REPORT OF THE
DEPARTMENT OF AGRICULTURE
AND CONSUMER SERVICES ON

The Use of Bar Codes in the Commonwealth

TO THE GOVERNOR AND
THE GENERAL ASSEMBLY OF VIRGINIA

HOUSE DOCUMENT NO. 20

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IN RESPONSE TO
HOUSE JOINT RESOLUTION 180

A REPORT
ON THE USE OF UNIFORM BAR CODES
IN THE COMMONWEALTH

PRESENTED BY THE
VIRGINIA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES
DIVISION OF PRODUCT AND INDUSTRY REGULATION
OFFICE OF WEIGHTS AND MEASURES

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A determination was made that the study of only uniform product bar codes would not totally address the issue of point-of-sales systems utilizing pricing means other than actual price entry. Therefore, the study was expanded to evaluate the use of any point-of-sales systems that utilized a code in lieu of the actual sales price.

CHAPTER III. BACKGROUND

A. General

The greatest advances in today's technology have been in the field of electronics. One of the benefactors of this advancement has been the retail industry through the development of scanner and other electronic point-of-sales systems. This is an area where new technology is being utilized to reduce overhead, improve service to consumers and increase profits.

In 1965, Checkout Management, by Edward M. Harwell, reported that conventional (mechanical) systems in use at that time, were less than 90 percent accurate. This report prompted the retail industry to move toward sales automation. The industry, by 1969, had taken the first step toward this goal with the introduction of the Singer's Company Modular Data Transaction System. This system was not a scanning system. It allowed for advanced bookkeeping and ultimately lead to the development of scanning systems by 1972.

B. SYSTEMS

UNIVERSAL PRODUCT CODE (UPC)

The 12-digit Universal Product Code is represented in the bars and spaces that make up the complete scanner readable symbol. The verification digit enables the scanner system to immediately verify the accurate data translation of the Universal Product Code as the symbol is scanned.

STOCK KEEPING UNIT (SKU)

The SKU code utilizes digits which are manually entered. Generally, these systems are capable of duplicating the benefits of the UPC system with the exception of incorporating scanning equipment.

PRICE LOOK UP (PLU)

PLU is a system which utilizes digits by manual entry to determine a sale price or price per unit charge. These units usually vary from location to location and may not be consistent within a company or chain of stores. Codes may utilize as little as 3 digits or may incorporate the digits of a UPC code in the system. The cashier may use a flip chart as reference or rely on memory when entering these codes which may result in errors.

DIGITAL READERS

A digital reader systems is capable of reading (scanning) digital codes in order to determine a sale price. Unlike SKU and PLU systems, the digital reader does not rely on manual entry in order to establish the total sales price.

C. USAGE AND APPLICATION

RETAIL BUSINESS CATEGORIES

For the purpose of this study, retail businesses were categorized in the following manner:

A. Clothing and Department Stores
B. Building, Hardware and Automotive Stores
C. Drug and Variety Stores
D. Retail Food Stores less than 30,000 Square Feet
E. Retail Food Stores greater than 30,000 Square Feet
F. Other, i.e., Virginia ABC Stores, Convenience Stores and Federal Commissaries.

The level of technology utilized and the actual applications sometimes varied within each of these categories; however, in general terms, each category utilized technology similarly.

DISTRIBUTION OF USE IN VIRGINIA

During the period of July 1, 1990 through October 31, 1990, the Weights and Measures field staff conducted the field survey portion of this study. A total of 1,035 visits were made to various retail businesses in the state. This sample represents approximately 85-90 percent of the retail businesses utilizing scanning or coding in point-of-sales systems.

The retail food industry, being the catalyst behind point-of-sales automation and scanner development, has made the greatest strides toward uniformity. Currently, 26 percent of the retail food stores operating in the Commonwealth are utilizing scanner equipment. The remainder of the retail food industry is making use of the new technology made available by less sophisticated electronic point-of-sales systems.

The businesses using scanning/coding equipment were identified and their location was established according to zip code. (See Table I, page 25-26)

CHAPTER IV. STUDY METHODOLOGY

STUDY DEVELOPMENT

The Office of Weights and Measures contacted the National Institute of Standards and Technology in order to gather information about other states which had conducted similar activities, as requested by HJR 180. Earlier studies had included only retail food stores using scanning systems. The scope of these earlier efforts was also limited by either the number of locations included in the study or the limited data collected.

The Office of Weights and Measures invited individuals and industry interested in participating in the development of the study to attend a meeting on April 24, 1990. The input received at this meeting was incorporated in the development of the study.

With the cooperation of the Virginia Retail Merchants Association and the Virginia Retail Food Dealers Association, the Office of Weights and Measures developed a questionnaire. This was submitted to the membership of the two associations in order to obtain some basic information concerning businesses operating in the Commonwealth.

The questionnaire results, along with earlier data gathered by the Office of Weights and Measures were shared with a representative of the Virginia Commonwealth University's Institute of Statistics. This was a vital step to develop a study methodology which would apply equally to all retail businesses.

REPORTING INSTRUMENT

The most important part of the study is the field accuracy survey. It depicts the actual use of scanning and coding systems. Therefore, the development of a reporting instrument that would fairly reflect conditions at the point-of-sale was crucial. To assure that selective sampling was employed by all field staff, the sampling process had to be allocated to eliminate personal bias. This would preclude the inspection staff from targeting one area of concern, such as "items on special" and concentrating on those items when making their sample selection.

A determination was made that the maximum sample at any one location would be 50 items, the sample was allocated in the following manner:

a.	Direct Delivery	10 items
b.	Items on Special	10 items
c.	Store Brands	5 items
d.	In-Store Codes	5 items
e.	Price Lookup Codes (PLU)	5 items
f.	Random Selection	15 items

ACCURACY SURVEY IMPLEMENTATION

During the month of July, the field portion of the study was implemented by the inspection staff of the Office of Weights and Measures. This part of the study was the most demanding on the resources of the Office of Weights and Measures, since it was predetermined that in order to obtain the data necessary to formulate sound recommendations no less than 3,000 inspection hours would have to be allotted to this project. The reporting form and specific instructions on its use were developed and forwarded to the field inspection staff. A letter was prepared, padded and given to the field inspection staff for distribution to the various merchants to help explain the purpose of the survey, detailing how the information was to be used and requesting their cooperation. The inspection staff also received specific instructions as to the number of hours to dedicate during each month for the time period of July 1 until October 31.

CHAPTER V. STUDY FINDINGS

The following information was assembled relating to the five major categories of the study based on the survey:

OVERALL FIELD RESULTS
FIVE MAJOR CATEGORIES

CATEGORY	A	B	C	D	E
Number of Visits	94	147	301	245	216
Number of Samples	2,559	4,235	10,392	10,817	10,577
Number of Errors	112	302	649	403	402
Percentage of Locations with Errors	46.81	74.83	74.09	69.98	69.91
Percentage of Errors as Compared with Total Samples	4.38	7.13	6.25	3.73	3.80

Category: A Clothing and Department Stores
B Building, Hardware and Automotive
C Drug and Variety Stores
D Retail Food Less than 30,000 Square Feet
E Retail Food Greater than 30,000 Square Feet

Information which was collected and determined to be limited or inconclusive is contained in the category OTHER shown below:

CATEGORY-OTHER

BUSINESS TYPE	A	B	C	D	E	F
Number of Visits	1	2	3	20	2	4
Number of Samples	25	50	135	490	43	100
Number of Errors	0	3	6	12	1	11
Percentage of Locations with Errors	0	100	66	35	50	75
Percentage of Errors as Compared with Total Samples	0	6.00	4.44	2.45	2.33	11.00

Business Type: A Jewelry
B Beauty Supply
C Commissary
D Virginia ABC
E Club Store
F Convenience Stores

STATISTICAL EVALUATION OF DATA

The overall results of the field accuracy survey were addressed as general descriptive variables. No hypothesis testing was conducted on these variables, which were offered to indicate the amount of data collected and the extent of the scanning project. (See Table 1, page 42).

To fully understand and describe the distribution of sample errors, one must focus on the sample mean and the error variables. The sample mean is the center of the data set about which the error measurements are distributed. For the error variables, a mean value equal to zero would indicate that on average the difference between the scanned and actual purchase price was zero; a negative error would indicate an error against the retailer; while positive errors are against the consumer.

A paired t-test technique was used to evaluate data, but in cases where the number of errors found were not sufficiently large, no statistical tests were conducted. Figures 1-5, pages 54-58, graphically present the means of the error variables, with significant results from the paired analyses marked with asterisks.

For the remainder of the analyses, two types of errors were segregated and examined, errors against the consumer (positive) and errors against the retailer (negative). As with the first hypothesis above, the magnitude of errors were tested, but here it was done for each type of error (See Tables 3-8, pages 44-48).

Following this, the hypothesis that the mean absolute error against the retailer was not significantly different from the mean absolute error against the consumer, was evaluated (See Figures 6-10, pages 59-63).

In addition to measuring and testing the centers of each of the data sets, the extent of variation of errors about the mean were composed.

Another approach to the statistical analysis compared the percentages of errors against retailers and consumers while disregarding the actual magnitudes of the errors (See Table 9-14, pages 49-51).

The final hypothesis involved testing between certain error variables in order to determine, how close sampling from direct deliveries and items on special mirrored

sampling at random. After testing for differences in the mean error between items on special and random selections, it was found that items on special had a significantly larger mean error than random items selected (See Table 16, page 53).

CHAPTER VI. SUMMARY OF STUDY

The study requested by House Joint Resolution 180 has identified three groups affected by pricing accuracy. The foremost group, the consumer, is entitled to receive goods at the advertised price. The second group, the retailer, is entitled to receive a fair profit in order to survive in today's marketplace. The third group, one not as readily identified as the previous groups, is the Commonwealth of Virginia. The State and localities are entitled to tax revenues based upon accurate gross sales receipts.

Based on the findings of the study, the following generalizations can be assumed:

a. This study of scanning/coding point-of-sales systems has revealed varying degrees of accuracy among five major retail categories. The retail industry has stood by the premise that when pricing errors occur, the majority of errors are against the retailer. Results demonstrate, at best, a slightly better than even chance of the consumer prevailing when a pricing error occurs.

b. This study has also concluded that 100 percent accuracy is not realistically achievable.

c. This study has revealed that accurate pricing by point-of-sales systems has a direct effect on the Commonwealth of Virginia. The final tabulation estimates a loss to the retail food industry of $42,444.33 during each quarter, which also represents a loss to the Commonwealth in uncollected sales tax.

d. This study has determined that the accuracy of use for any scanning/coding point-of-sales system is dependent on the accuracy of the item base for pricing and the accuracy of the displayed sales price. All available information indicates that electronic point-of-sales systems are extremely accurate. However, with any electronic device the output of information is only as accurate as the information supplied to the device.

e. This study concludes that errors associated with scanning/coding systems are the result of mismanaged information. At no time during this study were any indications of willful wrong doing found to be associated with the incorrect prices. Errors were found to result from correct pricing information not being updated as readily as price changes occurred.

CHAPTER VII. STUDY RECOMMENDATIONS

The following recommendations are offered to address the current situation as set forth in the preceding report:

a. The Virginia Department of Agriculture and Consumer Services, Office of Weights and Measures should be designated as the responsible agency in order to assure that the use of point-of-sales systems are monitored.

b. The Virginia Weights and Measures Law should be amended to add specific language to address the accuracy of point-of-sales systems.

c. To allow for means to enforce this additional law, further amendments to the Weights and Measures Law should incorporate civil penalties.

d. Further amendments to the Weights and Measures Law should be made to regulate the pricing of retail merchandise.

e. The addition of enforcement responsibilities for point-of-sales systems to the Weights and Measures Law, will require three full-time employees (FTE) and necessary funding.

f. In order to fulfill the increasing responsibilities of the Office of Weights and Measures, it will be necessary to amend Code Section 3.1-928. An amendment to remove the 12 month frequency of inspections is called for in order to allocate resources as needed to address expanding consumer issues.

CHAPTER II

INTRODUCTION

House Joint Resolution 180, passed during the 1990 Session of the Virginia General Assembly, requested that a study of the use of uniform product bar codes in the Commonwealth be conducted. The resolution further requested that this study determine the necessity for regulation and requested findings and recommendations be submitted to the Governor and the 1991 Session of the General Assembly. A complete text of the resolution is contained in Appendix A.

The resolution requested that the Department of Agriculture and Consumer Services be responsible for conducting the study. Because of the Office of Weights and Measures involvement with retail businesses, the task was assigned to them for completion.

The Office of Weights and Measures has, since 1985, been active in determining the level of accuracy of retail food stores utilizing scanning and coding equipment. However, other business applications had not been addressed. In order to properly evaluate the various retail applications, the retail industries' input was needed during the development of this study.

An initial meeting with industry members and representatives was held on April 24, 1990. Appendix B lists the individuals attending this meeting. During this meeting, it was determined that the study of only uniform product bar codes would not totally address the issue of point of sales systems utilizing pricing means other than actual price entry. Therefore, the group decided that the study be expanded to evaluate the use of any point of sale system that utilized a code in lieu of the actual sales price.

With the submission of this report, the Department of Agriculture and Consumer Services, Division of Product and Industry Regulation, Office of Weights and Measures believes it has satisfied the requirements of House Joint Resolution 180.

CHAPTER III

BACKGROUND

GENERAL

The greatest advances in today's technology have been in the field of electronics. One of the benefactors of this advancement has been the retail industry through the development of scanner and other electronic point-of-sales systems. This is an area where new technology is being used to reduce overhead, improve service to consumers and increase profits.

In 1965, Checkout Management, by Edward M. Harwell, reported that conventional (mechanical) systems used then, were less than 90 percent accurate. This report prompted the retail industry to move toward sales automation. The industry, by 1969, had taken the first step toward this goal with the introduction of the Singer's Company Modular Data Transaction System. This system was not a scanning system, but it allowed for advanced bookkeeping and ultimately lead to the development of scanning systems by 1972.

The Kroger Company at a location in Kenwood, Ohio was the first retail industry to install and operate a point-of-sales system which utilized scanning capabilities.

By 1981, retail food stores using scanning had grown to 4,568 and recent estimates by the Food Marketing Institute (FMI) places the number of retail food stores using scanning at over 17,000. Within the retail food industry, it is estimated that a single location placing scanning systems into use will realize a tangible savings of $23,026 during the first year of operation. At first glance this savings would seem small. However, additional savings achieved through the ability to enhance ordering and reduce inventory levels, better management of shelf space, improved product movement and increased productivity at the check-out lane have direct effect on the gross profit of an industry that has historically earned less than 1 cent on each dollar of investment.

HISTORY

When scanners were first introduced, the industry was positive that the single most important advance toward reducing cost, through the reduction of personnel, had been achieved. The prospect of people losing their jobs placed labor unions on the offensive. However, now that the scanner systems are being widely used by retail industry, the assumption of reduced personnel was misleading. The industry has now discovered that more personnel are necessary to make the system work accurately.

A February 1, 1990, news release by Barbara McConnell, President of the New Jersey Food Council, reported that a survey conducted by their 500 member stores showed a total scanner accuracy rate of 98.9%.

This is an impressive level of compliance and one that can be achieved if adequate resources are allotted. The most important part of the news release is contained in the following:

> "The results show that the average scanner store employs one full time Scanning Coordinator and two Assistant Coordinators who oversee all scanner and pricing operations. These individuals go through extensive training programs, and are responsible for file and pricing accuracy of 26-36,000 items, and are responsible for correcting any pricing discrepancies that may exist. To achieve their goal, Scanning Coordinators use hand held wand scanning units which enables them to price check up to 400 items per hour. This process checks the price that is marked on the item or shelf, against the store processor's item file price to insure that they are correct and the same. The average amount of time spent by these employees on scanner accuracy is 70-100 hours per week. The survey also shows that these Scanning Coordinators do sample price checks daily, and a complete store check once each week."

Although reductions in the physical demands of price changes have occurred by the elimination of item pricing, the work force level has not declined. The process of keeping up with price changes requires individuals with a higher level of competence to effect the change throughout the entire system.

In a July 2, 1985 letter to the editor of the New York Times, Odonna Mathews, Vice President of Consumer Affairs, Giant Foods, Inc. stated, "Shelf pricing, rather than item pricing, can and does work as long as the company involves its customers in the change and makes a commitment to accuracy." She went on to say, "A successful system of shelf pricing depends on the following:

> **Clear and easy-to-read shelf price labels.** Consumers must be able to tell, at a glance, the price they pay as well as the unit price per measure. These labels must be maintained in their proper location so the consumer can easily match the shelf price label to the correct product. With customer input, we redesigned the format of our shelf labels to make them easier to read.
>
> **Enlarged labels on the bottom shelf.** When Giant changed to shelf pricing, one concern was that consumers could not see prices on the bottom shelves without bending over. We enlarged the molding on all bottom shelves so they could accommodate a much larger shelf price label. We tilted the molding upward to make the label easier to see.
>
> **Consumer information about the computer-assisted checkout as well as unit pricing.** Ever since we opened our first computer-assisted checkout store in 1976, we have developed ways to educate customers about how the computer-assisted checkout works as well as the benefits of unit pricing. In 1981, we began an even more concentrated education effort about unit pricing as a means of comparing prices and finding the best buy.
>
> **A commitment to accuracy.** We have a system of checks and rechecks to assure the accuracy of our system. Our shelf price labels are produced by the same computer which transmits prices to the store's computer thus assuring that the price in the computer and the price on the shelf will always be the same.
>
> To show our commitment to accuracy and as an incentive for the stores to maintain an accurate system, we adopted and prominently display the following guarantee:

> If the scanned price is more than the shelf price, you get one of that item free. We have given away very few products since we began this program.
>
> **Marking crayons for customers.** We have marking crayons available in each store for those customers who wish to mark prices on the items as they shop. The detailed receipt tape also enables customers to keep trace of their purchases."

Giant Foods, Inc. made the change from item pricing to shelf pricing in 1981. Through random verifications that the Office of Weights and Measure has conducted it is apparent that this system works. The instance of error recorded during inspections at Giant Food locations are among the lowest in the retail food industry.

ENFORCEMENT

Since the introduction of scanning and electronic point-of-sales systems in the early 1970's, great concern has been expressed regarding their application, accuracy, and venue of regulation.

The National Conference on Weights and Measures (NCWM) adopted Policy and Guidelines, Section 3.2.9. Automated Checkout Stands in January 1987. This policy states that, "Automated checkout or point-of-sales systems are intended as direct sales situations. All of the requirements of the Uniform Weights and Measures Law and Handbook 44 directed to computing scales used for over the counter sales, as in the delicatessen section for example are applicable." The section later states that, "It is not expected that a weights and measures official, in the routine performance of his duties, would ascertain the accuracy of the UPC symbol on standard weight packages. However, in particular instances he may do so; or if a complaint were to be received, it would be his responsibility, and within the purview of the law, to ascertain whether or not the total price posted on the display of that particular commodity accurately reflected the price that would be charged the customer when the UPC symbol was "scanned" and recorded by the system."

The adoption of this policy by the NCWM prompted the Virginia Office of Weights and Measures to examine the accuracy of scanning equipment being used by the retail food industry. As the basis for authority, Virginia Code Section 3.1-949 Representations as to Price; was cited, which

states, "Whenever any commodity or service is sold, or is offered, exposed, or advertised for sale, by weight, measures or count, the price shall not be misrepresented, nor shall the price be represented in any manner tending to mislead or deceive an actual or prospective purchaser."

In the early stages of shelf/scanner inspections errors in major retail chain food stores were in excess of 10 percent in the majority of the inspections and some ranged as high as 12.5 percent. These first inspections were based on a sample of 40 items selected at random. It could be argued that these early inspections should not serve as the basis for evaluation and may have reflected personal bias. Nonetheless, these findings resulted in the Office of Weights and Measures conducting random, unannounced, verifications for accuracy of UPC scanning systems used by the retail food industry. These verifications have continued to date.

The data contained in this report indicates that the action of the Office of Weights and Measures and the responsible approach taken by the retail food industry has resulted in more accurate pricing.

Other states have addressed the accuracy of scanning systems somewhat differently than that of the Virginia Office of Weights and Measures. Since the early 1970's, eight states have adopted item pricing laws, which require that each package must display the sales price of the item.

This approach is limited in its overall effect. A recent report by the USDA Economic Research Service estimates that the removal of the item price from retail food items equates to a 0.3 percent savings. Therefore, requiring the use of item pricing only adds to the price charged to the consumer.

Errors may continue to occur even with item pricing, since the changes at both the point-of-sales system and the marking of the item price rely on human skills. Any system of pricing will only be as accurate as the information, being applied.

The actual affect of Item Pricing Laws on accuracy is not clear. The Massachusetts Law, which is one of the more strict, has been used as a model by other states adopting item pricing laws, yet during 1989 more than 300 violations of this law were cited.

Michigan's Item Pricing Law has been challenged in Builders Square vs. Michigan Department of Agriculture/ Michigan Department of Attorney General on the grounds that

it is unconstitutional. This case has advanced to the Michigan Supreme Court. Due to the uncertainty of the outcome of the pending case, the Michigan Department of Agriculture has suspended its enforcement of this law until a final ruling is given.

Virginia also considered legislation to require item pricing. The 1981 Session of the Virginia General Assembly, passed House Joint Resolution 301, which established a joint subcommittee to study item pricing. The committee had difficulty accurately measuring the cost benefit and the disadvantages/advantages to the consumer. Consequently, no legislation was offered or requested. Since that time, studies have established the amount of savings that can be expected by the use of scanners, such as the USDA report mentioned earlier. Based on this report alone, the actions of the subcommittee were bona fide then, and hold true today.

SYSTEMS

UNIVERSAL PRODUCT CODE (UPC)

The code, developed by the retail grocery industry, is now being introduced into drug and mass merchandise/discount outlets, office outfitters, department stores, marinas and home improvement centers.

The key to the UPC system is the Universal Product Code and its machine-readable symbol. This system was developed by the food industry to give every product a unique code number. This number allows simpler and more accurate product identification. The symbol makes possible the use of scanner-equipped checkstands which speed customer checkout operation, reduce item price-marking requirements, and enables the retailer to collect complete and accurate information on all aspects of sales transactions.

The Universal Product Code (UPC) is a 12-digit, all numeric code that will identify the consumer package. The code consists of a number system character, a 5-digit manufacturer identification number, a 5-digit item code number and the last digit which is used as a validation digit.

NUMBER SYSTEM CHARACTER--The first position in the 12 digit UPC code, the number system character serves to "key" the other numbers as to meaning, as well as category. There are currently seven categories of the number system character:

"0"--assigned to all items **except** as follows:
"2"--assigned to random-weight items such as meat and produce
"3"--assigned to companies which have delegated their NDC number as their UPC
"4"--assigned for retailer use only
"5"--assigned to coupons
"6 and 7"--assigned to industrial applications as well as retail applications, where they serve the same function as "0".

MANUFACTURER IDENTIFICATION NUMBER--The manufacturer number is a 5-digit number assigned by Uniform Code Council, Inc.

ITEM CODE NUMBER--The item code is a 5-digit number assigned and controlled by the member company. The item code should be unique for each consumer package and/or shipping container.

The 12-digit Universal Product Code is represented in the bars and spaces that make up the complete scanner readable symbol. The verification digit enables the scanner system to immediately verify the accurate data translation of the Universal Product Code as the symbol is scanned.

STOCK KEEPING UNIT (SKU)

The SKU code utilizes digits which are manually entered. Generally, these systems are capable of duplicating the benefits of the UPC system with the exception of incorporating scanning equipment.

PRICE LOOK UP (PLU)

PLU is a system which utilizes digits by manual entry to determine a sale price or price per unit charge. These units usually vary from location to location and may not be consistent within a company or chain of stores. Codes may utilize as little as 3 digits or may incorporate the digits of a UPC code in the system. The cashier may use a flip chart as reference or rely on memory when entering these codes which may result in errors.

DIGITAL READERS

A digital reader systems is capable of reading (scanning) digital codes in order to determine a sale price. Unlike SKU and PLU systems, the digital reader does not rely on manual entry in order to establish the total sales price.

USAGE AND APPLICATION

1. RETAIL BUSINESS CATEGORIES

For the purpose of this study, retail businesses were categorized in the following manner:

A. Clothing and Department Stores
B. Building, Hardware and Automotive Stores
C. Drug and Variety Stores
D. Retail Food Stores less than 30,000 Square Feet
E. Retail Food Stores greater than 30,000 Square Feet
F. Other, i.e., Virginia ABC Stores, Convenience Stores and Federal Commissaries.

The level of technology utilized and the actual applications sometimes varied within each of these categories; however, in general terms, each category utilized current technology in the following manner:

A. Clothing and Department Stores

For the majority of locations visited in this category, the largest application appears to be the use of digital readers. In most all cases, the digital code was accompanied by the sales price on the tag or ticket attached to the merchandise. If the system recorded an incorrect price, most often this was easily detected and immediately corrected.

According to store personnel at the 94 locations, visited in this category, the following was determined:

-- Price Changes Per Week

Low	5
High	2,500
Average	280

-- The number of electronically processed or coded items being offered for sale in retail outlets in this category varied from as few as 5,000 items to more than 40,000 items depending on the size of the business.

-- Twenty-four percent of the locations in this category established and maintained item base for pricing by manual entry at the store level. Electronic transfer by means of downloading pricing information from magnetic media to systems housed in store is being used by ten percent of the retail businesses in this category. Sixty-one percent of the businesses in this category developed their item base for pricing at a data center outside the store and implement changes by means of electronic transfer usually involving direct input to in store computers. The remaining five percent use a combination of the above methods.

-- Point-of-Sales Systems are operated usually at various locations throughout the business.

-- Seven of the ninety-four locations indicated that no formal audits for accuracy of shelf/item pricing versus item base for pricing were being conducted.

-- Of the ninety-four businesses visited, seventy-four indicated that only individual item pricing was being used.

B. Building, Hardware and Automotive Stores

This category of business, for the most part, utilizes the SKU code or similar type applications. In some applications, the SKU code was accompanied by the sales price on tag or ticket attached to the merchandise; however, this was not always the case. The price and SKU information varied among applications with the information appearing on the item, on the shelf, or on large advertisements.

According to store personnel at the 147 locations, visited in this category, the following was determined:

-- Price Changes Per Week	Low	5
	High	1,500
	Average	100

-- The number of electronically processed or coded items being offered for sale in retail outlets in this category varied from as few as 10,000 items to as many as 20,000 items depending on the size of the business.

-- Nine percent of the locations in this category established and maintained item base for pricing by manual entry at the store level. Electronic transfer by means of downloading pricing information from magnetic media to systems housed in store is being used by eight percent of the retail businesses in this category. Sixty-nine percent of the businesses in this category developed their item base for pricing at a data center outside the store and implement changes by means of electronic transfer usually involving direct input to in store computers. The remaining fourteen percent use a combination of the above methods.

-- Most Point-of-Sales Systems are operated at a single location, usually near or at the exit of the business.

-- Thirty-three of the 147 locations indicated that no formal audits for accuracy of shelf/item pricing versus item base for pricing were being conducted.

-- Of the 147 businesses visited, 16 percent indicated that only individual item pricing was being used, 43 percent used combination of item and shelf pricing, and 41 percent relied totally on shelf pricing.

C. Drug and Variety Stores

These retail operations employ the largest variety of coding systems, including in-house coding, UPC coding and SKU or number coding. Similar to other retail operations the price and price code may appear on the same tag or ticket attached to the merchandise, but in some instances, only shelf or advertised price is used in lieu of item pricing.

According to store personnel at the 301 locations, visited in this category, the following was determined:

-- Price Changes Per Week

Low	10
High	2,500
Average	270

-- The number of electronically processed or coded items being offered for sale in retail outlets in this category varied from as few as 10,000 items to as many as 40,000 items depending on the size of the business.

-- Twelve percent of the locations in this category established and maintained item base for pricing by manual entry at the store level. Electronic transfer by means of downloading pricing information from magnetic media to systems housed in store is being used by thirteen percent of the retail businesses in this category. Fifty-nine percent of the businesses in this category developed their item base for pricing at a data center outside the store and implement changes by means of electronic transfer usually involving direct input to in store computers. The remaining sixteen percent use a combination of the above methods.

-- Most Point-of-Sales Systems are operated at a single location, usually near or at the exit of the business.

-- Fifty-six of the 301 locations indicated that no formal audits for accuracy of shelf/item pricing versus item base for pricing were being conducted.

-- Of the 301 businesses visited, 37 percent indicated that only individual item pricing was being used, 49 percent used combination of item and shelf pricing, and 14 percent relied totally on shelf pricing.

D. Retail Food Stores (Less than 30,000 Square Feet)

Retail food stores in this category were made up of single unit businesses as well as national chain stores. Businesses in this group may be using scanners as their point of sales system or may be utilizing electronic cash registers.

According to store personnel at the 245 locations, visited in this category, the following was determined:

--	Price Changes Per Week	Low	15
		High	2,200
		Average	805

-- The number of electronically processed or coded items being offered for sale in retail outlets in this category varied from 10,000 items to as many as 30,000 items depending on the size of the business.

-- Thirteen percent of the locations in this category established and maintained item base for pricing by manual entry at the store level. Electronic transfer by means of downloading pricing information from magnetic media to systems housed in store is being used by fourteen percent of the retail businesses in this category. Sixty-two percent of the businesses in this category developed their item base for pricing at a data center outside the store and implement changes by means of electronic transfer usually involving direct input to in store computers. The remaining eleven percent use a combination of the above methods.

-- Most Point-of-Sales Systems are operated at a single location, usually near or at the exit of the business.

-- Eleven of the 245 locations indicated that no formal audits for accuracy of shelf/item pricing versus item base for pricing were being conducted.

-- Of the 245 businesses visited, 2 percent indicated that only individual item pricing was being used, 17 percent used combination of item and shelf pricing, and 81 percent relied totally on shelf pricing.

E. Retail Food Store (Greater than 30,000 Square Feet)

Retail food stores in this category were made up of in-state chain and national chain stores. Businesses in this group largely use scanners as their point of sales system and utilize PLU coding.

According to store personnel at the 216 locations, visited in this category, the following was determined:

-- Price Changes Per Week

Low	100
High	3,000
Average	1,056

-- The number of electronically processed or coded items being offered for sale in retail outlets in this category totaled over 40,000 items and varied depending on the size of the business.

-- Eleven percent of the locations in this category established and maintained item base for pricing by manual entry at the store level. Electronic transfer by means of downloading pricing information from magnetic media to systems housed in store is being used by sixteen percent of the retail businesses in this category. Fifty-eight percent of the businesses in this category developed their item base for pricing at a data center outside the store and implement changes by means of electronic transfer usually involving direct input to in store computers. The remaining fifteen percent use a combination of the above methods.

-- Most Point-of-Sales Systems are operated at a single location, usually near or at the exit of the business.

-- Three of the 216 locations indicated that no formal audits for accuracy of shelf/item pricing versus item base for pricing were being conducted.

-- Of the 216 businesses visited, 1 percent indicated that only individual item pricing was being used, 17 percent used combination of item and shelf pricing, and 82 percent relied totally on shelf pricing.

F. Others

This special category was developed to include retail business applications that would not be considered in the mainstream or due to their limited numbers were not grouped in any of the above categories. Included in the group are twenty visits to Virginia ABC Stores, three visits to commissaries operated on federal reservations, and four visits to convenience stores. A total of 32 businesses visited were grouped in this category.

2. DISTRIBUTION OF USE

During the period of July 1, 1990 through October 31, 1990, the Weights and Measures field staff conducted the field survey portion of this study. A total of 1,035 visits were made to various retail businesses in the state. This sample represents approximately 85-90 percent of the retail businesses utilizing scanning or coding in point-of-sales systems.

The retail food industry, being the catalyst behind point-of-sales automation and scanner development, has made the greatest strides toward uniformity within the industry and is the largest user of the current technology. Currently, 26 percent of the retail food stores operating in the Commonwealth are utilizing scanner equipment. The remainder of the retail food industry is making use of the new technology made available by less sophisticated electronic point-of-sales systems.

By use of zip codes, the following table depicts the uses of the systems by the retail industries and their location within the Commonwealth.

TABLE I, PAGE 1

DISTRIBUTION AND USE

LOCATION	CATEGORY A	B	C	D	E	F
Northern VA 22001-22399	9	30	104	45	59	4
Fredericksburg/Northern Neck 22401-22599	7	2	8	5	9	1
Winchester 22601-22699	3	3	5	8	5	
Culpeper 22701-22799	2		2			
Harrisonburg 22801-22899	6	8	6	13	3	
Charlottesville 22901-22999	3	10	10	8	6	
Richmond/ Williamsburg/Hampton 23001-23299	19	18	32	36	36	7
Tidewater/Eastern Shore 23301-23799	20	40	67	50	43	
Petersburg/Hopewell Franklin/Emporia 23801-23899	3	9	8	12	8	1
Farmville/Southside 23901-23999	1		4	5	2	
Radford/Roanoke/Martinsville 24001-24199	6	13	32	16	19	17

Category: A Clothing and Department Stores
B Building, Hardware and Automotive
C Drug and Variety Stores
D Retail Food Less than 30,000 Square Feet
E Retail Food Greater than 30,000 Square Feet
F Other

TABLE I, PAGE 2

DISTRIBUTION AND USE

LOCATION	CATEGORY A	B	C	D	E	F
Bristol/Norton 24201-24299		4	5	10	6	
Galax/Wythe/Smyth 24301-24399	1		3	5	4	1
Staunton/Lexington/ Covington 24401-24499	5	4	5	9	2	
Bedford/Lynchburg/ Danville/South Boston 24501-24599	9	6	10	19	13	1
Buchanan/Tazewell 24601-24699				4	1	
Grand Totals	94	147	301	245	216	32

Category: A Clothing and Department Stores
B Building, Hardware and Automotive
C Drug and Variety Stores
D Retail Food Less than 30,000 Square Feet
E Retail Food Greater than 30,000 Square Feet
F Other

CHAPTER IV

METHODOLOGY

Study Development

The Office of Weights and Measures contacted the National Institute of Standards and Technology in order to gather information about other states which had conducted similar activities, as directed by HJR 180. Earlier studies had only addressed the use of scanning systems by retail food stores. The scope of these earlier efforts was also limited by either the number of locations included in the study or the limited amount of data collected.

To develop and conduct a comprehensive study as requested by HJR 180, the input and cooperation of the various retail industries was needed. The Office of Weights and Measures invited individuals interested in participating in the development of the study to attend a meeting on April 24, 1990. The individuals attending this initial meeting are listed in Appendix B. As a result of this meeting, it was determined that the following issues should be addressed in the development of this study:

1. The study should address not only the use of uniform product bar codes, but also include all uses of codes in the determination of product sales prices.

2. The group agreed that all aspects of the retail industry should be included in the study.

3. Report results should be limited to findings related to a retail grouping and not the singling out of individual businesses. This was an important issue that was addressed to ensure the cooperation of retail businesses.

4. Any survey of accuracy needed to address all businesses equally and should report on the current condition of the industry.

5. The manner in which information is supplied to the point-of-sales system has a direct impact on the systems accuracy. Therefore, information concerning the methods used to update the item base for pricing was needed.

6. Identification of businesses using coding and scanners was needed in order to address all applications.

With the cooperation of the Virginia Retail Merchants Association and the Virginia Retail Food Dealers Association, the Office of Weights and Measures developed a questionnaire (Appendix C) that was submitted to the membership of the two associations in order to obtain some basic information concerning businesses operating in the Commonwealth.

The information obtained from the questionnaire and previous data gathered by the Office of Weights and Measures concerning the accuracy of scanning systems was shared with a representative of the Virginia Commonwealth University's Institute of Statistics to obtain guidance on developing an approach to the survey which would apply equally to all retail businesses.

REPORTING INSTRUMENT

The most important part of the study is the field accuracy survey. It depicts the actual use of scanning and coding systems. Therefore, the development of a reporting instrument that would fairly reflect conditions at the point-of-sale was crucial. Another major consideration was that twenty-five individuals would be collecting the information. It was important that the influence of personal bias be reduced.

The first step in the study design process was identifying the areas that would influence the accuracy of the item base for pricing which would be consistent throughout the major categories. Based on previous exposure to the retail food industry, it was determined that items delivered directly to the business by outside vendors offered a higher probability of being incorrectly priced. This was due to the vendor being responsible for the stocking of the shelf and pricing of the product. As price changes occur, information sometimes is not reflected in the item base for pricing due to a breakdown in communication between the vendor and the individual responsible for maintaining the item base for pricing.

The next largest area of concern was the items that are offered as "specials." This was an area where items were found to be misrepresented due to change in price not being reflected in the item base for pricing. These errors are the direct result of the absence of clear communication concerning price changes to the person responsible for updating either the item base for pricing or shelf prices.

In order to sample the condition of the entire location and to supply a comparison for the previously mentioned groups, a random selection of items was needed. This would be used to compare direct deliveries and items on special to determine if their rate of error was higher or lower for the individual location. Since not all locations would have the previously mentioned groups, the random selection may be the only sample.

Three other categories of lesser significance and areas that had not been examined previously included store brands, in-store coded items, and price look-up (PLU) coding. At the outset, the apparent impact, if any, these areas had on the accuracy of the item base for pricing was not clearly defined.

The next step toward developing the reporting instrument was the determination of the maximum sample for a location and its allocation to the predetermined areas of concern. Anticipating that as many as 50,000 items may be displayed at any one location, it was concluded that a sample of approximately 0.1 percent would reflect a representative selection, if proper sampling could be assured.

To assure that selective sampling was employed by all field staff, the sampling process had to be allocated to eliminate personal bias. This would not allow the inspection staff to find one area of concern, such as "items on special" and concentrate on those items when making their sample selection.

Having determined that the maximum sample to be selected at any one location would be 50 items, the sample was allocated in the following manner:

a.	Direct Delivery	10 items
b.	Items on Special	10 items
c.	Store Brands	5 items
d.	In-Store Codes	5 items
e.	Price Lookup Codes (PLU)	5 items
f.	Random Selection	15 items

Previous studies have established the likelihood of errors associated with manual dexterity at 10 percent. Therefore, to remove the errors associated with manual entry from this study, inspectors were instructed that codes were to be verified for accuracy upon entry. Items that would not scan or were incorrectly coded and manually entered were eliminated and not counted in the final tabulation.

ACCURACY SURVEY IMPLEMENTATION

By June 21, 1990, all information concerning the questionnaire and the plan for the field portion of the study was complete. The information was shared with industry representatives for final review and input. No further revisions were made and the plan was implemented immediately.

During the month of July the field portion of the study was implemented by the inspection staff of the Office of Weights and Measures. This part of the study was the most demanding on the resources of the Office of Weights and Measures. It was predetermined that in order to obtain the data necessary to formulate sound recommendations, no less than 3,000 inspection hours would have to be allotted to this project. The reporting form (Appendix D) and specific instructions were developed on the use of the reporting instrument (Appendix E) and were forwarded to the field inspection staff. A letter (Appendix F) was prepared, padded and given to the field inspection staff for distribution to the various merchants to help explain the purpose of the survey, detailing how the information was to be used and requesting their cooperation. The inspection staff also received specific instructions as to the number of hours to dedicate during each month for the time period of July 1 until October 31.

CHAPTER V

STUDY FINDINGS

The following information is the result of 3,353 inspection hours by the inspection staff of the Office of Weights and Measures and countless hours of research dedicated to finding topics related to this material.

Overall Results of Field Accuracy Survey

As a result of the field accuracy survey of the study the following information has been assembled as it relates to the five major categories of the study:

TABLE II

OVERALL FIELD RESULTS

FIVE MAJOR CATEGORIES

CATEGORY	A	B	C	D	E
Number of Visits	94	147	301	245	216
Number of Samples	2,559	4,235	10,392	10,817	10,577
Number of Errors	112	302	649	403	402
Percentage of Locations with Errors	46.81	74.83	74.09	69.98	69.91
Percentage of Errors as Compared with Total Samples	4.38	7.13	6.25	3.73	3.80

Category: A Clothing and Department Stores
B Building, Hardware and Automotive
C Drug and Variety Stores
D Retail Food Less than 30,000 Square Feet
E Retail Food Greater than 30,000 Square Feet

Other information which was collected; however, determined to be limited or inconclusive is contained in the category OTHER as in the following:

TABLE III

OVERALL FIELD RESULTS

CATEGORY-OTHER

CATEGORY	A	B	C	D	E	F
Number of Visits	1	2	3	20	2	4
Number of Samples	25	50	135	490	43	100
Number of Errors	0	3	6	12	1	11
Percentage of Locations with Errors	0	100	66	35	50	75
Percentage of Errors as Compared with Total Samples	0	6.00	4.44	2.45	2.33	11.00

Category: A Jewelry
B Beauty Supply
C Commissary
D Virginia ABC
E Club Store
F Convenience Stores

For the purpose of the remaining portion of this report, data, comparisons, and conclusions will be limited to the five major categories of the study contained in Table II.

The information contained in Table II was evaluated further in Table IV to show the number of errors in terms of overcharge (+) errors against the consumer, in favor of the retailer and errors in terms of undercharge (-) errors against the retailer, in favor of the consumer.

TABLE IV

VALUE OF ERRORS

CATEGORY	A	B	C	D	E
Number of Errors	112	302	649	403	402
Number of Plus Errors (errors against consumers)	49	140	335	193	199
Number of Minus Errors (errors against retailers)	63	162	314	210	203
Percentage of Errors Plus (errors against consumers)	43.8	46.35	51.6	47.9	49.5
Percentage of Errors Minus (errors against retailers)	56.2	53.64	48.4	52.1	50.5

Category: A Clothing and Department Stores
B Building, Hardware and Automotive
C Drug and Variety Stores
D Retail Food Less than 30,000 Square Feet
E Retail Food Greater than 30,000 Square Feet

TABLE V-PART I

REPORT OF FINDINGS BY CATEGORY
CATEGORY A CLOTHING AND DEPARTMENT STORES

CATEGORY	AA	BB	CC	DD	EE	FF
Number of Plus Errors (errors against the consumer)	1	30	5	0	0	13
Number of Minus Errors (errors against the retailer)	0	24	7	1	0	31
Dollar Value of Plus Errors (+)	0.01	420.22	17.53	0	0	40.28
Dollar Value of Minus Errors (-)	0	168.58	30.90	0.98	0	258.67
Average Plus (+) Error (Dollar)	n/a	14.01	3.51	n/a	n/a	3.10
Average Minus (-) Error (Dollar)	n/a	7.02	4.41	n/a	n/a	8.34
Maximum Plus Error	0.01	45.01	7.50	n/a	n/a	12.01
Maximum Minus Error	n/a	100.00	10.09	0.98	n/a	92.50

	NUMBER	PERCENTAGE
Visits	94	
Locations Revealing Errors	44	46.81
Locations Having Errors in Excess of 2%	43	97.73
Total Number of Samples	2,559	
Total Number of Errors Recorded	112	4.38
Overall Percentage of Plus Errors		1.92
Overall Percentage of Minus Errors		2.46

Category: AA Direct Delivery
BB Items on Special
CC Store Brands
DD In-Store Coding
EE PLU Codes
FF Random Selection

TABLE V-PART II

REPORT OF FINDINGS BY CATEGORY
CATEGORY B BUILDING, HARDWARE AND AUTOMOTIVE

CATEGORY	AA	BB	CC	DD	EE	FF
Number of Plus Errors (errors against the consumer)	2	57	12	2	0	67
Number of Minus Errors (errors against the retailer)	6	24	30	2	1	99
Dollar Value of Plus Errors (+)	0.46	489.56	10.23	1.83	0	96.86
Dollar Value of Minus Errors (-)	9.60	211.94	127.97	0.56	0.08	661.95
Average Plus (+) Error (Dollar)	0.23	8.59	0.85	0.92	0	1.45
Average Minus (-) Error (Dollar)	1.60	8.83	4.27	0.28	0.08	6.69
Maximum Plus Error	0.40	99.00	5.00	1.30	0	9.00
Maximum Minus Error	6.00	100.00	40.71	0.46	0.08	138.00

	NUMBER	PERCENTAGE
Visits	147	
Locations Revealing Errors	110	74.83
Locations Having Errors in Excess of 2%	110	100.00
Total Number of Samples	4,235	
Total Number of Errors Recorded	302	7.13
Overall Percentage of Plus Errors		3.30
Overall Percentage of Minus Errors		3.83

Category: AA Direct Delivery
BB Items on Special
CC Store Brands
DD In-Store Coding
EE PLU Codes
FF Random Selection

TABLE V-PART III

REPORT OF FINDINGS BY CATEGORY
CATEGORY C DRUG AND VARIETY STORES

CATEGORY	AA	BB	CC	DD	EE	FF
Number of Plus Errors (errors against the consumer)	80	128	21	1	1	104
Number of Minus Errors (errors against the retailer)	108	67	17	0	0	122
Dollar Value of Plus Errors (+)	27.76	153.85	6.72	7.00	0.10	69.38
Dollar Value of Minus Errors (-)	25.52	76.82	17.09	0	0	188.91
Average Plus (+) Error (Dollar)	0.35	1.20	0.32	n/a	n/a	0.67
Average Minus (-) Error (Dollar)	0.24	1.15	1.01	n/a	n/a	1.55
Maximum Plus Error	4.04	19.99	1.10	7.00	0.10	5.00
Maximum Minus Error	1.37	8.00	2.40	0	0	20.00

	NUMBER	PERCENTAGE
Visits	301	
Locations Revealing Errors	223	74.09
Locations Having Errors in Excess of 2%	219	98.21
Total Number of Samples	10,392	
Total Number of Errors Recorded	649	6.25
Overall Percentage of Plus Errors		3.22
Overall Percentage of Minus Errors		3.03

Category: AA Direct Delivery
BB Items on Special
CC Store Brands
DD In-Store Coding
EE PLU Codes
FF Random Selection

TABLE V-PART IV

REPORT OF FINDINGS BY CATEGORY
CATEGORY D RETAIL FOOD STORES OF LESS THAN 30,000 SQ. FEET

CATEGORY	AA	BB	CC	DD	EE	FF
Number of Plus Errors (errors against the consumer)	59	47	10	3	17	57
Number of Minus Errors (errors against the retailer)	64	32	13	5	26	70
Dollar Value of Plus Errors (+)	13.59	15.23	2.76	2.68	4.66	13.28
Dollar Value of Minus Errors (-)	17.59	9.01	3.59	2.82	8.61	20.75
Average Plus (+) Error (Dollar)	0.23	0.32	0.28	0.89	0.27	0.23
Average Minus (-) Error (Dollar)	0.28	0.28	0.28	0.56	0.51	0.30
Maximum Plus Error	1.00	1.99	1.20	2.38	1.60	1.50
Maximum Minus Error	2.00	1.80	1.28	1.16	1.06	3.00

	NUMBER	PERCENTAGE
Visits	245	
Locations Revealing Errors	169	68.98
Locations Having Errors in Excess of 2%	117	69.23
Total Number of Samples	10,817	
Total Number of Errors Recorded	403	3.73
Overall Percentage of Plus Errors		1.78
Overall Percentage of Minus Errors		1.95

Category: AA Direct Delivery
BB Items on Special
CC Store Brands
DD In-Store Coding
EE PLU Codes
FF Random Selection

TABLE V-PART V

REPORT OF FINDINGS BY CATEGORY
CATEGORY E RETAIL FOOD STORES OF GREATER THAN 30,000 SQ. FEET

CATEGORY	AA	BB	CC	DD	EE	FF
Number of Plus Errors (errors against the consumer)	44	54	14	0	28	59
Number of Minus Errors (errors against the retailer)	61	23	17	7	34	61
Dollar Value of Plus Errors (+)	12.65	19.95	4.36	0	9.92	16.99
Dollar Value of Minus Errors (-)	19.83	8.87	4.10	1.86	16.90	23.06
Average Plus (+) Error (Dollar)	0.29	0.37	0.31	0	0.35	0.29
Average Minus (-) Error (Dollar)	0.33	0.39	0.24	0.27	0.50	0.38
Maximum Plus Error	2.70	1.80	1.10	0	1.70	3.24
Maximum Minus Error	1.30	2.00	0.60	0.60	3.20	2.00

	NUMBER	PERCENTAGE
Visits	216	
Locations Revealing Errors	151	69.91
Locations Having Errors in Excess of 2%	113	74.83
Total Number of Samples	10,577	
Total Number of Errors Recorded	402	3.80
Overall Percentage of Plus Errors		1.88
Overall Percentage of Minus Errors		1.92

Category: AA Direct Delivery
BB Items on Special
CC Store Brands
DD In-Store Coding
EE PLU Codes
FF Random Selection

STATISTICAL ANALYSIS

In Table 1, overall summary statistics are given for some general descriptive variables of interest. No hypothesis testing was done on these variables, but they are presented here to show the amount of data collected and the extent of the scanning project. In order to fully understand and describe the distribution of sample errors, it will be helpful to focus on the sample mean. This represents the center of the data set about which the error measurements are distributed. For the error variables, a mean value equal to zero would indicate that on average the difference between the scanned price and the purchased price was zero; a negative error would indicate an error against the retailer, while a positive error would indicate an error against the consumer.

The first hypothesis that was tested was whether the mean errors were significantly different from zero error for each of the six error variables within each of the five store types. A paired t-test technique was used, but in cases where the number of errors found were not sufficiently large, no statistical tests were carried out. Table 2 shows the descriptive statistics on all the variables, along with the p-values from the paired analyses. Figures 1-5 graphically present the means of the error variables, with significant results from the paired analyses marked with asterisks. Errors were considered statistically significant at p-values < 0.05. Using the items on special as an example, the mean errors ($\pm$ the standard deviation) for Drug/Variety stores (0.393 ± 2.25) and Retail Food stores exceeding 30,000 sq. ft. (0.144 ± 0.54) were significantly different from a mean error of zero ($p=.016$ and $p=.021$, respectively). On the other hand, the mean errors for Hardware/Building supplies (3.43 ± 19.94), Retail Food stores less than 30,000 sq. ft. (0.08 ± 0.45), and Retail/Clothing stores (2.99 ± 17.77) were not ($p=.13$, $p=.13$, and $p=.22$, respectively).

For the remainder of the analyses, two types of errors were segregated and examined, errors against the consumer (positive errors) and errors against the retailer (negative errors). As with the first hypothesis above, the magnitude of the errors were tested, but here it was done for each type of error. Since the direction of the error was no longer important once the classification was made, tests were done and statistics were reported in terms of the absolute values of the errors. Tables 3-8 show the

descriptive statistics on the error variables for each direction of error, along with the resultant p-values from the paired analyses. Using the items on special again as an example, the mean error against the consumer for Retail/Clothing stores (11.01 ± 10.03) was significantly different from a mean error of zero at $p=0.0001$; yet the mean error against the retailer of 7.02 ± 20.31 was not ($p=0.104$).

Following this, the hypothesis that the mean absolute error against the retailer was not significantly different from the mean absolute error against the consumer, was evaluated. The resultant p-values from these two-sample t-test analyses can be seen in Tables 3-8 under the column "2-SAMPLE P-VALUES." Figures 6-10 further illustrate these comparisons for each error variable across the store types, where applicable. Again, differences were considered statistically significant at p-values < 0.05 and are marked with asterisks on the graphs when this occurred. For example, for store brands (Figure 8) in Drug/Variety stores, the mean error against the retailer (1.005 ± 0.88) was significantly greater ($p=.0061$) than the mean error against the consumer (0.32 ± 0.29).

In addition to measuring and testing the centers of each of the data sets (i.e., the sample means), the extent of variation of errors about the mean were composed, using the sample variances from the data sets, where the variance is the square of the standard deviation. Tables 3-8 also present the results of F-tests used for testing the hypothesis that the variability in the errors against the consumer was not different from the variability in the errors against the retailer. A difference in variability was considered significant if $p < 0.05$. For example, for direct deliveries in Drug and Variety stores, the variability in the errors against the retailer was significantly less than the variability in the errors against the consumer (variances = 0.053 and 0.243, respectively, with $p=0.0001$).

Another approach to the statistical analysis compared the percentages of errors against retailers and consumers, while disregarding the actual magnitudes of the errors themselves. Tables 9-14 present both the frequencies and percent of errors against retailers and consumers for each of the store types, separated by the error variables. In Figures 11-15, the height of the bards represent the percentages and the asterisks show when the differences were

significant for $p < 0.05$. The hypothesis tested, then, was that the percentage of errors found against retailers was not different from the percentage of errors found against consumers. From Table 10 and Figure 12, for example, it can be seen that for items on special, more than 55% of the errors occurred against the consumer across all store types. Furthermore, for 3 of these (Drug & Variety, Hardware & Building supplies, and Retail Food stores exceeding 30,000 sqft.) the percentages were significantly greater than those occurring against the retailer. On the other hand, for random selections (Table 14, Figure 15), more than 50% of the errors were found against retailers across all store types, while for 2 of these (Hardware and Clothing stores) the percentages were significantly greater than those found against consumers.

The final hypothesis involved testing between certain error variables in order to determine, in particular, how close sampling from direct deliveries and items on special mirrored sampling via random selection. Table 15 shows the descriptive statistics for direct deliveries and random selection, along with the resultant p-values from the 2-sample t-tests. It is clear from this that only the Drug & Variety stores showed any significant difference ($p=0.0007$), with a mean error of 0.012 for direct deliveries and a mean error of -0.529 for random selection. After testing for differences in the mean error between items on special and random selections, it was found that items on special had a significantly larger mean error than that from random selection across all store types (Table 16).

TABLE 1

OVERALL SUMMARY STATISTICS

Store Type	Visits	Locations W/ errors	Percent W/ errors	Total Sample	Total Errors	Error Rate
Drug/Variety	301	223	74.09	10,392	649	6.25
Building/Hardware Automotive	147	110	74.83	4,235	302	7.13
Food > 30,000 sqft.	216	151	69.91	10,577	402	3.80
Food < 30,000 sqft.	245	169	68.98	10,817	403	3.73
Retail/Clothing	94	44	46.81	2,559	112	4.38

TABLE 2
Descriptive statistics and paired t-test results

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE	P VALUES
TYPE=DRUG/VARIETY						
DIRECT DELIVERIES	188	0.012	0.465	-1.370	4.040	0.7235
ITEMS ON SPECIAL	195	0.393	2.254	-8.000	19.990	0.0159
STORE BRANDS	38	-0.273	0.908	-2.400	1.100	0.0720
IN-STORE CODING	1	7.000	.	7.000	7.000	.
PLU CODES	1	0.100	.	0.100	0.100	.
RANDOM SELECTION	226	-0.529	2.317	-20.000	5.000	0.0007
TYPE=HDWARE/BUILDING						
DIRECT DELIVERIES	8	-1.143	2.079	-6.000	0.400	0.1641
ITEMS ON SPECIAL	81	3.427	19.937	-100.000	99.000	0.1258
STORE BRANDS	42	-2.803	7.199	-40.710	5.000	0.0156
IN-STORE CODING	4	0.318	0.772	-0.460	1.300	0.4712
PLU CODES	1	-0.080	.	-0.080	-0.080	.
RANDOM SELECTION	166	-3.525	12.936	-138.000	9.000	0.0006
TYPE=FOOD > 30,000 sqft						
DIRECT DELIVERIES	105	-0.068	0.468	-1.300	2.700	0.1375
ITEMS ON SPECIAL	77	0.144	0.535	-2.000	1.800	0.0209
STORE BRANDS	31	0.008	0.369	-0.600	1.100	0.9002
IN-STORE CODING	7	-0.266	0.190	-0.600	-0.100	0.0102
PLU CODES	62	-0.113	0.729	-3.200	1.700	0.2289
RANDOM SELECTION	120	-0.050	0.554	-2.000	3.240	0.3243
TYPE=FOOD < 30,000 sqft						
DIRECT DELIVERIES	123	-0.033	0.370	-2.000	1.000	0.3319
ITEMS ON SPECIAL	79	0.079	0.454	-1.800	1.990	0.1276
STORE BRANDS	23	-0.036	0.481	-1.280	1.200	0.7225
IN-STORE CODING	8	-0.017	1.059	-1.160	2.380	0.9640
PLU CODES	43	-0.092	0.435	-1.060	1.600	0.1738
RANDOM SELECTION	127	-0.059	0.431	-3.000	1.500	0.1268
TYPE=RETAIL/CLOTHING						
DIRECT DELIVERIES	1	0.010	.	0.010	0.010	.
ITEMS ON SPECIAL	54	2.993	17.773	-100.000	45.010	0.2213
STORE BRANDS	12	-1.114	4.967	-10.090	7.500	0.4535
IN-STORE CODING	1	-0.980	.	-0.980	-0.980	.
PLU CODES	0	.	.	.	.	.
RANDOM SELECTION	44	-4.963	15.095	-92.500	12.010	0.0347

TABLE 3
Showing statistics on absolute errors against retailer and consumer
and results of paired, 2-sample, and variance testing

for DIRECT DELIVERIES

	N	MEAN	STD DEV	MINIMUM	MAXIMUM	PAIRED P-VALUES	2-SAMPLE P-VALUES	F-TEST P-VALUES
TYPE=DRUG/VARIETY								
CONSUMER	80	0.34700000	0.49296417	0.01000000	4.04000000	0.0001	0.0647	0.0001
RETAILER	108	0.23611111	0.22991194	0.01000000	1.37000000	0.0001		
TYPE=HDWARE/BUILDING								
CONSUMER	2	0.23000000	0.24041631	0.06000000	0.40000000	0.40	0.44	0.16
RETAILER	6	1.60000000	2.24410338	0.10000000	6.00000000	0.14		
TYPE=FOOD > 30,000 sqft								
CONSUMER	44	0.28750000	0.41584951	0.01000000	2.70000000	0.0001	0.61	0.036
RETAILER	61	0.32508197	0.31008398	0.02000000	1.30000000	0.0001		
TYPE=FOOD < 30,000 sqft								
CONSUMER	59	0.23033898	0.21389625	0.01000000	1.00000000	0.0001	0.36	0.003
RETAILER	64	0.27484375	0.31455684	0.01000000	2.00000000	0.0001		

TABLE 4
Showing statistics on absolute errors against retailer and consumer
and results of paired, 2-sample, and variance testing

for ITEMS ON SPECIAL

	N	MEAN	STD DEV	MINIMUM	MAXIMUM	PAIRED P-VALUES	2-SAMPLE P-VALUES	F-TEST P-VALUES
TYPE=DRUG/VARIETY								
CONSUMER	128	1.20195313	2.15146866	0.02000000	19.99000000	0.0001	0.8569	0.0024
RETAILER	67	1.15388060	1.52452472	0.01000000	8.00000000	0.0001		
TYPE=HDWARE/BUILDING								
CONSUMER	57	8.58877193	17.06054545	0.03000000	99.00000000	0.0004	0.9608	0.18
RETAILER	24	8.83083333	21.23922027	0.01000000	100.00000000	0.053		
TYPE=FOOD > 30,000 sqft								
CONSUMER	54	0.36907407	0.35898846	0.04000000	1.80000000	0.0001	0.8880	0.04
RETAILER	23	0.38565217	0.50886528	0.01000000	2.00000000	0.0015		
TYPE=FOOD < 30,000 sqft								
CONSUMER	47	0.32404255	0.34795464	0.02000000	1.99000000	0.0001	0.5901	0.89
RETAILER	32	0.28156250	0.33867969	0.04000000	1.80000000	0.0001		
TYPE=RETAIL/CLOTHING								
CONSUMER	30	11.00733333	10.02823082	1.00000000	45.01000000	0.0001	0.3861	0.0004
RETAILER	24	7.02416667	20.31328092	0.02000000	100.00000000	0.104		

TABLE 5
Showing statistics on absolute errors against retailer and consumer
and results of paired, 2-sample, and variance testing

for STORE BRANDS

	N	MEAN	STD DEV	MINIMUM	MAXIMUM	PAIRED P-VALUES	2-SAMPLE P-VALUES	F-TEST P-VALUES
TYPE=DRUG/VARIETY								
CONSUMER	21	0.32000000	0.29298464	0.03000000	1.10000000	0.0001	0.0061	0.0001
RETAILER	17	1.00529412	0.87665642	0.10000000	2.40000000	0.0002		
TYPE=HDWARE/BUILDING								
CONSUMER	12	0.85250000	1.41671274	0.08000000	5.00000000	0.06	0.0321	0.0001
RETAILER	30	4.26566667	8.04787215	0.10000000	40.71000000	0.007		
TYPE=FOOD > 30,000 sqft								
CONSUMER	13	0.33538462	0.31455300	0.10000000	1.10000000	0.0023	0.2793	0.025
RETAILER	18	0.22777778	0.17339365	0.02000000	0.60000000	0.0001		
TYPE=FOOD < 30,000 sqft								
CONSUMER	10	0.27600000	0.43884191	0.01000000	1.20000000	0.08	0.9993	0.57
RETAILER	13	0.27615385	0.36908758	0.02000000	1.28000000	0.019		
TYPE=RETAIL/CLOTHING								
CONSUMER	5	3.50600000	2.68564331	1.03000000	7.50000000	0.043	0.6036	0.79
RETAILER	7	4.41428571	3.15179767	0.01000000	10.09000000	0.010		

TABLE 6
Showing statistics on absolute errors against retailer and consumer
and results of paired, 2-sample, and variance testing

for IN-STORE CODING

	N	MEAN	STD DEV	MINIMUM	MAXIMUM	PAIRED P-VALUES	2-SAMPLE P-VALUES	F-TEST P-VALUES
TYPE=HDWARE/BUILDING								
CONSUMER	2	0.91500000	0.54447222	0.53000000	1.30000000			
RETAILER	2	0.28000000	0.25455844	0.10000000	0.46000000			
TYPE=FOOD < 30,000 sqft								
CONSUMER	3	0.89333333	1.28846162	0.10000000	2.38000000			
RETAILER	5	0.56400000	0.37138928	0.21000000	1.16000000			

TABLE 7

for PLU CODES

	N	MEAN	STD DEV	MINIMUM	MAXIMUM	PAIRED P-VALUES	2-SAMPLE P-VALUES	F-TEST P-VALUES
TYPE=FOOD > 30,000 sqft								
CONSUMER	28	0.35428571	0.45519575	0.06000000	1.70000000	0.0003	0.3334	0.03
RETAILER	34	0.49705882	0.69033821	0.01000000	3.20000000	0.0002		
TYPE=FOOD < 30,000 sqft								
CONSUMER	17	0.27411765	0.37301238	0.06000000	1.60000000	0.008	0.5945	0.20
RETAILER	26	0.33115385	0.28071804	0.10000000	1.06000000	0.0001		

TABLE 7:
Showing statistics on absolute errors against retailer and consumer
and results of paired, 2-sample, and variance testing

for RANDOM SELECTIONS

	N	MEAN	STD DEV	MINIMUM	MAXIMUM	PAIRED P-VALUES	2-SAMPLE P-VALUES	F-TEST P-VALUES
TYPE=DRUG/VARIETY								
CONSUMER	104	0.66644231	0.82269734	0.01000000	5.00000000	0.0001	0.0007	0.0001
RETAILER	122	1.54844262	2.67095737	0.03000000	20.00000000	0.0001		
TYPE=HDWARE/BUILDING								
CONSUMER	67	1.14731343	1.78287866	0.09000000	9.00000000	0.0001	0.0009	0.0001
RETAILER	99	6.68636364	15.95523498	0.06000000	138.00000000	0.0001		
TYPE=FOOD > 30,000 sqft								
CONSUMER	59	0.28898305	0.47516493	0.02000000	3.24000000	0.0001	0.2751	0.27
RETAILER	61	0.37803279	0.41089666	0.04000000	2.00000000	0.0001		
TYPE=FOOD < 30,000 sqft								
CONSUMER	57	0.23298246	0.22909734	0.04000000	1.50000000	0.0001	0.2747	0.0001
RETAILER	70	0.29642857	0.41154018	0.01000000	3.00000000	0.0001		
TYPE=RETAIL/CLOTHING								
CONSUMER	13	3.09846154	3.28946259	0.05000000	12.01000000	0.005	0.1051	0.0001
RETAILER	31	8.34419355	16.80212204	0.01000000	92.50000000	0.01		

TABLE 8
Showing frequencies and percent of errors against retailers and consumers

TYPE	Errors for Direct Deliveries		
FREQUENCY ROW PCT	RETAILER	CONSUMER	TOTAL
DRUG/VARIETY	108 57.45	80 42.55	188
HDWARE/BUILDING	6 75.00	2 25.00	8
FOOD > 30,000 sq	61 58.10	44 41.90	105
FOOD < 30,000 sq	64 52.03	59 47.97	123
RETAIL/CLOTHING	0 0.00	1 100.00	1
TOTAL	239	186	425

TABLE 9
Showing frequencies and percent of errors against retailers and consumers

TYPE	Errors for Items on Special		
FREQUENCY ROW PCT	RETAILER	CONSUMER	TOTAL
DRUG/VARIETY	67 34.36	128 65.64	195
HDWARE/BUILDING	24 29.63	57 70.37	81
FOOD > 30,000 sq	23 29.87	54 70.13	77
FOOD < 30,000 sq	32 40.51	47 59.49	79
RETAIL/CLOTHING	24 44.44	30 55.56	54
TOTAL	170	316	486

TABLE 10
Showing frequencies and percent of errors against retailers and consumers

TYPE	Errors for Store Brands		
FREQUENCY ROW PCT	RETAILER	CONSUMER	TOTAL
DRUG/VARIETY	17 44.74	21 55.26	38
HDWARE/BUILDING	30 71.43	12 28.57	42
FOOD > 30,000 sq	18 58.06	13 41.94	31
FOOD < 30,000 sq	13 56.52	10 43.48	23
RETAIL/CLOTHING	7 58.33	5 41.67	12
TOTAL	85	61	146

TABLE 11
Showing frequencies and percent of errors against retailers and consumers

TYPE	Errors for In-store Coding		
FREQUENCY ROW PCT	RETAILER	CONSUMER	TOTAL
DRUG/VARIETY	0 0.00	1 100.00	1
HDWARE/BUILDING	2 50.00	2 50.00	4
FOOD > 30,000 sq	7 100.00	0 0.00	7
FOOD < 30,000 sq	5 62.50	3 37.50	8
RETAIL/CLOTHING	1 100.00	0 0.00	1
TOTAL	15	6	21

TABLE 12
Showing frequencies and percent of errors against retailers and consumers

TYPE	Errors for PLU Codes		
FREQUENCY ROW PCT	RETAILER	CONSUMER	TOTAL
DRUG/VARIETY	0 0.00	1 100.00	1
HDWARE/BUILDING	1 100.00	0 0.00	1
FOOD > 30,000 sq	34 54.84	28 45.16	62
FOOD < 30,000 sq	26 60.47	17 39.53	43
RETAIL/CLOTHING	0 .	0 .	0
TOTAL	61	46	107

TABLE 13
Showing frequencies and percent of errors against retailers and consumers

TYPE	Errors for Random Selections		
FREQUENCY ROW PCT	RETAILER	CONSUMER	TOTAL
DRUG/VARIETY	122 53.98	104 46.02	226
HDWARE/BUILDING	99 59.64	67 40.36	166
FOOD > 30,000 sq	61 50.83	59 49.17	120
FOOD < 30,000 sq	70 55.12	57 44.88	127
RETAIL/CLOTHING	31 70.45	13 29.55	44
TOTAL	383	300	683

TABLE 14
Testing mean errors for Direct Deliveries vs. Random Selections

	N	MEAN	STD DEV	MINIMUM	MAXIMUM	2-SAMPLE P-VALUES	
TYPE=DRUG/VARIETY							
DIRECT	188	0.01202128	0.46526643	-1.37000000	4.04000000	0.0007	*
RANDOM	226	-0.52920354	2.31741605	-20.00000000	5.00000000		
TYPE=HDWARE/BUILDING							
DIRECT	8	-1.14250000	2.07918768	-6.00000000	0.40000000	0.0613	
RANDOM	166	-3.52457831	12.93566288	-138.00000000	9.00000000		
TYPE=FOOD > 30,000 sqft							
DIRECT	105	-0.06838095	0.46819441	-1.30000000	2.70000000	0.7887	
RANDOM	120	-0.05008333	0.55434949	-2.00000000	3.24000000		
TYPE=FOOD < 30,000 sqft							
DIRECT	123	-0.03252033	0.37022278	-2.00000000	1.00000000	0.6050	
RANDOM	127	-0.05881890	0.43123045	-3.00000000	1.50000000		
TYPE=RETAIL/CLOTHING							
DIRECT	1	0.01000000	.	0.01000000	0.01000000		
RANDOM	44	-4.96340909	15.09537553	-92.50000000	12.01000000		

TABLE 15
Testing mean errors for Items on Special vs. Random Selections

	N	MEAN	STD DEV	MINIMUM	MAXIMUM	2-SAMPLE P-VALUES	
TYPE=DRUG/VARIETY							
RANDOM	226	-0.52920354	2.31741605	-20.00000000	5.00000000	0.0001	*
SPECIALS	195	0.39251282	2.25367909	-8.00000000	19.99000000		
TYPE=HDWARE/BUILDING							
RANDOM	166	-3.52457831	12.93566288	-138.00000000	9.00000000	0.0051	*
SPECIALS	81	3.42740741	19.93730672	-100.00000000	99.00000000		
TYPE=FOOD > 30,000 sqft							
RANDOM	120	-0.05008333	0.55434949	-2.00000000	3.24000000	0.016	*
SPECIALS	77	0.14363636	0.53452859	-2.00000000	1.80000000		
TYPE=FOOD < 30,000 sqft							
RANDOM	127	-0.05881890	0.43123045	-3.00000000	1.50000000	0.030	*
SPECIALS	79	0.07873418	0.45442939	-1.80000000	1.99000000		
TYPE=RETAIL/CLOTHING							
RANDOM	44	-4.96340909	15.09537553	-92.50000000	12.01000000	0.021	*
SPECIALS	54	2.99333333	17.77320752	-100.00000000	45.01000000		

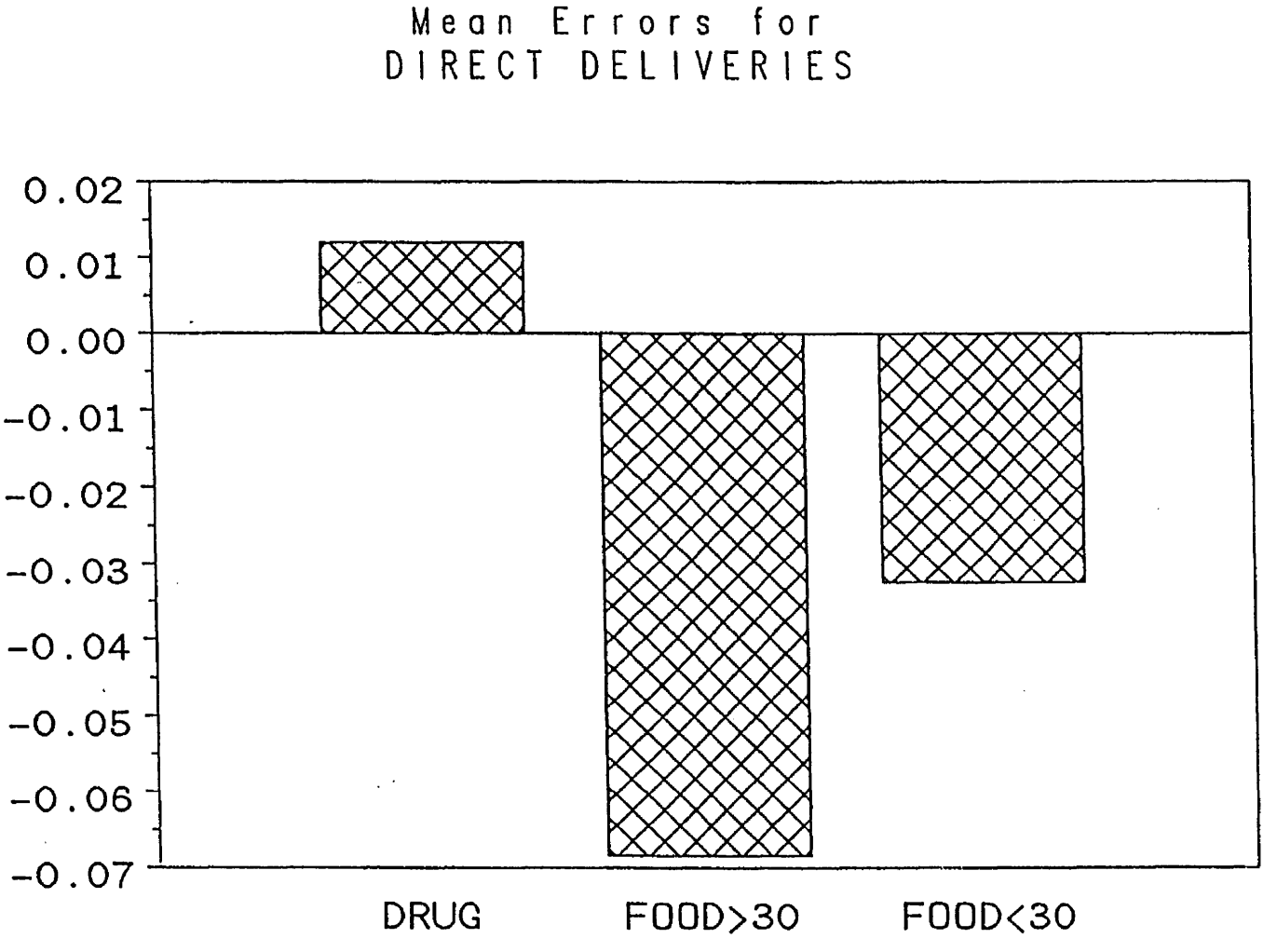
Mean Errors for
DIRECT DELIVERIES
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
DRUG
FOOD>30
FOOD<30

FIGURE 1

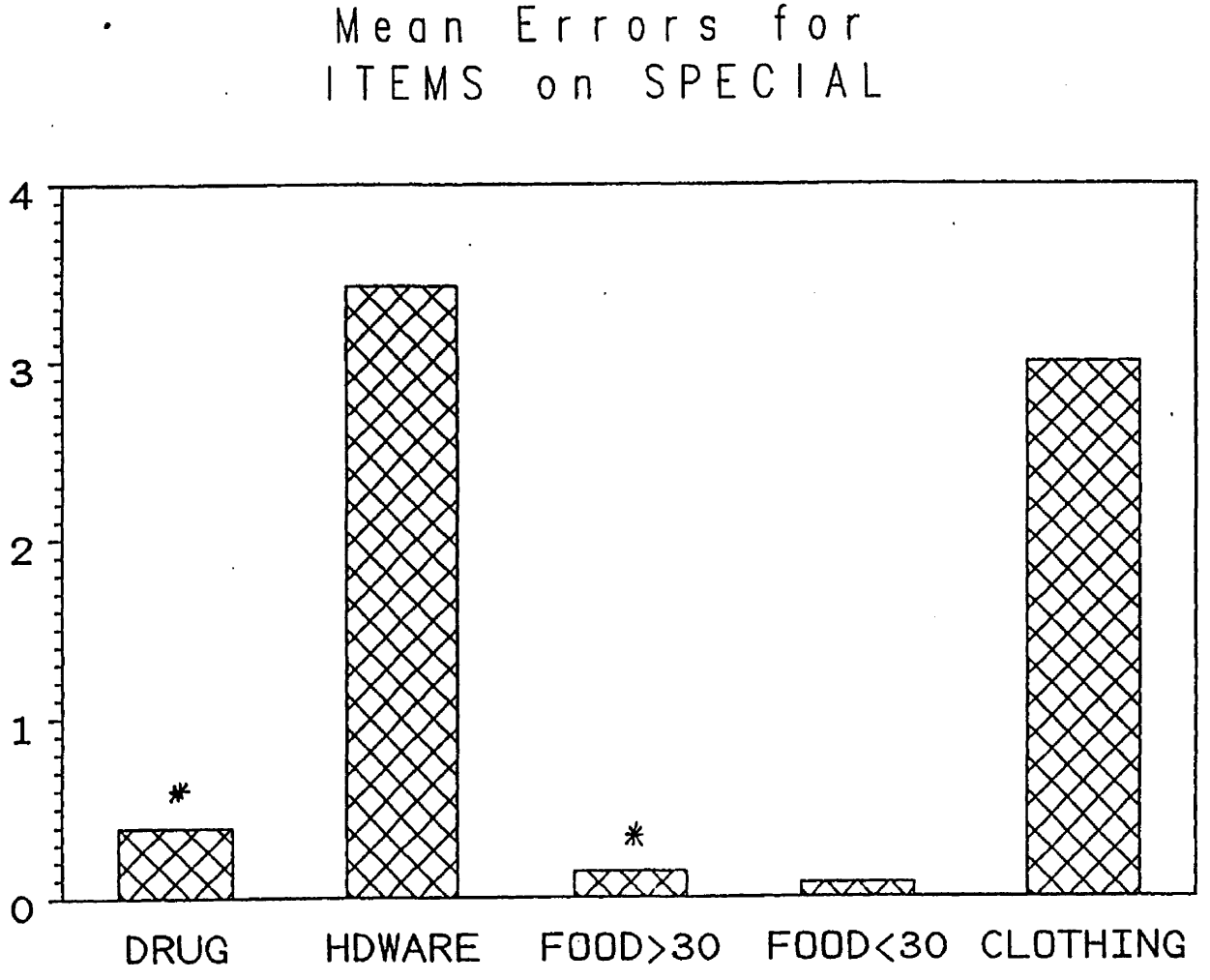
Mean Errors for
ITEMS on SPECIAL
4
3
2
1
0
*
*
DRUG
HDWARE
FOOD>30
FOOD<30
CLOTHING

FIGURE 2

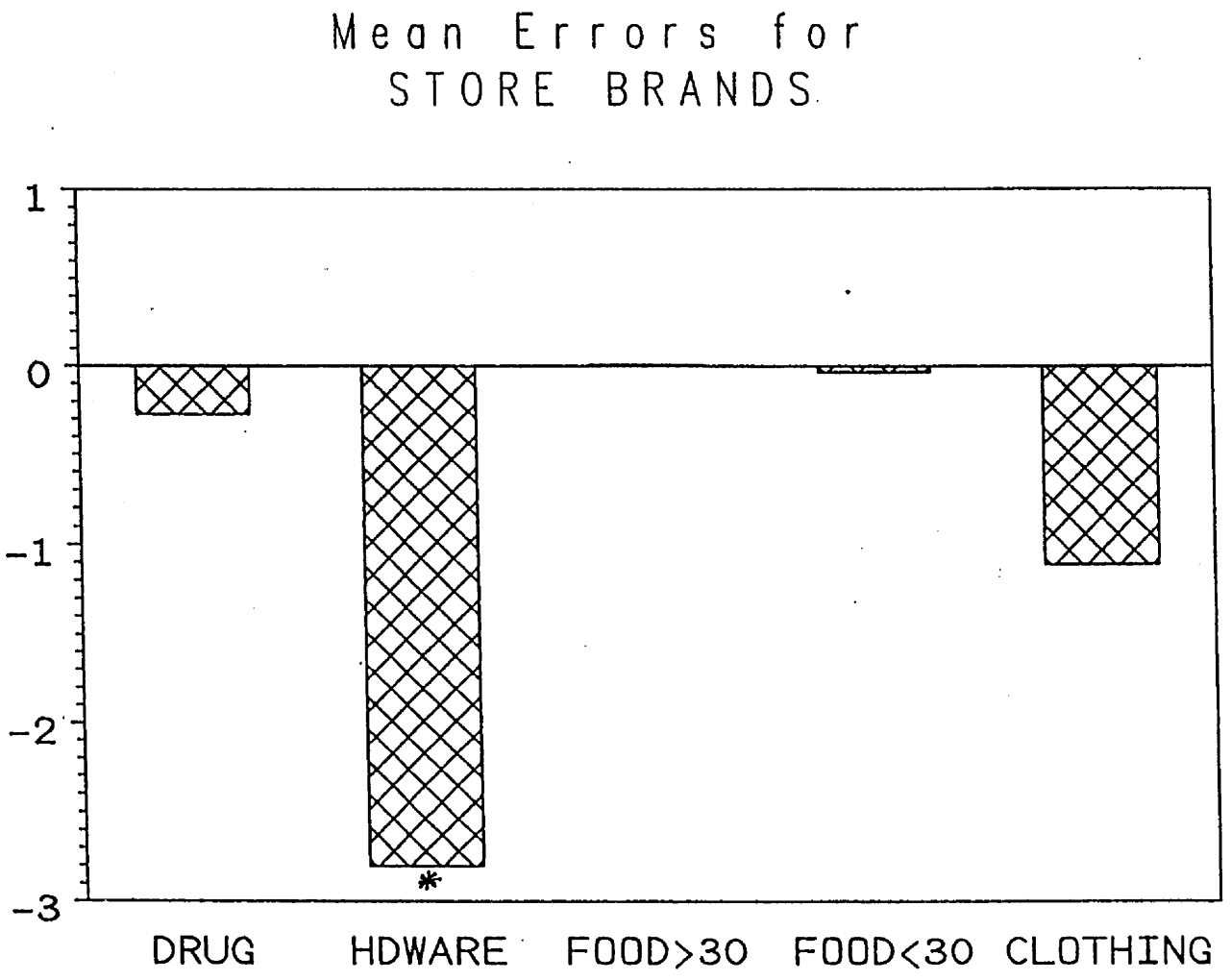
Mean Errors for
STORE BRANDS
1
0
-1
-2
-3
*
DRUG
HDWARE
FOOD>30
FOOD<30
CLOTHING

FIGURE 3

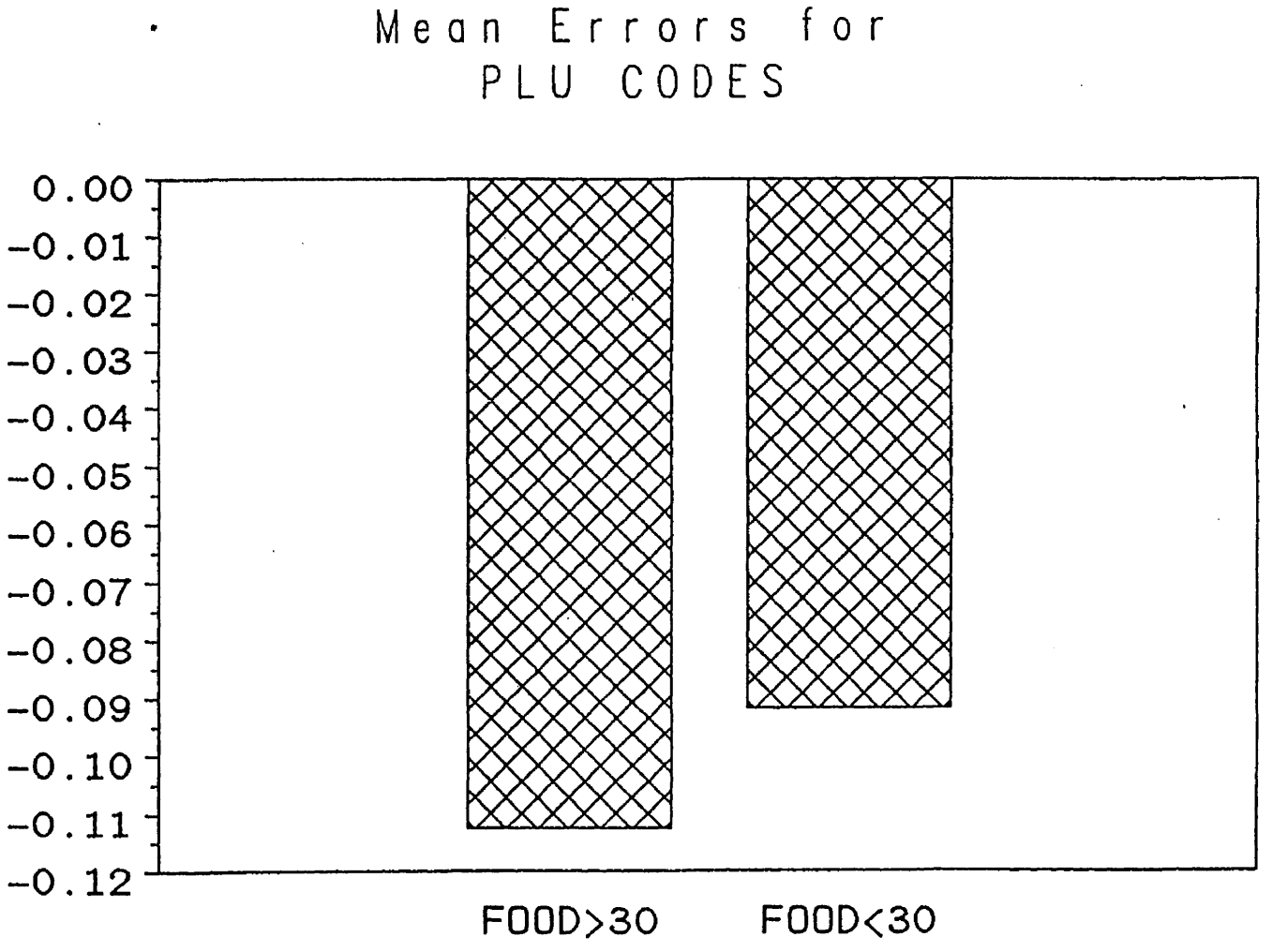
Mean Errors for
PLU CODES
0.00
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
-0.08
-0.09
-0.10
-0.11
-0.12
FOOD>30
FOOD<30

FIGURE 4

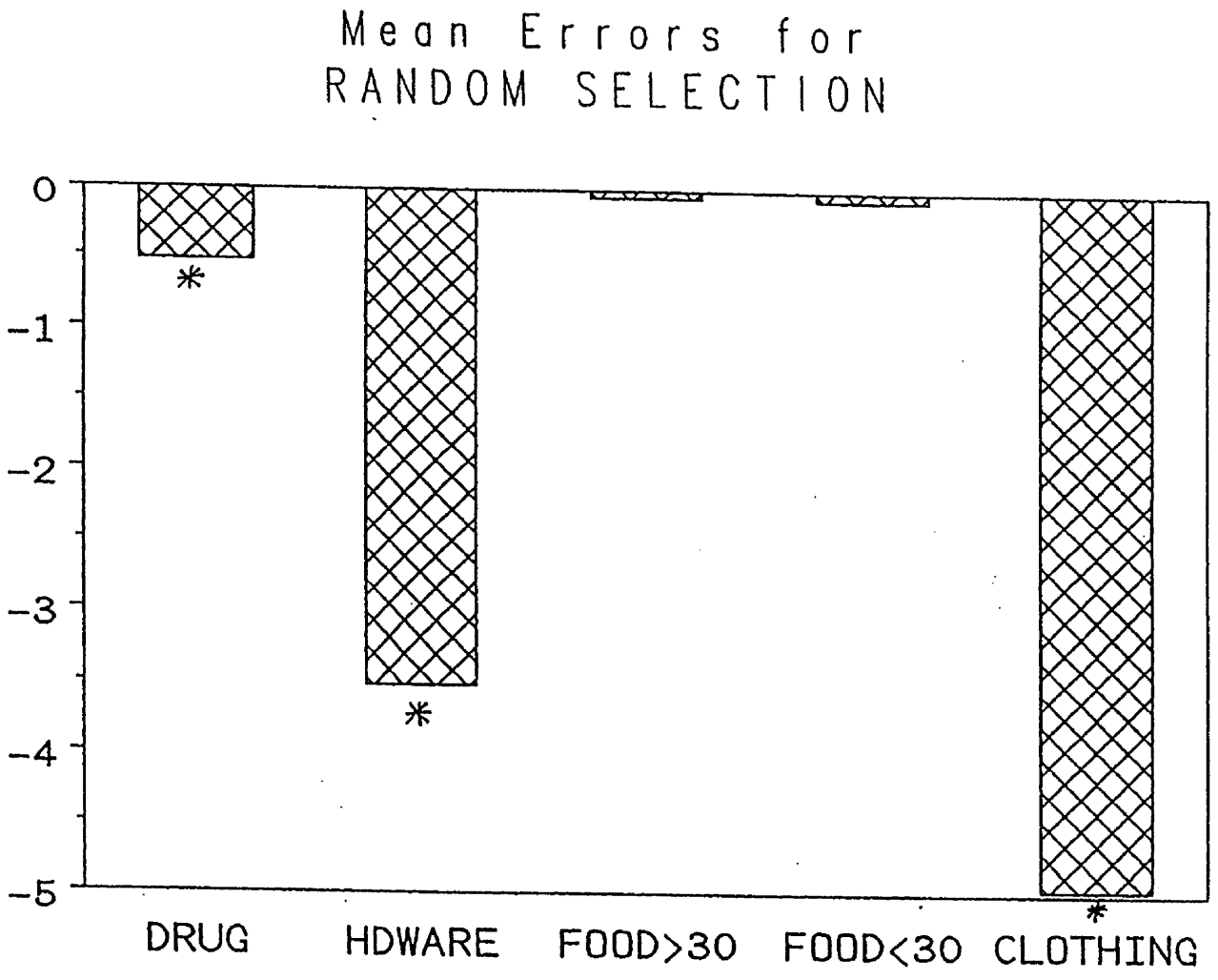
Mean Errors for
RANDOM SELECTION
0
-1
-2
-3
-4
-5
*
*
*
DRUG
HDWARE
FOOD>30
FOOD<30
CLOTHING

FIGURE 5

Mean Absolute Errors Against Retailer and Consumer for DIRECT DELIVERIES

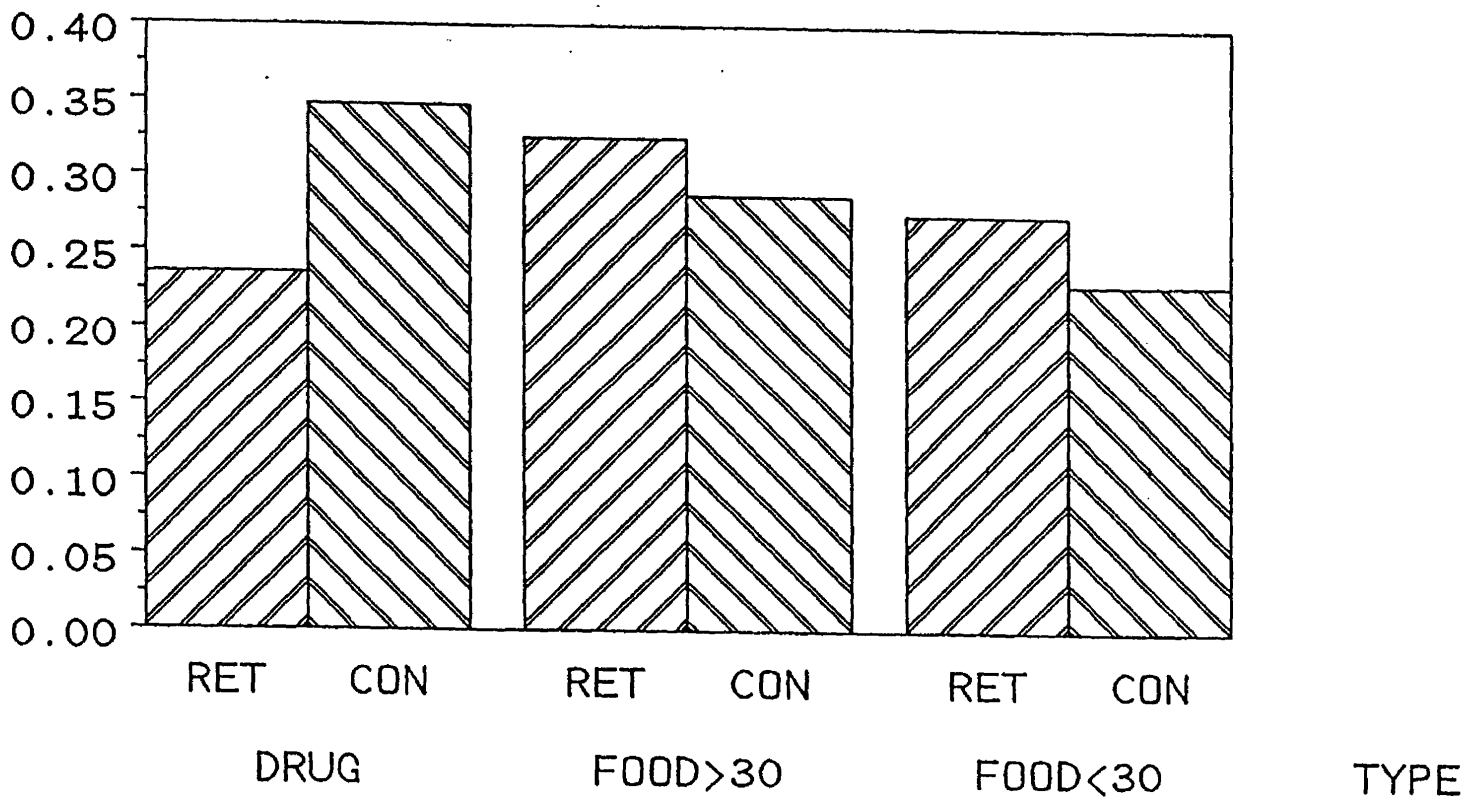

FIGURE 6

Mean Absolute Errors Against
Retailer and Consumer for
ITEMS on SPECIAL

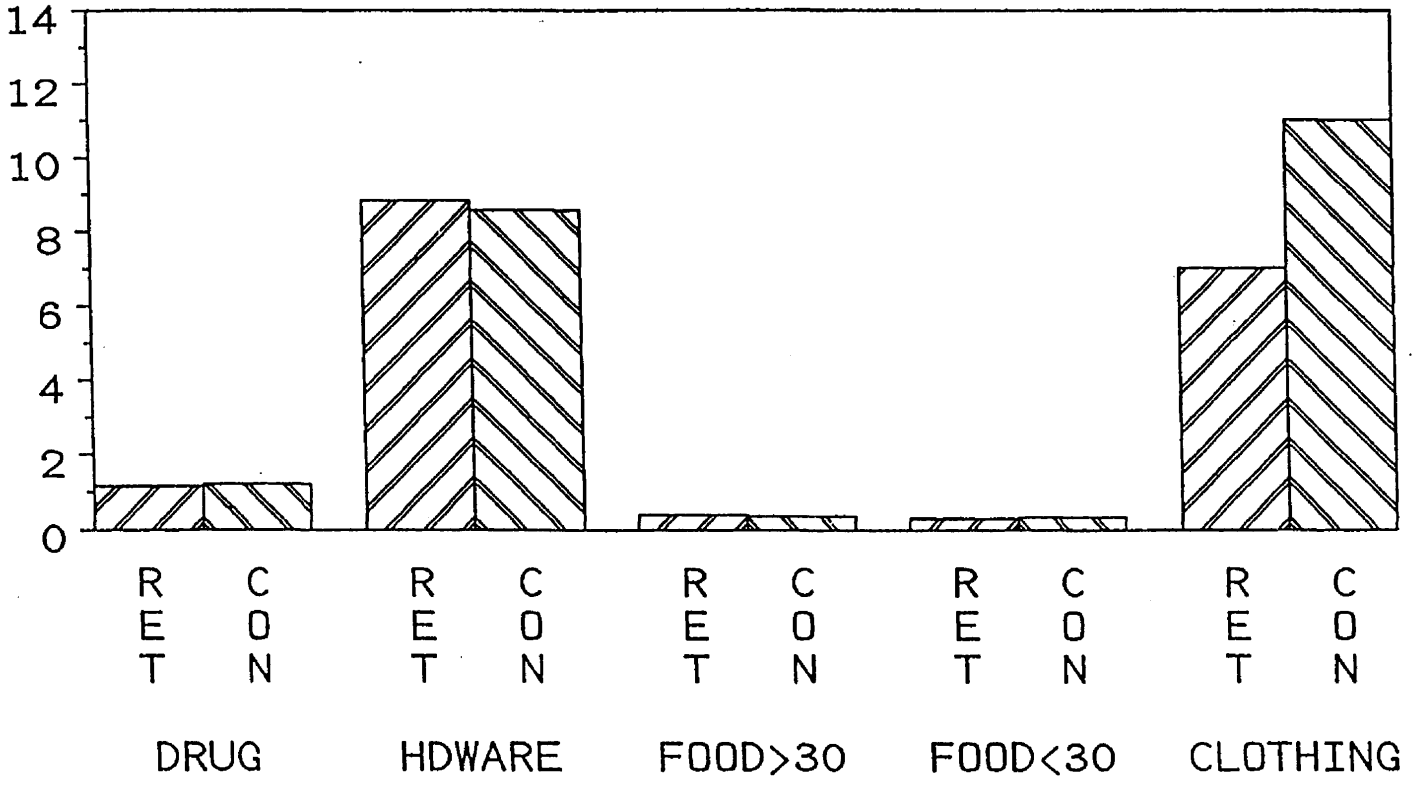

FIGURE 7

Mean Absolute Errors Against
Retailer and Consumer for
STORE BRANDS

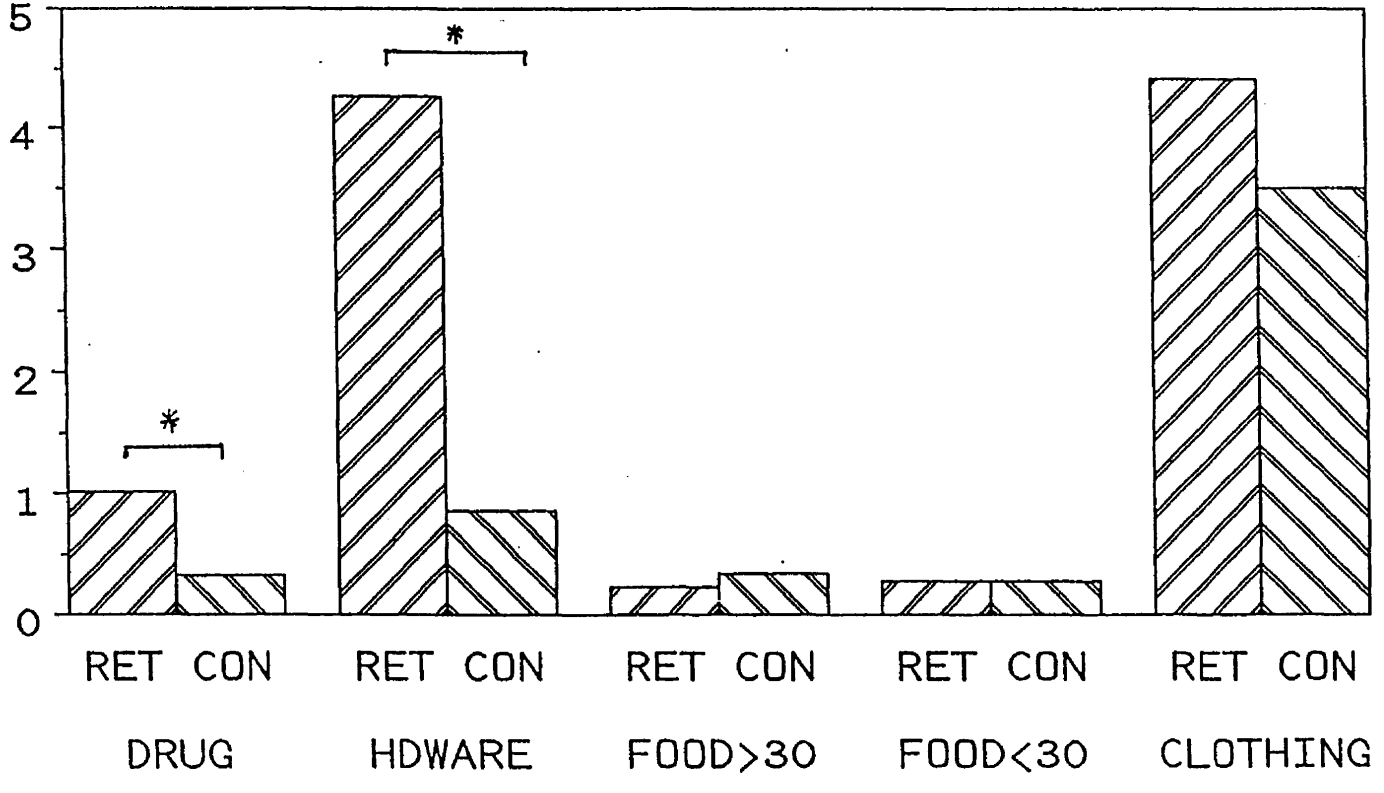

FIGURE 8

Mean Absolute Errors Against Retailer and Consumer for PLU CODES

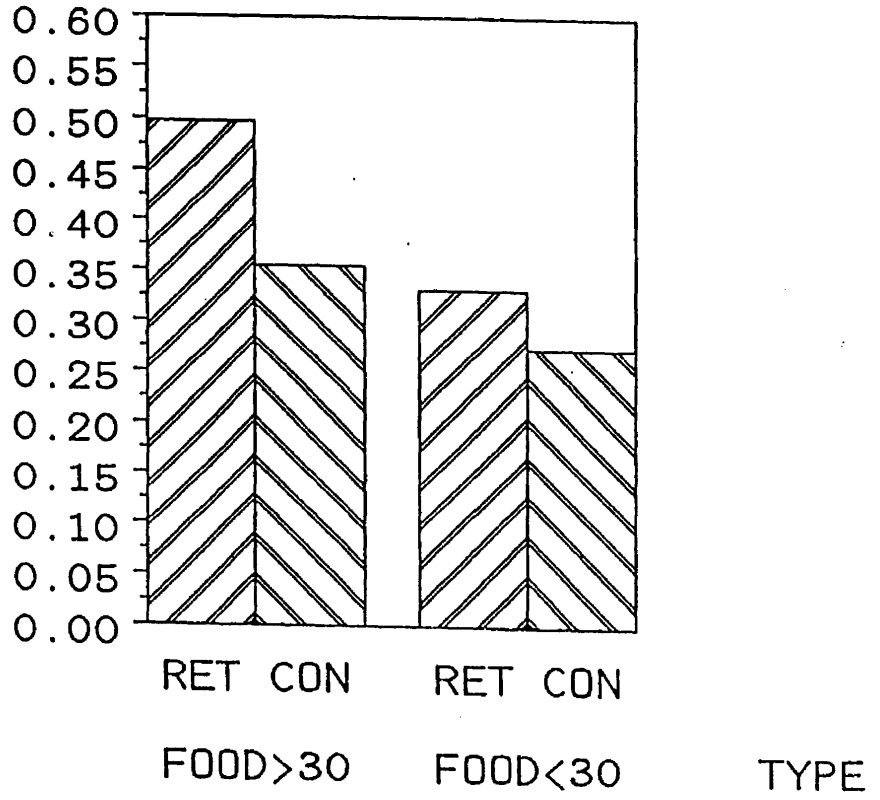

FIGURE 9

Mean Absolute Errors Against
Retailer and Consumer for
RANDOM SELECTIONS

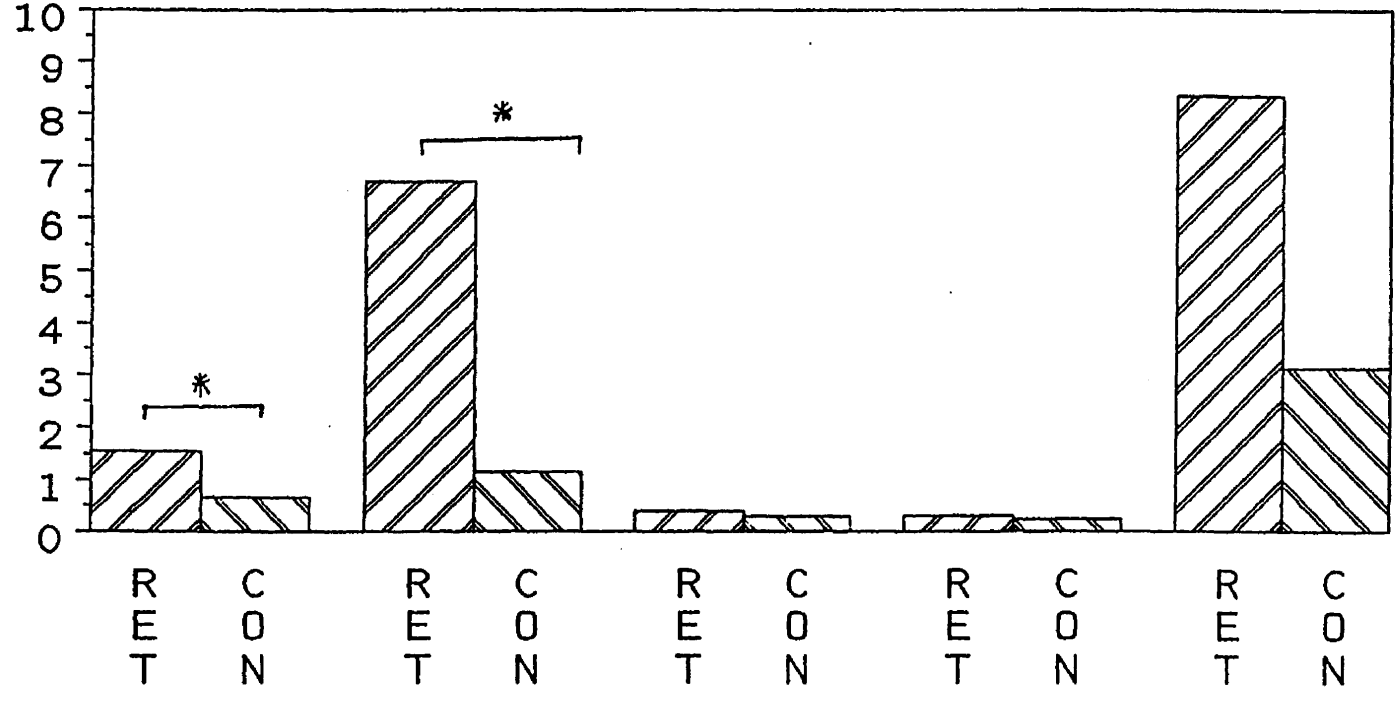

FIGURE 10

Percent of Errors Against Retailer and Consumer for DIRECT DELIVERIES

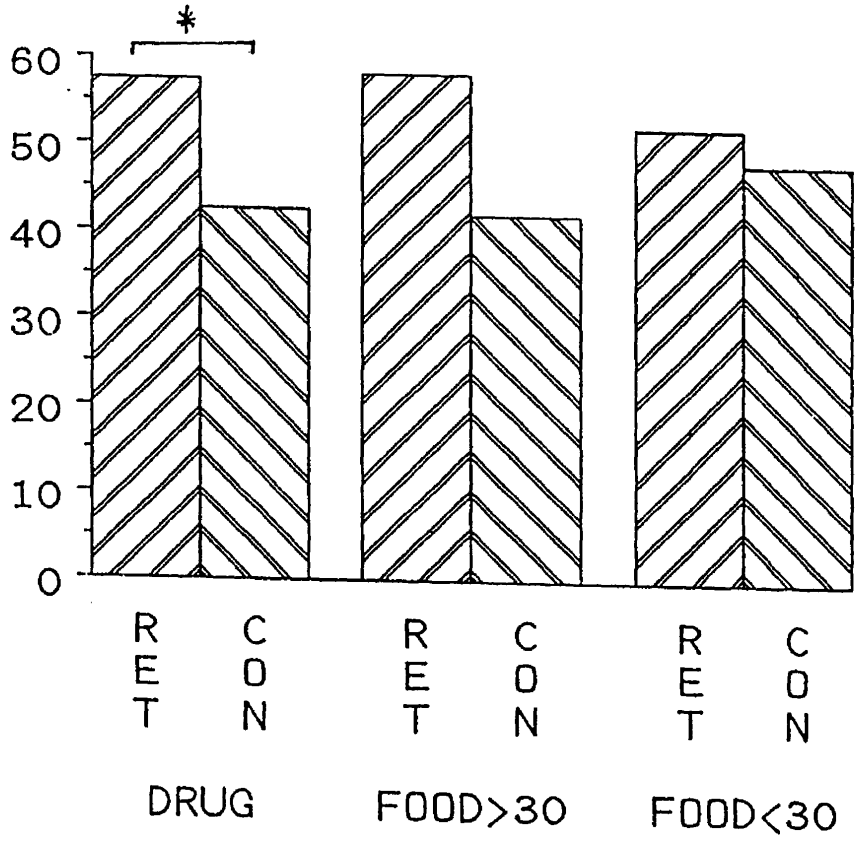

FIGURE 11

Percent of Errors Against Retailer and Consumer for ITEMS ON SPECIAL

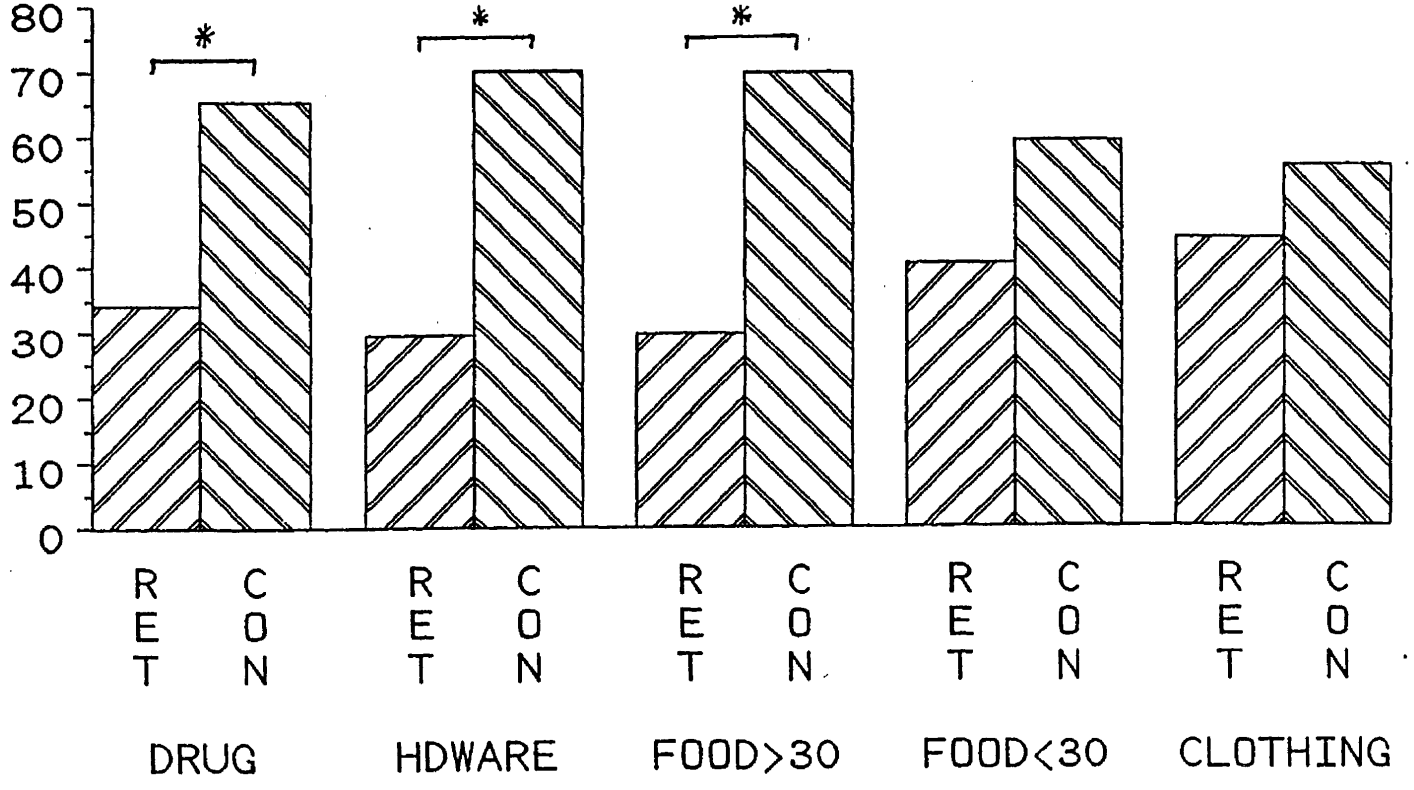

FIGURE 12

Percent of Errors Against Retailer and Consumer for STORE BRANDS

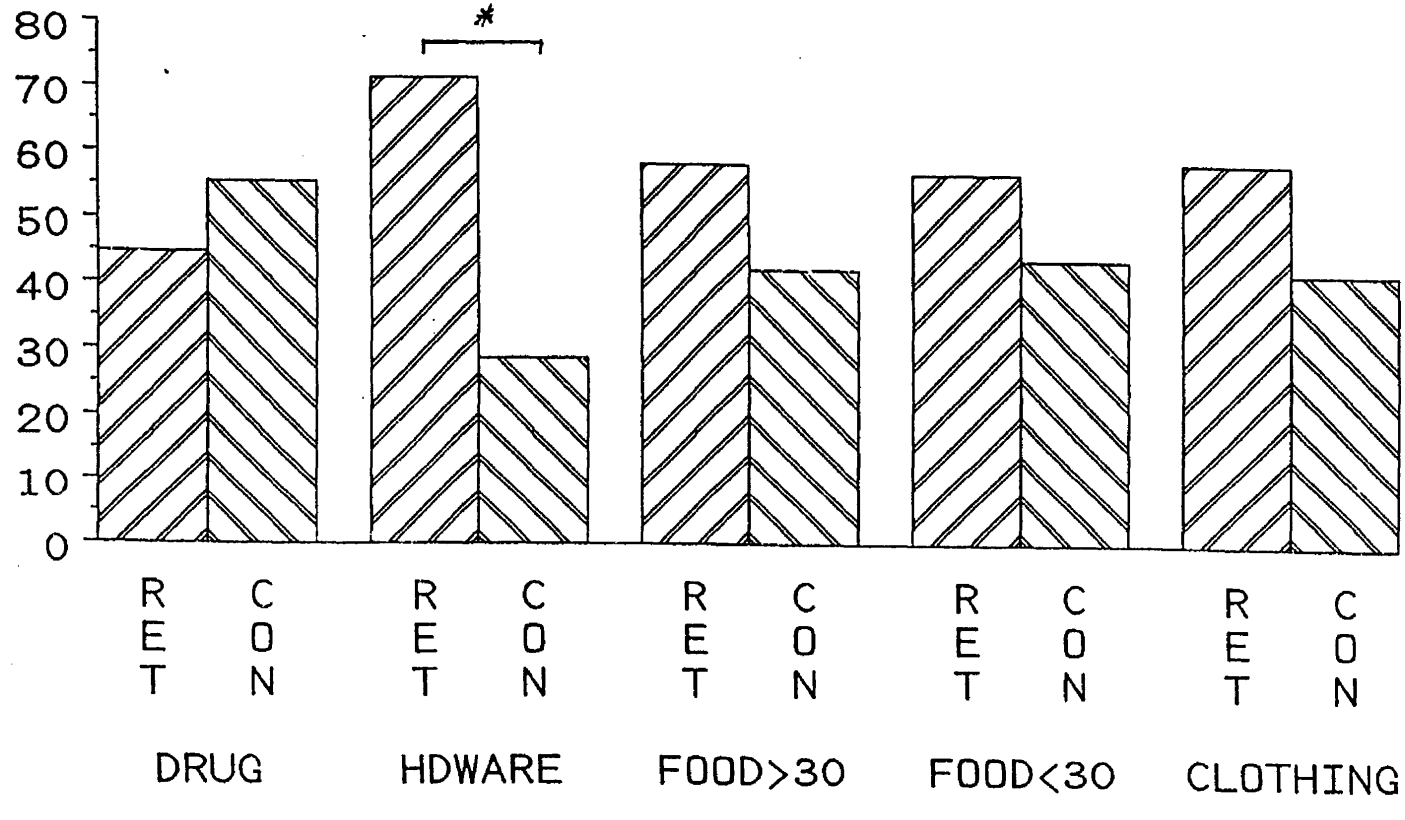

FIGURE 13

Percent of Errors Against Retailer and Consumer for PLU CODES

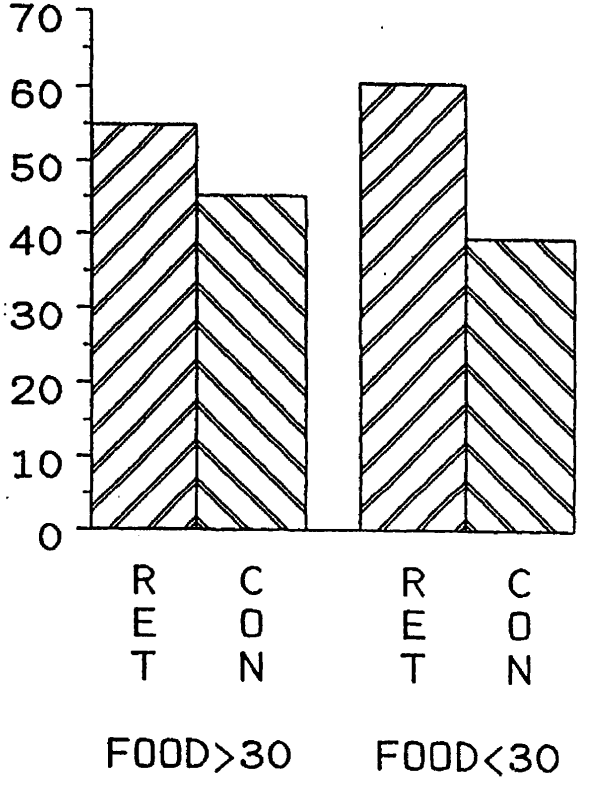

FIGURE 14

Percent of Errors Against Retailer and Consumer for RANDOM SELECTIONS

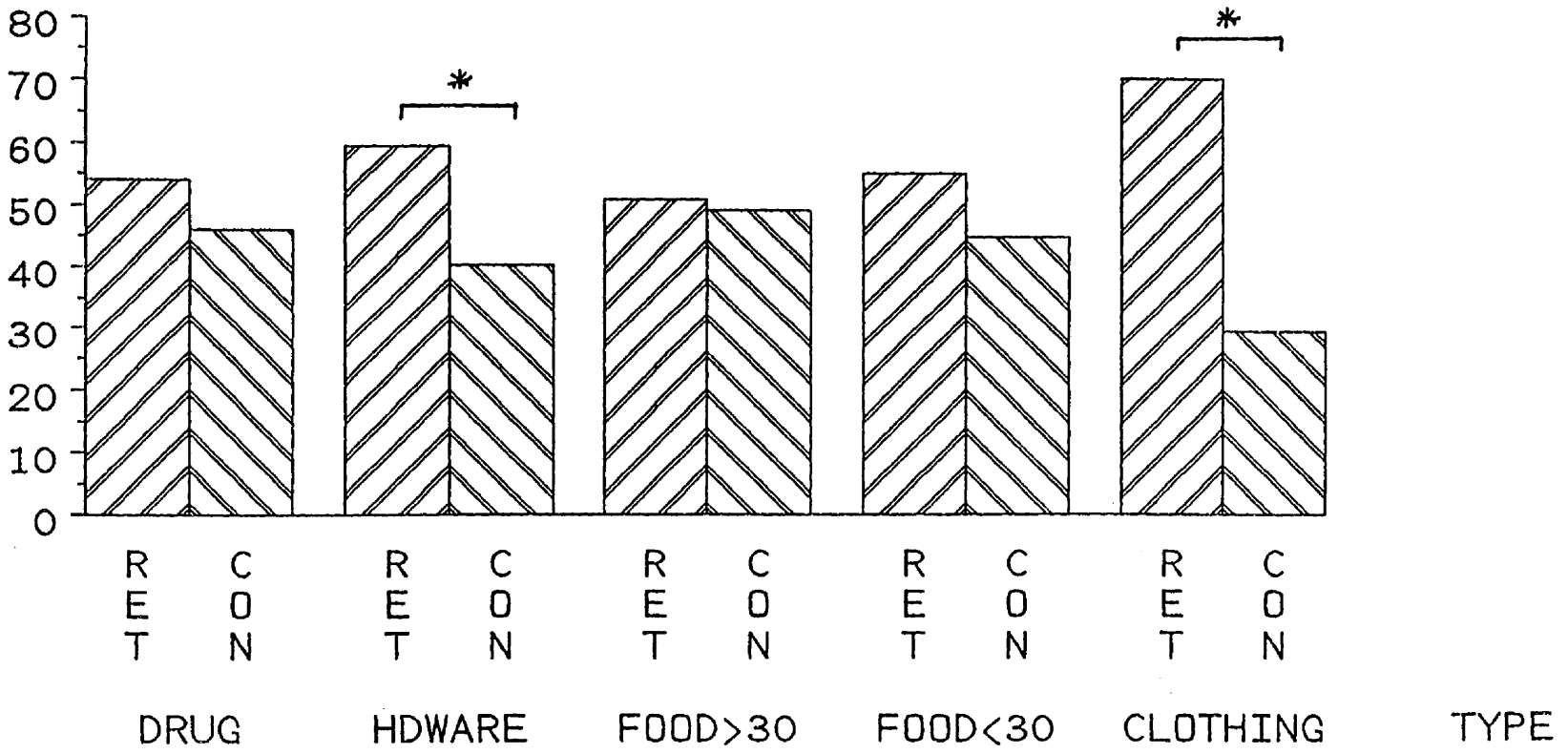

FIGURE 15

CHAPTER VI

SUMMARY OF STUDY

The study requested by House Joint Resolution 180 has identified three groups affected by pricing accuracy. The foremost group, the consumer, is entitled to receive goods at the advertised price. The second group, the retailer, is entitled to receive a fair profit in order to survive in today's marketplace. The third group, one not as readily identified as the previous groups, is the Commonwealth of Virginia. The State and localities are entitled to tax revenues based upon accurate gross sales receipts.

The retail industry has realized substantial savings with scanning/coding. They rationalize that it is also better for the consumer because most errors are against the retailer.

Based on the findings of the study, the following generalizations can be assumed:

a. This study of scanning/coding point-of-sales systems has revealed varying degrees of accuracy among five major retail categories. The retail industry has stood by the premise that when pricing errors occur, the majority of errors are against the retailer.

Study findings do not support this position. Results demonstrate, at best, a slightly better than even chance of the consumer prevailing when a pricing error occurs. For this premise to be substantiated, a single consumer would have to be involved in each of the millions of consumer transactions that occur annually in the Commonwealth.

b. This study has also concluded that 100 percent accuracy is not realistically achievable.

The New Jersey Food Council has reported a total accuracy rate of 98.9 percent. However, for the purpose of evaluation, a 2 percent "tolerance" was assessed on the errors incurred by the five major categories. (See Table V, Parts I-V) This "tolerance" has little or no affect on three of the five categories. The two categories representing the retail food industry are positively affected by a 2 percent "tolerance" and reduces the percent of locations considered in non-compliance from approximately 70 percent to less than 50 percent.

c. This study has revealed that accurate pricing by point-of-sales systems has a direct effect on the Commonwealth of Virginia.

An example of the effect that accurate pricing by point-of-sales systems has on the Commonwealth of Virginia is contained in the following scenario:

During the reporting period of May 1, 1990, through July 31, 1990, the Virginia Department of Taxation reported that the taxable sales for the "Food Group of Groceries, Meats, and Seafood" including both chain and non-chain operations was $2,120,948,610.00. Our study has established that twenty-six percent of the retail food industry is utilizing scanners at the point-of-sales. If this group represents fifty percent of the gross volume, it can be estimated that $1,060,474,305.00 in sales are scanned each quarter. The Food Marketing Institute estimates the average retail price of any consumer item is $1.56. Using this average price per item, it can be estimated that 679,791,221 items are scanned each quarter. This study has concluded that the average instance of error for retail food stores using scanners is approximately 3.75 percent. Therefore, it can be estimated that 25,492,170 items will be incorrectly priced. Of this total, 12,414,687 will be mispriced in favor of the consumer an average of 36 cents which is a loss to the retailer of $4,469,287.38 per quarter. On the other hand, 13,077,483 will be mispriced in favor of the retailer an average of 34.5 cents which is a loss to the consumer of $4,511,731.71.

These dollar amounts do not offset each other. The final tabulation represents a loss to the retail food industry of $42,444.33 during each quarter, which also represents a loss to the Commonwealth in uncollected sales tax during the same three month period.

The figures extrapolated result in projected losses of tax revenues across all categories of several thousand dollars annually.

d. This study has determined that the accuracy of use for any scanning/coding point-of-sales system is dependent on the accuracy of the item base for pricing and the accuracy of the displayed sales price.

All available information indicates that electronic point-of-sales systems are extremely accurate. Activities of the field inspection staff did not reveal any instances of error that could be associated with equipment error or failure. However, with any electronic device the output of information is only as accurate as the information supplied to the device. The partner in this information exchange is the price advertised to the consumer in any form. If changes occur at either the item base for pricing or the advertised price that are not reflected, errors occur.

e. This study concludes that errors associated with scanning/coding systems are the result of mismanaged information.

At no time during this study were any indications of willful wrong doing found to be associated with the incorrect prices. Errors were found to result from correct pricing information not being updated as readily as price changes occurred.

CHAPTER VII

STUDY RECOMMENDATIONS

The following recommendations are offered in response to the findings in this report:

a. **The Virginia Department of Agriculture and Consumer Services, Office of Weights and Measures should be designated as the responsible agency in order to assure that the use of point-of-sales systems are monitored.**

The results of this study indicate a need for monitoring the use and accuracy of point-of-sales systems. The instances of errors range from a low of 3.73 percent to as high as 7.13 percent among the five major categories. Yet, retail industries in other states are boasting an accuracy rate of up to 98.9 percent.

The 1987 inspections of the retail food industry by the Office of Weights and Measures revealed errors in excess of 10 percent. Through the continued monitoring and the cooperative effort of the food industry, their error rate has dropped to less than 4 percent.

b. **The Virginia Weights and Measures Law should be amended to add specific language to address the accuracy of point-of-sales systems.**

The Office of Weights and Measures has monitored the accuracy of scanning systems at retail food stores since 1987, under the provisions of Code Section 3.1-949. This code section states the advertised price shall not be misrepresented to an actual or prospective purchaser. While this approach has been successful in obtaining the voluntary cooperation of the retail food industry, strict enforcement of point-of-sales systems' accuracy under this provision of the law might not stand a legal challenge.

c. **To provide for a greater degree of enforcement, amendments to the Weights and Measures Law should be made to include civil penalties.**

Any violation of the Weights and Measures Law is punishable as a Class 1 Misdemeanor. This study has revealed a need for regulating the use of point-of-sales systems; however, to impose criminal sanctions would

not be the most judicious approach. This study indicates that the errors found resulted from the mismanagement of information related to pricing. At no time during this study were any indications of willful wrong doing found to be associated with the incorrect prices.

d. Further amendments to the Weights and Measures Law should be made to regulate the pricing of retail merchandise.

Requiring item pricing will result in additional costs to the retailer. Any increases in operating cost to the retailer will be passed on to the consumer. For this reason, item pricing is not advised. However, the study has revealed that the consumer is not always given adequate or accurate information, on which to make a sound value comparison.

During this study two businesses were visited that had no prices either attached to or posted for the prospective consumer. Other businesses were found to have poorly displayed or inaccurate information posted. Research conducted by the Virginia Department of Agriculture and Consumer Services' Office of Policy Analysis and Development could not produce any existing legislation that addresses posting prices of retail merchandise for the consumer.

Requiring shelf pricing for those businesses utilizing scanning or coding systems and requiring item pricing for those businesses continuing to operate manual point-of-sales systems, will assure the consumer basic protection. This will provide the consumer with information from which a value comparison can be made. Since the majority of the locations operating in the Commonwealth are presently conducting business in this manner, the impact of such legislation would be minimal.

e. Two full-time inspection positions, one clerical position and the necessary funding should be added to the Office of Weights and Measures to allow for monitoring of point-of-sales systems.

The field accuracy survey portion of this study required 3,353 work hours by the field inspection staff and approximately 600 hours for the collection and tabulation of data. To adequately regulate point-of-sales systems, regular inspections and reinspections of problem installations would be required. Administrative duties including assessment of civil penalties, if approved, will add to the office workload.

f. In order to fulfill the increasing responsibilities of the Weights and Measures Law, it will be necessary to amend Code Section 3.1-928. An amendment to remove the 12 month frequency of inspections is called for in order to allocate resources as needed to address expanding consumer issues.

Due to the increase in the number of businesses regulated by the Office of Weights and Measures and the assumption of local weights and measures programs, the current inspection staff cannot meet the requirement of annual inspections set forth in Code Section 3.1-928. The addition of point-of-sales systems to the Weights and Measures Law, as now written, will reduce the efficacy of the enforcement program. However, if the Code Section 3.1-928 were amended to remove the required annual inspection frequency, resources could be allocated to address the areas of greatest concern. This would also allow the Office of Weights and Measures to shift its posture from service orientation to regulatory.

This amendment will place further regulations on the retail industries of the State, no additional hardship will be borne by businesses interested in the accuracy of point-of-sales systems. These additions to the provisions of the Virginia Weights and Measures Law will assure protection to the citizens of the Commonwealth.

APPENDIX A

HOUSE JOINT RESOLUTION 180

GENERAL ASSEMBLY OF VIRGINIA--1990 SESSION

HOUSE JOINT RESOLUTION NO. 180

Requesting the Department of Agriculture and Consumer Services to study the use of uniform product bar codes in the Commonwealth.

Agreed to by the House of Delegates, February 13, 1990
Agreed to by the Senate, February 27, 1990

WHEREAS, the use of uniform product bar codes has saved the consumer time when shopping and has saved the merchant time when stocking inventory; and

WHEREAS, the uniform product code program is a national, voluntary program without specific regulation; and

WHEREAS, some stores stock only items which bear the bar codes; and

WHEREAS, there have been numerous complaints by consumers regarding the codes, such as being charged twice for one item, or not being charged the advertised price; and

WHEREAS, it appears unclear how the code system, its use, and scanner equipment should be regulated; now, therefore, be it

RESOLVED by the House of Delegates, the Senate concurring, That the Department of Agriculture and Consumer Services is requested to study the use of uniform product bar codes in the Commonwealth and the necessity of their regulation.

The Department shall complete its work in time to submit its findings and recommendations to the Governor and the 1991 Session of the General Assembly as provided in the procedures of the Division of Legislative Automated Systems for the processing of legislative documents.

APPENDIX B

ATTENDEES OF APRIL 24, 1990 MEETING

ATTENDEES OF APRIL 24, 1990 MEETING

John Walker, Director of Marketing
Fas Mart Convenience Inc.
Richmond, VA

Bob McNaughton
Farm Fresh Inc.
Norfolk, VA

Marvin Dillard
Ukrop's
Richmond, VA

Joe Hoehlein
Virginia Retail Merchants Association
Richmond, VA

Ed Taylor
Kroger
Roanoke, VA

Susan Mayo, V. Pres. of Consumer & Public Affairs
Farm Fresh Inc.
Norfolk, VA

Sumpter T. Priddy, Jr.
Virginia Retail Merchants Association
Richmond, VA

John DeMoss
Virginia Food Dealers Association
Richmond, VA

J. Alan Rogers, Program Manager
Office of Weights and Measures
Richmond, VA

APPENDIX C

INDUSTRY SURVEY FORM

SURVEY

TYPE OF BUSINESS: _____ Retail Food _____ Clothing _____ Hardware

_____ Variety _____ Drug _____ Convenience

1. Do you use UPC scanners at the check-out stations in your store(s)?

_____ Yes _____ No

If yes, how many check-out stations? _____

2. Do you use price look-up codes, SKU codes, or digital codes?

_____ Yes _____ No

3. How is the item base for pricing maintained?

_____ at store level manually

_____ at store level by electronic transfer

_____ at a data center outside the store level and implemented by electronic transfer

4. How often is data updated?

_____ daily

_____ weekly

_____ monthly

5. How is merchandise priced?

_____ price appears on individual items

_____ shelf pricing

6. When price changes occur:

_____ item data base updated first, then shelf price/item price updated

_____ shelf price/item price updated, then item data base updated

_____ no established policy

7. Please estimate number of pricing complaints your company has received during the past 12 months:

_____ 0 _____ 1 - 5 _____ 6 - 10

_____ 11 - 20 _____ 21 - 30 _____ 31 - 50

8. How many electronic processed scanner or coded items; i.e., price look-up, UPC, SKU, or digital coded, do you normally carry in your store(s)?

_____ 0 - 5,000 _____ 5,000 - 10,000 _____ 10,000 - 20,000

_____ 20,000 - 30,000 _____ 30,000 - 40,000 _____ Over 40,000

9. How often do you audit the accuracy of shelf/item pricing vs item base for pricing?

_____ Never _____ Daily _____ Weekly _____ Bi-Weekly

_____ Monthly _____ Other, specify _____

10. If records are maintained on internal audits of the system, can you share percentages of error?

_____ Number of items reviewed per audit

_____ Average number of errors revealed per audit

11. How are complaints concerning inaccurate pricing dealt with?

_____ Nothing is done

_____ Item is given to customer free

_____ Item and like item is given to customer free

_____ Other, specify _____

12. Number of store operated in Virginia? _____

13. Total annual sales volume: _____

14. Total number of customer transactions: _____

APPENDIX D

FIELD ACCURACY SURVEY FORM

VIRGINIA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES
DIVISION OF PRODUCT AND INDUSTRY REGULATION
OFFICE OF WEIGHTS AND MEASURES
P. O. BOX 1163, ROOM 403
RICHMOND, VIRGINIA 23209-1163

HR-180 SURVEY

Phone
804/786-2476

NAME_____ CITY OR COUNTY_____

MAILING ADDRESS_____ _____ _____ _____
(Street or P.O. Box) City Zip Phone

INTERVIEW

1. How is the item base for pricing maintained?

_____ at store level manually

_____ at store level by electronic transfer

_____ at a data center outside the store level and implemented by electronic transfer

2. How is merchandise priced?

_____ price appears on individual items

_____ shelf pricing

_____ other, specify _____

3. How many electronic processed scanner or coded items; i.e., price look-up, UPC, SKU, or digital coded, do you normally carry in your store(s)?

_____ 0 - 5,000 _____ 5,000 - 10,000 _____ 10,000 - 20,000

_____ 20,000 - 30,000 _____ 30,000 - 40,000 _____ Over 40,000

4. Estimated number of price changes weekly. _____

5. Does location conduct audits of accuracy of shelf/item pricing vs. item base for pricing? _____ Yes _____ No

6. Estimated square footage of establishment.

_____ 30,000 sq. ft. and less _____ 30,000 sq. ft. to 40,000 sq. ft.

_____ 40,000 sq. ft. to 50,000 sq. ft. _____ 50,000 sq. ft. and above

Comments: _____

_____

_____

_____

****

Business Coding

☐ UPC ☐ PLU ☐ SKU ☐ Digital ☐ Item

☐ Other, specify _____

☐ Food ☐ Convenience ☐ Clothing ☐ Commissary

☐ Variety ☐ Drug ☐ Hardware ☐ Club-Store

	Product Identification	Item Size (If Applicable)	Shelf/Item Price	Receipt Price	Differ (+ or -)
Direct Delivery 10 Items					
Items On Special 10 Items					
Store Brands 5 Items					
In-Store Coding 5 Items					
PLU 5 Items					
Random 15 Items					

APPENDIX E

INSTRUCTIONS FOR SURVEY

Instructions for Survey

1. Select items applicable to the designated groupings which appear to the left of the product identification on the survey form. Items must be recorded in the appropriate areas of the form. If the location does not have a particular group of items, leave that area blank -- DO NOT substitute other items.

2. (a) List items under the product identification category in a manner that will allow you to recall their identity after the items have gone through the check out lane.
(b) Record item size if applicable to assist in verifying correct pricing.
(c) Record the item/shelf or any other advertised price of the item.

3. Items selected that are not individually priced, should be compared to the shelf label or other materials advertising price to be sure that selected items match brand, variety, and net contents.

4. Request that the check out be placed in the "training mode." If possible, have items checked out; i.e., scanned or "rang up." Request the register receipt for price verification.

5. Record the price of the item recorded on the receipt only if it differs from the shelf item or otherwise advertised price. The receipt price category may be left blank or used to check off the correct items.

6. Errors found to be in the favor of the retail establishment shall be recorded as plus (+) example:

Product Identification	Item Size	Shelf/Item Price	Receipt Price	Differ
Lance Crackers	(8) 1 oz. Packs	1.49	1.79	+30

Errors found to be in favor of the consumer shall be recorded as minus (-)

Product Identification	Item Size	Shelf/Item Price	Receipt Price	Differ
Lance Crackers	(8) 1 oz. Packs	1.79	1.49	-30

7. For the (PLU) category, record the identity item price displayed/advertised. Have these items entered into the scale or point-of-sale system.

*NOTE: Pay close attention to display signs and cents off offerings to assure proper prices are charged.

APPENDIX F

MEMO TO VIRGINIA RETAILERS

S. MASON CARBAUGH
COMMISSIONER

COMMONWEALTH of VIRGINIA

C. KERMIT SPRUILL
DIRECTOR

DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES
Division of Product and Industry Regulation
P. O. Box 1163, Richmond, Virginia 23209

June 26, 1990

TO: Virginia Retailers

FROM: J. Alan Rogers, Program Manager
Virginia Department of Agriculture and Consumer Services
Office of Weights and Measures

SUBJECT: Study Requested by the General Assembly
House Joint Resolution No. 180

The 1990 session of the General Assembly requested the Virginia Department of Agriculture and Consumer Services to study the use of uniform product bar codes in the Commonwealth.

Through the cooperation of the Virginia Food Dealers Association, Virginia Retail Merchants Association, and other interested industry members it was determined that this study should encompass all forms of price determination in use so as to place this issue in its proper prospective.

We are now requesting your cooperation in conducting the field aspect of this study. Our inspectors will be asking you questions which have been identified as being pertinent to this study. The information which is given will not be used to identify the operation of a single location; however, we intend to group the information as it relates to the different types of businesses in the Commonwealth.

Our inspectors will also be selecting various items which are offered for sale at your location. The purpose of this is to establish the accuracy of item base for pricing.

Thank you for your cooperation! If you have any questions concerning this survey, please contact me at (804) 786-2476.

kmf

APPENDIX G

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BIBLIOGRAPHY

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APPENDIX H

GLOSSARY OF TERMS

DEFINITIONS:

Bar Code Reader - scanning device that reads data encoded in bar codes.

Centralized Processing - mode of operation in which all data is sent to a central computer for processing.

Clothing - locations engaged in the sales of clothing items.

Club Store - outlets engaged in sales to the public which require membership in order to make purchases.

Commissary - food markets operated on federal reservations offering sales to military personnel.

Convenience - a small retail establishment providing grocery and food items.

Database - a collection of related data.

Data Entry - process of entering characters directly into a computer.

Data Updating - altering specific fields, removing obsolete records, or rearranging records to keep a file timely and accurate.

Digital - the scanning of digits (numbers) to establish a sales price.

Direct Delivery - items delivered to retail, placed on retail shelves by the vendors, and/or priced by the outside vendor. (i.e., potato chips, soft drinks, bread, beer/wine)

Drug - retailers having drug and cosmetic sales.

Food - retail food stores.

Hardware - locations offering household items such as, locks, tools, and cutlery. For the purpose of this survey, we will include automotive stores and building supply retailers in this category.

In Store Coding - the production or manufacturing of bar codes at the retail level; i.e., random weight packages which have (UPC) bar codes.

Item Base for Pricing - the stored information related to pricing of individual items by use of codes or scanners.

Item Pricing - the price of the item appears on the package in a dollar and cents format.

Items on Special - items advertised in newspapers, flyers, radio, and television spots or posters.

Point-of-Sale System POS - electronic cas register, consisting of a keyboard, visual display area, cash drawer, and a printout of sales.

Price Lookup (PLU) Code - items that are priced by means of looking up a code for the particular item. These items are not marked with any identity, codes, or markings. The accuracy of the pricing is dependent of the cashier's accuracy in correctly identifying the item. Most often found in produce departments of retail food stores.

Random - the selection of items not represented by a designated category.

SKU (Stock Keeping Unit) - the use of a series of digits (numbers) to establish a sales price. The item may or may not display a price on it.

Store Brands - items that carry store or company brand names, for the purpose of this survey.

UPC (Universal Product Code) - a series of light and dark bars which is scanner readable and is used to determine product price and may include product identity.

Validation - checking data against predetermined limits to assure their accuracy.

Variety - retailers offering a broad range of items, to include, sporting, clothing, automotive, furniture, cosmetics, and some foods.