Analysis Plan

Project Name: Increasing homeowner participation in wildfire risk assessments

Project Code: 1903

Date Finalized: July 27, 2020

Project Description

The Montana Department of Natural Resources and Conservation (DNRC), supported by the USDA Forest Service, coordinates the provision of on-site wildfire risk assessments to property owners. Risk assessments can help property owners understand hazards they face from wildfire on their property and make decisions about actions to mitigate risk. The State and USDA Forest Service seek to increase property owner participation in wildfire risk assessments conducted by county and local fire professionals to promote fire-adapted communities. Owners who take action to reduce wildfire risks on their property also contribute to creating fire-adapted communities, structure protection, personal safety, and firefighter safety.

The project tests whether sending letters to property owners informing them of the wildfire risk assessment service offered by the State of Montana increases participation in the service. The letters provide instructions for how to request an assessment and what to expect in the process of receiving an assessment. The letters also test whether different versions of information content (program information only, program information plus individual risk framing, and program information plus community risk framing) have different effects on the likelihood a property owner will request an assessment. Letters were mailed on or about September 30, 2019.

The experimental design consists of a no-letter control group and three letter treatment conditions. Properties were block-randomized to experimental conditions based on the county where the property is located (Park or Gallatin Counties) and the wildfire hazard potential rating associated with the property (moderate or high hazard; properties in low-hazard areas are not included in the study). The design and planned sample are described in Table 1.

Table 1: Test arms and expected sample sizes

Test arm	**Description**	**Planned sample size (n)**
No-letter control	No letters sent	5,206

Information-only letter	Letter with basic information and instructions about making assessment requests.	1,300
Information + personal risk framing letter	Letter with basic information and instructions about making assessment requests, plus statement of property's relative wildfire risk.	1,303
Information + community risk letter	Letter with basic information and instructions about making assessment requests, plus statement of community wildfire risk.	1,300
Total treated sample		3,903
Total study sample		9,109
Note: The original study design called for a planned no-letter control group of n=1,302 and three additional treatment conditions with three letter versions mailed in Spring 2020. The planned mailing was cancelled in response to the coronavirus pandemic and the planned Spring treatment sample is included in the no-letter control group.		

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):
Outcome data is provided by the Montana DNRC. These data include requests for assessments made via a web form or phone. Outcome data are matched by property identifiers (e.g., address) to the sample frame data with treatment assignment.

Outcome Variables to Be Analyzed:
The primary outcome of interest is whether a property owner requests a risk assessment for one of their properties. Requests are made via a web form or by phone; the outcome is recorded as a request if a property owner makes a request for any property associated with a given owner, regardless of risk category.

Imported Variables:
In addition to a treatment assignment indicator and the outcome variable, blocking variables will be added to the raw data. These include the county where the property is located (Gallatin or Park) and hazard rating category (moderate or high). Wildfire hazard potential[1] is a

[1] Dillon, Greg, James Menakis, and Frank Fay. "Wildland fire potential: a tool for assessing wildfire risk and fuels management needs." In *In: Keane, Robert E.; Jolly, Matt; Parsons, Russell; Riley, Karin. Proceedings of the large wildland fires conference; May 19-23, 2014; Missoula, MT. Proc. RMRS-P-73. Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station. p. 60-76.*, vol. 73, pp. 60-76. 2015.

landscape-scale, 270 m^2 spatial resolution index that describes the relative potential for wildfire that would be difficult to suppress; it does not describe the risk to specific properties or structures, but instead describes the likelihood of wildfires and their likely severity for a geographic area. Properties are identified within these geographic areas and associated with the hazard potential rating of that area.

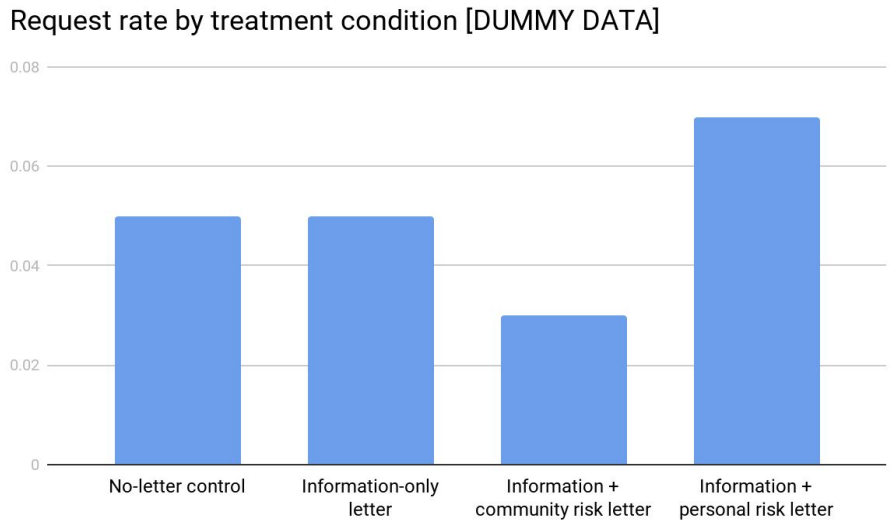
Data Exclusion:
We do not expect to exclude from the analysis any observations of requests that are matched to the study sample frame or any properties in the sample frame that are not associated with observed requests. We expect that a small number of letters mailed to property owners in the treatment conditions will be returned as undeliverable; letters returned as undeliverable because of invalid mailing addresses will be excluded from the analysis, as having a valid mailing address is a condition of inclusion for the sample frame. Some returned letters may be undeliverable because the property is a seasonal residence and the resident cannot have mail delivered at that address during the "off" season. If these returned letters can be identified, they will be included in analysis.

Observations of requests that cannot be matched to the sample frame will be considered as not a part of the study and ignored. Most requests recorded by the DNRC that cannot be matched to properties in the sample frame are likely from property owners who were not included in the study but were able to make a request. The web form for making requests was a publicly available website through the Montana DNRC website, and no special code or password was required to make a request. (Properties were not included in the study if, for example, they were in areas with low hazard ratings.) It is possible that some of these unmatched observations are for property owners who are in fact in the study population but could not be matched due to data recording errors or inconsistencies. Without any indication of whether these properties were in the study or what condition they were assigned to, they will be treated as though they were not a part of the study sample frame.

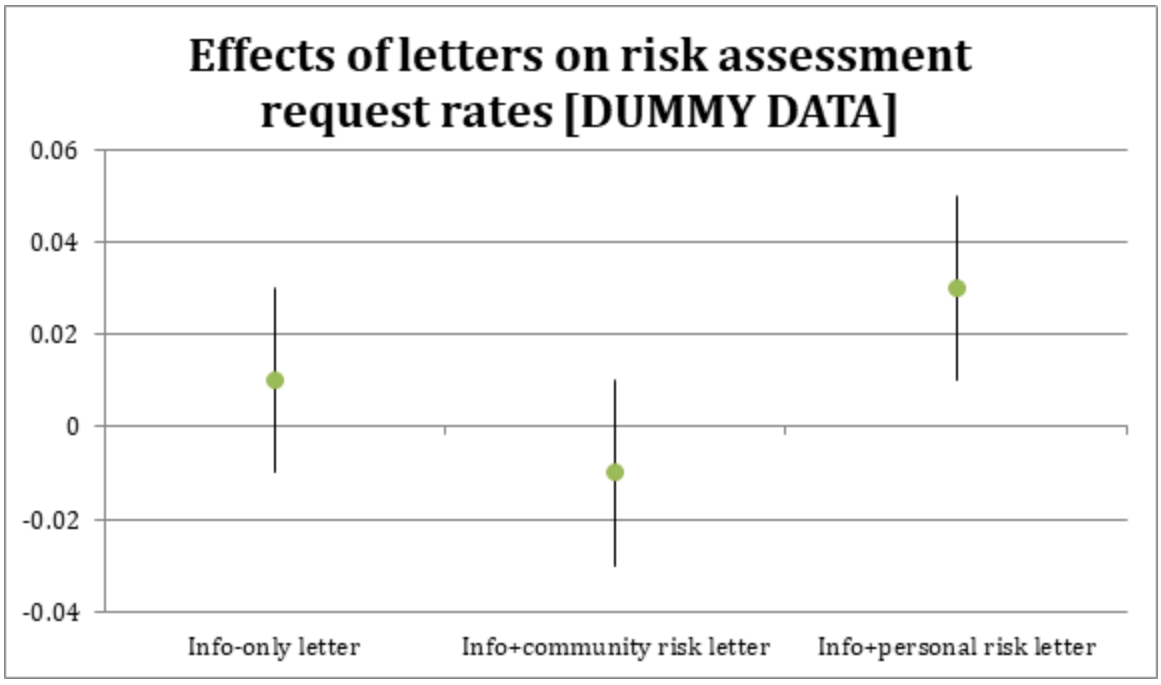
Treatment of Missing Data:
We do not anticipate any missing data. Only positive requests are observed, so not observing a property is identical to not requesting an assessment.

Descriptive Statistics, Tables, & Graphs

- Bar chart of request rates by condition:



- Coefficient point estimates from equation (3) (below) with 95% confidence intervals:



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:

The statistical analysis is designed to estimate main intention-to-treat (ITT) effects of sending letters in the treatment conditions on the likelihood of requesting an assessment, controlling for the county that the property is located in and wildfire hazard rating.

Hypothesis 1: Being sent any letter compared to not being sent a letter affects the likelihood that a property owner requests an assessment. To test this hypothesis, we will estimate an ordinary least squares (OLS) regression of the outcome variable (making an assessment request, Y_i) on an indicator for assignment to any letter condition (T_i) and indicators for county and hazard rating (the blocking variables):

(1) $Y_i = \beta_0 + \beta_1 T_i + \delta_1 County_i + \delta_2 Hazard_i + \varepsilon_i$

The coefficient β_1 is the estimate of the average treatment effect for being sent any letter compared with not being sent a letter. The null hypothesis is that $\beta_1 = 0$.

The following analysis WILL NOT be included in the abstract: In addition to the OLS estimates of the average treatment effect for the intention-to-treat model, we will estimate a compliers average causal effect (CACE) model using an instrumental variables (IV) regression. The CACE defines compliance as receipt of a mailed letter; non-compliers are those property owners in the letter conditions where the mailed letter was undeliverable because the resident could not receive mail at a seasonal residence. Assignment to treatment (T_i) will be used as the instrumental variable to predict receipt of the letter in the first-stage regression, and predicted receipt of the letter will replace treatment assignment in the main effects regression.

Hypothesis 2: Being sent a letter with behaviorally informed risk framing (either community- or personal-framed risk) compared with being sent a letter with only information about the program affects the likelihood that a property owner requests an assessment. We will test this hypothesis with a less restricted version of the OLS regression in equation (1):

(2) $Y_i = \beta_0 + \beta_1 T_{info,i} + \beta_2 T_{risk,i} + \delta_1 County_i + \delta_2 Hazard_i + \varepsilon_i$

The quantity $\beta_2 - \beta_1$ is an estimate of the difference in the average treatment effect for those sent a risk-framed letter (community or personal risk) compared with those sent an information-only letter. The null hypothesis is that $\beta_2 - \beta_1 = 0$.

Hypothesis 3: Being sent a letter where wildfire risk is framed in terms of community risk, as compared with letters with personal risk framing, affects the likelihood that a property owner requests an assessment. We will test this hypothesis with an unrestricted model estimated with OLS that includes indicators for each treatment condition:

(3) $Y_i = \beta_0 + \beta_1 T_{info,i} + \beta_2 T_{comm,i} + \beta_3 T_{pers,i} + \delta_1 County_i + \delta_2 Hazard_i + \varepsilon_i$

The quantity $\beta_3 - \beta_2$ is an estimate of the difference in the average treatment effect for those sent a letter framed with personal risk compared with those sent a letter framed with community risk. The null hypothesis is that $\beta_3 - \beta_2 = 0$.

Heteroskedasticity-consistent standard errors (HC2) will be used for all analyses.

Follow-Up Analyses:
For any of the hypothesis tests that reject the null of no main effect (based on inference criteria described below) we will run follow-up analyses of heterogeneous treatment effects by county and wildfire hazard rating. The general form of the model with treatment interactions is:

$$(4) \quad Y_i = \beta_0 + T_i\beta + X_i\delta + Z_i\Pi + \varepsilon_i$$

where T_i is a row vector of treatment indicators from the model specification(s) where main effect null hypothesis is rejected, $X_i = \{County_i, Hazard_i\}$ is a row vector of the two blocking variables indicating county and hazard rating, respectively, and Z_i is a row vector of the fully interacted combinations of T_i and X_i.

Inference Criteria, Including Any Adjustments for Multiple Comparisons:
For all hypotheses in the main-effects analysis, we will infer that we cannot reject the null hypothesis if *p*-values are greater than .05 using two-tailed tests. We will adjust *p*-values for the three main-effects hypotheses using the Holm stepwise procedure.

Limitations:
As noted above, it is possible that some observed requests for assessments were in fact from property owners in the study sample (either in the control or treatment groups) but could not be matched to the sample data due to data recording errors or inconsistencies.