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Asynergistic sales-effects of in-market advertising and price-reduction: a case study of the Ile-Ife palm-oil market

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Abstract

An extra-period Latin-square experimental design, a subset of which was a four-by-four Latin-square design, was first used to evaluate the carry-over effects of various treatments on unit sales of palm-oil in Ile-Ife market. The treatment carry-over being detected to be non-significant, the analysis of the regular Latin-square made up of four treatments in four market sites during four experimental market periods was performed.

The results indicated that point of sale promotion more than doubled the effect of price reduction on unit sales of palm-oil. With or without point-of-sale promotion, palm oil was found to be a non-giffen good. Each of the three components of the direct treatment variable-price, advertising and the combination of the two were found to be significant in effect. Asynergism was found to be present when point-of-sale advertising and price specials were combined.

Introduction

In Nigeria, and probably in the whole of the continent of Africa, research on retail merchandising of agricultural products has either not been done, or reported. This neglect is probably due to lack of recognition of the importance of this kind of research by researchers, marketing firms and policy makers. The retail sector is the final link with the ultimate consumers in the marketing channel, and what happens there is what will eventually affect the structure, conduct and performance of the other institutions involved in production and marketing. Retail-store merchandising research, whether conducted under private or public auspices, is designed to aid management in increasing the money volume of sales with respect to

a commodity or a group of commodities, and in increasing department or store traffic, thereby enhancing the opportunity for greater sales per square foot of space and per store employee. Greater efficiency in retailing is achieved, and under competitive conditions, savings in costs are shared with producers and consumers.

The realisation of the importance of research on retail merchandising of agricultural products by the relatively developed countries of the world is reflected in the fact that research in the area has been started as early as in the 1940s (Dominick, 1960). In the United States of America, for example, the passing of the Agricultural Marketing Act of 1946 by Congress, greatly accelerated research on retail merchandising of agricultural products, resulting in over 300 published reports between 1946 and 1960 (Dominick, 1960). A sample of these reports includes works on McIntosh Apples, (Dominick, 1953), Yellow Onions (Davis, 1955), Turkeys (Ellsworth, 1951), Honey (Ellsworth, 1953), Sweet Potatoes (Baker, 1947), Sweet Corn (Alban and Scott, 1954), Dry Beans (Allee, 1955), Butter and Oleo (Allred, 1954), Eggs (Anderson, 1957), Dairy products (Berry and Meenen, 1957), Fruits and Vegetables (Bitting, 1953), Beef (Branson, 1957), Frozen Stuffed Peppers (Brown, Blancom and Ferrier, 1957), Apples (Brunk and Federer, 1953), Oranges (Downie and Rauchschwalbe, 1951), Fryers (Gunn and Carpenter, 1955), Pears, Peanut Butter and Creamer Butter (Uelskamp, 1957), and Tomatoes (Moore, 1950).

These studies which had the general objective of determining the relative effectiveness of specific merchandising methods in increasing the sales of, and demand for farm products, used either of the following research techniques.

(1) Surveys using observation of existing practices, and interviews or mail questionnaires.
(2) Matched-lot experiments.
(3) Test-versus-control-store experiments.
(4) Test-store experiments, and
(5) Controlled experiments employing latin-square, randomised complete blocks, and other statistical (experimental) designs to equalise the effects of uncontrollable factors such as different time periods and stores, associated with sales.

The need for research in retail merchandising of farm products in the third world warranted this study. It was designed to answer two main questions:

(1) Will the use of in-market advertising at regular prices produce greater sales than the use of price specials without advertising?
(2) How significant to product sales are the synergistic effects of both a price special and in-market advertising?

Materials and methods

Three hypotheses were set. These were:

Hypothesis 1: The presence of point-of-sale advertising is more effective in increasing the sales of a product than a price reduction.

Hypothesis 2: Consumers will buy more of a product at a reduced price than at the normal price with point of sale advertising present or absent in both cases.

Hypothesis 3: Consumers will buy more of a product at the normal price with point of sale advertising than they will buy at the normal price when no point of sale advertising is present.

The product involved in the experiment was palm oil. This is a product for which one may intuitively expect exceptionally good sales response to a price special, and for whose quality, consumers are reasoned not to judge by price.

Experience was drawn from one of the indications provided by a previous familiarisation with the market conduct at the various market sites in Ile-Ife. This indication that the Ile-Ife market sites for many commodities can be correctly classified as belonging to the same market was accepted as a datum. A maintained hypothesis implied from the datum is that the cross-elasticity of demand between any two of the market sites is positive. The estimation of the cross elasticity of demand variable would have been necessary if the study were interested in testing the null hypothesis that nearness of market sites for a commodity does not necessarily mean that such sites belong to the same market. As that was not the interest of the study, and as the focus of analysis was the aggregate of all sales in all the sites that may be chosen, rather than sales made in each market site, the cross elasticity of demand between two or more market sites was not estimated.

In case however, this datum may be accepted whereas it may not hold (a kind of type 11 error), a precaution was taken. One of the experimental designs used (the regular Latin-square) was such that

would simultaneously control the effects of two independent variables, (Snedecor and Cochran, 1969), (Cochran and Cox, 1957), (Kempthrone, 1952), (Fisher, 1960) (Addelman, 1973), (Hoofnagle, 1965), (Steel and Torrie, 1960). The two independent variables in this case were market site and time period. A further check of the extent to which Latin-square design used was able to effectively achieve the controlling tasks was made by using analysis of variance. The market sites used were Sabo, Modakeke, Enuwa and Itakogun. These represent the biggest and generally well known sites in Ile-Ife.

The next step involved negotiations and communications with the retailers. There were 9 in Itakogun, 10 in Modakeke, 11 in Sabo, and 10 in Enuwa. The differences in these numbers were assumed not to be significant enough to become a significant explanatory variable for the observed sales. The retailers were well-informed about the project, they provided some preliminary though previously unwritten statistics, and assured the researcher of their cooperation. Many agreements emerged from the communications. These included the following:

(1) The researcher would make an initial purchase of four times the approximate estimation of each retailer's daily sale from respective retailers at the going rate of 75 kobo per bottle. The retailer would "do with them in anyway the researcher may suggest at any time". (Four times the estimated number of daily sales was mentioned by the researcher to encourage the retailers' participation in the project, and to prevent the retailers from selling from their reserve (if any); rather than from the ones the researcher had purchased. It was reasoned that with four times bought under this arrangement, very small (if any) would be left in the retailer's reserve per day). It would have been better if it were possible to obtain past demand schedules from the retailers during the negotiation period, so as to guess what price elasticity of demand might be, even in the same site. This was not done for three reasons:

   (a) retailers could easily estimate what their approximate daily sales had been but not with its associated price;
   (b) even when daily sales were guessed, the estimates were not provided in any time series way (e.g. It was "just about x bottles per day on the average");

(c) it appeared that even if demand schedules were obtained, the price variable may not have a reasonably good spread to make a reasonable estimation possible.

The resort would have been to design an experiment that would provide a reasonable spread of the price variable. This however would have been out of the interest of this particular project. A good use was therefore made of the approximate unit sales estimate provided by each retailer.

(2) The researcher may make further purchases from the retailer at any stage of the project.

(3) The retailers were each promised an equal bonus of money if they could participate fully and sincerely throughout the project life. The bonus was given at the end of the experiment.

(4) The retailers realised that other projects in which they could earn something may be forthcoming, and that the prospect of their being included will be a function of how accurately they help in executing the project under reference.

(5) Each retailer would display twenty-five bottles each morning, and periodic audits would be done, and at those times, advice would be given on whether additional bottles should be added. Twenty-five was arbitrarily chosen bearing in mind that the approximate estimation of daily sale was ten bottles per retailer. With twenty-five displayed per retailer, constancy would be maintained, and the probability that all those twenty-five would have been purchased within a four-hour interval would be almost zero; thus solving a possible "identification problem" (Johnson, 1963); Kmenta, 1971).

The initial purchases made from the retailers were used as foundation stock for the experiment. Daily replenishment to make the original number was purchased from the relevant or other retailers depending on who had supplies. Sales proceeds submitted by retailers were used for such replenishments. Audits were taken at unannounced hours falling within an interval of some three to four hours between the hours of 8 a.m. and 8 p.m. daily. At each audit, an advice was given to replenish the displayed palm-oil bottle to the constant level of twenty-five. The retailers were not given previous information on what the next experimental (marketing) plan would be (i.e. whether price reduction with or without promotion), until the moment of execution. Though instances of falsification of

reported sales, especially in the price special treatments, may not be totally ruled out, the various features of the execution of the project were such as to make such falsification minimal, and the likely error it may introduce into the analysis highly negligible.

To complete the regular 'Latin-square' design, four treatments were applied during four market periods made up of two weeks per market period, in each of the four market sites. The treatments were:

T_1 = No price reduction, no promotion
T_2 = Price reduction, no promotion
T_3 = No price reduction, promotion
T_4 = Price reduction, promotion.

To measure carryover effects of the treatments, a fifth period was added, thus forming an extra-period Latin-square design. This was done realising the implication of the extra-period Latin-square design. Apart from making a treatment to appear twice in each market site, the advantage of equal market site effect associated with all treatment variables possessed by the regular Latin-square design would be eliminated, should carry-over effects be significant. Nonetheless, the analysis was made to indicate which was which, a way of testing the validity of the assumptions inherent in the Latin-square design used now that an extra-period design was added.

Thus, the whole data collection period was a total of ten consecutive weeks, between October 1 and December 15, 1978. Communications and negotiations however started on the first day of September 1978. It was assumed that within as short a time as ten weeks during which the experiment was executed, some variables which can introduce some dynamics into demand especially those of close substitutes, tastes, number, composition, and structure of population would not have changed sufficiently to affect the results obtained. Definitely, the events of the season and times of the experiment: Ileya festivities, bulk purchases of salary earners and possible stock piling against the Christmas and New Year would affect the obtained estimates. Such an effect should be salutary, as it would only reflect things as they really are in real life. Such an effect could have caused some concern if the events leading to it were not happening to all the treaments at the same time; or/and if demand estimates at two different times of a year were being considered, a situation that would have been resolved by appropriate deseasonalisation (Kmenta, 1971).

A price reduction of 20 percent[1] – being assumed to be a significant reduction from the point of view of both the retailer and the consumer – was chosen for the experiment.

The type of point-of-sale advertising utilised was a simple, block lettered sign designed on a 3ft 6ins. cross-shaped signboard. The signboard containing the equivalent of the following statement "Good Fresh palmoil is here for sale"[2] and the drawing of 1 beer bottle[3] coloured red, on which the price was conspicuoulsy written,[4] was installed in the middle front of the stall of each retailer. This was a relatively crude form of point-of-sale advertising compared with those that could be used. The crude form of advertising, felt by the researcher to be the least effective type which could possibly be utilised was chosen to make the hypothecated effectiveness of point-of-sale advertising difficult to attain. If significant effectiveness was found while utilising only this minimum of the potential power which point-of-sale advertising holds, a robust test would substantiate hypothesis 1 above.

Results and discussion

The data obtained from the extra-period Latin-square design experiment are contained in Table 1, while Table 2 shows the analysis of variance.

Carry-over effects

As table 2 indicates, the treatment carry-over detected in the Latin-square with the extra period was not significant. Unit sales of the product were affected by the current treatment significantly, with no significant effect being brought about by any treatment in the preceding time period.

Further investigation of carry-over effect was done to determine whether the carry-over effect from any one treatment may signifi-

1. For price reduction 60k was used instead of 75k.
2. Epo Otun alailabawon, eroja rere fun obe wa nihin fun tita.
3. 1 Beer Bottle = 1.25 pints.
4. Where the price reduction featured; two additional things were done:
   (a) the equivalent of "at reduced prices too" (Ni edinwo pelu) already printed on a white strip of plastic was pasted on the signboard;
   (b) where the regular price had earlier been written on bottle, the price was crossed by two neat intersecting lines; and the new price written. This was done on the bottle drawn on the signboard, as well as on each palm oil bottle.

cantly differ from another. The presence of any significant carry-over effect would attenuate the hypotheses formulated. Unit sales associated with the carry-over from the treatment of no price reduction with no point of sale promotion were greater than for any other treatment carry-over effect. The carry-over effect from the treatment of a price reduction with point-of-sale promotion is associated with the lowest unit sales. This is exactly the opposite from the direct treatment effect, where observations of unit sales increased as treatments progressed from T_1 to T_4 (Table 1). This might indicate some stock-piling: that is, the higher the sales are in one period, the lower they are in the following period in the same market site because purchasers would buy more than their immediate needs.

An analysis of variance of carry-over effects among all six possible pairs of

$T_1\ T_2$ $\quad$ $T_1 T_3$ $\quad$ $T_1\ T_4$

$T_2\ T_3$ $\quad$ $T_2\ T_4$

$T_3\ T_4$

indicated however, that no significant difference exists among pairs of carry-over effects on units sales.

Effects of time period, market site and direct treatments

The treatment carry-over effects in this experiment having been found to be negligible, the analysis of the regular four by four Latin-square design was performed. Table 3 contains its results.

The calculated F for the variation between periods indicated that this variation could occur by chance alone about 20 percent of the time. In other words, little significant effect on palm oil sales could be attributed to the differences between time periods during which the experiment took place. The calculated F for the variation between markets could occur by chance alone 20 percent of the time. Again, little significance could be attributed to this effect. The third calculated F indicated that the effect of the treatments on sales was significant ($P < .0001$). The treatments made up of the four possible combinations of price and point-of-sale promotion were significant on palm oil sales during the course of the experiment.

Effects of price, advertising, and price plus advertising combined

Table 4 shows the analysis of variance for the effects of price, advertising and both price and advertising combined, on sales.

All the three components were found to be significant beyond the 0.01 level. Price alone significantly affected sales. Point of sale advertising was significant. The combination of price and point-of-sales advertising was also significant with its associated sales greater than the simple addition of those obtained for each of price and advertising treatments (Fig. 1).

A two-way analysis of variance was further used to investigate whether or not the different treatments provided significantly different sales. Examined for this were the sales for each pair of the six different total possible combinations of

$T_1\ T_2$ $T_1\ T_3$ $T_1\ T_4$
$T_2\ T_3$ $T_2\ T_4$
$T_3\ T_4$.

Differences among all possible pairs of treatments, as judged by their associated sales of the product were significant, with $T_1\ T_2$ significantly different at 0.055 level, $T_1\ T_4$ and $T_2\ T_4$ at 0.01 level, and all the others at 0.02 level.

Elasticities

Arc price Elasticity η of demand was calculated for each of the plots obtained in Fig. 1 illustrating more vividly the effect of in-site advertising.

For plot $T_2\ T_1$, (the demand curve obtained without point-of-sale advertising):

$$= \frac{\Delta q}{(q_1 + q_2)} = \frac{(680 - 1{,}000) \text{ bottles}}{(1{,}680) \text{ bottles}} \div \frac{(75 - 60)k}{(135)k}$$

$$\frac{\Delta P}{(P_1 + P_2)} = \frac{-320}{1{,}680} \times \frac{135}{15}$$

$$= -1.714$$

These results indicate that if price is decreased by one percent, the quantity of palm oil that would be purchased would increase by as much as 1.7 times when no point-of-sale advertising is done whereas, the increase would be over 3¼ times when there is point-of-sale advertising. It also indicates that the increase in total revenue that an equal percentage reduction in price of palm oil would bring to the retailers would be more when point-of-sale advertising strategy is used, compared with when it is not used.

TABLE 1: DATA FOR THE EXTRA PERIOD LATIN-SQUARE DESIGN EXPERIMENT IN PALM OIL SALES ILE-IFE, 1978.

Time Period	*Market Sites*							
	Itakogun		*Modakeke*		*Sabo*		*Enuwa*	
	Treament	Sales*	Treament	Sales*	Treament	Sales*	Treament	Sales*
1	T_3	1,230	T_1	574	T_2	902	T_4	2,091
11	T_4	2,870	T_2	1,107	T_3	1,394	T_1	451
111	T_2	943	T_4	3,444	T_1	779	T_3	1,312
IV	T_1	779	T_3	1,271	T_4	3,485	T_2	943
V	T_1	925	T_1	568	T_1	760	T_1	462

T_1 = No price reduction, no promotion
T_2 = Price reduction, no promotion
T_3 = No price reduction, promotion
T_4 = Price reduction, promotion
* = Number of bottles.

TABLE 2: ANALYSIS OF VARIANCE FOR EXTRA-PERIOD LATIN-SQUARE DESIGN EXPERIMENT: PALM OIL SALES, ILE–IFE, 1978.

Source of Variation	*Sum of Squares*	*Degrees of Freedom*	*Mean Square*	*F*	*Probability > F*
Time Period	13,312.5360	4	3,328.1340	.886	0.5253
Market Site	20,286.8000	3	6,762.2530	1.801	0.2471
Direct Treatment	288,267.3100	3	96,089.0760	25.596	0.0008
Carry-over	17,524.2200	3	5,841.3930	1.556	0.2947
Residual	22,524.3340	6	3,754.0420		
Total	361,915.2000	19			

TABLE 3: ANALYSIS OF VARIANCE FOR LATIN-SQUARE DESIGN EXPERIMENT IN PALM OIL SALES, ILE-IFE, 1978.

Source of Variation	*Sum of Squares*	*Degrees of Freedom*	*Mean Square*	*F*	*Probability > F*
Time period	11,528.6870	3	3,842.8931	2.1393	0.1965
Market site	11,610.6870	3	3,870.2278	2.1545	0.1946
Direct Treatment	313,309.1800	3	104,436.3900	58.1393	0.0001
Residual	10,777.8750	6	1,796.3125		
Total	347,226.4300	15			

TABLE 4: ANALYSIS OF VARIANCE FOR COMPONENTS OF DIRECT TREATMENT EFFECT: PALM-OIL SALES, ILE-IFE, 1978.

Source of Variation	*Sum of Squares*	*Degrees of Freedom*	*Mean Square*	*F*	*Probability > F*
Price	97,439.0420	1	97,439.0420	54.2440	0.0003
Advertising	171,895.0400	1	171,895.0400	95.6940	0.0001
Price & Advertising	43,975.0420	1	43,975.0420	24.481	0.0025

Summary

(Consumers responded to point-of-sale promotion by purchasing more palm oil than they did when a price reduction was utilised. They also purchased more palm oil when the price was reduced than when at the normal price. This was true when no point-of-sale or other promotion was utilised to call their attention to the product or its price.

Arc price elasticity of demand for no point-of-sale advertising situation was -1.714, while it was -3.272 when point-of-sale advertising strategy was used.

Consumers purchased more of the product at a price reduction when point-of-sale promotion was used than when no price reduction was used with the point-of-sale promotion. They also purchased more when pricing remained normal and point-of-sale promotion was utilised.

The combined effect of a price special and point of sale advertising resulted in more purchases than when neither point-of-sale advertising nor a price special was used. Carry-over did not have a significant effect on unit sales of palm oil in the experiment.. The direct treatment variable was the only independent variable with a significant effect on unit sales.

All three components of the direct treatment variable — price, advertising, and the combination of both were found to be significant.

When the effectiveness of a crude point-of-sale advertising device was compared to a price special, the results indicated the superiority of the point-of-sale advertising device in producing increased product sales.

Asynergism was found to be present when point of sale advertising and price special were combined. The independent mean increases in sales associated with the price special and point-of-sale advertising were 328 and 656 bottles respectively. If both were used, an asynergistic effect would produce a total effect of the sum of the two i.e. 984 bottles. The increase in this study was however 2,337 bottles.

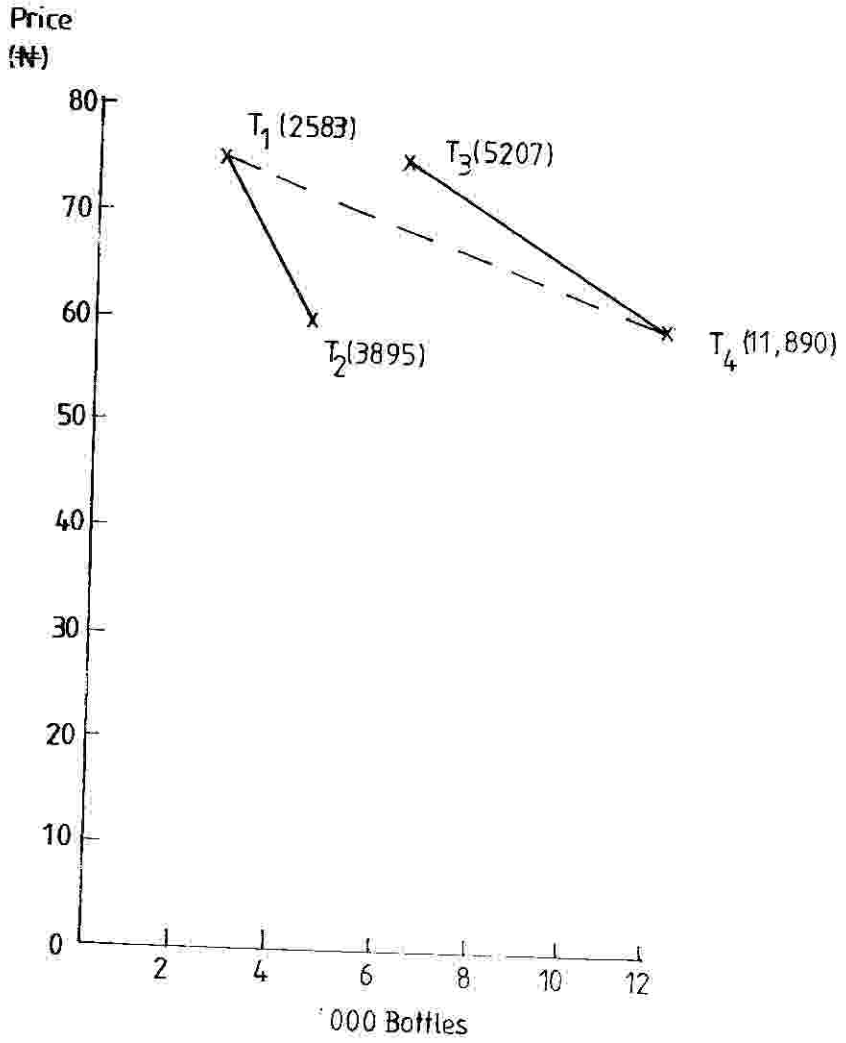

Fig. 1 — Asynergistic sales effect of inmarket advertising and price reduction (T_4–T_1) in Ile-Ife Palm oil market, 1979.

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References

Alban, E.K. and Scott, R.C. 1954. Post harvesting handling and marketing of garden fresh sweet corn. *Ohio Agric. Expt. Sta. Res. Cir.* 23, 31pp.

Addleman, S. 1973. Recent development in the design of Factorial Experiments. *J. Am. Stat. Assoc.*, 67: 103-111.

Allen, D.J. 1955. Merchandising dry beans. *Cornell Univ. Agric. Expt. Sta.* AE 958, 23pp.

Allred, W. 1954. Can Butter compete with Oleo? *Utah Agric. Expt. Sta. Farm & House Sci.*, 18 (2): 38-48.

Baker, J.M. 1947. Marketing Louisiana sweet potatoes in Pittsburgh. *La. Agric. Expt. Sta. Bull.* 422, 14pp.

Berry, C.R. and Meenen, J.J. 1957. Distributing dairy products through retail stores in Arkansas. *Ark. Agric. Expt. Sta. Bull.* 592, 36 pp.

Bitting, H.W. 1953. Produce department-space utilization, gross margins and operating cost in selected retail stores at Charlotte, North Carolina. *U.S.D.A. Mktg. Res. Rpt.* 36, 38pp.

Branson, R.R. 1957. The consumer market for beef. *Texas Agric. Expt. Sta. Bull.* 856, 28pp.

Brown, E.E., Van Blaricom, L.O. and Ferrier, W.T. 1957. Frozen stuffed peppers. A new frozen food? *Sc. Agric. Expt. Sta. Agric. Econ.* 127, 9pp.

Brunk, M.E. and Federer, W.T. 1953. How marketing problems of the apple industry were attached and the research results applied. *Cornell Univ. Agric. Expt. Sta. Methods of Res. In Marketing* 4, 15pp.

Cochran, W.G. and Cox, G.M. 1957. *Experimental Designs 2nd Ed.* J. Willey Inc., New York, 283pp.

Davis, L.H. 1955. Merchandising yellow onions in retail food stores. *N.Y. State Coll. Agric.*, AE 1014, 15pp.

Dominick, B.A. Jr. 1953. Merchandising McIntosh apples in retail stores. *Cornel Univ. Agric. Expt. Sta. Bull.* 895, 22pp.

Dominick, Bennett A. 1960. Research in retail merchandising of farm products Appraisal of methods and annotated bibliography. *U.S.D.A. Mkgt. Res. Rpt.* 416, 46 pp.

Downie, E.D. and Rauchschwalbe, O. 1951. Package and bulk selling of Florida oranges. *U.S.D.A. Prod. & Mkgt. Admin. Rpt.*, 18pp.

Ellsworth, H.M. 1951. Problems and possibilities of expanding the sale and consumption of Turkeys in California. *California Dept. Agric. Mkgt. Surv.*

Rpt. 5, 36pp.

Ellsworth, H.M. 1953. Expanding the consumption of California honey. *California Dept. Agric. Mkgt. Surv. Rpt.* 9, 36pp.

Fisher, R.A. 1960. *The Design of Experiments* 7th Ed., Hafner Publ. Co. Inc. N.Y. 248pp.

Gunn, T.I. and Carpenter, K.S. 1955. Merchandising Fryers in self-service supermarkets. *Cornell Univ. Agric. Expt. Sta. Bull.* AE 992, 16 pp.

Hoofagle, William S. 1965. Experimental designs in measuring the effectiveness of products. *J. Mkgt. Res.*, 2: 154-162.

Huelskamp, H.J. 1957. Evaluation of retail merchandising practices for pears, peanut butter and creamery butter. *U.S.D.A. Mkgt. Res. Rpt.* 180, 16pp.

Johnston, J. 1963. *Econometric Methods*, McGraw Hill Co. Inc., N.Y., 437pp.

Kempthrone, O. 1952. *Design and Analysis of Experiments*. J. Wiley Inc., N.Y. 631 pp.

Kmenta, Jan 1971. *Elements of Econometrics*. Macmillan Co., N.Y., 655pp.

Moore, C.A. 1950. Market preferences for fresh tomatoes at St. Louis, Missouri. *Ark. Agric. Expt. Sta. Bull.* 494, 16pp.

Snedecor, G.W. and Cochran, W.G. 1969. *Statistical Methods*. 6th Ed. Iowa State Univ. Press, Ames., U.S.A. 593pp.

Steel, R.G.D. and Torrie, J.H. 1960. *Principles and Procedures of Statistics* McGraw Hill Co., N.Y., 471 pp.

Tull, D.S. 1965. The carry-over effect of advertising. *J. Marketing*, 29: 46-53.