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AGRICULTURAL ECONOMICS RESEARCH

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The Long-Run Demand for Farm Products

By Rex F. Daly

No one knows exactly what the demands for farm products will be in 1960 and 1975. Nor can anyone foresee the exact supplies of agricultural commodities in these years. Yet farmers, legislators, and administrators of agricultural programs cannot work entirely in the dark. They must base their plans upon the best possible estimates of future demand and supply conditions. They expect the economist and the statistician to analyze current and prospective trends and to make useful projections indicating the probable direction of major changes in the future. With these needs in mind, the United States Department of Agriculture in the past has made and published several projections of the long-range demand for and supply of farm products. The present report brings up to date the Department's projections of potential demand for farm products around 1960 and 1975. While these projections show a substantial increase in total demand for farm products, they indicate some sharp differences in trends. For example, they point to sizable increases in the demand for livestock products and fruits and vegetables, and decidedly more limited increases for food grains and potatoes. Projections of demands and supplies are made on the basis of certain assumptions. We have assumed a stable price situation and a trend toward world peace. We have also made assumptions concerning such factors as population, labor force, employment, hours of work, and productivity. The projections shown in this report are not forecasts. Rather, they indicate what trends we would expect in the demand for farm products under a set of assumptions. The projections could go wrong if we suffered a long business depression, or if we became involved in a large-scale war, or if nutritional findings or consumer preferences brought changes in consumption patterns appreciably different from those indicated in this report.

FREDERICK V. WAUGH

GROWTH IN DEMAND for farm products during the next quarter-century will depend primarily on growth in population and consumer income. Total requirements for farm products for domestic use and export under conditions of full employment are projected for 1975 to a level around 40 to 45 percent above 1953. Population growth of 30 to 35 percent would contribute most to this expansion in demand. If current consumption rates are assumed, requirements for farm products would rise about a third. But with an approximate doubling in the size of the economy and rising consumer incomes, per capita consumption of farm products may increase about a tenth from 1953 levels. The increase would reflect primarily a shift to higher unit-cost foods rather than consumption of more food.

Projected use of livestock products increases by about 33 percent if current consumption rates are assumed, and by more than 40 percent for the higher projected consumption rates. Increases for cattle, hogs, and poultry would be larger than for sheep, dairy products, and eggs. Food use of crops on the average may total around a third larger in 1975 than in 1953, with much of the increase in vegetables and fruits, especially citrus. Little increase in use of food grains and such crops as potatoes and dry beans is indicated.

The projected rise in requirements for feed concentrates and hay, for the two consumption levels assumed, range from about 25 percent to around 40 percent from 1953 to 1975. These gains reflect the rise in livestock production. Substantial increases in total use of such nonfood crops as cotton, tobacco, and some oils are in prospect. Most of the tabulations in this report were computed on the basis of a population of 210 million people by 1975. If the higher population assumption of 220 million people is used, projected utilization and needed output would be 5 percent higher.

Foreign markets could take relatively large quantities of our cotton, grains, tobacco, and fats and oils in coming years. The volume of agricultural exports projected for 1975 is about a sixth above 1952–53, and somewhat below the large volume exported during the 1955–56 fiscal year, when large export programs were in effect.

Different rates of growth in demand and trends in technological developments on the supply side will make supply increases more difficult for some commodities than others. Under the projected consumption rates, production of livestock products as a whole would need to increase more than 40 percent from 1953 to 1975—around 45 to 50 percent for meat animals and poultry products, nearly 30 percent for dairy products.

Output increases that would be needed to match projected requirements based on current consumption rates are in general smaller—possibly around 25 to 30 percent above 1953 for most types of livestock products. With crop output well in excess of requirements in 1952–53, an output increase from that base year of about a fourth would meet prospective expansion in utilization under projected consumption rates. A smaller output of food grains, and little increase in potatoes and beans, would be indicated for 1975. Sizable increases in production, however, are suggested for feed grains, many vegetable crops, and fruits.

Why and How Projections Were Made

Appraisals of long-run demand for agricultural products are of continuing interest to farmers, consumers, industries that sell to farmers, other industries, legislators, and the Government. It should be realized that such projections are not forecasts. They are based on specific assumptions as to growth in population, labor force, and levels of consumer income. The major assumptions on which these projections are based are as follows:

1. Population will increase to 210–220 million people by 1975.

2. Labor force and employment will grow commensurately with the growth in population. A high-employment economy is assumed with unemployment averaging around 4 to 5 percent of the labor force.

3. A trend toward world peace is assumed, with the proportion of the Nation's output devoted to national defense becoming smaller.

4. Productivity of the labor force will grow much as in the past. Even with fewer hours of work per week, real income per capita for the total population may increase by more than 50 percent.

5. Prices in general are assumed at 1953 levels both for agriculture and for the economy as a whole.

Projections of this kind are of value in looking ahead to the possible role of agriculture in the future. Despite the fact that such projections are bound by the assumptions under which they are made, they highlight the underlying trends that affect agriculture. Within this framework some indication of the problems that are likely to emerge in agriculture, the directions of the research needs, and the potential markets for farm products, can be appraised. This gives some basis for appraising what agriculture might be called upon to do in terms of the needs for food and fiber in a prosperous, growing economy.

In appraising long-term growth in demand we have no economic forecasting techniques that are highly accurate, or to which usual probability error limits can be applied. Long-run economic appraisals are not unconditional predictions of the future; they are at best projections made in a framework of assumptions. The nature of growth and change in the economy, over time, does not lend itself to the rigorous type of analysis used in short-period or static appraisals.

The long-run appraisal must be concerned not only with current relationships but with possible changes in these relationships over time. The influence of prices and incomes on consumption probably vary, over time, with changes in real income, popular changes in "taste," technological developments, nutritional findings, and changes in modes of living. Much of the increase in consumption of frozen food during recent years, for

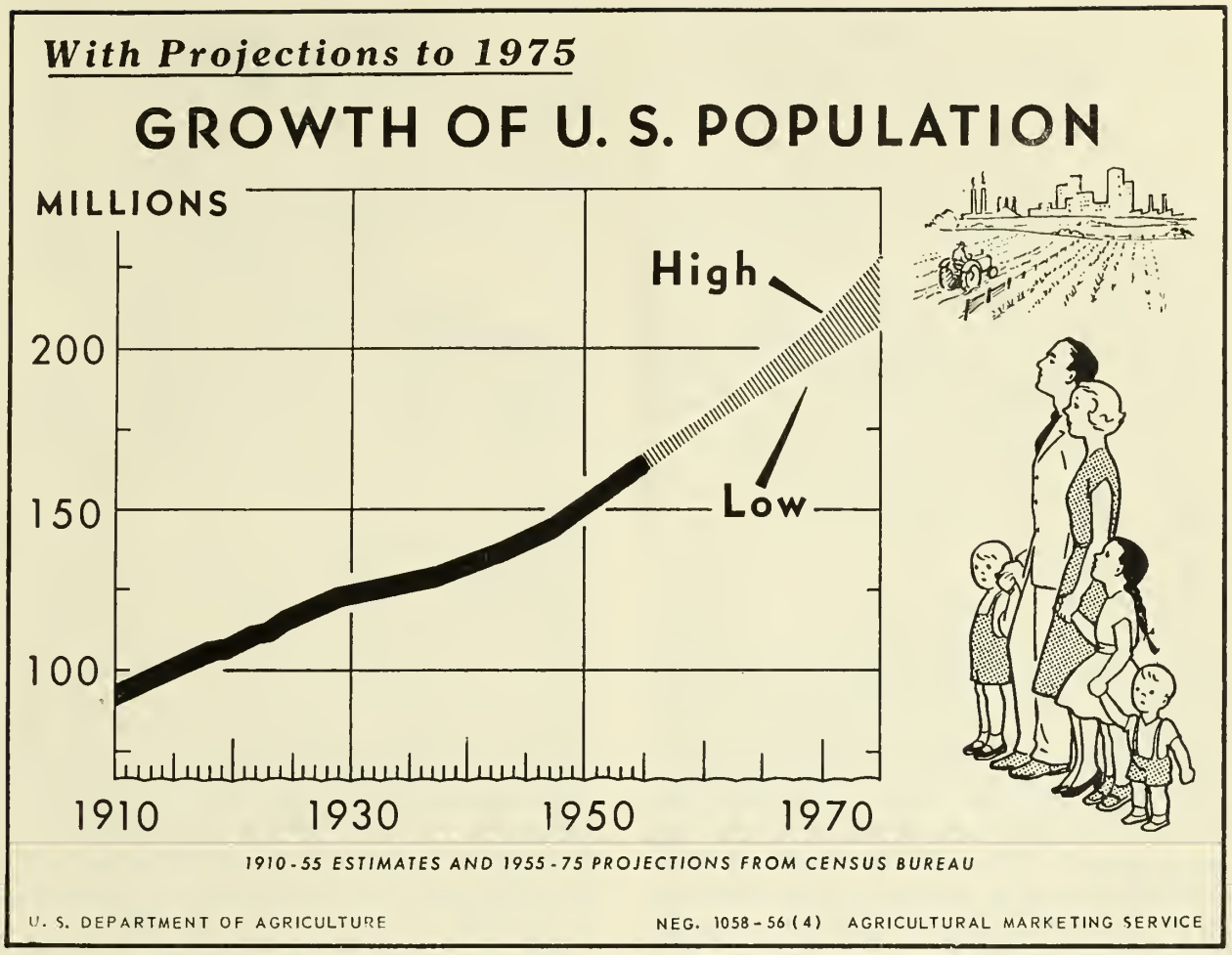

FIGURE 1.

example, can probably be attributed to factors other than changes in price and income. Likewise, some trends in per capita consumption of potatoes and cereals apparently reflect nutritional developments and changes in modes of living.

Methodology used for long-run appraisals must be largely historical insofar as past relationships and trends in economic, social, and political conditions provide a basis for appraising the future. Stability of rates of growth and the general inertia of consumer behavior patterns provide much of the foundation for an appraisal of prospective growth in demand for farm products during the next two or three decades. At best, refined statistical techniques must be supplemented by judgment. Despite the problems involved, projections of this type will be made as long as individuals are required to make decisions involving long-run commitments.

General Economic Framework

Expansion in demand for products of the farm depends primarily on population growth and the influence of consumer income and "taste" changes on the consumption of farm products. With rising real incomes, increased population tends to result in a corresponding expansion in demand for farm products. Rising incomes may not greatly expand total consumption but they will vary the rate of growth in demand for individual commodities.

Population Growth to Continue

Population in the United States in mid-1955 was estimated at more than 165 million people. Projections for 1975, prepared in 1955, range from 207 to 228 millions—somewhat above those made by the United States Bureau of the Census in 1953.

These projections range from about 30 to 43 percent above the base year 1953. Most calculations in this study assume a population increase of about 30 percent from 1953 to 210 million persons in 1975. However, some aggregates are adjusted to reflect a population increase of 36 percent to 220 million by 1975. These projections compare with a rise in population of 30 percent from 1929 to 1953 (fig. 1).

The shift of the rural population to urban areas and the downtrend in farm population are expected to continue during coming years. With growth in population there will be larger numbers in both the 10- to 20-year age groups and in the group 65 years and over. Regional shifts and different rates of growth are expected to result in rapid growth in population in the Pacific and Mountain States.

An Economy Twice As Large by 1975

The Nation's economy by 1975 may be nearly twice that of 1953, the base year for this study, if employment levels are well maintained. Growth of the economy will depend on expansion in demand and on potential output as determined by employment, hours worked, and output per manhour. Recent trends in productivity and prospective growth in the labor force indicate that a doubling in the gross national product in the next quarter-century is highly possible for an expanding peacetime economy.

Employment

A labor force of around 72 million workers by 1960 and around 90 to 95 by 1975 is indicated, on the basis of population growth and trends in labor-force participation rates by sex and major age groups. These trends reflect the tendency for more schooling in the lower age groups included in the labor force, for earlier retirement in the older age groups, and for a pronounced increase in the number of women who work.

In the projected framework a growing peacetime economy and a high level of employment are assumed. The length of the work week is expected to continue its long-run downtrend. An assumed unemployment rate of about 4 to 5 percent of the labor force does not rule out the probability of minor ups and downs in the economy in coming years. Depressions as severe as that of the 1930's are not considered likely.

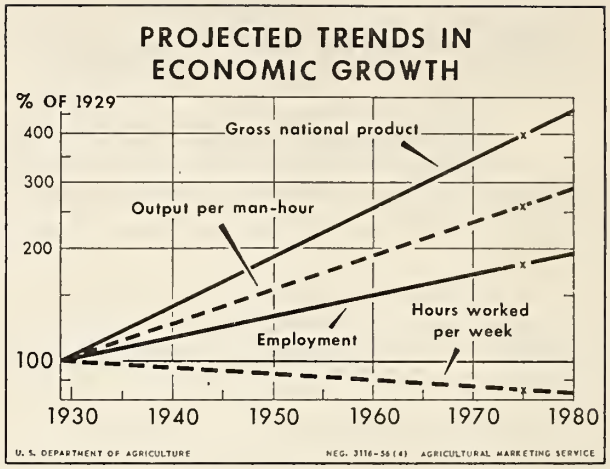

FIGURE 2.

Productivity and Output

Output per manhour for all workers, including those in Government and civilian services and in the Armed Forces, is projected to trend upward at a rate of about 2½ percent a year. The trend in output per manhour of work reflects not only the ability, training, and general efficiency of labor, but also the amount and efficiency of capital and other resources used in production. Although the projected rise is consistent with long-run trends, it may be conservative in view of the rapid growth in capital and recent developments in automation and possible new sources of power (fig. 2).

Output of goods and services under the employment and productivity assumptions indicated here would rise at the rate of about 3 to 3½ percent a year. The gross national product of the economy, after adjustment for price level change, doubled from 1929 to 1953, and it probably will at least double again by 1975. Real output of the economy could easily exceed projected levels, if demand increases continue to exert pressure on the economy as in recent years. But a somewhat higher level of total output and real income would not materially change the demand for farm products.

Consumer Income and Spending

A doubling of total output of the economy with the associated gain in employment would lead to an increase in per capita real income of around 60 percent between 1953 and 1975; the projected rise for 1960 is 10 to 15 percent. Such an increase in income will expand demand for all goods and services, including food, clothing, tobacco, and

other commodities made from farm products.

Government spending and revenue are expected to trend upward, but it is assumed that the Government will take a relatively smaller share of total output and income than in recent years. Investment outlays for new plant and equipment and residential building will rise with growth in the economy, possibly a little more rapidly than total output (table 1).

Demand for Farm Products

Total demand for farm products over time can be thought of as a relatively inelastic relationship between consumption and price—a relationship that shifts rather continuously in response to growth in population and real income. Thus the demand for farm products during the next quarter-century will depend to a large extent on population growth. Rising incomes, however, will contribute not only to an expanding total demand for farm products, but will influence the types of products that consumers want. Trends in popular consumption habits and technological developments also will influence changes in demand for farm products. Although foreign takings of farm products are small compared with total demand, the foreign market will continue to be important for such crops as wheat, rice, cotton, tobacco, and oils.

Population Growth a Major Demand Factor

Population growth during the next two or three decades may add 30 to 35 percent to total demand for farm products. This would be by far the most important contributor to growth in total demand for farm products. With rising incomes, population growth is assumed to add proportionately to the growth in demand for farm products. Some trends in the age composition and regional distribution of population may modify the effect of population on demand for farm products. But the uptrend in numbers of both younger and older persons, the decline in farm population, and regional shifts in population are not expected materially to influence total demand.

Rising Incomes and Consumption

Consumption of farm products as a whole is not very responsive to changes in either price or income; price and income elasticities are relatively

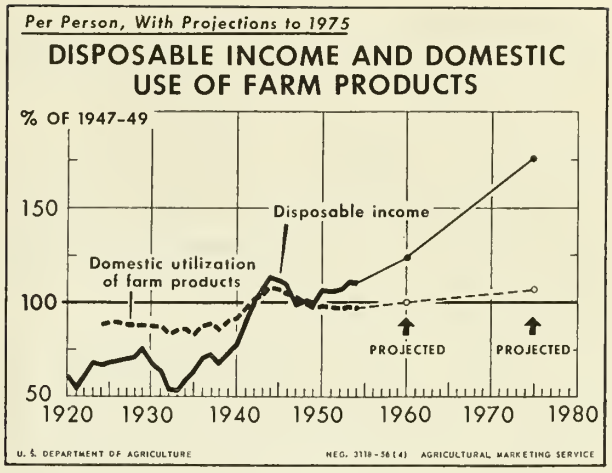

FIGURE 3.

small.[1] As a first approximation in this analysis, general price relationships existing in 1953 are assumed for the projections. Although this assumption temporarily rules out the effects of price change, such changes could have an important influence on consumption. The projected rise of around 60 percent in real income per person will probably result in a small increase in total per capita use of food and other farm products and will modify the pattern of consumption—the kinds of products desired (fig. 3).

Income effect on consumption.—Expenditures for food and other farm products tend to increase less, relative to income changes, than do expenditures for many nonfarm products.

Expenditures for food at retail stores and restaurants have increased during recent years about

[1] Income elasticity of consumption may be defined as the response of per capita use of a farm product to changes in per capita income. Suppose per capita consumption of a farm product is expressed in the following form:

$$q=kp^{a}y^{c} \qquad (1)$$

where (q) refers to quantity utilized per person, (p) to price per unit, and (y) to per capita real income. In terms of equation (1) income elasticity is represented by c and price elasticity by a.

This defines income elasticity as the relative change in quantity consumed divided by the relative change in income when other variables are held constant. For virtually all farm products, this relationship should be positive—consumption increases as real incomes rise. For some commodities, however, income elasticity is negative and consumers tend to use less of these products as their incomes rise. Price elasticity represents the relative change in quantity consumed divided by relative change in prices when other variables are held constant. The relationship is negative.

in proportion to income. This implies an elasticity of food expenditures with respect to income of around 1.0. But these expenditures include many services of processing and distribution. Expenditures for "eating out" or "TV dinners," for example, are very responsive to changes in income, but they may have little effect on total consumption of farm products. Bulk processing of food, furthermore, may result in less waste than comes from home preparation.

Demand for services is estimated to be around 5 times as responsive to changes in income as the demand for farm products. Empirical estimates based on a recent study[2] show an elasticity of outlays for marketing and processing (real terms) relative to real income of more than 0.7. The income elasticity of deflated farm value (an approximation of quantity) is only 0.15. The flexibility of retail expenditures (in real terms) relative to income, a weighted average of these elasticities, is about 0.4.[3] Weights are approximated on the basis of the farm share and the margin. The very low income elasticity of demand for farm products at the farm level will result in a long-run decline in the farmers' share. As this would give progressively less weight to the lower income elasticity, some change over time is implied for income elasticities at retail or for the marketing margin.

Changes in consumption are much less responsive to changes in income than are retail expenditures for farm products. For example, pounds of food consumed per person increased some during World War II, but they have not changed much during the last two or three decades. Consumer-purchase studies, based on a cross section of families, indicate that quantities of food consumed per person increase very little as incomes rise. Projected per capita use of food in pounds is about the same as the 1947–49 average.

Most indexes of food use per person are price-weighted to reflect up-grading of the diet as consumption shifts to livestock products and foods of higher cost. Analyses based on the Agricultural Marketing Service Index of Per Capita Food Consumption indicate an income elasticity of 0.2 to 0.25.[4] That is, an increase of 10 percent in real income per person is associated with an increase of 2 to 2½ percent in per capita use of food when prices are unchanged. But since the AMS index reflects some processing and marketing services, the elasticity may be higher than it would be at the farm level.

Moreover, some evidence suggests that income elasticities tend to decline at the higher income levels and may decline as incomes rise over time. Available statistical data show that income elasticities for most major farm products are somewhat smaller at the higher than at the lower levels of income. Estimates of per capita consumption of food in one study show an elasticity relative to income of 0.3 for consumer unit income levels $750 to $1,250 and an elasticity of about 0.15 for income groups $2,500 to $4,000.[5] It appears reasonable to expect that, as families move from lower to higher income levels, their consumption patterns reflect

[2] These analyses are based on estimates of food expenditures, the marketing margin, and the farm value developed in *Changes In Food Expenditures, 1929 to 1954*, a manuscript by Marguerite C. Burk.

[3] Value at retail is the sum of value at the farm and costs of processing and marketing as follows:

$$V_r = V_f + V_m$$

and

$$V_r = a + bI, b = \frac{dV_r}{dI}$$

$$V_f = a_1 + b_1 I, b_1 = \frac{dV_f}{dI}$$

$$V_m = a_2 + b_2 I, b_2 = \frac{dV_m}{dI}$$

then,

$$V_r = a_1 + a_2 + b_1 I + b_2 I \text{ and}$$

$$\frac{dV_r}{dI} = \frac{dV_f}{dI} + \frac{dV_m}{dI}$$

The elasticity is,

$$\frac{dV_r}{dI} \cdot \frac{I}{V_r} = \frac{\frac{dV_f}{dI} \cdot I + \frac{dV_m}{dI} \cdot I}{V_f + V_m}$$

and

$$\frac{dV_r}{dI} \cdot \frac{I}{V_r} = \frac{\left[\frac{dV_f}{dI} \cdot \frac{I}{V_f}\right] V_f + \left[\frac{dV_m}{dI} \cdot \frac{I}{V_m}\right] V_m}{V_f + V_m}$$

[4] See GERSHICK, M. A., and HAAVELMO, T., STATISTICAL ANALYSIS OF THE DEMAND FOR FOOD, Cowles Commission Papers, New Series, No. 24, 1947, p. 109; TINTNER, G., MULTIPLE REGRESSION FOR SYSTEMS OF EQUATIONS, Econometrica, 14: 34–36. 1946. BURK, MARGUERITE C., CHANGES IN THE DEMAND FOR FOOD FROM 1941 TO 1950, Journ. Farm Econ. 33: 281–98. 1951. WORKING, ELMER J., APPRAISING THE DEMAND FOR AMERICAN AGRICULTURAL OUTPUT DURING REARMAMENT, Journ. Farm Econ. 34: 209–15. 1952.

[5] CONSUMPTION OF FOOD IN THE UNITED STATES, 1909 TO 1948. U. S. Dept. Agr. Misc. Pub. No. 691, 1949. Page 142.

TABLE 1.—*Income, output, employment, and price level 1929, 1951–53, 1953, and projections for 1960 and 1975*

Item	Unit	1929	Average 1951–53	1953	Projection		
					1960 [1]	1975	1975 [2]
Gross national product	Bil. dol	104. 4	346. 0	364. 5	430	705	740
Personal consumption expenditures for goods and services.	Bil. dol	79. 0	219. 1	230. 6	284	476	500
Per capita	Dol	640	1, 376	1, 424	1, 590	2, 272	2, 272
Personal disposable income	Bil. dol	83. 1	237. 7	250. 4	308	513	540
Per capita	Dol	673	1, 493	1, 547	1, 725	2, 449	2, 449
Consumer price index	1947–49=100	73. 3	113. 0	114. 4	114. 4	114. 4	114. 4
Wholesale prices, all commodities	1947–49=100	61. 9	112. 2	110. 1	110	110	110
Population [3]	Mil	123. 5	159. 2	161. 9	178. 6	209. 5	220. 0
Labor force [4]	Mil	49. 4	66. 6	67. 4	72	91	95. 5
Employment, including military	Mil	47. 9	64. 9	65. 7	68. 5	86. 5	91. 0
Unemployment	Mil	1. 6	1. 7	1. 6	3. 5	4. 5	4. 5
Prices received by farmers	1910–14=100	148	283	258	258	258	258
Prices paid, interest, taxes and wage rates	1910–14=100	160	283	279	279	279	279
Parity ratio	1910–14=100	92	100	92	92	92	92

[1] The higher population of about 180 million in 1960 would raise the gross national product by around 5 billion dollars
[2] Assuming population of 220 million for 1975.
[3] Total population of continental United States as of July 1, including Armed Forces overseas, adjusted for underenumeration.
[4] Includes Armed Forces. Figures may not add to total, because of rounding.

some of the consumer behavior observed for higher income families. Assuming no change in the general price level or the relative income position of families, projected incomes for 1975 would put more than two-thirds of all families in income levels above $5,000. This compares with about 45 percent in 1950.

Income effect on kinds of goods consumed.—Although rising income may effect a relatively small increase in total use of food per person, it will influence the kinds of products consumers want. The nature and direction of these changes under given price assumptions are suggested by elasticities which approximate empirically the relationship of consumption to income.

Livestock Products.—Livestock products in general show more response to changes in income and price than do most crops. Consumption of beef and veal in a given framework of prices is more responsive than pork to changes in income. Consumption of chicken and turkey also is fairly responsive to changes in income. Dairy products in total apparently respond little to income change, and fats and oils in total show almost no response. Of course, there are many influences other than price and income which determine trends in consumption. For example, per capita use of lamb and veal will depend to a considerable extent on demand for dairy products and wool. Likewise supplies of chicken available are partly a function of the demand for eggs. In addition, for some commodities there are trends in popular consumption habits that appear to be largely independent of economic considerations (table 2).

Major crops.—A major part of the demand for crops is derived directly from the demand for livestock products as reflected in use of feed. In most years around 40 to 50 percent of total crop production is used for feed; food use may range from 25 to 30 percent; the remainder, in order of importance, goes into nonfood use, exports, and seed.

Feed supplies come primarily from the four major feed grains (corn, oats, barley, and grain sorghums) and from hay and pasture. But some wheat, rye, and several other crops are used for feed. Mill byproduct feeds, oilseed cake and meal, and animal proteins also provide an important part of the supplies of feed concentrates.

For feeds that are essentially a byproduct, supplies are determined largely by projected demand for major uses; cottonseed meal production, for example, will depend on output of cotton; mill feeds on quantities of grains milled. Supplies of

TABLE 2.—*Income elasticities assumed as a basis for projecting per capita consumption of major farm products* [1]

Major crops	Income elasticity	Major livestock products	Income elasticity
Vegetables (farm weight equivalent)		Meat	0. 25
Tomatoes	0. 40	Beef	. 40
Leafy, green and yellow [2]	. 25	Veal	([3])
Other vegetables [4]	. 20	Lamb	([3])
All vegetables	. 25	Pork	. 20
Melons and eantaloups [5]	—. 40	Poultry produets	
Potatoes and sweetpotatoes	—. 25	Chicken and turkey	. 30
Fruits		Eggs	. 15
Apples	([6])	Dairy produets	
Citrus	. 65	Total milk equivalent	. 10
Other [7]	. 13	Fluid milk and eream	. 12
All fruit	. 32	Fats and oils	. 06
Other food erops			
Wheat and flour	—. 20		
Dry beans and peas	—. 20		
Sugar	—. 07		

[1] These elastieities were assumed on the basis of statistical evidence, trend influenees,and judgments relating to other faetors. Thus some elastieities are implied by projeeted consumption.

[2] This group ineludes eabbage, a major vegetable, whieh in the 1948 consumer purehase survey showed a negative ineome elastieity of about —0.2 and possibly some trend in per eapita eonsumption.

[3] Per eapita use of veal and lamb was determined by output of the dairy and sheep industry which was dependent on other faetors.

[4] The "other group" contains onions, a major vegetable, and the 1948 study shows a negative elastieity of nearly —0.3.

[5] A gradual downtrend in eonsumption was assumed.

[6] Apples may show some positive ineome effect but a slight downtrend in eonsumption.

[7] May depend largely on composition and proportion used as fresh, eanned, or frozen.

byproduct feeds and projected total demand for feed based on livestock production, fix the requirements for major feed grains.

Although combined use of crops for food tends to change little in response to changes in income, per capita use of most vegetables and fruits, especially citrus, is fairly responsive to income changes. But per capita use of potatoes and sweetpotatoes, cereals, dry beans, and some vegetables, have tended to decline as incomes rise. Exact measurement of these tendencies—income elasticities—is more difficult than for livestock products, yet they can be approximated from available studies.

Empirical approximations of these income elasticities, based on consumer-purchase surveys, time-series analyses,[6] and judgment of commodity specialists, were used as a basis for projecting demand for individual farm products. These are summarized in table 2. In some instances, elasticities are implied by an independent projection of per capita consumption.

Consumption per Person

With a rise in real consumer income per person of about 60 percent from 1953 to 1975, and with no change in relative prices, what do the income elasticities imply for per capita consumption of farm products in total, and for major commodities?

Food consumption per person, as indicated by the Agricultural Marketing Service Index, would be expected to increase about 12 percent on the basis of the projected rise in income and an income elasticity of about 0.2. This would increase the index to around 113 percent (1947–49=100) by 1975.

Independent projections for individual commodities summarized in the AMS Index also push the total up about 12 percent by 1975, and 3 percent by 1960. Consumption increases reflect the continued shift to higher unit-cost foods and away

[6] See for example FOX, KARL A., FACTORS AFFECTING FARM INCOME, FARM PRICES, AND FOOD CONSUMPTION. Agricultural Economic Research, 3: 65–82, 1951. NORDIN, J. A., Judge, G. C., and WAHBY, O., APPLICATION OF ECONOMETRIC PROCEDURES TO THE DEMANDS FOR AGRICULTURAL PRODUCTS. Iowa State College Research Bul. No. 410. 1954. ROJKO, ANTHONY S., AN APPLICATION OF THE USE OF ECONOMIC MODELS TO THE DAIRY INDUSTRY, Journ. Farm Econ. 35: 834 ff. 1953.

from cereals and potatoes. In the projected diet, the pounds of food and calories consumed per person are changed only a little. Increases in proteins, minerals, and other requirements for an improved diet are provided.

As the Agricultural Marketing Service Index of Per Capita Consumption reflects some processing and marketing services, projected requirements were expressed at the farm level, and an index was constructed using prices received by farmers as weights. Requirements are worked back to the farm level by expressing, for example, meats in liveweight of meat animals and fruits and vegetables on a fresh farm-weight equivalent basis. This index would reflect the shift to higher unit-value foods at the farm level but not, for example, the shift to frozen and processed food. Projected per capita consumption of farm products summarized in this index increases nearly 10 percent from 1953 to 1975, about 2 percent by 1960.

A comparison of per capita consumption indexes for major groups of farm products suggests a tendency for the AMS retail price weighted consumption index to increase somewhat more, relative to income, than the increase at the farm level. For most livestock products, results for the two indexes appear consistent and only moderately different. In both, the increase in per capita consumption of livestock products is about a tenth from 1953 to 1975. Comparisons were somewhat more difficult to make for major crops. The same tendency for a smaller gain in the consumption index at the farm level was observed. Differences are sizable for grains and fruits which require considerable marketing and processing services.

Livestock products.—Per capita consumption of meats is projected to around 173 pounds by 1975 from 154 pounds in 1953. This increase reflects the rise in real income and its effect on consumption, as well as possible restrictions on the supply of veal and lamb. The gain of around 20 pounds in total meat consumption per person is about the same as the increase from 1925–29 to 1953. In the case of cattle and calves, prices were considered relatively low and consumption correspondingly high in 1953, the base year. Also, hog prices were relatively high and consumption low in 1953.

In appraising consumption prospects for 1975, prices of cattle are assumed about 12 percent higher and hog prices nearly a fifth lower than in 1953. Projected demand for dairy products indicates little change in per capita consumption of veal. Thus combined use of beef and veal is less than a tenth above the relatively large consumption per person in 1953. On the other hand, per capita consumption of pork projected for 1975 is nearly a fifth above the relatively small consumption in 1953. Consumption of lamb per person reflects primarily expected growth in the sheep industry.

Per capita consumption of dairy products in 1953 totaled 682 pounds (milk equivalent, fat-solids basis) compared with 798 pounds average for 1925–29. The decline of the last two to three decades was due to a drop of around one-half in per capita use of butter. Combined per capita demand for milk products is expected to increase slowly in response to the projected rise in income. Total milk consumption per person is projected to around 720 pounds (milk equivalent) for 1975. Most of the increase is in consumption of fluid milk. Butter consumption is held at about the 1954 level. Use of milk and butterfat in ice cream has held relatively steady in recent years but may decline some if use of vegetable fats becomes more widespread (table 3).

Consumption of chicken and turkey per person in 1953 totaled about 27 pounds (eviscerated weight), an increase of about 50 percent from the 1925–29 average. The projection for 1975 is almost a fifth above 1953. Egg consumption is projected to more than 400 eggs per person, an increase of nearly 8 percent from 1953; the increase from the 1925–29 average to 1953 was more than a fifth. The big increase in consumption of poultry products since 1925–29 reflects substantially lower prices relative to livestock products as a whole, and relative to all farm products. Technological developments in feeding and production of poultry products have been rapid in the last two or three decades.

Per capita consumption of food oils is not expected to change much during the next quarter-century. In 1953, consumption of food fats and oils totaled 43.5 pounds (fat content). This compares with an average of around 43 pounds in 1925–29. Stability in the total reflects a downtrend in consumption of butter and an uptrend in margarine. Consumption of oils in lard and shortening has changed little, but in salad oils and

TABLE 3.—*Per capita consumption of major livestock products, selected periods 1925 to 1955 and projections for 1960 and 1975*

Commodity	1925–29	1951–53	1953	1955	Projections	
					1960	1975
Meat (carcass weight):	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Beef	53. 8	64. 5	76. 7	81. 2	74. 0	85. 0
Veal	7. 3	7. 7	9. 5	9. 4	9. 5	9. 0
Lamb and mutton	5. 3	4. 0	4. 6	4. 6	4. 5	4. 0
Pork (excluding lard)	66. 9	68. 4	62. 9	66. 0	68. 0	75. 0
Total	133. 3	144. 6	153. 7	161. 2	156. 0	173. 0
Poultry and eggs:						
Chicken (eviscerated wt.)	14. 3	22. 6	22. 6	20. 9	24. 0	27. 0
Turkey (eviscerated wt.)	n. a.	4. 4	4. 5	5. 0	4. 5	5. 2
Total (eviscerated wt.)	n. a.	27. 0	27. 1	25. 9	28. 5	32. 2
Eggs (number)	330	382	374	366	380	403
Dairy Products:						
Total milk (fat solids basis)	798	693	682	700	698	720
Cheese	4. 5	7. 3	7. 3	7. 7	7. 5	8. 0
Ice cream (net milk used)	24. 1	46. 0	47. 6	48. 4	45. 0	40. 0
Fluid milk, cream, condensed and evaporated milk, milk equivalent	364	389	385	387	395	415
Fats and Oils: Food (fat content)	n. a.	42. 9	43. 5	45. 0	44. 7	45. 5

dressings, and in ice cream, it has increased materially during the last few years. Per capita use of oils is projected to 45.5 pounds for 1975, close to current consumption rates. In general, past trends in use of oils are expected to continue in the coming years (fig. 4).

Crops.—Consumption of fruit per person may increase nearly a fifth from 1953 to 1975. As indicated by the elasticities assumed, the increase would be greatest for citrus fruits—possibly more than a third. The projection of 27 pounds of commercial apples for 1975 compares with a per capita consumption (both commercial and noncommercial) of about 49 pounds for the 1925–29 average. On the other hand, per capita consumption of citrus more than doubled from 1929 to 1953. This large increase was due to much lower prices for citrus relative to other fruit, to innovations in processing, and to the gain in income. Consumption of other fruits in 1953 was down to 88.5 pounds from 98.9 pounds in 1925–29.

Vegetable consumption per person (excluding potatoes) is projected for 1975 to about a sixth above 1953. This compares with a gain in consumption of 38 percent from 1925–29 to 1953 due in part to lower relative prices for truck crops. The largest relative gain in per capita use of vegetables is projected for tomatoes, although consumption of most leafy, green, and yellow vegetables may increase as much or more than tomatoes. The leafy, green, and yellow group contains cabbage, and the "other vegetable" group contains onions. Per capita consumption of both these major vegetables probably will decline as real incomes rise (table 4).

Consumption of potatoes, dry beans and peas, and grain products is projected to continue their downtrend during the next two to three decades. Consumption of potatoes in 1925–29 averaged 144 pounds per person and by 1953 was down to 102 pounds. The projected decline to 1975 is expected to be somewhat less rapid; an expansion in such uses as potato chips and frozen french fries may moderate the downtrend in consumption. The grain equivalent of wheat and flour consumption in 1953 totaled 179 pounds per person compared with an average of 254 pounds in 1925–29. A continued, but somewhat slower, decline in consumption of wheat is projected for the next two decades.

Nonfood Use of Farm Products

Nonfood use of such commodities as cotton, wool, tobacco, some oils, and grains for industrial uses probably total, in most years, around 12 to 14 percent of farm production. Combined per

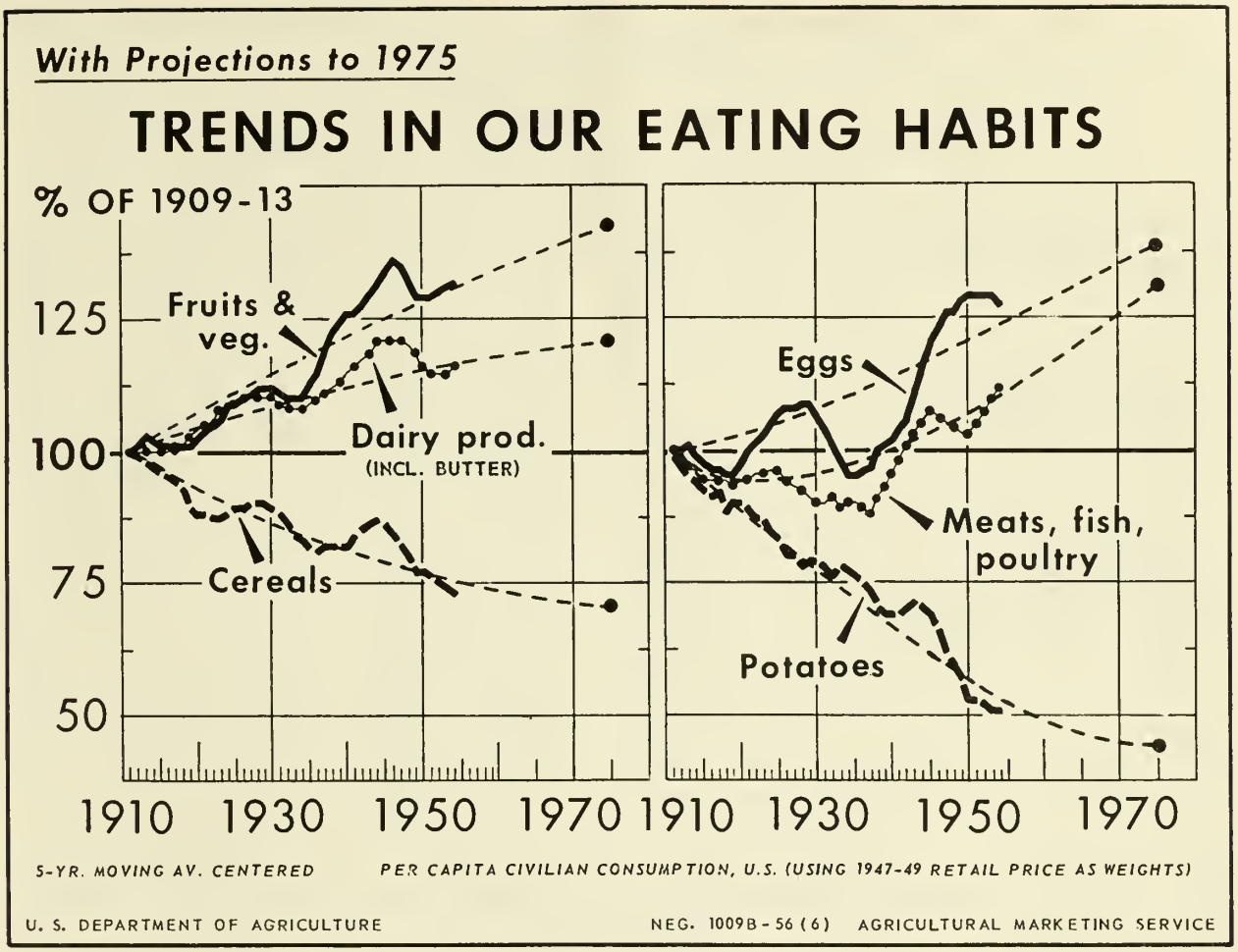

FIGURE 4.

capita use of these nonfood products is projected to rise around 8 percent from 1953 to 1975.

Demand for cotton is derived primarily from the demand for clothing, household furnishings, and industrial uses. Thus the level of income and economic activity is an influential determinant of per capita use of cotton. In recent decades, however, use of cotton per person has shown no pronounced upward trend. The same is true for wool although there have been sizable variations from periods of widespread unemployment to periods of swollen wartime demands. But use of synthetic fibers has expanded rapidly in recent decades, making substantial inroads in the market for natural fibers.

Although synthetic fibers will continue to compete with cotton and wool, with the substantial rise in consumer income an increase in per capita use of cotton is projected for 1975. Consumption of wool per person is held at about 1.8 pounds, somewhat below per capita use in 1953 but about at the current rate of use per person (table 5).

Use of tobacco per person has trended strongly upward during recent decades. With a substantial rise in income in prospect, a continued increase is projected for the next two or three decades. But recurrent publicity on possible adverse effects of smoking may moderate the uptrend in per capita use of tobacco.

Major nonfood uses of fats and oils are in the manufacture of such products as soap, paints, varnishes, linoleum, greases, and industrial products. Demand for these products in general tends to be relatively elastic. But the value of the raw materials used generally represents a small part of the final product cost. Moreover, in recent years

TABLE 4.—*Per capita consumption of major food crops, selected periods 1925 to 1955 and projections for 1960 and 1975*

Commodity	1925–29	1951–53	1953	1955	Projections	
					1960	1975
Fruits (farm weight equivalent):	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Apples (excluding noncommercial)	n. a.	28. 0	25. 7	26. 3	30. 0	27. 0
Citrus	32. 4	83. 1	84. 3	88. 6	92. 0	115. 0
Other	98. 9	86. 9	88. 5	84. 2	93. 0	95. 0
Total	180. 3	198. 0	198. 5	199. 1	215. 0	237. 0
Vegetables (farm weight equivalent):						
Tomatoes	31. 4	53. 1	53. 1	54. 3	55. 0	65. 0
Leafy, green and yellow	65. 3	82. 4	82. 5	80. 7	85. 0	95. 0
Other	52. 9	71. 2	71. 7	72. 1	74. 0	80. 0
Total	149. 6	206. 7	207. 3	207. 1	214. 0	240. 0
Potatoes and sweetpotatoes:						
Potatoes	144. 0	102. 0	102. 0	101. 0	98. 0	85. 0
Sweetpotatoes	21. 1	7. 4	8. 0	9. 0	9. 0	9. 0
Dry beans and peas (clean basis)	8. 4	8. 4	8. 2	8. 2	8. 0	7. 0
Grain products (grain equivalent):						
Wheat	254. 0	186. 0	179. 0	172. 0	175. 0	160. 0
Rye	3. 6	1. 9	1. 8	1. 7	1. 5	1. 5
Rice	5. 6	5. 4	5. 3	5. 3	5. 5	5. 5
Corn	n. a.	49. 4	48. 2	47. 3	47. 0	45. 0
Oats	n. a.	6. 9	6. 9	6. 8	6. 5	6. 5
Barley	n. a.	1. 8	1. 8	1. 8	1. 8	1. 8
Sugar, cane and beet	101. 0	95. 3	96. 5	96. 3	95. 0	93. 0

TABLE 5.—*Per capita nonfood use of major farm products, selected periods 1925 to 1955 and projections for 1960 and 1975*

Commodity	1925–29	1947–49	1951–53	1953	1955	Projection	
						1960	1975
Nonfood fats and oils:	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
Soap	n. a.	13. 6	8. 8	8. 1	6. 7	6. 5	4. 0
Drying oil	n. a.	6. 6	6. 3	6. 1	6. 3	6. 0	5. 0
Other industrial	n. a.	4. 9	6. 8	7. 0	7. 1	8. 5	11. 5
Total	n. a.	25. 1	21. 9	21. 2	20. 1	21. 0	20. 5
Cotton	27. 7	29. 5	29. 3	27. 9	26. 5	30. 0	32. 0
Wool, apparel	2. 1	3. 1	2. 3	2. 2	1. 7	1. 8	1. 8
Tobacco [1]	9. 0	12. 0	12. 8	12. 9	12. 2	13. 8	15. 4

[1] Unstemmed processing weight, per person 15 years and over including Armed Forces overseas.

synthetic detergents have taken over a large part of the market for soap manufactured from fats and oils.

Recent technological developments in the chemistry of the manufacture of paint and varnish have resulted in the use of more synthetic resins and rubber. Although these trends may continue, technological developments probably will expand other uses of industrial oils. Therefore little change is projected in total nonfood use of fats and oils. Industrial uses of grains are expected to expand as population and the economy grow.

Foreign Demand

The foreign market for United States farm products depends on a complex of forces, many of which are noneconomic in nature and difficult to appraise. World demand for food and fiber will increase, and world markets probably will continue in coming years to take relatively large quantities of our production of cotton, grains, tobacco, and fats and oils.

World population is expected to increase around 40 to 45 percent from 1950 to 1975 with larger than average gains in India and in countries of the Far East, Latin America, and the Middle East. Increases somewhat smaller than average are in prospect in Western Europe, Oceania, Japan, and Africa.

Population growth alone does not assure a corresponding increase in demand. But with consumer income and the level of living generally expected to rise, demand for food should increase more rapidly than growth in population.

Estimates based on income growth for major world areas and rough measures of income elasticity of demand for food were compared with estimates based on Food and Agriculture Organization targets for improved diets. These data suggest a world demand in 1975 some 50 to 65 percent above 1950. Larger than average gains are indicated for such areas as India, Communist China and Asian satellites, Latin America, the Middle East, and non-communist Far East (excluding Japan).

Rising incomes will lead to changes in the pattern of consumption in favor of more nutritive and protective foods. These changes can be only roughly appraised, but per capita demand for meat, dairy products, fruit, vegetables, and pulses (beans, peas, lentils) are likely to increase much more rapidly than the demand for cereals, starchy roots, and sugar. It appears probable that, with existing technology and readily accessible new lands, foreign agricultural production could be increased rapidly enough to meet a large part of projected needs in most areas of the world. Further, the trend toward self-sufficiency in the production of food and fiber will continue in most foreign countries, or groups of related countries, for reasons of politics and security.

World markets are expected to take relatively large quantities of our cotton, grain, tobacco, and fats and oils. The volume of agricultural exports projected for 1975 is about a sixth above the relatively small exports in 1952–53 and somewhat below the large volume exported during the 1955–56 fiscal year, when large export programs were in effect. The projected increase for fats and oils from 1952–53 to 1975 looks large but the big exports of fats and oils in the 1954–55 marketing year are close to levels projected for 1975 (table 6).

Agricultural exports in 1952–53 approximated less than a tenth of total output. Foreign takings are expected to continue to be a relatively small proportion of the total demand for farm products.

TABLE 6.—*Exports and shipments of major agricultural products, average 1947–49, 1952–53 and projection for 1960 and 1975*

Commodity	Crop year begining	Unit	1947–49	1952–53	Projection	
					1960	1975
Wheat, including flour and products	July 1	Mil. bu	433. 6	321. 6	250	275
Corn	Oct. 1	do	74. 8	139. 6	125	150
Cotton	Aug. 1	Mil. bales	4. 2	3. 0	[1] 4. 0	[1] 4. 5
Nonfood fats and oils	Oct. 1	Mil. lb	[2] 308	1, 169	1, 265	1, 620
Food fats and oils	do	do	[2] 945	1, 078	1, 369	2, 587
Tobacco	July–Oct.[3]	do	540	570	620	670
Total volume of exports	[2]	1947–49=100	100	86	85	101
Total volume of imports	[2] [4]	1947–49=100	100	112	117	140

[1] Assumes United States export prices will be substantially competitive with foreign prices.
[2] Computed from supply and disposition index made for this study.
[3] July for flue-cured and cigar wrapper. October for all other types. Tobacco exports include leaf equivalent of manufactured tobacco products exported.
[4] Volume of imports would be approximately comparable to the index of volume of supplementary or similar competing agricultural products grown in the United States.

Imports.—Imports of agricultural products are expected to rise with the growth in population and in economic activity. Imports of products similar to those produced in the United States, usually designated as supplementary, are projected for 1975 at about a fourth above 1953, and for 1960 possibly 4 or 5 percent higher. Imports of complementary products such as rubber, coffee, raw silk, cocoa beans, carpet wool, bananas, tea, and spices, probably will rise relatively more. Total consumption of these products, which is fairly responsive to rising incomes as well as to population growth, may well increase 50 percent or more from 1953 to 1975.

Projected Total Requirements

Population growth and domestic use per person, together with foreign takings, will determine total requirements for farm products. In this study, appraisals were made in some detail for two levels of consumption. The lower projection of requirements is based on approximately current rates of consumption. This assumes a situation in which the economy fails to grow as rapidly as expected, with conditions unfavorable enough to hold per capita consumption at about current (1955) levels. Exports were assumed at 1953 rates for the lower level of requirements.

The higher requirements are based on a projection of per capita consumption which reflects an increase of about 60 percent in income per person and trends in popular consumption habits. A population of 210 million was assumed for 1975, an increase of about 30 percent from 1953; the increase by 1960 may be around a tenth from 1953. This growth in population is conservative, especially the projection for 1975. Recent higher population projections suggest the possibility of about 220 million people by 1975. This assumption of a 5-percent larger population would add proportionately to projected requirements for farm products. Projected utilization shown in figure 5 is based on the higher projected consumption rates with the population for 1975 ranging from 210 to 220 million (fig. 5).

Requirements for farm products projected for 1975 on the basis of current consumption rates, which are only a little above 1953 base levels, reflect primarily population growth. On this basis, total utilization for 1975 would be nearly a third above 1953 with the increase for livestock products slightly in excess of that for crops.

Requirements would increase by around 40 percent from 1953 to 1975 on the basis of the projected higher consumption levels. Requirements for livestock products increase by more than 40 percent while the gain for crops would be around 36 percent.

Livestock products.—Projected requirements for meat animals increase by nearly 30 percent from 1953 to 1975 under the lower consumption rate, and increase by nearly 45 percent under the higher. The increase by 1960 is about a tenth above 1953 under both assumptions. Projected increases for pork from the relatively low levels in 1953 are generally larger than those for beef and lamb. Requirements projected for poultry products both in 1960 and 1975 are considerably smaller for current consumption rates than for the higher projected consumption rate. Requirements projected for dairy products are not materially different for current and projected consumption rates (table 7).

Assuming little change in average weight of animals and about average death loss and calf crop, projected requirements for the higher consumption rates point to around 125 million head of cattle on farms by 1975. There were 94 million

TABLE 7.—*Utilization of major livestock products, 1953 and alternative projections for 1960 and 1975* [1]

[1953=100]

Commodity	1953	Projection 1960		Projection 1975	
		I [2]	II [3]	I [2]	II [3]
Meat animals:					
Cattle and calves	100	109	105	127	138
Pork (excluding lard)	100	113	118	132	152
Sheep and lambs	100	111	108	130	113
Total	100	110	110	129	143
Dairy products, total:					
Milk (fat solid basis)	100	113	111	131	134
Poultry products:					
Eggs	100	108	112	126	140
Chicken and turkey	100	105	115	123	153

[1] Utilization includes domestic use (food and nonfood) and exports.

[2] Level I assumes approximately current consumption rates per person for both 1960 and 1975.

[3] Level II is based on a projection of per capita consumption reflecting the effects of an increase in real per capita income—about 60 percent from 1953 to 1975—and trends in popular consumption habits.

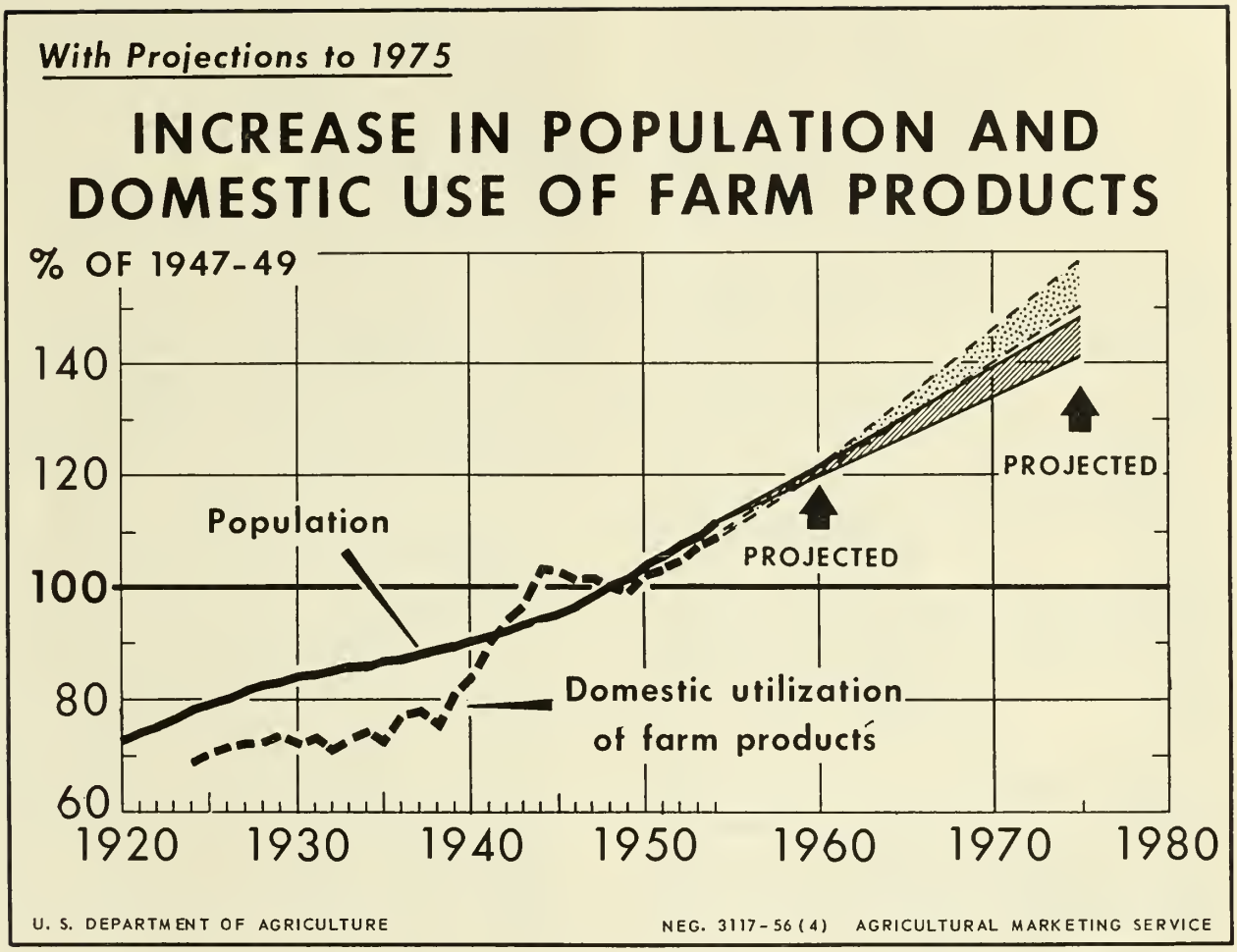

FIGURE 5.

head on January 1, 1953 and 96½ million in 1955. With a continued rise in milk output per cow, the required increase in number of cows milked may be small. The pig crop under the higher consumption rate would increase to around 130 million head from about 78 million in 1953 and 95 million in 1955. Sheep numbers increase to about 33 million stock sheep from 27.6 million in 1953 and 27 million in 1955. Chickens raised would increase under the higher consumption rates by more than a sixth, broilers by possibly 80 percent, and turkeys by around 50 percent from 1953 levels to meet expanded requirements in 1975. A larger population would require proportionately more livestock products.

Crops.—Use of crops is projected under the higher consumption rates to rise by about 36 percent from 1953 to 1975 and by more than a tenth by 1960. If approximately current consumption rates are assumed, projected use of crops increases from 1953 by about a tenth for 1960 and by about 30 percent by 1975. Variation in requirements for individual crops and groups of crops, however, is considerable.

Projected requirements for food grains and potatoes in general would change little from 1953. The assumption of current rates of consumption increases the requirements for these crops from 1953 to 1975 by more than would be true if projected consumption rates were used as a basis for calculating total requirements. This is because per capita consumption of cereals and potatoes in the projected consumption rates, trends downward rather than being assumed at current rates.

Larger requirements by 1975 were projected for vegetables, citrus fruits, feed concentrates, fats and

TABLE 8.—*Utilization of major crops, 1953 and projections for 1960 and 1975* [1]

[1953=100]

Commodity	1952–53	Projection 1960		Projection 1975	
		I [2]	II [3]	I [2]	II [3]
Food grains:					
Wheat	100	94	95	108	104
Rice	100	104	92	109	95
Fruits, fresh weight equivalent: [4]					
Apples	100	104	120	123	128
Citrus	100	117	122	135	176
Other	100	104	111	121	132
Vegetables, farm weight equivalent: [4]					
Tomatoes	100	112	113	130	154
Leafy, green and yellow	100	105	111	123	145
Other	100	105	110	123	138
Potatoes [4]	100	105	103	120	106
Dry, edible beans [4]	100	108	96	122	98
Sugar, raw [4]	100	111	110	130	126
Food fats and oils	100	113	115	130	148
Nonfood fats and oils	100	104	110	119	131
Feed concentrates	100	109	114	125	142
Cotton	100	107	118	116	143
Wool	100	85	90	99	105
Tobacco	100	107	117	129	155

[1] Utilization includes domestic use (food and nonfood) and exports.

[2] Level I assumes approximately current consumption rates per person for both 1960 and 1975.

[3] Level II is based on a projection of per capita consumption reflecting the effects of an increase in real per capita income—about 60 percent from 1953 to 1975—and trends in popular consumption habits.

[4] Calendar year 1953 is base year.

oils, cotton and tobacco. The gains, however, assuming current consumption rates, reflect primarily the growth in population and are smaller than requirements based on projected consumption rates (table 8).

Under the higher consumption rates, requirements for feed concentrates and hay are up about 40 percent from 1953 to 1975. This expansion may call for an increase of 40 to 45 percent for the major feed grains—corn, oats, barley and sorghum grains. It should be pointed out, in this connection, that feed requirements assume feeding rates per livestock production unit around 1951–53 levels. If there are extensive new efficiencies in feeding, concentrates fed per livestock production unit may decline some and thus moderate the projected rise in feed requirements.

A higher population assumption of about 220 million people by 1975 would add about 5 percent to projected utilization of major farm products.

Output Required to Meet Projected Demand

Growth in demand gives purpose and direction to productive activity, but it is not the purpose of this section to give an appraisal of probable changes in output during the next two or three decades. That is, it is not an appraisal of the probable supply response to rising demands. [7]

Projected total requirements for domestic use and export would not require corresponding increases in output. Production rates in recent years have exceeded use; they resulted in substantial accumulations in stocks of wheat, rice, cotton, and feed grains. Total net stock build-up in 1953 was equal to about 6 percent of net farm output; the build-up of crop inventories was equal to about 8 percent of crop output. Although the rate of inventory accumulation was slower in 1954 and 1955 than in 1953, production continued to exceed utilization.

With production running in excess of utilization, a projected increase of around 40 percent in requirements for domestic use and export, from 1953 to 1975, may require a rise of less than a third in total output of farm products. For livestock products the increase would exceed 40 percent whereas a gain of about 25 percent is indicated for crop output (table 9).

The lower level of requirements probably would require an increase of less than a fourth in total farm output; this would imply a rise of nearly a third for livestock products and possibly a fifth for crops.

Production of livestock products as a whole would need to increase under the higher consumption rates by more than 40 percent—about 45 to 50 percent for meat animals and poultry products and more than 25 percent for dairy products. The increase in production of cattle and calves from the high output in 1953 probably would be somewhat smaller than the required increase from the relatively low level of hog production in 1953. Sheep production may increase much less than output of cattle or hogs. Production of chicken and turkey may need to increase around 50 percent and egg production around 40 percent from

[7] A more complete discussion of the nature of the production job is reported in a companion report, *Farm Output, Past Changes, and Projected Needs*, by Glen T. Barton and Robert O. Rogers of Agricultural Research Service, U. S. Department of Agriculture.

TABLE 9.—*Output of major livestock products, 1953 and projections of output needed to meet projected requirements for 1960 and 1975* [1]

[1953=100]

Commodity	1953	Projection 1960		Projection 1975	
		I [2]	II [3]	I [2]	II [3]
Livestock and products	100	-----	111	-----	142
Meat animals	100	111	111	131	146
Beef and veal	100	109	104	128	138
Lamb and mutton	100	113	110	132	114
Pork (excl. lard)	100	115	121	135	156
Wool	100	114	114	118	118
Poultry products	100	-----	115	-----	148
Chicken and turkey	100	105	115	123	153
Eggs	100	108	112	127	140
Milk, total fat solid basis	100	107	106	125	129

[1] Output required to meet projected requirements.
[2] Level I output assumes approximately current consumption rates per person for both 1960 and 1975.
[3] Level II output is based on a projection of per capita consumption reflecting the effects of an increase in real per capita income—about 60 percent from 1953 to 1975—and trends in popular consumption habits.

1953 to 1975 to match the higher level of requirements. These increases are about the same as the projected rise in utilization of livestock products.

Output increases needed to match projected requirements for 1975, based on current consumption rates, are in general smaller than those based on the higher projected consumption rates for livestock products; they would range from 25 to 30 percent for most livestock products. The higher population assumption for 1975 would require correspondingly larger expansion in output of all livestock products (table 9).

Projected requirements for crops under the higher consumption rates are up about 36 percent from 1953 to 1975. But since the net build-up of crop inventories in the 1952–53 marketing year was equal to around 8 percent of total crop output, including feed and seed, an increase of about a fourth in crop output would meet expanded requirements.

With excess productive capacity in feed grains, the higher projection of requirements for livestock products would suggest an increase of around a third in combined output of the four major feed grains—corn, oats, barley, and sorghum grains. Assuming a further decline in per capita use of wheat, projected utilization of food grains for 1975 would require a smaller output than in 1952–53.

Furthermore, very little increase in output of potatoes and beans would be needed to meet projected requirements. Expanded needs for protein feed may result in a substantial increase in output of soybeans—possibly around 60 percent from 1952–53—which would probably lead to relatively large supplies of oil available for export.

The higher projection of requirements for 1975 would call for an increase of more than 40 percent in combined output of fresh vegetables and nearly 50 percent in production of fruits; much of the gain would be in citrus fruits.

With further increases in per capita use, tobacco production would have to rise by possibly 50 percent to meet the higher level of expanded domestic

TABLE 10.—*Output of major crops, 1953 and projections of output needed to meet projected requirements for 1960 and 1975* [1]

[1953=100]

Commodity	1952–53	Projection 1960		Projection 1975	
		I [2]	II [3]	I [2]	II [3]
Crops	100	-----	103	-----	124
Feed grains	100	103	108	117	135
Food grains	100	-----	75	-----	82
Wheat	100	72	74	83	81
Rice, milled	100	103	92	109	94
Rye	100	113	130	129	138
Fruits [4]	100	-----	115	-----	141
Apples	100	104	121	124	129
Citrus	100	117	121	136	176
Other	100	106	114	130	135
Vegetables [4]	100	-----	109	-----	141
Tomatoes	100	119	119	139	165
Leafy-green and yellow	100	103	109	120	142
Other	100	99	104	116	131
Potatoes [4]	100	101	99	116	102
Dry edible beans [4]	100	110	98	124	99
Sugar	100	101	101	101	101
Food fats and oils	100	105	106	120	137
Nonfood fats and oils	100	106	112	125	138
Cotton	100	88	96	95	117
Tobacco	100	103	114	123	150
Total farm output	100	-----	106	-----	131

[1] Output required to meet projected requirements.
[2] Level I output assume approximately current consumption rates per person for both 1960 and 1975.
[3] Level II output is based on a projection of per capita consumption reflecting the effects of an increase in real per capita income—about 60 percent from 1953 to 1975—and trends in popular consumption habits.
[4] Base year is calendar year 1953.

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use and export. The higher level of cotton utilization projected for 1975 would require a cotton crop about one-sixth larger than in 1953.

If the lower consumption rates are assumed, projected 1975 requirements point to need for a smaller cotton crop than in 1952–53. Even though per capita use of wheat is held at about the 1955 rate, output of wheat needed to match requirements would be well below the nearly 1.3 billion bushel 1952 crop and not much above the 1955 crop. But larger output would be required by 1975 for potatoes and dry beans if current consumption rates are assumed. The lower level of requirements for fruits, vegetables, feed grains, fats and oils, and tobacco, points to moderate increases in required output for these crops.

For both consumption levels, the higher population assumption of 220 million people by 1975 would add proportionately around 5 percent to output increases in the preceding paragraphs, which are based on a population of 210 million.

Prospective Demand for Farm Products by 1960

Some of the most pressing problems facing agriculture today revolve around the outlook for the next few years. The extent to which demand for farm products expands in coming years will be an important factor influencing programs that are designed to limit production and work down excessive stocks of some farm products. With continued growth in population and a further increase in consumer income, projected requirements for farm products by 1960 may total around 12 percent above the base year 1953. As current production rates are above 1953, and carryover stocks of some products are large, little or no further increase in output would be needed to meet projected requirements for 1960. However, some adjustment in the pattern of farm output is indicated.

To a considerable extent the small rise in per capita use of farm products projected for 1960 had already occurred by 1955. Per capita consumption of meat-animal products in total would change little from the base year 1953 and may not equal the high rate of use in 1955 when prices were relatively low. Milk consumption per person projected for 1960 and per capita use of poultry products for 1960 would be up some from 1953 levels. Per capita consumption of citrus fruits and most fresh vegetables is projected to increase from 1953 levels, in line with past trends. Although per capita use of wheat and potatoes is expected to trend downward, projections for 1960 are fairly close to current consumption rates. Per capita use of cotton and tobacco are a little above current rates (1955). Little change in per capita use of food and nonfood oils is in prospect.

Projected Requirements Rise Moderately

With population growth of about a tenth from 1953 to 1960 and a small rise in per capita use, domestic requirements for farm products would increase around 12 percent from 1953 to 1960; the required increase from 1955 may be less than a tenth. Total volume of agricultural exports are carried at levels about as large as in 1952–53. The same relative increase in requirements (12 percent) is indicated for both livestock products and crops. However, use of food grains, potatoes, and dry beans may total less than in 1953. Requirements for feed increase about the same as livestock products. Other nonfood uses, mainly cotton, tobacco, wool and oils, are projected to rise by nearly 12 percent from 1953 to 1960.

With continued population growth, per capita use of beef by 1960 may depend largely on the course of the cycle in cattle numbers during the next few years. Current trends suggest cattle numbers are at or near the top of their cycle. Projected requirements for 1960 suggest upward of 100 million head of cattle; there were 97½ million head on January 1, 1956. Thus supplies per person by 1960 may be smaller than the relatively large supplies in 1955. A total pig crop of between 100 and 105 million head is projected for 1960 compared with 95 million head in 1955. A moderate rise in requirements for dairy products is indicated. Projected requirements for poultry products, in total, increase more than an eighth from 1953 to 1960.

Required Farm Output Near Current Levels

An appraisal of output needed to meet projected utilization of farm products by 1960 requires some assumptions relative to accumulated stocks and probable production cycles. It is questionable whether a further increase in output will be needed to balance the projected increase in requirements for 1960. In 1953 we produced about

6 percent more farm products than were utilized; so an output increase of about 6 percent, with adjustments in composition, would match the projected increase of 12 percent in total requirements. With output in 1955 already up some 3½ percent above 1953, total output may be within 2 or 3 percent of that required to meet projected utilization of farm products by 1960.

Although projected requirements point to an increase in output of livestock products from 1953 to 1960, part of the gain had occurred by 1955. Cattle and calves on farms January 1, 1956 totaled 97½ million head, close to probable requirements for 1960. A pig crop of 100 to 105 million head is indicated compared with 95 million in 1955. The rise in requirements for dairy products probably can be met without increasing the number of cows milked. A larger output of poultry products is indicated by projected requirements (table 11).

The 1955 crops of wheat, major feed grains, potatoes, and cotton were about the same as the output that will be required for 1960. In addition to current high production rates for major crops, the carryover stocks are large for wheat, rice, feed grains, and cotton. Stocks of wheat and cotton exceed one year's production and feed grain stocks equal almost a third of feed grain output in 1955.

A major deviation in domestic and foreign demand from the gradual increase indicated in these calculations could modify demands by 1960. But it is clear that the supply situation could continue burdensome for food grains, cotton, and feed grains, for several years, if growing conditions are favorable. These conditions also point to the need for considerable adjustment in the pattern of farm output during the next few years.

TABLE 11.—*Production of major farm products 1955 and required output for 1960, assuming projected consumption rates*

Commodity	Unit	1955	Projected 1960
Livestock products:			
Cattle and calves on farms January 1.	Million	96. 6	98. 5
Pig crop	do	95. 3	103
Eggs produced	Mil. doz	5, 403	5, 960
Milk produced	Bil. lbs	123. 5	127. 5
Crops:			
Wheat	Mil. bu	938	962
Major feed grains [1]	Mil. ton	130	129
Corn	Mil. bu	3, 185	3, 340
Soybeans	do	371	341
Potatoes	do	382	377
Cotton	Million running bales.	14. 5	14. 5

[1] Corn, oats, barley, and grain sorghums.

Research on Objective Forecasts of Filbert Production

By Robert D. Parr and Lyle D. Calvin

Fruit and nut production in Oregon and other important producing areas is highly commercialized. Sales of many of these commodities are controlled by Federal marketing agreements to provide for orderly marketing of each year's crop. Officers of grower and processor organizations who are charged with the administration of the programs need accurate early-season forecasts of prospective production and quality of the product. Monthly production forecasts are published during the growing season by the Crop Reporting Service as part of the overall crop and livestock estimating program. However, the complexity of marketing problems faced by producers and their organizations has built up pressures for more detail and greater precision in such forecasts. This paper reports on a study being made on filberts in Oregon; the approach to the problem is typical of the approach now under study in several areas.

SOME NINE TREE fruit and nut crops are grown commercially in Oregon. Substantial numbers of growers belong to producer organizations. Many crops have multiple utilization patterns—the allocation of the total production in any given year to the various uses is a difficult and increasingly pressing problem. As a result, timely information during the growing season on the prospective volume and commercially pertinent characterstics of the crop is much in demand.

Monthly forecasts of prospective production by the Crop Reporting Service are based largely on growers' appraisals of crop conditions. Those appraisals are translated into production forecasts by means of a regression chart showing the relationship of reported data to final production in past years, with an allowance for time trend where necessary. A certain degree of judgment is interjected by the statistician in analyzing all of the information available to him at the time, and also by the Crop Reporting Board, which reviews his recommendations and is the ultimate authority in arriving at the forecast.

It has been argued that more specific observations on selected trees, such as early-season fruit counts, measurements of size of fruit, and counts of fruit dropping from the trees, should be more closely related to final production than is an overall appraisal of the condition of an entire orchard or grove.

It is not feasible to have such observations made by growers themselves because too many are unwilling to devote the necessary time to the work and, even if they were, there could be some doubt about the exactitude with which instructions for making the observations had been followed. This means that crews of trained samplers must be employed. The cost of such an operation is the largest single deterrent to having it adopted more generally. But needs for greater precision, particularly for highly specialized crops, are convincing an increasing number of interested groups that the higher cost is justified if appreciable improvements in the forecasts can be achieved.

For many years the citrus industry in California has successfully employed the "frame-count" procedure, supplemented by other pertinent observations, on sample trees in sample groves. To a lesser degree a similar approach has been tried in Florida. In recent years studies on the practicability of counting fruit on entire trees or on selected limbs of trees have been undertaken cooperatively by industry groups, State agencies, and the Crop Reporting Service, on citrus in Florida; on grapes, peaches, pears, lemons, and walnuts in California; and on filberts in Oregon.

Oregon Filbert Study

Forecasting production has been one of the many problems that the filbert industry has faced. The study described here was undertaken by the industry through the Filbert Control Board, the Oregon Filbert Commission, the Oregon Agricultural Experiment Station, and the Crop Reporting Service. It is a 3-year project and consists basically of an attempt to forecast production by measuring year-to-year changes in the set of nuts by making counts on sample limbs, together with

observations on size and weight, defects such as blanks and worm damage, and amount of pre-harvest drop. Although measures of year-to-year change are expected to be the forecasting device that will yield greatest precision, observations are taken in a way that will also permit "direct expansion." Data are now available for one season only.

Sample Design

A listing of all plantings in the major producing area of Oregon and Washington is available from a survey of all producers of record who sold or delivered filberts to independent or cooperative handlers and processors in 1953 or 1954, or in both years. Each planting or "block" was identified by location (township), age of trees, and number of trees in each age group. The present study was restricted to the commercial producing counties in Oregon, plus Clark County, Washington, comprising about 97 percent of the United States crop. A sample of 300 orchard blocks was selected by applying a systematic sampling procedure with a random start after arranging orchards by location, age, and size. About 75 percent of all trees in the universe are Barcelona; other varieties are planted mostly as pollinizers for Barcelona.

After locating each sample orchard block, a sketch showing the number of rows of trees in each direction was prepared. In some instances the rows were counted by the samplers, but when growers were able to supply the information no actual tree count was made. A sample tree was drawn by selecting a sample location on the sketch with a table of random numbers; this gave every tree in the block an equal chance of selection. Pollinizer trees were accepted when they happened to be selected. Usually nuts from pollinizer trees are part of the production. On the average one is present for about every 7 or 8 of the primary variety. Two trees adjacent to the randomly-selected tree were also included in the sample. In 20 percent of the sample blocks a fourth tree was included; nuts were stripped from that tree after counting and counted again to measure the accuracy of the on-tree count. Altogether, 960 trees were in the sample.

As this study visualizes an ultimate operation in which nuts are counted on only part of each tree, it was necessary to devise a system for subdividing individual trees into sampling units, and a system for selecting such units for observation.

By nature the filbert tree is shrub-like. If left to itself it would grow in the form of an ever-expanding dense aggregate of individual shoots emanating from the ground. But by pruning it can be trained into the shape of a tree with about five main limbs which are fused into a trunk a short distance above ground. A well-kept filbert orchard has the appearance of rows of trees. To keep a tree in that condition continuous pruning of shoots that come up around the trunk is necessary.

Although most commercial plantings are in that condition, some orchards are in various stages of neglect. Depending upon price, the production from such orchards may become a part of the total variety. Some bushes never have been trained to assume the shape of trees. Others have been so trained at one time but have since been neglected, so that the orchard has the appearance of rows of trees with a thicket of shoots surrounding each tree. In time, of course, a greater part of the tree's production will occur on the bushy part of such trees. Yield per tree, however, tends to diminish with neglect.

As the trees usually are trained by pruning to have about five limbs, it was decided to use a fifth of a tree or bush as the unit on which nuts were counted. Samplers were instructed to divide sample trees by limbs into approximately five equal parts and to select one of those at random. Dividing the tree into five approximately equal parts is, of course, based upon sampler judgment. On the average a fifth of the bearing portion of all sample trees would thus be counted.

It was also decided to investigate an alternative to the expansion factor derived from this sampling rate. In some of the studies mentioned earlier, it has been discovered that the sum of the cross-sectional areas of the branches of a tree at any stage of subdivision is equal to the cross-sectional area of the trunk. The loss of limbs or branches, by accident or pruning, would decrease this relationship. If the relationship holds true for filbert trees the ratio of the cross-sectional area of the trunk of the tree to the cross-sectional area of the sample limb should provide a more accurate expansion factor. To get some data on this point the circumference of each sample limb was measured at about a hand's width above the crotch, and the circumference of the trunk at about the same distance below the crotch.

For a bush not trained into the shape of a tree, a fifth of the shoots were taken as the sampling unit and all shoots measured.

Nut Counts and Other Observations

Filbert nuts grow in clusters, usually of from 1 to 4 nuts each, but there may be as many as 16 or more in a single cluster. It is not practical to count individual nuts. A count was made of all clusters, and every 15th cluster, starting with a random number from 1 to 15, was picked from the tree. Counts of nuts per cluster were made in the orchard. These nuts were placed in a paper bag and taken to the office for observations on green and dry weight, and on defects such as blanks and worm damage, and other conditions of quality.

A subsample of 30 orchards in Yamhill, Washington, and Clackamas Counties was selected from the main sample for more intensive observations. One tree in each orchard was marked. The total set of clusters of nuts was counted and sample clusters on the entire tree were collected as in the case of the main sample. At 2-week intervals after the original count, additional visits were made to these sample trees to collect data on the numbers of clusters that dropped during the growing season. Sample clusters were also picked from surrounding trees to obtain data on the growth of nuts and changes in quality factors. At harvest time all nuts from the trees in the subsample were harvested, counted, weighed and subjected to crack tests.

Development of a Forecasting Procedure

A workable forecasting procedure involves a practical sampling scheme for selecting orchards, trees, and parts of trees for observation. The procedure also requires a knowledge of the relationship of nut counts, size, and quality early in the season to the yield at harvest time. The sample is designed to permit direct expansion of observations to the level of the universe, although the use of percent-change indications will undoubtedly prove to be more efficient. With such an estimating procedure it is still desirable to have a sample that permits direct expansion.

The relationship of early-season observations to final yields can not be ascertained accurately until more experience has been obtained. A yield forecast as of any specified date involves predicting (1) how many nuts on the trees at that time will develop to maturity, and (2) the size, weight, and quality of the ripe nuts when that stage is reached. Normal losses that may occur during harvesting must also be taken into account.

Any early-season forecast must start with a count of nuts present at the time of the forecast. Experience will show whether the percentage drop and the percentage reaching maturity tend to remain fairly constant from year to year or, if not, whether those percentages can be predicted from observable weather factors or other variables. Assuming that the number of nuts that will reach maturity can be predicted, it is also necessary to predict size and weight at maturity. A study of growth will be needed to devise procedures for predicting size and weight of nuts at maturity from observations on immature nuts. The ratio of growth increments from one year to another may be useful in modifying the eventual ratio formula to be used.

It is reasonable to expect that factors affecting growth can be identified and that predictions of mature size and weight can be made from early-season observations. Quality of the product at harvest probably is closely related to weather factors and to earlier worm or disease damage. Experience should shed light on these matters.

So far as harvesting losses associated with harvesting the mature crop are concerned, it is still necessary to learn whether such losses tend to be constant, percentagewise, or whether they depend upon the characteristics of the crop and other factors from year to year. But here, too, it seems reasonable to suppose that such losses will behave in a predictable fashion.

Use of Order Statistics in Estimating Standard Deviations

By H. F. Huddleston

Although many statistical surveys and experimental studies have been and are being conducted for many segments of the economy, including agriculture, standard errors are seldom computed. Estimates of these errors are frequently needed to evaluate survey results and for the planning of future studies. The computation of standard errors is frequently omitted because of the time-consuming procedures required. The use of rank, or order, methods of analysis has increased rapidly in the last few years. These methods provide the analyst with a quick, effective, and inexpensive tool for making many statistical estimates. In this paper, the use of order statistics to estimate standard deviations for certain agricultural series is described and the results are compared with those obtained by the root mean square method.

AT the Bureau of the Census the author needed to compute some 100,000 standard deviations within a period of a few months. Using order statistics, as described in this article, it was possible to get the job done with only a few clerks and desk calculators.

The need for estimating standard deviations frequently arises in statistical work in the Department of Agriculture and cooperating agencies. The procedures based on order statistics are easy to apply, relatively unbiased, and efficient, and they are appropriate for a large class of distributions. Too often they are discounted by statisticians who prefer more "powerful" statistics. They are little used by workers except in quality control, despite their simplicity, and the economies that frequently result from their use.

Within a period of 15 minutes a clerk can "search" or machine sort a sample of 200 items to obtain the ordered values required to estimate the standard deviation and divide by an appropriate constant. Because of the labor involved in their estimation, standard errors are frequently not computed at all or only "guessed at" in the planning of surveys and evaluating results of probability samples.

Order statistics offer considerable economy in estimating levels of sampling errors in connection with large-scale operations, such as a sample census of agriculture or other multipurpose surveys. Thus it becomes practicable to indicate the degree of precision of surveys at the time results are published, and to provide estimates of variability for many problems of sample design. The author's experience with order statistics suggests that other workers might find similar procedures useful.

Results for several items in the 1950 Census of Agriculture are given, together with results from the root mean square method. The nature of the bias that may be associated with such estimates is examined for certain populations. Whereas the use of only two or four observations out of a sample of n may appear grossly inefficient on intuitive grounds, order statistics characterize the shape of sample distribution in the tails where the contributions to the variability are greatest.

Procedures for Estimating Standard Deviation

Estimates of the standard deviation are constructed by selecting one or more pairs of order statistics which specify a given proportion from the respective tails of the distribution. However, the best known and most widely used estimate is based on the sample range, defined as follows:

$$\hat{\sigma} = (X_n - X_1)/C_{1/n}$$

where $C_{1/n}$ is expected value of the difference $(Y_n - Y_1)$, Y_n and Y_1 being the greatest and least observations drawn from a sample of size n from a normal distribution with unit variance. That is, $C_{1/n}$ is the mean value of the ratio of the range to the standard deviation. Tables of $C_{1/n}$ for various size samples are available for estimating the standard deviation from the simple range R_1 (i. e., $X_n - X_1$) which have been published in tables for statisticians and biometricians and in various quality control texts.[1]

We may likewise consider the use of various other pairs of order statistics such as $(X_{n-m+1}$

[1] See for example: GRANT, E. L. STATISTICAL QUALITY CONTROL. Appendix III, table B.

$-X_m$) or R_m. For instance, we can use the statistics

$$\hat{\sigma}_m=(X_{n-m+1}-X_m)/C_{m/n}$$

where $C_{m/n}$ is the expected value of the difference $(Y_{n-m+1}-Y_m)$, and we count in m observations from each end of a sample of size n ordered according to the magnitudes of the items and the Y's are drawn from the normal distribution with unit variance. The problem of which of the various pairs of order statistics or combinations of pairs is most appropriate has been resolved by Mosteller[2] for the normal distribution. If we are interested in the optimum spacing of the order statistics in the minimum variance sense, we find for large sample sizes when $\lambda=m/n$ that the minimum value of the variance of $\hat{\sigma}$, occurs when $\lambda=0.0694$. However, the value of the variance of $\hat{\sigma}$ changes slowly in this neighborhood. Hence, varying λ by 0.01 or 0.02 will make little difference in the efficiency of the estimate $\hat{\sigma}$. For practical purposes, the optimum values for λ are 0.07 and 0.93. The value of λ from the lower tail is denoted as $m/n=\lambda_1$ and the value for the upper tail by $1-m/n=\lambda_2$.

However, if we wish, we can construct an estimate based upon four order statistics. For the normal distribution Mosteller has shown that if we hold the first two selected order statistics at their optimum values, i. e., $\lambda_1=0.07$ and $\lambda_2=0.93$, the two additional observations should be more centrally located. Under these conditions the variance of $\hat{\sigma}$ is minimized for λ_3 in the neighborhood of 0.20 and $\lambda_4=1-\lambda_3$. The unbiased estimate of $\hat{\sigma}$ is:

$$\hat{\sigma}_{r,s}=(X_{n-r+1}+X_{n-s+1}-X_s-X_r)/C_{rs/n}$$

where $C_{rs/n}$ is the expected value of the difference of

$$(Y_{n-r+1}+Y_{n-s+1}-Y_s-Y_r),$$

Y_{n-r+1}, Y_{n-s+1}, Y_s and Y_r being observations drawn from a sample of size n from a normal distribution with unit variance.

Tabled values of $C_{1/n}$ are available only for the normal distribution. As the mean value of the $C_{m/n}$ is not available for the numerous sample sizes and distributions encountered in practice, we need to know the utility of the norming constants of $C_{m/n}$ based on large samples drawn from a normal population.

[2] Mosteller, Frederick. on some useful "inefficient" statistics. Annals of Mathematical Statistics. 17: 377. 1946.

Biases Associated With Estimates of Standard Deviations

The use of the norming constants $C_{m/n}$ for the normal population with respect to large samples from several different types of populations will be examined. In particular, we would like to know the nature of any biases which may be encountered when we use the value of $C_{m/n}$ corresponding to the optimum percentage points derived for the normal population. Where $\lambda_1=0.07$ and $\lambda_2=0.93$ the norming constant, $C_{m/n}$, is 3.0. With respect to the theory the question is, How good is this mean value for general use? On intuitive grounds it would appear that R_m corresponding to very small values of λ_1 for populations having finite ranges will be less than the corresponding range or quasi-range for a normal population. This suggests that $C_{m/n}$ for populations having finite ranges may be less than for the same λ corresponding to a normal distribution. If such is the case, underestimates of $\hat{\sigma}$ will result by using the larger mean value of $C_{m/n}$ (i. e. divisor) corresponding to the normal distribution.

Comparisons with the normal distribution were made by the author for four distributions in table 1. The distributions are the right triangular $f(x)=\frac{2}{a}\left(1-\frac{x}{a}\right)$, $X\geq 0$; the isosceles triangular $f(x)=\frac{2}{a}\left(1-\frac{2x}{a}\right)$, $-\frac{a}{2}\leq X\leq\frac{a}{2}$; the rectangular $f(x)=\frac{1}{a}$, $o\leq X\leqq a$; and the exponential $f(x)=e^{-X}$, $X\geq 0$. e^{-X}

Table 1.—*Values of $C_{m/n}$ for large samples corresponding to $\lambda_1=0.01$ to 0.10*

λ_1	Type of distribution				
	Normal	Isosceles triangle	Right triangle	Rectangular	Exponential
0.01	4.7	4.2	3.8	3.4	4.6
0.02	4.1	3.9	3.6	3.3	3.9
0.03	3.8	3.7	3.4	3.3	3.5
0.04	3.5	3.5	3.3	3.2	3.2
0.05	3.3	3.4	3.2	3.1	2.9
0.06	3.1	3.2	3.1	3.1	2.8
0.07	3.0	3.1	3.0	3.0	2.6
0.08	2.8	3.0	2.9	2.9	2.4
0.09	2.7	2.8	2.8	2.8	2.3
0.10	2.6	2.7	2.7	2.8	2.2

In addition, comparisons for the chi-square family for different degrees of freedom show a result similar to that found for e^{-x}. As the vast majority of distributions encountered in agriculture are covered by the types examined, the use of the norming constant $C_{m/n}$ near the 7 and 93 percentage points would appear to yield relatively unbiased estimates of the standard deviation. For highly skewed populations possessing some extremely large units or a "contaminated" tail, the norming constant for the normal distribution may underestimate $\hat{\sigma}$. But in sampling agricultural populations or in census enumerations it is a common practice to develop special procedures for handling extremely large units; consequently an estimate of the standard deviation for the remaining portion of the population may be obtained by using the values of $C_{m/n}$ given for the normal distribution.

Working Rules and a Numerical Example

The preceding investigation of several distributions indicates that for large samples the norming constants, for say $\lambda_1=0.07$, may be used in most situations to obtain relatively unbiased estimates of the standard deviation. For moderate size samples there appears to be no reason apriori to believe that the expected values of $C_{m/n}$ for fixed percentage points would be very sensitive to or depend on the sample size, except for $C_{1/n}$. The author knows of no investigation of expected values for various sample sizes greater than 10, and he has not computed them. But the results obtained appear to agree rather well with results to be expected from the large sample values indicated in table 1.

To illustrate which of these "inefficient statistics" should be used for estimating standard deviations, table 2 is given, along with corresponding constants in table 3, as compiled by the author. It is necessary to arrange the two tails in ascending order of magnitude, using either a machine sort or "search" procedure so that $X_1 \leqq X_2 \leqq X_{n-1} < X_n$. Table 2 gives the appropriate X_{ni} and table 3 the $C_{m/n}$ values when only one pair of order statistics is used, except for samples highly skewed to the right, in which case, two pairs of order statistics are used. For moderate size in sample distributions with highly skewed right tails, it has been found worthwhile to use four order statistics.

TABLE 2.—*Pairs of order statistics used in estimating standard deviation for various sample sizes*

Sample size	Select the following sample values (X_{n-s+1} and X_s)	Additional order statistics to be used for sample distributions when $X_{n-r+1} \geq 2X_{n-s+1}$ ($r<s$)
2–25	Largest (X_n) and smallest (X_1).	None.
26–40	2d largest (X_{n-1}) and 2d smallest (X_2).	None.
41–60	3d largest (X_{n-2}) and 3d smallest (X_3).	None.
61–100	5th largest (X_{n-4}) and 5th smallest (X_5).	Largest (X_n) and smallest (X_1) (i. e., $r=1$).
101–200	10th largest (X_{n-9}) and 10th smallest (X_{10}).	2d largest (X_{n-1}) and 2d smallest (X_2) (i. e., $r=2$).
250–500	25th largest (X_{n-24}) and 25th smallest (X_{25}).	3d largest (X_{n-2}) and 3d smallest (X_3) (i. e., $r=3$).
500 or greater.	Use value of X_{ni} corresponding to $n-s+1 \approx 0.93n$ and $s \approx 0.07n$.	Use values of X_{ni} corresponding to $n-r+1 \approx 0.995n$ $r \approx 0.005n$.

That is, whenever the relationship between the sample values is such that $X_{n-r+1} \geqq 2X_{n-s+1}$ the use of two additional order statistics farther out in the tails than $\lambda_1=0.07$ and $\lambda_2=0.93$ tends to eliminate much of the bias that may exist between the estimated standard deviation given by the order statistics and the root mean square method. A comparison of the values of $C_{m/n}$ for $\lambda=0.01$ for the normal and exponential distributions indicate this is to be expected. But in such cases, the root mean square method may also not provide an accurate measure of the population variability.

Table 3 was constructed for use in the situation in which the size of sample was continuously changing and it was desirable to standardize the "searching" or ranking procedure. For instance, the machine operator or clerk was instructed to obtain the 5 largest and 5 smallest values whenever a sample of 61 to 100 items was encountered.

The following example illustrates the technique. For the variable "land in farms" in a sample of 70 farms of a given class in one county the 5 smallest and 5 largest values were:

TABLE 3.—*Values of norming constants to be used with pairs of order statistics given in table 2*

Sample size	One pair used $C_{s/n}$	Two pairs used $C_{s/n}+C_{rn}$
5	2. 3	
10	3. 1	
15	3. 5	
20	3. 7	
25	3. 9	
30	3. 3	
40	3. 5	
50	3. 1	
60	3. 2	
70	3. 0	7. 8
80	3. 2	8. 0
90	3. 3	8. 2
100	3. 4	8. 4
110	2. 7	6. 9
150	3. 0	7. 4
200	3. 3	7. 9
250	3. 5	8. 3
260	2. 6	7. 1
300	2. 8	7. 4
400	2. 9	7. 9
500	3. 3	8. 3
Over 500	3. 0	8. 1

X_1, X_2, X_3, X_4, X_5 10, 26, 35, 37, 40 and
$X_{66}, X_{67}, X_{68}, X_{69}, X_{70}$ 100, 120, 150, 200, 240

Here an estimate of σ is

$$(X_{66}-X_5)/C_{5/70} \text{ or } (100-40)/3=20 \text{ acres},$$

while the root mean square estimate was 33 acres. The divisor, 3, comes from line 10, column 2 of table 3 while the ordered values to be used in the numerator are specified by column 2 of table 2 for sample sizes of 61–100. But note that $X_{70}/X_{66}>2$. When this is the case, an estimate based on four order statistics, with the two additional values coming from near the upper and lower 1 percent point, is usually better. In this example such an estimate would be

$$(X_{70}+X_{66}-X_5-X_1)/C_{5,1/70}$$
$$(240+100-40-10)/(3+4.8)=37.2$$

The divisor, 7.8, is given in column 3 of table 3 and the values used in the numerator are specified by column 3 of table 2. When more than one pair of order statistics are used in the estimate, $C_{5.1/70}$ is the sum of the $C_{m/n}$ for each pair; in this example

$$C_{5,1/70}=C_{5/70}+C_{1/70}.$$

Some Results of Empirical Studies

The procedures in the preceding section were used for several agricultural items. Results for six items for various classes of farms are given for the 1950 Census of Agriculture (within-strata σ's). The six items were: Land in farm, crop land harvested, land rented from others, other pasture, unpaid family workers, and tractor repairs. The coefficients of variation rather than the standard deviations are plotted because of the differences in the magnitude of the variables. They are based on sample sizes varying from about 10 to 200.

For the great majority of distributions encountered in agricultural populations, the skewness is of the type found in the chi-square family of curves. But extremely large units are usually eliminated from such populations and samples, as in 1950 Census Enumeration. It is common practice in sampling studies to enumerate extremely large units completely as constituting a separate stratum.

In general, table 1 suggests that estimates of σ would be too low because $C_{m/n}$ for the normal distribution is larger than for the exponential distribution. For the range of λ values used, table 1 would indicate a downward bias of 12–15 percent.

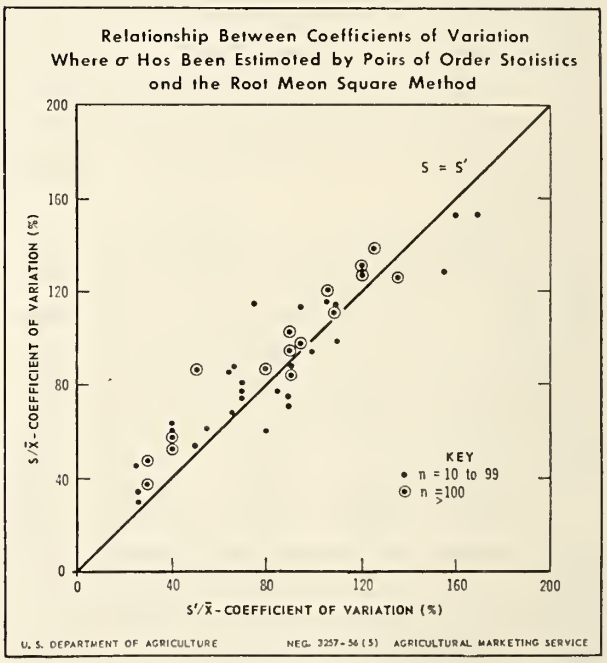

FIGURE 1.

Figure 1 indicates a similar bias. As this is evident for the larger samples ($n \geqq 100$), it appears that a 12–15 percent bias is a good estimate of the bias that can ordinarly be expected for an exponential type of distribution. Other distributions examined in table 1 and data for small samples indicate little or no bias compared with the root mean square estimate.

Book Reviews

Statistics: A New Approach. By W. Allen Wallis and Harry V. Roberts. The Free Press, Glencoe, Ill. 646 pages. 1956. $6.

HERE WE HAVE NOT ONLY a new approach but a most welcome departure from the unappetizing pottage of re-used and worn-out ingredients so often served as a course in "elementary statistical methods." The reader's interest is aroused from the beginning, both by the diversity of statistical problems and applications set before him and by the attractive way in which they are presented. If any pedagogical device can imbue a prospective student with a desire to study this subject, this text should be it. With all this to commend it, it would be disappointing indeed if its technical quality were to fall short of expectations. Any possible misgivings on that score are groundless.

Although the treatment is largely non-mathematical, in the sense that much of the algebraic symbolism cluttering up some texts is happily absent, even a cursory reading makes it clear that the basic concepts of modern statistical thinking are covered in admirable fashion. A surprisingly large amount of material that authors of other elementary texts regard as "too advanced" for beginners is included here without fuss or apology. The treatment confirms what the more astute among beginning students probably have long suspected—the important principles are not hard to grasp when explained in the vernacular by someone who understands them himself.

It is difficult to summarize the content of a work of such scope in a short review. The subject is introduced in a thought-provoking presentation of the nature of statistics and its application to many different subject-matter fields, the planning of statistical investigations, and the interpretation of data. This is a lively discussion with numerous case histories to illustrate ideas.

Tabulation of data and the use of ordinary descriptive statistical measures are covered in the next section. These also are presented in a manner that is a far cry from the usual drab recital with which most of us are all too familiar. Part III takes up sampling theory, statistical inference, probability, sampling distributions, the theory of testing hypotheses, decision functions, and the theory of estimation. The last section, entitled "Special Topics," treats experimental design, sample design, statistical quality control, regression analysis, and time series analysis. An appendix includes tables of squares, square roots, and random digits. Tables of the Normal Probability Integral are pasted to the insides of the two covers.

This reviewer finds only one possible fault with the book if it is used as a text: All of the material is presented so lucidly and challengingly that an instructor will find it hard to restrain himself from trying to crowd it all into a single one-year course. The intent of the authors is clearly that the instructor exercise judgment in the selection of topics for any one course. The wealth of material provided permits a selection that should fit the needs of almost any group with which an instructor is likely to be confronted.

Many mature practicing statisticians trained in the old school could read this work with profit. This reviewer knows of no way in which one could bring himself up to date on modern statistical thinking with less effort or mental strain. A reader at any level of statistical maturity can find something of interest in it.

Walter A. Hendricks

Income of the American People. By Herman P. Miller. John Wiley and Sons, Inc., New York. 206 pages. 1955. $5.50.

SECOND in the new Census Monograph Series, this study by Herman Miller maintains the high standards set by Ronald Mighell in the first volume of the series. Mighell, assigned to the subject of American agriculture, had to create fresh interest in a mass of Census and other data with which most of his readers would be at least partly familiar. In this difficult task he was surprisingly successful.

Miller was not faced with the problem of invoking new interest in old material. His assigned field, the Census income data, had not been nearly so thoroughly exploited as the Census agriculture data. Consequently, he had numerous opportunities for advancing our knowledge with respect to the size distribution of income in the United States. He has taken advantage of as many of these as could reasonably be expected.

The title selected by Miller or his editors is short and simple. Unfortunately, it is also a little misleading. The book is concerned almost exclusively with size distributions of income and changes therein, as measured by data collected in the decennial Censuses of Population for 1939 and 1949, and in the annual income surveys made by the United States Bureau of the Census for the years 1944–51. This is an important subject, well handled; but it is by no means all there is to know about the "income of the American people."

The analysis is mainly concerned with the measurable factors that help to account for differences in incomes among individuals in any given year. The overall distribution of persons by size of income is broken down into homogeneous groups with respect to sex, age, color, education, marital or family status, work experience, geographic location, and occupation. The relation of work experience to the income distribution, for example, is demonstrated by contrasting the income distribution for employed workers or full-year workers with that for all other persons. The role of geographic location is interpreted in terms of (1) regional differences in income, (2) differences associated with urban, rural farm, or rural nonfarm residence, and (3) differences associated with city size.

All of these factors are related to income, and the relationships are for the most part fairly well known. But Miller is not content simply to point them out once more; he interprets his results in the light of various theories advanced to account for the distribution of incomes. Although he rightly disclaims having demonstrated either the validity or invalidity of any single theory, his efforts are nevertheless productive of several new insights into the problem. Probably his most important contribution is the detailed analysis of occupational differentials in the distribution of income.

Preceded by a foreword, a preface, and an introduction, the nine main chapters start with a summary chapter that actually summarizes. They are followed by three long appendixes that cover (1) definitions and explanations, (2) the quality of Census income data, and (3) detailed tabulations of workers in each occupation by wage-salary income in 1939 and 1949. The introduction, written by Dorothy Brady, points out the book's significant contributions and some of the things that still need to be done in the income-size-distribution field. It thus constitutes a sort of built-in review by an outstanding authority.

Some farm income data are included, but the reader who has a special interest in farm income should be warned that he is not likely to find what he wants. The Census income data represent money income only, whereas nonmoney income is important for farm workers. For this reason, and because only wage and salary income was obtained in the 1940 Census, the farming occupations are excluded from the detailed tables and analysis of occupational differentials. The few tables included for farm income are generally based on residence (rural farm families and individuals) or principal occupation (farmers, farm managers, and farm laborers). The joint Census-Agriculture report on "Farms and Farm People" is the source of the only table here included on income of farm operators as defined in the Census of Agriculture.

The material in the book is well organized and carefully assembled. Diligent search by this reviewer revealed only two points to criticize, and

they are minor: (1) Hans Staehle's "Ability, Wages, and Income" in the *Review of Economic Statistics* for February 1943 is unaccountably omitted from an otherwise excellent bibliography; and (2) footnote references to "Farms and Farm People" give table numbers without specifying the chapter meant.

Ernest W. Grove

Input-Output Analysis: An Appraisal. Studies in Income and Wealth, Volume 18. By the Conference on Research in Income and Wealth. Princeton University Press, Princeton. 371 pages. 1955. $7.50.

INPUT-OUTPUT ANALYSIS, or the study of interindustry relations, although diverting a significant portion of our research talent in the 1940's and early 1950's, has remained somewhat of mystery to many in the economic profession. Thus, it was welcomed that the National Bureau of Economic Research Conference on Research in Income and Wealth devoted its 1952 meetings (1) to acquaint the economic profession with this relatively new analytical tool and (2) to assess the potentialities of this approach.

This book records the events of this meeting, or, we should say, the evidence presented by such champions of input-output analysis as Wassily Leontief, W. Duane Evans and Marvin Hoffenberg, and Frederick T. Moore in the defense of the approach, and that of Carl F. Christ and most of the discussants of the papers by the prosecution. The readers are the jury, for, in some ways, in contrast to the several books concerned with selected readings on a particular topic, the presentation resembles the record of a court case.

Here, as in the case of a jury trial, a member of the jury, or a reader, at times may question the relevance of some of the evidence presented. He may feel, as often is the case with a juryman, the need for final instructions to point up the central issues to be resolved. In this courtlike procedure, the proponents of input-output analysis, not unlike attorneys for the defense at times, have made some claims for their approach that have yet to be substantiated by empirical tests.

When we think of input-output economics, two aspects are considered: (1) Input-output tables which may be regarded as statistical descriptions of certain relations among industries; and (2) input-output analysis as an analytical tool for explaining consequences of policy decisions and for predicting behavior of our economic system. There appears to be considerable agreement that research in input-output work, especially that associated with input-output tables, has resulted in many contributions to better understanding of particular industries and the nature of relationships among industries, and that it has pinpointed deficiencies in our statistics and the need for consistency in our basic statistics. Some critics would even venture to say that this aspect of interindustry research may be the more lasting contribution.

It is in the potential use of this approach as an analytical tool to explain and predict economic behavior that little agreement is found. Input-output analysis is essentially a theory of production, in fact, a special type of production function.

Critics condemn input-output analysis from the standpoint of traditional theory because of the assumptions used in the approach, especially the controversial assumption that no substitution among inputs is possible in the production of any good or service, as Carl F. Christ indicates in his discussion.

Proponents, however, argue that there appears to be considerable stability in the input coefficients. They further point out that these coefficients may be revised to represent conditions existing as of date of problem. In addition, if input coefficients for a particular industry group are known to be poor, submodels may be constructed and linear programing techniques (which allow for substitution) may be used for that particular sector.

The final test as to whether the assumptions are too restrictive to permit reasonable results must wait until sufficient results from empirical tests are obtained. Only limited empirical evidence was available at the 1952 meeting.

The lack of material for evaluation of actual results of input-output analysis, the many prob-

lems of data and of techniques that had to be reconciled in preparing input-output tables, and the relative newness of the analytical tool, probably explain why considerable space in the papers was devoted to problems of data and technique. To newcomers in this field, particularly economists who are trained in marginal analysis, this wealth of information interspersed among the evidence submitted to quiet the controversy may at times be confusing. These will find it profitable to read first the papers by Carl F. Christ and Frederick T. Moore, especially pages 138–144 in the former, and pages 222–226 in the latter. These pages clearly define the conceptual framework of input-output analysis and show how it fits in with economic theory.

Anthony S. Rojko

Approaches to Economic Development. By Norman S. Buchanan and Howard S. Ellis. The Twentieth Century Fund, New York. 494 pages. $5.

THERE IS LITTLE in this book with which the economist will want to quarrel. It gives a long and sometimes overlapping account of the factors that influence economic development; examples of the history of development; and some desiderata for policies and attitudes in both underdeveloped and developed countries that would serve the cause of more rapid progress in the poorer areas. The book will be useful as a text to introduce students to a set of facts and considerations that have a bearing upon the fashionable topic of economic development in underdeveloped countries. Beyond that, it will be useful to economists primarily for reference purposes, as a rather comprehensive compendium of sidelights and ramifications of the subject.

Personally, I found most satisfying the chapter on "A General View of Economic Development," written by Professor Buchanan. Having just come from a roundtable discussion, during which some economists argued that technological progress could do nothing to change the capital-output ratio (though, to my way of thinking, that ratio is in part even a *function* of technology), I found Professor Buchanan's views on the subject refreshing: "The rate of growth of total output and real income per person is not determined by the rate of capital accretion alone * * * the secular rise in national incomes * * * must be partly attributable to other factors. Of those that are conceivably pertinent, none seems equal in importance to technical progress."

Readers will also be reminded of Schumpeter's insistence that economic development does not typically spring from the accumulation of new capital, but rather from "the realization of new combinations of the *existing* availabilities of factors of production." [Italics are the reviewer's.] Incidentally, there is no reference, in Buchanan and Ellis, to Schumpeter's *Theory of Economic Development.* Perhaps as a theory of the business cycle, the authors did not find it pertinent to their subject. But it is in the form of cycles that economic growth has materialized thus far.

The authors' theoretical opinions on important questions of fact and policy do not always coincide. Professor Ellis (pages 308 ff., and elsewhere) is rather critical of the thought that inflation is an effective mechanism in commandeering resources and factors for "new combinations" and thus, in some circumstances, may be of considerable positive importance for economic development. This attitude contrasts with Professor Buchanan's view that "credit creation, either through the state or through the banking system, played a major role in real capital formation; without it, there was no means by which labor and other productive resources could be brought together initially to make capital goods."

Again, Professor Ellis is stern on the question of protectionism in underdeveloped countries: "The real perils of infant industry protection in any objective view * * * are not its threat to the older countries, but the potential losses for the underdeveloped areas themselves. How long are these countries prepared to deny to their domestic consumers the gains of cheaper or better imports?" It is difficult to think that Professor Ellis is not prepared to admit "that economic fact which has * * * been one of the principal sources of the world's enrichment—namely, the existence of increasing returns," to quote Colin Clark's *The*

Conditions of Economic Progress. "With increasing returns," Clark adds, "a valid case *may* arise for economic nationalism or protectionism, * * * a country may transfer resources from industries *at present* more productive, to those which it proposes to protect, and *in the long run* enrich itself by so doing." [Italics are the reviewer's.]

Professor Buchanan's views on the subject appear to be rather different. He states that, "The rank and file of the labor force acquired their new knowledge and new skills by 'on-the-job' training and little else during the early phases of economic development in all countries, * * * they learned by doing." Accordingly, they developed efficient industries as they expanded them, and learned in the process. Professor Buchanan thus has a different evaluation of the facts of education, of increasing returns in industry, and—implicitly—of the role of protectionism in underdeveloped countries. I mention these divergencies among the authors not to express disapproval. On the contrary, I think it is healthy for young students of economics to find out for themselves that our discipline is by no means agreed on many theoretical conclusions, or policies based upon them.

In the chapter on "Interest and Responsibilities of the United States," Professor Ellis advocates an enlightened economic foreign policy for this country: To promote free trade; to stabilize its economy; to help stabilize the income of raw-material exporting nations, and to further economic development abroad in other ways. Similarly, we should applaud the unanimous conclusion of both authors that the main impediment to economic development is a cultural environment hostile to change. It points the way in which changes can be brought about; it also indicates the crucial difficulties that lie ahead. In Max Weber's view "the dominance of magic * * * has been one of the greatest impediments to the rationalization of economic life." (*Wirtschaftsgeschichte*, Munich, 1924, p. 308.) Weber also thought that, apart from Judaism and Christianity, there are only two or three Oriental sects (one of which is in Japan) that represent religions expressly hostile to magic. On this basis, it would appear more probable that economic development will proceed faster in Latin America than in East Asia—even if we leave out of consideration the differences in population density and other factors.

J. H. Richter

Measuring Business Changes. A Handbook of Significant Business Indicators. By Richard M. Snyder. John Wiley & Sons, Inc., New York. 382 pages. 1955. $7.95.

PREPARED PRIMARILY for businessmen, this book describes the nature, composition, and sources of most of the strategic statistical indicators of general economic activity prepared by private institutions and Government agencies. Its ultimate objective is to provide a working knowledge of these series which will enable businessmen to appraise the outlook for their own firms and industries in the light of changes in the general economic situation that these series reveal. The material will also prove valuable to economists and statisticians, including those in the field of agriculture, who have need for general economic time series in their analytic work.

Organized in handbook style, the volume is divided into separate sections dealing with statistical series on (1) national income and production; (2) population; (3) labor; (4) commodity prices; (5) production and business activity; (6) construction activity and cost; (7) trade; (8) financial activity; and (9) stock prices.

The series are described, and their meaning and usefulness explained, in remarkably understandable language. In this nontechnical presentation, however, much of the essence of the underlying economic and statistical concepts is retained. The reviewer was particularly impressed with the clarity and preciseness of the treatment of national income and production statistics, the various price indexes, and the series on industrial production.

Despite the success of the author in making economic statistical indicators more understandable and useful, a full understanding of the statistical series covered and their limitations require some knowledge of economics, statistics, and statistical methods beyond that provided in this particular volume. Readers without technical background will still find it necessary to consult other sources for a complete understanding of some of the materials presented. For example, one needs a fairly good grounding in index number theory and

construction to comprehend fully such a section as the one that deals with the various commodity price indexes.

In addition to the descriptions of specific series in the nine major sections, the introduction contains a general bibliography on sources of economic data, both Government and private. The usefulness and accuracy of the materials in the several sections are aided by the fact that leading statisticians in Government and business provide some of the explanatory materials, and reviewed parts of the manuscript. In general, this handbook is a welcome addition to the working libraries of economists, statisticians, and businessmen who need to understand and use a wide variety of statistical indicators that measure the performance of the American economy.

Robert H. Masucci

The Great Plains in Transition. By Carl Frederick Kraenzel. University of Oklahoma Press. 428 pages. 1955. $5.

A HUMID-AREA type of civilization cannot thrive in the semiarid Great Plains without constant subsidy or repeated impoverishment of the residents. Kraenzel states this as his basic hypothesis. He does an excellent job of recounting how the settlers moved into the Plains from the humid East, bringing their humid-area institutions, farming practices, and ways of thinking, with the consequences that followed. The first 20 chapters cover the physical features, early history, settlement, drought and depression, and problems of the Plains.

Kraenzel is in a particularly good position to tell this story. He saw many of these problems firsthand during the 1930's when he was associated with Montana State College and its efforts to develop programs for the Plains.

The question arises whether humid-area influences can still be blamed for difficulties in the Plains. Migration into the Plains from humid areas is a thing of the past. Instead, there has been a large outmigration from the Plains to the West Coast and other areas. Meanwhile, the Great Plains region has developed an agricultural economy of its own. It is true, as Kraenzel points out, that this economy is unstable and of high risk, because of climatic conditions in the region and the marginal nature of its agriculture. Perhaps much of the "transition" in the Plains occurred during the period of the drought and the depression, and in the war years that followed many of the vestiges of the humid system of agriculture disappeared.

In the latter part of the book, Kraenzel turns to solutions. For civilization to survive and thrive in the Plains, he thinks that the addition of three basic traits to the imported humid institutions will be necessary. These traits—reserves, flexibility, and mobility—would orient the humid institutions to such an extent that they could contribute to the cultural progress of the Plains.

Several chapters are devoted to regionalism as related to problems of the Plains. A form of administrative regionalism is proposed. A regional advisory council is suggested. It would be made up of 2 State senators and 2 United States senators from each of 10 States. The council would study the problems of the Plains and suggest solutions. It would also give advisory guidance to resource-development agencies.

Kraenzel's book is timely, for drought in the Southern Plains and surplus wheat production have again brought problems of the Plains to national attention. The United States Department of Agriculture, with the cooperation of the Great Plains Agricultural Council, recently issued its "Program for the Great Plains" as Miscellaneous Publication 709. The goal of this program is to achieve a more stable agriculture, more dependable sources of income, and a progressively satisfactory livelihood for the people of the region. Although Kraenzel's proposed regional council may not find general acceptance, his analysis and suggestions are basic to understanding the problem of the Plains.

Harry A. Steele

Agriculture in Haiti. By Marc Aurele Holly. Vantage Press, Inc., New York. 313 pages. 1955. $3.50.

TO ADOPT AND TO ADAPT is Marc Holly's message to students of underdeveloped countries who wish to apply knowledge newly gained from study abroad to their country's problems. The central issue for Mr. Holly is how the tradition-bound society of Haiti, composed of an illiterate peasantry and a small but sacrosanct elite, can develop a national will, and the organization, for higher than starvation levels of existence. The essential purpose of the book is to describe the technique of agriculture within the economical, sociological, and institutional framework of the Isle of Haiti. Another objective is to suggest how the situation might be improved.

Beginning in the traditional manner with climate and soils, the author leads you through a descriptive account of each type of crop and species of livestock in Haiti; with a minute brush he paints a picture of the state of things agricultural in the island. The first half gives a detailed description of past developments and the present situation, botanical names of all varieties of crops, with numerous quotations of their yields in Africa and India, and some generalizations about their possible yields in Haiti.

Other sections deal with agricultural education and marketing problems with regard to domestic demand and exports. The last chapter is devoted to general criticism of past regimes and to approval of the "dynamic and progressive" Government of President Maguire.

The author's description of the deplorable credit conditions in the agricultural sector of the economy may be accurate as of 1945, when he was writing most of this book while a student at Oxford University. He describes conditions under which the only sources of credit to agricultural entrepreneurs were the traditional money lenders, whose terms of credit varied from a week to a year, with interest rates of 50 to 200 percent. His solution is to develop credit unions among the peasantry. French and German sources are quoted to support this conclusion. But if Mr. Holly had brought his book up-to-date he could have given the reader a description and analysis of the 150 or so credit unions established by the Oblate Fathers and Service Cooperative Inter-Americain de Production Agricole.

This omission is typical of the shortcomings of the book. It gives almost no results of recent research on Haitian conditions that are readily available in Haiti. Instead, the book is more than adequately loaded with long quotations of authoritative land economists and economic geographers on England, Africa, and India.

Although he deplores the lack of statistical material in Haiti, the author overlooks a rather extensive body of data—reports of a series of crop-yield experiments and of results of programs and other agricultural research carried out in Haiti from 1946 until 1953, the year in which the book was in its final draft.

Mr. Holly is a Director of the Organization for the Development of the Artobonite Valley—O. D. V. A., which is Haiti's TVA. A rather extensive planning program for development of the Artobonite Valley, Haiti's area of greatest potential for increased production, was published in draft form in September 1952. There is little mention of the extensive and intensive collection of research results contained in that report.

In summary, Mr. Holly's book contains ample detailed descriptions of Haitian agriculture, together with a diagnosis of economic and social ills and a prescription for their cure. But it would have held more general interest for agricultural economists if the author had drawn from his own recent experiences and from studies more recent than those he cites in this work. Perhaps this will be matter for a later book.

John R. Churchill

Using American Agricultural Surpluses Abroad. By Howard R. Tolley. With a Statement by the Agriculture Committee on National Policy of the National Planning Association. Planning Pamphlet No. 91. National Planning Association, Washington, D. C. 30 pages. 1955. 50 cents.

POSSIBILITIES of greater utilization of our abundant supplies of agricultural products abroad are outlined. The long-run solution of the surplus problem, Mr. Tolley believes, lies in expanding world economy and a progressive reduction of trade barriers by all countries in the world. A statement of the Agriculture Committee on National Policy of the Association expresses the belief that our surplus farm products should be donated or sold for foreign currencies "to meet human needs and promote economic development abroad rather than be allowed to go to waste." In working out foreign distribution programs, however, the committee thinks "this country should consult and cooperate with other countries of the free world—to be sure that normal trade is not impaired and to obtain the support of other agricultural exporters in these programs."

List of Statistical Series Collected by International Agencies. United Nations, New York. 78 pages. 1955. 80 cents.

LISTED in this publication are the series published by the United Nations, the regional economic commissions, the specialized agencies, and certain of the intergovernmental organizations.

Selected Recent Research Publications in Agricultural Economics Issued by the United States Department of Agriculture and Cooperatively by the State Colleges [1]

ARTHUR, I. W., JOHNSON, E. A. and WUNDERLICH, GENE. FARM TENURE AND FAMILY ADJUSTMENTS TO SOCIAL SECURITY. U. S. Dept. Agr., Ext. Serv., PA–280, 12 pp. Feb. 1956. (Prod. Econ. Res. Br., ARC, cooperating.)

This pamphlet includes a summary of discussion of the old age and survivors insurance program, the benefits and costs of the program, and of the adjustments that farm families may wish to make to the program. It is intended for the use of extension workers in advising farm families.

FRIEDMAN, B. A. and RADSPINNER, W. A. VACUUM-COOLING FRESH VEGETABLES AND FRUITS. U. S. Dept. Agr. AMS–107, 13 pp. April 1956.

Vacuum-cooling as a means of preserving agricultural produce has progressed to the point where vacuum chambers large enough to accommodate a loaded refrigerator car or truck trailer have been constructed. Vacuum-cooling was first used commercially in 1948. The process, over-simplified, is one in which air is pumped out of a vacuum chamber in which the produce has been placed. Evaporation of water from the produce cools it.

GRAY, JAMES R. SOUTHWESTERN CATTLE RANCHES, ORGANIZATIONS, COSTS, RETURNS. N. Mex. Agr. Expt. Sta. Bul. 403, 87 pp., illus. Feb. 1956. (Prod. Econ. Res. Br. ARS.)

This is the fifth of a series of nationwide studies of family-operated farms and ranches that deals exclusively with western livestock ranches. From 1940 to 1954, the size of the average cattle ranch increased from 7,676 to 10,592 acres. Cattle numbers per ranch on January 1 varied from 213 head in 1940 to 227 head in 1952. The calf crop varied from 71 to 80 in the same period. The estimated value of investment per ranch averaged about $36,000 in 1940 and about $155,000 in 1952. Cash income per ranch varied from about $4,000 in 1940 to more than $18,000 in 1952.

GREIG, W. S., and SPURLOCK, A. H. MARGINS AND COSTS IN MARKETING FLORIDA SWEET CORN. U. S. Dept. Agr. Misc. Pub. 719, 11 pp., illus. April 1956.

Florida sweet corn marketed in Baltimore at the height of the production season in 1955 brought the grower $1.70 a crate of 4½ to 5 dozen ears, and consumers in Baltimore paid $3.87 for the corn at retail. Out of the grower's $1.70, he paid $1.03 for picking, packing, chilling, sale commission, and other shipping-point costs, leaving him 67 cents. Production costs had to come out of the 67 cents.

[1] Processed reports are indicated as such. All others are printed. State publications may be obtained from the issuing agencies of the respective States.

HOCHSTIM, ESTHER S. WOMEN'S OPINIONS OF COTTON AND OTHER FIBERS IN SELECTED ITEMS OF CLOTHING. U. S. Dept. Agr. Mktg. Res. Rept. 112, 118 pp. March 1956.

Cotton stood highest in women's preferences as the fabric for 10 out of 15 items of wearing apparel studied. Among the synthetics, nylon was well thought of; orlon and dacron were almost unknown to women at the time of the study. Cotton was the preferred fabric for housedresses and aprons, summer dresses and summer skirts, long- and short-sleeved and sleeveless blouses, and sportswear (slacks, shorts, and anklets).

HOCHSTIM, ESTHER S. WOMEN'S ATTITUDES TOWARD WOOL AND OTHER FIBERS IN SUITS, SKIRTS, AND SWEATERS. A PRELIMINARY SUMMARY REPORT. U. S. Dept. Agr. AMS–115, 15 pp. April 1956.

Wool is the leading fiber in American women's suit, skirt, and sweater wardrobes. Many women commented that wool wears well, holds its shape, doesn't wrinkle easily, is warm, looks well, is easy to care for, and has nice texture.

HOLE, ERLING, and MCPHERSON, W. W. FARMING IN THE COASTAL PLAIN OF NORTH CAROLINA. COSTS AND RETURNS, TOBACCO-COTTON AND TOBACCO FARMS, 1940–54. N. C. Expt. Sta. A. E. Inform. Ser. 47, 60 pp., illus. Dec. 1955. (Prod. Econ. Res. Br., ARS cooperating.)

From 1940 to 1954, in a 14-county area of the coastal plain of North Carolina, prices of products farmers sold and those of items they bought rose; tobacco acreage allotments fluctuated, cotton production programs changed, automatically controlled tobacco curers and improved varieties of crops were adopted; tractors and tractor-powered equipment were added, especially on the larger farms; mechanical cottonpickers and mechanical tobacco harvesters were introduced though not widely used; and rates of insect damage to cotton varied greatly.

To meet these changes, farmers in the area adjusted tobacco plantings to acreage allotments, went out and into cotton production and/or increased and decreased acreages inversely with changes in the acreage of tobacco. They used additional corn made available from increased production of corn and reductions in workstock to increase production of hogs, and to increase cash sales.

HUELSKAMP, H. J., HOOFNAGLE, W. S., and MYERS, M. EFFECT OF SPECIFIC MERCHANDISING PRACTICES ON RETAIL SALES OF BUTTER. U. S. Dept. Agr. Mktg. Res. Rept. 117, 9 pp., illus. May 1956.

Results of the 16-week experiment in Cleveland indicated that while there were differences in sales volumes under different methods of merchandising, none of the observed differences were statistically significant; that is, in all cases the probability is greater than 1 in 20 that the observed differences would occur as a result of chance.

HUTCHINS, WELLS A. THE OKLAHOMA LAW OF WATER RIGHTS. 81 pp. Okla. Planning and Resources Board, Div. of Water Resources, 1955. (Prod. Econ. Res. Br., ARS, cooperating.)

This statement is part of the revision of "Selected Problems in the Law of Water Rights in the West," which was issued in 1942 as Miscellaneous Publication 418 of the U. S. Department of Agriculture. The completed revision will comprise an overall discussion of water rights law for the 17 Western States.

IBACH, D. B. A GRAPHIC METHOD OF INTERPRETING RESPONSE TO FERTILIZER. U. S. Dept. Agr. Agr. Handb. 93, 27 pp., illus. Jan. 1956.

The exponential equation used here lends itself well to graphic methods of estimating response to fertilizers. The most profitable rate of a fertilizer can be read directly from a graphically fitted curve. The most profitable combination of two or more nutrients may be calculated readily after the constants of the equation are found by graphic methods for each nutrient. In connection with fertilizer rate experiments, the important use of a yield equation is to predict the most profitable rates and combinations, and the yields of the crops at those rates.

LEVINE, DANIEL B. HOMEMAKER PREFERENCES FOR PIES AND CANNED AND FROZEN CHERRIES IN DALLAS, DETROIT, AND KANSAS CITY. U. S. Dept. Agr. Mktg. Res. Rept. 116, 68 pp., illus. April 1956.

Eight out of 10 homemakers in each of the cities baked pie sometime during the year. About half of those interviewed had bought 1 or more pies during the year, and only 1 out of 20 had neither baked nor bought a pie during that period.

LEVINE, D. B., and HUNTER, J. S. HOMEMAKERS' PREFERENCES FOR SELECTED CUTS OF LAMB IN CLEVELAND, OHIO. U. S. Dept. Agr. Mktg. Res. Rept. 113, 44 pp. March 1956.

Almost half of the homemakers in Cleveland used lamb at some time during the 12 months preceding mid-1955. The reasons most often given for liking lamb were its distinctive flavor, nutritive qualities, lean texture, ease of cooking, and the variety it adds to meals. People who eat lamb are more likely to be in the upper income group, the better educated group, and over 45 years of age.

MAITLAND, S. T. THE HIRED FARM WORKING FORCE OF 1954. U. S. Dept. Agr. AMS–103, 26 pp. March 1956.

About 3 million persons 14 years old or older did some farm work for wages in the United States during 1954. Two-thirds of these workers did 25 or more days of farm wage work that year. About half of the workers who did 25 or more days of farm wage work during the year reported farm wage work as their chief activity during 1954.

PASCHAL, J. L., and FRENCH, B. L. A METHOD OF ECONOMIC ANALYSIS APPLIED TO NITROGEN FERTILIZER RATE EXPERIMENTS ON IRRIGATED CORN. U. S. Dept. Agr. Tech. Bul. 1141, 73 pp., illus. May 1956.

This bulletin reports on the application of a method of economic analysis illustrated by experimental results from plots designed to test the application of nitrogen fertilizer on irrigated corn in Oregon, Washington, and Nebraska. In the few experiments for which data were available, the first-year residual nitrogen produced a yield sufficient to pay much, if not all, of the cost of the nitrogen applied. Indications are that on fields of low fertility, the increased crude protein content of the corn more than paid the cost of the nitrogen applied.

Smith, H. M., Clement, W. E., and Hoofnagle, W. S. MERCHANDISING NATURAL CHEDDAR CHEESE IN RETAIL FOOD STORES. U. S. Dept. Agr. Mktg. Res. Rept. 115, 11 pp., illus. April 1956.

Four methods of displaying natural Cheddar cheese were compared in 12 retail food stores in Pittsburgh during the spring of 1955. The largest volume of sales resulted when cheese that was prepackaged in consumer packages before shipment to the stores and cheese that was packaged in the stores were both displayed and in 5 weight ranges varying from about 6 ounces up to 2 pounds.

Smith, H. M., Clement, W. E., and Hoofnagle, W. S. MERCHANDISING OF SELECTED FOOD ITEMS IN GROCERY STORES—CANNED RED SOUR CHERRIES, CARROTS, AND BANANAS. U. S. Dept. Agr. Mktg. Res. Rept. 111, 21 pp., illus. February 1956.

Consumers purchased 5 of the 19-oz. cans of red sour cherries to 4 of the 17-oz. cans, when the two sizes were displayed side by side in 12 retail food stores in Pittsburgh for 12 weeks. Carrots sold best when displayed without tops in 1- and 2-pound polyethylene bags. Of the four merchandising methods tested for bananas, none was significantly different from the others in terms of quantity sold.

U. S. Agricultural Marketing Service. MARKETING MARGINS FOR WHITE BREAD. U. S. Dept. Agr. Misc. Pub. 712, 15 pp., illus. March 1956.

During the last 10 years, average retail prices of bread have risen 7.3 cents per pound loaf, or 70 percent. The return to farmers for wheat and other ingredients advanced only 20 percent during this period, while charges for processing and distributing went up 87 percent. Marketing charges cover storage, insurance, transportation, milling, baking, slicing, wrapping, and delivery.

U. S. Agricultural Marketing Service. PORK— MARKETING MARGINS AND COSTS. U. S. Dept. Agr. Misc. Pub. 711, 46 pp., illus. April 1956.

Charges for marketing pork increased from 21.5 cents a retail pound in the second quarter of 1955 to a record high of 25.8 cents in the fourth quarter while prices to farmers for hogs were decreasing sharply. The decline in hog prices from June to December 1955 was the largest on record.

U. S. Agricultural Marketing Service. THE PRICE OF BEEF. U. S. Dept. Agr. Misc. Pub. 718, 4 pp., illus. April 1956.

(Based on "Beef Marketing Margins and Costs," Misc. Pub. 710.)

Webb, Robert W. EQUATIONS FOR PREDICTING COTTON PROCESSING PERFORMANCE AND PRODUCT QUALITY BY IMPROVED EVALUATIONS OF RAW-COTTON QUALITY. U. S. Dept. Agr. Mktg. Res. Rept. 114, 41 pp. April 1956.

Presents a number of new equations for predicting the strength and appearance of any size of carded yarn over a wide range, number of neps per 100 sq. in. of card web, and percentage of total picker and card waste on the basis of improved methods for evaluating raw-cotton quality.

Statistical Compilations

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U. S. Agricultural Marketing Service. ANNUAL REPORT ON TOBACCO STATISTICS, 1955. U. S. Dept. Agr. Statis. Bul. 169, 70 pp. March 1956.

U. S. Agricultural Marketing Service. CHICKENS AND EGGS. MONTHLY EGG PRODUCTION, YOUNG CHICKENS AND LAYERS ON FARMS, AND RATE OF LAY, BY STATES AND GEOGRAPHIC DIVISIONS, 1950–55, REVISED ESTIMATES. U. S. Dept. Agr. Statis. Bul. 174, 45 pp. April 1956.

U. S. Agricultural Marketing Service. FIELD AND SEED CROPS. FARM PRODUCTION, FARM DISPOSITION, VALUE, BY STATES, 1954–55. U. S. Dept. Agr. AMS–39 (1954–55), 39 pp. May 1956.

U. S. Agricultural Marketing Service. LIVESTOCK SLAUGHTER. NUMBER AND LIVE WEIGHT, BY STATES. MEAT AND LARD PRODUCTION, UNITED STATES, BY MONTHS, 1955. U. S. Dept. Agr. AMS–124, 14 pp. May 1956.

U. S. Agricultural Marketing Service. MEAT ANIMALS. FARM PRODUCTION, DISPOSITION, AND INCOME, BY STATES, 1954 AND 1955. U. S. Dept. Agr. AMS–35 (1954–55), 15 pp. April 1956.

U. S. Agricultural Marketing Service. MILK— FARM PRODUCTION, DISPOSITION, AND INCOME, REVISED ESTIMATES, 1950–54. U. S. Dept. Agr. Statis. Bul. 175, 32 pp. April 1956.

U. S. Agricultural Marketing Service. SUPPLEMENT FOR 1954 TO CONSUMPTION OF FOOD IN THE UNITED STATES, 1909–52. U. S. Dept. Agr. Agr. Handb. 62, 118 pp. October 1955.

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