



# NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

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MBA PROFESSIONAL REPORT

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## PREDICTING COMMISSARY STORE SUCCESS

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**December 2014**

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**PREDICTING COMMISSARY STORE SUCCESS**

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Submitted in partial fulfillment of the requirements for the degree of

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from the

**NAVAL POSTGRADUATE SCHOOL  
December 2014**

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# **PREDICTING COMMISSARY STORE SUCCESS**

## **ABSTRACT**

What external factors affect a commissary store's success? This thesis analyzes the impact of demographics, local prices and competitors on commissary stores sales per square foot. These three factors were found to account for approximately 60 percent of the variation in sales per square foot between different store locations. The only influential groups for commissary success were active duty members, retirees, and their dependents-Reservists and National Guard members had no impact. Equally important was the price differential between commercial grocery stores and commissary stores in the local area. The number of competitors did not matter in sales predictions.

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## **I. INTRODUCTION**

### **A. OVERVIEW**

The Defense Commissary Agency (DeCA) operates 246 commissary stores worldwide with total sales of \$5.9 billion. Commissary stores carry a wide selection of products including grocery, dry goods, meat, seafood and frozen goods. Most stores contain a bakery and deli. They are designed to offer a full service commercial grocery store substitute for authorized shoppers, who include active duty, reserve and retired military members as well as National Guard members and their families (Defense Commissary Agency, 2013).

DeCA sells all goods at cost, which includes the purchase price, transportation to the store and an allowance for shrinkage, spoilage and pilferage (about one to two percent). The sales of goods are reflected in Commissary Resale Stocks fund. Operating expenses, such as salary and utilities, are paid for by an appropriation from the Commissary Operations fund, which is in turn funded by appropriation from the Defense Working Capital Fund. The total appropriation for DeCA operations is approximately \$1.4 billion per year (Defense Commissary Agency, 2013).

The purpose of commissary stores is to increase the non-monetary benefit to eligible patrons, with emphasis on active duty members and their families. The Defense Commissary Agency maintains that commissary privileges are an integral part of pay and benefits. DeCA claims a two to one amplification of benefits—patrons receive \$2 in grocery savings for every \$1 of taxpayer money spent.

### **B. THESIS SCOPE AND APPROACH**

This thesis will analyze the factors that lead to success, defined as sales per square foot, of commissary stores located in the United States. This can be captured by examining factors that make any retail store successful: the number of shoppers, the price differential between a store and its competition, and the number of competitors a store faces. The scope covers only external factors in helping or hindering success and makes

every attempt to ignore the internal factors that affect shopper's habits. The intent is to analyze demographics, prices and competition for all commissary stores in the continental United States. This is not possible due to incomplete, unobtainable and inaccurate data for some metrics.

The intent of this thesis is to determine which commissary stores are so handicapped in their given external factors (location, population, competition) that they cannot succeed and also to aid in the planning of future stores to maximize the return on taxpayers' investment.

## **II. BACKGROUND**

### **A. COMMISSARY HISTORY**

Commissary stores began under the premise of providing wholesome food at cost as an additional benefit of serving in the Army. The Army began allowing officers to make purchases from commissary department warehouses for personal use in 1825. This benefit was soon extended to include officers' immediate families of the officers by 1841 and to enlisted soldiers by 1867. Benefits to retirees, reserve and guard members came much later. The Navy and Marine Corps had opened their own commissary stores by 1910 and the Air Force followed suit by 1948. All branch-specific commissary operations were combined into the Defense Commissary Agency (DeCA) in 1990. DeCA currently oversees all commissary stores (History, n.d.).

### **B. COMMISSARY REGULATIONS**

Top-level governmental regulations concerning Commissary establishment and operations are contained in Title 10 of the United States Code. Chapter 147 defines the existence and purpose of commissary stores, establishment and disestablishment criteria, store size and authorized merchandise and prices. Chapter 54 defines other personnel eligible to shop at commissary stores. The Department of Defense adds more detailed requirements for the above Commissary topics in Department of Defense Instruction (DoDI) 1330.17 (2014).

#### **1. Commissary Store Establishment Criteria**

Section 2482 of the U.S. Code states that the needs of active duty service members and their dependents shall be the priority when deciding the need and location of a new commissary store. DoDI 1330.17 refines the establishment criteria stating that at least 500 active duty, reserve and guard personnel must be permanently stationed near the new commissary store location (Department of Defense, 2014). Section 2482 further states that the size of a new store shall be determined based on the number of eligible patrons that are likely to use that store. Store size, as discussed in Title 10, is determined

according to DoDI 1330.17 based on the number of eligible patrons living within 20 miles of the zip code of the new commissary store (Department of Defense, 2014).

## **2. Authorized Commissary Store Patrons**

U.S. Code states that active duty service members, military retirees, members of both the Selected Reserve and Ready Reserve, retired reserves and dependents of all listed categories may use commissary stores. National Guard members and their dependents may also use commissary stores when they are called to active duty for certain emergencies. DoDI 1330.17 also states that other various groups are entitled to commissary benefits (Department of Defense, 2014). These groups include Medal of Honor recipients, cadets and midshipmen and members of the National Oceanic and Atmospheric Administration Commissioned Corps. These groups will be ignored due to their insignificant size compared to other military groups.

## **3. Authorized Goods and Pricing**

U.S. Code states that standard grocery items may be sold, as well as non-alcoholic beverages, non-food grocery items, tobacco, health and beauty aids and magazines. A more detailed list is enclosed in DoDI 1330.17 (Department of Defense, 2014). Sales prices of goods are required by law to be set at the actual cost of the goods plus the cost of transportation to the first destination plus the estimated cost of shrinkage, spoilage and pilferage. Section 2484 also states that a five percent surcharge shall be collected on the sale of all goods (10 U.S.C. § 2484, 2010). This surcharge is used only to fund construction, repair, improvement and maintenance (10 U.S.C. § 2484, 2010).

## **4. Commissary Store Disestablishment Criteria**

Section 2482 of U.S. Code (2010) states that the effect on the quality of life of active duty service members and their dependents shall be the primary concern when assessing the closure of a commissary store location. The effects on the welfare and security of the local military community and should also be taken into consideration. DoDI 1330.17 further states that a commissary store should be closed if the benefit to active duty service members from that store does not justify the expense of keeping that

store open (Department of Defense 2014). The instruction further states that the store should be closed if less than 100 active duty, reserve and guard personnel on active duty are attached to that installation.

### **C. LITERATURE REVIEW**

There have been several theses published from the Naval Postgraduate School regarding commissary stores and their value to eligible patrons. Alcott (1994) concluded that providing direct cash payments to eligible members in lieu of commissary benefits is more efficient and could save significant taxpayer dollars. Dearing (1984) analyzed perceptions of commissary shoppers with regard to the value of the commissary benefit. He found that commissary shoppers, on average, under-valued their savings. That is, their perceived savings was much lower than the amount they actually saved by shopping at the commissary. DeWilde (1998) analyzed the benefits of providing a commercial grocery subsidy to eligible members instead of operating commissary stores. He found that some commercial grocery store chains would provide service members a 5 to 6 percent discount with no subsidy from the government (deWilde, 1998). No theses could be found regarding the success of current commissary stores or if it is possible to predict that success.

Multiple studies of private commercial grocery consumer preferences, habits and demographics have been conducted (Carpenter & Moore, 2006; Chung & Myers, 1999; Kumar & Karande, 2000; McGoldrick & Andre, 1997). McGoldrick and Andre (1997) analyzed the loyalty of consumers to a particular grocery chain based on a regression involving age, travel time and income. It concluded that both family income and grocery expenditures of shoppers who were loyal to one store were significantly higher than those shoppers who had little loyalty to any grocery brand. This finding does not agree with earlier studies done on the same subject (Dunn & Wrigley, 1984; Enis & Paul, 1997). This is applicable to commissary success because loyalty to commissary or commercial grocery store chains will influence consumer spending at each.

Chung (1999) investigated the price differential between chain grocery stores and non-chain grocery stores in the Minneapolis-St. Paul Metropolitan area. The study found

that shoppers without access to a chain grocery store pay significantly more for groceries. These findings are likely applicable for remote commissary store locations.

Carpenter and Moore (2006) examined consumer demographics and their choice of grocery store format. The study found that consumers with higher incomes were more likely to shop in specialty grocery stores (e.g., Whole Foods). It also found that consumers who frequently shopped at specialty stores did not put a strong emphasis on price competitiveness as a reason for shopping at specialty stores. More important to them were cleanliness, product selection, courtesy of employees and crowding. Shoppers who frequented traditional supermarkets valued cleanliness, product selection, price competitiveness, crowding and courtesy of employees, in that order. The study found that patronage of supermarkets decreased as family size increased, with large families choosing supercenters (e.g., Wal-Mart) or warehouse clubs. The study further found that the likelihood of grocery shopping at a supercenter is decreasing in education level and income and increasing in family size. The study also found that the females are much more likely to shop at a supercenter than males. This has implications with respect to commissary sales because of the frequency of active duty sponsor deployments.

Kumar and Karande (2000) investigated the effect of retail store environment, both internal and external, on retailer performance. A store's internal environment included the number of checkout registers per square foot, the number of non-grocery products sold, whether the store doubles manufacturer coupons, whether there is a banking facility and whether the store is open 24 hours a day. The stores' external environment included the number of households in the trade area and the region in which it is located. Kumar postulated that sales per square foot (productivity) is a function of the number of checkout counters per 10,000 square feet of sales space, the number of non-grocery items sold, whether the store doubles manufacturer coupons, whether the store was open 24 hours a day, whether the store had a bank, the total number of households in the trade area, and the region in which it was located. His findings were that sales per square foot is positively and significantly correlated with checkout lanes per selling area, the acceptance of double coupons, being open 24 hours a day, and households in the trade area. Sales per square foot was driven lower by selling more non-grocery items and

having a bank in the store (Kumar & Karande, 2000). The study also found that stores in the Northeast have higher sales per square foot, most likely due to the higher population density. These external factors accounted for approximately 67 percent of sales per square foot variation (Kumar & Karande, 2000). Commissary stores normally have limited hours, no banks, do not allow double coupons and have few checkout lanes for their size.

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### III. MODEL

The model for predicting sales per square foot for each commissary store is given below.

*Sales per Square Foot*

$$= \alpha_1 ADT + \alpha_2 NGT + \alpha_3 REST + \alpha_4 RETT + \alpha_5 RRETT + \alpha_6 CPI \\ + \alpha_7 COMP$$

#### A. MEASURE OF SUCCESS

Sales per square foot, defined as commissary sales for fiscal year 2013 divided by the square footage of sales floor for each commissary, is the most appropriate measure of success. This metric was chosen for various reasons. First, the data was publicly available via a Freedom of Information Act inquiry to the Defense Commissary Agency. Second, it allows normalization of the data to account for individual commissary store size variations. With this process, a small store and a large store may have identical sales per square foot and are therefore equally successful with different gross sales volumes. Third, sales per square foot is the commercial retail industry standard for determining success of a location as evidenced by the metric appearing in almost every major retailers' financial statements. Fourth, commissary savings are meant to be a benefit to active patrons and therefore higher sales per square foot equates to more savings per commissary installation.

An alternate proposed measure of success is the ratio of sales to expenses incurred at each commissary. This measure could be appropriate because it evaluates how efficient each store is at generating revenue, however this measurement is outside of the scope of this thesis and focuses more on store operations and the success of management. Additionally, cost of goods sold data was not available, making this measure even less viable. Again, the intent of this thesis is to determine which commissary stores are so handicapped by external factors (e.g., location, population, competition) that they cannot succeed. The secondary intent is to aid in the planning of future stores and the closure of current weak performing stores in order to maximize the return on taxpayers' investment.

A second alternate proposed measure of success is the effective net profit of each store. This measure is defined as commissary store sales minus the total expenses incurred by that commissary. These expenses include the cost of goods sold, labor, rent and utilities. This metric is not feasible for two reasons: the design of the commissary selling model and the inability to obtain useful cost of goods sold data. The commissary selling model, as required by law, is to sell products with no markup—that is the customer is charged exactly what the government paid for that good, including transportation and estimated shrinkage/spoilage and pilferage. In a perfect setting, the cost of goods sold would exactly equal the net sales. This measure is not believed to be perfect and is therefore not used as a measure of success.

## **B. VARIABLES AND SOURCES**

I will now describe the logic and data sources for each of my dependent variables.

### **1. Populations**

Population size, specifically active duty and retirees, is predicted to be the most important factor in a commissary store's success due to the fact that more eligible patrons means more consumption and therefore higher sales per square foot.

Population data was obtained through queries of the Defense Manpower Database Reporting System located in Seaside, California. Population data obtained was the number of commissary eligible patrons with their home of record within 20 miles of the commissary stores' zip codes. The 20-mile distance metric was chosen because it is the distance specified in Department of Defense Instruction 1330.17 (2014) procedures regarding the required number of beneficiaries for establishment and disestablishment of commissary locations. Home of record does not change when a service member deploys (Department of Defense, 2014).

Patrons were classified into 10 categories: active duty sponsors and their dependents; reserve sponsors and their dependents; National Guard sponsors and their dependents; retired sponsors and their dependents; and retired reserve sponsors and their dependents. These categories do not differentiate between the branch of service of the

sponsor—the active duty sponsor category includes Army, Navy, Marines, Coast Guard and Air Force members. Dependents, as defined by U.S. Code Title 10 section 1072 (2010), are spouses, children under 21, children under 23 and enrolled in a full-time course of study, children incapable of self-support due to disabilities, un-remarried widows, and parents residing with the member and dependent on that member for one-half of their income.

If any eligible member's home was located within 20-miles of more than one commissary store location, the member was counted only as a patron of the commissary closest to the member's home of record. The same person was not counted as a customer of two commissary stores if living within 20 miles of both stores. The natural logarithm of the population size was used in order to present the data in the most linear fashion. Each population variable, when charted as a histogram, showed an exponential decrease as the x-axis value increased.

In order to make the data comparable, it is assumed that sponsors and their dependents perform all commissary shopping only at the commissary store located closest to their home of record. In actuality some patrons would likely shop at the commissary located in proximity to or on the military installation at which they work. Active duty shoppers likely have higher variability in their shopping habits due to being assigned to one installation and living closer to another. The mitigating factor of patrons living and working near two different commissary stores is that most shoppers have only one commissary location within a reasonable distance of their home of record. Fewer than 10 commissaries are located within 20 miles of another location.

The variables representing population are described below.

*a. ADT Variable (Total Active Duty)*

The natural logarithm of the total of active duty personnel of all branches of the military and their eligible dependents living within 20 miles of the commissary store location.

***b. NGT Variable (Total National Guard)***

The natural logarithm of the total of National Guard personnel and their eligible dependents living within 20 miles of the commissary store location.

***c. REST Variable (Total Reserves)***

The natural logarithm of the total of reserve personnel of all branches of the military and their eligible dependents living within 20 miles of the commissary store location.

***d. RETT Variable (Total Retired)***

The natural logarithm of the total of retired personnel of all branches of the military and their eligible dependents living within 20 miles of the commissary store location.

***e. RRETT Variable (Total Retired Reserve)***

The natural logarithm of the total of retired reserve personnel of all branches of the military and their eligible dependents living within 20 miles of the commissary store location.

**2. Pricing**

The price differential between commissary stores and commercial grocery stores is predicted to be the second most significant factor in determining patrons shopping habits and choices and therefore sales per square foot behind number of eligible patrons. The Consumer Price Index was used to provide a price comparison between commissary prices, which are nearly constant nationwide, and commercial grocery store prices, which vary widely by locality.

**3. CPI Variable (Consumer Price Index)**

Consumer Price Index data was obtained through a Council for Community and Economic Research cost of living index report of 2012 annual average data (Council for Community and Economic Research, 2013). The report gives the relative price levels for

307 urban areas. The consumer price index values are further broken down into six categories. Only the grocery category was used as a predicting variable. The CPI is presented such that the average price for all areas of the United States is 100. A price index of over 100 indicates that area's grocery prices are higher than average while an index under 100 indicates that area's grocery prices are less than the average. The CPI can also be read as a percent, with a CPI of 113 being 13 percent above the average while a CPI of 90 would be 90 percent of the average.

The consumer price index for groceries, which on average comprises approximately 13.5 percent of consumer spending, was used as the CPI metric in the model. The 13.5 percent is derived from government survey data on expenditure patterns for the top income quintile. This survey data may introduce some error but it is most likely negligible to the model because CPI data is presented in relative values. This effect is also mitigated because the fact that top quintile and median quintile families buy mainly the same grocery goods. The only income effect of CPI is assumed to be the weighting of the individual categories (grocery, housing, utilities, transportation, healthcare and miscellaneous) with respect to the overall CPI of that area. The overall CPI is not used, only that of groceries.

The CPI metric was chosen because data was available for a large portion of commissary store locations (77.5 percent). The CPI metric was also chosen for the model instead of a commissary price survey because of the high market basket uniformity of the CPI calculation. Identical name brand goods were used for pricing in each area in the calculation of CPI whereas commissary stores in different regions carry different goods.

A potential source of error is that data are from two different years. Commissary sales per square foot and population data are fiscal year 2013 annual data. CPI data is calendar year 2012 annual average data. This error is likely minimal because most areas have not seen high inflation relative to others in this short time frame.

*a. Alternative*

An alternative to using the CPI to determine price differentials was comparing regional average prices for civilian grocery stores to commissary prices. Regional

average prices were obtained through the United States Bureau of Labor statistics for commodity goods, such as butter, flour, meat and cheese. Commissary pricing for some stores (Offut Air Force Base, Travis Air Force Base and Fort Belvoir Virginia) was obtained via the Click2go web ordering system. The Click2Go system is in a trial period at three commissary stores in three different regions. It is designed to allow customers to place their commissary order online and retrieve that order, pre-packaged, at their chosen commissary store. Prices via Click2go were obtained in August 2014.

The regional price differential method was not used due in part to the Bureau of Labor Statistics regions matching imperfectly with DeCA pricing regions. The lack of price overlaps leads to a large number of commissary store pricing surveys to be completed in order to obtain an adequate sample size. This was not feasible due to difficulty in obtaining timely and accurate sample data.

This price differentiation method was not chosen due to lack of data as well as the irregularities introduced by different market baskets as well as the size of the basket per average patron.

***b. Competition***

Commissary store competition was defined as supermarkets and other grocery stores, excluding convenience stores. This market segment is represented by North American Industry Classification System (NAICS) code 445110. The number of competing locations was obtained from the United States Census Bureau Industry Portal. The data presented at the portal is the number of establishments ranked by the number of employees in each zip code. The number of competitors was further refined to grocery stores and supermarkets with greater than 20 employees, located in the same micropolitan or metropolitan area for each commissary store. The number of commercial grocery stores data was broken down the following employee size classes: 1–4, 5–9, 10–19, 20–49, 50–99, 100–249, 250–299, 500–999 and 1000 or more. Stores within the 20-49 employees category were chosen as the minimum size to compete with commissary stores. Stores with less than 20 employees are likely below the size class of most commissary stores. The number of employees in the Fort Ord Commissary, which falls in

the median 50 percent by sales floor square feet, is 41. The most recent data available was from the year 2012. Competition data for commissary stores that did not fall within a micro or metropolitan area was found by performing a zip code search for the number of stores in the same zip code as the commissary store.

Metropolitan and micropolitan areas are geographical areas defined by the Office of Management and Budget (Council for Community and Economic Research, 2013). These areas consist of cities, counties, and outlying areas that have strong social and economic ties.

The natural logarithm of the number of competing stores was taken due to the exponential nature of the data. Data error may have been introduced due to the difference in competition data collection metrics. This error is estimated to be small because only 19 commissary stores with sales comprising 13 percent of total sales were located outside of micro or metro areas.

## **C. CREATION OF SAMPLE**

The original sample size of the total number of worldwide commissary stores was 250 stores. Observations were removed for the reasons below. The sample creation is summarized in Table 1.

### **1. Overseas Locations**

Seventy-two of those stores were removed because they are located overseas (including Puerto Rico) where CPI and other data is difficult to obtain. Furthermore, it is difficult to determine an appropriate number of competitors due to the nature of international cultures and consumer preferences.

### **2. Missing Data**

Four of the remaining stores located in the United States had missing sales or population data and were eliminated.

### 3. Sales Per Patron

Sales per patron was calculated by dividing total sales for each commissary by the total number of eligible patrons (the sum of Active Duty, Reserve, National Guard, Retired and Retired Reserve). Locations having average sales of greater than \$10,000 per patron per year were eliminated due to this spending being much greater the national average per person. Per person grocery spending for males between 19 and 50 years old is approximately \$3,600 per year (USDA). This error is likely due to population errors that have been introduced through the method in which home of record data was produced. Sales per patron in excess of \$10,000 per year indicates that reported population data is lower than the actual population for that specific commissary store.

### 4. Average Family Size

Average family size was calculated by dividing the number of dependents by the number of sponsors in each category (active duty, reserve, National Guard, retired and retired reserve). Observations with an average family size of greater than six in any category were eliminated. Average family size greater than six, which is over twice the national average (“USA Average Household Size,” 2013), is indicative of incorrect population data caused by the manner in which location data was reported.

Table 1. Sample Creation

	Sample	Removed
Total worldwide commissary stores	250	
Less stores excluded because they are:		
Overseas	178	72
Missing sales data	177	1
Missing population data	174	3
Sales per patron over \$10,000	155	19
Average Family size greater than 6	129	26
No CPI data	100	29

#### D. DESCRIPTIVE STATISTICS

Table 2 contains a summary of the relevant descriptive statistics of all variables. Note that total active duty and total retired are by far the two largest population groups. Also, the consumer price index shows that the average commissary store is located in an area with a higher than the national average consumer price index.

Table 2. Descriptive Statistics

Variable	Mean	Std. Dev.	25 <sup>th</sup> Percentile	50 <sup>th</sup> Percentile	75 <sup>th</sup> Percentile
<b><i>Dependent Variable</i></b>					
<i>Sales/ft<sup>2</sup></i>	765	289	582	761	916
<b><i>Independent Variables</i></b>					
<i>ADT</i>	23,084	30,559	5,960	12,084	24,144
<i>REST</i>	5,953	6,671	1,870	4,188	7,498
<i>RETT</i>	20,275	21,183	8,226	13,586	26,683
<i>RRETT</i>	1,435	1,373	429	1,193	2,069
<i>NGT</i>	2,519	2,119	779	1,958	3,807
<i>COMP</i>	87	210	4	22	81
<i>CPI</i>	104	13	97	101	110

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## IV. ANALYSIS

This section will present the results of the regression, an interpretation of results and discuss other regressions that were considered.

### A. REGRESSION RESULTS

Results of the regression, as performed on StatPlus for Mac, are shown in Table 3.

Table 3. Regression Output

Regression Statistics							
R		0.79379					
R Square		0.63011					
Adjusted R Square		0.60196					
S		0.29408					
Total number of observations		100					
<b>Sales/Ft<sup>2</sup> = 2.5511 + 0.1804 * ADT - 0.0910 * REST + 0.2094 * RETT - 0.0823 * RRETT + 0.0748 * NGT + 0.0295 * COMP + 0.0096 * CPI</b>							
ANOVA							
	d.f.	SS	MS	F	p-level		
Regression	7.	13.55366	1.93624	22.38877	0.E+0		
Residual	92.	7.95639	0.08648				
Total	99.	21.51006					
	Coefficients	Standard Error	LCL	UCL	t Stat	p-level	H0 (5%) rejected?
<b>Intercept</b>	2.55113	0.41149	1.73387	3.36839	6.1997	0.	Yes
<b>ADT</b>	0.18038	0.05509	0.07095	0.2898	3.27397	0.0015	Yes
<b>REST</b>	-0.091	0.06547	-0.22103	0.03903	-1.38994	0.1679	No
<b>RETT</b>	0.20944	0.08765	0.03535	0.38353	2.3894	0.01892	Yes
<b>RRETT</b>	-0.08225	0.09047	-0.26194	0.09744	-0.90914	0.36565	No
<b>NGT</b>	0.07479	0.05525	-0.03495	0.18452	1.35355	0.1792	No
<b>COMP</b>	0.0295	0.01931	-0.00885	0.06786	1.52774	0.13001	No
<b>CPI</b>	0.00956	0.00246	0.00466	0.01445	3.87835	0.0002	Yes
T (5%)	1.98609						
LCL - Lower value of a reliable interval (LCL)							
UCL - Upper value of a reliable interval (UCL)							

### B. INTERPRETATION OF RESULTS

The significance of each variable is determined by the p-level value given in the above regression, with a p-level of less than .05 (or 5 percent) being significant in the results of the model. Any variable with a value of greater than .05 (or 5 percent) is deemed insignificant in the success of a commissary store. The p-value for all of the coefficients, simply stated, is the chance that a coefficient at least as large as the one predicted in the above regression could be found in a random sample. The null hypothesis in this regression is that each variable has no impact on sales per square foot. A p-value

of less than .05 means that the model provides enough evidence to reject the null hypothesis that the variable has no impact on sales per square foot.

**1. ADT (Total Active Duty)**

Active duty shoppers and their dependents who live within 20 miles of a particular store are the second most significant factor in commissary sales per square foot with a p-value of .0015. This p-value is low enough to reject the hypothesis that ADT has no impact on sales per square foot. An increase in the number of active duty patrons from the 25<sup>th</sup> percentile (5,960) to the 50<sup>th</sup> percentile (12,084), while holding all other variables constant at their respective medians, will increase sales per square foot by \$81.65. An increase in the number of active duty patrons from the 50<sup>th</sup> percentile (12,084) to the 75<sup>th</sup> percentile (24,144), while holding all other variables constant at their respective medians, will further increase sales per square foot by \$90.74.

**2. REST (Total Reserve)**

Reservist shoppers and their dependents who live within 20 miles of a particular store were not a significant factor in commissary sales per square foot with a p-value of .1679. This value is not low enough to reject the hypothesis that REST has no impact on sales per square foot, and therefore it has no impact on the regression model. The coefficient is unimportant in this case and will not be discussed.

**3. RETT (Total Retired)**

Retired shoppers and their dependents who live within 20 miles of a particular store are a significant factor in commissary sales per square foot with a p-value of .01892. An increase in the number of retired patrons from the 25<sup>th</sup> percentile (8,226) to the 50<sup>th</sup> percentile (13,586), while holding all other variables constant at their respective medians, will increase sales per square foot by \$68.03. An increase in the number of active duty patrons from the 50<sup>th</sup> percentile (13,586) to the 75<sup>th</sup> percentile (26,683), while holding all other variables constant at their respective medians, will further increase sales per square foot by \$103.57.

**4. RRET (Total Retired Reserves)**

Retired Reservist shoppers and their dependents who live within 20 miles of a particular store were not a significant factor in commissary sales per square foot with a p-value of .36565. This value is not low enough to reject the hypothesis that REST has no impact on sales per square foot, and therefore it has no impact on the regression model. The coefficient is unimportant in this case and will not be discussed.

**5. NGT (Total National Guard)**

National Guard shoppers and their dependents who live within 20 miles of a particular store were not a significant factor in commissary sales per square foot with a p-value of .1792. This value is not low enough to reject the hypothesis that REST has no impact on sales per square foot. This variable remained insignificant in every permutation of the model. The coefficient is unimportant in this case and will not be discussed.

**6. COMP (Competition)**

The number of competitors within the zip code or micro/metro area of the commissary store's location was not a significant factor in commissary store sales per square foot with a p-value of .13001. This value is not low enough to reject the hypothesis that competition has no impact on sales per square foot.

**7. CPI (Consumer Price Index)**

The consumer price index of the area in which a commissary store is located is a significant factor in the success of the commissary store with a p-value of .0002. An increase in the consumer price index from the 25<sup>th</sup> percentile (97) to the 50<sup>th</sup> percentile (101), while holding all other variables constant at their respective medians, will increase sales per square foot by \$25.69. An increase in the consumer price index from the 50<sup>th</sup> percentile (101) to the 75<sup>th</sup> percentile (110), while holding all other variables constant at their respective medians, will further increase sales per square foot by \$61.56.

## **C. ALTERNATE REGRESSIONS**

Several iterations of the regression were run with different combinations of variables in order to determine the best fit to the data. Two other models are discussed below.

### **1. Sponsor and Dependent Groups Split**

Each population variable in the above regression (ADT, REST, RETT, RRETT, NGT) is the sum of sponsors and dependents in that specific group. An alternate regression was to divide customer categories into two distinct sponsor and dependent groups (i.e., active duty sponsors and the dependents of those active duty members) in order to determine correlation between each group and sales per square foot. In all cases, p-values significant enough to reject the null hypothesis could not be obtained by splitting the groups. Maintaining variables as combined groups provided significant and meaningful results for the model.

### **2. Binary Split of Low and High Competition Groups**

An alternate to the COMP variable was assigning a binary variable for number of nearby competitors. This binary value was input as 1 for stores with the number of competitors under the median of 14. The binary value of 0 was input for stores with the number of competitors greater than or equal to the median number of competitors. The coefficient for this regression was positive with a p-value of approximately .07. This result implies that more competitors nearby lead to increased commissary store sales per square foot.

## **D. DISCUSSION**

In summary, the variables that have a significant effect on commissary store sales per square foot are the number of active duty members and their dependents, retirees and their dependents, and the consumer price index of the area.

## **V. CONCLUSION**

### **A. SUMMARY**

This thesis analyzed the external factors that affect a commissary store's sales per square foot. The model included all commissary benefit eligible populations within 20 miles of each store, the consumer price index of the commissary stores' locale, and the number of nearby competitors. The factors found to be significant when modeling sales per square foot were the number of active duty service-members, retirees, their dependents and the consumer price index of the local area. More eligible patrons and a higher consumer price index generally equates to higher sales per square foot for a commissary store.

The goals and purpose of the Defense Commissary Agency, as laid out in U.S. Code is to the enhance the quality of life of members of the uniform services, retirees and dependents as well as support readiness, recruitment and retention (10 U.S.C. § 2481). Based on the results of the regression, which shows that active duty service-members, retirees, and their dependents are the only groups that significantly effect sales per square foot, the conclusion can be drawn that it is primarily these populations that shop at commissary stores. This is an indication that DeCA is fulfilling its primary mission of providing benefit to active duty members and their dependents. One of DeCA's core values is to be accountable and fiscally responsible, which includes maximizing the use of taxpayer money. While a large part of efficiency is determined by the internal operations of individual stores, external factors as shown in the above model are also significant. To maximize efficiency, stores should be located in areas with a relatively large eligible population of active duty members and retirees and areas with a high consumer price index. This is shown to produce a higher sales per square foot and maximize the benefit to patrons while minimizing total system operations cost.

### **B. COMPLETENESS OF MODEL**

The seven variables used in the above model explain approximately 60 percent of the variation in sales per square foot of commissary stores. The other 40 percent of

unaccounted for variation is most likely due to internal factors of the commissary stores. These internal factors, as discussed by Kumar & Karande (2000) may include the number of checkout registers, the inclusion of certain amenities such as a bakery or deli, and coupon acceptance. This is a topic for further research.

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