Lab 02

CS3172-1, Spring 2023, Effat University

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Packages

```
library(tidyverse)
library(scales)
library(ggplot2)
```

Data

```
cas <- read_rds("data/canada_survey.rds")
```

Tasks

Task 1

Subset `cas` so that variables `energy_expense` and `household_income` only contain values greater than 0. Overwrite `cas`

```
cas <- filter(cas,energy_expense >0, household_income >0)
```

Use function `factor()` to change the variable `marital_status` to be a factor rather than double. Overwrite `cas`. Consult the data dictionary and write-out what the marital status codes mean.

```
cas <- mutate(cas, marital_status = factor(marital_status))
```

1. Married - a person who is legally married and living with their spouse.
2. Widowed - a person whose spouse has died and who has not remarried.
3. Divorced - a person who has been legally divorced and has not remarried.
4. Separated - a person who is legally separated from their spouse, but not divorced.
5. Never married/single - a person who has never been married, or not currently married.
6. Unknown - a person whose marital status is unknown or not reported.

Task 2

Recode `heat_equip` so instead of having values 1, 2, 3, 4, it contains values `"steam"`, `"forced air"`, `"stove"`, and `"electric heating"` according to the data dictionary. These new values are as defined below: o `steam`: steam or water furnace o `forced air`: forced air furnace o `stove`: heating stoves, cookstove, or other o `electric heating`: electric

```
cas <- mutate(cas, heat_equip = case_when(heat_equip == 1 ~ 'steam',
                                          heat_equip == 2 ~ 'forced air',
                                          heat_equip == 3 ~ 'stove',
                                          heat_equip == 4 ~ 'electric heating'))
```

Recode `heat_fuel` so instead of having values 1, 2, 3, 4, it contains values `"oil"`, `"gas"`, `"electricity"`, and `"other"` according to the data dictionary. These new values are as defined below: o `oil`: oil or other liquid fuel o `gas`: natural gas o `electricity`: electricity o `other`: bottled gas, wood, or other

```
cas <- mutate(cas, heat_fuel = case_when(heat_fuel == 1 ~ 'oil',
                                         heat_fuel == 2 ~ 'gas',
                                         heat_fuel == 3 ~ 'electricity',
                                         heat_fuel == 4 ~ 'other'))
```

Task 3

For each combination of heating fuel type and heating equipment, find the mean, median, and standard deviation of household energy expenditures. Print your results.

```
cas %>% group_by(heat_equip,heat_fuel) %>% summarise(
  mean_ener_exp = mean(energy_expense),
  median_ener_exp = median(energy_expense),
  sd_ener_exp = sd(energy_expense))
```

```
## ‘summarise()‘ has grouped output by ’heat_equip’. You can override using the
## ‘.groups‘ argument.
```

```
## # A tibble: 14 x 5
## # Groups:   heat_equip [4]
##    heat_equip       heat_fuel   mean_ener_exp median_ener_exp sd_ener_exp
##    <chr>            <chr>               <dbl>           <dbl>       <dbl>
##  1 electric heating electricity         2084.            1956        1270.
##  2 electric heating other               3240             3240          NA
##  3 forced air       electricity         2590.            2462.       1293.
##  4 forced air       gas                 3047.            2960        1395.
##  5 forced air       oil                 3499.            3200        2156.
##  6 forced air       other               2861.            2526        1655.
##  7 steam            electricity         1708.             915        1692.
##  8 steam            gas                 1698.             720        1820.
##  9 steam            oil                 2887.            2900        2142.
## 10 steam            other               2047.            1555        2279.
## 11 stove            electricity         2443.            2120        1229.
## 12 stove            gas                 2178.            2202        1024.
## 13 stove            oil                 3396.            3395        2074.
## 14 stove            other               2210.            2025        1140.
```

o What combination of fuel type and equipment has the highest average energy expense? the combination of heating equipment (forced air) and heat fuel (oil) has the highest average energy expense equal to 3498.850.

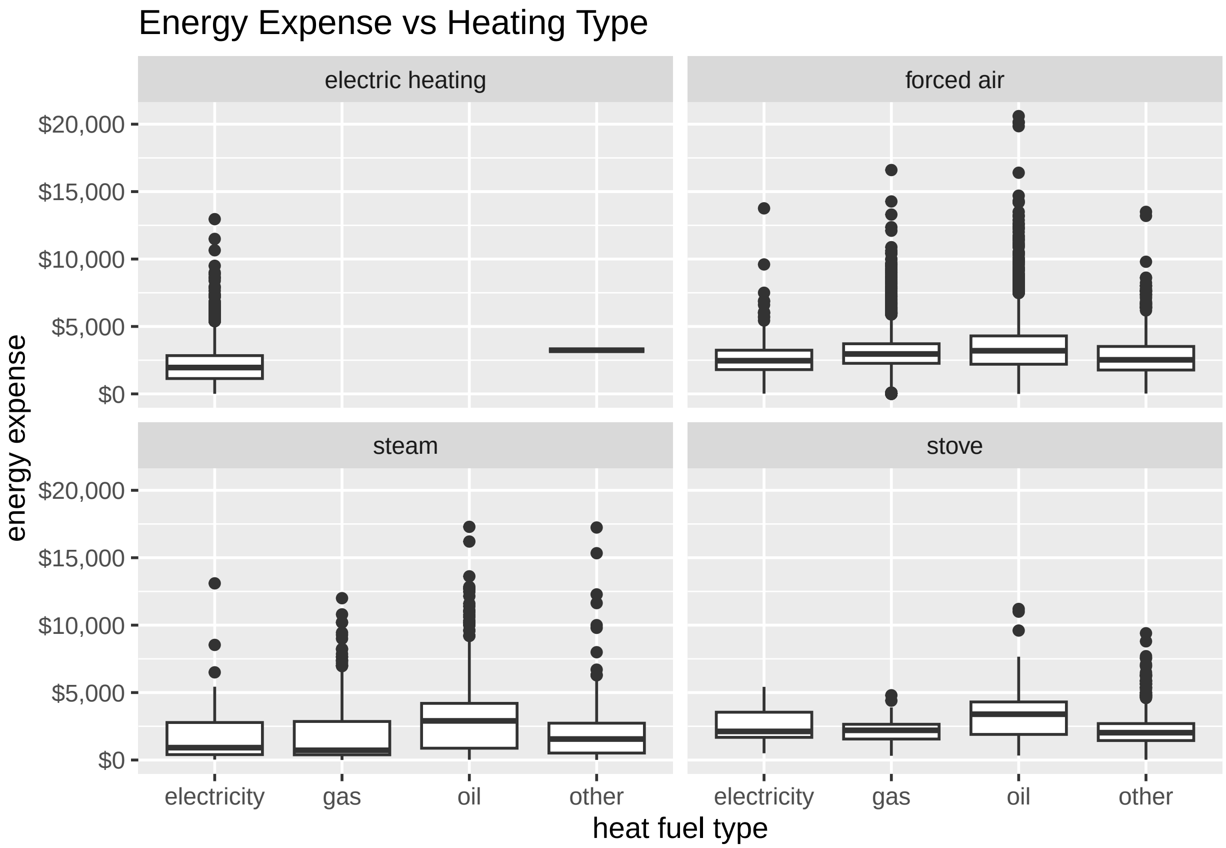
o Which combination has the most variability with regards to energy expense? the combination of heating equipment (steam) and heat fuel (other) will have the highest standard deviation and will have the most variability in energy expense.

o Which type of heating equipment doesn't take all possible fuel types? electric heating.

Task 4

Create a bar chart of energy expenses by heating fuel type and faceted by the type of heating equipment in a 2 x 2 grid. Your axis should be appropriately labeled with a dollar sign and commas. The `scales` package may be helpful here

```
ggplot(cas, mapping=aes(x=heat_fuel, y=energy_expense)) +
  geom_boxplot() +
  scale_y_continuous(labels = scales::dollar_format()) +
  facet_wrap(~ heat_equip, nrow =2) +
  labs(title = "Energy Expense vs Heating Type",
       x = "heat fuel type",
       y = "energy expense")
```



Task 5

Create a new variable describing the proportion of household income spent on energy related expenses, and then find the respondent that spent the highest proportion of their household income on energy and the respondent that spent the lowest proportion of their household income on energy. End your pipeline with the tibble being passed into `glimpse()`. Describe these respondents based on the data they have provided

```
cas1 <- cas %>% mutate(energy_prop = energy_expense/household_income) %>%
  arrange(desc(energy_prop)) %>%
  slice(1,n()) %>%
  glimpse()
```

```
## Rows: 2
## Columns: 25
## $ year                 <fct> 2009, 2009
## $ province             <fct> Saskatchewan, Ontario
## $ dwelling_type        <fct> "Single detached", "Apartment"
## $ year_built           <fct> 1971-1980, 1971-1980
## $ rooms                <dbl> 7, 6
## $ beds                 <dbl> 3, 2
## $ baths                <dbl> 1, 1
## $ heat_equip           <chr> "forced air", "forced air"
## $ heat_age             <fct> 2, 5
## $ heat_fuel            <chr> "gas", "gas"
## $ water_fuel           <fct> 2, 4
## $ cook_fuel            <fct> 2, 2
## $ income               <dbl> 100, 67000
## $ marital_status       <fct> 3, 3
## $ age                  <fct> 08, 14
## $ sex                  <fct> 2, 2
## $ education            <fct> 6, 1
## $ household_income     <dbl> 100, 67000
## $ energy_expense       <dbl> 3780, 1
## $ water_expense        <dbl> 540, 1
## $ electricity_expense <dbl> 1716, 0
## $ nat_gas_expense      <dbl> 1524, 0
## $ other_fuel_expense   <dbl> 0, 0
## $ consumption          <dbl> 19908, 16423
## $ energy_prop          <dbl> 3.780000e+01, 1.492537e-05
```

new column energy__prop is created, Energy__prop had a value of almost 3.78 for the respondent who spent the largest percentage of their household income on energy, This indicates the respondent is probably spending an excessive portion of their income to energy, we can see that this respondent is divorced, living in detached house, He has a relatively low household income, and he reported using electric heating and having a high level of energy consumption. On the other hand, the respondent who spent the lowest proportion of their household income on energy had energy__prop value of 1.49, which is much lower. This suggests that this respondent is using energy-efficient appliances or living in a small, energy-efficient apartment. he has a high household income of $67000 and reported a low level of consumption.

Task 6

For each year, find the province with the cheapest median energy expense per room. Your answer should consist of a single `dplyr` pipeline that results in two rows and three columns

```
cas %>%
  group_by(year, province) %>%
  summarize(median_energy_expense_per_room = median(energy_expense/rooms)) %>%
    group_by(year) %>%
    slice(which.min(median_energy_expense_per_room))
```

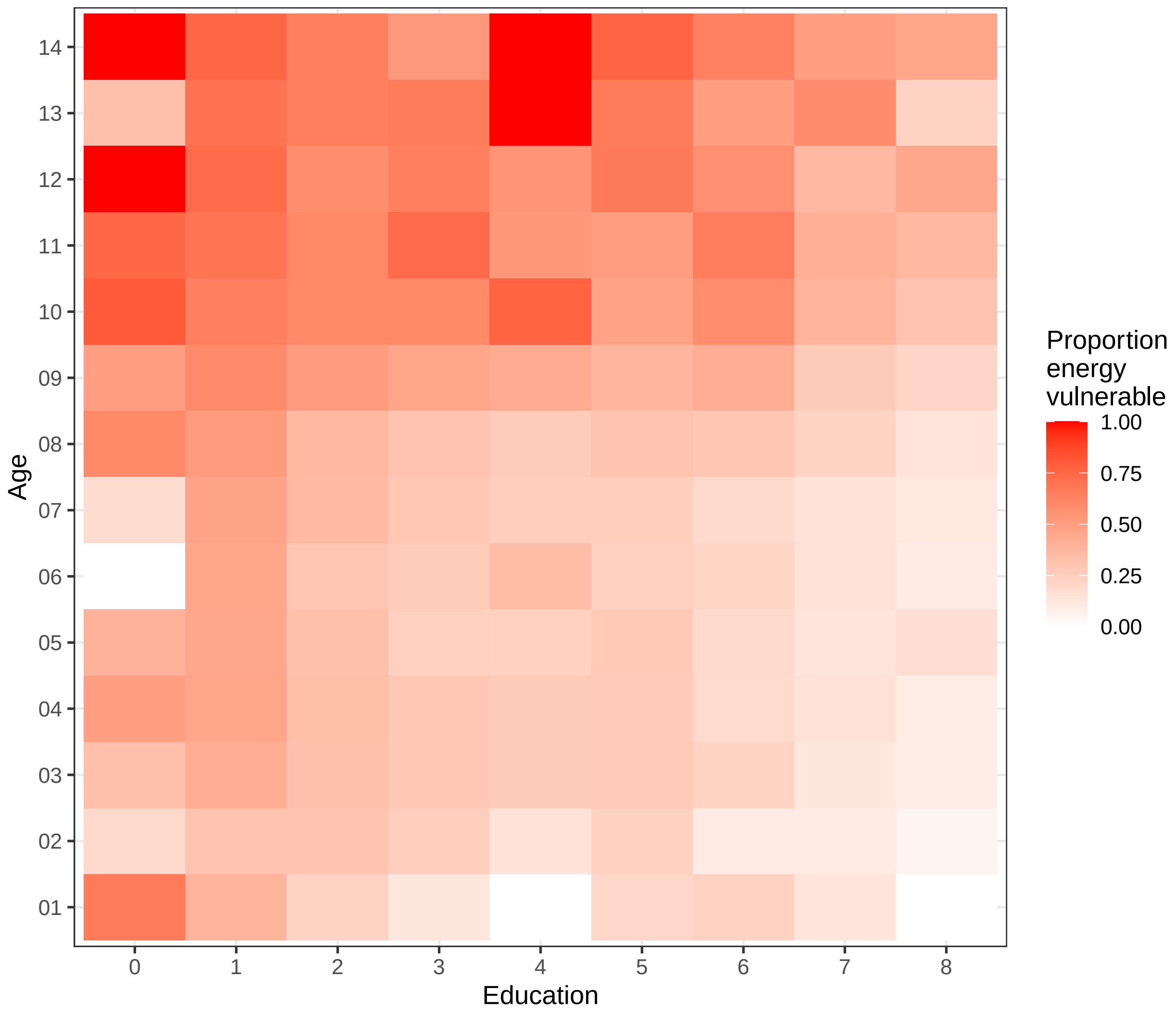
```
## # A tibble: 2 x 3
## # Groups:   year [2]
##   year  province median_energy_expense_per_room
##   <fct> <fct>                             <dbl>
## 1 2007  Quebec                             275
## 2 2009  Quebec                             269.
```

Task 7

A respondent is considered to be "energy vulnerable" if they spend more than 5% of their household income on energy expenses. Recreate the plot below, which shows the proportion of respondents who are energy vulnerable for each combination of age and education. In 2 - 3 sentences, describe what you observe in the plot.

```
cas %>% mutate(energy_prop = energy_expense / household_income,
  vulnerable = if_else(energy_prop > 0.05, "vulnerable", "not")) %>%
  group_by(education, age) %>%
  summarize(prop_vulnerable = mean(vulnerable == "vulnerable")) %>%
  ungroup() %>%

ggplot(aes(x = education, y = age, fill = prop_vulnerable)) +
  geom_raster() +
  scale_fill_gradient(low = "white", high = "red") +
  labs(x = "Education", y = "Age",
       fill = "Proportion\nenergy\nvulnerable") +
  theme_bw()
```



The graph shows that the proportion of energy-vulnerable susceptible people is higher for older people, older respondents are more likely to be energy vulnerable. and we observe a higher proportions of vulnerable households among those with lower levels of education.