Transportation and Distribution of Food Banks and Pantries

THESIS

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Abstract

According to data from U.S. Department of Agriculture's report, Ohio had the third lowest food security across United States. To ease food insecurity, some non-profit, charitable organizations, such as Food Banks and Pantries, distribute food to those who have difficulty purchasing enough to avoid hunger. They act as food storage and distribution depots for smaller agencies in different locations. Although there are many agencies offering food, some people still do not have access to this food because of consumer's transportation constraints or the organization's distribution schedule. The purpose of this research is to identify factors related to food insecurity and propose a plan to reduce these problems. This is achieved through county-level regression analysis, from 2015, to investigate the relationship between food insecurity and other variables such as the number of low income population, total population of 2010, median family income, number of kids and seniors, poverty rate, and ethnicity. Based on these results, it will be easier for agencies to predict the future trend of people with food insecurity. A recent innovation in SNAP, which builds on the cooperation between local grocery stores and Amazon may help those with food insecurity. Findings from this research offer Food Banks and Pantries, government agencies, and local non-profit organizations more directions to alleviate food insecurity problems.

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IV. Introduction

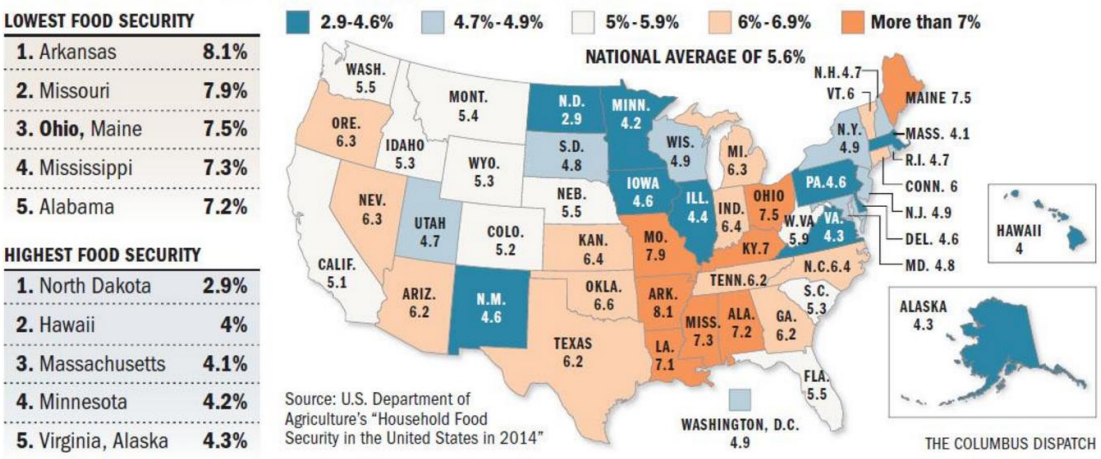
According to United States Department of Agriculture, food security means people have access at all times to get enough food for an active, healthy life. In 2010s, the generation of Baby Boomers is getting their 60s and 70s, which means that most of them are living without their kids or living in a nursing home. This generation is gradually losing their ability to make a living themselves so that the majority of them are suffering from food insecurity. With the development of science and technology, the gap between the poor and the rich grows larger and larger, which makes it hard for the poor people to find jobs to make a living. There is a clear increasing trend in food insecurity in the past ten years.

The solution of food insecurity varies states by states. For most states of United States, the most important cause of food insecurity is limited food accesses. From the report for Congress by the Economic Research service of the U.S. Department of Agriculture, nearly 2.3 million people live far away from supermarket or some food resources. Besides that, they do not have enough time to get food because most of them do not have a car.

This research will provide insights into the relationships between the demographics change and number of people with food insecurity, which aids to decision making in marketing and supply. This will help Food Banks and Pantries to make decisions on how much food to supply and where to supply. Secondly, this research conducted a case study to see if working with Amazon is good or not.

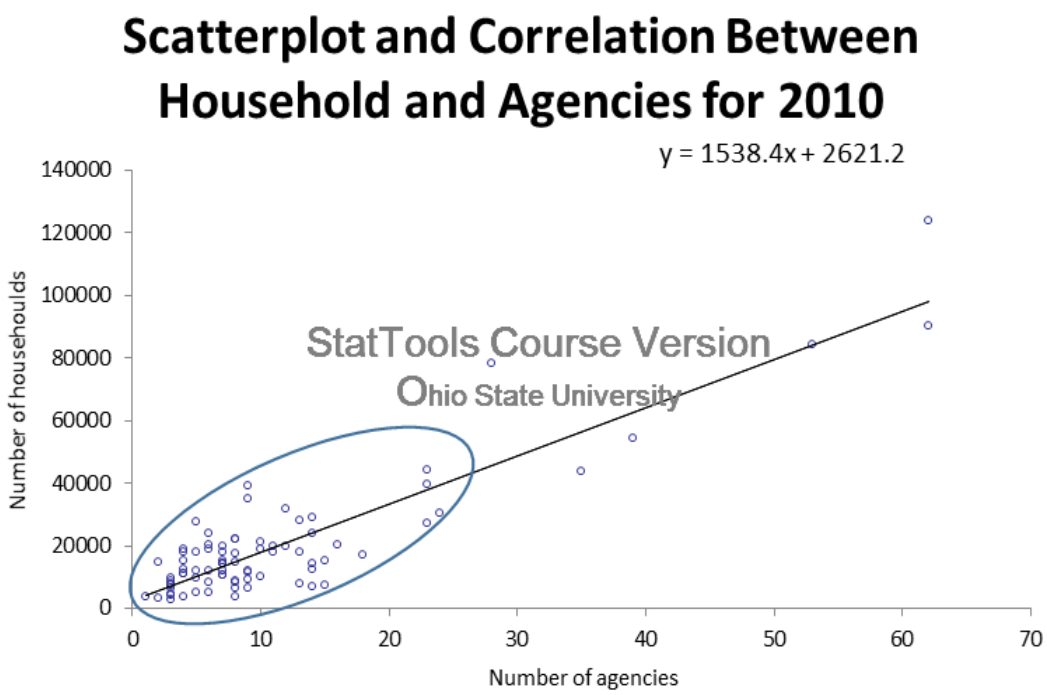
V. Background

According to the data from U.S. Department of Agriculture's Household Food security in the United States in 2014, Ohio was the third lowest food security across United States.

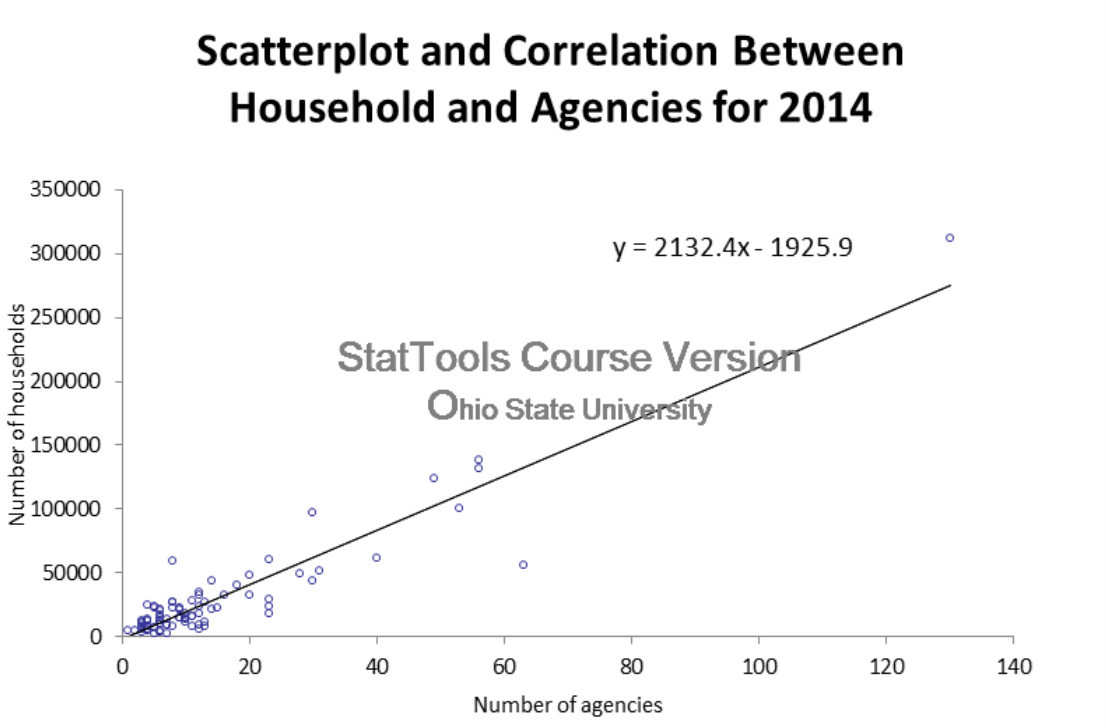


(graph resource: https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-statistics-graphics.aspx)

To alleviate food insecurity, government started a Supplemental Nutrition Assistance Program (SNAP). This program provides food assistance to households with different low-income level. People in SNAP can redeem food by using food stamps or Electronic Debit Card (EBT). Food Banks and Pantries, in conjunction with SNAP, are food storage and distribution center for different agencies across United States. In theory, each agency is responsible for people in certain area. Even though government and Food Banks and Pantries spent millions of dollars, there are still increasing number of people with food insecurity. From 2010 to 2014, the ratio between number of agencies and households is increasing, which means nowadays, each agency should serve more households with food insecurity.



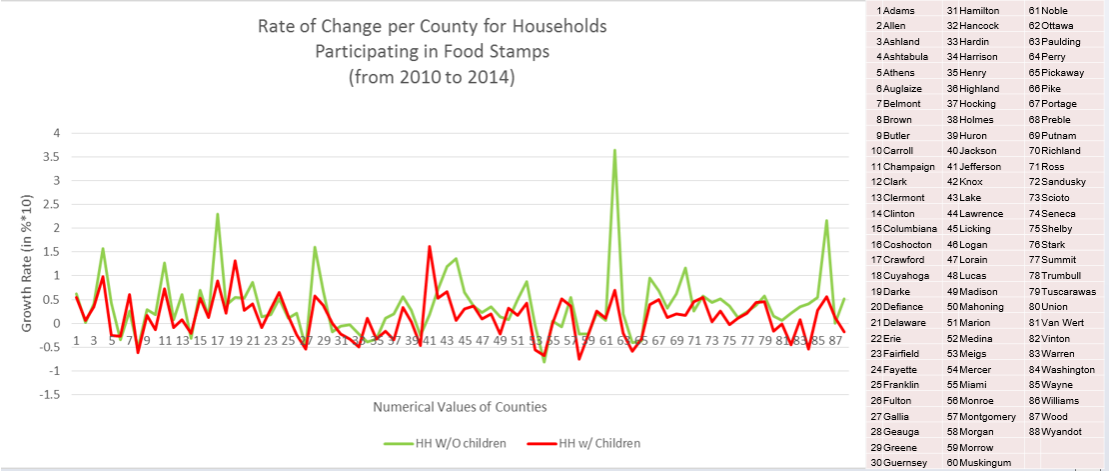
(figure 1)



(figure 2)

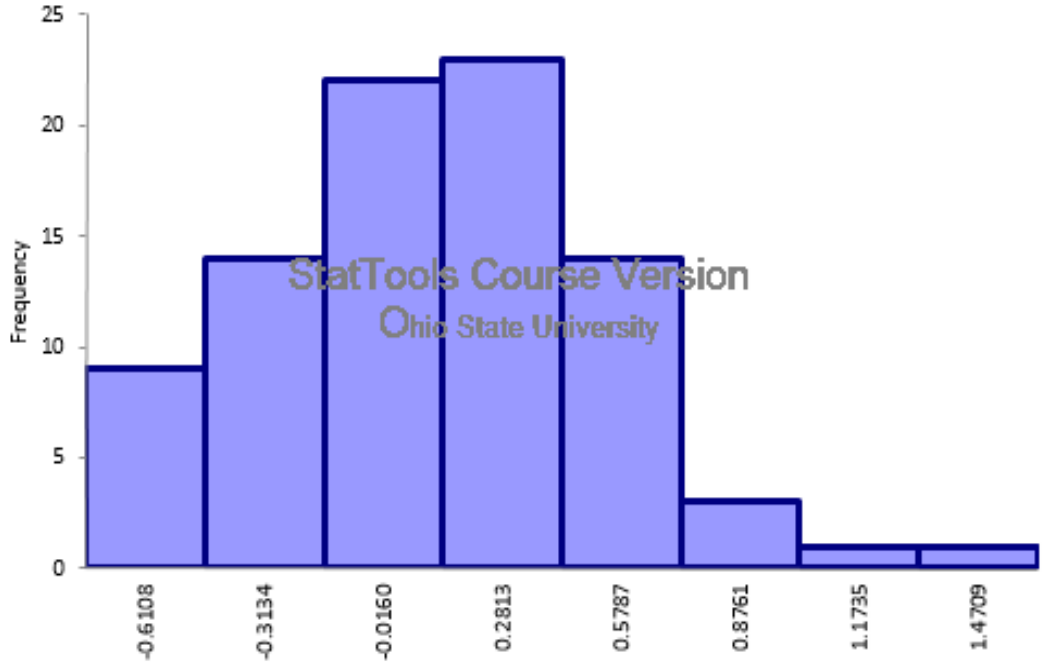
Figure 1 and Figure 2 show the correlation between number of agencies and the number of households that need food assistance. As expected, the number of agencies increase as the number of household increase. However, the number of households

served on average per increase in agency has increased significantly from 2010 to 2014. This can be seen in the equation generated by the fitted line in each of the graphs. In 2010 the equation y=1538.4x+2621.2 shows that per increase in agency there is approximately 1538 households served. In 2014 the equation has changed to y=2132.4x+1925.9 which means it has increased to approximately 2132 households served per agency increase.

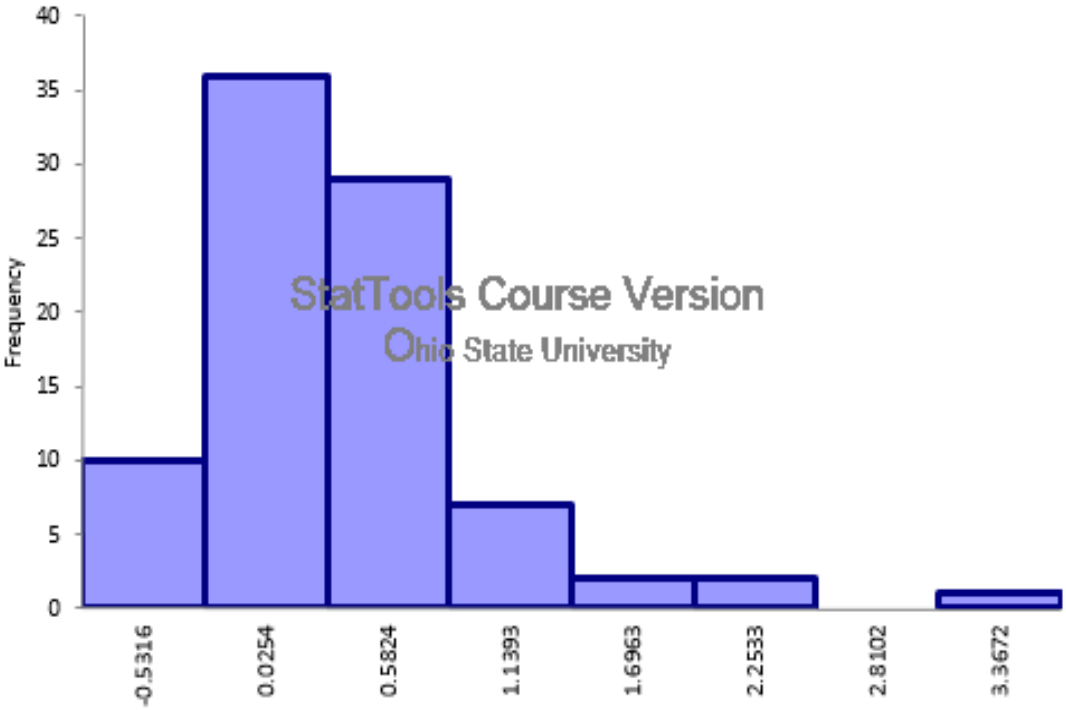


(figure 3)

Figure 3 shows the rate of change of households without children from 2010 to 2014 (shown in green) and households with children from 2010 to 2014 (shown in red). The county that each number references is shown to the right of the graph. Overall, households without children seem to have had a higher growth rate than households with children. There seemed to be a significant growth rate from 2010 to 2014 in County 62 (Ottawa), which should be investigated. County 17, 44, 66 and 86 had a significant higher growth rate (>10%) amongst their household without children compared to household with children. While County 41 and 19 had a significantly higher number of growth in households with children than households without children.



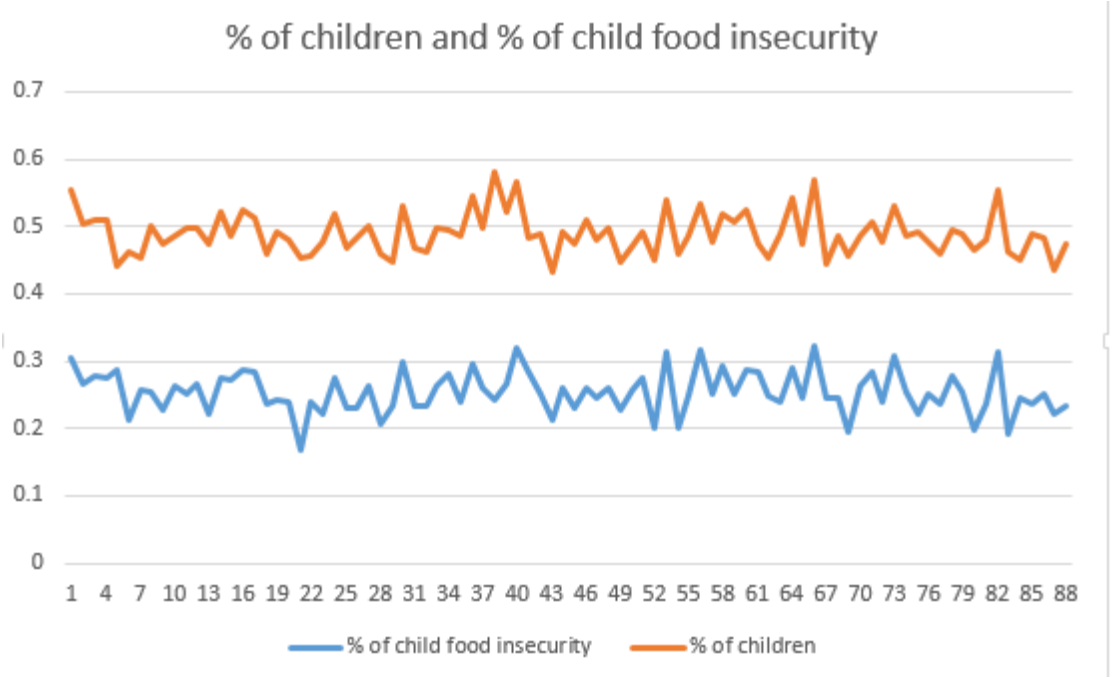
(figure 4)



(figure 5)

Figure 4 and Figure 5 show the frequency of the county's growth rate from years 2010 to 2014 for households with children and households without children. As we can see, the frequency of growth rate for households with children has a generally normal

distribution centered around a 0% growth rate. While the frequency of growth rate for households without children are skewed right and the majority of the growth rate is on the positive side.



(figure 6)

Figure 6 shows that the more children, the more food insecurity children.

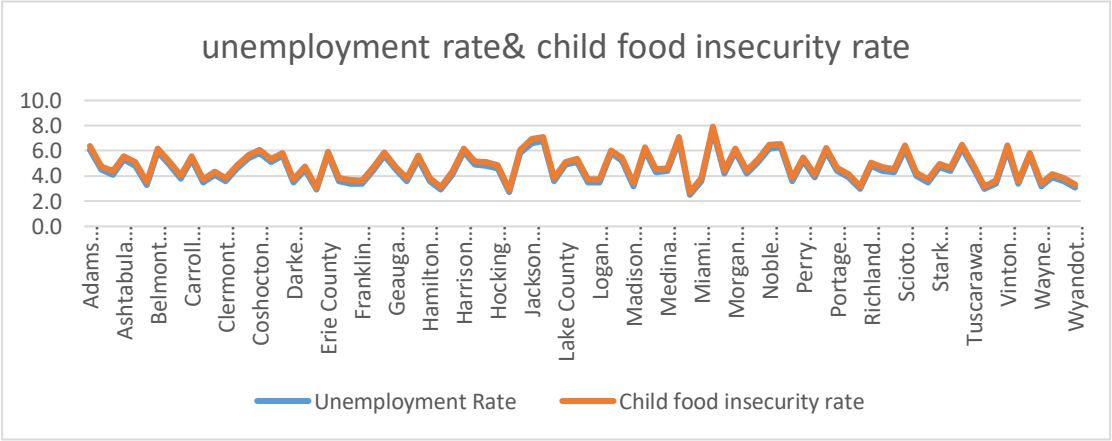


Figure (7)

One of the reason that causes child food insecurity is unemployment rate. Figure 7 shows that the unemployment rate is almost the same pattern as child food insecurity rate. From Figure 7, the pattern of unemployment rate and child food insecurity rate overlaps. Unemployment rate is a big factor of child food insecurity.

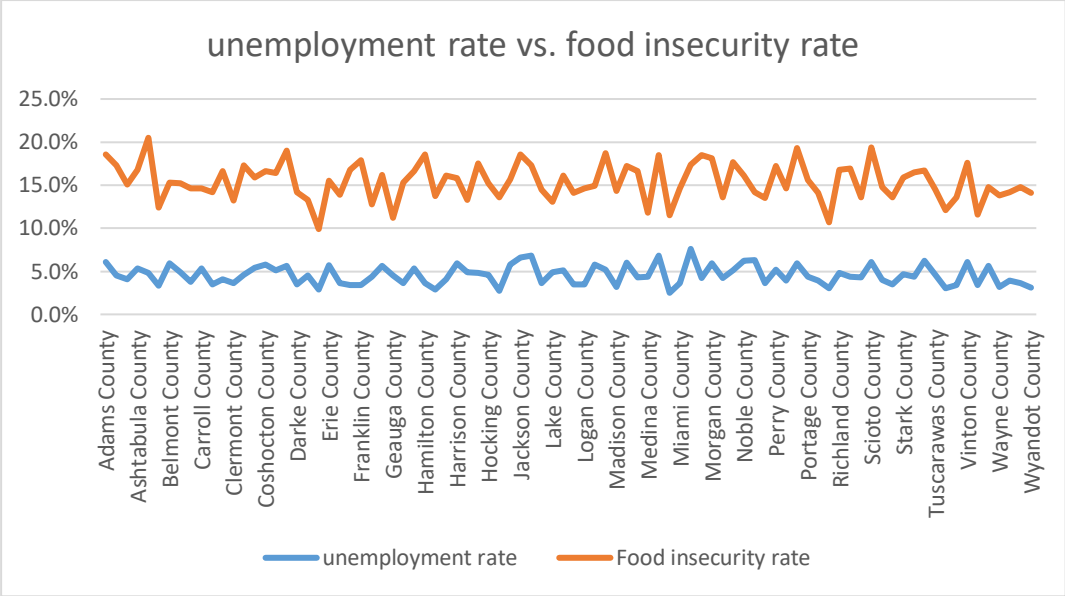


Figure 8

Another factor that causes food insecurity is median income level. Here we use median income because average income will have more outliers. Figure 8 shows the pattern of median income level and the number of households with food insecurity. The patterns almost the same but several counties are different. The food insecurity rates of counties like Butler, Delaware, and Sandusky are not influenced much by the unemployment rates. However, food insecurity rates of most counties are influenced by unemployment rates.

From the descriptive analysis of government agencies and number of people with food insecurity, government agencies are not enough for people with food insecurity to get enough food. Obviously, government agencies need helps from Food Banks and Pantries. In order to mitigate food insecurity problem, this research will build up a model to predict the number of housing receiving SNAP benefits and analyze the cooperation between Food Banks and Amazon Prime Fresh.

VI. Relevant Literature

There are multiple research papers about food insecurity and how to help more people to get food. A research paper (Rachel Loopstra and Valerie Tarasuk, 2012) addresses of food insecurity in Canada: because Canada lacks targeted policy to solve the problem of household food insecurity, Food Banks are still the main response to it. Researchers interviewed 371 people in low-income Toronto families, 75% of which are in food insecurity and 23% use a food bank. Most of Food Bank users still have food insecurity problem. The reason why some people are not using Food Banks is access barriers. These results reveal problems of the reliance of federal and provincial or territorial governments on food charity, access barriers and lack of food charity. Another research paper (Linda Theriault, Luc and Yadlowski, 2000) shares some ideas to solve the problems: promotion of Food Banks can attract donors and unite advocacy groups to work for food insecurity, which would make government to address this problem and make policies to solve it. Some research paper also talks about the volunteer problems. A study (Zelda Moldofsky, 2000) introduces a program that invite a group of people to cook for people with food insecurity and make nutritious and economical meals Cognitive behavior is used to change the negative attitudes towards this program and to overcome self-defeating and self-efficacy. This programs also help the participants to learn how to cook nutritious meals and build up self-esteem and self-efficacy.

VII. Hypothesis

This research will extend on this body of knowledge and experiments by analyzing two elements that will influence food insecurity:

1. Food availability: food must be in sufficient quantities and on consistent basis for people with food insecurity in an accessible area. Also, the local agencies like Food Banks have capacity to distribute food to people.

2. Food accessibility: people must be able to pick up adequate amount of food, through Food Banks and other agencies.

For the first element, this research finds the characteristics of people with food insecurity by using the online data that is provided by USDA. It'll be helpful to predict the future changes in demographics among people with food insecurity. The purpose is to find the demand of food and predict the future need for food so that Food Bank and Pantries can make correct decisions on how much they'd better offer and which area they need to focus on.

For the second element, this research finds the benefits of cooperation between Food Bank and Amazon. Recently, more and more researchers and marketers find that SNAP participants still tend to experience greater food insecurity problems than before. As a leader in online shopping industry, Amazon started to take the social responsibility because Amazon has a developed logistics and warehouse distribution systems. This decision will bring about a big change in food transportation because Amazon has its own warehouse and Amazon has already built up a relationship

between all those transportation service companies like USPS and UPS etc.

VIII. Methodology

Procedure

Research will be conducted by case study and regression analysis. The research shows regression analysis on the relationships between the number of housing receiving SNAP benefits and some factors like low income population, total population of 2010, median family income, number of kids and seniors, poverty rate, and ethnicity. The dataset used in this research is a subsample dataset from USDA website and consists of all the data of Food Access Research Atlas. After performing t test, some variables are statistically significant. This model is built via Ordinary Least Squares (OLS), which accounts for those statistically significant variables. To make this model accurate, this research also tests multicollinearity, omitted variable bias and heteroskedasticity. All the analysis is performed on STATA.

Besides that, the research shows a case study of SNAP program and Amazon. Recently Amazon has announced to cooperate with SNAP to make Prime membership more affordable to people who need government assistance. This research compares Amazon Prime Fresh with Kroger Pantry and non-profit organizations and charities in three perspectives: availability, time schedule, and product types. The main focus of case study is to show if Amazon can help to solve the food delivery problems. This case study is based on online journals and reports.

IX. Results and Discussions

9.1 Dataset Description

All data in the Food Access Research Atlas are aggregated into Excel spreadsheets. The variables in this regression is as following:

PovertyRate	Tract poverty rate	Share of the tract population living with income at or below the Federal poverty thresholds for family size
MedianFamilyIncome	Tract median family income	Tract median family income
TractLOWI	Tract low-income population, number	Total count of low-income population in tract
TractKids	Tract children age 0-17, number	Total count of children age 0-17 in tract
TractSeniors	Tract seniors age 65+, number	Total count of seniors age 65+ in tract
TractWhite	Tract White population, number	Total count of White population in tract
TractBlack	Tract Black or African American population, number	Total count of Black or African American population in tract
TractAsian	Tract Asian population, number	Total count of Asian population in tract
TractHispanic	Tract Hispanic or Latino population, number	Total count of Hispanic or Latino population in tract
TractSNAP	Tract housing units receiving SNAP benefits, number	Total count of housing units receiving SNAP benefits in tract
Urbanrural	Urban area or rural area	Urban county or rural county

From the dataset, the estimate equation shows as following:

$$\text{TrackSNAP} = \beta_0 + \beta_1 * POP2010 + \beta_2 * TractLOWI + \beta_3 * PovertyRate + \beta_4 * TractKids + \beta_5 * TractSeniors + \beta_6 * TractWhite + \beta_7 * TractBlack + \beta_8 * TractAsian + \beta_9 * TractHispanic + \beta_{10} * MedianFamilyIncome + \beta_{11} * Urbanrural$$

9.2 Multicollinearity

This research used both correlation coefficients and variance inflation factor to detect multicollinearity.

```
. corr TractLOWI TractSeniors
(obs=2,949)

             | TractL~I TractS~s
-------------+------------------
  TractLOWI  |   1.0000
TractSeniors |   0.1939   1.0000
```

```
. corr TractLOWI TractKids
(obs=2,949)

             | TractL~I TractK~s
-------------+------------------
  TractLOWI  |   1.0000
  TractKids  |   0.4067   1.0000
```

```
. corr TractLOWI TractWhite
(obs=2,949)

             | TractL~I TractW~e
-------------+------------------
  TractLOWI  |   1.0000
 TractWhite  |   0.2239   1.0000
```

```
. corr TractLOWI TractBlack
(obs=2,949)

             | TractL~I TractB~k
-------------+------------------
  TractLOWI  |   1.0000
 TractBlack  |   0.3312   1.0000
```

```
. corr TractLOWI TractAsian
(obs=2,949)

             | TractL~I TractA~n
-------------+------------------
   TractLOWI |   1.0000
  TractAsian |  -0.0257   1.0000
```

```
. corr TractLOWI TractHispanic
(obs=2,949)

             | TractL~I TractH~c
-------------+------------------
   TractLOWI |   1.0000
TractHispa~c |   0.3273   1.0000
```

```
. corr TractLOWI MedianFamilyIncome
(obs=2,949)

             | TractL~I Median~e
-------------+------------------
   TractLOWI |   1.0000
MedianFami~e |  -0.4666   1.0000
```

```
. corr TractLOWI PovertyRate
(obs=2,949)

             | TractL~I Povert~e
-------------+------------------
   TractLOWI |   1.0000
 PovertyRate |   0.4139   1.0000
```

The results show that all the correlation coefficients are less than 0.5, which is not high enough to influence the accuracy of regression model.

In this regression, there are more concerns in tract low income population number (TractLOWI) because it seems that there are more connections between TractLOWI and other independent variables, then variance inflation factor is performed as following:

TrackLowI= $\alpha_0 + \alpha_1 PovertyRate + \alpha_2 MedianFamilyIncome + \alpha_3 TractKids + \alpha_4 TractSeniors + \alpha_5 TractWhite + \alpha_6 TractBlack + \alpha_7 TractAsian + \alpha_8 Hispanic$

```
. reg TractLOWI PovertyRate MedianFamilyIncome TractKids TractSeniors TractWhite TractBlack TractAsian TractHisp
> anic
```

Source	SS	df	MS	Number of obs	=	2,949
				F(8, 2940)	=	733.48
Model	1.0160e+09	8	126995889	Prob > F	=	0.0000
Residual	509035558	2,940	173141.346	R-squared	=	0.6662
				Adj R-squared	=	0.6653
Total	1.5250e+09	2,948	517300.77	Root MSE	=	416.1

TractLOWI	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
PovertyRate	14.18091	.8087854	17.53	0.000	12.59506	15.76675
MedianFamilyIncome	-.0112128	.0004315	-25.99	0.000	-.0120589	-.0103668
TractKids	.2458179	.0356448	6.90	0.000	.1759265	.3157093
TractSeniors	.1739798	.0421335	4.13	0.000	.0913655	.256594
TractWhite	.1983845	.0131625	15.07	0.000	.1725758	.2241933
TractBlack	.2804876	.0182365	15.38	0.000	.2447299	.3162453
TractAsian	-.3909201	.0648836	-6.02	0.000	-.518142	-.2636983
TractHispanic	.5401512	.0484612	11.15	0.000	.44513	.6351725
_cons	572.2162	42.86533	13.35	0.000	488.1671	656.2653

Generally, if variance inflation factor is greater than 5, it is considered problematic. In this regression, $R^2 = 66.62\%$, variance inflation factor=$\frac{1}{1-R^2}$=$\frac{1}{1-66.62\%}$=2.9958<5. As a result, there's limited multicollinearity among groups of variables.

In this multicollinearity check, variance inflation factor is not severe enough to prevent testing.

9.3 Regression Model

```
. tab urban, gen(rdum)
```

urban	Freq.	Percent	Cum.
0	427	14.48	14.48
1	2,522	85.52	100.00
Total	2,949	100.00	

Set Urban as dummy variable.

```
. reg TractSNAP TractLOWI MedianFamilyIncome POP2010 PovertyRate TractKids TractSeniors TractWhite TractBlack T
> ractAsian TractHispanic rdum1
```

Source	SS	df	MS	Number of obs	=	2,949
				F(11, 2937)	=	929.77
Model	72345517.4	11	6576865.22	Prob > F	=	0.0000
Residual	20775361.4	2,937	7073.66747	R-squared	=	0.7769
				Adj R-squared	=	0.7761
Total	93120878.8	2,948	31587.8151	Root MSE	=	84.105

TractSNAP	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
TractLOWI	.1467496	.0040357	36.36	0.000	.1388366	.1546626
MedianFamilyIncome	-.0002164	.000097	-2.23	0.026	-.0004067	-.0000262
POP2010	.313607	.0364374	8.61	0.000	.2421615	.3850525
PovertyRate	2.479964	.1723722	14.39	0.000	2.141981	2.817946
TractKids	.0867827	.0073552	11.80	0.000	.0723608	.1012047
TractSeniors	.0998003	.0085997	11.61	0.000	.0829383	.1166624
TractWhite	-.3550235	.0364974	-9.73	0.000	-.4265866	-.2834604
TractBlack	-.3185235	.0370899	-8.59	0.000	-.3912484	-.2457987
TractAsian	-.4487603	.0407006	-11.03	0.000	-.5285648	-.3689558
TractHispanic	-.1439762	.0231344	-6.22	0.000	-.1893375	-.098615
rdum1	1.728475	4.830328	0.36	0.720	-7.742697	11.19965
_cons	-9.429334	8.987875	-1.05	0.294	-27.05251	8.19384

$$\begin{aligned}\text{TrackSNAP} = {} & -9.43 + 0.31 * POP2010 + 2.48 * \text{PovertyRate} + 0.15 \\ & * TractLOWI + 0.087 * TractKids + 0.10 * TractSeniors - 0.36 \\ & * TractWhite - 032 * TractBlack - 0.45 * TractAsian - 0.14 \\ & * TractHispanic - 0.00022 * MedianFamilyIncome + 1.73 \\ & * Urban\end{aligned}$$

From the regression result, all the variables, except constant and dummy variable, are statistically significant because the absolute t value is higher than critical t value at 99% significance level. All the variables in this model are important indicators to predict the number of housing receiving SNAP benefits.

On average, for each additional person, the number of family unit receiving SNAP would increase by 0.31. In other words, for each additional three people, the number of family unit receiving SNAP would increase by nearly 1. Ethnicity has negative impact on the number of family unit receiving SNAP.

9.4 Omitted Variable Bias

In this regression model, there are some omitted variable like unemployment rate. The correlation coefficient of food insecurity rate and unemployment rate is moderately correlated with each other. As a result, the omitted variable “unemployment rate” is not problematic.

```
. corr foodinsecurityrate unemploymentrate
(obs=88)
```

	foodin~e	unempl~e
foodinsecu~e	1.0000	
unemployme~e	0.6287	1.0000

9.5 Heteroskedasticity

One of the assumptions for OLS to be "Best Linear Unbiased Estimator" is no heteroskedasticity. This research performed White Test to see if there's heteroskedasticity. The result of heteroskedasticity in this model is shown as below:

```
. estat imtest, white

White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(65)     =   1441.56
         Prob > chi2  =    0.0000

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	1441.56	65	0.0000
Skewness	225.96	10	0.0000
Kurtosis	6.75	1	0.0094
Total	1674.27	76	0.0000

This result shows that there's heteroskedasticity in original regression model. In order to see if transformation of variables is needed, this research performed BOXCOX in STATA.

```
. boxcox TractLowI TractHispanic TractAsian TractBlack TractWhite TractSeniors TractKids MedianFamilyIncome Pove
> rtyRate
Fitting comparison model

Iteration 0:   log likelihood = -23583.032
Iteration 1:   log likelihood = -23383.036
Iteration 2:   log likelihood = -23351.652
Iteration 3:   log likelihood = -23351.384
Iteration 4:   log likelihood = -23351.384

Fitting full model

Iteration 0:   log likelihood = -21965.161
Iteration 1:   log likelihood = -21825.187
Iteration 2:   log likelihood = -21631.437
Iteration 3:   log likelihood = -21630.621
Iteration 4:   log likelihood = -21630.621

                                                Number of obs   =      2,949
                                                LR chi2(8)      =    3441.53
Log likelihood = -21630.621                     Prob > chi2     =      0.000
```

TractLowI	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
/theta	.5480273	.0147732	37.10	0.000	.5190723	.5769823

Estimates of scale-variant parameters

	Coef.
Notrans	
TractHispa~c	.018924
TractAsian	-.0146707
TractBlack	.0093108
TractWhite	.0072707
TractSeniors	.0119591
TractKids	.0101512
MedianFami~e	-.0004762
PovertyRate	.5919046
_cons	59.7491
/sigma	15.78373

Test H0:	Restricted log likelihood	LR statistic chi2	P-value Prob > chi2
theta = -1	-37060.524	30859.81	0.000
theta = 0	-22972.504	2683.77	0.000
theta = 1	-21965.161	669.08	0.000

This result shows that all three cases (H_0:theta=-1, H_0:theta=0, H_0:theta=1) return 0.000 p-value, rejecting all the possible specifications (reciprocal, log and linear specification respectively.)

Then this research used robust regression to correct heteroskedasticity in original model:

```
. reg TractSNAP TractLOWI MedianFamilyIncome POP2010 PovertyRate TractKids TractSeniors TractWhite TractBlack T
> ractAsian TractHispanic rdum1, robust

Linear regression                               Number of obs     =      2,949
                                                F(11, 2937)       =     608.68
                                                Prob > F          =     0.0000
                                                R-squared         =     0.7769
                                                Root MSE          =     84.105
```

TractSNAP	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
TractLOWI	.1467496	.0071698	20.47	0.000	.1326912	.1608079
MedianFamilyIncome	-.0002164	.000122	-1.77	0.076	-.0004557	.0000228
POP2010	.313607	.0555106	5.65	0.000	.2047634	.4224506
PovertyRate	2.479964	.2137428	11.60	0.000	2.060863	2.899064
TractKids	.0867827	.0163619	5.30	0.000	.0547008	.1188647
TractSeniors	.0998003	.013446	7.42	0.000	.0734358	.1261649
TractWhite	-.3550235	.0557644	-6.37	0.000	-.4643649	-.2456821
TractBlack	-.3185235	.05581	-5.71	0.000	-.4279543	-.2090928
TractAsian	-.4487603	.0621951	-7.22	0.000	-.5707107	-.3268099
TractHispanic	-.1439762	.0321414	-4.48	0.000	-.2069982	-.0809543
rdum1	1.728475	4.849525	0.36	0.722	-7.780337	11.23729
_cons	-9.429334	11.83365	-0.80	0.426	-32.63242	13.77375

The assumptions of P value in White Test depend on both independent variables and sample size. In this case, heteroskedasticity cannot be eliminated but robust regression corrected heteroskedasticity in this model. Coefficients in this model are not biased.

9.6 Case Study of Food banks and Amazon

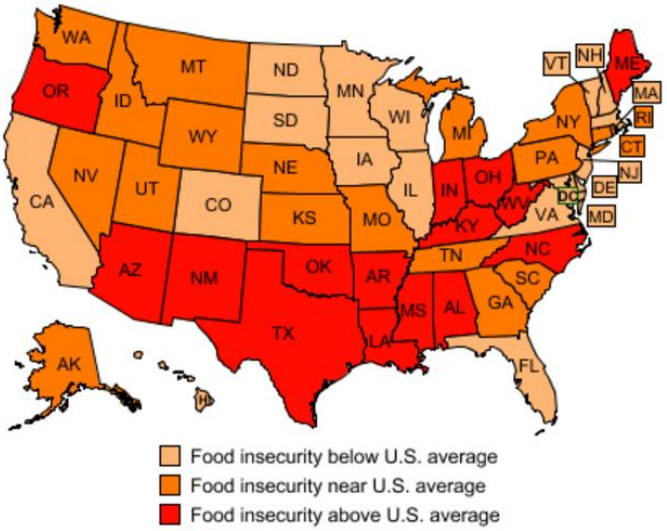
1) Introduction

This case is focus on the food access problems and proposes three alternatives to mitigate the food insecurity. After comparing the advantages, disadvantages and constraints of three alternatives, cooperation with Amazon is the best way to deliver and distribute food fast and efficiently.

2) Background

From the report of USDA, 41.2 million people are suffering food insecurity. Even though government, local food banks, and food pantries put a lot of efforts to mitigate food insecurity problems, there's no big change in food insecurity rate: 12.7% in 2015 and 12.3% in 2016.

Prevalence of food insecurity, average 2014-16



Source: USDA, Economic Research Service, using data from the December 2014, 2015, and 2016 Current Population Survey Food Security Supplements.

Based on the heatmap, Ohio has a severe problem of food insecurity: the food insecurity rate is much higher than U.S. average. However, government and local food banks and pantries spent millions of dollars on hunger and started programs to help local people with food insecurity or activities to address the public attention on hunger.

Given the rich agriculture history of Ohio, Ohio is a big state for food production. Fortunately, Ohio has research and development centers to mitigate the severe food problems. But simply growing and producing more food cannot solve the root cause of food insecurity. What are needed right now are consistent and sustainable food supply and more food accesses for people with food insecurity.

Nowadays, fewer acres of land are farmed so overproduction is popular in Ohio. Overproduction can easily cause food waste and increase the food price. Increasing food price will make more people food-insecured, which makes the situation worse. As a result, more food accesses are a significant key to ease food insecurity.

3) Alternatives

In order to help people with food insecurity, USDA kicked off Supplemental Nutrition Assistance Program (SNAP), which assists millions of low-income individuals and households to get food. There are three alternatives that most food banks and pantries are trying to implement.

a. Kroger Pantry.

In 2012, Kroger Community Food Pantry started to open to the community four days a week. Individuals or households with food insecurity can use food stamps or show the front desk their ID or documents to shop for food in Kroger Community Food Pantry. In Kroger Community Food Pantry, there will be volunteers to guide customers to buy different food.

However, there's only one Kroger Community Food Pantry in Ohio. The location of this food pantry is in Grove City, which is far away from where most food insecured people live. It took several hours of bus traveling to get to this pantry. Most food-insecured people are below average income so that they do not have cars to make the distance shorter. Getting food by bus will become a new problem for them.

Another issue with Kroger food pantry is that the open time fluctuates a lot based on volunteers because it needs volunteers to guide and operate for daily business. Usually this food pantry opens during business hour and rush hours, which makes it harder for poor people to get food. Some food-insecured people have daily jobs but the open hours of this food pantry are definitely not enough for them to get food after working. Besides that, the volunteer time is based on volunteers' schedules. Some poor people might have a time conflict with the volunteer time.

This pantry is a good starter but cannot solve the food access problem because of time variation and long distance.

b. Charity and Non-Profit Organization

Food banks cooperated with local charity and non-profit organization, most of which are churches or community organizations. The open hours of each church are various, depending on the daily operation of each church. Some churches only open on Friday but some are open on Sunday. For people with no religion, it's awkward to get food in church or get involved in church's activities.

For non-profit organization, their open hours depend on volunteers. If no volunteers participated, organization will not continue distributing food to food-insecured people. Distributing food is heavy labor work so it's really hard for organizations to attract volunteers to join in. Even if there are volunteers to distribute, it's hard for them to do it for a long time. Most of volunteering work lasts only one to two hours. It's not enough for some people to get their food.

4) Proposed Solution

Amazon Prime Fresh

Transportation is a big barrier of food access because most of food-insecured people cannot afford a car or gasoline cost. One possible solution to transportation problem is online shopping. The best partner to cooperate is Amazon.

On June 9, 2017, Amazon announced that it will lower the Prime cost for people on government assistance programs, including food stamps. This cooperation means that people with food insecurity can purchase food online by using Electronic Benefits Transfer cards. Prime membership will offer them a two-day shipping, which mediates the problems of food inaccessible for some low-income people.

Before this announcement, USDA starts a USDA-led program with many retailers and fresh goods suppliers. People can use their food stamps to purchase food through Amazon Pantry, which includes fresh goods and packaged goods. Moreover, Amazon

launched Amazon Cash earlies this year. Lower-income households or individuals can connect their debit or credit cards with their Amazon account and add cash to it. Also, they can enjoy Amazon discount while shopping at brick-and-mortar retailers.

Based on Amazon Cash and Amazon Prime Fresh, people with food insecurity can buy fresh foods and necessities online and it only takes two-day prime shipping so that they can get what they want faster than go to charity or organizations. Besides that, online shopping can reduce the transportation costs and save time for poor people and provide a convenient channel for them to get food. This channel offers poor people a chance to buy a variety of foods.

To solve the problem of limited food accesses, cooperation with Amazon is the best way to eradicated starvation of Ohio. Amazon Prime Fresh provides food-insecured households and individuals an opportunity to buy foods and daily supplies online through Amazon Pantry, which can save much time and money for poor people. Amazon also offers discounts on Prime membership for the starving people at $5.99 per person and anyone who has Prime membership can enjoy the two-day free shipping, saving much transportation fees for food-insecured people.

5) Future Implementation

In fact, Amazon Prime Fresh has its pros and cons. Before Amazon Prime Fresh implemented, most participants in SNAP program go to convenience stores for food. If Amazon started this program and established Amazon offices in the streets for people to get food or redeem food, the sales revenue of most convenience stores would drop quickly. In a long run, it will increase unemployment rate and more people would be food insecured.

From another perspective, most food that participants in SNAP program buy is unhealthy food like chips, ramen, and fast food. Amazon Prime Fresh would

definitely help them to buy fresh and healthy food. As a result, less people would have diabetes and it would decrease the medical expenditures for those poor families.

So for future study, researchers could find out if advantages outweigh disadvantages.

X. Conclusion

This research builds up a robust regression model based on the most current version of data published by USDA. The regression result shows some important variables that needed to be considered while predicting future amount of food. Those variables are low income population, poverty rate, population of 2010, number of kids, and the number of seniors. This model can help Food Banks and Pantries to estimate food amount of each county in future.

Moreover, the case study shows that Amazon Prime Fresh has comparative advantages over Kroger Pantries, non-profit organizations, and charities in availability, time schedule, and types of products. Amazon is a better partner for Food Banks and Pantries.

XI. Recommendations and Future Research

There are several unanswered questions about food accesses in this research that will lead to more future research and studies. Future research can investigate on how to attract more big companies like Amazon to work with food banks in order to distribute and make food for food-insecured people and why local restaurants and supermarkets do not partner with food banks to help the local community.

Recently there are more and more researchers concern about diabetes among food-insecured people because most of poor people like buying can food in convenience stores near gas station, which are high in sugar and calories. The reason why they like to buy in convenience stores is not only that it's convenient but also that they like the food in convenience stores. The scholars and professionals are still researching for solution of this behavior.

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