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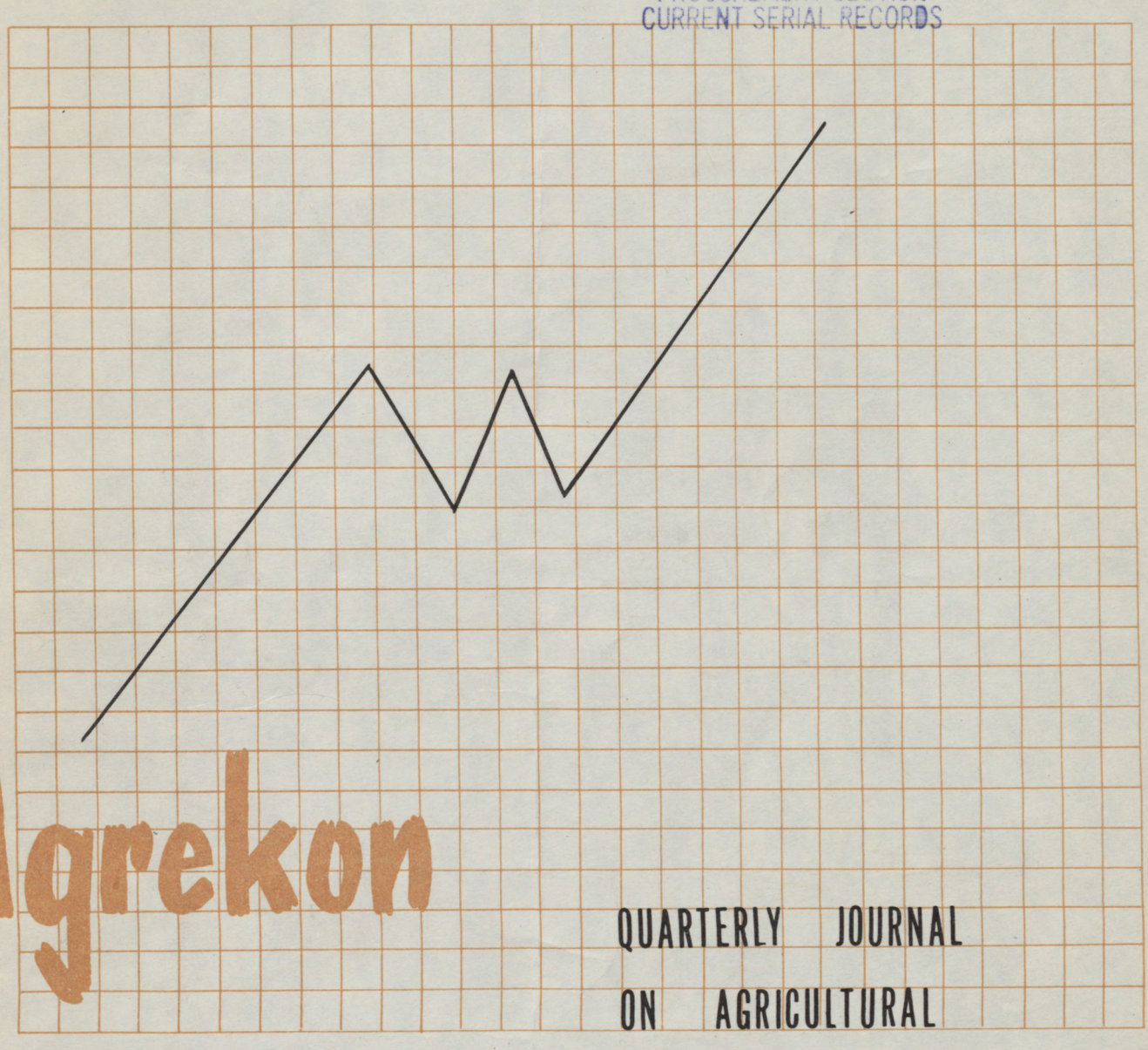

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SEASONAL VARIATIONS IN PRICE, PRODUCTION AND TOTAL INCOME OF SELECTED HORTICULTURAL PRODUCTS

by

W.L. NIEUWOUDT,
University of Natal*

INTRODUCTION

Prices of uncontrolled products vary from month to month largely as a reaction to the seasonality in production. Inelastic product demands may further amplify the effect of production on price.

Because prices of these crops are so volatile, they are often referred to as risky enterprises. More should be known about these products to make rational and efficient planning at the farm level feasible. Knowledge of seasonal production movements is useful in the marketing of the crop. The Banana Control Board, for example, uses this information in arranging and channeling supplies to different markets.

Total product sales are also studied for each month to establish whether income from these products actually falls in the top season as suggested by inelastic price elasticities of demand.

ANALYTICAL METHOD

Data studied over time are influenced by a number of forces acting simultaneously. It is convenient for this study to think of the original data (O) as composed of a trend (T), seasonal variations (S), cyclic variation (C) and random elements (R) in the form of the following equation :

$$O = T \times S \times C \times R$$

In order to study and isolate seasonal movements in prices or consumption it is firstly necessary to eliminate trend, cyclic and random forces. High inflation rates during the 1970's show up in prices, making it imperative that the trend effect be eliminated. Trend was eliminated by fitting a least squares equation to the original monthly data and then dividing the original data by trend ordinates. By a careful selection of the period, the cyclic effect is eliminated and computing monthly averages of a number of years eliminates random influences. A period of about 10 years has the advantage that all the data are of a recent nature while it is long enough to give significance to results.[1]

In studying the seasonality in monthly consumption data, the number of days in a month must also be considered because months with fewer days would have a smaller production. All months were thus standardised to a four weekly basis.

RESULTS

Data were analysed for selected tree crops and vegetables produced in the Transvaal Lowveld. The tree crops, avocado pears, pawpaws, pineapples and bananas and the vegetables, cabbage, cauliflower, green beans and green peas are discussed.

Producer income related to price elasticity of demand

Demand functions were fitted for pawpaws, bananas and avocado pears by regressing seasonal production indexes on seasonal price indexes. Seasonal indexes were isolated as discussed earlier.[2] Total revenue functions were calculated from individual demand functions and portrayed in Fig. 1. The crops, avocados, pawpaws and bananas were selected because these crops cannot be stored or processed and do not have close substitutes. Individual product prices should thus be sensitive to production changes of the corresponding products.

Fig. 1 is of interest because it brings out the dilemma faced by agriculture that a bigger crop sometimes results in a smaller total income than a smaller crop. As production of, say bananas, increases from winter to early summer, total revenue realised per pool (or month) increases but at a diminishing rate. Total revenue from the banana crop reaches a maximum at a seasonal production index of 157[3] and then falls if production exceeds this point. Net revenue, when packing, picking and transport costs are also

* The writer is indebted to Messrs D.N. Marshall and S.M. Kassier, graduates of the University of Natal (1976), for calculating seasonal indexes.

considered, should fall more. This explains why the Banana Control Board resorted to such drastic measures in the past as destroying a portion of the crop during 'surplus' periods.

With total revenue functions shaped as in Fig. 1, producer income could be increased substantially if products could be stored in the surplus months and sold in the off season. If a constant supply to the markets is possible, then producer income is expected to increase both during the off season and the top season. Further, if the same daily quantity of produce is sold during the year, then the total income from the crop, excluding storage costs, would be maximised. It can be shown that the income from selling quantities A and B in two different months would be less than the income from selling $(A + B) \div 2$ in each of the two months with total revenue functions shaped as in Fig. 1.[4]

Fig. 1 also casts light on the nature of the product demand elasticities. At the point of maximum total revenue for a specific product, the demand elasticity for that product is unitary, to the left of that point it is greater than one and to the right it is less than one.[5]

A number of questions could be raised in the above analysis. Seasonal demand could change from winter to summer. To investigate the importance of this factor, monthly production indexes for different years were related to total revenue. These results indicate that monthly production changes over the years had a similar effect on income as portrayed in Fig. 1, supporting the above findings. In the case of avocados and pawpaws data for the Johannesburg market were used. Months stretching over the holiday season were thus excluded because of a shift in population during this season. Multicollinearity problems were anticipated and cross elasticities were thus not estimated. Cross elasticities were, however, assumed to be small for the products studied i.e. avocados, pawpaws and bananas. The Seasonality in prices will now be further investigated.

Seasonal price movements of some tree crops

(a) Avocado pears

According to Fig. 2 seasonal price and production indexes show symmetrical movements. Prices are high from November to January and low in April. The two graphs intersect at a lower price in February - March than in September - October implying a greater seasonal demand in the latter period. The fact that avocado prices are so responsive to production according to Fig. 2, could be explained by the fact that avocados cannot be stored for any length of time or processed and that no close substitutes exist.

(b) Pawpaws

For the first half of the year prices are almost the exact inverse of the production curve (Fig. 3) but it is interesting to note that in the second half of the year, when supplies are increasing rapidly to a peak in November, prices decline very slowly and are virtually constant for some months. This is most likely due to high demand for this product in the early summer months, as fruits of this nature are traditionally associated with summer living.

Another conspicuous feature is the gradual production increase over nine months (February to November) and the very sudden production drop over December, January and February.

(c) Pineapples

Seasonal price and quantity indices for pineapples do not vary over as wide a range according to Fig. 4 as for the two previously discussed products. Three factors probably contribute to this. Firstly, pineapples store better than pawpaws and avocados. Secondly, they are canned to a large extent and processing stabilises sales and thus prices. Thirdly, seasonal variation in production is relatively small.

From July to November both prices and production are increasing, implying a greater demand (demand shift) during the early summer months. This fruit by itself or as a salad ingredient is popular during summer months. The ratios of Queen to Cayenne sold during different times of the year may also affect average prices because Queen commands higher prices.

(d) Bananas

According to Fig. 5 there is a direct inverse relationship between price and production. Prices are thus sensitive to production changes and substitutes or complements appear unimportant.

As in the case of pineapples, prices do not fluctuate over a wide range. This is most likely due to the influence of the Banana Control Board which operates a pool scheme. Bananas can be stored to some extent when harvested green and the artificial ripening techniques allow the board to feed the market to some degree and thus stabilise prices.

Demand for this fruit is also high in summer, and thus the price does not fall as low as one would expect in November, December and January when production is at its highest.

Except for pineapples, price and production cycles for the other tree crops discussed, moved in an opposite but symmetrical pattern. This could be explained by the fact that these products cannot be stored for any length of time or processed and that no close substitutes exist.

Seasonal price movements of some vegetables

The seasonal movement in prices of some vegetables as established for the period 1966 - 1975 will be compared with that of earlier studies of Behrmann and Kassier[6] and Mostert[7]. It is not certain, however, if trend factors were eliminated in earlier studies.

(a) Cabbage

Supply, according to Fig. 6, shows a distinct seasonality. As cabbage is a cool season crop,

production is the lowest during the warm season and increases to reach a peak in August when crops sown during late autumn and early winter in the Transvaal Lowveld are ready for reaping.

Prices reach their peak in March after which they decrease rapidly to reach a low in November with a minor increase in July.

The findings of Behrmann and Kassier and Mostert show similar fluctuations in prices with corresponding peaks and troughs. Hybrid cabbage was introduced in the early sixties which enabled the supply of better quality cabbage and a higher production during the summer months. This may explain why the latter two studies have higher price peaks, due to better quality and, therefore, greater demand, and lower troughs, due to relative higher supply during the summer, because of hybrids grown in the Transvaal Highveld.

During the early winter months both production and prices are above average and during the early summer months both are below average. This implies a stronger demand during the first period which could be attributed to a higher quality produce. The same phenomenon prevails if the months during the summer holidays are discounted and it is also evident for cauliflower (Fig. 7) and green beans (Fig. 8).

Production cycles of the products investigated, i.e. cabbage, beans, cauliflower and green peas were similar (Figures 6,7,8 and 9) indicating that little substitution in production is possible amongst the products.

(b) Cauliflower

Although the supply of cauliflower shows the most pronounced seasonality of the vegetables studied (Fig. 7), prices are more stable than those of the other vegetables. This illustrates the stabilising effect processing has on price. The difference between pre-season high price (May, April) and post season low prices (November) resembles storage and processing cost.-

(c) Green beans

It is interesting to note that while production is high during the winter months (Fig. 8) prices are also high. This could be attributed to high quality of produce during this season.

Green beans are a typical summer crop with supply reaching a peak in May - June and then again in September.

(d) Green peas

Peas are a cool season crop and follow similar price and supply variations (Fig. 9) to that of cabbages and cauliflower.

Of the vegetables studied, green pea prices were the most sensitive to variations in supply. The simple correlation between supplies and prices of peas is -0,87. Peak prices are reached in March - April, then fall off to reach a trough in September - October. The increased processing of peas in the past twenty years reduced price variations as can be seen by comparing the prize variations as reported by Behrmann and Kassier with the later studies.

SUMMARY

It was shown for pawpaws, bananas and avocados that total income from these crops actually falls if production exceeds a certain level during a specific month. These crops were analysed because they cannot be processed or stored for any length of time and do not have close substitutes. For these reasons, prices of these products were found to be extremely sensitive to production. Processing stabilised prices, especially in the case of pineapples, cauliflower and green peas.

Cauliflower price and production indexes depict the typical situation of a storable product showing how the pre-season price increases till the season starts and how the post-season price again increases from the trough to reflect the cost of storage as the difference between the two prices. In the case of cabbage and green beans it appears as if the seasonal demand is stronger during the winter months than during the early summer months. This could be attributed to higher quality produce during the earlier period.

FIG. 1 - Production related to total revenue

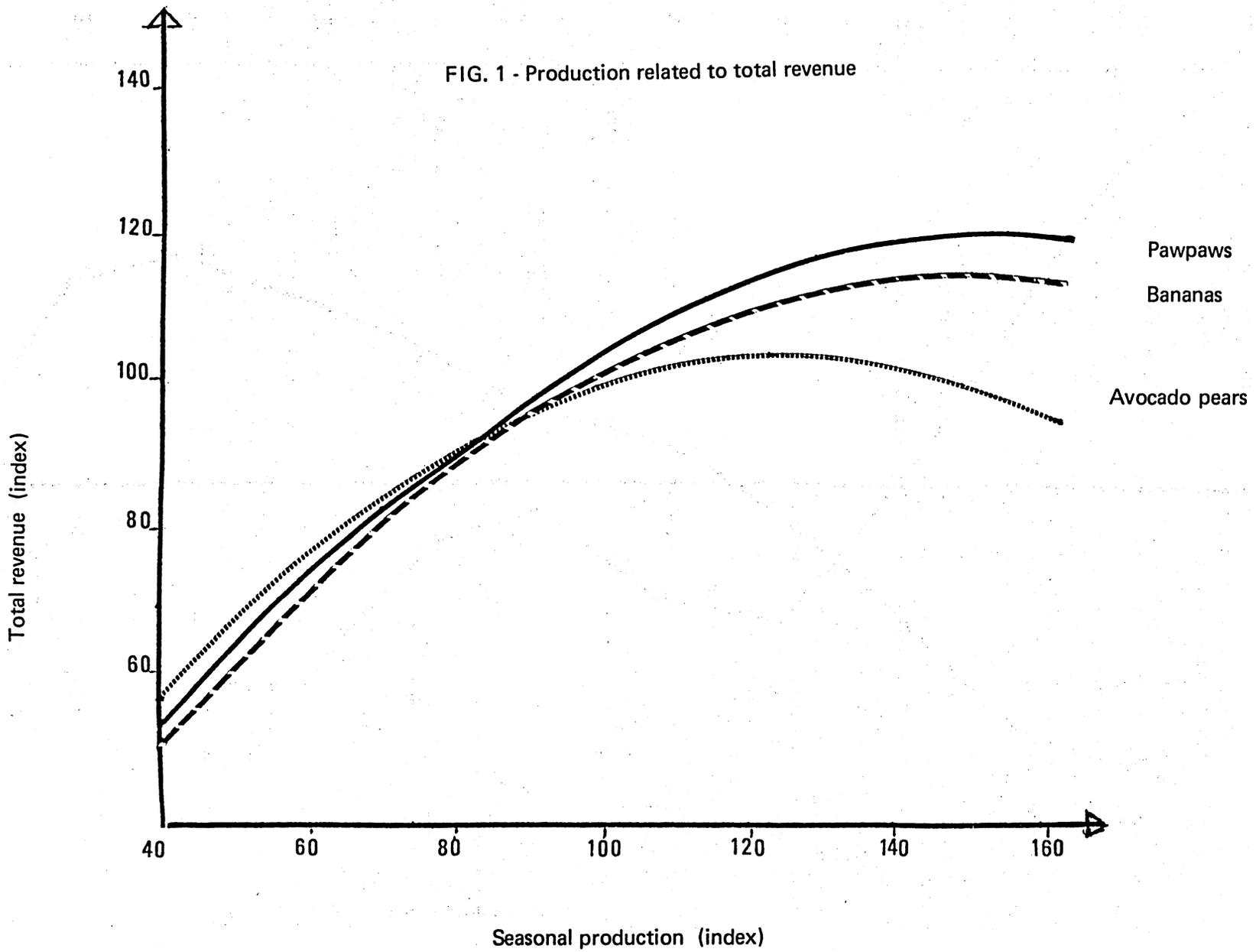


FIG. 2 - Avocado pears, seasonal indexes, 1967 - 75

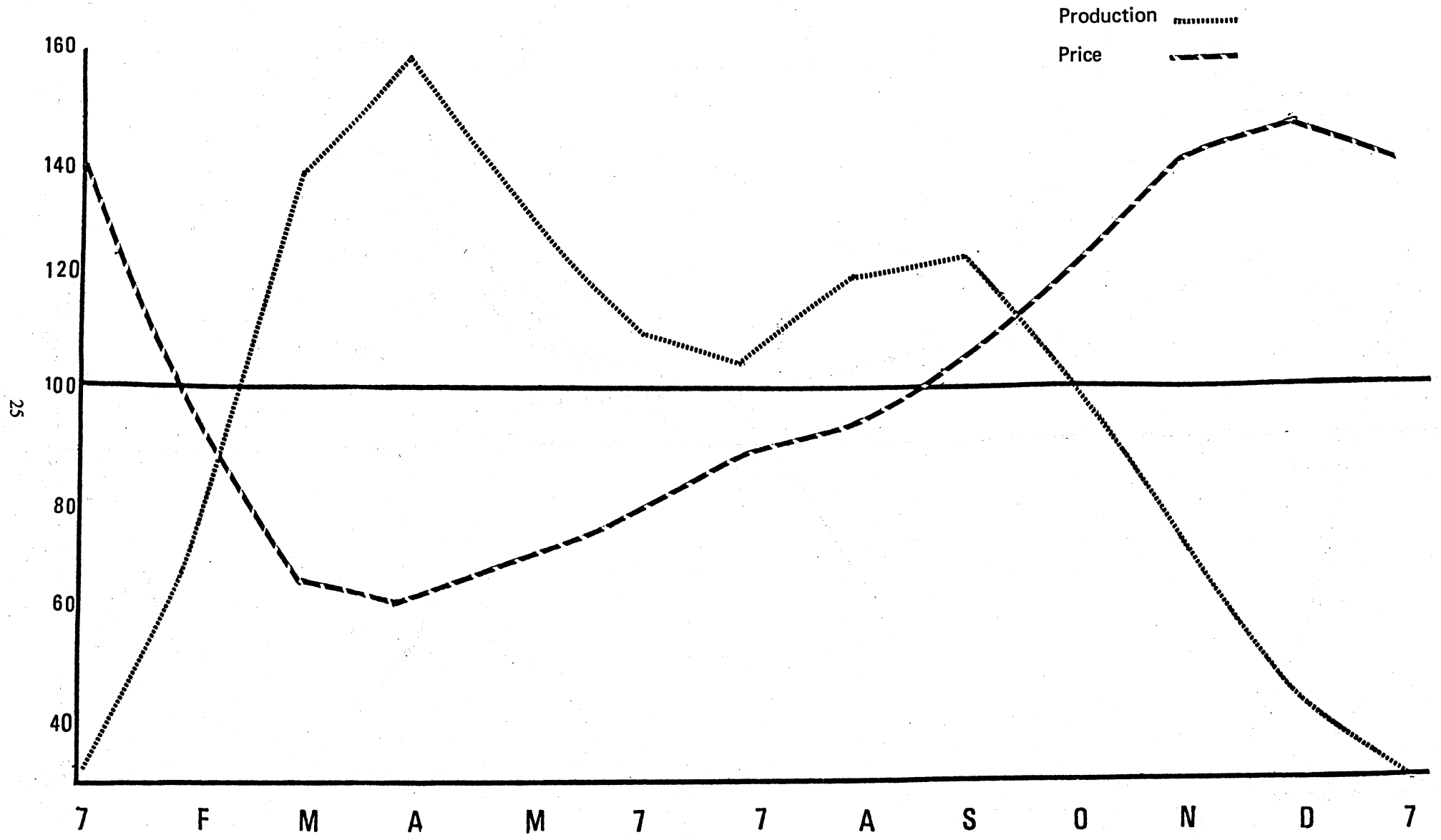


FIG. 3 - Pawpaws, seasonal indexes, 1967 - 75

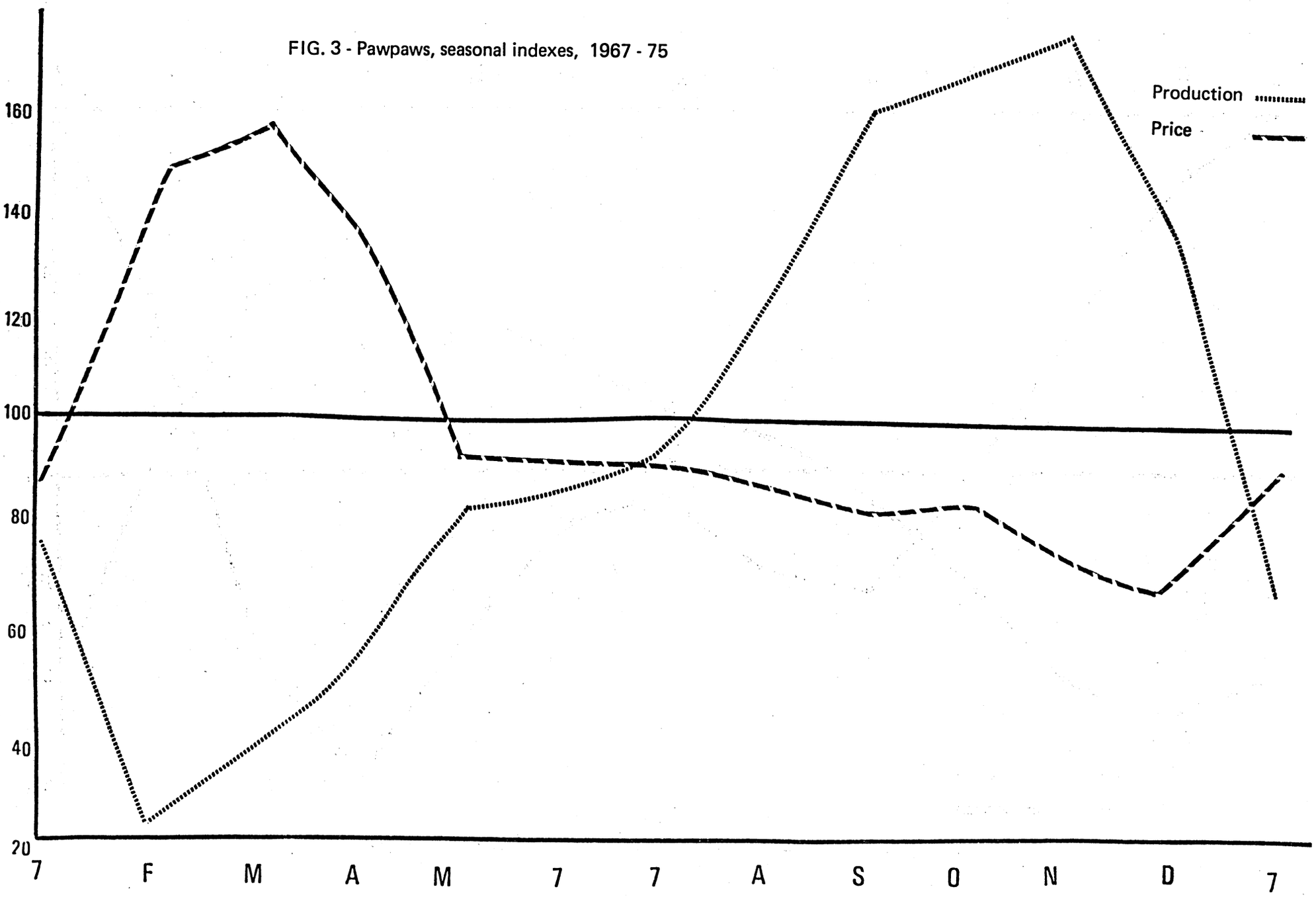


FIG. 4 - Pineapples, seasonal indexes, 1967 - 75

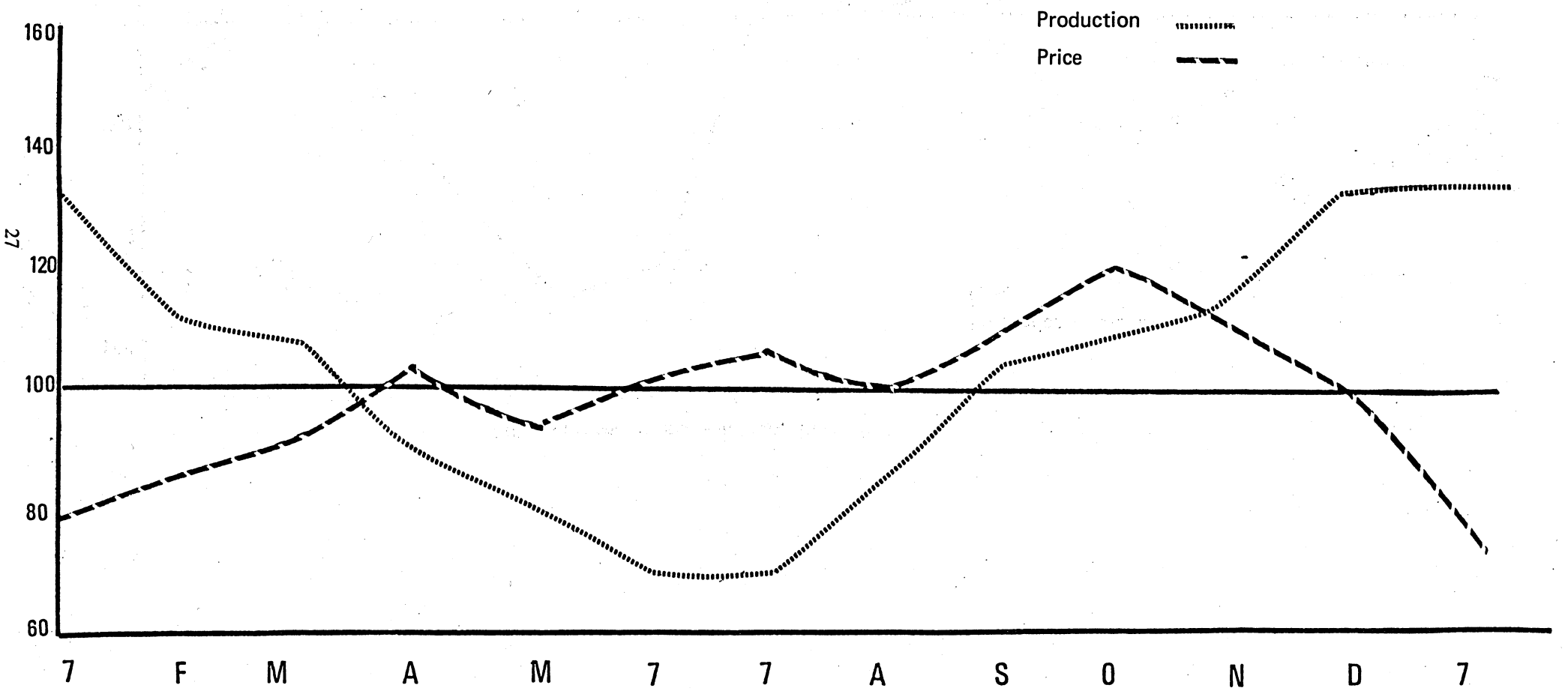


FIG. 5 - Bananas, seasonal indexes, 1967 - 75

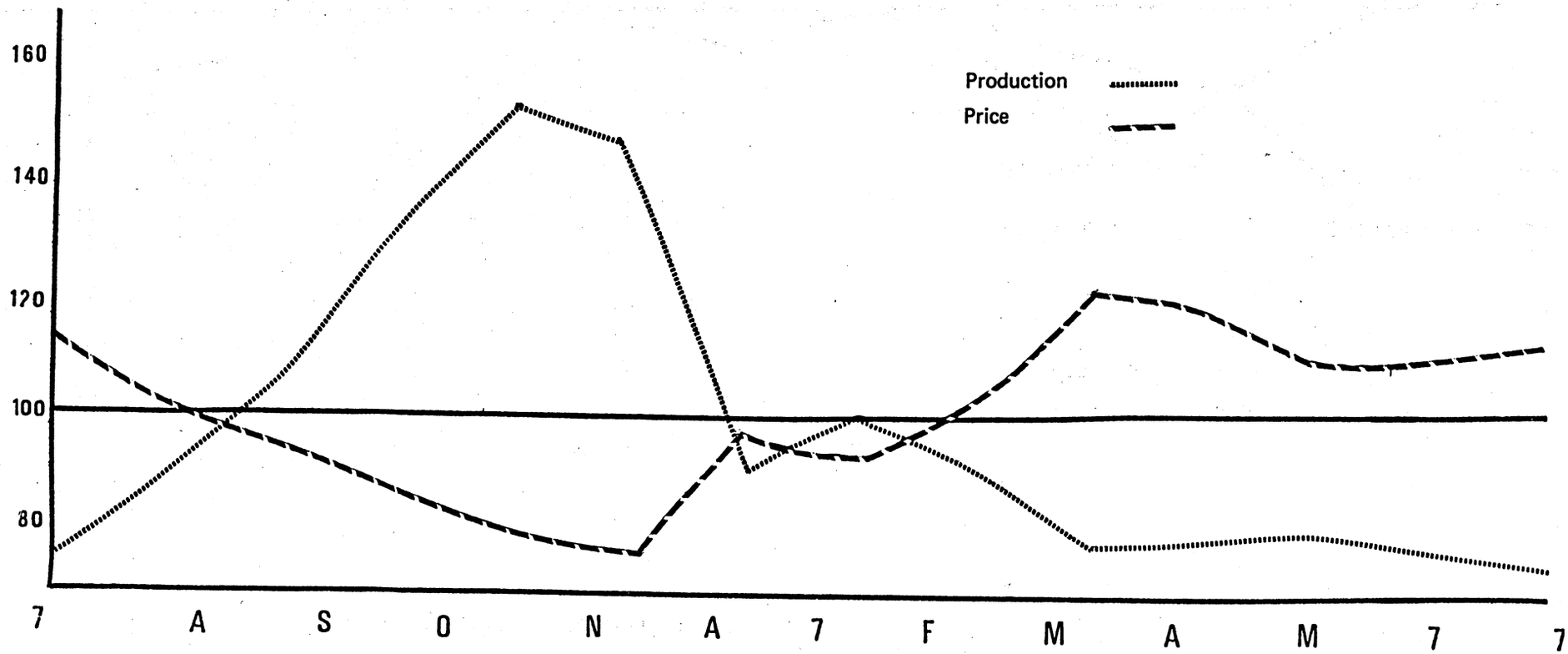
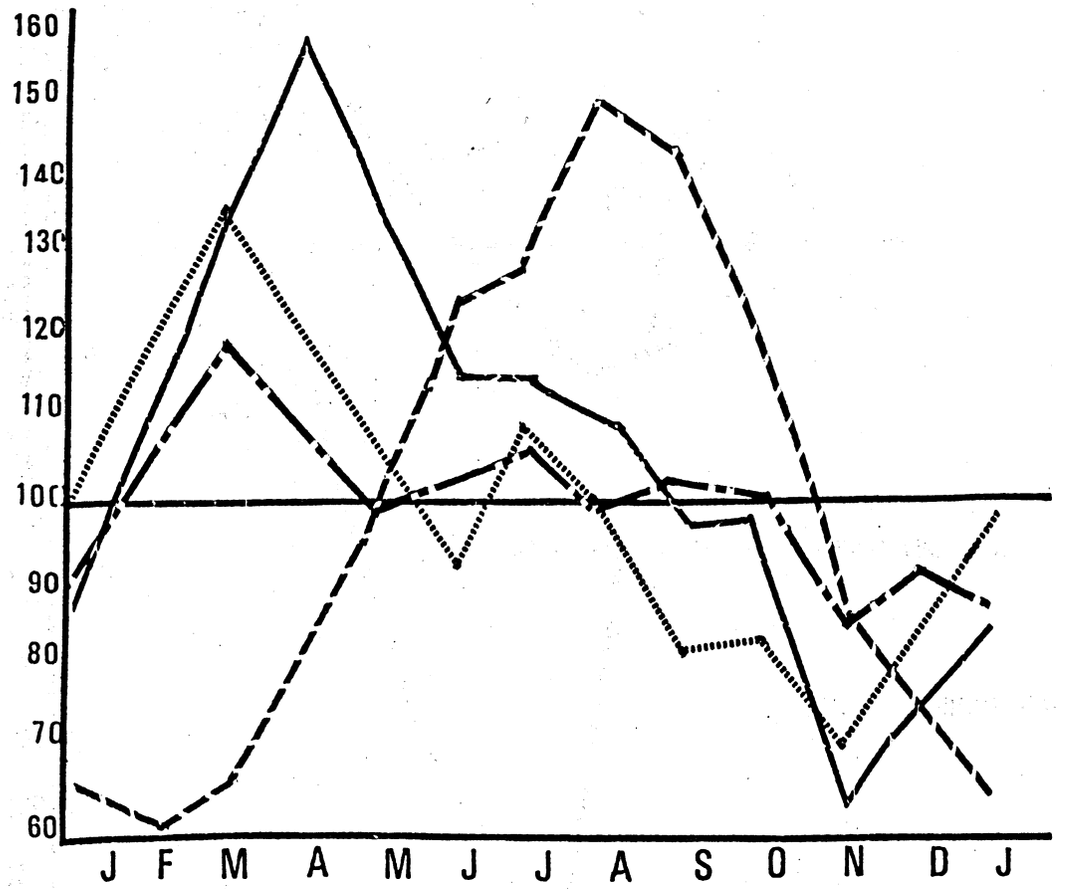


FIG. 6 - Cabbage, seasonal indexes, 1936 - 75



Supply indices (1966 - 75)

Price indices

Price variations

J.C. Mostert (1954 - 64)

Behrmann & Kassier (1936 - 54)

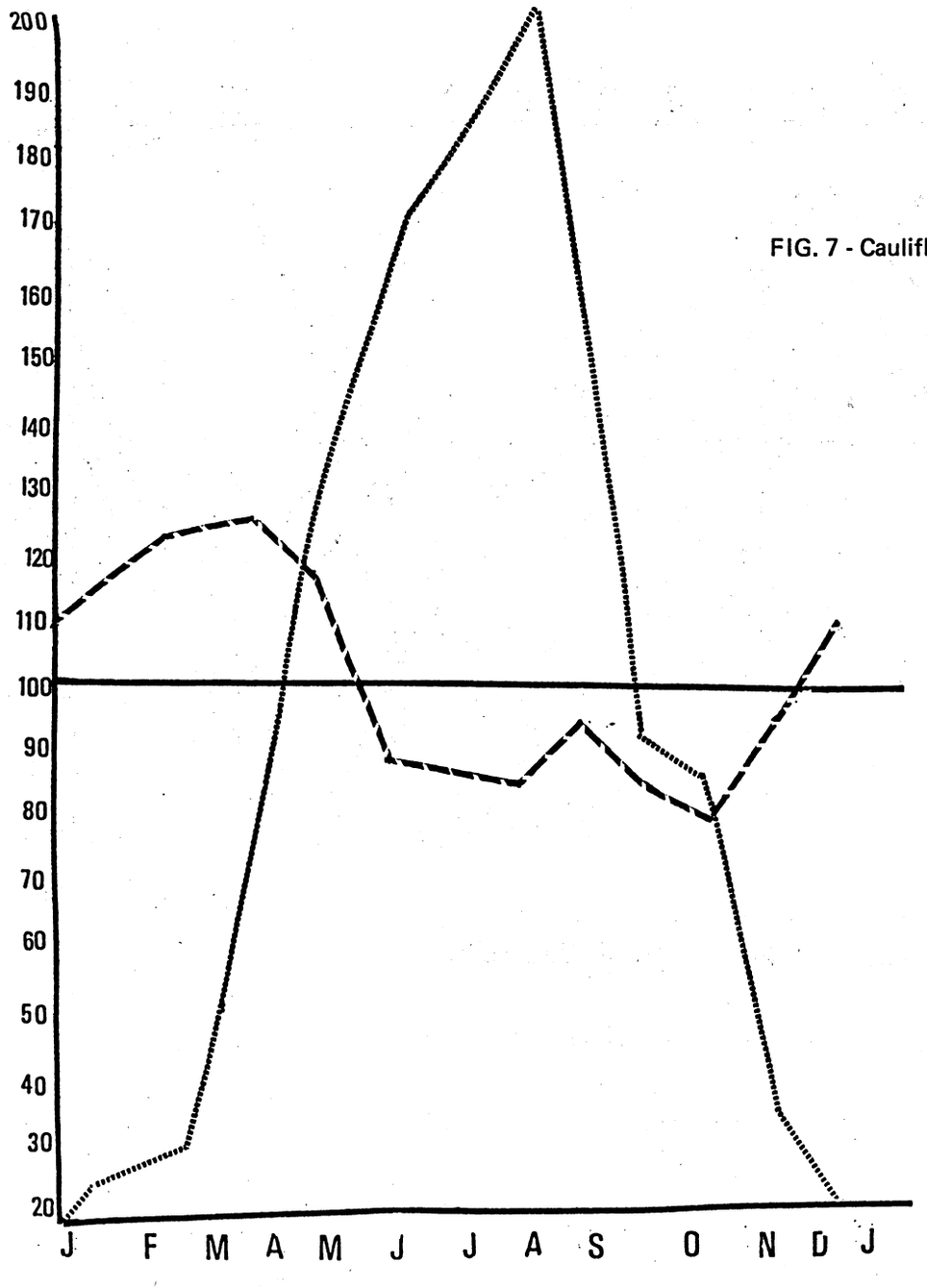
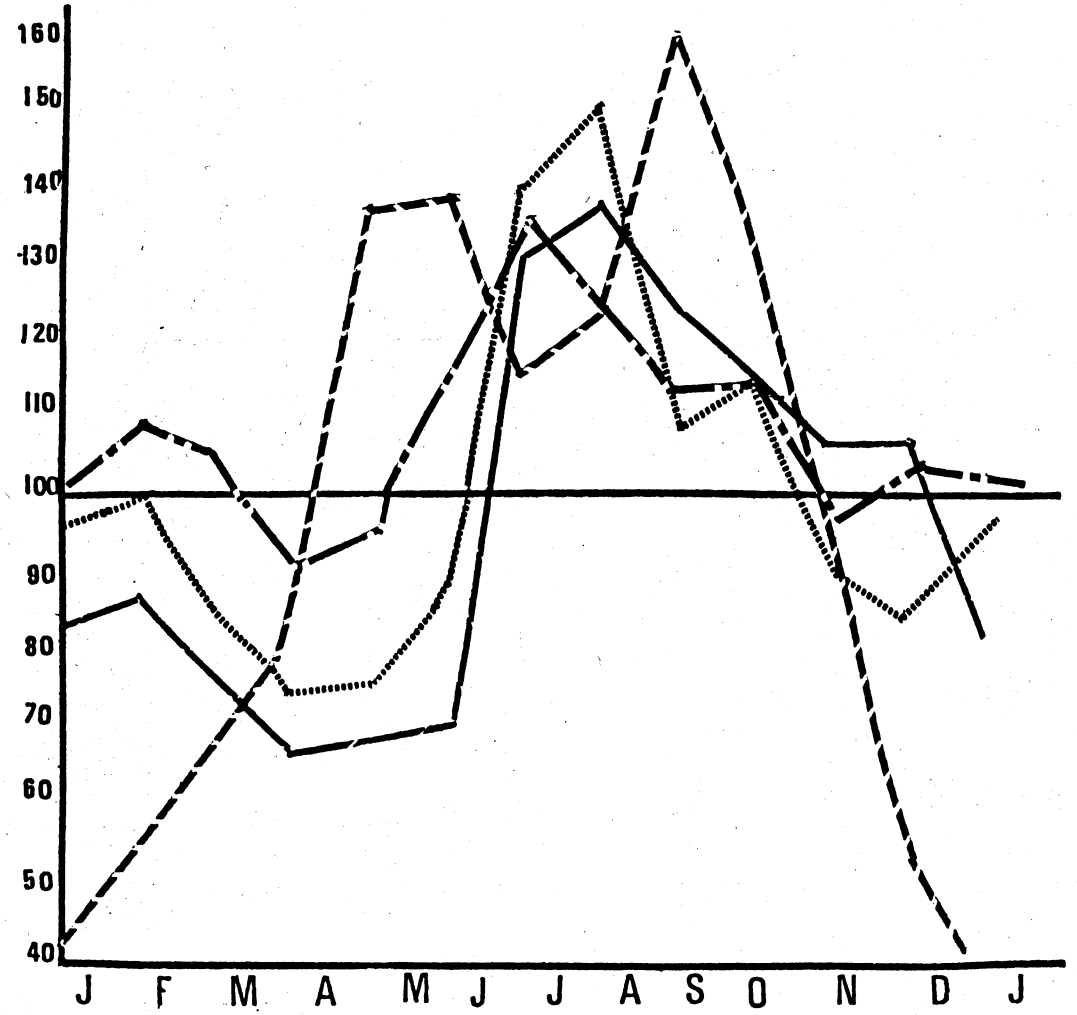


FIG. 7 - Cauliflower, seasonal indexes, 1966 - 75

Supply indices .....

Price indices ———

FIG. 8 - Green beans, seasonal indexes, 1936 - 75



Supply indices

Price indices (1956 - 75)

Price variations

J.C. Mostert (1954 - 64)

Behrmann & Kassier (1936 - 54)

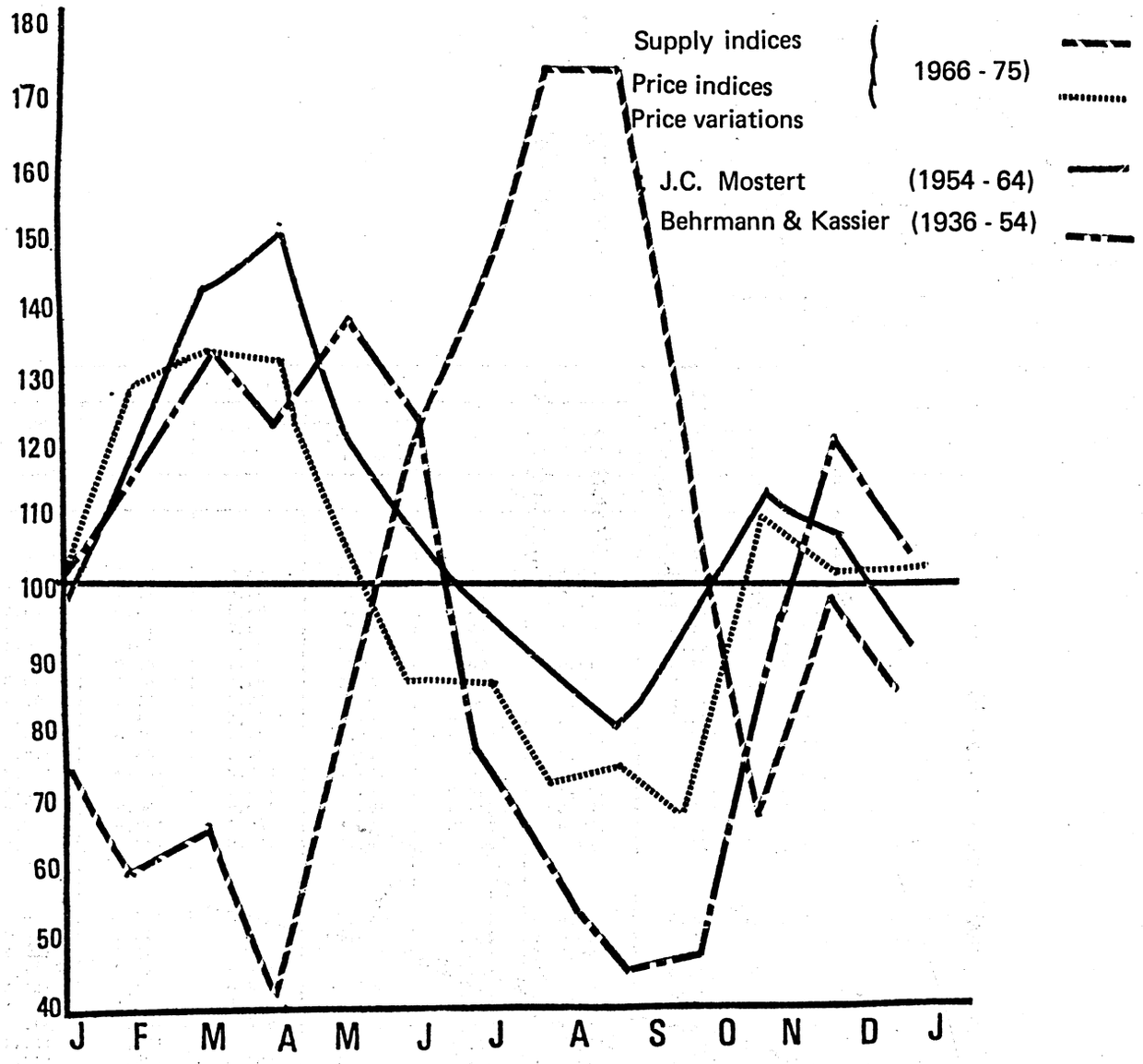


FIG. 9 - Green peas, seasonal indexes, 1936 - 75

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1. For a discussion of methods employed, refer to Wessel, R.H., Willet, E.R. and Simone, A.J. Statistics as applied to economics and business. Holt, Rinehardt and Winston, pp. 356 - 376, 1965.
2. *Ibid.*
3. A production index of 157 for a specific month means that production for that month is 57% above the average monthly production during the year.
4. To prove this statement take any two points A and B on the quantity axis (Fig. 1) and read the corresponding total revenues from the curve. Connect the two total revenues with a straight line. At the point (A + B) ÷ 2 the reading on the straight line would be smaller than the reading on the curve. The reading on the curve represents the income if production is stabilised through storage at the average level (A + B) ÷ 2, while the reading on the straight line gives the average income when quantities A and B are sold separately.
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