Rental Eviction and Assistance Model Amid the Covid-19 Pandemic

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Purpose

The purpose of this model is to explore the dynamics of residency and eviction for households renting in the greater Phoenix (Arizona) metropolitan area. The model uses a representative population of renters modified from American Community Survey (ACS) data that includes demographic, housing and economic information. Each month, households pay their subsistence, rental and utility bills. If a household is unable to pay their monthly rent or utility bill they apply for financial assistance. This model provides a platform to understand the impact of various economic shock upon households. Also, the model includes conditions that occurred as a result of the Covid-19 pandemic which allows for the study of eviction mitigation strategies that were employed, such as the eviction moratorium and stimulus payments. The model allows us to make preliminary predictions concerning the number of households that may be evicted once the moratorium on evictions ends and the long-term effects on the number of evicted households in the greater Phoenix area going forward.

Entities, State Variables and Scales

The agent-based model is composed of rental households with the characteristics of a synthetic dataset of rental households created from American Community Survey (ACS) data. Once a household is placed in a city or town, the patch they are placed on takes on the characteristics of the rental property for that entry. The household variables are indicated in Table 1.

Table 1: Household Variables

number-of-persons	The number of people in a household.
SNAP	Supplemental Nutrition Assistance Program funds.
PAP	The amount of TANF, Temporary Assistance for Needy Families.
annual-household-income	The annual amount of income for a household.
monthly-rental-payment	The amonut of rent due each month for a rental property.
balance	The amount of money a household has.
subsistence-cost	The amount of money a household spends on food and other essentials.
utility-cost	The amonut of money due for utility bills
rental-arrears	The amount of money past due on a rental propety
utility-arrears	The amount of money owed for past utilities.

residence-type	Record is a household is living in an apartment or a home.
puma	Public use census area in which a household is located
town	The town in which a household is located. e.g. "Tempe"
evicted?	A T/F variable that records if a household is living in a rental property
annual-ss-income	Income from social security.

The NetLogo patches are used to record information about rental properties and effectively act as rental property agents. Once a random patch within a city or town is chosen, it takes on the characteristics of the rental property for the duration of the simulation. NetLogo patches record the information in Table 2.

Table 2: Rental Property Variables

rent	The monthly rent for the property
tenant?	Is the rental property occupied
rental-puma	The PUMA location information for the property
is-a-rental-property?	Is there a rental propety at this location
building-type	Is the property a house or an apartment
township	The town or city is the patch located in.

Global variables used in the simulation are described in Table 3. Please note that there are also a number of variables not included in the table which are used to record information, but do not affect the behavior of the model. These variables begin with the word "average" or "count."

Table 3: Global Variables

month	A numerical representation of the month
year	The number of years the simulation has run
cap-" "-utility-pot	The amount of money available to a municipal community assistance program for utilities assistance in a month
cap-" "-rental-pot	The amount of money available to a municipal community assistance program for rental assistance in a month.
faith-based-assist-pot	The amount of money available in a month for rental and utility assistance.
rental-properties	Patches which have rental-properties on them.
evictions-begin-again	The month in which evictions will begin again.
month-incomes-improve	The month in which incomes begin to improve.
pause-month	The month in which evictions pause based on an eviction moratorium.
income-shock- frequency	The percent of the popula8on which can experience a shock to their monthly income.
income-shock- magnitude	The percent of a household's monthly income that a household's income will decrease if they are experiencing a shock.

covid-shock-quantity	The percent of the population which can experience a shock to their monthly income during the Covid-19 outbreak.
covid-shock- magnitude	The percent of a household's monthly income that a household's income will decrease if they are experiencing a shock during the Covid-19 outbreak.

Process Overview and Scheduling

The model begins with a stylized map of the cities and townships in our study area. These regions were chosen because they correspond to divisions used to give rental and utility assistance (Figure 1). The specific regions include Phoenix, Scottsdale, Tempe, Mesa and Gilbert-Chandler. Households are then created based on a synthetic dataset created from ACS data. This information includes information about each household including where it is located, and each household is randomly placed within their respective region. A rental property agent is created at the same location, but remains in its township if the household is evicted.
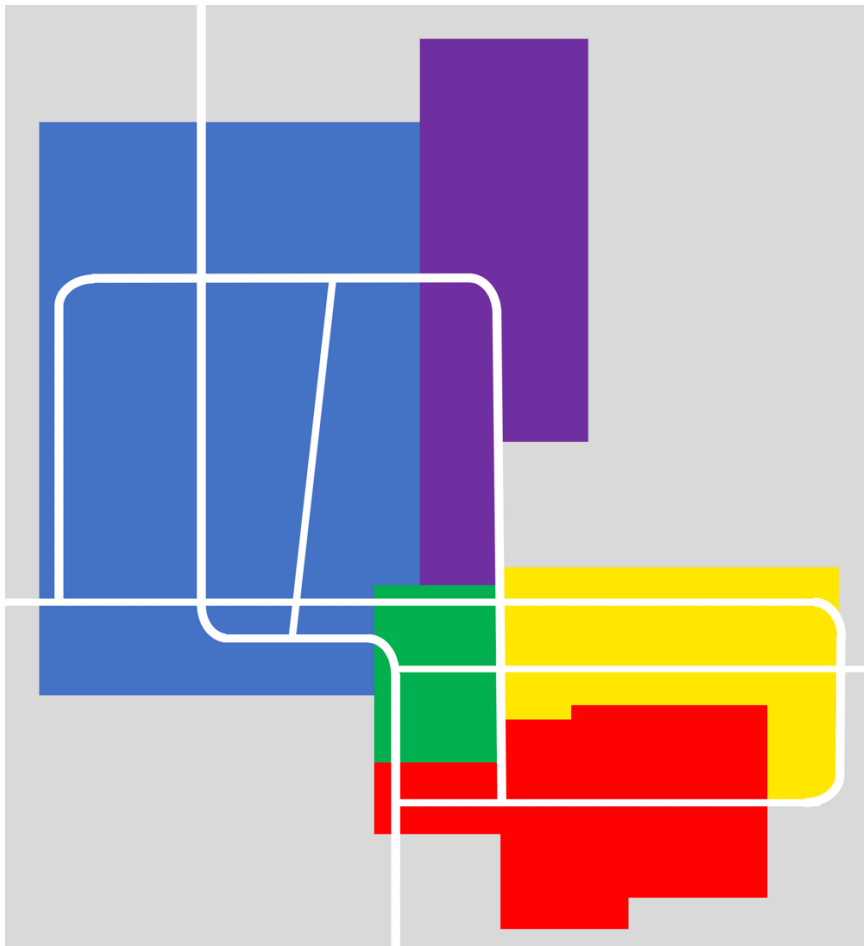

Figure 1. Stylized map of the study area. The regions include Phoenix (blue), Scottsdale (purple), Tempe (green), Mesa (yellow) and Chandler-Gilbert (red). The white lines indicate major highways and loops.

After the model has been initialized, it progresses on a monthly timescale. Each month, households receive a monthly income that may be affected by random shocks or the economic

effects of Covid-19. The general economic effects and those resulting from the Covid-19 pandemic are modeled in the same manner, except that the Covid-19 effects begin in April 2020 and end at a user defined time whereas the general economic effects occur in every month.

The economic shocks have a random chance of occurring to each household during each month (`income-shock-frequency` or `covid-shock-quantity`). If a household experiences an economic shock, the household's monthly income is decreased by a user defined percentage (`income-shock-magnitude` or `covid-shock-magnitude`). A household may also receive social security income, this amount is not effected economic shocks. Next households that are currently evicted use their new monthly income to pay any existing debts. If money is left over, evicted household attempt to move into a new rental property that is empty, and has a monthly rent that is less than their previous rent. A switch controls if the evicted household must also be able to pay the first and last month rent of the available property.

Next, households which reside in a rental property ay their monthly bills. If they are unable to pay for the rent, the attempt to pay the remaining balance with money from a rental assistance agency. The amount of monthly funds available depends on the location of the agent. This process is also repeated for utility bills and utility assistance (Figure 2).

If a household is unable to pay their rent or utilities after attempting to get financial assistance it may be evicted. Eviction occurs when households have multiple consecutive arrears, and the amount is greater than consecutive-arrears-for-eviction. Once a household is evicted, the rental property becomes available for other household agents to rent and the household becomes part of the visible evicted population located on the margins of the model.

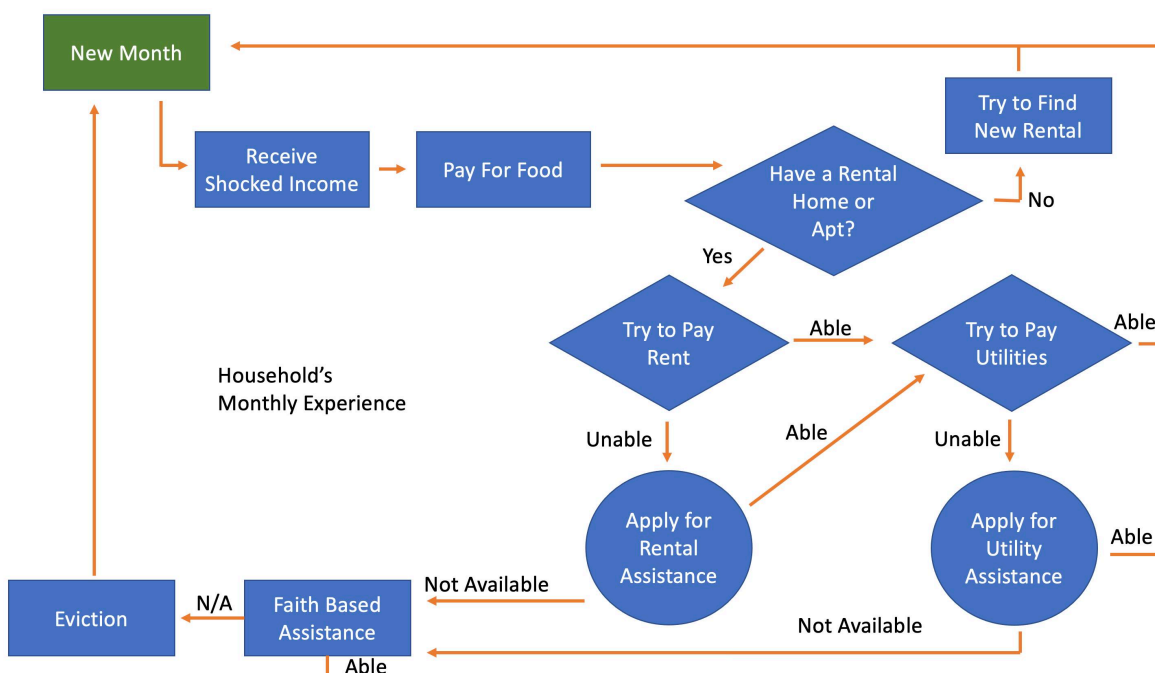These processes continue on a monthly scale until the `number-of-years` set by the user is reached.

Figure 2. Flowchart of rental households' monthly decisions.

A number of processes related to the Covid-19 pandemic may also occur in the course of the model. These processes are controlled in the user interface with the `covid-effects` switch. If the switch is turned to "on", income will be reduced until the month in 2021 chosen by the user via `income-improvement-begins`. Evictions may be paused in the 4th month of the simulation, April 2020, and the user may also choose the month in which evictions begin during 2021. Also, the user may specify amounts of money to be dispersed to the agents for stimulus payments.

Initialization

The model loads a stylized map of the city of Phoenix and surrounding municipalities (Figure 1). The image is supplied so that differences in the number of rental properties can be observed, but the image does not directly affect the behavior of the agents. The household agents are loaded from a synthetic dataset based on ACS data. Each household is created with the economic and demographic characteristics of a household in the synthetic dataset. The model also relies on a number of parameters that are set in the user interface. These parameters control the timing of general income shocks or control the timing of covid related effects on income and eviction moratoriums. Finally, the amount of money available to each of community assistance programs for a year is also set in the interface.

Input

The model agents are based on a synthetic dataset of rental households created from American Community Survey (ACS) data containing household characteristics including property information. This synthetic dataset is read from a CSV file which is derived from both the person and household level 2019 Five Year PUMS samples for Arizona available via the US Census Bureau. The person and household samples were combined, and the relevant PUMS for the greater Phoenix metropolitan area were selected. The resulting dataset was further filtered to contain only renting households. Finally, several variables were recoded or derived, most importantly a SS variable indicating all social security related income, as well as the UTIL variable to provide a consistent numeric value for utility costs. The data elements used from the synthetic population file are shown in Table 4. Also, included with this model is a Jupiter notebook that records the steps used to create the population for this simulation.

Table 4: Relevant Synthetic Population Variables

SERIALNO	identifier for household
PUMA	household statistical area
WGTP	the observation weight
TYPE	type of household, recoded
BLD	type of building in which household resides
NP	number of persons in the household
RNTP	household monthly rent
SNAP	flag whether or not household obtains SNAP assistance

RMSP	number of room in the property
VEH	number of vehicles owned by the household
HHT	type of household
HINCP	household income
TANF	amount of TANF assistance
SS	total amount of social security income for the household, derived
POVPIP	the income to poverty ratio for the household
NOC	number of children in the household
UTIL	total utility costs for the household, derived

Covid Shock Quantity

The quantity of households that experience an income shock from Covid-19 is set within the model code and reproduced below. These values were taken from the "pulse" survey conducted by the US Census Bureau.
https://www.census.gov/data/experimental-data-products/household-pulse-survey.html

The month number represents the number of months since the simulation begins. Thus, month 4 is April of 2020 and month 16 is April of 2021.

Month	Covid-Shock-Quantity
1	5
2	5
3	5
4	5
4	34
5	31
6	32
7	38
8	32
9	22
10	26
11	27
12	27
13	26
14	21

	15		17
	16		15
	17		13
	17		10
	18		11
	19		9
	20		7
	21		5
	22		3
	23		2
	24		1
	24		0

Submodels

Apply for Assistance

Need Rental Funds → YES → Received Assistance within last 12 months? → NO → Income is 60% or less than the median HH income? → YES → Determine which CAP you belong to: City of PHX / Mesa / Maricopa County → Fund Until CAP Pot is empty.

Received Assistance within last 12 months? → YES → No Assistance Available

Income is 60% or less than the median HH income? → NO → No Assistance Available
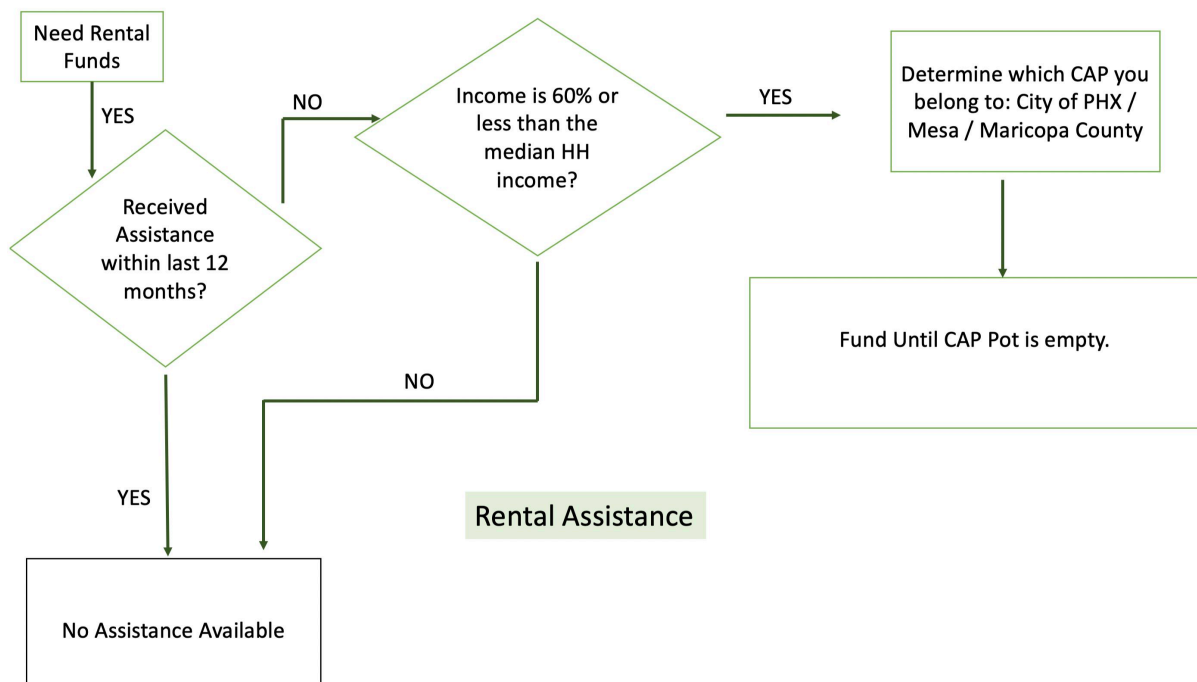
Rental Assistance

Figure 3. Rental Assistance Flowchart

If a household is unable to pay a rent or utility bill, the household will attempt to receive financial assistance to pay the remaining funds. The community assistance program chosen by the household must correspond to the municipality in which a household currently resides. Each rental property, or NetLogo patch in this case, tracks which municipality it belongs to. For example, if a household lives in a rental property in Phoenix, the household must try to procure funds from the rental and utility assistance programs for Phoenix residents. The criteria for rental assistance are shown below in Figure 3. If a household has not received
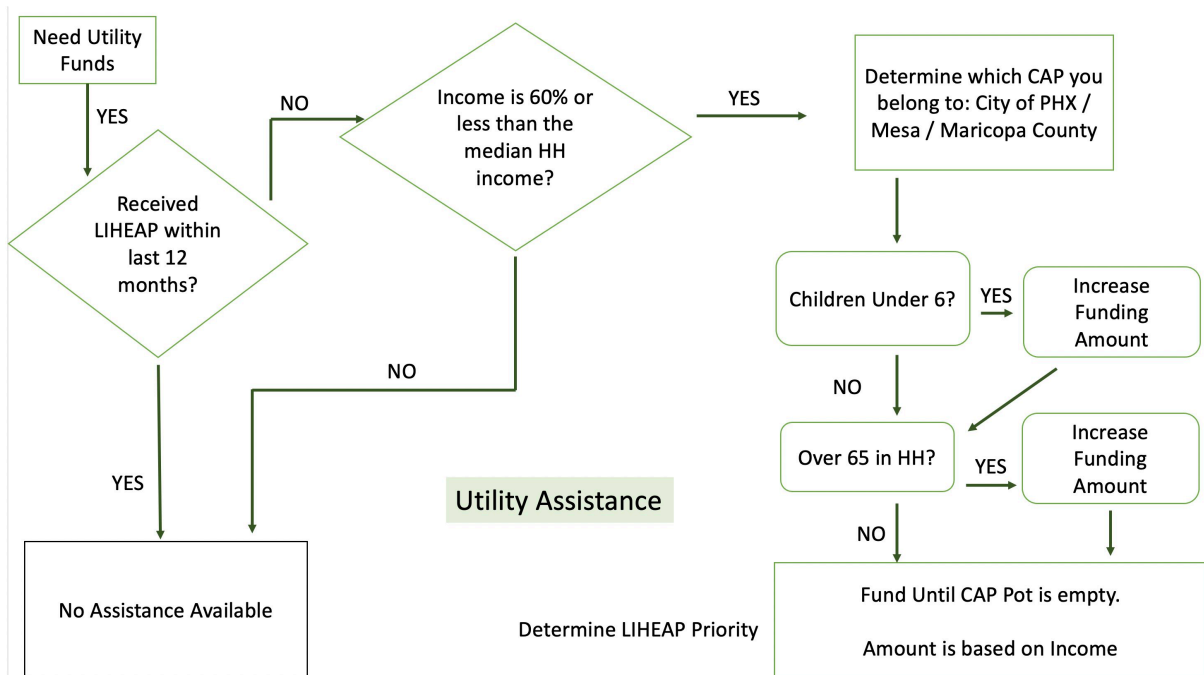

Figure 4. Utility Assistance Flowchart

assistance in the last 12 months and their income is 60% less than the median HH income and if their Community Assistance Program has funds, they will receive funds equal to the amount they owe for rent.

If a household owes any money towards their utility bill, they attempt to receive funds from their local utility assistance program. The specific criteria for the amount of funds are described in Figure 4. Much like the rental assistance program, a household must meet an income requirement, must not have received assistance within the last year and the program must have funds available for that month.

Eviction
If a household is unable to pay for their rent or utilities they may be evicted from a rental property. If a household is unable to pay rent in a given month they are considered to be in arrears. If this occurs as many times as consecutive-arrears-for-eviction, then a household may be evicted with a likelihood of eviction-probability. The same is true for utilities. If a household is in arrears due to utilities for a consecutive number of months equal to consecutive-arrears-for-eviction then a household will be evicted with a likelihood of

eviction-probability. Once a household is evicted, the household agent moves to the black margins of the model and rental patches change their rental status.

Find New Rental Property
At the beginning of the month, households that have been evicted attempt to find a new place to live. First households pay their monthly subsistence needs and pay off any remaining rental or utility debt. To move into an available rental property, households must have enough money to pay the first month's rent (and possibly the last month; this is controlled by a switch in the user-interface). The rent for any new property must also be less than the rent at the previous location. In order to be available, a rental property must also not have a tenant.

Running the Model Using Behavior Space

The model may be used to test a wide array of hypotheses concerning evictions in the Phoenix area and the effects of the Covid-19 pandemic on households that rent. Four main experiments have been conducted so far.

1. The first experiment compared the relationship between the timing of income improvement and when evictions are allowed to resume. The behavior space experiment is entitled `experiment1-eviction-and-income-improvement-timing`.

2. The second experiment is designed to show how the percentage of households effected by income shocks during Covid-19 effects the number of households evicted when evictions are allowed to resume. The behavior space experiment is entitled `experiment2-income-shock`.

3. The third experiment was used to understand the effect of the government's second stimulus by testing multiple amounts. The behavior space experiment is entitled `experiment3-second-stimulus-test`.

4. The fourth experiment is designed to understand the effects of reducing a household's missed rent from months during covid once they have been evicted. The behavior space experiment is entitled `experiment4-covid-rental-debt-reduction`.