

From Problem Statement to Datafile

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URSC 645 - February 18, 2025

Overview

Project example of how research team followed the following steps:

1. Problem Statement
2. Research Question
3. Theoretical Construct Domains
4. Data Collection
5. Data File
6. Modeled results



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**HAZARD REDUCTION
& RECOVERY CENTER**
TEXAS A & M UNIVERSITY



DESIGNSAFE



All Data and Instruments available on DesignSafe-CI:

Rosenheim, N. Peacock, W. Williams, A. Lane, G. Watson, M. Sullivan, E. Katare, A. Kastor, H. (2021) "Report of Applied Methods", in *Food Access Impact Survey for Harris County and Southeast Texas after Hurricane Harvey in 2017*. DesignSafe-CI. <https://doi.org/10.17603/ds2-dh61-m731>.

This material is based upon work supported by the National Science Foundation under Grant No. (1760726). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

The Problem

Principal Proposition: Access after disasters to resources such as food poses planning problems that affect millions of people each year.

Interacting proposition: Most post-disaster research focuses on store closures, property damage, and proximity-based measures of accessibility. Which may underestimate the number of days with limited access to food after a disaster.

Speculative Proposition: Understanding how disasters disrupt and alter food access during the initial steps of the recovery process provides new evidence to inform both food system and disaster planning.



Credit: REUTERS/Richard Carson

Research Questions

Research Question 1: How did critical infrastructure failure impact the functioning of food suppliers?

Research Question 2: Did the change in functioning of food suppliers also change food access?

Assessing Research Questions:

A research question formulated according to the following criteria ensures that your study has a solid center that can hold all of the pieces of the study together:

1. The research question clearly identifies the **theoretical construct** you are studying.
2. The research question contains some suggestion of recognizability of the **theoretical construct**. Will you be able to locate it and distinguish it easily from other constructs that appear in your data?
3. The research question (usually) transcends your data.
4. The research question identifies your study's contribution to an understanding of the **theoretical construct**.
5. The research question has the capacity to surprise. Do you already know the answer?
6. The research question can produce robust results. If you can answer the question with yes or no, results are not robust.

Research Questions: Theoretical Constructs

Research Question 1: How did **critical infrastructure failure** impact the **functioning** of **food suppliers**?

Research Question 2: Did the change in **functioning** of **food suppliers** also change **food access**?

Theoretical Construct Domains

Research Question 1:

How did **critical infrastructure failure**
impact the **functioning** of
food suppliers?

<u>Key Concepts</u>	<u>Domains</u>
Critical Infrastructure	Buildings Electricity Water Transportation Communications
Failure	Building damage Power loss Water loss Street closure Sidewalk closure Landline phone loss Internet loss
Food Suppliers	Food Aid Agencies Food Retailers

Theoretical Construct Domains

Research Question 1:

Research Question 2: Did
the change in **functioning** of
food suppliers also change
food access?

Key Concepts	Domains
Functioning of food suppliers	People
	Property
	Product
	Accessibility
	Affordability
Food Access	Availability
	Acceptability
	Accommodation

Food Retail Data Collection

Critical Infrastructure Failure Functioning

Food Access

POST-HURRICANE HARVEY FIELD STUDY IN SOUTH EAST TEXAS FOOD RETAIL SURVEY



STOREID: DATE: - -

From Friday, August 25 through Thursday, August 31, Hurricane Harvey brought over 50 inches of rain to the Houston-area. The record amount of rain caused power outages, flooding, road closures, and crippled area water supplies. A research team from Texas A&M University's Hazard Reduction and Recovery Center wants to learn more about how Hurricane Harvey's flooding and infrastructure disruptions directly affected the food retailers of South East Texas.

We would like to ask you some brief survey questions about this business's experience before and after Hurricane Harvey. Your participation is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participation at any time without penalty. If you have any questions or concerns, please contact the survey's principal investigator Nathanael Rosenheim at nrosenheim@arch.tamu.edu or 979-845-7813.

(The following questions should be answered by the business owner, a manager or an employee with knowledge about store operations and food availability before and after Hurricane Harvey)

1. What is your role with this business? 1. Owner 2. Manager 3. Owner and Manager

4. Assistant Manager 5. Other _____

If owner or manager is not available, determine if the person available to complete the interview has sufficient knowledge to complete the survey. If not request a time or alternative way to interview the owner or manager.

a. Did you work at this business prior to Hurricane Harvey? 1. Yes 2. No

INFRASTRUCTURE DAMAGE- Now we would like to ask questions related to how infrastructure (buildings, water, electric power, roads, etc.) failed during and after Hurricane Harvey.

2. Did Hurricane Harvey flood waters touch this business's building? 1. Yes 2. No

a. If yes, approximately how high did the waters reach in the building: _____ feet _____ inches

3. What kind of physical damage (if any) was caused by Hurricane Harvey and how severe was the damage?

Building damage	1. <input type="checkbox"/> None 2. <input type="checkbox"/> Minor 3. <input type="checkbox"/> Moderate 4. <input type="checkbox"/> Severe 5. <input type="checkbox"/> Complete
Non-food inventory damage	1. <input type="checkbox"/> None 2. <input type="checkbox"/> Minor 3. <input type="checkbox"/> Moderate 4. <input type="checkbox"/> Severe 5. <input type="checkbox"/> Complete
Fresh food inventory damage	1. <input type="checkbox"/> None 2. <input type="checkbox"/> Minor 3. <input type="checkbox"/> Moderate 4. <input type="checkbox"/> Severe 5. <input type="checkbox"/> Complete
Machinery/equipment damage	1. <input type="checkbox"/> None 2. <input type="checkbox"/> Minor 3. <input type="checkbox"/> Moderate 4. <input type="checkbox"/> Severe 5. <input type="checkbox"/> Complete
- If yes to equipment	
Freezer damage	1. <input type="checkbox"/> None 2. <input type="checkbox"/> Minor 3. <input type="checkbox"/> Moderate 4. <input type="checkbox"/> Severe 5. <input type="checkbox"/> Complete
Refrigerator damage	1. <input type="checkbox"/> None 2. <input type="checkbox"/> Minor 3. <input type="checkbox"/> Moderate 4. <input type="checkbox"/> Severe 5. <input type="checkbox"/> Complete

4. [www.typesofdamagetoinfrastructure.com](#) (only were applicable to this business)

Did this business lose: (loss includes loss of quality and dependability)	4a. If yes, how long until it was fully repaired? (Back to normal)	Still not fully repaired
Electric Power	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No 3. <input type="checkbox"/> DK 4. <input type="checkbox"/> N/A	_____ Hours or _____ Days
Water	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No 3. <input type="checkbox"/> DK 4. <input type="checkbox"/> N/A	_____ Hours or _____ Days
Sewer	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No 3. <input type="checkbox"/> DK 4. <input type="checkbox"/> N/A	_____ Hour or _____ Days
Natural Gas	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No 3. <input type="checkbox"/> DK 4. <input type="checkbox"/> N/A	_____ Hour or _____ Days
Landline Phone	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No 3. <input type="checkbox"/> DK 4. <input type="checkbox"/> N/A	_____ Hours or _____ Days
Internet	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No 3. <input type="checkbox"/> DK 4. <input type="checkbox"/> N/A	_____ Hours or _____ Days

- a. If yes to loss of electric power, did this business use a backup generator? 1. Yes 2. No 3. Did Not Ask
i. If yes, how long was the backup generator used? _____ days
- b. If yes to loss of water, did this business have backup water supply? 1. Yes 2. No 3. Did Not Ask
i. If yes, how long did the backup water supply last? _____ days
- c. Any other backup systems used besides generators or water supply? 1. Yes 2. No 3. Did Not Ask
i. If yes please describe _____

Food Retail Data Collection

Critical Infrastructure Failure

Functioning

Food Access



- □ □ □ □ □ □
5. Did this business experience any accessibility problem (i.e. street or sidewalk closure)? 1. Yes 2. No
6. Did Hurricane Harvey flood waters impact the neighborhood surrounding this business? 1. Yes 2. No
a. If yes, what were the impacts in the neighborhood surrounding the business? (check all that apply)
i. Streets around the business were flooded, but vehicles could pass 1. Yes 2. No
ii. Streets around business were severely flooded, vehicles could not pass through streets 1. Yes 2. No
iii. Homes in the neighborhood were flooded 1. Yes 2. No
iv. Other businesses in the neighborhood were flooded 1. Yes 2. No
v. Other (Please describe) _____ 1. Yes 2. No

IMPACT ON EMPLOYEES

7. Before Hurricane Harvey, how many employees did this business have? What about now?
Before: Total Number of Employees _____ [Full time _____ Part time _____]
Now: Total Number of Employees _____ [Full time _____ Part time _____]
8. How many of this business's current employees worked for this business prior to Hurricane Harvey?
Total Number of Employees _____ [Full time _____ Part time _____]

Now I would like to ask questions about issues employees may have had reporting to work.

9. After Hurricane Harvey, did employees experience problems reporting to work? 1. Yes 2. No
a. Employee(s) could not report to work due to road network problems? 1. Yes 2. No
b. Employee(s) could not report to work due to personal vehicle problems? 1. Yes 2. No
c. Employee(s) could not report to work due to damage to home? 1. Yes 2. No
d. Employee(s) could not report to work due to being forced out of home? 1. Yes 2. No
e. Other reasons (specify) _____

IMPACT ON CUSTOMERS

10. Due to Hurricane Harvey, did this business experience an increase in customers? 1. Yes 2. No
a. If yes, approximately what was the percent increase in customers _____%
b. For what time period(s) did this business see an increase in customers _____
11. Due to Hurricane Harvey, did this business experience a loss of customers? 1. Yes 2. No
a. If yes, approximately what was the percent decrease in customers _____%
b. For what time period(s) did this business see an decrease in customers _____

12. Before Hurricane Harvey, was this business open 7 days a week? 1. Yes 2. No

- a. If no, how many days a week? _____
13. Immediately following Hurricane Harvey, did this business's operating hours change? 1. Yes 2. No
a. Did this business completely cease operations (close) at this location? 1. Yes 2. No
i. For what time period(s) was this business closed? _____
ii. What day did this business reopen? _____
iii. What were the primary reasons [show numbered list p. 5]? _____
b. Did this business reduce hours of operation at this location? 1. Yes 2. No
i. For what time period(s) did this business operate at reduced hours? _____
ii. What were the primary reasons [show numbered list p. 5]? _____
c. Did this business increase hours of operation at this location? 1. Yes 2. No
i. For what time period(s) did this business operate at increased hours? _____

Food Retail Data Collection

Critical Infrastructure Failure

Functioning

Food Access

POST-HURRICANE HARVEY FIELD STUDY IN SOUTH EAST TEXAS
FOOD RETAIL SURVEY



STOREID: DATE: - -

IMPACT ON FRESH FOOD AVAILABILITY - Now we would like to ask questions related to the availability of fresh food after Hurricane Harvey.

14. Before Hurricane Harvey did this business sell:

- a. Fresh Fruit 1. Yes 2. No
- b. Fresh Vegetables 1. Yes 2. No
- c. Fresh Meat 1. Yes 2. No
- d. Dairy 1. Yes 2. No
- e. Bread 1. Yes 2. No

Stopped Sales of Fresh Food – NOTE: If the store was closed base these dates after the store was reopened

15. Once the store was reopened, did this business stop selling any fresh food items (mentioned above) after Hurricane Harvey? 1. Yes 2. No 3. Did not ask

- a. If yes, which fresh food items?

Did this business stop selling:	If yes, when did this business start selling?	Still not selling
Fresh Fruit	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No	date _____ or days or weeks 1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No
Fresh Vegetables	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No	date _____ or days or weeks 1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No
Fresh Meat	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No	date _____ or days or weeks 1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No
Dairy	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No	date _____ or days or weeks 1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No
Bread	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No	date _____ or days or weeks 1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No

- b. If yes to any fresh food group above, we want to find out the reasons why this store stopped selling fresh food items after Hurricane Harvey. What were the primary reasons [show numbered list p. 5]?

i. Fresh Fruit _____

ii. Fresh Vegetables _____

iii. Fresh Meat _____

iv. Dairy _____

v. Bread _____

Reduced Sales of Fresh Food – Shortages of Supply or Reduced Demand

16. Once the store was reopened, did this business experience reduced sales of fresh food items after Hurricane Harvey? 1. Yes 2. No 3. Did not ask

- a. If yes, which fresh food items?

Did this business have reduced sales of	If yes, when did sales return to normal	Still not normal
Fresh Fruit	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No	date _____ or days or weeks 1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No
Fresh Vegetables	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No	date _____ or days or weeks 1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No
Fresh Meat	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No	date _____ or days or weeks 1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No
Dairy	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No	date _____ or days or weeks 1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No
Bread	1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No	date _____ or days or weeks 1. <input type="checkbox"/> Yes 2. <input type="checkbox"/> No

- b. If yes to any fresh food group above, we want to find out the reasons why this store had reduced sales of fresh food items after Hurricane Harvey. What were the primary reasons [show numbered list p. 5]?

vi. Fresh Fruit _____

vii. Fresh Vegetables _____

viii. Fresh Meat _____

ix. Dairy _____

x. Bread _____

17. Did this store limit food sales – for example limiting bread and milk to 1 item per customer? 1. Yes 2. No

Data File

Critical Infrastructure Failure

Functioning

Food Access

Variable name	Storage type	Display format	Value label	Variable label
rstoreid02	str11	%11s		* Random Storeid 2
cntrgn	int	%18.0g	cntrgn_f	* County Region Primary Sampling Unit
stratum	byte	%38.0g	sample_f	* Stratum
county	str9	%9s		* County
countyfp	int	%8.0g		* COUNTYFP
access1	float	%8.0g		* Days closed (accessibility)
access2	float	%8.0g		* Days reduced hours after reopening (accommodation)
access3	int	%8.0g		* Days without dairy or bread after reopening
bldgdmg_34	int	%8.0g		Building Damage Moderate or Severe
machdmg_45	int	%8.0g		Machine Damage Severe or Complete
road_access_h~h	int	%8.0g		* Limited Road Access
eltc_days	float	%10.0g		* Electricity Loss (days)
eltc_daysv2	float	%10.0g		* Electricity loss after reopen (days)
water_days	byte	%10.0g		* Water Loss (days)
water_dausr2	float	%10.0g		* Water loss after reopen (days)
employee_high	int	%8.0g		* Employee issues
ffdmg_45	int	%8.0g		Fresh Food Damage Severe or Complete
supply_issues	int	%8.0g		* Supply Issues
StrTp_D11rt	byte	%9.0g		* Dollar Store
StrTp_t50	byte	%9.0g		* Large Supermarket
StrTp_CO	byte	%9.0g		* Combination Store
lilatracts_1~10	byte	%17.0g	lilatracts_1and10_f	* USDA Food Desert
floodplain	byte	%18.0g	floodplain_f	* Flood Plain

Data File

Critical Infrastructure Failure

Functioning

Food Access

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	rstoreid02	cntrgn	stratum	county	countyfp	access1	access2	access3	bldgdmg	machdmg	road_acce	eltc_days	eltc_days	water_day	water_day	employee	ffdmg_45	supply_is_S
2	RID02000024		1	3 JEFFERSON	245	7	37	14	0	0	1			0	0	1	0	1
3	RID02000026		0	2 HARRIS	201													
4	RID02000031		0	2 HARRIS	201	7			0	0	0	0	0	0	0		0	
5	RID02000036		1	3 JEFFERSON	245	0	0		0	0	0	0	0	0	0	0	0	
6	RID02000040		0	3 HARRIS	201	10	0	12	0	0	1	3	0			0	0	1
7	RID02000043		0	4 HARRIS	201	0	4	7	0	0	1	2	2			1	0	1
8	RID02000059		0	3 HARRIS	201													
9	RID02000105		0	3 HARRIS	201	0	0	0	0	0	1	0	0	0	0	0	0	0
10	RID02000111		2	1 ORANGE	361	2	42	2	0	0	0	0	0	0	0	1	0	1
11	RID02000112		0	4 HARRIS	201	0	0	5	0	0	1	0	0	0	0	0	0	1
12	RID02000114		0	1 HARRIS	201	3			0	0	0					0	0	
13	RID02000132		0	4 HARRIS	201	0	0		0	0	1	0	0	0	0	1	0	
14	RID02000133		0	2 HARRIS	201													

Theoretical Construct Domains in Model

Research Question 1:

How did **critical infrastructure failure**
impact the **functioning** of
food suppliers?

<u>Key Concepts</u>	<u>Domains</u>
Critical Infrastructure	Buildings Electricity Water Transportation Communications
Failure	Building damage Power loss Water loss Street closure Sidewalk closure Landline phone loss Internet loss
Food Suppliers	Food Aid Agencies Food Retailers

Theoretical Construct Domains in Model

Research Question 1:

Research Question 2: Did
the change in **functioning** of
food suppliers also change
food access?

Key Concepts	Domains
Functioning of food suppliers	People
	Property
	Product
	Accessibility
	Affordability
	Availability
	Acceptability
	Accommodation

FINDINGS: Multivariate Regression

	Days Closed (Accessibility)	Days Reduced Hours After Reopening (Accommodation)	Days Without Dairy or Bread After Reopening (Availability)	Damage and Infrastructure significant for accessibility.
Property Damage				
Building Damage	0.78*	1.67**	-0.43	
Equipment Damage	6.34***	-1.29	1.33	
Critical Infrastructure				Food desert stores closed an extra day.
Limited Road Access	1.42***	-0.29	1.16*	
Electricity Loss (days)	0.41***			
Electricity Loss after reopen (days)		1.16**	-0.02	
Water Loss (days)	-0.08			
Water Loss after reopen (days)		0.22**	0.07	Electricity, water, and store type significant for accommodation.
People				
Employee Issues	-0.05	0.97	-0.20	
Product				Product issues dominate availability.
Fresh Food Damage	2.45**	0.90	8.33**	
Supply Issues	-0.43	0.75	7.95***	
Store Type (compared to non-chain or convenience store)				
Dollar Store	0.27	1.59**	0.24	
Large Supermarket	0.03	4.06***	3.85	
Combination Store	1.27*	2.74***	-0.03	Food desert stores resupplied dairy and bread faster.
Store Location				
USDA Food Desert	0.77**	2.87	-1.55***	
FEMA Flood Plain	0.01	1.26	-0.14	

* p<=0.1, ** p<=0.05, *** p<=0.01

Detailed Data Example: Survey Question

Theoretical construct of Critical Infrastructure includes transportation, which includes the failure domain for street closure.

8 possible questions

POST-HURRICANE HARVEY FIELD STUDY IN SOUTH EAST TEXAS
FOOD RETAIL SURVEY



STOREID: DATE: - -

5. Did this business experience any accessibility problem (i.e. street or sidewalk closure)? 1. Yes 2. No
6. Did Hurricane Harvey flood waters impact the neighborhood surrounding this business? 1. Yes 2. No
- a. If yes, what were the impacts in the neighborhood surrounding the business? (check all that apply)
- i. Streets around the business were flooded, but vehicles could pass 1. Yes 2. No
- ii. Streets around business were severely flooded, vehicles could not pass through streets 1. Yes 2. No
- iii. Homes in the neighborhood were flooded 1. Yes 2. No
- iv. Other businesses in the neighborhood were flooded 1. Yes 2. No
- v. Other (Please describe) _____ 1. Yes 2. No

List of Potential Reasons used in questions 13, 15, and 16

Damage
1. Damage to building
2. Damage to inventory
3. Damage to equipment
Infrastructure Failure
4. Road Closures
5. No electricity service
6. No water service
7. No telephone service
8. No Internet service
People
9. Employees unavailable
10. Few or no customers
Food Inventory
11. Supply not available
12. Suppliers not operating
13. Food safety
Other Reason
14. Please describe below

Detailed Data Example: Cleaned Data

Theoretical construct
of Critical
Infrastructure
includes
transportation, which
includes the failure
domain for street
closure.

road_access_high	Limited Road Access
Type: Numeric (int)	
Range: [0,1]	Units: 1
Unique values: 2	Missing :: 205/468
<hr/>	
FARM_2fv7_CleanModelData_2023-12-13	Wednesday December 13 16:56:28 2023 Page 9
Tabulation: Freq. Value	
118 0	
145 1	
205 .	
<hr/>	
road_access_high:	
1. Road access limited and higher than average scale	
2. = 0 if road_scale == 0	
3. = 0 if road_access_low == 1	
4. = 1 if road_scale > 3.464419475655431 & road_scale != .	
5. Road issues mentioned 4-8 times	

Actual Code

The code to create the variable for Road closures, was actually very complicated and shows how the survey questions did not make it easy to create a variable for road closures.

The code is messy but it captures all of the decisions and assumptions made.

```
/*
/* CLEAN DATA - Road Issues - Scale Road Issues */
*/
capture drop road_scale
gen int road_scale= 0
label variable road_scale "Limited Road Access (Scale)"
notes road_scale: Road access on a scale, increasing as road access mentioned // on multiple survey questions

foreach surveyquestion in Q3_10_ Q3_11_ Q3_12_1_ Q3_12_2_ Q4_3_2_ {
    codebook `surveyquestion'*, notes
    notes road_scale: Variable is based on ///
    `surveyquestion'SETX and `surveyquestion'HCTX.
    replace road_scale=1+road_scale if `surveyquestion'SETX ==1
    replace road_scale=1+road_scale if `surveyquestion'HCTX==1
    tab `surveyquestion'SETX road_scale
    tab `surveyquestion'HCTX road_scale
}

codebook rsn*4, notes
replace road_scale=1+road_scale if rsnclsr4 ==1
replace road_scale=1+road_scale if rsnhours4==1
replace road_scale=1+road_scale if rsnfavloss4==1
tab road_scale, missing

* Road access2 missing if questions not answered
codebook Q3_10_SETX Q3_10_HCTX, notes
replace road_scale = . if Q3_10_SETX ==. & Q3_10_HCTX == . & road_scale == 0
replace road_scale = . if Q3_11_SETX ==. & Q3_11_HCTX == . & road_scale == 0

sum road_scale
tab road_scale, missing
```

Actual Code

The code to create the variable for Road closures, was actually very complicated and shows how the survey questions did not make it easy to create a variable for road closures.

The code is messy but it captures all of the decisions and assumptions made.

```
gen int road_access_high= .
label variable road_access_high "Very Limited Road Access"
notes road_access_high: Road access limited and higher than average scale
replace road_access_high = 0 if road_scale == 0
notes road_access_high: = 0 if road_scale == 0
replace road_access_high = 0 if road_access_low == 1
notes road_access_high: = 0 if road_access_low == 1
sum road_scale
replace road_access_high = 1 if road_scale > r(mean) & road_scale != .
notes road_access_high: = 1 if road_scale > `r(mean)' & road_scale != .
codebook road_access_high, notes

bysort road_access_low: sum road_scale
bysort road_access_high: sum road_scale

tab road_scale road_access_low, missing
tab road_scale road_access_high, missing
tab road_access_low road_access_high, missing
```