R Generate Variables Conditional on Other Variables, Categorical from Continuous

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Contents

1 Generate Variables Conditional On Others

Go to the **RMD**, **R**, **PDF**, or **HTML** version of this file. Go back to fan's REconTools research support package, R4Econ examples page, PkgTestR packaging guide, or Stat4Econ course page.

1.1 Categorical Variable based on Several Variables

Given several other variables, and generate a new variable when these varaibles satisfy conditions. Note that case_when are ifelse type statements. So below

1. group one is below 16 MPG
2. when do *qsec >= 20* second line that is elseif, only those that are *>=16* are considered here
3. then think about two dimensional mpg and qsec grid, the lower-right area, give another category to manual cars in that group

First, we generate categorical variables based on the characteristics of several variables.

```r
# Get mtcars
df_mtcars <- mtcars

# case_when with mtcars
df_mtcars <- df_mtcars %>%
    mutate(
        mpg_qsec_am_grp =
            case_when(
                mpg < 16 ~ "< 16 MPG",
                qsec >= 20 ~ "> 16 MPG & qsec >= 20",
                am == 1 ~ "> 16 MPG & asec < 20 & manual",
                TRUE ~ "Others"
            )
    )
```

Now we generate scatter plot based on the combined factors

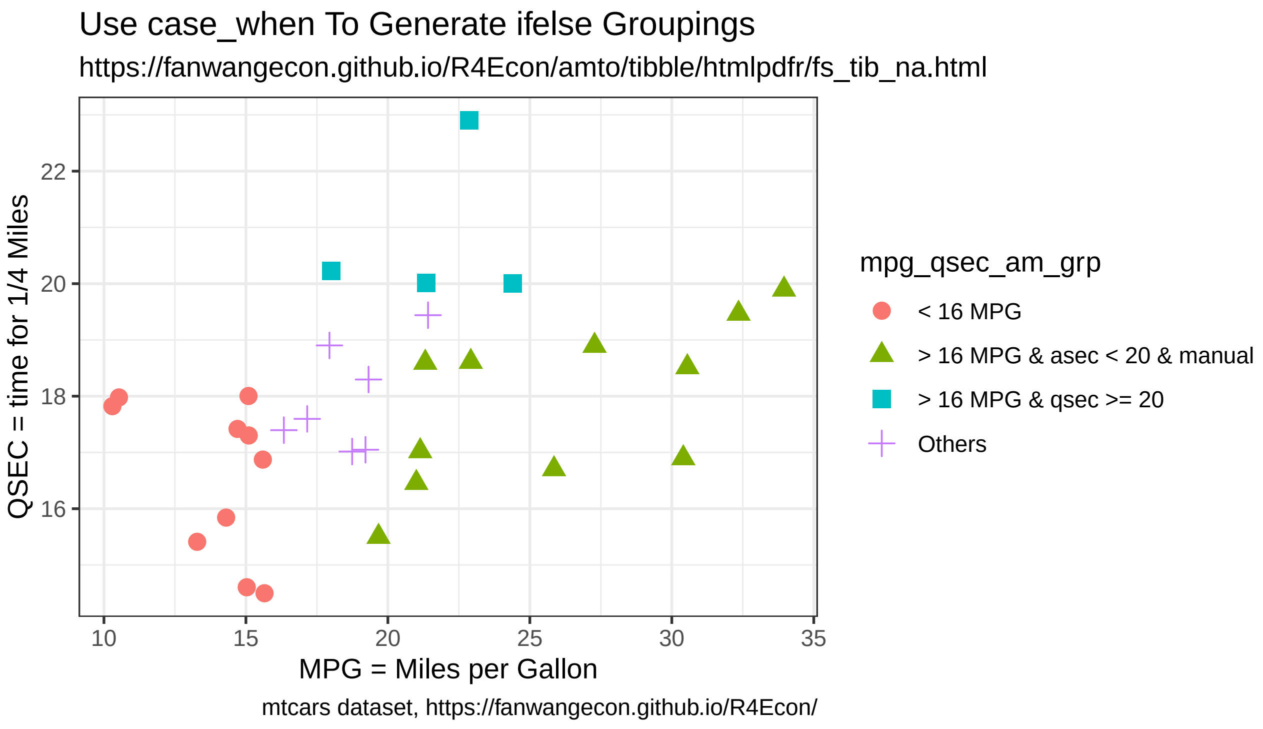
```r
# Labeling
st_title <- paste0("Use case_when To Generate ifelse Groupings")
st_subtitle <- paste0(
    "https://fanwangecon.github.io/",
    "R4Econ/amto/tibble/htmlpdfr/fs_tib_na.html"
)
st_caption <- paste0(
    "mtcars dataset, ",
    "https://fanwangecon.github.io/R4Econ/"
)
st_x_label <- "MPG = Miles per Gallon"
st_y_label <- "QSEC = time for 1/4 Miles"

# Graphing
plt_mtcars_casewhen_scatter <-
    ggplot(
        df_mtcars,
        aes(
            x = mpg, y = qsec,
            colour = mpg_qsec_am_grp,
            shape = mpg_qsec_am_grp
        )
    ) +
    geom_jitter(size = 3, width = 0.15) +
    labs(
        title = st_title, subtitle = st_subtitle,
        x = st_x_label, y = st_y_label, caption = st_caption
    ) +
    theme_bw()

# show
print(plt_mtcars_casewhen_scatter)
```

Categorical from continuous with non-continuous values matching to same key

gear	gear 5 hp 110 to 130	gear 5 hp les sequal 110	gear is 3	gear is 4	otherwise
3	NA	NA	15	NA	NA
4	NA	NA	NA	12	NA
5	2	1	NA	NA	2



1.2 Categorical Variables based on one Continuous Variable

We generate one categorical variable for gear, based on "continuous" gear values. Note that the same categorical label appears for gear is 3 as well as gear is 5.

```
# Generate a categorical variable
df_mtcars <- df_mtcars %>%
    mutate(gear_cate = case_when(
        gear == 3 ~ "gear is 3",
        gear == 4 ~ "gear is 4",
        gear == 5 & hp <= 110 ~ "gear 5 hp les sequal 110",
        gear == 5 & hp > 110 & hp <= 200 ~ "gear 5 hp 110 to 130",
        TRUE ~ "otherwise"
    ))
# Tabulate
df_mtcars_gear_tb <- df_mtcars %>%
  group_by(gear_cate, gear) %>%
  tally() %>%
  spread(gear_cate, n)
# Display
st_title <- "Categorical from continuous with non-continuous values matching to same key"
df_mtcars_gear_tb %>% kable(caption = st_title) %>%
  kable_styling_fc()
```

1.3 Generate NA values if Variables have Certain Value

In the example below, in one line:

1. generate a random standard normal vector
2. two set na methods:
   - if the value of the standard normal is negative, set value to -999, otherwise MPG, replace the value *-999* with *NA*
   - case_when only with type specific NA values
   - Assigning NA yields error in case_when
   - note we need to conform NA to type
3. generate new categorical variable based on NA condition using is.na with both string and numeric NAs jointly considered.
   - fake NA string to be printed on chart

```r
# Get mtcars
df_mtcars <- mtcars

# Make some values of mpg randomly NA
# the NA has to conform to the type of the remaining values for the new variable
# NA_real_, NA_character_, NA_integer_, NA_complex_
set.seed(2341)
df_mtcars <- df_mtcars %>%
    mutate(mpg_wth_NA1 = na_if(
        case_when(
            rnorm(n(), mean = 0, sd = 1) < 0 ~ -999,
            TRUE ~ mpg
        ),
        -999
    )) %>%
    mutate(mpg_wth_NA2 = case_when(
        rnorm(n(), mean = 0, sd = 1) < 0 ~ NA_real_,
        TRUE ~ mpg
    )) %>%
    mutate(mpg_wth_NA3 = case_when(
        rnorm(n(), mean = 0, sd = 1) < 0 ~ NA_character_,
        TRUE ~ "shock > 0 string"
    ))

# Generate New Variables based on if mpg_wth_NA is NA or not
# same variable as above, but now first a category based on if NA
# And we generate a fake string "NA" variable, this is not NA
# the String NA allows for it to be printed on figure
df_mtcars <- df_mtcars %>%
    mutate(
        group_with_na =
            case_when(
                is.na(mpg_wth_NA2) & is.na(mpg_wth_NA3) ~
                    "Rand String and Rand Numeric both NA",
                mpg < 16 ~ "< 16 MPG",
                qsec >= 20 ~ "> 16 MPG & qsec >= 20",
                am == 1 ~ "> 16 MPG & asec < 20 & manual",
                TRUE ~ "Fake String NA"
            )
    )
```

	mpg	mpg_wth_NA1	mpg_wth_NA2	mpg_wth_NA3
Mazda RX4	21.0	NA	NA	shock > 0 string
Mazda RX4 Wag	21.0	21.0	21.0	NA
Datsun 710	22.8	NA	NA	NA
Hornet 4 Drive	21.4	NA	21.4	NA
Hornet Sportabout	18.7	NA	18.7	NA
Valiant	18.1	18.1	NA	shock > 0 string
Duster 360	14.3	14.3	NA	shock > 0 string
Merc 240D	24.4	NA	24.4	NA
Merc 230	22.8	22.8	22.8	NA
Merc 280	19.2	19.2	NA	NA
Merc 280C	17.8	NA	NA	NA
Merc 450SE	16.4	16.4	16.4	NA
Merc 450SL	17.3	NA	NA	shock > 0 string

```r
# show
kable(head(df_mtcars %>% select(starts_with("mpg")), 13)) %>%
    kable_styling_fc()
```

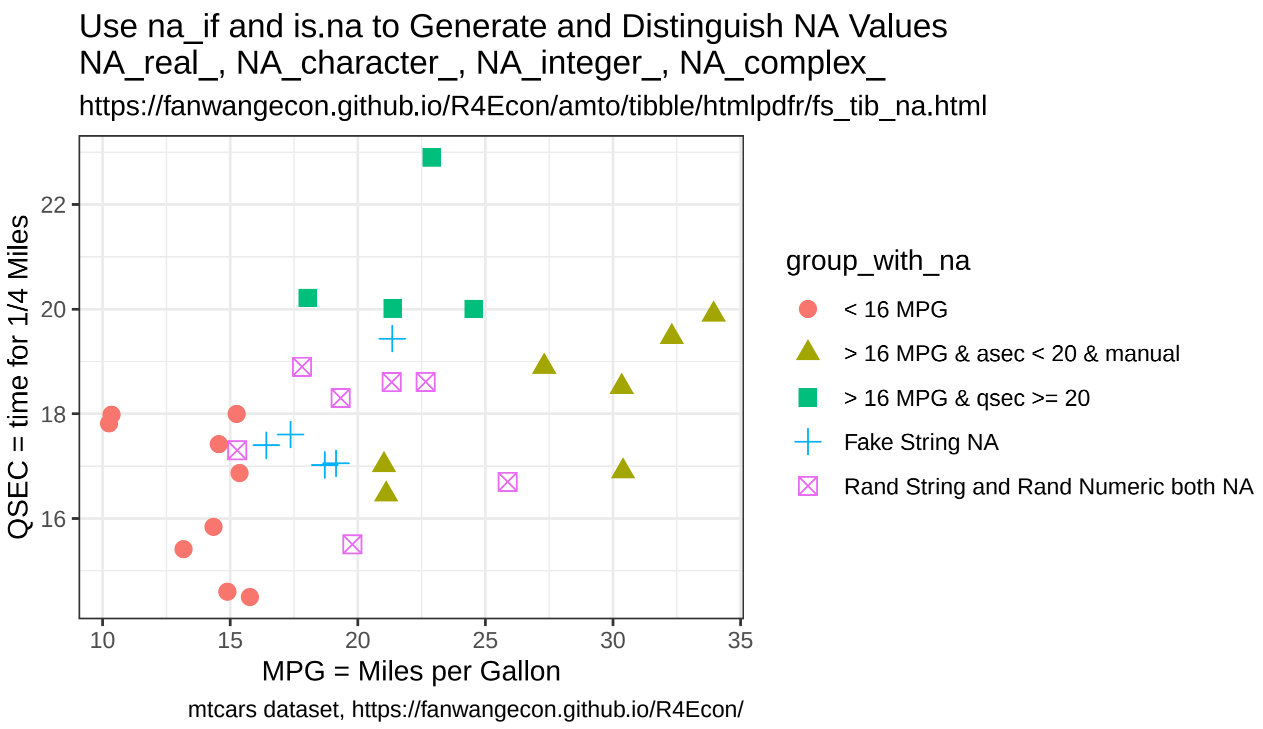
```r
# # Setting to NA
# df.reg.use <- df.reg.guat %>% filter(!!sym(var.mth) != 0)
# df.reg.use.log <- df.reg.use
# df.reg.use.log[which(is.nan(df.reg.use$prot.imputed.log)),] = NA
# df.reg.use.log[which(df.reg.use$prot.imputed.log==Inf),] = NA
# df.reg.use.log[which(df.reg.use$prot.imputed.log==-Inf),] = NA
# df.reg.use.log <- df.reg.use.log %>% drop_na(prot.imputed.log)
# # df.reg.use.log$prot.imputed.log
```

Now we generate scatter plot based on the combined factors, but now with the NA category

```r
# Labeling
st_title <- paste0(
    "Use na_if and is.na to Generate and Distinguish NA Values\n",
    "NA_real_, NA_character_, NA_integer_, NA_complex_"
)
st_subtitle <- paste0(
    "https://fanwangecon.github.io/",
    "R4Econ/amto/tibble/htmlpdfr/fs_tib_na.html"
)
st_caption <- paste0(
    "mtcars dataset, ",
    "https://fanwangecon.github.io/R4Econ/"
)
st_x_label <- "MPG = Miles per Gallon"
st_y_label <- "QSEC = time for 1/4 Miles"

# Graphing
plt_mtcars_ifisna_scatter <-
    ggplot(
        df_mtcars,
        aes(
            x = mpg, y = qsec,
            colour = group_with_na,
            shape = group_with_na
        )
    ) +
    geom_jitter(size = 3, width = 0.15) +
    labs(
        title = st_title, subtitle = st_subtitle,
        x = st_x_label, y = st_y_label, caption = st_caption
    ) +
    theme_bw()

# show
print(plt_mtcars_ifisna_scatter)
```



1.4 Approximate Values Comparison

- r values almost the same
- all.equal

From numeric approximation, often values are very close, and should be set to equal. Use *isTRUE(all.equal)*. In the example below, we randomly generates four arrays. Two of the arrays have slightly higher variance, two arrays have slightly lower variance. They sd are to be 10 times below or 10 times above the tolerance comparison level. The values are not the same in any of the columns, but by allowing for almost true given some tolerance level, in the low standard deviation case, the values differences are within tolerance, so they are equal.

This is an essential issue when dealing with optimization results.

```
# Set tolerance
tol_lvl <- 1.5e-3
sd_lower_than_tol <- tol_lvl / 10
sd_higher_than_tol <- tol_lvl * 10
```

```r
# larger SD
set.seed(123)
mt_runif_standard <- matrix(rnorm(10, mean = 0, sd = sd_higher_than_tol), nrow = 5, ncol = 2)

# small SD
set.seed(123)
mt_rnorm_small_sd <- matrix(rnorm(10, mean = 0, sd = sd_lower_than_tol), nrow = 5, ncol = 2)

# Generates Random Matirx
tb_rnorm_runif <- as_tibble(cbind(mt_rnorm_small_sd, mt_runif_standard))

# Are Variables the same, not for strict comparison
tb_rnorm_runif_approxi_same <- tb_rnorm_runif %>%
    mutate(
        V1_V2_ALMOST_SAME =
            case_when(
                isTRUE(all.equal(V1, V2, tolerance = tol_lvl)) ~
                    paste0("TOL=", sd_lower_than_tol, ", SAME ALMOST"),
                TRUE ~
                    paste0("TOL=", sd_lower_than_tol, ", NOT SAME ALMOST")
            )
    ) %>%
    mutate(
        V3_V4_ALMOST_SAME =
            case_when(
                isTRUE(all.equal(V3, V4, tolerance = tol_lvl)) ~
                    paste0("TOL=", sd_higher_than_tol, ", SAME ALMOST"),
                TRUE ~
                    paste0("TOL=", sd_higher_than_tol, ", NOT SAME ALMOST")
            )
    )

# Pring
kable(tb_rnorm_runif_approxi_same) %>% kable_styling_fc_wide()
```

V1	V2	V3	V4	V1_V2_ALMOST_SAME	V3_V4_ALMOST_SAME
-0.0000841	0.0002573	-0.0084071	0.0257260	TOL=0.00015, SAME ALMOST	TOL=0.015, NOT SAME ALMOST
-0.0000345	0.0000691	-0.0034527	0.0069137	TOL=0.00015, SAME ALMOST	TOL=0.015, NOT SAME ALMOST
0.0002338	-0.0001898	0.0233806	-0.0189759	TOL=0.00015, SAME ALMOST	TOL=0.015, NOT SAME ALMOST
0.0000106	-0.0001030	0.0010576	-0.0103028	TOL=0.00015, SAME ALMOST	TOL=0.015, NOT SAME ALMOST
0.0000194	-0.0000668	0.0019393	-0.0066849	TOL=0.00015, SAME ALMOST	TOL=0.015, NOT SAME ALMOST