Tornado Mitigation:
Results from the Oklahoma Safe Room Initiative

by Matthew Jaremski
Austin College
Sherman, TX
Matthew Jaremski, Class of ‘06

- Triple Major: Economics, Business Administration, and Classics
- Student Coordinator, Austin College Social Science Lab
Undergraduate Research at Austin College

- AC Weather Station
- Social Science Research Lab
  - Community Opinions
  - 2004 Florida Hurricanes
  - Saferoom Survey
    - Funded by Dept. of Commerce - NIST through Texas Tech, the Mellon Foundation, and Institute for Catastrophic Loss Reduction
Recent Insured Losses

- Tornadoes
  - April 2001 - $1.9 billion
- Hurricanes
  - Katrina - $38.1 billion
  - Ivan – $11.0 billion
  - Charley - $8.0 billion
- September 11th
  - $20.0 billion
Research Questions

- Empirical examination of mitigation attitudes from consumers of saferooms.
- Results provide policymakers more information about the types of people wanting tornado safe rooms and how much they are willing to pay.
Previous Research

- “Consumer Attitudes on Tornado Shelters”
  - *Disaster Safety Review* Spring 2005
- “Buying Tornado Safety: What Will It Cost?”
  - by Miller, Morgan, and Womack
  - *Southwestern Economic Review, 29* 35-44.
- Various Studies on Hurricanes and Tornadoes
  - Simmons, Kruze, and Willner
Data Sources

- Two Surveys of Oklahoma Residents:
  - Participants in the Oklahoma Saferoom Initiative - 2004
  - Residents of Oklahoma - 2005
- County Tax Assessor Survey- SQ 696
- Builder Interviews (Austin College and the University of Oklahoma)
Two Surveys

- Designed from input of academic economists, engineers, the Saferoom Assoc., and Saferoom providers.
Project Contributors

- Jamie Brown Kruse, East Carolina University
- Laura Dwyer, DuPont
- Kevin M. Simmons, Austin College
- Connie Dill, OK Dept. of Emer. Mgmt.
- Ernie Kiesling, Texas Tech University
- Ann Patton, Project Impact
- Jim Waller, Nat. Safe Room Assoc.
2004 Survey

- Funded by Department of Commerce - NIST grant through Texas Tech University
- 1300 surveys were mailed to approved applicants by the state of Oklahoma.
  - Three groups
    - Those who suffered damage
    - Those living in a county affected by a recent tornado
    - Residents of OK
- 280 surveys were returned for inclusion in the study.
2005 Survey

- Funded by Institute for Catastrophic Loss Reduction and Mellon Foundation
- 5000 surveys were mailed to approved applicants by the state of Oklahoma.
- 410 surveys were returned for inclusion in the study.
- Differences from 2004 survey
  - Question Order
  - Additional Questions
    - Ownership of saferoom
    - Household disaster safety plan
Counties Represented (65 of 72)
Test 1 - Direct Comparison

- Taking respondents 2004 survey and comparing their responses to those surveyed in 2005
- Drawing conclusions from statistically significant differences (means test)
# Home Statistics*
**(Saferoom Owners vs. Non)**

<table>
<thead>
<tr>
<th>Owners</th>
<th>Non-Owners</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>House Age</strong></td>
<td></td>
</tr>
<tr>
<td>Average - 1985</td>
<td>Average - 1976</td>
</tr>
<tr>
<td><strong>Intended stay</strong></td>
<td></td>
</tr>
<tr>
<td>17.28 years</td>
<td>10.3 years</td>
</tr>
<tr>
<td><strong>Tenure</strong></td>
<td></td>
</tr>
<tr>
<td>10.89 years</td>
<td>12.93 years</td>
</tr>
<tr>
<td><strong>Value</strong></td>
<td></td>
</tr>
<tr>
<td>&lt;$100,000</td>
<td>$75,000</td>
</tr>
<tr>
<td></td>
<td>Owners</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Likelihood of tornado</td>
<td>7.4</td>
</tr>
<tr>
<td>Importance of saferoom</td>
<td>9.45</td>
</tr>
<tr>
<td>How seriously do you</td>
<td>9.49</td>
</tr>
<tr>
<td>take warnings</td>
<td></td>
</tr>
</tbody>
</table>

*Risk Assessment* - Likert Scale
Willingness to Pay

Owners
- Average: $3,000
- Range:
  - Minimum: $500
  - Maximum: > $7,500
- WTP compared to the value of the grant. ($2,000)
  - 60% willing to pay more than the grant
  - 40% not willing to pay more than the grant

Non-Owners
- Average: $1,435.14
- Range:
  - Minimum: $0
  - Maximum: $5,000
Inhabitants Special Needs

Owners
- People – 2 people
- Over 65
  - 20% had at least one senior member
- Small Children
  - 42% had small children
- Additional Assistance
  - 20% would need some type of assistance

Non-Owners
- People – more than 2
- Over 65
  - 25% had at least one senior member
- Small Children
  - 35% had small children
- Additional Assistance
  - 35% would need some type of assistance
Demographic Comparison

Owners
- Income* - $65,000
- Education – some college
- Age – 48
- Native
  - 58% born in Oklahoma

Non-Owners
- Income* - $50,000
- Education – some college
- Age – 50
- Native
  - 64% born in Oklahoma

Native
- 58% born in Oklahoma
- 64% born in Oklahoma
Safety Information*

Owners
- 28% did not receive any information
- 37% within the last 6 months
- 31% within the last year
- 3% within 5 years

Non-Owners
- 75% did not receive any information
- 8% within the last 6 months
- 9% within the last year
- 7% within 5 years
Incentives: Range 1-6, most to least desired

**Owners**
- Tax Break – 2.5
- Mortgage Discount – 3.9
- Low Interest Rate Loans – 3.8
- Insurance Discounts – 2.6

**Non-Owners**
- Tax Break – 2.8
- Mortgage Discount – 4.2
- Low Interest Rate Loans – 4.0
- Insurance Discounts – 3.0
Saferoom Questions (owners only)

- Shelter Type
  - Below Ground – 86%
  - Above Ground – 14%

- Sharing
  - 70% will be sharing saferoom
  - Even higher in smaller populated counties
Safety Plan (non-owners)

- If given 20 minutes warning before a tornado is expected to strike your area would you . . .
  - Remain in your house – 50%
  - Travel to a neighbor’s house - 10%
  - Travel to a nearby location that contains a tornado safe room/shelter – 40%
Comparison Results

- Significant variable differences for lack of saferooms
  - Safety Information – Less Information Received
  - House Age – Older houses
  - Tenure in House – Less time
  - House Value – Less Valuable homes
  - Perceived Likelihood of Tornado

- Age and Education hold some significance (older/less educated are not owners)
Other Comparison Results

- Natives of Oklahoma Attitudes about Tornadoes Differ from non-natives
  - More likely to seek shelter outside of own home
  - Less Likely to purchase/build saferooms

- SQ 696 – Saferoom Tax Abatement (Spring 2005)
  - Put into effect after Jan. 1, 2002
  - Oklahoma does not compile statewide participation
  - Found 2264 total claims in the entire state
    - About half were found in Oklahoma County alone
    - Only half of the counties had any claims
Test 2 - Probit Regression

- Compares the impact that selected demographic variables have on the probability that a household will decide to purchase a saferoom.
- Utilizes on 2005 respondents dividing those who had purchased saferooms (n=55) with those who had not (n=233).
Model

- In order to gain best model several regressions were run to test the significance and stability of all hypothesized variables.

- Additional variables generated not in comparison study:
  - Comparison of county average income and house value
  - Actual occurrence of tornados
## Probit Results

### Type III Analysis of Effects

<table>
<thead>
<tr>
<th>Effect</th>
<th>DF</th>
<th>Chi-Square</th>
<th>Pr &gt; ChiSq</th>
</tr>
</thead>
<tbody>
<tr>
<td>income</td>
<td>1</td>
<td>3.2590</td>
<td>0.0710</td>
</tr>
<tr>
<td>intend</td>
<td>1</td>
<td>4.1565</td>
<td>0.0415</td>
</tr>
<tr>
<td>wtp</td>
<td>1</td>
<td>4.2313</td>
<td>0.0397</td>
</tr>
<tr>
<td>value</td>
<td>1</td>
<td>0.0012</td>
<td>0.9722</td>
</tr>
<tr>
<td>built</td>
<td>1</td>
<td>0.0791</td>
<td>0.7785</td>
</tr>
<tr>
<td>age</td>
<td>1</td>
<td>0.0019</td>
<td>0.9655</td>
</tr>
<tr>
<td>people</td>
<td>1</td>
<td>1.9036</td>
<td>0.1677</td>
</tr>
<tr>
<td>native</td>
<td>1</td>
<td>0.0045</td>
<td>0.9468</td>
</tr>
<tr>
<td>likelihood</td>
<td>1</td>
<td>0.6072</td>
<td>0.4358</td>
</tr>
<tr>
<td>experience</td>
<td>1</td>
<td>0.3062</td>
<td>0.5800</td>
</tr>
<tr>
<td>county</td>
<td>1</td>
<td>3.8276</td>
<td>0.0504</td>
</tr>
</tbody>
</table>
Final Model

\textbf{Own} = F (\textit{income}, \textit{tenure in house}, \textit{willingness to pay}, \textit{population of county})

<table>
<thead>
<tr>
<th>Effect</th>
<th>DF</th>
<th>Chi-Square</th>
<th>Pr &gt; ChiSq</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income</td>
<td>1</td>
<td>3.7026</td>
<td>0.0543</td>
</tr>
<tr>
<td>Intend</td>
<td>1</td>
<td>3.8988</td>
<td>0.0483</td>
</tr>
<tr>
<td>Wtp</td>
<td>1</td>
<td>4.2627</td>
<td>0.0390</td>
</tr>
<tr>
<td>Bigc</td>
<td>1</td>
<td>2.5168</td>
<td>0.1126</td>
</tr>
</tbody>
</table>
What If?

- If Oklahoma budgeted $18 million for saferoom subsidies next year (assuming $2,000/saferoom)
  - 9,000 saferooms would be built
- However if the subsidy was reduced at a certain income level to $1,000/saferoom and if only a third of the applicants exceeded the income level then
  - 12,000 saferooms would be built
The Next Step

- Additional regression and modeling
- Another sample attempting to capture a larger group of Oklahoma residents
  - Florida/Louisiana residents facing rebuild after hurricanes
- Find optimal grant amount