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THE EFFECTIVENESS OF HURRICANE SHUTTERS IN MITIGATING STORM DAMAGE

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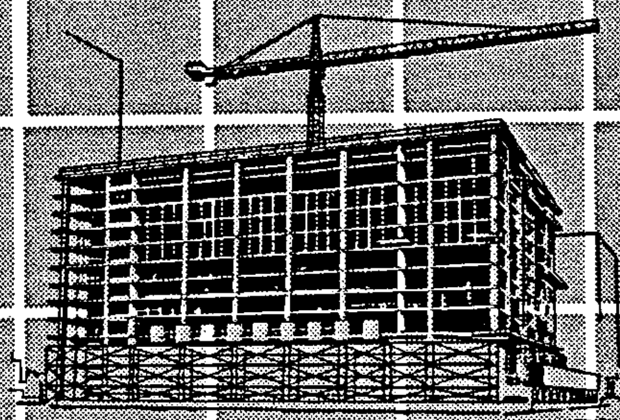

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Miami, Florida
1995

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And last, but not least, to the many Dade County homeowners who, after having to deal with the storm of the century and its aftermath, had the patience and the interest in our common welfare to take the time to cooperate with the research team.

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EXECUTIVE SUMMARY

In the early morning hours of August 24, 1992, a category 4 (Saffir-Simpson scale) hurricane named Andrew made landfall on the southeast coast of Florida in the southern part of Dade County. Andrew was a relatively small sized, rapidly moving, and relatively dry hurricane. It was not the strongest hurricane ever to hit the mainland of the United States (Herbert and Taylor, 1988). By any standards, however, Andrew is to date the most destructive and costliest hurricane ever to have affected the U.S. coastline.

In the aftermath of the storm many investigations were undertaken by various academic, governmental, industry, trade, and judicial bodies in an attempt to ascertain the causal factors for the devastation left by Andrew. The investigative reports issued by these bodies listed numerous causes responsible for the storm damage. One factor determined to be a cause by all the investigations was the loss of integrity of the building envelope due to breach of glass, windows, doors, garage doors, sliding glass doors, gable ends, etc.

As a consequence of the extent of the observed damage attributable to building envelope penetration, a cry for mandatory requirements for building envelope protection resounded from many quarters. This clamor for mandatory protection of the building envelope was based entirely on informal and not scientifically based comparisons of damage due to Andrew and other storms. It was of interest in this study, then, to determine if shuttered houses suffered less damage, on the average, than did non-shuttered (comparable) houses due to Andrew. Because hurricane damage differed greatly among areas and types of houses, variation due to variables other than the existence (or lack of) shutters, such as architecture, orientation, exposure, area, and wind velocity were eliminated by pairing houses - an almost entirely shuttered house (shuttered), with one that had no shutters on (comparable) during the storm.

To the authors' knowledge no formal scientific study prior to this one has ever been conducted comparing hurricane caused damage of paired structures whose only characteristic difference was whether or not shutters were installed and in place during the storm.

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CONCLUSIONS AND RECOMMENDATIONS

CONCLUSION

In this study, 32 pairs of shuttered and comparable (unshuttered) houses subjected to Hurricane Andrew were matched by type and location and compared on damage estimates using appraised building and total values. Although not originally matched on appraised values, the pairs did not differ significantly on the 1992 appraised building or total values. The houses were well-chosen, in that both sets - shuttered and comparables - had reduced appraised values after the hurricane as would be expected. (These mean reductions in building and total values from 1992 to 1993 for each set of houses were statistically significant). Comparison of shuttered and comparable houses' reduction in appraised values from 1992 to 1993 suggested that the average percent reduction in appraised building value for shuttered houses (12.4%) was less than that for their comparables (17.5%) at a marginally significant level ($p<0.061$). The average percent reduction in appraised total value showed a similar pattern. These statistical significances, however, were probably attributable to 4 pairs of houses where shuttered outperformed comparables from 30.8% to 54.8% with respect to appraised building values, since 63% of the pairs of houses (20 of 32 pairs) differed in percent appraised building reduction by less than 5%.

The four pairs of houses that exhibited such large differences in building reduction were examined for any commonalities on the measured variables that might suggest a reason why the shuttered houses outperformed their comparables. Three of the four pairs (75%) were subjected to wind speeds above the mean (132 to 135.3 mph), but 14 of the other 28 pairs of houses (50%) also were subjected to winds this high, but had much lower damage estimate differences. Comparison of the 4 pairs on 1992 appraised building values showed no common range, with the appraisals being scattered from the low end to the high end in the set of houses (mid $50,000's, mid $60,000's, low $100,000's, high $200,000's). If commonalities existed among these 4 pairs of houses, they were not apparent from the variables measured for this study.

RECOMMENDATIONS

These statistical analyses suggest two recommendations for future research. First, pairing houses by type and location is essential to reduce variability between houses so that meaningful comparisons can be made. Hard as it was to obtain matched houses, without pairing so much variability is present that very many more observations would be necessary to detect any differences statistically.

Even with pairing, this study showed that about 400 pairs of houses would have been needed to detect observed differences between pairs using actual dollar reduction in appraised values. Although dollar reduction is an appealing variable to use since it is easily interpretable, the appraised values vary greatly, either due to large inherent variability or inconsistent or non-uniform appraising. Therefore, the second recommendation is to use the variable, *percent reduction in appraised building value* to measure differences between shuttered and comparable houses. If a sample of 100 to 120 pairs of houses would have been available for this study, the observed mean difference in percent appraised building reduction would have been statistically significant at the 5% level. Even with only the available 32 pairs in this study that met the criteria, percent reduction had low enough variability to detect a marginally statistically significant difference between the two groups of houses. In future studies, perhaps other variables can be obtained to measure damage estimates more precisely.

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CHAPTER 1

INTRODUCTION AND BACKGROUND INFORMATION

INTRODUCTION

In the early morning hours of August 24, 1992, a category 4 (Saffir-Simpson scale) hurricane named Andrew made landfall on the southeast coast of Florida in the southern part of Dade County. Andrew was a relatively small sized, rapidly moving, and relatively dry hurricane. It was not the strongest hurricane ever to hit the mainland of the United States (Herbert and Taylor, 1988). Two other hurricanes, the unnamed storm that hit the Florida Keys in 1935, and Camille in 1969, were much larger and much stronger hurricanes (both were category 5 storms). By any standards, however, Andrew is to date the most destructive and costliest hurricane ever to have affected the U.S. coastline.

On September 24, 1992 *The Miami Herald* published the following estimates related to the storm:

1. $20 billion in total property damage

2. $7.3 billion in insurance industry losses
3. 160,000 people left homeless
4. 86,000 out of work
5. 82,000 businesses destroyed or damaged
6. 28,000 homes destroyed
7. 52 hurricane related deaths

Two years later, on August 24, 1994, *The Miami Herald* published the following additional statistics related to the storm:

1. 107,800 private homes were destroyed or damaged
2. 49,000 of those were rendered uninhabitable
3. 1,624 public housing units damaged or destroyed
4. 100,000 people were forced to move from South Dade in the storm's aftermath
5. 7,000 households permanently relocated from the area
6. 795,912 insurance claims were filed
7. $16.04 billion dollars in claims were paid
8. 35 million tons of debris were cleared from the area

In the aftermath of the storm many investigations were undertaken by various academic, governmental, industry, trade, and judicial bodies in an attempt to ascertain the causal factors for the devastation wrought by Andrew. These bodies included the Wind Engineering Research Council Post Disaster Team, the Federal Emergency Management Agency Building Performance Assessment Team, the Metropolitan Dade County Code Evaluation Task Force, the Florida Department of Community Affairs Damage Assessment Team, and the Dade County Grand Jury. As stated in the introduction to the report of the Dade County Grand Jury:

> We wanted... to find the answers to the many questions raised by this disaster regarding the standards, designs, and materials used in our local construction; the oversight and regulation provided to the construction industry; the responsibilities of the construction industry to our community; and our state of preparedness for the next hurricane. [1]

The investigative reports issued by these bodies listed numerous causes responsible for the storm damage. One factor determined to be a cause by all the investiga-

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1. *Final Report of the Dade County Grand Jury*, Circuit Court of the Eleventh Judicial Circuit, December 14, 1992.

tions was the loss of integrity of the building envelope. According to the Florida Department of Community Affairs Damage Assessment Report:

> The loss of doors (primarily garage and sliding glass doors) and windows was the second most important and costly aspect of the storm. Flying debris (particularly from roofing materials) contributed to a significant portion of this damage. The loss of windows and doors, along with the loss of roof coverings, caused the large amount of damage to building interiors and contents.[2]

Penetration of the building envelope was also directly responsible for many of the catastrophic failures of roof structural systems which permeated South Dade County. According to the Federal Emergency Management Agency "Breaching of the building envelope allowed an uncontrolled buildup of internal air pressure that resulted in further deterioration of the building's integrity.[3]

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2. Cook, Ronald, A., Editor, *Hurricane Andrew - Damage Investigation and Assessment: Summary of Damages to Conventional Residential Structures,* Florida Department of Community Affairs, September 24, 1992.

3. Building Performance Assessment Team, *Draft of Preliminary Report in Response to Hurricane Andrew, Dade County, Florida,* Federal Emergency Management Agency, Federal Insurance Administration, September 30, 1992.

As a consequence of the extent of the observed damage attributable to building envelope penetration, a cry for mandatory requirements for building envelope protection resounded from many quarters. For example, the Metropolitan Dade County Building Code Evaluation Task Force recommended to the Dade County commission that it:

> Adopt mandatory protection of exterior building envelopes in new construction by requiring that the components of exterior walls such as cladding, glazing, doors and windows of enclosed buildings be specifically designed and constructed to preserve the enclosed building envelope against wind pressure and impact loads from windborne debris, or, in the alternative, be protected by fixed, operable or portable demountable storm shutters.[4]

This clamor for mandatory protection of the building envelope was based mostly on informal and not scientifically based comparisons of damage due to Andrew and other recent storms. Although much work has been done since the early 1970's by Minor, McDonald, Mehta, Walker, Beeson, Harris and many others, to the authors' knowledge no

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4. Metropolitan Dade County, *Building Code Evaluation Task Force - Final Report*, December 16, 1992.

formal scientific study (prior to this one) had ever been conducted comparing hurricane caused damage of paired structures whose only characteristic difference was whether or not shutters were installed during the storm.

CHAPTER 2

LITERATURE SEARCH

2.1 Protection of the Building Envelope - Historical Perspective

A search of the literature reveals that homeowners have used shutters for decades to protect their properties from damage caused by wind and windborne debris. As far back as the beginning of this century, storm shutters were already in use during the 1926 hurricane that struck South Florida. That hurricane was a Category 4 storm (on the Saffir/Simpson scale). L.R. Reardon, historian and native from Miami who survived the hurricane, wrote about the experience in her book *The Florida Hurricane and Disaster, 1926*, and recalls how her brother helped her father get out the heavy wooden shutters to board up every window and door.[5]

Hurricane shutters made of rustic wood and logs are described in the book *Historia de los Temporales de*

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5. Reardon, L.F., *The Florida Hurricane and Disaster, 1926*, Arva Parks and Company, Coral Gables, Florida, 1986. p. 2.

Puerto Rico y las Antillas (1492 a 1970)[6] by Luis Salivia, M.D. Salivia recalls that on September 26, 1932, the population was warned that a storm was about to strike Puerto Rico. He and his companions decided to weather the storm at one of the old (and solid) residences of the University of Puerto Rico, because these were built of reinforced concrete. They invited members of families whose houses were deemed to be structurally weak to stay with them. Salivia narrates how they all worked to reinforce all windows and doors with strong boards and wooden crossbars nailed down with 3-inch nails.

Impressive testimonies recording the devastation caused by the September 2, 1935 hurricane that struck the Florida Keys are also found in the literature. It is told that some local residents took precaution when there was time to do so. For example, the owner of the Matecumbe Hotel boarded up the hotel the night before. Likewise, the owner of a yacht supply business, a store, a camp, and a two-hundred-foot service dock, spent a whole day preparing his buildings for the storm. Another resident

6. Salivia, Luis A., *Historia de los Temporales de Puerto Rico y Las Antillas (1492-1970)*, Artes Gráficas Medinaceli, S.A., Barcelona, España, 1972. pp. 300-301.

of the Keys testified that he "had everything under control...everything battened down, fastened up."[7] Despite those precautions, apart from the Matecumbe Hotel and a few other buildings, most structures were destroyed.

More recently, Juan Almeida Bosque, author of *Contra el Agua y el Viento*, relates in detail how people secured doors and windows with wood boards and common nails to protect themselves against Hurricane Flora, which struck Cuba in October of 1963.[8]

2.2 <u>Engineering and Scientific Work on Windborne Debris</u>

Even though much wind related damage occurs every year throughout the world due to tornadoes, hurricanes, and just plain windstorms, serious engineering and scientific study of wind effects on structures is a relatively recent phenomenon. Work on damage caused by breach of the building envelope is even more recent. This is evident from the dearth of literature found by the research team

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7. Best, Gary D., *FDR and the Bonus Marchers, 1933-1935*, Praeger Publishers, West Port, Connecticut, 1992. p. 47.

8. Almeida Bosque, Juan, *Contra el Agua y el Viento*, Casa de Las Américas, La Habana, Cuba, 1986. p. 26.

on the subject. It is not until the early 1970's that literature on the subject begins to appear.

According to Minor[9] the first mention of windborne debris as a probable cause for failure of architectural glazing during windstorms was made by Reed in 1970. Reed "observed that windborne debris was a significant factor in the relatively large storm window glass breakage rates on high rise buildings during the Lubbock storm of May 11, 1970." The literature on the subject becomes more abundant after Reed, as Minor, McDonald, Mehta, Walker, Beeson and others begin to record observations of damage caused by succeeding windstorm events (Hurricane Cecilia - Corpus Christi, 1970; Cyclone Tracy - Darwin, 1974; Hurricane Frederic - Mobile Bay, 1979; Hurricane Allen - Corpus Christi, 1980; Hurricane Alicia - Houston, 1983;Hurricane Hugo - South Carolina, 1989; and Hurricanes Andrew and Iniki - South Dade and Hawaii, 1992. As a result breach of the building envelope has been undeniably linked to windborne debris and with high and fluctuating wind pressures. Unfortunately, the sources of

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9. Minor, Joseph E., "Windborne Debris and the Building Envelope," *Journal of Wind Engineering and Industrial Aerodynamics,* Volume 53, pp. 207-222. 1994.

potential windborne debris cannot be entirely eliminated, since there will invariably always be potential projectiles (e.g. rocks and tree limbs) lying about susceptible to becoming airborne due to high winds. In hurricanes and tornadoes, the pool of potential projectiles is increased enormously due to the increased debris generated from damaged structures. Even though construction materials, processes, and quality may improve over the course of time, high winds will inevitably result in projectiles generated from damage to accessories to homes (porches, garages, storage buildings, pool enclosures, fences); roofing materials (shingles, tiles, and gravel); inadequately attached or over stressed components and cladding of building (sheathing and siding).[10] In its assessment of the damage caused by tropical cyclone Tracy, which passed through the city of Darwin in Australia on Christmas Day in 1974, a survey team from the Center for Building Technology of the U.S. National Bureau of Standards found that windborne debris generated by failure of upwind structures caused many openings in walls and other elements which failed under the continuous attack of

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10. U.S. Department of Housing and Development and NAHB Research Center. *Assessment of Damage to Single-Family Homes Caused by Hurricanes Andrew and Iniki*, Washington D.C., September, 1993. p. 50.

flying materials. The study concluded that failure of upwind buildings in the area created a considerable number of missiles which was a most important factor among the major causes of failures.[11]

Describing some of the damage caused by the August 1970 hurricane (Celia) which struck Corpus Christi, Texas, Minor relates how the Guaranty Bank Plaza Building was damaged by windborne roof gravel from one and two story roofs upwind.[12] He also describes the resulting devastation caused by the buildup of internal pressures occurring after windward wall window failures. Dr. Minor postulates that the internal pressure buildup progressively caused the failures of leeward and side wall windows, and the resulting extensive damage which was wrought upon internal partitions and furnishings.[13]

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11. Marshall, Richard D., *Engineering Aspects of Cyclone Tracy, Darwin, Australia, 1974*, U.S. Department of Commerce, National Bureau of Standards, Institute for Applied Technology, Center for Building Technology, Washington D.C., 1976. p.11.

12. Minor, Joseph E., "Window Glass Performance and Hurricane Effects" *Proceedings of the Specialty Conference 'Hurricane Alicia, One Year Later'*. Galveston, Texas, August 16-17, 1984, American Society of Civil Engineers, 1985, p. 159.

13. Minor, Joseph E., "Window Glass Performance and Hurricane Effects," *Ibid*, p. 159.

Wind tunnel research conducted on models of housing structures at the University of Kansas in the early 70's revealed that these structures were more wind resistant when the building envelope was kept intact with openings completely closed. In testing the old adage that windows on the leeward side should be opened during windstorms, researchers found just the opposite. In several tests they observed that when windows were opened on the lee-ward side, the structure failed very suddenly. "The roof left the walls nearly intact; the walls and partitions splintered into a number of parts."[14]

Damage surveys conducted after Hurricane Tracy revealed that more than 50% of the 7,000 houses surveyed were damaged beyond repair, and only 400 were considered intact with only minor damage to windows, roofing and wall cladding. The investigators concluded that breakage of windows and failure of doors on windward faces were the causes for most of the roof failures which were ultimately the most important damage suffered in homes.[15]

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14. Eagleman, Joe R., et al., *Thunderstorms, Tornadoes, and Building Damage*, Lexington Books, Lexington, Massa-chussets, 1975, p. 236.

15. Marshall, Richard D., *op. cit.*, p. 5.

As a result, questions were raised as to whether structural design criteria should include exposure to this type of loading instead of considering static loads only.

In 1978, Beason and Minor suggested that when it came to designing cladding systems, "typical glass cladding will not be adequate unless accompanied by the use of structural screens, temporary shutters, or other protective barrier."[16]

After Hurricane Iwa (November 1982) the U.S. Department of Commerce published an informative bulletin titled *Hawaiian Hurricanes and Safety Measures*. It included an action checklist which recommended the use of shutters to protect windows. Further, if no shutters were available, it recommended taping or boarding them to cover glass and prevent shattering.[17]

Beason and Kohutek, investigating damage caused by Hurricane Alicia in Houston, Texas, (August 18, 1983)

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16. Selvam, R. Panneer, "Wind Speed Over Irregular Terrain: State of the Art," *High Winds and Building Codes:Proceedings of the WERC/NSF Wind Engineering Symposium*, Kansas City, Missouri, November 2-4, 1987, p. 247.

17. U.S. Department of Commerce and National Oceanic and Atmospheric Administration. *Hawaiian Hurricanes and Safety Measures, with Central Pacific Tracking Chart.* Washington D.C., 1984, p. 3.

determined that the distance between gravel (the most common flying debris during that hurricane) and impact points were 150 feet or more. At such distance, the gravel may accelerate enough to reach a velocity of 0.80 times the basic wind speed before impact. Sometimes, the velocity can be higher.[18]

Minor, also investigating damage caused by Hurricane Alicia, reported that a survey of 14 glass distributors in Houston showed that more than 80 percent of window glass replaced after the hurricane had been broken by windborne debris. These investigations also led Minor to report that failures caused by windborne debris generally occurred before lateral pressures on the glass became critical, and that all types and thicknesses of monolithic glass are susceptible to failure due to windborne debris. He also suggested that sustained and turbulent winds create repetitions of relatively large pressure conditions (cyclic or fatigue loading) on glass surfaces which weaken the glass and increase its susceptibility to

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18. Beason, W. Lynn and T.L. Kohutek. "Suggested Design Criteria for Windborne Missiles". *High Winds and Building Codes, Proceedings of the WERC/NSF Wind Engineering Symposium*, Kansas City, Missouri, November 2-4, 1987, p. 425.

damage by windborne debris.[19]

In 1985, Hurricane Gloria struck Long Island, N.Y. Paul De Cicco, Professor of Civil and Environmental Engineering at Polytechnic University in New York, reported that window breakage contributed to 14% of the total external losses; however, to some extent they contributed to the 50% of losses due to roof failure.[20]

On September 21, 1989 Hurricane Hugo struck the South Carolina coast. By now the types of failures observed by post storm investigations followed familiar patterns. Ben Mieche, an architect with the Naval Facilities Engr. Command in Charleston, conducted a survey that revealed that windows resisted wind pressures well, but failed due to flying materials or natural missiles.[21] As in other hurricanes, the loss of windows, doors and other

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19. Minor, Joseph E., "Window Glass Performance and Hurricane Effects," *op. cit.*, p. 159.

20. De Cicco, Paul R., "Assessment of Wind Design Provisions of Building Codes", *High Winds and Building Codes, Proceedings of the WERC/NSF Wind Engineering Symposium,* Kansas City, Missouri, November 2-4, 1987. pp. 132-133.

21. Mieche, Ben K., "Architectural Lessons Learned from Hurricane Hugo", *Proceedings of the Symposium and Public Forum 'Hurricane Hugo, One Year Later',* Charleston, South Carolina, September 13-15, 1990. American Society of Civil Engineers. p. 155.

opening failures caused extensive water damage to the interior of buildings.[22]

On August 24, 1992, a category 4 (Saffir-Simpson scale) hurricane named Andrew struck the southeast coast of Florida in the southern part of Dade County. The devastation caused by this hurricane was briefly described in Chapter 1. Andrew was quickly followed by Hurricane Iniki, which struck Hawaii. Damage investigations once again universally concluded that much of the devastation was caused by loss of integrity of the building envelope.

> The loss of doors (primarily garage and sliding glass doors) and windows was the second most important and costly aspect of the storm. Flying debris (particularly from roofing materials) contributed to a significant portion of this damage. The loss of windows and doors, along with the loss of roof coverings, caused the large amount of damage to building interiors and contents.[23]

Penetration of the building envelope was also di-

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22. Murden, J.A., "Hugo 1989-The Performance of Structures in the Wind," *Ibid*, p. 54.

23. Cook, Ronald, A., Editor, *Hurricane Andrew - Damage Investigation and Assessment: Summary of Damages to Conventional Residential Structures*, Florida Department of Community Affairs, September 24, 1992.

rectly responsible for many of the catastrophic failures of roof structural systems which permeated South Dade County. According to the Federal Emergency Management Agency "Breaching of the building envelope allowed an uncontrolled buildup of internal air pressure that resulted in further deterioration of the building's integrity.[24]

One homeowner's description of damage to his property gives an indication of the strength of Andrew's storm winds. This individual relates that a fractured clay roof tile projectile punctured his metal hurricane shutter, broke the window, and continued across the room, slamming into the piano.[25] In another instance, a South Miami homeowner, who thought his house was stormproof, relates:

> On Sunday, it was clear that the storm was coming toward us. The neighborhood was boarding up. Last year, I'd gotten these really elaborate hurricane shutters for the house...About 3 (a.m.) the wind was

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24. Building Performance Assessment Team, *Draft of Preliminary Report in Response to Hurricane Andrew, Dade County, Florida*, Federal Emergency Management Agency, Federal Insurance Administration, September 30, 1992.

25. U.S. Department of Housing and Urban Development and NAHB Research Center, *op. cit.*, p. 41.

> pelting the rain so hard against the shutters it woke us up...After a while, there was a really terrible noise. I went into the family room and I could see outside. At first I thought I was seeing things. Then I realized the shutters were gone.[26]

The literature reviewed clearly indicates that there is wide agreement on the importance of maintaining an unbreached building envelope in order to minimize damage during hurricanes.

> Window and door damage contribute to increased levels of water damage as well as a greater potential for structural damage through internal pressurization. Internal pressurization from wind entering a breached opening can effectively double the wind loads on structural components such as roof sheathing. In the Florida survey, 64 percent of the accessible homes experienced damage to at least one window. In most homes surveyed, it was apparent that little regard was given to proper window protection. In most instances of window damage, it is likely that a simple but effectively applied plywood covering would have provided the needed protection.[27]

26."Operators Tell Tales of Andrew", *Restaurants and Institutions*, Chicago, Illinois, Cahners Pub. co. Vol. 102, N25., October 21, 1992, pp. 28-30.

27. U.S. Department of Housing and Urban Development and NAHB Research Center, *op. cit.*, p. xiv from the Report's Executive Summary.

The use of shutters to protect openings is one alternative. There were instances during Andrew, however, when windows were considered well protected, yet severe damage was sustained. Cases wherein shutters were severely bent or even penetrated by flying debris are documented. A Federal Emergency Management Agency building performance assessment team reported, however, that storm shutters performed well, reducing the extent of the overall damage to properties.[28] The NAHB team also reached the same conclusion.[29]

Despite all the investigations, surveys, and unanimity of conclusions, a review of the literature indicates that there has been no controlled engineering or scientific work conducted to date that provides data documenting the effectiveness of shutters in reducing damage during hurricanes. This lack of knowledge has been a serious obstacle to citizens, organizations, governmental and regulatory agencies striving to develop standards and codes to deal with the problem of protection of the building envelope.

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28. Federal Emergency Management Agency, *op. cit.*. p.3.

29. U.S. Department of Housing and Urban Development and NAHB Research Center, *op. cit.*, p. 47.

CHAPTER 3

THE STUDY

3.1 CONCEPT

To accomplish the objectives of this project the research concept was, on the surface, simple and straightforward. The research team proposed to locate single family residences that had installed shutters in place during Hurricane Andrew, and pair each of the residences so identified with comparable residences in the same neighborhood known not to have had shutters installed during the storm. The damage to the paired residences would then be compared using one of several possible measures.

3.2 METHODOLOGY

The storm area contained a full spectrum of property damage ranging from minimal, or no damage at all, to the complete destruction of all physical aspects of houses. While the usefulness of shutters at extremes of the spectrum is arguably nil and evidence of that usefulness even more elusive, the extended mid-range of damage as related to the mid-range of wind intensities and direction was identified as offering the most meaningful and most available information for our study. From examination of wind intensity profiles and related damage range attributable to the storm, certain geographical areas were chosen as containing the population to draw our samples from. These areas were coincident with zip code areas easily identifiable for map study, travel, and relation to other analysis parameters. The selected areas were: 33156, 33157, 33158, 33176, 33186.

A database consisting of all customer files of residential shutter sales by a reputable and long established shutter manufacturer/installer with a large business volume was obtained for the identified study area. This database contained contact names and addresses, type of shutters installed, and date of sale. This list gave no indication of house size, architecture, market or appraised value, number of stories, type of construction, orientation, completeness of installation, features of the surrounding terrain and structures, or whether the shutters were actually in place or not during the storm.

These features, however, were necessary to give our selected samples and pairs sufficient uniformity to make our analysis valid. Further, the researchers wanted to know if and to what degree the property had been damaged. In order to determine such information it became necessary to contact the owner/occupants of the candidate houses furnished by the shutter company.

3.3 FIELD INFORMATION COLLECTION

In practice, the implementation of what appeared to be deceptively simple turned out to be extremely frustrating. Included among the problems encountered were insufficient numbers of potentially shuttered houses within the geographical bounds to be studied; difficulties in locating and communicating with owner/occupants of potentially shuttered houses; obtaining the cooperation of owner/occupants; locating houses that were substantially shuttered; establishing whether or not potential comparables had shutters on during the storm; establishing the use, and then obtaining, meaningful damage estimates.

3.3.1 Procedure

A form letter was prepared and sent out over the signatures of study investigators to over one hundred owner/occupants in the selected zip code areas identified by the shutter company. The letter explained the purpose of the study, gave assurance that it was a legitimate governmental study, and informed recipients that they would be contacted later for more information. This letter was followed by several attempts to make live contact by way of telephone during evening hours when it was considered most likely to find people at home. Difficulties were experienced in effecting dialogue with owner/occupants for a number of reasons; people had moved, phones had been changed or disconnected, no answer to the phone, new owners, telephone answering machines with no response to messages left, and some refusals to cooperate. This first round provided less than twenty potential shuttered houses. This was far less than the 50 pairs which was the number originally desired for the study.

As a result, the research team decided to expand the area of coverage to include zip codes 33149, 33173, 33143, 33177, 33187, 33183, 33193, 33196. An expanded list of installations was obtained from the shutter company and a second round of letters was conducted. This second round of letters was followed by two more mailings later in the project.

All together, several sets of letters were sent to 239 candidates. From these, a total of 192 telephone interviews were consummated. The list of candidates was then reduced by elimination of houses with more than one or two openings left unshuttered (substantially unshuttered) or no shutters in place at all during the storm; dwellings other than single family residences (townhouses, duplexes, etc.); structures with more than one story; structures which utilized Bahama, roll-down, pvc, and other types of shutters which were reported in many of the post Andrew investigations not to have fared well during the storm; houses of owner/occupants that refused to cooperate; houses of owner/occupants who were not occupying the structure during the storm and did not know if shutters had or had not been in place. It is appropriate to note here that many candidate properties required many telephone calls and/or letters before effective contact and dialogue could be achieved. (Samples of letters used in the mailings are shown in Appendix B).

Based on the telephone interview information, 110 houses were discarded as unsuitable, leaving 82 as potentially viable shuttered subjects and therefore candidates for visual inspection.

The list of reduced candidates was then organized to facilitate the 82 site visits by a member of the research team. The visits were made by a registered professional engineer with over 30 years of professional experience in South Florida; an individual that has experienced the hurricanes that have struck the area during that time. The visits were used to record the type of construction, orientation, roof architecture, type of roof covering, garage door and entry door location, type of entry door, surrounding terrain and siting of surrounding structures or other features such as fields, canals, etc, of the candidates for shuttered samples. The first few site visits were conducted jointly by the professional engineer named above and by the Principal Investigator. The intent of the joint visits were to establish uniformity and consistency in the interpretation of the goals and objectives of the site visits, in the execution of the visits to achieve these goals and objectives, and in the furtherance of accurate communication between the individual performing the field work and the rest of the research team.

The visits were also used to locate potential comparables, within a reasonable proximity, to pair with the shuttered samples. Selection criteria for comparables included proximity to the shuttered subject as well as similarity of: construction, orientation, roof architecture, type of roof covering, garage door and entry door location, type of entry door, and surrounding terrain and siting of surrounding structures or other features such as fields, canals, etc. Special emphasis was placed in ensuring that shuttered and comparables had similar types and orientations of certain key features which post storm investigations focused on as being involved in much of the damage. For example, if the shuttered subject had a gable end over a double car garage door facing east, emphasis was placed on identifying a comparable with the same features. This emphasis carried through to single versus double entry front doors, inward or outward swing, and door orientation/exposure with respect to the cardinal points.

As a result of the site visits 50 of the reduced number of candidates had to be rejected, leaving 32 suitable shuttered subjects houses with appropriate comparables. Even though less than the 50 pairs originally envisioned, time and other constraints dictated that no further field work be conducted in the interest of timely completion of the data reduction and final reporting.

3.3.2 Problems

The apparent ease of collecting field information for the study was off-set by a number of operational difficulties encountered during the process. Many of these involved human elements, embodied in access to and cooperation of owner/occupants. Some of these related to the hundreds of telephone calls made have been discussed previously. Others related to final selection of the comparables are different. After visual identification of a potential comparable, attempts to contact the owner occupants were futile in many cases. Usually, all the research team had for a potential comparable was an address. It was not possible to obtain telephone numbers and frequently, owner/occupants would not answer approaches to a door. Frequently they were not home; oftentimes there were language and/or comprehension difficulties with those who did answer; and, in spite of identification carried by the professional engineer on his site visits, there was still incredulity and skepticism as to the legitimacy of the study, leading to hostility on the part of many who did come to the door. This hostility frequently underlay a refusal to cooperate.

In some cases, then, it became necessary to look for lack of actual physical evidence of some shutter installation (e.g. tracks, fasteners, holes around windows and doors, etc.) as acceptable evidence that a potential comparable had not been shuttered during the storm. In these cases lack of any of these usually resulted in acceptance of a house for comparable consideration.

3.4 MEASURE OF DAMAGE

There were three potential measures of damage that the research team could have used for the shuttered vs. comparable comparisons. These were: insurance settlements based on loss estimates calculated by insurance company adjusters, repair estimates prepared by contractors bidding to perform the repair work, and changes to property values as established by the Dade County Property Appraiser. The first two would appear to be more direct than the third and, on first thought, maybe more accurate. Close examination of the post storm conditions in the storm affected areas, however, suggested to the research team that this was not the case.

3.4.1 Insurance Settlements

Many factors combined to cast doubt on the use of insurance loss estimates as the measure of damage. These included, among others, the qualifications and experience of the adjusters, the sheer magnitude of the work they were called to undertake, the question of just how much damage was attributable to the storm, and the impact of illegitimate claims (fraud).

The magnitude of the devastation caused by Andrew was so large that the ability and resources of insurance companies to respond to their policyholders was totally overwhelmed. Adjusters had to be quickly trained and brought in from all over the United States. Many had very little experience, and many more were totally unfamiliar with the type of construction found in South Florida. Even knowledgeable and experienced adjusters had problems with lack of accurate information about post storm labor, material, and equipment costs. It was common for these individuals to work seven days a week, from early morning until late at night, with little time for themselves. Despite bringing in hundreds of adjusters from other locales and assigning each of them enormous numbers of claims to handle, many claimants were not able to get an adjuster to visit their property for days, weeks, or even months. As a result damage due to the hurricane was frequently compounded by the daily rainstorms that drenched South Florida after the storm, and the vandalism and looting that frequently took place. The resources of the property insurance industry were just totally overwhelmed. "Reports from insurance loss adjusters at work in South Florida indicated that a variety of factors were complicating, delaying, and disrupting the claims settlement process altogether."[29] All these factors contributed to loss estimates that appear to have been significantly inflated. In fact, most people in South Dade eventually were quite pleased with the resolution of their insurance claims. A *Miami Herald* poll taken in March 1993 revealed that eight out of ten homeowners had already settled their insurance claims from Andrew, and that 90% were satisfied with the settlement. Six out of every ten were "very satisfied." Only five percent were not satisfied.[30] Further north, at an Allstate hearing in Ft. Lauderdale, "policy holder after policy holder grabbed the microphone to complain about excessive claims payments to South Dade residents. One contractor, Tom Torrioni, made a comment that homeowners were inflating claims, then refusing to fix up their homes as promised. 'Money,' he said, 'was literally thrown at homeowners.'"[31]

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29. National Association of Independent Insurers, *South Florida After Hurricane Andrew - An NAII Appraisal of Issues and Challenges to Rebuilding,* Des Plaines, Ill., November 1992. p. 3

30. Satterfield, D., "Insurance: Andrew's Impact," *The Miami Herald,* March 13, 1993. p. 1A.

31. Satterfield, D., "Dade's Cesspool of Fraud," *The Miami Herald,* June 21, 1993. p. 1A.

Fraud also appears to have played a role in inflated insurance settlements. Some estimates conclude that as much as 10% of the $16 billion in claims paid out after Andrew were for fraudulent claims. "Hurricane Andrew planted the seeds of temptation and deceit throughout South Florida; just inflate the insurance claim and it's easy cash."[32]

In addition to questions about their accuracy and consistency, there was one other obstacle to the use of insurance settlements which probably would have been insurmountable. Homeowners, pleasantly surprised by the generosity of insurance adjusters and clearly concerned about the legal and income tax ramifications of inflated payments, refused to divulge or even discuss details of their settlements with neighbors, friends, and even their own family. The research team believes that the selection of this item as the measure of damage would have guaranteed that the sample of shuttered houses would be even less than the 32 that were obtained. Difficulty in establishing communication with owners of comparables to obtain the corresponding information from them would

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32. Satterfield, D., "Dade's Cesspool of Fraud," *op. cit.*, p. 1A.

also have proved next to impossible.

3.4.2 Contractors' Repair Estimates

As with insurance settlement, there were compelling reasons for the research team not using contractors' repair estimates. Hurricane Andrew,

> "the most expensive natural disaster in American history, created a unique kind of chaos in South Florida. Tens of thousands of homeowners were desperate to get their lives back to normal. Their most personal possession, their home, had been violated, and they wanted action taken quickly. Contractors were flooded with work. Some were long established, reputable companies. Others were individuals with little experience trying to make a buck. All had to hire legions of workmen who poured in from all over the country. Some workmen were excellent. Others were disasters. Then came problems getting supplies. Getting permits. Getting inspections. Every sector of the construction industry-from the lumber company to the government inspector-was overworked. The result-a maddening confusion.[33]

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33. Dorschner, J., "Andrew's Curse," *The Miami Herald,* October 3, 1992. *Tropic,* p. 8.

The chaos described resulted in contractors' repair estimates that were widely divergent. "Andrew's devastating winds sent plywood prices flying, and disrupted markets from roofing materials to heavy equipment rentals."[34] Everything became scarce. Homeowners were willing to pay any price, to practically anyone available, to make their homes habitable. "This was an emotional response that is typical after a disaster."[35] Andrew not only affected material prices in South Florida, but nationwide as well. "Plywood prices went ballistic, sending shock waves up and down the supply chain and setting the stage for a prolonged period of high prices for contractors nationwide."[36] Some contractors refused to perform the work for the amounts stipulated in the estimates written by insurance company adjusters, since the estimates were nowhere near what the market required.[37]

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34. Grogan, T., and Setzer, S., "Hurricane Triggers Price Storm," *Engineering News Record,* September 28, 1992. p. 25.

35. Setzer, S., "Andrew Blows Out Plywood Prices," *Engineering News Record,* September 28, 1992. p. 30.

36. *Ibid,* p. 30.

37. National Association of Independent Insurers, *op. cit.*, p.5.

The problems cited above were compounded by the heightened activity of unlicensed individuals working as contractors. "These unlicensed guys can charge at least 30 percent less than a licensed contractor, because they don't have to pay license fees, warehouse or office rental, secretarial salary, or insurance."[38]

Dishonest contractors were also a problem. Numerous contractors were accused of "overcharging, prevaricating, prestidigitating, malingering, disappearing, or up-screwing in the aftermath of Hurricane Andrew."[39] As of August 1994 6,382 complaints resulting in 1,125 charges filed had been lodged against contractors or individuals acting in that capacity. As of this date the Dade County Construction Fraud Task Force had already succeeded in obtaining 83 felony convictions for post storm charges.[40] Some individuals were charged with defrauding hundreds of

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38. Sheridan, T., "Unlicensed Contractors Tempt With Low Prices, Quick Service," *The Miami Herald,* September 13, 1992. *Home and Design* p. 56.

39. Dorschner, J., "Andrew's Curse," *op. cit.*, p. 8.

40. Hirsch, R., and Clifford, D., "Andrew, Recovery By The Numbers," *The Miami Herald,* August 24, 1994. p. 18A.

homeowners.[41]

Again, as with insurance settlements, questions about the accuracy and uniformity of contractors' repair estimates led the research team to shy away from their use. Additionally, the research team believes that, as was previously discussed with regards to divulging insurance settlements, homeowners would have been reticent to revealing repair costs for fear of disclosing net gain, if any. This, combined with difficulty in establishing communication with owners of comparables to obtain the corresponding information from them would also have contributed to further reducing the sample size available for the study.

3.4.3 Changes in Assessed Property Values

Due to the just described problems with insurance settlements and contractors' repair estimates, the research team decided to use changes in property values from 1992 to 1993 as determined by the Dade County

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41. Hartman, T., "Contractor Arrested By Task Force," *The Miami Herald,* August 20, 1994. p. 1B

Property Appraiser as the study's measure of damage.

Appendix C contains a description of the damage assessment process used by Dade County. Due to the tremendous number of structures that suffered significant damage, the damage assessment process utilized three major building components to establish value adjustments related to the storm damage. These were the roof, the exterior wall, and the interior. The procedure focused strictly on the amount of damage observed, together with some assumptions regarding the extent of damage that could not be observed.

> The basic premise of the process was that assumptions regarding levels of interior damage could be made based on the extent of observed damage to the "roof" or "exterior wall" components. For example, an observation that a significant percentage of the roof sheathing had been exposed (without waterproof membrane) would indicate that a large quantity of water was allowed to enter the interior of the structure, thus causing significant levels of water damage to the "interior" component.[42]

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42. Dade County Property Appraisal Department, *Damage Assessment: Field Inspection Process,* internal department document.

Every property south of Kendall Drive (S.W. 88 street) was looked at individually in one of three ways. These included actual field inspections by Property Appraisal field teams, information obtained from actual field inspections made by the Dade County Building and Zoning Department, and analysis of aerial photographs. According to the Property Appraisal staff, a significant number of the assessed value changes resulted from actual field inspections of the properties.

The process used to obtain the changes in assessed property values was not without its problems and weaknesses (see *Findings, Conclusions, and Recommendations*). The research team felt, however, that it would be more suitable than the other two potential damage measures. The process, as described to the team, appears to have been controlled by a formal set of rules designed to carefully consider post storm damage situations and building conditions. According to the Property Appraiser's Office, every effort was made to strictly adhere to these rules. As a minimum, the process offered uniformity and consistency in the determination of property value changes. One additional benefit in its use was the relative ease with which the research team was able to obtain information. The Dade County Property Appraisal Department spared no effort to cooperate with the team to make this portion of the study possible.

CHAPTER 4

SUMMARY OF DATA ANALYSIS

Note: This chapter presents an abbreviated discussion of the data analysis performed in this project. The discussion was summarized with the goal of maintaining a focus on the results, rather than on the statistical tools and processes used in the analysis. An unabbreviated version of the data analysis is contained in Appendix A.

It was of interest in this study to determine if shuttered houses suffered less damage, on the average, than did non-shuttered (comparable) houses because of Hurricane Andrew. Because hurricane damage differed greatly among areas and types of houses, variation due to variables other than the existence (or lack of) shutters, such as architecture, orientation, exposure, area, and wind velocity were eliminated by pairing houses - an almost entirely shuttered house (shuttered), with one that had no shutters on (comparable) during the storm. The characteristics that were used to match houses have been previously discussed. Because of the difficulties encountered in field data collection, of the original pool of 239 potential shuttered houses only 32 met the criteria for the study. Therefore the data analysis that follows was performed on 32 matched pairs (total of 64) of houses.

4.1 DAMAGE VARIABLES

Since direct measures of damage were not available, indirect measures were used to approximate damage. They were: dollar value loss from 1992 to 1993 in appraised value of the building, and dollar value loss from 1992 to 1993 in appraised total value (building and land). However, dollar value loss amounts varied widely , thus threatening the ability of the statistical analysis to detect differences between shuttered and unshuttered houses. To reduce the fluctuations, dollar value losses were transformed to percent losses, (dollar value losses from 1992 to 1993 divided by the 1992 appraised values). All statistical analyses were performed on the dollar losses, and on the percent losses: appraised building value percent loss from 1992 to 1993, and appraised total value percent loss from 1992 to 1993. Note that analyses on appraised total values (building and land) and on appraised total value percent losses were similar to building-only analyses and are presented in Appendix A.

4.2 WIND SPEED VARIABLE

To contrast the differences in damage between shuttered and comparable houses by the wind velocity, maximum one minute sustained surface wind velocities that may have occurred during Hurricane Andrew were obtained for each pair of houses.[43]

4.3 STATISTICAL METHODS USED IN THE ANALYSIS

Statistical analysis techniques used in comparison of damages between shuttered and comparable houses included parametric tests: t-tests, Pearson's correlation coefficients, and regression analysis. Non-parametric

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43. Powell, M.D., Houston, S.H., Dorst, N. and Christoe, B., "Hurricane Andrew's Wind Field At Landfall In South Florida - Part II: Applications To Real-Time Analysis And Preliminary Damage Assessment." Submitted to *Monthly Weather Review*, 1994.

tests were also performed to confirm the parametric tests since sample sizes were small and variability was large. These included Wilcoxon signed rank tests, Wilcoxon rank sum tests, and Spearman's rank correlations.

All tests were carried out at a 5% significance level. Parametric and non-parametric tests agreed in all cases; the statistical decisions remained unchanged at the 5% significance level, although the p-values differed somewhat in magnitude. Consequently, throughout this analysis only the parametric results will be discussed. (See Appendix D for a complete computer listing of the statistical results).

4.4 COMPARISON OF APPRAISED VALUES FOR SHUTTERED AND COMPARABLE HOUSES - 1992

Shuttered and comparable houses were matched on the variables previously described (proximity, exposure, orientation, architecture, etc.) but they were not directly matched on appraised values. To ascertain that appraised values did not differ statistically between the two groups of houses, t-tests were performed on mean two groups of houses, t-tests were performed on mean appraised values for the buildings. For 1992, the 32 shuttered houses had appraised building values which ranged from \$30,877 to \$428,072 with a mean of \$102,756 (sd = \$81,803) while the 32 comparable houses had appraised building values which ranged from \$29,061 to \$283,666 with a mean of \$82,059 (sd = \$47,868). The mean appraised building values did not differ significantly ($t=1.86$, $p<0.072$). (See Table 1). Thus, not only did the pairs of houses match on the characteristics of type and location, but they also were well matched on appraised building values for 1992.

4.5 COMPARISON OF REDUCTION IN APPRAISED VALUES SHUTTERED AND COMPARABLE HOUSES

Because houses were well matched, differences in reductions in appraised values between pairs of houses were calculated by subtracting the reduction in appraised value from 1992 to 1993 for the shuttered house from the reduction for its comparable house. Thus, if the reduction difference was positive, the comparable house sustained more damage than its matched shuttered house.

4.5.1 Dollar Reduction in Appraised Building Values

Eleven of 32 pairs of houses (34% of the pairs) had positive differences in reductions in appraised building values. Building loss differences ranged from -$41,092 to $135,069 with a mean loss difference of $4,065 (sd=$28,077). (See Table 6). Although the mean building loss difference was positive, suggesting that shuttered houses had less average damage than their comparables, due to the large variability and small number of pairs, the mean loss was not significant at the 5% level ($t=0.82$, $p<0.210$). To detect a mean loss difference as large as was found 80% of the time with such a large standard deviation, the study would have needed to review 408 pairs of shuttered and comparable houses.

4.5.2 Percent Reduction in Appraised Building Value

To mitigate the impact of variability on the dollar values, differences were also calculated on the percent reductions in appraised building values from 1992 to 1993, where all differences were computed by subtracting the percent reduction for the shuttered house from that for the comparable house. Sixteen of the 32 pairs of houses (50% of the pairs) had positive reduction differences, i.e., the shuttered houses sustained less percent building loss than comparables. Percent reduction differences ranged from -28.7% to 54.8%. (See Table 7). The mean percent reduction difference of 5.1% was positive, but due to the substantial variability (sd=18.1%), the mean loss could not be shown to be significant at the 5% level (t=1.59, p<0.061). The p-value of 0.061, however, suggests a marginally significant difference (p<0.10). This means the result obtained would occur by chance alone less than 1 out of 10 times in repeated sampling.

Further examination of the building percent reduction differences revealed that for 4 pairs of houses (12.5%), the shuttered houses sustained from 30.8% to 54.8% less damage than their comparables, while no comparables outperformed their matched shuttered houses by such large percentages. However, twenty of the pairs of houses (63%) differed in percent building loss by no more or comparable better than its matched shuttered). To detect a mean percent difference as large as was found at the 5% significance level 80% of the time, with the same size standard deviation, the study would have needed to review 108 pairs of houses. Although this is only one quarter the number needed to detect the mean difference in dollars, it is still three times as many pairs as were available to this study.

4.6 RELATIONSHIP OF WIND VELOCITY WITH DAMAGE

4.6.1 Correlational Analysis

The maximum one minute sustained surface wind that may have occurred during Hurricane Andrew was determined for each pair of houses in the study.[44] Wind speeds ranged from 119 to 136 mph with a mean of 129.9 mph (sd=4.9 mph). For shuttered houses, significant Pearson's correlation coefficients were found between wind velocity and percent building loss ($r=0.48$, $p<0.002$). (See Fig. 11). For comparable houses, significant Pearson's correlations were found between wind speed and

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44. Powell, M.D., et al., op. cit.

Pearson's correlations were found between wind speed and percent building loss (r=0.45, p<0.003). (See Fig. 10). Significant Pearson's correlation coefficients means that higher wind speeds resulted in larger percent building loss. However, correlations for the two groups of houses were very similar, suggesting that the relationships between damage estimates and wind speed were not appreciably different for shuttered and comparable houses.

4.6.2 Regression Analysis

To determine what average percent loss resulted from changes in wind speed, regression lines were fit to shuttered and comparable groups. It should be noted that the wind speed range is quite narrow for this set of observations so extrapolation outside of the interval is risky. Furthermore, regression analysis assumes the variables are linearly related, so that wind speed and percent damage must be assumed to have a linear relationship over the given interval. This may or may not be true in this hurricane situation. For shuttered houses, an increase of one mile per hour in wind speed in this range resulted in a significant mean increase in building loss of 1.7%, (t= 3.02, p<0.002). For comparable houses, increases were similar. For an increase of one mph in wind speed, the average percent building loss significantly increased 2.4% (t= 2.73, p<0.003). Although these results are statistically significant, they should be viewed as only a first step in relating changes in wind speed to damage estimates.

Regression of Reduction in App Total Value % on Wind Speed

GROUP=Comparable

Model: MODEL1
Dependent Variable: PTV23 % App. Total Value Reduct from 1992-93

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	1750.54928	1750.54928	7.243	0.0115
Error	30	7250.22144	241.67405		
C Total	31	9000.77072			

Root MSE	15.54587	R-square	0.1945
Dep Mean	8.56308	Adj R-sq	0.1676
C.V.	181.54539		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|	Variable Label
INTERCEP	1	-189.704080	73.71919605	-2.573	0.0153	Intercept
WIND	1	1.525902	0.56696278	2.691	0.0115	Wind Velocity

Means And Standard Deviations Of Shuttered And Comparable Houses' Appraised Values And Reduction In Appraised Values For 1992 And 1993

	Appraised Value				Reduction In Appraised Value From 1992 To 1993			
	1992		1993		Dollar Reduction		% Reduction	
	Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
Variable Group								
Building Value:								
Shuttered Houses	$102,756	$ 81,803	$ 89,756	$ 76,476	$13,000**	$26,422	12.4**	17.2
Comparable Houses	$ 82,058	$ 47,868	$ 64,993	$ 35,602	$17,065**	$31,748	17.5**	27.0
Total Value:								
Shuttered Houses	$196,492	$133,700	$185,752	$125,293	$10,740*	$27,602	5.2**	10.8
Comparable Houses	$175,063	$ 96,595	$157,903	$ 83,163	$17,160**	$35,781	8.6**	17.0

* Statistically Significant Reduction At 5% Level.
** Statistically Significant Reduction At 1% Level.

Table 1

Distribution Of Reductions In Appraised Building Values Of Shuttered And Comparable Houses From 1992 To 1993

Dollar	Shuttered		Comparable	
Reduction	%	Frequency	%	Frequency
<$ 1,000	25.0	8	31.3	10
$ 1,000< $5,000	21.9	7	15.6	5
$ 5,000<$10,000	18.8	6	25.0	8
$10,000<$20,000	18.8	6	6.3	2
$20,000<$50,000	12.5	4	12.5	4
>$50,000	3.1	1	9.4	3

Table 2

Distribution Of Percentage Reductions In Appraised Building Values Of Shuttered And Comparable Houses From 1992 To 1993

Percent Reduction	Shuttered %	Shuttered Frequency	Comparable %	Comparable Frequency
<1.0%	18.8	6	21.9	7
1.0%< 5.0 %	18.8	6	21.9	7
5.0%< 10.0%	25.0	8	15.6	5
10.0%< 20.0%	21.9	7	21.9	7
20.0%< 50.0%	9.4	3	6.3	2
50.0%<100.0%	6.3	2	12.5	4

Table 3

Distribution Of Reductions In Appraised Total Values Of Shuttered And Comparable Houses From 1992 To 1993

Dollar Reduction	Shuttered %	Shuttered Frequency	Comparable %	Comparable Frequency
<$ 1,000	34.0	11	38.0	12
$ 1,000< $5,000	19.0	6	9.0	3
$ 5,000<$10,000	19.0	6	25.0	8
$10,000<$20,000	13.0	4	6.0	2
$20,000<$50,000	13.0	4	9.0	3
>$50,000	3.0	1	13.0	4

Table 4

Distribution Of Percentage Reductions In Appraised Total Values Of Shuttered And Comparable Houses From 1992 To 1993

Percent Reduction	Shuttered		Comparable	
	%	Frequency	%	Frequency
<1.0%	41.0	13	38.0	12
1.0%< 5.0 %	28.0	9	28.0	9
5.0%< 10.0%	13.0	4	13.0	4
10.0%< 20.0%	9.0	3	3.0	1
20.0%< 50.0%	9.0	3	13.0	4
50.0%<100.0%	0.0	0	6.0	2

Table 5

Distribution Of Reductions In Appraised Building Value Differences Between Comparable And Shuttered Houses From 1992 To 1993

Reduction In Appraised Building Value	Comparable-Shuttered %	Comparable-Shuttered Frequency
-$50,000<-$20,000	9.4	3
-$20,000<-$10,000	0.0	0
-$10,000< -$5,000	12.5	4
-$ 5,000< -$1,000	15.6	5
-$ 1,000< $0	21.9	7
$ 0< $1,000	15.6	5
$ 1,000< $ 5,000	9.4	3
$ 5,000< $10,000	0.0	0
$10,000< $20,000	0.0	0
$20,000< $50,000	12.5	4
>$50,000	3.1	1

Note:

RABVD = Reduction In Appraised Building Value Difference
ABV93 = Appraised Building Value For 1993
ABV92 = Appraised Building Value For 1992

RABVD = (ABV93-ABV92) Comparables - (ABV93-ABV92) Shuttered

Table 6

Distribution Of Percentage Reductions In Appraised Building Value Differences Between Comparable And Shuttered Houses From 1992 To 1993

Reduction In Appraised Building Percentage	Comparable-Shuttered %	Comparable-Shuttered Frequency
-100.0% <-50.0%	0.0	0
- 50.0% <-20.0%	3.1	1
- 20.0% <-10.0%	3.1	1
- 10.0% < -5.0%	9.4	3
- 5.0 % < -1.0%	12.5	4
- 1.0 % < 0.0 %	18.8	6
0.0 % < 1.0 %	21.9	7
1.0 % < 5.0 %	9.4	3
5.0 % <10.0 %	3.1	1
10.0% <20.0 %	3.1	1
20.0% <50.0 %	9.4	3
50.0% <100.0%	6.3	2

Note:

PRABVD = % Reduction In Appraised Building Value Difference
PABV93 = % Appraised Building Value For 1993
PABV92 = % Appraised Building Value For 1992

PRABVD = (PABV93-PABV92) Comparables - (PABV93-PABV92) Shuttered

Table 7

Distribution Of Reductions In Appraised Total Value Differences Between Comparable And Shuttered Houses From 1992 To 1993

Reduction In Appraised Total Value	Comparable-Shuttered %	Comparable-Shuttered Frequency
-$50,000<-$20,000	9.0	3
-$20,000<-$10,000	0.0	0
-$10,000< -$5,000	13.0	4
-$ 5,000< -$1,000	13.0	4
-$ 1,000< $0	25.0	8
$ 0< $1,000	13.0	4
$ 1,000< $ 5,000	9.0	3
$ 5,000< $10,000	0.0	0
$10,000< $20,000	3.0	1
$20,000< $50,000	9.0	3
>$50,000	6.0	2

Note:

RATVD = Reduction In Appraised Total Value Difference
ATV93 = Appraised Total Value For 1993
ATV92 = Appraised Total Value For 1992

RATVD = (ATV93-ATV92) Comparables - (ATV93-ATV92) Shuttered

Table 8

Distribution Of Percentage Reductions In Appraised Total Value Differences Between Comparable And Shuttered Houses From 1992 To 1993

Reduction In Appraised Building Percentage	Comparable - Shuttered %	Comparable - Shuttered Frequency
-100.0% <-50.0%	0.0	0
- 50.0% <-20.0%	0.0	0
- 20.0% <-10.0%	3.0	1
- 10.0% < -5.0%	6.0	2
- 5.0 % < -1.0%	19.0	6
- 1.0 % < 0.0 %	22.0	7
0.0 % < 1.0 %	19.0	6
1.0 % < 5.0 %	13.0	4
5.0 % <10.0 %	6.0	2
10.0% <20.0 %	0.0	0
20.0% <50.0 %	13.0	4
50.0% <100.0%	0.0	0

Note:

PRATVD = % Reduction In Appraised Total Value Difference
PATV93 = % Appraised Total Value For 1993
PATV92 = % Appraised Total Value For 1992

PRATVD = (PATV93-PATV92) Comparables - (PATV93-PATV92) Shuttered

Table 9

Distribution of Reduction in Appraised Building Value of Shuttered and Comparable Houses From 1992 to 1993

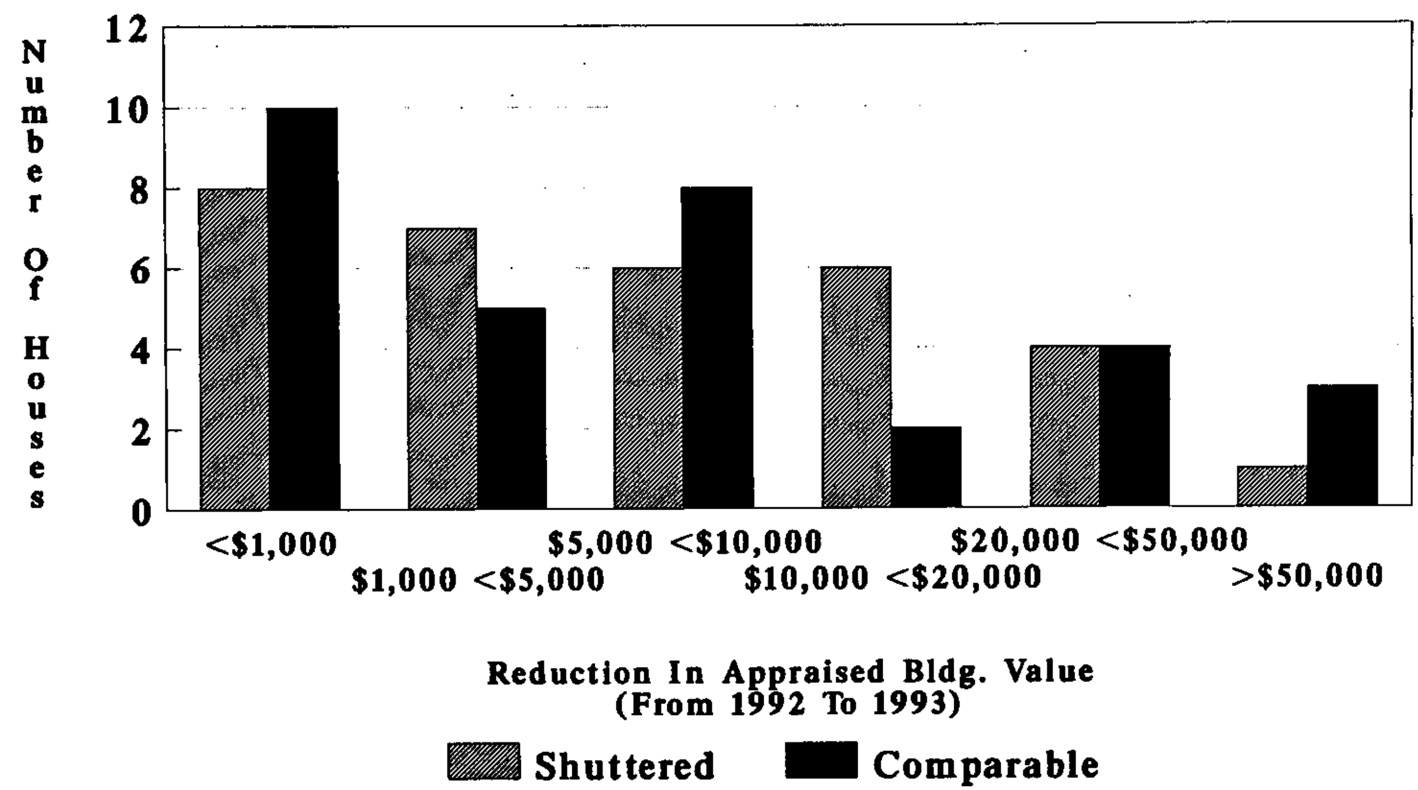


Fig. 1

Distribution of Percentage Reductions In Appraised Building Values of Shuttered And Comparable Houses From 1992 to 1993

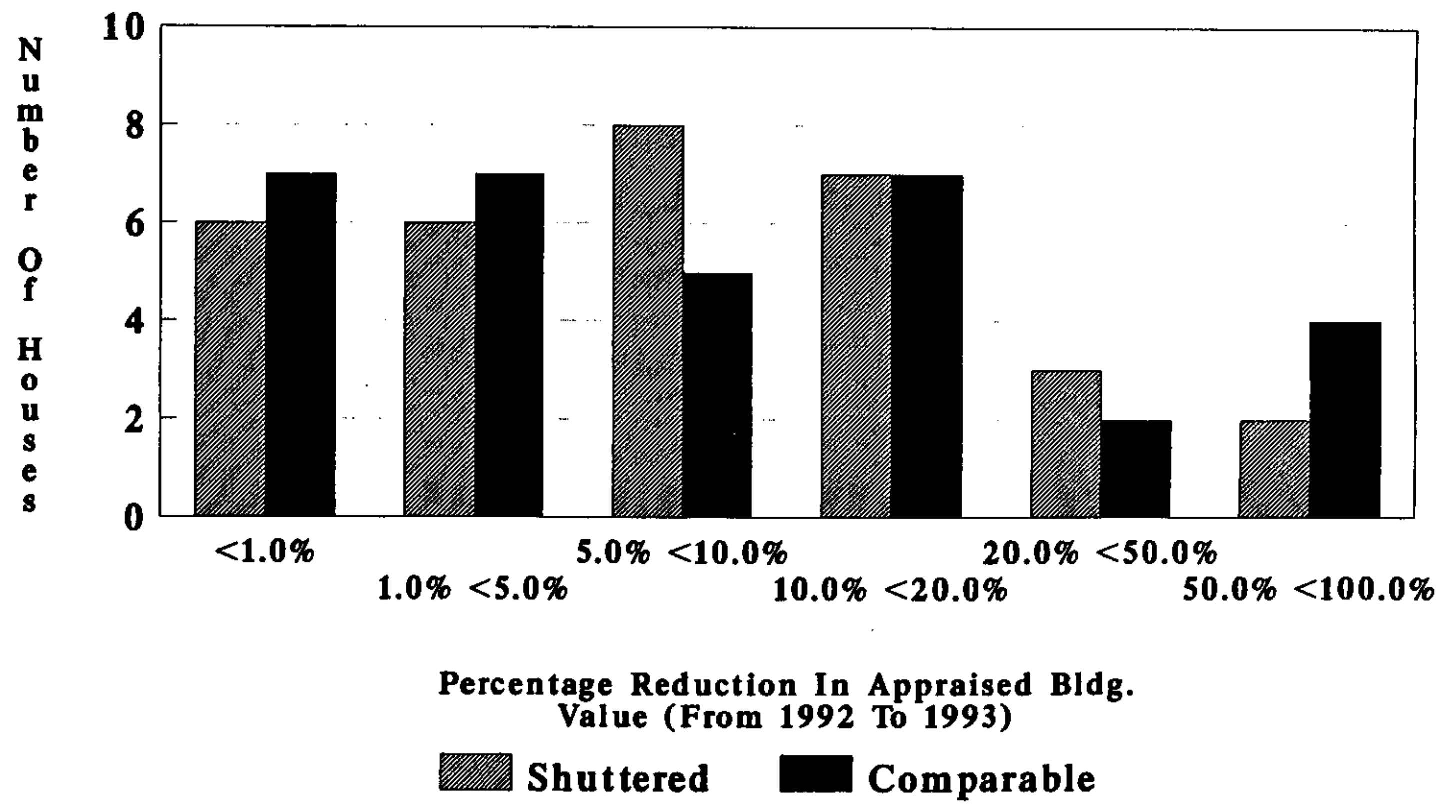


Fig. 2

Distribution of Reductions In Appraised Total Values of Shuttered and Comparable Houses From 1992 to 1993

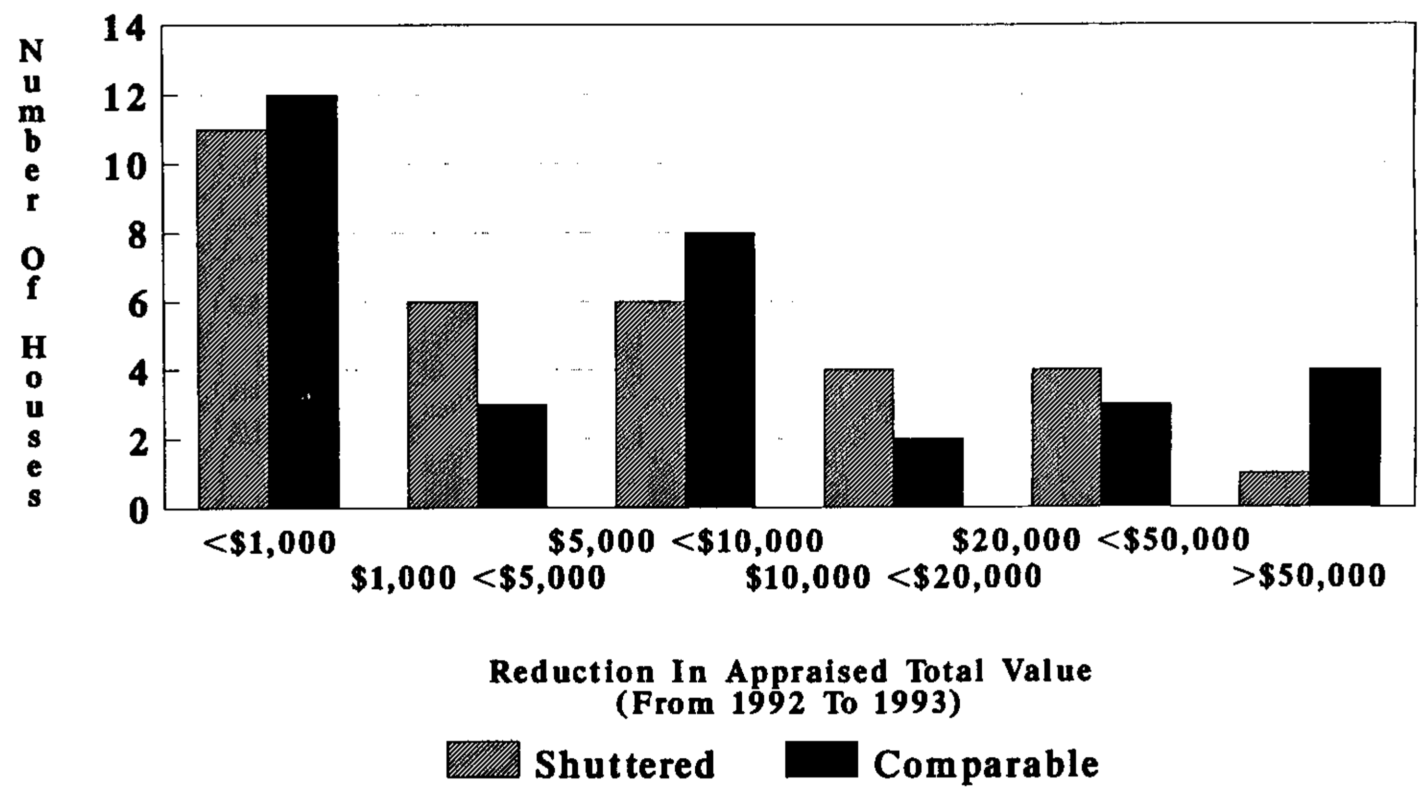


Fig. 3

Distribution of Percentage Reductions In Appraised Total Values of Shuttered And Comparable Houses From 1992 to 1993

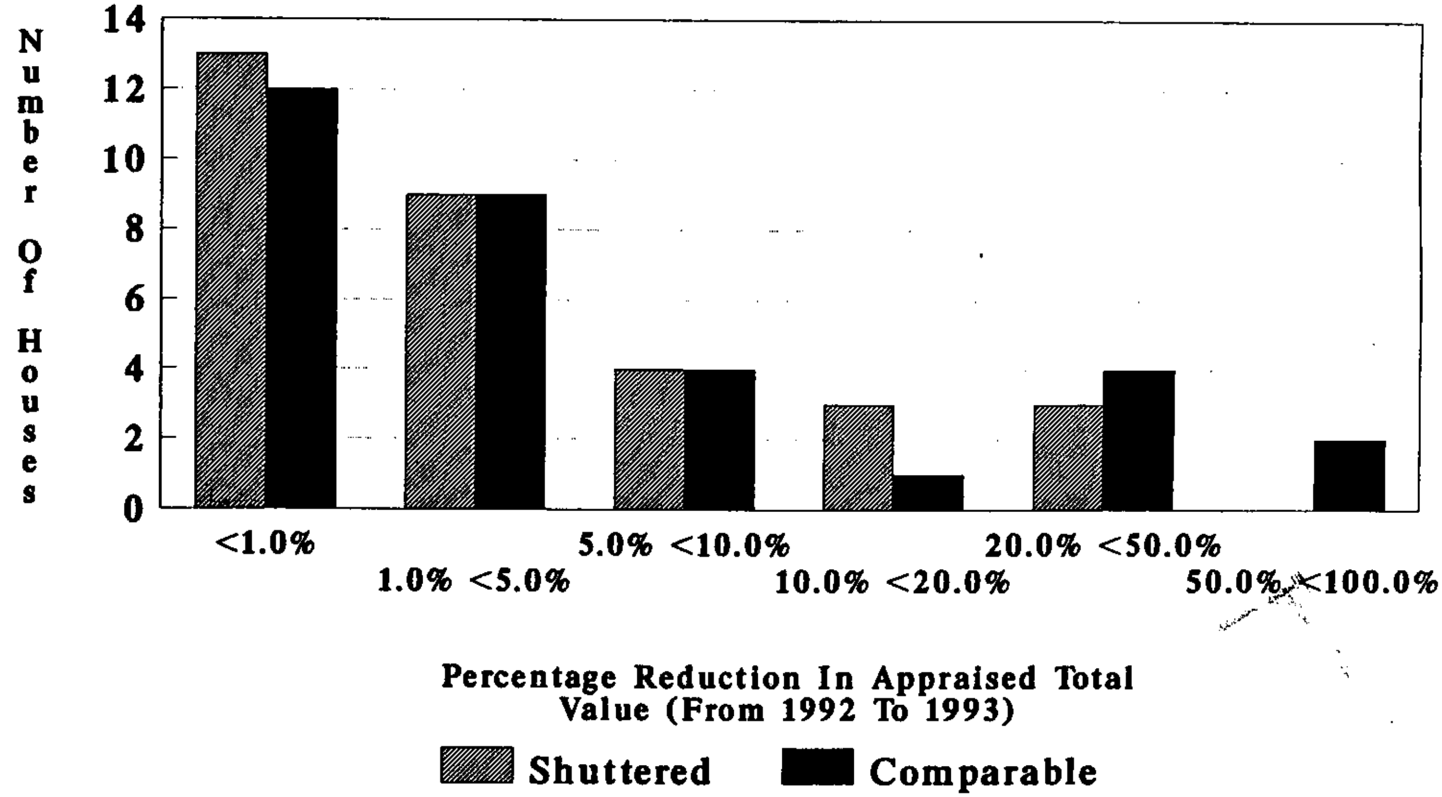


Fig. 4

Distribution of Reductions In Appraised Building Value Differences Between Comparable And Shuttered Houses From 1992 To 1993

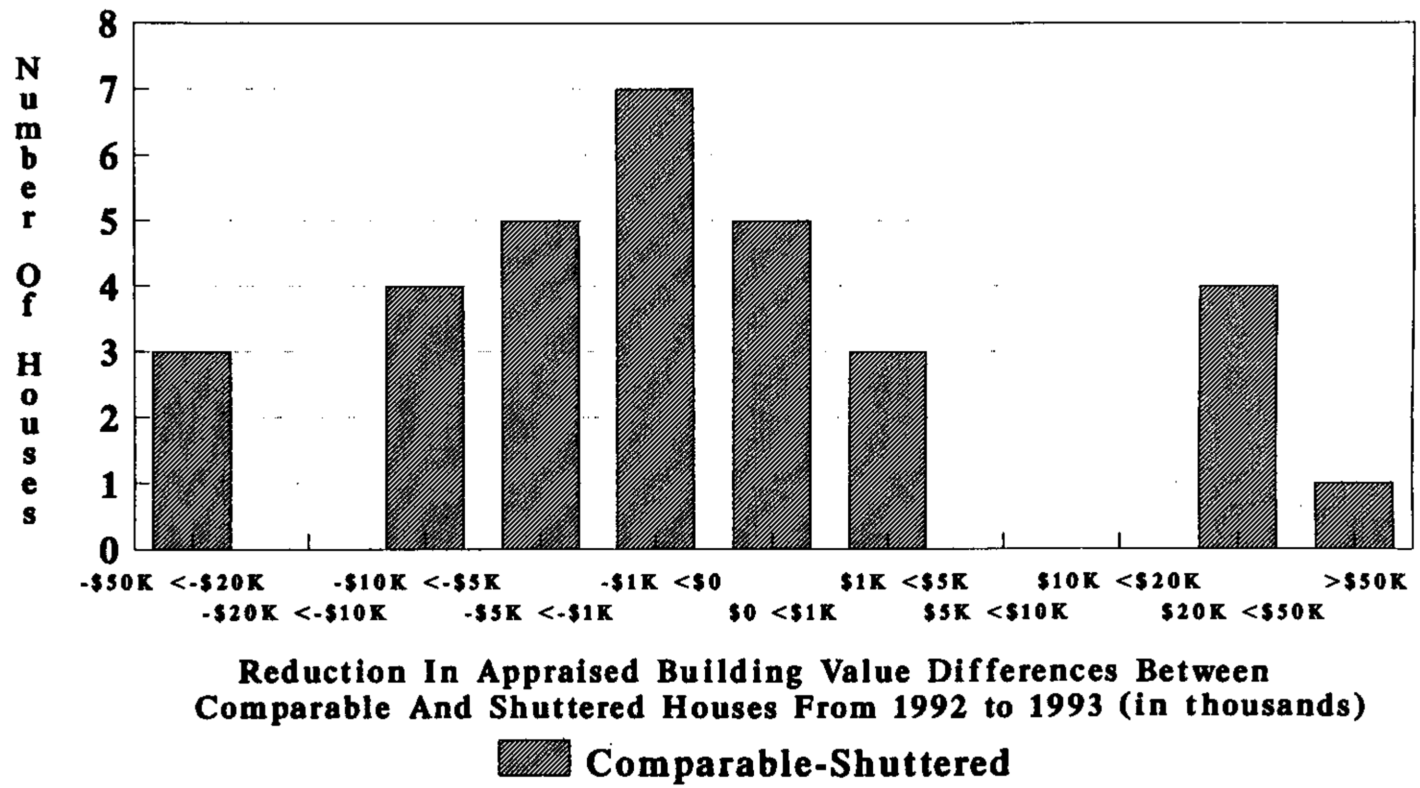


Fig. 5

Distribution of Percentage Reductions In Appraised Building Value Differences Between Comparable and Shuttered Houses From 1992 To 1993

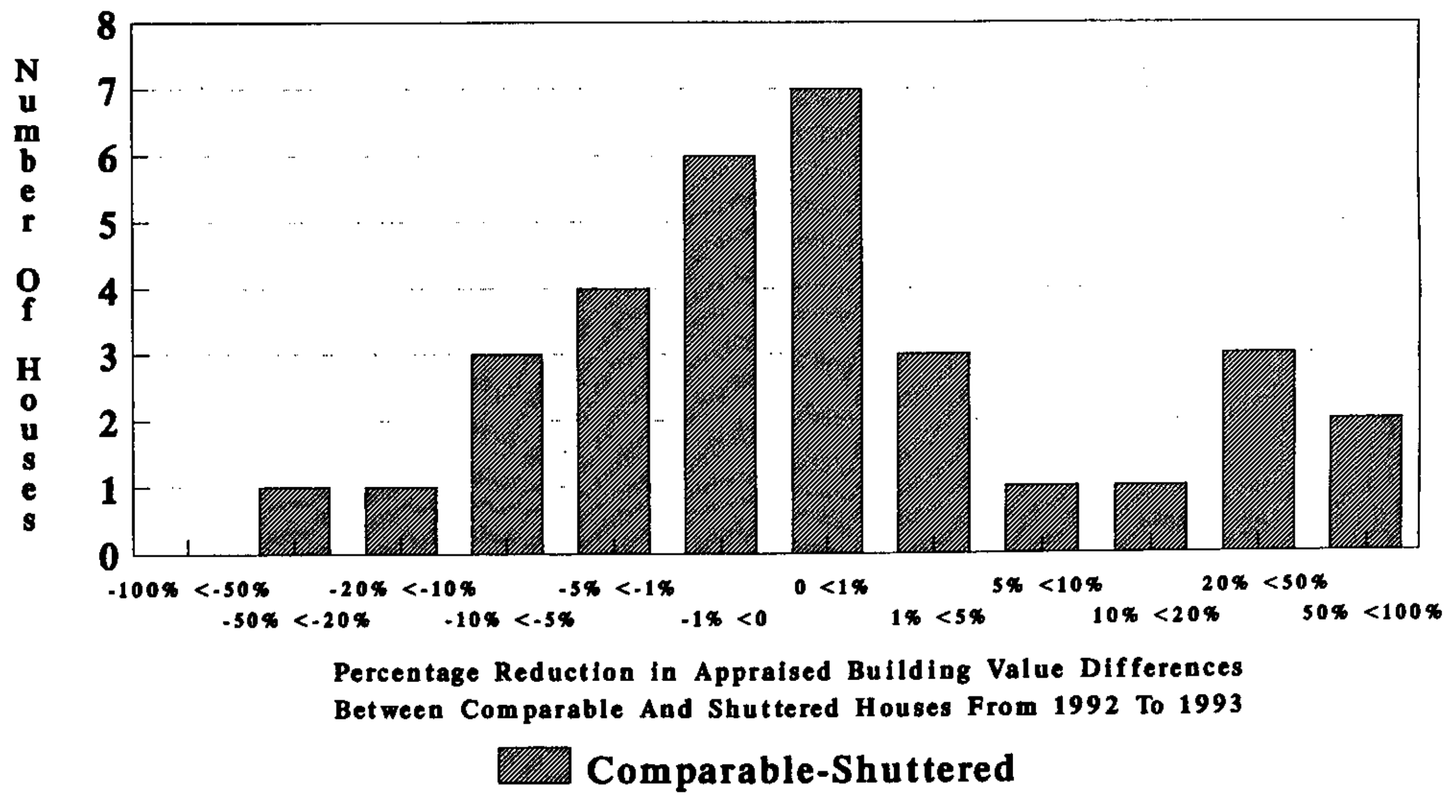


Fig. 6

Distribution of Reductions In Appraised Total Value Differences Between Comparable and Shuttered Houses From 1992 To 1993

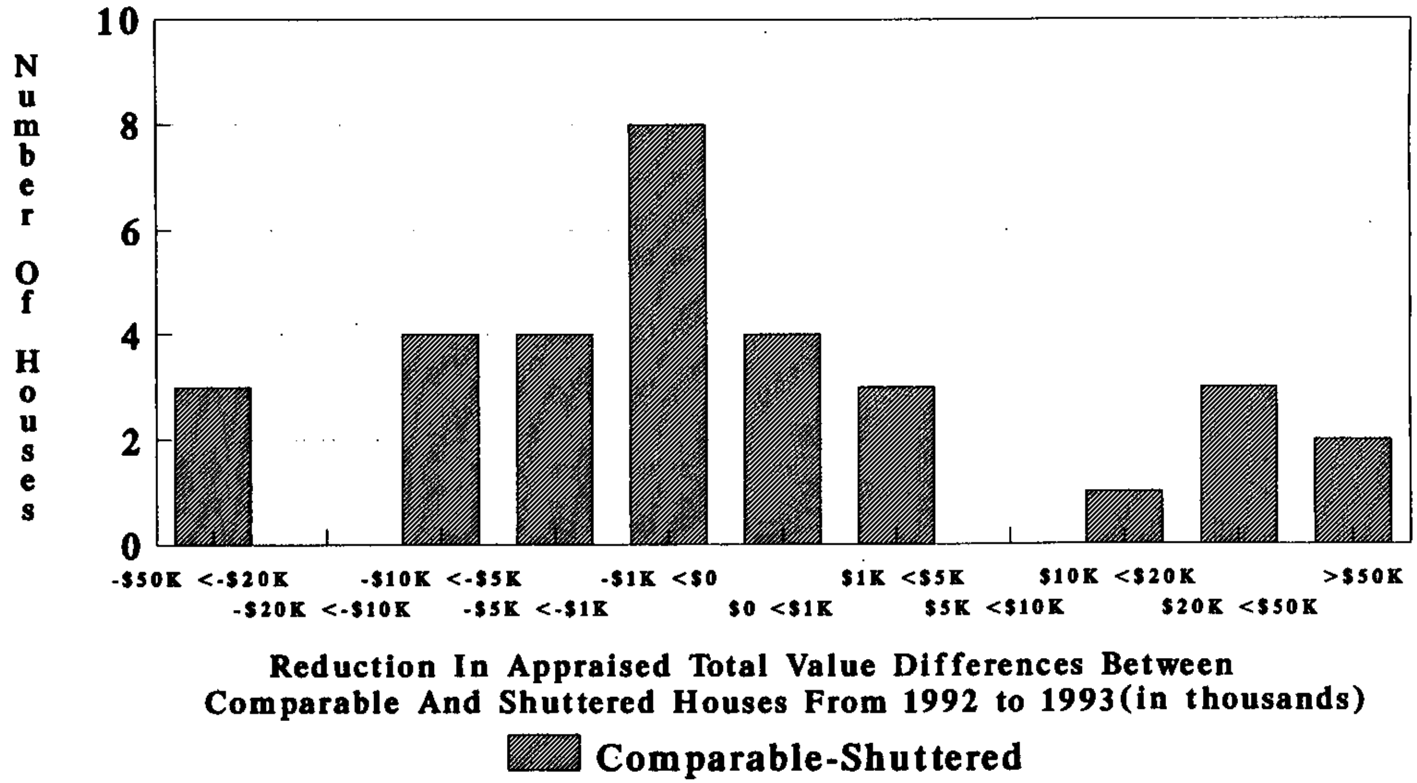


Fig. 7

Distribution of Percentage Reductions In Appraised Total Value Differences Between Comparable and Shuttered Houses From 1992 To 1993

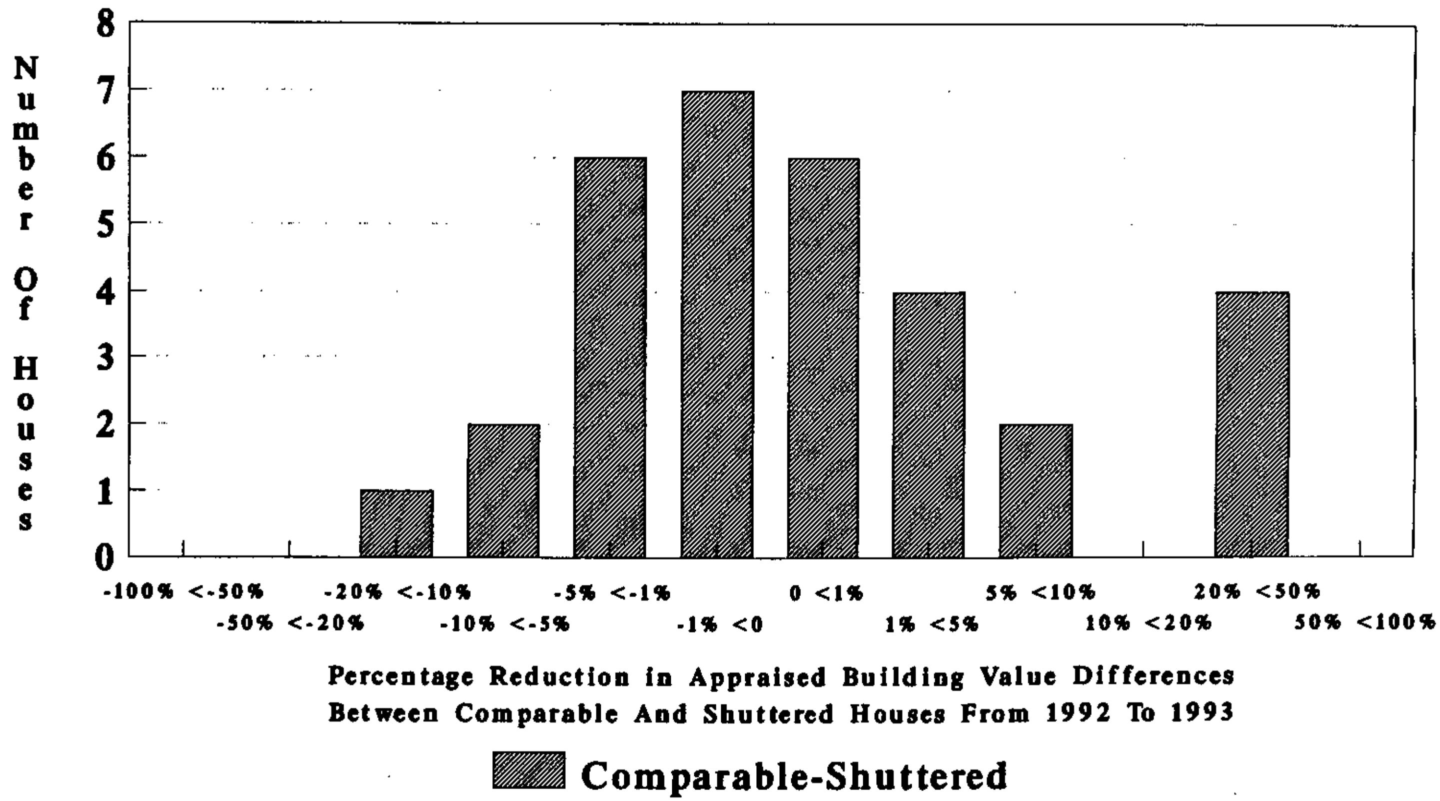


Fig. 8

Percent Reduction In Appraised Total Value Differences Between Shuttered And Comparable Houses (1992 to 1993) vs Max 1 Minute Sustained Surface Wind Speed

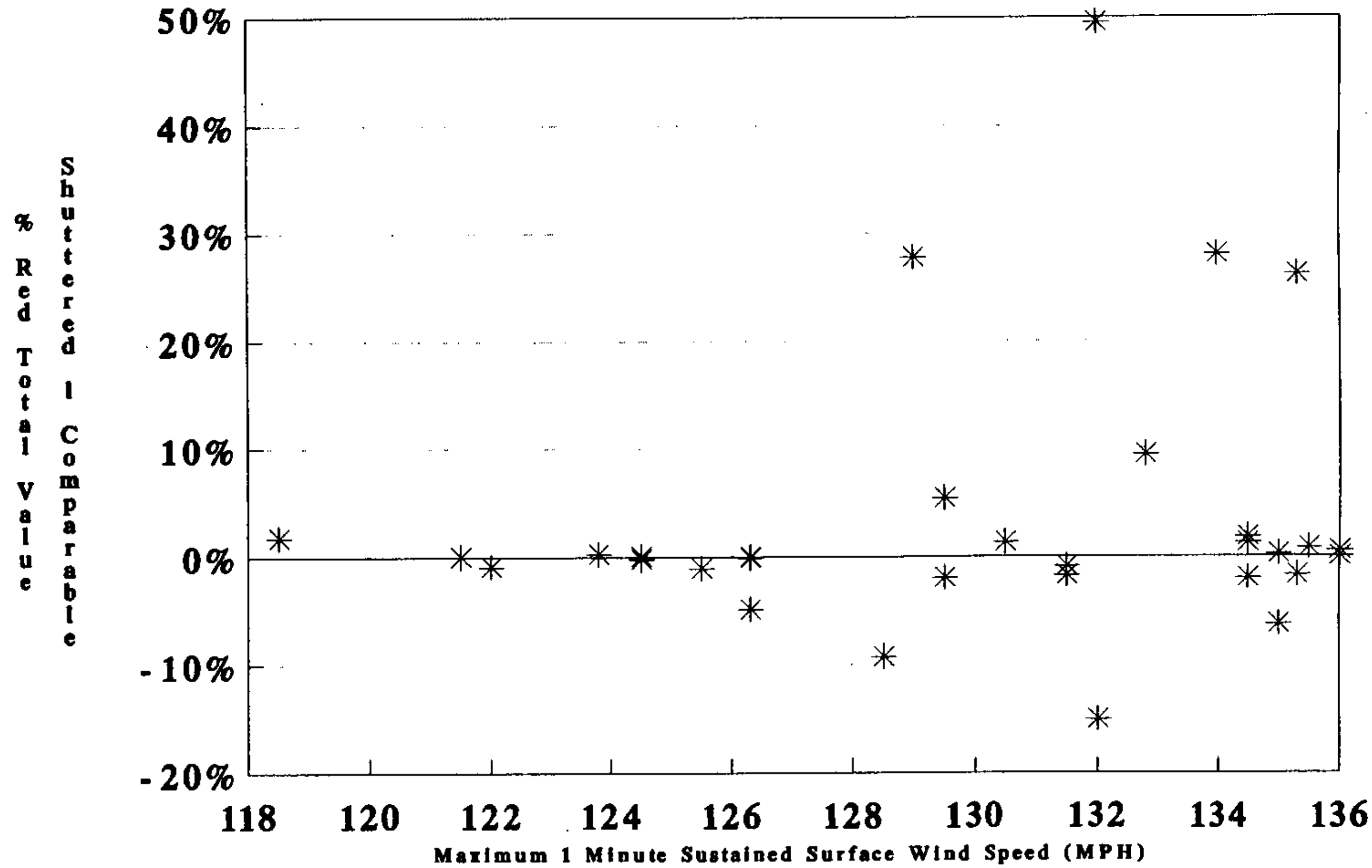


Fig. 9

Percent Reduction In Appraised Building Values Of Comparable Houses From 1992 To 1993 vs Max 1 Minute Sustained Surface Wind Speed (MPH)

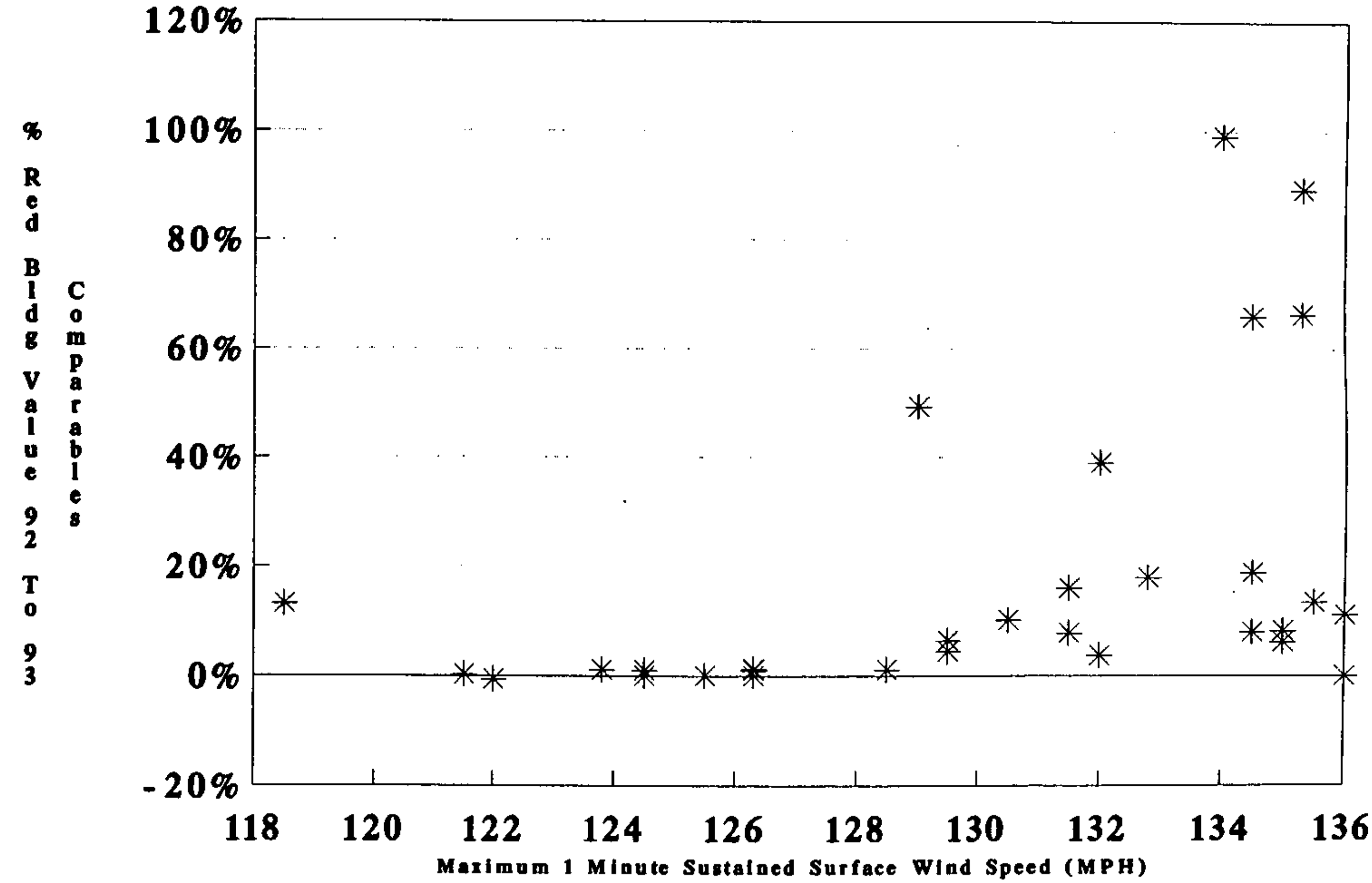


Fig. 10

Percent Reduction In Appraised Building Values Of Shuttered Houses From 1992 To 1993 vs Max 1 Minute Sustained Surface Wind Speed (MPH)

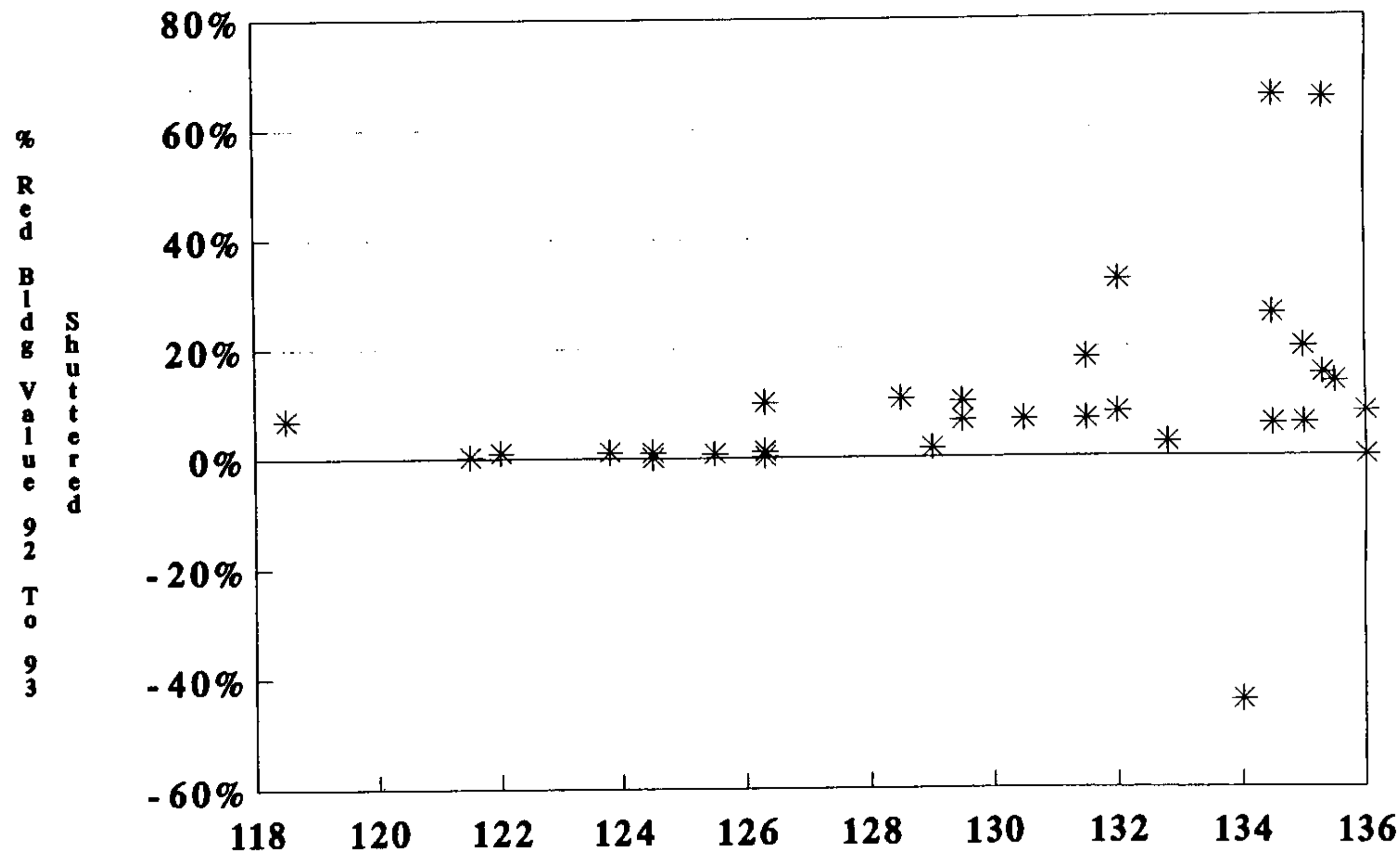
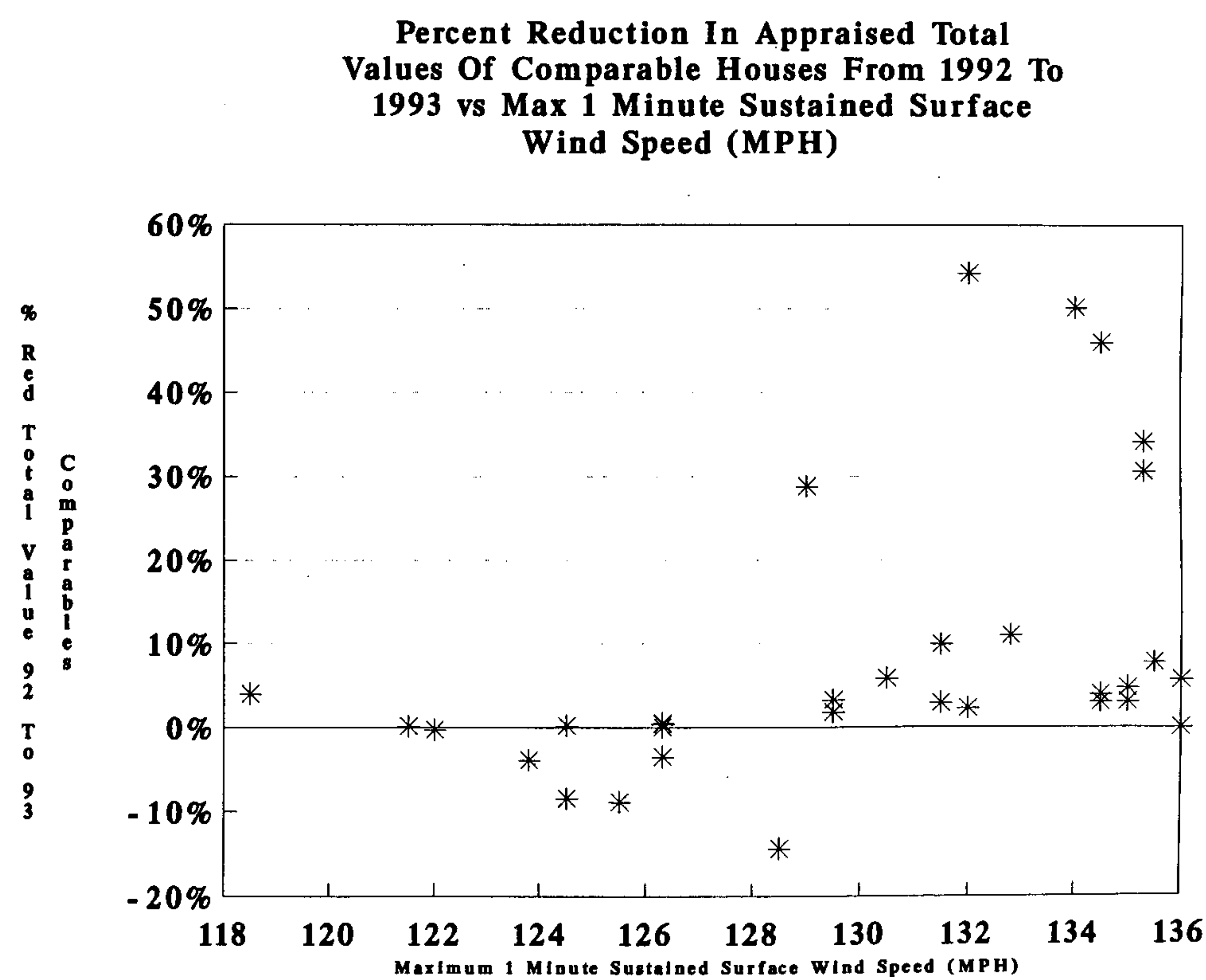


Fig. 11


Percent Reduction In Appraised Total Values Of Comparable Houses From 1992 To 1993 vs Max 1 Minute Sustained Surface Wind Speed (MPH)
% Red Total Value 92 To 93
Comparables
60%
50%
40%
30%
20%
10%
0%
-10%
-20%
118
120
122
124
126
128
130
132
134
136
Maximum 1 Minute Sustained Surface Wind Speed (MPH)
Fig. 12

Percent Reduction In Appraised Total Values Of Shuttered Houses From 1992 To 1993 vs Max 1 Minute Sustained Surface Wind Speed (MPH)

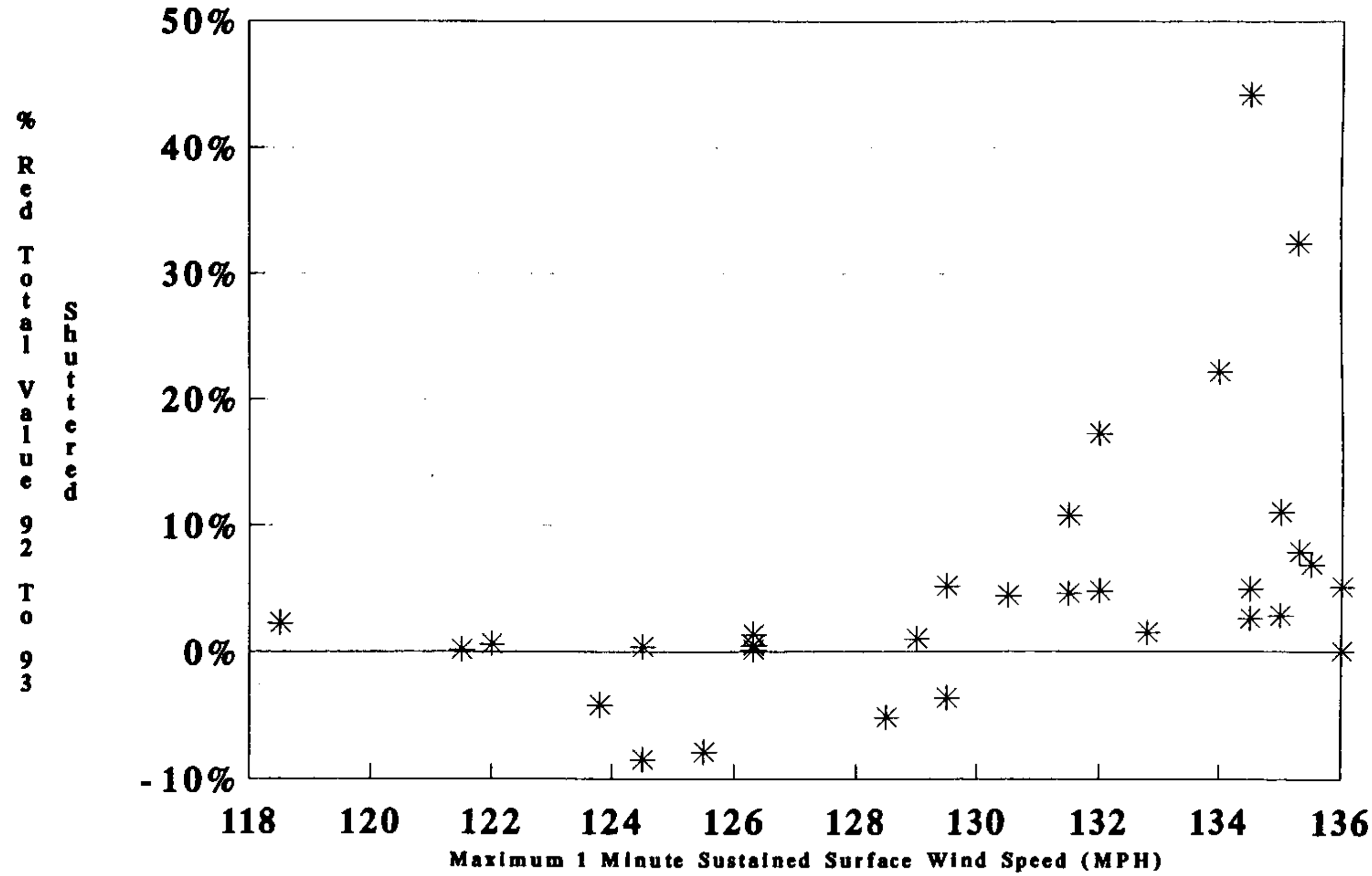


Fig. 13

Percent Reduction In Appraised Building Value Differences Between Shuttered And Comparable Houses (1992 to 1993) vs Max 1 Minute Sustained Surface Wind Speed

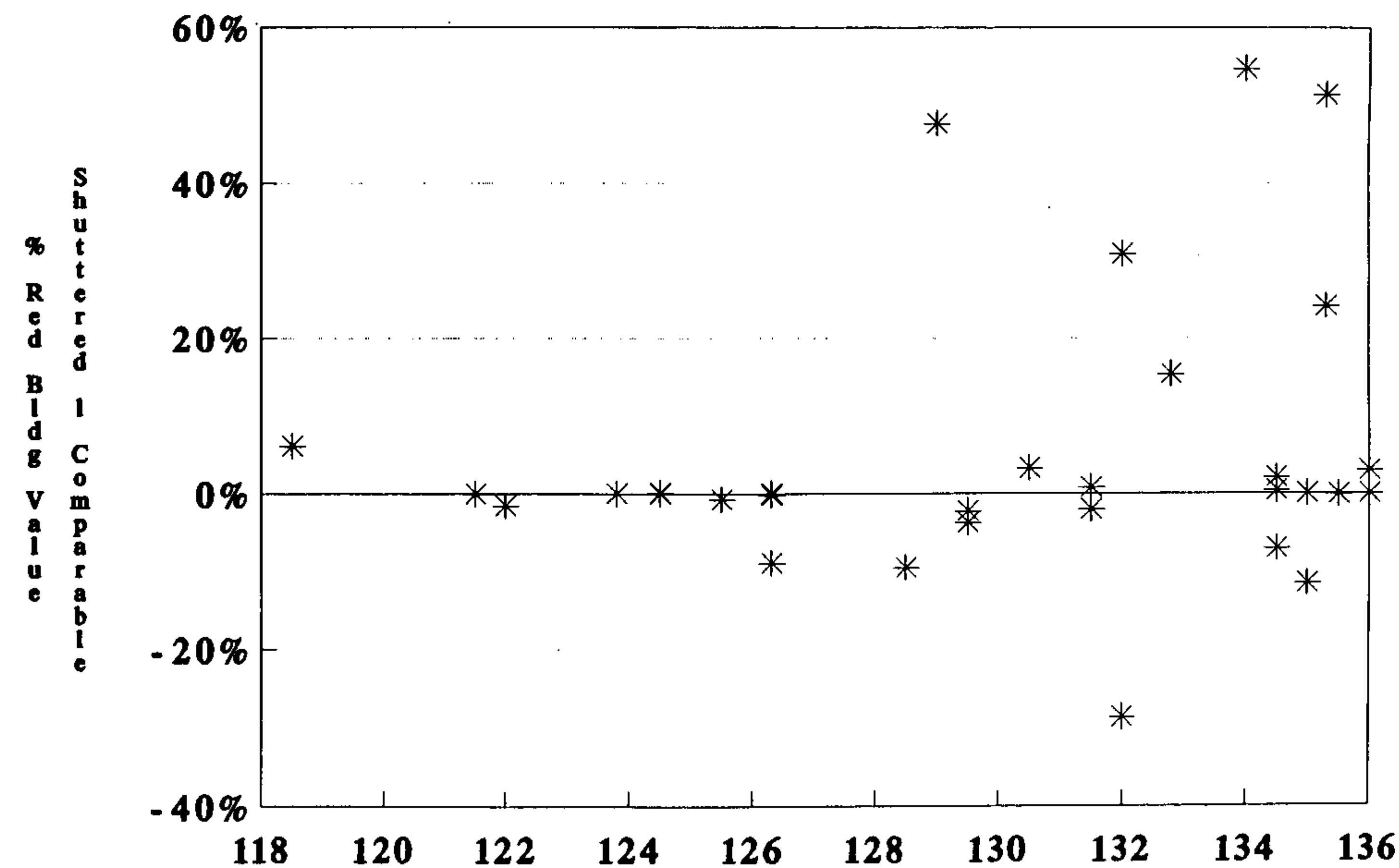


Fig. 14

APPENDIX A

DATA ANALYSIS

Note: All tables and figures referenced in Appendix A are found within Chapter 4 - Summary of Data Analysis, in the body of this report.

APPENDIX A

DATA ANALYSIS

It was of interest in this study to determine if shuttered houses suffered less damage, on the average, than did non-shuttered (comparable) houses because of Hurricane Andrew. Because hurricane damage differed greatly among areas and types of houses, variation due to variables other than the existence (or lack of) shutters, such as architecture, orientation, exposure, area, and wind velocity were eliminated by pairing houses - an almost entirely shuttered house (shuttered), with one that had no shutters on (comparable) during the storm . The characteristics that were used to match houses have been previously discussed. Because of the difficulties encountered in field data collection, of the original pool of 239 potential shuttered houses only 32 met the criteria for the study. Therefore the data analysis that follows was performed on 32 matched pairs (total of 64) of houses.

A.1 DAMAGE VARIABLES

Since direct measures of damage were not available, indirect measures were used to approximate damage. They were: dollar value loss from 1992 to 1993 in appraised value of the building, and dollar value loss from 1992 to 1993 in appraised total value (building and land). However, dollar value loss amounts varied widely , thus threatening the ability of the statistical analysis to detect differences between shuttered and unshuttered houses. To reduce the fluctuations, dollar value losses were transformed to percent losses, (dollar value losses from 1992 to 1993 divided by the 1992 appraised values). All statistical analyses were performed on the dollar losses, and on the percent losses: appraised building value percent loss from 1992 to 1993, and appraised total value percent loss from 1992 to 1993.

A.2 WIND SPEED VARIABLES

To contrast the differences in damage between shuttered and comparable houses by the wind velocity, maximum one minute sustained surface wind velocities that may have occurred during Hurricane Andrew were obtained for each pair of houses.[45]

A.3 STATISTICAL METHODS USED IN THE ANALYSIS

Statistical analysis techniques used in comparison of damages between shuttered and comparable houses included parametric tests: t-tests, Pearson's correlation coefficients, and regression analysis. Non-parametric tests were also performed to confirm the parametric tests since sample sizes were small and variability was large. These included Wilcoxon signed rank tests, Wilcoxon rank sum tests, and Spearman's rank correlations. Non-parametric tests are statistical tests that do not use the actual data values themselves as parametric tests do, (dollar values and percents in this study), but instead, use the ranks of the data values (from 1 to n), when the data values are ordered from smallest to largest. (See

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45. Powell, M.D., Houston, S.H., Dorst, N. and Christoe, B., "Hurricane Andrew's Wind Field At Landfall In South Florida - Part II: Applications To Real-Time Analysis And Preliminary Damage Assessment." Submitted to *Monthly Weather Review*, 1994.

Appendix E for a complete computer listing of the statistical results).

A.3.1 Means Analysis

T-tests are statistical tests used to assess whether or not one mean differs from a given value, or whether or not two means differ from one another. The tests are appropriate when the data values have a bell-shaped distribution or the number of observations is large (n>50) and no extremely large or small values are present. The non-parametric Wilcoxon signed rank tests and rank sum tests are similar to t-tests except that the statistics are calculated based on the ranks of the data values. For this analysis, t-tests and Wilcoxon tests were used extensively to test for differences between shuttered and comparable groups on the damage variables.

A.3.2 Correlational Analysis

Pearson's correlation coefficients measure the strength of the linear association between two variables.

Correlation coefficients range from +1 to -1, with a +1 indicating a perfect positive (direct) linear relationship between the two variables, and -1 indicating a perfect negative (inverse) linear relationship. A coefficient of 0 indicates that no relationship exists. Spearman's correlation coefficients are similar to Pearson's, but are computed based on the ranks of the data values. In this study, correlation coefficients were used to measure the strength of the relationships between the wind velocity and the damage variables.

A.3.3 Regression Analysis

Regression analysis linearly relates a dependent variable to one or more independent variables, in a similar manner to correlation analysis. However, regression coefficients can be found that directly relate changes in the independent variables to changes in the dependent variable. In this study, the shuttered and comparable houses' damages were regressed on the wind velocity to determine if changes in wind velocity could predict changes in damage amounts.

A.3.4 Statistical Significance

For all tests, an appropriate test statistic and its associated p-value were determined. A p-value is the probability of obtaining the test statistic value by chance alone. If the p-value is small, (less than 0.05), then the result is considered rare enough to conclude that a significant difference exists. For instance, in measuring damage, a significant difference would mean that less than 5% of the time would the obtained results be expected to occur in a random sample of 32 pairs of houses if the populations of shuttered and comparable houses had similar amounts of damage.

Statistical hypothesis tests are carried out as one-sided or two-sided tests. A one-sided test has an alternative hypothesis that is directional whereas a two-sided test has an alternative hypothesis that is non-directional. For example, in this study tests comparing mean damages between comparable and shuttered houses were directional since the alternative hypothesis was that comparable houses sustained more damage than shuttered. But tests comparing 1992 appraised values for shuttered versus comparable houses were two-sided since it was of interest only to see if a difference existed, either that shuttered houses were appraised higher or that the comparables were. Correlational and regression tests were carried out as directional tests associating increases in wind speed with increases in damage estimates.

All tests except for the regression analysis were carried out both parametrically and non-parametrically at a 5% significance level. Parametric and non-parametric tests agreed in all cases; the statistical decisions remained unchanged at the 5% significance level, although the p-values differed somewhat in magnitude. Consequently, throughout this analysis only the parametric results will be discussed.

A.4 COMPARISON OF APPRAISED VALUES FOR SHUTTERED AND COMPARABLE HOUSES - 1992

Shuttered and comparable houses were matched on the variables previously described (proximity, exposure, orientation, architecture, etc.) but they were not directly matched on appraised values. To ascertain that appraised values did not differ statistically between the two groups of houses, t-tests were performed on mean appraised values for the buildings and for the totals (land and building). For 1992, the 32 shuttered houses had appraised building values which ranged from $30,877 to $428,072 with a mean of $102,756 (sd = $81,803) while the 32 comparable houses had appraised building values which ranged from $29,061 to $283,666 with a mean of $82,059 (sd = $47,868). The mean appraised building values did not differ significantly ($t=1.86$, $p<0.072$). (See Table 1).

Similarly, 1992 appraised total values (land and building), did not significantly differ between shuttered and comparable houses ($t=1.85$, $p<.073$). For the 32 shuttered houses, appraised total values ranged from $68,721 to $641,222 with a mean of $196,492 (sd=$133,700) while for the 32 comparables, appraised total values ranged from $68,935 to $486,346 with a mean of $175,063 (sd=$96,595). (See Table 1). Thus, not only did the pairs of houses match on the characteristics of type and location, but they also were well matched on appraised building and total values for 1992.

A.5 REDUCTION IN APPRAISED BUILDING AND TOTAL VALUES FROM 1992 TO 1993

Because the damage variables were rough measures made by many different inspectors, the distributions of damage estimates (calculated as differences between 1992 and 1993 appraised values) were examined carefully and mean losses were tested to confirm that overall, appraised values did decrease as would be expected after the hurricane. Although this may be expected to be obvious after a hurricane such as Andrew, it may have been possible to have randomly chosen a set of houses with no damage as measured by the variables used in this study. This could have occurred as a result of poor selection or due to arbitrary appraising. The fact that significant average reductions in appraised building and total values exist, however, indicates that meaningful comparisons of reductions between shuttered and comparable houses can be made.

A.5.1 Shuttered Houses' Reduction in Appraised Building Value

After the hurricane in 1993 appraised building values for the 32 shuttered houses had decreased to a range of $16,855 to $398,503 with a mean of $89,756 (sd = $76,476). Thus, actual reduction in appraised building values ranged from $0 to $147,763 with a mean reduction of $13,000 (sd = $26,422). (See Tables 1,2). Thirty of the 32 shuttered houses suffered building damage (as measured in dollars) and this mean loss was significant ($t=2.78$, $p < 0.005$). Percent losses from 1992 to 1993 in appraised building values for the shuttered houses ranged from 0% to 65.6% with a mean percent loss of 12.4% (sd = 17.2%), which was also significant ($t=4.09$, $p<0.001$). (See Tables 1,3).

A.5.2 Comparable Houses' Reduction in Appraised Building Value

A similar pattern emerged for the 32 comparable houses. After the hurricane in 1993, appraised building values had decreased to a range of $621 to $143,801 with a mean of $64,993 (sd = $35,602). Actual appraised building value losses ranged from -$270 to $139,865 with a mean loss of $17065 (sd = $31,748). (See Tables 1,2). Again, 30 of the 32 houses suffered damage with a significant observed mean loss (t=3.04, p <0.002). The percent losses from 1992 to 1993 in appraised building values ranged from 0.6% to 99.0% with a mean percent loss of 17.5% (sd = 27.0%), which was also significant (t=3.67, p<0.001). (See Tables 1,3).

Similar analyses were carried out on damages as measured by the difference between 1992 and 1993 total appraised value. However, the damage estimates found using total appraised values (the sum of appraised building and land values) muted the effect of the hurricane since most of the hurricane damage was reflected in the appraised building loss and not in the appraised land value loss. Appraised land values changed very little from 1992 to 1993. In fact, no appraised land values decreased from 1992 to 1993 for any of the houses, but in 5 of the 32 shuttered houses (16%) and in 4 of the 32 comparable houses (13%), appraised land values actually increased after the hurricane, thus lessening the overall total appraised loss for those houses.

A.5.3 Shuttered Houses' Reduction in Appraised Total Value

For the shuttered houses total appraised values decreased in 1993 with values ranging from $40,596 to $611,653 with a mean of $185,752 (sd=$125,293). The mean dollar loss from 1992 to 1993 on total appraised values for this group of houses was $10,740 (sd=$27,604) and was significant ($t=2.20$, $p<0.018$), with total appraised losses ranging from -$14,810 to $147,763. (See Tables 1,4). Only 26 of the 32 shuttered houses (81%) had damage from the hurricane as measured by the total appraised loss. As with the total dollar loss variable, the percent loss variable on total appraised values from 1992 to 1993 was smaller than the appraised building loss, since it included the appraised land values which did not decrease because of the hurricane. The mean percent total loss for shuttered houses was only 5.2% (sd=10.8%) compared to the mean percent building loss of 12.4% (sd=17.2%), but was still significant ($t=2.71$, $p<0.005$). (See Tables 1,5).

A.5.4 Comparable Houses' Reduction in Appraised Total Value

For the comparable houses total appraised values in 1993 decreased to a range of $42,402 to $370,853 with a mean of $157,903 (sd=$83,163). Thus, dollar losses from 1992 to 1993 on total appraised values ranged from -$15,531 to $139,865 with a significant observed mean loss of $17,160 (sd=$35,781; $t=2.71$, $p<0.005$). (See Tables 1,4). Twenty-five of the 32 comparables (78%) suffered damage from the hurricane as measured by the total appraised loss. The mean percent total loss for the comparables of 8.6% (sd=17.0%) was significant ($t=2.84$, $p<0.004$), even though it was much smaller than the mean percent building loss of 17.5%. (See Tables 1,5). In summary, all damage estimates confirmed statistically that appraised values, on the average, decreased after the hurricane as would be expected. Furthermore, percent total losses were less than percent building losses because the addition of land values lessened the total damage impact.

A.6 COMPARISON OF REDUCTION IN APPRAISED VALUES BETWEEN SHUTTERED AND COMPARABLE HOUSES

Because houses were well matched, differences in reductions in appraised values between pairs of houses were calculated by subtracting the reduction in appraised value from 1992 to 1993 for the shuttered house from the reduction for its comparable house. Thus, if the reduction difference was positive, the comparable house sustained more damage than its matched shuttered house.

A.6.1 Dollar Reduction in Appraised Building Values

Eleven of 32 pairs of houses (34% of the pairs) had positive differences in reductions in appraised building values. Building loss differences ranged from -$41,092 to $135,069 with a mean loss difference of $4,065 (sd=$28,077). (See Table 6). Although the mean building loss difference was positive, suggesting that shuttered houses had less average damage than their comparables, due to the large variability and small number of pairs, the mean loss was not significant at the 5% level (t=0.82, p<0.210). To detect a mean loss difference as large as was found 80% of the time with such a large standard deviation, the study would have needed to review 408 pairs of shuttered and comparable houses.

A.6.2 Percent Reduction in Appraised Building Value

To mitigate the impact of variability on the dollar values, differences were also calculated on the percent reductions in appraised building values from 1992 to 1993, where all differences were computed by subtracting the percent reduction for the shuttered house from that for the comparable house. Sixteen of the 32 pairs of houses (50% of the pairs) had positive reduction differences, i.e., the shuttered houses sustained less percent building loss than comparables. Percent reduction differences ranged from -28.7% to 54.8%. (See Table 7). The mean percent reduction difference of 5.1% was positive, but due to the substantial variability (sd=18.1%), the mean loss could not be shown to be significant at the 5% level (t=1.59, p<0.061). The p-value of 0.061, however, suggests a marginally significant difference (p<0.10). This means the result obtained would occur by chance alone less than 1 out of 10 times in repeated sampling.

Further examination of the building percent reduction differences revealed that for 4 pairs of houses (12.5%), the shuttered houses sustained from 30.8% to 54.8% less damage than their comparables, while no comparables outperformed their matched shuttered houses by such large percentages. However, twenty of the pairs of houses (63%) differed in percent building loss by no more than 5% either way (shuttered better than its comparable or comparable better than its matched shuttered). To detect a mean percent difference as large as was found at the 5% significance level 80% of the time, with the same size standard deviation, the study would have needed to review 108 pairs of houses. Although this is only one quarter the number needed to detect the mean difference in dollars, it is still three times as many pairs as were available to this study.

A.6.3 Dollar Reduction in Appraised Total Value

Similar analyses were performed on the differences between shuttered and comparable houses in reduction in total appraised value. Twelve of 32 pairs of houses (38%) had positive total reduction differences. Total loss differences ranged from -$41,092 to $135,069 with a mean loss difference of $6,420 (sd=$31,515). (See Table 8). Note that because most appraised land values did not change from 1992 to 1993, the total dollar reduction difference reflected the building dollar reduction difference closely, so the mean and standard deviation for total reduction differences were very similar to those of building reduction differences. Mean total dollar loss was positive, but it was not statistically significant ($t=1.15$, $p<0.129$). In order to detect a mean loss difference of the size observed with the same amount of variability 80% of the time, 206 pairs of houses would have to have been studied.

A.6.4 Percent Reduction in Appraised Total Value

Fifteen of the 32 pairs of houses (47%) had positive percent total reduction differences, i.e., in 47% of the pairs, the shuttered house had less percent total loss than did its comparable. Percent total loss differences ranged from -15.0% to 49.5% with a positive mean percent loss of 3.4% (sd=12.5%). (See Table 9). At the 5% significance level, the mean percent total loss was not significant (t=1.52, $p<0.069$). The p-value of 0.069 suggests a marginally significant difference ($p<0.10$). this means the result obtained would have occurred in repeated sampling less than 1 out of 10 times by chance alone. As with percent building loss results, in 4 pairs of houses the shuttered house sustained from 26.2% to 49.5% less damage than its comparable, while no comparable outperformed its match by such a large percentage. However, 23 of the 32 pairs (72%) differed from each other by no more than 5% total loss. In order to detect a mean percent total loss difference as large as was observed under the same circumstances, 80% of the time, 116 pairs of houses would have to have been studied.

A.7 RELATIONSHIP OF WIND VELOCITY WITH DAMAGE

A.7.1 Correlational Analysis

The maximum one minute sustained surface wind that may have occurred during Hurricane Andrew was determined for each pair of houses in the study.[46] Wind speeds ranged from 119 to 136 mph with a mean of 129.9 mph (sd=4.9 mph). For shuttered houses, significant Pearson's correlation coefficients were found between wind velocity and percent building loss ($r=0.48$, $p<0.002$), and wind speed and percent total loss ($r=0.50$, $p<0.001$). (See Fig. 11,13). For comparable houses, significant Pearson's correlations were found between wind speed and percent building loss ($r=0.45$, $p<0.003$) and between wind speed and percent total loss ($r=0.44$, $p<0.003$). (See Fig. 10,12). Significant Pearson's correlation coefficients means that higher wind speeds resulted in larger percent building and total losses. However, correlations for the two groups of houses were very similar, suggesting that the relationships between damage estimates and wind speed were not appreciably different for shuttered and comparable houses.

A.7.2 Regression Analysis

To determine what average percent loss resulted from changes in wind speed, regression lines were fit to

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46. Powell, M.D., et al., op. cit.

shuttered and comparable groups. It should be noted that the wind speed range is quite narrow for this set of observations so extrapolation outside of the interval is risky. Furthermore, regression analysis assumes the variables are linearly related, so that wind speed and percent damage must be assumed to have a linear relationship over the given interval. This may or may not be true in this hurricane situation. For shuttered houses, an increase of one mile per hour in wind speed in this range resulted in a significant mean increase in building loss of 1.7%, ($t= 3.02$, $p<0.002$), and a significant mean increase in percent total loss of 1.1%, ($t=3.18$, $p < 0.001$). For comparable houses, increases were similar. For an increase of one mph in wind speed, the average percent building loss significantly increased 2.4% ($t= 2.73$, $p<0.003$), and the average percent total loss significantly increased 1.5% ($t= 2.69$, $p<0.003$). Although these results are statistically significant, they should be viewed as only a first step in relating changes in wind speed to damage estimates.

APPENDIX B

SAMPLES OF LETTERS USED TO SOLICIT THE COOPERATION OF HOMEOWNERS OF POTENTIAL SHUTTERED HOUSES

National Hurricane Center
1320 South Dixie Highway
Coral Gables, FL 33146-2967

16 August 1993

Mr. John Doe
Address
Miami

Dear Mr. Doe:

To properly assess damage related to Hurricane Andrew and prescribe proper defensive measures for the future, it is necessary to conduct certain studies. Organizations such as The National Hurricane Center and Florida International University have been asked by government authorities to do some of this work.

One of the studies which we are conducting is to define levels of damage in homes that were protected by hurricane shutters versus levels of damage in homes that were not so protected when Andrew came through. This is a joint study being shared by the National Hurricane Center and the Department of Construction Management at FIU.

There are several important variables we must consider in the study that require factual input from homeowners whose property was located in the geographical area of interest. You have been chosen as one of those property owners we feel will be able to help us to develop the necessary data. Therefore, we solicit your cooperation in a field type survey we shall conduct over the next few months.

You will be contacted shortly by Mr Lorenz Minicone, P.E. who is a Research Associate in Construction with the University and is working on this joint effort project. He will be asking a series of questions related to shutters, damage, and restoration. We trust that you will find the time to share your experience with us through Larry and help us refine our thoughts in the interest of conservation of property and community betterment.

Sincerely,

Dr. Robert C. Sheets, Director
National Hurricane Center

Prof. Wilson C. Barnes, AIA
Dept. of Construction Management
Florida International University

National Hurricane Center
1320 South Dixie Highway
Coral Gables, FL 33146-2967

28 September 1993

Mr. John Doe
Address
Miami

Dear Mr. Doe:

To properly assess damage related to Hurricane Andrew and prescribe proper defensive measures for the future, it is necessary to conduct certain studies. Organizations such as The National Hurricane Center and Florida International University have been asked by government authorities to do some of this work.

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Sincerely,

Dr. Robert C. Sheets, Director
National Hurricane Center

Prof. Wilson C. Barnes, AIA
Dept. of Construction Management
Florida International University

National Hurricane Center
1320 South Dixie Highway
Coral Gables, FL 33146-2967

1 February 1994

John Doe
Address
Miami

Dear Mr. Doe:

Last fall we attempted to contact you but were not successful. With this letter, we are re-sending our original letter which explained our mission and interest in talking with you.

Mr. Larry Minicone will again attempt to reach you by phone. Should you not speak with him within ten days of your receiving this letter, we request that you be kind enough to call one of the following numbers and leave a message as to how and when he can contact you by phone: Dade - 348-3172 or Broward - 475-4183.

We understand that you may have been through a trying time recovering from the hurricane, but your cooperation with our efforts should result in future benefit to all the people of South Florida.

Sincerely,

Dr. Robert C. Sheets, Director
National Hurricane Center

Prof. Wilson C. Barnes, AIA
Dept. of Construction Management
Florida International University

11 March 1994

Mr. John Doe
Address
Miami

Dear Mr. Doe:

We have made several attempts to contact you since your home is one that is important geographically to data we are collecting on consequences of Hurricane Andrew.

Our effort is legitimately framed as part of research sponsored by the State of Florida and is not connected in any way with sales promotion of any kind.

We are now in the closing stages of our survey. We would be most appreciative if you could call one of the numbers in the enclosed letter copy and tell us how and when we can call you back.

Sincerely,

Wilson C. Barnes, AIA
Assistant Professor

APPENDIX C

DADE COUNTY PROPERTY APPRAISAL DEPARTMENT

DAMAGE ASSESSMENT: FIELD INFORMATION PROCESS

DATA ENTRY GUIDELINES

Damage Assessment: Field Inspection Process

The damage assessment/valuation adjustments for 1993 tax roll will be based on the estimated costs to repair storm damage inflicted on a structure. Due to the tremendous number of structures that suffered significant damage, a simplified damage assessment process using major building components has been developed. This procedure will expedite the field inspection process required for value adjustments related to the storm damage.

The "Field Inspection Process" will be one of three techniques to be employed in estimating the value adjustments necessary for the 1993 tax roll values. The other two techniques include the use of some information obtained in the field by the Dept. of Building and Zoning, as well as, additional information obtained by this Dept. from the analysis of aerial photographs. The technique utilizing aerial photographs will only be employed where the roof and roof related damage is clearly visible to the aerial analysis teams. Therefore, there will be a large number of properties that cannot be adjusted using the other two techniques. It should be noted that the full range of damage is expected to be encountered by the field inspection teams.

The properties to be field inspected will present the staff with its most difficult damage assessment task. The expected high volume of inspections and the variations of damage likely to be encountered during the field inspection process requires a completely new procedure unlike that which has been used by this office in the past. The revised procedure will focus strictly on the amount of damage observed together with some assumptions regarding the extent of damage that cannot be observed. Building jackets will not be used in this procedure.

The basic concept of this procedure is to convert observed damage to an estimate of repair costs (i.e."costs-to-cure") which is calculated as additional physical depreciation. The "costs-to-cure" have been developed from cost estimating publications and localized information which reflect the tremendous increase in construction costs after the storm.

As mentioned, this "Field Inspection Process" will utilize three major building components as a basis: 1) roof; 2) exterior wall; 3) interior.

The "roof" component includes the following:
A) Roof cover (tile, shingles, shakes, etc);
B) Waterproof membrane (tarpaper, rolled slate, hot mopped tar, etc.);
C) Sheathing or decking (plywood panels, particle board panels, tongue & groove boards, etc.);
D) Trusses (roof supporting structure including rafters, joists, etc.)

The "exterior wall" component includes the following:
A) Perimeter bearing wall (concrete block, poured concrete, wood frame)
B) Exterior wall finish (stucco, siding, stone or brick veneer)
C) Exterior windows and doors
D) Gable walls (typically attached to end truss in gable style roof)

The "interior" component includes the following:
A) Interior walls, doors and trim
B) Ceiling and insulation
C) Floor coverings (carpet, tile, wood, marble, etc.)
D) Electical panel, wiring, fixtures, built-in appliances and AC mechanical)
E) Plumbing

The basic premise utilized in this damage assessment field inspection process is that assumptions regarding levels of interior damage can be made based on the extent of observed damage to the "roof" or "exterior wall" components. For example, an observation that a significant percent of the roof sheathing had been exposed (without waterproof membrane) would indicate that a large quantity of water was allowed to enter the interior of the structure, thus, causing significant levels of water damage to the "interior" component.

However, if the roof, in example above, had been replaced at the time of inspection, the assumptions could not be made regarding the level of damage to the "interior" component. In the latter case, the "roof" component is not damaged, but, the "interior" component may still be heavily damaged, thus, requiring further efforts by the field inspector.

As indicated previously, the "exterior wall" component is made up of a number of items. Damage to some of these items included in the "exterior wall" component may result in significant interior damage (i.e. doors, windows, gable walls), while others may not (i.e. wall finish).

This simplified inspection procedure requires an inspection of the building structures only. Extra feature items will be given the same additional physical depreciation as the building structure to which they are coded in the electronic file.

Groups or teams of Evaluators will be assigned to areas within a targeted section. The sections will be the primary geographic control unit for tracking the progress of the damage assessment work completed by field inspection.
Each team will be provided with the following information:

1) A "Field Processing Control List" for the areas within the section;
2) REDI section maps;
3) Other maps which may be useful in locating/identifying the properties to be inspected in the field.

The "Field Processing Control List" will be produced in folio order and includes a folio number, address, CLUC, year built, property owner, value, PA's building number, B & Z flag, aerial flag and the legal description of each parcel. The B & Z and aerial flags (B or A) will be shown on the "Field Processing Control List" to assist the Evaluator in locating the properties requiring field inspections. The portion of the form where the damage assessment information is to be recorded is organized into five entry line items. These five lines require a percentage entry when applicable (in 5% intervals only):

1) Roof Sheathing Missing or Exposed* ____________%
2) Roof Trusses Missing or Damaged ____________%
3) Roof Cover Missing or Damaged** ____________%
4) Exterior Wall Damage ____________%
5) Interior Damage** ____________%

Roof Sheathing Missing or Exposed

An entry is made on this line to reflect the percentage of all roof sheathing (i.e. decking) that has become exposed or is actually missing. The entry made on this line eliminates the need to make entries on the Roof Cover Missing or Damaged line and the Interior Damage line. When this line is entered into the computer an automatic calculation of the appropriate percent of damage to Roof Cover Missing or Damaged and Interior Damage will take place.

*Please note, it is extremely important when an entry is made on this line that entries not be made on the Roof Cover Missing or Damaged line and the Interior Damage line. This will cause the entry personnel to return the form to the Evaluator for correction, as the computer will not accept entries on these lines if the Roof Sheathing Missing or Exposed line has a number entered.

Roof Trusses Missing or Damaged

An entry is made on this line to reflect the percentage of all roof trusses that are damaged or missing. There are no automatic calculations made to other components with this entry.

Roof Cover Missing or Damaged

An entry is made on this line to reflect the percentage of all roof cover (tile, shingles, shakes, etc) missing or damaged. This entry is to be used when only the roof cover is missing or damaged and there is no apparent damage to the waterproof membrane (tarpaper, rolled slate, hot mopped tar, etc.). There are no automatic calculations made to other components with this entry.

**Please note, it is extremely important when an entry is made on this line that an entry has not been made on the Roof Sheathing Missing or Exposed line. This will cause the entry personnel to return the form to the Evaluator for correction, as the computer will not accept an entry on this line if the Roof Sheathing Missing or Exposed line has a number entered.

Exterior Wall Damage

An entry is made on this line to reflect the percentage of the exterior wall that sustained damage. There are no automatic calculations made to other components with this entry.

In making this estimate use the following guides: 5% for each gable wall damaged or missing ; Doors and windows make up 30% of exterior wall, therefore, determine the ratio of damaged doors/windows to total and multiply by 30% (.30) and round to the nearest percent.

Important notes:

Remember to make appropriate entry on the Roof Trusses Missing or Damaged line if gable wall is damaged or missing.

If doors/windows are damaged/missing, determine extent of interior damage.

Interior Damage

An entry is made on this line to reflect the percentage of the interior component damaged from wind or water. If an entry has been made on the Roof Sheathing Missing or Exposed line then no entry is necessary for this line (see explanation under Roof Sheathing Missing or Exposed).

**Please note, it is extremely important when an entry is made on this line that an entry has not been made on the Roof Sheathing Missing or Exposed line. This will cause the entry personnel to return the form to the Evaluator for correction, as the computer will not accept an entry on this line if the Roof Sheathing Missing or Exposed line has a number entered.

Upon the assignment of a area to a team, the "Field Processing Control List", section maps and other maps will be provided. The inspection work will generally proceed in folio order within a subdivision (including when a subdivision crosses a section line) and the Evaluator indicating on the "Field Processing Control List" the appropriate damage assessment entries by folio number.

The following steps are suggested upon arrival to a property to be inspected:

1) Match the address of the property to that on the "List"
2) If the address does not match, check the name on the mail box, wall, etc. with that on the "List".
3) Utilize the legal description to identify the subject parcel on the location maps provided.
4) Examine the condition of the roof component by looking for:
   a) Trusses and/or gable wall missing or damaged
   b) Exposed/missing sheathing as a percentage of total roof area.
   c) Areas of temporary repairs indicated by use of tarps, plastic sheets or felt tin-tagged on a portion of the roof. (If due to the temporary repairs, a determination cannot be made regarding the extent of roof damage, use 5% on the Roof Sheathing Missing or Exposed line.) If Possibility of Interior D
   d) Same as "c" but a gable wall is obviously damaged or missing. (Use 20% on the Roof Sheathing Missing or Exposed line and an appropriate percentage on the Roof Trusses Missing or Damaged line.
   e) Missing or damaged facia boards. (especially where there is evidence of an attached screen enclosure torn away) Check interior for damage
   f) Roof cover damaged or missing ,but, waterproof membrane undamaged. (If the entire roof has new felt/rolled slate tin-tagged and ready for new roof cover use 100% on Roof Cover Missing or Damaged line and check for interior damage).
   g) New roof (fresh color w/o fading and shiny drip edge). Check interior for damage.

5) Examine the condition of the exterior wall component by looking for:

a) Holes and cracks along tie-beams and wood frame walls (Indicates possible structural and/or roof truss damage)

b) Obvious shifting of wood frame walls. (especially 2nd story)

c) Siding or stucco missing from wood frame walls.

d) Damaged and/or boarded-up window and door openings. Check interior for damage. (see instructions for the Exterior Wall Damage line)

e) New windows which may be a clue regarding interior damage (check for stickers or sticker glue on panes, fresh stucco and/or chaulking around window frames)

f) New entry doors which, together with item e, may indicate interior damage.

6) Determine the condition of the interior component by looking for:
(This is not necessary if an entry has been made on the Roof Sheathing Missing or Exposed line)

a) Open structure with clear entry. Check ceilings, walls, floor coverings, etc. for missing and/or damaged areas and estimate the % of the total interior floor area with significant damage.

1) Look for exposed partitions and ceiling joists. (under repair)

2) Look for water stains, mildew and mold on ceilings and walls.

3) Look for sagging ceilings and walls

4) Look for damaged cabinets and vanities. (swelling particle board and separated laminate)

b) The owner/occupant/workers that you can interview about interior damage.

1) Check to see if there is someone in a camper or trailer on site used as temporary living qtrs. or construction office.

2) Only after attempting item 1 and you cannot find anyone on site, try to look through windows/glass doors to determine the extent of interior damage.

c) Check to see if there is a dumpster or rubbage pile with old drywall, insulation and other interior materials.

d) Check electric meter to see if any electrical appliances are on.

e) Check exterior hose connection for water flow.

If you cannot determine the extent of interior damage due to lack of access or personal contact, but items 6c,d and e suggest that the structure has sustained interior damage, use 10% or 15% on the Interior Damage line.

In this damage assessment process, time is of the essence, so every attempt should be made to expedite the field inspection procedure. However, this should not work to the detriment of the taxpayers. Please give the taxpayer every benefit of the doubt in this damage assessment process.

Exercise Samples:

1) A single family home appears to have some roof shingles missing and portions of the roof temporarily repaired with felt (i.e. tarpaper). The area missing shingles is approximately 5% of the total roof area. The portions of temporary repairs equal approximately 20% of the total roof area. The exterior walls are OK except for some minor areas with chipped paint. There is no evidence of damaged windows or doors. The degree of interior damage cannot be determined, but the electric and water are on. What entries should be made on the "Field Processing Control List" ? Why?

Roof Sheathing Missing or Exposed ____________%
Roof Trusses Missing or Damaged ____________%
Roof Cover Missing or Damaged ____________%
Exterior Wall Damage ____________%
Interior Damage ____________%

2) All facts are the same as #1 with the exception of those relating to the roof damage. In this case approximately 50% of the roof tile is damaged or missing, however, the waterproof membrane is still intact. What entries should be made on the "Field Processing Control List" ? Why?

Roof Sheathing Missing or Exposed ____________%
Roof Trusses Missing or Damaged ____________%
Roof Cover Missing or Damaged ____________%
Exterior Wall Damage ____________%
Interior Damage ____________%

3) A cluster home appears to have approximately 25% of the roof tiles missing and damaged. The sheathing is visible in scattered areas of the roof and equals approximately 20% of the total roof area. A gable wall is leaning back into the roof slightly and it appears that the first 2 trusses on that end are damaged. The structure has a total of 12 windows and 3 entry doors, of which 3 windows are boarded up. Interior damage cannot be determined. What entries should be made on the "Field Processing Control List" ? Why?

Roof Sheathing Missing or Exposed ____________%
Roof Trusses Missing or Damaged ____________%
Roof Cover Missing or Damaged ____________%
Exterior Wall Damage ____________%
Interior Damage ____________%

4) A large ranch style home appears to have a freshly "dried-in" roof. The entire roof has new tin-tagged felt, new drip edge, new flashings and no roof shingles. All the windows and sliding glass doors are new with stickers still visible. In the driveway there is a dumpster containing debris including drywall, plaster, insulation, etc. When looking through the sliding glass doors, all partitions and ceiling joists visible are down to the wood. What entries should be made on the "Field Processing Control List" ? Why?

Roof Sheathing Missing or Exposed ____________%
Roof Trusses Missing or Damaged ____________%
Roof Cover Missing or Damaged ____________%
Exterior Wall Damage ____________%
Interior Damage ____________%

Field Entry Guidelines

Roof Sheathing Miss/Exp line

Use 5% entry when -

Exposed, missing, damaged sheathing equals approximately 5% of the total roof area. (exposed includes areas where membrane is damaged)

Temporary repairs (i.e. tarps, plastic sheets, tarpaper patches) cover 50% or less of the total roof area and no other damage information can be observed or obtained.

Use 10% entry when -

Exposed, missing, damaged sheathing equals approximately 10% of the total roof area. (exposed includes areas where membrane is damaged)

Temporary repairs (i.e. tarps, plastic sheets, tarpaper patches) cover more than 50% of the total roof area and no other damage information can be observed or obtained.

Temporary repairs (i.e. tarps, plastic sheets, tarpaper patches) cover a portion of the roof area and interior damage of less than 40% of the floor area can be observed or estimated by other means.

Use 15% entry when -

Exposed, missing, damaged sheathing equals approximately 15% of the total roof area. (exposed includes areas where membrane is damaged)

Temporary repairs (i.e. tarps, plastic sheets, tarpaper patches) cover a portion of the roof area and interior damage of between 40% and 60% of the floor area can be observed or estimated by other means.

Use 20% entry when -

Exposed, missing, damaged sheathing equals approximately 20% of the total roof area. (exposed includes areas where membrane is damaged)

Roof damage includes a damaged or missing gable wall.

Temporary repairs (i.e. tarps, plastic sheets, tarpaper patches) cover a portion of the roof area and interior damage of between 60% and 80% of the floor area can be observed or estimated by other means.

Use 25% + entry when -

Exposed, missing, damaged sheathing equals approximately 25%+ of the total roof area. (exposed includes areas where membrane is damaged)

Roof damage includes two or more damaged or missing gable walls.

Temporary repairs (i.e. tarps, plastic sheets, tarpaper patches) cover a portion of the roof area and interior damage of more than 80% of the floor area can be observed or estimated by other means.

Roof Trusses Miss/Dmg line (Indicates damaged/missing sheathing)

Use 5% entry when -

Missing or damaged roof trusses equal approximately 5% of the total roof area.

There is one damaged or missing gable wall.

Use 10%+ entry when -

Missing or damaged roof trusses equal 10% or more of the total roof area.

There is two or more damaged or missing gable walls. (5% per gable wall)

Roof Cover Miss/Dmg line*

Use 100% entry when -

There is damage to roof tile, shingle, shakes but membrane is still intact.
(Note: if no temporary repairs are evident, assume membrane is OK)

Roof is permanently "dried-in" with new felt/ tarpaper tin-tagged and/or cemented, awaiting new cover.

* (Do not make entry here if Roof Sheathing Miss/Exp line has an entry)

Exterior Wall Damage line

Use 5% entry when -

Missing or damaged windows/doors equal approximately 5% of the total exterior wall area. (Doors and windows make up approximately 30% of the exterior wall, therefore, determine the ratio of damaged doors/windows to total doors /windows and multiply by 30% (.30) and round to the nearest 5 percent.)

There is one damaged or missing gable wall.

Use 10%+ entry when -

Missing or damaged windows/doors equal approximately 10% or more of the total exterior wall area. (See formula above)

There is two or more damaged or missing gable walls. (5% per gable wall)

Interior Damage line**

Use 5% entry when -

There is approximately 5% of the interior floor area damaged or under repair.

There is no significant damage to roof tile, shingle, shakes but a minimal number (5%) of windows/doors are boarded-up but no other damage information can be observed or obtained.

Roof is permanently "dried-in" with new felt/ tarpaper tin-tagged and/or cemented, awaiting new cover. However, a minimal number (5%) of windows/doors are boarded-up but no other damage information can be observed or obtained.

Use 10% entry when -

There is approximately 10% of the interior floor area damaged or under repair.

There is no significant damage to roof tile, shingle, shakes but a moderate number (10%) of windows/doors are boarded-up but no other damage information can be observed or obtained.

Roof is permanently "dried-in" with new felt/ tarpaper tin-tagged and/or cemented, awaiting new cover. However, a moderate number(10%) of windows/doors are boarded-up but no other damage information can be observed or obtained.

Use 15%+ entry when -

There is approximately 15% or more of the interior floor area damaged or under repair.

There is no significant damage to roof tile, shingle, shakes but a large number (15%+) of windows/doors are boarded-up but no other damage information can be observed or obtained.

Roof is permanently "dried-in" with new felt/ tarpaper tin-tagged and/or cemented, awaiting new cover. However, a large number (15%+) of windows/doors are boarded-up but no other damage information can be observed or obtained.

There is no significant roof damage but there is a dumpster or rubbish pile containing drywall, insulation, etc. and the electric and/orwater appear to be off. However, no other damage information can be observed or obtained.

** (Do not make entry here if Roof Sheathing Miss/Exp line has an entry)

Damage

Interior		Additional Depreciation
5%	=	5%
10%	=	10%
15%	=	16%
20%	=	21%
25%	=	26%
30%	=	31%
35%	=	36%
50%	=	52%
75%	=	74%
100%	=	93%

Exterior		
5%	=	1%
10%	=	2%
15%	=	3%
20%	=	4%
25%	=	5%
30%	=	6%
35%	=	7%
50%	=	10%
75%	=	16%
100%	=	21%

Roof Cover		
5%	=	0%
10%	=	0%
15%	=	1%
20%	=	1%
25%	=	1%
30%	=	1%
35%	=	2%
50%	=	2%
75%	=	3%
100%	=	5%

Roof Trusses		
5%	=	0%
10%	=	1%
15%	=	1%
20%	=	1%
25%	=	1%
30%	=	2%
35%	=	2%
50%	=	3%
75%	=	4%
100%	=	6%

Roof Sheathing Exp/Missing	=	Roof Cover	=	Interior	=	Additional Depreciation
5%	=	30%	=	20%	=	23%
10%	=	60%	=	40%	=	45%
15%	=	90%	=	60%	=	66%
20%	=	100%	=	80%	=	85%
25%	=	100%	=	100%	=	99%

Note: 1) Area percentages can be allocated in 5% increments up to 100%.
2) On roof cover and roof trusses the 5% or 10% area adjustments will not result in any depreciation but should be made for informational purposes.

DATE RUN: 03DEC92

METRO-DADE PROPERTY APPRAISER
FIELD PROCESSING CONTROL LIST
STORM DAMAGE ASSESSMENT

SUB 30-5014-011

T-R-S / FOLIO NUMBER	CLUC YEAR	PROPERTY ADDRESS / LEGAL DESCRIPTION		OWNER /	DAMAGE ESTIMATE
55-40-14 (X) 30-5014-011-0490 LAND 128,553 BLDG 80,322 TOTAL 208,875	 0001 BLDG # 1 1960	12745 SW 69 AVE 14 55 40 ROCK LAKE LOT 26 OR 13379-2306 0787 1	 PB 65-44 BLK 4	 FELIX J RIERA &W LESLIE	ROOF SHEATHING MISS/EXP ______ ROOF TRUSSES MISS/DMG ______ ROOF COVER MISS/DMG ______ EXTERIOR WALL DAMAGE ______ INTERIOR DAMAGE ______
55-40-14 (X) 30-5014-011-0500 LAND 121,870 BLDG 68,496 TOTAL 190,366	 0001 BLDG # 1 1959	12725 SW 69 AVE 14 55 40 ROCK LAKE LOT 27 OR 15398-345 0292 1	 PB 65-44 BLK 4	 STEPHEN N MOYNAHAN &W LISA H	ROOF SHEATHING MISS/EXP ______ ROOF TRUSSES MISS/DMG ______ ROOF COVER MISS/DMG ______ EXTERIOR WALL DAMAGE ______ INTERIOR DAMAGE ______
55-40-14 (X) 30-5014-011-0510 LAND 123,065 BLDG 78,434 TOTAL 201,499	 0001 BLDG # 1 1958	12701 SW 69 AVE 14 55 40 ROCK LAKE LOT 28 OR 13495-3889 1187 1	 PB 65-44 BLK 4	 MALACHI T HOGAN &W JANETTE B	ROOF SHEATHING MISS/EXP ______ ROOF TRUSSES MISS/DMG ______ ROOF COVER MISS/DMG ______ EXTERIOR WALL DAMAGE ______ INTERIOR DAMAGE ______
55-40-14 (X) 30-5014-011-0520 LAND 86,762 BLDG 118,677 TOTAL 205,439	 0001 BLDG # 1 1963	6890 SW 128 ST ROCK LAKE LOT 1, LOT SIZE SITE VALUE OR 13000-1045 0886 1	 PB 65-44 BLK 5	 STANLEY YU &W WINNIE	ROOF SHEATHING MISS/EXP ______ ROOF TRUSSES MISS/DMG ______ ROOF COVER MISS/DMG ______ EXTERIOR WALL DAMAGE ______ INTERIOR DAMAGE ______
55-40-14 (X) 30-5014-011-0530 LAND 86,762 BLDG 62,818 TOTAL 149,580	 0001 BLDG # 1 1958	6860 SW 128 ST ROCK LAKE LOT 2 OR 15219-769 1091 5 CARL F JOHNSTON &W CHARLOTTE L	 PB 65-44 BLK 5	 ANA MARIA SUERO	ROOF SHEATHING MISS/EXP ______ ROOF TRUSSES MISS/DMG ______ ROOF COVER MISS/DMG ______ EXTERIOR WALL DAMAGE ______ INTERIOR DAMAGE ______
55-40-14 (X) 30-5014-011-0540 LAND 91,621 BLDG 110,482 TOTAL 202,103	 0001 BLDG # 1 1962	6840 SW 128 ST ROCK LAKE LOT 3 OR 15150-2445 0791 1 W M CAIN &W WILMA E	 PB 65-44 BLK 5	 OSCAR SUAREZ JR &W LEONOR M	ROOF SHEATHING MISS/EXP ______ ROOF TRUSSES MISS/DMG ______ ROOF COVER MISS/DMG ______ EXTERIOR WALL DAMAGE ______ INTERIOR DAMAGE ______
55-40-14 (X) 30-5014-011-0550 LAND 84,860 BLDG 67,635 TOTAL 152,495	 0001 BLDG # 1 1961	12900 SW 68 AVE 14 55 40 ROCK LAKE LOT 4 LOT SIZE IRREGULAR	 PB 65-44 BLK 5	 YOKOHAMA INTERNATIONAL INC	ROOF SHEATHING MISS/EXP ______ ROOF TRUSSES MISS/DMG ______ ROOF COVER MISS/DMG ______ EXTERIOR WALL DAMAGE ______ INTERIOR DAMAGE ______
55-40-14 (X) 30-5014-011-0560 LAND 86,762 BLDG 64,149 TOTAL 150,911	 0001 BLDG # 1 1958	6845 SW 129 TERR ROCK LAKE LOT 5 OR 14528-62 0490 1 RONALD F SMITH &W ANN A	 PB 65-44 BLK 5	 THOMAS A HUNTER &W CONNIE	ROOF SHEATHING MISS/EXP ______ ROOF TRUSSES MISS/DMG ______ ROOF COVER MISS/DMG ______ EXTERIOR WALL DAMAGE ______ INTERIOR DAMAGE ______

APPENDIX D

STATISTICAL ANALYSES AND RESULTS

List of Pairs of Houses with 1992,93 Appraised Bldg and Total Values, and Reductions ($,%)

OBS	GROUP	ID	BV2	BV3	BV23	PBV23	TV2	TV3	TV23	PTV23	WIND
1	Shuttered	101	50760	45620	5140	10.13	99060	93920	5140	5.19	129.5
2	Comparable	201	50697	47514	3183	6.28	98997	95814	3183	3.22	129.5
3	Shuttered	102	226523	78760	147763	65.23	456088	308325	147763	32.40	135.3
4	Comparable	202	119360	12689	106671	89.37	348435	241764	106671	30.61	135.3
5	Shuttered	103	103616	70112	33504	32.33	193694	160190	33504	17.30	132.0
6	Comparable	203	139491	134414	5077	3.64	224622	219545	5077	2.26	132.0
7	Shuttered	104	297262	292466	4796	1.61	486201	481405	4796	0.99	129.0
8	Comparable	204	283666	143801	139865	49.31	486346	346481	139865	28.76	129.0
9	Shuttered	109	96098	89471	6627	6.90	148598	141971	6627	4.46	130.5
10	Comparable	209	70161	63079	7082	10.09	122661	115579	7082	5.77	130.5
11	Shuttered	110	123403	120237	3166	2.57	212653	209487	3166	1.49	132.8
12	Comparable	210	141223	116036	25187	17.83	230473	205286	25187	10.93	132.8
13	Shuttered	113	122510	112668	9842	8.03	192238	182396	9842	5.12	136.0
14	Comparable	213	73867	65750	8117	10.99	143595	135478	8117	5.65	136.0
15	Shuttered	116	33096	33096	0	0.00	68721	68721	0	0.00	136.0
16	Comparable	216	33838	33838	0	0.00	72313	72313	0	0.00	136.0
17	Shuttered	117	149647	139508	10139	6.78	259454	268898	-9444	-3.64	129.5
18	Comparable	217	76489	73092	3397	4.44	192469	189072	3397	1.76	129.5
19	Shuttered	118	101535	87891	13644	13.44	197262	183618	13644	6.92	135.5
20	Comparable	218	98637	85446	13191	13.37	171314	158123	13191	7.70	135.5
21	Shuttered	119	428072	398503	29569	6.91	641222	611653	29569	4.61	131.5
22	Comparable	219	109445	101047	8398	7.67	298095	289697	8398	2.82	131.5
23	Shuttered	120	53128	39384	13744	25.87	276078	262334	13744	4.98	134.5
24	Comparable	220	40275	32712	7563	18.78	255875	248312	7563	2.96	134.5
25	Shuttered	121	77563	72981	4582	5.91	174688	170106	4582	2.62	134.5
26	Comparable	221	95711	88105	7606	7.95	196336	188730	7606	3.87	134.5
27	Shuttered	122	49020	16855	32165	65.62	72761	40596	32165	44.21	134.5
28	Comparable	222	54816	18661	36155	65.96	78557	42402	36155	46.02	134.5
29	Shuttered	124	64670	36071	28599	44.22	128864	100265	28599	22.19	134.0
30	Comparable	224	62035	621	61414	99.00	122291	60877	61414	50.22	134.0
31	Shuttered	125	58932	50116	8816	14.96	111460	102644	8816	7.91	135.3
32	Comparable	225	55555	18687	36868	66.36	108083	71215	36868	34.11	135.3
33	Shuttered	127	71440	57322	14118	19.76	127477	113359	14118	11.07	135.0
34	Comparable	227	84980	78037	6943	8.17	147568	140625	6943	4.70	135.0
35	Shuttered	128	79173	78535	638	0.81	135282	145960	-10678	-7.89	125.5
36	Comparable	228	70351	70349	2	0.00	126460	137774	-11314	-8.95	125.5
37	Shuttered	130	39809	39713	96	0.24	82264	82168	96	0.12	126.3
38	Comparable	230	48994	48989	5	0.01	91449	91444	5	0.01	126.3
39	Shuttered	131	30877	30517	360	1.17	70567	70207	360	0.51	126.3
40	Comparable	231	29061	28724	337	1.16	68935	68598	337	0.49	126.3
41	Shuttered	132	63036	51661	11375	18.05	105428	94053	11375	10.79	131.5
42	Comparable	232	61286	51506	9780	15.96	99106	89326	9780	9.87	131.5
43	Shuttered	137	46055	41109	4946	10.74	94730	99609	-4879	-5.15	128.5
44	Comparable	237	38688	38260	428	1.11	72081	82495	-10414	-14.45	128.5
45	Shuttered	138	46575	43755	2820	6.05	99075	96255	2820	2.85	135.0
46	Comparable	238	52595	49404	3191	6.07	105095	101904	3191	3.04	135.0
47	Shuttered	141	106959	96168	10791	10.09	189459	186968	2491	1.31	126.3
48	Comparable	241	111902	110722	1180	1.05	190842	197680	-6838	-3.58	126.3
49	Shuttered	142	66492	65740	752	1.13	170242	169490	752	0.44	126.3
50	Comparable	242	48845	48283	562	1.15	152595	152033	562	0.37	126.3
51	Shuttered	145	114687	114687	0	0.00	173927	188737	-14810	-8.52	124.5

List of Pairs of Houses with 1992,93 Appraised Bldg and Total Values, and Reductions ($,%)

OBS	GROUP	ID	BV2	BV3	BV23	PBV23	TV2	TV3	TV23	PTV23	WIND
52	Comparable	245	120929	120901	28	0.02	183163	198694	-15531	-8.48	124.5
53	Shuttered	146	58294	58129	165	0.28	139660	139495	165	0.12	121.5
54	Comparable	246	58786	58656	130	0.22	140152	140022	130	0.09	121.5
55	Shuttered	147	95272	94202	1070	1.12	177449	184858	-7409	-4.18	123.8
56	Comparable	247	96476	95406	1070	1.11	174236	181064	-6828	-3.92	123.8
57	Shuttered	148	173985	172313	1672	0.96	437985	436313	1672	0.38	124.5
58	Comparable	248	68536	67853	683	1.00	371536	370853	683	0.18	124.5
59	Shuttered	149	72210	71474	736	1.02	124816	124080	736	0.59	122.0
60	Comparable	249	43301	43571	-270	-0.62	88651	88921	-270	-0.30	122.0
61	Shuttered	150	83774	77892	5882	7.02	263653	257771	5882	2.23	118.5
62	Comparable	250	78088	67882	10206	13.07	257967	247761	10206	3.96	118.5
63	Shuttered	112	103714	95225	8489	8.19	176697	168208	8489	4.80	132.0
64	Comparable	212	107791	65748	42043	39.00	181717	83000	98717	54.32	132.0

Table 1. Statistics for 1992, 1993 Appraised Bldg and Total Values and Reductions

GROUP	N Obs	Variable	Label	N	Mean	Std Dev	Minimum	Maximum
Shuttered	32	BV2	1992 Appraised Bldg Value $	32	102755.84	81803.49	30877.00	428072.00
		BV3	1993 Appraised Bldg Value $	32	89755.66	76476.03	16855.00	398503.00
		BV23	$ App. Bldg Value Reduct from 1992-93	32	13000.19	26421.97	0.00	147763.00
		PBV23	% App. Bldg Value Reduct from 1992-93	32	12.41	17.18	0.00	65.62
		TV2	1992 Appraised Total Value $	32	196492.28	133699.84	68721.00	641222.00
		TV3	1993 Appraised Total Value $	32	185751.88	125293.32	40596.00	611653.00
		TV23	$ App. Total Value Reduct from 1992-93	32	10740.41	27603.57	-14810.00	147763.00
		PTV23	% App. Total Value Reduct from 1992-93	32	5.19	10.84	-8.52	44.21
		WIND	Wind Velocity	32	129.93	4.92	118.50	136.00
Comparable	32	BV2	1992 Appraised Bldg Value $	32	82058.59	47868.19	29061.00	283666.00
		BV3	1993 Appraised Bldg Value $	32	64993.22	35602.33	621.00	143801.00
		BV23	$ App. Bldg Value Reduct from 1992-93	32	17065.38	31748.38	-270.00	139865.00
		PBV23	% App. Bldg Value Reduct from 1992-93	32	17.49	26.95	-0.62	99.00
		TV2	1992 Appraised Total Value $	32	175062.97	96595.36	68935.00	486346.00
		TV3	1993 Appraised Total Value $	32	157902.56	83162.80	42402.00	370853.00
		TV23	$ App. Total Value Reduct from 1992-93	32	17160.41	35780.88	-15531.00	139865.00
		PTV23	% App. Total Value Reduct from 1992-93	32	8.56	17.04	-14.45	54.32
		WIND	Wind Velocity	32	129.93	4.92	118.50	136.00

Comparison of Appraised Bldg, Total Values in 1992 Betw Comparable and Shuttered

Variable	Label	N	Mean	Std Dev	Std Error	Minimum	Maximum
BV2CS	$ Diff Btw 1992 Comp & Shut App Bldg Val	32	-20697.25	62953.63	11128.73	-318627.00	35875.00
TV2CS	$ Diff Btw 1992 Comp & Shut App Tot Val	32	-21429.31	65359.89	11554.11	-343127.00	30928.00

Variable	Label	T	Prob>|T|
BV2CS	$ Diff Btw 1992 Comp & Shut App Bldg Val	-1.86	0.0724
TV2CS	$ Diff Btw 1992 Comp & Shut App Tot Val	-1.85	0.0732

Table 1. Tests of Appraised Bldg, Total Reductions from 1992-1993

GROUP	N Obs	Variable	Label	N	Mean	Std Dev	Std Error	Minimum
Shuttered	32	BV23	$ App. Bldg Value Reduct from 1992-93	32	13000.19	26421.97	4670.79	0.00
		TV23	$ App. Total Value Reduct from 1992-93	32	10740.41	27603.57	4879.67	-14810.00
		PBV23	% App. Bldg Value Reduct from 1992-93	32	12.41	17.18	3.04	0.00
		PTV23	% App. Total Value Reduct from 1992-93	32	5.19	10.84	1.92	-8.52
Comparable	32	BV23	$ App. Bldg Value Reduct from 1992-93	32	17065.38	31748.38	5612.37	-270.00
		TV23	$ App. Total Value Reduct from 1992-93	32	17160.41	35780.88	6325.23	-15531.00
		PBV23	% App. Bldg Value Reduct from 1992-93	32	17.49	26.95	4.76	-0.62
		PTV23	% App. Total Value Reduct from 1992-93	32	8.56	17.04	3.01	-14.45

GROUP	N Obs	Variable	Label	Maximum	T	Prob>|T|
Shuttered	32	BV23	$ App. Bldg Value Reduct from 1992-93	147763.00	2.78	0.0091
		TV23	$ App. Total Value Reduct from 1992-93	147763.00	2.20	0.0353
		PBV23	% App. Bldg Value Reduct from 1992-93	65.62	4.09	0.0003
		PTV23	% App. Total Value Reduct from 1992-93	44.21	2.71	0.0108
Comparable	32	BV23	$ App. Bldg Value Reduct from 1992-93	139865.00	3.04	0.0048
		TV23	$ App. Total Value Reduct from 1992-93	139865.00	2.71	0.0108
		PBV23	% App. Bldg Value Reduct from 1992-93	99.00	3.67	0.0009
		PTV23	% App. Total Value Reduct from 1992-93	54.32	2.84	0.0078

Tables 2-5, App Bldg, Total Reductions from 1992-1993, Complete Description

GROUP=Shuttered

Univariate Procedure

Variable=BV23 $ App. Bldg Value Reduct from 1992-93

```
                 Moments                          Quantiles(Def=5)                         Extremes

N               32  Sum Wgts         32   100% Max    147763      99%   147763     Lowest   Obs    Highest   Obs
Mean      13000.19  Sum          416006    75% Q3    12509.5      95%    33504          0(   26)    28599(   15)
Std Dev   26421.97  Variance  6.9812E8     50% Med      5511      90%    29569          0(    8)    29569(   11)
Skewness  4.564661  Kurtosis  23.24235     25% Q1        911      10%      165         96(   19)    32165(   14)
USS       2.705E10  CSS       2.164E10      0% Min         0       5%        0        165(   27)    33504(    3)
CV         203.243  Std Mean  4670.788                             1%        0        360(   20)   147763(    2)
T:Mean=0  2.783296  Pr>|T|      0.0091   Range        147763
Num ^= 0        30  Num > 0         30   Q3-Q1       11598.5
M(Sign)         15  Pr>=|M|     0.0001   Mode              0
Sgn Rank     232.5  Pr>=|S|     0.0001
W:Normal   0.46361  Pr<W        0.0001

    Stem Leaf                     #  Boxplot                      Normal Probability Plot
      14 8                        1     *      145000+                                                 *
      13                                             |
      12                                             |
      11                                             |
      10                                             |
       9                                             |
       8                                             |
       7                                        75000+                                                  ++++
       6                                             |                                              ++++
       5                                             |                                           +++
       4                                             |                                       ++++
       3 024                      3     0            |                                   ++++  * *
       2 9                        1     |            |                               ++++    **
       1 0011444                  7  +--+--+         |                           ++++ ******
       0 00000111123355556789    20  *-----*     5000+     *     * * ** **************
         ----+----+----+----+                         +----+----+----+----+----+----+----+----+----+----+
    Multiply Stem.Leaf by 10**+4                           -2        -1         0        +1        +2
```

Tables 2-5, App Bldg, Total Reductions from 1992-1993, Complete Description

GROUP=Shuttered

Univariate Procedure

Variable=BV23 $ App. Bldg Value Reduct from 1992-93

Frequency Table

Value	Count	Percents Cell	Percents Cum	Value	Count	Percents Cell	Percents Cum	Value	Count	Percents Cell	Percents Cum	Value	Count	Percents Cell	Percents Cum
0	2	6.3	6.3	1672	1	3.1	31.3	6627	1	3.1	56.3	13744	1	3.1	81.3
96	1	3.1	9.4	2820	1	3.1	34.4	8489	1	3.1	59.4	14118	1	3.1	84.4
165	1	3.1	12.5	3166	1	3.1	37.5	8816	1	3.1	62.5	28599	1	3.1	87.5
360	1	3.1	15.6	4582	1	3.1	40.6	9842	1	3.1	65.6	29569	1	3.1	90.6
638	1	3.1	18.8	4796	1	3.1	43.8	10139	1	3.1	68.8	32165	1	3.1	93.8
736	1	3.1	21.9	4946	1	3.1	46.9	10791	1	3.1	71.9	33504	1	3.1	96.9
752	1	3.1	25.0	5140	1	3.1	50.0	11375	1	3.1	75.0	147763	1	3.1	100.0
1070	1	3.1	28.1	5882	1	3.1	53.1	13644	1	3.1	78.1				

Tables 2-5, App Bldg, Total Reductions from 1992-1993, Complete Description

GROUP=Shuttered

Univariate Procedure

Variable=TV23 $ App. Total Value Reduct from 1992-93

Moments

N	32	Sum Wgts	32
Mean	10740.41	Sum	343693
Std Dev	27603.57	Variance	7.6196E8
Skewness	4.175598	Kurtosis	20.579
USS	2.731E10	CSS	2.362E10
CV	257.0068	Std Mean	4879.668
T:Mean=0	2.201053	Pr>|T|	0.0353
Num ^= 0	31	Num > 0	26
M(Sign)	10.5	Pr>=|M|	0.0002
Sgn Rank	154	Pr>=|S|	0.0014
W:Normal	0.558037	Pr<W	0.0001

Quantiles(Def=5)

100% Max	147763	99%	147763
75% Q3	12509.5	95%	33504
50% Med	4689	90%	29569
25% Q1	262.5	10%	-7409
0% Min	-14810	5%	-10678
		1%	-14810
Range	162573		
Q3-Q1	12247		
Mode	-14810		

Extremes

Lowest	Obs	Highest	Obs
-14810(	26)	28599(	15)
-10678(	18)	29569(	11)
-9444(	9)	32165(	14)
-7409(	28)	33504(	3)
-4879(	22)	147763(	2)

```
   Stem Leaf                         #   Boxplot
     14 8                            1      *
     12
     10
      8
      6
      4
      2 9024                         4      0
      0 0000112233555678901444      22   +--+--+
     -0 51975                        5      |
        ----+----+----+----+--
   Multiply Stem.Leaf by 10**+4
```

```
                        Normal Probability Plot
   150000+                                                  *
         |
         |
         |
    70000+                                             ++++++++
         |                                      +++++++
         |                               +++++++** * *
         |                    *******************
   -10000+     *     * * **+++++++
          +----+----+----+----+----+----+----+----+----+----+
              -2        -1         0        +1        +2
```

Frequency Table

Value	Count	Percents Cell	Percents Cum
-14810	1	3.1	3.1
-10678	1	3.1	6.3
-9444	1	3.1	9.4
-7409	1	3.1	12.5
-4879	1	3.1	15.6
0	1	3.1	18.8
96	1	3.1	21.9
165	1	3.1	25.0
360	1	3.1	28.1
736	1	3.1	31.3
752	1	3.1	34.4
1672	1	3.1	37.5
2491	1	3.1	40.6
2820	1	3.1	43.8
3166	1	3.1	46.9
4582	1	3.1	50.0
4796	1	3.1	53.1
5140	1	3.1	56.3
5882	1	3.1	59.4
6627	1	3.1	62.5
8489	1	3.1	65.6
8816	1	3.1	68.8
9842	1	3.1	71.9
11375	1	3.1	75.0
13644	1	3.1	78.1
13744	1	3.1	81.3
14118	1	3.1	84.4
28599	1	3.1	87.5
29569	1	3.1	90.6
32165	1	3.1	93.8
33504	1	3.1	96.9
147763	1	3.1	100.0

Tables 2-5, App Bldg, Total Reductions from 1992-1993, Complete Description

GROUP=Shuttered

Univariate Procedure

Variable=PBV23 % App. Bldg Value Reduct from 1992-93

Moments

N	32	Sum Wgts	32
Mean	12.41011	Sum	397.1235
Std Dev	17.18235	Variance	295.2331
Skewness	2.179256	Kurtosis	4.430288
USS	14080.57	CSS	9152.227
CV	138.4545	Std Mean	3.037439
T:Mean=0	4.085715	Pr>|T|	0.0003
Num ^= 0	30	Num > 0	30
M(Sign)	15	Pr>=|M|	0.0001
Sgn Rank	232.5	Pr>=|S|	0.0001
W:Normal	0.693352	Pr<W	0.0001

Quantiles(Def=5)

100% Max	65.61608	99%	65.61608
75% Q3	14.19867	95%	65.2309
50% Med	6.901784	90%	32.33477
25% Q1	1.127032	10%	0.283048
0% Min	0	5%	0
		1%	0
Range	65.61608		
Q3-Q1	13.07164		
Mode	0		

Extremes

Lowest	Obs	Highest	Obs
0(	26)	25.8696(	12)
0(	8)	32.33477(	3)
0.241151(	19)	44.22298(	15)
0.283048(	27)	65.2309(	2)
0.80583(	18)	65.61608(	14)

```
Stem Leaf                   #  Boxplot
   6 56                     2     *
   6
   5
   5
   4
   4 4                      1     0
   3
   3 2                      1     |
   2 6                      1     |
   2 0                      1     |
   1 58                     2     |
   1 0013                   4  +--+--+
   0 66777788               8  *-----*
   0 000011111123          12  +-----+
     ----+----+----+----+
 Multiply Stem.Leaf by 10**+1
```

```
                      Normal Probability Plot
 67.5+                                              *    *
     |                                                       +
     |                                                    +++
     |                                                 +++
     |                                              *  ++
     |                                            +++
     |                                         +*+
     |                                      ++++*
     |                                    +++
     |                                 +++   **
     |                              +++  ****
  2.5+      *     * * ** ******  +*******
      +----+----+----+----+----+----+----+----+----+----+
          -2        -1         0        +1        +2
```

Frequency Table

Value	Count	Percents Cell	Percents Cum
0	2	6.3	6.3
0.241151	1	3.1	9.4
0.283048	1	3.1	12.5
0.80583	1	3.1	15.6
0.961002	1	3.1	18.8
1.019249	1	3.1	21.9
1.1231	1	3.1	25.0
1.130963	1	3.1	28.1
1.165916	1	3.1	31.3
1.613392	1	3.1	34.4
2.565578	1	3.1	37.5
5.907456	1	3.1	40.6
6.05475	1	3.1	43.8
6.775278	1	3.1	46.9
6.896085	1	3.1	50.0
6.907483	1	3.1	53.1
7.021272	1	3.1	56.3
8.03363	1	3.1	59.4
8.185009	1	3.1	62.5
10.08891	1	3.1	65.6
10.12608	1	3.1	68.8
10.73933	1	3.1	71.9
13.43773	1	3.1	75.0
14.95961	1	3.1	78.1
18.04524	1	3.1	81.3
19.76204	1	3.1	84.4
25.8696	1	3.1	87.5
32.33477	1	3.1	90.6
44.22298	1	3.1	93.8
65.2309	1	3.1	96.9
65.61608	1	3.1	100.0

Tables 2-5, App Bldg, Total Reductions from 1992-1993, Complete Description

GROUP=Shuttered

Univariate Procedure

Variable=PTV23   % App. Total Value Reduct from 1992-93

Moments

N	32	Sum Wgts	32
Mean	5.194438	Sum	166.222
Std Dev	10.83844	Variance	117.4717
Skewness	2.110499	Kurtosis	5.385415
USS	4505.054	CSS	3641.624
CV	208.6547	Std Mean	1.915983
T:Mean=0	2.711108	Pr>|T|	0.0108
Num ^= 0	31	Num > 0	26
M(Sign)	10.5	Pr>=|M|	0.0002
Sgn Rank	153	Pr>=|S|	0.0015
W:Normal	0.786239	Pr<W	0.0001

Quantiles(Def=5)

100% Max	44.20637	99%	44.20637
75% Q3	6.052732	95%	32.39791
50% Med	2.426962	90%	17.29739
25% Q1	0.249946	10%	-4.17528
0% Min	-8.51507	5%	-7.89314
		1%	-8.51507
Range	52.72144		
Q3-Q1	5.802786		
Mode	-8.51507		

Extremes

Lowest	Obs	Highest	Obs
-8.51507(	26)	11.07494(	17)
-7.89314(	18)	17.29739(	3)
-5.15043(	22)	22.19316(	15)
-4.17528(	28)	32.39791(	2)
-3.63995(	9)	44.20637(	14)

```
 Stem Leaf                     #  Boxplot
   4 4                         1     *
   3
   3 2                         1     *
   2
   2 2                         1     0
   1 7                         1     0
   1 11                        2     |
   0 5555578                   7  +--+--+
   0 00000111112334           14  *-----*
  -0 44                        2     |
  -0 985                       3     0
     ----+----+----+----+
 Multiply Stem.Leaf by 10**+1
```

Normal Probability Plot

```
 42.5+                                                 *
     |
     |                                            *   +++
     |                                              ++++
     |                                         *++++
 17.5+                                     ++*+
     |                                ++++* *
     |                           +++++****
     |                  **************
     |            ** +++++
 -7.5+    *     * *++++
      +----+----+----+----+----+----+----+----+----+----+
          -2        -1         0        +1        +2
```

Frequency Table

Value	Count	Percents Cell	Percents Cum
-8.51507	1	3.1	3.1
-7.89314	1	3.1	6.3
-5.15043	1	3.1	9.4
-4.17528	1	3.1	12.5
-3.63995	1	3.1	15.6
0	1	3.1	18.8
0.116697	1	3.1	21.9
0.118144	1	3.1	25.0
0.381748	1	3.1	28.1
0.441724	1	3.1	31.3
0.510153	1	3.1	34.4
0.589668	1	3.1	37.5
0.986423	1	3.1	40.6
1.314796	1	3.1	43.8
1.48881	1	3.1	46.9
2.230963	1	3.1	50.0
2.622962	1	3.1	53.1
2.846329	1	3.1	56.3
4.459683	1	3.1	59.4
4.611351	1	3.1	62.5
4.804269	1	3.1	65.6
4.978303	1	3.1	68.8
5.119695	1	3.1	71.9
5.188774	1	3.1	75.0
6.916689	1	3.1	78.1
7.909564	1	3.1	81.3
10.78935	1	3.1	84.4
11.07494	1	3.1	87.5
17.29739	1	3.1	90.6
22.19316	1	3.1	93.8
32.39791	1	3.1	96.9
44.20637	1	3.1	100.0

Tables 2-5, App Bldg, Total Reductions from 1992-1993, Complete Description

GROUP=Comparable

Univariate Procedure

Variable=BV23 $ App. Bldg Value Reduct from 1992-93

```
                 Moments                              Quantiles(Def=5)                         Extremes

N               32  Sum Wgts        32   100% Max    139865       99%    139865     Lowest   Obs    Highest    Obs
Mean      17065.38  Sum         546092    75% Q3    11698.5       95%    106671       -270(    30)    36868(    16)
Std Dev   31748.38  Variance   1.008E9    50% Med      6010       90%     42043          0(     8)    42043(    32)
Skewness  2.814553  Kurtosis  8.153003    25% Q1        495       10%         5          2(    18)    61414(    15)
USS      4.057E10  CSS       3.125E10     0% Min       -270        5%         0          5(    19)   106671(     2)
CV        186.0397  Std Mean  5612.373                              1%      -270         28(    26)   139865(     4)
T:Mean=0   3.04067  Pr>|T|      0.0048   Range      140135
Num ^= 0        31  Num > 0         30   Q3-Q1     11203.5
M(Sign)       14.5  Pr>=|M|     0.0001   Mode          -270
Sgn Rank       243  Pr>=|S|     0.0001
W:Normal  0.584706  Pr<W        0.0001

   Stem Leaf                     #  Boxplot                        Normal Probability Plot
     14 0                        1     *        145000+
     13                                               |                                         *
     12                                               |
     11                                               |
     10 7                        1     *        115000+                                    *
      9                                               |                                              +++
      8                                          85000+                                          +++
      7                                               |                                      +++
      6 1                        1     *              |                                   *++
      5                                          55000+                               +++
      4 2                        1     0              |                            +++ *
      3 67                       2     0              |                         +++ *  *
      2 5                        1     |         25000+                     ++++  *
      1 003                      3  +--+--+           |                 +++     **
      0 000000011113335777888    21 *-----*           |   *  * ** ***************
     -0 0                        1     |         -5000+  *        +++
        ----+----+----+----+-                         +----+----+----+----+----+----+----+----+----+----+
   Multiply Stem.Leaf by 10**+4                            -2        -1         0        +1        +2
```

Tables 2-5, App Bldg, Total Reductions from 1992-1993, Complete Description

GROUP=Comparable

Univariate Procedure

Variable=BV23 $ App. Bldg Value Reduct from 1992-93

Frequency Table

Value	Count	Percents Cell	Percents Cum	Value	Count	Percents Cell	Percents Cum	Value	Count	Percents Cell	Percents Cum	Value	Count	Percents Cell	Percents Cum
-270	1	3.1	3.1	562	1	3.1	28.1	6943	1	3.1	53.1	13191	1	3.1	78.1
0	1	3.1	6.3	683	1	3.1	31.3	7082	1	3.1	56.3	25187	1	3.1	81.3
2	1	3.1	9.4	1070	1	3.1	34.4	7563	1	3.1	59.4	36155	1	3.1	84.4
5	1	3.1	12.5	1180	1	3.1	37.5	7606	1	3.1	62.5	36868	1	3.1	87.5
28	1	3.1	15.6	3183	1	3.1	40.6	8117	1	3.1	65.6	42043	1	3.1	90.6
130	1	3.1	18.8	3191	1	3.1	43.8	8398	1	3.1	68.8	61414	1	3.1	93.8
337	1	3.1	21.9	3397	1	3.1	46.9	9780	1	3.1	71.9	106671	1	3.1	96.9
428	1	3.1	25.0	5077	1	3.1	50.0	10206	1	3.1	75.0	139865	1	3.1	100.0

Tables 2-5, App Bldg, Total Reductions from 1992-1993, Complete Description

GROUP=Comparable

Univariate Procedure

Variable=TV23 $ App. Total Value Reduct from 1992-93

Moments

N	32	Sum Wgts	32
Mean	17160.41	Sum	549133
Std Dev	35780.88	Variance	1.2803E9
Skewness	2.292574	Kurtosis	4.881262
USS	4.911E10	CSS	3.969E10
CV	208.5084	Std Mean	6325.226
T:Mean=0	2.713011	Pr>|T|	0.0108
Num ^= 0	31	Num > 0	25
M(Sign)	9.5	Pr>=|M|	0.0009
Sgn Rank	155	Pr>=|S|	0.0012
W:Normal	0.676088	Pr<W	0.0001

Quantiles(Def=5)

100% Max	139865	99%	139865
75% Q3	11698.5	95%	106671
50% Med	6010	90%	61414
25% Q1	67.5	10%	-6838
0% Min	-15531	5%	-11314
		1%	-15531
Range	155396		
Q3-Q1	11631		
Mode	-15531		

Extremes

Lowest	Obs	Highest	Obs
-15531(	26)	36868(	16)
-11314(	18)	61414(	15)
-10414(	22)	98717(	32)
-6838(	24)	106671(	2)
-6828(	28)	139865(	4)

```
Stem Leaf                     #  Boxplot
  14 0                        1     *
  12
  10 7                        1     *
   8 9                        1     *
   6 1                        1     *
   4
   2 567                      3     0
   0 0000113335778888003     19  +--+--+
  -0 610770                   6     |
     ----+----+----+----+
Multiply Stem.Leaf by 10**+4
```

Normal Probability Plot

```
150000+                                                *
      |                                           *         ++
      |                                         *   ++++++
 70000+                                      *+++++
      |                                 +++++
      |                           ++++++ ** *
-10000+    *      * * **+*++++****************
       +----+----+----+----+----+----+----+----+----+----+
           -2        -1         0        +1        +2
```

Frequency Table

Value	Count	Percents Cell	Cum	Value	Count	Percents Cell	Cum	Value	Count	Percents Cell	Cum	Value	Count	Percents Cell	Cum
-15531	1	3.1	3.1	130	1	3.1	28.1	6943	1	3.1	53.1	13191	1	3.1	78.1
-11314	1	3.1	6.3	337	1	3.1	31.3	7082	1	3.1	56.3	25187	1	3.1	81.3
-10414	1	3.1	9.4	562	1	3.1	34.4	7563	1	3.1	59.4	36155	1	3.1	84.4
-6838	1	3.1	12.5	683	1	3.1	37.5	7606	1	3.1	62.5	36868	1	3.1	87.5
-6828	1	3.1	15.6	3183	1	3.1	40.6	8117	1	3.1	65.6	61414	1	3.1	90.6
-270	1	3.1	18.8	3191	1	3.1	43.8	8398	1	3.1	68.8	98717	1	3.1	93.8
0	1	3.1	21.9	3397	1	3.1	46.9	9780	1	3.1	71.9	106671	1	3.1	96.9
5	1	3.1	25.0	5077	1	3.1	50.0	10206	1	3.1	75.0	139865	1	3.1	100.0

Tables 2-5, App Bldg, Total Reductions from 1992-1993, Complete Description

GROUP=Comparable

Univariate Procedure

Variable=PBV23 % App. Bldg Value Reduct from 1992-93

Moments

N	32	Sum Wgts	32
Mean	17.48508	Sum	559.5227
Std Dev	26.94946	Variance	726.2732
Skewness	1.96164	Kurtosis	2.954956
USS	32297.77	CSS	22514.47
CV	154.1283	Std Mean	4.764036
T:Mean=0	3.670225	Pr>|T|	0.0009
Num ^= 0	31	Num > 0	30
M(Sign)	14.5	Pr>=|M|	0.0001
Sgn Rank	243	Pr>=|S|	0.0001
W:Normal	0.674569	Pr<W	0.0001

Quantiles(Def=5)

100% Max	98.99895	99%	98.99895
75% Q3	16.89644	95%	89.36914
50% Med	6.975869	90%	65.95702
25% Q1	1.08039	10%	0.010205
0% Min	-0.62354	5%	0
		1%	-0.62354
Range	99.62249		
Q3-Q1	15.81605		
Mode	-0.62354		

Extremes

Lowest	Obs	Highest	Obs
-0.62354(	30)	49.30623(	4)
0(	8)	65.95702(	14)
0.002843(	18)	66.36306(	16)
0.010205(	19)	89.36914(	2)
0.023154(	26)	98.99895(	15)

```
Stem Leaf                   #  Boxplot                      Normal Probability Plot
   9 9                      1     *            95+                                              *
   8 9                      1     *              |                                         *     ++
   7                                             |                                            ++++
   6 66                     2     *              |                                   * * ++++
   5                                             |                                     +++
   4 9                      1     0            45+                                  ++*+
   3 9                      1     |              |                              ++++*
   2                                |              |                          ++++
   1 0133689                7  +--+--+           |                      +++  ******
   0 000001111114466888    18  *-----*           |              * *  ** ************
  -0 1                      1     |             -5+    *               ++++
     ----+----+----+----+                          +----+----+----+----+----+----+----+----+----+----+
Multiply Stem.Leaf by 10**+1                            -2        -1         0        +1        +2
```

Frequency Table

Value	Count	Percents Cell	Percents Cum	Value	Count	Percents Cell	Percents Cum	Value	Count	Percents Cell	Percents Cum	Value	Count	Percents Cell	Percents Cum
-0.62354	1	3.1	3.1	1.106286	1	3.1	28.1	7.673261	1	3.1	53.1	17.83491	1	3.1	78.1
0	1	3.1	6.3	1.109084	1	3.1	31.3	7.94684	1	3.1	56.3	18.7784	1	3.1	81.3
0.002843	1	3.1	9.4	1.150578	1	3.1	34.4	8.170158	1	3.1	59.4	39.00418	1	3.1	84.4
0.010205	1	3.1	12.5	1.15963	1	3.1	37.5	10.09393	1	3.1	62.5	49.30623	1	3.1	87.5
0.023154	1	3.1	15.6	3.639661	1	3.1	40.6	10.98867	1	3.1	65.6	65.95702	1	3.1	90.6
0.221141	1	3.1	18.8	4.441161	1	3.1	43.8	13.06987	1	3.1	68.8	66.36306	1	3.1	93.8
0.996557	1	3.1	21.9	6.067117	1	3.1	46.9	13.37328	1	3.1	71.9	89.36914	1	3.1	96.9
1.054494	1	3.1	25.0	6.278478	1	3.1	50.0	15.95797	1	3.1	75.0	98.99895	1	3.1	100.0

Tables 2-5, App Bldg, Total Reductions from 1992-1993, Complete Description

GROUP=Comparable

Univariate Procedure

Variable=PTV23 % App. Total Value Reduct from 1992-93

Moments

N	32	Sum Wgts	32
Mean	8.563076	Sum	274.0184
Std Dev	17.03958	Variance	290.3474
Skewness	1.560067	Kurtosis	1.67631
USS	11347.21	CSS	9000.771
CV	198.9891	Std Mean	3.012201
T:Mean=0	2.842796	Pr>|T|	0.0078
Num ^= 0	31	Num > 0	25
M(Sign)	9.5	Pr>=|M|	0.0009
Sgn Rank	148	Pr>=|S|	0.0022
W:Normal	0.779493	Pr<W	0.0001

Quantiles(Def=5)

100% Max	54.32458	99%	54.32458
75% Q3	8.784059	95%	50.21956
50% Med	2.99602	90%	34.11082
25% Q1	0.049112	10%	-3.91882
0% Min	-14.4476	5%	-8.9467
		1%	-14.4476
Range	68.77222		
Q3-Q1	8.734947		
Mode	-14.4476		

Extremes

Lowest	Obs	Highest	Obs
-14.4476(	22)	30.61432(	2)
-8.9467(	18)	34.11082(	16)
-8.47933(	26)	46.02391(	14)
-3.91882(	28)	50.21956(	15)
-3.58307(	24)	54.32458(	32)

```
 Stem Leaf                    #  Boxplot
    5 04                      2     *
    4 6                       1     *
    4
    3
    3 14                      2     0
    2 9                       1     0
    2
    1
    1 01                      2     |
    0 5668                    4  +--+--+
    0 00000022333344         14  *-----*
   -0 440                     3     |
   -0 98                      2     |
   -1 4                       1     0
      ----+----+----+----+
 Multiply Stem.Leaf by 10**+1
```

```
                      Normal Probability Plot
  52.5+                                                 *   *   +
      |                                               *     +++
      |                                                  +++
      |                                               +++
      |                                          **+++
      |                                         *+++
      |                                       +++
      |                                    +++
      |                                 +++    *
      |                              +++  ****
      |                        *************
      |                ** * ++
      |             * *  +++
 -12.5+        *      +++
       +----+----+----+----+----+----+----+----+----+----+
           -2        -1         0        +1        +2
```

Frequency Table

Value	Count	Percents Cell	Percents Cum
-14.4476	1	3.1	3.1
-8.9467	1	3.1	6.3
-8.47933	1	3.1	9.4
-3.91882	1	3.1	12.5
-3.58307	1	3.1	15.6
-0.30457	1	3.1	18.8
0	1	3.1	21.9
0.005468	1	3.1	25.0
0.092756	1	3.1	28.1
0.183831	1	3.1	31.3
0.368295	1	3.1	34.4
0.488866	1	3.1	37.5
1.76496	1	3.1	40.6
2.260242	1	3.1	43.8
2.817223	1	3.1	46.9
2.95574	1	3.1	50.0
3.0363	1	3.1	53.1
3.215249	1	3.1	56.3
3.873971	1	3.1	59.4
3.95632	1	3.1	62.5
4.70495	1	3.1	65.6
5.652704	1	3.1	68.8
5.773636	1	3.1	71.9
7.699896	1	3.1	75.0
9.868222	1	3.1	78.1
10.9284	1	3.1	81.3
28.75833	1	3.1	84.4
30.61432	1	3.1	87.5
34.11082	1	3.1	90.6
46.02391	1	3.1	93.8
50.21956	1	3.1	96.9
54.32458	1	3.1	100.0

Tables 2-5, App Bldg, Total Reductions from 1992-1993, Complete Description

Univariate Procedure
Schematic Plots

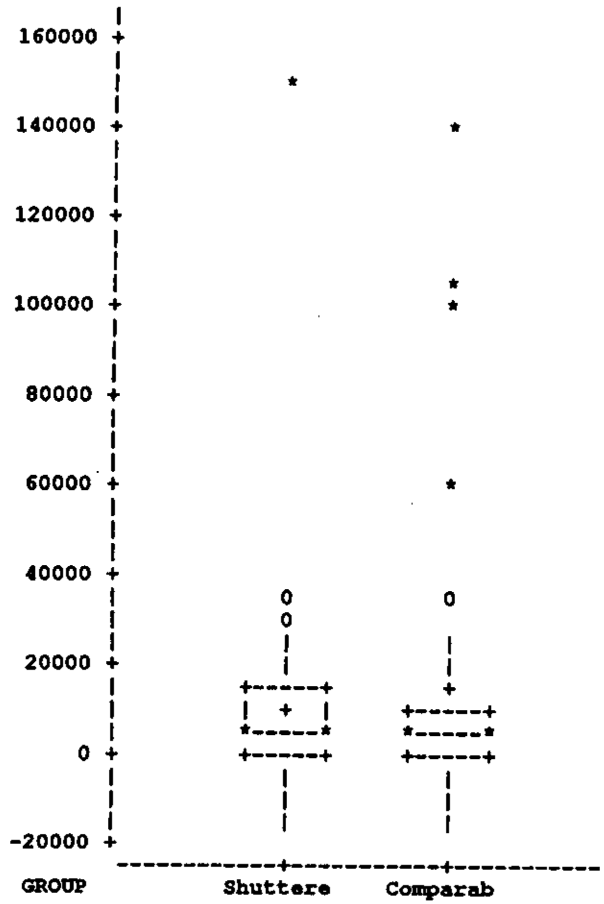
Variable=BV23 $ App. Bldg Value Reduct from 1992-93

```
        |
 160000 +
        |
        |               *
        |
 140000 +                              *
        |
        |
        |
 120000 +
        |
        |
        |                              *
 100000 +
        |
        |
        |
  80000 +
        |
        |
        |
  60000 +                              *
        |
        |
        |
  40000 +                              0
        |             0                0
        |             0
        |             |                |
  20000 +             |                |
        |          +--+--+             +
        |          |     |          +-----+
        |          *-----*          *-----*
      0 +          +-----+          +-----+
         -------------+----------------+-----------
GROUP              Shuttere         Comparab
```

Tables 2-5, App Bldg, Total Reductions from 1992-1993, Complete Description

Univariate Procedure
Schematic Plots

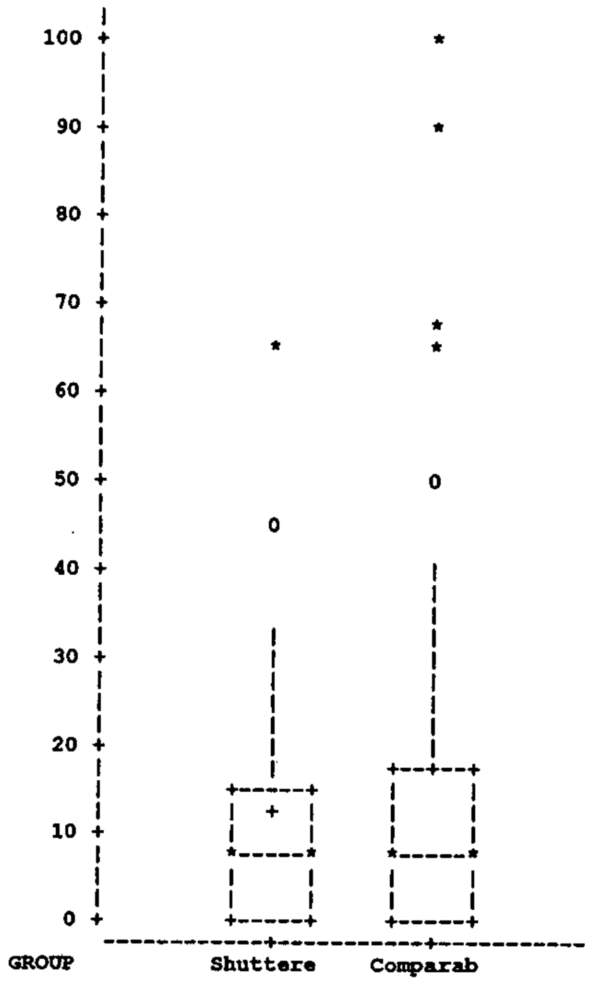
Variable=TV23 $ App. Total Value Reduct from 1992-93



Tables 2-5, App Bldg, Total Reductions from 1992-1993, Complete Description

Univariate Procedure
Schematic Plots

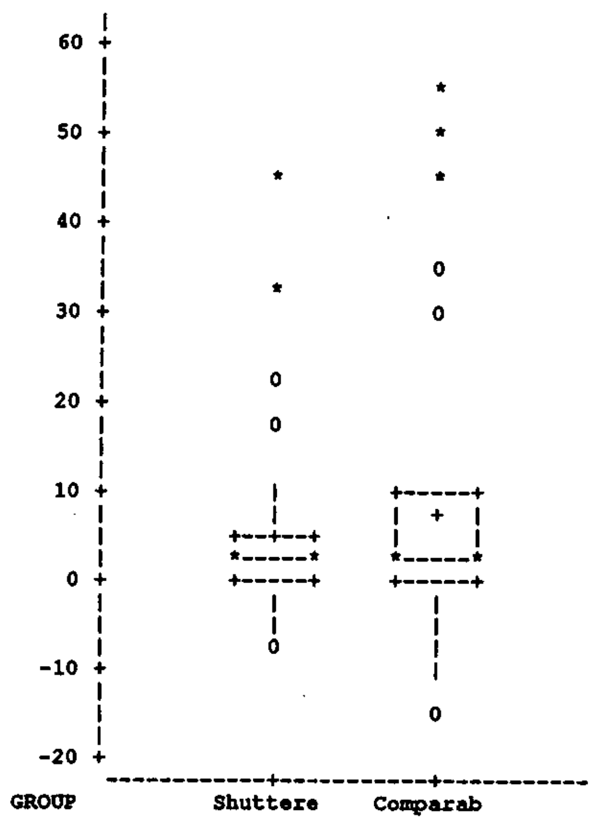
Variable=PBV23 % App. Bldg Value Reduct from 1992-93



Tables 2-5, App Bldg, Total Reductions from 1992-1993, Complete Description

Univariate Procedure
Schematic Plots

Variable=PTV23 % App. Total Value Reduct from 1992-93



Comparison in Reduction of App Values btw Comparable and Shuttered Houses
(Positive Numbers mean Comp Reduction > Shut Reduction)

Variable	Label	Mean	Std Dev	Std Error	N	Minimum	Maximum
BVCS	$ Diff Btw Comp & Shut App Bldg Reduct	4065.19	28077.21	4963.40	32	-41092.00	135069.00
PBVCS	% Diff Btw Comp & Shut App Bldg Reduct	5.07	18.08	3.20	32	-28.70	54.78
TVCS	$ Diff Btw Comp & Shut App Total Reduct	6420.00	31514.73	5571.07	32	-41092.00	135069.00
PTVCS	% Diff Btw Comp & Shut App Total Reduct	3.37	12.52	2.21	32	-15.04	49.52

Variable	Label	T	Prob>|T|
BVCS	$ Diff Btw Comp & Shut App Bldg Reduct	0.82	0.4190
PBVCS	% Diff Btw Comp & Shut App Bldg Reduct	1.59	0.1224
TVCS	$ Diff Btw Comp & Shut App Total Reduct	1.15	0.2580
PTVCS	% Diff Btw Comp & Shut App Total Reduct	1.52	0.1380

Tables 6-9. Distribution of Reduction of App Values btw Comparable and Shuttered Houses
(Positive Numbers mean Comp Reduction > Shut Reduction)

Univariate Procedure

Variable=BVCS $ Diff Btw Comp & Shut App Bldg Reduct

Moments

N	32	Sum Wgts	32
Mean	4065.188	Sum	130086
Std Dev	28077.21	Variance	7.8833E8
Skewness	3.367535	Kurtosis	15.72445
USS	2.497E10	CSS	2.444E10
CV	690.6745	Std Mean	4963.397
T:Mean=0	0.819033	Pr>|T|	0.4190
Num ^= 0	30	Num > 0	11
M(Sign)	-4	Pr>=|M|	0.2005
Sgn Rank	-34.5	Pr>=|S|	0.4873
W:Normal	0.624732	Pr<W	0.0001

Quantiles(Def=5)

100% Max	135069	99%	135069
75% Q3	1739.5	95%	33554
50% Med	-140.5	90%	28052
25% Q1	-3237.5	10%	-9611
0% Min	-41092	5%	-28427
		1%	-41092
Range	176161		
Q3-Q1	4977		
Mode	0		

Extremes

Lowest	ID	Highest	ID
-41092	(02)	22021	(10)
-28427	(03)	28052	(25)
-21171	(19)	32815	(24)
-9611	(41)	33554	(12)
-7175	(27)	135069	(04)

```
Stem Leaf                  #  Boxplot                      Normal Probability Plot
  12 5                     1     *        130000+                                              *
  10                                            |
   8                                            |
   6                                       70000+                                            ++++++
   4                                            |                                      +++++++
   2 2834                  4     *              |                               ++++++** * *
   0 00000344              8  +--+--+      10000+                         ++++*******
  -0 0776522211100000     16  *-----*           |                ** ***********
  -2 81                    2     *              |            ***+++++
  -4 1                     1     *        -50000+      +*+++++
     ----+----+----+----+                        +----+----+----+----+----+----+----+----+----+----+
  Multiply Stem.Leaf by 10**+4                        -2        -1         0        +1        +2
```

Frequency Table

Value	Count	Percents Cell	Percents Cum	Value	Count	Percents Cell	Percents Cum	Value	Count	Percents Cell	Percents Cum	Value	Count	Percents Cell	Percents Cum
-41092	1	3.1	3.1	-1957	1	3.1	28.1	-91	1	3.1	53.1	3990	1	3.1	81.3
-28427	1	3.1	6.3	-1725	1	3.1	31.3	-35	1	3.1	56.3	4324	1	3.1	84.4
-21171	1	3.1	9.4	-1595	1	3.1	34.4	-23	1	3.1	59.4	22021	1	3.1	87.5
-9611	1	3.1	12.5	-1006	1	3.1	37.5	0	2	6.3	65.6	28052	1	3.1	90.6
-7175	1	3.1	15.6	-989	1	3.1	40.6	28	1	3.1	68.8	32815	1	3.1	93.8
-6742	1	3.1	18.8	-636	1	3.1	43.8	371	1	3.1	71.9	33554	1	3.1	96.9
-6181	1	3.1	21.9	-453	1	3.1	46.9	455	1	3.1	75.0	135069	1	3.1	100.0
-4518	1	3.1	25.0	-190	1	3.1	50.0	3024	1	3.1	78.1				

Tables 6-9. Distribution of Reduction of App Values btw Comparable and Shuttered Houses
(Positive Numbers mean Comp Reduction > Shut Reduction)

Univariate Procedure

Variable=PBVCS   % Diff Btw Comp & Shut App Bldg Reduct

Moments

N	32	Sum Wgts	32
Mean	5.074976	Sum	162.3992
Std Dev	18.07662	Variance	326.7642
Skewness	1.573863	Kurtosis	2.589602
USS	10953.86	CSS	10129.69
CV	356.1912	Std Mean	3.195525
T:Mean=0	1.588151	Pr>|T|	0.1224
Num ^= 0	31	Num > 0	16
M(Sign)	0.5	Pr>=|M|	1.0000
Sgn Rank	28	Pr>=|S|	0.5915
W:Normal	0.758313	Pr<W	0.0001

Quantiles(Def=5)

100% Max	54.77597	99%	54.77597
75% Q3	3.07644	95%	51.40345
50% Med	0.006183	90%	30.81918
25% Q1	-1.86503	10%	-9.03442
0% Min	-28.6951	5%	-11.5919
		1%	-28.6951
Range	83.47109		
Q3-Q1	4.941474		
Mode	-28.6951		

Extremes

Lowest	ID	Highest	ID
-28.6951	(03)	24.13823	(02)
-11.5919	(27)	30.81918	(12)
-9.63305	(37)	47.69283	(04)
-9.03442	(41)	51.40345	(25)
-7.0912	(20)	54.77597	(24)

```
 Stem Leaf                      #  Boxplot
    5 15                        2     *
    4 8                         1     *
    3 1                         1     *
    2 4                         1     *
    1 5                         1     0
    0 00000012336              11  +--+--+
   -0 974222100000             12  +-----+
   -1 20                        2     0
   -2 9                         1     *
      ----+----+----+----+
 Multiply Stem.Leaf by 10**+1

                    Normal Probability Plot
   55+                                             *    *  +
     |                                           *    +++++
     |                                        * ++++++
   15+                                    ++*++
     |                              ++++++*
     |                        ++*********
     |               * ** *********
     |             * +++++
  -25+    * ++++++
      +----+----+----+----+----+----+----+----+----+----+
           -2        -1         0        +1        +2
```

Frequency Table

Value	Count	Percents Cell	Percents Cum
-28.6951	1	3.1	3.1
-11.5919	1	3.1	6.3
-9.63305	1	3.1	9.4
-9.03442	1	3.1	12.5
-7.0912	1	3.1	15.6
-3.84761	1	3.1	18.8
-2.33412	1	3.1	21.9
-2.08728	1	3.1	25.0
-1.64279	1	3.1	28.1
-0.80299	1	3.1	31.3
-0.23095	1	3.1	34.4
-0.06445	1	3.1	37.5
-0.06191	1	3.1	40.6
-0.01402	1	3.1	43.8
-0.00629	1	3.1	46.9
0	1	3.1	50.0
0.012366	1	3.1	53.1
0.019615	1	3.1	56.3
0.023154	1	3.1	59.4
0.035554	1	3.1	62.5
0.340945	1	3.1	65.6
0.765778	1	3.1	68.8
2.039384	1	3.1	71.9
2.955039	1	3.1	75.0
3.197842	1	3.1	78.1
6.048598	1	3.1	81.3
15.26934	1	3.1	84.4
24.13823	1	3.1	87.5
30.81918	1	3.1	90.6
47.69283	1	3.1	93.8
51.40345	1	3.1	96.9
54.77597	1	3.1	100.0

Tables 6-9. Distribution of Reduction of App Values btw Comparable and Shuttered Houses
(Positive Numbers mean Comp Reduction > Shut Reduction)

Univariate Procedure

Variable=TVCS $ Diff Btw Comp & Shut App Total Reduct

Moments

N	32	Sum Wgts	32
Mean	6420	Sum	205440
Std Dev	31514.73	Variance	9.9318E8
Skewness	2.818863	Kurtosis	9.83896
USS	3.211E10	CSS	3.079E10
CV	490.8837	Std Mean	5571.07
T:Mean=0	1.152382	Pr>|T|	0.2580
Num ^= 0	31	Num > 0	12
M(Sign)	-3.5	Pr>=|M|	0.2810
Sgn Rank	-14	Pr>=|S|	0.7888
W:Normal	0.648021	Pr<W	0.0001

Quantiles(Def=5)

100% Max	135069	99%	135069
75% Q3	3507	95%	90228
50% Med	-140.5	90%	28052
25% Q1	-1841	10%	-9329
0% Min	-41092	5%	-28427
		1%	-41092
Range	176161		
Q3-Q1	5348		
Mode	-41092		

Extremes

Lowest	ID	Highest	ID
-41092	(02)	22021	(10)
-28427	(03)	28052	(25)
-21171	(19)	32815	(24)
-9329	(41)	90228	(12)
-7175	(27)	135069	(04)

```
 Stem Leaf                     #  Boxplot                        Normal Probability Plot
   12 5                        1     *       130000+                                                 *
   10                                              |
    8 0                        1     *             |                                            *     ++
    6                                        70000+                                          ++++++
    4                                              |                                    +++++++
    2 283                      3     *             |                              ++++++** *
    0 00013443                 8  +--0--+    10000+                        +++++*********
   -0 9766222111100000        16  *-----*          |              ** ************
   -2 81                       2     *             |          * ++++++
   -4 1                        1     *      -50000+     *++++++
      ----+----+----+----+                         +----+----+----+----+----+----+----+----+----+----+
   Multiply Stem.Leaf by 10**+4                         -2        -1         0        +1        +2
```

Frequency Table

Value	Count	Percents Cell	Percents Cum	Value	Count	Percents Cell	Percents Cum	Value	Count	Percents Cell	Percents Cum	Value	Count	Percents Cell	Percents Cum
-41092	1	3.1	3.1	-1725	1	3.1	28.1	-91	1	3.1	53.1	3990	1	3.1	78.1
-28427	1	3.1	6.3	-1595	1	3.1	31.3	-35	1	3.1	56.3	4324	1	3.1	81.3
-21171	1	3.1	9.4	-1006	1	3.1	34.4	-23	1	3.1	59.4	12841	1	3.1	84.4
-9329	1	3.1	12.5	-989	1	3.1	37.5	0	1	3.1	62.5	22021	1	3.1	87.5
-7175	1	3.1	15.6	-721	1	3.1	40.6	371	1	3.1	65.6	28052	1	3.1	90.6
-6181	1	3.1	18.8	-636	1	3.1	43.8	455	1	3.1	68.8	32815	1	3.1	93.8
-5535	1	3.1	21.9	-453	1	3.1	46.9	581	1	3.1	71.9	90228	1	3.1	96.9
-1957	1	3.1	25.0	-190	1	3.1	50.0	3024	1	3.1	75.0	135069	1	3.1	100.0

Tables 6-9. Distribution of Reduction of App Values btw Comparable and Shuttered Houses
(Positive Numbers mean Comp Reduction > Shut Reduction)

Univariate Procedure

Variable=PTVCS % Diff Btw Comp & Shut App Total Reduct

Moments

N	32	Sum Wgts	32
Mean	3.368638	Sum	107.7964
Std Dev	12.51529	Variance	156.6326
Skewness	2.263765	Kurtosis	5.773357
USS	5218.738	CSS	4855.611
CV	371.5239	Std Mean	2.212412
T:Mean=0	1.522608	Pr>|T|	0.1380
Num ^= 0	31	Num > 0	15
M(Sign)	-0.5	Pr>=|M|	1.0000
Sgn Rank	19	Pr>=|S|	0.7161
W:Normal	0.690958	Pr<W	0.0001

Quantiles(Def=5)

100% Max	49.52031	99%	49.52031
75% Q3	1.519655	95%	28.02639
50% Med	-0.01064	90%	26.20126
25% Q1	-1.41858	10%	-4.89787
0% Min	-15.0371	5%	-9.29721
		1%	-15.0371
Range	64.55746		
Q3-Q1	2.938234		
Mode	-15.0371		

Extremes

Lowest	ID	Highest	ID
-15.0371	(03)	9.439585	(10)
-9.29721	(37)	26.20126	(25)
-6.36999	(27)	27.77191	(04)
-4.89787	(41)	28.02639	(24)
-2.02256	(20)	49.52031	(12)

```
 Stem Leaf                     #  Boxplot
    5 0                        1     *
    4
    4
    3
    3
    2 688                      3     *
    2
    1
    1
    0 59                       2     0
    0 0000111122              10  +--+--+
   -0 222211100000            12  *-----*
   -0 965                      3     0
   -1
   -1 5                        1     *
      ----+----+----+----+
 Multiply Stem.Leaf by 10**+1
```

```
                    Normal Probability Plot
  52.5+
      |                                                  *
      |
      |
      |                                                   ++++
      |                                         * * * ++++
      |                                             ++++
  17.5+                                          ++++
      |                                      ++++
      |                                  ++++   * *
      |                              ++**********
      |                  ** ***********
      |              * *  ++++
      |               ++++
 -17.5+     *   ++++
       +----+----+----+----+----+----+----+----+----+----+
           -2        -1         0        +1        +2
```

Frequency Table

Value	Count	Percents Cell	Percents Cum	Value	Count	Percents Cell	Percents Cum	Value	Count	Percents Cell	Percents Cum	Value	Count	Percents Cell	Percents Cum
-15.0371	1	3.1	3.1	-1.05356	1	3.1	28.1	0	1	3.1	53.1	1.725357	1	3.1	78.1
-9.29721	1	3.1	6.3	-0.92113	1	3.1	31.3	0.035734	1	3.1	56.3	1.817532	1	3.1	81.3
-6.36999	1	3.1	9.4	-0.89423	1	3.1	34.4	0.189972	1	3.1	59.4	5.404911	1	3.1	84.4
-4.89787	1	3.1	12.5	-0.19792	1	3.1	37.5	0.256461	1	3.1	62.5	9.439585	1	3.1	87.5
-2.02256	1	3.1	15.6	-0.11123	1	3.1	40.6	0.533008	1	3.1	65.6	26.20126	1	3.1	90.6
-1.97353	1	3.1	18.8	-0.07343	1	3.1	43.8	0.783207	1	3.1	68.8	27.77191	1	3.1	93.8
-1.79413	1	3.1	21.9	-0.02539	1	3.1	46.9	1.251009	1	3.1	71.9	28.02639	1	3.1	96.9
-1.7836	1	3.1	25.0	-0.02129	1	3.1	50.0	1.313953	1	3.1	75.0	49.52031	1	3.1	100.0

Correlations of Wind with Reductions in Appraised Bldg, Total Values

GROUP=Shuttered

Correlation Analysis

1 'WITH' Variables: WIND
4 'VAR' Variables: BV23 PBV23 TV23 PTV23

Simple Statistics

Variable	N	Mean	Std Dev	Median	Minimum	Maximum	Label
WIND	32	129.934375	4.924698	131.000000	118.500000	136.000000	Wind Velocity
BV23	32	13000	26422	5511.000000	0	147763	$ App. Bldg Value Reduct from 1992-93
PBV23	32	12.410109	17.182350	6.901784	0	65.616075	% App. Bldg Value Reduct from 1992-93
TV23	32	10740	27604	4689.000000	-14810	147763	$ App. Total Value Reduct from 1992-93
PTV23	32	5.194438	10.838438	2.426962	-8.515067	44.206374	% App. Total Value Reduct from 1992-93

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0 / N = 32

	BV23	PBV23	TV23	PTV23
WIND Wind Velocity	0.35135 0.0486	0.48280 0.0051	0.39218 0.0264	0.50187 0.0034

Spearman Correlation Coefficients / Prob > |R| under Ho: Rho=0 / N = 32

	BV23	PBV23	TV23	PTV23
WIND Wind Velocity	0.52195 0.0022	0.54490 0.0013	0.59848 0.0003	0.64384 0.0001

Correlations of Wind with Reductions in Appraised Bldg, Total Values

GROUP=Comparable

Correlation Analysis

1 'WITH' Variables: WIND
4 'VAR' Variables: BV23 PBV23 TV23 PTV23

Simple Statistics

Variable	N	Mean	Std Dev	Median	Minimum	Maximum	Label
WIND	32	129.934375	4.924698	131.000000	118.500000	136.000000	Wind Velocity
BV23	32	17065	31748	6010.000000	-270.000000	139865	$ App. Bldg Value Reduct from 1992-93
PBV23	32	17.485085	26.949457	6.975869	-0.623542	98.998952	% App. Bldg Value Reduct from 1992-93
TV23	32	17160	35781	6010.000000	-15531	139865	$ App. Total Value Reduct from 1992-93
PTV23	32	8.563076	17.039585	2.996020	-14.447635	54.324582	% App. Total Value Reduct from 1992-93

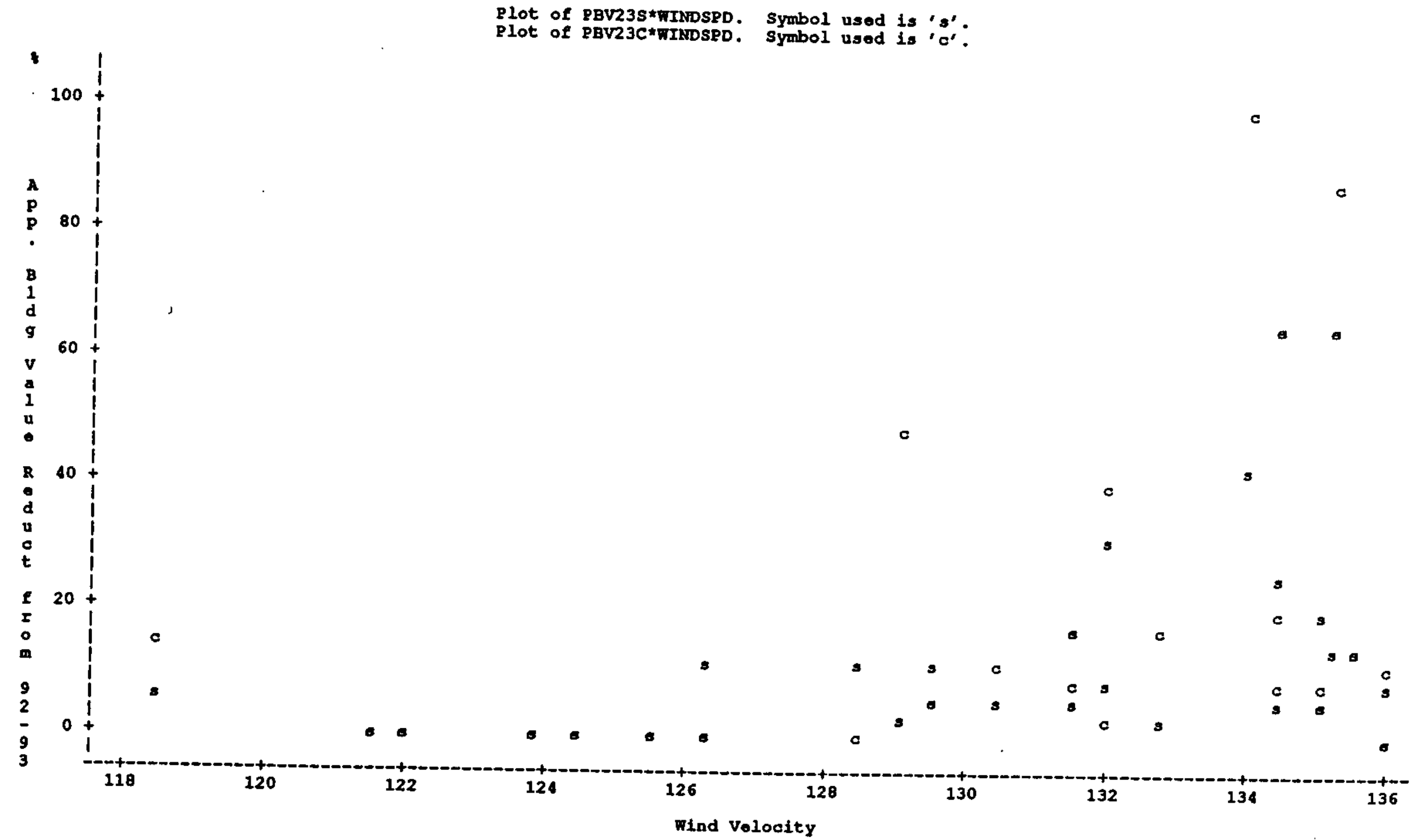
Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0 / N = 32

	BV23	PBV23	TV23	PTV23
WIND Wind Velocity	0.28107 0.1192	0.44554 0.0106	0.31254 0.0816	0.44101 0.0115

Spearman Correlation Coefficients / Prob > |R| under Ho: Rho=0 / N = 32

	BV23	PBV23	TV23	PTV23
WIND Wind Velocity	0.52043 0.0023	0.56707 0.0007	0.55110 0.0011	0.59425 0.0003

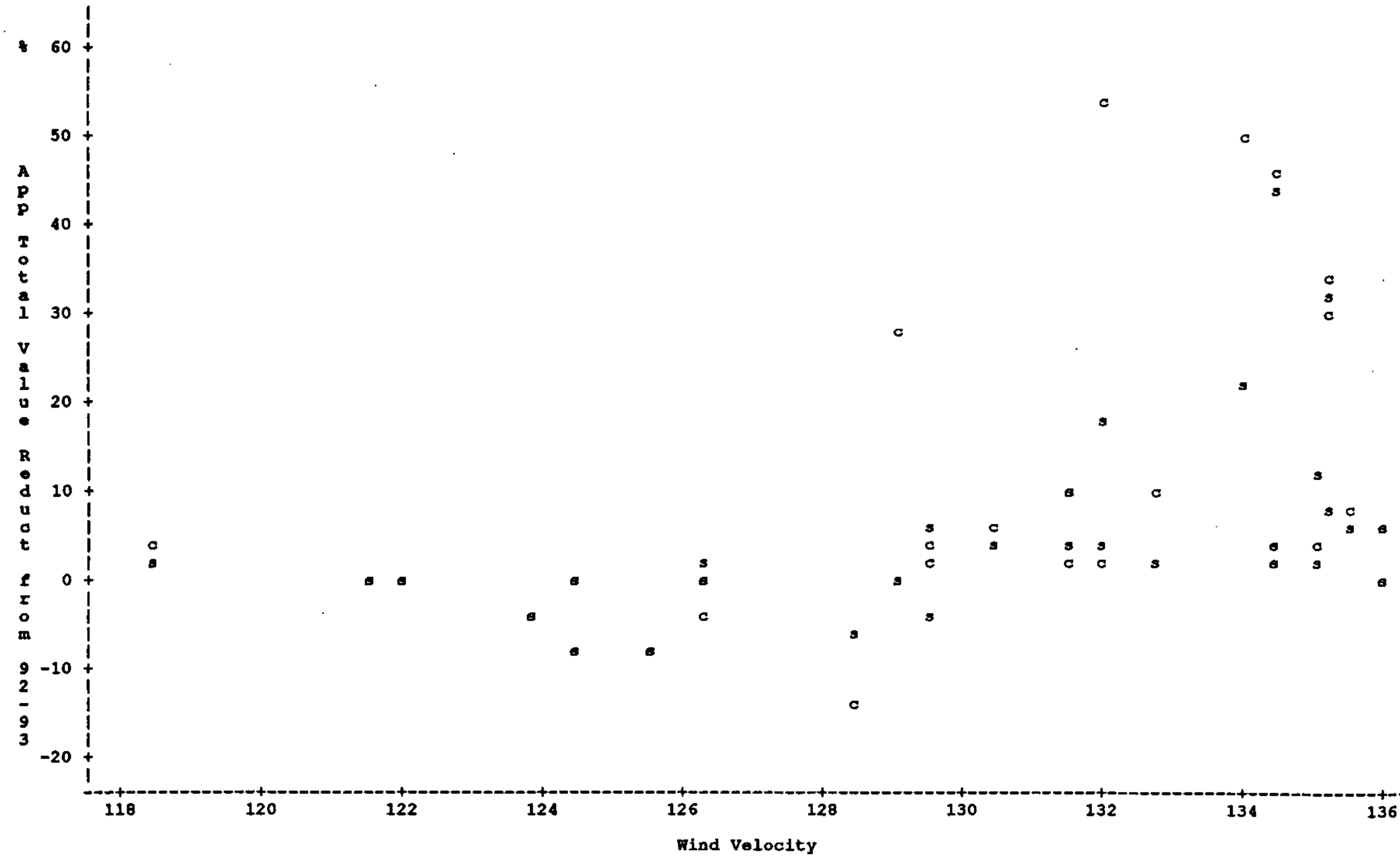
Reductions in App Bldg Values by wind speed for Shuttered (s) and Comparable(c)



NOTE: 8 obs hidden.

Reductions in App Total Values by wind speed for Shuttered (s) and Comparable(c)

Plot of PTV23S*WINDSPD. Symbol used is 's'.
Plot of PTV23C*WINDSPD. Symbol used is 'c'.



NOTE: 5 obs hidden.

Regression of Reduction in App Bldg Value $ on Wind Speed

GROUP=Shuttered

Model: MODEL1
Dependent Variable: BV23 $ App. Bldg Value Reduct from 1992-93

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	2671617127.3	2671617127.3	4.225	0.0486
Error	30	18970115242	632337174.72		
C Total	31	21641732369			

Root MSE	25146.31533	R-square	0.1234
Dep Mean	13000.18750	Adj R-sq	0.0942
C.V.	193.43040		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|	Variable Label
INTERCEP	1	-231935	119244.93452	-1.945	0.0612	Intercept
WIND	1	1885.066398	917.09410072	2.055	0.0486	Wind Velocity

Regression of Reduction in App Bldg Value $ on Wind Speed

GROUP=Comparable

Model: MODEL1
Dependent Variable: BV23 $ App. Bldg Value Reduct from 1992-93

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	2468548576.1	2468548576.1	2.573	0.1192
Error	30	28778190883	959273029.45		
C Total	31	31246739460			

Root MSE	30972.13311	R-square	0.0790
Dep Mean	17065.37500	Adj R-sq	0.0483
C.V.	181.49108		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|	Variable Label
INTERCEP	1	-218377	146871.21895	-1.487	0.1475	Intercept
WIND	1	1812.009129	1129.5635241	1.604	0.1192	Wind Velocity

Regression of Reduction in App Bldg Value % on Wind Speed

GROUP=Shuttered

Model: MODEL1
Dependent Variable: PBV23 % App. Bldg Value Reduct from 1992-93

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	2133.32696	2133.32696	9.118	0.0051
Error	30	7018.90040	233.96335		
C Total	31	9152.22736			

Root MSE	15.29586	R-square	0.2331
Dep Mean	12.41011	Adj R-sq	0.2075
C.V.	123.25323		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|	Variable Label
INTERCEP	1	-206.462954	72.53364373	-2.846	0.0079	Intercept
WIND	1	1.684489	0.55784488	3.020	0.0051	Wind Velocity

Regression of Reduction in App Bldg Value % on Wind Speed

GROUP=Comparable

Model: MODEL1
Dependent Variable: PBV23 % App. Bldg Value Reduct from 1992-93

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	4469.18320	4469.18320	7.430	0.0106
Error	30	18045.28696	601.50957		
C Total	31	22514.47016			

Root MSE	24.52569	R-square	0.1985
Dep Mean	17.48508	Adj R-sq	0.1718
C.V.	140.26636		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|	Variable Label
INTERCEP	1	-299.309452	116.30191111	-2.574	0.0153	Intercept
WIND	1	2.438112	0.89445977	2.726	0.0106	Wind Velocity

Regression of Reduction in App Total Value $ on Wind Speed

GROUP=Shuttered

Model: MODEL1
Dependent Variable: TV23 $ App. Total Value Reduct from 1992-93

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	3632987543.7	3632987543.7	5.453	0.0264
Error	30	19987686442	666256214.73		
C Total	31	23620673986			

Root MSE	25811.93938	R-square	0.1538
Dep Mean	10740.40625	Adj R-sq	0.1256
C.V.	240.32554		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|	Variable Label
INTERCEP	1	-274884	122401.35309	-2.246	0.0322	Intercept
WIND	1	2198.221732	941.36962117	2.335	0.0264	Wind Velocity

Regression of Reduction in App Total Value $ on Wind Speed

GROUP=Comparable

Model: MODEL1
Dependent Variable: TV23 $ App. Total Value Reduct from 1992-93

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	3876881375.5	3876881375.5	3.248	0.0816
Error	30	35811538232	1193717941.1		
C Total	31	39688419608			

Root MSE	34550.22346	R-square	0.0977
Dep Mean	17160.40625	Adj R-sq	0.0676
C.V.	201.33686		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|	Variable Label
INTERCEP	1	-277896	163838.68093	-1.696	0.1002	Intercept
WIND	1	2270.810005	1260.0576147	1.802	0.0816	Wind Velocity

Regression of Reduction in App Total Value % on Wind Speed

GROUP=Shuttered

Model: MODEL1
Dependent Variable: PTV23 % App. Total Value Reduct from 1992-93

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	1	917.22693	917.22693	10.100	0.0034
Error	30	2724.39701	90.81323		
C Total	31	3641.62395			

Root MSE	9.52960	R-square	0.2519
Dep Mean	5.19444	Adj R-sq	0.2269
C.V.	183.45773		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|	Variable Label
INTERCEP	1	-138.322118	45.18977226	-3.061	0.0046	Intercept
WIND	1	1.104531	0.34754746	3.178	0.0034	Wind Velocity