HW 02

Confounding and Simpson's Paradox

due Wednesday, Feb 12 at 11:59p

```
library(tidyverse)
library(mosaicData)
data(Whickham)
```

Exercise 1

Do you think these data come from an observational study or an experiment? Why? Check out the help documentation for this data.

The data most likely came from an observational study rather than an experiment. Based on the information from the help document, the data for this study was collected through the use of a survey. This study also utilized and revolved around the mortality rate for smokers vs. non-smokers. As we learned in class, experiments typically avoid the use of potentially fatal health related studies, as it would be considered immoral to experiment with potentially fatal factors.

Exercise 2

How many observations are in this data set, and what does each observation represent?

There are 1314 observations in this data set, with each observation being a woman that was surveyed for the study.

Exercise 3

How many variables are in this data set, and what R data type is each variable?

```
var_types <- character(length(Whickham))
for (i in seq_along(Whickham)) {
  var_types[i] <- Whickham %>%
    pull(i) %>%
    typeof()
}
var_types
```

```
## [1] "integer" "integer" "integer"
```

There are 3 variables in the data set. Outcome represents the survival status of the person after 20 years. This is indicated using a factor with levels "Alive" or "Dead". The smoker variable indicates whether the person was a smoker using a factor with levels "Yes" or "No". Lastly, the age variable indicates the age of the person at the time of the first survey. Outcome, smoker, and age are all of type "integer".

Exercise 4

What would you expect the relationship between smoking status and health outcome to be? Which is the explanatory variable, and which is the response variable?

I would expect that those that smoke would be in worse health condition/more likely to be dead considering that smoking introduces many harmful chemicals to the body while destroying the person's lungs, often leading to lung cancer or other forms of cancer. The "smoker" variable would be the explanatory variable and the "outcome" variable would be the response variable. This is due to the fact that the status of a person being either a smoker or non-smoker is a potentially large factor in explaining changes in the outcome of a person's survival status.

Exercise 5

Create a visualization depicting the relationship between smoking status and health outcome. Briefly describe this relationship and whether it meets your expectations in Exercise 4.

```
Whickham %>%
  count(smoker, outcome) %>%
  group_by(smoker) %>%
  mutate(prob_survive = n / sum(n))
```

```
## # A tibble: 4 x 4
## # Groups:   smoker [2]
##   smoker outcome     n prob_survive
##   <fct>  <fct>   <int>        <dbl>
## 1 No     Alive     502        0.686
## 2 No     Dead      230        0.314
## 3 Yes    Alive     443        0.761
## 4 Yes    Dead      139        0.239
```

```
ggplot(data=Whickham, mapping = aes(x = smoker, fill = outcome))+
  geom_bar(position = "fill") +
  labs(title = "Smoking Status on Survival Rate", x = "Smoking status",
       y = "Proportion of survivors")
```

Smoking Status on Survival Rate
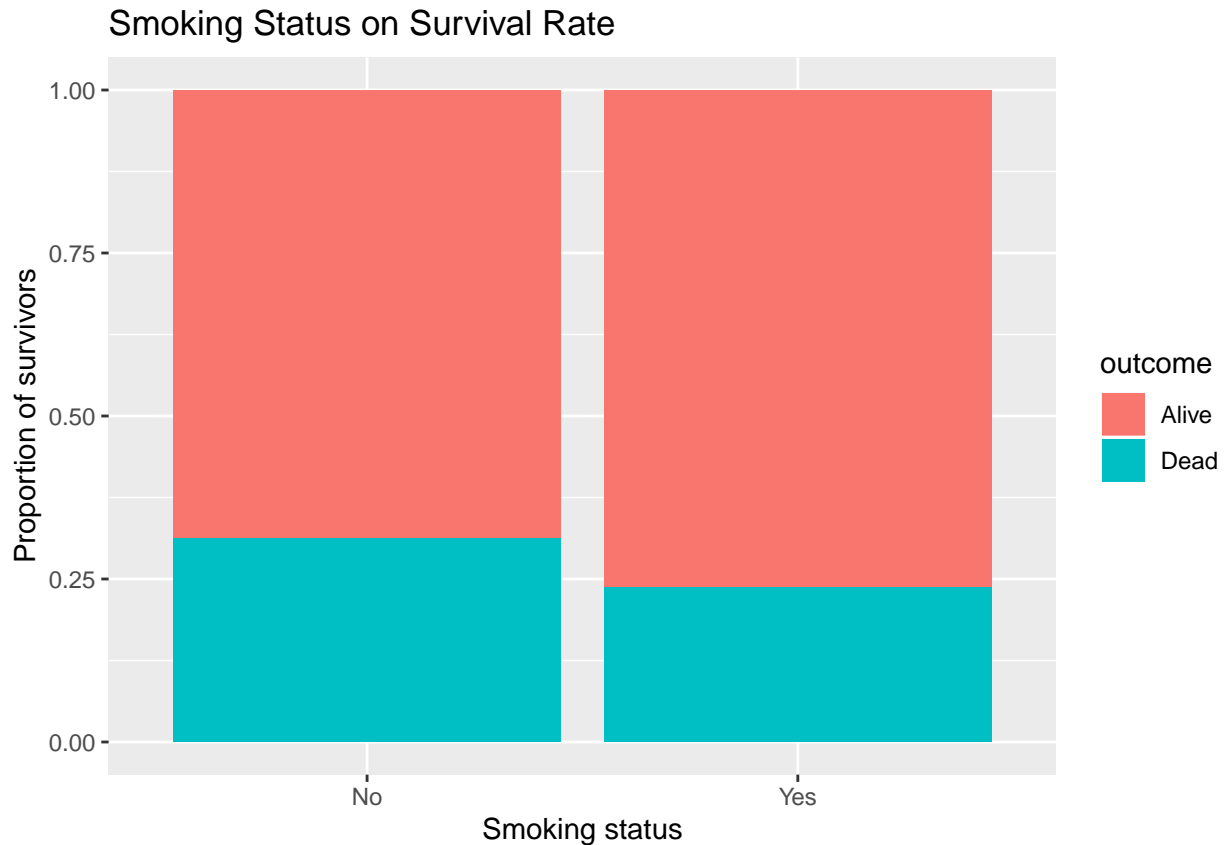
Surprisingly, those that smoked had more people alive than those that did not smoke after 20 years. This did not meet my expectations as most people would assume that smoking would lead to higher mortality rates than those that don't smoke.

Exercise 6

How many smokers and non-smokers at the time of the survey were between 45 and 64 years of age inclusive? Display your result as a data frame with variable smoker and the corresponding counts for each smoker level.

```
Whickham %>%
  filter(45 <= age & age <= 64) %>%
  count(smoker) %>%
  group_by(smoker) %>%
  summarize(counts = sum(n))
```

```
## # A tibble: 2 x 2
##   smoker counts
##   <fct>   <int>
## 1 No        200
## 2 Yes       247
```

There were 447 women between 45 and 64 years of age(inclusive) at the time of the survey. 200 women between ages 45 and 64 did not smoke and 247 women in that age group smoked.

Exercise 7

Create a new variable which categorizes age based on the following scheme: age 44 or younger: "18-44" age 45 to 64, inclusive: "45-64" age 65 or older: "65+"

```
newWhickham <- Whickham %>%
  mutate(agegroup = case_when(
    (18 <= age & age <= 44) ~ "18-44",
    (45 <= age & age <= 64) ~ "45-64",
    (65 <= age) ~ "65+"
  ))
newWhickham
```

```
##       outcome smoker age agegroup
## 1       Alive    Yes  23    18-44
## 2       Alive    Yes  18    18-44
## 3        Dead    Yes  71      65+
## 4       Alive     No  67      65+
## 5       Alive     No  64    45-64
## 6       Alive    Yes  38    18-44
## 7       Alive    Yes  45    45-64
## 8        Dead     No  76      65+
## 9       Alive     No  28    18-44
## 10      Alive     No  27    18-44
## 11      Alive     No  28    18-44
## 12      Alive    Yes  34    18-44
## 13      Alive     No  20    18-44
## 14       Dead    Yes  72      65+
## 15      Alive    Yes  48    45-64
## 16      Alive    Yes  45    45-64
## 17       Dead     No  66      65+
## 18      Alive    Yes  30    18-44
## 19      Alive     No  67      65+
## 20      Alive    Yes  33    18-44
## 21       Dead     No  68      65+
## 22       Dead     No  72      65+
## 23      Alive    Yes  34    18-44
## 24       Dead     No  61    45-64
## 25       Dead     No  66      65+
## 26      Alive     No  43    18-44
## 27       Dead     No  71      65+
## 28      Alive    Yes  47    45-64
## 29       Dead     No  67      65+
## 30      Alive     No  22    18-44
## 31      Alive     No  39    18-44
## 32       Dead    Yes  71      65+
## 33      Alive    Yes  38    18-44
## 34       Dead     No  80      65+
## 35       Dead    Yes  59    45-64
## 36      Alive    Yes  47    45-64
## 37       Dead    Yes  56    45-64
## 38       Dead     No  62    45-64
## 39      Alive    Yes  30    18-44
## 40      Alive    Yes  51    45-64
```

```
## 41      Alive     No   34   18-44
## 42      Alive     No   39   18-44
## 43       Dead     No   56   45-64
## 44      Alive     No   32   18-44
## 45       Dead     No   56   45-64
## 46      Alive    Yes   60   45-64
## 47       Dead    Yes   60   45-64
## 48      Alive     No   30   18-44
## 49      Alive    Yes   33   18-44
## 50      Alive     No   37   18-44
## 51       Dead     No   66     65+
## 52       Dead    Yes   71     65+
## 53      Alive    Yes   23   18-44
## 54      Alive     No   38   18-44
## 55      Alive    Yes   36   18-44
## 56       Dead    Yes   38   18-44
## 57      Alive    Yes   50   45-64
## 58      Alive     No   45   45-64
## 59      Alive    Yes   36   18-44
## 60       Dead     No   55   45-64
## 61       Dead    Yes   73     65+
## 62       Dead    Yes   52   45-64
## 63      Alive     No   52   45-64
## 64      Alive    Yes   37   18-44
## 65      Alive     No   61   45-64
## 66      Alive     No   39   18-44
## 67      Alive     No   72     65+
## 68      Alive    Yes   25   18-44
## 69      Alive    Yes   50   45-64
## 70       Dead     No   68     65+
## 71      Alive    Yes   53   45-64
## 72      Alive     No   31   18-44
## 73       Dead     No   73     65+
## 74      Alive     No   54   45-64
## 75      Alive    Yes   56   45-64
## 76      Alive    Yes   51   45-64
## 77       Dead     No   76     65+
## 78      Alive     No   55   45-64
## 79       Dead    Yes   56   45-64
## 80      Alive     No   56   45-64
## 81       Dead    Yes   69     65+
## 82       Dead     No   79     65+
## 83       Dead    Yes   75     65+
## 84       Dead     No   67     65+
## 85      Alive     No   20   18-44
## 86      Alive     No   20   18-44
## 87       Dead     No   68     65+
## 88       Dead    Yes   68     65+
## 89      Alive     No   21   18-44
## 90      Alive    Yes   29   18-44
## 91      Alive    Yes   33   18-44
## 92      Alive    Yes   30   18-44
## 93      Alive    Yes   24   18-44
## 94       Dead    Yes   61   45-64
```

```
## 95    Alive   Yes   54   45-64
## 96    Alive   No    26   18-44
## 97    Dead    No    68     65+
## 98    Alive   Yes   49   45-64
## 99    Dead    No    72     65+
## 100   Alive   No    21   18-44
## 101   Alive   No    28   18-44
## 102   Alive   No    47   45-64
## 103   Dead    No    68     65+
## 104   Dead    No    71     65+
## 105   Alive   Yes   59   45-64
## 106   Alive   No    64   45-64
## 107   Alive   Yes   47   45-64
## 108   Dead    No    84     65+
## 109   Alive   No    28   18-44
## 110   Alive   No    67     65+
## 111   Alive   No    30   18-44
## 112   Dead    Yes   33   18-44
## 113   Dead    No    68     65+
## 114   Dead    No    55   45-64
## 115   Dead    No    79     65+
## 116   Alive   No    40   18-44
## 117   Alive   No    43   18-44
## 118   Alive   Yes   37   18-44
## 119   Dead    No    73     65+
## 120   Dead    Yes   45   45-64
## 121   Alive   No    49   45-64
## 122   Alive   Yes   44   18-44
## 123   Alive   Yes   74     65+
## 124   Alive   Yes   20   18-44
## 125   Alive   Yes   31   18-44
## 126   Alive   No    20   18-44
## 127   Alive   No    61   45-64
## 128   Dead    Yes   66     65+
## 129   Alive   No    53   45-64
## 130   Alive   Yes   36   18-44
## 131   Dead    No    71     65+
## 132   Dead    Yes   64   45-64
## 133   Alive   No    52   45-64
## 134   Alive   No    37   18-44
## 135   Alive   Yes   34   18-44
## 136   Alive   No    61   45-64
## 137   Alive   Yes   46   45-64
## 138   Alive   Yes   26   18-44
## 139   Alive   No    33   18-44
## 140   Alive   No    32   18-44
## 141   Alive   Yes   47   45-64
## 142   Alive   No    27   18-44
## 143   Alive   No    25   18-44
## 144   Dead    No    69     65+
## 145   Dead    Yes   43   18-44
## 146   Dead    Yes   71     65+
## 147   Alive   No    33   18-44
## 148   Dead    No    73     65+
```

```
## 149     Dead    No  68     65+
## 150    Alive    No  31  18-44
## 151    Alive    No  35  18-44
## 152     Dead    No  73     65+
## 153     Dead   Yes  59  45-64
## 154    Alive    No  31  18-44
## 155     Dead    No  77     65+
## 156    Alive   Yes  33  18-44
## 157    Alive   Yes  48  45-64
## 158    Alive   Yes  34  18-44
## 159    Alive    No  43  18-44
## 160     Dead    No  68     65+
## 161    Alive   Yes  29  18-44
## 162     Dead    No  71     65+
## 163     Dead   Yes  21  18-44
## 164    Alive    No  18  18-44
## 165    Alive    No  24  18-44
## 166    Alive   Yes  30  18-44
## 167    Alive    No  24  18-44
## 168     Dead    No  74     65+
## 169    Alive   Yes  57  45-64
## 170    Alive    No  23  18-44
## 171    Alive    No  42  18-44
## 172    Alive    No  34  18-44
## 173    Alive   Yes  46  45-64
## 174    Alive    No  40  18-44
## 175    Alive   Yes  64  45-64
## 176     Dead   Yes  20  18-44
## 177    Alive   Yes  30  18-44
## 178     Dead   Yes  81     65+
## 179     Dead   Yes  45  45-64
## 180    Alive    No  26  18-44
## 181     Dead    No  77     65+
## 182    Alive   Yes  53  45-64
## 183    Alive   Yes  46  45-64
## 184     Dead    No  69     65+
## 185    Alive   Yes  44  18-44
## 186     Dead   Yes  50  45-64
## 187    Alive   Yes  50  45-64
## 188     Dead    No  62  45-64
## 189     Dead   Yes  60  45-64
## 190    Alive    No  19  18-44
## 191    Alive   Yes  21  18-44
## 192    Alive   Yes  50  45-64
## 193    Alive   Yes  33  18-44
## 194     Dead    No  59  45-64
## 195     Dead    No  81     65+
## 196    Alive   Yes  31  18-44
## 197     Dead    No  77     65+
## 198    Alive   Yes  23  18-44
## 199    Alive    No  55  45-64
## 200    Alive    No  51  45-64
## 201    Alive    No  26  18-44
## 202    Alive    No  20  18-44
```

```
## 203   Alive   No   57   45-64
## 204   Dead    No   67     65+
## 205   Alive   No   29   18-44
## 206   Alive   Yes  28   18-44
## 207   Alive   Yes  26   18-44
## 208   Dead    No   76     65+
## 209   Alive   No   32   18-44
## 210   Dead    Yes  40   18-44
## 211   Alive   No   40   18-44
## 212   Alive   No   52   45-64
## 213   Dead    No   35   18-44
## 214   Alive   Yes  27   18-44
## 215   Alive   Yes  33   18-44
## 216   Alive   Yes  20   18-44
## 217   Alive   Yes  31   18-44
## 218   Alive   No   28   18-44
## 219   Alive   No   22   18-44
## 220   Dead    Yes  73     65+
## 221   Alive   No   23   18-44
## 222   Alive   Yes  24   18-44
## 223   Alive   No   48   45-64
## 224   Alive   No   60   45-64
## 225   Alive   Yes  50   45-64
## 226   Alive   Yes  37   18-44
## 227   Alive   Yes  29   18-44
## 228   Alive   No   35   18-44
## 229   Dead    No   67     65+
## 230   Alive   No   33   18-44
## 231   Alive   Yes  36   18-44
## 232   Dead    No   64   45-64
## 233   Alive   Yes  59   45-64
## 234   Alive   No   23   18-44
## 235   Alive   Yes  63   45-64
## 236   Alive   No   26   18-44
## 237   Dead    No   50   45-64
## 238   Dead    No   36   18-44
## 239   Dead    Yes  51   45-64
## 240   Alive   No   25   18-44
## 241   Alive   No   48   45-64
## 242   Alive   No   24   18-44
## 243   Dead    Yes  42   18-44
## 244   Alive   No   64   45-64
## 245   Alive   No   36   18-44
## 246   Alive   Yes  47   45-64
## 247   Alive   No   64   45-64
## 248   Alive   No   22   18-44
## 249   Alive   No   31   18-44
## 250   Alive   No   55   45-64
## 251   Dead    Yes  78     65+
## 252   Alive   No   27   18-44
## 253   Alive   No   63   45-64
## 254   Dead    Yes  83     65+
## 255   Alive   No   55   45-64
## 256   Alive   Yes  57   45-64
```

```
## 257   Alive   Yes   31   18-44
## 258    Dead    No   64   45-64
## 259   Alive   Yes   25   18-44
## 260   Alive    No   38   18-44
## 261    Dead    No   68     65+
## 262   Alive    No   59   45-64
## 263   Alive   Yes   63   45-64
## 264   Alive   Yes   18   18-44
## 265   Alive   Yes   44   18-44
## 266   Alive    No   38   18-44
## 267    Dead   Yes   72     65+
## 268   Alive   Yes   28   18-44
## 269   Alive   Yes   37   18-44
## 270    Dead    No   51   45-64
## 271    Dead   Yes   53   45-64
## 272   Alive   Yes   31   18-44
## 273    Dead    No   69     65+
## 274   Alive   Yes   51   45-64
## 275   Alive   Yes   36   18-44
## 276   Alive    No   27   18-44
## 277   Alive   Yes   24   18-44
## 278   Alive   Yes   64   45-64
## 279   Alive    No   64   45-64
## 280   Alive   Yes   64   45-64
## 281    Dead    No   64   45-64
## 282   Alive   Yes   46   45-64
## 283   Alive   Yes   67     65+
## 284   Alive   Yes   40   18-44
## 285   Alive   Yes   49   45-64
## 286   Alive   Yes   25   18-44
## 287   Alive   Yes   36   18-44
## 288    Dead    No   82     65+
## 289   Alive   Yes   56   45-64
## 290    Dead   Yes   56   45-64
## 291   Alive    No   37   18-44
## 292    Dead   Yes   59   45-64
## 293   Alive   Yes   42   18-44
## 294   Alive    No   44   18-44
## 295   Alive   Yes   18   18-44
## 296   Alive   Yes   44   18-44
## 297   Alive    No   32   18-44
## 298   Alive   Yes   38   18-44
## 299   Alive   Yes   32   18-44
## 300   Alive   Yes   29   18-44
## 301   Alive    No   51   45-64
## 302   Alive   Yes   34   18-44
## 303   Alive   Yes   32   18-44
## 304   Alive    No   23   18-44
## 305   Alive   Yes   48   45-64
## 306   Alive   Yes   24   18-44
## 307   Alive   Yes   21   18-44
## 308   Alive    No   54   45-64
## 309    Dead    No   68     65+
## 310   Alive   Yes   26   18-44
```

```
## 311      Alive      No   51      45-64
## 312      Alive     Yes   45      45-64
## 313      Alive      No   31      18-44
## 314      Alive     Yes   43      18-44
## 315      Alive     Yes   30      18-44
## 316       Dead      No   72        65+
## 317      Alive      No   19      18-44
## 318      Alive      No   31      18-44
## 319       Dead      No   70        65+
## 320      Alive      No   58      45-64
## 321      Alive      No   27      18-44
## 322      Alive      No   56      45-64
## 323       Dead     Yes   46      45-64
## 324       Dead      No   75        65+
## 325      Alive      No   35      18-44
## 326      Alive      No   30      18-44
## 327       Dead      No   47      45-64
## 328      Alive      No   63      45-64
## 329      Alive      No   66        65+
## 330      Alive     Yes   41      18-44
## 331       Dead     Yes   82        65+
## 332      Alive     Yes   39      18-44
## 333      Alive     Yes   33      18-44
## 334       Dead     Yes   60      45-64
## 335       Dead      No   73        65+
## 336      Alive     Yes   26      18-44
## 337      Alive      No   21      18-44
## 338      Alive     Yes   39      18-44
## 339       Dead     Yes   51      45-64
## 340      Alive      No   28      18-44
## 341      Alive     Yes   54      45-64
## 342      Alive      No   51      45-64
## 343       Dead      No   69        65+
## 344      Alive     Yes   63      45-64
## 345      Alive     Yes   47      45-64
## 346      Alive      No   38      18-44
## 347       Dead     Yes   61      45-64
## 348      Alive     Yes   31      18-44
## 349      Alive     Yes   62      45-64
## 350      Alive      No   62      45-64
## 351      Alive     Yes   21      18-44
## 352      Alive     Yes   32      18-44
## 353      Alive      No   38      18-44
## 354       Dead      No   67        65+
## 355      Alive      No   59      45-64
## 356       Dead      No   71        65+
## 357      Alive      No   35      18-44
## 358      Alive     Yes   28      18-44
## 359      Alive     Yes   31      18-44
## 360       Dead     Yes   58      45-64
## 361      Alive     Yes   53      45-64
## 362      Alive      No   48      45-64
## 363      Alive      No   27      18-44
## 364      Alive      No   30      18-44
```

```
## 365      Dead    Yes   50      45-64
## 366      Dead    Yes   43      18-44
## 367     Alive     No   41      18-44
## 368     Alive     No   37      18-44
## 369     Alive     No   31      18-44
## 370     Alive     No   30      18-44
## 371     Alive    Yes   52      45-64
## 372     Alive    Yes   37      18-44
## 373     Alive     No   45      45-64
## 374     Alive    Yes   36      18-44
## 375     Alive    Yes   34      18-44
## 376     Alive    Yes   39      18-44
## 377     Alive     No   30      18-44
## 378      Dead    Yes   57      45-64
## 379     Alive     No   40      18-44
## 380      Dead    Yes   62      45-64
## 381     Alive    Yes   62      45-64
## 382     Alive    Yes   60      45-64
## 383     Alive     No   56      45-64
## 384     Alive     No   45      45-64
## 385     Alive     No   22      18-44
## 386     Alive     No   27      18-44
## 387     Alive    Yes   18      18-44
## 388     Alive    Yes   26      18-44
## 389      Dead     No   77        65+
## 390     Alive     No   33      18-44
## 391     Alive     No   35      18-44
## 392     Alive     No   33      18-44
## 393      Dead     No   55      45-64
## 394     Alive     No   45      45-64
## 395     Alive     No   32      18-44
## 396     Alive     No   34      18-44
## 397     Alive     No   67        65+
## 398     Alive     No   35      18-44
## 399      Dead    Yes   72        65+
## 400      Dead     No   79        65+
## 401     Alive    Yes   35      18-44
## 402     Alive     No   38      18-44
## 403     Alive    Yes   25      18-44
## 404     Alive    Yes   37      18-44
## 405     Alive     No   56      45-64
## 406      Dead     No   66        65+
## 407      Dead     No   49      45-64
## 408     Alive    Yes   33      18-44
## 409      Dead     No   59      45-64
## 410     Alive     No   44      18-44
## 411     Alive     No   39      18-44
## 412      Dead     No   58      45-64
## 413     Alive     No   64      45-64
## 414     Alive     No   18      18-44
## 415     Alive    Yes   45      45-64
## 416     Alive     No   33      18-44
## 417     Alive     No   32      18-44
## 418      Dead     No   80        65+
```

```
## 419   Alive   Yes   44   18-44
## 420   Alive   Yes   25   18-44
## 421   Alive    No   68     65+
## 422   Alive   Yes   34   18-44
## 423   Alive   Yes   29   18-44
## 424    Dead   Yes   72     65+
## 425   Alive   Yes   32   18-44
## 426   Alive   Yes   56   45-64
## 427   Alive   Yes   43   18-44
## 428    Dead   Yes   60   45-64
## 429   Alive   Yes   53   45-64
## 430   Alive   Yes   41   18-44
## 431   Alive   Yes   63   45-64
## 432    Dead   Yes   57   45-64
## 433   Alive    No   24   18-44
## 434   Alive   Yes   39   18-44
## 435   Alive   Yes   39   18-44
## 436   Alive    No   31   18-44
## 437   Alive   Yes   45   45-64
## 438   Alive    No   66     65+
## 439   Alive    No   18   18-44
## 440    Dead    No   72     65+
## 441   Alive    No   49   45-64
## 442   Alive    No   37   18-44
## 443    Dead    No   68     65+
## 444    Dead   Yes   69     65+
## 445   Alive    No   27   18-44
## 446   Alive   Yes   20   18-44
## 447   Alive    No   52   45-64
## 448   Alive   Yes   62   45-64
## 449   Alive   Yes   64   45-64
## 450   Alive   Yes   42   18-44
## 451   Alive    No   66     65+
## 452    Dead    No   78     65+
## 453   Alive    No   33   18-44
## 454   Alive    No   31   18-44
## 455   Alive   Yes   49   45-64
## 456   Alive    No   58   45-64
## 457   Alive   Yes   23   18-44
## 458   Alive   Yes   41   18-44
## 459   Alive   Yes   34   18-44
## 460   Alive   Yes   30   18-44
## 461   Alive   Yes   24   18-44
## 462   Alive   Yes   31   18-44
## 463   Alive   Yes   64   45-64
## 464    Dead   Yes   81     65+
## 465    Dead    No   79     65+
## 466   Alive    No   54   45-64
## 467   Alive   Yes   47   45-64
## 468   Alive   Yes   25   18-44
## 469    Dead   Yes   68     65+
## 470   Alive   Yes   23   18-44
## 471   Alive    No   74     65+
## 472   Alive   Yes   25   18-44
```

```
## 473    Alive    Yes    54    45-64
## 474    Dead     No     78     65+
## 475    Dead     No     65     65+
## 476    Alive    Yes    39    18-44
## 477    Dead     No     73     65+
## 478    Alive    No     27    18-44
## 479    Alive    Yes    62    45-64
## 480    Alive    Yes    26    18-44
## 481    Dead     Yes    57    45-64
## 482    Alive    No     41    18-44
## 483    Alive    No     41    18-44
## 484    Dead     Yes    66     65+
## 485    Dead     Yes    48    45-64
## 486    Dead     Yes    68     65+
## 487    Alive    Yes    43    18-44
## 488    Alive    No     28    18-44
## 489    Alive    Yes    58    45-64
## 490    Dead     Yes    56    45-64
## 491    Dead     Yes    40    18-44
## 492    Dead     No     69     65+
## 493    Alive    Yes    47    45-64
## 494    Alive    Yes    52    45-64
## 495    Alive    Yes    52    45-64
## 496    Dead     No     80     65+
## 497    Alive    Yes    64    45-64
## 498    Alive    No     39    18-44
## 499    Alive    Yes    54    45-64
## 500    Alive    No     55    45-64
## 501    Alive    No     51    45-64
## 502    Alive    Yes    28    18-44
## 503    Dead     No     77     65+
## 504    Alive    Yes    27    18-44
## 505    Dead     No     82     65+
## 506    Dead     No     65     65+
## 507    Dead     No     80     65+
## 508    Alive    No     46    45-64
## 509    Alive    Yes    38    18-44
## 510    Alive    Yes    28    18-44
## 511    Dead     No     49    45-64
## 512    Alive    Yes    44    18-44
## 513    Alive    No     30    18-44
## 514    Alive    No     63    45-64
## 515    Alive    No     63    45-64
## 516    Dead     Yes    68     65+
## 517    Alive    Yes    46    45-64
## 518    Alive    No     52    45-64
## 519    Alive    No     52    45-64
## 520    Alive    No     55    45-64
## 521    Alive    No     74     65+
## 522    Alive    Yes    44    18-44
## 523    Alive    No     51    45-64
## 524    Alive    Yes    35    18-44
## 525    Alive    Yes    36    18-44
## 526    Alive    Yes    33    18-44
```

```
## 527     Alive     No    26    18-44
## 528     Alive     No    21    18-44
## 529     Alive     No    18    18-44
## 530     Alive     No    30    18-44
## 531     Dead      No    81      65+
## 532     Alive     Yes   63    45-64
## 533     Dead      Yes   42    18-44
## 534     Alive     No    35    18-44
## 535     Alive     Yes   38    18-44
## 536     Alive     No    28    18-44
## 537     Alive     Yes   62    45-64
## 538     Alive     No    39    18-44
## 539     Alive     No    39    18-44
## 540     Alive     No    61    45-64
## 541     Alive     Yes   19    18-44
## 542     Alive     Yes   46    45-64
## 543     Dead      Yes   70      65+
## 544     Alive     Yes   38    18-44
## 545     Alive     No    33    18-44
## 546     Alive     Yes   53    45-64
## 547     Alive     No    19    18-44
## 548     Dead      No    82      65+
## 549     Alive     Yes   49    45-64
## 550     Alive     Yes   47    45-64
## 551     Dead      No    78      65+
## 552     Alive     Yes   22    18-44
## 553     Alive     Yes   31    18-44
## 554     Alive     No    31    18-44
## 555     Alive     No    57    45-64
## 556     Alive     No    65      65+
## 557     Dead      No    68      65+
## 558     Alive     Yes   22    18-44
## 559     Alive     Yes   27    18-44
## 560     Alive     Yes   50    45-64
## 561     Dead      Yes   53    45-64
## 562     Alive     No    34    18-44
## 563     Alive     Yes   37    18-44
## 564     Alive     No    35    18-44
## 565     Alive     No    38    18-44
## 566     Dead      No    43    18-44
## 567     Alive     Yes   34    18-44
## 568     Alive     No    64    45-64
## 569     Alive     No    43    18-44
## 570     Dead      Yes   57    45-64
## 571     Alive     Yes   55    45-64
## 572     Alive     Yes   34    18-44
## 573     Alive     No    29    18-44
## 574     Alive     No    18    18-44
## 575     Dead      No    38    18-44
## 576     Alive     Yes   40    18-44
## 577     Alive     No    44    18-44
## 578     Dead      No    71      65+
## 579     Dead      Yes   61    45-64
## 580     Alive     Yes   26    18-44
```

```
## 581    Dead    No   35    18-44
## 582    Alive   No   26    18-44
## 583    Alive   No   39    18-44
## 584    Alive   Yes  43    18-44
## 585    Alive   Yes  44    18-44
## 586    Alive   No   38    18-44
## 587    Alive   No   37    18-44
## 588    Dead    Yes  52    45-64
## 589    Alive   No   56    45-64
## 590    Dead    No   70      65+
## 591    Alive   Yes  39    18-44
## 592    Dead    Yes  57    45-64
## 593    Alive   Yes  46    45-64
## 594    Alive   Yes  28    18-44
## 595    Alive   No   21    18-44
## 596    Dead    Yes  66      65+
## 597    Alive   Yes  38    18-44
## 598    Alive   Yes  32    18-44
## 599    Alive   Yes  23    18-44
## 600    Alive   No   61    45-64
## 601    Alive   Yes  32    18-44
## 602    Alive   No   27    18-44
## 603    Dead    Yes  73      65+
## 604    Alive   Yes  36    18-44
## 605    Alive   No   33    18-44
## 606    Alive   No   28    18-44
## 607    Alive   No   43    18-44
## 608    Alive   Yes  56    45-64
## 609    Alive   No   27    18-44
## 610    Alive   No   36    18-44
## 611    Alive   No   20    18-44
## 612    Dead    No   69      65+
## 613    Alive   No   44    18-44
## 614    Alive   Yes  26    18-44
## 615    Dead    Yes  31    18-44
## 616    Dead    No   72      65+
## 617    Dead    No   84      65+
## 618    Alive   Yes  48    45-64
## 619    Alive   No   18    18-44
## 620    Dead    Yes  82      65+
## 621    Alive   Yes  51    45-64
## 622    Alive   Yes  33    18-44
## 623    Alive   No   56    45-64
## 624    Alive   No   74      65+
## 625    Alive   No   24    18-44
## 626    Dead    No   74      65+
## 627    Alive   No   28    18-44
## 628    Alive   Yes  58    45-64
## 629    Alive   Yes  49    45-64
## 630    Dead    Yes  64    45-64
## 631    Alive   No   34    18-44
## 632    Dead    No   84      65+
## 633    Dead    Yes  47    45-64
## 634    Alive   Yes  58    45-64
```

```
## 635     Dead    Yes   63    45-64
## 636     Dead    No    57    45-64
## 637     Alive   Yes   18    18-44
## 638     Alive   No    23    18-44
## 639     Alive   No    51    45-64
## 640     Alive   No    55    45-64
## 641     Alive   No    49    45-64
## 642     Dead    No    60    45-64
## 643     Alive   No    39    18-44
## 644     Alive   No    48    45-64
## 645     Alive   No    28    18-44
## 646     Dead    No    74    65+
## 647     Alive   Yes   61    45-64
## 648     Alive   Yes   33    18-44
## 649     Dead    No    64    45-64
## 650     Dead    No    77    65+
## 651     Alive   Yes   51    45-64
## 652     Alive   Yes   23    18-44
## 653     Dead    No    43    18-44
## 654     Alive   No    47    45-64
## 655     Alive   No    27    18-44
## 656     Alive   No    48    45-64
## 657     Alive   Yes   29    18-44
## 658     Alive   No    45    45-64
## 659     Alive   Yes   31    18-44
## 660     Dead    Yes   60    45-64
## 661     Alive   No    53    45-64
## 662     Alive   No    26    18-44
## 663     Dead    Yes   61    45-64
## 664     Alive   No    38    18-44
## 665     Alive   No    22    18-44
## 666     Alive   Yes   41    18-44
## 667     Alive   Yes   27    18-44
## 668     Alive   No    63    45-64
## 669     Dead    Yes   60    45-64
## 670     Dead    No    64    45-64
## 671     Alive   No    58    45-64
## 672     Alive   No    42    18-44
## 673     Dead    No    82    65+
## 674     Dead    No    62    45-64
## 675     Alive   No    64    45-64
## 676     Alive   No    34    18-44
## 677     Alive   No    58    45-64
## 678     Alive   Yes   63    45-64
## 679     Dead    No    63    45-64
## 680     Dead    No    79    65+
## 681     Alive   No    44    18-44
## 682     Alive   No    41    18-44
## 683     Alive   No    34    18-44
## 684     Alive   Yes   38    18-44
## 685     Alive   Yes   54    45-64
## 686     Alive   No    53    45-64
## 687     Dead    No    80    65+
## 688     Dead    Yes   46    45-64
```

```
## 689    Alive    Yes    61    45-64
## 690     Dead     No    72      65+
## 691    Alive    Yes    61    45-64
## 692    Alive    Yes    28    18-44
## 693    Alive    Yes    20    18-44
## 694     Dead    Yes    46    45-64
## 695     Dead     No    56    45-64
## 696     Dead     No    84      65+
## 697     Dead    Yes    64    45-64
## 698     Dead     No    42    18-44
## 699    Alive     No    30    18-44
## 700    Alive     No    48    45-64
## 701    Alive    Yes    25    18-44
## 702     Dead     No    76      65+
## 703     Dead    Yes    61    45-64
## 704    Alive     No    41    18-44
## 705    Alive     No    29    18-44
## 706     Dead     No    80      65+
## 707    Alive    Yes    56    45-64
## 708    Alive    Yes    58    45-64
## 709     Dead     No    73      65+
## 710    Alive     No    18    18-44
## 711    Alive     No    42    18-44
## 712     Dead     No    67      65+
## 713    Alive     No    30    18-44
## 714     Dead     No    78      65+
## 715     Dead    Yes    36    18-44
## 716     Dead     No    78      65+
## 717    Alive     No    44    18-44
## 718    Alive     No    35    18-44
## 719    Alive    Yes    53    45-64
## 720     Dead     No    52    45-64
## 721    Alive    Yes    63    45-64
## 722     Dead     No    79      65+
## 723    Alive     No    51    45-64
## 724    Alive     No    59    45-64
## 725    Alive     No    62    45-64
## 726    Alive     No    35    18-44
## 727    Alive     No    32    18-44
## 728    Alive    Yes    48    45-64
## 729     Dead    Yes    53    45-64
## 730     Dead    Yes    49    45-64
## 731    Alive    Yes    23    18-44
## 732    Alive    Yes    50    45-64
## 733    Alive     No    26    18-44
## 734     Dead    Yes    44    18-44
## 735     Dead    Yes    71      65+
## 736     Dead     No    78      65+
## 737    Alive     No    40    18-44
## 738    Alive     No    71      65+
## 739    Alive    Yes    62    45-64
## 740    Alive     No    30    18-44
## 741    Alive     No    32    18-44
## 742     Dead     No    71      65+
```

```
## 743      Alive      No   70      65+
## 744      Alive      No   27      18-44
## 745       Dead     Yes   60      45-64
## 746       Dead      No   65      65+
## 747       Dead      No   72      65+
## 748      Alive      No   22      18-44
## 749      Alive     Yes   26      18-44
## 750      Alive      No   26      18-44
## 751      Alive     Yes   30      18-44
## 752      Alive     Yes   21      18-44
## 753      Alive     Yes   28      18-44
## 754      Alive      No   60      45-64
## 755      Alive      No   53      45-64
## 756      Alive     Yes   59      45-64
## 757       Dead     Yes   63      45-64
## 758      Alive     Yes   36      18-44
## 759      Alive      No   34      18-44
## 760      Alive     Yes   61      45-64
## 761       Dead      No   65      65+
## 762       Dead     Yes   59      45-64
## 763       Dead      No   70      65+
## 764       Dead     Yes   48      45-64
## 765      Alive     Yes   50      45-64
## 766       Dead      No   83      65+
## 767      Alive      No   51      45-64
## 768      Alive     Yes   24      18-44
## 769      Alive      No   46      45-64
## 770      Alive      No   19      18-44
## 771      Alive     Yes   36      18-44
## 772      Alive      No   33      18-44
## 773       Dead      No   56      45-64
## 774      Alive      No   57      45-64
## 775      Alive      No   44      18-44
## 776      Alive      No   53      45-64
## 777      Alive     Yes   30      18-44
## 778      Alive      No   42      18-44
## 779      Alive     Yes   42      18-44
## 780      Alive     Yes   58      45-64
## 781      Alive      No   32      18-44
## 782      Alive      No   30      18-44
## 783       Dead      No   73      65+
## 784      Alive      No   34      18-44
## 785       Dead     Yes   76      65+
## 786      Alive     Yes   51      45-64
## 787       Dead      No   71      65+
## 788       Dead      No   60      45-64
## 789      Alive      No   36      18-44
## 790      Alive     Yes   18      18-44
## 791      Alive      No   34      18-44
## 792       Dead      No   70      65+
## 793      Alive     Yes   50      45-64
## 794      Alive     Yes   41      18-44
## 795      Alive      No   55      45-64
## 796      Alive      No   36      18-44
```

```
## 797     Dead     Yes    66      65+
## 798    Alive      No    58    45-64
## 799    Alive     Yes    31    18-44
## 800    Alive      No    36    18-44
## 801     Dead      No    68      65+
## 802    Alive      No    24    18-44
## 803    Alive      No    25    18-44
## 804    Alive     Yes    42    18-44
## 805    Alive      No    31    18-44
## 806    Alive     Yes    18    18-44
## 807    Alive     Yes    27    18-44
## 808    Alive      No    20    18-44
## 809    Alive      No    40    18-44
## 810    Alive     Yes    57    45-64
## 811    Alive      No    73      65+
## 812    Alive      No    44    18-44
## 813    Alive      No    63    45-64
## 814    Alive      No    19    18-44
## 815     Dead     Yes    49    45-64
## 816    Alive      No    59    45-64
## 817    Alive     Yes    23    18-44
## 818    Alive     Yes    53    45-64
## 819    Alive     Yes    51    45-64
## 820    Alive     Yes    22    18-44
## 821    Alive      No    24    18-44
## 822    Alive     Yes    51    45-64
## 823    Alive     Yes    26    18-44
## 824     Dead      No    68      65+
## 825     Dead      No    56    45-64
## 826    Alive      No    47    45-64
## 827    Alive     Yes    36    18-44
## 828    Alive     Yes    46    45-64
## 829    Alive      No    26    18-44
## 830    Alive     Yes    74      65+
## 831    Alive      No    26    18-44
## 832    Alive     Yes    52    45-64
## 833    Alive      No    57    45-64
## 834    Alive     Yes    34    18-44
## 835    Alive      No    60    45-64
## 836    Alive     Yes    32    18-44
## 837    Alive     Yes    41    18-44
## 838     Dead      No    82      65+
## 839    Alive     Yes    31    18-44
## 840    Alive      No    68      65+
## 841    Alive      No    25    18-44
## 842     Dead      No    84      65+
## 843    Alive      No    37    18-44
## 844    Alive      No    37    18-44
## 845     Dead      No    83      65+
## 846    Alive      No    62    45-64
## 847    Alive      No    25    18-44
## 848    Alive     Yes    55    45-64
## 849    Alive      No    23    18-44
## 850    Alive     Yes    52    45-64
```

```
## 851    Alive   Yes  33    18-44
## 852    Alive   Yes  53    45-64
## 853    Alive    No  55    45-64
## 854    Alive   Yes  45    45-64
## 855    Alive   Yes  19    18-44
## 856    Alive   Yes  53    45-64
## 857    Alive    No  18    18-44
## 858    Alive   Yes  32    18-44
## 859    Alive    No  32    18-44
## 860     Dead    No  67      65+
## 861     Dead   Yes  60    45-64
## 862    Alive   Yes  35    18-44
## 863    Alive   Yes  60    45-64
## 864    Alive   Yes  56    45-64
## 865    Alive    No  28    18-44
## 866     Dead    No  61    45-64
## 867    Alive   Yes  46    45-64
## 868    Alive    No  22    18-44
## 869     Dead    No  55    45-64
## 870     Dead    No  66      65+
## 871     Dead   Yes  71      65+
## 872     Dead    No  68      65+
## 873    Alive    No  50    45-64
## 874    Alive   Yes  32    18-44
## 875    Alive    No  24    18-44
## 876    Alive    No  38    18-44
## 877    Alive    No  64    45-64
## 878     Dead   Yes  51    45-64
## 879    Alive   Yes  29    18-44
## 880     Dead    No  77      65+
## 881    Alive    No  25    18-44
## 882    Alive    No  50    45-64
## 883    Alive    No  61    45-64
## 884    Alive   Yes  23    18-44
## 885     Dead    No  67      65+
## 886     Dead    No  73      65+
## 887    Alive    No  23    18-44
## 888    Alive   Yes  59    45-64
## 889     Dead    No  61    45-64
## 890    Alive   Yes  43    18-44
## 891    Alive    No  25    18-44
## 892    Alive    No  39    18-44
## 893    Alive    No  45    45-64
## 894    Alive    No  25    18-44
## 895    Alive   Yes  52    45-64
## 896     Dead    No  46    45-64
## 897    Alive    No  25    18-44
## 898    Alive    No  30    18-44
## 899    Alive   Yes  62    45-64
## 900    Alive    No  58    45-64
## 901    Alive   Yes  25    18-44
## 902    Alive    No  31    18-44
## 903     Dead    No  46    45-64
## 904     Dead   Yes  27    18-44
```

```
## 905    Dead    No  68      65+
## 906   Alive   Yes  35   18-44
## 907   Alive    No  25   18-44
## 908   Alive   Yes  42   18-44
## 909    Dead    No  72      65+
## 910   Alive   Yes  55   45-64
## 911   Alive    No  29   18-44
## 912   Alive   Yes  29   18-44
## 913   Alive   Yes  36   18-44
## 914    Dead    No  51   45-64
## 915    Dead    No  80      65+
## 916    Dead    No  74      65+
## 917   Alive    No  20   18-44
## 918    Dead    No  45   45-64
## 919   Alive    No  46   45-64
## 920   Alive   Yes  43   18-44
## 921   Alive    No  66      65+
## 922    Dead   Yes  45   45-64
## 923   Alive   Yes  71      65+
## 924   Alive    No  43   18-44
## 925   Alive   Yes  27   18-44
## 926   Alive    No  22   18-44
## 927   Alive   Yes  41   18-44
## 928   Alive    No  60   45-64
## 929   Alive   Yes  46   45-64
## 930   Alive    No  29   18-44
## 931    Dead   Yes  55   45-64
## 932   Alive   Yes  36   18-44
## 933    Dead    No  84      65+
## 934   Alive    No  67      65+
## 935    Dead    No  45   45-64
## 936   Alive    No  34   18-44
## 937    Dead    No  65      65+
## 938   Alive   Yes  32   18-44
## 939    Dead    No  71      65+
## 940   Alive    No  26   18-44
## 941   Alive   Yes  26   18-44
## 942    Dead    No  72      65+
## 943   Alive    No  45   45-64
## 944   Alive    No  27   18-44
## 945   Alive   Yes  36   18-44
## 946   Alive    No  34   18-44
## 947    Dead    No  78      65+
## 948   Alive   Yes  20   18-44
## 949   Alive   Yes  46   45-64
## 950   Alive    No  27   18-44
## 951   Alive    No  74      65+
## 952   Alive   Yes  46   45-64
## 953   Alive   Yes  31   18-44
## 954   Alive   Yes  46   45-64
## 955   Alive    No  58   45-64
## 956    Dead    No  72      65+
## 957    Dead   Yes  56   45-64
## 958   Alive    No  45   45-64
```

```
## 959    Alive    No   60    45-64
## 960     Dead    No   65      65+
## 961     Dead    No   71      65+
## 962     Dead    No   76      65+
## 963    Alive    No   55    45-64
## 964    Alive    No   35    18-44
## 965    Alive   Yes   44    18-44
## 966     Dead   Yes   47    45-64
## 967     Dead   Yes   63    45-64
## 968    Alive   Yes   32    18-44
## 969    Alive    No   43    18-44
## 970    Alive   Yes   35    18-44
## 971     Dead   Yes   63    45-64
## 972    Alive    No   29    18-44
## 973    Alive    No   51    45-64
## 974    Alive   Yes   42    18-44
## 975     Dead   Yes   45    45-64
## 976    Alive   Yes   19    18-44
## 977     Dead    No   69      65+
## 978    Alive   Yes   39    18-44
## 979     Dead   Yes   61    45-64
## 980    Alive   Yes   19    18-44
## 981    Alive    No   53    45-64
## 982    Alive   Yes   61    45-64
## 983    Alive    No   40    18-44
## 984    Alive    No   37    18-44
## 985    Alive    No   37    18-44
## 986     Dead    No   65      65+
## 987    Alive    No   74      65+
## 988    Alive   Yes   50    45-64
## 989    Alive   Yes   25    18-44
## 990    Alive    No   32    18-44
## 991    Alive    No   28    18-44
## 992    Alive    No   71      65+
## 993     Dead    No   27    18-44
## 994    Alive    No   23    18-44
## 995    Alive   Yes   64    45-64
## 996    Alive    No   28    18-44
## 997     Dead    No   56    45-64
## 998    Alive    No   25    18-44
## 999     Dead   Yes   61    45-64
## 1000   Alive    No   63    45-64
## 1001   Alive    No   24    18-44
## 1002   Alive    No   64    45-64
## 1003    Dead    No   58    45-64
## 1004   Alive    No   34    18-44
## 1005   Alive    No   31    18-44
## 1006   Alive   Yes   33    18-44
## 1007   Alive   Yes   48    45-64
## 1008   Alive   Yes   55    45-64
## 1009   Alive    No   72      65+
## 1010   Alive    No   43    18-44
## 1011   Alive   Yes   20    18-44
## 1012   Alive   Yes   62    45-64
```

```
## 1013   Alive   No   18   18-44
## 1014   Alive   Yes  21   18-44
## 1015   Alive   No   38   18-44
## 1016   Alive   Yes  45   45-64
## 1017   Dead    Yes  81     65+
## 1018   Alive   Yes  66     65+
## 1019   Alive   No   33   18-44
## 1020   Alive   Yes  32   18-44
## 1021   Alive   No   29   18-44
## 1022   Alive   Yes  53   45-64
## 1023   Alive   No   21   18-44
## 1024   Alive   No   61   45-64
## 1025   Alive   No   24   18-44
## 1026   Dead    No   54   45-64
## 1027   Alive   Yes  46   45-64
## 1028   Alive   No   58   45-64
## 1029   Dead    No   65     65+
## 1030   Dead    No   82     65+
## 1031   Alive   No   53   45-64
## 1032   Dead    No   33   18-44
## 1033   Alive   Yes  49   45-64
## 1034   Alive   No   42   18-44
## 1035   Alive   Yes  43   18-44
## 1036   Alive   Yes  20   18-44
## 1037   Dead    No   56   45-64
## 1038   Dead    No   82     65+
## 1039   Dead    No   72     65+
## 1040   Alive   No   20   18-44
## 1041   Dead    No   82     65+
## 1042   Alive   No   62   45-64
## 1043   Alive   Yes  54   45-64
## 1044   Alive   No   54   45-64
## 1045   Dead    Yes  82     65+
## 1046   Alive   Yes  47   45-64
## 1047   Alive   Yes  18   18-44
## 1048   Dead    No   72     65+
## 1049   Alive   Yes  35   18-44
## 1050   Dead    No   69     65+
## 1051   Alive   No   52   45-64
## 1052   Dead    No   59   45-64
## 1053   Dead    Yes  52   45-64
## 1054   Alive   Yes  29   18-44
## 1055   Alive   No   21   18-44
## 1056   Alive   No   28   18-44
## 1057   Alive   Yes  25   18-44
## 1058   Alive   Yes  25   18-44
## 1059   Alive   Yes  58   45-64
## 1060   Alive   Yes  43   18-44
## 1061   Alive   No   62   45-64
## 1062   Dead    No   67     65+
## 1063   Alive   Yes  48   45-64
## 1064   Alive   Yes  54   45-64
## 1065   Alive   Yes  42   18-44
## 1066   Alive   No   66     65+
```

```
## 1067     Alive     Yes     23     18-44
## 1068     Alive     Yes     67       65+
## 1069     Alive      No     47     45-64
## 1070     Alive      No     28     18-44
## 1071     Alive      No     38     18-44
## 1072     Alive      No     64     45-64
## 1073      Dead      No     57     45-64
## 1074     Alive      No     56     45-64
## 1075     Alive      No     34     18-44
## 1076     Alive     Yes     50     45-64
## 1077     Alive      No     58     45-64
## 1078     Alive      No     32     18-44
## 1079      Dead      No     77       65+
## 1080     Alive     Yes     23     18-44
## 1081     Alive     Yes     36     18-44
## 1082      Dead      No     18     18-44
## 1083     Alive      No     47     45-64
## 1084      Dead      No     70       65+
## 1085      Dead     Yes     60     45-64
## 1086      Dead      No     71       65+
## 1087      Dead     Yes     56     45-64
## 1088     Alive     Yes     32     18-44
## 1089     Alive      No     28     18-44
## 1090     Alive      No     51     45-64
## 1091     Alive      No     37     18-44
## 1092     Alive      No     30     18-44
## 1093      Dead      No     77       65+
## 1094      Dead      No     70       65+
## 1095     Alive      No     41     18-44
## 1096     Alive      No     32     18-44
## 1097     Alive     Yes     48     45-64
## 1098     Alive      No     53     45-64
## 1099      Dead     Yes     65       65+
## 1100      Dead      No     66       65+
## 1101      Dead     Yes     59     45-64
## 1102      Dead      No     60     45-64
## 1103      Dead     Yes     58     45-64
## 1104     Alive      No     64     45-64
## 1105     Alive     Yes     61     45-64
## 1106      Dead      No     62     45-64
## 1107     Alive      No     58     45-64
## 1108     Alive      No     37     18-44
## 1109      Dead     Yes     53     45-64
## 1110     Alive      No     65       65+
## 1111     Alive      No     27     18-44
## 1112      Dead      No     72       65+
## 1113      Dead     Yes     60     45-64
## 1114     Alive     Yes     45     45-64
## 1115     Alive     Yes     63     45-64
## 1116     Alive      No     32     18-44
## 1117     Alive      No     18     18-44
## 1118     Alive     Yes     49     45-64
## 1119     Alive      No     34     18-44
## 1120     Alive      No     23     18-44
```

```
## 1121   Alive   No   61   45-64
## 1122   Alive   No   44   18-44
## 1123   Alive   No   66     65+
## 1124   Alive   No   28   18-44
## 1125   Alive  Yes   44   18-44
## 1126   Alive  Yes   29   18-44
## 1127   Alive  Yes   38   18-44
## 1128   Alive  Yes   52   45-64
## 1129   Alive  Yes   54   45-64
## 1130   Alive  Yes   63   45-64
## 1131    Dead  Yes   45   45-64
## 1132    Dead   No   74     65+
## 1133   Alive   No   24   18-44
## 1134   Alive   No   40   18-44
## 1135   Alive   No   28   18-44
## 1136   Alive  Yes   30   18-44
## 1137   Alive  Yes   43   18-44
## 1138    Dead  Yes   63   45-64
## 1139   Alive  Yes   33   18-44
## 1140   Alive  Yes   41   18-44
## 1141   Alive   No   60   45-64
## 1142   Alive  Yes   31   18-44
## 1143   Alive  Yes   47   45-64
## 1144    Dead   No   81     65+
## 1145    Dead   No   78     65+
## 1146   Alive   No   56   45-64
## 1147    Dead   No   73     65+
## 1148   Alive   No   56   45-64
## 1149   Alive  Yes   28   18-44
## 1150   Alive  Yes   22   18-44
## 1151   Alive   No   34   18-44
## 1152   Alive   No   48   45-64
## 1153   Alive   No   27   18-44
## 1154   Alive  Yes   47   45-64
## 1155   Alive   No   31   18-44
## 1156   Alive   No   47   45-64
## 1157    Dead   No   60   45-64
## 1158    Dead   No   59   45-64
## 1159    Dead   No   80     65+
## 1160   Alive  Yes   41   18-44
## 1161    Dead  Yes   46   45-64
## 1162   Alive  Yes   50   45-64
## 1163   Alive   No   48   45-64
## 1164   Alive   No   37   18-44
## 1165   Alive  Yes   50   45-64
## 1166   Alive  Yes   25   18-44
## 1167   Alive   No   25   18-44
## 1168   Alive   No   41   18-44
## 1169   Alive   No   24   18-44
## 1170   Alive  Yes   57   45-64
## 1171    Dead   No   71     65+
## 1172   Alive  Yes   26   18-44
## 1173    Dead   No   32   18-44
## 1174   Alive   No   25   18-44
```

```
## 1175    Dead    No  84    65+
## 1176   Alive   Yes  19   18-44
## 1177   Alive    No  26   18-44
## 1178   Alive   Yes  58   45-64
## 1179    Dead   Yes  67    65+
## 1180   Alive    No  24   18-44
## 1181    Dead   Yes  74    65+
## 1182   Alive   Yes  58   45-64
## 1183   Alive    No  57   45-64
## 1184   Alive   Yes  52   45-64
## 1185   Alive   Yes  42   18-44
## 1186   Alive    No  42   18-44
## 1187    Dead    No  69    65+
## 1188    Dead   Yes  39   18-44
## 1189    Dead   Yes  84    65+
## 1190   Alive   Yes  57   45-64
## 1191   Alive    No  42   18-44
## 1192   Alive    No  35   18-44
## 1193   Alive    No  23   18-44
## 1194   Alive    No  65    65+
## 1195   Alive   Yes  28   18-44
## 1196   Alive    No  39   18-44
## 1197   Alive   Yes  36   18-44
## 1198   Alive    No  40   18-44
## 1199   Alive    No  39   18-44
## 1200   Alive    No  19   18-44
## 1201   Alive    No  61   45-64
## 1202   Alive   Yes  37   18-44
## 1203   Alive   Yes  52   45-64
## 1204   Alive   Yes  62   45-64
## 1205   Alive    No  30   18-44
## 1206   Alive   Yes  23   18-44
## 1207    Dead   Yes  72    65+
## 1208   Alive   Yes  46   45-64
## 1209   Alive    No  33   18-44
## 1210   Alive    No  32   18-44
## 1211   Alive    No  27   18-44
## 1212    Dead   Yes  72    65+
## 1213    Dead   Yes  53   45-64
## 1214    Dead   Yes  58   45-64
## 1215   Alive   Yes  32   18-44
## 1216   Alive    No  25   18-44
## 1217    Dead    No  71    65+
## 1218   Alive   Yes  37   18-44
## 1219   Alive   Yes  41   18-44
## 1220    Dead    No  75    65+
## 1221   Alive    No  29   18-44
## 1222    Dead   Yes  62   45-64
## 1223   Alive   Yes  30   18-44
## 1224   Alive    No  20   18-44
## 1225   Alive   Yes  26   18-44
## 1226    Dead    No  60   45-64
## 1227    Dead    No  65    65+
## 1228    Dead   Yes  63   45-64
```

```
## 1229   Alive   No   19   18-44
## 1230    Dead  Yes   55   45-64
## 1231   Alive  Yes   45   45-64
## 1232   Alive   No   28   18-44
## 1233   Alive  Yes   21   18-44
## 1234   Alive   No   35   18-44
## 1235   Alive   No   24   18-44
## 1236    Dead   No   74     65+
## 1237    Dead   No   63   45-64
## 1238   Alive   No   44   18-44
## 1239   Alive  Yes   26   18-44
## 1240    Dead   No   84     65+
## 1241   Alive  Yes   27   18-44
## 1242   Alive   No   28   18-44
## 1243    Dead  Yes   60   45-64
## 1244   Alive   No   44   18-44
## 1245    Dead   No   82     65+
## 1246    Dead   No   29   18-44
## 1247   Alive  Yes   52   45-64
## 1248   Alive  Yes   42   18-44
## 1249   Alive  Yes   18   18-44
## 1250    Dead   No   61   45-64
## 1251    Dead   No   60   45-64
## 1252   Alive  Yes   19   18-44
## 1253    Dead   No   84     65+
## 1254    Dead   No   72     65+
## 1255   Alive   No   59   45-64
## 1256    Dead   No   78     65+
## 1257   Alive   No   41   18-44
## 1258   Alive   No   21   18-44
## 1259   Alive   No   31   18-44
## 1260    Dead   No   83     65+
## 1261   Alive   No   62   45-64
## 1262    Dead   No   76     65+
## 1263    Dead  Yes   63   45-64
## 1264   Alive   No   44   18-44
## 1265    Dead   No   65     65+
## 1266   Alive   No   33   18-44
## 1267   Alive  Yes   40   18-44
## 1268   Alive   No   50   45-64
## 1269    Dead   No   74     65+
## 1270   Alive   No   19   18-44
## 1271   Alive   No   50   45-64
## 1272    Dead  Yes   62   45-64
## 1273   Alive  Yes   25   18-44
## 1274    Dead  Yes   66     65+
## 1275   Alive   No   67     65+
## 1276   Alive  Yes   18   18-44
## 1277   Alive  Yes   28   18-44
## 1278   Alive  Yes   49   45-64
## 1279   Alive  Yes   39   18-44
## 1280   Alive  Yes   33   18-44
## 1281   Alive   No   44   18-44
## 1282   Alive   No   48   45-64
```

```
## 1283    Alive    Yes  37      18-44
## 1284     Dead    Yes  71         65+
## 1285     Dead     No  66         65+
## 1286    Alive    Yes  34      18-44
## 1287     Dead    Yes  77         65+
## 1288    Alive     No  48      45-64
## 1289    Alive    Yes  60      45-64
## 1290    Alive     No  41      18-44
## 1291    Alive     No  55      45-64
## 1292    Alive    Yes  46      45-64
## 1293    Alive     No  55      45-64
## 1294    Alive     No  20      18-44
## 1295     Dead    Yes  80         65+
## 1296    Alive    Yes  57      45-64
## 1297    Alive     No  52      45-64
## 1298    Alive    Yes  48      45-64
## 1299    Alive     No  30      18-44
## 1300    Alive    Yes  57      45-64
## 1301    Alive    Yes  37      18-44
## 1302    Alive     No  27      18-44
## 1303    Alive     No  37      18-44
## 1304    Alive     No  36      18-44
## 1305    Alive     No  23      18-44
## 1306     Dead     No  55      45-64
## 1307    Alive     No  40      18-44
## 1308    Alive     No  33      18-44
## 1309    Alive     No  23      18-44
## 1310    Alive    Yes  35      18-44
## 1311    Alive     No  33      18-44
## 1312    Alive    Yes  21      18-44
## 1313    Alive     No  46      45-64
## 1314    Alive    Yes  41      18-44
```

Exercise 8

Consider this new variable as a possible explanation of the data. What has changed, and what might explain this change? Create a data visualization to support your narrative.

```
newWhickham %>%
  count(agegroup, smoker) %>%
  group_by(smoker)
```

```
## # A tibble: 6 x 3
## # Groups:   smoker [2]
##   agegroup smoker     n
##   <chr>    <fct>  <int>
## 1 18-44    No       339
## 2 18-44    Yes      285
## 3 45-64    No       200
## 4 45-64    Yes      247
## 5 65+      No       193
## 6 65+      Yes       50
```

```
ggplot(data=newWhickham, mapping = aes(x = smoker, fill = outcome)) +
  geom_bar(position = "fill") +
  facet_grid(. ~agegroup, labeller = label_both) +
  theme_bw() +
  labs(title = "Outcome of Smoker Status by Age Group",
       x = "Smoker?", y = "Proportion of Survivors")
```
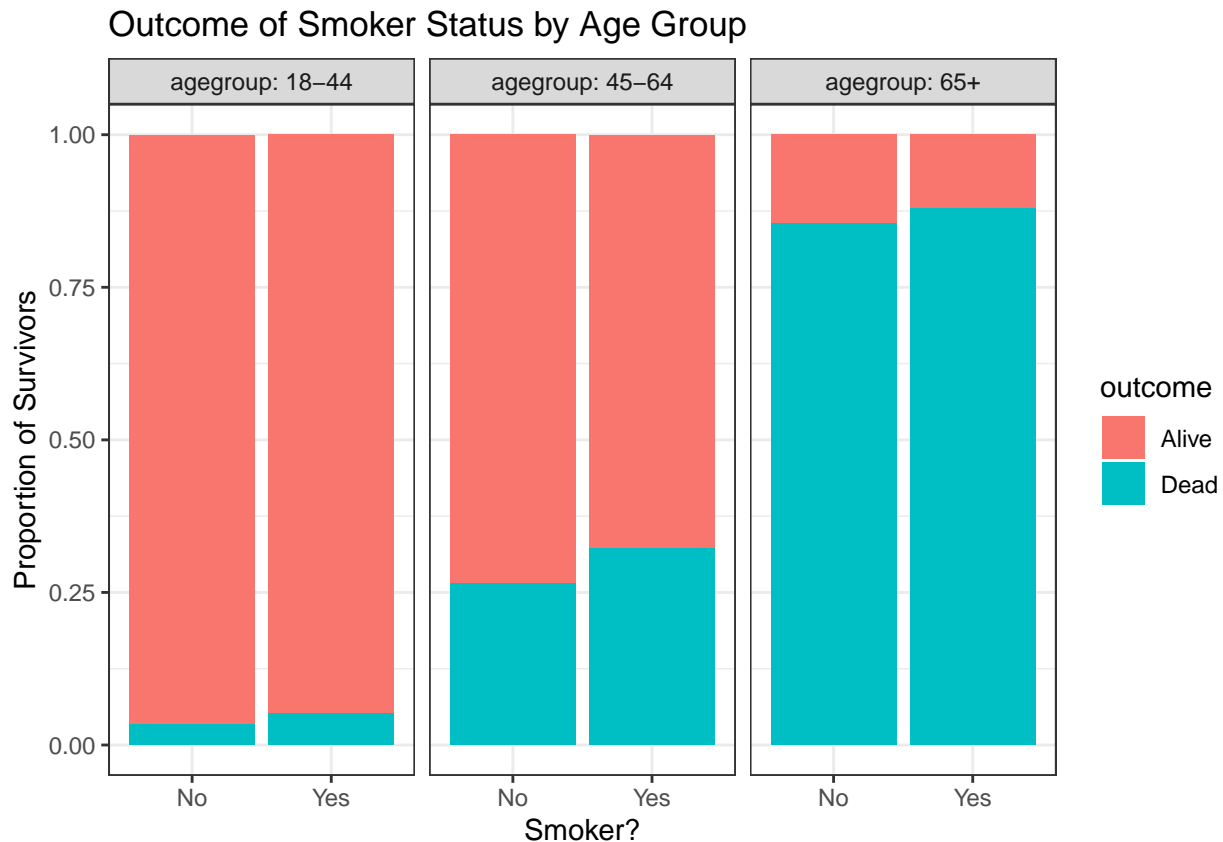

When taking into account age groups and faceting by them, we can see that the previous data representations might have been skewed. This is a case of Simpson's Paradox, where a trend may appear in different groups of data but disappear or potentially reverse when those groups are combined. When taking these age groups into account, we can also see that my initial prediction stands, with a greater proportion of non-smokers being alive than smokers. This trend is apparent throughout all age groups, with it being least apparent in age groups 18-44 and 65+, while being most apparent in the age group 45-64. This is most likely due to the fact that most 18-44 year olds have not yet hit an age where the effects of smoking are apparent/detrimental, especially when considering that the legal age to smoke is 18. Most of the smokers in this age group have simply not smoked for long enough. For the age group 45-65, this trend is more apparent as members of this age group have smoked long enough for the negative effects of smoking to show up. This trend is not as apparent in the 65+ age group as this group is in the age range to pass from old age. Even so, there still is a small difference in proportion of those alive between smokers and non-smokers.