

Scanning Certification: The Pennsylvania Model

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Introduction

Scanning is a technological innovation that uses an electronic "reader" to identify the price of an item. Scanning matches product prices which are stored in a computer with universal product codes (UPC), a series of bar lines printed on product labels. Scanners use low power laser beams to electronically scan UPC product codes. For consumers, scanners promise faster checkout, more accurate pricing, more informative receipts, and, possibly, a slower rise in prices. These savings were projected to be around 2 percent to 3 percent. For retailers, scanners offer improved checkout productivity, elimination of manual entry errors, decreases in labor costs, automatic reordering, better sales analysis and item tracking, and an efficiency in labor scheduling. Savings were projected to be about 3 percent to 4.5 percent (Goodstein, Escalas, 1994). While scanning is intended to be quicker and more accurate than manual cash register entry, since the invention of scanner technology in 1972, consumers have been worried about the accuracy of the price scanners in grocery stores.

In the early 1960's, Harwell's (1963) found an average of 11.3 percent of the items entered on manual cash registers in error, and Harwell and Kinslow (1978) found an average of 0.31 percent net loss to retailers due to undercharges. In 1982, Gabe (1982) compared electronic scanners and electronic cash register systems finding that "in the scanning system the overall error rates ranged from 4.18 percent to 5.36 percent, compared with 5.86 percent to 7.12 percent in the electronic system. New York City's Department of Consumer Affairs 1991 found overcharges were ten times more likely than undercharges for sale items (O'Connell, 1993). Finally, a study conducted by Goodstein (1994) reveals those error rates for sale items and end-of-aisle displays in scanner-equipped stores exceed those for regular priced items. *Money* magazine estimated that scanner computer losses to consumers amount to one billion dollars in overcharges each year (O'Connell, 1993). Information Week estimates losses to be around 2.5 billion dollars a year.

Such studies and reports of pricing inaccuracy have led many states and local communities to develop or consider laws or voluntary programs to help protect consumers from scanner errors at the cash register. The food marketing industry also recognizes the value of pricing accuracy in a 1994 report which stated, in part: "There is no doubt accurate pricing is essential to the grocery industry. Whether customers are undercharged or overcharged, confidence and loyalty are undermined. Pricing errors also impact the accuracy of scan data when it is pulled from the system to analyze sales, promotions, inventory and profitability." (Food Marketing Institute 1994.)

In Pennsylvania, the Pennsylvania Food Merchants Association (PFMA) called together a group of industry, consumer, labor and government representatives who designed and established a voluntary Scanning Certification Program (SCP). This paper describes the SCP which has become a model nationally and provides data on experiences to date.

Study Questions

Previous studies and concerns of consumers and the food marketing industry lead to a number of questions about scanning certification that will be addressed in this paper. Four questions/issues and six hypotheses are addressed below. First, are consumers being charged the lowest advertised price at checkout? *Hypothesis A: Stores with scanners will have higher error rates than shown in previous studies of mechanical and electronic checkout.* Second, when errors occur, are consumers paying more than they would if a correct bill were tendered? Probability theory would predict a 50/50 split over time for undercharges and overcharges. Skeptical consumers would say that stores overcharge purposely as a technological version of the "low-ball/high-ball" scam. Store managers would say that regular items that do not have price changes are at higher risk since they are not attended to as frequently as items with frequent price changes and thus undercharges would be more frequent. Studies of older technology, mechanical and electronic checkout (non scanner), find that undercharges are more frequent than overcharges. *Hypothesis B: Assuming that no*

systematic bias is skewing the system, undercharges and overcharges will balance out. Hypothesis C: The financial pinch will lead stores to overcharge to meet their margin: overprice errors will be more frequent than underprice errors. Hypothesis D: Most errors will occur in regular priced items compared with special, prepriced, item-priced or end-aisle stacks. Third, previous studies have suggested that human mistakes are the main source of errors and not the technology and machines it produces. Hypothesis E: The source of the majority of pricing errors identified by the SCP will be human errors not scanner errors. Finally, does experience with the scanning accuracy process affect performance? Hypothesis F: Accuracy Increases Over Time. The next section gives an overview of the development and operation of the Pennsylvania Scanning Certification Program (SCP). The following sections provide an overview of development of the SCP, the sampling plan, and analysis of data on the SCP toward addressing the six hypotheses above.

Development

The Pennsylvania Scanning Certification Program (SCP) was developed by a coalition of concerned consumers, grocery store and industry representatives, consumer researchers, and representatives of labor unions, state Weights and Measures professionals, and AARP, in cooperation with the Pennsylvania Food Merchants Association (PFMA). The coalition developed the program and subsequently established an independent nonprofit corporation, 501(C)(3), with its own budget and Board of Advisors. This Scanning Certification Board of Advisors handles all policy and program issues, problems, complaints and any other issues involving SCP. SCP has three general goals as follows: (1) pricing information: to assure that the prices of all items in the store are clearly identified for the customer; (2) pricing accuracy: to ensure that scanners charge the advertised price; and (3) certification: to provide public recognition for stores which have reached high standards in pricing accuracy.

For certification, stores must pass an annual inspection consisting of placement of Scanning Accuracy Policy signs, shelf label signs, properly labeled shelf tags, and a 200-item random sample of store items which include regular, sale, and end-of-aisle displays. SCP stores initially had to demonstrate a 97 percent accuracy rate for all of their scannable items; the level was raised to 98 percent in 1996. SCP stores must also adopt the scanning accuracy policy which is intended to provide incentives for both stores and consumers to identify pricing errors.

If the scanned price of a product is higher than any shelf* or advertised price, the customer will receive that one item free up to a limit of \$10.00. For an item over \$10.00, the customer will receive \$10.00 off the lowest shelf or advertised price. The customer will be charged the lower price for any additional items of that product in the order. ("Shelf" price includes any displayed or posted price. Void when prohibited by law.) (SCP 1993)

An educational component is also a key to the SCP. Stores that wish to enroll in SCP begin by ordering the SCP manual and attending a seminar on implementing the program. Stores must then conduct a self-study to see how they rate according to SCP policies. During this part of the process, stores implement different procedures to fully comply with SCP standards and policies. All employees dealing with scanners must know the SCP policy and what to do when errors occur. The results of the self-study are sent to the SCP manager who then schedules an unannounced inspection of the store within a month's time. Stores that fail the inspection may repeat the process. Certification is effective for one year from the date of certification subject to annual recertification. Interim unannounced spot-inspections are also part of the SCP program. As will be seen below, the educational component may be a key to higher levels of accuracy.

Sampling Issues

The SCP Board decided that the primary objective of the program is price verification of a representative sample of the items in a supermarket. Checking every item would be financially prohibitive. Statistical sampling allows prediction of the number of errors that would be found if all items were checked. Several approaches to sampling were examined: predetermined item selection, stratified sampling, cluster sampling, and simple random selection (Poister 1978; Henry 1990). After considering the pro's and con's of the different methods, a representative sampling process was chosen. *Random (representative) sampling* involves creating a procedure wherein every item in the store has an equal chance of being included in the sample. This approach gives equal probability to all items in the store. It is the simplest to implement. It is not bound by the nature or types of items included in the store. It does not require searching for specific items. It eliminates the possibility of bias being introduced by those who construct the list and those charged

with selecting an item from the shelf (e.g., which brand or size of applesauce to choose for this store, and whether it is a sale or direct delivery item). This approach allows selecting a sample of items that represent the population of items in the store. Such a sample represents the accuracy of items in the store irrespective of the number and type of items carried. The one disadvantage of this approach noted by some observers is that it does not provide for targeting of high-probability of error items. However, following consultation with researchers at The Pennsylvania State University, the representative sampling approach was selected.

Systematic random sampling as implemented by the SCP involves a random start followed by sampling every Nth item. The key is determining the appropriate skip factor, the number of cases to be skipped over before choosing the next item. As noted by Poister (1978), "systematic samples are often used interchangeably with simple random samples on the assumption that there is nothing inherent in the procedure that would produce a biased sample." Population size is typically large--25,000 to 100,000 or more items--and will have little effect on sample accuracy. The SCP consulted several sampling experts on this issue and settled on 200 items for a probability sample at the 95 percent assurance level. A ten step sampling process allows the process to be carried out with a moderate amount of training.

Scanning Certification Results: Testing the Hypotheses

As noted, the Scanning Certification Program (SCP) seeks to provide pricing accuracy and appropriate pricing information for customers of certified supermarkets. The goals of the program are to provide standards for clearly identifying for customers the prices of all items in a store and to ensure that scanners charge the advertised price. SCP guidelines require stores to ensure that shelf tags are accurate and legible, that scanners are programmed to accurately charge *the lowest posted or advertised prices*, and that information about customer rights is available for consumers.

The SCP has been in operation since 1991. New stores have been enrolled each year with the total reaching almost 500 stores in 1997. The following sections provide analyses of data on the SCP toward testing the hypotheses posited above.

Table 1
ACCURACY RATES FOR
BASELINE INSPECTIONS

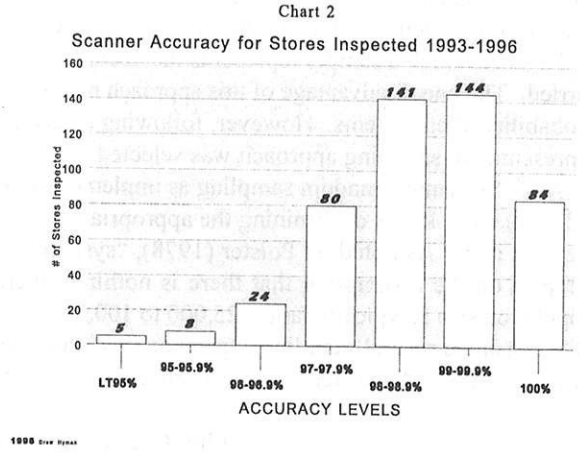
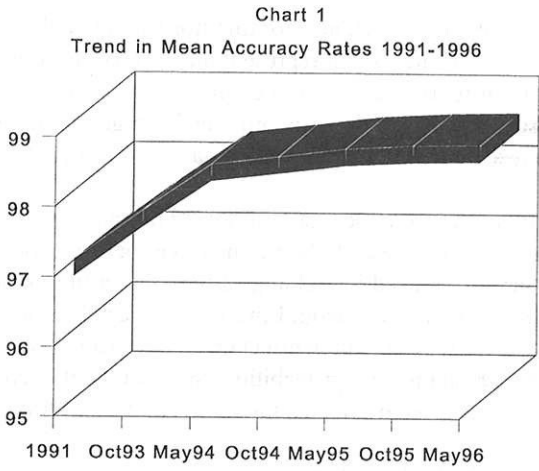
Store 1	99.6
Store 2	99.1
Store 3	98.5
Store 4	97.4
Store 5	98.0
Store 6	95.8
Store 7	95.5
Store 8	94.8
Store 9	94.8
Store 10	94.5

Baseline Study N = 10

Hypothesis A: Accuracy Rates Compared to Traditional Methods.

A baseline study of ten stores using scanner technology conducted before the program started found an average accuracy rate of 96.90 percent. The range was from 94.5 percent for the store with the lowest accuracy rating to 99.6 percent for the store with the highest accuracy rating (see Table 1). The SCP Board considered these data and set the initial rate for certification at 97.0 percent.

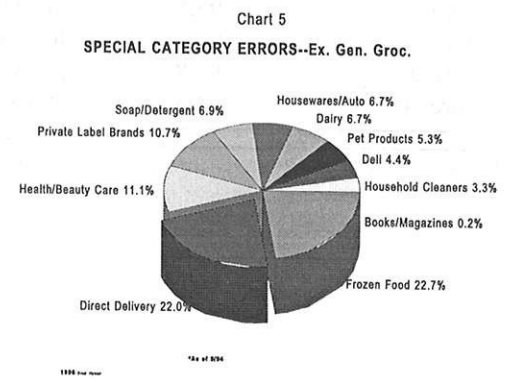
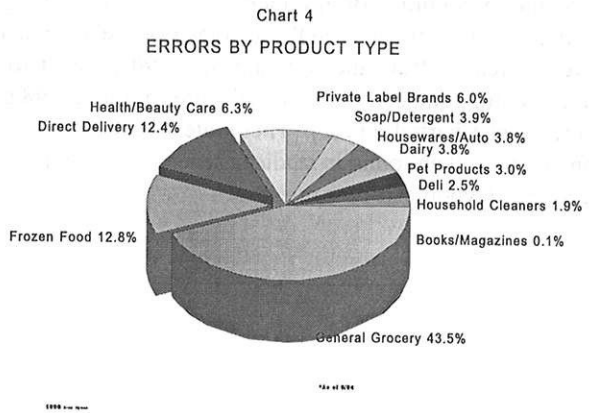
To be awarded certification a store had to have an accuracy rating of 97.0 percent on the inspection. Both undercharges and overcharges are included in the rating. From 1991 to 1996 the average price-scanner accuracy for certified stores increased from the baseline of 96.90 percent to 98.57 percent. The overwhelming majority of certified stores are in the 98 percent and above categories (see Charts 1 and 2). These rates show higher accuracy levels for scanning systems than found in studies of mechanical and electronic checkout cited earlier. Hypothesis A is rejected.



Hypotheses B & C: Overcharges vs. Undercharges. The SCP counts all errors in the certification process. Certification data show that undercharges routinely exceed overcharges. This pattern is evident in the baseline taken before the program started and in the data for each year since. These data are also consistent with figures provided by the Philadelphia Office of Weights and Measures, which inspects grocery stores as part of the city's item pricing law, and with data from full-store audits for supermarkets (SCP 1995).

For example, of all 87,440 items checked in the 1995 certification process, 1,143 or 1.3 percent were in error. Of the items with errors, 69.6 percent were undercharges, 17.4 percent were overcharges, and 12.9 percent were items with no visible shelf or item price. The average undercharge for certified stores is \$.40 and the average overcharge is \$.30. The average error is a \$.17 undercharge to the consumer. This means that a net average undercharge is the bottom line for the average customer. Hypothesis B, that over and under charges will balance out, is rejected. Hypothesis C, that financial incentives will lead stores to overcharge more than undercharge, is also rejected.

Hypothesis D: Errors in Regular vs. Special Items. The largest category of errors occurs with general grocery items compared to special categories such as direct delivery, frozen foods, health and beauty aids, etc. Chart 4 shows on the one hand that 43.5 percent of the errors detected are in the former area. On the other hand, the chart also shows that the majority of the errors are in the special areas, the largest two categories of which are frozen foods and direct



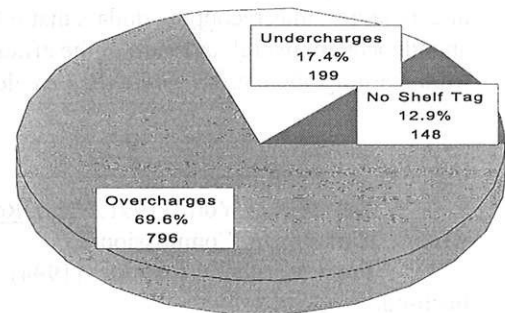
delivery.

Chart 5 shows the distribution of errors for these special areas excluding the general grocery items. The frozen food and direct delivery items account for almost half of these errors. Different reasons are given by stores as the cause of these errors. Frozen food errors are typically attributed to the large variety of items in frozen food lockers and the small amount of space given to each; a similar situation exists for many health/beauty aids and housewares/auto items. As a result there are many labels, frequently in tiers or crowded together, which are easily misplaced or misread. Direct delivery errors are a different story. In this case, the store does not price the items or even place them on the shelves.

These functions are not carried out by supermarket employees but by the wholesaler who prices the items and puts them in the store--direct delivery to the shelves. Reportedly, these people frequently change prices and do not inform the store manager or the scanning manager, resulting in errors at checkout. These results are similar to those reported in the literature and lead to rejection of Hypothesis D.

Hypothesis E: Accuracy Increases Over Time. Chart 1 (above) shows the trends in error rates for SCP stores from 1991 to 1996. In 1993 there were only 20 stores in the program. This increased to 72 in 1994, 190 in 1995 and 212 in 1996. First, as noted above, these data show that accuracy increases over time for stores in the program. Second, most of the stores inspected in the latter years were recertifications of stores already in the program. Similarly, accuracy increased during these years. Thus Hypothesis E, that stores that have been through the SCP process will be more accurate over time, is supported. This fact supported the SCP Board of Advisors desire to increase the level for certification. In 1996 the SCP increased the required accuracy rate for certification to 98.0 percent. Hypothesis E is supported.

Chart 3
COMPOSITION OF ERROR RATES



Conclusions

The Pennsylvania Scanning Certification Program (SCP) was the first of its kind, and it remains the only non-governmental certification program to date. It provided the model on which both the Philadelphia law and the National Conference on Weights and Measures (NCWM) guidelines for national standards and procedures are based. The analyses above show a steady growth in the number of stores that voluntarily enroll in the certification process accompanied with a steady growth in the accuracy of stores certified. Despite these gains, most stores in the state remain uncertified. In December 1996, the Pennsylvania legislature enacted a law requiring an annual inspection for all retail checkout scanners, but exempts those that participate in an approved private certification program that provides inspections on an unannounced basis. The SCP is the only organization that has been so approved to date. In 1997, many additional stores applied to enroll in the voluntary SCP: the total is now approaching 500 stores in the program.

Analyses of data on the SCP lead to several conclusions. Stores with scanners in the SCP have lower error rates than shown in previous studies of mechanical and electronic checkout systems. When errors occur, average undercharges exceed overcharges in both number and amount of money involved. Errors occur for all types of items although some types of items such as frozen food and sale items do tend to have higher error rates than general grocery items. The source of most errors that do occur is human error of some type, not mechanical errors by the scanning machinery. Finally, we believe the educational and self-study components of the Pennsylvania SCP lead to higher levels of accuracy and compliance than do programs that do not have this feature. However, this study does not identify whether voluntary or government mandated certification/licensing is more effective. Nor does it address the issue of whether conscious pricing errors occur and are masked by the speed and efficiency of scanners. Further studies of these issues and replication elsewhere are tasks for the future.

We also suggest that scanning certification is not analogous to a zero sum game where consumers win and store owners lose or vice versa. Nor is this a program that gives consumers promises that things are well and no compensation when they are not. Scanning certification is like a variable sum game which offers both the store management and consumers benefit from pricing accuracy, and it provides consequences for store errors and incentives for identifying and eliminating them. Consumers benefit in two major ways. First, certification is provided only to stores that have been inspected and found to have an accepted level of accuracy. Interim inspections between regular certification visits contribute toward maintaining accuracy. This is reassuring but does not guarantee that errors do not occur--requiring the second consumer benefit. Second, consumers who detect overcharges on items they are purchasing receive a direct benefit via compensation as promised by the Scanning Price Accuracy Policy. This generally means that the consumer will receive free one of each product for which they detect an overcharge and the rest at the correct price.

Stores also benefit. First, customers who detect overcharges are provided immediate redress and do not go away mad. In fact, providing a free item produces quite the opposite reaction in most consumers. Studies show that many consumers do not complain to the store management about problems but they do tell others and may also stop shopping there (Hyman, Shingler and Miller (1992). Happy customers return. Second, the store has the opportunity to

correct the source of the overcharge and avoid additional errors and unhappy customers. Third, the SCP inspection procedure identifies undercharges as well as overcharges. In fact, the average inspection identifies more dollar value in undercharges than overcharges. Stores where this occurs have the opportunity to initiate procedures to correct undercharges, thus recouping dollars that otherwise would have gone out the door. Finally, a periodic inspection gives an independent overall measure of the efficiency of the store's pricing procedures. Owners and managers can benefit from learning about areas where they are doing well and where attention is needed.

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Endnote

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