Analysis Plan

Project Name: Increasing Applications to the Homeowner Assistance Fund using Mailers - Pilot

Project Code: 2206 - B

Date Finalized: 12/22/22

Project Description

The Homeowner Assistance Fund (HAF) Program provides $9.96 billion in funding to states, territories, and other entities (e.g. tribal governments) to assist eligible homeowners to prevent mortgage delinquencies and defaults, foreclosures, and the loss of utilities or home energy services. Most programs run by states are overseen and implemented by their housing finance agency (HFA) . States can designate HAF funding[1] to help eligible homeowners with various mortgage-related costs including mortgage payment assistance, financial assistance in reinstating a mortgage after delinquency or default, and mortgage rate reductions.

Our objective is to work with a state's housing finance agency (HFA) to evaluate mailer outreach targeted to reach socially disadvantaged homeowners who are likely to be eligible for HAF. We plan to test the effectiveness of this outreach on application initiation rates, as well as other application-related outcomes, including application completion rates and funding status.

Preregistration Details

This Analysis Plan will be posted on the OES website at oes.gsa.gov before outcome data are analyzed.

Analysis Plan Summary

This project is a randomized impact evaluation that will measure the effectiveness of printed mailers (postcards) at increasing applications from households at risk of foreclosure. The sample consists of 1651 potential applicant households: 826 received the mailer four weeks earlier than the other 825. In addition to comparing application initiation rates, we plan to assess differences in the proportion of potential applicants who fully complete all parts of an application, the proportion who receive funding, and differences in demographic characteristics of those who apply (i.e., race, gender, ethnicity, income).

[1] For this particular HFA, funds are disbursed directly to the homeowner's mortgage lender/servicer or land contract holder, the State Tax Commission, Hazard Insurance Provider, Homeowner's Association/Condominium Association, or utility provider. Funds are not disbursed directly to homeowners.

Hypotheses

Our primary hypothesis is that HAF-eligible homeowners (identified as in preforeclosure or foreclosure status) will be more likely to initiate a HAF application if they receive an early mailer than if they are in the holdout group.

Our secondary hypotheses are that (1) HAF-eligible homeowners (identified as in preforeclosure or foreclosure status) will be more likely to complete a HAF application if they receive an early mailer than if they are in the holdout group , and that (2) they will be more likely to receive HAF funding if they receive an early mailer than if they are in the holdout group. We consider that it is possible the mailer induces people with different demographic characteristics (i.e. race, ethnicity, gender) to apply (compared to those in the holdout group), but do not have strong prior knowledge or beliefs about those for whom it is most effective. The null hypothesis testing procedure proposed in the 'Statistical Models' section reflects this, in that it seeks any suggestive evidence of differences, without focusing on any particular group. The subsequent planned mailer study provides an opportunity to specify particular hypotheses about which groups may be most likely to respond to mailers, based on suggestive findings in this pilot.

Data and Data Structure

This section describes variables that will be analyzed, as well as changes that will be made to the raw data with respect to data structure and variables.

Data Source(s):

The primary data sources are described in table 1 below.

Table 1: Data sources

Dataset and source	Timepoint	Data
Address dataset (held by HFA vendor, provided by HFA)	Directly prior to randomization assignment	Full list of homeowner addresses, (those identified as being in preforeclosure/ foreclosure), containing: 1. Applicant full name 2. Applicant home address (and address for homeowner site, if different).
Application dataset (provided by HFA)	Directly prior to randomization assignment	Application data, containing: 1. Case ID 2. HAF application case status 3. Applicant full name 4. Applicant home address (and mailing address, if different).
Randomization	Randomization	Random assignment (generated from address data),

Dataset and source	Timepoint	Data
assignment dataset (OES)	assignment	containing: 1. Dataset of *N* = 1,651 potential applicants 2. Randomly generated indicator to either receive a mailer (early mailer), or receive a mailer at a later time point (holdout mailer).
Outcome data (provided by HFA)	Directly prior to holdout mailer being sent	Application data, containing: 1. Applicant full name 2. Applicant home address (and mailing address, if different) 3. Age 4. Ethnicity 5. Gender 6. Race 7. Whether income meets AMI[2] 8. Household annual income 9. Household monthly income 10. Household size 11. Household AMI ratio 12. Whether English is primary language 13. Whether English is limited 14. Whether residing in US territory Indian Reservation 15. Date of sale of house due to bankruptcy/foreclosure 16. Receipt of documentation about legal action such as Notice of Intent to Foreclosure letter from lender, servicer, homeowners' association or other

The categories for fields in the application data are noted in the table 2 below.

[2] Area Median Income, defined as "100% of the area median income for a household means two times the income limit for very low income families, for the relevant household size", "150% of the area median income for a household means three times the income limit for very low income families, for the relevant household size".

Table 2: Fields in the application data

Variable	Variable type	Response categories	Required?
Ethnicity	Categorical	• Non-Hispanic or Latino/a • Hispanic or Latino/a • Declined to Answer	Y
Gender	Categorical	• Female • Male • Nonbinary • Declined to Answer	Y
Race	Categorical	• American Indian or Alaska Native • Asian • Asian - Chinese • Asian - Filipino • Asian - Indian • Asian - Korean • Asian - Other • Black or African American • Pacific Islander • Pacific Islander - Guamanian or Chamorro • Pacific Islander - Native Hawaiian • Pacific Islander - Samoan • Pacific Islander - Other • White • Other Multi-Racial • Declined to Answer	Y
Eligibility Income Meets Area Median Income (AMI)[3]	Categorical	• Yes • No	Y
Household Annual Income	Numerical (in $)	N/A	Y
Household Monthly Income	Numerical (in $)	N/A	Y
Household Size	Numerical	N/A	Y
Household AMI[4] Ratio	Numerical (in %)	N/A	Y

[3] Homeowner eligibility is defined in HAF Guidance issued by the U.S. Department of the Treasury as the following: "Homeowners are eligible to receive amounts allocated to a HAF participant under the HAF if they experienced a financial hardship after January 21, 2020 (including a hardship that began before January 21, 2020, but continued after that date) and have incomes equal to or less than 150% of the area median income or 100% of the median income for the United States, whichever is greater. A HAF participant may provide HAF funds only to a homeowner with respect to qualified expenses related to the dwelling that is such homeowner's primary residence."

[4] Area Median Income, defined as "100% of the area median income for a household means two times the income limit for very low income families, for the relevant household size", "150% of the area median income for a household means three times the income limit for very low income families, for the relevant household size".

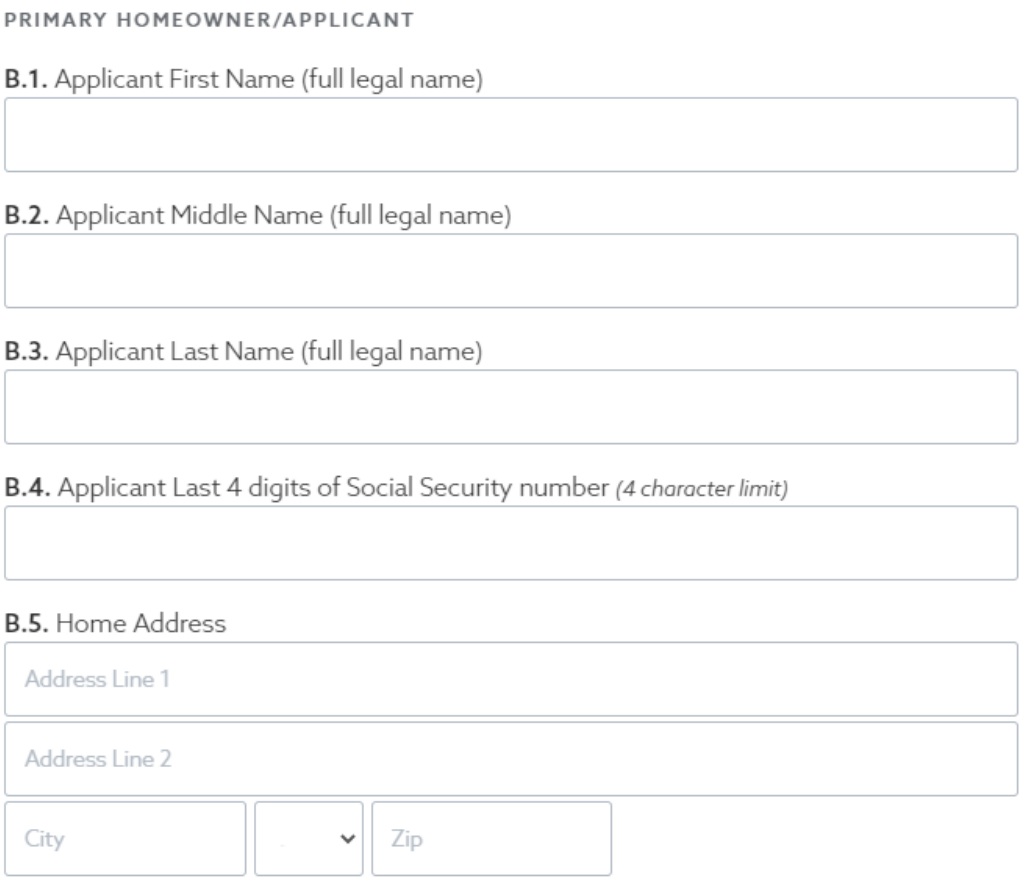
Applicant English Proficiency	Categorical	• I have limited ability to read, speak, write, or understand English • I read, speak, write, and understand English very well • Prefer not to answer	N
English as Primary Language	Categorical	• Yes • No • Prefer not to say	Y
English Limited Proficiency	Categorical	• True • False	Y
Residence in US Indian Reservation	Categorical	• True • False	Y
Foreclose Bankrupt Sale Date	Categorical	• Yes, my sale date is set and is less than 60 days from today • No	N
Foreclose Bankrupt Loss Legal Action	Categorical	• Yes • No	N

Outcomes to Be Analyzed:

The key outcome of interest is the proportion of potential applicants that initiate an application. Applications cannot be initiated unless the homeowner successfully registers by providing an email address. Once they start the application process, they self attest that they meet the eligibility requirements, and provide basic application information, including name and address. We define 'initiating an application' as the potential applicant providing their full name and address in Section B. See figure 1 below for a screenshot of part B of the application platform.

Secondary outcomes are the proportion of potential applicants that fully complete all parts of an application through the final submission screen (including answering all eligibility-related questions within the application), funding status (i.e. whether a homeowner received funding), and the comparison of demographic characteristics (i.e. race, gender, ethnicity, income) for applicants in the early mailer vs. holdout groups.

Figure 1: Screenshot of grantee application section B



Imported Variables:
Address data (described above), which will contain the randomization assignment (early mailer or holdout mailer), will be merged with the raw application outcome data, to conduct the primary outcome analysis.

Our ability to match 1) application data (which contains outcome data) to 2) address data (containing randomization assignment) will be limited since the grantee does not have a unique identifier linking both datasets - the datasets come from two different sources (address data comes from their external printing vendor, and application data comes from the HFA's platform). Thus, we will use fuzzy matching on names and addresses, in order to match participants from the address dataset to the application data. This process is described in full below.

Fuzzy matching process:

Fuzzy matching will be conducted using the 'reclink' command in Stata on names and addresses (string variables) in the two datasets, 1) application data, and 2) address data. This command will produce an output that lists potential matches based on an accuracy score between 0 and 1.
In order to quality assure the fuzzy matching result, we will also:

1. Manually go through the "successful" matches (matches that have a score of 0.60 or above)[5] to ensure that the names and addresses correspond to one another.
2. Test the robustness of results to different score cutoffs. This will allow us to check whether the result of matches is sensitive to the threshold chosen. If the result appears to be sensitive to the threshold chosen, we will adapt the threshold accordingly.
3. We will consider robustness to another fuzzy matching approach (e.g. the Stata command 'dtalink') to check if this provides the same output.

We will also internally record an excel list containing the list of matches, showing 1) matches that appear correct above the chosen cutoff score, and 2) matches that are incorrect below the chosen cutoff score.

Transformations of Variables (from application data):

1. **application_initiated:** Binary variable (with an assignment of 0 if potential applicant has not initiated an application, or 1 if the potential applicant has completed section C of the application)
2. **application_completed:** Binary variable (with an assignment of 0 if potential applicant has not completed all steps of the application, or 1 if the potential applicant has completed all steps of the application)
3. **funding_granted:** Binary variable (with an assignment of 0 if potential applicant has not been awarded funding, or 1 if the potential applicant has been awarded funding). This variable is conditional on submitting an application
4. **age:** Discrete variable (rounded down)
5. **gender:** Categorical variable, with indicators for different genders
6. **ethnicity:** Categorical variable, with indicators for different ethnicities
7. **race:** Categorical variable, with indicators for different races
8. **income:** Categorical variable, with indicators for different income brackets
9. **moved:** Binary variable (with an assignment of 0 if potential applicant has not moved/relocated directly prior to sending the early mailer, or 1 if potential applicant has moved/relocated directly prior to sending the early mailer)
10. **already_applied:** Binary variable, with an assignment of 0 if potential applicant has not already applied (at the point of sending the early mailer), or 1 if potential applicant has already applied

[5] On initial exploration of the address and application datasets sent by the grantee for the randomization, a cutoff score of 0.60 or above provided a "successful" match, where names and addresses corresponded to one another. On receiving outcome data, we will determine whether a different cutoff score (e.g. 0.65 or above) is more appropriate. Any changes to the determination of the cutoff score will be detailed in the final report.

Transformations of Data Structure:

It is possible that homeowners may have already applied to HAF in the period directly prior to randomization (pre-randomization; when we received up-to-date application data), and when the early mailer was received (post-mailer). In order to account for this, we will transform the dataset into a two-period panel (pre- and post-sending of early mailer). We will then use the baseline outcome as a predictor in regression analysis (i.e. accounting for applications received in the period between pre-randomization and post-mailer).

Data Exclusion:

We excluded any potential applicants (prior to randomization assignment) who had already initiated an application, based on conducting a fuzzy matching process (see 'Imported Variables' section above for more information on this process).[6] This data was provided to us by the grantee, directly prior to conducting randomization, and consisted of $n = 30$ homeowners who had already initiated an application (approximately 1.8% of the total sample), reducing our sample size to 1,651 potential applicants.

It will not be possible for the grantee's printer to send mailers to potential applicants who have already moved at the point of sending the mailer (to either the early mailer or holdout group). The grantee will provide us with information on the potential applicants who have already moved (at the point of delivering the intervention), so that we can account for this in our analysis.

Treatment of Missing Data:

We will have full data for 1) initiation of an application, 2) completion of an application, and 3) funding status.

Analysis 1: no missingness -- all people in randomization get either a 0 if we don't find a match to applications data or a 1 if we do. We control for the following covariates, which are available for all potential applicants included in randomization: moved and already_applied.

Analysis 2: no missingness -- 0 assigned to every person in randomization if we find no match or we find a match but they don't complete the application. 1 for completed applications.We control for the following covariates, which are available for all potential applicants included in randomization: moved and already_applied.

[6] It is important to note that given the nature of the data and the fuzzy matching process, the identification of potential applicants who have already initiated an application is subject to error (e.g. there may be more potential applicants in the dataset who have already initiated applications, but were not identified as matches through fuzzy matching).

Analysis 3: no missingness -- 0 assigned to every person in randomization if we find no match or we find a match but they do not get funded. 1 for funded applications. We control for the following covariates, which are available for all potential applicants included in randomization: moved and already_applied.
Analysis 4: this analysis is deliberately subset to applicants because we want to see if characteristics of applicants are imbalanced. We have item-level missingness, insofar as applicants can decline to answer categories, as well as unit-level missingness, insofar as applicants can initiate an application then abandon it before answering demo questions. We deal with both forms of missingness by treating them as outcomes. When dummying out categorical variables for the F-test, the dummies will indicate application incomplete and declined to answer. Thus, some outcome is observed for all applicants in this analysis, but the extent of missingness poses some interpretative challenges, as noted in the 'Limitations' section below.

Descriptive Statistics, Tables, & Graphs

We plan to report descriptive statistics to the agency partner on demographics associated with applications initiated, applications completed, and applications funded.

Statistical Models & Hypothesis Tests

This section describes the statistical models and hypothesis tests that will make up the analysis — including any follow-ups on effects in the main statistical model and any exploratory analyses that can be anticipated prior to analysis.

Statistical Models:

In generic terms, the first three specifications will be a linear regression of the outcome on a binary treatment indicator for the mailer treatment. We will include two binary covariates: one that indicates whether the potential applicant moved prior to the time of sending the early mailer, and one that indicates whether the potential applicant already submitted an application (i.e., between the randomization and sending the mailer). Model estimates excluding the covariate adjustments will be included in an Appendix.

<u>Primary outcome: HAF application initiation ("analysis 1")</u>
The intent-to-treat effect (ITT) of the mailer on the proportion of potential applicants who initiate a HAF application, after the early mailer is sent out (12/2/22), and before the holdout mailer is sent out (date TBD, approximately 4-6 weeks after the early mailer is sent).

<u>Secondary outcome 1: HAF application completion ("analysis 2")</u>
The ITT of the mailer on the proportion of potential applicants who complete a HAF application, after the early mailer is sent out (12/2/22), and before the holdout mailer is sent out (TBD).

Secondary outcome 2: Funding status ("analysis 3")
The ITT of the mailer on the proportion of potential applicants who receive HAF funding, after the early mailer is sent out (12/2/22), and before the holdout mailer is sent out (TBD).

Secondary outcome 3: Applicant demographics ("analysis 4")
Conducting individual tests for each demographic attribute would pose a multiple comparisons problem. Therefore, we will conduct an omnibus test of the null hypothesis that the difference in means between the demographic attributes of applicants in the early mailer and holdout groups is zero across all attributes.

Specifically, we subset the sample to applicants (analyses above are conducted among all potential applicants), in order to focus on demographic imbalances induced by the treatment. We will conduct an F-test comparing two regressions. In the first regression, we regress the mailer treatment indicator on the two control variables defined above (whether a potential applicant moved and whether they applied prior to the mailer). In the second regression, we regress the treatment indicator on those same control variables as well as all of our demographic variables, which are outlined in Table 2 (excluding one category and dummying the categorical variables, including "Declined to answer" responses). The F-test comparing these two regressions can be interpreted as a test of the null hypothesis that the true coefficients on the demographic variables are all equal to zero. Rejection of the null hypothesis therefore implies that at least one of the demographic variables is imbalanced with respect to the treatment indicator. We interpret a significant finding to imply that the mailer induced potential applicants with different characteristics to apply. While we can visually inspect the individual demographic differences between applicants who did and did not receive the early mailer using a plot, we will await the scaled up version of this study before attempting to test for any specific demographic differences.

Exploratory Analysis:
N/A

Inference Criteria, Including Any Adjustments for Multiple Comparisons:
Null hypothesis. Our key null hypothesis is that potential applicants are equally likely to initiate a HAF application if they receive the early mailer, than if they receive the holdout mailer. Similarly, for secondary outcomes 1-2, our null hypotheses are that potential applicants are as likely to 1) complete an application or 2) receive funding if they receive the early mailer, than if they receive the holdout mailer. Lastly, for secondary outcome 3, our null hypothesis is that there are no demographic differences between potential applicants who apply for HAF after receiving a mailer, versus those who apply for HAF in the absence of a mailer.

Statistical significance. We will test for statistical significance using p-values calculated with randomization inference, setting alpha = .05 as the testwise rejection threshold. More specifically, we will simulate the joint distribution of test statistics (regression coefficients in analyses 1-3 and F-statistics in analysis 4) under the sharp null hypothesis of no effect for any unit, using five

thousand simulated random assignments to re-estimate the test statistics from the four tests. We will conduct a two-tailed test for the regression coefficients, taking the proportion of all simulated coefficients at least as large in absolute value as the observed regression coefficient as our p-value. We will conduct a one-tailed test for the F-test, e.g., the proportion of simulated F statistics that is at least as large as the observed value. Following the OES SOP, we will calculate standard errors using the HC2 estimator. We will report unadjusted p-values in the main tables.

Multiple comparisons. To account for multiple comparisons, in the text we will report the testwise alpha level that would need to be set in order to bring the probability of a familywise error to 5%, under the global sharp null of no effect for any unit across all outcomes. We estimate the adjusted alpha by obtaining five thousand parametric p-values under the global sharp null hypothesis as part of the permutations described above, which are used to obtain randomization inference p-values. Each time the treatment assignment is re-randomized, we pull the test statistics and their associated *parametric* p-values for each test. Because these parametric p-values are generated under the global sharp null hypothesis, their marginal distributions should be uniform and the testwise probability that one of the parametric p-values falls at or below .05 should thus be .05. However, a Bonferroni-adjusted alpha of .05/4 = .0125 would be far too conservative as it is unlikely the parametric p-values are distributed independently.

Rather, the adjusted testwise alpha that we would need to apply in order to obtain a familywise rejection rate of .05 is likely to be greater than the conservative Bonferroni alpha of .0125 due to correlations in the *joint* distribution of the parametric p-values. For example, randomizations that produce large estimated effects on application completion likely also exhibit large estimated effects on application *initiation*, and so if one parametric p-value of those tests is small the other is also likely to be small. We instead obtain our adjusted testwise alpha using an optimization algorithm that finds the testwise alpha that brings the familywise error rate as close as possible to .05. If indeed the tests are dependent, we should expect to find an adjusted testwise alpha between .0125 and .05. If the p-values obtained through randomization inference fall below the adjusted alpha level, we will describe our findings as robust to adjustment for multiple comparisons.

Limitations:
The type of analysis we are conducting for “analysis 4” above poses an interpretative issue, but given this is a small-scale pilot, we do not plan to conduct any bounding exercise to mitigate for this. Instead, we plan to do so for the larger evaluation.

Link to an Analysis Code/Script:

N/A