# Ethiopia Poverty Measurement Training

Day 4: housing

Valuing Housing

- Housing is a major component of household's wellbeing

- Market tenants:
  - rent dwelling at market rates
  - those who purchased a dwelling in an area with deep market for buying/selling dwellings

- Non-market tenants:
  - those who live in a dwelling they constructed / inherited or bought in a shallow market
  - those whose dwelling is provided for free/at a subsidized rate by the state / their employer / friends or family.
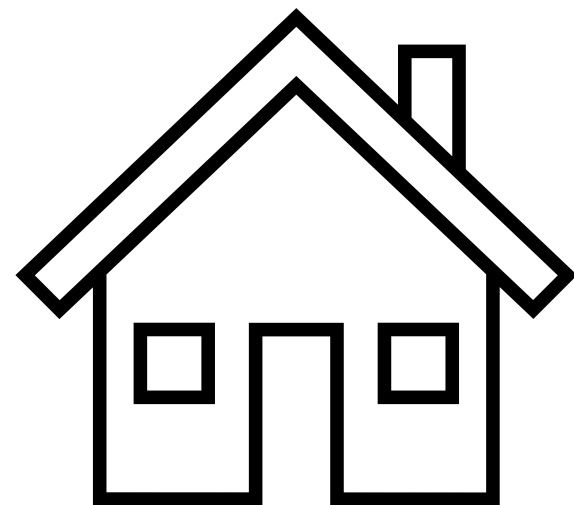
Market Tenants

- For renters, use actual rent paid in almost all cases
- For those who purchased their dwelling, and a strong market exists
  - could consider as a durable good
  - could use mortgage payment
  - however, housing tends to appreciate so dwelling functions both as consumer durable good and as investment
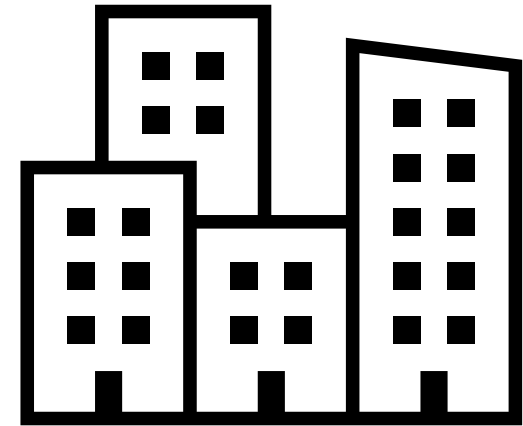
Non-Market Tenants

- For owner-occupiers: if a rental market exists, the opportunity cost of living in a dwelling you own is the forgone income from not renting it out. Can either:
  - ask respondent to estimate this directly, or
  - use a regression to estimate based on characteristics and actual rent for other dwellings in the area
- In rural areas of many low-income countries:
  - no rental market exists
  - still need to account for the time and materials households spent to construct and maintain their dwelling
- Dwellings provided by the state / employer / friends or family
  - may be considered as income/transfer
  - actual utility they provide to the household is hard to quantify

Respondent-Estimated Rental Value

- Ask the respondent "How much would you have to pay to rent a house / apartment like yours?"

- Rental markets may not be present in all areas, particularly in rural areas, making this question very difficult to answer meaningfully

- Even if there is a rental market, studies show that owners tend to over-estimate the rental value of their properties

Hedonic Regression

- Use actual observed rents (from renters) to construct a model of rent based on various characteristics of the dwelling (size, location, construction materials, amenities)

- Using the population of renters, regress the logarithm of the actual rent paid on various characteristics of the dwelling:
$$\ln rent_h = \beta x_h + \varepsilon_h = \beta_0 + \beta_1 x_{1h} + \cdots + \beta_k x_{kh} + \varepsilon_h$$

- Then use this model to predict rental values out of sample for homeowners and non-market tenants

- Might have separate regressions for different strata (capital city, other urban areas, rural areas)

- Can use method such as stepwise or lasso to select independent variables for regression

- Need all independent variables to be nonmissing in order to predict
  - Any missing values will have to be imputed using median for similar households

Correct Estimator from Log Model

- Note that the dependent variable in the model is log rent, this is what will be predicted

- The correct expected value of rent is not simply the exponential of this but (assuming errors are normally distributed)

$$\widehat{rent}_{adj} = \exp(\hat{\beta}x) \cdot \exp\left(\hat{\sigma}^2/2\right)$$

where $\hat{\sigma} = \frac{\sum_{h=1}^{N} \varepsilon_h}{N-2}$ is the standard error of the regression.

- Stata can easily do this for you using the `glm` (generalized linear models) command
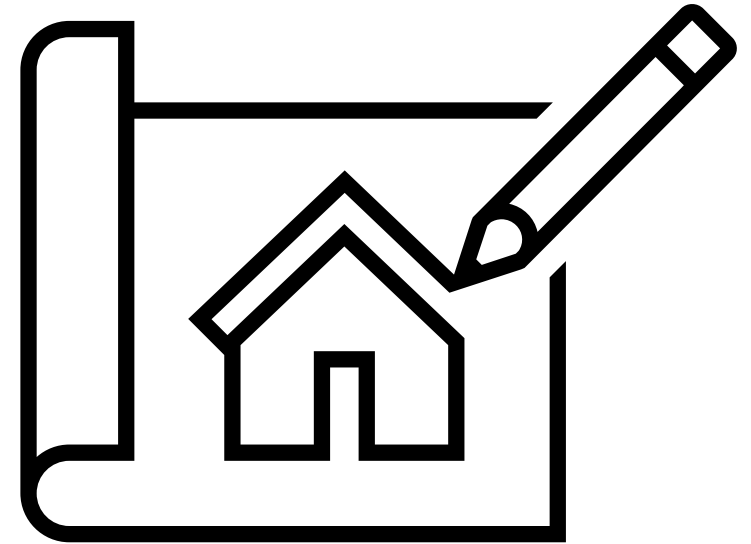
# Hedonic Regression – code example

Rent is actual rent paid. *Renter* is a binary for whether a hh is a renter (market rate) or not. Variables *nrooms floor* etc are characteristics of the dwellings.

```
gen logrent = log(rent)
glm logrent nrooms floor etc [aw = wta_hh], link(log)
predict logrent_glm
gen usevalue = exp(logrent_glm)
gen consexp = rent if renter
replace consexp = usevalue if !renter
```

Hedonic Regression – modification

- In many countries, renters are highly concentrated in urban markets and a model developed based mainly on modern apartments in urban areas may do very poorly predicting the value of traditional houses in rural areas

- Can incorporate respondent-estimated rental values into the regression and then used the predicted value from this regression as the rental-equivalent
  - Assumes respondent-estimated rental values have some information to contribute but provides more consistent relationship between characteristics and value
  - Should include a binary variable for whether the observation is actual rent or respondent-estimate. If this variable is significant, consider using predictions for all households (including market tenants) for consistency
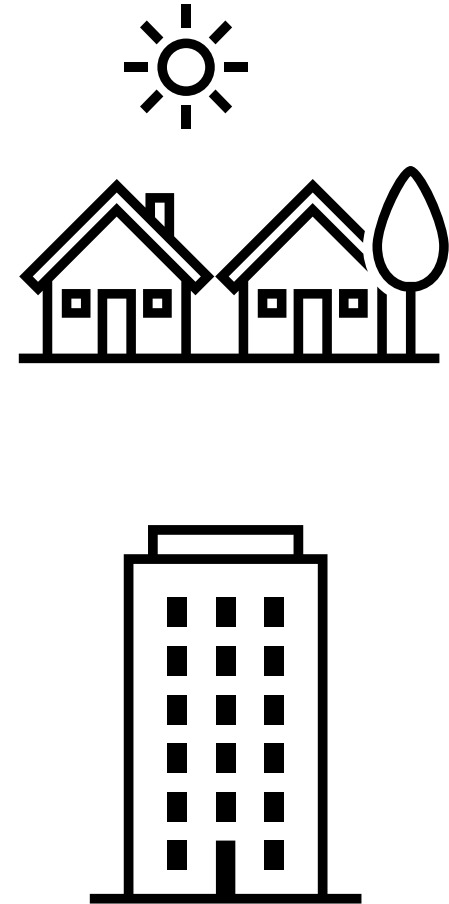
Exclude Housing Altogether?

- Some east African countries have excluded housing altogether in rural areas due to difficulty in constructing a reasonable use value
  - Very thin to non-existent rental markets in rural areas
  - Too hard to quantify cost / opportunity cost of living in your own home
  - Housing may not be something you need money for in rural parts of these countries
- Requires separate poverty lines for urban and rural areas
- Timor Leste considering excluding housing altogether due to very thin rental markets even in urban areas
- Tajikistan excluded housing altogether due to low rates of renting (most households still live in dwellings allocated by the communist state)

Robust Data Processing

- Check inputs into hedonic regression
  - Exclude any invalid values
  - Exclude outliers in actual rent paid (both upper and lower outliers) assuming log-normal distribution
  - Make sure actual rent paid is converted to common recall period
- Check percent of renters in each strata, R2 of regression, sign of coefficients
- Winsorize outliers for actual and imputed rent (can consider as one distribution)
- Any missing values in actual rent (household rents but value of actual rent is missing / invalid) can be imputed from the hedonic regression if using
- Check distributions

WMS 2022

Variable	Description
wq5103	On what basis did the HH occupy the dweeling?
wq5104a	How many living rooms the HH occupy?
wq5104b	Among the rooms,how many of them are bed rooms?
wq5105	Main construction material for the wall ?
wq5106	Main construction material for the roof ?
wq5107	The floor of the main dwelling is predominately made of what material?
wq5108	The ceiling of the main dweeling is predominantly made of what material?
wq5109	Does any member of the household including the Head own dwelling or own another
wq5110	How many dwellings does the household own in total
wq5201	WHO IS THE PRIMARY RESPONDENT FOR THIS SECTION?
wq5202	What is the main source oF light for the HH?
wq5203	During the past 7 days, how many outages/blackouts occurred
wq5204	During the past 7 days, how many hours long was a typical outage/blackout
wq5205	On average, how many hours of electricity were available each day during the last 7 days
wq5206	On average, how many hours of electricity were available each evening between 6pm to 12pm during the last 7 days? (Max 4 hours)
wq5207	In the last 12 months, did any of your appliances get damaged because of issue in the electrical system?
wq5208	What type of kitchen does the household use?
wq5209	Does the household share this kitchen with other household?
wq5210	What type of cookstove is your primary cookstove
wq5211	Where does your household normally cook with the cookstove?
wq5212	Do you usually use a chimney, hood or other exhaust system while using this stove?
wq5213	What is the primary type of oven (Mitad) used for backing Injera/bread?
wq5214	In the last 12 months, what is primary fuel you commonly used for this cookstove?
wq5302	What is the main source of drinking water in rainy season?

WMS 2022

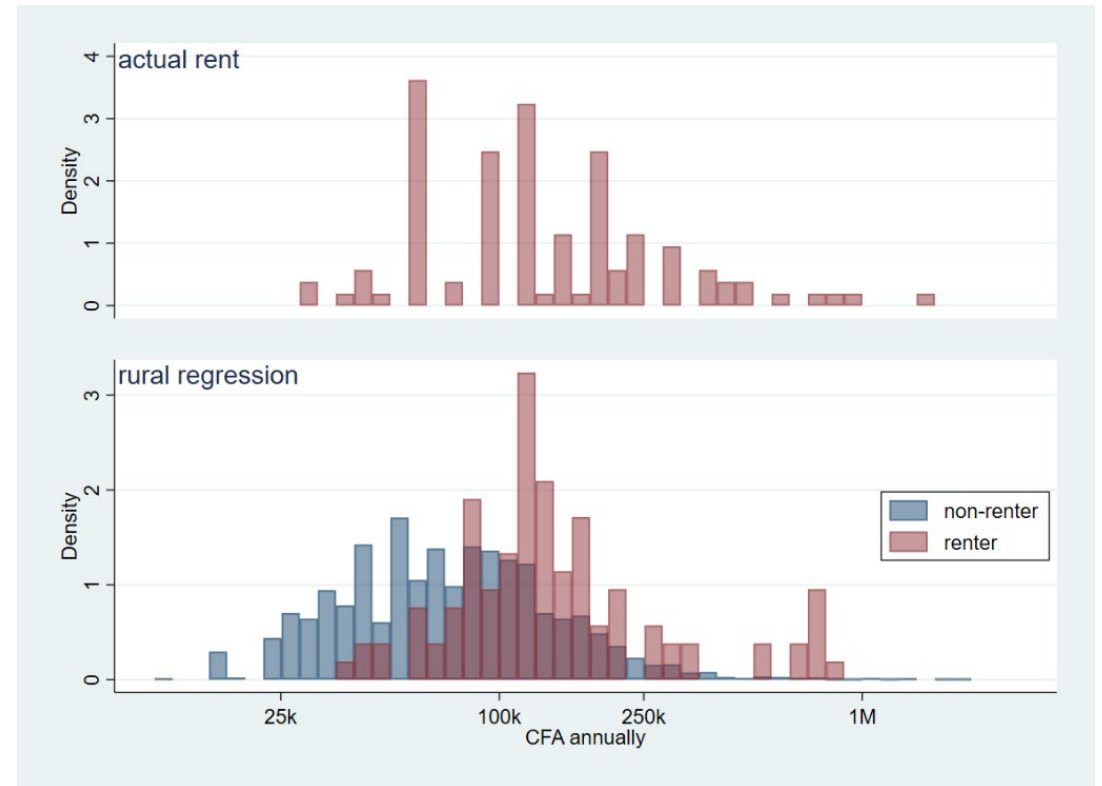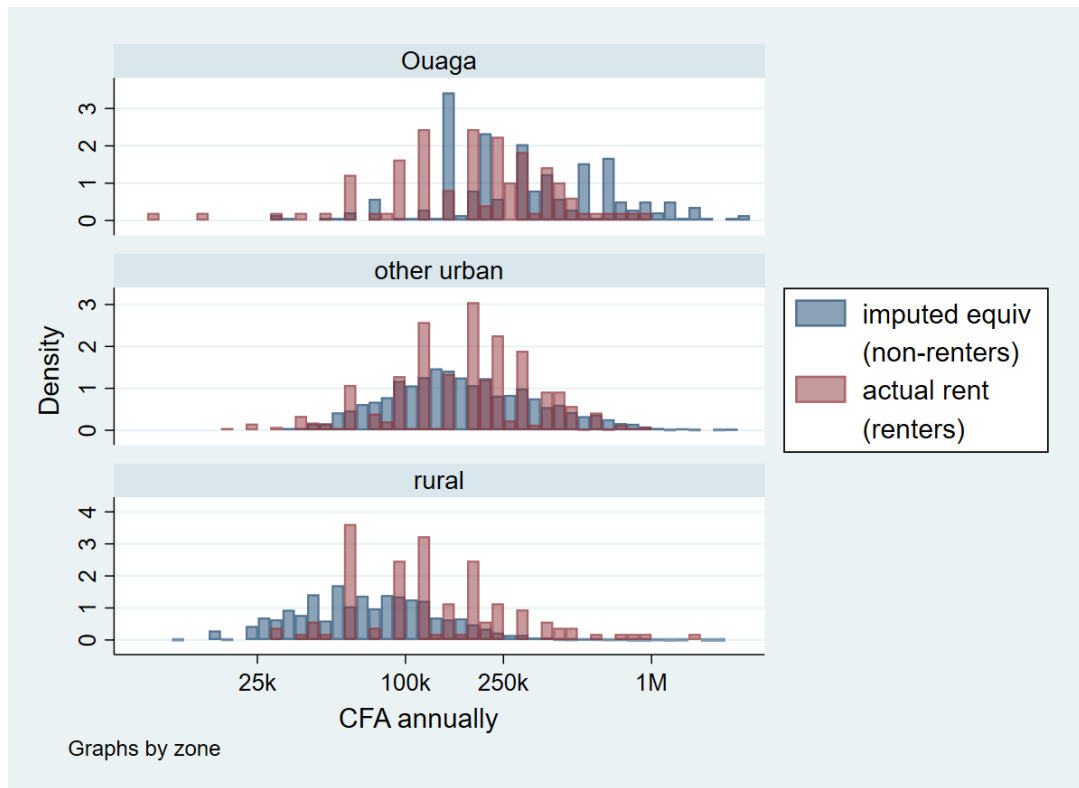| Variable	Description
wq5303	Where is the water from the rainy season source collected from?
wq5304	How long does it take to go there and come back?(in minutes)
wq5305	Out of which time spent waiting? (in minutes)
wq5306	In the last 30 days,has there been any time your household did not have sufficient quantities of drinking waterwhen needed?
wq5307	In the Rainy season, is your household's main source of drinking water different
wq5308	What is the main source of drinking water in dry season?
wq5309	Where is the water from the dry season source collected from?
wq5310	How long does it take to go there and come back?(in minutes)
wq5311	Out of which time spent waiting? (in minutes)
wq5312	In the last 30 days,has there been any time your household did not have suffici
wq5313	In the dry season, is your household's main source of drinking water different t
wq5314	What do you do to make the water safe for drinking?
wq5315	Does the household use Iodized Salt consumption?
wq5402	What type of toilet facilities does the HH use?
wq5403	Has your pit latrine or septic tank ever been emptied?
wq5404	The last time it was emptied, where were the contents emptied to?
wq5405	Is this toilet facility shared with other households?
wq5406	Where is the toilet facility located?
wq5407	What type of bathing facilities does the unit has?
wq5408	Is there a washing place or item in your dwelling or yard/plot members can wash
wq5409	At this moment, is there water available for the hand washing location or item?
wq5410	At this moment, do you have any soap or detergent available for hand washing?
wq5411	What type of solid waste disposal facilities does the household use?

Stratum	Household populations	Percent of renters	Number of observations for model	R-squared of model
Douala	1,418	50.7	698	0.74
Yaoundé	1,138	58.9	670	0.82
Autre Urbain	3,090	38.3	1,183	0.62
Rural	4,900	5.9	288	0.63
Total	10,546	26.8		

```
      Source |       SS           df       MS      Number of obs   =       698
-------------+----------------------------------   F(14, 683)      =    139.55
       Model |  203.193344        14  14.5138103   Prob > F        =    0.0000
    Residual |  71.0343592       683  .104003454   R-squared       =    0.7410
-------------+----------------------------------   Adj R-squared   =    0.7357
       Total |  274.227703       697  .393440034   Root MSE        =     .3225

------------------------------------------------------------------------------
     lnloyer | Coefficient  Std. err.      t    P>|t|     [95% conf. interval]
-------------+----------------------------------------------------------------
     lnpiece |   .6646646   .0266767    24.92   0.000     .6122864    .7170429
     toilet1 |   .2040172    .032664     6.25   0.000     .1398833    .2681511
        sol2 |    .248517   .0331627     7.49   0.000      .183404      .31363
        clim |   .5509055   .0797434     6.91   0.000      .394334    .7074771
  route_goud |   .1274475   .0303283     4.20   0.000     .0678995    .1869954
        mur1 |   .1594682   .0382358     4.17   0.000     .0843944     .234542
         eau |   .0988231   .0298864     3.31   0.001     .0401429    .1575033
     eausee1 |   .1357262   .0356572     3.81   0.000     .0657153    .2057371
      excre2 |   .0744715   .0282468     2.64   0.009     .0190106    .1299324
    ordures2 |   .1192191   .0496455     2.40   0.017     .0217428    .2166953
     eausee3 |   .0730525   .0343174     2.13   0.034     .0056723    .1404327
  reseau_tel |  -.2010445   .0900249    -2.23   0.026    -.3778033   -.0242856
  route_late |   .0706526   .0324785     2.18   0.030     .0068829    .1344222
    ordures1 |   .0842887   .0492931     1.71   0.088    -.0124954    .1810729
       _cons |   11.88372   .1016803   116.87   0.000     11.68407    12.08336
------------------------------------------------------------------------------
```
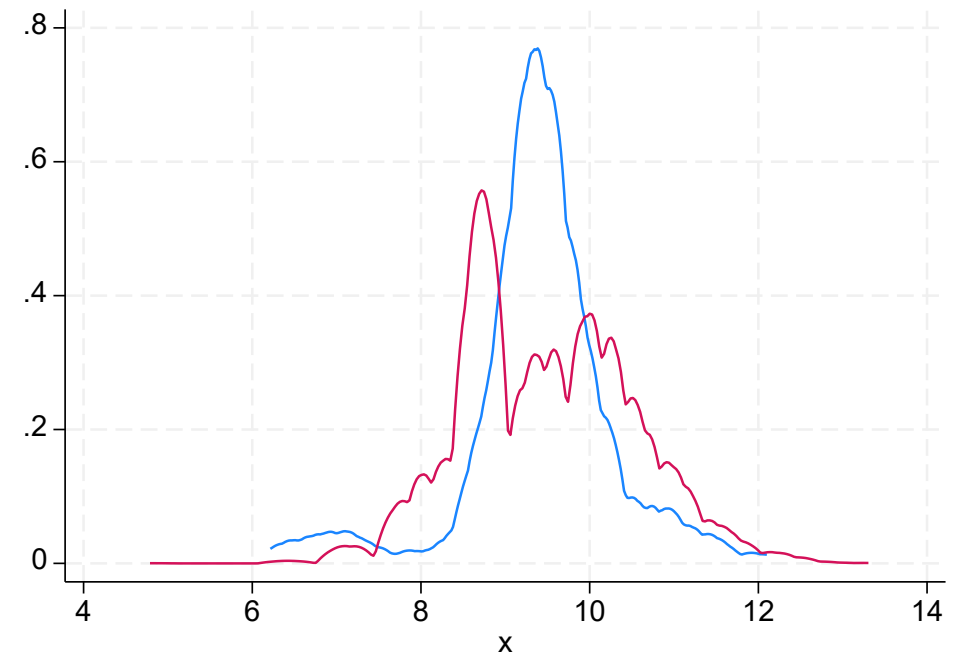
Reporting Imputation Results

Sample graph 1

Sample graph 2