Final Project

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Data Import

```
cancer_raw =
  read_csv("./data/Cancer_Registry.csv") %>%
  janitor::clean_names() %>%
  dplyr::select(target_death_rate, geography, everything()) %>%
  separate(geography, into = c("county", "state"), sep = ",")
```

Data varibale dictionary:

- **target_death_rate:** mean per capita (100,000) cancer mortalities (a)
- **avg_ann_count:** mean number of reported cases of cancer diagnosed annually (a)
- **avg_deaths_per_year:** mean number of reported mortalities due to cancer (a)
- **incidence_rate:** mean per capita (100,000) cancer diagnoses (a)
- **med_income:** median income per county (b)
- **pop_est2015:** population of county (b)
- **poverty_percent:** percent of population in poverty (b)
- **study_per_cap** per capita number of cancer-related clinical trials per county (a)
- **binned_inc:** median income per capita binned by decile (b)
- **median_age:** median age of county residents (b)
- **median_age_male:** median age of male county residents (b)
- **median_age_female:** median age of female county residents (b)
- **geography:** county name (b)
- **avg_household_size:** mean household size of county (b)
- **percent_married:** percent of county residents who are married (b)
- **pct_no_hs18_24:** percent of county residents ages 18-24 highest education attained: less than high school (b)
- **pct_hs18_24:** percent of county residents ages 18-24 highest education attained: high school diploma (b)
- **pct_some_col18_24:** percent of county residents ages 18-24 highest education attained: some college (b)
- **pct_bach_deg18_24:** percent of county residents ages 18-24 highest education attained: bachelor's degree (b)
- **pct_hs25_over:** percent of county residents ages 25 and over highest education attained: high school diploma (b)
- **pct_bach_deg25_over:** percent of county residents ages 25 and over highest education attained: bachelor's degree (b)
- **pct_employed16_over:** percent of county residents ages 16 and over employed (b)
- **pct_unemployed16_over:** percent of county residents ages 16 and over unemployed (b)
- **pct_private_coverage:** percent of county residents with private health coverage (b)
- **pct_private_coverage_alone:** percent of county residents with private health coverage alone (no public assistance) (b)

- **pct_emp_priv_coverage:** percent of county residents with employee-provided private health coverage (b)

- **pct_public_coverage:** percent of county residents with government-provided health coverage (b)
- **pct_public_coverage_alone:** percent of county residents with government-provided health coverage alone (b)

- **pct_white:** percent of county residents who identify as White (b)

- **pct_black:** percent of county residents who identify as Black (b)
- **pct_asian:** percent of county residents who identify as Asian (b)

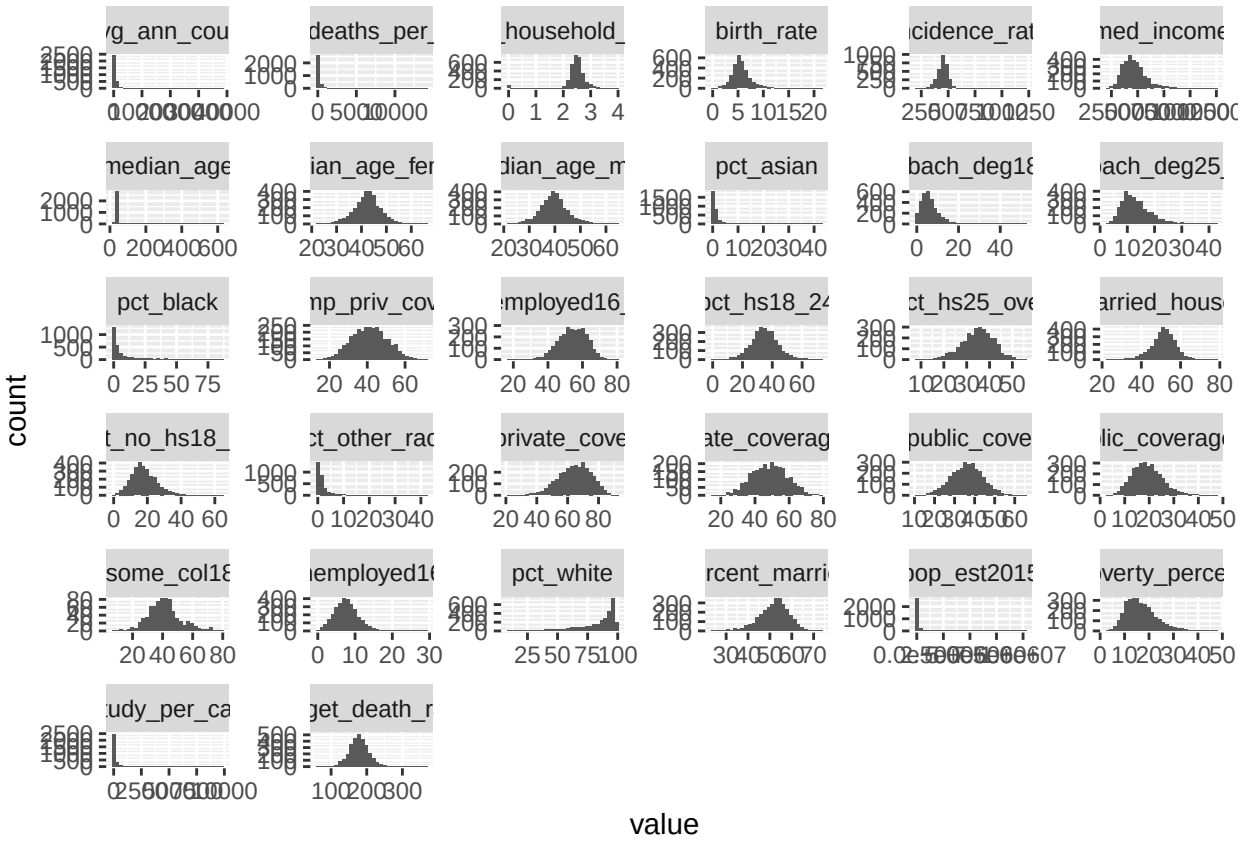
- **pct_other_race:** percent of county residents who identify in a category which is not White, Black, or Asian (b)

- **pct_married_households:** percent of married households (b)
- **birth_rate:** number of live births relative to number of women in county (b)

Look at the distribution of all varibales:

```
cancer_raw %>%
  keep(is.numeric) %>%
  gather() %>%
  ggplot(aes(value)) +
    facet_wrap(~ key, scales = "free") +
    geom_histogram(bins = 30)
```

```
## Warning: Removed 3046 rows containing non-finite values (stat_bin).
```



Choose variables:

```
cancer_county =
  cancer_raw %>%
  janitor::clean_names() %>%
  dplyr::select(target_death_rate, incidence_rate, med_income, poverty_percent, median_age:median_age_f
  dplyr::select(-pct_hs25_over, -pct_bach_deg25_over, -pct_employed16_over, -percent_married) %>%
  mutate(pct_upto_hs18_24 = pct_no_hs18_24 + pct_hs18_24,
         pct_above_hs18_24 = 100 - pct_upto_hs18_24,
         pct_with_coverage = pct_private_coverage + pct_public_coverage_alone,
         income_cat = ifelse(med_income < 35000, 0, 1)) %>%
  dplyr::select(-(pct_no_hs18_24:pct_bach_deg18_24), -pct_above_hs18_24, -(pct_private_coverage:pct_publ
```

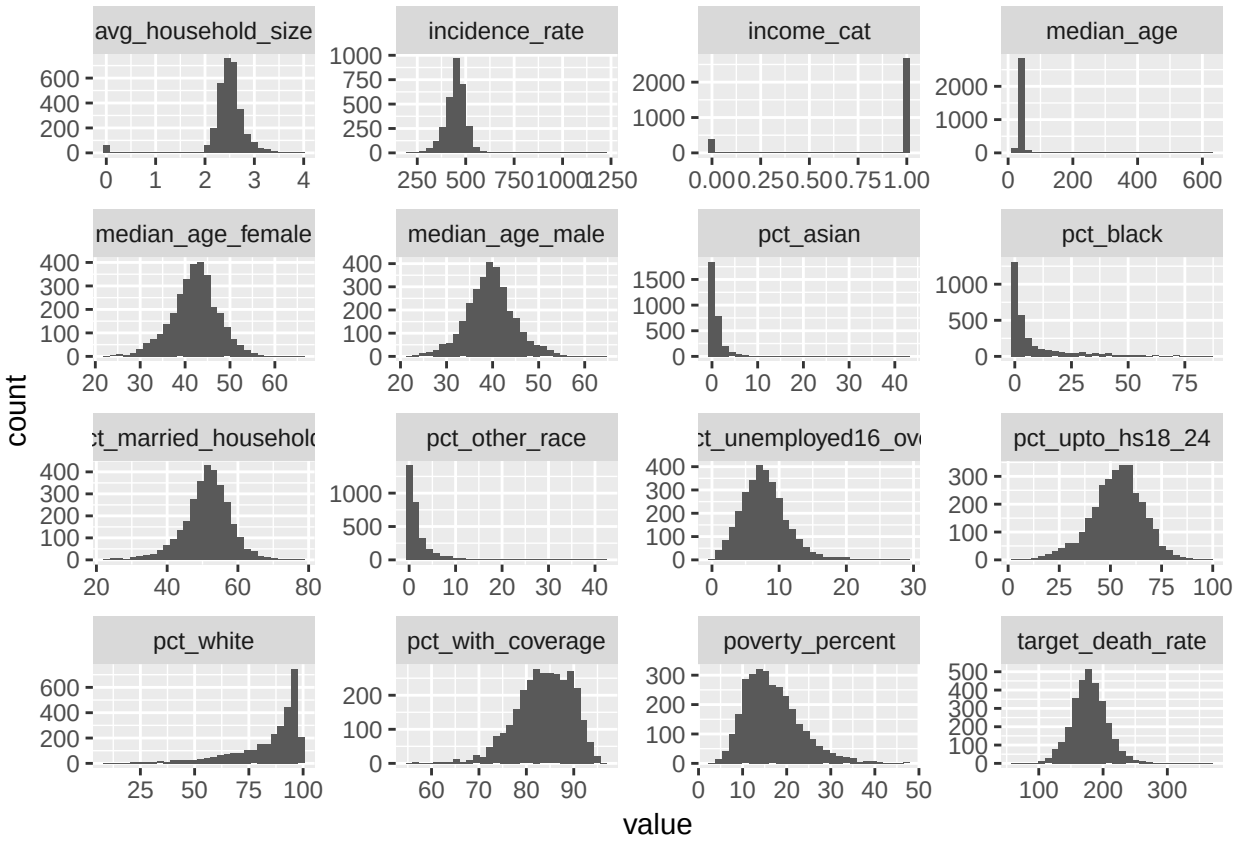
Check correlation and distribution:

```
cor(cancer_county) %>%
  knitr::kable()
```

	target_death_rate	incidence_rate	poverty_percent	median_age	median_age_male	m
target_death_rate	1.0000000	0.4494317	0.4293890	0.0043751	-0.0219294	
incidence_rate	0.4494317	1.0000000	0.0090463	0.0180892	-0.0147332	
poverty_percent	0.4293890	0.0090463	1.0000000	-0.0292800	-0.2140010	
median_age	0.0043751	0.0180892	-0.0292800	1.0000000	0.1291195	

	target_death_rate	incidence_rate	poverty_percent	median_age	median_age_male	n
median_age_male	-0.0219294	-0.0147332	-0.2140010	0.1291195	1.0000000	
median_age_female	0.0120484	-0.0091056	-0.1481635	0.1246784	0.9336961	
avg_household_size	-0.0369053	-0.1184000	0.0743076	-0.0319441	-0.3431887	
pct_unemployed16_over	0.3784124	0.0999795	0.6551481	0.0185904	-0.1427375	
pct_white	-0.1774000	-0.0145098	-0.5094328	0.0350094	0.3980444	
pct_black	0.2570236	0.1134890	0.5115297	-0.0171732	-0.2427481	
pct_asian	-0.1863311	-0.0081234	-0.1572887	-0.0384239	-0.2383224	
pct_other_race	-0.1898936	-0.2087483	0.0470959	-0.0302765	-0.2666554	
pct_married_households	-0.2933253	-0.1521763	-0.6049528	0.0145036	0.2222777	
pct_upto_hs18_24	0.2443042	-0.0929669	0.2517431	0.0401926	0.2371826	
pct_with_coverage	-0.2292798	0.2302489	-0.6516658	0.0049621	0.1497702	
income_cat	-0.3030288	0.0110839	-0.6344122	0.0103377	0.0266055	

```
cancer_county %>%
  gather() %>%
  ggplot(aes(value)) +
  facet_wrap(~ key, scales = "free") +
  geom_histogram(bins = 30)
```



The discriptive statistics:

```
state_summary = function(x){
  mean = mean(x)
```

```
  max = max(x)
  min = min(x)
  median = median(x)
  var = var(x)
  sd = sd(x)
  sample_size = length(x) - sum(is.na(x))
  tibble(mean, max, min, median, var, sd, sample_size)
}

#cancer_county %>% dplyr::select(-income_cat) %>% gather() %>% group_by(key) %>% nest() %>% mutate(summ

df_target_death_rate = state_summary(cancer_county$target_death_rate)
df_incidence_rate = state_summary(cancer_county$incidence_rate)
df_poverty_percent = state_summary(cancer_county$poverty_percent)
df_median_age = state_summary(cancer_county$median_age)
df_median_agemale = state_summary(cancer_county$median_age_male)
df_median_agefemale = state_summary(cancer_county$median_age_female)
df_avg_household_size = state_summary(cancer_county$avg_household_size)
df_pct_unemployed16_over = state_summary(cancer_county$pct_unemployed16_over)
df_pct_white = state_summary(cancer_county$pct_white)
df_pct_black = state_summary(cancer_county$pct_black)
df_pct_asian = state_summary(cancer_county$pct_asian)
df_pct_other_race = state_summary(cancer_county$pct_other_race)
df_pct_married_households = state_summary(cancer_county$pct_married_households)
df_pct_upto_hs18_24 = state_summary(cancer_county$pct_upto_hs18_24)
df_pct_with_coverage = state_summary(cancer_county$pct_with_coverage)

state_des <- bind_rows(df_target_death_rate,
                       df_incidence_rate,
                       df_poverty_percent,
                       df_median_age,
                       df_median_agemale,
                       df_median_agefemale,
                       df_avg_household_size,
                       df_pct_unemployed16_over,
                       df_pct_white,
                       df_pct_black,
                       df_pct_asian,
                       df_pct_other_race,
                       df_pct_married_households,
                       df_pct_upto_hs18_24,
                       df_pct_with_coverage)
variable = c("target_death_rate", "incidence_rate","poverty_percent", "median_age", "median_agemale", "

state_wholedes = cbind(variable, state_des)

knitr::kable(state_wholedes)
```

variable	mean	max	min	median	var	sd	sample_size
target_death_rate	178.664063	362.80000	59.70000	178.1000000	770.1463805	27.7515113	3047
incidence_rate	448.268586	1206.90000	201.30000	453.5494221	2976.8735549	54.5607327	3047
poverty_percent	16.878175	47.40000	3.20000	15.9000000	41.0763948	6.4090869	3047
median_age	45.272333	624.00000	22.30000	41.0000000	2052.4959218	45.3044802	3047

variable	mean	max	min	median	var	sd	sample_size
median_agemale	39.570725	64.70000	22.40000	39.6000000	27.3112504	5.2260167	3047
median_agefemale	42.145323	65.70000	22.30000	42.4000000	28.0142518	5.2928491	3047
avg_household_size	2.479662	3.97000	0.02210	2.5000000	0.1841906	0.4291744	3047
pct_unemployed16_over	7.852412	29.40000	0.40000	7.6000000	11.9188640	3.4523708	3047
pct_white	83.645286	100.00000	10.19916	90.0597742	268.3052265	16.3800252	3047
pct_black	9.107978	85.94780	0.00000	2.2475763	211.2527926	14.5345379	3047
pct_asian	1.253965	42.61942	0.00000	0.5498117	6.8135428	2.6102764	3047
pct_other_race	1.983523	41.93025	0.00000	0.8261852	12.3742846	3.5177101	3047
pct_married_households	51.243872	78.07540	22.99249	51.6699411	43.2018812	6.5728138	3047
pct_upto_hs18_24	53.226518	100.00000	4.80000	53.9000000	160.1814371	12.6562805	3047
pct_with_coverage	83.595011	95.70000	54.60000	84.0000000	35.3664623	5.9469709	3047

Model building:

Stepwise:

```
# building full model
full_model <- lm(target_death_rate ~., data = cancer_county)
summary(full_model)
```

```
##
## Call:
## lm(formula = target_death_rate ~ ., data = cancer_county)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -129.883  -11.469    0.163   12.142  126.523
##
## Coefficients:
##                           Estimate Std. Error t value Pr(>|t|)
## (Intercept)             72.058821  12.583888   5.726 1.13e-08 ***
## incidence_rate           0.219657   0.007547  29.104  < 2e-16 ***
## poverty_percent          1.036531   0.120008   8.637  < 2e-16 ***
## median_age              -0.004080   0.008394  -0.486 0.626969
## median_age_male         -0.241798   0.212259  -1.139 0.254726
## median_age_female        0.046110   0.209093   0.221 0.825476
## avg_household_size      -0.117704   1.007617  -0.117 0.907015
## pct_unemployed16_over    0.781391   0.153410   5.093 3.73e-07 ***
## pct_white                0.067342   0.058298   1.155 0.248127
## pct_black               -0.016016   0.057020  -0.281 0.778818
## pct_asian               -0.628303   0.178918  -3.512 0.000452 ***
## pct_other_race          -0.940645   0.124524  -7.554 5.56e-14 ***
## pct_married_households -0.220555   0.088361  -2.496 0.012611 *
## pct_upto_hs18_24         0.392918   0.038241  10.275  < 2e-16 ***
## pct_with_coverage       -0.194259   0.101672  -1.911 0.056145 .
## income_cat              -4.104213   1.507502  -2.723 0.006516 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 20.77 on 3031 degrees of freedom
## Multiple R-squared:  0.4427, Adjusted R-squared:  0.4399
## F-statistic: 160.5 on 15 and 3031 DF,  p-value: < 2.2e-16
```

```r
# Using the stepwise
stepwise_model = stepAIC(full_model, direction = "both", trace = FALSE)
summary(stepwise_model)
```

```
##
## Call:
## lm(formula = target_death_rate ~ incidence_rate + poverty_percent +
##     median_age_male + pct_unemployed16_over + pct_white + pct_asian +
##     pct_other_race + pct_married_households + pct_upto_hs18_24 +
##     pct_with_coverage + income_cat, data = cancer_county)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -129.978  -11.453    0.127   12.095  126.386
##
## Coefficients:
##                           Estimate Std. Error t value Pr(>|t|)
## (Intercept)             70.812109  11.698781   6.053 1.60e-09 ***
## incidence_rate           0.219430   0.007509  29.223  < 2e-16 ***
## poverty_percent          1.038613   0.119140   8.718  < 2e-16 ***
## median_age_male         -0.202308   0.086539  -2.338 0.019465 *
## pct_unemployed16_over    0.774783   0.152081   5.095 3.71e-07 ***
## pct_white                0.080440   0.034847   2.308 0.021043 *
## pct_asian               -0.613378   0.167491  -3.662 0.000254 ***
## pct_other_race          -0.933301   0.119239  -7.827 6.84e-15 ***
## pct_married_households -0.222728   0.086039  -2.589 0.009680 **
## pct_upto_hs18_24         0.394452   0.037753  10.448  < 2e-16 ***
## pct_with_coverage       -0.194337   0.099299  -1.957 0.050430 .
## income_cat              -4.069227   1.500008  -2.713 0.006709 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 20.76 on 3035 degrees of freedom
## Multiple R-squared:  0.4426, Adjusted R-squared:  0.4406
## F-statistic: 219.1 on 11 and 3035 DF,  p-value: < 2.2e-16
```

```r
vif(stepwise_model)
```

```
##         incidence_rate        poverty_percent        median_age_male
##               1.186642               4.122196               1.446080
##  pct_unemployed16_over             pct_white             pct_asian
##               1.948976               2.303407               1.351383
##         pct_other_race pct_married_households       pct_upto_hs18_24
##               1.243892               2.261059               1.614089
##      pct_with_coverage             income_cat
##               2.465515               1.729209
```

```r
# Cp and AIC and Adjusted R2
model_dig = glance(stepwise_model) %>%
  as.data.frame() %>%
  dplyr::select(adj.r.squared, sigma, p.value, AIC, BIC) %>%
  rename(RES = sigma) %>%
  mutate(cp = ols_mallows_cp(stepwise_model, full_model))

model_dig
```

```
##   adj.r.squared      RES p.value      AIC      BIC      cp
## 1     0.4405848 20.75648       0 27143.23 27221.51 8.35992
```

Cross validation and Criterion method summery

```
cross_df = crossv_mc(cancer_county, n = 100, test = 0.2)

cross_result =
  cross_df %>%
  mutate(
    step_mod = map(train, ~lm(target_death_rate ~ incidence_rate + poverty_percent +
    median_age_male + pct_unemployed16_over + pct_white + pct_asian +
    pct_other_race + pct_married_households + pct_upto_hs18_24 +
    pct_with_coverage + income_cat, data = .x)),
    rmse_train = map2_dbl(step_mod, train, ~rmse(model = .x, data = .y)),
    rmse_test = map2_dbl(step_mod, test, ~rmse(model = .x, data = .y))
    )


mse_results = cross_result %>%
  dplyr::select(rmse_train, rmse_test) %>%
  summarize(mse_train = (mean(rmse_train))^2,
            mse_test = (mean(rmse_test))^2) #mse results

#LOOCV
glm.fit = glm(target_death_rate ~ incidence_rate + poverty_percent +
    median_age_male + pct_unemployed16_over + pct_white + pct_asian +
    pct_other_race + pct_married_households + pct_upto_hs18_24 +
    pct_with_coverage + income_cat, data = cancer_county)

cv.err = cv.glm(cancer_county, glm.fit)

# The two delta values should be similar: we use the first one
# The second value is bias corrected
cv.err$delta   #434.8355
```

```
## [1] 434.8355 434.8346
```

```
anova(stepwise_model)[12, 3] #MSE: 431
```

```
## [1] 430.8316
```

```
tibble(
  mse_model = anova(stepwise_model)[12, 3],
  mse_LOOCV = cv.err$delta,
  mse_CV_train = mse_results$mse_train,
  mse_CV_test = mse_results$mse_test
)
```

```
## # A tibble: 2 x 4
##   mse_model mse_LOOCV mse_CV_train mse_CV_test
##       <dbl>     <dbl>        <dbl>       <dbl>
## 1      431.      435.         427.        439.
## 2      431.      435.         427.        439.
```

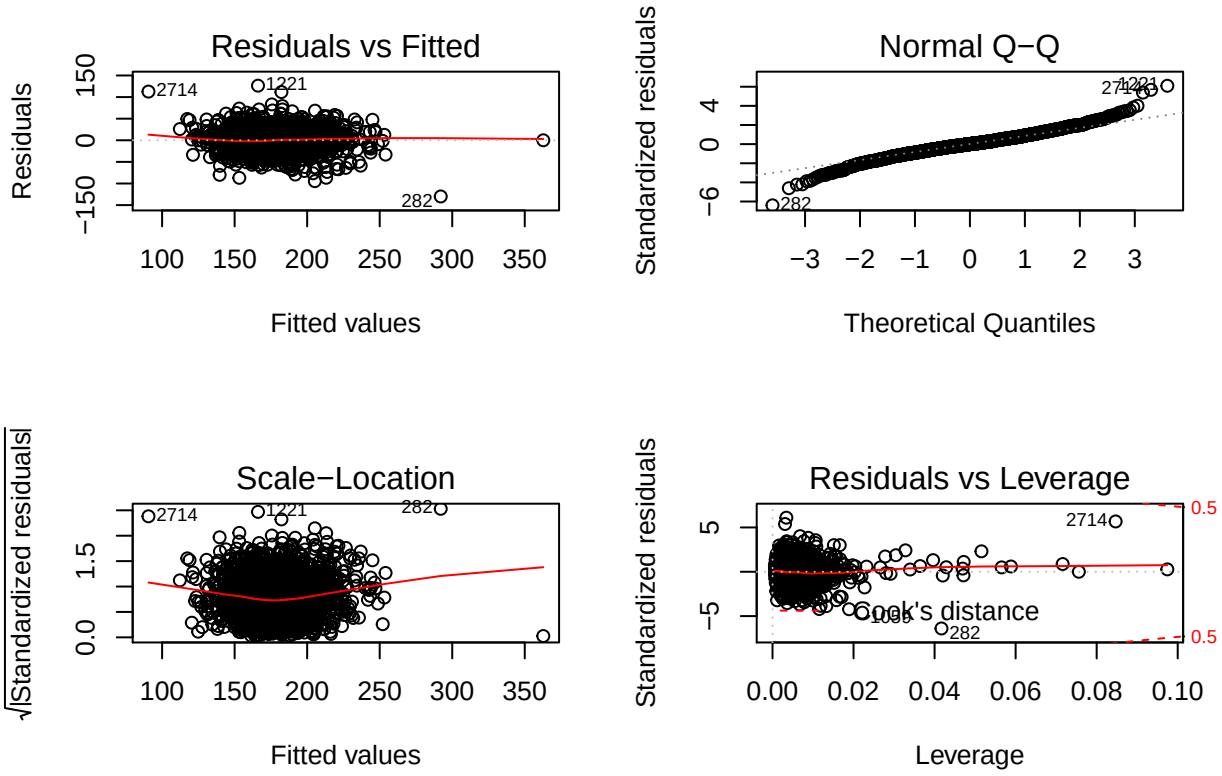
Bootstrap

```
cancer_county %>%
  modelr::bootstrap(n = 1000) %>%
  mutate(models = map(strap, ~lm(target_death_rate ~ incidence_rate + poverty_percent +
    median_age_male + pct_unemployed16_over + pct_white + pct_asian +
    pct_other_race + pct_married_households + pct_upto_hs18_24 +
    pct_with_coverage + income_cat, data = .x)),
         results = map(models, broom::tidy)) %>%
  dplyr::select(-strap, -models) %>%
  unnest() %>%
  group_by(term) %>%
  summarize(boot_se = sd(estimate))
```

```
## # A tibble: 12 x 2
##    term                   boot_se
##    <chr>                    <dbl>
##  1 (Intercept)            14.5
##  2 incidence_rate          0.0130
##  3 income_cat              1.77
##  4 median_age_male         0.101
##  5 pct_asian               0.268
##  6 pct_married_households  0.103
##  7 pct_other_race          0.152
##  8 pct_unemployed16_over   0.187
##  9 pct_upto_hs18_24        0.0427
## 10 pct_white               0.0430
## 11 pct_with_coverage       0.122
## 12 poverty_percent         0.146
```

Outliers

```
par(mfrow = c(2,2))
plot(stepwise_model) # we observe the 282, 1059 are outliers
```




```
# Using the studentized residuals
stu_res_step <- rstandard(stepwise_model)
outliers_y_step = stu_res_step[abs(stu_res_step) > 2.5]
outliers_y_step
```

```
##       116       119       120       122       124       166       189
##  3.832977 -2.987984 -2.938723  3.451322 -3.218087  3.004467 -2.722478
##       209       250       254       256       264       282       522
##  2.634644  2.588483  3.557345 -2.852694 -3.008080 -6.396845  2.942781
##       524       621       627       666       775       783       803
##  2.568705 -2.758364  3.045997  2.920921  3.334436 -2.537021 -2.663472
##       812       845       912       921       979      1048      1058
## -3.536931 -3.028088 -3.843379 -3.048353  2.507593 -2.742014 -2.740598
##      1059      1066      1076      1094      1217      1221      1261
## -4.608218 -2.851923  2.589435 -3.878191  2.599136  6.099415  3.086750
##      1310      1331      1345      1366      1429      1497      1797
##  2.535483 -2.754403 -2.677687  5.386441 -3.247185  4.014689 -2.821788
##      1868      1942      1958      1965      2016      2036      2066
## -2.751254 -4.227918  3.000271 -2.799419  2.516370  2.505926 -3.205862
##      2174      2176      2318      2323      2444      2549      2563
##  2.961474  2.732626 -3.324763 -2.721648 -3.437022  2.598223  2.685328
##      2590      2600      2626      2637      2642      2646      2659
##  2.708745  3.313439 -3.205136  3.444507 -2.786091 -4.202767 -3.695226
##      2669      2674      2696      2714      2726      2727      2809
## -2.505761 -3.095519 -2.594155  5.675093  2.838797  3.252953 -2.983391
```

```
# various measure of influence
influence.measures(stepwise_model) %>%
  summary() #we observe the 282, 1059 are potential outliers
```

```
## Potentially influential observations of
##   lm(formula = target_death_rate ~ incidence_rate + poverty_percent +      median_age_male + pct_unem
##
##      dfb.1_ dfb.incd_ dfb.pvr_ dfb.md__ dfb.p_16 dfb.pct_w dfb.pct_s
## 21    0.03   0.04     -0.07     0.04     0.01    -0.05     -0.05
## 116   0.19   0.04     -0.23     0.02     0.13     0.13     -0.04
## 119  -0.04  -0.01      0.12     0.09    -0.12    -0.04      0.01
## 120   0.00  -0.01      0.05     0.06    -0.10    -0.03      0.01
## 122   0.05  -0.01     -0.09     0.15     0.14     0.03      0.05
## 124   0.00  -0.01      0.01     0.02    -0.02    -0.03      0.00
## 140   0.00   0.00      0.00     0.00     0.00     0.00     -0.01
## 147   0.01   0.00      0.00     0.00     0.00     0.01      0.02
## 150   0.00   0.01      0.00     0.01     0.00     0.00      0.07
## 156   0.00   0.00      0.00     0.00     0.00     0.00      0.02
## 161   0.01   0.00      0.00     0.02    -0.01     0.00      0.00
## 165   0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 166  -0.05   0.05     -0.01     0.14    -0.09     0.02     -0.03
## 176  -0.11   0.07      0.01     0.03     0.01     0.12      0.04
## 177   0.00   0.00      0.00     0.03    -0.01     0.00     -0.02
## 180   0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 181   0.00  -0.02      0.02    -0.01     0.01     0.01     -0.03
## 184   0.00   0.00      0.00     0.06    -0.03     0.01     -0.04
## 188   0.00   0.01      0.01    -0.03    -0.01     0.00      0.01
## 189   0.11  -0.11     -0.13    -0.06     0.01    -0.03     -0.03
## 191   0.01   0.00     -0.01     0.00     0.00     0.00      0.00
## 194   0.02  -0.01      0.00    -0.01     0.00     0.00      0.01
## 209   0.02  -0.11      0.02     0.00     0.05     0.06      0.01
## 210  -0.01  -0.01      0.00     0.00     0.00    -0.01      0.06
## 217   0.00   0.01     -0.02     0.01     0.01    -0.01     -0.01
## 237   0.02  -0.06      0.01     0.02     0.01     0.03      0.00
## 245  -0.01   0.00      0.01     0.00    -0.01    -0.01      0.00
## 250  -0.01  -0.09      0.05    -0.02     0.05     0.05      0.00
## 253   0.01  -0.01     -0.01     0.00     0.00     0.00      0.00
## 254   0.12  -0.26     -0.10    -0.06     0.08     0.14      0.01
## 256   0.03  -0.24     -0.11     0.04     0.17    -0.05     -0.11
## 264  -0.02  -0.13     -0.12     0.10     0.10    -0.12     -0.07
## 270   0.01   0.00     -0.01     0.00     0.00     0.02      0.01
## 271  -0.02  -0.06      0.04    -0.01     0.01     0.05      0.02
## 274   0.00   0.00      0.00     0.01     0.00    -0.01      0.00
## 282   0.13  -1.22_*   -0.06     0.14     0.16    -0.11     -0.15
## 284   0.01   0.00      0.00     0.01    -0.01     0.00      0.01
## 292   0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 294   0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 296  -0.01   0.01     -0.01    -0.01     0.02     0.00     -0.02
## 300   0.00   0.00      0.00     0.00     0.00     0.00     -0.02
## 321   0.00   0.00     -0.01     0.01     0.00    -0.01      0.00
## 394  -0.01   0.00      0.00    -0.01     0.01    -0.02     -0.04
## 469   0.10  -0.02     -0.05     0.00    -0.07     0.02     -0.02
## 479   0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 492   0.04   0.02      0.02     0.00    -0.06    -0.06     -0.02
## 522  -0.01  -0.09      0.08    -0.02    -0.05    -0.10     -0.04
## 524   0.03   0.03     -0.05     0.02    -0.05    -0.08      0.01
## 537   0.03   0.01     -0.01     0.04    -0.01    -0.04     -0.06
## 564   0.01   0.02      0.02    -0.01     0.01     0.05      0.00
```

```
## 576  -0.03   0.00      0.02     0.01     0.01     0.00     -0.03
## 585  -0.01   0.00      0.01     0.02     0.00     0.00      0.12
## 591   0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 594   0.02   0.00     -0.02     0.00    -0.01    -0.01     -0.02
## 597   0.03   0.02     -0.01     0.01    -0.10    -0.03      0.02
## 621   0.04  -0.09      0.01    -0.05     0.04     0.05      0.00
## 627   0.07  -0.06     -0.02     0.14    -0.06    -0.01     -0.01
## 650  -0.08   0.02      0.04    -0.05     0.02    -0.01      0.03
## 660   0.06   0.01     -0.06    -0.07     0.07     0.01     -0.04
## 666   0.02   0.02      0.01     0.08    -0.09    -0.03     -0.01
## 670   0.02  -0.07     -0.01     0.04    -0.02     0.00     -0.02
## 727  -0.11  -0.03      0.14     0.00    -0.06     0.00      0.03
## 749  -0.07   0.02      0.06     0.02     0.04     0.03      0.01
## 775  -0.01  -0.04      0.08    -0.02    -0.12    -0.06      0.01
## 780  -0.07   0.02      0.06     0.03    -0.08    -0.08     -0.02
## 783  -0.04   0.03     -0.02     0.04     0.08    -0.03     -0.02
## 796  -0.05   0.00      0.04     0.06    -0.07    -0.09     -0.01
## 803   0.09  -0.06     -0.03     0.02     0.00     0.03      0.00
## 809   0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 812  -0.09  -0.05      0.03     0.05     0.03    -0.01      0.00
## 840   0.01  -0.01     -0.01     0.01     0.02     0.01      0.00
## 845  -0.19   0.04      0.11    -0.03    -0.02     0.03      0.02
## 853  -0.03  -0.01      0.03     0.01     0.00    -0.01      0.00
## 884   0.00   0.00      0.00     0.00     0.00     0.01     -0.03
## 886   0.00   0.01      0.01    -0.01     0.00     0.01     -0.04
## 900  -0.04   0.03     -0.09     0.06     0.06    -0.06     -0.03
## 905  -0.02   0.03     -0.06     0.06     0.02    -0.08     -0.04
## 912  -0.13   0.09     -0.02     0.22    -0.03    -0.20     -0.06
## 913  -0.10   0.08      0.02     0.09    -0.03    -0.14      0.00
## 921  -0.07   0.03      0.07     0.05    -0.06    -0.03      0.00
## 922  -0.01   0.00      0.00     0.00     0.00     0.00      0.00
## 925  -0.07   0.03      0.09     0.05    -0.01    -0.05     -0.01
## 927   0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 937  -0.05   0.00      0.06     0.08    -0.01     0.00      0.01
## 961   0.01  -0.01     -0.01     0.00     0.00     0.00      0.01
## 979   0.00  -0.09      0.01     0.00     0.01     0.04      0.00
## 982   0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 1000  0.00   0.00      0.00     0.00     0.00     0.00      0.01
## 1005 -0.01   0.00      0.01     0.00     0.01     0.00      0.00
## 1007 -0.11   0.07      0.12    -0.01    -0.11    -0.04      0.03
## 1013  0.00   0.00      0.00     0.00     0.00     0.00      0.02
## 1016  0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 1017  0.00   0.00      0.00     0.00     0.00     0.00      0.01
## 1019 -0.01   0.00      0.00     0.00     0.01     0.00      0.01
## 1022  0.00   0.00      0.01     0.02    -0.01     0.02      0.14
## 1023 -0.01   0.00      0.01     0.00     0.01     0.00      0.02
## 1025 -0.01   0.00      0.00     0.01     0.00     0.00      0.04
## 1027 -0.02   0.00      0.01     0.02     0.00     0.00      0.11
## 1033 -0.01   0.01      0.00     0.01     0.02     0.00      0.06
## 1036  0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 1043 -0.01   0.00      0.01     0.00     0.00     0.00      0.02
## 1048 -0.02   0.01      0.03    -0.10    -0.02     0.01      0.00
## 1050  0.01   0.01     -0.02     0.00     0.00     0.00      0.00
## 1058 -0.05   0.12      0.01    -0.07    -0.07    -0.10     -0.04
```

```
## 1059  0.33   0.18     -0.24    -0.02    -0.46    -0.20     -0.03
## 1063  0.00  -0.01      0.00     0.00     0.00     0.00      0.00
## 1066 -0.12   0.07      0.12     0.06     0.00    -0.02      0.04
## 1074 -0.04  -0.01      0.08    -0.09    -0.08    -0.05      0.00
## 1076  0.07  -0.05      0.01     0.03    -0.07    -0.03     -0.03
## 1094 -0.26   0.22      0.28     0.02    -0.11    -0.15      0.03
## 1105  0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 1139  0.01   0.00      0.00    -0.01     0.00    -0.03      0.00
## 1174  0.07  -0.01     -0.09    -0.10    -0.01     0.02     -0.03
## 1202  0.00  -0.01     -0.01     0.00     0.00     0.02      0.01
## 1203  0.01  -0.03      0.01     0.01    -0.10     0.03      0.03
## 1204 -0.06   0.01      0.16     0.10    -0.09    -0.11      0.01
## 1217  0.00   0.06      0.02    -0.02    -0.03    -0.05     -0.03
## 1221  0.03   0.01     -0.01     0.01    -0.11    -0.30     -0.09
## 1236  0.04  -0.03     -0.03     0.02     0.13    -0.05     -0.04
## 1261  0.07  -0.08     -0.05     0.02    -0.03     0.05      0.01
## 1297 -0.04   0.05     -0.03    -0.02     0.02    -0.02     -0.06
## 1299 -0.03   0.02      0.03     0.07    -0.02    -0.05     -0.03
## 1310 -0.06   0.04      0.05    -0.05    -0.07    -0.06     -0.06
## 1311 -0.02  -0.01      0.03     0.01     0.00    -0.01      0.01
## 1331  0.03  -0.01     -0.05    -0.03     0.09     0.03      0.02
## 1345 -0.01   0.01      0.02    -0.07     0.01    -0.01      0.02
## 1350  0.00   0.01     -0.01     0.00     0.01     0.00     -0.01
## 1366  0.07   0.03      0.04     0.13    -0.14     0.07      0.02
## 1390 -0.04   0.06      0.09     0.03    -0.04     0.03      0.03
## 1422  0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 1429 -0.02  -0.01      0.04    -0.10    -0.10     0.19      0.08
## 1490  0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 1497 -0.07   0.08      0.09     0.08    -0.18    -0.01     -0.02
## 1542  0.01  -0.02      0.03     0.00    -0.01    -0.04     -0.01
## 1554  0.00   0.01      0.00     0.00    -0.02     0.00     -0.01
## 1568  0.06   0.00     -0.01    -0.04    -0.09    -0.03     -0.01
## 1601  0.00   0.00     -0.01     0.01     0.00    -0.01      0.00
## 1633 -0.06   0.01      0.03     0.04     0.01    -0.01     -0.01
## 1687 -0.04  -0.02      0.00     0.03    -0.03    -0.04     -0.05
## 1695  0.03   0.02     -0.03    -0.07     0.00     0.01      0.00
## 1723 -0.02   0.00      0.02    -0.01    -0.02    -0.01      0.00
## 1771  0.01   0.02     -0.01    -0.01    -0.02     0.02      0.01
## 1797 -0.07   0.02     -0.07     0.09     0.04    -0.12     -0.05
## 1813  0.03   0.01     -0.04     0.00     0.02     0.00     -0.01
## 1817 -0.02   0.01     -0.03     0.01     0.00    -0.03     -0.07
## 1818 -0.12   0.04      0.05     0.08    -0.08    -0.10     -0.11
## 1824  0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 1828  0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 1840  0.00   0.00      0.00     0.00     0.00     0.00     -0.01
## 1843  0.00   0.00      0.00     0.01     0.01     0.00      0.00
## 1844  0.02   0.00     -0.01    -0.02    -0.01     0.00      0.00
## 1846 -0.01  -0.04      0.06     0.01    -0.05    -0.01      0.01
## 1848  0.05  -0.01     -0.01    -0.04    -0.01     0.02      0.02
## 1849 -0.03   0.02      0.00     0.05    -0.03    -0.03     -0.07
## 1858 -0.01  -0.02      0.00     0.04     0.06     0.00      0.00
## 1868 -0.10   0.03     -0.05     0.09     0.03    -0.10     -0.05
## 1888 -0.03   0.01      0.03     0.00    -0.02    -0.01     -0.02
## 1898  0.00   0.02     -0.03     0.00     0.01    -0.02      0.01
```

```
## 1916 -0.09   0.01      0.04     0.07    -0.04    -0.07     -0.01
## 1918  0.01  -0.01     -0.01     0.00     0.00     0.00      0.00
## 1933  0.01   0.00      0.00     0.03     0.00     0.00      0.00
## 1942 -0.37   0.25      0.23     0.10    -0.03    -0.22     -0.17
## 1945  0.01   0.01     -0.01     0.01    -0.02    -0.01     -0.02
## 1946  0.01  -0.01      0.00     0.01     0.01     0.00      0.00
## 1958  0.06   0.08     -0.04     0.06    -0.05    -0.03     -0.09
## 1965 -0.15   0.01     -0.01     0.11    -0.03    -0.15     -0.05
## 1968  0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 1979 -0.01  -0.01     -0.01     0.04    -0.04    -0.07     -0.11
## 2016  0.03   0.03      0.02    -0.02    -0.02     0.04      0.02
## 2022  0.04  -0.11      0.00    -0.01     0.01     0.00      0.00
## 2036  0.01  -0.06     -0.01     0.03     0.02    -0.02     -0.02
## 2066 -0.15  -0.02      0.04     0.05    -0.12     0.13      0.04
## 2087  0.00   0.00      0.00    -0.01     0.00     0.00     -0.04
## 2157  0.03  -0.11     -0.02    -0.01     0.03    -0.07     -0.06
## 2174 -0.02  -0.04      0.03     0.00     0.00    -0.01     -0.03
## 2176 -0.09   0.06      0.14     0.00    -0.05     0.08      0.06
## 2204 -0.05  -0.01      0.03     0.03     0.00    -0.01      0.00
## 2292  0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 2305 -0.01   0.02      0.00     0.00     0.01     0.02      0.01
## 2313  0.01   0.00     -0.01    -0.01     0.00     0.01     -0.02
## 2314 -0.01   0.00      0.01     0.01    -0.01     0.00      0.08
## 2315 -0.04  -0.01      0.05     0.04    -0.03    -0.02      0.22
## 2316  0.02   0.00     -0.02    -0.01     0.01     0.01     -0.08
## 2318 -0.04   0.00      0.09    -0.08    -0.09    -0.06     -0.04
## 2323 -0.05   0.04      0.06    -0.02     0.03    -0.02      0.01
## 2328 -0.03   0.07      0.01     0.01    -0.01    -0.01      0.00
## 2347  0.12   0.05     -0.17     0.07    -0.03     0.01      0.00
## 2353  0.03   0.05      0.01     0.07    -0.05    -0.03      0.04
## 2355 -0.05   0.05      0.08     0.08    -0.05    -0.05      0.02
## 2395  0.04   0.09     -0.04    -0.02     0.01     0.09      0.02
## 2426  0.00  -0.05     -0.01     0.03     0.02     0.04      0.00
## 2444  0.00   0.09     -0.12     0.01     0.13     0.14     -0.03
## 2452  0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 2510  0.00   0.00      0.00     0.00     0.00     0.00      0.00
## 2546 -0.01   0.04     -0.06     0.00     0.01     0.09      0.03
## 2549  0.04  -0.03     -0.02    -0.02     0.09    -0.10     -0.07
## 2563 -0.05   0.09      0.07    -0.02    -0.05     0.05      0.04
## 2573 -0.06   0.01      0.07     0.00     0.01     0.02      0.02
## 2579 -0.08   0.02      0.07    -0.02     0.05     0.05      0.03
## 2590 -0.03   0.11      0.03    -0.01    -0.02     0.04      0.02
## 2594 -0.09   0.02      0.15     0.02    -0.07     0.06      0.06
## 2596 -0.05   0.10      0.02    -0.01     0.05     0.08      0.03
## 2598 -0.04   0.13      0.01    -0.05    -0.05     0.10      0.04
## 2600 -0.18   0.08      0.18     0.09    -0.07     0.02      0.03
## 2626 -0.02   0.07      0.00     0.01    -0.06     0.08      0.02
## 2637  0.01   0.01      0.06     0.03    -0.02    -0.02      0.01
## 2642 -0.03   0.09     -0.01    -0.02     0.03     0.09      0.03
## 2646 -0.09  -0.26      0.03    -0.02     0.04    -0.08      0.00
## 2659  0.04  -0.08     -0.15    -0.09     0.16     0.18      0.00
## 2669 -0.01  -0.02      0.04    -0.01    -0.08     0.01      0.01
## 2671  0.00  -0.01      0.02    -0.01    -0.01     0.00      0.00
## 2674  0.02  -0.06     -0.13    -0.02     0.21     0.12     -0.01
```

```
## 2682 -0.06   0.02      0.03    -0.06     0.07    -0.02      0.00
## 2684  0.00   0.01     -0.09     0.05     0.07    -0.04     -0.04
## 2689  0.01  -0.02      0.00     0.01     0.01    -0.05     -0.03
## 2696  0.02   0.00      0.00    -0.01    -0.03     0.10      0.03
## 2699  0.02  -0.02     -0.05    -0.01     0.03     0.02      0.00
## 2706  0.02  -0.01      0.01     0.02     0.00    -0.03     -0.01
## 2714  0.22  -0.38      0.02     0.19    -0.31     0.07      1.54_*
## 2716  0.05  -0.08     -0.04    -0.06     0.06    -0.12     -0.04
## 2718  0.10  -0.01     -0.08    -0.03     0.01    -0.12     -0.03
## 2720 -0.15  -0.01      0.11    -0.03     0.06     0.00     -0.04
## 2724  0.09   0.02     -0.05    -0.01    -0.02     0.00      0.24
## 2726  0.09   0.04     -0.07    -0.07     0.04    -0.15     -0.05
## 2727  0.18   0.06     -0.21    -0.02    -0.02    -0.13      0.03
## 2729  0.01  -0.01     -0.01    -0.01     0.01    -0.01     -0.01
## 2733 -0.04  -0.01      0.03     0.00    -0.01     0.02      0.01
## 2747  0.01   0.02     -0.01     0.00    -0.01    -0.01      0.00
## 2783  0.00   0.00      0.00    -0.01     0.00     0.00      0.00
## 2785  0.03   0.05      0.00     0.04    -0.12     0.02      0.01
## 2789  0.04   0.06     -0.01     0.02     0.03     0.00      0.01
## 2790 -0.05  -0.02      0.06     0.02    -0.05     0.02      0.02
## 2809 -0.02  -0.03     -0.07     0.02     0.09     0.08      0.00
## 2811  0.02   0.15     -0.04    -0.07     0.00    -0.01     -0.01
## 2826  0.00   0.00      0.00    -0.01     0.01     0.00      0.00
## 2842 -0.01   0.07     -0.02    -0.01     0.02     0.01     -0.01
## 2858 -0.02   0.07      0.03     0.02    -0.04     0.00     -0.01
## 2922 -0.03   0.03      0.00     0.02     0.03     0.02     -0.01
## 3040  0.03   0.03     -0.01     0.05    -0.06    -0.02     -0.02
##      dfb.pct_t_ dfb.pct_m_ dfb.p__1 dfb.pct_w_ dfb.incm_ dffit   cov.r
## 21     0.01       0.01       0.02    -0.05      -0.03     -0.13    1.01
## 116    0.12      -0.23       0.02    -0.18      -0.01      0.36_*  0.96_*
## 119    0.01       0.02      -0.10     0.03       0.02     -0.21_*  0.97_*
## 120    0.03      -0.05      -0.04     0.03      -0.01     -0.16    0.97_*
## 122    0.06      -0.16      -0.04    -0.06       0.05      0.31_*  0.97_*
## 124   -0.01       0.01      -0.05     0.02      -0.04     -0.11    0.96_*
## 140    0.00       0.00       0.00     0.00       0.00     -0.01    1.02_*
## 147    0.01      -0.01       0.00    -0.01       0.00      0.03    1.02_*
## 150   -0.01       0.01       0.00    -0.01       0.00      0.08    1.03_*
## 156    0.00       0.01       0.00     0.00       0.00      0.03    1.02_*
## 161    0.00       0.01      -0.02    -0.01      -0.01      0.04    1.02_*
## 165    0.00       0.00       0.00     0.00       0.00      0.00    1.01_*
## 166    0.27      -0.11       0.05     0.07      -0.16      0.37_*  0.98_*
## 176    0.05      -0.04       0.04     0.06       0.04     -0.24_*  0.99
## 177    0.07       0.00      -0.03     0.00      -0.02      0.08    1.05_*
## 180   -0.02       0.00       0.00     0.00       0.01     -0.02    1.02_*
## 181    0.08       0.00      -0.04     0.01       0.01      0.10    1.01_*
## 184    0.22      -0.06      -0.03     0.02      -0.06      0.25_*  1.05_*
## 188   -0.05       0.02       0.00     0.00      -0.01     -0.07    1.02_*
## 189   -0.04      -0.05       0.00     0.00      -0.10     -0.20_*  0.98_*
## 191   -0.02       0.00       0.00    -0.01       0.00     -0.02    1.01_*
## 194   -0.08       0.02       0.00    -0.03       0.02     -0.09    1.05_*
## 209   -0.02       0.03      -0.07     0.01      -0.10      0.21_*  0.98_*
## 210   -0.01       0.03       0.01     0.01      -0.01      0.08    1.02_*
## 217    0.00       0.00       0.01    -0.01      -0.01     -0.03    1.01_*
## 237   -0.02      -0.01      -0.02    -0.02       0.03      0.10    0.98_*
```

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## 245   0.00       0.00       0.01     0.02       0.01      0.03    1.02_*
## 250  -0.03      -0.01      -0.02     0.03       0.05      0.14    0.98_*
## 253   0.00      -0.01       0.00     0.00       0.00      0.02    1.01_*
## 254  -0.02      -0.18       0.03     0.05      -0.19      0.37_*  0.97_*
## 256   0.00       0.09       0.02     0.02      -0.06     -0.38_*  0.99
## 264   0.01       0.08       0.08     0.04      -0.07     -0.33_*  0.98_*
## 270   0.00      -0.02       0.00     0.00      -0.02      0.03    1.01_*
## 271   0.00       0.03      -0.01     0.01       0.04     -0.11    1.01_*
## 274   0.00       0.01       0.00    -0.01       0.01     -0.02    1.02_*
## 282  -0.10       0.02       0.24     0.22      -0.02     -1.34_*  0.89_*
## 284  -0.04      -0.01      -0.01    -0.01       0.00     -0.05    1.03_*
## 292  -0.01       0.00       0.00     0.00       0.00     -0.01    1.02_*
## 294   0.02       0.00       0.00     0.00       0.00      0.02    1.02_*
## 296   0.08       0.00       0.01     0.01       0.00      0.09    1.01_*
## 300   0.00       0.00       0.00     0.00       0.00     -0.02    1.01_*
## 321   0.00       0.00       0.01    -0.01      -0.01     -0.03    1.01_*
## 394  -0.03       0.05       0.00     0.00       0.00     -0.08    1.02_*
## 469  -0.03      -0.07      -0.02    -0.06      -0.02      0.14    0.99_*
## 479   0.00       0.00       0.00     0.00       0.00      0.00    1.01_*
## 492  -0.03       0.01      -0.03    -0.04       0.03      0.11    1.02_*
## 522  -0.05      -0.03       0.04     0.08       0.10      0.22_*  0.98_*
## 524  -0.03       0.00       0.03    -0.01      -0.13      0.18    0.98_*
## 537   0.09       0.00      -0.06    -0.04       0.03      0.14    0.98_*
## 564  -0.01      -0.03       0.00    -0.03       0.04      0.10    0.98_*
## 576   0.15       0.01       0.00     0.02       0.02      0.16    1.01_*
## 585   0.00       0.01       0.01     0.00       0.00      0.12    1.04_*
## 591   0.00       0.00       0.00     0.00       0.00      0.00    1.02_*
## 594  -0.04      -0.01       0.00    -0.01      -0.01     -0.05    1.02_*
## 597  -0.14      -0.03       0.03    -0.01      -0.03     -0.19_*  1.01
## 621   0.00      -0.08      -0.03     0.02       0.02     -0.17    0.98_*
## 627  -0.02      -0.04      -0.07    -0.08       0.01      0.21_*  0.97_*
## 650   0.00       0.03       0.09     0.07       0.01     -0.14    0.99_*
## 660   0.01      -0.03      -0.07    -0.02      -0.03     -0.16    0.99_*
## 666  -0.01       0.02      -0.07    -0.04       0.00      0.15    0.97_*
## 670  -0.01      -0.03      -0.03     0.02      -0.01      0.12    0.98_*
## 727   0.01       0.03       0.07     0.11       0.00      0.19    1.01
## 749   0.01       0.04       0.00     0.02       0.05      0.11    0.98_*
## 775  -0.03       0.02       0.10     0.02       0.06      0.20_*  0.96_*
## 780   0.03       0.11       0.02     0.04       0.00      0.17    0.99_*
## 783  -0.08       0.00      -0.11     0.06      -0.03     -0.24_*  0.99_*
## 796  -0.05       0.03       0.01     0.05       0.05     -0.16    1.01_*
## 803  -0.01      -0.10      -0.05    -0.05       0.00     -0.16    0.98_*
## 809   0.00       0.00       0.00     0.00       0.00     -0.01    1.01_*
## 812   0.05       0.02       0.00     0.08       0.13     -0.21_*  0.96_*
## 840   0.00       0.00      -0.02    -0.01       0.01     -0.03    1.01_*
## 845   0.07       0.11       0.00     0.15       0.08     -0.28_*  0.98_*
## 853   0.01       0.01       0.00     0.03       0.02     -0.05    1.01_*
## 884   0.01      -0.01       0.00     0.00       0.00     -0.03    1.02_*
## 886   0.00      -0.01       0.00     0.00       0.01     -0.05    1.01_*
## 900   0.02      -0.03       0.03     0.07      -0.06     -0.18    1.01
## 905   0.02      -0.03      -0.01     0.05       0.02     -0.17    1.01
## 912   0.08      -0.05      -0.01     0.14       0.13     -0.42_*  0.96_*
## 913  -0.05       0.07       0.03     0.05       0.09     -0.23_*  0.99
## 921   0.06      -0.01      -0.01     0.08       0.01     -0.15    0.97_*
```

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## 922   0.00       0.01       0.00     0.00       0.00     -0.01    1.01_*
## 925   0.04       0.08      -0.11     0.04       0.01     -0.17    0.99_*
## 927   0.00      -0.01       0.00     0.00       0.00     -0.01    1.01_*
## 937   0.04      -0.05       0.01     0.04       0.04     -0.14    0.99_*
## 961   0.00      -0.01       0.00     0.00       0.00      0.02    1.01_*
## 979  -0.01       0.01      -0.03     0.04      -0.13      0.19    0.98_*
## 982   0.00       0.00       0.00     0.00       0.00     -0.01    1.02_*
## 1000  0.01       0.00       0.00     0.00       0.00      0.02    1.02_*
## 1005  0.02       0.00       0.00     0.00       0.00      0.02    1.02_*
## 1007 -0.05       0.07       0.05     0.08       0.02     -0.20_*  1.00
## 1013  0.01       0.00       0.00     0.00       0.00      0.03    1.02_*
## 1016 -0.01       0.00       0.00     0.00       0.00     -0.01    1.01_*
## 1017  0.00       0.00       0.00     0.00       0.00      0.01    1.01_*
## 1019  0.02       0.01       0.00     0.00       0.00      0.03    1.01_*
## 1022 -0.01      -0.03       0.01    -0.01       0.00      0.15    1.07_*
## 1023  0.01       0.01       0.00     0.00       0.00      0.03    1.02_*
## 1025  0.00       0.00       0.00     0.00       0.00      0.05    1.04_*
## 1027  0.00       0.02       0.01     0.00       0.00      0.12    1.06_*
## 1033  0.01       0.01       0.01     0.01       0.00      0.07    1.01_*
## 1036  0.00       0.00       0.00     0.00       0.00      0.00    1.02_*
## 1043  0.01       0.00       0.00     0.00       0.00      0.03    1.01_*
## 1048 -0.07      -0.02       0.02     0.07      -0.02     -0.17    0.98_*
## 1050  0.00       0.00      -0.01    -0.01      -0.01     -0.02    1.02_*
## 1058 -0.01       0.05       0.04     0.04       0.09     -0.25_*  0.98_*
## 1059 -0.18      -0.15       0.09    -0.28       0.02     -0.70_*  0.94_*
## 1063  0.00       0.00       0.00     0.00       0.00      0.01    1.01_*
## 1066 -0.05       0.06      -0.01     0.05       0.05     -0.18    0.98_*
## 1074 -0.05       0.06       0.04     0.05       0.10     -0.20_*  0.99
## 1076 -0.04       0.02      -0.11    -0.06       0.00      0.16    0.98_*
## 1094  0.03       0.37      -0.02     0.07       0.07     -0.45_*  0.96_*
## 1105  0.00      -0.01       0.00     0.00       0.00      0.01    1.01_*
## 1139 -0.02       0.00       0.02    -0.01       0.02      0.05    1.02_*
## 1174 -0.02      -0.04       0.04    -0.02      -0.05      0.15    0.98_*
## 1202  0.01       0.00       0.00    -0.01       0.00     -0.04    1.01_*
## 1203  0.01       0.02       0.00    -0.02       0.01     -0.18    1.01
## 1204 -0.03       0.05       0.01     0.00       0.14      0.24_*  1.00
## 1217 -0.02       0.02      -0.02     0.00       0.03      0.11    0.98_*
## 1221 -0.04       0.11      -0.11     0.05       0.00      0.36_*  0.87_*
## 1236 -0.03       0.00      -0.07    -0.02      -0.03      0.21_*  1.00
## 1261 -0.03      -0.10       0.03    -0.03       0.00      0.16    0.97_*
## 1297  0.19       0.05       0.03     0.02      -0.02      0.23_*  1.01
## 1299  0.05       0.07      -0.09     0.00       0.00      0.13    1.02_*
## 1310  0.11       0.11      -0.02     0.06      -0.01      0.22_*  0.99_*
## 1311  0.02       0.01      -0.01     0.02       0.01     -0.07    0.99_*
## 1331 -0.01      -0.01       0.02    -0.03      -0.01     -0.13    0.98_*
## 1345 -0.01       0.04       0.04     0.00       0.00     -0.12    0.98_*
## 1350  0.08      -0.01       0.00     0.00       0.00      0.09    1.03_*
## 1366 -0.02      -0.14      -0.02    -0.10       0.07      0.30_*  0.90_*
## 1390  0.00       0.10      -0.09    -0.03      -0.06      0.20_*  0.99
## 1422  0.00      -0.01       0.00     0.00       0.00      0.01    1.01_*
## 1429  0.03       0.00       0.07    -0.03       0.06     -0.33_*  0.97_*
## 1490  0.00       0.00       0.00     0.00       0.00      0.00    1.09_*
## 1497  0.23      -0.02       0.09     0.01       0.04      0.33_*  0.95_*
## 1542 -0.03       0.03      -0.01    -0.02       0.05      0.10    0.98_*
```

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## 1554  0.08       0.00       0.01     0.00       0.00      0.09    1.02_*
## 1568 -0.03      -0.02      -0.03    -0.03      -0.04     -0.13    0.99_*
## 1601  0.00       0.00       0.01    -0.01       0.01     -0.03    1.01_*
## 1633  0.04      -0.02      -0.01     0.07       0.00     -0.10    1.02_*
## 1687  0.16       0.03       0.03     0.05      -0.01      0.20_*  1.00
## 1695 -0.01      -0.03       0.05    -0.01       0.03     -0.11    1.01_*
## 1723  0.00       0.00       0.03     0.02       0.01      0.04    1.01_*
## 1771  0.00       0.00       0.01    -0.02       0.00     -0.05    1.01_*
## 1797 -0.01      -0.05       0.05     0.11       0.08     -0.29_*  0.98_*
## 1813  0.00      -0.02      -0.02    -0.02      -0.02     -0.05    1.02_*
## 1817  0.24      -0.01       0.02     0.03      -0.02      0.27_*  1.04_*
## 1818  0.49       0.09       0.02     0.09      -0.01      0.54_*  1.04_*
## 1824  0.00       0.00       0.00     0.00       0.00      0.00    1.01_*
## 1828  0.00       0.00       0.00     0.00       0.00      0.01    1.01_*
## 1840  0.00       0.00       0.00     0.00       0.00     -0.01    1.02_*
## 1843 -0.02       0.00      -0.01     0.00       0.01     -0.03    1.02_*
## 1844 -0.01       0.00       0.01    -0.02       0.00      0.03    1.02_*
## 1846  0.01       0.02       0.01     0.01       0.03      0.09    1.01_*
## 1848 -0.10      -0.02       0.00    -0.04      -0.01     -0.11    1.02_*
## 1849  0.31      -0.01       0.02     0.01       0.01      0.33_*  1.02_*
## 1858  0.00      -0.03      -0.04     0.02       0.01     -0.12    0.99_*
## 1868  0.00      -0.09       0.09     0.15       0.08     -0.32_*  0.99_*
## 1888  0.09       0.00       0.02     0.03       0.01      0.10    1.02_*
## 1898 -0.06       0.00       0.00     0.01      -0.02     -0.09    1.01_*
## 1916  0.01      -0.02       0.03     0.10       0.07     -0.18    1.01
## 1918  0.00       0.00       0.01    -0.01      -0.01      0.02    1.01_*
## 1933  0.01      -0.02      -0.02    -0.01       0.00     -0.04    1.01_*
## 1942  0.11       0.17      -0.11     0.30       0.23     -0.59_*  0.95_*
## 1945  0.09       0.01       0.00    -0.02      -0.01      0.11    1.05_*
## 1946  0.00       0.00      -0.01    -0.01       0.00      0.02    1.01_*
## 1958  0.32       0.04      -0.10    -0.11      -0.01      0.39_*  0.99_*
## 1965  0.03      -0.06       0.10     0.22       0.07     -0.36_*  0.99
## 1968 -0.01       0.00       0.00     0.00       0.00     -0.01    1.01_*
## 1979  0.40       0.04      -0.01     0.01      -0.01      0.45_*  1.01_*
## 2016 -0.03      -0.02       0.00    -0.05      -0.07      0.15    0.98_*
## 2022 -0.05       0.03      -0.04    -0.02       0.01      0.14    0.99_*
## 2036 -0.03       0.05      -0.04    -0.01       0.00      0.12    0.98_*
## 2066  0.14      -0.13       0.09     0.23      -0.13     -0.41_*  0.98_*
## 2087  0.00       0.00       0.00     0.00       0.00     -0.04    1.03_*
## 2157  0.00       0.00      -0.07     0.03       0.09     -0.20_*  0.99_*
## 2174 -0.02       0.05      -0.06     0.03       0.01      0.12    0.97_*
## 2176  0.01       0.05       0.00     0.04      -0.06      0.23_*  0.98_*
## 2204  0.03      -0.01       0.00     0.06       0.01     -0.08    1.03_*
## 2292  0.00       0.00       0.00     0.00       0.00      0.00    1.01_*
## 2305  0.01       0.00       0.01    -0.01       0.02     -0.04    1.01_*
## 2313  0.00       0.00       0.00     0.00       0.00     -0.03    1.03_*
## 2314 -0.02       0.01       0.01     0.00       0.00      0.09    1.11_*
## 2315 -0.05       0.04       0.04     0.01       0.01      0.24_*  1.08_*
## 2316  0.02      -0.01      -0.02    -0.01       0.00     -0.09    1.05_*
## 2318  0.02       0.06      -0.09     0.10      -0.03     -0.25_*  0.97_*
## 2323 -0.07       0.06      -0.02     0.02       0.02     -0.14    0.98_*
## 2328  0.03       0.00      -0.01     0.02      -0.01     -0.10    0.98_*
## 2347  0.02      -0.19       0.09    -0.08      -0.06     -0.27_*  1.01_*
## 2353 -0.09       0.01      -0.07    -0.07       0.00     -0.16    0.99_*
```

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## 2355 -0.02       0.05      -0.07     0.01       0.02     -0.15    0.99_*
## 2395  0.01       0.02      -0.08    -0.10       0.02     -0.19_*  1.00
## 2426  0.02       0.00      -0.05     0.00       0.06     -0.16    0.99_*
## 2444  0.09      -0.03      -0.06    -0.05       0.05     -0.31_*  0.97_*
## 2452 -0.01       0.01      -0.01     0.00       0.00     -0.02    1.02_*
## 2510  0.00       0.00       0.00     0.00       0.00      0.00    1.01_*
## 2546  0.03       0.01       0.04    -0.04       0.00     -0.19_*  1.00
## 2549 -0.04      -0.02      -0.07     0.03      -0.06      0.25_*  0.99_*
## 2563  0.00       0.08       0.00     0.00      -0.11      0.21_*  0.98_*
## 2573  0.01       0.04       0.01     0.04       0.01      0.09    1.02_*
## 2579  0.01       0.05       0.02     0.05      -0.01      0.14    1.01_*
## 2590 -0.01       0.01       0.03    -0.04       0.04      0.15    0.98_*
## 2594  0.01       0.02       0.03     0.05       0.01      0.19    1.01_*
## 2596  0.01       0.03       0.00    -0.01      -0.09      0.19_*  0.99
## 2598  0.02      -0.06       0.09     0.02      -0.10      0.23_*  0.99
## 2600  0.03       0.05       0.03     0.09       0.09      0.23_*  0.97_*
## 2626  0.06       0.05      -0.10    -0.03       0.04     -0.28_*  0.97_*
## 2637 -0.05       0.14      -0.13    -0.08       0.03      0.20_*  0.96_*
## 2642  0.00      -0.01      -0.04    -0.02       0.08     -0.21_*  0.98_*
## 2646 -0.19      -0.09       0.12     0.25       0.18     -0.46_*  0.95_*
## 2659  0.05      -0.10       0.00     0.04      -0.14     -0.31_*  0.96_*
## 2669 -0.02       0.00       0.00     0.02       0.09     -0.16    0.98_*
## 2671  0.00       0.00      -0.01     0.00       0.01      0.03    1.01_*
## 2674  0.00       0.01      -0.10    -0.02       0.03     -0.33_*  0.98_*
## 2682  0.00       0.10       0.00     0.04       0.01      0.15    1.01_*
## 2684  0.00       0.03       0.04    -0.04       0.04     -0.20_*  1.00
## 2689 -0.01      -0.01      -0.03     0.03      -0.02      0.09    1.01_*
## 2696  0.03       0.03      -0.07    -0.07       0.04     -0.22_*  0.98_*
## 2699  0.00      -0.01       0.01    -0.02      -0.01     -0.07    1.02_*
## 2706 -0.01       0.00      -0.04    -0.01      -0.01      0.07    1.01_*
## 2714 -0.32      -0.18       0.36    -0.23       0.00      1.74_*  0.97_*
## 2716 -0.08       0.03       0.06     0.00       0.05      0.23_*  1.01
## 2718 -0.07       0.01       0.01    -0.08       0.02      0.18    1.01
## 2720  0.05       0.08      -0.03     0.15       0.01     -0.21_*  1.00
## 2724 -0.08       0.03       0.01    -0.13      -0.02      0.29_*  1.02_*
## 2726 -0.10      -0.01       0.07    -0.07       0.08      0.30_*  0.98_*
## 2727 -0.07      -0.13       0.09    -0.12      -0.02      0.34_*  0.97_*
## 2729 -0.01       0.00       0.01    -0.01       0.00      0.03    1.02_*
## 2733  0.02       0.01       0.00     0.05      -0.02     -0.07    1.02_*
## 2747 -0.03      -0.01       0.00    -0.01      -0.01     -0.04    1.01_*
## 2783  0.00       0.00       0.00     0.00       0.00      0.01    1.01_*
## 2785  0.02      -0.03      -0.03    -0.05       0.01     -0.17    1.02_*
## 2789  0.01       0.02      -0.09    -0.08       0.01     -0.13    0.99_*
## 2790  0.02       0.01       0.00     0.04       0.03     -0.09    1.02_*
## 2809  0.07      -0.02      -0.03     0.04      -0.08     -0.19    0.97_*
## 2811  0.02       0.04      -0.04    -0.06      -0.04     -0.19_*  0.99_*
## 2826  0.00       0.00       0.00     0.00       0.00      0.02    1.02_*
## 2842  0.01       0.03      -0.02    -0.03       0.00      0.10    0.99_*
## 2858 -0.01       0.05      -0.03    -0.02       0.01      0.11    0.98_*
## 2922  0.00       0.01      -0.02     0.01       0.01      0.08    0.99_*
## 3040  0.02       0.01      -0.05    -0.05      -0.01      0.11    0.99_*
##      cook.d hat
## 21     0.00   0.01_*
## 116    0.01   0.01
```

```
## 119   0.00   0.00
## 120   0.00   0.00
## 122   0.01   0.01
## 124   0.00   0.00
## 140   0.00   0.01_*
## 147   0.00   0.01_*
## 150   0.00   0.03_*
## 156   0.00   0.01_*
## 161   0.00   0.02_*
## 165   0.00   0.01
## 166   0.01   0.02_*
## 176   0.00   0.01
## 177   0.00   0.05_*
## 180   0.00   0.01_*
## 181   0.00   0.01_*
## 184   0.01   0.05_*
## 188   0.00   0.01_*
## 189   0.00   0.01
## 191   0.00   0.01
## 194   0.00   0.05_*
## 209   0.00   0.01
## 210   0.00   0.02_*
## 217   0.00   0.01
## 237   0.00   0.00
## 245   0.00   0.01_*
## 250   0.00   0.00
## 253   0.00   0.01
## 254   0.01   0.01
## 256   0.01   0.02_*
## 264   0.01   0.01_*
## 270   0.00   0.01
## 271   0.00   0.01_*
## 274   0.00   0.01_*
## 282   0.15   0.04_*
## 284   0.00   0.02_*
## 292   0.00   0.01_*
## 294   0.00   0.01_*
## 296   0.00   0.01_*
## 300   0.00   0.01
## 321   0.00   0.01
## 394   0.00   0.01_*
## 469   0.00   0.00
## 479   0.00   0.01
## 492   0.00   0.02_*
## 522   0.00   0.01
## 524   0.00   0.00
## 537   0.00   0.00
## 564   0.00   0.00
## 576   0.00   0.01_*
## 585   0.00   0.04_*
## 591   0.00   0.01
## 594   0.00   0.02_*
## 597   0.00   0.01_*
## 621   0.00   0.00
```

```
## 627   0.00   0.00
## 650   0.00   0.00
## 660   0.00   0.00
## 666   0.00   0.00
## 670   0.00   0.00
## 727   0.00   0.01_*
## 749   0.00   0.00
## 775   0.00   0.00
## 780   0.00   0.01
## 783   0.00   0.01
## 796   0.00   0.02_*
## 803   0.00   0.00
## 809   0.00   0.01
## 812   0.00   0.00
## 840   0.00   0.01
## 845   0.01   0.01
## 853   0.00   0.01
## 884   0.00   0.01_*
## 886   0.00   0.01
## 900   0.00   0.01_*
## 905   0.00   0.01_*
## 912   0.01   0.01_*
## 913   0.00   0.01
## 921   0.00   0.00
## 922   0.00   0.01
## 925   0.00   0.01
## 927   0.00   0.01
## 937   0.00   0.00
## 961   0.00   0.01
## 979   0.00   0.01
## 982   0.00   0.02_*
## 1000  0.00   0.01_*
## 1005  0.00   0.02_*
## 1007  0.00   0.01
## 1013  0.00   0.02_*
## 1016  0.00   0.01
## 1017  0.00   0.01
## 1019  0.00   0.01
## 1022  0.00   0.06_*
## 1023  0.00   0.01_*
## 1025  0.00   0.03_*
## 1027  0.00   0.06_*
## 1033  0.00   0.01
## 1036  0.00   0.01_*
## 1043  0.00   0.01
## 1048  0.00   0.00
## 1050  0.00   0.01_*
## 1058  0.01   0.01
## 1059  0.04   0.02_*
## 1063  0.00   0.01
## 1066  0.00   0.00
## 1074  0.00   0.01
## 1076  0.00   0.00
## 1094  0.02   0.01_*
```

```
## 1105  0.00   0.01
## 1139  0.00   0.01_*
## 1174  0.00   0.00
## 1202  0.00   0.01
## 1203  0.00   0.01_*
## 1204  0.00   0.01_*
## 1217  0.00   0.00
## 1221  0.01   0.00
## 1236  0.00   0.01
## 1261  0.00   0.00
## 1297  0.00   0.02_*
## 1299  0.00   0.02_*
## 1310  0.00   0.01
## 1311  0.00   0.00
## 1331  0.00   0.00
## 1345  0.00   0.00
## 1350  0.00   0.02_*
## 1366  0.01   0.00
## 1390  0.00   0.01
## 1422  0.00   0.01
## 1429  0.01   0.01
## 1490  0.00   0.08_*
## 1497  0.01   0.01
## 1542  0.00   0.00
## 1554  0.00   0.02_*
## 1568  0.00   0.00
## 1601  0.00   0.01
## 1633  0.00   0.02_*
## 1687  0.00   0.01
## 1695  0.00   0.01_*
## 1723  0.00   0.01
## 1771  0.00   0.01
## 1797  0.01   0.01
## 1813  0.00   0.01_*
## 1817  0.01   0.04_*
## 1818  0.02   0.05_*
## 1824  0.00   0.01
## 1828  0.00   0.01
## 1840  0.00   0.02_*
## 1843  0.00   0.02_*
## 1844  0.00   0.01
## 1846  0.00   0.01
## 1848  0.00   0.02_*
## 1849  0.01   0.03_*
## 1858  0.00   0.00
## 1868  0.01   0.01_*
## 1888  0.00   0.02_*
## 1898  0.00   0.01
## 1916  0.00   0.01_*
## 1918  0.00   0.01
## 1933  0.00   0.01
## 1942  0.03   0.02_*
## 1945  0.00   0.04_*
## 1946  0.00   0.01
```

```
## 1958  0.01   0.02_*
## 1965  0.01   0.02_*
## 1968  0.00   0.01
## 1979  0.02   0.03_*
## 2016  0.00   0.00
## 2022  0.00   0.00
## 2036  0.00   0.00
## 2066  0.01   0.02_*
## 2087  0.00   0.03_*
## 2157  0.00   0.01
## 2174  0.00   0.00
## 2176  0.00   0.01
## 2204  0.00   0.02_*
## 2292  0.00   0.01
## 2305  0.00   0.01
## 2313  0.00   0.03_*
## 2314  0.00   0.10_*
## 2315  0.00   0.07_*
## 2316  0.00   0.04_*
## 2318  0.01   0.01
## 2323  0.00   0.00
## 2328  0.00   0.00
## 2347  0.01   0.02_*
## 2353  0.00   0.00
## 2355  0.00   0.00
## 2395  0.00   0.01_*
## 2426  0.00   0.00
## 2444  0.01   0.01
## 2452  0.00   0.02_*
## 2510  0.00   0.01
## 2546  0.00   0.01
## 2549  0.01   0.01
## 2563  0.00   0.01
## 2573  0.00   0.02_*
## 2579  0.00   0.01_*
## 2590  0.00   0.00
## 2594  0.00   0.02_*
## 2596  0.00   0.01
## 2598  0.00   0.01
## 2600  0.00   0.00
## 2626  0.01   0.01
## 2637  0.00   0.00
## 2642  0.00   0.01
## 2646  0.02   0.01
## 2659  0.01   0.01
## 2669  0.00   0.00
## 2671  0.00   0.01
## 2674  0.01   0.01
## 2682  0.00   0.01_*
## 2684  0.00   0.01
## 2689  0.00   0.01_*
## 2696  0.00   0.01
## 2699  0.00   0.02_*
## 2706  0.00   0.01
```

```
## 2714  0.25   0.08_*
## 2716  0.00   0.02_*
## 2718  0.00   0.01_*
## 2720  0.00   0.01
## 2724  0.01   0.03_*
## 2726  0.01   0.01
## 2727  0.01   0.01
## 2729  0.00   0.02_*
## 2733  0.00   0.02_*
## 2747  0.00   0.01
## 2783  0.00   0.01
## 2785  0.00   0.02_*
## 2789  0.00   0.00
## 2790  0.00   0.02_*
## 2809  0.00   0.00
## 2811  0.00   0.01
## 2826  0.00   0.01_*
## 2842  0.00   0.00
## 2858  0.00   0.00
## 2922  0.00   0.00
## 3040  0.00   0.00
```

Remove outliers:

```
# filter outlier 282
step_model_no_282 <- cancer_county %>%
  dplyr::select(-median_age, -pct_black, -median_age_female, avg_household_size) %>%
  tibble::rowid_to_column() %>%
  filter(rowid != 282) %>%
  na.omit()

step_no_282 <- update(stepwise_model, . ~ ., data = step_model_no_282)
summary(step_no_282)
```

```
##
## Call:
## lm(formula = target_death_rate ~ incidence_rate + poverty_percent +
##     median_age_male + pct_unemployed16_over + pct_white + pct_asian +
##     pct_other_race + pct_married_households + pct_upto_hs18_24 +
##     pct_with_coverage + income_cat, data = step_model_no_282)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -93.887 -11.689  -0.051  11.936 126.194
##
## Coefficients:
##                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)            69.286035  11.623979   5.961 2.80e-09 ***
## incidence_rate          0.228536   0.007592  30.102  < 2e-16 ***
## poverty_percent         1.045635   0.118358   8.834  < 2e-16 ***
## median_age_male        -0.214490   0.085989  -2.494  0.01267 *
## pct_unemployed16_over   0.750476   0.151124   4.966 7.21e-07 ***
```

```
## pct_white               0.084336   0.034622   2.436  0.01491 *
## pct_asian              -0.587738   0.166433  -3.531  0.00042 ***
## pct_other_race         -0.920930   0.118468  -7.774 1.04e-14 ***
## pct_married_households -0.224288   0.085471  -2.624  0.00873 **
## pct_upto_hs18_24        0.385467   0.037529  10.271  < 2e-16 ***
## pct_with_coverage      -0.215951   0.098701  -2.188  0.02875 *
## income_cat             -4.039980   1.490114  -2.711  0.00674 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 20.62 on 3034 degrees of freedom
## Multiple R-squared:  0.4501, Adjusted R-squared:  0.4481
## F-statistic: 225.7 on 11 and 3034 DF,  p-value: < 2.2e-16
```

```r
# filter #282, 1059
step_model_no_all <- cancer_county %>%
  dplyr::select(-median_age, -pct_black, -median_age_female, avg_household_size) %>%
  tibble::rowid_to_column() %>%
  filter(rowid != 282 & rowid != 1059) %>%
  na.omit()

step_no_all <- update(stepwise_model, . ~ ., data = step_model_no_all)
summary(step_no_all)
```

```
##
## Call:
## lm(formula = target_death_rate ~ incidence_rate + poverty_percent +
##     median_age_male + pct_unemployed16_over + pct_white + pct_asian +
##     pct_other_race + pct_married_households + pct_upto_hs18_24 +
##     pct_with_coverage + income_cat, data = step_model_no_all)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -88.069 -11.710  -0.021  11.854 126.460
##
## Coefficients:
##                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)            65.423198  11.615333   5.632 1.94e-08 ***
## incidence_rate          0.227187   0.007572  30.002  < 2e-16 ***
## poverty_percent         1.073476   0.118117   9.088  < 2e-16 ***
## median_age_male        -0.212629   0.085703  -2.481 0.013155 *
## pct_unemployed16_over   0.820282   0.151376   5.419 6.47e-08 ***
## pct_white               0.091233   0.034539   2.641 0.008297 **
## pct_asian              -0.583348   0.165881  -3.517 0.000443 ***
## pct_other_race         -0.900209   0.118158  -7.619 3.40e-14 ***
## pct_married_households -0.211546   0.085231  -2.482 0.013117 *
## pct_upto_hs18_24        0.382276   0.037410  10.218  < 2e-16 ***
## pct_with_coverage      -0.188060   0.098557  -1.908 0.056468 .
## income_cat             -4.075167   1.485162  -2.744 0.006107 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 20.55 on 3033 degrees of freedom
## Multiple R-squared:  0.4528, Adjusted R-squared:  0.4508
## F-statistic: 228.2 on 11 and 3033 DF,  p-value: < 2.2e-16
```

```
par(mfrow = c(2,2))
plot(step_no_all)
```