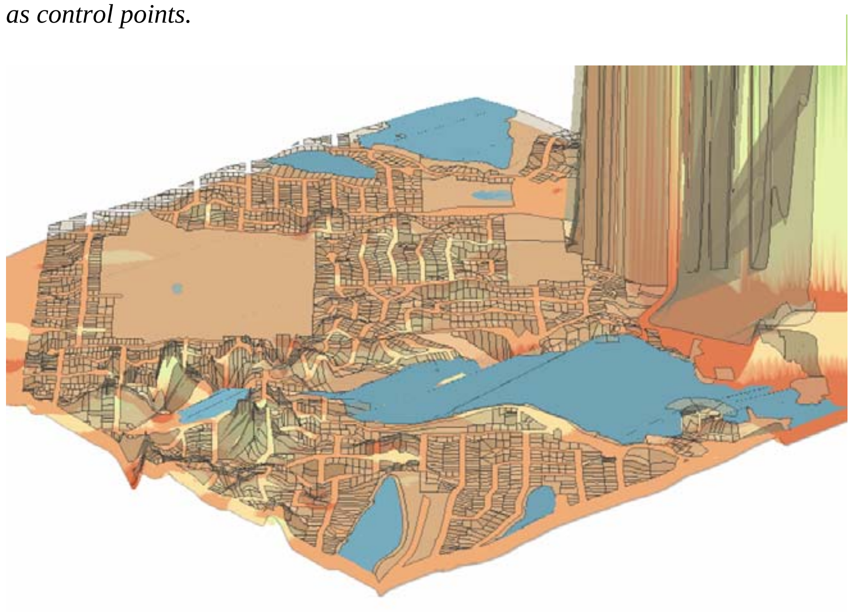
This extension allows the user to perform additional functions that the stock package of ArcMap9.0 does not include. The extension is called 3D Analyst and was originally produced for processing and visualizing elevation data. The extension is designed to behave in an elevation manner by interpolating the surrounding gradient. For sections of a study area where data is missing for one reason or another, the extension creates a gradient and elevation values based on surrounding trends. There are many similarities between the way this extension interpolates slope data and how it could potentially interpolate land value if we used land value in place of elevation data. 3D Analyst is also a very powerful visualization tool, which allows functions available in the stock package of ArcMap9.0 to work. For example, ArcScene could be used to view land value in a 3D map if a model was produced using 3D analyst. This alone is very interesting from an assessment perspective because it allows data to be displayed in a manner that has not been introduced to Service Nova Scotia. This would allow recent transactions to be mapped in a 3D manner where as the basic version of ArcMap only allows 2D images. I will go in to more detail about the potential this tool has from a theoretical perspective below.

Every property parcel in a neighborhood has a centre point that can be determined by using the create points from features tool in ArcMap9.0. The property value of a lot would be attached to that center point as an ID figure, much the same as if we had a point with an elevation value attached as its ID. The extension analyses all of the points in a study area and produces a grid that shows a smooth flow between points. Points with a high transaction would mean there would be an increase in the grid value around that point. If a lot with a low transaction was located one block away from a lot with a high transaction than the grid would interpolate the two points and create a smooth surface between the two points. If there were no transactions between the two points than the grid would create values for the section between the two points. The grid would most likely be divided up in to square footage cells; each cell would contain a different value which is determined by the control points (transactions). If we overlaid the property boundaries we could perform a simple query select function to add all the cells together that fall within a lot to get a land value. In theory this would work for large study areas that have a high number of recent transactions.

INVERSE DISTANCE WEIGHTING

3D Analyst can interpolate data in many different ways; one of these methods is called the inverse distance weighting method or **IDW (Figure 16)*. If we were working with a study area that contains a low number of transactions than the inverse distance weighting method would be the best grid to produce. Recent transactions in a study area would work as control points that represent land value for that section of the neighborhood. The inverse distance weighting method would analyze the points, the values attached to each point, the distance between each point, common patterns, and trends present in the neighborhood to

Figure 16 *Inverse Distance Weighting Model Created by recent transactions as control points.*



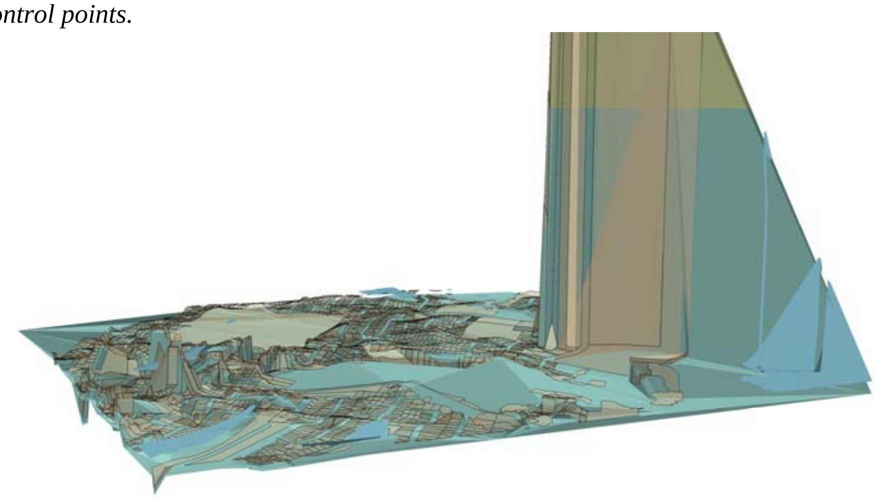
create a grid. The values are generated by taking all of the variables present in the study area into consideration and create a grid that flows from point to point, reflecting the variables. The inverse distance weighting method differs from other methods available in 3D analyst in the way it creates values. The transition from point to point is a much smoother flowing surface when compared to a triangular irregular network, which I will discuss in the next section. After the IDW is created it can be loaded in to ArcScene and displayed by cell value. Cells with a high value would have a higher elevation than cells with a low value. The example above is displayed using the results of the Spatial Assessment tool.

IDW: *IDW interpolation explicitly implements the assumption that things that are close to one another are more alike than those that are farther apart. To predict a value for any unmeasured location, IDW will use the measured values surrounding the prediction location. Those measured values closest to the prediction location will have more influence on the predicted value than those farther away. Thus, IDW assumes that each measured point has a local influence that diminishes with distance. It weights the points closer to the prediction location greater than those farther away, hence the name inverse distance weighted. Retrieved May 08, 2005 from ArcGIS Desktop Help*

TRIANGULAR IRREGULAR NETWORK

The triangular irregular network or **TIN* method would be used for neighborhoods that have a high number of transactions with and a wide range of values between each transaction. This method creates a series of triangles between points *(Figure 17)*. The values tend to decrease or

Figure 17 *Triangular Irregular Network Model Created by recent transactions as control points.*



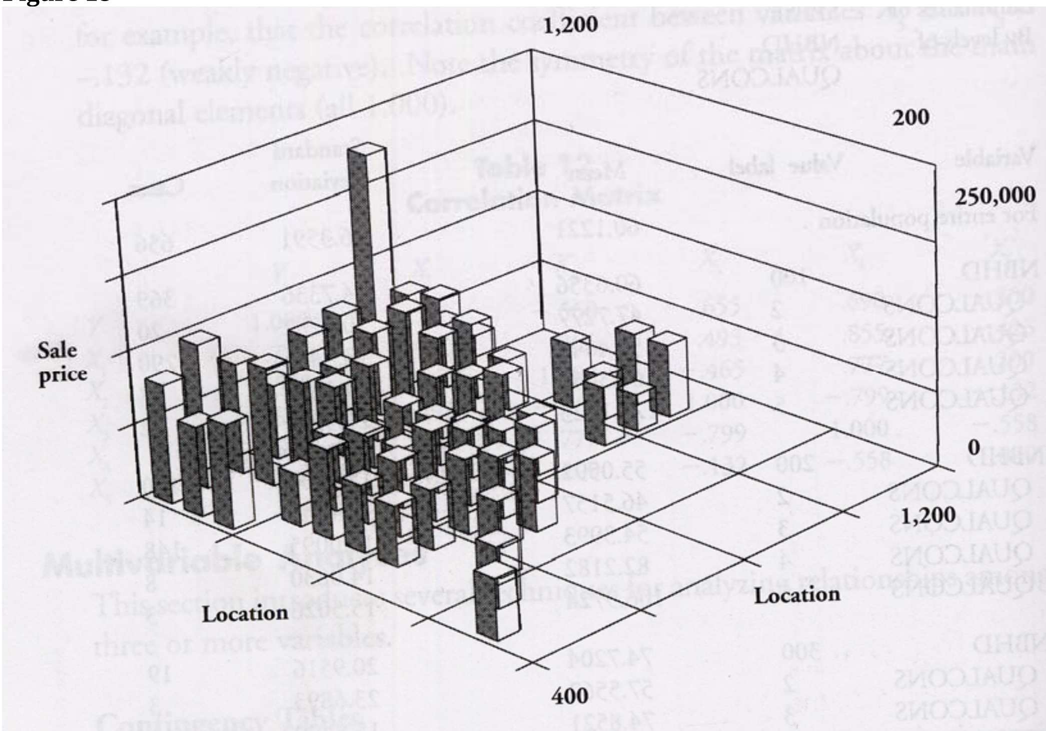
increase in equal intervals from point to point where as the inverse distance weighting method creates a smooth rolling surface. The triangular irregular network method would be better for diverse neighborhoods with a high number of transactions because it could easily change from increasing values to decreasing values when going from a point with a high value per square foot to a point that has a low value per square foot.

***TIN:** *In a triangulated irregular network (TIN) model, the world is represented as a network of linked triangles drawn between irregularly spaced points with x, y, and z values. TINs are an efficient way to store and analyze surfaces. Heterogeneous surfaces that vary sharply in some areas and less in others can be modeled more accurately, in a given volume of data, with a triangulated surface than with a raster. That is because many points can be placed where the surface is highly variable, and fewer points can be placed where the surface is less variable. In using only the points necessary, TINs also provide a more efficient method to store data. ArcGIS stores triangulated surfaces as TIN datasets. As with rasters, you can add TIN datasets to a map in ArcMap and manage them with ArcCatalog. Retrieved May 08, 2005 from ArcGIS Desktop Help*

VALUATION POTENTIAL

The 3D analyst extension, at the least, works as a great tool for displaying data. It also has potential to work as a valuation model. One of the functions contained in Base Rate Script IV calculates the value per square footage of land for properties with recent transactions. These properties and values per square foot of land are used as control points for the valuation model. Both the TIN and the IDW were generated using these control points. If the TIN or IDW is viewed in ArcMap, the identification tool can be used to reveal the value of land for the section of the neighborhood you click on. *Figure 18* is a graph that displays how this valuation method works. The flat surface on the bottom of the graph would be the study area. Each bar of the graph would represent the value of land per square foot for that section of the neighborhood. If the IDW method was applied to this graph the bars would be replaced with a smooth surface that falls over the top of each bar. Since a smooth surface connects each control point it is possible to get values for any section of the neighborhood.

Figure 18



CONCLUSION

The Spatial Assessment tool is a demonstration tool that could be refined and improved with more time. The framework of the application is solid, but adding formulas that allow old transactions to be corrected to reflect the current market value would improve the results of this application substantially. The technical side was kept as simple as possible however; the four scripts that have been written for the base rate function could be reduced to one script. The results would be the same and the only benefit in doing this would be that the user can click the mouse only once, rather than four times. If Spatial Assessment was going to be worked on and improved in the future, I would recommend creating functions that allows the user too perforce proximity analysis through the use of buffers. The base rate can be used as a starting point where more advanced calculations can be made. If the buffer theory explained in the 'Introduction to

Spatial Assessment' section were to be implemented than the base rate could be put in to a percentage formula to reflect the feature being buffered.

The section that explains 3D analyst and its capabilities provides a brief overview of the extension. There is a shocking resemblance between the way elevation data is interpolated and how land value could potentially be interpolated.

The Spatial Assessment tool and the theories noted in this report are unique from CAMA systems on today's market because the concept of this application is to generate a **unit value* based on relative factors in a neighborhood, whereas CAMA systems on today's market uses a predetermined unit value that has been generated by a theoretical assessor. Generating a unit value is a huge advantage because unit values are always changing; calculating unit values would relieve a huge amount of work from government employees and also increases the accuracy of property assessments.

****Unit Value:** The value of something based on a unit of measurement. (ie. Value of land per square foot of real property)*

A company by the name of Spatialist, who is a business partner of NovaLIS technologies, has already started to investigate land valuation in this manner. It is my belief that the next generation of CAMA systems will follow this approach to land valuation because it supports the market value approach to land appraisals, the market value approach is the most widely used and accepted approach to land valuation in North America.

<u>All of theVBA scripts can be found in the appendix.</u>

Section

3.1

COMPUTER ASSISTED MASS APPRAISAL

Spatial Assessment

Appendix

```
Sub BaseRate_Step1()
'Private Sub BaseRate_Step1()

' Set up MxDocument, FeatureLayer, FeatureClass and Fields for Context menu
    Dim pMxDoc As IMxDocument
    Set pMxDoc = ThisDocument

    Dim pFLayer As IFeatureLayer
    Set pFLayer = pMxDoc.ContextItem

    Dim pFClass As IFeatureClass
    Set pFClass = pFLayer.FeatureClass

    Dim pFields As IFields
    Set pFields = pFClass.Fields

' queryValue0 as AVESQFEET

    Dim queryValue0 As Double
    queryValue0 = pFields.FindField("aveSqFeet")

    If queryValue0 = -1 Then
        Dim pFieldEdit0 As IFieldEdit
        Set pFieldEdit0 = New Field

        pFieldEdit0.Name = "aveSqFeet"
        pFieldEdit0.Type = esriFieldTypeDouble

        pFClass.AddField pFieldEdit0
        queryValue0 = pFields.FindField("aveSqFeet")
    End If

 ' queryValue1 as LANDVALUE

    Dim queryValue1 As Double
    queryValue1 = pFields.FindField("LandValue")

    If queryValue1 = -1 Then
        Dim pFieldEdit1 As IFieldEdit
        Set pFieldEdit1 = New Field

        pFieldEdit1.Name = "LandValue"
        pFieldEdit1.Type = esriFieldTypeDouble
```

```
        pFClass.AddField pFieldEdit1
        queryValue1 = pFields.FindField("LandValue")
    End If

' queryValue2 as LANDAVE

    Dim queryValue2 As Double
    queryValue2 = pFields.FindField("LandAve")

    If queryValue2 = -1 Then
        Dim pFieldEdit2 As IFieldEdit
        Set pFieldEdit2 = New Field

        pFieldEdit2.Name = "LandAve"
        pFieldEdit2.Type = esriFieldTypeDouble

        pFClass.AddField pFieldEdit2
        queryValue2 = pFields.FindField("LandAve")
    End If

' queryValue3 as AREASQFEET

    Dim queryValue3 As Double
    queryValue3 = pFields.FindField("AreaSqFeet")

    If queryValue3 = -1 Then
        Dim pFieldEdit3 As IFieldEdit
        Set pFieldEdit3 = New Field

        pFieldEdit3.Name = "AreaSqFeet"
        pFieldEdit3.Type = esriFieldTypeDouble

        pFClass.AddField pFieldEdit3
        queryValue3 = pFields.FindField("AreaSqFeet")
    End If

' queryValue4 as SALEPRICE - must exist in feature table

    Dim queryValue4 As Double
    queryValue4 = pFields.FindField("SALEPRICE")

' queryValue5 as SALEYMD - must exist in feature table

    Dim queryValue5 As Double
    queryValue5 = pFields.FindField("SALEYMD")
```

```
' queryValue6 as AREA - must exist in feature table in m2

    Dim queryValue6 As Double
    queryValue6 = pFields.FindField("Area")

' queryValue7 as BuildValue - must exist in feature table

    Dim queryValue7 As Long
    queryValue7 = pFields.FindField("PBLDG1")

' queryValue8 as BuildValue - must exist in feature table

    Dim queryValue8 As Long
    queryValue8 = pFields.FindField("PBLDG2")

' queryValue9 as BuildValue - must exist in feature table

    Dim queryValue9 As Long
    queryValue9 = pFields.FindField("PBLDG3")

' queryValue10 as BuildValue - must exist in feature table

    Dim queryValue10 As Long
    queryValue10 = pFields.FindField("PBLDG4")

' queryValue11 as BuildValue - must exist in feature table

    Dim queryValue11 As Long
    queryValue11 = pFields.FindField("PBLDG5")

' queryValue12 as BuildValue - must exist in feature table

    Dim queryValue12 As Long
    queryValue12 = pFields.FindField("PBLDG6")

' Populate new field QueryValue3 - AREASQFEET - with AREA m2 converted to sq.ft.

    Dim pFCursor As IFeatureCursor
    Set pFCursor = pFClass.Update(Nothing, True)

    Dim pFeature As IFeature
    Set pFeature = pFCursor.NextFeature

    Do Until pFeature Is Nothing
        pFeature.Value(queryValue3) = pFeature.Value(queryValue6) * 10.762498
```

```
            pFCursor.UpdateFeature pFeature
        Set pFeature = pFCursor.NextFeature
    Loop

    Dim totalAssess As Double
    Set pFCursor = pFClass.Search(Nothing, True)
    Set pFeature = pFCursor.NextFeature
    Dim pFRow As IRow
    Set pFRow = pFCursor.NextFeature

    Do Until pFeature Is Nothing
        If pFRow.Value(queryValue4) > 1 And pFRow.Value(queryValue5) >= 20020000
Then
            totalAssess = totalAssess + pFeature.Value(queryValue3)
        End If
        Set pFeature = pFCursor.NextFeature
    Loop

    Dim pCursor As IFeatureCursor
    Dim pRow As IRow
    Set pCursor = pFClass.Search(Nothing, True)
    Set pRow = pCursor.NextFeature


' Variables NumberOfCosts, TotalCost, totalSqFootage

    Dim NumberOfCosts As Integer
    Dim TotalCost As Double
    Dim totalSqFootage As Double

    Do Until pRow Is Nothing
      If pRow.Value(queryValue4) > 1 And pRow.Value(queryValue5) >= 20020000 Then
        NumberOfCosts = NumberOfCosts + 1
        TotalCost = pRow.Value(queryValue1) + TotalCost
        totalSqFootage = totalSqFootage + pRow.Value(queryValue6) * 10.762498
      End If
      Set pRow = pCursor.NextFeature
    Loop

' Averaging Variables

    Dim varLandAve As Double
    Dim varAveSqFeet As Double
    varLandAve = TotalCost / NumberOfCosts
    varAveSqFeet = totalSqFootage / NumberOfCosts
```

```
' Populating fields

   Dim pFCursorA As IFeatureCursor
   Set pFCursorA = pFClass.Update(Nothing, True)

   Dim pFeatureA As IFeature
   Set pFeatureA = pFCursorA.NextFeature

    Do Until pFeatureA Is Nothing
      If pFeatureA.Value(queryValue4) > 1 And pFeatureA.Value(queryValue5) >=
20020000 Then
         pFeatureA.Value(queryValue1) = pFeatureA.Value(queryValue4) -
pFeatureA.Value(queryValue7) - pFeatureA.Value(queryValue8) -
pFeatureA.Value(queryValue9) - pFeatureA.Value(queryValue10) -
pFeatureA.Value(queryValue11) - pFeatureA.Value(queryValue12)
         pFeatureA.Value(queryValue0) = varAveSqFeet
         pFCursorA.UpdateFeature pFeatureA
      End If
      Set pFeatureA = pFCursorA.NextFeature
   Loop


' Thats all!
End Sub
```

BASE RATE SCRIPT TWO

```
Sub BaseRate_Step2()
'Private Sub BaseRate_Step2()

' Set up MxDocument, FeatureLayer, FeatureClass and Fields for Context menu
   Dim pMxDoc As IMxDocument
   Set pMxDoc = ThisDocument

   Dim pFLayer As IFeatureLayer
   Set pFLayer = pMxDoc.ContextItem

   Dim pFClass As IFeatureClass
   Set pFClass = pFLayer.FeatureClass

   Dim pFields As IFields
   Set pFields = pFClass.Fields

' queryValue1 as LANDVALUE
```

```
    Dim queryValue1 As Double
    queryValue1 = pFields.FindField("LandValue")


' queryValue2 as LANDAVE

    Dim queryValue2 As Double
    queryValue2 = pFields.FindField("LandAve")


' queryValue4 as SALEPRICE - must exist in feature table

    Dim queryValue4 As Double
    queryValue4 = pFields.FindField("SALEPRICE")

' queryValue5 as SALEYMD - must exist in feature table

    Dim queryValue5 As Double
    queryValue5 = pFields.FindField("SALEYMD")

'setting pCursor and pRow

    Dim pCursor As IFeatureCursor
    Dim pRow As IRow
    Set pCursor = pFClass.Search(Nothing, True)
    Set pRow = pCursor.NextFeature

' variables, NumberOfCosts and TotalCost

    Dim NumberOfCosts As Integer
    Dim TotalCost As Double

    Do Until pRow Is Nothing
      If pRow.Value(queryValue1) > 1 Then
        NumberOfCosts = NumberOfCosts + 1
        TotalCost = TotalCost + pRow.Value(queryValue1)
      End If
      Set pRow = pCursor.NextFeature
    Loop

' calculating varLandAve

    Dim varLandAve As Double
    varLandAve = TotalCost / NumberOfCosts
```

```
        ' Populating LandAve

            Dim pFCursorA As IFeatureCursor
            Set pFCursorA = pFClass.Update(Nothing, True)

            Dim pFeatureA As IFeature
            Set pFeatureA = pFCursorA.NextFeature

            Do Until pFeatureA Is Nothing
                If pFeatureA.Value(queryValue1) <> 0 Then
                    pFeatureA.Value(queryValue2) = varLandAve
                    pFCursorA.UpdateFeature pFeatureA
                End If
                Set pFeatureA = pFCursorA.NextFeature
            Loop

        ' Thats all!

End Sub
```

BASE RATE SCRIPT THREE

```
Sub BaseRate_Step3()
'Private Sub BaseRate_Step3()

' Set up MxDocument, FeatureLayer, FeatureClass and Fields for Context menu
    Dim pMxDoc As IMxDocument
    Set pMxDoc = ThisDocument

    Dim pFLayer As IFeatureLayer
    Set pFLayer = pMxDoc.ContextItem

    Dim pFClass As IFeatureClass
    Set pFClass = pFLayer.FeatureClass

    Dim pFields As IFields
    Set pFields = pFClass.Fields

' queryValue1 as LANDVALUE

    Dim queryValue1 As Long
    queryValue1 = pFields.FindField("LandValue")

' queryValue2 as LANDAVE
```

```
    Dim queryValue2 As Long
    queryValue2 = pFields.FindField("LandAve")

' queryValue3 as AVESQFEET

    Dim queryValue3 As Long
    queryValue3 = pFields.FindField("aveSqFeet")

' queryValue4 as AveperFoot

    Dim queryValue4 As Double
    queryValue4 = pFields.FindField("AveperFoot")

    If queryValue4 = -1 Then
        Dim pFieldEdit4 As IFieldEdit
        Set pFieldEdit4 = New Field

        pFieldEdit4.Name = "AveperFoot"
        pFieldEdit4.Type = esriFieldTypeDouble

        pFClass.AddField pFieldEdit4
        queryValue4 = pFields.FindField("AveperFoot")
    End If


' setting pCursor and pRow
    Dim pCursor As IFeatureCursor
    Dim pRow As IRow
    Set pCursor = pFClass.Search(Nothing, True)
    Set pRow = pCursor.NextFeature

' Variables NumberOfCosts, TotalCost, totalSqFootage

    Dim NumberOfCosts As Integer
    Dim TotalCost As Double
    Dim totalSqFootage As Double

    Do Until pRow Is Nothing
      If pRow.Value(queryValue1) > 1 Then
         NumberOfCosts = NumberOfCosts + 1
         TotalCost = pRow.Value(queryValue1) + TotalCost
         totalSqFootage = totalSqFootage + pRow.Value(queryValue3)
      End If
      Set pRow = pCursor.NextFeature
    Loop
```

```
' Averaging Variables

    Dim aveTotalCost As Double
    Dim aveSqFootage As Double
    aveTotalCost = TotalCost / NumberOfCosts
    aveSqFootage = totalSqFootage / NumberOfCosts

' Averaging Variables varValSqFoot

    Dim varValSqFoot As Double
    varValSqFoot = aveTotalCost / aveSqFootage


' Populating fields

    Dim pFCursorA As IFeatureCursor
    Set pFCursorA = pFClass.Update(Nothing, True)

    Dim pFeatureA As IFeature
    Set pFeatureA = pFCursorA.NextFeature

    Do Until pFeatureA Is Nothing
            pFeatureA.Value(queryValue4) = varValSqFoot
            pFCursorA.UpdateFeature pFeatureA
        Set pFeatureA = pFCursorA.NextFeature
    Loop


' Thats all!


End Sub
```

BASE RATE SCRIPT FOUR

```
Sub BaseRate_Step4()
'Private Sub BaseRate_Step4()

' Set up MxDocument, FeatureLayer, FeatureClass and Fields for Context menu
    Dim pMxDoc As IMxDocument
    Set pMxDoc = ThisDocument

    Dim pFLayer As IFeatureLayer
    Set pFLayer = pMxDoc.ContextItem
```

```
    Dim pFClass As IFeatureClass
    Set pFClass = pFLayer.FeatureClass

    Dim pFields As IFields
    Set pFields = pFClass.Fields

' queryValue1 as AveperFoot

    Dim queryValue1 As Double
    queryValue1 = pFields.FindField("AveperFoot")

' queryValue2 as AREASQFEET

    Dim queryValue2 As Double
    queryValue2 = pFields.FindField("AreaSqFeet")

' queryValue3 as BASERATE1

    Dim queryValue3 As Double
    queryValue3 = pFields.FindField("BaseRate1")

    If queryValue3 = -1 Then
        Dim pFieldEdit3 As IFieldEdit
        Set pFieldEdit3 = New Field

        pFieldEdit3.Name = "BaseRate1"
        pFieldEdit3.Type = esriFieldTypeDouble

        pFClass.AddField pFieldEdit3
        queryValue3 = pFields.FindField("BaseRate1")
    End If

' setting pCursor and pRow

    Dim pCursor As IFeatureCursor
    Dim pRow As IRow
    Set pCursor = pFClass.Search(Nothing, True)
    Set pRow = pCursor.NextFeature

' Populating fields

    Dim pFCursorA As IFeatureCursor
    Set pFCursorA = pFClass.Update(Nothing, True)

    Dim pFeatureA As IFeature
    Set pFeatureA = pFCursorA.NextFeature
```

```
    Do Until pFeatureA Is Nothing
            pFeatureA.Value(queryValue3) = pFeatureA.Value(queryValue1) *
pFeatureA.Value(queryValue2)
            pFCursorA.UpdateFeature pFeatureA
        Set pFeatureA = pFCursorA.NextFeature
    Loop


' queryValue4 as LandValue

    Dim queryValue4 As Long
    queryValue4 = pFields.FindField("LandValue")

' queryValue5 as AREASQFEET

    Dim queryValue5 As Double
    queryValue5 = pFields.FindField("AreaSqFeet")

' queryValue6 as ValperFoot

    Dim queryValue6 As Double
    queryValue6 = pFields.FindField("ValperFoot")

    If queryValue6 = -1 Then
        Dim pFieldEdit6 As IFieldEdit
        Set pFieldEdit6 = New Field

        pFieldEdit6.Name = "ValperFoot"
        pFieldEdit6.Type = esriFieldTypeDouble

        pFClass.AddField pFieldEdit6
        queryValue6 = pFields.FindField("ValperFoot")
    End If


' Populating fields

    Set pFCursorA = pFClass.Update(Nothing, True)

    Set pFeatureA = pFCursorA.NextFeature

     Do Until pFeatureA Is Nothing
        If pFeatureA.Value(queryValue1) > 1 Then
            pFeatureA.Value(queryValue6) = pFeatureA.Value(queryValue4) /
pFeatureA.Value(queryValue5)
```

```
            pFCursorA.UpdateFeature pFeatureA
        End If
        Set pFeatureA = pFCursorA.NextFeature
    Loop


' Thats all!
End Sub
```