THE DISASTER GAP

Analyzing Distributional Equity in FEMA Individual Assistance Programshorizontal line



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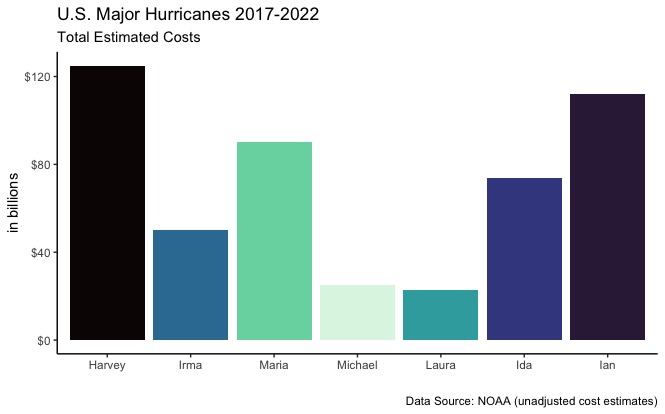
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# EXECUTIVE SUMMARY

Since 2017, the U.S. and its territories have experienced six major category 4 hurricanes and one category 5 hurricane. The National Oceanic Administration (NOAA) estimates the unadjusted costs of these events range from just under 24 billion dollars for losses experienced during Hurricane Laura to approximately 125 billion for losses caused by Hurricane Harvey.1

Over two decades of research on climate change and natural disasters finds that the burden of these storms are not being shared equally among survivors.2 Wealthy households, especially white wealthy households, often gain additional wealth after a disaster, while many underserved populations lose wealth, possibly ending up even worse off than they were before the storm hit.3 The observed disparities appear to be influenced by underlying societal inequities, which are often exacerbated by major disaster events.4

The Federal Emergency Management Agency (FEMA) is the federal agency tasked with overseeing the nation’s disaster response and recovery operations across states and territories affected by federally declared disasters.5 The agency administers several disaster assistance programs under its umbrella, including direct financial assistance to individuals and households.

Recent research indicates that current FEMA policies lack adequate measures to ensure procedural and distributional equity among disaster-impacted populations and that, as a result of these failures, the agency is directly contributing to the exacerbation of existing racial and economic disparities between disaster survivors.6 FEMA has responded to these findings by making equity a central focus of its 2022-2026 strategic plan with a goal to *“Instill equity as a foundation of emergency management”*.7 Under the strategic plan, the agency’s focus is to develop an agency culture that reflects the diversity of the communities it serves, remove program barriers for underserved populations, and to achieve equitable outcomes between communities.8

This analysis draws from the strategic plan and examines FEMA’s current policies in conjunction with applicant and recipient data from the agency’s Individuals Housing and Assistance Program (IHP). The findings are contrasted with a spatial analysis using demographic data from the U.S. Census to answer the following questions:

* Are FEMA IHP funds being distributed equitably between disaster-impacted households?
* Do eligibility and funding decisions correspond with sociodemographic patterns?

|  |
| --- |
| KEY FINDINGS |
| There is significant variability between storms when comparing the percentage of households eligible for housing assistance and other needs assistance. |
| Overall, less than 50 percent of referrals for housing assistance end up being eligible |
| Hurricane Ida Survivors received more approvals for housing and other needs assistance than any other storm, suggesting recent policy changes may have had an impact. |

* What are the alternative policy solutions to ensure FEMA can deliver on its commitment to improve equity between IHP applicants and recipients?

Suggested recommendations include, increasing resources directed toward program access and continued exploration of alternative methods and procedures, including the development of an index-based evaluative measure to improve distributional equity among disaster survivors.

# THE DISASTER GAP

The rapid increase in catastrophic weather events resulting from climate change worsens existing vulnerabilities between populations with communities and underserved populations bearing much of the burden of these events. A recent analysis of factors related to displacement caused by environmental disasters finds that disaster-caused displacement disproportionately impacts marginalized communities, with households in those communities often being displaced in areas further away and for longer periods of time households in wealthier communities.9 The long-term financial consequences of disasters follow the same pattern. A report from the Urban Institute found that households in disaster-impacted communities often experience increased debt ratios and decreased credit scores long after the disaster occurs.10 These patterns were particularly pronounced for underserved neighborhoods. Communities of color, for example, experienced an average credit score drop of 31 points, compared to an average drop of only 4-points in majority white communities.

The examples above add to existing evidence regarding the existence of significant gaps in disaster response patterns. These “Disaster Gaps”, have long-term, even generational, consequences, including the reinforcement of structural racism and limitation of social mobility. Many researchers have attributed the deepening of social inequities after disaster to governmental decisions. This paper utilizes a distributional equity lens to analyze gaps between disaster-impacted communities, specifically relating to FEMA disaster assistance funding. In the policy context, equity is generally defined as relating to justice and impartiality.11 The definition of distributional equity in this report concerns the equal allocation of resources among disaster-impacted communities. 12

## the u.s. Disaster assistance framework

In April of 1979, President Carter signed Executive Order 12127 establishing the Federal Emergency Management Agency (FEMA), as the federal agency tasked with coordinating emergency response efforts across federal and state agencies.13 In 1988, The Robert T. Stafford Disaster Relief and Emergency Assistance Act (The Stafford Act) further defined FEMA’s role and authority.14 Specifically, the act authorizes the President to provide Federal support to state, local, tribal and territorial governments (SLTT) who do not have the capacity to carry out response and recovery efforts.

FEMA administers three major categories of financial assistance under the Stafford Act: Public Assistance (PA), Individual Assistance (IA), and the Hazard Mitigation Grant Program (HMGP). PA assists states and private non-profits in responding to and recovering from declared disasters. IA provides both direct and indirect assistance to individual households recovering from disaster, and the HMGP provides funding for community mitigation projects.

FEMA’s Individual and Households Program Assistance (IHP) is one of seven different IA programs. IHP assistance is directly available to uninsured or underinsured households and consists of Housing Assistance (HA) and Other Needs Assistance (ONA).15 HA is comprised of direct housing assistance, as well as funding for repairs or replacement of damaged property. Examples of ONA include; funeral assistance, child care, vehicle repair, moving and storage expenses. Disaster survivors must apply for IHP within 90 days of a disaster event and assistance is generally limited to 18 months post-disaster.

## Major Policy Developments

### The Homeland Security Act of 2002

### The Homeland Security Act of 2002 placed FEMA and its budgeting authority under the newly established U.S. Department of Homeland Security (DHS).16 The consolidation of FEMA under the DHS was intended to streamline disaster response efforts. However, it also allowed additional pathways to increase domestic security spending levels without necessarily needing to increase agency budgets, leaving FEMA’s portion of the DHS budget vulnerable to transfers or “reprogramming” for competing priorities.17 During the Trump administration, DHS was criticized for using its authority to reprogram funds from the Disaster Relief Fund (DRF) toward other purposes on multiple occasions, including a transfer of 155 million dollars to Immigration and Customs Enforcement (ICE) for increased border security measures at the beginning of the 2019 hurricane season.18

### Post-Katrina Emergency Management Reform Act of 2006

The images of the 9th ward taken after Hurricane Katrina slammed into the city of New Orleans in 2005 are a haunting reminder of the massive governmental failures that resulted in more than 1,500 unnecessary deaths and a shattered city that is still recovering 18 years later.19 In May of 2006, The Committee on Homeland Security and Governmental Affairs released a scathing report blaming all levels of government for the inadequate response efforts. The report was followed by the Post-Katrina Emergency Management Reform Act, signed into law by President Bush in October of 2006.20 The act significantly expanded FEMA’s authority over U.S. disaster planning and response operations. Other provisions of the act included mandates to improve evacuation planning strategies and increased attention to the needs of individuals with disabilities. It also included the development of a National Emergency Communications Plan and put in place requirements for states to develop catastrophic planning measures.

### Sandy Recovery Improvement Act of 2013

The Sandy Recovery Improvement Act of 2013 (SRIA), signed by President Obama, contained significant enhancements to disaster funding and reporting requirements, including strategies to reduce disaster costs and improvements to the Individual Assistance program.21 Under the act, FEMA established alternative procedures for PA applicants to allow for greater flexibility and less administrative burden, including cost-sharing adjustments for debris removal, a nationwide dispute resolution process, and a memorandum of agreement between FEMA and the Federal Transit Administration (FTA) for public infrastructure repair and restoration projects. Improvements to IHP include the allowance of ONA funds for childcare expenses and more objective criteria for evaluating community needs. The SRIA also requires FEMA to compile a monthly report to Congress regarding the status of the DRF account.

### The Disaster Recovery Reform Act of 2018

The Disaster Recovery Reform Act of 2018 (DRRA) focused primarily on expanding funding for pre-disaster mitigation and recovery projects and streamlining interagency operations.22 DRRA Strategic goals include incentivizing investments to reduce risk, including the adoption and enforcement of building codes, reducing agency complexities, and strengthening the grant management process. The DRRA created separate caps for HA and ONA, allowing households to receive up to $34,900 for each, rather than a single cap of $33,300 for both. It also allows survivors to rent alternative housing without being subject to the cap. The previous limit left many survivors without enough funds to pay for rental assistance while waiting for habitability repairs to be finished.

### Executive Orders 13985 and 14091

Executive order 13985, Advancing Racial Equity and Support for Underserved Communities through the Federal Government, was signed by President Biden in 2021.23 The order directs federal agencies to review programs and implement policy changes to improve equity wherever necessary. In 2023, the Biden administration issued a second executive order to reinforce its commitment to equity across the federal government. Executive order 14091, Further Advancing Racial Equity and support for Underserved Communities through the Federal Government expands on the previous order by offering additional guidance for embedding equity into federal agency frameworks.24

## current policy environment

FEMA’s current procedures have been found to create additional disaster risk through a flawed organizational decision-making process.25 The inequities in FEMA assistance are due to a combination of factors, including a lack of engagement with vulnerable communities and survivors during and after a disaster, inequitable geographic responses, prioritization of mitigation projects in wealthier communities, and the agency’s bureaucratic processes which disproportionately impact survivors, often along racial lines.

A 2020 National Advisory Council report to FEMA’s administrator acknowledged these issues and pointed out several areas for improvement.In its report, the council recognized that wealthier households with more time and income have an easier time accessing its financial assistance programs than underserved households. It also acknowledged the agency’s focus on property ownership focuses on wealthier communities and disadvantages renters and the homeless. Proposed changes included a call for the National Flood Insurance Program (NFIP) to address the affordability of flood insurance policies and for more resources to be directed toward underserved and rural communities who do not have the resources to meet current PA requirements.25

FEMA has already started taking steps to address criticisms of the agency by introducing several specific initiatives to improve equity in its policies and procedures. The agency responded to both executive orders and the recommendations of its own council by making equity the centerpiece of its 2022-2026 Strategic Plan.26 FEMA plans to improve equity across its programs through policies directing more resources to reduce disparities between communities recovering from disaster, making greater investments in underserved and rural communities, and reducing barriers to assistance for individual disaster survivors and households.

FEMA’s updated 2021 Individual Assistance Program and Policy Guide (IAPPG) includes several policy changes that align with its commitment to equity, including relaxing documentation requirements to prove ownership and occupancy.27 Other recent changes include incorporating social vulnerability into damage assessment calculation and requiring states to provide 40 percent of the benefits of mitigation funds to underserved areas. FEMA claims these changes have allowed them to approve several thousand more applicants since 2021. Whether those changes are enough to achieve equitable outcomes remains to be seen. A review of the literature below provides a more comprehensive view of the scope of the problem.

## agency challenges and outlook

FEMA operates on a base budget of 2 billion dollars in addition to the DRF. The agency does not budget for future events and relies on authorization and appropriation funds from Congress.28

The DRF is administered under the Stafford Act and is authorized for the following activities:

* Repair, replacement, and improvements to the resiliency of damaged infrastructure
* Debris removal
* Critical Services
* Costs for home repairs, property replacement and other needs for affected households
* Implementation of projects designed to mitigate the impact of future disasters

In April 2023, FEMA administrator, Deanne Criswell, testified to the House Appropriations Subcommittee on Homeland Security regarding FEMA’s 2024 budget request.29 During her testimony Administrator Criswell noted the agency had provided more than 3.2 billion direct assistance to survivors and 30 billion to support rebuilding and repair of community infrastructure following disasters. The agency requested a total of 30.2 billion dollars for 2024, including 18.3 million toward community-level equity measures. Funding requests included:

* Modernizing flood insurance flood insurance products and 6.9 million to hire additional personnel and increase outreach efforts
* 1.1 million for mitigation grant outreach to underserved communities
* 1 billion for the Building Resilient Infrastructure Communities (BRIC) grant program
* Over 88 million for DHS border security measures and payments to non-profits and local entities who provide shelter and services to noncitizens released from DHS custody.

The COVID-19 pandemic and multiple fund transfers from FEMA to other DHS agencies over the last 6 years rapidly depleted the agency’s funding. Without congressional support, the agency is expected to run out of funds by the end of August and run into a deficit of over 4 billion dollars by the end of September.30

# WEALTH, POWER AND RACISM

## REVIEW OF THE LITERATURE

Existing research confirms that inequitable policies and governmental procedures exacerbate existing racial, social, and economic inequities between disaster-impacted communities. Three key themes are prevalent throughout the literature: the influence of politics and power differentials in disaster funding and resource allocation, the exacerbation of existing economic and racial inequities, and the long-term impact of disaster-caused inequities on communities and individual survivors.

### Wealth

Wealth, often a marker of the distribution of power in a society, is a substantial factor in disaster-related inequities. A spatio-temporal analysis to observe post-disaster mobility of Hurricane Irma survivors found considerable differences in evacuation decisions and the extent of property damage between poor and wealthy disaster survivors. 31The analysis used census data in conjunction with location data from survivors’ mobile phones and discovered that those living in higher-income areas evacuated at a higher rate and sooner than those living in low-income areas. Higher-income individuals also evacuated further away and to safer places than low-income individuals. In addition, housing and infrastructure in wealthier areas sustained less damage than in poor areas. According to the researchers, these patterns indicate a need for officials to ensure mass evacuations and consider the differences in need between survivors of different income strata.

The results of a county-level analysis of FEMA buyout programs across disaster-impacted communities concluded significant disparities between urban areas with excess resources receiving a greater share of buyouts than rural areas with fewer resources.32 An analysis of the data at the individual level found that minorities in those urban areas were less likely to receive federal aid than their white peers. These disparities were especially prevalent for Black survivors with results that remained consistent even after accounting for geographic, socioeconomic, and demographic features between counties.

An analysis of FEMA’s Hazard Mitigation Grant Program (HMGP), intended to provide communities with funding for projects to reduce future damage risks, revealed the presence of rural-urban inequities in allocating funds for construction and rehabilitation projects following major disaster events.33 According to the authors, recipients in urban areas received much higher amounts of HMGP funds when compared to recipients in rural areas. These findings were consistent even after accounting for differences between social and climate factors between communities

Survey data from a study regarding the emotional impact of Hurricane Harvey on survivors showed a relationship between disaster exposure and increased Post-Traumatic Stress Symptoms (PTSS) and depression.34 Although the study acknowledged that all disaster survivors who experience trauma are susceptible to subsequent mental health symptoms, the authors concluded that survivors with fewer psychosocial resources available were especially vulnerable to the lasting mental health effects of a disaster. The ongoing impact of unhealed trauma affect all aspects of one’s life, including diminished earning capacity and increased financial instability.35

### Power

When researchers explored the role of power relationships in post-disaster recovery efforts among survivors of Hurricane Katrina in Mississippi, their analysis showed that, despite disaster-caused disruptions to the social hierarchy, power dynamics significantly influenced post-disaster recovery for disadvantaged populations and the front-line workers serving them.36 The authors specifically cited the influence of power relationships on communication levels, resource distribution decisions, and capacity levels. The results of which reinforce social inequality and increase stress and burnout among the front-line workers seeking to help disadvantaged populations recover from a major disaster.

A 2013 white paper by researchers with the Superstorm Research Lab also explored the influence of power dynamics in disaster policy and procedures by examining response efforts after Hurricane Sandy.37 The authors noted a prioritization of the needs of more powerful stakeholders, such as the New York City Government, elite institutions, and large organizations, over the needs of less powerful and more vulnerable small businesses, community-based groups, and citizens. Such decisions exacerbated poverty, increased unemployment levels, and reduced affordable housing availability in low-income areas.

Hurricane Maria is, perhaps, one of the most significant examples of the connection between political power and disaster response efforts. When researchers analyzed congressional appropriation records in conjunction with FEMA procurement data, they found significant differences between the timeliness of initial responses to Hurricanes Harvey, Irma, and Maria.38 Even after accounting for differences in storm severity, federal efforts began sooner and were more robust for Hurricanes Harvey and Irma than Hurricane Maria in Puerto Rico. The overall findings revealed that Hurricane Harvey and Irma survivors received over 100 million dollars in federal aid within nine days contrasting with Hurricane Maria survivors who only received 6 million. In addition, spending in Texas and Florida exceeded 1 billion dollars, approximately two months after landfall, while it took four months for Puerto Rico to receive the same amount. Mortality data collected from the National Oceanic and Atmospheric administration (NOAA) and vital statistics records confirmed that such governmental decisions resulted in significant consequences to public health and increased mortality rates.39

### Race

There is consistent evidence of racial inequities in disaster response and recovery efforts throughout the literature. It is often the largest influence and independent of other factors. The placement of Black neighborhoods in high-risk areas is just one of the long-term consequences of the post-civil war reconstruction era. Decades of U.S. housing policies, including redlining and neighborhood segregation tactics including strategic placement of freeway systems in northern cities to the floodplains in the south leave Black households more vulnerable to environmental hazards and natural disasters than white households by design.40 Such realities are reflected in multiple geographic analyses, including a study of flood-plain area populations in the southern United States, which found that Black households are disproportionately located in high-risk, flood-prone areas compared to white households.41

However, housing policies are not the only culprit when it comes to the presence of disparities between disaster survivors. FEMA’s own data has consistently demonstrated the problematic history of the agency’s practices. Researchers analyzing FEMA IHP recipient data on a county level between 2010-2018 found significant differences in the total assistance, housing repair and replacement, and other needs assistance spending among disaster-impacted populations.42 Race being the most significant negative influence on recovery funding compared to all other factors.

In 2017, Researchers at Rice University and the University of Pittsburgh published a longitudinal study that used a population-centered approach linking property damage to income.43 The results of the study implicate the influence of race and other social factors on post-disaster financial and housing instability. These disparities were especially pronounced for Latino men compared to white men and Black and Latina women, with Black women experiencing the greatest burden. The overall findings indicated that Minority households experience more housing instability than white households of similar characteristics.

Race is also a significant factor in post-disaster health and mortality. A time-series analysis of patient hospital records to examine the impact of cardiovascular disease (CVD) before, during, and after Hurricane Katrina looked at 383,552 hospitalization records of patients over 65 living in the three most populated parishes hit by the storm.44 The analysis indicated that disparities between white and Black patients peaked approximately one week after the hurricane made landfall with many developing chronic health conditions. The conclusion posits that the psychosocial impact of the storm, including the inadequate response and unequal resource allocation during its aftermath, significantly impacted Black elderly patients at much higher rates than elderly white patients.

# ANALYSIS

## Research Design

The research design incorporates an exploratory analysis of secondary data collected from FEMA and the ACS. Both datasets are publicly available from OpenFEMA and the U.S. Census website. The purpose behind the use of separate data sources is to explore the relationships between FEMA Individual Housing and Other Needs Assistance programs according to racial, economic, political, and community contexts. Each data set was analyzed separately and collectively to look for sociodemographic and geographic trends regarding FEMA’s Individual and Housing Assistance Program eligibility.

## Objective

### The intent of the analysis is to examine trends between FEMA housing and other needs assistance program according to the sociodemographic features of disaster-impacted communities. The results are expected to provide further insight into possible paths to improve procedural and distributional equity among disaster survivors.

The analysis specifically aims to discover patterns of racial and economic inequities in FEMA Individual Assistance program decisions among disaster-affected areas and populations.

* Is federal disaster assistance being directed toward households and communities most in need of funding?
* Is there a more equitable way to distribute FEMA aid among impacted households and communities?

## Hypothesis

The null hypothesis holds that FEMA assistance is equitable between survivors and communities without any identifiable racial, economic or political patterns. The alternative hypothesis holds that a relationship does exist between FEMA assistance and the racial, economic and geographic patterns of a disaster-impacted area.

## METHODOLOGY

### Study Population

The sample population for the statistical analysis included households registered for FEMA IHP assistance for Hurricanes Harvey, Irma, Michael, Laura, Ida and Ian.[[1]](#footnote-1) All of which made landfall at a category 4, with the exception of Hurricane Michael which made landfall at a category 5. Prior to analysis, the NOAA storm profiles for each storm were consulted to look at the communities where each storm made the biggest impact.

The statistical analysis looked at two population groupings. The first group included all households located in counties and parishes approved for assistance by in presidential declarations. The second group was more limited, including registrants’ living in communities that experienced category four windspeeds.

The spatial analysis included both populations, in addition to a separate analysis of larger urban populations. This allowed for a better view of eligibility and funding differences between racial and economic groups, without rural confounders. The table below displays intake registrations aggregated by ZCTA for each storm. Due to the wide variation in population sizes, the analysis used percentages and weights for comparison rather than raw numbers.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Total Registrations | | | | | | |
| *Storm* | *Min* | *Q1* | *Median* | *Mean* | *Q3* | *Max* |
| Harvey | 95 | 253 | 733 | 2,269 | 2,702 | 11,365 |
| Ian | 266 | 3,948 | 6,053 | 7,779 | 11,560 | 22,091 |
| Ida | 44 | 922 | 1,793 | 3,722 | 3,422 | 16,690 |
| Irma | 322 | 1,593 | 3,156 | 4,685 | 5,500 | 18,514 |
| Laura | 171 | 682 | 3,541 | 5,620 | 7,794 | 20,747 |
| Michael | 53 | 1,401 | 2,470 | 4,765 | 7,973 | 14,836 |

### 

### Data

### The analysis used two FEMA data sets, the Registration Intake and Individuals Household Program (RI-IHP) dataset and the Individual Assistance Registrant – Large Disaster dataset. The Registration intake dataset contains aggregated, unedited intake data from declared disasters. The registrant dataset, contains non-aggregated applicant data from FEMA’s Individual and Households Program (IHP), including the results of preliminary property damage assessments and temporary shelter, rental, repair or replacement assistance, as well as non-housing assistance to address other disaster-related needs. The dataset includes over 6 million claims from a select number of large disasters. The registrant data set had not yet been updated to include registrations from Hurricane Ian at the time of the analysis, so it was not included.

Several ACS datasets provided demographic information on the communities impacted by each storm. The ACS is an ongoing yearly survey administered by the U.S. Census to over 3 million households across the U.S. and includes thousands of variables with a 90 percent confidence level. Several ACS tables, using 2021 five-year estimate data, provided the population characteristics for each storm for comparison.

### Variables

The variables in the registration intake dataset represented eligibility status and funding amounts for housing assistance and other needs assistance applicants under FEMA’s Individuals and Housing Program (IHP). The FEMA large disaster registrant dataset variables of interest included home ownership status, self-reported gross income, insurance status, damage statistics in addition to approvals for temporary shelter assistance (TSA) and more specific information regarding assistance types, including rental assistance, funding for habitability repairs, including replacement of property. ACS variables included data related to household occupancy and home ownership, race, income, employment, education, poverty, and the GINI Index of Inequality.

### Data preparation

The initial data cleaning process was performed in Excel. Records that included missing or incorrect zip codes were removed prior to the analysis. The U.S. Census reports demographic and housing information by Zip Code Tabulation Areas (ZCTAs), instead of U.S. postal service codes (ZIPs). As a result, zip codes from the FEMA dataset had to be matched to census ZCTAs. This process was completed using the Uniform Data System Mapper (UDS Mapper) zip code to ZCTA crosswalk. Any unpopulated ZCTAs were scrubbed from the analysis. The data was then geocoded for the mapping analysis in Posit software using the statistical package, tinygeocoder. The ACS data was obtained through the Census API using the tidycensus package, also available in Posit. The statistical testing and mapping methods also required the installation of additional packages prior to data analysis, which are notated in the results.

### Statistical Approach

The analytical approach included the collection of several descriptive statistics and cross tabulations between variables. Several Kruskal-Wallis Sum Ranking tests measured the variability in assistance between and within storms. These tests were followed by several regressions to measure relationships between variables. Predictors included, the method of registration, self-reported gross income, home ownership and insurance status, in addition to geographic details. Outcome variables included assistance types, eligibility and funding amounts. Relationships were analyzed using a combination of OLS and Quantile regression models. Quantile regression was performed in conjunction with standard linear regression due to highly heteroskedastic data. The FEMA analysis was followed by a descriptive analysis of ACS demographic data for each disaster impacted area. The results of both analyses were combined with spatial data to compare geographic patterns of each storm.

# SUMMARY OF FINDINGS

Below is a brief discussion regarding some of the more prominent findings. Figures illustrating various findings related to FEMA’s IHP program eligibility and assistance decisions are located at the end of the section.

Several Kruskal-Wallis tests found significant variabilities in eligibility decisions at multiple levels of analysis. Such variabilities are somewhat expected, due to the unique path and strength of each storm. However, some of these variabilities persisted even after limiting the sample to communities that experienced category IV winds only. The results indicate an expected finding that HA eligibility decisions are less variable closer to landfall locations, while the variability between ONA eligibility decisions remains significant between all storms, regardless of proximity to landfall. The P-values from all tests were significant at < 0.05, with the accompanying partial epsilon squared figures indicating large effect sizes. The results of the Dunn-Pairwise analysis are noted by brackets above any significant relationships identified, along with Holm corrections. Figures 2 and 3 display variability in HA and ONA eligibility for all applicants, while Figures 4 and 5 display variability regarding applicants living in communities impacted by category IV windspeeds only.

Unfortunately, the quality of the data limited the extent of the analysis. no significant relationships were found between wealth and home ownership and receipt of FEMA assistance or amounts. However, given that these results are in opposition to the established research, it is likely due to poor methodology or the data quality.

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## spatial pattern analysis

Several demographic characteristics of communities were analyzed through spatial pattern analysis. One of the more interesting analyses included computing segregation indexes for the more populated areas impacted by each storm.

### Segregation

Social scientists often measure segregation by computing the Dissimilarity Index for a particular area. The index is expressed by the equation:

where A represents the entire population of study, represents a particular group in a given unit, while B and represent the same for the second group being studied. An index score of “0” represents total integration while a score of “1” represents total segregation.

This report included a calculation of the index scores for several storm-impacted urban areas to better understand racial dynamics. Dissimilarity scores were calculated for White, Black, and Hispanic/Latino households. The Mutual Information Index and Theil’s Entropy Index were also calculated to measure combined differences between multiple races. The maps of each urban area display the local multi-group segregation index found within the community and are followed by a summary of additional sociodemographic information gathered from each community.

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# CLOSING THE GAP

## LIMITATIONS

The analysis has several limitations. The first of which is a reliance on unofficial public data, which introduces a larger margin of error. In addition, the majority of data is self-reported, making it difficult to determine the accuracy of results. The data cleaning process uncovered a significant issue regarding incorrect or missing zip codes in both of the FEMA datasets. Both datasets also included eligibility and claims information for counties and states that were not approved by the presidential declaration for disaster number. There were also several applications submitted with PO BOX or large volume zip codes that matched to ZCTAs reporting 0 populations. Large volume zip codes are usually reserved for businesses and other large volume shippers. Some of these records may have included eligible applicants.

Likewise, the reliance on aggregated ACS data for demographic and housing characteristics only allows for a general comparison at the community level and does not represent differences between individual applicants. FEMA does not provide address level data so there is no way to verify if the household matches the demographic profile for the ZCTA.

Other concerns include external influences on referral and eligibility decisions, including decisions at the local level outside of FEMA’s authority. Finally, the severity of the storm and the vulnerability of the structures in its path differ between communities and geographic features. The analysis compensates somewhat for this weakness by limiting each sample to counties and ZCTA’s impacted during the initial category of the storm when it made landfall. However, these limitations should be weighed heavily when drawing conclusions.

One challenge that appeared early in the analysis was the lack of economic and racial diversity in the areas where storms made landfall. Although the storms passed over at least one large urban area during their course, landfall locations were near smaller cities that represented little economic and racial diversity, making it difficult to compare different racial and economic groupings. The analysis had to be modified to accommodate for these factors, which meant moving away from the most severely impacted areas to areas further away not as impacted.

## FUTURE RESEARCH

Future research should continue to focus on the long-term economic impacts to vulnerable survivors and communities. Longitudinal studies regarding health and well-being of survivors have the potential to provide valuable insight into the immediate and long-term effects of a disaster.

Continued research regarding alternative approaches to decision-making and funding formulas is also necessary. Disaster researchers have long advocated for FEMA to implement alternative funding mechanisms that focus more on social vulnerability and resilience than property value. Several frameworks have been proposed that take into account various vulnerability and resilience factors. One of the more recent models that have been proposed is known as the Societally-Informed Optimization of Resource Distributions (SIORD) model.45

The SIORD model is meant to function as an alternative framework for disaster resource distribution. Among the potential metrics of the framework are measures to assess opportunity loss, resource inaccessibility, social capital, and household disruption. The framework’s six steps include the type and intensity of hazard, societal damage indicators, and community factors, followed by resource distribution decisions and optimization. Although the framework has not been amalgamated into real-world practices, proponents see the design as a rigorous alternative to the current framework, primarily focusing on wealth.

Social vulnerability and other index-based models are not perfect, however. They can be just as challenging to implement equitably across different population segments. For example, a comparison of the Social Vulnerability Index (SoVI) developed by researchers at the University of South Carolina and the Global Delta Risk Index (GDRI) on the census tract level, showed significant inconsistencies when used to measure social and environmental vulnerability factors along the Mississippi delta area.46 These results demonstrate rigorous methodological evaluations between vulnerability-based indexes should be completed prior to implementation of such models.

# POLICY RECOMMENDATIONS

Although FEMA is attempting to address the disparities in its current policies, the evidence indicates small-scale policy changes are insufficient to improve racial and economic equity. In order to deliver on its commitment to equity, FEMA should continue to progress toward implementing feasible alternatives to current policies, including the options detailed below. Such policy changes must be strong enough to protect vulnerable communities and individuals against unequal resource distribution

**1. Improve Data Collection**

FEMA should implement more comprehensive data collection methods, including voluntary collection of sociodemographic characteristics. The additional data would allow for better analysis of individual and community characteristics. Moreover, the data would hold the agency more accountable for racial and economic disparities.

Alternatively, FEMA could align its current geographic measurement levels with U.S. Census geographies rather than limiting geographic information to the zip code level. Many of the zip codes in the FEMA datasets used in this analysis were assigned to PO Boxes, limiting the ability to confirm the jurisdiction of the damaged property or to conduct a spatial analysis.

**2. Continue to Explore Index-Based Measures**

Currently, FEMA makes the majority of its decisions based on property value and county level information. However, data at this level can mask the true community picture, depending on the overall wealth of the county. If the agency continues to focus on property value and county level data as its primary evaluation method, it risks basing decisions on data that does not account for income disparities between communities. The agency should continue to explore index-based measures as an alternative to property value.

**3. Improve Program Accessibility**

FEMA should continue to pay attention to the circumstances of each geographic area and ensure locations are placed in areas that are easily accessible to vulnerable populations, including disabled, elderly, and low-income households that may not have the technology or transportation to travel to an intake office or temporary shelter location. The agency should consider providing transportation or implementing transportation-free methods more available for survivors with transportation and mobility issues. FEMA should also ensure it is accessible to households that are unable to communicate during traditional working hours. Low-income survivors often do not have the luxury of taking time off work, which can prevent them from successfully navigating the system and meeting requirements.

The agency should also examine the burden its current time limitations might place on survivors, especially those experiencing extraordinary circumstances. FEMA may also benefit from allowing survivors additional time to wait for insurance company decisions. FEMA’s current timeline of 90 days encourages unqualified survivors to apply for assistance while waiting for private insurance claims to be paid “just in case” they need assistance later. Allowing these households additional time to wait for private claims to go through would reduce submissions of ineligible applications.

**4. Improve oversight**

FEMA has been investigated by the OIG several times for neglecting to oversee its contractors. Several of these oversight failures have result in millions of dollars of overpayments that can be difficult to recover. FEMA should weigh the cost of additional staffing against these losses and determine if increasing its oversight would be more cost-effective.

FEMA should also consider working with other agencies at the federal and state levels to hold NFIP partners and other private insurance companies accountable to policy holders. A more stringent regulatory framework would discourage insurers from denying valid claims, which ultimately places the burden on FEMA and, by extension, tax payers to reimburse survivors who invested in private insurance coverage.

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# APPENDICES

## Appendix A: FEMA Intake registrationS

Detailed Tables

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Total Registrations | | | | | | |
| *Storm* | *Min* | *Q1* | *Median* | *Mean* | *Q3* | *Max* |
| Harvey | 95 | 253 | 733 | 2,269 | 2,702 | 11,365 |
| Ian | 266 | 3,948 | 6,053 | 7,779 | 11,560 | 22,091 |
| Ida | 44 | 922 | 1,793 | 3,722 | 3,422 | 16,690 |
| Irma | 322 | 1,593 | 3,156 | 4,685 | 5,500 | 18,514 |
| Laura | 171 | 682 | 3,541 | 5,620 | 7,794 | 20,747 |
| Michael | 53 | 1,401 | 2,470 | 4,765 | 7,973 | 14,836 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Web Registrations (%) | | | | | | |
| *Storm* | *Min* | *Q1* | *Median* | *Mean* | *Q3* | *Max* |
| Harvey | 0.36 | 0.40 | 0.43 | 0.45 | 0.49 | 0.58 |
| Ian | 0.30 | 0.42 | 0.44 | 0.47 | 0.53 | 0.75 |
| Ida | 0.21 | 0.25 | 0.28 | 0.29 | 0.32 | 0.38 |
| Irma | 0.22 | 0.57 | 0.63 | 0.62 | 0.65 | 0.75 |
| Laura | 0.23 | 0.28 | 0.30 | 0.32 | 0.37 | 0.42 |
| Michael | 0.19 | 0.23 | 0.27 | 0.30 | 0.38 | 0.47 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Call Center Registrations (%) | | | | | | |
| *Storm* | *Min* | *Q1* | *Median* | *Mean* | *Q3* | *Max* |
| Harvey | 0.12 | 0.19 | 0.20 | 0.20 | 0.23 | 0.26 |
| Ian | 0.08 | 0.11 | 0.16 | 0.18 | 0.22 | 0.59 |
| Ida | 0.12 | 0.25 | 0.31 | 0.31 | 0.39 | 0.51 |
| Irma | 0.08 | 0.09 | 0.12 | 0.12 | 0.14 | 0.16 |
| Laura | 0.12 | 0.17 | 0.19 | 0.19 | 0.21 | 0.24 |
| Michael | 0.18 | 0.32 | 0.46 | 0.42 | 0.51 | 0.55 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Mobile Registrations (%) | | | | | | |
| *Storm* | *Min* | *Q1* | *Median* | *Mean* | *Q3* | *Max* |
| Harvey | 0.20 | 0.25 | 0.37 | 0.35 | 0.40 | 0.51 |
| Ian | 0.10 | 0.28 | 0.35 | 0.34 | 0.41 | 0.53 |
| Ida | 0.28 | 0.36 | 0.39 | 0.40 | 0.43 | 0.61 |
| Irma | 0.15 | 0.25 | 0.26 | 0.26 | 0.29 | 0.37 |
| Laura | 0.37 | 0.48 | 0.51 | 0.50 | 0.52 | 0.57 |
| Michael | 0.15 | 0.26 | 0.27 | 0.29 | 0.31 | 0.41 |

## Appendix B: FEMA INTAKE Referral and Eligibility

Detailed Tables

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| IHP – Referral (%) | | | | | | |
| *Storm* | *Min* | *Q1* | *Median* | *Mean* | *Q3* | *Max* |
| Harvey | 0.66 | 0.81 | 0.85 | 0.84 | 0.89 | 0.93 |
| Ian | 0.58 | 0.79 | 0.82 | 0.81 | 0.86 | 0.89 |
| Ida | 0.86 | 0.97 | 0.97 | 0.97 | 0.97 | 1.00 |
| Irma | 0.60 | 0.76 | 0.78 | 0.76 | 0.81 | 0.84 |
| Laura | 0.82 | 0.92 | 0.93 | 0.92 | 0.95 | 0.96 |
| Michael | 0.72 | 0.81 | 0.93 | 0.88 | 0.94 | 0.96 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| IHP – Eligible (%) | | | | | | |
| *Storm* | *Min* | *Q1* | *Median* | *Mean* | *Q3* | *Max* |
| Harvey | 0.29 | 0.54 | 0.61 | 0.58 | 0.65 | 0.71 |
| Ian | 0.37 | 0.46 | 0.51 | 0.52 | 0.56 | 0.82 |
| Ida | 0.65 | 0.79 | 0.83 | 0.81 | 0.84 | 0.86 |
| Irma | 0.41 | 0.43 | 0.47 | 0.49 | 0.53 | 0.61 |
| Laura | 0.36 | 0.50 | 0.55 | 0.54 | 0.58 | 0.74 |
| Michael | 0.10 | 0.23 | 0.35 | 0.35 | 0.51 | 0.66 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Housing Assistance – Referral (%) | | | | | | |
| *Storm* | *Min* | *Q1* | *Median* | *Mean* | *Q3* | *Max* |
| Harvey | 0.56 | 0.75 | 0.81 | 0.80 | 0.86 | 0.90 |
| Ian | 0.54 | 0.69 | 0.74 | 0.74 | 0.80 | 0.86 |
| Ida | 0.80 | 0.94 | 0.95 | 0.94 | 0.96 | 0.98 |
| Irma | 0.59 | 0.68 | 0.72 | 0.71 | 0.74 | 0.82 |
| Laura | 0.80 | 0.89 | 0.91 | 0.90 | 0.93 | 0.95 |
| Michael | 0.65 | 0.77 | 0.92 | 0.85 | 0.93 | 0.95 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Housing Assistance – Eligible (%) | | | | | | |
| *Storm* | *Min* | *Q1* | *Median* | *Mean* | *Q3* | *Max* |
| Harvey | 0.13 | 0.29 | 0.38 | 0.37 | 0.44 | 0.58 |
| Ian | 0.08 | 0.15 | 0.21 | 0.24 | 0.29 | 0.60 |
| Ida | 0.06 | 0.35 | 0.40 | 0.42 | 0.54 | 0.72 |
| Irma | 0.26 | 0.33 | 0.36 | 0.36 | 0.41 | 0.45 |
| Laura | 0.22 | 0.26 | 0.30 | 0.34 | 0.40 | 0.60 |
| Michael | 0.07 | 0.19 | 0.30 | 0.31 | 0.46 | 0.61 |

## APPENDIX B: FEMA INTAKE REFERRAL AND ELIGIBILITY DATA

Detailed Tables

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Other Needs Assistance – Referral (%) | | | | | | |
| *Storm* | *Min* | *Q1* | *Median* | *Mean* | *Q3* | *Max* |
| Harvey | 0.34 | 0.49 | 0.54 | 0.53 | 0.60 | 0.65 |
| Ian | 0.23 | 0.46 | 0.50 | 0.49 | 0.53 | 0.62 |
| Ida | 0.61 | 0.81 | 0.84 | 0.82 | 0.85 | 0.87 |
| Irma | 0.22 | 0.40 | 0.41 | 0.41 | 0.50 | 0.53 |
| Laura | 0.47 | 0.53 | 0.58 | 0.58 | 0.61 | 0.71 |
| Michael | 0.25 | 0.31 | 0.36 | 0.37 | 0.43 | 0.52 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Other Needs Assistance – Eligible (%) | | | | | | |
| *Storm* | *Min* | *Q1* | *Median* | *Mean* | *Q3* | *Max* |
| Harvey | 0.51 | 0.72 | 0.75 | 0.73 | 0.78 | 0.80 |
| Ian | 0.43 | 0.67 | 0.74 | 0.73 | 0.79 | 0.93 |
| Ida | 0.89 | 0.92 | 0.93 | 0.93 | 0.93 | 0.96 |
| Irma | 0.43 | 0.56 | 0.59 | 0.61 | 0.67 | 0.74 |
| Laura | 0.51 | 0.73 | 0.75 | 0.74 | 0.77 | 0.89 |
| Michael | 0.11 | 0.22 | 0.41 | 0.36 | 0.46 | 0.62 |

## APPENDIX C: STATISTICAL PACKAGES AND REFERENCES

All statistical operations were performed in Posit (formerly R Studio) software developed by Hadley Wickham and using the open-source software packages. The Packages are cited below in alphabetical order by package author. For more information: <https://posit.co/products/open-source/rstudio/>

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Lüdecke D, Ben-Shachar M, Patil I, Waggoner P, Makowski D (2021). Performance: An R Package for Assessment, Comparison and Testing of Statistical Models. *Journal of Open Source Software*, 6(60), 3139. [doi:10.21105/joss.03139](https://doi.org/10.21105/joss.03139).

Patil, I. (2021). Visualizations with statistical details: The 'ggstatsplot' approach. Journal of Open Source Software, 6(61), 3167, doi:10.21105/joss.03167

Walker, K. (2023). Analyzing U.S. Census data: Methods, maps and models in R. CRC Press. <https://walker-data.com/census-r/index.html>

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Wickham, H., Çetinkaya-Rundel, M., Grolemund, G. (2023). R for data science (2e). <https://r4ds.hadley.nz/>.

1. Hurricane Ian was excluded from the registrant analysis due to the absence of available data on the storm. Hurricane Maria was fully excluded from the analysis for several different reasons: 1) It was nearly impossible to compare claims between the U.S. mainland and Puerto Rico due to the different economic and political context between the two and the U.S. Government’s poor logistical response to the island compared to other major hurricanes. 2) Hurricane Maria never weakened below a category four as it passed over Puerto Rico, making it a significant outlier both in the number of deaths and the amount of infrastructure damage it caused. [↑](#footnote-ref-1)