

AN ANALYSIS AND EVALUATION OF QUALITY AND PRICE
OF EGGS IN SELECTED RETAIL OUTLETS

By
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AN ABSTRACT

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The exterior and interior quality of 527 dozens of consumer grades of eggs were analyzed after purchasing them bi-weekly from selected retail outlets during 1957. The measurements used to analyze the quality of the eggs were shell cleanliness, shell condition, shell thickness, egg weight, candled quality, Haugh units, USDA albumen scores, color of yolk, incidence of meat and blood spots, and incidence of inedibles.

Only 33 percent of the dozens qualified for grade A on a cleanliness basis. Chi square values for cleanliness of dozens of eggs among three stores were significant at the 1 percent level and at the 5 percent level between two stores, but not significant among other stores.

Poor shell condition was found in 10.8 percent of the eggs purchased. No significant differences in shell condition of eggs (dozen basis) were found among eggs from different stores. The differences in mean shell thickness of eggs (dozen basis) among stores were not significant.

A majority of the eggs purchased were white shelled. Although 82 percent of the cartons purchased were not labeled as to egg shell color, the color varied from white to dark brown in some cartons.

On a candled basis 26.9 percent of the eggs (dozen

basis) were classified as grade A; 47.1 percent as grade B; 21.8 percent were grade C; and 4.2 percent were either loss or inedible. Based on mean Haugh score per dozen eggs, 22.58 percent were grade AA, 71 percent were grade A; and 5.50 percent were grade B. The monthly mean Haugh score was highest in January (77.2 Haugh units) and lowest in July (62.2 Haugh units). The mean Haugh score per dozen for eggs purchased was 70.9. The mean Haugh scores per dozen eggs were significantly (1 percent level) different among seasons. Eggs purchased in January, February, and March had the highest mean Haugh score (75.8) and those purchased in July, August, and September had the lowest mean Haugh score (65.2). Haugh scores for grade A eggs and checks were significantly higher than scores of grade B eggs. Differences in Haugh scores of eggs among brands were not significant. Haugh scores of eggs of different sizes ranged from 65.9 (extra large) to 79.3 (small). The mean Haugh score for grade A small eggs was significantly higher than for grade A extra large eggs. The quality of eggs based on mean USDA scores showed that 91.0 percent were A quality or above and only 9.0 percent were B quality. The mean USDA score per dozen of eggs purchased during the year was 4.8 or average A grade.

The incidence and size of meat spots found showed that 20.93 percent of the dozens would not qualify for A or B

grade and 18.60 percent were classified as loss. Blood spots found in the eggs observed were serious enough to classify 9.7 percent of the dozens as grade C and 5.1 percent as loss. The remaining 85.2 percent would qualify as grade A. Very few inedible eggs were found. Only 16 sour eggs were found in ten dozen eggs and two eggs with seeping yolks were found in two additional dozens of grade A eggs during the summer months of 1957.

Sixteen out of the 511 dozen eggs were below the minimum net weight per dozen. These were concentrated in eggs from stores 1, 2, 4, and 6.

The retail prices of eggs of each size, brand and grade varied considerably among stores. It appeared that a direct relationship existed between quality and price. The price was highest in the winter when the quality was highest. This may have been associated with the age of birds in the flocks producing these eggs. The differential between the standard wholesale price and the existing retail price showed considerable variation among stores. An analysis of variance of the margins for all sizes of eggs was significant at the 1 percent level.

A composite analysis of the measurements of the egg quality of the 527 dozens of eggs purchased revealed that only 128 dozens or 25.6 percent met all official standards for grade A eggs.

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INTRODUCTION

In recent years, increasing concern over the quality of eggs offered through retail markets resulted in the passage of the Agricultural Marketing Act of 1946, which set aside funds for research on a regional basis to determine the quality of eggs available. The North Central Region, which includes the state of Michigan, is so large, however, that possible errors could be made in applying the findings of that study to any specific location in that area. Since the time the study was initiated, great progress has been made in marketing practices which have direct bearing upon the quality of eggs found in retail outlets.

Nelson (1956) surveyed 2,976 dozens of shell eggs or twenty three lots from four Michigan cities for inspection of quality as used by consumers. A total of 648 dozens were carefully weighed and candled. Nine of the lots were not in compliance with the law as to grade or size. A 60 dozen sample from one lot of 160 dozens was below the weight requirements for the size designated.

In order to give a more accurate picture of the egg situation on a local level, as it occurs at the present time, a study was made of the quality and price of eggs merchandized in local independent and chain stores, regional chain stores, and national chain stores in the greater Lansing area during the 1957 calendar year. This study would supplement others of recent years by furnishing a comprehensive analysis of internal and external quality of eggs as well as a store by store comparison of overall egg quality, price, and egg merchandising practices.

Objectives of the study were to:

- a. Determine the quality and size of eggs offered for sale in Lansing, Michigan,
- b. Ascertain the relationship of indicated quality and broken out quality of the eggs,
- c. Reveal the relationship of price to the quality of eggs sold, and
- d. Provide basic information pertinent to the quality and volume of eggs merchandised in Lansing, Michigan.

EXPERIMENTAL PROCEDURE

Retail stores were selected from national, regional and local chains and independent stores, because such a selection would afford a cross-section of the egg merchandising practices in this area. After a preliminary investigation of the retail stores in the area six retail outlets were selected from which the eggs were purchased during the period of January, 1957, through December, 1957. One dozen eggs representing each size, grade and brand offered for sale in each store was obtained on a biweekly basis. Purchases were made with other groceries so that store personnel could not detect that the eggs were being purchased for any reason other than consumption in the home.

As soon as the eggs were purchased they were brought to the M. S. U. Poultry Department and placed in a 55°F. refrigerated room designed for holding eggs. Each dozen of eggs was taken to the egg technology room where the stated grade, price, type of carton, date of candling, color, size, and brand of eggs were recorded. The eggs were then checked for shell color, cleanliness, and shell condition and each egg was weighed. Each egg was candled and observations made for air cell depth and defects, blind cracks, blood and meat spots, and abnormalities of the albumen and yolk.

Each egg was broken out on a glass plate, checked for

blood and meat spots, color of the yolk, U. S. D. A. score, and abnormal conditions of the albumen; then a measurement of the height of the thick albumen was made with a micrometer approximately half way between the yolk and the edge of the thick albumen. The thickness of the egg shell was measured with a micrometer.

The criteria for assessing the quality of the eggs, purchased from the six retail outlets, were the United States Department of Agriculture Standards of Quality for Individual Shell Eggs (Hauver and Hamann, 1955), United States Specifications for Grades of Eggs, and modifications of the United States standards and grades.

Each egg was evaluated for the various quality and size factors according to the following designations:

A. Shell color

- | | |
|----------|----------------|
| 1. White | 3. Light brown |
| 2. Tint | 4. Dark brown |

B. Shell cleanliness

- | | |
|-----------------|-----------------|
| 1. A. Clean | 4. C. Scattered |
| 2. B. Scattered | 5. C. Localized |
| 3. B. Local | 6. Stain |
| | 7. Dirty |

C. Shell condition

- | | |
|----------------|------------|
| 1. Sound | 4. Smashed |
| 2. Blind crack | 5. Leaker |
| 3. Crack | |

D. Weight in ounces per dozen

Size or weight classification	Min. net Wt. per doz. ounces	Min. wt. for indi- vidual eggs at rate per dozen Ounces
----------------------------------	---------------------------------	--

1. Jumbo	30	29
2. Extra Large	27	26
3. Large	24	23
4. Medium	21	20
5. Small	18	17
6. Pee Wee	15	--

E. Canded quality (U. S. D. A. Standards) (Hauver and Hamann, 1955)

F. U. S. D. A. Score (1-12) Brant and Shrader (1952)

G. Albumen height in inches

H. Shell thickness in thousandths of inches

I. Yolk color--1 to 24 (light to dark)

J. Haugh score--a Haugh score is a recognized measurement for determining the quality of eggs Haugh (1934)
79 and above--AA quality; 55-78.9--A quality;
31-54.9--B quality; 0-30.9--C quality.

K. Abnormalities

- | | | |
|---------------------|---|---------------------------------|
| 1. Meat spots | } | a. less than 1/32 inch--C |
| 2. Blood spots | | b. between 1/32 and 1/8 inch--C |
| 3. Sour - inedible) |) | c. larger than 1/8 inch--loss |

The characteristics pertaining to all eggs were summarized and mean values for each characteristic were recorded. Appropriate statistical analyses were made with data from both individual eggs and dozens of eggs regarding shell cleanliness, shell condition, shell thickness, yolk color, candling results, Haugh scores, brands, sizes, prices, U. S. D. A. scores, blood and meat spots, and price margins.

REVIEW OF LITERATURE

Numerous investigations pertinent to the quality of eggs offered for sale and some of the factors affecting the quality of eggs sold to consumers have been reported.

Quality of Eggs Sold in Retail Stores

Cray (1952) discovered that complete food stores, groceries, delicatessens, meat markets, other independent stores, and chain stores in Cleveland, Ohio sold AA large, A extra large, A large, and A medium, white-shelled eggs, A large, and A medium, brown-shelled eggs. Chain stores, complete food stores and other types of independent stores sold grade B large brown-shelled eggs. All of the retail stores, exclusive of the chain stores, sold small or assorted eggs. NyBrotten, (1952) reported that only two-thirds of the 179 retail stores surveyed in West Virginia offered grade A eggs. Kemp, et al. (1952) disclosed that seventy percent of the retail stores in the northeast region of the United States sold A or AA quality eggs. Kantner (1954) revealed that the quality of eggs offered for sale in 1,641 retail food stores in New York state was the result of the influence of time, temperature, grade of eggs when delivered, and packaging at the various stages of the marketing process. Stores selling less than 30 dozens per week had 67 percent A or AA quality eggs, while those which sold 150 dozens or more per

week had **73** percent A or AA quality eggs. Smith and Hawes (1956) reported that inspection records from 2,225 retail stores in Maryland showed that 81 percent of the eggs were A quality. There was no up-grading or down-grading of eggs.

Savage (1951) reported that the quality was designated for only 60 percent of the lots displayed by retail stores in Maine. Kemp, et al. (1952) disclosed that there was very little difference between the eggs claimed to be A or AA quality by retail stores and the stores not indicating the quality of their eggs in nine northeastern states. The claims made of grades were lower than the corresponding grades of federal standards.

Becker, (1953) revealed that egg marketing by retail stores in Pennsylvania showed that the producer-to-retail-store method of marketing provided higher levels of quality than the less direct marketing method. Jasper and Cray, (1953) disclosed that 45 percent of the consumers bought eggs from farmers and 37 percent from retail grocery stores. Sixty percent of these consumers in Columbus, Ohio listed quality as their most important consideration for choice of patronage. Ninety percent of all the customers surveyed had no method of determining interior quality before purchasing eggs, but most knew something about broken out egg quality. Kantner (1954) reported that the quality of eggs sold in 1,641 retail food stores in New York state was associated with the sources of supply. Eggs supplied to retail stores by wholesale egg

distributors, cooperatives, poultrymen, meat packers and chain warehouses were 72, 71, 68, 62, and 57 percent grade AA or A respectively. Taylor, et al (1954) revealed that 92 percent of the consumers in a Rhode Island state study did not change their source of purchase the year around. Forty five percent of the consumers said freshness or quality was the reason they did not change.

Larzelere and Nichols (1950) reported that consumers in Greater Detroit, Ann Arbor, Ypsilanti, Lansing, Grand Rapids, Saginaw, and Mt. Pleasant complained about poor flavors and odors found in eggs that had been held an average of 11.6 days between packing and consumer purchase. Other complaints were yolks too easily broken, watery whites, dark or blood spots on yolks, yolks too dark, dirty shells, and shells too easily broken.

Size of Eggs Sold

Savage (1951) reported that two-thirds of the retail stores in Maine offered only large eggs. Chain stores had more variety of sizes than either the independent or cooperative stores. The size of the eggs was stated in 85 percent of the lots studied. Cray (1952) reported chain stores, delicatessens, meat markets, complete food stores, grocery stores and other independent stores in Cleveland, Ohio sold extra large, large, and medium size white and brown shelled

eggs. Chain stores did not sell any small or assorted size eggs; however, all other stores listed above sold small and assorted sizes of eggs.

NyBrotten, (1952) revealed that few retail stores in West Virginia were concerned with individual egg weights, although nearly all met the total dozen weight standards.

Kemp, et al. (1952) disclosed that retail stores in the northeastern region of the United States came much closer to the federal dozen weight standards than to the federal individual weight standards. Becker, (1953) reported that of 835 retail food stores in Pennsylvania inspected for egg merchandising, the eggs offered for sale lacked uniformity within the dozen as to size. Twelve percent of the eggs offered did not meet requirements as to weight per dozen.

Color of Shells and Yolks

Savage, (1951) reported that the color of the eggs was stated in only six out of 902 lots of eggs in retail stores in Maine. The color was visibly displayed in 183 lots.

Jasper and Cray, (1953) revealed that more consumers in Columbus, Ohio preferred a medium yolk color over light and dark yolks and still more housewives were concerned with uniformity than with shade of color. Slocum and Swanson, (1954) disclosed that consumers in Seattle, Washington

preferred medium, light and dark colored yolks, respectively in order of preference. Taylor et al. (1954) in four studies on consumer preferences in Providence, Rhode Island, found 46 percent of the consumers preferring a medium yolk, 18 percent, dark yolk color, and 10 percent with no yolk color preference.

Effect of Refrigeration on Quality

Morris and Parrish, (1950) revealed that eggs held for 100 days under refrigeration are as fresh as some eggs 3 days old. The experiment showed that temperatures of 99°, 77°, 67° and 37° would cause A quality eggs to drop to B quality in 3, 8, 23, and 100 days, respectively. Savage, (1951) discovered that the length of time eggs were held in retail stores in Maine had an important effect on quality. Eggs held two days or less, three to eight days and nine to sixteen days were of 89, 85, and 71 percent A quality respectively. NyBrotten, (1952) reported that eggs kept under refrigeration were of higher quality than those not kept under refrigeration in 179 retail stores in West Virginia. Eggs of AA or A quality decreased 6 points for each day kept at the store. Stadelman and Jensen, (1952) disclosed that less than half as much of the albumen quality was lost in refrigerated eggs when compared to non-refrigerated eggs in retail stores in the state of Washington. Eggs held under refrigeration had a better broken out appearance than those refrigerated part

of the time or not at all. Kantner, (1954) reported that the quality of individual eggs not held under refrigerated conditions in retail stores in New York state was slightly higher than eggs held under refrigerated conditions. The unrefrigerated eggs graded 73 percent A or AA and the refrigerated eggs graded 67 percent A or AA.

Dawson (1956) revealed that the candled quality of eggs held in a refrigerated cooler at $58^{\circ}\text{F.} \pm 2^{\circ}\text{F.}$, showed 56.2 percent AA quality. Those held in the basement at a temperature of 72°F. to 77°F. showed 26 percent AA quality; whereas those held in the feed room (33°F.) had only 17 percent AA quality eggs.

Fry and Newell, (1956) studied the effect of holding conditions on the interior quality of eggs by holding eggs at 60°F. for one day and at 30°F. for seven days. The eggs held for one day at 60°F. were lower in quality than those held for seven days at 30°F.

Smith and Hawes, (1956) reported that greater emphasis was placed on refrigeration of eggs during the spring and summer months than other months in Maryland retail stores. Stores located in high income areas gave more attention to refrigeration than those located in other areas. Two thirds of the eggs were kept under refrigeration in chain and independent stores.

Procurement and Merchandising Practices

Savage, (1951) disclosed that most of the eggs from independent and cooperative retail stores in Maine were purchased from farmers while the chain stores were supplied by wholesalers and chain store warehouses. Cray, (1952) stated that all of the chain stores in Cleveland, Ohio received their eggs from wholesalers, whereas independents purchased 70 percent from wholesalers and 10 percent from farmers. Smith and Hawes, (1956) found that chain stores in Maryland received 87 percent of their eggs from local warehouses and the remainder from wholesalers and jobbers. Independent retail stores in Maryland received 69 percent of their eggs, 13, 8, 4, and 6 percent from wholesalers, hucksters, jobbers, producers and other suppliers respectively.

Larzelere and Nichols, (1950) revealed that consumers in seven Michigan cities usually purchased eggs once per week while 27.5, 35.2, 28.0, and 9.3 percent of the purchases of eggs had been packed 0-3, 4-7, 7-14, and 15-34 days, respectively. Stadelman and Jensen, (1952) divulged that three-fourths of the eggs purchased by retail stores in the state of Washington were held 7 days and $\frac{1}{4}$ were held 8-14 days. Cray (1952) reported that chain stores in Cleveland purchased eggs completely processed and for sale to the consumers. Sixty-nine percent purchased them twice per week and thirty-one percent received them four times per week.

Only forty-seven percent of the independent stores purchased eggs two or more times a week. Seventy-three percent of the independents received eggs completely processed and twenty-five percent secured them in bulk, forcing them to be cartoned in the stores. Jasper and Cray, (1953) disclosed that most consumers in Columbus purchased eggs once per week. Taylor, et al. (1954) reported that 81 percent of the families surveyed in Rhode Island bought eggs once per week at the time of shopping for groceries or from peddlers and farmers.

NyBrotten, (1952) found that the average retail store in West Virginia sold less than 74 dozen eggs per week in the summer of 1949. These stores sold 5.1 dozen eggs for each \$100.00 gross sales. Stores selling a large volume had higher quality eggs.

Price Differentials and Margins

Darrah and Henderson, (1953) disclosed that a price differential in quality of 4-6 cents per dozen was preferred by consumers buying grade AA and A quality eggs in supermarkets in New York state. Thirty-seven percent of all customers bought grade A large eggs, and forty-five percent of egg customers bought the highest quality eggs available. Jasper and Cray (1953) reported that seventy-five percent of the consumers in Columbus, Ohio were willing to pay a

premium for good eggs. Slocum and Swanson, (1954) revealed that twenty-two percent of the egg consumers in Seattle would be willing to pay a premium of five cents for good quality eggs.

Savage, (1951) disclosed that the gross margins for eggs in retail stores in Maine averaged 8.8 cents with a range from 2 to 22 cents. The average margin for chain stores was 5.3 cents, 8.2 cents for cooperative stores, and 9.2 cents for independent stores. Kemp et al. (1952) revealed that "the gross margin in independent and voluntary chain stores in the northeast region of the United States varied from 0 to 25 cents a dozen. The margin increased with the size of eggs per dozen. The average margin was 9.5 cents for the independent stores and 9.6 cents for voluntary chains." Becker, (1953) in a study of egg marketing in retail stores in Pennsylvania found the average margin in independent stores to be 9.1 cents per dozen. The average margin varied with the method of mark-up, type of package, point of packaging, and size of eggs.

Conlogue and Pritchard (1955) studied the marketing margins of independent and chain retailers in Washington, D. C. for two years, during which they found that the margins varied among grades and sizes of eggs but that a consistent pattern was maintained in relation to egg prices and season of the year. It appeared that the independent retailers attempted to maintain a margin of 12 cents throughout the

year regardless of price, size, volume or season. The chain stores in the Washington area had an average margin of 8.2 cents per dozen but there was considerable variation in the margins among the different chains. Some of the chains had margins of only 3 to 4 cents per dozen, while others had a gross margin of 10 cents. The difference in margins among the stores appeared to be the results of differences in methods of handling eggs and differences in store policies in regard to prices and margins.

Conlogue and Mason (1956) reported that retail prices and farm-retail spreads for the large and medium grade A eggs displayed were remarkably similar in their variation. The variations in price spreads seemed to be due to "lags" in the movement of retail prices. Losses in egg quality during hot weather greatly increased marketing cost.

Conlogue and Gray (1956) traced 15,000 dozens of eggs from a western farm through the channels of distribution to ascertain detailed information on prices and operating costs and practices from all marketing agencies handling these eggs. The retail margin averaged 10 cents per dozen for large stores and 12.5 cents per dozen for small independent stores.

Conlogue and Kaiser (1958) discovered that there was a large per dozen increase in margins for eggs in 1957 over the 1953 and 1954 margins. Most of the increase appeared to be due to a change in pricing policy for eggs rather than to

a rise in cost of handling. Gross margins of chain-store retailers in Washington averaged about 12.5 cents per dozen as compared with 8.3 cents for 1953-54.

Gray (1957) reported that egg margins from the farm to retail were lower in 1956 than in any year since 1949. This downward trend has been gradual and the changes in margins in cents per dozen have not been large.

RESULTS AND DISCUSSION

Description of Eggs Obtained and Broken

Eggs obtained for this study from the six retail outlets in the Lansing area were similar to those available to all shoppers and were identified in terms of quality, size, color, and brand, as shown in Table 1. Quality designations were grade A, grade B, and checks. Eggs designated as grade A were sold in only four stores and in only one store were eggs sold as grade B; and in only one store were there eggs sold as checks as well as grade A. Grade B eggs were sold in store 3 for four months, while checks were sold throughout the year in store 2. Four sizes of eggs were offered to consumers: extra large, large, medium, and small. Brown and white eggs were both offered in store 2 throughout the year in the four sizes mentioned above. Associated with grade A eggs were 5 brands which are identified as brands L, M, N, O, and P.

Exterior Quality

Shell Cleanliness

A. Analysis on an Individual Egg Basis

Nearly three fourths of all eggs examined were clean enough to satisfy requirements for the stated quality; that is, 4688 of the 6323 eggs examined were clean. About one fifth (21.4 percent) were classified as B quality for cleanliness,

TABLE 1 Eggs Offered by Six Retail Outlets

Store number	Store designation	Grades	Sizes	Brands	Colors
1	Local chain	A	Extra large Large Medium	L M	White
2	Independent	A Chex	Extra large Large Medium Small		White Brown
3	National chain	A	Large Medium		White
4	Regional chain	B A	Large Extra large Large Medium Small(one month)		White White
5.	Regional chain	A	Large Medium	N O P	White
6	Independent	A	Extra large Large Medium Small	-	White

.9 percent as C, and 4.5 percent as dirty (3.7 percent had serious stains and .8 percent had adhering dirt). The cleanest eggs were sold in store 4 followed by stores 6, 3, 5, 2, and 1 respectively. The percentage of eggs below the stated quality is shown in Table 2 and Figure 1.

A Chi square analysis showed that eggs sold by stores 4 and 6 were not significantly different in cleanliness; however, Chi square values showed that eggs from these two stores (4 and 6) were significantly cleaner (1 % level) than eggs from all other stores. (Table 3).

B. Analysis on a Dozen Basis

In candling and sorting procedures, eggs are all classified individually and are then placed in appropriate carton or case. Because of human variability and possible error, certain tolerances are allowed in grades of eggs sold. For each dozen of eggs, this tolerance amounts to two eggs allowable in the next lower quality, hence any one dozen of grade A eggs may contain two eggs with B cleanliness.

Only 33 percent of the dozens qualified for grade A on a cleanliness basis, whereas 32.8 percent would have been classified as grade B, 3.2 percent as C and 31.0 percent as dirty. Only one dozen in three met the grade A standard for cleanliness, one in three met the grade B standard, three in one hundred grade C standard, and three in ten were classified as dirty. (Table 4).

TABLE 2 Shell Cleanliness of Individual Eggs, By Stores

Cleanliness quality	Stores						Total of all stores	% of total
	1	2	3	4	5	6		
A quality	646	1379	450	808	593	812	4688	74.14
B quality	408	450	118	53	186	77	1292	21.43
C quality	19	16	2	11	5	3	56	.89
Stains	54	78	27	34	26	16	235	3.72
Dirty	13	21	3	5	6	4	52	.82
Total eggs examined	1140	1944	600	911	816	912	6523	100.00
Total eggs below A quality	494	565	150	103	223	100	1635	
% below A quality	43.3	29.0	25.0	11.3	27.3	10.9		25.86

FIGURE 1 SHELL CLEANLINESS OF GRADE A EGGS
FROM SIX RETAIL OUTLETS

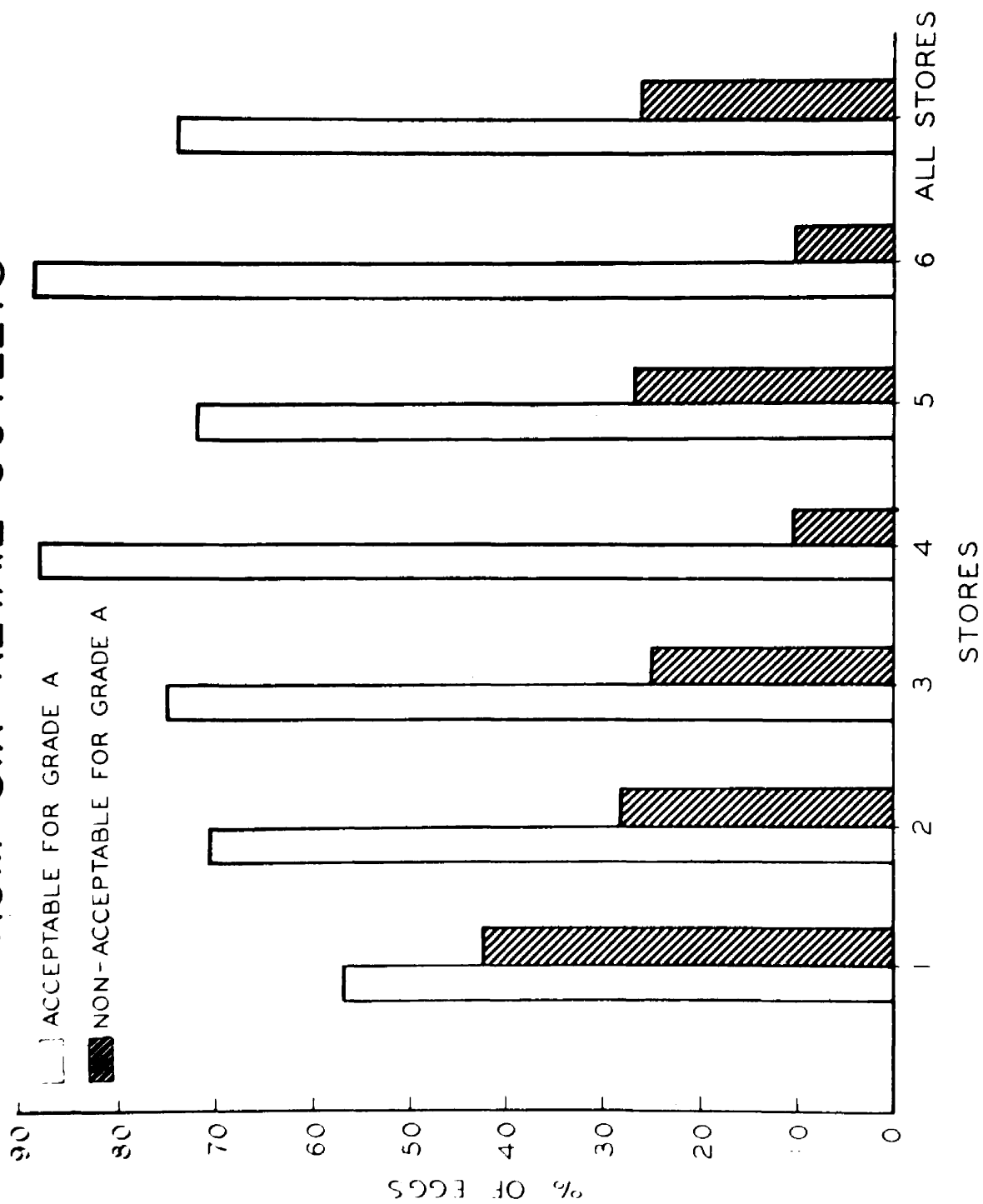


TABLE 3 Chi Square Values for Cleanliness;
Dozens of Eggs, Between Stores

Store comparisons					Chi square values	Sign. values in table	
Store 6 versus store 1					10.05**	χ^2_{05}	$\chi^2_{.01}$
"	"	"	"	2	7.29**	3.84	6.64
"	"	"	"	3	4.32*		
"	"	"	"	4	3.34*		
"	"	"	"	5	5.15*		

* Significant at 5% level.

** Significant at 1% level.

TABLE 4 Shell Cleanliness of Dozens of Eggs, By Stores

Cleanliness classifi- cation	Stores						Total of all stores	% of total
	1	2	3	4	5	6		
Dozens of Eggs								
Grade A	14	45	15	23	29	48	174	33.0
Grade B	42	54	16	26	22	13	173	32.8
Grade C	3	7	2	3	--	2	17	3.2
Stains	28	40	3	15	9	10	105	19.9
Dirty	8	16	14	9	8	3	58	11.1
Total dozens examined	95	162	50	76	68	76	527	100.0
Total dozens below grade A	81	117	35	53	39	28	353	

Shell Condition

A. Analysis on Individual Egg Basis

A majority of all eggs purchased (88.9 percent) had sound shells, and only 11.1 percent were unsound. Eggs from store 6 had the highest percentage of sound shells with eggs from stores 5, 2, 3, 1, and 4 ranked in order below 6. (Table 5).

The unsound eggs were classified as blind cracks, cracks, smashed, and leakers. Seventy nine percent of the unsound eggs had blind cracks, 17.6 percent had cracks, three percent were leakers, and .4 percent were smashed. (Figure 2). These results agree with data reported by Hauver and Hamann (1955) in which they reported that "blind checks are the most common and frequently the most difficult to detect in rapid candling. Such eggs will not keep well or stand even moderately rough handling."

Table 6 shows the ranking of the stores on the basis of soundness of eggs sold and Table 7 shows the significant differences in shell soundness of eggs between stores 3 and 4 based on Chi square analysis.

B. Analysis on a Dozen Basis

All of the eggs were sound shelled in nearly two fifths (38.6 percent of the dozens purchased. Of those dozens containing unsound shells, blind cracks accounted for 60.8 percent; cracks, for 31.9 percent, and leakers, 6.7 percent.

(Table 8).

TABLE 5 Shell Condition of A Quality Eggs, By Stores

Shell condition	Stores						Total of all stores	% of total
	1	2	3	4	5	6		
Number of Eggs								
Sound	979	1562	534	773	749	851	5447	88.90
Blind cracks	125	170	47	98	53	49	533	8.69
Cracks	33	21	11	35	14	12	125	2.03
Smashed	1	--	2	--	--	--	3	.01
Leakers	4	8	6	5	1	--	23	.04
Total	1140	1752*	600	911	816	912	6141	100.00
Total below A quality	161	181	66	138	67	61	684	
% below A quality	14.1	10.3	10.9	15.3	8.3	6.7		11.10

FIGURE II SHELL CONDITION OF GRADE A EGGS
FROM SIX RETAIL OUTLETS
1957

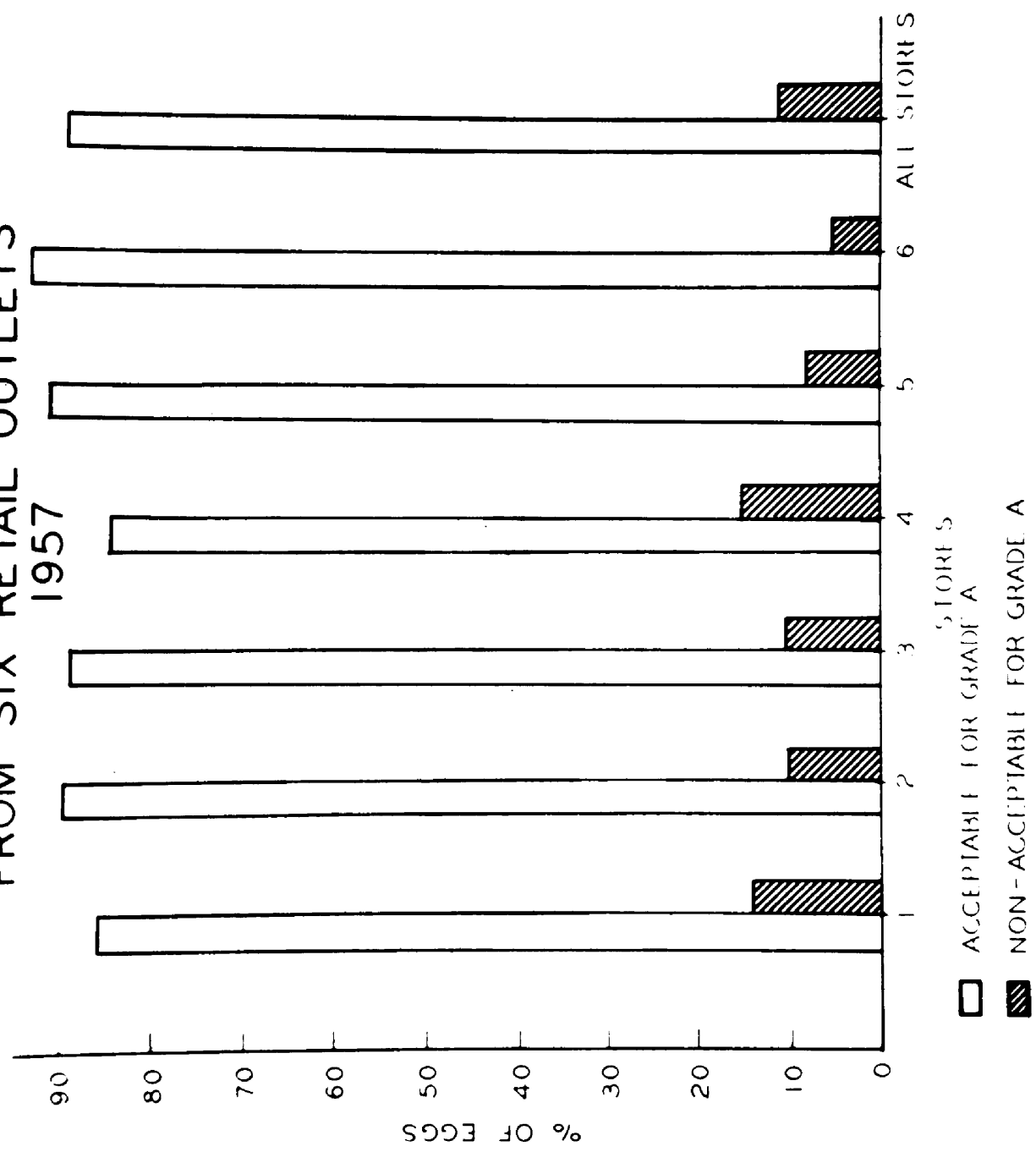


TABLE 6 Retail Stores Ranked According to Percentage
Of Sound Shells for Individual Eggs

Store	Rank	% with sound shells	Stores significantly below ranked store
6	1	48.7	1**, 2***, 3*** and 4**
5	2	44.0	1 and 4 (*** each)
2	3	43.2	1** and 4***
3	4	42.0	4*
1	5	25.3	2
4	6	29.0	None

* Significant at 5 % level.
 ** " " 1 % " "
 *** Significant at .1 % " "

TABLE 7 Observed and Expected Frequency
Of Shell Condition of Eggs
From Two Stores

Condition	Store 3			Store 4			Total
	Observed	Expected	Diff.	Observed	Expected	Diff.	
Sound	600	586.8	13.2	911	924.2	13.2	1511
Unsound	66	79.2	-13.2	138	124.8	13.2	204
Total	666			1049			1715

$\chi^2 = 4.08$ * significant at 5% level.

TABLE 8 Shell Condition of Dozens of Eggs, By Stores

Shell Condition	Stores						% of dozens purchased	% of violations
	1	2	3	4	5	6		
	Dozens of Eggs						Total	
Sound	24	63	21	22	30	37	197	38.55
Blind crack	37	58	13	28	26	28	191	39.38
Crack	30	17	11	20	11	11	100	19.57
Smashed	1	--	1	--	--	--	2	.39
Leakers	3	8	4	6	1	--	21	4.11
Total dozens examined	95	146**	50	76	68	76	511**	100.00
Total dozens below grade A	71	83	29	54	38	39	314	
% below grade A	74.7	56.8	58.0	71.0*	56.0	51.3		100.00

197 dozen sound; 314 dozen unsound.

* - 1 missing egg.

** - 16 dozen checks omitted.

No significant difference in shell condition was found, Chi square analysis, among the stores when analyzed for grade A eggs; therefore the differences were most likely due to chance.

Shell Thickness

The mean shell thickness for all eggs from each store was essentially the same. Individual egg shell thickness varied from .007 inch to .015 inch; however the mean shell thickness of all dozens of eggs was .012 inch. The recommended standard is .013 inch, (Brant and Shrader, 1952).

In Table 9 the mean shell thickness for dozens of eggs from each store is given. The mean shell thickness ranged from .011 inch (store 6) to .12 inch, all other stores. The standard error of the thickness scores for stores 1 and 6 were computed because they had the greatest difference between means. The difference was not significant.

Shell Color

In most stores visited, very few brown shelled eggs were sold and the color was usually not stated. However in store 2, white and brown eggs were offered every week. Brown eggs were offered in store 6 occasionally and the color was stated on the carton. Thirty eight percent of all cartons contained both brown and white eggs. In some cartons the color varied from 1 to 4; that is, white to dark brown.

TABLE 9 Mean Shell Thickness of Dozens of Eggs, By Stores

Shell thickness thousandths inch	Stores						Total of all stores	Total % of total
	1	2	3	4	5	6		
	Dozens of Eggs							
7	-	1	-	2	-	-	3	.56
8	-	1	1	1	1	-	4	.76
9	1	8	-	2	3	3	17	3.23
10	8	22	7	2	4	12	55	10.44
11	42	55	20	37	27	38	219	41.56
12	16	30	10	15	13	6	90	17.08
13	7	13	7	3	6	6	42	7.97
14	11	24	5	14	12	9	75	14.23
15	10	8	-	-	2	2	22	4.17
Total	95	162	50	76	68	76	527	100.00
Mean	11.98	11.71	11.58	11.60	11.82	11.46	11.71	

Eighty two percent of all the eggs purchased were not labelled as to color; yet their mean shell color was 1.5, or a tint.

Interior Quality

Quality of Eggs as Indicated by Candling

A. Analysis on an Individual Egg Basis

Three fourths (73.5) percent) of all eggs purchased were classified as A quality or better by candling. Of the remaining eggs, 13.2 percent were B quality and 12.8 were C quality (Table 10). A ranking of the stores according to the percentage of A quality eggs purchased is shown in Table 11. Eggs from store 6 ranked first with 87.6 percent of all eggs being A quality or better, whereas eggs from store 3 were lowest in percentage of A quality or better (60.5 percent).

B. Analysis on a Dozen Basis

The percentage of dozens qualifying for grade A was much less than the percentage of individual eggs of A quality or better. Approximately one fourth (26.9 percent) of the dozens of eggs were classified as grade A, 47.1 percent were classified as grade B, 21.8 percent were grade C, and 4.2 percent were loss and inedibles. Store 6 again ranked first in percentage of dozens of the top grade (Table 12).Candled grades of eggs from each store are shown in Table 13.

TABLE 10 Candled Quality of Eggs From Each Store

Quality	Stores												Total no. eggs	% all stores
	1		2		3		4		5		6			
	No. eggs	%	No. eggs	%	No. eggs	%	No. eggs	%	No. eggs	%	No. eggs	%		
AA or A	818	71.7	1511	77.7	363	60.5	628	68.9	530	65.0	799	87.6	4649	73.5
B	233	20.4	216	11.1	149	24.8	98	10.9	132	16.2	7	.8	835	13.2
C	81	7.1	205	10.5	86	14.3	180	19.7	152	18.6	106	11.6	810	12.8
Others	8	.7	12	.7	2	.4	5	.5	2	.2	---		29	.5
Total	1140	100.0	1944	100.0	600	100.0	911*	100.0	816	100.0	912	100.0	6323	100.0

* 1 egg missing

TABLE 11 Rank of Stores According to Percentage of A Quality Eggs Found by Candling

Rank	Stores	Percentage of A Quality eggs
1	6	87.6
2	2	77.7
3	1	71.7
4	4	68.9
5	5	65.0
6	3	60.5

TABLE 12 Rank of Stores According to Percentage Of Dozens Qualifying for Grade A

Rank	Stores	Percentage of Dozens Grade A
1	6	42.1
2	2	31.5
3	1	26.3
4	3	24.0
5	4	19.8
6	5	10.3

TABLE 13 Canded Grades of Eggs from Each Store (Dozens)

Grades	Stores						Total No. Doz.
	No. 1 Doz. %	No. 2 Doz. %	No. 3 Doz. %	No. 4 Doz. %	No. 5 Doz. %	No. 6 Doz. %	
AA or A	25 26.3	51 31.5	12 24.0	15 19.7	7 10.3	32 42.1	142 26.9
B	61 64.2	63 38.9	24 48.0	28 36.8	42 61.8	30 39.5	248 47.1
C	6 6.3	36 22.2	12 24.0	28 36.8	19 27.9	14 18.4	115 21.8
Others	3 3.2	12 7.4	2 4.0	5 6.6	-- ----	-- ----	22 4.2
Total	95 100.0	162 100.0	50 100.0	76 100.0	68 100.0	76 100.0	527 100.0

Many of the dozens sold as grade A eggs were not grade A when candled in the laboratory. The rapidity of candling in the egg processing plants, the element of human judgment in classifying eggs, and the elapsed time since candling resulted in these lower qualities. Further analysis of the eggs by other methods of measuring quality in this study is warranted.

Haugh Scores

A. Analysis on Individual Egg Basis

A Haugh score was determined for each egg broken. On this basis, 88.5 percent were A or AA quality, and 11.5 percent were below A quality, that is, below a Haugh score of 55.0. (Table 14). The eggs purchased as grade B had 74 eggs of C quality. Thus, of the 168 eggs purchased as grade B, a larger proportion of the eggs were A quality than were of the stated quality. Eggs from store 6 had a mean Haugh score of 83.9, or 12.8 higher than any other stores.

B. Analysis on a Dozen Basis

Because of the wide range of 24 Haugh units between the lowest and highest qualities within each grade, a Haugh score distribution table with class limits of 8 units was used to divide each grade into three levels: high, average, and low. The mean score for each dozen indicated that 22.58 percent were AA quality; 71.91 were A quality; and 5.50 percent were B quality. Table 15.

TABLE 14 Haugh Scores of Individual Eggs, By Stores

Quality	Haugh Scores	Stores						Total	%
		1	2	3	4	5	6		
AA	79-103	251	527	117	164	166	660	1885	29.81
A	55-78.9	755	1184	383	619	35	236	3712	58.71
B	31.0-54.9	121	210	92	115	104	13	655	10.36
C	0.0-30.9	13	23	8	13	11	3	71	1.12
Total		1140	1944	600	911	816	912	6323	100.00
$\bar{X}$		69.1	70.3	67.3	67.5	67.9	83.9	71.1	

TABLE 15 Haugh Score Distribution for Dozens of Eggs, By Stores

Haugh Score Class Limits	Stores						Total		Percent	
	1	2	3	4	5	6	Level	Grade	Level	Grade
	Number of Dozens									
AA 95-102						1	3		.58	
87-94.9	1	2				22	25		4.74	
79-86.9	11	24	7	5	4	40	91	119	17.26	22.58
A 71-78.9	35	56	14	22	22	12	161		30.55	
63-70.9	29	43	11	29	25		137		25.99	
55-62.9	14	28	12	14	12	1	81	379	15.37	71.91
B 47-54.9	3	6	6	5	5		25		4.74	
39-46.9	1	1		1			3		.58	
31-38.9	1						1	29	.19	5.50
Total	95	162	50	76	68	76	527	527	100.00	100.00

The distribution of Haugh scores per dozen of eggs in AA, A, and B grades according to stores is shown in the Appendix, Tables i through vi. Table 16 shows a ranking of the stores according to the quality of eggs sold as measured by Haugh scores. Eggs from store 6 ranks first in percentage of AA eggs and eggs from store 5 ranked last.

Table 16 Stores Ranked According to the Percentage of Dozens Qualifying for Each Grade Based on Haugh Scores

Percentage of eggs in grade AA		
Rank	Store	Percentage
1	6	82.89
2	2	17.28
3	3	14.00
4	1	12.63
5	4	6.58
6	5	5.88
Percentage of eggs in grade A		
1	5	86.76
2	4	85.52
3	1	82.10
4	2	78.39
5	3	74.00
6	6	17.10
Percentage of eggs in grade B		
1	6	.00
2	2	4.32
3	1	5.27
4	5	7.36
5	4	7.89
6	3	12.00*

* Of this number, 10 percent of the dozens were

purchased as grade B, thus of the eggs purchased as grade A, store 3 would rank second for percentage of dozens qualifying for grade A on Haugh score basis.

The monthly mean Haugh score for dozens of eggs from the six retail outlets was highest in January (77.2 Haugh units) and lowest in July, (62.2 Haugh units). The mean Haugh score for dozens of eggs for the duration of the study was 70.9. (Figure III).

An analysis of variance was made for Haugh scores for dozens of eggs by seasons, color of shell, grade, brands, and size.

1. Seasons

Haugh scores by seasons were as follows:

Season 1 (January, February, March)-----	Haugh score 75.8
Season 2 (April, May, June)-----	Haugh score 75.8
Season 3 (July, August, September)-----	65.2
Season 4 (October, November, December)--	72.4

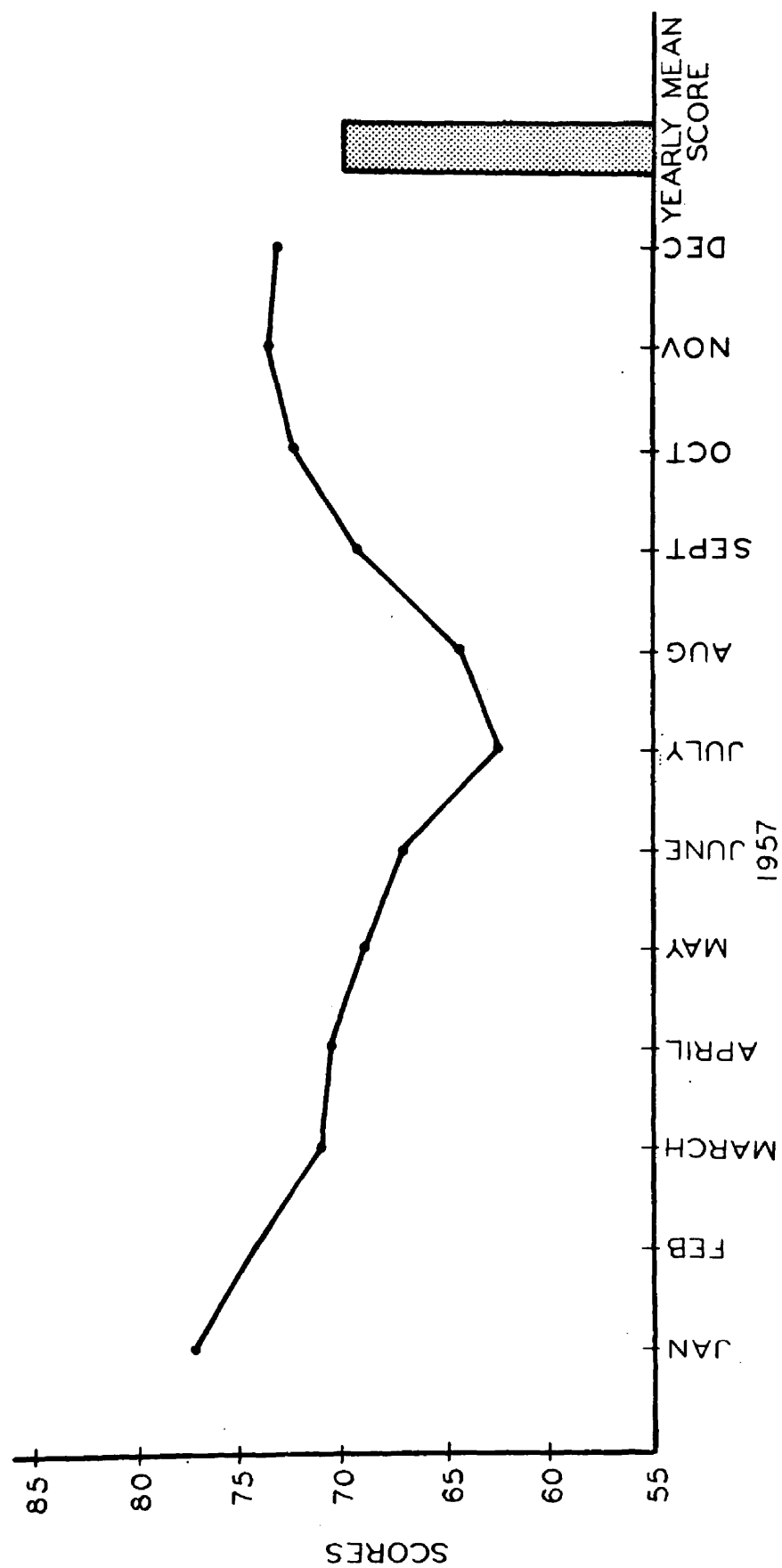
TABLE 17 Analysis of Variance for Mean Dozen Haugh Scores for Four Seasons

Source	SS	d.f	MS	F	F.01
Total	52807.6	526			
Grades	7562.4	3	2520.8	29.14*	4.65
Error	45245.2	523	86.5		

* Significant at the 1 percent level.

According to Table 17 above quality of eggs in these

FIGURE III MONTHLY HAUGH SCORE OF DOZENS OF EGGS FROM SIX RETAIL OUTLETS



stores was significantly lower in the summer months than in the winter months.

2. Shell color

The mean Haugh score for white shelled eggs was 70.3 and for brown shelled eggs, 70.7. This difference was not significant.

3. Grade

The mean Haugh score for grade A eggs was, 68.3; grade B, 59.1; and for checks, 65.4. The quality of grade A large and checks was significantly higher than the quality of grade B large eggs. (Table 18).

TABLE 18 Analysis of Variance for Distribution
 Of Haugh Scores Among
 Three Grades of Eggs

Source	d.f	SS	MS	F	F.05	F.01
Total	53	5151.1				
Grades	2	725.8	362.9	4.18*	3.18	5.06
Error	51	4425.3	86.8			

* Significant at the 5 percent level.

4. Brands

The mean Haugh score for the brands of extra large grade A eggs were 66.5 (brand L) and 65.3 (brand M). The difference between the mean Haugh scores of each brand was

not significant. The mean Haugh scores were 72.5, 66.5, 69.0, and 66.1 for brands L, M, N, and O of grade A large eggs respectively. (Table 19). Brands L, M, and P had mean Haugh scores of 74.6 (brand L), and 74.2 (brand M) and 68.5 (brand P) for medium eggs.

TABLE 19 Analysis of Variance for Haugh Scores
For Four Brands of Grade A Large Eggs

Source	d.f	SS	MS	F	F.05	F.01
Total	84	4891.2			2.72	F.01
Brands	3	529.5	176.5	3.28*		
Error	81	4361.7	53.8			

* Significant at the 5 percent level.

From the calculated F value of 3.28 and the mean Haugh scores for each brand, it was concluded that grade A large eggs of brands L and N were significantly superior to brands M and O grade A large eggs. All other differences were not significant.

5. Sizes

The mean Haugh scores for each size of eggs purchased from each store is shown in Table 20. Haugh scores for extra large eggs among stores were not significantly different.

The difference in Haugh scores for grade A large eggs among stores 1 through 5 was 2.4 Haugh units. The mean Haugh score for store 6 was 14.1 units higher than the lowest of

TABLE 20
Mean Haugh Score of Eggs by Size, Brand, and Mean
Of All Eggs from Each Store

Egg Size	Stores						Mean all Stores
	1		2	3	4	5	
	L	M			N	O	
	P						
X-L	66.5	65.3	66.4		65.1		65.8
L	72.5	66.5	69.9	68.3	67.6	69.0	81.6
M	74.6	74.2	72.7	76.5	70.3		84.6
S			76.0				84.3
Chex			65.4				84.3
B				59.1			59.1
Mean	69.9	70.0	67.9	67.7	67.9	83.5	70.9*

* Difference due to rounding error.

the other stores. Difference in mean Haugh scores among grade A large eggs from the six stores was significant at the 1 percent level, (Table 21).

TABLE 21 Analysis of Variance of Haugh Scores
For Dozens of Grade A Large Eggs From
Six Stores

Source	d.f	SS	MS	F	F.01
Total	203	14118.2			
Stores	5	3869.6	773.9	14.94**	3.11
Error	198	10248.6	51.8		

** Significant at the 1 percent level.

The stores were ranked according to the mean Haugh scores of medium size eggs purchased from them (Table 22). The mean Haugh score ranged from 68.5 (store 5) to 84.6 (store 6).

TABLE 22 Stores Ranked According to Haugh Units
Of Medium Sized Eggs

Rank	Store	Mean Haugh Score
1	6	84.6
2	3	76.5
3	1	74.4
4	2	72.7
5	4	70.3
6	5	68.5

The differences in mean Haugh scores for medium sized eggs were significant at the 1 percent level. (Table 23).

TABLE 23 Analysis of Variance of Mean Haugh Scores
For Grade A Medium Eggs From Six Stores

Source	d.f	SS	MS	F	F.01
Total	143	13634.6			3.19
Stores	5	4131.5	826.3	11.99*	
Error	138	9503.1	68.9		

* Significant at the 1 percent level.

Grade A small eggs were sold consistently in only stores 2 and 6. The mean Haugh score for these eggs from store 6 was 84.3 compared to 76.0 for store 2. This difference was significant at the 1 percent level.

The mean Haugh score for all eggs of all sizes ranged from 65.9 (extra large) to 79.3 (small). Table 24.

TABLE 24 Mean Haugh Scores For All Eggs, By Size

Size	Mean Haugh Score
Extra large	65.9
Large	70.2
Medium	74.3
Small	79.3

The differences in mean Haugh scores among sizes were significant at the 1 percent level. (Table 25).

TABLE 25 Analysis of Variance of Haugh Scores
For All Eggs Purchased from Six Stores

Source	d.f	SS	MS	F	F.01
Total	497	47996.3			3.82
Sizes	3	7580.6	2526.9	30.89**	
Error	494	40415.7	81.8		

The analysis of variance shows that Haugh scores of eggs increased significantly with a decrease in size.

U.S.D.A. Scores

A. Analysis on Individual Egg Basis

The USDA scores ranged from 1--high AA quality, to 12--low C quality. The mean USDA score for all eggs was 5.1 or average A quality. The mean score for the eggs from each store were 4.1, 5.5, 5.6, 5.9, 5.9, and 4.0 for stores 1 through 6 respectively.

B. Analysis on a Dozen Basis

According to USDA scores, 91 percent of the dozens of eggs qualified for grade A or above, while only 9.0 percent were low enough for B grade. (Table 26). The mean USDA score of all dozens from store 6 was 3.5 or high A quality with 47 percent of the dozens qualifying for AA grade.

TABLE 26 USDA Score Distribution for Dozens of Eggs by Stores

USDA Classifi- cation	No.	Stores						Total all Sizes	
		1	2	3	4	5	6	No.	%
		Number of Dozens							
High AA	1	-	3	-	-	-	1	4	.76
Med. AA	2	-	2	7	-	-	12	17	3.20
Low AA	3	3	14	2	4	4	23	50	9.46
High A	4	25	30	5	10	12	26	108	20.52
Med. A	5	2	53	14	22	17	12	150	28.40
Low A	6	30	47	20	27	25	2	151	28.41
High B	7	5	14	6	11	7	-	41	8.10
Med. B	8	1	-	-	2	3	-	6	1.14
Low B	9								
Total		95	162	50	76	68	76	527	100.00
$\bar{X}$		3.7	5.0	5.4	5.5	5.4	3.5	4.8	

The dozens of eggs from other stores (1 through 5) had mean scores of 3.7, 5.0, 5.4, 5.5, and 5.4 respectively.

Meat Spots

A. Analysis on Individual Egg Basis

Meat spots of various sizes and colors were found in 1,290 eggs, an average of 1 spot in each 5 eggs. About one-fourth of these meat spots (335) were size 1 (less than 1/32 inch in size), 525 were size 2 (from 1/32 to 1/8") and the remaining 430 were larger than 1/8" in diameter. Table 27 shows the distribution of spots among sizes of eggs from each store. The number of spots found per dozen eggs ranged from 1.7 (store 3) to 2.9 (store 1).

B. Analysis on a Dozen Basis

Chi square analyses were made for differences in number of meat spots found in eggs of different sizes and among stores. No significant differences were found in number of spots contained in extra large eggs among stores. However, significant differences were found in number of spots among large sized eggs. Eggs from stores 1, 2, and 5 contained significantly more spots than those eggs from store 3. The number of spots found in eggs from stores 4 and 6 were significantly more than were found in eggs from store 3 (5 percent level).

Medium sized eggs from stores 4 and 5 had significantly fewer spots (5 percent level) than eggs from store 2. Small sized eggs from store 6 had significantly fewer spots than did

TABLE 27 Meat Spots in Individual Eggs, By Stores

Weight class	Spot Size	Stores and Brands										Total all stores
		1	2	3			4	5			6	
		L	M	Wh.	Br.	A	B	N	O	P		
Extra large	1	11	12	23	13							73
	2	24	15	30	25							122
	3	21	25	23	40							138
	Total	56	52	76	78							333
Large	1	19	19	16	15	16	9	16	11		20	163
	2	32	20	32	24	24	12	30	29		30	251
	3	20	14	16	26	10	16	11	20		10	165
	Total	71	53	64	65	50	37	57	60		60	579
Medium	1	9	-	11	10	22				10	12	74
	2	22	-	17	20	17				19	23	118
	3	16	-	4	10	20				22	23	95
	Total	47	-	32	40	59				51	58	287
Small	1			10	6						9	25
	2			8	2						24	34
	3			6	6						20	32
	Total			24	14						53	91
Total spots		174	105	196	197	87	192	57	60	51	171	1290
Total eggs purchased		528	612	1068	876	600	912	252	276	288	912	6323
Total doz. bought		44	51	89	73	50	76	21	23	24	76	527
Spots per dozen		2.9	2.4	1.7	2.5	2.4	2.2	2.4	2.2	2.4	2.4	53

Code: 1 = Less than 1/32" --C grade; 2 = Less than 1/8" --C grade; 3 = greater than 1/8" --Loss

eggs from stores 6 and 2.

Chi square tests for meat spots between brands showed that brand L had significantly fewer spots than brand M (5 percent level) and fewer than brand P (1 percent level).

The relatively high meat spot incidence indicated that 18.60 percent of the dozens may have been classified as loss; 30.93 percent may have been classified as C; and only 50.47 percent would have qualified as grade A. (Table 28).

Blood Spots

A Analysis on Individual Egg Basis

Blood spots were of major consideration in the eggs observed, ranging in size from $1/32$ inch to $1\frac{1}{4} \times \frac{1}{4}$ inches. Table 29 shows the distribution of blood spots found by stores, sizes, and grades of eggs.

B. Analysis on a Dozen Basis

The mean number of blood spots per dozen found in eggs from each of the six stores was .46, .49, .44, .30, .31, and .84 from stores 1 through 6 respectively. The mean incidence of blood spots per dozen was .48 or less than 1 spot in every two dozen eggs. (Table 29). The effect of blood spots on the grade of eggs is shown in Table 30. Only 15 percent of the dozens may have been penalized because of blood spots.

Chi square tests for blood spots in eggs among stores,

TABLE 28 Meat Spot Incidence in Eggs Broken,
By Stores

Grade	Stores						Total	% of Total
	1	2	3	4	5	6		
Absence of meat spots	43	70	33	41	36	43	266	50.47
Grade C	30	64	10	21	19	19	163	30.93
Loss	22	28	7	14	13	14	98	18.60
Total	95	162	50	76	68	76	527	100.00
No. below grade A	52	92	17	35	32	33	252	
% below grade A	45.2	56.7	34.0	46.0	47.0	43.3	47.8	

TABLE 29 Blood Spots in Dozens of Eggs, By Stores

Weight class	Spot size	Stores and Brands										Total all stores
		1	2	3	4	5	6	7	8	9	10	
		L	M	Wh.	Br.	A	B	C	D	E	F	
Extra large	1	1	3	2	2							
	2	2	1	1	8							
	3	4	7	1	15							
	Total	7	11	4	25							55
Large	1	-	7	11	4	7						
	2	1	-	2	9		4					
	3	7	2	4	9		11					
	Total	8	9	7	22		22					101
Medium	1	2	1	1	2							
	2	1	3	3	7							
	3	2	2	2	2							
	Total	5	6	6	11							63
Small-	1				3							
	2											
	3											
	Total				3							33
Total spots		20	22	22	58		22	23	8	5	8	252
Total eggs purchased		528	612	1068	876		600	912	252	276	288	912
Total dozen bought		44	51	89	73		50	76	21	23	24	527
$\bar{X}$ spots per dozen		.46		.49		.44	.30			.31		.48

TABLE 30 Distribution of Egg Quality As Affected
 By Blood Spot Incidence Within Dozens
 Of Eggs

Grade	Stores						Total	% of all eggs
	1	2	3	4	5	6		
A	84	141	31	69	62	62	449	85.2
C	5	15	15	4	3	9	51	9.7
Loss	6	6	4	3	3	5	27	5.1
Total	95	162	50	76	68	76	527	100.0

sizes, and brands showed the following results: eggs from store 5 had significantly fewer blood spots than eggs from store 6 (5 percent level); and eggs from store 4 had significantly fewer blood spots than eggs from store 6 at the 1 percent level. Eggs from other stores were not significantly different in number of blood spots.

No significant differences were found in blood spot incidence among extra large eggs. However in all other size, differences were noted as follows: Among large eggs, those from store 1 had significantly more spots than eggs from store 2, store 2 had significantly more spots than eggs from store 5, and store 5 had significantly more spots than eggs from store 6 (five percent level). Among medium eggs, store 5 had significantly more blood spots than store 6 (5 percent level), and store 4 had significantly more spots than store 6 (1 percent level). Among small eggs, store 2 had significantly more spots than eggs from store 6 (1 percent level).

Brands

No significant difference in incidence of blood spots in eggs was found among brands, although differences were found among stores.

Inedible Eggs in Grade A Egg Purchases

Very few inedible eggs were found in this study. Only

fourteen sour eggs were found, all within ten dozen eggs, and one seeping yolk was found in each of two dozen grade A eggs during the summer months of 1957. (Table 31). All of the stores sold some eggs which were inedible except store 6. One sour egg was detected by candling and when broken out had a very pungent odor. Sour eggs may be caused by Pseudomonas fluorescens.

On a basis of the U. S. standards for dozens of grade A eggs, it was found that 85.2 percent would be classified as grade A; 9.7 percent would be classified as grade C; and 5.1 percent would be classified as loss.

Size of Eggs Retailed in Lansing Stores

A. Analysis on Individual Egg Basis

A majority of the eggs purchased qualified for the stated weight. Only .28 percent or 17 out of 6107 eggs observed were below the weight tolerance for individual eggs, and were all found in eggs from stores 5 and 6. Eleven eggs below the tolerance (65 percent) were found in large eggs, and 6 eggs were from medium sized eggs.

B. Analysis on a Dozen Basis

Sixteen dozen eggs out of 511 were below the minimum net weight per dozen. Dozens of eggs below the weight standards were from stores 1, 2, 4, and 6 with 1, 3, 1, and 11 dozens respectively. Table 32 shows the distribution of dozens of eggs found to be underweight among sizes of eggs

TABLE 31 Distribution of Number of Sour Eggs
Per Dozen Per Store

Number of eggs	Stores						Total sour eggs all stores
	1	2	3	4	5	6	
1	1	2	1	-	1	-	5
2	1	1	-	1	1	-	4
3	-	1	-	-	-	-	1
Total dozens with sour eggs	3	7	1	2	3		10 doz.
Total sour eggs	3	7	1	2	3	-	16 eggs

TABLE 32 Dozens of Eggs Below Minimum Weight By Stores

Sizes	Stores						Total
	1	2	3	4	5	6	
Extra large		1					1
Large	1	1				8	10
Medium				1		3	4
Small		1					1
Total	1	3		1		11	16

and stores.

Yolk color

A. Analysis on Individual Egg Basis

Each egg yolk was scored for color by comparison with a yolk color rotor having colors 1 (white) to 24 (red). Nearly two-fifths (39.8 percent) of the 6323 eggs observed were given a color score of 11. Twenty-three percent were lighter than 11, while 36.9 percent were darker.

The yolk color for individual eggs varied considerably between stores. The range in yolk color for each store is shown in Table 33.

B. Analysis on a Dozen Basis

Considerable variation in color among eggs within individual dozens was found. The mean yolk color for all dozens of eggs was 11.49 or a medium yellow color. (Table 34).

TABLE 33 Yolk Color of Individual Eggs From Six Retail Outlets

Color	Store								Total	% of total eggs	
	1		2	3	4	5		6			
	L	M				N	O				P
1											
2			1						3	2	6
3			2	1	1				2	1	7
4			3		2				2	1	8
5			7	6	4					1	18
6			5	3	6		1		2	4	21
7			12	4	6				2	8	32
8			37	4	20		1	6	9	14	97
9		1	5	8	19		5	9	14	26	158
10		7	5	65	116		29	42	50	178	989
11		49	107	353	65		100	84	89	402	2511
12		220	270	707	252		43	37	50	114	813
13		83	69	209	101		42	59	36	110	959
14		90	96	277	103		20	16	7	31	390
15		40	37	140	34		8	16	9	13	180
16		24	13	64	12		2	3	6	6	78
17		12	9	30	3		-	1	6	1	27
18		2	-	13	2		1	3	1	-	21
19		-	1	12	2		1	-	-	-	6
20		-	-	5	-		-	-	-	-	2
Total	521	612					252	276	288		6323
G. T.	1140	1944	600	911	816					912	100.000

TABLE 34 Mean Yolk Color of Dozens of Eggs
From Retail Outlets

Mean Colors	Stores						Total	%
	1	2	3	4	5	6		
6			1	1			2	.38
7		1					1	.19
8				2	1		3	.57
9		8		2	4		14	2.66
10	10	21	7	1	4	14	57	10.82
11	42	60	22	39	26	41	230	43.65
12	23	38	8	18	21	12	120	22.77
13	10	17	9	8	7	6	57	10.83
14	10	17	3	4	4	3	41	7.80
15				1	1		2	.38
Total dozens	95	162	50	76	68	76	527	100.00
$\bar{X}$	11.66	11.51	11.46	11.25	11.53	11.25	11.49	

Egg Prices

The retail prices received for eggs of each brand, size, and grade varied considerably among stores. The mean price for all eggs purchased was 52.0 cents per dozen. No two stores priced their eggs the same during any one week, nor were the prices within stores similar for different sizes and brands of eggs. Table 35 shows the mean prices received per dozen eggs purchased from each store by brand, grade and size.

The mean price per dozen for extra large eggs varied from 54.4 cents (store 1) to 60.9 cents (store 4). Mean prices per dozen during the year for large eggs varied from 51.4 cents (store 6) to 56.6 (store 5) and medium sized eggs varied from 45.0 cents (store 6) to 54.0 cents (store 1).

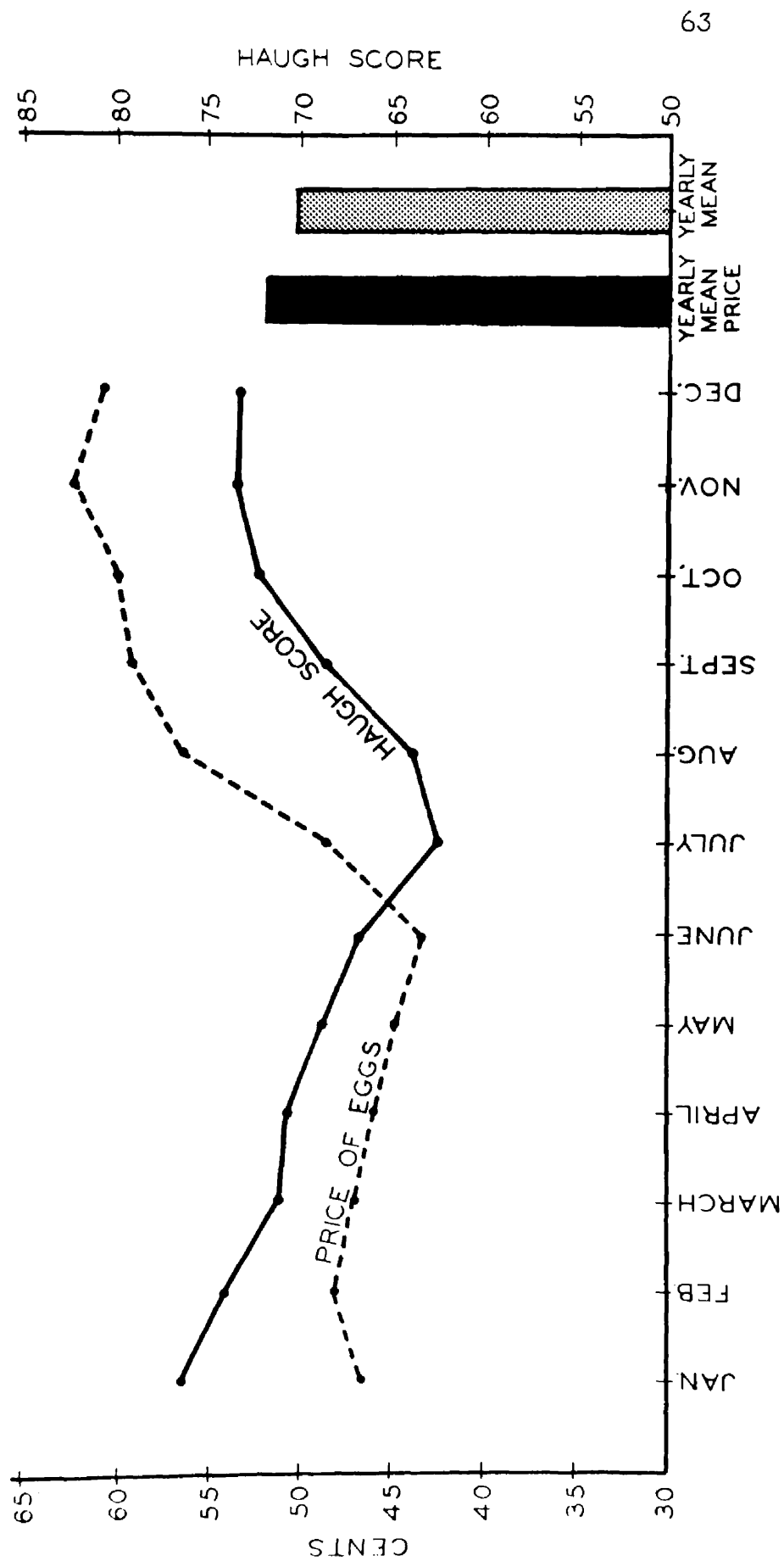
- Figure IV shows the relationship between the monthly mean price per dozen for all eggs purchased and average Haugh score. It appears that there is a direct relationship between quality and price. This is probably a chance=relationship rather than a cause and effect since Haugh scores were high in the fall and winter when the laying flocks are younger and normally lay eggs with higher albumen quality.

Price data for all stores revealed that the average difference in price between extra large eggs and large eggs was four cents; between large eggs and medium sized eggs was five cents; and between medium sized eggs and small eggs was

TABLE 35 Mean Annual Price Received for Eggs,
By Sizes and Brand in 6 Stores

Store & brand		Size and Quantity				Check	Mean Price
Store & brand		A extra large	A Large	A Medium	A Small		
1	- L	54.4	53.3	51.1	--	--	--
1 1	- M	55.6	55.8	54.0	--	--	54.4
2		60.4	54.4	49.7	38.7	40.4	50.8
3		--	54.1	51.2	--	45.2	51.8
4		60.9	55.7	49.9	--	--	55.6
5	N	--	56.6	--	--	--	52.5
5	O	--	54.3	--	--	--	--
5	P	--	--	47.1	--	--	--
6		--	51.4	45.0	38.5	--	45.0

FIGURE IV HAUGH SCORE AND PRICE OF DOZENS OF EGGS FROM SIX RETAIL OUTLETS 1957



eight cents. The checks averaged two cents above the small eggs and four cents below large grade B eggs.

The total number of dozens purchased from each store is shown in Table 36 and the mean price per dozen and the cost of eggs for each season, are given in Table 37. Table 38 shows the mean price by size and brand from each store. Seasonal differences in egg prices are shown in Figure V. The seasonal variations of prices was significant at the 1 percent level.

TABLE 36 Number of Dozens by Size of Eggs Purchased from Each Store

Sizes	Stores							Total	% of eggs pur- chased by each size	
	1	2	3	4	5					6
					N	O	P			
X-L	14	20	43	25				102	19.35	
Large	19	22	44	38	21	23	25	217	41.18	
Medium	11	9	38	12**	24		24	144	27.32	
Small			21		2*		25	48	9.11	
Chex			16					16	3.04	
Total dozens	44	51			21	23	24			
	95		162	50	76	68	76	527	100.00	
% of eggs purchased by each store	18.03	30.74	9.49	14.42	12.90		14.42		100.00	

*--omitted in Chi square analysis

***included with large eggs

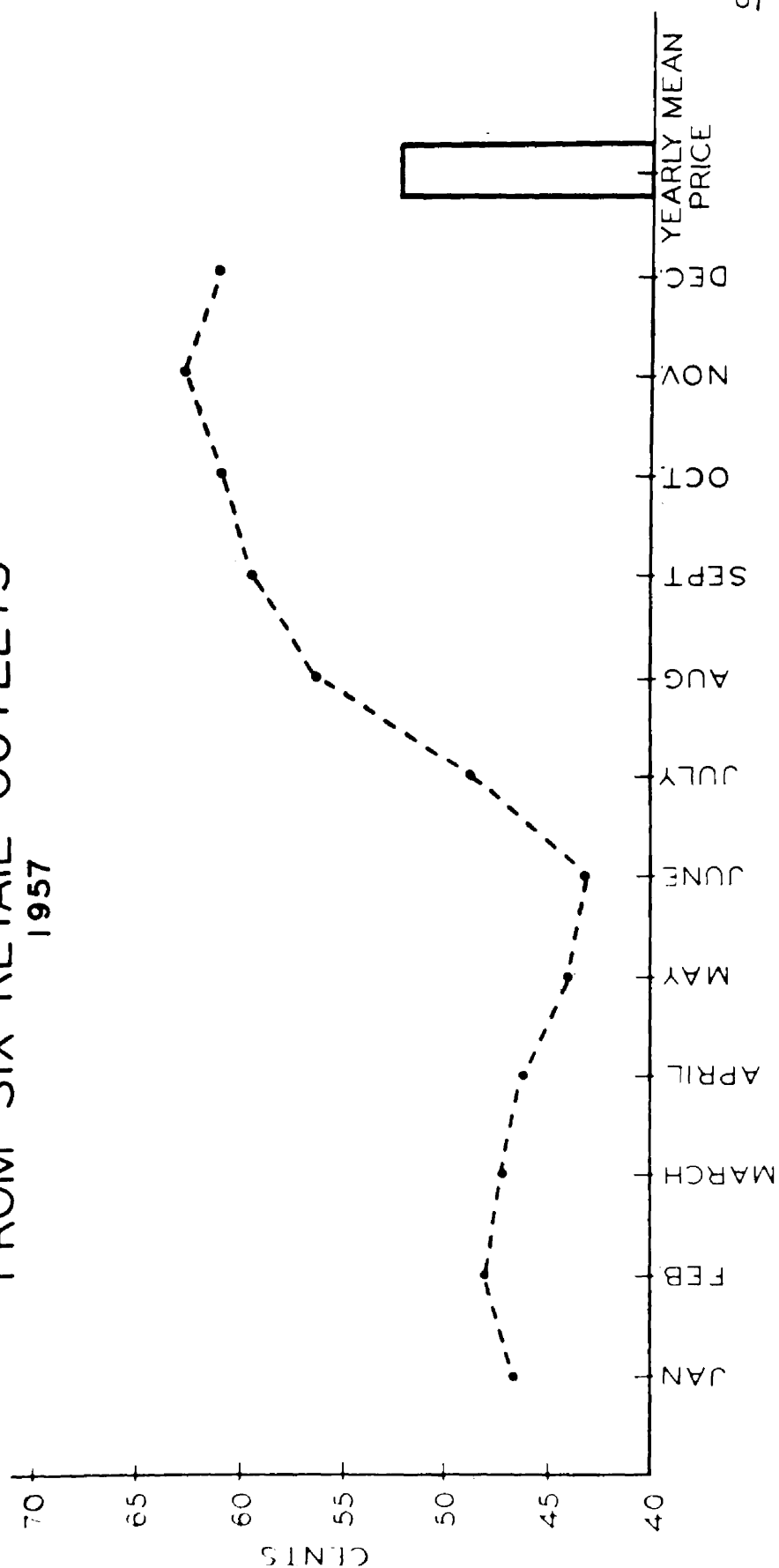
TABLE 37 Total Cost and Mean Price of All Eggs
Purchased by Seasons

Seasons	Dozens Purchased	Cost	Mean cents per dozen
1	120	61.27	51.1
2	141	64.33	45.6
3	137	67.61	49.3
4	129	78.09	60.7
Total	527	271.30	

TABLE 38 Mean Price of Eggs by Size and Brand
From Each Store

Sizes	Stores									
	1		2	3	4	5		6		
	L	M				N	O	P		
X-L	54.4	55.6	60.4		60.9					
L	53.3	55.8	54.4	54.1	55.7	56.6	54.3			51.4
M	51.1	54.0	49.7	51.2	49.9			47.1		45.0
S			38.7							38.5
Check			40.4							
B				45.2						

FIGURE V MEAN MONTHLY PRICE OF ALL EGGS
FROM SIX RETAIL OUTLETS
1957



Stores 1, 2, and 4 offered extra large grade A eggs. The mean prices per dozen for extra large eggs were 55.1, 59.7, and 60.9 cents in stores 1, 2, and 4 respectively. The analysis of variance of price per dozen among the three stores is shown in Table 39. Differences are significant at the 5 percent level.

TABLE 39 Analysis of Variance of Prices For
Extra Large Grade Eggs In
Stores 1, 2, and 4

Source	d.f	SS	MS	F	F.05	F.01
Total	101	7941.4				
Stores	2	606.2	303.1	4.08*	3.09	4.82
Error	99	7335.2	74.3			

* Significant at the 5 percent level.

All of the stores in the study offered large grade A eggs. The mean prices per dozen for large grade A eggs purchased from stores 1 through 6 were 54.7 cents, 53.8, 54.1, 55.7, 55.4, and 51.4 cents respectively. The analysis of variance of price of eggs among the six stores indicated that price differentials were not significant. (Table 40).

TABLE 40 Analysis of Variance of Price of Large
Grade A Eggs in Six Stores

Source	d.f	SS	MS	F	F.05
Total	203	15627.5			
Stores	5	328.8	65.8	85 NS	2.26
Error	198	15298.7	77.3		

A total of 144 grade A medium eggs were purchased from the six stores, however their mean price per dozen differed as much as seven cents. An analysis of variance showed that the variance in prices was significantly different at the five percent level. (Table 41).

TABLE 41 Analysis of Variance of Price of Grade
A Medium Eggs from 6 Stores

Source	d.f	SS	MS	F	F.05	F.01
Total	143	7242.9				
Stores	5	783.0	156.6	3.35*	2.44	3.46
Error	138	6459.9	46.8			

* Significant at the 5 percent level.

Forty-six dozens of small eggs were purchased during 1957 from stores 2 and 6 which offered grade A small eggs every week. An analysis of variance showed prices of small eggs purchased from those stores were not significantly different.

Differences in prices paid for extra large grade A eggs and large grade A eggs for the different brands were not significant; however differences in prices paid for three brands of grade A medium eggs were significant at the 1 percent level. (Table 42).

Price differentials between eggs of different brands were not consistent. In store 1, price of eggs for brand L were 1 to 3 cents higher than the prices for eggs of brand M for 8 months. Price for eggs of brand M were then increased to equal those of brand L and for a period of four week surpassed the prices of brand L eggs by 2 cents per dozen each week. In store 5, N and O brands were both grade A large. The price of eggs of N brand was always priced above that of O brand. The greatest difference in the price between these two brands was 6 cents when brand N eggs reached a peak price of 69 cents in December. The peak price for brand P (medium) was reached four weeks earlier; then its price decreased by 2 cents per week. This may have been due to a decrease in demand for brand O.

TABLE 42 Analysis of Variance of Prices for Three Brands Of Medium Eggs

Source	d.f	SS	MS	F	F.01
Total	43	1572.9			
Brands	2	340.7	170.4	5.66**	5.17
Error	41	1232.2	30.1		

** Significant at the 1 percent level.

The eggs from store 2 were the only eggs purchased where the correlation between prices and Haugh scores were significant. As the quality of these eggs increased, the price decreased. As shown in Figure VI, an apparent positive correlation existed between price and Haugh score of all eggs in the study.

Correlation of the Price of Eggs with Haugh Scores (Store 2 Only)

In the correlation of price with the Haugh score, the price was used as the dependent variable and the Haugh score as the independent variable. The correlation coefficient of price and Haugh score for 162 dozens of eggs was $-.183$. The $F_{.05}$ level was $.15$, therefore the correlation of price and Haugh score of eggs in store 2 is significant.

Further analysis of the association of price with Haugh score was done by an analysis of variance of X and Y values around the regression line. This analysis shows in Table 43 that the variance was significant at the five percent level.

TABLE 43 An Analysis of Variance of the Deviations of Prices from the Regression Line

Source	d.f	SS	MS	F	F.05
Total	161	19501.10			
SS Regression	1	654.77	654.8	5.56*	3.91
Error	160	18846.33	117.8		

* Significant at the 5 percent level.

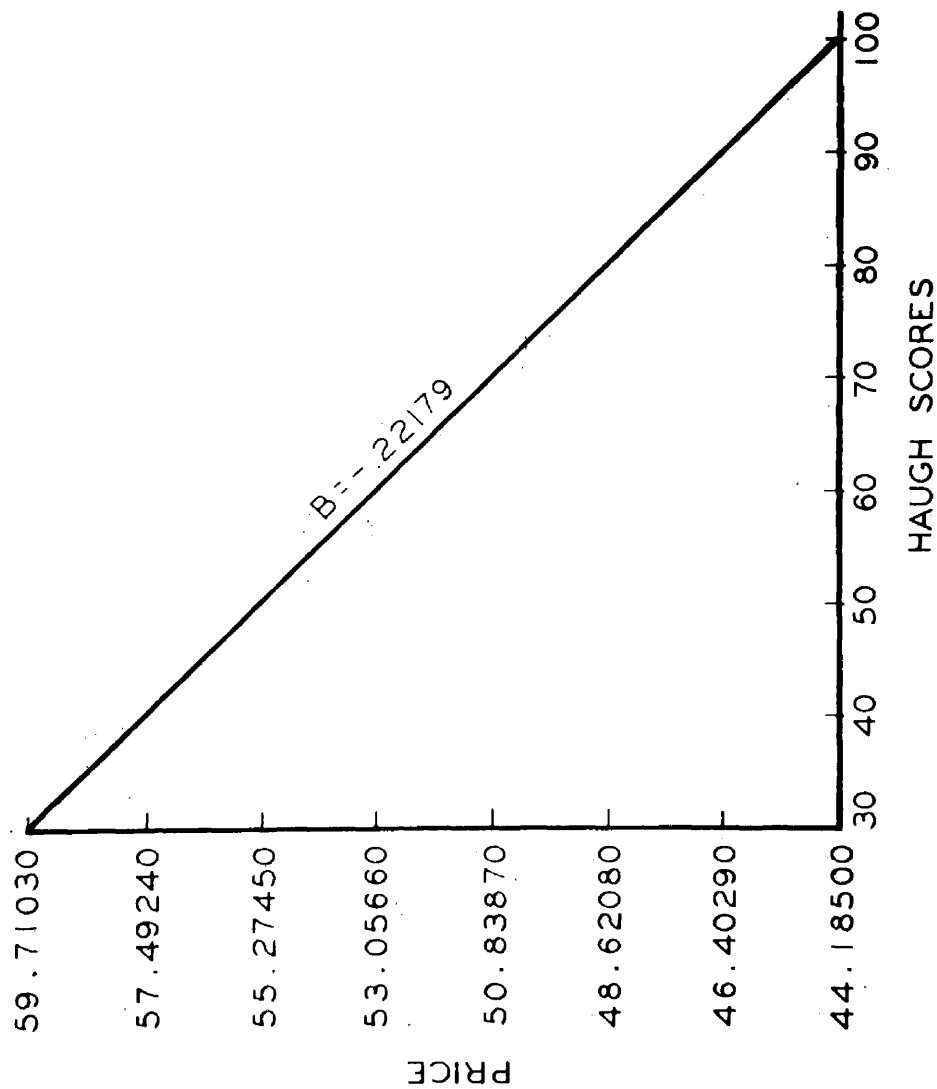
The standard error of the estimate of the best fit of the regression line is equal to the square root of the mean square (117.8) or 10.8, therefore we would expect to find 95 percent of the observations for price as a dependent variable and the Haugh score as the independent variable to be within $\pm$ two standard errors of the estimate of the best fit of the regression line.

$Y = a + bx$ where Y is the price and X is Haugh score. A is the intercept of b on the vertical axis or the dependent variable, where b is the slope of the regression line. The slope of the regression line was found to be equal to $-.22179$; that is, a negative slope or coefficient, therefore as the Haugh score increases 1 unit the price decreases $-.22179$ units. (Figure VI). A high Haugh score indicated good quality. The practice of lowering the price when the quality is high does not seem to be a good merchandising procedure.

Retailers Margins for Eggs

The mean monthly Detroit wholesale price for grade A large eggs plus the cost of cartons during the year of the study was 46.12 cents, while the mean monthly selling price at the retail level for the six stores was 54.65 cents. The difference between the mean buying price and mean selling price was 8.50 cents per dozen, or 18.4 percent markup.

FIGURE VI
 LINEAR REGRESSION OF HAUGH SCORE AND
 PRICE FOR EGGS FROM STORE # 2 1957



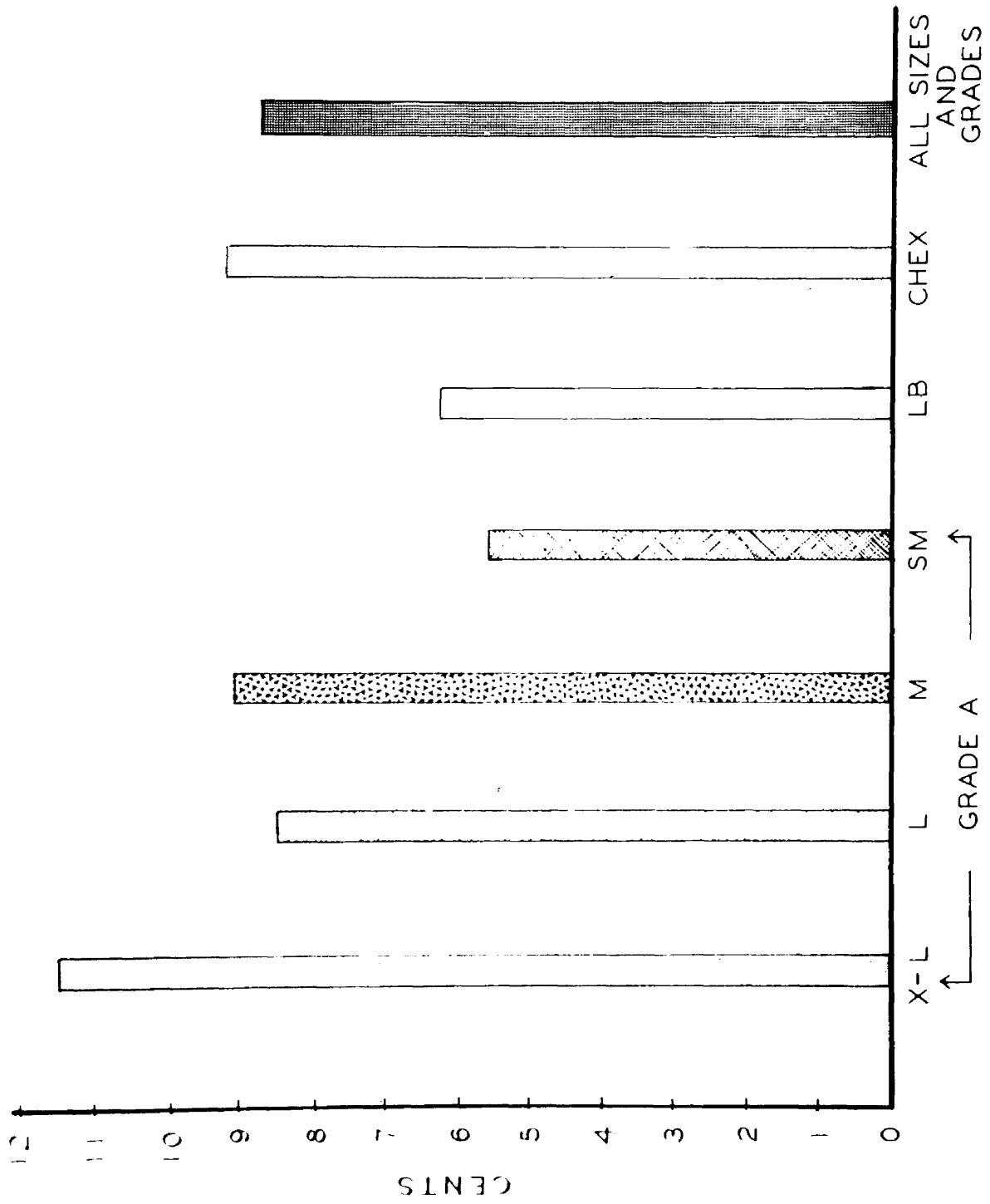
The mean monthly margin for extra large grade A eggs was 11.48 cents, for large grade A--8.50 cents, for medium grade A--9.01 cents, small grade A--5.54 cents, checks--9.15 cents, and large grade B--6.36. (Figure VII).

Margin in the study refers to the mean selling price minus the Detroit wholesale price plus two cents for cartons.

The lowest monthly margin for all eggs offered for sale was 5.13 cents in July with a mean selling price of 52.25 cents per dozen. The highest monthly margin was 11.50 in December with a mean retail price of 62.75 cents per dozen. Within the limits of this study the lowest price was not associated with the lowest margin, nor were the highest prices associated with the greatest margin per dozen of eggs; therefore the margins per dozen of eggs appeared to be more closely linked with production than with demand. (Figure VIII).

The mean weekly margins for all eggs fluctuated from week to week with no apparent relationship to the wholesale price of eggs. The lowest weekly mean margin for large grade A eggs was recorded the week of October 10th with a margin of two cents and the mean retail price of 63 cents; whereas the highest weekly mean margin was 13 cents per dozen in the week of December 12th when large grade A eggs sold for 63 cents or the same retail price when a margin of two cents was obtained. The mean margins for sizes and grades are shown in Table 44.

FIGURE VII MEAN MARGINS BY SIZE AND GRADE OF EGG SOLD IN RETAIL STORES IN 1957



MEAN MONTHLY DETROIT WHOLESALE PRICES AND MEAN SELLING PRICES FOR GRADE A LARGE EGGS

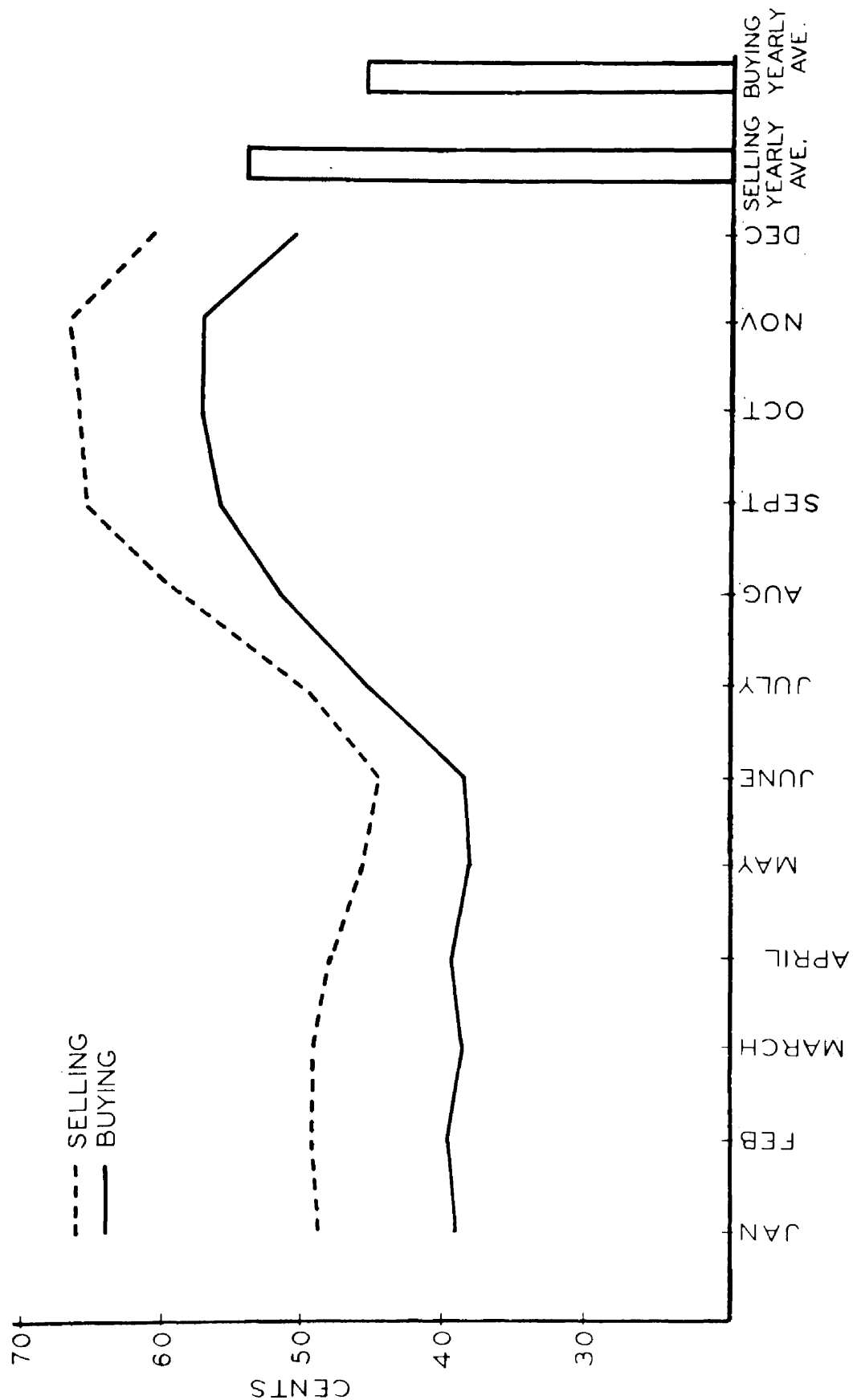


FIGURE VIII

1957

TABLE 44 Mean Margins for Sizes and Grades
 Of Eggs Purchased

Sizes and Grades	Cents
Extra large	11.48
Large	8.50
Medium	9.01
Small	5.54
Large grade B	6.36
Checks	9.15

An analysis of variance of the margin for all sizes of eggs secured during the study revealed a significant difference at the 1 percent level. (Table 45).

An analysis of variance between mean margins for pairs of sizes, and or, grades of eggs revealed that the calculated F value for margins for extra large grade A versus checks was 6.91 which was significant at the five percent level; and an analysis of the variance of extra large margins versus the medium margins was significant at the one percent level in favor of extra large eggs. The mean margins for large grade A versus checks, large grade A versus medium, and large grade B versus small, grade A margins were not significantly different; however, large grade A margins versus large grade B margins were significantly different at the five percent level in favor of large grade A.

TABLE 45 Analysis of Variance of Margins
For Six Weights and Grades of Eggs

Source	d.f	SS	MS	F	F.01
Total	187	1881.08			9.07
Sizes	5	577.53	115.51	16.02**	
Error	182	1311.55	7.21		

** Significant at the 1 percent level.

MERCHANDISING PRACTICES OF EGGS

Various egg merchandising practices in the retail outlets considered in this study are source of supply, refrigeration of eggs, types of egg cartons, volume of eggs displayed, volume of sales per week, and promotion and advertising of eggs.

Sources of supply

Table 46 shows the source of supply of eggs merchandised in the stores from which the eggs were obtained.

TABLE 46 Source of Supply of Eggs for 6 Retail Outlets

Store	Description	Source
3	National chain	Chain store warehouse
5	" "	" " "
4	Regional chain	" " "
1	Local chain	Wholesale dealers and direct from farms
2	Independent retail store	" " "
6	Independent retail store	Producer, plus egg cooperative when needed

The eggs from the chain store warehouses were produced in Minnesota and Wisconsin, while those from the wholesale dealers, cooperatives and farmers were produced in Michigan.

Refrigeration of Eggs

Eggs were refrigerated in display cases in all stores except store 2. However, on several occasions the display cases were so full that some of the eggs extended beyond the top of the display so that some eggs were affected by room temperatures. In an effort to sell more eggs, stores 4 and 5 displayed eggs in the aisles of the store without refrigeration. Specifically, on May 23, 1957, one half of the eggs were refrigerated in store 4 and one half were un-refrigerated. Similarly, on July 3, 1957, eggs in store 5 were displayed in the aisles in front of the dairy case without refrigeration. Eggs held prior to display were refrigerated in all stores, however, some of the eggs in store 3 were not placed in the cooler because of lack of space.

Although eggs in store 2 were not refrigerated while they were on display, the Haugh scores for the extra large eggs were not significantly different from the Haugh score of extra large eggs from other stores, and the albumen quality of the large, medium, and small eggs were surpassed only by eggs from store 6. These findings are in agreement with Kantner (1953) who reported that eggs not held in refrigeration in retail stores in New York were slightly higher than

refrigerated eggs. The findings are not in agreement with Jensen and Stadelman (1951) of Washington, and NyBroten (1952) of West Virginia.

Types of Egg Cartons Used

Egg cartons used by the 6 stores were of two major types: the 3 x 4 and the 2 x 6 cartons. The 2 x 6 type carton was used by five of the stores and the 3 x 4 type by only one of the independents. Divisible 2 x 6 type cartons were used by only store 1, while non-divisible cartons were used by stores 3, 4, 5, and 6.

The 3 x 4 type cartons were of a non-gloss pulp with a very dull finish with no description of quality and size. These cartons were frequently torn and soiled from extensive use. The 2 x 6 type cartons were of varying shades of colors with the quality, size, and brand printed in bold letters on the package.

Bi-Weekly Volume of Eggs on Display at Each Outlet

The volume of eggs on display at each outlet varied from 460 dozen eggs to zero. The chain stores tended to display a greater quantity of eggs than the independents, which is in keeping with the number of consumers patronizing those stores. The independents exhibited a smaller quantity of eggs; in fact, store 2 displayed less than 20 dozens for 23 weeks, while store 6 had a modal display of 35 dozens.

On several occasions store 6 was without eggs; however, the largest display this store carried was 280 dozen eggs. (Table 47).

The volume of eggs displayed varied widely from week to week and month to month. There was a noticeable decline in eggs displayed the week following high prices. For example, four of the smallest displays were during December in stores 1, 2, and 5.

Volume of Egg Sales

Information on the volume of eggs merchandised in the six retail outlets was obtained by interviews with the personnel of the stores. The largest volume of eggs sold per week was an average of 3,000 dozens at store 4, followed by 1,000 dozen at store 3. Stores 1 and 5 each averaged 300 dozen per week, while store 6 sold 700 dozens and store 2 sold 1,200 dozens.

One of the chain stores sold nearly as many eggs as the other stores combined. The mean volume of eggs sold per week from all stores was 1,050 dozens. The mean volume of eggs sold was 950 dozens in independent stores. The local chain sold an average of 300 dozens per week, the regional chain, 3,000 dozens, the national chain 650 dozen eggs per week.

If the mean sales per week were valid, and if the yearly sales were computed from the mean, then the total sales for the six retail outlets would be 327,600 dozens or 10,920 cases.

TABLE 47. Biweekly Volume of Eggs on Display
At Each of the Six Retail Outlets

Dozens	Stores						Total
	1	2	3	4	5	6	
Under 40		23	1			10	34
41-80	2	3	2		1	9	17
81-120			11	1	4	3	19
121-160	3		11	2	7	2	25
161-200	8		1	8	10	1	28
201-240	4			8	3	1	16
241-280	3			5	1		9
Over 280	6			2			8

Promotion and Advertising of Eggs

The stores that were members of local, regional and national chains advertised their eggs in the Lansing State Journal along with other food products, and by frequent use of handbills. For nine months the store of the regional chain promoted egg sales by a contest for the best recipes containing eggs, while a "valuable coupon" worth ten cents toward the purchase of specific items was used by the national chain for four months.

Egg sales were not promoted in independent stores during the duration of the study, except by small posters in the stores, yet eggs had to be purchased by one of these stores from two sources because the demand for eggs exceeded the usual supply.

All of the stores except an independent, store 2, used Easter egg prints as a means of promoting eggs during the Easter holiday season.

The five types of promotion used by the retail outlets were advertising in the daily paper, handbills, recipes, special coupons, and Easter egg prints.

SUMMARY AND CONCLUSIONS

Five hundred and twenty seven dozens of eggs were purchased from six retail outlets and the quality of the eggs evaluated.

1. Only 33 percent of the dozens qualified for grade A on a cleanliness basis, whereas 32.8 percent would have been classified as grade B, 3.2 percent grade C and 31.0 percent as dirty. Significant differences in shell cleanliness were found among 4 stores.
2. All of the eggs were sound shelled in 38.6 percent of the dozens of eggs purchased. Of the dozens containing unsound shells, blind cracks accounted for 60.8 percent; cracks, for 31.9 percent; and leakers, 6.7 percent. No significant differences in shell condition were found among the stores.
3. The mean shell thickness of all eggs from each of the stores was .012 inch. The differences between the mean shell thickness for eggs from the six stores were not significant.
4. Eighty-two percent of the dozens of eggs purchased were not labeled as to color, yet their mean shell color was 1.5 or a tint.
5. Based on candling observations, 26.9 percent of the dozens of eggs were classified as grade A, 47.1 percent were classified as grade B, 21.8 percent grade C,

and 4.2 percent were loss and inedibles according to candling results.

6. The mean Haugh score per dozen of eggs was 71.0 units. The highest Haugh score per dozen of eggs was 77.2 in January and the lowest Haugh score was 62.2 in July. Haugh scores were significantly higher in winter than in the summer. Brands L and N of grade A large eggs were superior to brands M and O. As the size of the eggs increased the Haugh scores decreased. Haugh scores of the eggs among stores were not significantly different.
7. According to USDA scores, 91 percent of the dozens of eggs qualified for grade A or above while only 9 percent were low enough for grade B. The mean USDA score was 4.8 which is medium grade A.
8. The relatively high incidence of meat spots in dozens of eggs caused 30.93 percent to be classified as grade C, 18.60 percent as loss and only 50.27 percent would have qualified as grade A. Significant differences in meat spot incidence between brands and among stores were found. The mean number of meat spots per dozen of eggs was 2.4.
9. Blood spots in the eggs ranged from pin point size to over an inch in length. The mean number of blood spots per dozen was .48. Fifteen percent of the dozens of eggs

purchased had spots large enough to result in a classification of grade C or loss. Significant differences were found in the number of blood spots among stores but not among brands.

10. Very few inedible eggs were found during the study. One or more sour eggs was found in each of ten dozens and one seeping yolk in each of two additional dozens.
11. Sixteen dozen eggs were below the weight standards as specified on the carton.
12. The mean yolk color for the dozens of eggs purchased was a medium yellow. Considerable variation in color among eggs and within individual dozens was found.
13. Prices of eggs among stores varied widely on a weekly and monthly basis. The mean price for all eggs purchased during the year was 52 cents per dozen. Prices of dozens of eggs were significantly different among stores, seasons, sizes, and grades. Price was negatively correlated with Haugh score in store 2.
14. Retailers' margins for eggs did not appear to be associated with highest or lowest buying prices. The mean monthly margins were 11.48 cents for extra large eggs; 8.50 cents for large; 9.01 cents for mediums; 5.54 for smalls; 9.15 cents for checks; and 6.36 cents for large grade B. The margins by sizes and grades were significant at the 1 percent level.

15. National and regional chain stores received their eggs from chain store warehouses while local chains and independents received their eggs from wholesale dealers, cooperatives and/or farms. Eggs from chain store warehouses are produced in Minnesota and Wisconsin, but other eggs were produced in Michigan.
16. Most of the eggs were displayed in refrigerated cases while in the stores.
17. Eggs were merchandised in 2 x 6 cartons in all stores except one, where the 3 x 4 type cartons were used.
18. The volume of eggs displayed varied weekly. Volume of eggs displayed was usually reduced after a period of relatively high prices.
19. The range in the volume of sales per week was 300 dozen in one independent store to 3,000 dozens in the regional chain.
20. Eggs were promoted by advertisement in local papers, recipe contests and special coupons and posters.
21. The rank of the stores according to a summation of quality factors of eggs purchased:

<u>Rank</u>	<u>No. of Store</u>	<u>Type of Store</u>
1	6	Independent
2	3	National Chain
3	5	National Chain
4	4	Regional Chain
5	2	Farmers Market
6	1	Local Chain

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APPENDIX

TABLE i Distribution of Dozens of Eggs by Sizes
Among Haugh Score Class Limits
Store 1

Haugh score class limits		Brand						Total	%
		L			M				
		Egg Size							
		X-L	L	M	X-L	L	M		
Grade		Dozens of Eggs							
95-102	AA	-	-	-	-			-	
87-94.9			1					1	
79-86.9		2	4	3			2	11	12.63
71-78.9	A	5	7	5	6	7	5	35	
63-70.9		5	6	2	7	7	2	29	
55-62.9		1		1	7	5		14	82.10
47-54.9	B	1				2		3	
39-46.9		1						1	
31-38.9		1						1	5.27
Total		16	18	11	20	21	9	95	100.00

TABLE ii Distribution of Dozens of Eggs by Sizes
 Among Haugh Score Class Limits
 Store 2

Haugh score class limits	XL		L		M		S				Total %	
	W	B	W	B	W	B	W	B	Chex	No.	Level	Grade
AA 95-101							1	1		1	1.23	
87-94							1	1		2	1.23	
79-86	1	3	4	2	3	4	4	2	1	24	14.82	17.28
A 71-78	6	5	6	8	11	5	6	4	5	56	34.57	
63-70	8	6	6	11	3	1	4		4	43	26.54	
55-62	4	6	5	2	4	4			3	28	17.28	78.39
B- 47-54	3	1							2	6	3.70	
39-46									1	1	.62	
31-38												4.52
Total	22	21	21	23	22	15	16	6	16	162	100.00	100.00

TABLE iii Distribution of Dozens of Eggs by Sizes
 Among Haugh Score Class Limits
 Store 3

Haugh score class limits	Large		Med.		Total	
	A	B	A	No.	Level	% Grade
AA 95-102						
87-94						
79-86	3		4	7	14.00	14.00
A 71-78	7	1	6	14	28.00	
63-70	6	4	1	11	22.00	
55-62	8	4		12	24.00	74.00
B 47-54	1	5		6	12.00	
39-46						
31-38						12.00
Total	25	14	11	50	100.00	100.00

TABLE iv Distribution of Dozens of Eggs by Sizes
 Among Haugh Score Class Limits
 Store 4

Haugh score class limits	X-L	Large	Med.	Small	Total	% of Total	
						Level	Grade
AA 95-102							
87-94							
79-86			5		5	6.58	6.58
A 71-78	6	6	10		22	28.94	
63-70	12	15	2		29	38.15	
55-62	4	4	5	1	14	18.42	85.52
B 47-54	3		2		5	6.58	
39-46				1	1	1.32	
31-38							7.89
Total	25	25	24	2	76	100.00	100.00

TABLE v Distribution of Dozens of Eggs by Sizes
 Among Haugh Score Class Limits
 Store 5

Haugh score class limits	N	Large A			% of Total	
		O	P	Total	Level	Grade
AA 95-102						
87-94						
79-86	1	1	3	4	45.88	5.88
A 71-78	8	6	8	22	32.35	
63-70	10	8	7	25	36.76	
55-62	3	6	3	12	17.64	86.76
B 47-54		2	3	5	7.36	
39-46						
31-38						7.36
Total	21	23	24	68	100.00	100.00

TABLE vi Distribution of Dozens of Eggs by Sizes
 Among Haugh Score Class Limits
 Store 6

Haugh score class limits	Large A	Med. A	Small A	Total	% of Total	
	W	W	W		Level	Grade
AA-95-102		1		1	1.32	
A-87-94	5	9	8	22	28.94	
79-86	14	12	14	40	52.63	82.89
A 71-76	5	4	3	12	15.78	
63-70						
55-62	1			1	1.32	17.10
B 47-54						
39-46						
31-38						
Total	25	26	25	76	100.00	100.00

STATISTICAL FORMULAS

1. Chi square -- $\sum_{i=1}^K \frac{(f_i - F_i)^2}{F_i}$ where f_i is the observed frequency and F_i is the expected frequency.

2. Standard error of

difference between two means -- $S_{\bar{X}} = \sqrt{\frac{EX^2 - \frac{(EX)^2}{N}}{N - 1}}$

$(S_{\bar{X}_1} - S_{\bar{X}_2}) = \text{difference}$

3. Mean from group data --

$$\bar{X} = \frac{\sum EfX}{\sum Ef} = \frac{\text{midpoint of class X frequency}}{\sum Ef}$$

4. Correlation -- (a) $r = \frac{EXY - \frac{EXEY}{N}}{\sqrt{\frac{(EX^2 - \frac{(EX)^2}{N})(EY^2 - \frac{(EY)^2}{N})}{N}}}$

(b) $Y - \bar{y} = b(X - \bar{X})$ then

$Y = \bar{y} - b\bar{X} + bX$

(c) $a = \bar{y} - b\bar{X}$

5. Regression analysis --

$$(a) \text{ Total sum of squares of regression} = \frac{EY^2 - (EY)^2}{N}$$

$$(b) \text{ Regression sum of squares} = b \left[EXY - \frac{(EX)(EY)}{N} \right]$$

$$(c) \text{ Error (Residual) sum of squares} = \text{Total SS} - \text{Regression SS}$$

6. Analysis of Variance

$$\text{Total sum of squares} = EX^2_{ij} - C. T.$$

$$\text{Stores sum of squares} = \frac{EX^2}{N} - C. T.$$

$$\text{Error sum of squares} = \text{Total SS} - \text{Store SS}$$

* E = summation

See reference books in Bibliography:

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