

**Center for Teaching Old Models New Tricks (TOMNET)  
A USDOT Tier 1 University Transportation Center**

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**PROJECT PROPOSAL 2022-2023**

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**Title:** Access to Food in a Severe Prolonged Disruption: The Case of Grocery and Meal Shopping During the COVID-19 Pandemic

**Principal Investigator:** Ram M. Pendyala, Professor, School of Sustainable Engineering and the Built Environment, Arizona State University

**Co-Principal Investigator:** Irfan Batur, Associate Research Technologist, School of Sustainable Engineering and the Built Environment, Arizona State University

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## **1. Introduction/Problem Statement**

Access to good food is critically important to leading a healthy life. Even in a wealthy and well-developed nation such as the United States, 38 million people struggle with hunger (USDA, 2022) and 13.8 million households, which comprise 10.5 percent of all US households, were considered food insecure at some time during 2020 (USDA, 2022). The proportion of under-nourished people globally stands at about 10 percent (i.e., 828 million people) (WHO, 2022). These statistics suggest that, despite enormous progress in advancing food security, access to good food remains a challenge for many. Access to good food generally involves ensuring that a variety of healthy, wholesome food options are available within close proximity (for the household) and that the food options are affordable. In the United States, nearly 20 million people live in a food desert, which the US Department of Agriculture defines as a place where at least one-third of the population lives greater than one mile away from a supermarket for urban areas, or greater than 10 miles away for rural areas (USDA, 2021). In other words, the ability to access good food by traversing distances is critical to good health, thus implying that transportation plays a major role in enabling food security.

During a severe disruptive event, food security may come under threat (Mouloudj et al., 2020; Savary et al., 2020). This was seen during the height of the COVID-19 pandemic. Due to public health concerns, many jurisdictions ordered businesses to close, restaurants to cease operations, and grocery stores to limit hours and occupancy levels (Niles et al., 2020). Many individuals, especially those with immunocompromised systems and other underlying health conditions, feared going to stores or restaurants for fear of getting infected (Ahmed et al., 2021). Even individuals without such health conditions avoided going to food establishments to avoid taking any risks (Jacobsen and Jacobsen, 2020). However, in response to the COVID-19 disruption, many grocery stores and restaurants quickly ramped up their virtual options. Grocery stores enabled systems allowing people to order groceries online and then travel to the store to pick them up (in a reasonably touchless transaction system) or have them delivered to the home. Similarly, restaurants also pivoted rapidly, implementing systems that made it easy to order freshly prepared meals over the phone or online. The consumer could travel to the restaurant to pick up

the meal or use a delivery service to deliver the food to the doorstep. All of these virtual options (online grocery with pickup/delivery; online restaurant with pickup/delivery) provided many with the ability to access food during the height of the pandemic while minimizing exposure and risk of contagion. This represents a high degree of adaptability, with systems rapidly adjusting to circumstances to retain access to goods and services.

The extent to which such services and options were utilized by different socio-economic and demographic groups is worthy of exploration. Many pickup and delivery services charge an additional fee, possibly rendering such services unaffordable for low-income households (Rummo et al., 2020). Some households may be on the wrong side of the digital divide or not have the technology-savviness to use virtual platforms for ordering groceries and fresh meals (Ali et al., 2021). Individuals in these households may feel compelled to go in-person (to avoid paying a fee), even though they may be concerned about their safety in the midst of a pandemic. Individuals who are unable or unwilling to travel (due to health risks) and unable to take advantage of virtual platforms (due to affordability or technology constraints) may end up experiencing food insecurity (Ahmed et al., 2021; Ali et al., 2021).

A number of studies have explored physical and virtual participation in activities, particularly in the wake of the pandemic. Virtual activity participation increased during the pandemic as people substituted in-person interactions for alternative modalities such as virtual socialization, online school, and telecommuting (Chakraborty et al., 2020; Javadinasr et al., 2021). Those who embrace virtual activity participation are more inclined to utilize online shopping services, including food pickup and delivery services (Akhter, 2015; Ali et al., 2021; Zhang et al., 2017). However, there is evidence that these virtual alternatives to in-person interactions were not viewed as equivalent substitutes by everyone during the pandemic or even available options for some (disadvantaged) subgroups. Individuals with higher social proclivities were found to be negatively associated with social distancing (Carvalho et al., 2020). Two of the largest barriers to following social distancing protocols included loneliness and the need to help others run errands (Coroui et al., 2020), illustrating how some chose to break health and safety protocols while others had no choice but to shop in-person. Virtual activity perspectives and social interaction propensity influence the choice to purchase food in-person or online for those who are capable of choosing. However, those in disadvantaged subgroups may have no option to purchase food online, potentially leading to food insecurity.

This project aims to explore and identify the market segments most at risk of food insecurity in the wake of a severe, prolonged disruption such as the COVID-19 pandemic. Subgroups capable of accessing food through virtual means may be considered adaptable, i.e., they have the ability to adapt to circumstances and not be compromised with respect to food and meals. On the other hand, subgroups of the population unable to travel and afford or use virtual platforms are left behind and vulnerable. These groups do not exhibit adaptability, and they need assistance through public services to ensure they do not lose access to healthy food and meals. Through a comprehensive modeling effort, this project aims to identify the subgroups who are adaptable and those who are vulnerable. Not only does the project seek to characterize the subgroups in terms of socio-economic and demographic attributes, but the project also seeks to characterize them in terms of their attitudes, perceptions, and risk averseness or tolerance. The project utilizes a rich data set collected through a survey administered across the United States. The data set, collected as part of the COVID Future Survey study, includes all respondent records for the first wave of the panel survey conducted at the height of the pandemic in 2020. The extensive survey is able to obtain a detailed picture of physical and virtual activity engagement during the pandemic.

The project considers two commodities: groceries and freshly prepared meals. There are three access modalities for each commodity type: in-person, online order + in-person pickup, and online order + delivery to home. Thus, there are a total of six possible options for accessing food and meals. In the survey data set, respondents have recorded the number of days they participated in each of these six modalities (in the past seven days). The six frequency variables constitute the project's endogenous (dependent) variables; they are all modeled jointly in a simultaneous equation modeling framework, thus enabling the consideration of all six dimensions as a lifestyle choice bundle, where decisions to participate in each of the modalities are made contemporaneously. As the frequency variables may be treated as ordered choices, the multivariate ordered probit modeling methodology is adopted in this project. The joint modeling framework explicitly accounts for error correlations across the six endogenous variables, thus capturing the potential effects/presence of correlated unobserved factors that simultaneously impact multiple endogenous variables. The Generalized Heterogeneous Data Model (GHDM) modeling methodology (Bhat, 2015) will be adopted for model estimation.

## **2. Project Objectives**

This project aims to identify vulnerable and less adaptable groups in the context of access to food. Using a comprehensive behavioral survey data set collected during the height of the pandemic in 2020, this study aims to provide insights into the groups that may have experienced food access vulnerability during the disruption when businesses and establishments were restricted from providing normal service, the risk of contagion was high, and accessing online platforms required technology-savviness and the ability to afford delivery charges.

## **3. Proposed Methodology and Data**

This project utilizes a subset of data from the first wave of the COVID Future Panel Survey. Wave 1 data, collected from April – October 2020, was used because this data was collected at the peak of the pandemic when there were significant health concerns, fear of the spread of the virus, and public and private entities that attempted to stem the spread through the implementation of limited business and restaurant operations. These restrictions may have differentially impacted various market segments. A total of 9,912 responses were obtained in the first wave of the panel survey. After deleting these erroneous responses and filtering the data to remove records with substantial missing data, the final analysis sample includes 8,392 responses.

The data set includes six endogenous variables stemming from two commodity types that can both be accessed via three modalities. While it is possible to model the six dependent variables independently, there is a high likelihood that there are correlated unobserved factors that simultaneously affect the six endogenous outcome variables of interest. Moreover, it is likely that decisions about participation in the respective activity modalities are not made in isolation from one another. Treating these six endogenous choice variables as representative of an overall integrated lifestyle approach (choice bundle) to accessing food would help in modeling the phenomenon in a comprehensive and holistic framework. For this reason, this project employs a simultaneous equation modeling framework capable of accounting for error correlations and endogeneity of attitudinal constructs. The analytical framework aims to provide the ability to specify and estimate a joint model that considers six main outcome variables associated with people's in-store shopping and online purchase frequencies of groceries and meals.

The model is formulated as a multivariate ordered response model system with error correlations engendered through the recognition that the latent constructs themselves are stochastic

variables with error components. By accounting for error correlations between the three latent constructs, error correlations between the endogenous choice dimensions can be inferred and computed. The three latent constructs are themselves endogenous variables (influenced by socio-economic and demographic attributes), and they in turn influence the outcome variables of interest. Socio-economic and demographic variables (exogenous attributes) may directly affect the outcome variables (frequency of grocery and meal activities by various modalities) and/or affect them indirectly through the latent factors (which serve as mediating variables). Factor scores are continuous variables, while the six endogenous variables represent ordered discrete outcomes. The entire model structure can be estimated in an integrated econometric framework using the Generalized Heterogenous Data Model (Bhat, 2015). The latent constructs will be modeled through a structural equations model (SEM) component and measurement equations model (MEM) component of the GHDM; the latent constructs will appear as exogenous variables in the multivariate ordered-response probit (MORP) model of the six main outcomes. However, the entire model system will be estimated in one step through the GHDM approach.

#### **4. Work Plan (Project Tasks)**

##### **Task 1: Literature Review and Data Assembly**

During this task, a comprehensive review of the literature on the disruptive nature of COVID on shopping patterns, especially in regard to grocery and meal in-store purchases, pickups, and delivery will be conducted. An additional review of individuals' safety perceptions during the pandemic, individuals' virtual activity participation, and the relations between social interaction propensity and willingness to follow social distancing regulations will be explored. A subset of the COVID Future Panel Survey, specifically Wave 1, will be utilized for this project due to its collection at the peak of the pandemic, from April to October 2020.

##### **Task 2: Simultaneous Equations Modeling**

The data set includes six endogenous variables stemming from two commodity types that can both be accessed via three modalities. While it is possible to model the six dependent variables independently, there is a high likelihood that there are correlated unobserved factors that simultaneously affect the six endogenous outcome variables of interest. Moreover, it is likely that decisions about participation in the respective activity modalities are not made in isolation from one another. Treating these six endogenous choice variables as representative of an overall integrated lifestyle approach (choice bundle) to accessing food would help in modeling the phenomenon in a comprehensive and holistic framework. For this reason, this project will employ a simultaneous equation modeling framework capable of accounting for error correlations and endogeneity of attitudinal constructs.

The model will be formulated as a multivariate ordered response model system with error correlations engendered through the recognition that the latent constructs themselves are stochastic variables with error components. By accounting for error correlations between the three latent constructs, error correlations between the endogenous choice dimensions can be inferred and computed. The three latent constructs are themselves endogenous variables (influenced by socio-economic and demographic attributes), and they in turn influence the outcome variables of interest. Socio-economic and demographic variables (exogenous attributes) may directly affect the outcome variables (frequency of grocery and meal activities by various modalities) and/or affect

them indirectly through the latent factors (which serve as mediating variables). Factor scores are continuous variables, while the six endogenous variables represent ordered discrete outcomes. The entire model structure can be estimated in an integrated econometric framework using the Generalized Heterogenous Data Model (Bhat, 2015). The latent constructs will be modeled through a structural equations model (SEM) component and measurement equations model (MEM) component of the GHDM; the latent constructs appear as exogenous variables in the multivariate ordered-response probit (MORP) model of the six main outcomes. However, the entire model system will be estimated in one step through the GHDM approach

**Task 3: Model Estimation Results and Bivariate Model of Behavioral Outcomes**

Results of the latent constructs model will be analyzed and interpreted. Similarly, estimation results for the multivariate ordered probit model of six endogenous outcomes representing food access modalities will be analyzed and interpreted. Policy implications, further discussion, and conclusions can then be drawn based on the results of the analyses.

**Task 4: Project Deliverables**

The project deliverables, including the research report, conference, and journal papers, will be prepared in this step.

**5. Project Schedule**

Table 1 illustrates the timeline for all the tasks explained in the previous section.

TABLE 1 Project Schedule

Aug-22	Sep-22	Oct-22	Nov-22	Dec-22	Jan-23	Feb-23	Mar-23	Apr-23	May-23	Jun-23	Jul-23
Task 1			Task 2				Task 3		Task 4		

**6. Relevance to the Center Theme/Mission**

TOMNET’s mission is to enhance and improve the existing travel demand and behavior models by introducing new sets of variables and methods. Findings from this project are expected to show that attitudes and perceptions, together with a host of socio-economic and demographic attributes, significantly affect participation in different activity modalities. Additionally, it is expected that findings will show that critical inequities render certain population subgroups more vulnerable to food insecurity during severe and prolonged disruption. These findings have implications for the future of travel in severe and prolonged disruptions, especially when focusing on specific subgroups. The findings are expected to point out critical inequities rendering some population subgroups more vulnerable to food insecurity than others which can lead to conclusions on the technological resources that need to be made available and the policies that need to be passed to combat these issues.

## 7. Anticipated Outcomes and Deliverables

The project findings are anticipated to show that critical inequities render certain population subgroups more vulnerable to food insecurity during severe and prolonged disruption. Certain groups are likely to exhibit a greater proclivity to engage in in-store shopping even after accounting for the attitudinal proclivities and lifestyle preferences for social interactions. It is likely that these groups continued to shop in-store and place themselves in harm's way because alternative online-based options were out of reach or unaffordable. Groups continuing to shop in-store during the pandemic were likely minorities. These minority groups also experience a greater digital divide, rendering it difficult for them to access online platforms and utilize them effectively to access goods and services. In the case of food deliveries, the cost must be considered; it is probable that lower-income individuals are less likely to procure groceries via delivery mechanisms, presumably because of delivery fees.

The findings are anticipated to show that some subgroups of the population need to be provided technological resources so they can participate in the online economy and leverage virtual platforms for procuring essential goods and services, including food. Providing assistance and training in the use of technology platforms would further assist in reducing vulnerability. Delivery fees can be quite substantial when ordering food and meals frequently, thus rendering the use of such services unaffordable for the income-constrained segments of society. If the anticipated findings are found to be accurate, public subsidy programs (such as SNAP) need to be modified to cover delivery fees (perhaps up to a certain limit), thus enabling low-income individuals who depend on such programs for food to obtain groceries and meals without exposing themselves to risk. The project deliverables include the research report, conference, and journal papers.

## 8. Research Team and Management Plan

The research team is led by Dr. Ram Pendyala, who will serve as the Principal Investigator for the project at ASU. Irfan Batur will serve as the co-principal investigator for the project and will assist in each and every project task. The project will support one highly qualified Ph.D. student completely, and a few graduate research assistants (who will assist with different data assembly and model estimation practices) partially.

**Ram M. Pendyala** is a Professor of Transportation Systems in the School of Sustainable Engineering and the Built Environment at Arizona State University. He serves as the Director of TOMNET. Pendyala is an expert in activity-travel behavior modeling and has led the development of a number of large-scale behaviorally robust microsimulation model systems. He has published extensively in the literature and serves as the Chair of the Transportation Research Board's Planning and Environment Group (2015-2018). He previously served as Chair of the Travel Analysis Methods Section (2009-2015) as well as the Traveler Behavior and Values Committee (2003-2009). He has also served as the Chair of the International Association for Travel Behavior Research (IATBR). He is currently an Associate Editor for Transportation Research Part D. He has his Ph.D. and MS degrees in Civil and Environmental Engineering with a specialization in transportation from the University of California at Davis, and his Bachelor's degree in Civil Engineering from the Indian Institute of Technology-Madras in India.

**Irfan Batur** is an Associate Research Technologist at Arizona State University's School of Sustainable Engineering and the Built Environment, where he is currently pursuing a PhD in Civil, Environmental, and Sustainable Engineering. With research interests spanning sustainable transportation, machine learning, smart cities, and travel demand forecasting, Irfan has led several research projects at the TOMNET University Transportation Center as principal or co-principal

investigator. Irfan's work has been featured in top-tier transportation journals, and he has also developed open-source software and tools and mentored undergraduate and graduate students. Additionally, Irfan serves as the Research Communications and Technology Transfer Coordinator at the TOMNET UTC and is a member of TRB's Standing Committee on Traveler Behavior and Values (AEP30).

Ram Pendyala will be the primary point of contact for all aspects related to this research and will manage all aspects of the project. He will work closely with graduate students to accomplish the project tasks.

## **9. Technology Transfer Plan**

The project team believes in executing an effective technology transfer plan by disseminating project information and results widely to the professional community. During the one-year duration of this particular project, each milestone will be disseminated using one of the TOMNET communication mechanisms (e.g., website, webinar, seminar, teleconference). Project team members will prepare articles for publication in refereed journals and conference proceedings. Project team members will participate in conferences and deliver presentations about this work and the outcomes of the effort.

## **10. Workforce Development and Outreach Plan**

The project incorporates a strong workforce development and outreach plan. The project will employ a full-time Ph.D. graduate student as a graduate research associate. The doctoral student will be involved in all aspects of the project including literature review, data assembly, and model estimation. At ASU, project team members will engage with the National Summer Transportation Institute, a three-week residential summer program for high school students that aims to expose them to transportation-related careers. Finally, the project will also welcome high school students who may be interested in serving as volunteer researchers under the TOMNET Scholar Initiative. Findings from the project will be integrated into graduate-level courses taught at various institutions in the consortium so that the research and workforce development activities of the center are seamlessly blended together.

## **11. References**

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- Akhter, S.H. Impact of Internet Usage Comfort and Internet Technical Comfort on Online Shopping and Banking. *Journal of International Consumer Marketing*, 2015. 27:207-219.
- Ali, S., N. Khalid, H.M.U. Javed, and D.M.Z. Islam. Consumer Adoption of Online Food Delivery Ordering Services in Pakistan: The Impact of the COVID-19 Pandemic Situation. *Journal of Open Innovation: Technology, Market, and Complexity*, 7:10.
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- Dias, F.F., P.S. Lavieri, S. Sharda, S. Khoeini, C.R. Bhat, R.M. Pendyala, A.R. Pinjari, G. Ramadurai, and K.K. Srinivasan. A Comparison of Online and In-Person Activity Engagement: The Case of Shopping and Eating Meals. *Transportation Research C: Emerging Technologies*, 2020. 114:643-656.
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## 12. Qualifications of Investigators (One-page CV per Investigator)

### **RAM M. PENDYALA**

**Professor**, Sustainable Engineering and the Built Environment

Arizona State University (ASU), Tempe, AZ 85287-3005 Email: [ram.pendyala@asu.edu](mailto:ram.pendyala@asu.edu)

#### **Education**

Ph.D., Civil Engineering (Transportation), University of California-Davis, December 1992.

M.S., Civil Engineering (Transportation), University of California-Davis, June 1990.

B.Tech., Civil Engineering, Indian Institute of Technology-Madras, June 1988

#### **Employment and Professional Experience (last 25 years)**

Professor, Sustainable Engineering and the Built Environment, ASU, 2006-2014 & 2016-present.

Frederick R. Dickerson Chair Professor, School of Civil and Environmental Engineering, Georgia Institute of Technology, 2014-2016

Senior Sustainability Scientist - Global Institute of Sustainability, ASU, 2011-Present.

Asst/Assoc/Professor, Civil & Environmental Engineering, Univ of South Florida, 1994-2006.

Assistant Professor, Civil Engineering, University of Louisiana at Lafayette, 1992-1994.

#### **Fields of Interest and Expertise**

(1) Multimodal transportation systems planning; (2) Activity-travel behavior analysis; (3) Transportation demand modeling and forecasting; (4) Mobility analytics and visualization; (5) Statistical and econometric analysis of transportation data; (6) Dynamic mobility management; (7) Travel survey methods and data collection; (8) Built environment – transportation – energy

#### **5 Recent Relevant Publications (from over 200)**

1. Salon, D., Conway, M. W., Capasso da Silva, D., Chauhan, R. S., Derrible, S., Mohammadian, A., ... & Pendyala, R. M. (2021). The potential stickiness of pandemic-induced behavior changes in the United States. *Proceedings of the National Academy of Sciences*, 118(27), e2106499118.
2. Mahmoudi, M., Tong, L. C., Garikapati, V. M., Pendyala, R. M., & Zhou, X. (2021). How many trip requests could we support? An activity-travel based vehicle scheduling approach. *Transportation Research Part C: Emerging Technologies*, 128, 103222.
3. Astroza, S., Garikapati, V. M., Pendyala, R. M., Bhat, C. R., & Mokhtarian, P. L. (2019). Representing heterogeneity in structural relationships among multiple choice variables using a latent segmentation approach. *Transportation*, 46, 1755-1784.
4. Long, K., Capasso da Silva, D., Dias, F. F., Khoeini, S., Bhat, A. C., Pendyala, R. M., & Bhat, C. R. (2019). Role of childhood context and experience in shaping activity-travel choices in adulthood. *Transportation research record*, 2673(7), 575-585.
5. Lavieri, P. S., Garikapati, V. M., Bhat, C. R., Pendyala, R. M., Astroza, S., & Dias, F. F. (2017). Modeling individual preferences for ownership and sharing of autonomous vehicle technologies. *Transportation research record*, 2665(1), 1-10.

#### **Graduate Student Supervision/Advising**

**Graduated:** 13 PhDs (includes 2 women), 51 Masters; **Current Supervision:** 3 PhDs

#### **Recent Honors and Awards**

Pyke Johnson Award for Best Paper in Planning and Environment, Transportation Research Board of the National Academies, 2011 and 2013

Invited Speaker, Distinguished Lecture Series, Department of Civil and Environmental Engineering, Florida International University, 2015

Invited Keynote Speaker at 5 International/National Conferences, 2014-2016

## **IRFAN BATUR**

**Associate Research Technologist**, Sustainable Engineering and the Built Environment  
Arizona State University (ASU), Tempe, AZ 85287-3005 Email: [ibat@asu.edu](mailto:ibat@asu.edu)

### **Education**

Ph.D., Civil, Environmental and Sustainable Engineering, Arizona State University, 2023 (expected)  
M.S., Industrial and System Engineering, Istanbul Sehir University, Istanbul, Turkey, 2014.  
B.S., Industrial Engineering, TOBB Economy and Technology University, Ankara, Turkey, 2012

### **Employment and Professional Experience (last 25 years)**

Associate Research Technologist, Arizona State University, Tempe, AZ, Apr 2022 – Present  
Graduate Teaching Associate, Arizona State University, Tempe, AZ, Aug 2019 – Present  
Graduate Research Associate, Arizona State University, Tempe, AZ, Aug 2019 – Apr 2022  
Research Specialist, Arizona State University, Tempe, AZ, Sep 2018 – Aug 2019  
Research Assistant, Qatar Foundation, Doha, Qatar, Aug 2015 – Sep 2018  
Graduate Teaching Assistant, Yildiz Technical University, Istanbul, Turkey, Jan 2014 – Sep 2015  
Graduate Teaching Assistant, Istanbul Sehir University, Istanbul, Turkey, Sep 2012 – Jan 2014

### **Fields of Interest and Expertise**

(1) Multimodal transportation systems planning; (2) Activity-travel behavior analysis; (3) Transportation demand modeling and forecasting; (4) Mobility analytics and visualization; (5) Statistical and econometric analysis of transportation data; (6) Sustainable and equitable transportation; (7) Travel survey methods and data collection; (8) Emerging transportation technologies; (9) Smart cities

### **5 Recent Relevant Publications (from over 200)**

1. Nair, G. S., Bhat, C. R., Batur, I., Pendyala, R. M., & Lam, W. H. (2020). A model of deadheading trips and pick-up locations for ride-hailing service vehicles. *Transportation Research Part A: Policy and Practice*, 135, 289-308.
2. Batur, I., Sharda, S., Kim, T., Khoeini, S., Pendyala, R. M., & Bhat, C. R. (2019). Mobility, Time Poverty, and Well-Being: How Are They Connected and How Much Does Mobility Matter?. Technical paper, Arizona State University.
3. Da Silva, D. C., Astroza, S., Batur, I., Khoeini, S., Magassy, T. B., Pendyala, R. M., & Bhat, C. R. (2019). Are Millennials Really All That Different Than Generation X? An Analysis of Factors Contributing to Differences in Vehicle Miles of Travel.
4. Batur, İ., Bayram, I. S., & Koc, M. (2019). Impact assessment of supply-side and demand-side policies on energy consumption and CO2 emissions from urban passenger transportation: The case of Istanbul. *Journal of Cleaner Production*, 219, 391-410.
5. Batur, İ., & Koç, M. (2017). Travel Demand Management (TDM) case study for social behavioral change towards sustainable urban transportation in Istanbul. *Cities*, 69, 20-35.

### **Recent Honors and Awards**

Pyke Johnson Award for Best Paper in Planning and Environment, Transportation Research Board of the National Academies, 2022  
Arizona State University 2021-22 GPSA Outstanding Research Award, Spring 2022.  
Best Presentation Award at the 2021 ITS Arizona Students' Transportation Summit, Apr 30, 2021.

### 13. Budget Including Non-Federal Matching Funds

**Institution:** Arizona State University

**Project Title:** Access to Food in a Severe Prolonged Disruption: The Case of Grocery and Meal Shopping During the COVID-19 Pandemic

**Principal Investigator:** Ram Pendyala

**Budget Period:** 8/1/2022 - 07/31/2023

CATEGORY	Budgeted Amount from Federal Share	Budgeted Amount from Matching Funds	Explanatory Notes; Identify Source of Matching Funds
Faculty Salaries			
Other Staff Salaries			
Student Salaries			
Fringe Benefits			
<b>Total Salaries &amp; Benefits</b>			
Student Tuition Remission			
Operating Services and Supplies			
Domestic Travel			
Other Direct Costs (specify)			
Other Direct Costs (specify)			
<b>Total Direct Costs</b>			
F&A (Indirect) Costs			
<b>TOTAL COSTS</b>			

**Grant Deliverables and Reporting Requirements for UTC Grants (November 2022)**  
**Exhibit F**

<b>UTC Project Information</b>	
Project Title	Access to Food in a Severe Prolonged Disruption: The Case of Grocery and Meal Shopping During the COVID-19 Pandemic
University	Arizona State University
Principal Investigator	Ram M. Pendyala
PI Contact Information	
Funding Source(s) and Amounts Provided (by each agency or organization)	
Total Project Cost	
Agency ID or Contract Number	
Start and End Dates	8/1/2022 - 07/31/2023
Brief Description of Research Project	The COVID-19 pandemic has revealed the fault lines in society. Whether it be remote work, remote learning, online shopping, grocery and meal deliveries, or medical care, there are disparities and inequities among socio-economic and demographic groups that leave some segments of society more vulnerable and less adaptable. This project aims to identify vulnerable and less adaptable groups in the context of access to food. Using a comprehensive behavioral survey data set collected during the height of the pandemic in 2020, this project aims to provide insights on the groups that may have experienced food access vulnerability during the disruption when businesses and establishments were restricted, the risk of contagion was high, and accessing online platforms required technology-savviness and the ability to afford delivery charges. The project proposes and presents estimation results for a simultaneous equations model of six endogenous choice variables defined by a combination of two food types (groceries and meals) and three access modalities (in-person, online with in-person pickup, and online with delivery). The model estimation results are anticipated to show that attitudes and perceptions play a significant role in shaping pandemic-era access modalities. The model is anticipated to reveal that, even after controlling for a host of attitudinal indicators, minorities, low-income individuals, and individuals residing in rural low-density areas are particularly vulnerable to being left behind and experiencing challenges in accessing food during severe and prolonged disruption. This has implications for social programs' plans of action and for policies that more effectively direct help to those most in need.
Describe Implementation of Research Outcomes (or why not implemented)	The model is anticipated to reveal that, even after controlling for a host of attitudinal indicators, minorities, low-income individuals, and individuals residing in rural low-density areas are particularly vulnerable to being left behind and experiencing challenges in accessing food during severe and prolonged disruption. If these anticipated findings are accurate, social
Place Any Photos Here	

	<p>programs should aim to provide these vulnerable groups with tools and financial resources to leverage online activity engagement and access modalities. This project is anticipated to show that minorities, individuals residing in households with low income, and rural residents are prone to food insecurity and vulnerability in the wake of a COVID-19 pandemic-type disruption. These groups need to be provided technological resources so they can participate in the online economy and leverage virtual platforms for procuring essential goods and services, including food. Providing assistance and training in the use of technology platforms would further assist in reducing vulnerability. Delivery fees can be quite substantial when ordering food and meals frequently, thus rendering the use of such services unaffordable for the income-constrained segments of society. Public subsidy programs (such as SNAP) need to be modified to cover delivery fees (perhaps up to a certain limit), thus enabling low-income individuals who depend on such programs for food to obtain groceries and meals without exposing themselves to risk.</p>
<p>Impacts/Benefits of Implementation (actual, not anticipated)</p>	<p>This project will result in the identification of and increased awareness about the most vulnerable populations in regard to food access in a period of severe and prolonged disruption. The anticipated findings provide insights for those leading social programs and policymakers to more accurately and efficiently help those most challenged and in need in future similar situations.</p>
<p>Web Links</p> <ul style="list-style-type: none"> <li>• Reports</li> <li>• Project Website</li> </ul>	