



Invited paper

Designing and implementing a real estate appraisal system: The case of Québec Province, Canada

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ABSTRACT

Real estate appraisal is of great importance to several socio-economic stakeholders for different reasons and justifications: local governments and municipalities for taxation purposes; banks for mortgage and other credit applications processing; property valuation companies for marketing activities; and property developers and investors for sound investment decision-making. This paper summarizes the real estate appraisal system that has been developed for and with CUQ (Coomunauté urbaine de Québec), CUM (Communauté urbaine de Montréal), and Communauté urbaine de Gatineau (CUG) and implemented over the last twenty years in the Province of Québec. The salient features of the property appraisal system are: (1) property-specific individual appraisal using a new regression method called “analogical regression”, (2) mass-appraisal based on property-specific individual appraisals, and (3) the size of real estate coverage (over 1,050,000 properties) and the variety of real estate profiles considered (shopping centers, office buildings, residential properties, farms, industrial units, etc.).

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1. Introduction

This study was initiated and motivated by the need of Communauté urbaine de Québec (CUQ) for designing and implementing a real estate appraisal system that is efficient, effective, and reflecting market values. The primary objective was to estimate real estate values periodically that will constitute the basis for equitable, defensible, and implementable property taxation system.

Property taxes in many countries and particularly in the United States and Canada constitute a primary source of government revenues, especially at the local and municipality levels [2]. In the United State, “property taxes constitute approximately 10% of all taxes collected by all units of government – federal, state, local – and represent about 3% of the country’s GDP” [28]. Property taxation as a primary source of government revenues has advantages: (i) real estates can be located and identified with relative ease, for they are immovable and thus serve as excellent collateral for unpaid taxes, (ii) there is a direct correspondence between local services provided and property values, justifying the rightfulness or legitimacy of property taxes. Youngman (1994) [39] discusses in

some details the legal issues in property valuation and taxation. However, there is a disadvantage of property taxation: the cost of maintaining sufficient number of appraisers to cope with millions of real estate properties possessing different profiles ranging from single-family houses to museums, houses of worship, schools, shopping malls, office buildings, industrial units, and so on. The colossal size of property inventories and their diversities necessitate an effective and efficient computer-assisted appraisal system, for there are always budget cuts and reductions in the number of appraisers assigned to valuation task.

In the Province of Québec, property taxation is based on assessment processes executed by official appraisers according to *ad valorem* principle; that is, according to the market value of the property in question. Estimating market values is not an easy task at times when there are millions of real estates awaiting valuation periodically [10]. As Owens (2000) [28] states, many property tax issues are related to the appraisal process of estimating market value for real estate. After pointing out that market value estimation is “critical for property taxation purposes since assessed value is typically set at market value,” Owens (2000) [28] draws attention to appraisal issues that need to be dealt with. Among these are: (i) significant year-to-year changes in property values – a phenomenon generally witnessed, including also the Province of Québec, (ii) an ever-increasing diversity of properties and their numbers – again something frequently

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observed in the Province of Québec, and (iii) the existence of unique “specialty” properties (houses of worship, museums, schools, clubhouses, and the likes) which are often assessed at “use value” instead of market value – such properties abundantly exist in the Province of Québec. These issues have been fully taken into consideration in the design of our property appraisal system in order to come up with fair, defensible market values, and hence equitable property taxes [1].

The gigantic size of real estate inventories and their profile diversities make property appraisal processes very much dependent on computer-assisted systems. For this purpose, many decisions support systems for appraisers are available either through in-house projects or acquisition of commercially available, or the systems jointly developed in partnership by the user and software developers. The appraisal system which is the subject of this paper has been a joint effort over the years between Modellium, Inc., a software development company located in Québec City and the users [Communauté urbaine de Québec (CUQ), Communauté urbaine de Montréal (CUM), and Communauté urbaine de Gatineau (CUG)]. The role and importance of computer-assisted real estate appraisals have appeared in the pertinent literature, such as [8,9,17].

In the context of property appraisal for taxation purposes, it is almost a sin not to mention the three approaches used to estimate the value of a property for taxation purposes. These are: (i) the sale price approach – also called the market approach [33], (ii) the cost approach [24,31], and (iii) the capitalization approach – also named the income approach [32]. Hodges (1993) [14] gives a historical background how initially available eight valuation methods in the United States have dropped to the only three approaches above. According to him, this is first due to appraisers, because majority of them have opted for the above three for their perceived simplicity and ease of use. Embracing this simple triad seems to have “allowed the appraisal profession to be dominated by the courts, legislators, and public administrative bodies, which have imposed the three approaches on all appraisal practitioners through court decisions, legislative mandates, and mortgage regulation.” In the development of our property appraisal system, we concur with this trend and our approach has been based on these three thinking as well, although there are several novelties and uniqueness in our methodology.

The organization of this paper is as follows: Section 2 summarizes the context within which our real estate appraisal system has been developed and implemented in three main stages. Section 3 is devoted to the conceptual explanation of the methodology behind the designed real estate appraisal system. This section covers the concepts being used, the relationships between the concepts, the idea of “analogical” regression for property valuation and its comparison with “conventional” regression analysis. Section 4 includes the mathematical formulation of the analogical regression model employed in the appraisal system designed and implemented.

Section 5 completes the paper with some discussions and concluding remarks.

2. Real estate appraisal context

The context of real estate appraisal summarized in this paper has evolved over a period of almost 20 years from an inventory size of 4000 real estate units initially in 1995 to 1,050,000 properties currently. Each increase in the real estate inventory size has offered new conceptual, methodological, and technological challenges in order to meet the new needs of different socio-economic stakeholders. As summarized in Table 1, the current real estate appraisal system has evolved through three stages. Stage 1 entails an experimental study. The methodology developed for this purpose was summarized in Ref. [17]; a study initially based on the ideas forwarded in Ref. [16] to illustrate how an appraisal method can be developed and used in the case of the City of Cap-Rouge, a suburb of Québec City, Canada, involving around 4000 residential properties. The sponsor and the user of this experimental study was Communauté urbaine de Québec (CUQ) in mid 1990s. The primary objective of CUQ was to come with an appraisal method for the purpose of taxation by which the property value estimates can be justified as to their fairness and reliability in the eyes of property owners [1,4]. Another objective was to support defending and justifying the estimates should the property owners decide to take CUQ to the courts of law to challenge the likely perceived unfairness of the CUQ appraisals.

Stage 2 is a response to the second major contextual change due to the inclusion of more municipalities of Québec City in the property appraisal process. This stage includes all of the 12 municipalities under the administration of CUQ with a total of almost 165,000 real estate properties. This stage distinguishes itself from the previous one not only in terms of the increased number of real estate properties covered (from 4000 to 165,000 units) but also from the inclusion of more profile types of properties (such as farms, commercial places, and industrial units) that were dealt with in the appraisal process. The primary goal of the appraisal system develop for CUQ was again the very purpose of determining the taxes to be charged to the real estate owners, this time in the Greater Québec City.

The third contextual extension is the system that has been designed and developed for the Communauté urbaine de Montréal (CUM) – approximately 450,000 real estate properties; and for the Communauté urbaine de Gatineau (CUG) – around 70,000 units, totaling an inventory size of about 685,000 real estates, with those of CUQ.

Table 1 summarizes the context within which our appraisal system has been developed and implemented in terms of: (i) stages and the commercial names of the appraisal system in use, (ii) the characteristics of the mathematical models being used in the appraisal system, (iii) the nature of hardware & software requirements as well as the data management features, and (iv) the

Table 1
Main stages of the Québec Province real estate appraisal system.

Stages	Modeling characteristics	Hardware & software requirements	Number of real estate properties
Stage 1: Experimental study – Cap-Rouge municipality (PariTOP – 1)	Multi-criteria analysis through optimal piecewise liner approximation	Data files. Excel-based decision support system.	1 Municipality 4000 Units
Stage 2: Expanded study – Québec City (PariTOP – 2)	Multi-criteria analysis based on goal programming	Data base. Single intranet distributed system.	12 Municipalities 165,000 Units
Stage 3: Extensive study – Québec Province (G+)	Multi-criteria analysis based on analogical regression through goal programming	Data warehouse. Multi-intranet distributed systems.	1,050,000 Units (Québec City – 165,000, Montreal – 450,000, Gatineau – 70,000, Evimbec – 350,000, duProprio – 70,000)

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