DETERMINING THE OPTIMAL LOCATION FOR A LARGE ORGANIC FOOD STORE IN MONTREAL

Beibei Li
Department of Agricultural Economics
McGill University, Montreal

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Abstract

In this thesis, the optimal location for a large format, organic food retail store is determined using the Huff Model in Montreal, Canada. The Huff Model has been widely used in marketing analysis to determine the optimal location in a variety of contexts. First, the study used Statistics Canada 2001 food expenditure data for Montreal to generate a double log linear food expenditure model for Montreal consumers. Variance Inflation Factors were calculated to test if there were multicollinearity problems, and a Breusch-Pagen test was done to test for heteroskedasticity. Neither of the results showed any statistical problems. Second, AC Nielson survey results were used to facilitate the organic food expenditure calculation process. Third, the travel distance from all census tracts in Montreal to the candidate store locations were calculated using the Manhattan distance calculator (McLafferty and Grady, 2005). Finally, the Huff Model was used to calculate an attractiveness index for each candidate location. The conclusion from the results of the empirical analysis was that, among the 45 candidate locations, which are scattered all across Montreal, 5445 de Gaspe gained the highest attractiveness index. This location is situated close to relatively affluent and highly populated areas of the city, and is also very accessible. Not only is this just a few blocks from two metro stations, and close to city bus routes, it is also adjacent to several major streets such as Saint-Laurent to the west, Saint-Denis to the east, Rosemont to the north and Saint-Joseph to the south. This thesis has provided a new application of the Huff model, which could be used in various markets, and has provided an interesting combination of models from the field of Economic Geography, and Agricultural Economics.

Résumé

Dans cette thèse, le Modèle d'Huff a été utilisé pour déterminer l'emplacement optimal d' un magasin de nourriture biologique dans la ville de Montréal, au Canada. Le Modèle d'Huff a été largement utilisé dans les analyses de commercialisation pour déterminer l'emplacement optimal dans des contextes très variés. Pour commencer, l'étude a utilisé les données provenant de : ¨Dépenses de nourriture au Québec¨ de Statistique Canada pour produire un modèle linéaire logarithmique double pouvant être utilisé pour les consommateurs de Montréal. Les facteurs de variance d'inflation ont été calculés pour déceler les problèmes de collinéarité multiples, et un test de Breusch-Pagen a été fait pour dépister les problèmes d'hétéroskedasticité. Ces deux résultats on conclut négativement. Ensuite, les résultats de l'étude de ACNielson ont été utilisés pour faciliter le procédé de calcul de dépense de nourriture biologique. Par la suite, la méthode de calcul de distance de Manhattan a été utilisée pour évaluer la distance des itinéraires de tous les points de Montréal. Finalement, le Modèle d'Huff a été utilisé pour calculer un index d'attrait pour chaque emplacement suggéré dans le modèle. La conclusion des résultats de l'analyse empirique a conclue que parmi les 45 emplacements potentiels dispersés à travers Montréal, le 5445 de Gaspé procurait le plus haut indice d'attrait. Cet emplacement est situé près de secteurs relativement peuplés de la ville et de plus, est très accessible. La location déterminée par l'index est situé à quelques rues de deux stations de métro et à proximité de d'itinéraires d'autobus. L'endroit est aussi adjacent à plusieurs rues importantes telles que Saint-Laurent à l'ouest, Saint-Denis à l'est, Rosemont au nord et Saint-Joseph au sud. Cette thèse a fourni une nouvelle application au modèle d'Huff. Cette application étant la combinaison d'un modèle de géographie économique et d'économie agricole et a la qualité de pouvoir être appliqué à diverses situations

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CHAPTER 1

Introduction

1.1 General Introduction

With retail sales estimated at US$ 750-1,000 million in 2003, Canada is ranked as the sixth largest market in the world for organic food and beverages (Kortbech-Olesen, 2004). These products used to be primarily sold through farm gate sales, open-air markets and small health food stores, however, with the rapid growth of 20-25% annually in recent years, organic food sales are becoming increasingly reliant on mainstream retail channels such as large health food specialized stores and conventional mainstream grocery retailers (Agriculture and Agri-Food Canada, 2006). Organic food is sold nationwide at the retail level by two main groups of retailers—natural/health food stores and conventional/mainstream retail organizations. The two retailer types probably account for a similar share of organic sales, slightly less than 50% each (Kortbech-Olesen, 2004).

Loblaws, the largest food distributor and retailer in Canada, is becoming increasingly involved with the organic market. It has launched its own line of organic products with over 275 certified organic products already launched in its corporate stores. The front of each President's Choice (PC) branded package has a large green PC organics logo, which helps consumers find these food quickly. Organic food is also of interest to other large grocers such as Sobeys. Sobeys has introduced a new line of organic products to its supermarkets and in the fall of 2005 purchased Rachelle Bery stores—the largest Montreal-based organic retailer. The reason for purchasing an independent organic food store is that conventional store outlets can only sell a limited quantity of organic food as existing expandable shelf spaces are limited (Lampert, 2006).

With a growing number of consumers, and the lower prices that come with scale, organic foods have spurred large organic food specialized stores such as Whole Foods, Wild Oats and Rachelle Bery to establish more new stores, while expanding the size of their existing outlets. In addition, organic foods are now filling a greater number of shelves in large conventional grocery stores that are also buying out smaller health food chains for more development in the future (Lampert, 2006). Choosing locations for new stores has thus become an essential part of the marketing strategy of these grocery giants. Whole Foods has been actively seeking new store locations, as advertised on its company webpage (Whole Foods, 2006) while Wild

Oats also acknowledges acquisitions and new store development have merited their fast growing market share (Wild Oats, 2006). The main focus of this thesis is, therefore, to seek an optimal location for a new large organic food store.

The greater Montreal area has been chosen as the study area. The greater Montreal area is also called census metropolitan area of Montreal (CMAM) by Statistics Canada. This area includes the city of Montreal, other municipalities east of the island of Montreal and other municipalities on or beside the island of Montreal, Laval to the north, Longueuil, Lemoyne, Greeenfield Park, Saint-Hubert, Saint-Lambert and Brossard on the south shore, and several other municipalities east and west of the island. With a population of 3.7 million people and an area of 4000sq. km (Statistics Canada, 2006), the CMAM is the second largest urban area in Canada, and has a significant potential demand for organic food. The CMAM is home to many organic producers and is located in the province that has the largest number (900) of certified organic producers (Macey, 2006). This region also has home-based large organic product distributors such as Bianca International Organic Inc. (Kortbech-Olesen, 2004).

To date, the CMAM remains underserved by large organic retailers, compared with the other two major Canadian urban centers, Toronto and Vancouver. Toronto and Vancouver both have their own large organic food stores (Table 1.1) at around 40,000 sq. ft in size. The largest store in the CMAM is only 7,200sq.ft. In Montreal, there are few organic retail stores of more than 5,000sq.ft while most of the conventional grocers such as Loblaws, Provigo, Metro and IGA have an average size of over 20,000sq.ft, not to mention discounting centers such as Maxi and Super C that normally are over 30,000sq.ft.

Table 1.1 Whole Foods and Wild Oats in Canada

Retailer	**Size**	**Established**
Whole Foods, Yorkville, Toronto	40,000sq. ft	May,02
Whole Foods, Oakville, Toronto	44,000sq.ft	May, 05
Whole Foods, West Vancouver	39,735sq. ft	Sep,04
Cambie Capers Community Market (Wild Oats)	20,000sq. ft	Summer, 06

With a large number of consumers and producers, relatively little competition, the CMAM seems to have a good potential of being chosen as the region to set up the next large organic food store.

1.2 Problem Statement

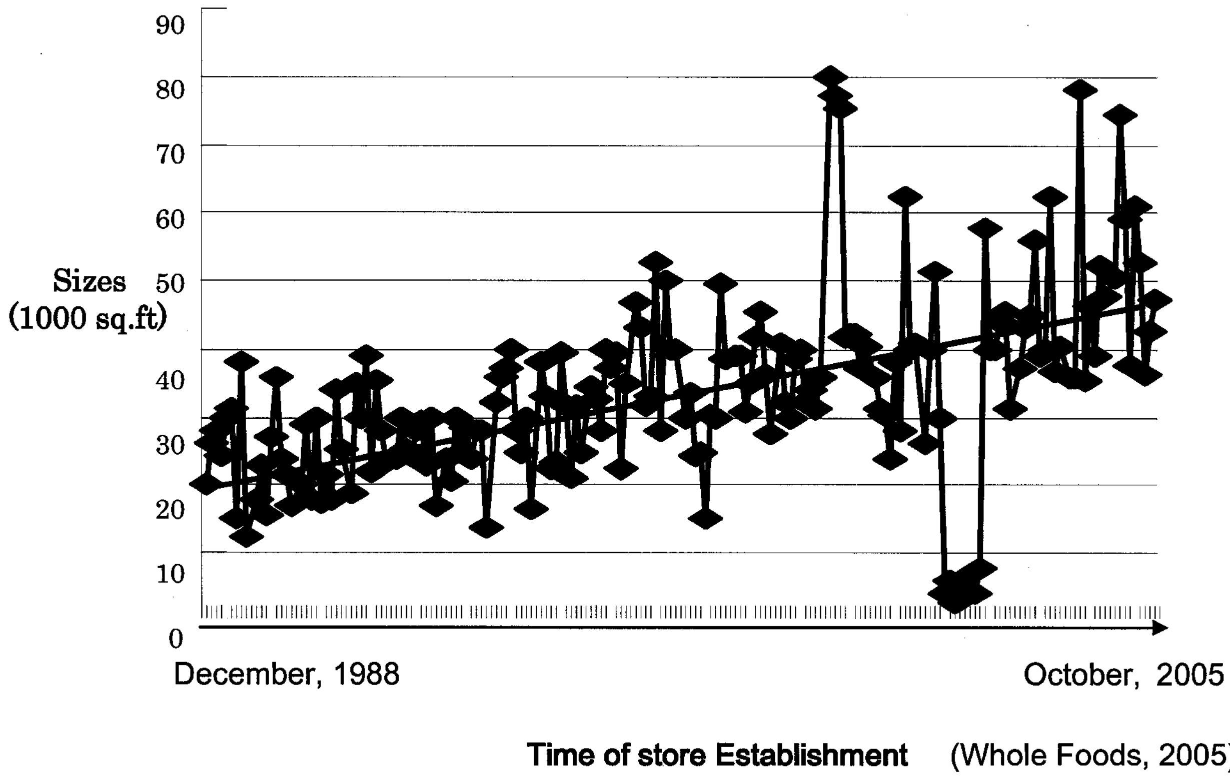
Conventional grocers are slowly getting more involved in the organic food business, allocating an increasing amount of shelf space to organic products. Loblaw is promoting its President's Choice organic products; while Sobeys Quebec, confronting fierce competition, introduced a new line of organic products called "Compliments Organics" to its IGA supermarkets (Lampert, 2006). Although the strategy of expanding the shelf space devoted to organics in a conventional store has the advantage of utilizing conventional grocers' existing logistical infrastructure as well as their well established outlets, the limitation is that the total space available to organic food would still be relatively small. The integration of organic food with conventional food also increases consumers' search costs. An alternative strategy is to establish large organic specialized stores, with conventional stores still carrying some organic food. In reality, Sobeys has taken a similar approach, already setting aside 1,000 sq. ft for a Rachelle Bery store connected to their IGA store. This situation seems much like the no name brand development decades ago. In 1978, after seeing a market trend in low price food, Loblaw launched 17 no name brands in its existing stores. Such a launch was accompanied by price comparisons, testimonials and in-store assistance (Coriolis Chart Watch, 2004). Soon after the success of no name brands, many discount centers were built in the purpose of attracting lower-income and price sensitive shoppers (Table 1.2).

The survival of a store is mainly determined by consumers' expenditures in it, and Huff (1963) suggested that size has the greatest positive influence over consumers' store choice. Many existing health stores, such as Whole Foods, Wild Oats and Rachelle Bery, which is the largest organic food store in Montreal, have already been establishing more large size stores in the pursuit of higher customer visitation rates (Figure 1.1 and Table 1.3). In addition, it might be expected that large organic outlets would be able to make more profits by attracting higher-income and health oriented consumers.

Table 1.2 Discount Centers of 3 Major Grocers in Quebec

Name	**Owner**	**Year of Establishment**
Maxi	Loblaws	1984
Super C	Metro	1992
Price Chopper	Sobeys	1973(U.S.A), 1980s(Canada)

Figure 1.1 Time Series of Whole Foods Established Branches and Their Respective Sizes from December, 1988 to October, 2005



(Whole Foods, 2005)

Table 1.3 Expansion of Rachelle Bery in Montreal

Year	Total Number of Stores
1984	1
1987	2
1996	4
2000	6
2001	7 (Opening of the then largest franchised store)
2002	9 (Opening of the currently largest franchised store, 7,200 sq.ft)

(Rachelle Bery, 2005)

Larger organic retailers can buy their products in bulk, which lowers the normally high price of organic food, making it more accessible for consumers. Along with well developed logistical systems, they will be able to have a better control of the product-flow from producers to consumers with lower prices and better terms from suppliers. Private-label brands and specialized organic food promotion give them more chance of establishing consumer loyalty and thus acquiring a growing portion of consumer expenditures. Whole Foods Company (WFC), the largest natural and organic foods company in the world, has been rapidly expanding its chain in major cities across the globe. With 174 stores in the U.S. and 7 in the U.K., WFC has been expanding its business in Canada since its first appearance in Toronto in 2002. In less than four years, WFC opened two more stores in Canada, one in Oakville and another in West

Vancouver. WFC has store sizes that average 32,000sq.ft and is still looking for potential sites to establish new branches with sizes that range from 40,000sq.ft to 75,000sq.ft (Whole Foods, 2006). The US organic giant Wild Oats had been thought by many grocers to have attempted to aquire Rachelle Bery before Sobeys got the deal and decided to establish new larger outlets (Lampert, 2006). In light of this growth, it is anticipated that large grocers may find the CMAM a particularly attractive market for organic products and thus may establish one or more large stores in this region. Given the cost associated with running such a large store, the choice of location for this store will be critical. As the location factor is the least flexible resource of all the elements in a retailer's decision mix, the choice of location for this future large organic food store will have a profound effect on the entire business life of the grocery retail operation (Davidson, 1982). Although a large organic outlet will benefit from economies of size, and better supply chain management, the store must be in a location that can support the level of sales that are necessary to its survival.

Taking into account the general factors that are common to all retail industries, such as attributes of the site, level of accessibility and socioeconomic environment (Rodrigue et Slack, 2006), this study was conducted by combining an analysis of consumer socioeconomic characteristics with consumer geographic distribution to determine the optimal location for a large organic food store.

1.3 Research Objectives

The purpose of this study is to determine the optimal location for a large organic food store. This study includes a descriptive analysis of the Canadian organic food retail industry, and combines this with an analysis of food expenditure patterns to predict and compare organic food retail sales. The study has three objectives:

1. To develop a descriptive analysis of the organic market in Canada and consumer demand for organic products at various locations in the CMAM.

2. To investigate the extent to which the demographics and geographic distribution of consumers might influent sales of organic food in Montreal.

3. Find an appropriate method to determine the optimal location for establishing a large organic food store.

1.4 Organization of the Thesis

This introductory chapter presents the research problems and objectives. The rest of the thesis is organized as follows: Chapter 2 describes the profile of Montreal consumers as well as this region's organic industry before providing a brief review of the literature on location models and organic consumption. Chapter 3 describes the methodology and the estimation process. Chapter 4 interprets the results of the study. Chapter 5 concludes with recommendations for future research.

CHAPTER 2

Literature Review

2.1 Introduction

Environmental and health issues have attracted more and more attention from researchers, policy makers, consumers and businesses. In the food retail industry, conventional grocers have initiated several programs to directly encourage and support the growth of healthy food sales. The objective of this chapter is not only to provide a context for the present study by surveying recent Canadian consumer profile studies and the structure of the Canadian organic food industry, but also to provide a review of literatures related to the food expenditure, especially organic food expenditure studies. Various previous studies provided a framework for the evaluation of market locations and the estimation of food consumption patterns. These previous works were divided into three categories: general food consumption models, organic food consumption patterns and location choice models. Previous theories and research results from these three categories have supported the further research reported in this thesis.

2.1.1 Canadian Consumers

A recent ACNielsen study shows that size of Canadian families shrank from 3.7 persons per family in 1971 to 2.5 persons per family in 2000. The total share of middle age childless couples, empty nesters and older singles in the population has increased from 41% in 1998 to 46.7% in 2003, while the total share of young singles and new families in the Canadian population has decreased from 23% to 15.5% during the same period (ACNielsen, 2005). Bearing this aging trend in mind, grocers need to meet changing consumer needs, with regards to product quality and quantity, as well as accessibility.

The population is becoming more concerned with environmental issues. According to a poll, there was a 10% increase from 1993 to 1997 of Canadians who agreed to pay more tax for environmental protection (CORA, 1997). More recently, a sustainability survey of 2,500 Canadians conducted by McAllister Opinion Research of Vancouver (Kane, 2006) in all provinces except Quebec found out that 8 out of 10 surveyed Canadians want tougher laws to protect the environment. Pollara's (2005) pre-screened phone survey of 1,275 Canadians, 18 years of age and older conducted between January 31, 2005 and February 5, 2005 showed again that environmental issues have been Canadian consumers' primary concern when it comes to the purchasing of products. 92% of the surveyed consumers prefer buying goods that are produced using environmentally conscious processes.

Surveys also show that North American consumers are becoming more concerned over food health issues. A poll conducted by the Canadian Health Food Association in 1999 (Jude, 2000) showed that, compared to 1997, more than one quarter of Canadians were more likely to shop at a health food store, and more than one third of Canadians were more likely to purchase organic foods. The Whole Foods market organic trend tracker survey (WFMOTTS, 2004) found that 27% of Americans were eating more organic food in 2004, compared to the previous year. Consumers have increased their organic food consumption steadily in the past few years and studies have projected that organic consumption will continue to grow in the future. Shoppers from British Columbia, the province with the highest organic food consumption in Canada (ACNielsen, 2005), estimated their organic food expenditure share in the total food budget would increase 50% in the near future (OFSSR, 2003). Consumers are more aware of food quality and increasingly link their health to the food they eat (Agriculture and Agri-Food Canada, 2006).

Many studies have shown that health and food safety, along with concern for the environment are the top quality attributes considered by organic buyers (Goldman and Clancy, 1991; Estes and Bender, 1994; Schifferstein and Oude, 1998). Organic products seem to fit with and appeal to these consumer concerns and values, and that could explain their quick penetration into consumers' everyday food consumption in recent years. Loureiro et al. (1997) found that households were more likely to prefer organic to non-organic foods when the households had higher concerns about food safety and the environment. They assumed equal price and better quality to have positive effects on the probability of purchasing eco-labelled apples. In a recent survey by Whole Foods (2004), respondents indicated that they purchase organic foods because, compared to most non-organic foods, organic products tend to be better for the environment (58%), more healthy (54%), and more supportive towards small and local farmers (57%). In addition, 32% of the respondents believed that organic food tastes better, while another 42% believed that organic foods are of better quality (WFMOFTT, 2004). Even though the respondents were U.S. residents, it could be assumed that they would have similar perspectives to food consumption as Canadians. As a typical Canadian metropolitan area, Montreal could be considered to have similar consumer profile to the rest of Canada.

2.1.2 Quebec Organic Producers

Organic food statistics for 2004 reveal an increasing number of certified organic producers in Quebec. The number rose by 2.5 times from 359 in 1998 to 900 in

2004 (Macey, 2004). Despite this rapid increase, the number of organic producers in the province represents only a small portion of farmers in Quebec, accounting for only 2.8%. Relative to the nation, however, Quebec possesses a large concentration of organic food producers, accounting for 24.5% of total organic producers nationwide on a total acreage of 30,000 ha. Quebec organic food producers produced organic products worth about $25 million in 2003 and $45-65 million in 2004. They produce mostly grains, oilseeds, wild rice, vegetables, fruit, nuts and herbs. The value of their production continues to increase as thousands of hectares of land is still in transition to organic farms (Macey, 2004).

2.1.3 Organic Distributors and Brokers

The organic food market has grown strongly in recent years. It has been transformed from primarily small scale local stores to supermarket-scale outlets while the conventional food industry is also becoming more involved. In recent years, most organic products go through large distribution channels before they reach consumers. Only 3% are traded in farmers' markets or community supported agricultural programs (Rosalie Cunningham, 2001). Organic distribution and the retail sector in Quebec are furthermore undergoing a consolidation process through acquisitions, mergers and alliances. Before Sobeys' effort to buy the Rachelle Bery chain in May, 2006, a U.S.

based manufacturer and distributor of nutritional supplements NBTY Inc. bought Quebec health-products chain Jean-Marc Brunet Naturiste. Many organic retail giants have developed their own organic processing, packaging and distribution systems while others have allied with large food manufacturers and distributors for further expansion. One example is food giant Kellogg that bought organic cereal-maker Kashi in 2001.

According to a recent report by Kortbech-Olesen (2004), Canada has 46 certifying bodies, and 150 processors and distributors in the organic food sector, whose distribution channels are characterized by the large territorial size of the country. Regional distribution is well developed nationwide. Many distributors of fresh produce have distribution centers in Vancouver, Toronto and Montreal. The major distributors and brokers are listed below (Kortbech-Olesen, 2004).

SunOpta Inc (Toronto, On)

In recent years, SunOpta has become a large national distributor of natural and organic foods mainly through acquisitions. It owns Distribue-Vie Fruits and Legumes Biologiques Inc. in Quebec, Pro Organics, Canada's leading distributor of organic fresh produce with distribution centers in Vancouver, Toronto and Montreal, and

Snapdragon Natural Foods Inc, a supplier of organic groceries and frozen products with warehouses in Calgary, Toronto and Montreal (SunOpta Inc. 2006).

Ontario Natural Food Co-op (Etobicoke, On)

It is a major distributor of natural foods in Ontario and Eastern Canada. It is a co-operative federation of retail food co-operatives, food buying clubs, and non-collectively structured retailers. It operates a 31,000 sq. ft wholesale warehouse, from which it distributes all member and non-member orders. It also has existing delivery routes throughout Ontario and into Western Quebec (ONFC, 2006).

Great Lakes Organic Inc (Petrolia, On)

It is a farmer owned organic trading company, which works with forward contracts, spot markets, and specialty items. It is not only a producer of organic grains, feeds, value added products and pedigreed seed, but also an international broker of organic commodities (GLO, 2006).

Westpoint Distributors Ltd (Vancouver, BC)

It is a natural whole foods distributor of dry food products, including organics, e.g. flour, grains, fruits and nuts, herbs and spices. It distributes more than 1800 different health food products and has reached coast to coast across Canada and parts of U.S. This company also offers customer packaging and labelling services (WDL, 2006).

Bianca International Organic Inc (Montreal, QC)

It is an Importer of organic products, including spices, herbs and essential oils, dried and processed fruit and vegetables, including juices and concentrates, fats and oils, culinary ingredients, grains, teas and herbal teas. Its clients are mainly processors and packers of organic food items, and it acts as a sales agent who connects the buyer directly to the seller, and thereby enables a lower price. The company has developed a large data base of organic products which can be manufactured under the customer's own label (BIOI, 2006).

Tree of Life Canada (Holland)

It is one of the top distributors of organic food in North America, and besides Tree of Life, it owns Ashley-Koffman Division, Preisco/Jentash Foods and BEC Trading. It expanded its distribution reach into Canada in 1999 and is the primary distributor for Wild Oats (Tree of Life, 2006).

2.1.4 Organic Retailers

Because organic products are credence goods, consumers may not be able to distinguish them from conventional products, thus organic labels/logos and shopping area differentiation may help consumers' decision making by transforming the credence characteristics into searchable attributes (Yiridoe, 2006). This specific character of organic products has made their marketing at the retail level important.

The organic retail sector remains a small segment of Canada's retail market. Retail sales of organic foods were expected to reach $3.1 billion in 2005 (SAF, 2003), or only 3.8% of $82 billion total Canadian food retail sales in 2004 (Zafiriou, 2005). Although retail sales of organic products have been relatively small, their growth has been brisk during the last decade. This industry was estimated to have been growing at 20% annually in the past ten years (Olijnyk , 2006). According to Kortbech-Olesen (2004), organic foods are sold, at the retail level, by two major groups of retailers, i.e. natural food stores and conventional grocery stores, both of which cover slightly less than 50% of total retail sales.

The first group, natural food stores, consist of a large number of relatively small and independent stores, co-ops, and other large health food retail chains. This group makes up half of total organic sales in Canada. In particular, this group of retailers includes a few large international and regional retailers, which are introduced below.

Whole Foods (Texas, U.S.)

It is the largest health food chain in North America with 160 stores of over 30,000 sq. ft on average and private label products. It has opened three large organic food outlets in Canada, two in the Toronto area and one in West Vancouver, and is planning to open more stores across Canada. Sales of this organic giant have grown from $92 million in 1991 to $4.7 billion in 2005 (Whole Foods, 2006).

Wild Oats (Colorado, U.S.)

It is the second largest natural and organic foods chain in North America with over 113 stores in the U.S. and British Columbia. Its four Capers Community Market stores in BC range from 20,000 to 35,000 sq. ft. Sales have grown from $700 million in 1999 to 1.1 billion in 2005 (Wild Oats, 2006).

Thrifty Foods (Vancouver, BC)

It is an Independent chain of supermarket-scale health food stores. As of 2005, the chain operated 18 supermarkets and carried 600 organic food items, which make it the dominant supermarket chain on Vancouver Island. The chain has a main warehouse in British Columbia, from where its fleet of trucks also supplies 60 other independent grocers in the province. Starting from a single grocery store, Thrifty Foods has grown into a large grocery franchise that is the largest private-sector employer on Vancouver island. It now boasts a 40% natural and organic food market share on Vancouver Island (Thrifty Foods, 2006).

Planet Organic Health Corp (Edmonton, AB)

It is a national health foods retail chain with two national retail divisions, i.e. a natural food supermarket chain called Planet Organic Market and a natural health supplements outlet chain called Sangster's Health Centres. It has stores in Edmonton and three other stores in western Canada, and is planning to expand to 25 other locations nationwide in the next few years. This chain has grown by approximately 1700% since 2001 through acquisitions, mergers and new retail operations in the natural and organic foods industry in Canada. Its strategy of vertical integration within the natural products industry allows it to streamline systems and take advantage of economies of scale. Sales of this chain increased by $15.1 million to $27.2 million for the year 2005 (POHC, 2005).

Rachelle Bery (Montreal,QC)

It has developed from a tiny grocery store to the largest health food store chain in Quebec with eight medium size stores of 1000 to 7000 sq. ft and annual sales of over $10 million. It was recently bought by Sobeys, who plans to develop a health food store network and to set up a private label under the name of Rachelle Bery (Rachlle Bery, 2006). At present, this chain is still too small and limited in its geographic appearance to be listed in the same category as the previous retailers.

The second group of retailers comprises conventional grocers, which represent the other 50% of organic sales. The recent ACNielsen organic food study shows that compared with 2003, organic food segment sales rose 27% in 2005 to cover 1.4% of total grocery store sales (ACNielsen, 2005). Most large conventional grocers already have their own Canadian based manufacturing and logistical systems and have started developing new store-branded healthy food. Two typical large grocers that are involved in the organic food retail are introduced below.

Loblaw Companies Limited is the largest food distributor and grocery chain in Canada and Quebec, with more than 1000 stores, and head quarters in Ontario. Loblaws stores are run under different names such as Superstore or Supervalu in Ontario, and Loblaws, Provigo, or Maxi in Quebec. Decades ago, it launched a strong private label program called President's Choice (PC), which was the company's upscale brand that covers nearly every food category. It then launched an "Organics" line of food, called PC organics in June 2001, which aims to make healthy eating easier, yet retaining flavor. This company estimated that organic food will account for 5% of all food sales within a five year period and to reach 400 organic items (Kortbech-Olesen, 2004).

Sobeys Canada Inc. is the second largest retail grocery chain in Canada that owns or franchises over 1,300 stores throughout Canada, and operates over 25 distribution centers and about 20 foodservice operations. IGA is Sobeys' main brand in Quebec and western Canada while Price Choppers and Sobeys are the main brands in Ontario. Its private label food is branded "Compliments", which was developed in the late 1990's and is now getting much more shelf preference. In 2005, it expanded its supply of organic products by purchasing Rachelle Bery, the largest organic food retail chain in Quebec and introducing a private label called "Compliments Organic" in 2006 (Lampert, 2006). It is thought that Sobeys' involvement in the organic food business is a strategy to take advantage of what used to be a niche market and is now a billion-dollar industry in Canada (Lampert, 2006).

2.2 Previous Studies

This section briefly reviews the literature related to this study and intends to provide a framework for estimating households' food consumption patterns and evaluating sites for locating an organic food store. Previous work is grouped into three categories: general food consumption models, organic food consumption patterns and location choice models.

2.2.1 Food Expenditure Studies

Economic studies have often focused on the role of household demographics and socioeconomic characteristics in food consumption choices. Demographic variables include household size as well as age, race and gender components of the household, while socioeconomic variables are often captured by household income. Most studies have found that income and size both had positive and significant impact on food consumption, although some other variables also affected the household's food expenditure.

There have been several works which present the functional forms used for demand analysis. They are either single equations or regression systems. Among a wide range of expenditure analysis models, linear models have been very popular (Andrikopoulos and Brox, 1983). Widely used examples of the linear models are Stone's linear expenditure system (Stone, 1954), Leser's approximation (1963), and Powell's approximation (1978). The strength of these linear systems is the ease with which one can measure income and price elasticities of demand although the system may not satisfy certain relationships as required by the theory of demand. Linear models are considered to have merited further investigation as models for marketing demand projections (Andrikopoulos and Brox, 1983). The log linear model was introduced as an alternative estimation model to the traditional linear expenditure functions (Tyrrell and Mount, 1982). The log linear model has the same advantage of the traditional linear models, and it also automatically satisfies the budget constraint. The log linear model provides a framework and assumptions to clearly construct an estimation model and the method to evaluate the relationships between the dependent variable and the independent variables.

There are a number of studies that have analysed the factors that affect consumer demand. The study by Davis et al. (1983) examined how income, age, gender, region, education, race and the food stamp program (FSP) may influence the food expenditure of US households. Their empirical model was specified as a double-logarithmic linear function. The log of the household's monthly food expenditure was regressed on 6 independent variables, including log of household size (continuous), a dichotomous variable indicating weather or not the household was a participant in participation in FSP (binominal), age group of adult homemaker (binominal), education level of the adult homemaker (trinomial), race of the adult homemaker (trinomial) and urban dwelling (binominal). Results of this study indicated that household income, size, and FSP exert significant positive impacts on household monthly food expenditures. Even though education level does not have direct impact on food expenditures, it was considered by the authors as being able to increase the household's food expenditure efficiency and thereby has the potential of decreasing food expenditures. The double-logarithmic regression model was used for the study because of its plausibility of relationships, ease of estimation and ready interpretation compared to other linear, quadratic or semi-logarithmic forms. The findings of this research, such as the variables tested and the regression model provided the foundation of food expenditure analysis in the next chapter.

Liu and Chern (2001) studied the role of demographic characteristics in influencing food consumption. Their study established demand functions in three different forms: the Working-Leser form, the linear expenditure system (LES) and the almost ideal demand system (LAIDS). It showed that all three forms gave similar results. Using 1994 data in Jiangsu, China, the study investigated the effects of demographic variables on food consumption, demographics being captured by variables such as family size, presence of children, gender, education and age of household head. Their results showed that most of the parameter estimates were statistically significant. Their respective sign and magnitude were also considered suitable for analyzing marginal impacts and elasticities. The authors concluded that as to the model specification, the performance of the Working-Leser is similar to that of the LA/AIDS. Compared with these two models, a single equation functional form, such as LES, is easier for computation work but difficult to impose or test the regularity conditions. All three models indicated the gender of householder to be insignificant, while effects of other demographic variables were slightly different among the three models: education was significant in the Working-Leser and LA/AIDS while household size and the number of children under 17 were significant in the LES. The authors also indicated that even though there were some insignificant variables in each model, incorporation of the same demographic effects was valuable in all three models.

Sdrali (2003) analyzed food expenditure patterns in the Greek prefecture of Fthiotida with a special emphasis on some selected characteristics such as age groups, household size, income, and education that determine the living conditions of the Greek household. The author chose the log linear function for further analysis. The dependent variables were the food expenditure and the model included 11 independent variables: age of household head (continuous), household size (continuous), monthly total income (continuous), number of earners (continuous), presence of children (binominal), education level of husband (binominal), education level of wife (binominal), urban region of residence (binominal), male household manager (binominal), ownership of a farm (binominal) and working wife (binominal). The author found that income was the most important economic factor of food expenditure. Household size had a positive impact on the food expenditure even though this impact decreased with the increasing of the family size. Presence of children was tested to be insignificant, but it also has a positive impact on the food expenditure. Other variables had relatively small impacts on the food expenditure. Male head of household manager had a slight negative effect on food expenditure while the variables education level of spouses and the age of household head were found to be not significant in their model. Their findings were consistent with the previous study by David et al. (1983) in their choice of model as well as the results such as the impact and significance of each variable.

Previous conclusions and discussions are good examples of the significance of estimating food expenditures using a linear demand system. The simplicity of the linear model provides ease of analysis and interpretation, which can be expanded in later studies to accommodate greater complexities.

Gracia and Albisu (2001) studied consumption of different food categories in different European countries and found that the consumption patterns and accessibility to each food category were similar across certain European nations. Some of these similarities were related to classical economic factors, others to actual lifestyles, and many others to socio-demographic characteristics such as relatively similar income level and similar accessibility (distribution and retailing) to each food category across these European countries. The author found that, despite the national boundaries and cultural differences, consumers share similar consumption patterns across most European nations because of converging social trends such as increasing number of working women, higher safety and quality demands, and most importantly, the increasing concentration of food manufacturers and retailers. The authors found that in most European countries, more than half of sales correspond to the three most important retailers.

2.2.2 Organic Food Studies

Previous research on consumer behaviour and their preferences for organic food has been voluminous, and branching out into many areas. Some studies have focused on finding the specific characteristics that affect the purchase of organic food while others have examined the future development of the organic retail market.

Nelson et al. (1970) first introduced the term “Credence characteristics” into the study of organic products. Credence characteristics means not detectable or absent product characteristics even after purchase and use, and organic products were considered to be credence goods as they are hardly separated from conventional products by their appearances and tastes. To bring these characteristics to the knowledge of consumers, retailers need to engage themselves in giving consumers quality signals such as product labels, special shopping areas and on-site education. These endeavors will help transform credence characteristics into searchable attributes, thereby providing convenience to consumers' purchases. Weir et al. (2003) examined the Danish organic market, a market that was relatively mature compared to other countries. After the authors performed a regression analysis, using each household's stated importance of various use and non-use attributes for organic goods, they found that compared to non-buyers, organic food consumers were more health concerned, more focused on residues, animal welfare, and environmental attributes. They cared less about prices and they preferred home-made food. According to their study, non-use values, such as origin and organic labeling were important to most consumers. Use values, such as utility from taste, health and/or freshness, had lower rankings on the scale of importance. Robles et al (2005) studied the Spanish organic food market. The authors found that accessibility to organic foods and commuting distance to commercial establishments were two of the most important variables hindering the development of organic food market. From a retail research stand point, Lohr and Semali (2000) suggested several control variables that affect organic food sales such as using specific store knowledge to reduce store costs, launching organic education programs, developing consumers' personal belief in organic foods' environmental and health advantages and the organic labeling. All this empirical evidence supports the hypothesis that it is important to separate organic products from conventional products by giving organic products their own shelf/store space and developing their private labels.

Income, age, gender and education level of organic product purchasers, as well as size of households have been considered to be the main elements that determine organic purchases. Certain studies showed a positive correlation between income and willingness to buy organic products (Hutchins and Greenhalgh, 1997; Ekelund, 1990; Byrne, 1991). Studies on age and gender variables have produced contrary results. Certain studies showed women to have positive impact on organic food expenditure, as they are usually the primary grocery shoppers and are more informed of the health issues (O'Donovan and McCarthy, 2002; Buzby and Skees, 1994; Roddy et al. 1996; Van and Hoehn, 1991) while Wandel and Bugge (1997) suggested that men tend to pay much higher premium for organic products. Many studies suggested a negative relationship between age and organic food consumption (Baker and Crosbie, 1993;

Werner and Alvensleben, 1984; Huang, 1996) while Jolly (1991) found no correlation between age and organic buying behavior. Bhaskaran and Hardly (2002) have further suggested a hypothesis that older consumers tend to be more aware of health issues, partly because of perceived health vulnerability and an awareness of their weaker health situation compared to younger generations. Attempts at explaining the relationships between age/gender variables and organic food expenditures have been complicated by interlinked variables (i.e. differences between household primary income earners and household food shoppers, relationship between age and income/ household size). Many individuals with higher education levels tend also to have a more comfortable working environment as well as higher incomes. It could be that one of the three variables such as income makes the other two redundant for analyzing organic buying behavior. The same dilemma happens with household size and presence of children as the latter could simply indicate a bigger household size.

While previous studies have produced interesting results, they fail to explicitly consider the role of geography in the demand for organic food. Nor do they focus their research on the location choice of retail food stores in relation to how it might affect consumer demand. This study intends to fill this gap. It focuses on a different issue, which is the decision of where to locate a large organic food store, considering the consumer demand for organic food products. This study incorporates location models in understanding of the organic food market. The next section briefly reviews the literature on location models.

2.2.3 Trade Area Analysis

Location models have long been used to assist in the process of locating facilities in some given space. Applications of these models include estimating the volume of transportation, analyzing international trade as well as locating shopping centers and power generating stations. Each application has its own field of utilization, so that a variety of models have been used to analyze different scenarios. There are several location models that can be used to help to determine the attractiveness of sites. Some of these will be explained below.

Newton's Gravity Model (Rodrigue et al. 2006)

In essence, the gravity model posits that the attraction between two objects is proportional to their mass and inversely proportional to their respective distance. In other words, the bigger or the more populated the shopping area and the closer it is to a consumer, the more attractive it is to that consumer. This model has been widely adopted to empirically examine the direction and intensity of international trade (Inmaculada and Felicitas, 2003). It has also been applied to study transportation and regional planning. Much of the research effort has been dedicated to finding accurate parameters for the gravity model to ensure that the estimated results are similar to the observed flow (Kumo, 2003; Mao and Demetscky, 2002). The gravity model has also been applied at a city or regional level to simulate and predict additional traffic flows if population increases or if alternative transport infrastructures are provided (Rodrigue, 2006). The gravity model is the origin of many other trade area analysis models; however, it is only capable of handling two trading locations at a time.

Reilly's Model of Retail Gravitation (1929)

In Reilly's law of retail gravitation, he broadened the range of Newton's Gravity model to include retail sales. The model determines the percentage of a specific small city's population that will travel to each of the other bigger cities for shopping. Reilly supposed that under normal conditions two cities will draw retail trade from a smaller city in direct proportion to some power of the population (power equals 1 according to Reilly) of these two cities and in reverse proportion to some power of distance (power equals 2 according to Reilly) between the two cities. Reilly's Law provides a mathematical formula that can be used to calculate the distance that people will travel. It is an extension of the gravity model, and like the gravity model, Reilly's law is also only capable of handling two cities at a time.

Weber's Theory of the Location of Industries (1929)

This model proposes that the location of an industry should be based upon the pulling equilibrium of three factors: the weight of raw materials, labour cost, and agglomeration of the industry. It has long been used by economists and planners to assess the extent to which these pulling forces might influence the location of an industry. Changes in these location factors can lead to three types of changes in an industry: a spatial or vertical splitting of production and distribution, diversification within the plant of various processes, and division of labour between industries. Location may affect the costs of an industry in securing a location and obtaining raw and auxiliary materials. General regional factors may also affect the costs of manufacturing and transport costs in shipping to consumers.

Recent studies have added new pulling powers such as a new tax into Weber's location model, aiming to find new industrial equilibrium under various socio-economic environments (Hwang and Mai, 2004; Lentnek et al, 1992). Weber's theory is the basis of many recent industry location models. However, even though it is increasingly relevant to today's global markets and trans-national corporations, this model only focuses on whole industry analysis rather than the analysis of one specific retail site.

Christaller's Central Place Theory (1966)

The central place theory assumes that a central place is a settlement which provides one or more services for the population living around it. Simple basic services, such as grocery stores, are said to be of lower orders, while specialized services, such as education and medical facilities, are said to be of higher orders. The sphere of influence is the area influenced by the central place. The minimum population size required to profitably maintain a service is the threshold population. Factors affecting a fall in the threshold population are decrease in population, change in tastes and introduction of substitutes. This model suggests that in a given area, the larger the settlement, the fewer the number of central places, and the farther away a similar size settlement can be found. Also, a larger population supports a greater sphere of influence and the existence of higher-order services. The theory is often used to identify and classify central places (Berry and Garrison, 1958), assess the economic base of small businesses (Thomas, 1960), trace the spatial behaviour of consumers (Golledge, R.G et al, 1966), and to define the extent of market areas (Peterson, D.A., 1975). This theory is used in planning the placements of different services in a given settlement rather than in estimating sales of one specific retail store.

Losch's Model of Spatial Equilibrium (1938)

This model is an extension of the central place theory, but differs in that it starts from one unit of consumption. It is a more comprehensive analysis of the location of firms and price systems in spatial economies. The fundamental objective of Loschian analysis was to show that economic factors generate spatial differences even on a homogeneous plane. Losch concluded that every firm in spatial equilibrium sets up an identical price for its goods, and sells them in market areas of identical size. The plane is then filled with a symmetrical location network. However, when identical products are supplied on a plane, their supply-area sizes are not always the same. They emerge in different sizes. It therefore seems that a new approach that incorporates interdependence among firms into the profit-maximization scheme better explains the real-world supply structure. The model suggested that at the equilibrium of a symmetrical location net work, excess profits must disappear, market areas must be as small as possible, firms should stay away from competitors (location competition shrinks the number of consumers), and business should stay closer to customers (excess profit is monotonically related to the number of customers within the range that is closer to one firm than to the others). The Loschian model was able to explain the development of a service system in an area of dense agricultural settlement, and had been mainly used to predict the distribution of new facilities such as industrial and commercial finance corporations, or even small businesses such as video rental stores (Miron, 2002). The Losch equilibrium is calculated from historical data of almost similar size stores, and it considers competition as measured by the number of competitors. However, in the grocery retail business the size and accessibility of competitors should also be considered.

The Huff Model

The Huff model (Huff, 1963) was developed as an extension of the gravity model. It was developed for the analysis of the relationship between retail sales and indicators of store attractiveness to potential consumers such as store size, layout, product categories, parking spaces and traffic access. The distinguishing feature of the Huff model is that it can handle the interaction among three or more retail districts. This development has made the gravity model more useful for retail sale predictions.

The Huff model has mostly been used to determine the distribution of sales between retailers by finding the ratio of one store's attractiveness to the sum of the attractiveness of all the other stores. For a consumer located at i, the model is stated as:

$$H_{ij} = \frac{U_j * (D_{ij}^{-\lambda})}{\sum_{j=1}^{n} \left[U_j * \left(D_{ij}^{-\lambda} \right) \right]} \tag{1}$$

Where,

H_{ij} = the probability that a customer located at i will patronize a particular store j out of all n similar stores

U_j = Utility of store j

D_{ij} = the distance between i and store j

λ = the distance decay parameter

In the equation, the distance decay parameter is estimated from empirical observations. This parameter models the decay in the drawing power of the store as potential customers are located further away from the store. Increasing the exponent would decrease the relative influence of a store on more distant customers (Huff, 1963). A number of studies have suggested λ to be 3 for shopping centers and 1.5-2.5 for retail stores (Huff, 1963; Susilawati et al, 2002; Drezner, 2004). In Japan, where location choice is highly considered and where the Huff model has been widely used, the Japanese Ministry of Economy recommended 2 as the value of λ for retailers located in urban areas (Japanese Ministry of Economy, 2004).

Reducing transaction costs and search costs are important topics, and Huff suggested that store size is the most important indicator of store utility, based on the economics of information. Huff claimed that consumers' shopping choices are mainly based on the efficiency of travel. The larger the store, the more types of goods a facility can provide and the more chance the trip could be successful, and thus more attractive to consumers (Huff, 1963). Recognizing this, Huff modified his model with a means to estimate the likelihood that a consumer will patronize a particular store.

$$H_{ij} = \frac{A_j * (D_{ij}^{-2})}{\sum_{j=1}^{n} \left[A_j * \left(D_{ij}^{-2} \right) \right]} \qquad (2)$$

Where,

H_{ij} = the probability that a customer located at i will patronize store j out of all n similar stores

A_j = Attractiveness index of store j = Size (square footage) of store j

D_{ij} = the distance between consumer i and store j

The percentage H_{ij} is factored into determining the total sales of the store after information is obtained on total number of potential consumers as well as their respective total expenditure. (Huff, 1963)

In recent applications, the Huff model has been used by many companies and governments to analyse a single trading area using specific variable(s) for site attractiveness (Lea, 2005), compare potential income for two sites (Pick, 2005), predict traffic flow—use of consumer spotting data, information on shopping trips and model calibration (Dramowicz, 2005; Yrigoyen and Otero, 1998), offer greater intelligence and reduced risk to companies expanding or disposing of real estate (Daniel, 1994; MRGSP, 1998), crime analysis, emergencies and incidence of disease (Huang, 2004; McLafferty and Grady, 2005:).

2.3 Summary

The first part of this chapter describes the structure of the organic food market in Canada, and specifically, the province of Quebec. It provides general descriptions of consumers, producers, the distribution channels and the retailers in the organic food market. Results show that the demand for organic foods has been rising in the last decade due to environmental and health issues. It is also projected that with the increasing number of organic food producers and distributors, such a trend will continue, a situation that creates favourable market conditions for retailers of organic food products. Meanwhile, with the still limited number of organic food specialized chains and their small size, as well as constrained shelf space for organic products in conventional supermarkets and few investments from international large organic food grocers, the organic food retail sector in Quebec could still be considered as underdeveloped, even with the recent growth. In sum, these observations imply a strong potential for organic food retailers to grow.

The second half of this chapter reviewed the literature related to the present research. Even though there have been many studies on organic consumers or retail location choice, there are few of them focusing on how location choice may affect food retailers, especially organic food retailers. Jones et al. (2001) observed that traditionally the organic market had been filled with a limited number of small specialist independent retailers, however, as consumer demand grew, organic food moved from a niche to a more mainstream market. For this reason, large grocery retailers might quickly capture the dominant market share. This is what has been happening in Canada and consistent with the objective of this present thesis, to determine the best site to locate a large organic retail store in Montreal.

CHAPTER 3

Methodology

3.1 Introduction

Based on previous economics and economic geography models, this thesis aims to find the location that will give a large organic retail store the highest sales using a food expenditure model and a location model. Specifically, this study applied the Huff model in the Montreal organic retail market to estimate an organic store's optimal location. The methodology is summarized below.

Determine the demographic and socioeconomic variables to be used in a food expenditure model. The Statistics Canada 2001 food expenditure survey was used to estimate parameters for each variable. Estimate the portion that organic food covers the total food expenditure for different types of households using the ACNielsen organic food survey (2005).

Predict food expenditure for a representative household in each census tract (CT) in the CMAM based on the food expenditure model and the 2001 census data.

Multiply the food expenditure of each representative household in the CT by the total number of households in each CT in order to estimate the total food expenditure for each CT.

Identify potential locations for the organic store in the CMAM. Calculate the distances between each potential location and each CT. The final step is to use the Huff model to calculate the attractiveness index for each potential location and choose the one with the highest index to be the location for the store.

3.2 Food Expenditure Model

Data for the food expenditure model came from the Statistics Canada Food Expenditure Survey (2001) which was carried out in all 10 provinces of Canada. This dataset consists of more than 0.4 million records and 79 variables. In order to analyze Montreal consumers, 971 records for Quebec urban areas were used. Each area includes a minimum population of 1,000 and a population density of at least 400 per sq. km, based on the 1996 population census. Previous studies in the field of food demand analysis have shown that variables such as income, size, marital status, and presence of children are important in the determination of food expenditure. In the case of other variables such as age, gender and education of family shoppers, their influence is not so clear due to their interlinkage with other variables such as income and family size. The variables of the primary food expenditure model were chosen based on previous research.

3.2.1 Data and Unit of Analysis

The 2001 food expenditure data contain household demographic and socio-economic characteristics, which involve variables describing a household's unique identifier, region of residence, size of resident area, marital status, age, gender, household type, average household income, etc. A household includes all the persons who occupy a housing unit. The occupants may be a single family, one person living alone, two or more families living together, or any other group of related or unrelated persons who share living arrangements (Statistics Canada, 2005). Several irrelevant series were eliminated from the dataset: rural dwellers, food categorical files and adjusted variables that do not appear in the census micro data, including age of the household head, gender of the household head and age of the spouse. As showed in table 3.1, the independent variables kept for analysis were household size, marital status, presence of children and household gross annual income level (Table 3.2). These variables also exist in the census data and were considered to be important in predicting household food expenditure by several previous studies. The dependent variable is each household's expenditure on food bought from stores. This variable does not include food expenditure in restaurants and meals received free or reimbursed.

Table 3.1 Variables Kept for Analysis

Type	**Variables**
Dummy variables 0/1	family type (couple=1 or not =0), Income level 0—8 (Falls in =1 or not=0), Presence of children (yes=1 or no=0)
Continuous variables	Expenditures on food bought in stores, Household size

Table 3.2 Income Levels

Variables	household annual Income level	Variables	household annual Income level
inc 0	income of less than $10,000	inc 5	income between $40,000 and $50,000
inc 1	income between $10,000 and $15,000	inc 6	income between $50,000 and $60,000,
inc2	income between $15,000 and $20,000	inc 7	income between $60,000 and $70,000
inc 3	income between $20,000 and $30,000	inc 8	income between $70,000 and $80,000
inc 4	income between $30,000 and $40,000	inc 9	income over $80,000

Summary statistics for these variables are presented in Tables 3.3 and 3.4, which provide a perspective on their magnitudes and distributions. Table 3.3 presents the means of food expenditure and household size. The food expenditure variable indicates the annual amount spent on food bought from stores. Household size indicates the number of members of the household at the time of the interview. This is based on weekly purchase records converted to an annual equivalent.

Table 3.4 shows the food expenditures of selected subgroups. As would be expected, households with couples tend to buy more food from stores. In general, the higher the income, the more the household will spend on food from stores, although the relationship is not monotonic. In addition, there is more variability at higher income levels than lower.

Table 3.3 Continuous Variables

Variables	**Number of observations**	**Mean**	**Max**	**Min**	**SD.D.**
Total food expenditure	971	4793.83	25750.26	147.68	3170.08
Household size	971	2.46	6	1	1.26

Table 3.4 Dummy 0/1 Variables

Variables	Number of observations	Total food expenditure ($)			
		Max	Min	Mean	SD.D. (*10^4)
Couple 1	596	5949.65	147.68	3317.33	2.6
0	375	2956.83	502.32	1744.74	1.2
Children 1	277	6348.63	618.28	3469.45	2.6
0	694	4172.25	147.68	2814.31	2.5
Income 1	82	2837.01	637.00	1735.63	0.8
Income 2	80	3382.07	542.62	1963.77	1.0
Income 3	122	3633.28	502.32	2831.44	2.5
Income 4	132	4344.10	629.20	2403.28	1.5
Income 5	114	4716.79	578.50	2668.37	1.4
Income 6	94	5393.74	638.04	2931.06	1.7
Income 7	75	5189.88	147.68	2401.87	1.2
Income 8	48	6144.46	655.72	3861.40	1.7
Income 9	174	7369.88	1008.54	3715.82	2.6

3.2.2 Food Expenditure Model

This thesis uses a double-logarithmic linear model to express the relationship between household socioeconomic characteristics and food expenditure. This type of linear model, with advantages introduced in the previous chapter, has been widely used to report income and price elasticities (Emil et al. 1999, Simeon et Steven 2000, Ivanova, 2005).

In this model, a household is viewed as a single organizational unit in which food expenditure behaviour can be explained as:

$$E = f(S, I, CO, CD) \tag{3}$$

Where,

S = the number of persons in the household

I = the household's gross annual income

CO = whether a couple occupy the household, either married or common in law

CD = whether the household has children less than 15 years old

As would be expected, the number of persons in the household has been shown to have a significant and positive impact on food expenditures (Allen and Bowley, 1955, Davis et al, 1983, Sdrali, 2003).

Income reflects the economic condition of the household. The quantity and quality of a household's food consumption pattern is expected to be correlated with the purchasing power of the household (Davis et al, 1983, Elsner, 1999, Sdrali, 2003).

Many studies have shown that the variable couple and presence of children have some impact on food expenditure. However these have not received as much attention by previous works as the previous two variables (Davis et al, 1983; Liu and Chern, 2001; Elsner, 1999). In this study, tests will be carried out to see if these two variables are important in predicting food expenditures. On the basis of preliminary regression results, variables that were not significant in the food expenditure model were discarded in later analysis (Appendix 1).

The model is briefly described as below:

$$\ln E_i = \beta_0 + \alpha_0 \ln S_i + \alpha_1 inc1_i + \alpha_2\, inc2_i + \alpha_3 inc3_i + \alpha_4 inc4_i + \alpha_5 inc5_i + \alpha_6 inc6_i + \alpha_7 inc7_i + \alpha_8 inc8_i + \alpha_9 inc9_i + \alpha_{11} CO_i + \alpha_{12} CD_i \quad (4)$$

Where,

E_i= Annual food expenditure of household i

S_i= Size of household i

CO_i=If household i is composed by married couples or common-in-law partners

CD_i=If household i has children under 15

Household expenditures and size were specified in the natural logarithm formats so the value of the size coefficient can be interpreted as the elasticity of household size for food expenditures. All other independent variables were specified as binary 0/1 variables. There are 9 income category variables whose coefficients explain the percentage increase in food expenditure relative to the lowest income category, which is annual income less than $10,000. The coefficients of couple and children show the percentage increase in food expenditure if a couple or a child is present in the household, compared to where there are none.

3.3 Prediction of Food Expenditure

3.3.1 Data

1996 Census Data

The Census is Canada's largest and most comprehensive survey which is conducted every five years. The Census of Population and Housing gathers information on the demographic, social and economic conditions of the population. Data used are aggregated at the census tract (CT) level for the Metropolitan area of Montreal (CMA= 462). Data for different variables were extracted from the large data base so as to match the previous food expenditure model. It was then used to provide the data required to estimate the total food expenditure in each CT.

1996 Census Geography File—CMAM

The geography files include census tract metropolitan areas—Montreal files and Montreal's street network files. This file has all Montreal CT areas and streets delineated for the collection, compilation, analysis and dissemination of census data. It was downloaded for further calculation of distances between each CT and each candidate store site.

3.3.2 Analysis Unit and Method of Data Matching

To match the food expenditure data, which were based on each household, the analysis of Montreal's census data was first based on each census tract and then calculated to the average household level to match the previous linear model.

CTs are small, relatively stable geographic areas within census metropolitan areas and larger census agglomerations (with an urban core population of 50,000 or more at the previous census). CTs are populations of 2,500 to 8,000 people where boundaries generally follow permanent physical features, such as major streets and railways, and attempt to approximate cohesive socio-economic areas at the time of creation. The boundaries of CTs are generally held constant from one census to the next, so that the CTs are comparable over time. CT was used instead of Dissemination Area (DA, small, relatively stable geographic unit composed of one or more blocks. Smallest standard geographic area for which all census data are disseminated) even though the latter is a smaller geographic unit, because a CT is considered to be more stable from both demographic and socioeconomic perspectives and CT files contain more detailed information on the characteristics of households (Statistics Canada, 2006). To match the CT data with the food expenditure survey data, the value of each variable for each CT was divided by the total number of households in that CT so that both datasets could be analysed at the average household level. Final results of food expenditures at average household level were multiplied by total number of households to get the total food expenditure of each CT.

Matching geographic data with micro data presents a challenge to the researcher related to data disaggregation. In this study, on one hand, the CT data provides a geographically aggregated profile of Montreal's CTs. On the other hand, the census micro data and the 2001 food expenditure data are disaggregated at the household level. According to previous studies introduced in the previous chapter, it was assumed that the households in each CT could be represented by that CT's average household characteristics. As a CT was created by professionals to embrace cohesive socio-economic areas, it was considered to be a neighbourhood where families are homogeneous. It could also be assumed that families with children tend to cluster in the communities where education and health facilities are well developed. Higher income families tend to cluster in the more affluent communities. Accordingly, households dwelling in the same CT area could be assumed to belong to similar income groups since they have similar real estate properties. They are also assumed to have the same accessibility to food, and share the same communities.

3.4 Organic Food Expenditure

In May, 2005, ACNielsen reported their research results on organic food consumption by different types of Canadian households who joined ACNielsen's Homescan consumer panel. The data were collected through scanned consumer sales transactions at retail point-of-sale from February, 2004 to February, 2005 in all provinces of Canada excluding Newfoundland and Labrador. Each week, ACNielsen's 12,300 Canadian Homescan consumer panel members track their household purchases. These consumers got hand-held scanners designed to read the barcodes. Once a week, the scanner transmits purchase data such as place of purchase, type of food purchased, the quantity and price for each type of food, and total expenditure of each shopping occasion to ACNielsen. ACNielsen then captures all-outlet purchase information from these demographically balanced and statistically reliable Canadian households (ACNielsen, 2005). Sales of specific items were estimated by multiplying the share of households purchasing such item by the total amount purchased. For example, if the total sales of organic milk in the ACNielsen panel are $100,000, and the panel covers 5% of the total Canadian population, then total sales of organic milk in Canada could be estimated to be $2 million.

In the ACNielsen report, the numbers for reporting organic and non-organic food expenditures were expressed as indexes (Table 3.5). These are calculated as the share of one type of household's organic or non-organic dollar expenditures in the total organic or non-organic food consumption nationwide divided by the share of this type of household's population in the national population. ACNielsen divided households into 3 main categories, which are singles, childless families and families with children. Each of the 3 categories was then divided into 3 sub categories according to age of the household. The index ranges from 0 to infinity. When the index is greater than 100, this indicates that this type of household tends to spend more on organic or non-organic products compared to the average. For example, in table 3.5, organic expenditure index for young singles is 47, and this group covered 2.5% of the total population. With both numbers, we can estimate that the share of the young single group's dollar expenditure on organic products in the total organic food expenditure is only 1.2%, which is far below this group's population share.

Table 3.5 Index of Food Expenditures in Different Household Types (2004)

Type of Household	**Organic Expenditure (Index)**	**Non-organic Expenditure (Index)**	**Percent of Population (%)**
Young Single	47	44	2.5
Middle Age Single	70	47	11.9
Older Single	65	52	12.3
Childless Young Couple	73	75	4.8
Middle Age Childless Couple	114	104	13.7
Empty Nestler	106	100	22.9
New Family	221	126	5.3
Maturing Family	102	151	18.7
Established Family	104	141	7.9

(ACNielsen, 2005)

For Each Household i,

$$I_{io} = \left(\frac{E_{io}}{E_o} \right) * \left[\left(\frac{P_i}{P}\right)^{-1} \right] \tag{5}$$

Where,

I_{io} = Index of households of type i's organic food expenditure share in its total food expenditure

E_{io} = Expenditure on organic food by households of type i

E_o = Total expenditure on organic food for all household types

P_i= Total population in households of type i

P = Total population

$$I_{in} = \left(\frac{E_{in}}{E_n} \right) * \left[\left(\frac{P_i}{P}\right)^{-1} \right] \tag{6}$$

Where,

I_{in} = Index of households of type i's non-organic food expenditure share in its total food expenditure

E_{in} = Expenditure on non-organic food by households of type i

E_n = Total expenditure on non-organic food for all household types

P_i= Total population in households of type i

P = Total population

The ACNielsen survey shows that households who purchase the most organic food tend to be new families and middle age childless couples. Older and young single households are those who have the lowest expenditure per person.

Consider their data from another perspective, to see if the percentage that organic represents within the total food expenditure varies much among all types of families. Divide equation (5) by equation (6), the share of organic expenditure in households of type i's total food expenditure can be expressed as:

$$R_{io} = E_{io} * \left[\left(E_{in} + E_{io} \right)^{-1} \right] = \frac{I_{io}}{E_n * I_{in} * \left(E_o^{-1} \right) + I_{io}} \qquad (7)$$

From equation (5), the dollar value of organic expenditure by households of type i can be expressed as:

$$E_{io} = I_{io} * E_o * \left(\frac{P_i}{P} \right) \qquad (8)$$

Table 3.6 shows the comparison between Rio (7) and Eio (8) when

$$\frac{E_n}{E_o} = \frac{(1 - 3.8\%)}{3.8\%} \approx 25.3 \qquad \text{(9) (Zhang, 2005)}$$

Table 3.6 Comparison between R_{io} and E_{io}

Type of Household	R_{io}	E_{io}
Young Single	0.0405	$1.2*E_o$
Childless Young Couple	0.0370	$3.5*E_o$
New Family	0.0648	$11.7*E_o$
Maturing Family	0.0260	$19.1*E_o$
Established Family	0.0283	$8.2*E_o$
Middle Age Single	0.0556	$8.3*E_o$
Middle Age Childless Couple	0.0415	$15.6*E_o$
Empty Nestler	0.0402	$24.3*E_o$
Older Single	0.0471	$8.0*E_o$
Mean	0.0423	$11.1*E_o$
Median	0.0405	$9.7*E_o$
SD.D.	0.0123	$6.7*E_o$
Coef. Of Variation = $\frac{SD.D.}{Mean}$ **(%)**	29.1	60.9

The table indicates that on average, households spend about 4% of their food expenditures on organic. With a coefficient of variation of 29%, there is not too much variability in organic expenditures as compared to food expenditures in total. In addition, Montreal consumers could be considered to have similar food consumption patterns because of the relatively small cultural and economical disparities and the city's developed and similar food distribution and retail system that is within the reach of almost every consumer. The above results will be used to calculate the organic expenditure share of the representative households in each CT of the CMAM in the next section.

3.5 Trade Area Analysis

3.5.1 Introduction

The previous literature on consumer behaviour related to organic food has been mostly non-spatial, regardless of the role of the location of an organic food store in affecting households' consumption choices. This thesis intends to bridge this gap by providing a linkage between organic expenditure and location preferences. A trade area is the geographic territory from which consumers are drawn to a retail site. Trade area analysis relies on information about the economics, demographic and psychographic characteristics of potential consumers in a trade area. Since a trade area's shape and size are affected by the transportation system, physical and psychological barriers to the retail site, it usually does not conform to geographic areas for which statistical data are readily available (Carn et al, 1988). Therefore, the retail trade area must be adjusted to conform to geographic areas such as counties, census tracts, zip code areas or blocks. Census tracts are considered to be suitable if the retail development is a community shopping center that is easily accessible in a metropolitan area (Carn et al, 1988).

A trade area is defined on the basis of two principle variables: travel distance and total sales (Bruner and Mason, 1968). While travel distance can be easily calculated by some geographic information systems (GIS), total sales can only be estimated. Total sales have been estimated on the basis of household average dollar expenditure on the product offered and the number of consumers in the retail trade area (Carn et al. 1988). The average dollar expenditure on the product offered is only a proxy because of differences in household demographic and economic patterns, expenditure patterns, and travel conditions. Even though using disaggregate household data would be superior in terms of predicting sales, access to such data is very difficult. To pursue the analysis at the aggregate level (trade areas) where the variables are readily available in census documents is feasible, when, in most cases, to obtain detailed household data is not permitted. The general aggregation method groups households by geographic location, assuming that the households in each defined trade area can be represented by average household characteristics (Fotheringham, 1988). Aggregation has long been studied by researchers in development economics, especially in poverty mapping, where community-level averages were used instead of data on household units. It has been employed by researchers at the World Bank and various centers of the Consultative Group on International Agricultural Research (CGIAR) system (World Bank, 2000; Minot, 2000). After comparing Vietnamese poverty at disaggregated and census level, Minot and Baulch (2002) concluded that if household-level census data are not available, as is often the case, it is possible to generate reasonably accurate estimates using aggregated census data. Having reviewed these previous comments, and unable to access to detailed household data, the aggregation method was employed for future analysis.

The Huff model, which has been widely used for estimating retail sales in other contexts, will be employed in this study. The Huff model has mostly been used by conventional retailers in determining the probability that a consumer residing in a particular area will shop at a specific store. As making profits is the objective for retailers from all marketing fields, retail sales in the organic market should be governed, in part, by common principles with the sales of conventional retailers. The Huff model was chosen in this study due to its conceptual appeal, relative ease of use, and applicability to the exact range of our problem, of which predicting consumer spatial behaviour is the most important factor.

3.5.2 The Empirical Huff Model and Assumptions

This study aims to provide an approach to evaluate potential organic retail locations from a spatial and consumer demand interaction perspective. The Huff model will be used to explain the relationship between consumer preferences and site attractiveness, According to the Huff model, total sales of organic food store j can be computed by summing over the representative households for each CT:

$$S_j = \sum_{i=1}^{m} E_{ij} = \sum_{i=1}^{m} \left(R_i * E_i * H_{ij}\right) \tag{10}$$

Where,

S_j = total sales of store j

E_{ij} = expenditure in store j for a household located at i

R_i = the share of organic expenditure in the total food expenditure for a household located at i

E_i = total food expenditure for a household located at i

H_{ij} = the probability that a household located at I will patronize a particular store j out of all n similar stores

Combining equation (10) with equation (2), the total sales of organic food store j is expressed as:

$$S_j = \sum_{i=1}^{m} \left\{ R_i * E_i * \left\{ \frac{A_j * \left(D_{ij}^{-2}\right)}{\sum_{j=1}^{n} \left[A_j * \left(D_{ij}^{-2}\right)\right]} \right\} \right\} \tag{11}$$

To show the pragmatism of the above equation and to facilitate future calculation, the following assumptions were made:

Assumption 1: The new store has a size of 30,000sq.ft.

30,000sq ft is comparable to trends in the retail industry in Canada. For example, Loblaws in Ontario and Quebec has an average store size of between 30,000 and 40,000 sq. ft (Greenwood, Salterio, 1999). A typical large conventional supermarket is considered to have a size of 40,000 sq. ft (New Rules Project, 2006; Food Marketing Institute, 2005). Whole Foods, the largest organic retailer in the world has an average store size of 32,000 sq. ft and newly opened stores in North America are around 30,000 sq. ft (Whole Foods, 2005).

Assumption 2: R_i is constant across all household types

It is known from section 3.4 that even though different household types have different dollar expenditures on organic food, the percentage that organic represents within the total food expenditure does not vary as much among all types of households with most of the data scattered between $\pm 29.0\%$ around the mean (Table 3.6). We assume the differences in R_i among all types of households to be small enough that they can be neglected. This assumption was used to facilitate future calculations given that detailed data on consumers' organic food expenditure data were not accessible.

Assumption 3: The representative household in each CT has equal access to organic products

The accessibility concept was created by McLafferty and Grady (2005) as an extension of the Huff model. Accessibility to facility j for individual i is simply calculated as:

$$I_{ij} = \frac{A_j}{D_{ij}^{\lambda}} \qquad (12)$$

Where,

I_{ij} = Accessibility to facility j for individual i

A_j= Attractiveness of facility j

D_{ij}= Distance between facility j and individual i

λ = Distance decay parameter

The assumption that ΣI_{ij} could be constant among representative households from all CTs is based on the fact that each CT contains a similar population (Statistics Canada, 2005), and that the food and road system are almost equally developed across the CMAM. Besides, as a novel market, organic retailers have few competitors and a growing number of patrons. Its nature as a novel market makes the organic market easy to be covered by a few large stores that will cause the relocation of other small businesses (Miron, 2002). When there are disparities in access to this novel market, new businesses will fill the gap and make profits. Accordingly, households in each CT area in Metropolitan Montreal are assumed to have relatively equal access to organic food.

Assumption 4: Rent, labour and other variable costs are constant in Montreal

The study assumed that rent, labour and other variable costs are constant across the region of Montreal. This being the case, then the location which brings the highest sales also brings the highest profit. We have eliminated the comparison of rent and labour cost in each location under the assumption that if Montreal consumers have relatively equal CPI (Consumer Price Index), then labour costs, along with other variable costs such as electricity and appliances will not vary much. In the case of rent, it is assumed that the variation does not take more than 10% of the total sales (Table 3.7) and that lower rent can be traded off by lower traffic accessibility or higher renovation costs. In Toronto, another metropolitan area in Canada, the share of cost of store area rentals per sq. ft in the stores' per sq. ft sales averages only about 8% across the region. In reality, the store sales of Whole Foods have more than covered their rent expenses (Lubove, 2005).

Table 3.7 Rental (per sq. ft)/Sales (per sq. ft) in Toronto Area

Avg Annual Rental/SF	**Avg Annual Sales/SF**	**Rental/Sales (%)**	**Place**
$ 4.26	$ 48.50	8.78	GTA Central
$ 5.11	$ 68.00	7.51	GTA East
$ 6.25	$ 69.67	8.97	GTA North
$ 5.70	$ 71.80	7.94	GTA West
$ 5.33	$ 64.49	8.26	GTA All

(Collier International, 2005)

Combining equation (11) with previous assumptions, total sales of store j can be expressed as follows:

$$S_j = \frac{R_i * A_j}{\sum_{j=1}^{n} \left[A_j * \left(D_{ij}^{-2} \right) \right]} * \sum_{i=1}^{m} \left[E_i * \left(D_{ij}^{-2} \right) \right]$$

$$S_j = C * V_j \tag{13}$$

Where,

$$C = \frac{R_i * A_j}{\sum_{j=1}^{n} \left[A_j * \left(D_{ij}^{-2} \right) \right]} \qquad V_j = \sum_{i=1}^{m} \left[E_i * \left(D_{ij}^{-2} \right) \right]$$

According to previous assumptions, C is a positive constant, which means that a larger V_j leads to larger S_j. The location with the highest V_j will have the highest profits, which correspond to the optimal location.

3.6 Candidate Locations and Distance Calculation

Before starting the analysis, it is important to first find the potential sites where this 30,000 sq. ft store could be located. 30,000 sq. ft is considered to be the store's floor area. This approach has often been used in market analysis to forecast future sales (Carn et al, 1988). The floor area is defined as gross leasable area (GLA), which is the total floor area occupied exclusively by a tenant, including shopping area, accessory utility, storage, and administrative space. In this study, GLA is considered to be the same as gross building area (GBA). Most real estate companies list the sizes of their properties by GBA. To find potential locations for this store is the same as to find vacant existing industrial and commercial use buildings (office buildings excluded because of construction limitations) with GBAs over 30,000 sq. ft. For buildings with GBAs over 30,000 sq. ft, the excess area is considered to be used by other businesses. In order to get reliable results, all annotated internet websites for real properties in Montreal were consulted during the first week of January 2006, which was the date when further calculations started. The consulted websites were the Appraisal Institute of Cananda, Building Owners and Managers Association of Canada, Canadian Home Buyers and Home Owners Association, Canadian Real Estate Association, Canadian Institute of Public Real Estate Companies, Canada Mortgage and Housing Corporation, Metronet, National Association of Industrial and Office Properties, Realnet, Real Estate Institute of Canada, Urban Land Institute, and the most comprehensive rental source in Montreal called louer.com. The search provided 45 possible locations.

The Manhattan distance between each potential location and each CT was then calculated.

$$D_{12} = |X_1 - X_2| + |Y_1 - Y_2| \tag{14}$$

Where,

X_1= latitude of location 1

Y_1=longitude of location 1

X_2= latitude of location 2

Y_2=longitude of location 2

The Manhattan distance calculates the rectangular distance between two locations. The distance calculator program in Mapinfo was not used as it only gives the straight line distance between two locations while practically most roads are built north-south or east-west in Montreal.

Mapinfo was used to get each CT area's X (latitude) and Y (longitude) coordinates (X_i, Y_i) and candidate locations' estimated X and Y coordinates (X_j, Y_j). The equation for calculating Manhattan distance (D_{ij}) between each CT area and the candidate store location is then able to be expressed as follows:

$$D_{ij} = 111141.5158 * |X_i - X_j| + 78158.0354 * |Y_i - Y_j| \quad (15)$$

Since Montreal is located at 45°30" latitude, 73°35" longitude, it was calculated that in the Montreal Region, the length of a degree of latitude should be 111141.5158 meters while length of a degree of longitude should be 78158.0345 meters (GMT network, 2006). For all 45 candidate store locations, each of their Manhattan distances to all CTs were calculated.

3.7 Summary

The study differs from conventional studies on organic or conventional food consumption in the respect that it is based on the idea of connecting organic market studies with classic location models. It adopts a consumer's perspective and aims to find out the optimal location for a large food store that is specialized in selling organic food products. It considers not only consumers' demographic and socioeconomic characteristics but also their geographic distribution. It analyzes consumers' food expenditure patterns, using the 2001 food expenditure survey data, while taking into consideration consumers' geographic distribution based on 2001 census data

CHAPTER 4

Empirical Results and Interpretation

4.1 Introduction

In this chapter, the results of the food expenditure analysis will be presented and their implications will also be discussed. First, the results for the food expenditure model for Montreal will be presented. The second step is to use the expenditure model to estimate the food expenditures for each Census Tract in Montreal. In the next step, the distances between candidate store locations and Census Tracts will be calculated. Finally, sales for each candidate store location will be predicted and used to rank the candidate locations.

4.2 Results of the Food Expenditure Model

The food expenditure model for Montreal was estimated using ordinary least squares in STATA, statistical software. 971 observations were available for use in the model. Studentized residuals, which are calculated as residuals divided by standard error, were used to identify outliers. In linear regression, an outlier is an observation with a large residual. An outlier may indicate a sample peculiarity or may indicate a data entry error or other problem.

The studentized residuals were examined with a stem and leaf plot (Appendix 2), a diagnostic tool introduced by Tukey (1977). It illustrates the distribution of the data in a sample by using the leading digits from each observation to create stems and the following digits to create leaves. The digits to the right of the vertical line each represent one observation. Any unusual outside points are shown on the top and bottom stems. The stem and leaf plot showed 2 potential outliers, one with an annual food expenditure of $148 (r=-6.8, lnexp=4.995) and the other of $247149 (r=3.6, lnexp=10.115). Both outliers were eliminated from the dataset before estimating the expenditure model.

The results of the regression analysis for the food expenditure model (equation 4) are presented in table 4.1. A log linear model was chosen given the rationale presented in previous studies (David et al, 1983). A robust standard errors (RSE) procedure was used, recognizing that there were not very strong reasons to prefer one specification over the others. Browne and Arminger (1995) argued that RSE should be used whenever the researcher is ignorant of the true likelihood function. RSE uses a "robust" estimator to estimate the variance-covariance matrix, and can help to avoid misspecifications and heteroskedasticity.

The results show that all variables except inc1 and existence of children are statistically significant at the 5% level or less. Inc1 is statistically significant at the 10% level while existence of children had a p value of 53%. The result was consistent with Sdrali (2003) and David et al. (1983). Since the coefficient was far from significant, it was then eliminated from the model. Another regression was run without the variable existence of children and the results are shown in table 4.2. Results showed that eliminating existence of children had little impact on the other variables or on the total performance of the model.

Multicolllinearity is one of the concerns for a regression model. Multicollinearity exists when two or more independent variables are correlated to one another. When this is the case, the significance of these variables may be reduced and one or more of the variables might be removed, transformed or combined with other variables. The Variance Inflation Factor (VIF) is a diagnostic that can be used to test for multicollinearity. The VIF equals $1/(1 - R_j^2)$ in a regression with k variables, where R_j^2 is the R^2 that results when variable j is regressed on the other k-1 variables. When there is multicollinearity, R_j^2 will be large, as will be the VIF. For typical social science research, multicollinearity is considered not a problem if the VIF is lower than 4

(Garson, 2006). The VIF in table 4.3 are between 1.98 and 4.30. This means that between 23% and 51% of the variance of a particular independent variable is not explained by the other independent variables. The results showed a low degree of multicollinearity with low VIF values for all variables. The variable inc9 has a significant coefficient, and its VIF is relatively high but not clearly a significant problem as it is still within the acceptable range. Another consideration is sample size when considering the consequences of multicollinearity. In this case, the sample is large, most of the regressors are significant, and bias is not a concern. Thus, no corrective action is required.

Table 4.1 Food Expenditure Regression Results with robust standard errors

ln(expenditure)	**Coef.**	**Std. Err.**	**t**	**P>|t|**	**Statistical Results**
ln(size)	0.492	0.061	8.080	0.000	**Number of obs**=969
inc1	0.176	0.109	1.610	0.108	**F(12, 958)** =56.87
inc2	0.228	0.112	2.030	0.043	**Prob > F=** 0.0000
inc3	0.216	0.105	2.060	0.040	**R-squared** = 0.413
inc4	0.328	0.105	3.110	0.002	**Root MSE** = 0.528
inc5	0.408	0.107	3.820	0.000	
inc6	0.431	0.111	3.870	0.000	
inc7	0.479	0.112	4.280	0.000	
inc8	0.420	0.133	3.160	0.002	
inc9	0.655	0.105	6.230	0.000	
child	-0.032	0.052	-0.630	0.531	
couple	0.188	0.053	3.560	0.000	
constant	7.409	0.094	78.980	0.000	

Table 4.2 Food Expenditure Regression Results without the Child Variable

ln(expenditure)	**Coef.**	**Std. Err.**	**t**	**P>|t|**	**Statistical Results**
ln(size)	0.468	0.047	10.060	0.000	**Number of obs**=969
inc1	0.178	0.109	1.630	0.103	**F(11, 957)** =62.05
inc2	0.231	0.112	2.060	0.040	**Prob > F**= 0.0000
inc3	0.218	0.104	2.090	0.037	**R-squared**= 0.413
inc4	0.330	0.105	3.150	0.002	**Root MSE** = 0.528
inc5	0.414	0.106	3.890	0.000	
inc6	0.433	0.111	3.910	0.000	
inc7	0.481	0.112	4.296	0.000	
inc8	0.424	0.133	3.198	0.001	
inc9	0.659	0.105	6.270	0.000	
couple	0.197	0.051	3.850	0.000	
constant	7.409	0.094	79.080	0.000	

Table 4.3 VIF Test Results

Variable	VIF	1/VIF
Income $10000-15000	2.43	0.412
Income $15000-20000	2.41	0.415
Income $20000-30000	3.08	0.325
Income $30000-40000	3.33	0.300
Income $40000-50000	3.06	0.327
Income $50000-60000	2.87	0.349
Income $60000-70000	2.46	0.407
Income $70000-80000	2.04	0.489
Income over $80000	4.30	0.232
Existence of Couples	2.06	0.485
Size	1.98	0.505

Table 4.4 The Breusch Pagen Test

chi2(1)	Prob > chi2
2.72	0.0991

Another diagnostic test was conducted to detect the presence of heteroskedasticity. Heteroskedasticity is defined as non-constant variance of the error term. When heteroskedasticity occurs, the error variance is systematically larger or smaller in some portions of the sample. This error will cause OLS to place more weight on the observations with large error variances than on those with small error variances, and thus lead to biased estimates of the variances of each of the estimated parameters. The Breusch-Pagan test was conducted to test the null hypothesis of homoskedasticity versus an alternative hypothesis of heteroskedasticity. The results are shown in table 4.4. The critical value of chi-square distribution with 11 degrees of freedom is 19.7. The model has a calculated chi-squared value of 2.72, which is below the critical value. With a P value over 0.05, the null hypothesis can not be rejected and the variance is homogenous. The model does not show strong heteroscedasticity.

The R-squared is relatively low at 41.3%. However, this is not unusual for cross-sectional data, and each parameter has the expected sign and is of reasonable magnitude. In addition, most coefficients were significant. There is no evidence of multicollinearity or heteroskedasiticity at the usual significance levels.

All income levels have significant positive coefficients. As would be expected, this indicates that higher household income exerts a positive influence on food expenditures. For example, income between $10000 and $15000 has a coefficient of 0.18, which indicates that the food expenditure of this group is 18% over that of the lowest income group (income under $10000). This phenomenon is reasonable since a household in a higher income group should have a higher budget on food. The results also showed a monotonic increase in food expenditure with an increase of income. The combined results for all income groups confirmed the hypothesis that food expenditure generally rises with increasing income of the household.

Expenditures increase with household size, and the coefficient of the elasticity of household size for food expenditures is 0.46, which is positive and significant at the 0.5% level. If, for example, the household size increases by 20%, such as a new member coming into a 5-person household, without considering other variables, the food expenditure will increase by about 10%.

A couple in the household has a significant and positive impact on in-store food expenditure. Households where there is a couple spend 20% more than non-couple households. The results suggest that a difference in marital status may be a factor in determining the value of food expenditures. This result could be explained by the fact that the food expenditure data are the expenditure on food purchased in stores as opposed to food purchased from elsewhere such as restaurants. Households with couples may tend to prefer meals cooked at home.

4.3 Food Expenditure Estimation

The food expenditure estimation analysis was done in four steps. First, coefficients of the food expenditure model were estimated and tested to be significant. Second, for each Census Tract in Montreal, data are available on the average value of each variable in the expenditure model. The next step is to use the expenditure model and the average value of each variable to estimate the average food expenditure in each Census Tract. Finally, the total expenditure on food for each Census Tract can be achieved by multiplying the average food expenditure by the number of households. This is shown in the following equations.

$$Ln\overline{E_i} = 7.41 + 0.47 * Ln\overline{S_i} + 0.18 * \overline{inc1_i} + 0.23 * \overline{inc2_i} + 0.22 * \overline{inc3_i} + 0.33 * \overline{inc4_i} + 0.41 * \overline{inc5_i}$$
$$+ 0.43 * \overline{inc6_i} + 0.48 * \overline{inc7_i} + 0.42 * \overline{inc8_i} + 0.66 * \overline{inc9_i} + 0.20 * \overline{CO_i}$$

$$E_i = N_i * \overline{E_i} \qquad (16)$$

Where,

$\overline{E_i}$ = Average annual food expenditure of a household in census tract i

$\overline{S_i}$ = average size of a household in census tract i

$\overline{CO_i}$ = The percentage of couple households in census tract i

$\overline{CD_i}$ = The percentage of households having children under 15 in census tract i

$\overline{inc1_i}$ to $\overline{inc9_i}$ = percentage of households lying in each income level in census tract i

N_i = the total number of households in census tract i.

In order to obtain the values of the 11 variables for each of the 845 Census Tracts in Montreal, the 2001 census data (Statistics Canada, 2005) were used. It contains data on household income, size and marital status for Census Tracts of Census Metropolitan Areas. Average household income and size were already contained in the original data file while the proportion of couple families in each CT had to be calculated based on the total number of families and the number of couple families in each CT. Detailed average household income data were transferred to categorical data according to different income levels. The percentage of couple-households for each Census Tract was also calculated and used as the couple variable in the food expenditure model, which was then used to calculate the average food budget of each Census Tract.

Frequency distribution tests were conducted on both total and average food expenditures of each census tract, and the results are illustrated in figure 4.1 and figure 4.2. These tests were used to examine the distributions for significant departures from normality. The total food expenditure data set has a positive value of skewness, which indicates lack of symmetry and that the data set is skewed right. The left tail is relatively shorter than the right tail (Table 4.5). The average food expenditure data set has a positive value of skewness, which is even higher than that of the total expenditure (Table 4.6). This data set is more skewed to the right and the lack of symmetry is more apparent as can be seen in figure 4.2. Both data sets have kurtosis values just above 3, which indicate slightly peaked distributions for both data sets. A Shapiro-Wilk test was also conducted to test normality (Table 4.7). The null hypothesis is that the data are normal. Both data sets have p-values of zero, so normality is rejected for both data sets. The non-normality may be caused by non-normally distributed household components among census tracts, such as income and population. However, with large sample sizes and no critical assumption based upon the normal distribution of original data sets, the non-normality probably would not have a serious effect on further calculations. The log form of expenditure data has normal distribution with no obvious kurtosis or skewness (Figure 4.3).

Since it was assumed that each household has equal portions of food expenditure on organic food, without affecting the results, the total food expenditure is used instead of estimated total organic food expenditure for future calculations (Equation 11).

Figure 4.1 Frequency Distribution of estimated total food expenditure for each CT

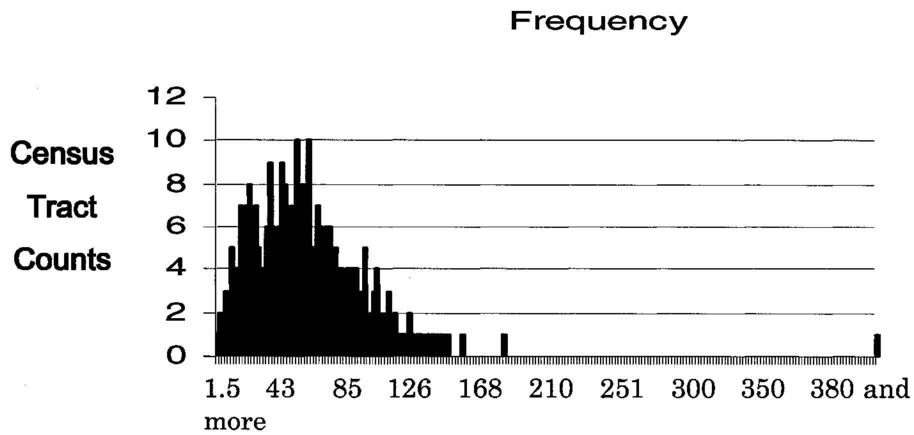


Table 4.5 Summary Statistics of Estimated Total Food Expenditure for each CT

Obs	Mean	SD.D.	Min
845	5268084	2884627	144930.9
	Max	**Skewness**	**Kurtosis**
	1.75e+07	0.66	3.38

Figure 4.2 Frequency Distribution of estimated average food expenditure for each CT

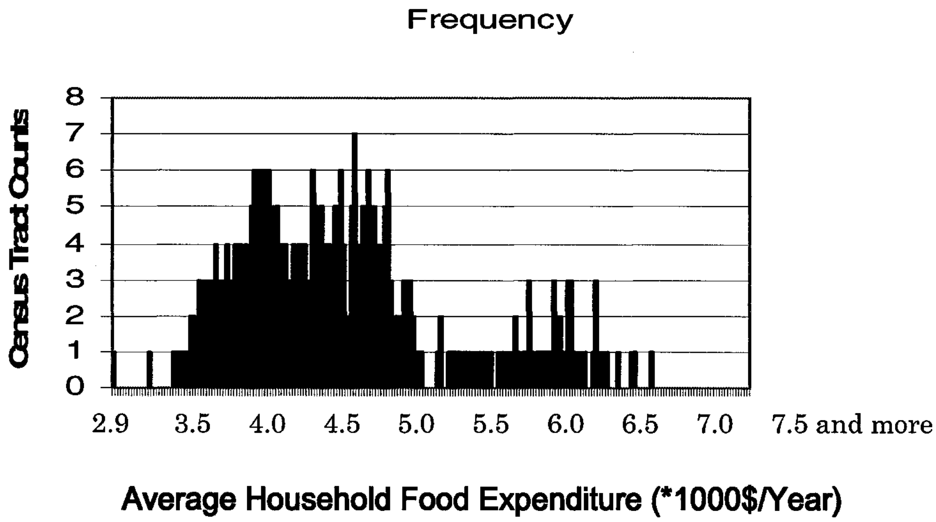


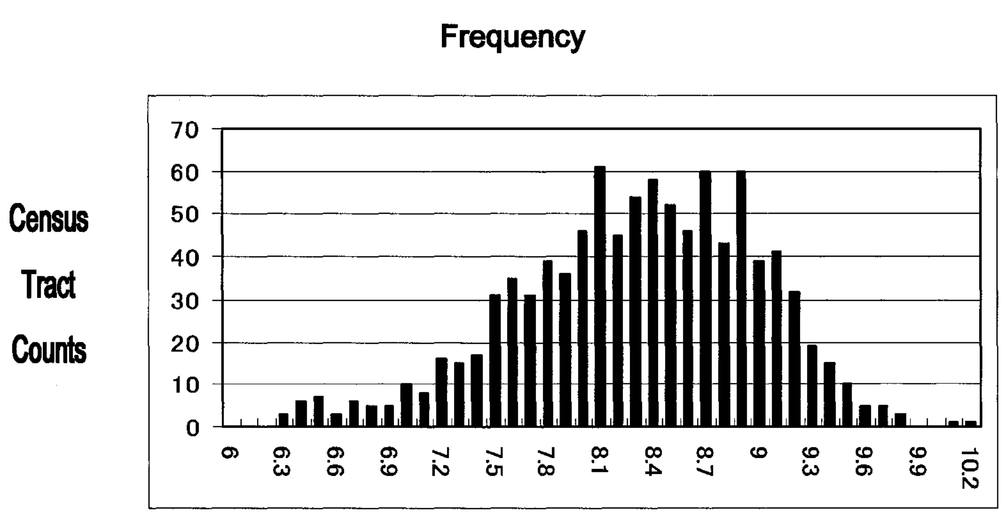
Table 4.6 Summary Statistics of Estimated Average Food Expenditure for Each CT

Obs	Mean	SD.D.	Min
	4631.38	782.84	2857.71
846	**Max**	**Skewness**	**Kurtosis**
	7116.90	0.82	3.21

Table 4.7 Shapiro-Wilk Test for Normality

Shapiro-Wilk W test for normal data					
Variable	Obs	W	V	z	Pr > z
Total Exp	845	0.96948	16.515	6.896	0.00000
Average Exp	845	0.94149	31.657	8.497	0.00000

Figure 4.3 Distribution of lnexp



4.4 Rankings of Candidate Locations

As has been mentioned previously, the attractiveness index was to be calculated for each of the 43 candidate locations scattered in the east, center and west of Montreal Island and two others located in Rive-Nord and Monteregie Sud (Figure 4.4). With each Census Tract's food budget and the distances calculated, the attractiveness for each candidate location could then be calculated. The final rankings of all candidate locations are shown in table 4.8.

Figure 4.4 45 Candidate Locations

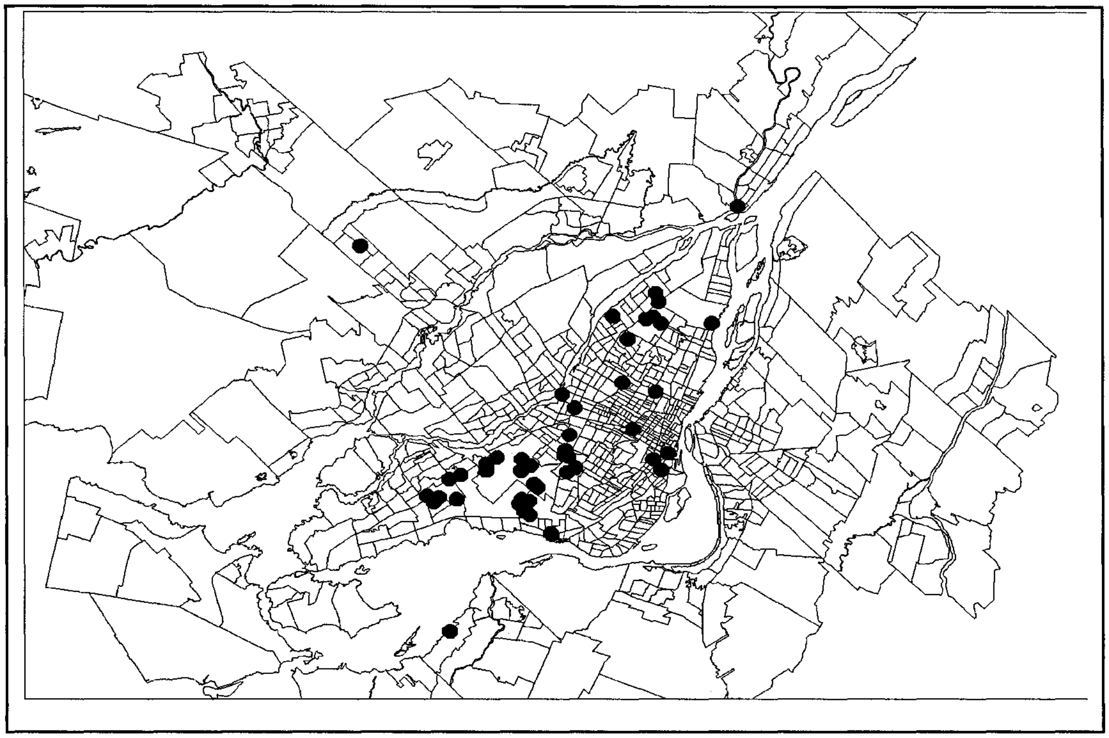
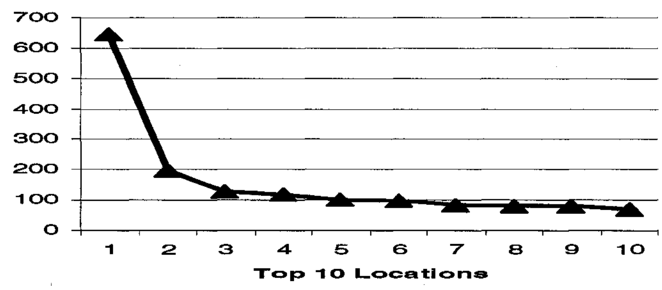


Table 4.8 Ranking of the Candidate Locations

RANK	ADDRESS	V	RANK	ADDRESS	V
45	1010 Chemin du Golf	13.51	**22**	11000 Parkway	42.97
44	550 L'assumption	18.96	**21**	165 Hymus	46.73
43	6520 Abrams	24.59	**20**	8975 Robert Armour	49.39
42	2200 52Avenue	25.00	**19**	5796 Ferrier	51.82
41	10150 Notre Dame	25.01	**18**	7777 Transcanada	52.74
40	195 Voyageur	25.19	**17**	1220 Cure Labelle	53.81
39	1700 50Avenue	25.77	**16**	507 Place d'arms	54.05
38	6161 Cypihot	26.31	**15**	105 Nordic	56.37
37	1221 32Avenue	26.64	**14**	5375 Cote de Liesse	57.52
36	10050 Cote de Liesse	26.67	**13**	255 Decarie	57.58
35	889 Montee de Liesse	28.27	**12**	101 Marcel Laurin	58.39
34	3015 Brabant Marineau	28.40	**11**	Pont Viau	68.70
33	150 Montee de Liesse	29.03	**10**	1380 William	70.96
32	111 46Avenue	33.29	**9**	1134 St Catherin	78.29
31	88 Brunswick	33.80	**8**	430 Stinson	81.06
30	9001 Henri-Bourrasa	35.74	**7**	1440 Parre	83.43
29	3737 Cote Vertu	36.42	**6**	9800 St Urbain	95.89
28	3626 Poirier	37.76	**5**	3565 Jarry	100.19
27	800 Selkirk	38.99	**4**	12060 Albert Hudon	117.29
26	1870 St Regis	40.12	**3**	2100 Jeanne d'arc	126.98
25	8787 4^{e} Cross	40.31	**2**	9155 Langelier	196.48
24	2200 Victoria	41.66	**1**	5445 De Gaspe	643.92
23	8600 Place Upton	42.81			

Figure 4.5 Location Rankings and Score



The results show that the location with the highest score is quite central to the island of Montreal at 5445 de Gaspe, with a score of 643. This is more than 3 times the number two location at 9155 Langelier with a score of 196, and 50 times the score of the lowest ranked location at 1010 Chemin du Golf.

Figure 4.5 shows the relationship between the scores and the rankings for the top 10 candidate locations. The biggest gap is between the first and the second rankings while the gap between the second and the third is also substantial. Thereafter, the decline in the index is slower and linear. The top ten locations are indicated on the map of Montreal (Figure 4.6). All ten locations are clustered in the center and eastern part of the island, which are more populated than the west of the island. The top candidate location, 5445, De Gaspe, is located between two major boulevards of the island, Saint-Laurent and Saint-Denis. Boulevard Saint-Laurent is considered to be the border that separates the east and west of Montreal. This street used to be the place where the French community in the east traded with the English community in the west. It is still one of the most populated streets on the island, and a vibrant commercial district. The candidate location is also adjacent to Mont-Royal, Outremont, and Westmont, which are considered to be the wealthiest areas on the Island. It is also close to Saint-Michel and Mont-Royal, two of the most populated districts on the island. The small distance between this location and a large affluent population probably explains why it was chosen as the optimal location. From a practical marketing point of view, the candidate location is situated in a wealthy and populated area, and is very accessible. Not only is this just a few blocks from two metro stations, Rosemont and Laurier, and close to city bus routes, it is also adjacent to several major streets such as Saint-Laurent to the west, Saint-Denis to the east, Rosemont to the north and Saint-Joseph to the south. All these other factors give strong support to the result of the theoretical Model.

Figure 4.6 Top Ten Candidate Locations

CHAPTER 5

Conclusions and Discussions

5.1 Conclusions

The objective of this thesis was to find the most lucrative location in Montreal for an organic specialized retailer to establish a store with a size consistent with current market trends. Montreal is an attractive location for organic retailers because of its large population and growing consumer concern for food safety. Another reason for choosing Montreal as the objective of this study is that even though the two other biggest urban areas in Canada, Toronto and Vancouver, both have large organic retail stores established, Montreal, the second largest urban area in Canada, is still underserved by large organic retailers. Given these conditions, there exists a possibility of growth for large organic stores in Montreal.

The method of this study involved several steps. First, data from Statistics Canada's 2001 food expenditure survey for Quebec were used to estimate the parameters of a food expenditure model. The food expenditure model produced similar results compared with previous studies. The model indicated that family income, family size and marital status have positive impacts on the food budget. Even though some other studies have shown that existence of children has a significant impact on food expenditure, the children variable in this study turned out to be insignificant and was removed from the food expenditure model.

Next, ACNielsen's organic food survey (2005) was used to support the assumption that different households have similar portions of food budgets for organic food. This result was used along with the food expenditure model for further calculations. The 2001 Montreal census tract data were used with the food expenditure model to estimate the total food expenditure for each Census Tract in Montreal.

Another significant part of the study was to identify candidate locations to establish a large store. In order to get reliable results, all annotated websites for real estate properties were consulted, and 45 available vacant industrial or commercial buildings over 30,000 sq. ft were selected as the candidate locations. The final step was to rank the candidate locations.

An innovative feature of this thesis was the use of an economic geography model to do this ranking. The Huff model is an extension of the gravity model which has been widely used in competitive retail markets to determine the optimal location of shopping centers or single stores. It considers size and distance as the two key factors that determine the potential sales of a store, and has provided the foundation for this thesis. The Huff model was used to estimate each location's attractiveness based upon their distances to each Census Tract and the total food expenditure of each Census Tract. Based on the results of the Huff model, the location with the highest attractiveness was 5445 de Gaspe. This location is in central Montreal and is close to some of the wealthiest and the most populated districts in the city. Since this is a busy commercial district, and well served by various transportation links, the results of the analysis are plausible.

5.2 Suggestions for Future Research

This study assessed a variety of locations in Montreal in terms of their potential as a location for a large format store. The results appeared to be reasonable. However, due to data and time limitations, there were some constraints in this study.

Although vacant real estate properties may change over time, to facilitate the study, the evaluated sites were limited to vacant commercial or industrial buildings in early January, 2006. However, the methodology could also be used to evaluate any other new sites. Keeping up to date with the real estate market is also a very important factor for the success of a store.

Since Census Tracts were considered to contain approximate cohesive socio-economic areas, inequalities of income and household composition inside each Census Tract were considered to be small. Average household characteristics were then used rather than household level data. To estimate organic food expenditures more precisely, employing more detailed data, such as the census household data, would be recommended. However, the detailed data are still hard to get because of security considerations.

To facilitate the use of the Huff model, it was assumed that each Census Tract in Montreal had equal access to organic products, however, there do exist some deviations among Census Tracts. Further investigation concerning the locations and sizes of all established organic stores could make the results of the Huff model more precise.

The results of the Huff model could be more accurate if access time was used instead of distance. Distance was used as a proxy for access time. For example, when two locations are the same distance from one Census Tract, even if one is near a metro or highway while the other is not, these receive the same score by using the distance proxy. However, if access time was used, the one near the metro or highway would have a lower distance cost and thus the result would be more plausible. However, this would require specialized GIS software such as Mapinfo Professional, which calculates the access time by car. Even so, potential customers can use public transportation, or walk, each of which imply different access times.

This thesis has provided a new application of the Huff model, and the general idea can be utilized by miscellaneous retailers in various markets. It is acknowledged that consumers' food consumption is more than what the survey data can reveal, and that to combine the results from the survey data with the geographic data may cause aggregation errors. In reality, there would be still more work to be done before final decisions on the store location could be made, but this thesis provides an important beginning.

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Appendix 1 List of all variables in original data sets

2001 Food Expenditure Data

Week and quarter of Survey reply

Region of Atlantic, Ontario, Prairies, British Columbia

Rural residence

Age of reference person

Gender of reference person

Age of Spouse

Number economic families in household

Free meals

Total food purchased from restaurants

Number of meals purchased from restaurants

Daily expenditure on food and beverages purchased from stores

Household record flag

Detailed food category file

Purchased meat, fish, dairy products, eggs, bakery, cereal, fruits, nuts, vegetables, condiments, spices, vinegar, sugar, coffee, tea, fats, oils, non-alcoholic beverages, and other foods.

1996 Census Data

Data file outside CMA Montreal

Number of census families fell in each calculation category

Number of married/common-in-law families and lone-parent families fell in categories by number of sons/daughters

Number of never-married son/daughter

Number of persons in each type of private households

Number of occupied private dwellings by structural type of dwelling

Number of population by citizenships, place of birth, province of residence

Non-immigrant population

Immigrants by selected countries of birth

Visible minority population

Population of 15 years and older by labor force activity

Occupation division

Hours of work

Level and type of education

Number of migrants

Number of economic families fell in each calculation category

Number of families fell in each category by number of members in the labor force

Period of dwelling construction

Type of dwelling status

Tenants

Level of rent

Appendix 2 Stem and Leaf Plot of Studentized residuals for 2001 food expenditure data

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-6. | 8
-6s |
-6f |
-6t |
-6* |
-5. |
-5s |
-5f |
-5t |
-5* |
-4. |
-4s |
-4f |
-4t |
-4* |
-3. |
-3s | 76
-3f | 554
-3t |
-3* |
-2. | 998
-2s | 777666
-2f | 555444
-2t | 3222
-2* | 1111000000000
-1. | 9999988888888888
-1s | 777777766666666666666
-1f | 55555554444444444444
-1t | 33333322222222222222
-1* | 111111111111111111110000000000000
-0. | 999999999999999999999999888888888888888888888
-0s | 77777777777777777777777777766666666666666666666666
-0f | 5555555555555555555555555555555555544444444444444444444444444444444444
-0t | 333333333333333333333333333332222222222222222222222222222222222222222
-0* | 111111111111111111111111111111111111111
 0* | 00000000000000000000000000000000000000001111111111111111111111 ... (81)
 0t | 22222222222222222222222222222222222222222222222222223333333333333 ... (97)
 0f | 44444444444444444444444444445555555555555555555555555555555555555 ... (80)
 0s | 66666666666666666666666666666666666666666666666666666677777777777 ... (86)
 0. | 88888888888888888888888888888888888888888889999999999999999999999999
 1* | 0000000000000000000000000000111111111111111111111111
 1t | 2222222222222222222223333333333
 1f | 44444444444555555555555
 1s | 66677777777
 1. | 888888899999
 2* | 000000
 2t | 233333
 2f |
 2s |
 2. |
 3* |
 3t |
 3f |
 3s | 6
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