Methodology

Deriving county-level per capita consumption values

A critical business activity, estimating demand, enables a firm to determine the mix of enterprises it should consider, how many units it could sell and the logistical systems it needs to reach buyers. Demand represents the total product quantity typically purchased within a given period for a given area. For a given product, estimated demand equals population multiplied by per capita consumption.

Working with averages

The demand estimates produced for Intel for Ag reflect county averages. Per capita consumption does vary by individual consumer. However, for most food products, the cost-benefit ratio is too high to identify consumption behavior, quantity and location for each consumer. County averages sufficiently suggest per capita consumption — and consequently, total estimated demand — needed for scenario analysis and business planning.

The estimates do adjust for geographic consumption differences that arise due to eating habitat variations. Multiple factors shape these habitual differences on a geographic basis: consumer socioeconomic standing; consumer demographics; and climate, product knowledge and historical consumption that differ by locale. For most foods, the relationship between consumption and eating habits has continuity over time. Using historical causes (e.g., factors affecting eating habits) and effects (product consumption) is generally accepted.[1] County per capita consumption is estimated by considering how variations in food habit causes affect per capita consumption patterns at a county level.

Defining assumptions

Because population and per capita consumption drive a product's estimated demand, both represent important assumptions for Intel for Ag's demand modeling. The estimated population of an area is well-known, and the data are easily accessible through the Bureau of Labor Statistics census estimates. The locations of retail establishments, which serve as the markets that sellers often use to reach consumers, can be determined with relatively low human search costs.

With respect to per capita consumption, this analysis used the national average per capita availability level that USDA reported for 2020 as the starting value for each product. Per capita consumption could be approximated by adjusting availability for losses in the supply chain. Per

[1] None of the products represented were susceptible to an abrupt change in consumption due to a significant shift in preference. If we would have been aware of a significant change in a particular causation factor leading to a significant change in consumption, then we would have adjusted this relationship accordingly. The following hypothetical example summarizes how a cause-effect change may arise. *A past study found a particular ethnicity has a hereditary trait that causes higher rates of cancer when consumers of that ethnicity eat a particular food (i.e., cause), and consumers of that ethnicity now eat less of that food (i.e., effect).*

capita availability was used because our interest is in the levels of product transferred between producers and retail, institutional, or wholesale buyers. Then, the starting values had marginal adjustments made to ensure the per capita consumption levels reflected typical product consumption in a geographic area. This step is necessary because consumers in particular geographic areas can have more or less affinity for a particular food product than the national average would suggest.

Computing demand estimates

To arrive at a demand estimate for a particular product, we applied the marginal adjustments by geographic area to national per capita consumption. We utilized the findings from Lin et al. (2003) to approximate the cause-effect relationship between consumption and eating habitat traits.[2] The reference study conducted a national survey of U.S. households and reported average and standard deviation values to indicate how multiple factors affect food product consumption. Along with the cause-effect relationships from the reference study, we used the consumption-informing factor averages as the reference level of each factor. The consumption-informing factors considered in the reference study included food knowledge, eating out preference, age, employment status, race, ethnicity, household size, income and educational attainment. Models were specified for both at-home and away-from-home consumption.[3]

Note, knowing how much product is consumed at home (e.g., purchased at a grocery store for consumption at home) or away from home (e.g., consumed at a restaurant or hospital) has value for businesses that must determine delivery routes and choose market channels. For our study, at-home and away-from-home consumption values were computed separately.

We next gathered county-level data for each of the consumption-informing factors. We adjusted consumption in an additive two-step process for each consumption-informing factor: 1) find the marginal difference between reported average in the reference level and actual county-level representation and 2) multiply this marginal difference by the relationship coefficient reported in the reference study.

The following employment-consumption example explains how the model will adjust to a region based on data from the refence study. Assume pork's national average per capita at-home consumption totals 30 lb. per year. The reference study indicates the average employed person from the national study is 93% employed. From the reference study, assume the relationship factor between being employed and consuming pork at home is 0.1. This relationship infers that for each 1 percentage point increase in average employment level, an individual is likely to increase at-home pork per capita consumption by 0.1 lb. per year. A given county recorded a 96% employment rate. The employment rate difference between the county of interest and the reference study's national average is 3 percentage points. To adjust the 30-

[2] Food and Agricultural Commodity Consumption in the United States: Looking Ahead to 2020

[3] Some of the consumption-informing factors were recorded as binary (0 or 1), meaning either the individual responding indicated "yes = 1" to the factor or "no = 0" to the factor. An example is race; an individual of Asian descent would indicate "yes" to being of Asian descent.

lb. at-home pork consumption per year average and make it specific to the particular county, add 0.3 lb. to reach 30.3 lb. per year. This estimate approximates the county's per capita at-home pork consumption after adjusting for employment rate (30.3 lb. = 30 lb. + [0.1 x 3]). We repeated this process for every adjustment factor considered in the reference study, so the county-level estimate reflects the sum of marginal differences.

These adjustment steps were completed for each animal product considered in Intel for Ag. Because the reference study reported cause-effect relationships for at-home and away-from-home consumption, we used the similar methodology to arrive at estimated at-home and away-from-home per capita consumption by county. Adding these values leads to approximating total per capita consumption. Multiplying at-home, away-from-home or total consumption per capita by an area's population yields the demand estimates for that area.

The reference study did not offer cause-effect relationships for each product listed in Intel for Ag. It did provide the cause-effect relationship for close substitutes, which we used as an approximation for most products included in the site. To account for differences between an approximate category and a specific product category, we scaled each consumption-informing factor by the difference in the specific product's per capita consumption and the reference study's reported average for the approximate category's per capita consumption.