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Relation Between Egg Quality and Price

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In order that the poultryman may feel justified in placing special emphasis on the quality of eggs and secure in making the extra expenditure involved in producing a higher grade product, he should have some assurance that quality values are recognized by the consumer. This study is an attempt to discover the relationship between quality and price of eggs as found on the retail market.

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SUMMARY

1. Prices were related to weight under practically all conditions. This is the most definite and significant relationship found in the correlation analysis.
2. The combined effect of all quality factors on price was most significant in August and least significant in April.
3. The relative seasonal effect of the individual quality factors on price was as follows:
 - Weight was most significant in August, least in November.
 - Air space was most significant in November, least in April.
 - Condition of yolk was most significant in April, least in November.
 - Condition of white was most significant in August, least in April.
4. Average quality varied with price throughout the lower and middle price ranges only.
5. The range in quality *within* each price range varied so widely that price could not be used as a criterion of quality.
6. Dirty eggs affected price more than variations in color within each dozen.
7. Range in weight of eggs within each dozen had very little relation to price.
8. The average quality of eastern eggs was invariably higher than the quality of western eggs.
9. There was little to be gained in purchasing labeled eggs, because within each brand the quality and weight varied as widely in relation to price as was true of unbranded eggs.

RELATION BETWEEN EGG QUALITY AND PRICE

By Adrian H. Lindsey, Professor of Agricultural Economics, and
Hubert W. Yount¹

INTRODUCTION

The Problem

Market information dealing with egg prices usually stresses the factors of supply, such as receipts and storage holdings, while little space is given to quality. The price of eggs at any given time is determined by a number of factors, among which are the supply and demand factors commonly considered. For any individual store and in many cases for individual producers or shippers, the quality of eggs placed upon the market with respect to the average quality of the grade may have as much effect on price at the time of sale as the influences affecting the general price level of the grade, which are supply and demand factors.

Egg grades are based on certain external and internal characteristics which have been found to have an influence in determining the price among the members of the wholesale trade. Attempts by the extension services of the New England States to carry the idea of quality to the consumer through building up consumer recognition of grades and their identifying marks such as labels and trade names have failed to meet with marked success, either because consumers as a class fail to understand the factors entering into a good grade of eggs versus a bad grade, or because the factors which supervisory authorities have considered in making up the grades are not the factors really considered by consumers in buying eggs. No attempt has previously been made to determine the relative importance of the factors entering into the several grades established by state authorities. Extension specialists in approaching producers with a marketing program have specified certain qualifications for eggs which may or may not be the particular qualifications demanded by consumers, particularly those for which the consumer is willing to pay a premium over the average price.

As a result of these observations the study was undertaken to answer the question as to what quality factors consumers were willing to pay for. It is doubtful, however, whether the study completely answers this question. The method of purchasing eggs from retail stores in cartons or by telephone gives the consumer very little opportunity to judge whether the eggs are of sufficient quality to justify the price asked. In such instances the consumer must and does depend upon the retailer to deliver a dozen eggs of good quality. If she continues to buy eggs from this store or continues to purchase the same grade, it may be assumed that she is either ignorant of what constitutes quality, or satisfied with what she has received, price considered.

The producer, as well as the consumer, should be interested in knowing whether price is a criterion of quality. The methods used in securing the data, by comparing prices paid with quality of each dozen purchased, should tell

¹Mr. Yount, formerly Assistant Professor of Agricultural Economics, initiated the project, directed the collection of data, and completed some of the correlation analyses.

whether there is any relationship between quality and price. The study will also determine the extent to which these quality factors affect price and the relative importance of each, if statistical measures are applied.

The method used in the study was to purchase eggs at retail from a selected sample of stores representative of the consuming areas in Massachusetts. At each store visited a purchase was made consisting of one dozen of each grade of eggs sold by that store. Each sample was given a number and a form was filled out giving data concerning the type of store, the name of the grade, the price for which it was sold, and other identifying information. The samples were taken immediately to a central point where they were candled by an egg specialist. They were weighed and the external characteristics noted.

In order to correct for seasonal conditions, samples were collected at three different times during the year: first, during the period of highest prices in November; second, during April when receipts of eggs in all the central markets were heavy and the average quality was high; third, in August, when current receipts were low and the quality of production was also low, due to temperature and methods of handling. The first sample was taken in November, 1928, in the cities of Springfield, Worcester and Boston, while the samples collected in April and August (1929) were confined to the metropolitan area in and around Boston.

Quality Factors Considered

An attempt was made to obtain a measure of every quality factor that might have any influence on price. The factors considered were as follows:

I. External

- a. Appearance—clean or dirty
- b. Color
- c. Number of broken eggs, crax or leakers
- d. Weight of eggs—net weight per dozen
- e. Range in weight

II. Internal

- a. Shrinkage as indicated by air space
- b. Condition of yolk
- c. Condition of white
- d. Inedibles—such as rots, stuck yolks, blood and meat spots

Method of Indicating Quality

For each dozen of eggs purchased a data sheet was filled out similar to that in Figure 1. External characteristics were indicated by count and internal measurement. Thus, on appearance the number of dirty eggs was indicated. On color the number of eggs of the less important color was noted. On uniformity the range in weight between the largest and smallest egg was noted. The net weight was indicated by weighing the eggs as sold in the carton and deducting the weight of the carton.

In indicating the internal quality the factors were graded into classes. Thus, air space was divided into five classes as follows:

<i>Class</i>	<i>Inches</i>
1	0 - $\frac{1}{16}$
2	$\frac{1}{16}$ - $\frac{1}{8}$
3	$\frac{1}{8}$ - $\frac{1}{4}$
4	$\frac{1}{4}$ - $\frac{3}{8}$
5	$\frac{3}{8}$ and over

On condition of the yolk three grades were used.

<i>Class</i>	<i>Grade</i>
1	Not visible
2	Slightly visible
3	Clearly visible

Condition of the white was indicated by three grades also.

<i>Class</i>	<i>Grade</i>
1	Firm and clear
2	Reasonably firm
3	Weak and watery or worse

An example of the scoring for each internal quality factor is shown in Figure 1 under the candling record. From these records a score was made for each dozen on the basis of adding the figures for individual eggs. Variations in these scores were indicative of differences between individual dozens with respect to each of the qualities considered.

The external score was computed by deducting $1\frac{1}{4}$ points for each dirty egg and 2 points for each egg differing in color from the majority. Uniformity was scored as follows:

<i>Range in Weight</i> <i>(ounces)</i>	<i>Points</i> <i>off</i>
5	1
6	2
7	4
8	6
9	9
10	12
11	15
12	18

Net weight per dozen was scored on the basis of a weight of less than 24 ounces. No attempt was made to score eggs of more than 24 ounces. The method of scoring was as follows:

<i>Weight per dozen</i>	<i>Points off</i>
23	1
22	2
21	6
20	12
19	20
18	30

A deduction of 10 points was made for each broken egg.

The external score of the dozen in Figure 1 was figured as follows: 3 and $\frac{3}{4}$ points for the 3 dirty eggs, 4 points for the 2 white eggs in the brown dozen, 6

No. 24 City Boston Date 8/29/29
 Section Track Bay
 Name of Firm _____
 Street Address _____

1. Type of Store
 Cash and Carry Chain General Market
 Credit and Delivery Private Neighborhood

2. Business _____ Residential, G A _____ P _____

3. Refrigeration: Full _____ Part None _____

4. Eggs Brand Fancy XXXX Advertised Grade Selected Fresh

a. Selling Grade
 Nearby
 1 65 cents
 2
 Eastern
 1
 2
 Western
 1
 2

b. Cartoned
 Bulk

c. Weight
 Gross 25
 Tare 2
 Net 23

d. Range in Weight 20-28

e. Number of
 White eggs 2
 Irregular shape
 Dirties 3

5. Candling Record

a. Air Space (5)	b. Condition of Whites (3)	c. Condition of Yolks (3)
3 : 3 : 2 : 2 :	2 : 2 : 2 : 2 :	2 : 1 : 2 : 2 :
2 : 3 : 3 : 3 :	2 : 2 : 3 : 3 :	1 : 1 : 2 : 3 :
2 : 2 : 2 : 2 :	1 : 1 : 2 : 2 :	1 : 1 : 2 : 2 :
Score <u>29</u>	Score <u>24</u>	Score <u>20</u>

d. Germ Development Developed
 e. Inedibles Before laying
 f. Number of Cracks From handling

Figure 1. Data Sheet for One Dozen Eggs.
 Showing type of information obtained and method of scoring.

points for the range of 8 ounces between the size (per dozen) of the smallest and the largest eggs, and an additional point because the weight lacked one ounce of being a full 24-ounce dozen. Thus it may be seen that in the case of both the internal scores and the external scores the higher the score the poorer the quality of the eggs.

Method of Analysis

The individual data sheet as illustrated by Figure 1 and the above scoring method made it possible to obtain a score for each individual quality factor and a final or total external, and internal, quality score for each dozen. In order to evaluate the importance of these four factors, the records were first sorted by general grade, whether eastern, western or cold storage, and by type of store as between private and chain. The purpose of this split was to eliminate basic differences in retailing methods between private and chain stores as one factor in price differences, as well as to eliminate broad grade differentials as between nearby and western or cold storage eggs. This analysis was made separately for the sample collected in each of the three periods in order to obtain a further check on the relative importance of each factor at different seasons of the year.

Tabular analyses were made to discover the simple relationships between average quality and price for eastern and western eggs in chain and private stores. Multiple correlation analyses were made for both external factors and internal factors in order to determine the influences which each of the various quality factors had on price under all conditions.

TABULAR ANALYSIS²

Simple analysis was made by the use of tables to determine the variation of prices between stores for the same and for different qualities of eggs. These tables should tell whether price may be used as a criterion of quality. In other words, can a consumer depend upon price paid to insure quality?

In this analysis the store and egg grade relationships are used, as indicated previously. Weights are given in ounces. It should be kept in mind at all times when considering interior quality scores that the lower the score, the better the egg. The final scoring includes air cell, condition of white and condition of yolk. In order to gain a better conception of the meaning of interior scores examples may be cited. The best dozen of eggs purchased scored 41 and the poorest, a dozen of cold storage eggs, scored 129. The poorest "fresh" dozen scored 120.

April Eggs

The extreme range of prices paid for eggs in April was from 30 to 65 cents. (Table 1). The most frequent prices paid were 33, 39, 45 and 55 cents, with 45 cents the most common. It was in the April group that the best and the poorest dozens of fresh eggs were found. Two dozen eggs scored 41 each. One of these dozen had perfect white and yolks, and only five eggs out of the dozen had air cells larger than one-sixteenth inch. This dozen sold for 55 cents. The other dozen scoring 41 sold for 49 cents. The poorest dozen of eggs scoring 120 sold at 39 cents. In this dozen, nine eggs had weak and watery whites and clearly visible yolks, one of which was stuck. The air cells were all over one-fourth inch and 7 were over three-eighths inch. This latter dozen was branded³ eggs.

²Prices in the following tables are in cents per dozen. Frequencies represent number of dozens at given prices. The method of indicating quality scores is described on pages 4 and 5.

³Branded eggs will be used to indicate labeled or trade marked eggs.

TABLE 1.—PRICE RANGE AND FREQUENCY TABLE, APRIL EGGS

Price per dozen (cents)	Frequencies ¹				Total
	Chain Western	Private Western	Chain Eastern	Private Eastern	
30	....	....	....	1	1
31	7	....	....	....	7
32	3	1	....	....	4
33	17	1	....	....	18
34	1	....	....	....	1
35	5	5	....	....	10
37	2	....	....	....	2
38	2	3	....	....	5
39	16	5	....	1	22
40	5	5	....	....	10
41	4	....	2	....	6
42	....	1	....	1	2
43	1	3	1	2	7
44	2	1	....	....	3
45	7	9	3	6	25
46	1	....	3	....	4
47	7	1	3	1	12
48	1	3	....	3	7
49	1	2	2	6	11
50	....	....	3	10	13
51	....	....	1	2	3
52	....	....	....	1	1
53	....	....	2	6	8
54	....	....	....	1	1
55	....	....	5	14	19
56	....	....	....	1	1
57	....	....	....	1	1
58	....	....	....	2	2
59	....	....	1	2	3
60	....	....	....	3	3
65	....	....	....	5	5
Total	82	40	26	69	217

¹Number of dozens at given prices.

Eastern Eggs

Chain stores sell very few eastern eggs in relation to western eggs in April, and prices vary widely. The range in price was from 41 to 55 cents, with 45 to 50 cents most frequently paid. (Table 1). In Table 2 it will be seen that prices advance with weight up through the 50-54 cent price range. The heaviest dozen, however, was sold at 47 cents. Price increased as air space decreased but fresher eggs were purchased at 49 cents than in the 50-54 cent range.

Eastern eggs in private stores sold most frequently at 55 cents with a range of from 30 cents to 65 cents. There was no advantage in weight to be gained by paying more than 54 cents. Eggs purchased for more than 54 cents were generally lower in quality than in the 50-54 cent group.

Western Eggs

Among western eggs sold in chain stores the prices reflected the quality very well. There was considerable variation within the groups, but average weights and freshness increased as prices increased.

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TABLE 2.—WEIGHT AND QUALITY SCORES, APRIL EGGS

Price per dozen (cents)	Frequencies	Weight (ounces)		Air Space		Final Internal Score	
		Range	Average	Range	Average	Range	Average
Chain Eastern							
Under 45	3	19½-25	22½	39-45	43	78-89	82
45-49	11	23¼-29½	25½	20-40	35	55-89	77½
50-54	6	24 -27	25	32-42	36	71-87	79
55-59	6	24½-26	25	27-33	31	58-78	67
Total	26	19½-29½	24	27-45	36	55-89	76
Private Eastern							
Under 45	5	21 -23½	22	29-44	35	61-88	75
45-49	16	23¼-29	24½	13-43	29	41-89	66
50-54	20	22¼-27½	25	14-38	25	44-87	59
55-59	20	22 -27	25	16-37	28	41-79	64
60-65	8	24 -26	25	19-36	27	46-73	62
Total	69	21 -27½	24	13-44	28	41-89	65
Chain Western							
30-34	28	21 -25	23	26-52	41	60-108	85
35-39	25	19½-25½	24	29-55	39	60-120	81
40-44	12	23 -28	24½	21-54	37½	52-101	78
45-49	17	23 -26	24½	29-44	36	58- 92	74
Total	82	19½-28	24	21-55	38	52-120	79
Private Western							
Under 40	15	21¼-26	23½	30-44	37	57- 93	77
40-44	10	22 -25	23½	29-51	36	61- 89	72
45-49	15	23 -26	24½	22-48	36	53- 89	75
Total	40	21¼-26	24	22-51	36.3	53- 93	75

Price ranges among western eggs were similar to those of eastern eggs. The range for chain stores was 31-49 cents and for private stores 32-49 cents. The most frequent sales were made at 33 cents and 39 cents for chain stores, and 45 cents for private stores.

It will be seen here, as well as later, that among private stores higher premiums do not necessarily guarantee higher quality eggs. Weight was often reflected in the higher price paid but interior quality was not necessarily better.

August Eggs

Differences in quality were more pronounced in August than in April. Naturally the price range was greater. The extreme range for all grades was from 35 cents to 87 cents, or 52 cents as compared with 39 cents for April. A few dozen cold storage eggs were purchased but the number was not sufficient to use as a basis for analysis.

Eastern Eggs

Prices paid for eastern eggs ranged from 51 to 79 cents, in the case of chain stores, and from 45 to 87 cents in privately owned stores. The most frequent price in the case of chains was 63 cents, and for private stores 75 cents. (Table 3).

TABLE 3.—PRICE RANGE AND FREQUENCY TABLE, AUGUST EGGS

Price per dozen (cents)	Frequencies ¹					Total
	Chain Storage	Chain Western	Private Western	Chain Eastern	Private Eastern	
35	....	2	....	....	....	2
36	1	....	....	....	....	1
38	1	1	....	....	....	2
39	....	1	2	....	....	3
40	1	1	2	....	....	4
41	3	26	3	....	....	32
42	....	....	1	....	....	1
43	....	1	1	....	....	2
45	1	....	2	....	1	4
46	....	....	....	....	1	1
48	2	1	2	....	2	7
49	....	2	1	....	....	3
50	1	....	5	....	....	6
51	....	13	....	3	....	16
52	1	1	2	....	....	4
53	....	1	....	2	....	3
55	....	1	4	1	4	10
57	....	....	1	....	....	1
58	....	....	....	1	....	1
59	....	2	1	....	1	4
60	....	....	1	1	2	4
62	....	....	....	....	1	1
63	....	3	1	24	....	28
65	....	....	....	3	4	7
68	....	....	....	....	1	1
69	....	....	....	1	1	2
70	....	1	....	....	....	1
72	....	....	....	....	1	1
73	....	....	....	1	4	5
75	....	....	....	7	14	21
77	....	....	....	1	2	3
78	....	....	....	....	4	4
79	....	....	....	2	1	3
80	....	....	....	....	6	6
85	....	....	....	....	4	4
87	....	....	....	....	1	1
Total	11	57	29	47	55	199

¹Number of dozens at given prices.

Weight and quality were reflected in price up through the 75 cent group in eastern eggs sold in chain stores (Table 4). Nothing was gained by paying a premium over this amount. This was also true of private stores. It will be noted here that a 25-ounce egg with an internal score of 56 was purchased at an average price of 70 cents (66-75) in the chain stores and a 24½-ounce egg with the same interior quality at an average price of 77 (75-79) cents in the private store group. This margin between private and chain stores was the greatest for any time period, but the scores were almost identical with April. The average final score of the private-store eggs was 66 as against 75 for the chain. The private-store eggs were slightly fresher but not quite as heavy. It is important to note that eastern eggs had scores practically identical with April scores, whereas the August scores for western eggs were much higher. This observation indicates fairly conclusively the reason for the wide differential in price of eastern over western eggs in the late summer months.

Western Eggs

The range in price of western eggs in chain stores was from 35 to 70 cents, with one-half of the sales concentrated around 41 and 25 per cent around 51 cents. Weights showed considerable variation, especially in the lower-priced groups. Poorest eggs were found in the most frequently paid price groups, and better eggs were found in the higher-priced groups. Outside of these two groups, price advanced with quality and weight. In private stores price advanced with weight and quality except for the 45-49 cent group. The eggs in the latter were comparable in quality with the highest-priced group though $1\frac{1}{2}$ ounces lighter in weight.

TABLE 4.—WEIGHT AND QUALITY SCORES, AUGUST EGGS

Price per dozen (cents)	Frequencies	Weight (ounces)		Air Space		Final Internal Score	
		Range	Average	Range	Average	Range	Average
Chain Eastern							
55 or under	6	22½-24½	23½	32-48	39	74-108	90
56-65	29	22½-28	24	20-54	35	46-113	74
66-75	10	23½-25½	25	12-40	22	46- 74	56
76 or over	3	24 -25½	25	23-41	30	61- 89	71
Total	48	22½-28	24½	12-54	32½	46-113	75
Private Eastern							
Under 54	4	21 -23	22	32-53	39	72-110	87
55-59	5	20½-24½	23	27-44	34	62- 92	75
60-64	3	24 -24½	24½	30-41	33	79- 92	84
65-69	14	22½-26	23	22-41	31	56-100	75
70-74	5	23½-26	24	22-42	29	58- 83	67
75-79	21	21½-27½	24½	13-28	21	42- 82	56
80-84	6	23½-26	24½	15-33	21	44- 70	57
85-89	5	25 -27	25½	13-33	23	44- 81	60
Total	63	20½-27½	24	13-53	27	42-110	66
Chain Western							
35-39	4	19½-21½	20½	23-51	37	55-107	77
40-44	28	21 -24½	22½	28-55	44	76-117	97
45-49	3	21½-24	22	32-39	36	70- 96	81
50-54	16	22 -25½	23½	16-48	44	43-102	84
55-59	3	22½-23½	23	25-41	33	53- 95	76
60 or over	4	23½-25	24	19-33	28	53-78	65
Total	58	19½-25½	22	16-55	40	43-117	88
Private Western							
39 or under	2	23 -23½	23	44-46	45	95- 99	97
40-44	7	20½-23½	22	27-58	42	72-119	92
45-49	5	22½-24	23	26-40	32	55- 90	72
50-54	7	22 -24	23	30-47	37	67-102	87
55-59	6	20 -24½	23½	25-48	34	71-116	83
60-64	2	23½-25½	24½	26-34	30	59- 86	73
Total	29	20 -25½	23	25-58	37	55-119	85

November Eggs

With peak prices of eggs occurring in November, it is natural that prices show the greatest range for this month. The extreme range was from 36 to 98 cents. However, considering only fresh eggs, as in the two previous cases, the range is from 48 to 98 cents, a variation of but 50 cents.

The data for this month are not so valuable because of the smaller number of dozens purchased. The introduction of storage eggs necessitates the division into six classes instead of four. It will be noted, also, that the percentage of western eggs purchased was very small. Western eggs comprised 20 per cent, eastern 45 per cent, and storage 35 per cent of the samples for November.

Storage Eggs

Prices of storage eggs ranged from 36 to 69 cents with the highest price found in a chain store. (Table 5). In both private and chain stores among storage eggs the weight increased as price increased. The lack of relationship between air space and interior quality would seem to prove that weight was a predominating factor in the price of storage eggs. (Table 6).

TABLE 5.—PRICE RANGE AND FREQUENCY TABLE, NOVEMBER EGGS

Price per dozen (cents)	Frequencies ¹						Total
	Chain Storage	Private Storage	Chain Western	Private Western	Chain Eastern	Private Eastern	
36	1	....	..	....	....	....	1
37	1	....	..	....	....	....	1
39	6	1	..	....	....	....	7
40	1	3	..	....	....	....	4
41	7	....	..	....	....	....	7
45	5	2	..	....	....	....	7
48	....	....	..	2	....	....	2
49	5	2	..	....	....	....	7
50	....	1	..	1	....	....	2
51	....	1	..	....	....	....	1
55	....	1	1	2	....	....	4
58	....	....	..	1	....	....	1
59	6	....	1	1	1	1	10
60	....	1	1	1	....	1	4
63	....	1	..	....	1	....	2
65	....	....	..	1	1	2	4
67	....	....	4	....	1	....	5
68	....	....	..	2	....	....	2
69	1	....	..	1	1	1	4
70	....	....	..	1	....	....	1
71	....	....	..	....	1	....	1
73	....	....	..	....	....	1	1
74	....	....	1	1	1	....	3
75	....	....	..	3	....	4	7
77	....	....	1	....	....	....	1
79	....	....	..	....	11	1	12
85	....	....	..	....	3	5	8
89	....	....	..	....	3	2	5
90	....	....	..	....	1	4	5
92	....	....	..	....	1	1	2
94	....	....	..	....	....	2	2
95	2	4	6
97	1	1
98	1	1
Total	33	13	9	17	28	31	131

¹Number of dozens at given prices.

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TABLE 6.—WEIGHT AND QUALITY SCORES, NOVEMBER EGGS

Price per dozen (cents)	Frequencies	Weight (ounces)		Air Space		Final Internal Score	
		Range	Average	Range	Average	Range	Average
Chain Eastern							
Under 69	5	19½-24½	21½	35-57	42	74-117	87
70-74	2	22¾-26½	24½	33-50	41	77-103	90
75-79	11	23¼-25½	24½	36-52	42	75-106	89
80-84	0	.....	.....	.....	.....	.....	.....
85-89	6	23¾-26	25	36-47	42	76-106	90
90-95	4	24¼-25½	25	37-43	30	78-102	86
Total	28	19½-26½	24	33-57	41	74-117	88
Private Eastern							
59-68	4	20¼-24	22	20-50	35	54- 86	75
69-78	6	20 -24¾	23	29-51	42	64-108	87
79-88	6	22¼-25¼	23½	16-41	30	45- 77	68
89-98	15	21¾-26	24	19-47	29	43-105	66
Total	31	20 -26	23	16-51	34	43-108	74
Chain Western							
Under 60	3	23¼-24½	24	44-45	44	86- 98	92
61-71	4	23¼-25	24	44-50	47	89-112	100
72-77	2	25½	25½	35-36	35½	67- 85	76
Total	9	23¼-25½	24½	35-50	42	67-112	89
Private Western							
54 or under	3	21½-23¼	22	49-53	51	105-117	109
55-64	5	23 -25½	24	42-53	49	85-118	97
65-74	6	22¼-24¼	23½	34-52	45	84-103	93
75 or over	3	23 -23¾	23¼	38-52	45	97-101	98
Total	17	21½-25½	23	34-53	47½	84-118	99
Chain Storage							
Under 40	8	20½-28	22½	42-54	51	87-119	106
40-44	8	20 -24½	22½	46-60	53	93-129	108
45-49	10	20½-26	23	40-57	50	81-120	102
50 or over	7	22 -25¼	23½	51-57	53	96-112	105
Total	33	20 -28	23	40-60	52	81-129	105
Private Storage							
Under 45	4	20¼-23¼	22½	43-51	48	94-110	101
45-49	4	22¾-24¼	23½	22-51	42	82-105	93
50-54	2	23¾-24	24	46-48	47	93- 99	96
55 or over	3	23¾-25	24½	35-59	43	70-123	90
Total	13	20¼-25	23½	22-59	45	70-123	95

Eastern Eggs

Eastern eggs predominated in the November market. Again tabular analysis seems to show the dominating influence of weight. There was but little variation in quality at different prices among the chain stores. However, the quality of the higher-priced private-store eastern eggs was much higher than for the lower-priced groups.

Western Eggs

The western eggs which were purchased at chain stores at the higher prices were slightly larger and of much better quality than those purchased at lower prices. Among private stores price was not a criterion of weight and quality above the lowest price group.

Group Averages

Tables 7 and 8 afford an opportunity to observe average price differentials between stores and egg grades relative to weight and quality. Average weight for the various classes is a constant in April. There is an average margin of 3 cents among private stores over chains. The buyer would be compensated for this charge by the extra service rendered by the private stores.

The 3-cent margin carries through for the other months, with the exception of eastern eggs in August when the margin is 6 cents and for western eggs in November when the differential is reversed. Weights, however, are variable and the higher differential is often for a lighter egg.

TABLE 7.—WEIGHT AVERAGES AND AVERAGE PRICE PAID

	April		August		November	
	Weight	Price	Weight	Price	Weight	Price
Chain Eastern	24	49	24½	65	24	80
Private Eastern	24	52	24	71	23	83
Chain Western	24	38	22	46	24½	66
Private Western	24	41	23	49	23	63
Chain Storage	....	....	22	43	23	46
Private Storage	....	....	.....	....	23½	48

In quality, however, the private-store eggs were superior except in the case of western eggs in November. The superior quality of private-store eggs is especially noticeable in eastern eggs. A study of these averages also indicates very well the reason for the low price differential between western and eastern eggs in April and the wide differential in August and November. There is very little difference in quality between westerns and easterns in April, but there is considerable difference in August and November. It may be noted in passing that August cold storage eggs were superior in quality to westerns and were purchased at a lower price.

TABLE 8.—QUALITY AVERAGES AND AVERAGE PRICE PAID

	April			August			November		
	Air Space	Internal Score	Price	Air Space	Internal Score	Price	Air Space	Internal Score	Price
Chain Eastern	36	76	49	32½	75	65	41	88	80
Private Eastern	28	65	52	27	66	71	34	74	83
Chain Western	38	79	38	40	88	46	42	89	66
Private Western	36	75	41	37	85	49	47	99	63
Chain Storage	....	....	....	36	78	43	52	105	46
Private Storage	....	....	....	.....	....	....	45	95	48

Branded Eggs⁴

If the above variations in quality appear in the ordinary dozen of eggs at retail stores, the question may be asked—"Can the consumer be sure of quality and value for his money by buying branded eggs?" A record of brands was taken for April and August only. Although 26 brands were purchased in the survey, only 5 brands in April and 4 in August occur frequently enough to be of significance. Table 9 gives the variations which were found in each of the internal and external quality factors. Internal quality varied from moderately fresh eggs to the poorest quality found in the survey. Internal quality was poorer in August than in April. The variation in weight per dozen was about the same for the two months. The range in weight of eggs within the dozen was about the same in both months.

TABLE 9.—QUALITY VARIATIONS IN BRANDED EGGS

Brand No.	Price (cents)	Air Space (score)	Whites (score)	Yolks (score)	Net Weight (ounces)	Range in Weight (ounces)	Dirties	Final Internal Score
April								
1	31-35	36-49	14-26	18-26	21½-23½	12-26	1-10	68- 97
2	37-39	34-55	13-33	13-32	22½-26½	21-28	0- 6	60-120
3	39-41	31-54	16-30	17-26	21 -26½	18-29	0- 6	73-110
4	33-47	33-49	12-23	17-25	22 -25½	18-28	0- 5	66- 92
5	33-55	27-44	12-25	16-25	20½-26	20-28	0- 3	58- 89
August								
1	41	32-51	23-31	20-29	20½-23½	17-28	1-11	51-110
2	51	32-48	20-29	18-27	22½-25½	18-28	0- 7	74-102
3	29-51	35-45	22-31	18-31	21½-24½	19-28	1- 9	79-106
4	63	30-54	19-30	16-29	23 -25	21-26	2- 8	67-113

To illustrate the variations within the brand, Tables 10 and 11 are shown. The conclusion is obvious that the branding of eggs does not constitute a guarantee of quality or of uniformity, nor is there any assurance that the brand is worth the price paid.

Grade Maintenance

Undoubtedly some of the difficulties found in branded eggs lie in the policy of the management in the houses back of the branded eggs. Their candlers may receive different instructions at different times. However, it is quite apparent that much is still to be done in the care of eggs in retail stores. The retailers have no uniform practice in regard to the care of eggs. There is also a great variation in the manner in which stores are equipped to carry eggs. There is little variation between equipment possessed by chain and private stores. About one-third of the stores have full refrigeration. About one-fourth have partial refrigeration and nearly two-fifths have no refrigeration. It was found in a survey carried on by the Bureau of Agricultural Economics⁵ that eggs under ordinary circumstances were lowered one grade for the first three to five days under ordinary store conditions. In addition our survey tells us nothing of the care the eggs re-

⁴Only distributors' brands are used in the analysis. Producers' brands occurred too infrequently.

⁵Botsford, H. E. Some facts about eggs and the retailing of them. American Creamery and Poultry Produce Review, December 3, 1930, p. 201.

ceived by the managers. It will never be possible to guarantee quality to the consumer until there is some uniformity of care given to the preservation of eggs in local stores.

TABLE 10.—VARIATION IN QUALITY FOUND IN FOURTEEN DOZEN OF A POPULAR BRAND OF EGGS

BRAND No. 2

Price per dozen (cents)	Air Space (score)	Whites (score)	Yolks (score)	Net Weight (ounces)	Range in Weight (ounces)	Dirtyes	Final Internal Score
April							
37	43	23	24	26½	23-26	4	90
39	34	13	13	25½	23-28	2	60
39	40	18	25	25	24-28	6	83
39	47	18	14	24	22-26	3	79
39	34	19	17	22½	21-26	0	70
39	55	33	32	24	2-28	1	120
August							
51	40	21	20	23½	20-24	3	81
51	32	22	20	24	23-26	3	74
51	38	20	18	25½	23-28	1	76
51	46	26	24	23	18-26	0	96
51	37	28	27	22½	19-28	7	92
51	48	28	26	22½	22-23	4	102
51	38	26	27	23	21-27	3	91
51	47	29	25	23	21-24	5	101

TABLE 11.—VARIATION IN PRICE AND QUALITY FOUND IN ONE BRAND OF EGGS BRAND No. 5

Price per dozen (cents)	Air Space (score)	Whites (score)	Yolks (score)	Net Weight (ounces)	Range in Weight (ounces)	Dirtyes	Final Internal Score
April							
33	35	16	16	24½	20-28	1	67
41	34	20	19	20½	20	0	73
46	44	19	23	24½	22-24	2	86
46	39	20	23	24	21-26	1	82
46	39	25	25	24½	21-26	2	89
46	40	23	22	24½	21-25	0	85
55	33	15	17	25	24-26	0	65
55	27	12	19	25½	23-28	1	58
55	33	16	17	26	24	3	66
55	28	18	18	26	23-26	0	64
55	30	21	20	25½	24-27	0	71

Summary of Tabular Analysis

The tabular analysis may be summarized as follows: The best and the poorest dozen of eggs were found in April. The poorest dozen, a well-known, labeled brand, was almost inedible and cost but 10 cents less than the very best dozen. The consumer who buys eggs in cartons has but little opportunity to know what she is buying. However, although the consumer does have to take a

chance, the survey would show that, on the average, weight varies with price through most of the price range. Quality, as reported by air cell, condition of yolk and condition of white, is a much more variable factor. Although quality was more variable than weight, the lowest price of eggs usually represented the lowest quality. Moderately high prices usually insured high quality, but high premiums paid did not guarantee highest quality. Many of the eggs for which the highest prices were paid were no better than those purchased in the moderately priced groups. The average quality of eastern eggs was invariably higher than the average quality of western eggs. Storage egg prices showed but little relationship to quality, but weight varied directly with price throughout the price range.

The margin between private-store and chain-store prices was 3 cents as an average in the three time periods. As the average quality was also better, the extra service rendered by the private store cost nothing.

Branded or labeled eggs should assure the consumer of some degree of uniformity of quality. The survey indicated that this was not true. There was a great range of quality and some range in weight in any one of the various brands purchased. Price was the only uniform factor.

It may be concluded from the survey that price is not a satisfactory criterion of egg quality in eggs purchased from retail stores. It is, however, the best measure the householder has when she buys eggs. Undoubtedly much of the variation in quality occurs after the eggs are in the hands of the retailer. All the work which has been done in egg grading will come to naught as long as retailers treat eggs as they would canned goods. Producers, consumers and dealers should be interested in the consumer getting what she pays for.

CORRELATION ANALYSIS

The tabular analysis was conducted in order that the average reader might understand the results of the study. However, in order to make a tabular analysis it was necessary to classify the data and conduct the analysis by means of averages. In such an analysis many characteristics of the data and relationships are covered up. A more scientific analysis may be made by the use of correlation methods.

Relation of External Quality to Price

External quality factors may be observed by the buyer. Hence it is often assumed that there should be some definite relationship between the appearance of a dozen of eggs and the price paid. The quality factors considered as external are: weight, number of dirties, uniformity of color and uniformity of size. Weight, as shown in the tabular analysis, has a dominating influence. The other factors proved to have some influence on price. Weight was taken from the other external factors and placed along with the internal factors for study.

The multiple correlation coefficients which were obtained show that there is some relationship between price and external quality factors (less weight) for August and April. In both months the relationship was significant in each of the sub-classifications except for eastern eggs in April. It appears that external factors exert very little influence on price of eggs sold in chain stores in August. In one case only, that of private-store eggs in August, do the external quality factors cause as much as 35 per cent of the price variations due to quality. In all of the remaining cases the influence is below 25 per cent. (See Table 12).

TABLE 12.—CORRELATION OF PRICE AND EXTERNAL QUALITY FACTORS MINUS WEIGHT

	Coefficient of Correlation	Regression Coefficients		
		Range in Weight	Variation in Color	Dirty Eggs
April—N=217				
All Eggs	+ .48155	-.0724	-.2391	-.3666
Chain Stores	+ .4769	-.1767	-.1451	-.3910
Private Stores	+ .4691	+ .0168	-.2101	-.3556
Eastern Eggs	+ .1772	-.0304	-.0838	-.1557
Western Eggs	+ .4494	-.1481	-.1343	-.3681
August—N=198				
All Eggs	+ .47655	+ .0050	-.2126	-.3607
Chain Stores	+ .2592	-.0517	-.1018	-.2080
Private Stores	+ .5951	+ .1179	-.2593	-.4170
Eastern Eggs	+ .4055	+ .1672	-.2646	-.1926
Western Eggs	+ .4352	+ .0406	-.1129	-.3839
November—N=84				
All Eggs	+ .1682	+ .0380	-.0756	-.1311
Chain Stores	+ .2121	-.0363	-.2161	+ .0049
Private Stores	+ .2283	+ .0919	+ .0025	-.2202
Eastern Eggs	+ .3438	+ .2314	-.1549	-.1418
Western Eggs	+ .3677	-.1244	+ .1865	-.2552

The November measures are statistically nonsignificant, partially due to the small number of samples for that month. Because of the insignificance of the coefficients obtained for this month there will be no further discussion of the November measures in regard to external factors.

Range in Weight

Range in weight, as explained above, refers to the lack of uniformity of egg size within each dozen. The lack of significance in the regression coefficients leads to the conclusion that the variation in the size of eggs within each dozen has little or no effect on price.

Number of Eggs Off Color

The effect of off-color eggs on price was more important than weight variation. For each egg off color the reduction of price in April for all eggs was nearly .5 of a cent. In private stores this amount was .4 of a cent but only .25 of a cent for chain-store and western eggs.

In August the reduction in price for each egg of different color was nearly .5 of a cent. The reduction was highest in private stores and for eastern eggs. These losses were slightly over .5 of a cent in either case. Among chain-store and western eggs the loss was less than .25 of a cent for each off-color egg.

Dirty Eggs

The significance of dirty eggs as an influence on price was very similar to that of off-color eggs. The reduction in price for each dirty egg in April was from .45 to .50 of a cent except in the case of eastern eggs.

In August the reduction for each dirty egg was slightly higher except for eggs sold in chain stores and for eastern eggs. For the latter group the loss in price was about .25 of a cent for each dirty egg.

Net Effect of External Quality Factors on Price

In figuring the combined effect of external quality factors on the price of eggs, range in weight may be disregarded. Considering the other two factors, the influence was from zero, in the case of eggs which contained no off-color or dirty eggs, to 8.36 cents a dozen with six off-color and twelve dirty eggs. The price of eastern eggs in April appeared to be unaffected by these factors, but it is probable that such results were obtained because of the small percentage of eastern eggs which were dirty and a still smaller percentage of off-color eggs.

In August the maximum loss of all eggs could be but 6.8 cents as compared with 8.36 cents in April. For eastern eggs the maximum loss would be 5.49 cents, but in any case it is hardly conceivable that the conditions under which there would be a maximum loss in price would take place.

Internal Quality Factors

The combined effect of weight, together with the three factors of internal quality for all eggs purchased in all stores, was greater during the period of high prices and during the period of low demand and hot weather than in the spring of the year when quality was good and supply was well in excess of current demands. These factors had most effect on price during hot weather, the difference being 15 per cent more than during the period of low prices. As between stores the factors had relatively more effect on price in private stores than in chain stores during every period of the year. This was especially noticeable in April when the percentage was 20.5 per cent in favor of the private stores. Similarly quality and weight factors had more influence on the price of eastern eggs than western eggs at all seasons of the year. These relationships are also shown when each major grade group is broken down as between private and chain stores.

TABLE 13.—CORRECTED CORRELATION COEFFICIENTS BETWEEN INTERNAL QUALITY SCORES (INCLUDING WEIGHT) AND PRICE

	April	August	November
All Eggs.....	.656	.762	.705
All Eggs (omitting weight).....	.519	.643	.....
Chain Stores.....	.517	.708	.629
Private Stores.....	.682	.770	.715
Eastern Eggs.....	.530	.663	.606
Western Eggs.....	.427	.582	.426

Importance of Air Space

Air space, representing the amount of shrinkage in the egg, is a direct function of the time and conditions under which eggs have been held. It affects flavor and interior quality and any relationship shown between air space and price should be of significance in the establishment of grades, since it is the one factor of internal quality that can be determined easily by the individual producer. In November, air space was the most important single factor affecting price in both types of stores. It stands second in importance to weight on the basis of major grade groups, eastern and western. It is the most important internal factor, being the only one having any marked relationship to price. In general, an increase of one point in the score on account of air space produced a drop of

slightly more than one cent in price. This may be interpreted to mean that for each $\frac{1}{8}$ inch additional air space per egg, prices on the average drop one cent per dozen. If all twelve eggs in a dozen showed $\frac{1}{4}$ inch air space instead of $\frac{1}{8}$ inch, prices in November would be more than 12 cents below the average. This varies somewhat between eastern and western eggs and between chain and private stores. In November the drop in price in chain stores for increasing air space was approximately 63.63 per cent higher than the drop in private stores.

In April, air space is relatively unimportant as compared with weight. The average for all stores shows a net drop of 3 cents per dozen for each unit increase in air space score, or $\frac{1}{4}$ of one cent decrease for each $\frac{1}{8}$ inch increase in size of air space in each egg. Relatively, then, air space has about one-fourth as much significance during a period of low prices as during a period of high prices.

TABLE 14.—REGRESSION COEFFICIENTS BETWEEN INTERNAL QUALITY SCORES (INCLUDING WEIGHT) AND PRICE

	April	August	November
Air Space			
All Eggs.....	-.265	-.517	-1.172
All Eggs (omitting weight).....	-.446	-.798	.....
Chain Stores.....	-.222	-.303	-1.801
Private Stores.....	-.024	-.641	-1.101
Eastern Eggs.....	+.068	-.388	-.550
Western Eggs.....	-.021	-.298	-.532
Yolks			
All Eggs.....	-.479	+.192	+.027
All Eggs (omitting weight).....	-.479	-.068	.....
Chain Stores.....	-.021	+.116	-.176
Private Stores.....	-.762	+.091	+.373
Eastern Eggs.....	-.852	-.105	+.643
Western Eggs.....	-.274	+.431	+.033
Whites			
All Eggs.....	+.205	-.326	+.049
All Eggs (omitting weight).....	+.281	-.129	.....
Chain Stores.....	-.130	-.374	+.285
Private Stores.....	+.214	-.134	-.419
Eastern Eggs.....	+.356	-.141	-.408
Western Eggs.....	+.004	-.356	+.065
Weight			
All Eggs.....	+2.424	+4.461	+3.180
All Eggs (omitting weight).....	.....	.....	.....
Chain Stores.....	+1.873	+4.278	+2.258
Private Stores.....	+2.819	+4.481	+3.592
Eastern Eggs.....	+2.444	+2.313	+3.015
Western Eggs.....	+1.461	+2.672	+2.522

During August, when quality is relatively poor, air space again assumes a prominent part in determining price, standing next to weight. For eastern eggs it is more significant than weight. Air space is relatively twice as important in determining price in private stores as in chain stores during August. In general the average for all stores shows a decrease in price of $\frac{1}{2}$ of a cent for each egg

showing an air space $\frac{1}{8}$ inch above the average, while private stores show a decrease in price of $\frac{3}{5}$ of a cent for a similar increase in air space.

Condition of Yolk

Condition of yolk is relatively unimportant except during the spring of the year at which time it has more effect than air space in determination of price. It is particularly important in connection with eastern eggs and in private stores. During this period an increase of one point in the score on account of poor yolks is sufficient to reduce the price per dozen almost $\frac{1}{2}$ of a cent. In private stores the effect is to reduce prices $\frac{3}{4}$ of a cent, while with eastern eggs the average is more than $\frac{4}{5}$ of a cent reduction in price for each additional egg in a dozen with a poor yolk.

Condition of White

Condition of white also appears to be relatively unimportant in price determination at any of the three seasons studied. August is the only month in which any significant relationship appears. The average for all eggs in this month shows a net loss of .3 cents per dozen for each additional point on the score of the condition of white. This factor is more important for chain stores than for private stores and for western eggs than for eastern eggs, although the exact measure of this difference is indeterminate.

The apparent unimportance of the condition of white and yolk is accounted for in part by the interrelationship between size of air space and the other two internal factors. This is shown by the relatively high correlation between these factors at all seasons, but particularly in November and August.

Effect of Weight

Weight is one of the most important factors affecting price at all seasons of the year, but is most important both relatively and actually in August. In this month each additional ounce per dozen causes an increase of 4.5 cents per dozen in price. In April each additional ounce of weight produces an increase of 2.4 cents per dozen, while in November the increase is 3.2 cents per dozen. In April weight is relatively more important in connection with eastern eggs and eggs sold in private stores, and in November the same holds true. In August the effect of weight is slightly greater in private stores than in chain stores and for western eggs than for eastern eggs. The differences are not large enough to be significant in either case.

The effect of the several factors on the price of all eggs may be summarized as follows:

	CENTS PER DOZEN		
	April	August	November
Each $\frac{1}{8}$ air space per egg.....	-3.0	-6.0	-12.0
Each yolk worse than average.....	-6.0	-2.3	0
Each white worse than average.....	-2.4	-3.6	0
Each additional ounce per dozen less than average	-2.4	-4.5	-3.2
The combined effect of these factors.....	-13.8	-16.4	-15.2

Assume that a farmer or a storekeeper stores eggs under improper conditions; that perhaps the purpose of storing is to secure a higher market price. What are the chances of a net gain in receipts for the eggs? The eggs when gathered weighed 24 ounces per dozen. During the whole period they lose, on an average,

1 ounce per dozen, air space increases $\frac{1}{8}$ inch, and there is an average loss of one egg on whites and no loss on yolks. According to the table shown above, this deterioration would amount to 7.8 cents per dozen in April, 14.1 cents per dozen in August and 15.2 cents in November. The loss per case would be \$2.34 in the spring, \$4.23 in the summer and \$4.56 in the fall. This represents the cost of tardy marketing or of storing eggs under improper conditions.

Conclusion

The most definite and significant relationship discovered from this analysis is that prices are directly related to weight under all conditions. That weight is a significant factor is not new, the trade has long recognized this fact. However, it has not been known that weight is more important at one season of year than another and that the premiums which are paid for weight are fairly definite. If premiums are known, it is possible to carry on further research in egg production to determine whether the production of large eggs is profitable.

Size of air space, condition of white, and condition of yolk are largely determined by the delay in marketing and the conditions under which the eggs are stored from the time they are produced until they reach the consumer. Until further research is carried on as to the effect of time and various conditions of temperature and handling on the quality of eggs, all unnecessary delays must be prevented and temperature kept low if the eggs are to reach the market in proper condition.