Propensity Score Diagnostics

Lucy D'Agostino McGowan

Wake Forest University

Checking balance

- Love plots (Standardized Mean Difference)
- ECDF plots

Standardized Mean Difference (SMD)

$$d = \frac{\bar{x}_{treatment} - \bar{x}_{control}}{\sqrt{\frac{s^2_{treatment} + s^2_{control}}{2}}}$$

SMD in R

Calculate standardized mean differences

```
library(halfmoon)
library(tidyverse)

smds <- tidy_smd(
  df,
  .vars = c(confounder_1, confounder_2, ...),
  .group = exposure,
  .wts = wts # optional,
  make_dummy_vars = TRUE # optional
)
```

Calculating SMDs

```
vars <- c(
  "sex", "race", "age", "education",
  "smokeintensity", "smokeyrs",
  "exercise", "active", "wt71"
)

smds <- tidy_smd(
  nhefs_complete_wts,
  .vars = all_of(vars),
  .group = qsmk,
  .wts = w_ate,
  make_dummy_vars = TRUE
)

smds
```

Calculating SMDs

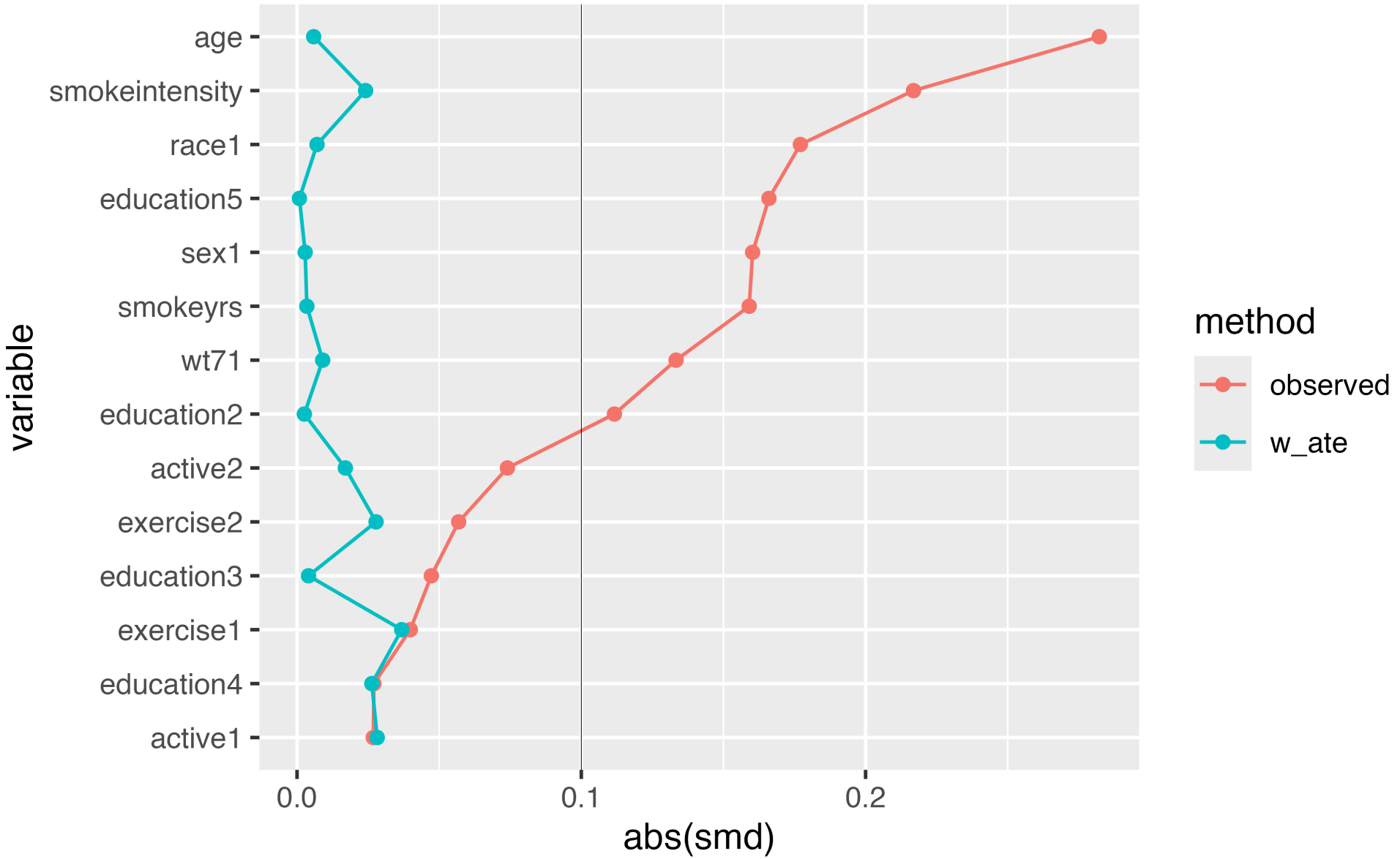
```
# A tibble: 28 × 4
   variable        method   qsmk      smd
   <chr>           <chr>    <chr>   <dbl>
 1 sex1            observed 1       0.160
 2 race1           observed 1       0.177
 3 age             observed 1      -0.282
 4 education2      observed 1       0.112
 5 education3      observed 1       0.0472
 6 education4      observed 1       0.0270
 7 education5      observed 1      -0.166
 8 smokeintensity observed 1       0.217
 9 smokeyrs        observed 1      -0.159
10 exercise1       observed 1      -0.0398
# ℹ 18 more rows
```

Plotting SMDs

Plot them! (in a Love plot!)

```
ggplot(
  data = smds,
  aes(
    x = abs(smd),
    y = variable,
    group = method,
    color = method
  )
) +
  geom_love()
```

Love plot


age
smokeintensity
race1
education5
sex1
smokeyrs
wt71
education2
active2
exercise2
education3
exercise1
education4
active1
variable
0.0
0.1
0.2
abs(smd)
method
observed
w_ate

Your turn 1

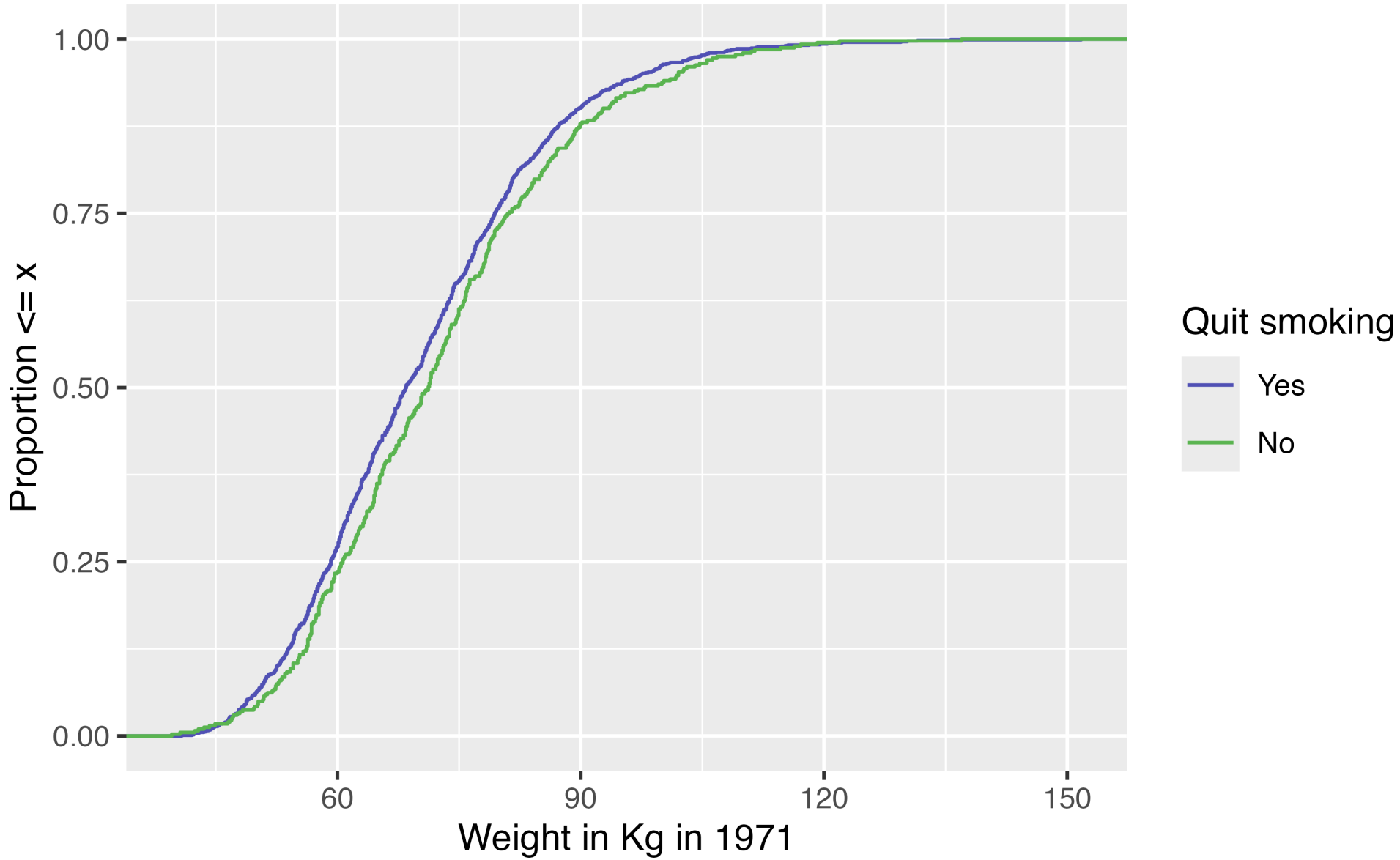
Create a Love Plot for the propensity score weighting you created in the previous exercise

06:00

ECDF

For continuous variables, it can be helpful to look at the ***whole*** distribution pre and post-weighting rather than a single summary measure

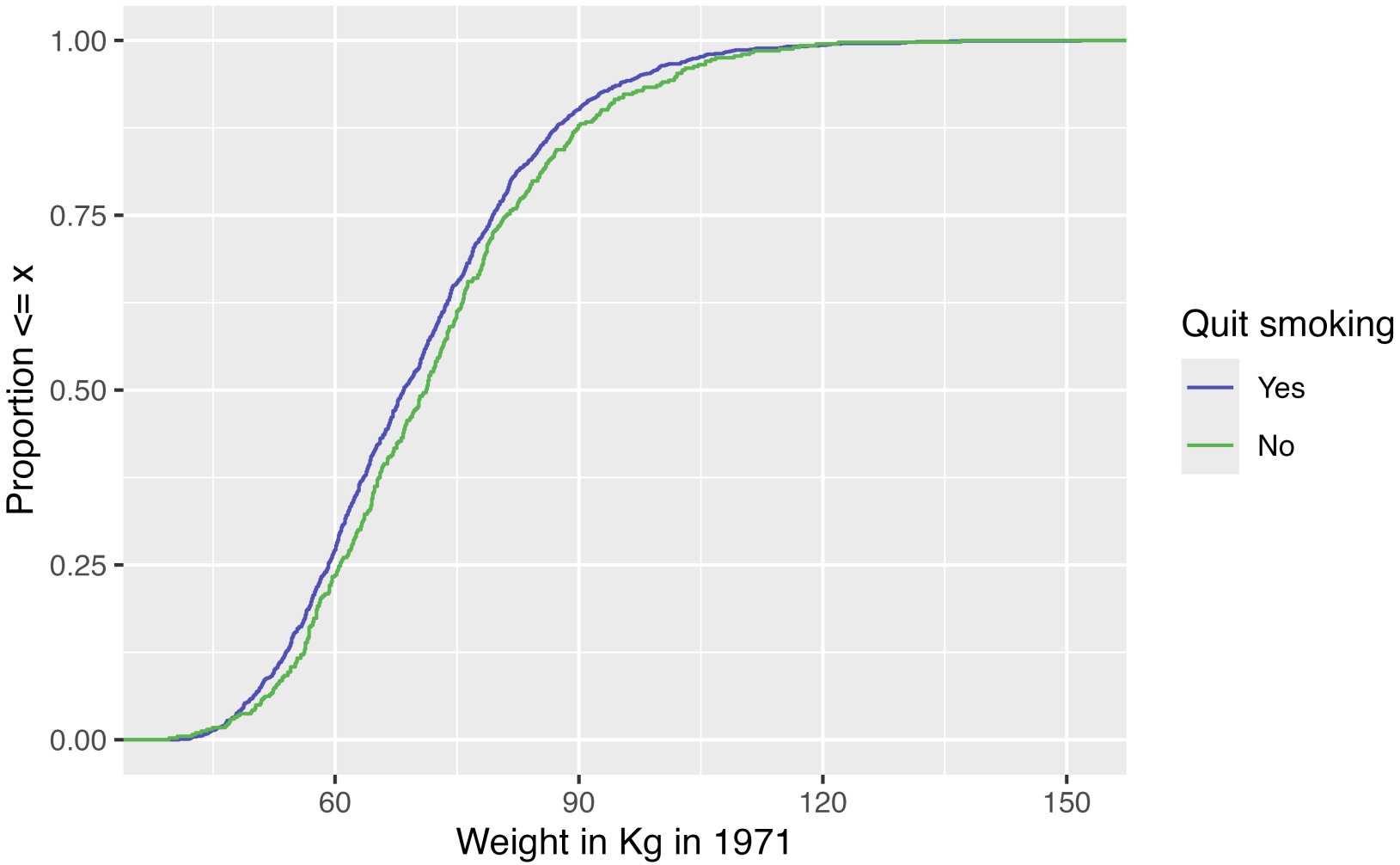
ECDF


1.00
0.75
0.50
0.25
0.00
Proportion <= x
60
90
120
150
Weight in Kg in 1971
Quit smoking
Yes
No

Unweighted ECDF

```
ggplot(nhefs_complete_wts, aes(x = wt71, color = factor(qsmk))) +
  geom_ecdf() +
  scale_color_manual(
    "Quit smoking",
    values = c("#5154B8", "#5DB854"),
    labels = c("Yes", "No")
  ) +
  xlab("Weight in Kg in 1971") +
  ylab("Proportion <= x")
```

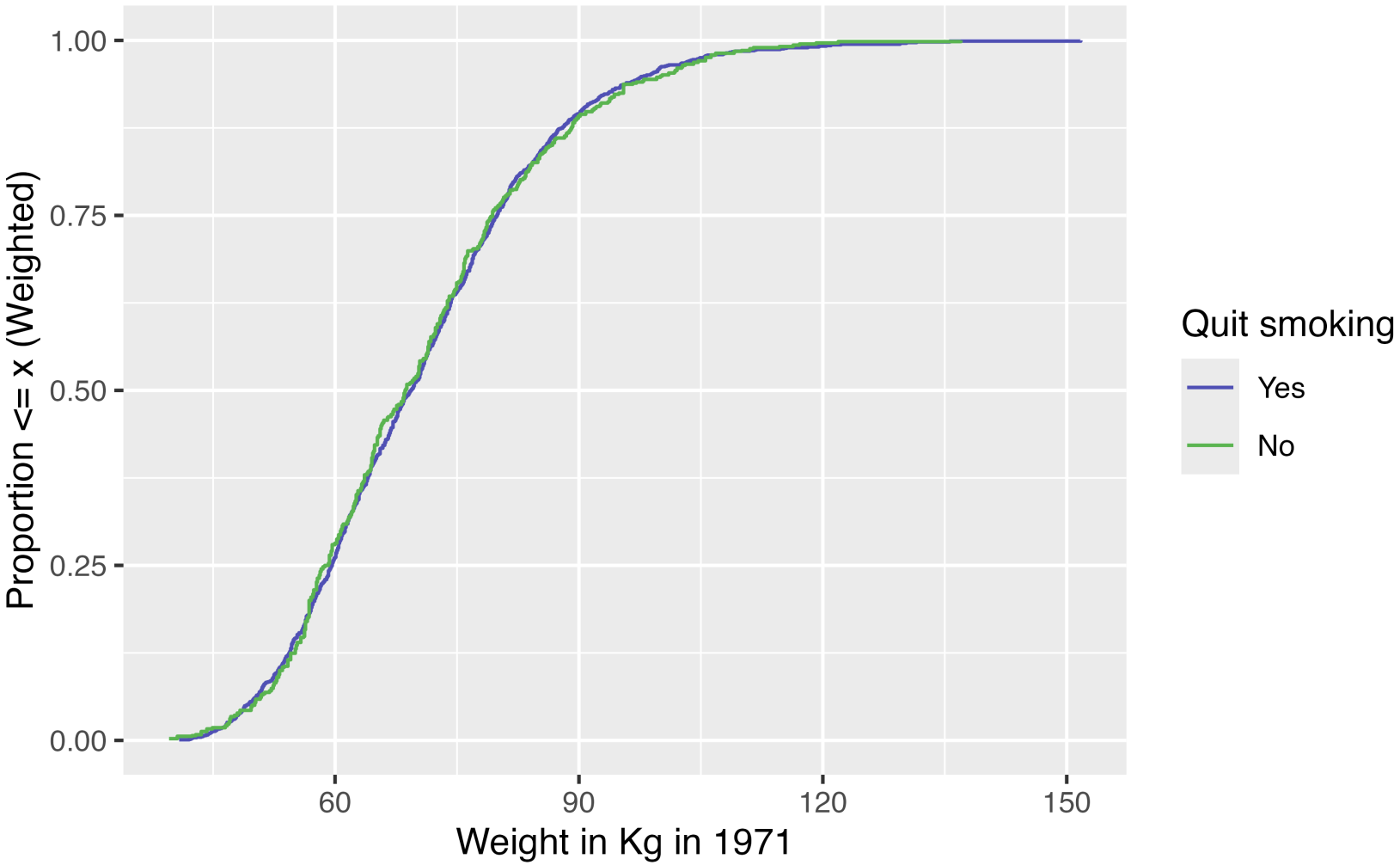
Unweighted ECDF



Weighted ECDF

```
ggplot(nhefs_complete_wts, aes(x = wt71, color = factor(qsmk))) +
  geom_ecdf(aes(weights = w_ate)) +
  scale_color_manual(
    "Quit smoking",
    values = c("#5154B8", "#5DB854"),
    labels = c("Yes", "No")
  ) +
  xlab("Weight in Kg in 1971") +
  ylab("Proportion <= x (Weighted)")
```

Weighted ECDF



Your turn 2

Create an unweighted ECDF examining the `park_temperature_high` confounder by whether or not the day had Extra Magic Hours.

Create a weighted ECDF examining the `park_temperature_high` confounder

06:00

Bonus! Weighted Tables in R

1. Create a “design object” to incorporate the weights

```
library(survey)

svy_des <- svydesign(
  ids = ~ 1,
  data = df,
  weights = ~ wts
)
```

2. Pass to `gtsummary::tbl_svysummary()`

```
library(gtsummary)
tbl_svysummary(svy_des, by = x) |>
  add_difference(everything() ~ "smd")
# modify_column_hide(ci) to hide CI column
```

Characteristic	0 N = 1,565[1]	1 N = 1,561[1]	Difference[2]	95% CI[2]
WEIGHT IN KILOGRAMS IN 1971	69 (60, 80)	69 (59, 79)	0.01	-0.06, 0.08
0: WHITE 1: BLACK OR OTHER IN 1971			0.01	-0.06, 0.08
0	1,359 (87%)	1,352 (87%)		
1	206 (13%)	209 (13%)		
AGE IN 1971	43 (33, 52)	43 (33, 53)	-0.01	-0.08, 0.06
0: MALE 1: FEMALE			0.00	-0.07, 0.07
0	764 (49%)	764 (49%)		
1	802 (51%)	797 (51%)		
NUMBER OF CIGARETTES SMOKED PER DAY IN 1971	20 (10, 25)	20 (10, 30)	0.02	-0.05, 0.09
YEARS OF SMOKING	24 (15, 33)	24 (14, 33)	0.00	-0.07, 0.07
IN RECREATION, HOW MUCH EXERCISE? IN 1971, 0:much exercise,1:moderate exercise,2:little or no exercise			0.04	-0.03, 0.11
0	302 (19%)	294 (19%)		
1	665 (42%)	691 (44%)		
2	599 (38%)	576 (37%)		
IN YOUR USUAL DAY, HOW ACTIVE ARE YOU? IN 1971, 0:very active, 1:moderately active, 2:inactive			0.03	-0.04, 0.10
0	700 (45%)	684 (44%)		
1	718 (46%)	738 (47%)		
2	147 (9.4%)	138 (8.9%)		

[1] Median (Q1, Q3); n (%)
[2] Standardized Mean Difference
Abbreviation: CI = Confidence Interval

Bonus Your Turn: Weighted Tables