Decompose Right Hand Side Variables from Linear Regression

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Contents

Decompose RHS

Go back to fan's REconTools Package, R4Econ Repository, or Intro Stats with R Repository.

One runs a number of regressions. With different outcomes, and various right hand side variables.

What is the remaining variation in the left hand side variable if right hand side variable one by one is set to the average of the observed values.

- Dependency: *R4Econ/linreg/ivreg/ivregdfrow.R*

The code below does not work with categorical variables (except for dummies). Dummy variable inputs need to be converted to zero/one first.

```
ff_lr_decompose <- function(df, vars.y, vars.x, vars.c, vars.z, vars.other.keep,
                            list.vars.tomean, list.vars.tomean.name.suffix,
                            df.reg.out = NULL,
                            graph=FALSE, graph.nrow=2) {

    vars.xc <- c(vars.x, vars.c)

    # Regressions
    # regf.iv from C:\Users\fan\R4Econ\linreg\ivreg\ivregdfrow.R
    if(is.null(df.reg.out)) {
      df.reg.out <- as_tibble(bind_rows(lapply(vars.y, regf.iv,
                                               vars.x=vars.x, vars.c=vars.c, vars.z=vars.z, df=df)))
    }

    # Select Variables
    str.esti.suffix <- '_Estimate'
    arr.esti.name <- paste0(vars.xc, str.esti.suffix)
    str.outcome.name <- 'vars_var.y'
    arr.columns2select <- c(arr.esti.name, str.outcome.name)
    # arr.columns2select

    # Generate dataframe for coefficients
    df.coef <- df.reg.out[,c(arr.columns2select)] %>% mutate_at(vars(arr.esti.name), as.numeric) %>% co
    # df.coef
    # str(df.coef)
```

```
    # Decomposition Step 1: gather
    df.decompose <- df %>%
                            filter(svymthRound %in% c(12, 18, 24)) %>%
                            select(one_of(c(vars.other.keep, vars.xc, vars.y))) %>%
                            drop_na() %>%
                            gather(variable, value, -one_of(c(vars.other.keep, vars.xc)))

    # Decomposition Step 2: mutate_at(vars, funs(mean = mean(.)))
    # the xc averaging could have taken place earlier, no difference in mean across variables
    df.decompose <- df.decompose %>%
                          group_by(variable) %>%
                          mutate_at(vars(c(vars.xc, 'value')), funs(mean = mean(.))) %>%
                          ungroup()

    # Decomposition Step 3 With Loop
    for (i in 1:length(list.vars.tomean)) {
        var.decomp.cur <- (paste0('value', list.vars.tomean.name.suffix[[i]]))
        vars.tomean <- list.vars.tomean[[i]]
        var.decomp.cur
        df.decompose <- df.decompose %>% mutate((!!var.decomp.cur) := ff_lr_decompose_valadj(., df.coef
    }

    # Additional Statistics
    df.decompose.var.frac <- df.decompose %>%
            select(variable, contains('value')) %>%
            group_by(variable) %>%
            summarize_all(funs(mean = mean, var = var)) %>%
            select(variable, matches('value')) %>% select(variable, ends_with("_var")) %>%
            mutate_if(is.numeric, funs( frac = (./value_var))) %>%
            mutate_if(is.numeric, round, 3)

    # Graph
    g.graph.dist <- NULL
    if (graph) {
      g.graph.dist <- df.decompose %>%
          select(variable, contains('value'), -value_mean) %>%
          rename(outcome = variable) %>%
          gather(variable, value, -outcome) %>%
          ggplot(aes(x=value, color = variable, fill = variable)) +
              geom_line(stat = "density") +
              facet_wrap(~ outcome, scales='free', nrow=graph.nrow)
    }

    # Return
    return(list(dfmain = df.decompose,
                dfsumm = df.decompose.var.frac,
                graph = g.graph.dist))

}

# Support Function
ff_lr_decompose_valadj <- function(df, df.coef, vars.tomean, str.esti.suffix) {
    new_value <- (df$value +
```

```
                    rowSums((df[paste0(vars.tomean, '_mean')] - df[vars.tomean])
                            *df.coef[df$variable, paste0(vars.tomean, str.esti.suffix)]))
    return(new_value)
}
```

Decomposition Program

```
# Library
library(tidyverse)
library(AER)

# Load Sample Data
setwd('C:/Users/fan/R4Econ/_data/')
df <- read_csv('height_weight.csv')
```

Prepare Decomposition Data

```
## Parsed with column specification:
## cols(
##   S.country = col_character(),
##   vil.id = col_double(),
##   indi.id = col_double(),
##   sex = col_character(),
##   svymthRound = col_double(),
##   momEdu = col_double(),
##   wealthIdx = col_double(),
##   hgt = col_double(),
##   wgt = col_double(),
##   hgt0 = col_double(),
##   wgt0 = col_double(),
##   prot = col_double(),
##   cal = col_double(),
##   p.A.prot = col_double(),
##   p.A.nProt = col_double()
## )
```

```
# Source Dependency
source('C:/Users/fan/R4Econ/linreg/ivreg/ivregdfrow.R')

# Setting
options(repr.matrix.max.rows=50, repr.matrix.max.cols=50)
```

Data Cleaning.

```
# Convert Variable for Sex which is categorical to Numeric
df <- df
df$male <- (as.numeric(factor(df$sex)) - 1)
summary(factor(df$sex))
```

```
## Female   Male
##  16446  18619
```

```
summary(df$male)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.000   0.000   1.000   0.531   1.000   1.000
```

Parameters.

```
var.y1 <- c('hgt')
var.y2 <- c('wgt')
vars.y <- c(var.y1, var.y2)
vars.x <- c('prot')
vars.c <- c('male', 'wgt0', 'hgt0', 'svymthRound')
vars.other.keep <- c('S.country', 'vil.id', 'indi.id', 'svymthRound')

# Decompose sequence
vars.tomean.first <- c('male', 'hgt0')
var.tomean.first.name.suffix <- '_A'
vars.tomean.third <- c(vars.tomean.first, 'prot')
var.tomean.third.name.suffix <- '_B'
vars.tomean.fourth <- c(vars.tomean.third, 'svymthRound')
var.tomean.fourth.name.suffix <- '_C'
list.vars.tomean = list(vars.tomean.first,
                        vars.tomean.third,
                        vars.tomean.fourth)
list.vars.tomean.name.suffix <- list(var.tomean.first.name.suffix,
                                     var.tomean.third.name.suffix,
                                     var.tomean.fourth.name.suffix)
```

```
df.use <- df %>% filter(S.country == 'Guatemala') %>% filter(svymthRound %in% c(12, 18, 24))
vars.z <- NULL
list.out <- ff_lr_decompose(df=df.use, vars.y, vars.x, vars.c, vars.z, vars.other.keep,
                            list.vars.tomean, list.vars.tomean.name.suffix,
                            graph=TRUE, graph.nrow=1)
options(repr.matrix.max.rows=10, repr.matrix.max.cols=50)
list.out$dfmain
```

Example Guatemala OLS

```
## # A tibble: 1,382 x 19
##    S.country vil.id indi.id svymthRound  prot  male  wgt0  hgt0 variable value prot_mean male_mean
##    <chr>      <dbl>   <dbl>       <dbl> <dbl> <dbl> <dbl> <dbl> <chr>    <dbl>     <dbl>     <dbl>
##  1 Guatemala      3    1352          18  13.3     1 2545.  47.4 hgt       70.2      20.6     0.550
##  2 Guatemala      3    1352          24  46.3     1 2545.  47.4 hgt       75.8      20.6     0.550
##  3 Guatemala      3    1354          12   1       1 3634.  51.2 hgt       66.3      20.6     0.550
##  4 Guatemala      3    1354          18   9.8     1 3634.  51.2 hgt       69.2      20.6     0.550
##  5 Guatemala      3    1354          24  15.4     1 3634.  51.2 hgt       75.3      20.6     0.550
##  6 Guatemala      3    1356          12   8.6     1 3912.  51.9 hgt       68.1      20.6     0.550
##  7 Guatemala      3    1356          18  17.8     1 3912.  51.9 hgt       74.1      20.6     0.550
##  8 Guatemala      3    1356          24  30.5     1 3912.  51.9 hgt       77.1      20.6     0.550
##  9 Guatemala      3    1357          12   1       1 3791.  52.6 hgt       71.5      20.6     0.550
## 10 Guatemala      3    1357          18  12.7     1 3791.  52.6 hgt       77.8      20.6     0.550
## # ... with 1,372 more rows, and 7 more variables: wgt0_mean <dbl>, hgt0_mean <dbl>,
## #   svymthRound_mean <dbl>, value_mean <dbl>, value_A <dbl>, value_B <dbl>, value_C <dbl>
```

```
options(repr.plot.width = 10, repr.plot.height = 4)
list.out$dfsumm
```

```
## # A tibble: 2 x 11
##   variable value_var value_mean_var value_A_var value_B_var value_C_var value_var_frac
##   <chr>        <dbl>          <dbl>       <dbl>       <dbl>       <dbl>          <dbl>
```

```
## 1 hgt           21.9             NA        20.3        18.4        8.40              1
## 2 wgt      2965693.              NA   2863501.    2659434.   2346297.               1
## # ... with 4 more variables: value_mean_var_frac <dbl>, value_A_var_frac <dbl>,
## #   value_B_var_frac <dbl>, value_C_var_frac <dbl>
```

```
df.use <- df %>% filter(S.country == 'Guatemala') %>% filter(svymthRound %in% c(12, 18, 24))
vars.z <- c('vil.id')
list.out <- ff_lr_decompose(df=df.use, vars.y, vars.x, vars.c, vars.z, vars.other.keep,
                            list.vars.tomean, list.vars.tomean.name.suffix,
                            graph=TRUE, graph.nrow=1)
```

Example Guatemala IV = vil.id

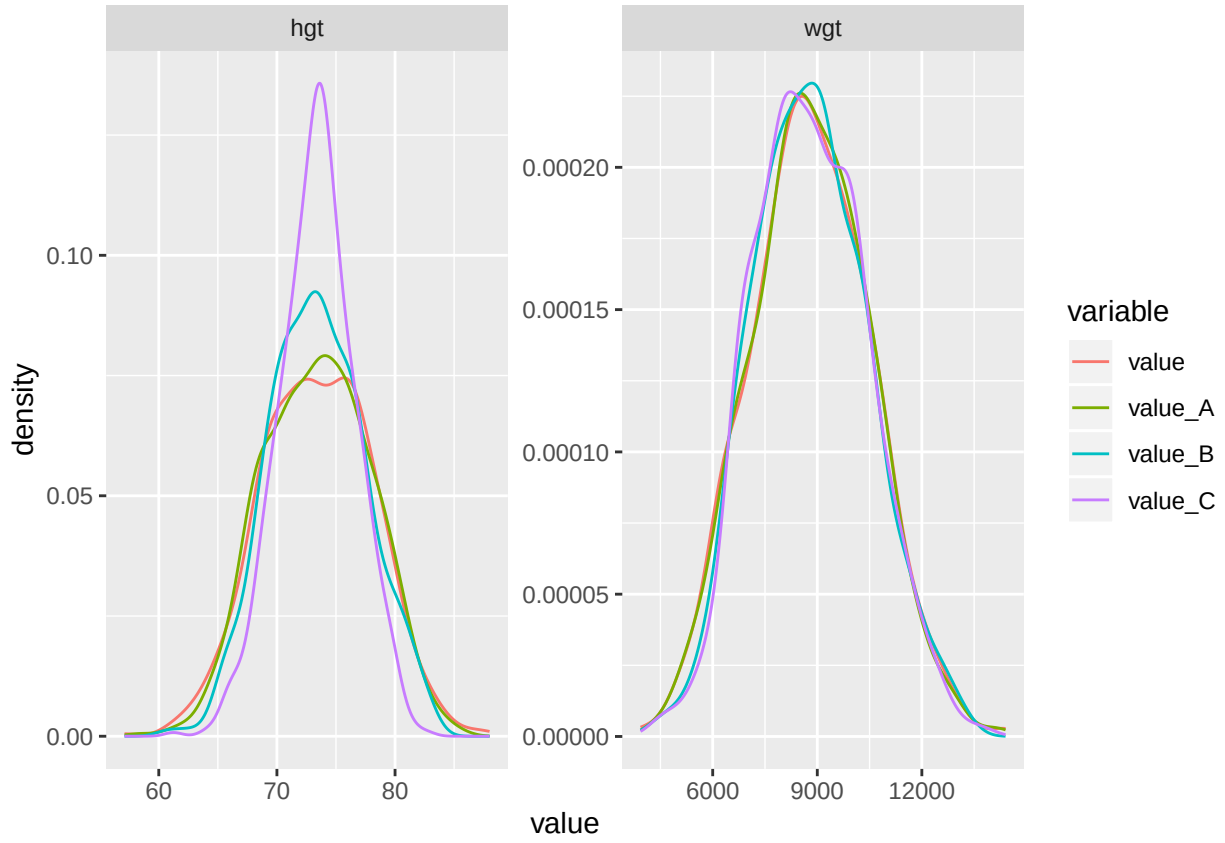
```
## Warning: attributes are not identical across measure variables;
## they will be dropped

## Warning: attributes are not identical across measure variables;
## they will be dropped
```

```
list.out$dfsumm
```

```
## # A tibble: 2 x 11
##   variable value_var value_mean_var value_A_var value_B_var value_C_var value_var_frac
##   <chr>        <dbl>          <dbl>       <dbl>       <dbl>       <dbl>          <dbl>
## 1 hgt           21.9             NA        20.2        16.3        10.0              1
## 2 wgt      2965693.              NA   2876683.    2676220.    2583301.               1
## # ... with 4 more variables: value_mean_var_frac <dbl>, value_A_var_frac <dbl>,
## #   value_B_var_frac <dbl>, value_C_var_frac <dbl>
```

```
options(repr.plot.width = 10, repr.plot.height = 2)
list.out$graph
```




```
df.use <- df %>% filter(S.country == 'Cebu') %>% filter(svymthRound %in% c(12, 18, 24))
vars.z <- NULL
list.out <- ff_lr_decompose(df=df.use, vars.y, vars.x, vars.c, vars.z, vars.other.keep,
                            list.vars.tomean, list.vars.tomean.name.suffix,
                            graph=TRUE, graph.nrow=1)
options(repr.matrix.max.rows=10, repr.matrix.max.cols=50)
list.out$dfmain
```

Example Cebu OLS

```
## # A tibble: 7,262 x 19
##    S.country vil.id indi.id svymthRound  prot  male  wgt0  hgt0 variable value prot_mean male_mean
##    <chr>      <dbl>   <dbl>       <dbl> <dbl> <dbl> <dbl> <dbl> <chr>    <dbl>     <dbl>     <dbl>
##  1 Cebu           1       1          12  11.3     1 2044.  44.2 hgt       70.8      17.0     0.526
##  2 Cebu           1       2          12   5.9     0 2840.  49.7 hgt       72.2      17.0     0.526
##  3 Cebu           1       2          18   0.5     0 2840.  49.7 hgt       76.5      17.0     0.526
##  4 Cebu           1       2          24  14.1     0 2840.  49.7 hgt       79.2      17.0     0.526
##  5 Cebu           1       3          12  21.4     0 3446.  51.7 hgt       68        17.0     0.526
##  6 Cebu           1       3          18  23.6     0 3446.  51.7 hgt       71.6      17.0     0.526
##  7 Cebu           1       3          24  20.6     0 3446.  51.7 hgt       76.7      17.0     0.526
##  8 Cebu           1       4          12   0.7     0 3091.  50.2 hgt       69.1      17.0     0.526
##  9 Cebu           1       4          18   7.2     0 3091.  50.2 hgt       74.3      17.0     0.526
## 10 Cebu           1       4          24  10.3     0 3091.  50.2 hgt       78.1      17.0     0.526
## # ... with 7,252 more rows, and 7 more variables: wgt0_mean <dbl>, hgt0_mean <dbl>,
## #   svymthRound_mean <dbl>, value_mean <dbl>, value_A <dbl>, value_B <dbl>, value_C <dbl>
```

```
options(repr.plot.width = 10, repr.plot.height = 4)
list.out$dfsumm
```

```
## # A tibble: 2 x 11
##   variable value_var value_mean_var value_A_var value_B_var value_C_var value_var_frac
##   <chr>        <dbl>          <dbl>       <dbl>       <dbl>       <dbl>          <dbl>
## 1 hgt           24.4             NA        22.6        21.3        10.0              1
## 2 wgt      3337461.              NA   3218987.    3039514.    2558514.               1
## # ... with 4 more variables: value_mean_var_frac <dbl>, value_A_var_frac <dbl>,
## #   value_B_var_frac <dbl>, value_C_var_frac <dbl>
```

```
df.use <- df %>% filter(S.country == 'Cebu') %>% filter(svymthRound %in% c(12, 18, 24))
vars.z <- c('wealthIdx')
list.out <- ff_lr_decompose(df=df.use, vars.y, vars.x, vars.c, vars.z, vars.other.keep,
                            list.vars.tomean, list.vars.tomean.name.suffix,
                            graph=TRUE, graph.nrow=1)
```

Example Cebu IV

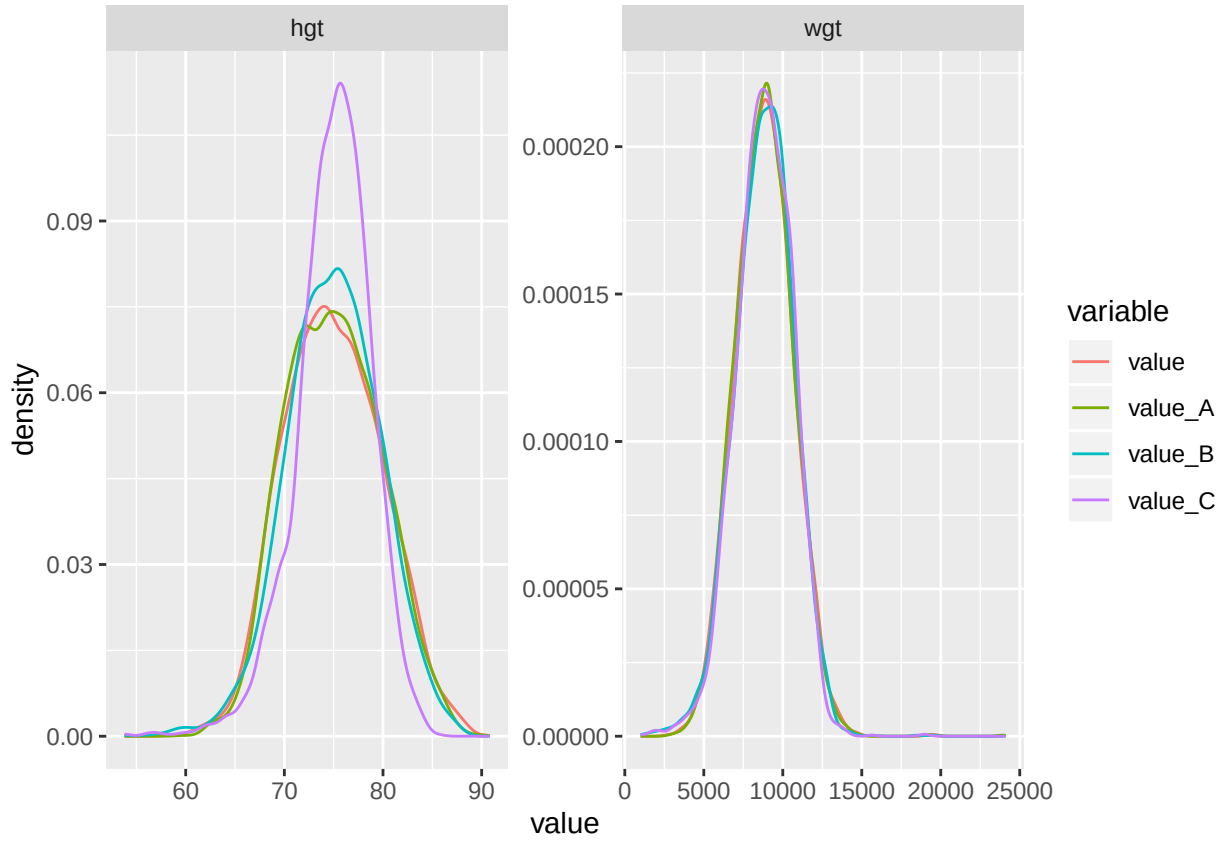
```
## Warning: attributes are not identical across measure variables;
## they will be dropped

## Warning: attributes are not identical across measure variables;
## they will be dropped
```

```
list.out$dfsumm
```

```
## # A tibble: 2 x 11
##   variable value_var value_mean_var value_A_var value_B_var value_C_var value_var_frac
##   <chr>        <dbl>          <dbl>       <dbl>       <dbl>       <dbl>          <dbl>
## 1 hgt           24.4             NA        22.6        22.2        14.4              1
## 2 wgt      3337461.              NA   3237415.    3385815.    3158659.               1
## # ... with 4 more variables: value_mean_var_frac <dbl>, value_A_var_frac <dbl>,
## #   value_B_var_frac <dbl>, value_C_var_frac <dbl>
```

```
options(repr.plot.width = 10, repr.plot.height = 2)
list.out$graph
```



Examples Line by Line The examples are just to test the code with different types of variables.

```
df.use <- df %>% filter(S.country == 'Guatemala') %>% filter(svymthRound %in% c(12, 18, 24))
dim(df.use)
```

```
## [1] 2022   16
```

Setting Up Parameters.

```
# Define Left Hand Side Variables
var.y1 <- c('hgt')
var.y2 <- c('wgt')
vars.y <- c(var.y1, var.y2)
# Define Right Hand Side Variables
vars.x <- c('prot')
vars.c <- c('male', 'wgt0', 'hgt0', 'svymthRound')
# vars.z <- c('p.A.prot')
vars.z <- c('vil.id')
# vars.z <- NULL
vars.xc <- c(vars.x, vars.c)

# Other variables to keep
vars.other.keep <- c('S.country', 'vil.id', 'indi.id', 'svymthRound')

# Decompose sequence
vars.tomean.first <- c('male', 'hgt0')
var.tomean.first.name.suffix <- '_mh02m'
```

```
vars.tomean.second <- c(vars.tomean.first, 'hgt0', 'wgt0')
var.tomean.second.name.suffix <- '_mh0me2m'
vars.tomean.third <- c(vars.tomean.second, 'prot')
var.tomean.third.name.suffix <- '_mh0mep2m'
vars.tomean.fourth <- c(vars.tomean.third, 'svymthRound')
var.tomean.fourth.name.suffix <- '_mh0mepm2m'
list.vars.tomean = list(
#                         vars.tomean.first,
                        vars.tomean.second,
                        vars.tomean.third,
                        vars.tomean.fourth
                        )
list.vars.tomean.name.suffix <- list(
#                                     var.tomean.first.name.suffix,
                                    var.tomean.second.name.suffix,
                                    var.tomean.third.name.suffix,
                                    var.tomean.fourth.name.suffix
                                   )
```

```
# Regressions
# regf.iv from C:\Users\fan\R4Econ\linreg\ivreg\ivregdfrow.R
df.reg.out <- as_tibble(bind_rows(lapply(vars.y, regf.iv,
                                         vars.x=vars.x, vars.c=vars.c, vars.z=vars.z, df=df)))
```

Obtain Regression Coefficients from somewhere

```
## Warning: attributes are not identical across measure variables;
## they will be dropped

## Warning: attributes are not identical across measure variables;
## they will be dropped
```

```
# Regressions
# reg1 <- regf.iv(var.y = var.y1, vars.x, vars.c, vars.z, df.use)
# reg2 <- regf.iv(var.y = var.y2, vars.x, vars.c, vars.z, df.use)
# df.reg.out <- as_tibble(bind_rows(reg1, reg2))
```

```
options(repr.matrix.max.rows=50, repr.matrix.max.cols=50)
df.reg.out
```

```
## # A tibble: 2 x 37
##   X.Intercept._Es~ X.Intercept._Pr~ X.Intercept._St~ X.Intercept._zv~ hgt0_Estimate hgt0_Pr...z..
##   <chr>            <chr>            <chr>            <chr>            <chr>         <chr>
## 1 22.2547168993562 8.9088080511633~ 1.21637209166939 18.2959778934199 0.6834853337~ 4.5575874740~
## 2 -1101.090058068~ 0.0051062029326~ 393.210441213089 -2.800256408938~ 75.486789661~ 3.0043362381~
## # ... with 31 more variables: hgt0_Std.Error <chr>, hgt0_zvalue <chr>, male_Estimate <chr>,
## #   male_Pr...z.. <chr>, male_Std.Error <chr>, male_zvalue <chr>, prot_Estimate <chr>,
## #   prot_Pr...z.. <chr>, prot_Std.Error <chr>, prot_zvalue <chr>, Sargan_df1 <chr>,
## #   svymthRound_Estimate <chr>, svymthRound_Pr...z.. <chr>, svymthRound_Std.Error <chr>,
## #   svymthRound_zvalue <chr>, vars_var.y <chr>, vars_vars.c <chr>, vars_vars.x <chr>,
## #   vars_vars.z <chr>, Weakinstruments_df1 <chr>, Weakinstruments_df2 <chr>,
## #   Weakinstruments_p.value <chr>, Weakinstruments_statistic <chr>, wgt0_Estimate <chr>,
## #   wgt0_Pr...z.. <chr>, wgt0_Std.Error <chr>, wgt0_zvalue <chr>, Wu.Hausman_df1 <chr>,
## #   Wu.Hausman_df2 <chr>, Wu.Hausman_p.value <chr>, Wu.Hausman_statistic <chr>
```

```
# Select Variables
str.esti.suffix <- '_Estimate'
arr.esti.name <- paste0(vars.xc, str.esti.suffix)
str.outcome.name <- 'vars_var.y'
arr.columns2select <- c(arr.esti.name, str.outcome.name)
arr.columns2select
```

```
## [1] "prot_Estimate"        "male_Estimate"        "wgt0_Estimate"        "hgt0_Estimate"
## [5] "svymthRound_Estimate" "vars_var.y"
```

```
# Generate dataframe for coefficients
df.coef <- df.reg.out[,c(arr.columns2select)] %>% mutate_at(vars(arr.esti.name), as.numeric) %>% column
df.coef
```

```
##     prot_Estimate male_Estimate wgt0_Estimate hgt0_Estimate svymthRound_Estimate
## hgt    -0.2714772      1.244735  0.0004430418     0.6834853             1.133919
## wgt   -59.0727542    489.852902  0.7696158110    75.4867897           250.778883
```

```
str(df.coef)
```

```
## 'data.frame':    2 obs. of  5 variables:
##  $ prot_Estimate       : num  -0.271 -59.073
##  $ male_Estimate       : num  1.24 489.85
##  $ wgt0_Estimate       : num  0.000443 0.769616
##  $ hgt0_Estimate       : num  0.683 75.487
##  $ svymthRound_Estimate: num  1.13 250.78
```

```
# Decomposition Step 1: gather
df.decompose_step1 <- df.use %>%
                      filter(svymthRound %in% c(12, 18, 24)) %>%
                      select(one_of(c(vars.other.keep, vars.xc, vars.y))) %>%
                      drop_na() %>%
                      gather(variable, value, -one_of(c(vars.other.keep, vars.xc)))
options(repr.matrix.max.rows=20, repr.matrix.max.cols=20)
dim(df.decompose_step1)
```

Decomposition Step 1

```
## [1] 1382   10
```

```
df.decompose_step1
```

```
## # A tibble: 1,382 x 10
##    S.country vil.id indi.id svymthRound  prot  male  wgt0  hgt0 variable value
##    <chr>      <dbl>   <dbl>       <dbl> <dbl> <dbl> <dbl> <dbl> <chr>    <dbl>
##  1 Guatemala      3    1352          18  13.3     1 2545.  47.4 hgt       70.2
##  2 Guatemala      3    1352          24  46.3     1 2545.  47.4 hgt       75.8
##  3 Guatemala      3    1354          12   1       1 3634.  51.2 hgt       66.3
##  4 Guatemala      3    1354          18   9.8     1 3634.  51.2 hgt       69.2
##  5 Guatemala      3    1354          24  15.4     1 3634.  51.2 hgt       75.3
##  6 Guatemala      3    1356          12   8.6     1 3912.  51.9 hgt       68.1
##  7 Guatemala      3    1356          18  17.8     1 3912.  51.9 hgt       74.1
##  8 Guatemala      3    1356          24  30.5     1 3912.  51.9 hgt       77.1
##  9 Guatemala      3    1357          12   1       1 3791.  52.6 hgt       71.5
## 10 Guatemala      3    1357          18  12.7     1 3791.  52.6 hgt       77.8
## # ... with 1,372 more rows
```

```
# Decomposition Step 2: mutate_at(vars, funs(mean = mean(.)))
# the xc averaging could have taken place earlier, no difference in mean across variables
df.decompose_step2 <- df.decompose_step1 %>%
                        group_by(variable) %>%
                        mutate_at(vars(c(vars.xc, 'value')), funs(mean = mean(.))) %>%
                        ungroup()

options(repr.matrix.max.rows=20, repr.matrix.max.cols=20)
dim(df.decompose_step2)
```

Decomposition Step 2

```
## [1] 1382   16
```

```
df.decompose_step2
```

```
## # A tibble: 1,382 x 16
##    S.country vil.id indi.id svymthRound  prot  male  wgt0  hgt0 variable value prot_mean male_mean
##    <chr>      <dbl>   <dbl>       <dbl> <dbl> <dbl> <dbl> <dbl> <chr>    <dbl>     <dbl>     <dbl>
##  1 Guatemala      3    1352          18  13.3     1 2545.  47.4 hgt       70.2      20.6     0.550
##  2 Guatemala      3    1352          24  46.3     1 2545.  47.4 hgt       75.8      20.6     0.550
##  3 Guatemala      3    1354          12   1       1 3634.  51.2 hgt       66.3      20.6     0.550
##  4 Guatemala      3    1354          18   9.8     1 3634.  51.2 hgt       69.2      20.6     0.550
##  5 Guatemala      3    1354          24  15.4     1 3634.  51.2 hgt       75.3      20.6     0.550
##  6 Guatemala      3    1356          12   8.6     1 3912.  51.9 hgt       68.1      20.6     0.550
##  7 Guatemala      3    1356          18  17.8     1 3912.  51.9 hgt       74.1      20.6     0.550
##  8 Guatemala      3    1356          24  30.5     1 3912.  51.9 hgt       77.1      20.6     0.550
##  9 Guatemala      3    1357          12   1       1 3791.  52.6 hgt       71.5      20.6     0.550
## 10 Guatemala      3    1357          18  12.7     1 3791.  52.6 hgt       77.8      20.6     0.550
## # ... with 1,372 more rows, and 4 more variables: wgt0_mean <dbl>, hgt0_mean <dbl>,
## #   svymthRound_mean <dbl>, value_mean <dbl>
```

```
ff_lr_decompose_valadj <- function(df, df.coef, vars.tomean, str.esti.suffix) {
    new_value <- (df$value +
                  rowSums((df[paste0(vars.tomean, '_mean')] - df[vars.tomean])
                          *df.coef[df$variable, paste0(vars.tomean, str.esti.suffix)]))
    return(new_value)
}

# # Decomposition Step 3: mutate_at(vars, funs(mean = mean(.)))
# var.decomp.one <- (paste0('value', list.vars.tomean.name.suffix[[1]]))
# var.decomp.two <- (paste0('value', list.vars.tomean.name.suffix[[2]]))
# var.decomp.thr <- (paste0('value', list.vars.tomean.name.suffix[[3]]))
# df.decompose_step3 <- df.decompose_step2 %>%
#                         mutate((!!var.decomp.one) := f_decompose_here(., df.coef, list.vars.tomean[[1
#                                (!!var.decomp.two) := f_decompose_here(., df.coef, list.vars.tomean[[2
#                                (!!var.decomp.thr) := f_decompose_here(., df.coef, list.vars.tomean[[3

# options(repr.matrix.max.rows=10, repr.matrix.max.cols=20)
# dim(df.decompose_step3)
# df.decompose_step3
```

Decomposition Step 3 Non-Loop

```
df.decompose_step3 <- df.decompose_step2
for (i in 1:length(list.vars.tomean)) {
    var.decomp.cur <- (paste0('value', list.vars.tomean.name.suffix[[i]]))
    vars.tomean <- list.vars.tomean[[i]]
    var.decomp.cur
    df.decompose_step3 <- df.decompose_step3 %>% mutate((!!var.decomp.cur) := ff_lr_decompose_valadj(.,

}
options(repr.matrix.max.rows=10, repr.matrix.max.cols=20)
dim(df.decompose_step3)
```

Decomposition Step 3 With Loop

```
## [1] 1382   19
```

```
df.decompose_step3
```

```
## # A tibble: 1,382 x 19
##    S.country vil.id indi.id svymthRound  prot  male  wgt0  hgt0 variable value prot_mean male_mean
##    <chr>      <dbl>   <dbl>       <dbl> <dbl> <dbl> <dbl> <dbl> <chr>    <dbl>     <dbl>     <dbl>
##  1 Guatemala      3    1352          18  13.3     1 2545.  47.4 hgt       70.2      20.6     0.550
##  2 Guatemala      3    1352          24  46.3     1 2545.  47.4 hgt       75.8      20.6     0.550
##  3 Guatemala      3    1354          12   1       1 3634.  51.2 hgt       66.3      20.6     0.550
##  4 Guatemala      3    1354          18   9.8     1 3634.  51.2 hgt       69.2      20.6     0.550
##  5 Guatemala      3    1354          24  15.4     1 3634.  51.2 hgt       75.3      20.6     0.550
##  6 Guatemala      3    1356          12   8.6     1 3912.  51.9 hgt       68.1      20.6     0.550
##  7 Guatemala      3    1356          18  17.8     1 3912.  51.9 hgt       74.1      20.6     0.550
##  8 Guatemala      3    1356          24  30.5     1 3912.  51.9 hgt       77.1      20.6     0.550
##  9 Guatemala      3    1357          12   1       1 3791.  52.6 hgt       71.5      20.6     0.550
## 10 Guatemala      3    1357          18  12.7     1 3791.  52.6 hgt       77.8      20.6     0.550
## # ... with 1,372 more rows, and 7 more variables: wgt0_mean <dbl>, hgt0_mean <dbl>,
## #   svymthRound_mean <dbl>, value_mean <dbl>, value_mh0me2m <dbl>, value_mh0mep2m <dbl>,
## #   value_mh0mepm2m <dbl>
```

```
df.decompose_step3 %>%
        select(variable, contains('value')) %>%
        group_by(variable) %>%
        summarize_all(funs(mean = mean, var = var)) %>%
        select(matches('value')) %>% select(ends_with("_var")) %>%
        mutate_if(is.numeric, funs( frac = (./value_var))) %>%
        mutate_if(is.numeric, round, 3)
```

Decomposition Step 4 Variance

```
## # A tibble: 2 x 10
##   value_var value_mean_var value_mh0me2m_v~ value_mh0mep2m_~ value_mh0mepm2m~ value_var_frac
##       <dbl>          <dbl>            <dbl>            <dbl>            <dbl>          <dbl>
## 1      21.9             NA             25.4             49.0             23.1              1
## 2 2965693.              NA        2949188.         4192770.         3147507.               1
## # ... with 4 more variables: value_mean_var_frac <dbl>, value_mh0me2m_var_frac <dbl>,
## #   value_mh0mep2m_var_frac <dbl>, value_mh0mepm2m_var_frac <dbl>
```

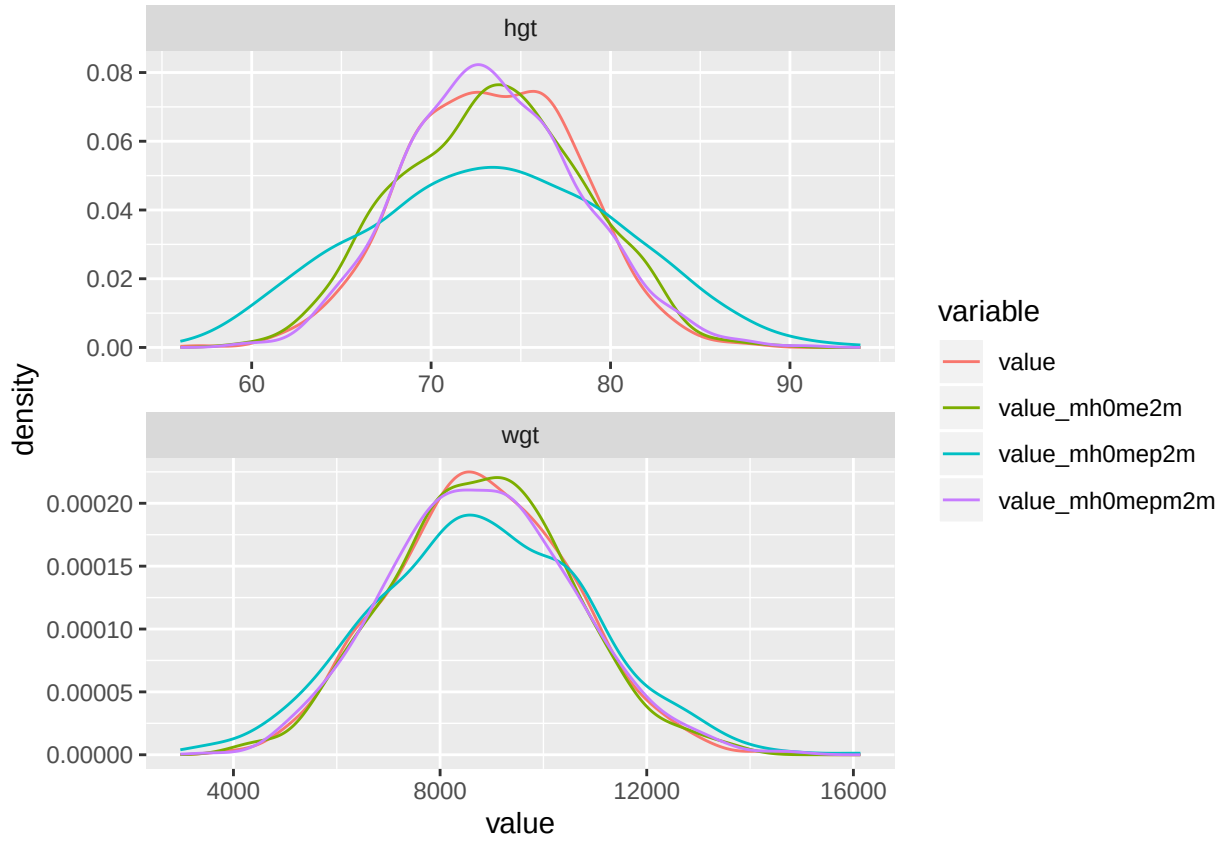
Graphical Results Graphically, difficult to pick up exact differences in variance, a 50 percent reduction in variance visually does not look like 50 percent. Intuitively, we are kind of seeing standard deviation, not

variance on the graph if we think abou the x-scale.

```
df.decompose_step3 %>%
    select(variable, contains('value'), -value_mean)
```

```
## # A tibble: 1,382 x 5
##    variable value value_mh0me2m value_mh0mep2m value_mh0mepm2m
##    <chr>    <dbl>         <dbl>          <dbl>           <dbl>
##  1 hgt       70.2          73.2           71.2            71.7
##  2 hgt       75.8          78.8           85.8            79.4
##  3 hgt       66.3          63.6           58.3            65.6
##  4 hgt       69.2          66.5           63.6            64.1
##  5 hgt       75.3          72.6           71.2            64.9
##  6 hgt       68.1          64.3           61.1            68.4
##  7 hgt       74.1          70.3           69.6            70.0
##  8 hgt       77.1          73.3           76.0            69.7
##  9 hgt       71.5          66.8           61.5            68.8
## 10 hgt       77.8          73.1           71.0            71.5
## # ... with 1,372 more rows
```

```
options(repr.plot.width = 10, repr.plot.height = 4)
df.decompose_step3 %>%
    select(variable, contains('value'), -value_mean) %>%
    rename(outcome = variable) %>%
    gather(variable, value, -outcome) %>%
    ggplot(aes(x=value, color = variable, fill = variable)) +
        geom_line(stat = "density") +
        facet_wrap(~ outcome, scales='free', nrow=2)
```




```
head(df.decompose_step2[vars.tomean.first],3)
```

Additional Decomposition Testings

```
## # A tibble: 3 x 2
##    male  hgt0
##   <dbl> <dbl>
## 1     1  47.4
## 2     1  47.4
## 3     1  51.2
```

```
head(df.decompose_step2[paste0(vars.tomean.first, '_mean')], 3)
```

```
## # A tibble: 3 x 2
##   male_mean hgt0_mean
##       <dbl>     <dbl>
## 1     0.550      49.8
## 2     0.550      49.8
## 3     0.550      49.8
```

```
head(df.coef[df.decompose_step2$variable, paste0(vars.tomean.first, str.esti.suffix)], 3)
```

```
##       male_Estimate hgt0_Estimate
## hgt        1.244735     0.6834853
## hgt.1      1.244735     0.6834853
## hgt.2      1.244735     0.6834853
```

```
df.decompose.tomean.first <- df.decompose_step2 %>%
    mutate(pred_new = df.decompose_step2$value +
        rowSums((df.decompose_step2[paste0(vars.tomean.first, '_mean')] - df.decompose_step2[vars.tomean
            *df.coef[df.decompose_step2$variable, paste0(vars.tomean.first, str.esti.suffix)])) %>%
        select(variable, value, pred_new)
head(df.decompose.tomean.first, 10)
```

```
## # A tibble: 10 x 3
##    variable value pred_new
##    <chr>    <dbl>    <dbl>
##  1 hgt       70.2     71.2
##  2 hgt       75.8     76.8
##  3 hgt       66.3     64.7
##  4 hgt       69.2     67.6
##  5 hgt       75.3     73.7
##  6 hgt       68.1     66.1
##  7 hgt       74.1     72.1
##  8 hgt       77.1     75.1
##  9 hgt       71.5     69.0
## 10 hgt       77.8     75.3
```

```
df.decompose.tomean.first %>%
        group_by(variable) %>%
        summarize_all(funs(mean = mean, sd = sd))
```

```
## # A tibble: 2 x 5
##   variable value_mean pred_new_mean value_sd pred_new_sd
##   <chr>         <dbl>         <dbl>    <dbl>       <dbl>
## 1 hgt            73.4          73.4     4.68        4.53
## 2 wgt          8808.         8808.    1722.       1695.
```

Note the r-square from regression above matches up with the 1 - ratio below. This is the proper decomposition method that is equivalent to r2.

```
df.decompose_step2 %>%
    mutate(pred_new = df.decompose_step2$value +
        rowSums((df.decompose_step2[paste0(vars.tomean.second, '_mean')] - df.decompose_step2[vars.tomea
            *df.coef[df.decompose_step2$variable, paste0(vars.tomean.second, str.esti.suffix)])) %>%
        select(variable, value, pred_new) %>%
        group_by(variable) %>%
        summarize_all(funs(mean = mean, var = var)) %>%
        mutate(ratio = (pred_new_var/value_var))
```

```
## # A tibble: 2 x 6
##   variable value_mean pred_new_mean value_var pred_new_var ratio
##   <chr>         <dbl>         <dbl>     <dbl>        <dbl> <dbl>
## 1 hgt            73.4          73.4      21.9         25.4 1.16
## 2 wgt          8808.         8808.  2965693.     2949188.  0.994
```