

## Teaching and Educational Commentary

# Demand Dashboards: Interactive Tools to Communicate Consumer Behavior

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### Abstract

A publicly available dashboard is developed and discussed as an alternative, time-efficient approach to extension education, reflecting an intersection of survey design methods, statistical analysis, and web application development. The dashboard targets consumer behavior in the U.S. meat sector and serves as a dynamic and easily accessible source of market information for users with unique data needs and limited time. An overview of the dashboard and examples of its value to industry professionals are provided.

## 1 Introduction

Academic research conducted at land-grant universities is generally distributed to the public via written reports, radio interviews, and extension meetings. Such traditional methods, though impactful when thoughtfully prepared, necessitate stakeholders' investment of both their time (e.g., listening to a radio broadcast, searching for articles online) or physical attendance (i.e., attending an in-person extension seminar). Additionally, most available information on the domestic meat industry is either production focused or highly aggregated both geographically and over time. An example of such production data includes the United States Department of Agriculture (USDA) Agricultural Marketing Service's Estimated Weekly Meat Production Under Federal Inspection or SJ\_LS712 report (U.S. Department of Agriculture, Agricultural Marketing Service 2023). On the consumer side, meat disappearance data is provided by the USDA Economic Research Service's supply and disappearance tables (U.S. Department of Agriculture, Economic Research Service 2023), but is available only at the national level and experiences a delay in reporting.

Meat protein is a significant portion of U.S. consumers' food expenditures, having notable impacts on the broader agricultural industry. Changing consumer behavior in this market over time and space has important economic implications. This, combined with a society that increasingly values timely, refined insights and data visualizations, has created the need for innovation in extension education and distribution of consumer-focused domestic meat data.

A collection of online extension tools exists to better inform production decisions in both crop and livestock operations. The University of Missouri provides "Missouri Ag Intel," serving as a resource to help local producers learn about alternative agricultural opportunities and assess the suitability of their farm ground for growing alternative crops (University of Missouri 2022). Kansas State University has created a hay inventory calculator to aid livestock producers in determining how much hay is needed for their cowherds and in estimating storage losses (AgManager.info 2022c). Relating to agricultural finance, Colorado State University provides a ratio analysis decision tool to help farm operations better understand their liquidity, profitability, and a host of other indicators of financial health (Colorado State University 2022). These are just a handful of the numerous available production-focused online extension tools.

Recently, a series of dashboards have been created by Purdue University's Center for Food Demand Analysis and Sustainability. These include dashboards conveying price, supply, and production information, but also consumer behavior data obtained from their Consumer Food Insights survey

(Subramaniam, Polzin, and Lusk 2022). The monthly consumer survey assesses trends in food demand, food security, and other factors. Additionally, the center provides “#Meat,” a dashboard that tracks broad sentiment toward various animal and alternative proteins on social media and news outlets (Widmar et al. 2022). These educational tools motivate our work.

This paper provides an example of how a publicly available dashboard can be utilized to effectively and broadly convey academic research on domestic meat demand to producer groups and other food industry participants. The dashboard discussed here is an alternative, time-efficient approach to extension education, reflecting an intersection of survey design methods, statistical analysis, and web application development. Further, to the best of our knowledge, it is the first to offer agricultural industry stakeholders with results from discrete choice experiments and the first to target consumer behavior in the economically important U.S. meat industry.

The dashboard provides current and easily accessible summaries of raw survey data that can be viewed at the user's discretion. These survey results provide industry users with information on consumers' preferences for meat, trends in spending behavior over time, and measurements of important issues in the domestic meat industry—all quickly found within a single online location and from any electronic device. Additionally, interactivity allows users to select the geographic location and measure of consumer behavior that most aligns with their unique information needs. As such, the dashboard is an innovative and powerful tool to communicate market developments and industry performance.

## 2 Meat Demand Monitor Survey Overview

The Meat Demand Monitor (MDM) project was launched in February 2020 with funding support from the beef and pork checkoff programs. The MDM is a national survey issued monthly and designed to be representative of U.S. Census Bureau estimates for various demographic factors, including age, education, gender, income, region, and race. Each month, more than 2,000 survey responses are typically available for subsequent analyses after data quality filtering (AgManager.info 2022a). Monthly reports summarizing the latest national results, survey instruments, project methodology, and raw survey data are available through AgManager.info (AgManager.info 2022b).

The MDM survey focuses on domestic meat demand and consumer behavior, both in retail and foodservice outlets. Month to month, core topics remain the same. These include question blocks about respondents' awareness of a variety of issues in the U.S. meat industry (e.g., gestation stalls, bird flu, high protein diets), the importance of various food characteristics when making protein purchasing decisions (e.g., price, environmental impact), and a recall of prior day meat consumption.

Also included each month is a choice experiment providing survey participants with a list of meat products and associated prices.<sup>1</sup> Varying the prices of each product over nine choice sets, mean willingness to pay for the respective meat products is calculated and discussed in monthly MDM reports. That is, utilizing the results from the choice experiment, a multinomial logit model is estimated to determine how much the average U.S. citizen is willing to spend on a specific meat product as well as that product's share of the market for meat. This provides a measure of demand for the listed products and how demand is changing month to month. Furthermore, the willingness to pay estimates are regressed against respondents' demographic information to determine the factors impacting demand for the most popular retail and foodservice meat products.

Beyond topics relating to meat demand, the MDM survey has the flexibility to ask sets of ad hoc questions each month, providing a valuable source of information on more general topics and on current

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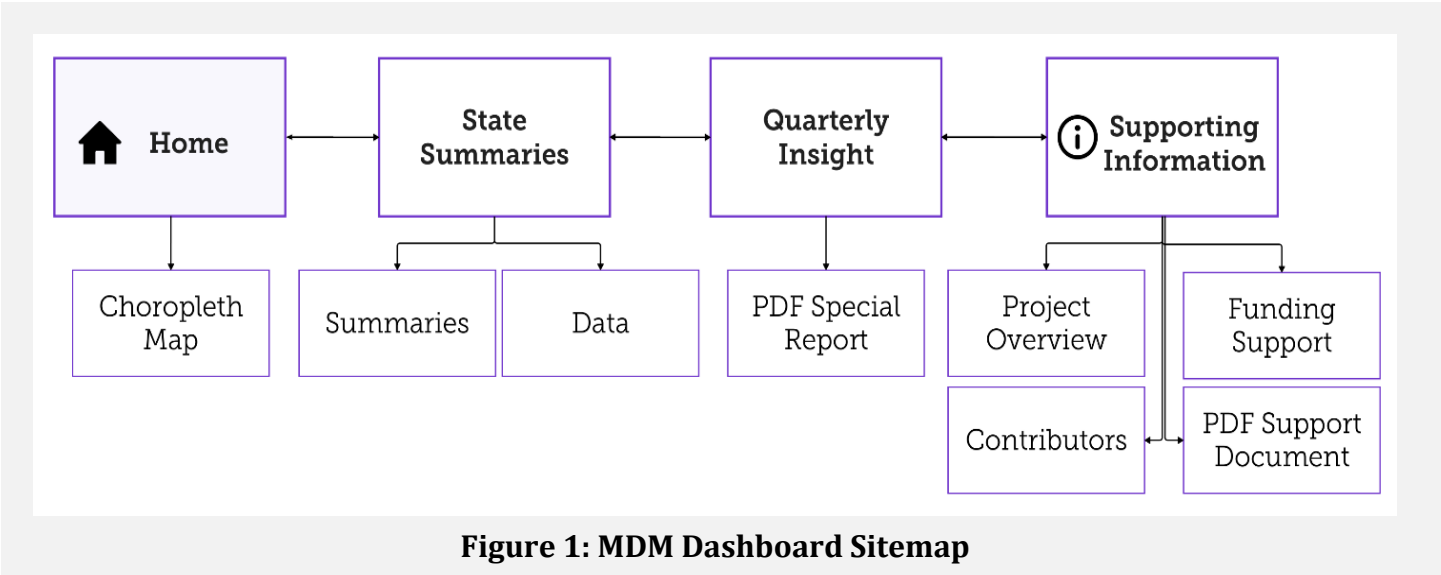
<sup>1</sup> Half of the monthly respondents are provided a retail-focused choice experiment. The listed retail meat products include items such as ground beef, chicken breast, and bacon. The other half of respondents are provided a foodservice-focused choice experiment. Foodservice meat products include dinner meals with entrée items such as ribeye steak, pork chops, and baby back ribs.

issues faced by U.S. consumers. This has included respondents’ weekly household food expenditures, financial sentiment, economic impact payments received during the COVID-19 pandemic, and price expectations for various meat products, to name a few. Specifically, the MDM showcased its usefulness in capturing trends in a rapidly changing U.S. meat market during the onset of the pandemic. In Spring 2020, several questions were included in the survey to quantify the amount of meat that respondents had on hand in their homes and to record the availability of meat in respondents’ most recent grocery store visit (in terms of volume and type of product). Answers to these and similar ad hoc questions can directly inform policymakers on observed consumer-level impacts of an economic disruption and illustrates U.S. residents’ experiences during volatile market conditions.

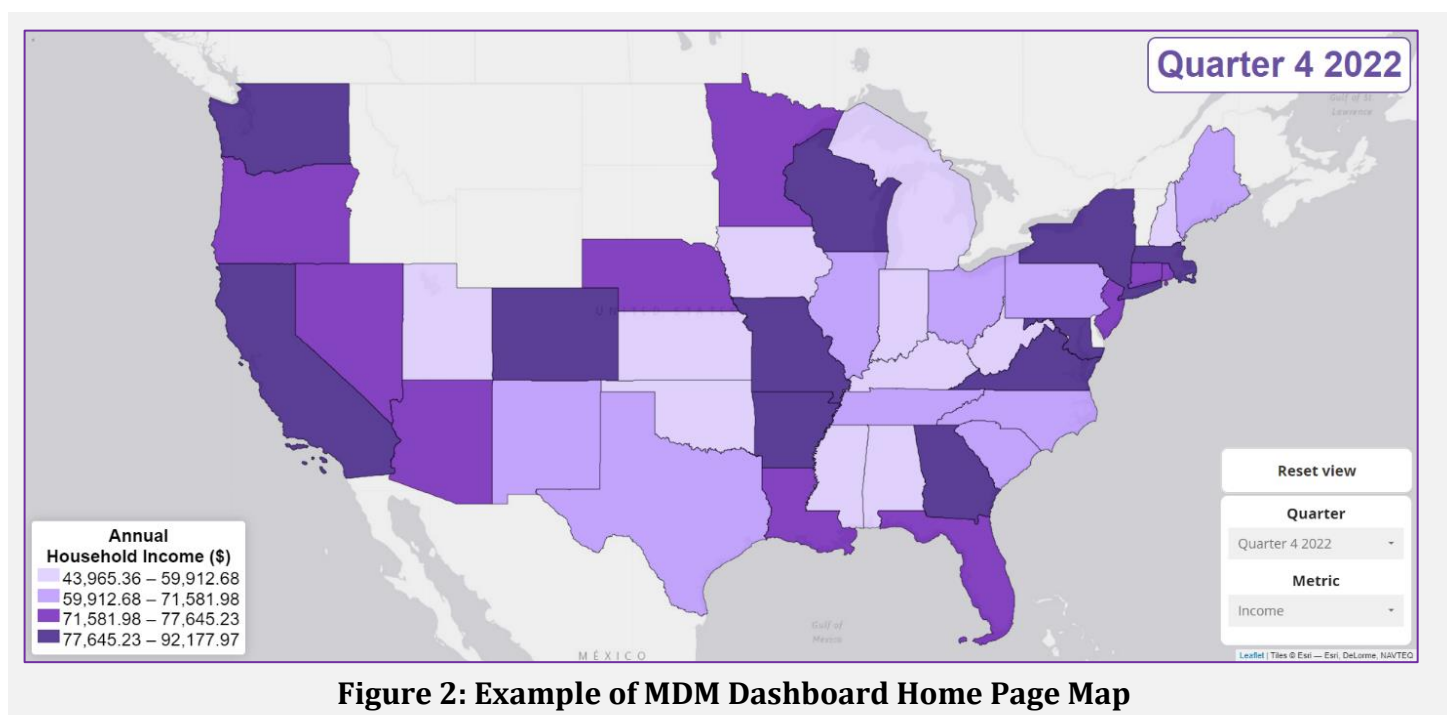
Over its short life, the MDM has already been used in a variety of academic research efforts. These include refereed articles on meat consumption amid media coverage of “meat avoidance” (Tonsor and Lusk 2022), consumption and perception of beef versus plant-based proteins (Taylor et al. 2022), and consumer behavior in domestic meat markets during the COVID-19 pandemic (Tonsor, Lusk, and Tonsor 2021). The survey data has also been used in government testimony at both the state and federal levels (KS Legislature 2021; Tonsor 2021) as well as in a variety of media outlets.

### 3 Meat Demand Monitor Dashboard

Approaching three years of data collection, the MDM has received more than 80,000 usable survey respondents and can now speak deeply to geographic variation in consumer behavior and preferences over time. With geographic heterogeneity of U.S. consumers in mind, we developed the MDM Dashboard to provide state-level information in a timely manner. The dashboard includes national aggregates similar to those provided in the monthly MDM reports, but additionally includes the same metrics of consumer behavior disaggregated by state—all from an easily accessible online platform. Figure 1 provides a sitemap of the MDM Dashboard, showcasing the structure of the application.



When the dashboard is opened, the user is presented with a home page that includes choropleth mapping of the fifty U.S. states and Washington DC. States are colored by their respective averages across respondents for the selected quarter (year) and variable of interest. Coloring is done by quartile. That is, states with averages in the bottom 25 percent for the selected variable are colored with the lightest shade of purple while states with averages in the top 25 percent are colored with the darkest shade of purple. Figure 2 serves as an example, displaying state-level averages for household income in



Quarter 4, 2022.<sup>2</sup> Note, a block of states in the Northern Plains are not colored. We implement a threshold of at least 30 respondents in the state and survey quarter (year) to be included as a data point on the home page map.<sup>3</sup> This serves as a quality measure, omitting thinly sampled states whose results we cannot assign a reasonable degree of confidence. On that note, and in the interest of transparency, we provide the number of respondents from each state and quarter (year) throughout the application. Additionally, rather than home page choropleth maps, quarterly and annual results for thinly sampled states are available under the “State Summaries” tab, if desired.

The “State Summaries” tab provides a more refined view of survey results by state. Again, the user can select the desired survey quarter (year) and state. The number of respondents for the selected period and state are displayed at the top of the page, along with average household income and weekly food expenditures. A variety of graphics are also provided on this page, including respondents’ awareness of issues in the meat industry, relative importance of various meat product characteristics, measures of both meat consumption and demand, diet split (e.g., vegetarian, vegan), and price expectations. All graphics are created dynamically, automatically updating the underlying data, titles, and axis labels based on the user’s selected period and state. Accordingly, the downloadable graphics are ready for use without further manipulation by the dashboard user.

A summary of variables, or metrics, provided in the MDM Dashboard, and available for download in the “State Summaries” tab, is depicted in Table 1. This information is also available to users in the dashboard’s “Supporting Information” tab, discussed in ensuing sections.

<sup>2</sup> All graphics and data provided in the dashboard can be downloaded by the user.

<sup>3</sup> Although the MDM is a monthly survey, we elected to provide quarterly and yearly state-level averages in the dashboard. We are more confident in these results for typically lower-sampled states than the monthly results.

**Table 1: MDM Dashboard Variable Descriptions**

| Variable  | Description  |
|---|--|
| Survey  | The year or quarter (an aggregate of the respective twelve or three survey months)   |
| State   | The state or all states (a national aggregate consisting of all 50 states plus Washington DC)  |
| Respondents   | The number of useable survey respondents after all filtering   |
| Income  | The average annual household income (\$)   |
| FAH   | The average weekly household expenditure on food at home (\$)  |
| FAFH  | The average weekly household expenditure on food away from home (\$)   |
| `Awareness_Animal Welfare` ...<br>`Awareness_Salmonella`                          | The average awareness of the topic (0 to 5)  |
| `CE_FoodServ_Baby back ribs` ...<br>`CE_FoodServ_Shrimp`                          | The average number of selections of the item from a nine-scenario, food service-focused choice experiment (0 to 9)                                     |
| `CE_Retail_Bacon` ... `CE_Retail_Shrimp`  | The average number of selections of the item from a nine-scenario, retail-focused choice experiment (0 to 9)   |
| `Diet_Flexitarian/semi-vegetarian` ...<br>`Diet_Vegetarian`                       | The share of respondents reporting the diet (0 to 1)   |
| `ExpPriceChange_Bacon` ...<br>`ExpPriceChange_Ribeye steak`                       | The average expected percentage price change of the item for the next month (-10 to 10)  |
| `ExpPriceMovement_Bacon_Higher` ...<br>`ExpPriceMovement_Ribeye steak_Same`       | The share of respondents reporting expected price movement of the item for the next month higher, same, or lower (0 to 1)                              |
| `ExpPriceMovement_Bacon_Relative` ...<br>`ExpPriceMovement_Ribeye steak_Relative` | The percentage of respondents reporting higher expected prices for the item next month minus the percentage reporting lower expected prices (0 to 100) |
| `Prior_Alternative proteins` ... `Prior_Pork`                                     | The average number of yesterdays' meals containing the protein (0 to 3)  |
| `PV_Animal welfare` ... `PV_Taste`  | The average importance of the value when making purchasing decisions (-1 to 1)   |
| `PV_Animal welfare_Rank_Least` ...<br>`PV_Taste_Rank_Most`                        | The share of respondents reporting the value is among their most, medium, or least important when making purchasing decisions (0 to 1)                 |
| `PV_Order_1` ... `PV_Order_12`  | The values ordered from most (PV_Order_1) to least (PV_Order_12) important when making purchasing decisions  |
| `PV_Order_1_MeanImp` ...<br>`PV_Order_12_MeanImp`                                 | The average importance of the ordered values   |



Also provided in the MDM Dashboard is a “Quarterly Insight” tab that provides a special report on some ad hoc or “hot topic” issue that is not already discussed in the MDM monthly reports or included in the rest of the dashboard. This quarterly report highlights some important economic issues and creates an additional incentive for industry users to return to the dashboard.

The final tab, labeled “Supporting Information,” provides a brief overview of the MDM project with a URL link to the AgManager.info webpage, from which further information and raw data can be obtained. Similarly, URL links are provided to the beef and pork checkoff programs’ respective webpages. Importantly, a PDF file is embedded on this page offering an overview of data filtering and survey weighting procedures used for the dashboard. All variables are also defined in the document should users desire to download the underlying state-level data.

## 4 Educational Value

The MDM Dashboard offers a variety of important insights into consumer preferences and market developments, from which industry users can better understand customers’ behavior and make more informed, forward-looking business decisions. Benefits of the dashboard as an educational tool can also be realized in an academic setting.

### 4.1 Extension Education

Of notable interest to food retailers and restaurant chains are changes in dietary patterns and an uptick in expenditures on plant-based proteins (Zhao et al. 2022). Quarter 4, 2022, survey estimates indicate, on a national level, 69 percent of respondents self-declare to regularly consume meat, 12 percent are flexitarian (i.e., those who mostly follow a vegetarian diet but occasionally eat meat or fish), and 13 percent are either vegetarian or vegan vegetarian. Implications for regional plant-based protein product placement and advertising can be addressed with the dashboard’s addition of state-level diet breakdowns. Notably, a group of states in the Eastern Corn Belt (i.e., Indiana, Kentucky, etc.) have the largest share of respondents self-declaring to regularly eat animal protein products. Efforts to place plant-based alternatives in these areas of the country are likely to be less effective relative to other areas. Conversely, the highly populated states of California, Illinois, and New York experienced larger shares of respondents self-reporting a vegetarian or vegan diet (between 8 and 12 percent) over the same period, perhaps indicating increased opportunity in those states for manufacturers of plant-based proteins and an opportunity for expansion of restaurant menus into more vegetarian options.

Dietary trends can be evaluated in further detail with prior-day consumption recall information collected from each survey respondent. This information indicates separately for each meal (i.e., breakfast, lunch, and dinner) where the meal was consumed (i.e., at or away from home) and which animal or alternative protein was included in the meal, if any. Furthermore, if respondents report having eaten an animal or alternative protein, they are prompted to provide the specific product. Such disaggregated consumption data provides a valuable resource for industry stakeholders to understand which consumer groups are driving protein purchases and where product needs to flow geographically.

The MDM Dashboard currently includes prior-day dietary recall information for four major animal proteins: beef, chicken, fish/seafood, and pork. Quarter 4, 2022, national results indicate respondents ate those broad protein classifications in roughly 0.7, 0.8, 0.3, and 0.5 of their prior-day meals on average, respectively. The dashboard’s state-level reporting provides additional important information. Inclusion rates of pork in respondents’ meals are relatively higher for states in the Southeast. Respondents from Alabama, Arkansas, Georgia, Louisiana, and Mississippi consumed pork in 0.62 to 0.76 of their daily meals on average. Conversely, states in the Northeast and Southwest have lower pork consumption with daily meal inclusion rates of around 0.25 to 0.35 in Arizona, Massachusetts, New Hampshire, and Utah. Prior-day beef consumption rates for the same quarter were higher in the Southern Plains and Mississippi Delta regions of the country. Arkansas, Kansas, Louisiana,

Mississippi, and Texas respondents indicated eating beef in 0.8 to 1.1 of their prior-day meals on average. Beef consumption rates were lower for the Northeastern states of Maine (0.51), Massachusetts (0.57), and New Hampshire (0.6).

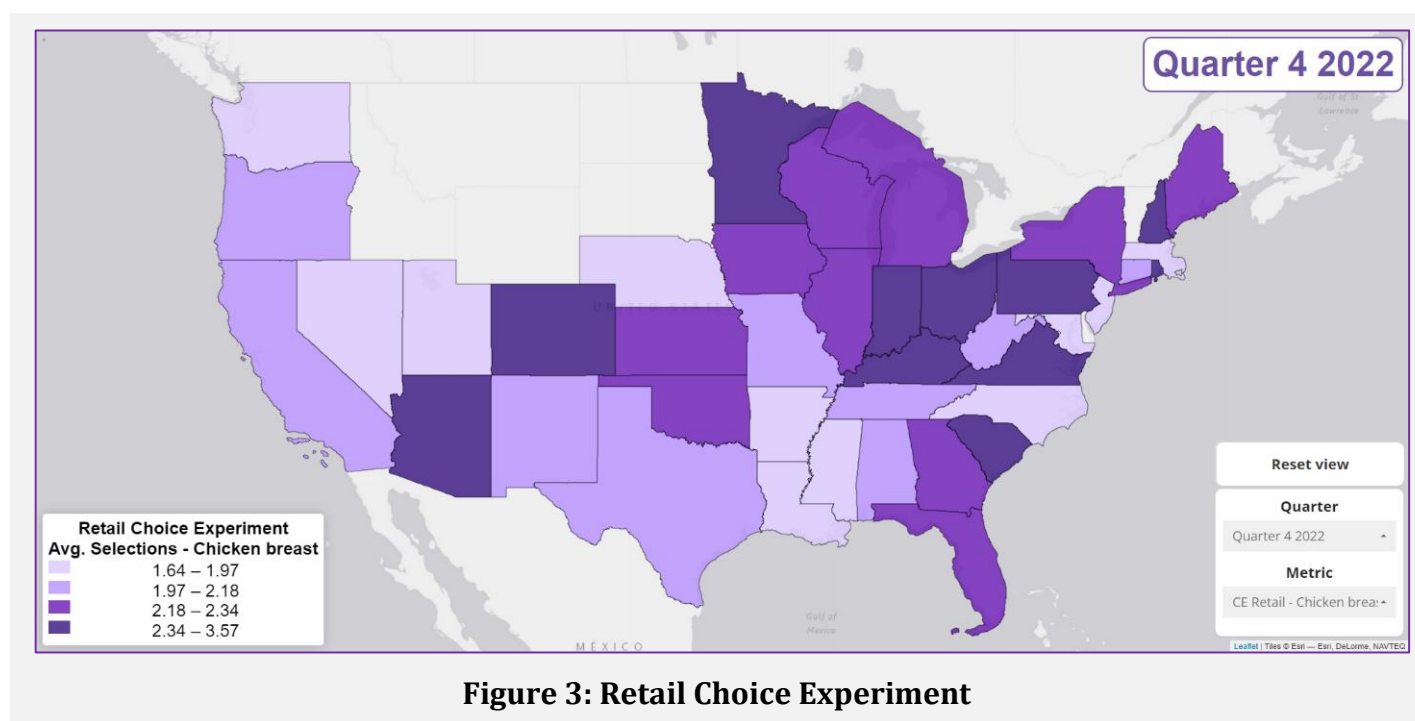
A related, but distinct demand (rather than just prior-day consumption) measure is also captured in the MDM survey. It is important to recognize that consumption of a good is not the same as demand for the good. Consumption is an equilibrium quantity at a given price. Purcell (1998) states per-capita consumption measures per-capita supply, not demand for a good. Prices will adjust to the required level to clear per-capita supply (Purcell 1998). Demand, on the other hand, is the schedule of quantities taken by consumers across various prices (Purcell 1998) and holding other factors constant.

A nine-question choice experiment is presented to each MDM respondent to assess demand for retail and foodservice meat items. Randomly assigned to either a retail or foodservice-framed choice experiment sequence, respondents are asked to choose from a list of eight meat items and a ninth “opt out” alternative (Tonsor et al. 2021). Prices of the meat items vary across the nine questions. Monthly MDM reporting and Tonsor et al. (2021) utilize a conventional multinomial logit model to recover mean willingness to pay for each meat alternative.

For the purposes of the MDM Dashboard, a simple sum across each respondent’s nine choice sets and for each meat alternative provides a measure of the respondents’ demand for various products on a scale of one to nine. Put another way, if over their nine retail-framed choice sets, a respondent chooses ground beef three times, we then have a quantified measure of the respondent’s retail demand for ground beef (equal to three). Calculated in this fashion, products with a total number of selections closer to nine display higher demand relative to products with selections closer to zero. For dashboard reporting, averages of the respondent-level sums are calculated for each state.

At the national level for Quarter 4, 2022, chicken breast and ground beef experienced relatively higher demand in retail with average selections just over 2. Retail demand for pork chops follows with a national average of around 1.25. Ribeye steak, bacon, and a variety of non-red meat proteins experienced the lowest relative demand. For assessments of geographic demand differences, our state-level dashboard reporting provides useful information. Retail ground beef demand for Quarter 4, 2022, was highest in several Great Plains and Eastern Corn Belt states. Respondents from Kansas, Nebraska, Ohio, and Pennsylvania reported on average summed selections of 2.68, 2.30, 2.35, and 2.32, respectively, for ground beef on the retail choice experiment. Retail demand for pork chops was higher in the same period in the Midwestern states of Illinois and Missouri and in the Northeast relative to other areas of the country, while retail demand for chicken breast was higher for states in the Eastern Corn Belt. Figure 3 highlights the regional difference in retail demand for chicken breast as available on the home page of the MDM Dashboard.

Analogous comparisons can be made from the foodservice-oriented choice experiment. National results for Quarter 4, 2022, indicate higher demand in dinner meal restaurant settings for beef hamburger, with an average number of selections exceeding 2. This was followed by ribeye steak, chicken breast, and shrimp, all with average selections of around 1.3. Pork chops and plant-based patties experienced the lowest relative foodservice demand with average selections below 0.5. Demand for beef hamburger was relatively higher in the Southern Plains, with Kansas and Oklahoma having an average number of selections of 2.77 and 2.69, respectively. Demand for chicken breast in foodservice outlets

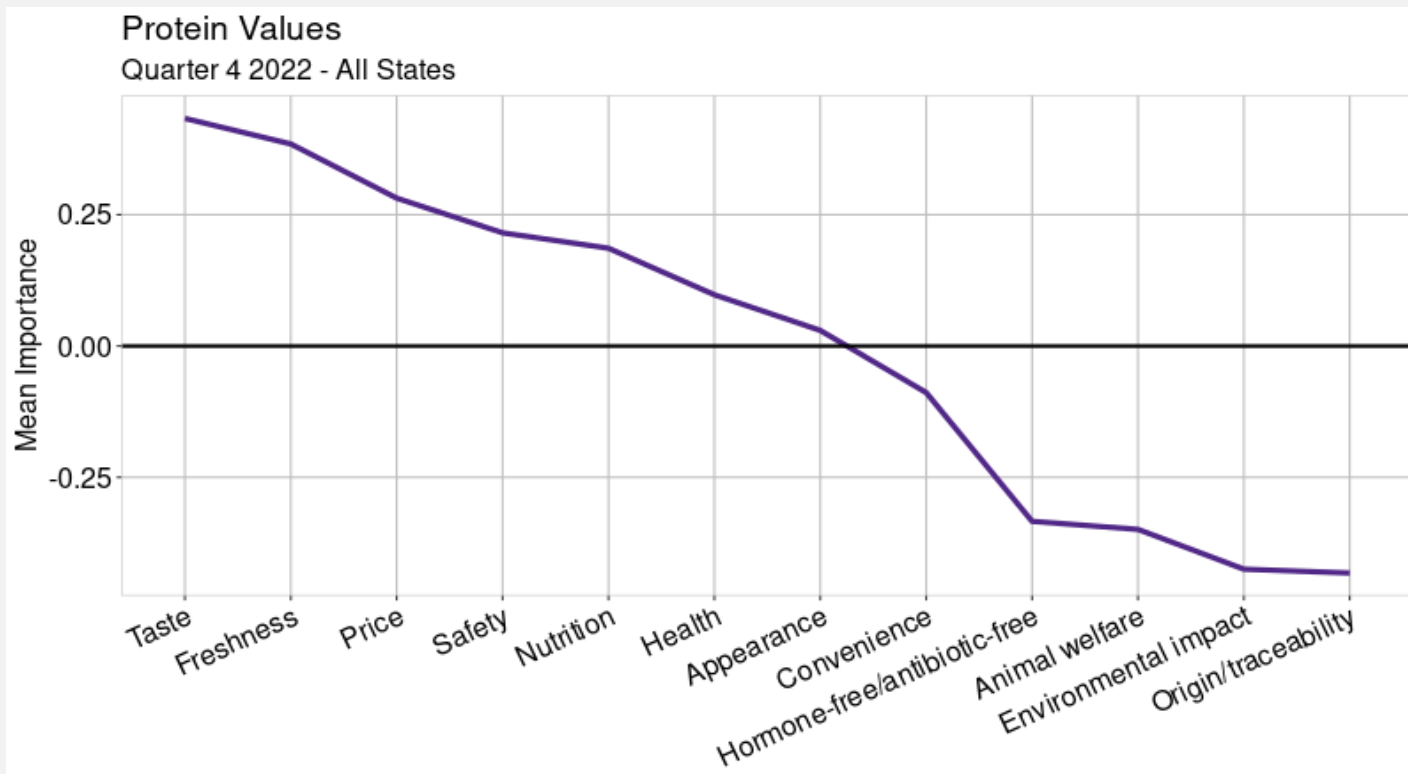


was relatively higher in the Northeast. Respondents from Maine, Massachusetts, New Hampshire, and Rhode Island had average selections of chicken breast of between 1.6 and 3.1. States in the Southeast displayed comparatively lower demand for chicken breast in foodservice settings. Foodservice demand for shrimp was higher along the coastal states of Georgia, South Carolina, and Virginia, likely a reflection of higher quality and availability of fresh seafood. Respondents from these states reported average shrimp selections of around 1.6 to 1.9 while respondents from landlocked Kansas, Nebraska, and Utah reported average selections of around 0.9 to 1.

The MDM also prompts respondents to provide the importance they assign to various food characteristics when making a protein purchasing decision. These characteristics include appearance, animal welfare, convenience, environmental impact, freshness, health, hormone or antibiotic free, nutrition, origin or traceability, price, safety, and taste. The questionnaire block implements a forced ranking method so that four characteristics are assigned as “most important,” four are assigned as “medium important,” and four are assigned as “least important.” If selected as one of the respondent’s most important considerations when purchasing, the characteristic, or “protein value,” takes a value of one. If selected as having medium importance, the protein value takes a value of zero. Product characteristics deemed as least important in the purchasing decision are given a value of negative one. Averages are then taken to rank protein values relative to one another, with protein values having a higher (or more positive) average considered as more important to the typical consumer than protein values with a lower average. Figure 4 is obtained from the “State Summaries” tab of the dashboard and displays the national results for Quarter 4, 2022.

MDM respondents report placing higher importance on product characteristics such as taste, freshness, and price when purchasing protein items. To illustrate, respondents reported on average a value of 0.26 for price and 0.20 for nutrition. This indicates that price was 1.3 times more important than nutrition to respondents for the quarter. Lower importance is assigned to hormone- and antibiotic-free labeling, animal welfare concerns, environmental impact, and origin and traceability of the product. These results are consistent over survey months and quarters, and have important implications for effectiveness of advertising campaigns promoting environmentally friendly or hormone-free foods. Interesting patterns emerge using the dashboard to compare state-level results. As an example, environmental impact is a more important consideration for respondents from the West Coast and New York, and, surprisingly, a string of states in the south-central portion of the country. However, the





**Figure 4: Protein Value Mean**

protein value still takes on a negative average, suggesting that even respondents from these states place on average less importance on environmental impacts than on product price, freshness, and other traits.

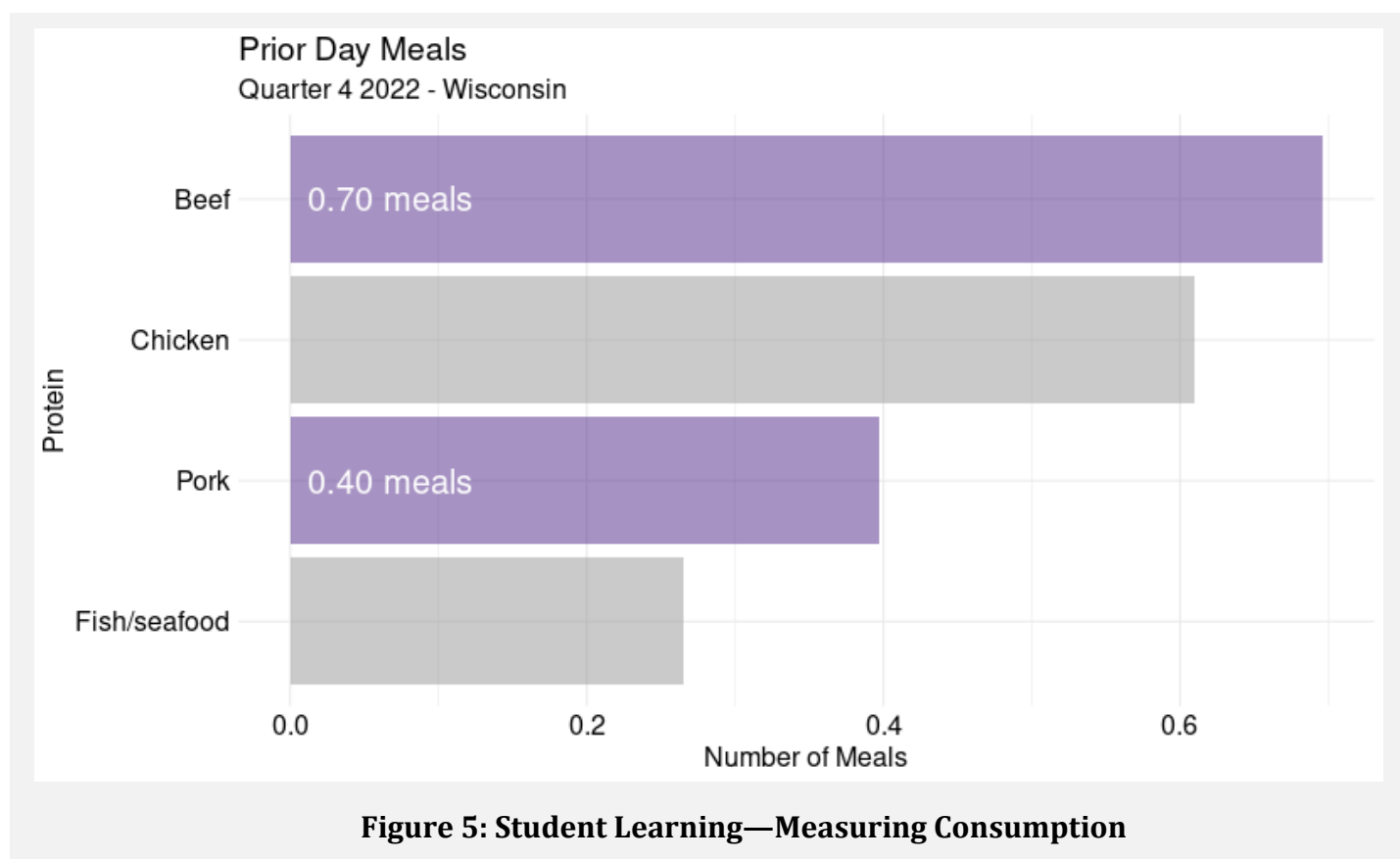
At time of writing, the topic of inflation has received widespread media coverage. From U.S. Bureau of Labor Statistics (2022) estimates, the 12-month percentage changes (August 2021 to August 2022) in the Consumer Price Index for all food and for meats, poultry, fish, and eggs were, respectively, 11.4 percent and 10.6 percent. In light of increasing inflation, the MDM has asked respondents since March 2021 what they expect the following month for retail prices of bacon, pork chops, ground beef, and ribeye steak. If respondents indicate expected higher or lower prices, they are then prompted to provide a percentage expected price increase or decrease from which we calculate average expected price movements. Impacts of inflation and consumers' expectations surrounding prices of meat products have important implications for household grocery budgeting and purchasing behavior.

Nationally for Quarter 4, 2022, MDM respondents reported expecting next month's prices to increase by between 2.4 and 3 percent across all four retail meat products. A series of states, including Arizona, Hawaii, Maryland, Nevada, New York, Rhode Island, South Carolina, and Tennessee experienced relatively higher average expected price increases for at least three of the following products: bacon, pork chops, ground beef, and ribeye steak. Food retailers and restaurants in these areas may be able to capitalize on consumers' price expectations by setting prices of those products slightly beneath reported expected increases. That is, consumers may be more willing to purchase when they are provided a price below what they had expected.

## 4.2 Classroom Education

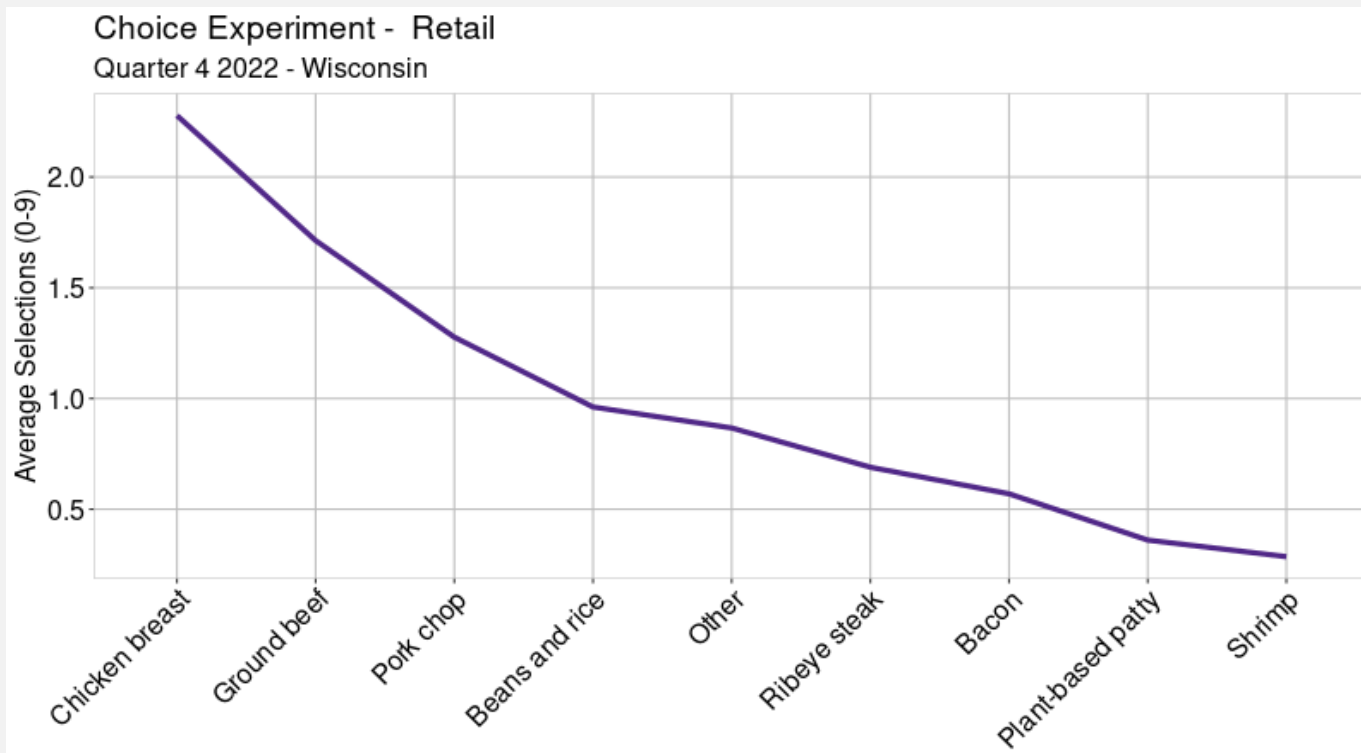
The dashboard's innovative approach to distribution of information can better serve agricultural economics instructors in their efforts to provide fresh, engaging content to students. An example educational point relating to economics directly is the important difference between demand and consumption. Such distinction may elude students unless presented visually. A brief discussion of the topic, and related display using the dashboard, could be immediately extended upon by visiting the MDM project methodology and viewing how the two measures are captured in their respective survey question blocks.

As a concrete example, when viewing state averages for Wisconsin in Quarter 4, 2022, we can show that respondents consumed beef in 0.7 of their prior-day meals, on average. This was followed by chicken at around 0.6 meals, as depicted in Figure 5. It is important to remember that this is a consumption measure that does not consider the price of the respective products.



Conversely, results from the retail-framed choice experiment depicted in Figure 6 indicate that, of the nine choice sets, Wisconsin respondents selected chicken breast 2.3 times, on average, as compared to 1.7 times for ground beef. Thus, when considering product price, we observe a different relative ranking of products. Such a depiction would be greatly beneficial for students' learning in classes such as price or demand analysis.

Another example educational point could be made on the masking of variation by using aggregated data. Consider, for example, the national average weekly household food-away-from-home expenditure of \$67.16 in Quarter 4, 2022. This is found in the "State Summaries" tab by clicking "Quarter 4 2022" and "All States" in the drop-down lists. From the underlying state-level data available on the same page, we can show that weekly household expenditures on food away from home ranged from \$25.87 for Idaho to \$90.60 for Delaware for the same quarter. This is a clear example of aggregation



**Figure 6: Student Learning—Measuring Demand**

versus disaggregation and how data needs to be carefully interpreted based on the objectives of the research. Such insights are valuable for any data analytics or applied econometrics courses.

Further, utilizing the dashboard in a classroom setting may expose students for the first time to extension education and pique their interest in the profession. Specifically, the dashboard serves as an intersection of survey design methods, statistical analysis, and web application development. These are generally not covered in the classroom to the same extent as subjects like economics or animal and crop sciences. Students may not be exposed to these subjects or be unaware that opportunities exist in the agricultural industry for individuals with quantitative and technical skills. Exploiting the dashboard to attract young, technologically savvy students serves as a cost-efficient investment in the future of extension education and agriculture as a whole.

## 5 Usage Tracking

To assess MDM Dashboard use, the application was linked to the website traffic reporting platform Google Analytics. This allows for tracking of the number of users, page views, and a variety of user engagement measures, which can be disaggregated by time and user location. Further, in-dashboard activity can be seen in real time, allowing the creators to determine which components of the dashboard are most heavily utilized after quarterly updates or social media postings related to the MDM. It should be noted that confidentiality restrictions do not allow us to view an archive of in-dashboard activity at this time. It is our hope that, as the MDM Dashboard obtains more users, we meet the Google Analytics volume threshold for viewing historical in-dashboard activity. However, an archive of general tracking measures (e.g., number of users, number of clicks, etc.) is always available to the dashboard creators.

A trial period from mid-September 2022 to mid-January 2023 resulted in 198 new users and 50 returning users, for a crude measure of user retention of 25 percent. Though the absolute number of users was small, the rate of retention was satisfactory and confirmed the value of the dashboard as it

continues to be introduced to industry professionals. Additionally, dashboard users came from fourteen countries over the period, including the United States, Canada, and Mexico, highlighting the relevance of trends in the U.S. meat industry in global trade. Further, users spent on average 1 minute and 56 seconds per session in the dashboard and recorded roughly fifteen “events” per session. That is, once in the dashboard, users clicked on about fifteen different items on average. Our focus being on the dynamic, accessible, and time-efficient distribution of market information, this showcases users’ engagement with the tool and may indicate their ability to quickly obtain needed data and insights.

## 6 Conclusions

The MDM Dashboard notably increases the reach and accessibility of academic research for industry professionals, and in an area that is underserved with current information distribution methods—consumer behavior in domestic meat markets. The visual map of state-level information along with detailed state summaries that are easily downloadable have a larger impact than what traditional extension channels can provide and offer improved understanding of ever-changing market trends. Additionally, utilizing such a dashboard in a classroom setting serves as a low-cost investment in the future of extension education, exposing the next generation of potential economists and educators to new, exciting research and distribution methods.

As information collection and dissemination efforts continue to evolve, and as industry stakeholders continue to demand refined data insights, we encourage the creation of similar dashboards for other applications in the agri-food industry. Such tools, beyond providing valuable market information and more informed decision-making to industry participants, may later incite industry funding support for the underlying data collection and base academic projects. This multifaceted and mutually beneficial relationship between academia and industry is in line with the land-grant mission and is particularly important when traditional sources of research funding are less available.

It is said that what you cannot measure, you cannot manage. What is less appreciated, but perhaps equally important, is that you cannot have influence and value unless you keep up with the times. Here, the measure is consumer behavior in U.S. meat markets that is evolving over time and is heterogenous across consumer groups and geographic space. The times include improved technical ability to support online dashboards, aiding in data visualization when societal interest for information seems insatiable. This article showcases the new MDM Dashboard and illustrates the associated impact it can have on education efforts. We hope this example motivates similar efforts across extension programs.

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