replication_modeling

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2024-02-11

Replication File – Modeling

```
options(scipen=999)
library(tidyverse)
```

```
-- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
v dplyr     1.1.4     v readr     2.1.4
v forcats   1.0.0     v stringr   1.5.1
v ggplot2   3.4.4     v tibble    3.2.1
v lubridate 1.9.3     v tidyr     1.3.1
v purrr     1.0.2
-- Conflicts ------------------------------------------ tidyverse_conflicts() --
x dplyr::filter() masks stats::filter()
x dplyr::lag()    masks stats::lag()
i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to beco
```

```
library(patchwork)
library(jtools)
library(stringr)
library(car)
```

```
Loading required package: carData

Attaching package: 'car'

The following object is masked from 'package:dplyr':

    recode
```

```
The following object is masked from 'package:purrr':

    some
```

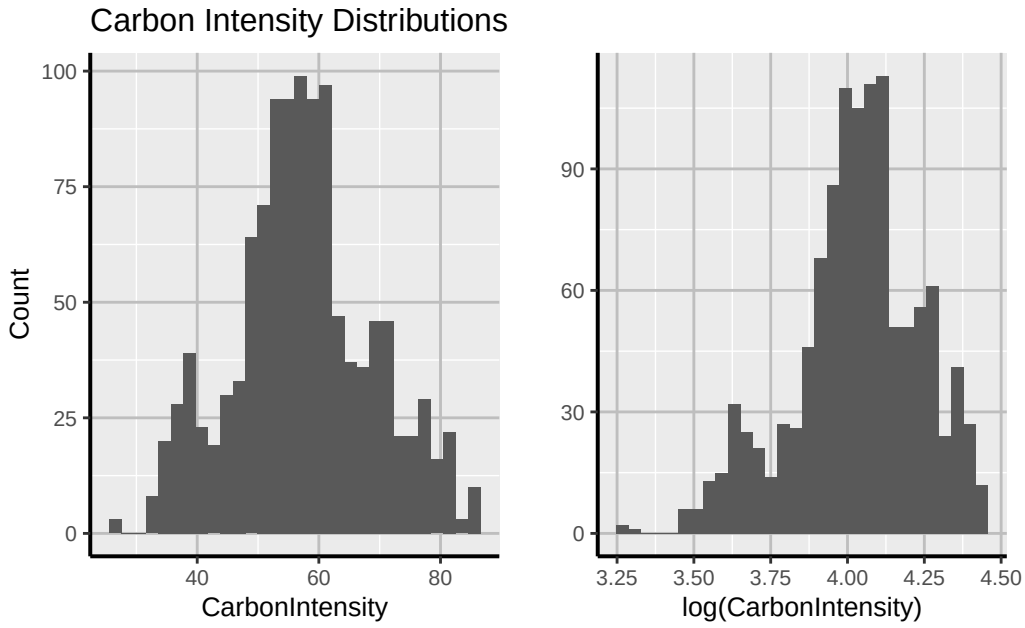
```
set.seed(07151129)

science_theme = theme(panel.grid.major = element_line(linewidth = 0.5, color = "grey"),
    axis.line = element_line(linewidth = 0.7, color = "black"), legend.position = c(0.85,
        0.7), text = element_text(size = 10))
theme_set(science_theme)
```

```
panel <- read.csv("panel_with_count_FEB11.csv")
```

Side-by-side plots of variable and log(variable + x) with x being the minimum constant necessary to have all >= 1

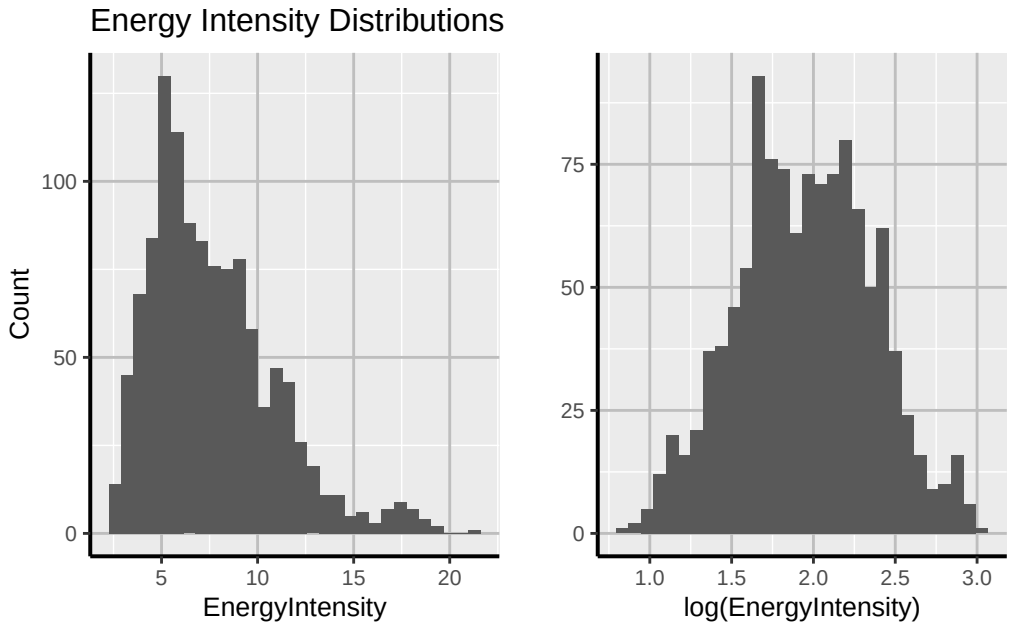
```
p1 <- ggplot(panel, aes(x=CarbonIntensity)) + geom_histogram() + labs(y = "Count", title =
p2 <- ggplot(panel, aes(x=log(CarbonIntensity))) + geom_histogram() + labs(y = "")

p1 + p2
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



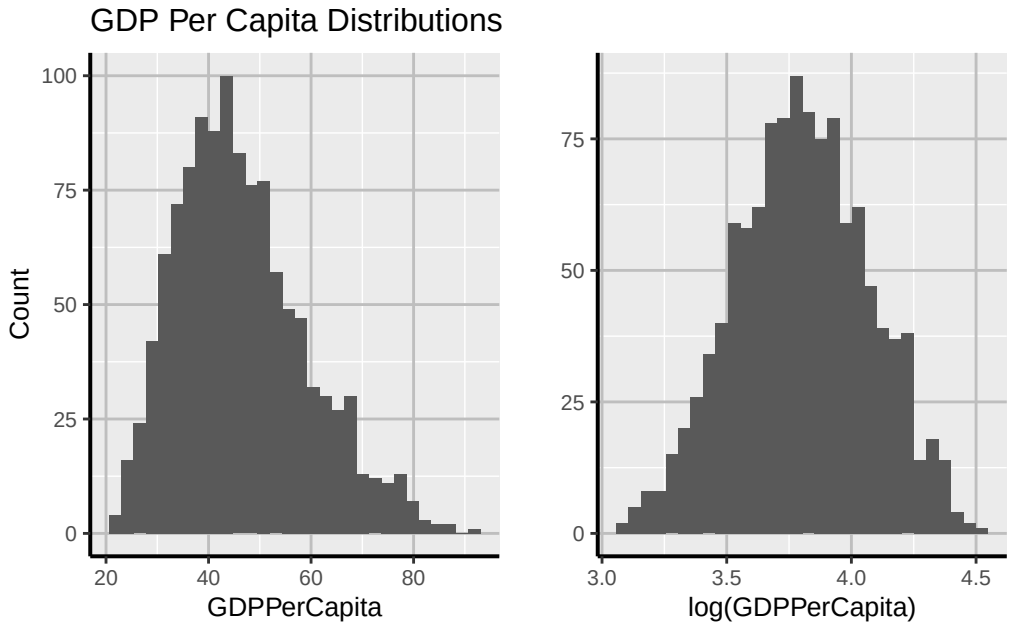

```
p3 <- ggplot(panel, aes(x=EnergyIntensity)) + geom_histogram() + labs(y = "Count", title =
p4 <- ggplot(panel, aes(x=log(EnergyIntensity))) + geom_histogram() + labs(y = "")

p3 + p4
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



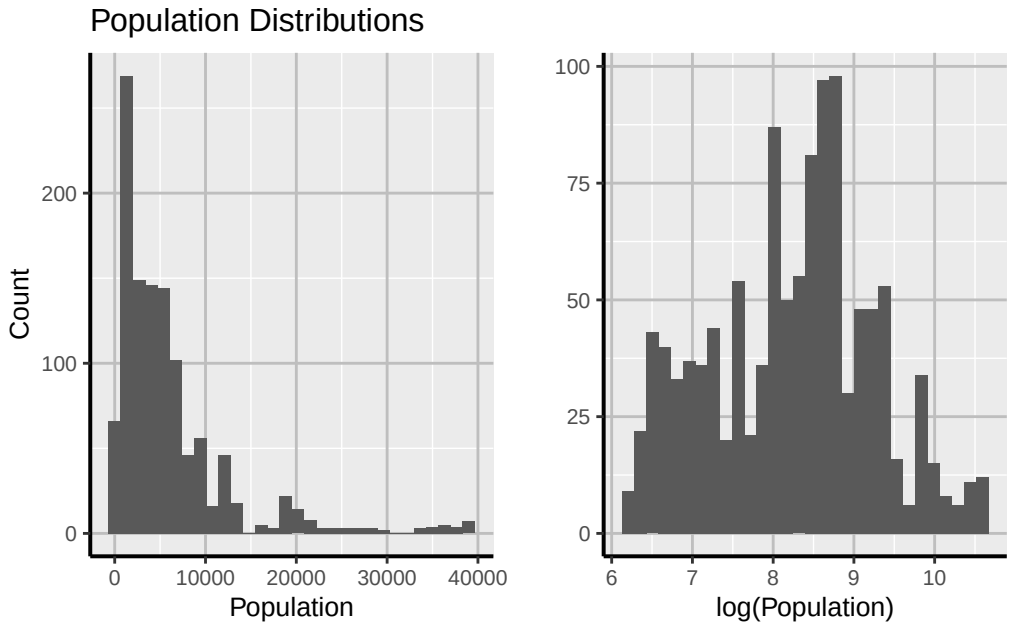

```
p5 <- ggplot(panel, aes(x=GDPPerCapita)) + geom_histogram() + labs(y = "Count", title = "G
p6 <- ggplot(panel, aes(x=log(GDPPerCapita))) + geom_histogram() + labs(y = "")

p5 + p6
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
p7 <- ggplot(panel, aes(x=Population)) + geom_histogram() + labs(y = "Count", title = "Pop
p8 <- ggplot(panel, aes(x=log(Population))) + geom_histogram() + labs(y = "")

p7 + p8
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



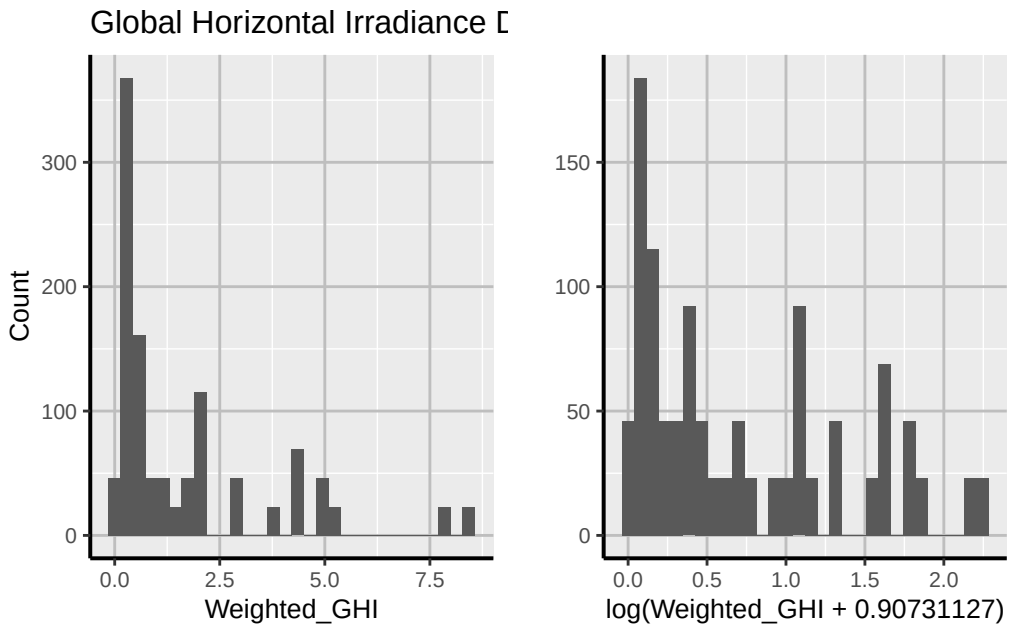

```
p9 <- ggplot(panel, aes(x=Weighted_GHI)) + geom_histogram() + labs(y = "Count", title = "G
p10 <- ggplot(panel, aes(x=log(Weighted_GHI+0.90731127))) + geom_histogram() + labs(y = ""

p9 + p10
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
Warning: Removed 46 rows containing non-finite values (`stat_bin()`).
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
Warning: Removed 46 rows containing non-finite values (`stat_bin()`).
```



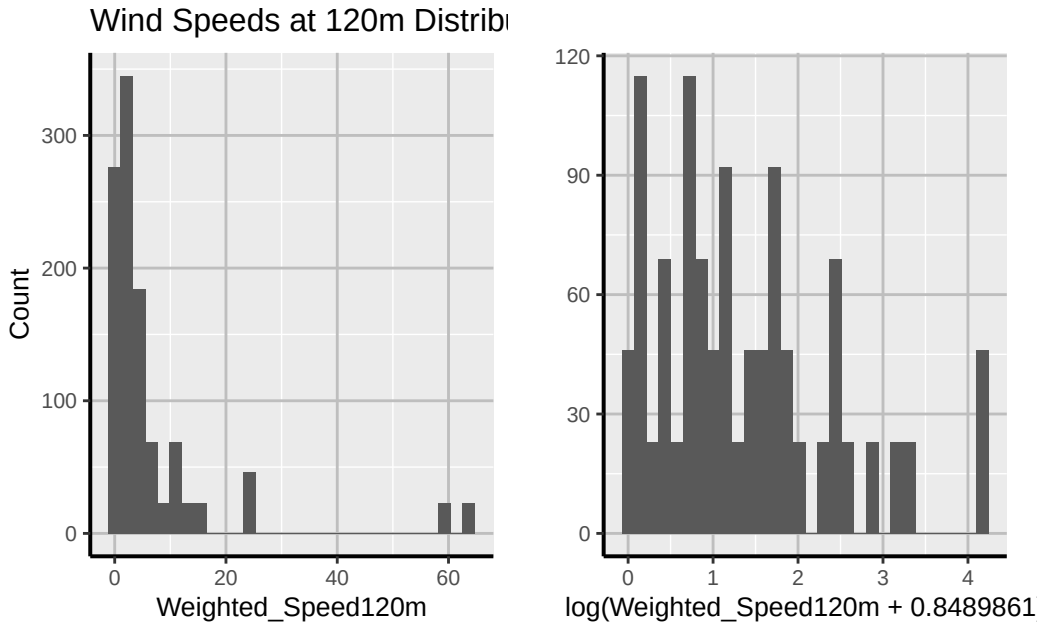

```
p11 <- ggplot(panel, aes(x=Weighted_Speed120m)) + geom_histogram() + labs(y = "Count", tit
p12 <- ggplot(panel, aes(x=log(Weighted_Speed120m+0.8489861))) + geom_histogram() + labs(y

p11 + p12
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
Warning: Removed 46 rows containing non-finite values (`stat_bin()`).
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
Warning: Removed 46 rows containing non-finite values (`stat_bin()`).
```



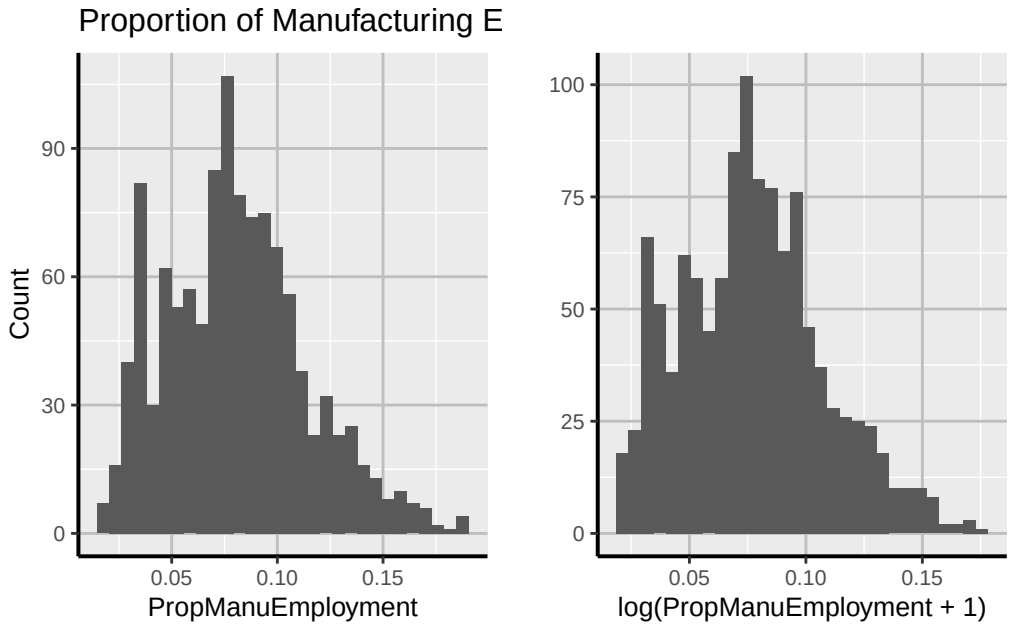

```
p13 <- ggplot(panel, aes(x=PropManuEmployment)) + geom_histogram() + labs(y = "Count", tit
p14 <- ggplot(panel, aes(x=log(PropManuEmployment+1))) + geom_histogram() + labs(y = "")

p13 + p14
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
Warning: Removed 3 rows containing non-finite values (`stat_bin()`).
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
Warning: Removed 3 rows containing non-finite values (`stat_bin()`).
```

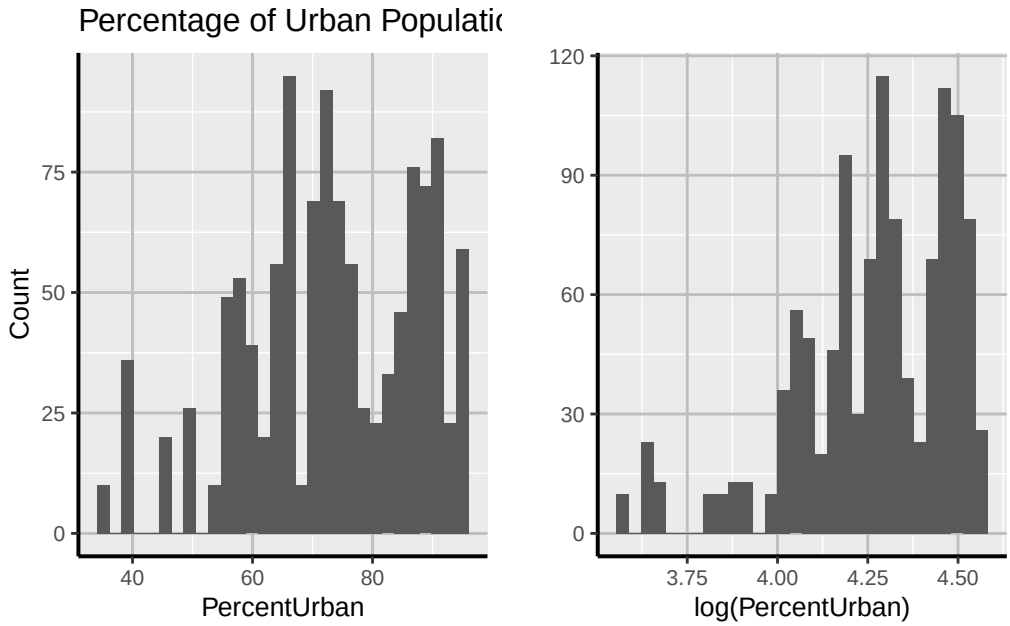



```
p15 <- ggplot(panel, aes(x=PropFarmEmployment)) + geom_histogram() + labs(y = "Count", tit
p16 <- ggplot(panel, aes(x=log(PropFarmEmployment+1))) + geom_histogram() + labs(y = "")

p15 + p16
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```


```
p17 <- ggplot(panel, aes(x=PercentUrban)) + geom_histogram() + labs(y = "Count", title = "
p18 <- ggplot(panel, aes(x=log(PercentUrban))) + geom_histogram() + labs(y = "")

p17 + p18
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



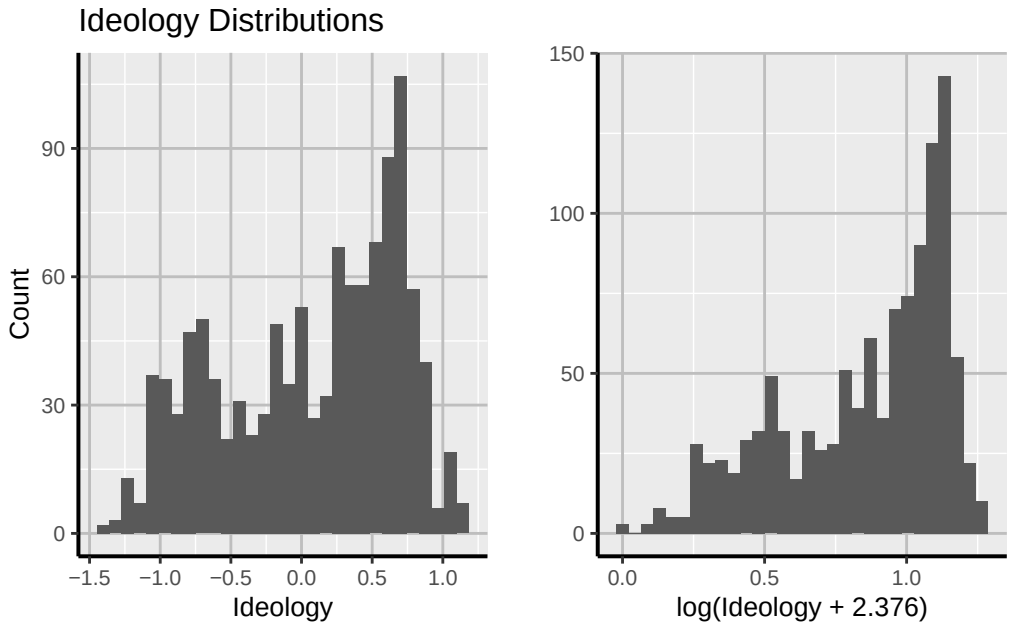

```
p19 <- ggplot(panel, aes(x=Ideology)) + geom_histogram() + labs(y = "Count", title = "Ideo
p20 <- ggplot(panel, aes(x=log(Ideology+2.3760))) + geom_histogram() + labs(y = "")

p19 + p20
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
Warning: Removed 16 rows containing non-finite values (`stat_bin()`).
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
Warning: Removed 16 rows containing non-finite values (`stat_bin()`).
```



Fixed effects models

```
m1 <- lm(
  data = panel, log(CarbonIntensity) ~ Ideology + factor(State) + factor(Year)
)

m2 <- lm(
  data = panel, log(EnergyIntensity) ~ Ideology + factor(State) + factor(Year)
)

cooks_distance_m1 <- cooks.distance(m1)
influential_m1 <- which(cooks_distance_m1 > (4/(length(cooks_distance_m1)-length(coefficie
m3 <- update(m1, subset = -influential_m1)

cooks_distance_m2 <- cooks.distance(m2)
influential_m2 <- which(cooks_distance_m2 > (4/(length(cooks_distance_m2)-length(coefficie
m4 <- update(m2, subset = -influential_m2)

summary(m1)
```

```
Call:
```

```
lm(formula = log(CarbonIntensity) ~ Ideology + factor(State) +
    factor(Year), data = panel)

Residuals:
      Min        1Q    Median        3Q       Max
-0.223759 -0.020215  0.000178  0.024011  0.175126

Coefficients:
                   Estimate Std. Error t value             Pr(>|t|)
(Intercept)       4.1101630  0.0109689 374.709 < 0.0000000000000002 ***
Ideology          0.0042517  0.0046074   0.923             0.356328
factor(State)AL  -0.0909491  0.0126069  -7.214   0.0000000000010307 ***
factor(State)AR  -0.0522889  0.0126091  -4.147   0.0000363873733048 ***
factor(State)AZ  -0.0682848  0.0126038  -5.418   0.0000000746453113 ***
factor(State)CA  -0.1003454  0.0148050  -6.778   0.0000000000202026 ***
factor(State)CO   0.1276210  0.0131845   9.680 < 0.0000000000000002 ***
factor(State)CT  -0.1884482  0.0143091 -13.170 < 0.0000000000000002 ***
factor(State)DE   0.1316454  0.0132918   9.904 < 0.0000000000000002 ***
factor(State)FL   0.0317832  0.0126146   2.520             0.011896 *
factor(State)GA  -0.0223013  0.0126009  -1.770             0.077044 .
factor(State)HI   0.1687788  0.0139141  12.130 < 0.0000000000000002 ***
factor(State)IA  -0.0071814  0.0127864  -0.562             0.574478
factor(State)ID  -0.3605241  0.0126512 -28.497 < 0.0000000000000002 ***
factor(State)IL  -0.1148709  0.0130416  -8.808 < 0.0000000000000002 ***
factor(State)IN   0.2425268  0.0128822  18.827 < 0.0000000000000002 ***
factor(State)KS   0.0365362  0.0126160   2.896             0.003857 **
factor(State)KY   0.2561894  0.0147717  17.343 < 0.0000000000000002 ***
factor(State)LA  -0.1523395  0.0126073 -12.083 < 0.0000000000000002 ***
factor(State)MA   0.0119355  0.0144811   0.824             0.410005
factor(State)MD   0.0137673  0.0139338   0.988             0.323351
factor(State)ME  -0.3282470  0.0132756 -24.726 < 0.0000000000000002 ***
factor(State)MI   0.0107681  0.0126086   0.854             0.393285
factor(State)MN  -0.0563071  0.0129506  -4.348   0.0000150708641438 ***
factor(State)MO   0.1952555  0.0126443  15.442 < 0.0000000000000002 ***
factor(State)MS  -0.0451462  0.0126008  -3.583             0.000355 ***
factor(State)MT   0.0281704  0.0126026   2.235             0.025606 *
factor(State)NC  -0.0433831  0.0126713  -3.424             0.000641 ***
factor(State)ND   0.2562320  0.0127513  20.095 < 0.0000000000000002 ***
factor(State)NE  -0.0146683  0.0126016  -1.164             0.244685
factor(State)NH  -0.3186510  0.0127599 -24.973 < 0.0000000000000002 ***
factor(State)NJ  -0.1032085  0.0139179  -7.416   0.0000000000002474 ***
factor(State)NM   0.1675715  0.0134713  12.439 < 0.0000000000000002 ***
factor(State)NV   0.0425142  0.0129702   3.278             0.001080 **
```

```
factor(State)NY  -0.1646788  0.0138729 -11.871 < 0.0000000000000002 ***
factor(State)OH   0.1451165  0.0126323  11.488 < 0.0000000000000002 ***
factor(State)OK   0.0553081  0.0126592   4.369   0.0000137054121977 ***
factor(State)OR  -0.4434810  0.0132405 -33.494 < 0.0000000000000002 ***
factor(State)PA  -0.0272441  0.0126605  -2.152             0.031630 *
factor(State)RI  -0.0019771  0.0133451  -0.148             0.882253
factor(State)SC  -0.2498541  0.0126038 -19.824 < 0.0000000000000002 ***
factor(State)SD  -0.2417686  0.0126289 -19.144 < 0.0000000000000002 ***
factor(State)TN  -0.0338477  0.0126011  -2.686             0.007342 **
factor(State)TX  -0.0954728  0.0126524  -7.546   0.0000000000000965 ***
factor(State)UT   0.2318934  0.0126375  18.350 < 0.0000000000000002 ***
factor(State)VA  -0.0451796  0.0126580  -3.569             0.000374 ***
factor(State)VT  -0.5152323  0.0135147 -38.124 < 0.0000000000000002 ***
factor(State)WA  -0.4641892  0.0133604 -34.744 < 0.0000000000000002 ***
factor(State)WI   0.0221623  0.0126221   1.756             0.079404 .
factor(State)WV   0.3470358  0.0128764  26.951 < 0.0000000000000002 ***
factor(State)WY   0.3048180  0.0126050  24.182 < 0.0000000000000002 ***
factor(Year)1999 -0.0097837  0.0083921  -1.166             0.243944
factor(Year)2000  0.0061663  0.0083463   0.739             0.460192
factor(Year)2001  0.0196531  0.0083456   2.355             0.018709 *
factor(Year)2002  0.0073203  0.0083457   0.877             0.380612
factor(Year)2003  0.0191915  0.0083482   2.299             0.021705 *
factor(Year)2004  0.0162701  0.0083486   1.949             0.051579 .
factor(Year)2005  0.0133547  0.0083457   1.600             0.109852
factor(Year)2006  0.0001823  0.0083457   0.022             0.982574
factor(Year)2007  0.0006216  0.0083606   0.074             0.940745
factor(Year)2008 -0.0161838  0.0083632  -1.935             0.053242 .
factor(Year)2009 -0.0415546  0.0085114  -4.882   0.0000012098753839 ***
factor(Year)2010 -0.0461028  0.0086138  -5.352   0.0000001064521347 ***
factor(Year)2011 -0.0708043  0.0084103  -8.419 < 0.0000000000000002 ***
factor(Year)2012 -0.0863867  0.0084144 -10.266 < 0.0000000000000002 ***
factor(Year)2013 -0.0873273  0.0083963 -10.401 < 0.0000000000000002 ***
factor(Year)2014 -0.0915057  0.0083968 -10.898 < 0.0000000000000002 ***
factor(Year)2015 -0.1004500  0.0084437 -11.897 < 0.0000000000000002 ***
factor(Year)2016 -0.1132525  0.0084482 -13.406 < 0.0000000000000002 ***
factor(Year)2017 -0.1257942  0.0084412 -14.902 < 0.0000000000000002 ***
factor(Year)2018 -0.1270589  0.0083920 -15.140 < 0.0000000000000002 ***
factor(Year)2019 -0.1407178  0.0083534 -16.846 < 0.0000000000000002 ***
factor(Year)2020 -0.1763769  0.0083487 -21.126 < 0.0000000000000002 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.04173 on 1061 degrees of freedom
```

```
  (16 observations deleted due to missingness)
Multiple R-squared:  0.9615,    Adjusted R-squared:  0.9589
F-statistic: 367.7 on 72 and 1061 DF,  p-value: < 0.00000000000000022
```

```r
summary(m2)
```

```
Call:
lm(formula = log(EnergyIntensity) ~ Ideology + factor(State) +
    factor(Year), data = panel)

Residuals:
      Min        1Q    Median        3Q       Max
-0.277867 -0.032899  0.000167  0.032826  0.258819

Coefficients:
                  Estimate Std. Error t value             Pr(>|t|)
(Intercept)       2.799163   0.015490 180.711 < 0.0000000000000002 ***
Ideology          0.025907   0.006506   3.982    0.000073047643522 ***
factor(State)AL  -0.236501   0.017803 -13.285 < 0.0000000000000002 ***
factor(State)AR  -0.267710   0.017806 -15.035 < 0.0000000000000002 ***
factor(State)AZ  -0.918658   0.017798 -51.615 < 0.0000000000000002 ***
factor(State)CA  -1.242132   0.020907 -59.413 < 0.0000000000000002 ***
factor(State)CO  -0.942712   0.018618 -50.633 < 0.0000000000000002 ***
factor(State)CT  -1.377606   0.020206 -68.177 < 0.0000000000000002 ***
factor(State)DE  -1.033672   0.018770 -55.071 < 0.0000000000000002 ***
factor(State)FL  -0.939173   0.017814 -52.722 < 0.0000000000000002 ***
factor(State)GA  -0.739364   0.017794 -41.551 < 0.0000000000000002 ***
factor(State)HI  -1.118978   0.019649 -56.949 < 0.0000000000000002 ***
factor(State)IA  -0.368275   0.018056 -20.396 < 0.0000000000000002 ***
factor(State)ID  -0.405038   0.017865 -22.672 < 0.0000000000000002 ***
factor(State)IL  -0.868807   0.018417 -47.175 < 0.0000000000000002 ***
factor(State)IN  -0.369889   0.018191 -20.333 < 0.0000000000000002 ***
factor(State)KS  -0.511355   0.017816 -28.703 < 0.0000000000000002 ***
factor(State)KY  -0.244743   0.020860 -11.733 < 0.0000000000000002 ***
factor(State)LA   0.257512   0.017803  14.464 < 0.0000000000000002 ***
factor(State)MA  -1.333276   0.020449 -65.199 < 0.0000000000000002 ***
factor(State)MD  -1.052468   0.019676 -53.489 < 0.0000000000000002 ***
factor(State)ME  -0.541477   0.018747 -28.883 < 0.0000000000000002 ***
factor(State)MI  -0.707384   0.017805 -39.729 < 0.0000000000000002 ***
factor(State)MN  -0.752772   0.018288 -41.162 < 0.0000000000000002 ***
```

```
factor(State)MO  -0.680053   0.017856 -38.086 < 0.0000000000000002 ***
factor(State)MS  -0.152192   0.017794  -8.553 < 0.0000000000000002 ***
factor(State)MT  -0.270916   0.017797 -15.223 < 0.0000000000000002 ***
factor(State)NC  -0.806223   0.017894 -45.056 < 0.0000000000000002 ***
factor(State)ND  -0.065828   0.018007  -3.656             0.000269 ***
factor(State)NE  -0.517290   0.017795 -29.069 < 0.0000000000000002 ***
factor(State)NH  -1.068642   0.018019 -59.307 < 0.0000000000000002 ***
factor(State)NJ  -1.061451   0.019654 -54.007 < 0.0000000000000002 ***
factor(State)NM  -0.506619   0.019023 -26.631 < 0.0000000000000002 ***
factor(State)NV  -0.927038   0.018316 -50.614 < 0.0000000000000002 ***
factor(State)NY  -1.450114   0.019591 -74.021 < 0.0000000000000002 ***
factor(State)OH  -0.672241   0.017839 -37.685 < 0.0000000000000002 ***
factor(State)OK  -0.345787   0.017877 -19.343 < 0.0000000000000002 ***
factor(State)OR  -0.782131   0.018697 -41.831 < 0.0000000000000002 ***
factor(State)PA  -0.790700   0.017878 -44.227 < 0.0000000000000002 ***
factor(State)RI  -1.214321   0.018845 -64.437 < 0.0000000000000002 ***
factor(State)SC  -0.394634   0.017798 -22.172 < 0.0000000000000002 ***
factor(State)SD  -0.459993   0.017834 -25.793 < 0.0000000000000002 ***
factor(State)TN  -0.539733   0.017795 -30.331 < 0.0000000000000002 ***
factor(State)TX  -0.385815   0.017867 -21.594 < 0.0000000000000002 ***
factor(State)UT  -0.784611   0.017846 -43.966 < 0.0000000000000002 ***
factor(State)VA  -0.848786   0.017875 -47.485 < 0.0000000000000002 ***
factor(State)VT  -0.914462   0.019085 -47.916 < 0.0000000000000002 ***
factor(State)WA  -0.925384   0.018867 -49.048 < 0.0000000000000002 ***
factor(State)WI  -0.682717   0.017824 -38.303 < 0.0000000000000002 ***
factor(State)WV  -0.193103   0.018183 -10.620 < 0.0000000000000002 ***
factor(State)WY   0.018404   0.017800   1.034             0.301403
factor(Year)1999 -0.015269   0.011851  -1.288             0.197860
factor(Year)2000 -0.029092   0.011786  -2.468             0.013731 *
factor(Year)2001 -0.064470   0.011785  -5.470    0.000000055997367 ***
factor(Year)2002 -0.071339   0.011785  -6.053    0.000000001967200 ***
factor(Year)2003 -0.092419   0.011789  -7.840    0.000000000000011 ***
factor(Year)2004 -0.110767   0.011789  -9.395 < 0.0000000000000002 ***
factor(Year)2005 -0.134674   0.011785 -11.427 < 0.0000000000000002 ***
factor(Year)2006 -0.168544   0.011785 -14.301 < 0.0000000000000002 ***
factor(Year)2007 -0.162817   0.011806 -13.791 < 0.0000000000000002 ***
factor(Year)2008 -0.187696   0.011810 -15.893 < 0.0000000000000002 ***
factor(Year)2009 -0.206059   0.012019 -17.144 < 0.0000000000000002 ***
factor(Year)2010 -0.191336   0.012164 -15.730 < 0.0000000000000002 ***
factor(Year)2011 -0.222473   0.011877 -18.732 < 0.0000000000000002 ***
factor(Year)2012 -0.267171   0.011882 -22.485 < 0.0000000000000002 ***
factor(Year)2013 -0.246426   0.011857 -20.784 < 0.0000000000000002 ***
factor(Year)2014 -0.254193   0.011857 -21.438 < 0.0000000000000002 ***
```

```
factor(Year)2015 -0.289988   0.011924 -24.320 < 0.0000000000000002 ***
factor(Year)2016 -0.307740   0.011930 -25.795 < 0.0000000000000002 ***
factor(Year)2017 -0.316649   0.011920 -26.564 < 0.0000000000000002 ***
factor(Year)2018 -0.306332   0.011851 -25.849 < 0.0000000000000002 ***
factor(Year)2019 -0.329782   0.011796 -27.957 < 0.0000000000000002 ***
factor(Year)2020 -0.376044   0.011790 -31.896 < 0.0000000000000002 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.05893 on 1061 degrees of freedom
  (16 observations deleted due to missingness)
Multiple R-squared:  0.9811,    Adjusted R-squared:  0.9799
F-statistic: 766.5 on 72 and 1061 DF,  p-value: < 0.00000000000000022
```

Multiple linear regressions

```r
m5 <- lm(
  data = panel, log(CarbonIntensity) ~ Ideology + log(GDPPerCapita) + log(Population) + We
)

m6 <- lm(
  data = panel, log(EnergyIntensity) ~ Ideology + log(GDPPerCapita) + log(Population) + We
)

summary(m5)
```

```
Call:
lm(formula = log(CarbonIntensity) ~ Ideology + log(GDPPerCapita) +
    log(Population) + Weighted_GHI + Weighted_Speed120m + PercentUrban +
    PropManuEmployment + PropFarmEmployment, data = panel)

Residuals:
     Min       1Q   Median       3Q      Max
-0.56547 -0.10937  0.01163  0.11652  0.51641

Coefficients:
                     Estimate Std. Error t value             Pr(>|t|)
(Intercept)         4.7958465  0.1204951  39.801 < 0.0000000000000002 ***
Ideology            0.0565096  0.0106998   5.281          0.0000001550 ***
log(GDPPerCapita)  -0.2580143  0.0267766  -9.636 < 0.0000000000000002 ***
log(Population)    -0.0202035  0.0080194  -2.519               0.01190 *
```

```
Weighted_GHI       -0.0193163  0.0034395  -5.616         0.0000000249 ***
Weighted_Speed120m -0.0016810  0.0005274  -3.187              0.00148 **
PercentUrban        0.0063252  0.0005878  10.760 < 0.0000000000000002 ***
PropManuEmployment -0.9481733  0.2338011  -4.055         0.0000536323 ***
PropFarmEmployment  1.3289549  0.4911583   2.706              0.00692 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1876 on 1079 degrees of freedom
  (62 observations deleted due to missingness)
Multiple R-squared:  0.1869,    Adjusted R-squared:  0.1809
F-statistic: 31.01 on 8 and 1079 DF,  p-value: < 0.00000000000000022
```

```r
summary(m6)
```

```
Call:
lm(formula = log(EnergyIntensity) ~ Ideology + log(GDPPerCapita) +
    log(Population) + Weighted_GHI + Weighted_Speed120m + PercentUrban +
    PropManuEmployment + PropFarmEmployment, data = panel)

Residuals:
    Min      1Q  Median      3Q     Max
-0.6356 -0.1283 -0.0183  0.1002  1.0162

Coefficients:
                    Estimate Std. Error t value             Pr(>|t|)
(Intercept)         4.2835301  0.1462024  29.299 < 0.0000000000000002 ***
Ideology            0.1935241  0.0129825  14.906 < 0.0000000000000002 ***
log(GDPPerCapita)  -0.5476625  0.0324893 -16.857 < 0.0000000000000002 ***
log(Population)     0.0127661  0.0097303   1.312               0.1898
Weighted_GHI       -0.0115366  0.0041733  -2.764               0.0058 **
Weighted_Speed120m -0.0006898  0.0006400  -1.078               0.2813
PercentUrban       -0.0058270  0.0007132  -8.170 0.000000000000000857 ***
PropManuEmployment -1.2070116  0.2836819  -4.255 0.000022739509825411 ***
PropFarmEmployment  7.7137424  0.5959454  12.944 < 0.0000000000000002 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.2276 on 1079 degrees of freedom
  (62 observations deleted due to missingness)
```

```
Multiple R-squared:  0.6861,    Adjusted R-squared:  0.6838
F-statistic: 294.9 on 8 and 1079 DF,  p-value: < 0.00000000000000022
```

```r
vif(m6)
```

```
          Ideology  log(GDPPerCapita)    log(Population)       Weighted_GHI
          1.379630           1.585699           1.958658           1.508170
Weighted_Speed120m       PercentUrban PropManuEmployment PropFarmEmployment
          1.405295           2.282120           1.758328           1.898391
```

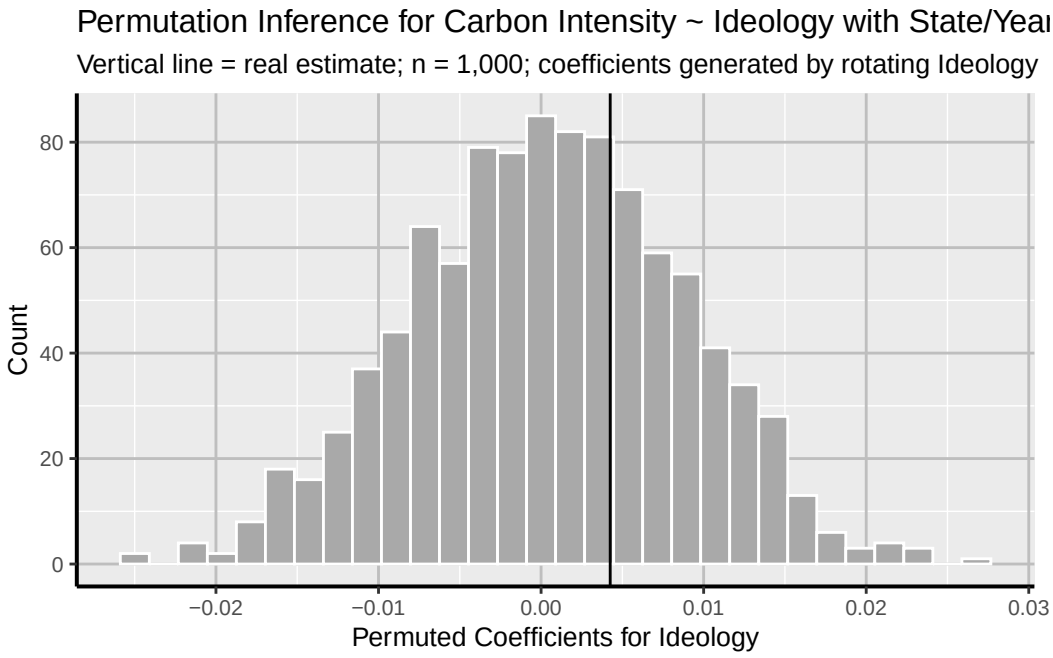
```r
cooks_distance_m5 <- cooks.distance(m5)
influential_m5 <- which(cooks_distance_m5 > (4/(length(cooks_distance_m5)-length(coefficie
m7 <- update(m5, subset = -influential_m5)

cooks_distance_m6 <- cooks.distance(m6)
influential_m6 <- which(cooks_distance_m6 > (4/(length(cooks_distance_m6)-length(coefficie
m8 <- update(m6, subset = -influential_m6)
```

Permutation Inference - Carbon Intensity

```r
baseline_CI_FE <- lm(log(CarbonIntensity) ~ Ideology + factor(State) + factor(Year), data

baseline_coef_Ideology <- coef(baseline_CI_FE)["Ideology"]

n_permutations <- 1000
permuted_coefs <- numeric(n_permutations)

for(i in 1:n_permutations) {
  # Rotate ideologies within each state
  shuffled_data <- panel %>%
    group_by(State) %>%
    mutate(
      order = row_number(), # Preserves original order
      shift = sample(1:n(), 1), # Random shift for each state
      Ideology = Ideology[(order - shift) %% n() + 1] # Apply shift
    ) %>%
    ungroup()

  model <- lm(log(CarbonIntensity) ~ Ideology + factor(State) + factor(Year), data=shuffle
  permuted_coefs[i] <- coef(model)["Ideology"]
}
```

```
ggplot() +
  geom_histogram(aes(x = permuted_coefs), fill = "darkgray", color = "white") +
  geom_vline(aes(xintercept = baseline_coef_Ideology), color = "black") +
  labs(x = "Permuted Coefficients for Ideology", y = "Count",
       title = "Permutation Inference for Carbon Intensity ~ Ideology with State/Year FEs"
       subtitle = "Vertical line = real estimate; n = 1,000; coefficients generated by rot
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
p_value <- mean(abs(permuted_coefs) >= abs(baseline_coef_Ideology))
p_value
```

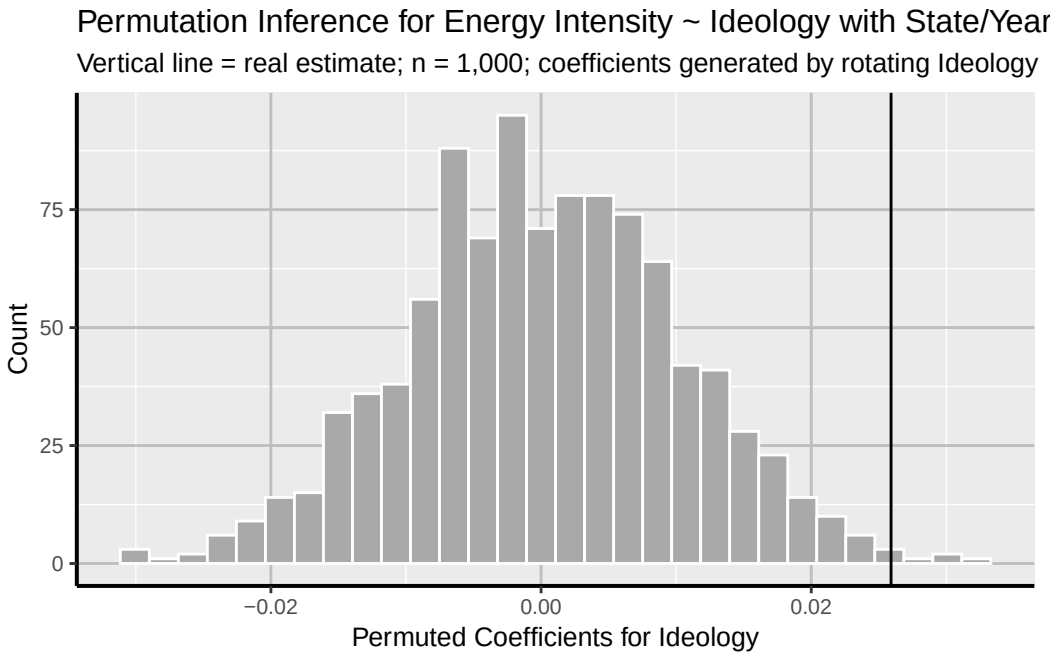
```
[1] 0.617
```

Permutation Inference - Energy Intensity

```
baseline_EI_FE <- lm(log(EnergyIntensity) ~ Ideology + factor(State) + factor(Year), data

baseline_coef_Ideology <- coef(baseline_EI_FE)["Ideology"]
```

```r
n_permutations <- 1000
permuted_coefs <- numeric(n_permutations)

for(i in 1:n_permutations) {
  # Rotate ideologies within each state
  shuffled_data <- panel %>%
    group_by(State) %>%
    mutate(
      order = row_number(), # Preserves original order
      shift = sample(1:n(), 1), # Random shift for each state
      Ideology = Ideology[(order - shift) %% n() + 1] # Apply shift
    ) %>%
    ungroup()

  model <- lm(log(EnergyIntensity) ~ Ideology + factor(State) + factor(Year), data=shuffle
  permuted_coefs[i] <- coef(model)["Ideology"]
}


ggplot() +
  geom_histogram(aes(x = permuted_coefs), fill = "darkgray", color = "white") +
  geom_vline(aes(xintercept = baseline_coef_Ideology), color = "black") +
  labs(x = "Permuted Coefficients for Ideology", y = "Count",
       title = "Permutation Inference for Energy Intensity ~ Ideology with State/Year FEs"
       subtitle = "Vertical line = real estimate; n = 1,000; coefficients generated by rot
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
p_value <- mean(abs(permuted_coefs) >= abs(baseline_coef_Ideology))
p_value
```

```
[1] 0.009
```

Stringency Regression - All Policies

```
m9 <- lm(data = panel,
         Score ~ Ideology + factor(State) + factor(Year))

summary(m9)
```

```
Call:
lm(formula = Score ~ Ideology + factor(State) + factor(Year),
    data = panel)

Residuals:
    Min      1Q  Median      3Q     Max
-9.1275 -1.8713  0.0749  2.0787  6.8755
```

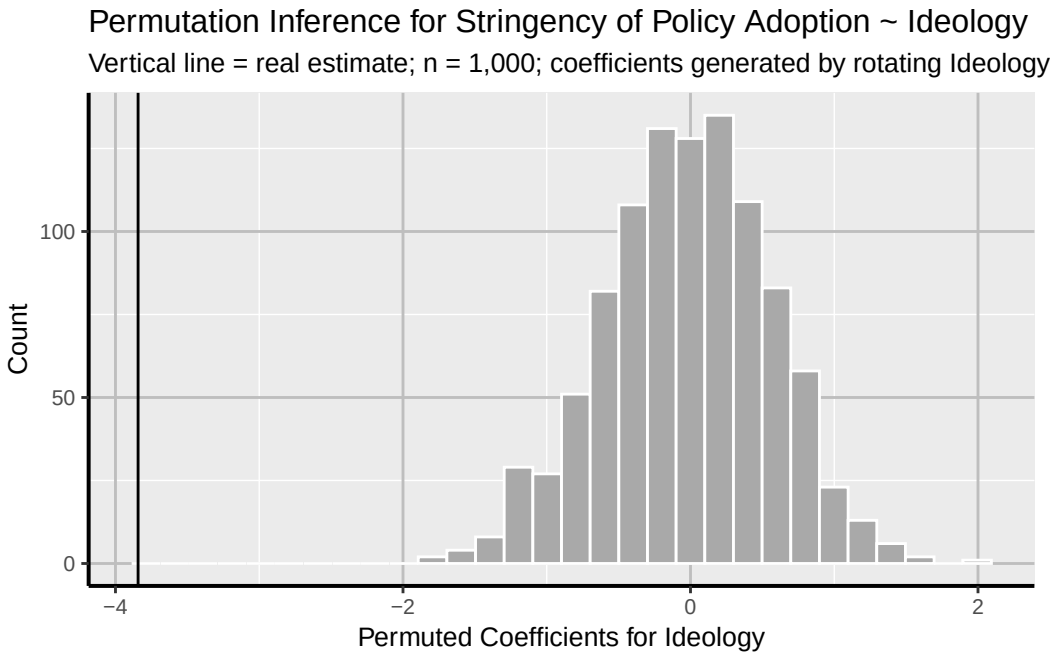
Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-4.1472	0.7603	-5.455	0.000000060948437029	***
Ideology	-3.8428	0.3193	-12.034	< 0.0000000000000002	***
factor(State)AL	2.3818	0.8738	2.726	0.006520	**
factor(State)AR	2.8516	0.8739	3.263	0.001138	**
factor(State)AZ	8.5123	0.8736	9.744	< 0.0000000000000002	***
factor(State)CA	15.1005	1.0261	14.716	< 0.0000000000000002	***
factor(State)CO	7.6947	0.9138	8.420	< 0.0000000000000002	***
factor(State)CT	13.3627	0.9918	13.474	< 0.0000000000000002	***
factor(State)DE	5.1417	0.9213	5.581	0.000000030320401377	***
factor(State)FL	7.1314	0.8743	8.157	0.000000000000000967	***
factor(State)GA	4.9482	0.8734	5.666	0.000000018859999703	***
factor(State)HI	6.5307	0.9644	6.772	0.000000000021006831	***
factor(State)IA	8.1200	0.8862	9.162	< 0.0000000000000002	***
factor(State)ID	1.5690	0.8769	1.789	0.073850	.
factor(State)IL	6.9524	0.9039	7.692	0.000000000000033087	***
factor(State)IN	3.9559	0.8929	4.431	0.000010373721506312	***
factor(State)KS	2.8907	0.8744	3.306	0.000978	***
factor(State)KY	2.8976	1.0238	2.830	0.004740	**
factor(State)LA	1.9819	0.8738	2.268	0.023524	*
factor(State)MA	10.0658	1.0037	10.029	< 0.0000000000000002	***
factor(State)MD	10.6225	0.9657	10.999	< 0.0000000000000002	***
factor(State)ME	9.6193	0.9201	10.454	< 0.0000000000000002	***
factor(State)MI	9.9053	0.8739	11.335	< 0.0000000000000002	***
factor(State)MN	15.6979	0.8976	17.489	< 0.0000000000000002	***
factor(State)MO	5.5454	0.8764	6.328	0.000000000366585887	***
factor(State)MS	-1.5063	0.8734	-1.725	0.084863	.
factor(State)MT	8.7231	0.8735	9.987	< 0.0000000000000002	***
factor(State)NC	10.0342	0.8782	11.425	< 0.0000000000000002	***
factor(State)ND	1.3254	0.8838	1.500	0.133998	
factor(State)NE	-0.7171	0.8734	-0.821	0.411790	
factor(State)NH	7.5155	0.8844	8.498	< 0.0000000000000002	***
factor(State)NJ	10.1753	0.9646	10.548	< 0.0000000000000002	***
factor(State)NM	4.9572	0.9337	5.309	0.000000134010321630	***
factor(State)NV	8.4540	0.8990	9.404	< 0.0000000000000002	***
factor(State)NY	12.7861	0.9615	13.298	< 0.0000000000000002	***
factor(State)OH	8.7192	0.8755	9.959	< 0.0000000000000002	***
factor(State)OK	4.2491	0.8774	4.843	0.000001470502624315	***
factor(State)OR	13.9744	0.9177	15.228	< 0.0000000000000002	***
factor(State)PA	6.0796	0.8775	6.928	0.000000000007370093	***
factor(State)RI	11.3957	0.9249	12.320	< 0.0000000000000002	***

```
factor(State)SC    3.0787     0.8736   3.524             0.000443 ***
factor(State)SD    4.8086     0.8753   5.494 0.000000049302997189 ***
factor(State)TN    0.9309     0.8734   1.066             0.286727
factor(State)TX    7.8408     0.8769   8.941 < 0.0000000000000002 ***
factor(State)UT    5.6045     0.8759   6.399 0.000000000234864191 ***
factor(State)VA    8.9269     0.8773  10.175 < 0.0000000000000002 ***
factor(State)VT   11.0734     0.9367  11.822 < 0.0000000000000002 ***
factor(State)WA   13.0962     0.9260  14.143 < 0.0000000000000002 ***
factor(State)WI   12.3618     0.8748  14.130 < 0.0000000000000002 ***
factor(State)WV   -1.4233     0.8925  -1.595             0.111049
factor(State)WY   -0.2142     0.8737  -0.245             0.806400
factor(Year)1999   0.5698     0.5817   0.980             0.327482
factor(Year)2000   0.8682     0.5785   1.501             0.133700
factor(Year)2001   1.6393     0.5784   2.834             0.004683 **
factor(Year)2002   1.8240     0.5784   3.153             0.001660 **
factor(Year)2003   2.3530     0.5786   4.067 0.000051222337041247 ***
factor(Year)2004   2.9684     0.5786   5.130 0.000000344418159210 ***
factor(Year)2005   3.5899     0.5784   6.206 0.000000000776878679 ***
factor(Year)2006   4.4559     0.5784   7.703 0.000000000000030318 ***
factor(Year)2007   6.6227     0.5795  11.429 < 0.0000000000000002 ***
factor(Year)2008   8.5671     0.5797  14.780 < 0.0000000000000002 ***
factor(Year)2009  10.5169     0.5899  17.828 < 0.0000000000000002 ***
factor(Year)2010  11.6605     0.5970  19.531 < 0.0000000000000002 ***
factor(Year)2011  12.8897     0.5829  22.112 < 0.0000000000000002 ***
factor(Year)2012  13.0811     0.5832  22.430 < 0.0000000000000002 ***
factor(Year)2013  13.2708     0.5819  22.804 < 0.0000000000000002 ***
factor(Year)2014  13.5073     0.5820  23.209 < 0.0000000000000002 ***
factor(Year)2015  14.2422     0.5852  24.336 < 0.0000000000000002 ***
factor(Year)2016  14.6018     0.5855  24.937 < 0.0000000000000002 ***
factor(Year)2017  16.1421     0.5851  27.590 < 0.0000000000000002 ***
factor(Year)2018  16.5553     0.5816  28.463 < 0.0000000000000002 ***
factor(Year)2019  15.2618     0.5790  26.360 < 0.0000000000000002 ***
factor(Year)2020  15.4713     0.5786  26.737 < 0.0000000000000002 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.892 on 1061 degrees of freedom
  (16 observations deleted due to missingness)
Multiple R-squared:  0.899, Adjusted R-squared:  0.8921
F-statistic: 131.1 on 72 and 1061 DF,  p-value: < 0.00000000000000022
```

```r
baseline_all <- lm(data = panel,
         Score ~ Ideology + factor(State) + factor(Year))

baseline_coef_Ideology <- coef(baseline_all)["Ideology"]

n_permutations <- 1000
permuted_coefs <- numeric(n_permutations)

for(i in 1:n_permutations) {
  # Rotate ideologies within each state
  shuffled_data <- panel %>%
    group_by(State) %>%
    mutate(
      order = row_number(), # Preserves original order
      shift = sample(1:n(), 1), # Random shift for each state
      Ideology = Ideology[(order - shift) %% n() + 1] # Apply shift
    ) %>%
    ungroup()

  model <- lm(Score ~ Ideology + factor(State) + factor(Year), data=shuffled_data)
  permuted_coefs[i] <- coef(model)["Ideology"]
}

ggplot() +
  geom_histogram(aes(x = permuted_coefs), fill = "darkgray", color = "white") +
  geom_vline(aes(xintercept = baseline_coef_Ideology), color = "black") +
  labs(x = "Permuted Coefficients for Ideology", y = "Count",
       title = "Permutation Inference for Stringency of Policy Adoption ~ Ideology",
       subtitle = "Vertical line = real estimate; n = 1,000; coefficients generated by rot
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
p_value <- mean(abs(permuted_coefs) >= abs(baseline_coef_Ideology))
p_value
```

```
[1] 0
```

Stringency Regression - Carbon Intensity Policy

```
m10 <- lm(data = panel,
          CI_Score ~ Ideology + factor(State) + factor(Year))

summary(m10)
```

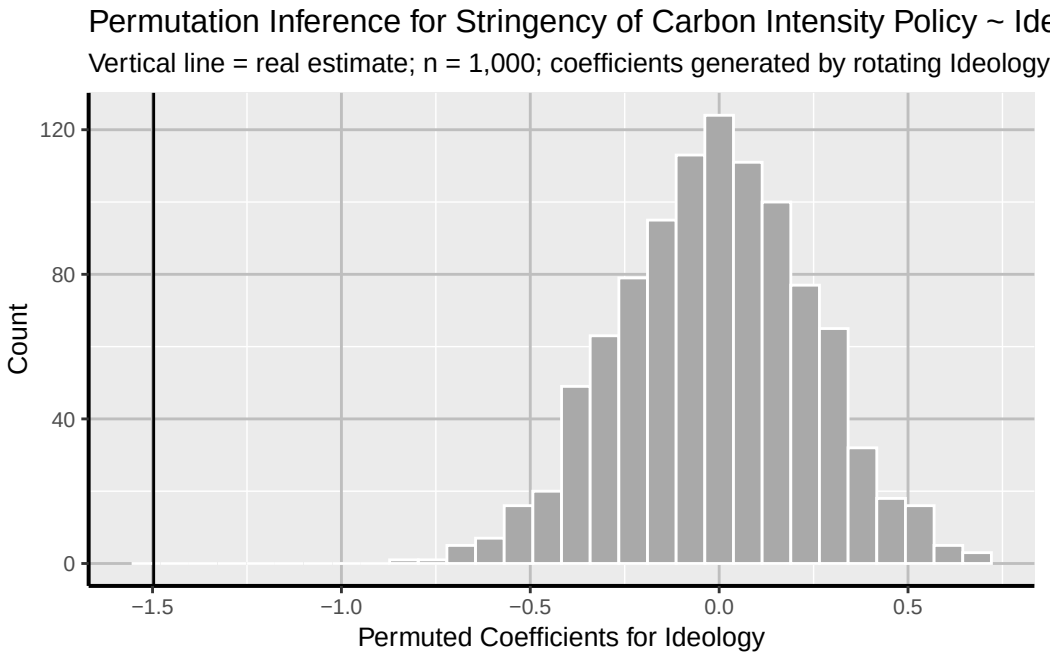
```
Call:
lm(formula = CI_Score ~ Ideology + factor(State) + factor(Year),
    data = panel)

Residuals:
    Min      1Q  Median      3Q     Max
-3.8493 -0.7781  0.0159  0.7844  2.9663
```

```
Coefficients:
                 Estimate Std. Error t value             Pr(>|t|)
(Intercept)      -1.44333    0.29938  -4.821  0.00000163601812795 ***
Ideology         -1.49700    0.12575 -11.904 < 0.0000000000000002 ***
factor(State)AL  -0.69211    0.34409  -2.011             0.044531 *
factor(State)AR  -0.36453    0.34414  -1.059             0.289738
factor(State)AZ   4.09333    0.34400  11.899 < 0.0000000000000002 ***
factor(State)CA   4.17261    0.40408  10.326 < 0.0000000000000002 ***
factor(State)CO   4.17642    0.35985  11.606 < 0.0000000000000002 ***
factor(State)CT   5.62539    0.39054  14.404 < 0.0000000000000002 ***
factor(State)DE   4.75827    0.36278  13.116 < 0.0000000000000002 ***
factor(State)FL   3.24424    0.34430   9.423 < 0.0000000000000002 ***
factor(State)GA   1.63469    0.34392   4.753  0.00000227868994899 ***
factor(State)HI   3.17190    0.37976   8.352 < 0.0000000000000002 ***
factor(State)IA   6.77512    0.34898  19.414 < 0.0000000000000002 ***
factor(State)ID  -0.19576    0.34529  -0.567             0.570886
factor(State)IL   1.64892    0.35595   4.632  0.00000406159024609 ***
factor(State)IN   2.35076    0.35160   6.686  0.00000000003702154 ***
factor(State)KS   2.58298    0.34433   7.501  0.00000000000013316 ***
factor(State)KY   1.34124    0.40317   3.327             0.000909 ***
factor(State)LA   1.47845    0.34409   4.297  0.00001893246936018 ***
factor(State)MA   4.20538    0.39524  10.640 < 0.0000000000000002 ***
factor(State)MD   4.06987    0.38030  10.702 < 0.0000000000000002 ***
factor(State)ME   4.55757    0.36233  12.578 < 0.0000000000000002 ***
factor(State)MI   3.63948    0.34413  10.576 < 0.0000000000000002 ***
factor(State)MN   5.90038    0.35346  16.693 < 0.0000000000000002 ***
factor(State)MO   2.38681    0.34511   6.916  0.00000000000800479 ***
factor(State)MS  -1.06864    0.34392  -3.107             0.001939 **
factor(State)MT   5.42163    0.34397  15.762 < 0.0000000000000002 ***
factor(State)NC   3.78573    0.34584  10.946 < 0.0000000000000002 ***
factor(State)ND   2.52060    0.34803   7.243  0.00000000000084487 ***
factor(State)NE   0.77922    0.34394   2.266             0.023678 *
factor(State)NH   3.82758    0.34826  10.991 < 0.0000000000000002 ***
factor(State)NJ   5.08198    0.37987  13.378 < 0.0000000000000002 ***
factor(State)NM   3.67173    0.36768   9.986 < 0.0000000000000002 ***
factor(State)NV   4.52528    0.35400  12.783 < 0.0000000000000002 ***
factor(State)NY   4.37754    0.37864  11.561 < 0.0000000000000002 ***
factor(State)OH   3.72728    0.34478  10.811 < 0.0000000000000002 ***
factor(State)OK   1.22337    0.34551   3.541             0.000416 ***
factor(State)OR   5.11598    0.36138  14.157 < 0.0000000000000002 ***
factor(State)PA   2.29862    0.34555   6.652  0.00000000004618560 ***
factor(State)RI   3.92216    0.36423  10.768 < 0.0000000000000002 ***
```

```
factor(State)SC   1.52857    0.34400   4.444  0.00000977901213384 ***
factor(State)SD   1.75475    0.34468   5.091  0.00000042146263491 ***
factor(State)TN   0.35976    0.34393   1.046              0.295775
factor(State)TX   4.37372    0.34533  12.665 < 0.0000000000000002 ***
factor(State)UT   3.14166    0.34492   9.108 < 0.0000000000000002 ***
factor(State)VA   3.91555    0.34548  11.334 < 0.0000000000000002 ***
factor(State)VT   4.28446    0.36886  11.615 < 0.0000000000000002 ***
factor(State)WA   5.25495    0.36465  14.411 < 0.0000000000000002 ***
factor(State)WI   4.89413    0.34450  14.207 < 0.0000000000000002 ***
factor(State)WV  -0.04728    0.35144  -0.135              0.893012
factor(State)WY   0.41675    0.34403   1.211              0.226025
factor(Year)1999  0.42096    0.22905   1.838              0.066361 .
factor(Year)2000  0.48424    0.22780   2.126              0.033757 *
factor(Year)2001  0.90753    0.22778   3.984  0.00007231758702628 ***
factor(Year)2002  1.02597    0.22778   4.504  0.00000740064125091 ***
factor(Year)2003  1.28740    0.22785   5.650  0.00000002057821956 ***
factor(Year)2004  1.65340    0.22786   7.256  0.00000000000076786 ***
factor(Year)2005  1.79166    0.22778   7.866  0.00000000000000899 ***
factor(Year)2006  2.11398    0.22778   9.281 < 0.0000000000000002 ***
factor(Year)2007  2.99743    0.22819  13.136 < 0.0000000000000002 ***
factor(Year)2008  3.44358    0.22826  15.086 < 0.0000000000000002 ***
factor(Year)2009  4.26043    0.23230  18.340 < 0.0000000000000002 ***
factor(Year)2010  4.46616    0.23510  18.997 < 0.0000000000000002 ***
factor(Year)2011  4.84507    0.22955  21.107 < 0.0000000000000002 ***
factor(Year)2012  4.86396    0.22966  21.179 < 0.0000000000000002 ***
factor(Year)2013  4.89788    0.22916  21.373 < 0.0000000000000002 ***
factor(Year)2014  4.94335    0.22918  21.570 < 0.0000000000000002 ***
factor(Year)2015  5.27259    0.23046  22.879 < 0.0000000000000002 ***
factor(Year)2016  5.38753    0.23058  23.365 < 0.0000000000000002 ***
factor(Year)2017  5.48988    0.23039  23.829 < 0.0000000000000002 ***
factor(Year)2018  5.56644    0.22905  24.303 < 0.0000000000000002 ***
factor(Year)2019  4.31756    0.22799  18.937 < 0.0000000000000002 ***
factor(Year)2020  4.33451    0.22786  19.022 < 0.0000000000000002 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.139 on 1061 degrees of freedom
  (16 observations deleted due to missingness)
Multiple R-squared:  0.8875,    Adjusted R-squared:  0.8798
F-statistic: 116.2 on 72 and 1061 DF,  p-value: < 0.00000000000000022
```

```r
baseline_ci <- lm(data = panel,
         CI_Score ~ Ideology + factor(State) + factor(Year))

baseline_coef_Ideology <- coef(baseline_ci)["Ideology"]

n_permutations <- 1000
permuted_coefs <- numeric(n_permutations)

for(i in 1:n_permutations) {
  # Rotate ideologies within each state
  shuffled_data <- panel %>%
    group_by(State) %>%
    mutate(
      order = row_number(), # Preserves original order
      shift = sample(1:n(), 1), # Random shift for each state
      Ideology = Ideology[(order - shift) %% n() + 1] # Apply shift
    ) %>%
    ungroup()

  model <- lm(CI_Score ~ Ideology + factor(State) + factor(Year), data=shuffled_data)
  permuted_coefs[i] <- coef(model)["Ideology"]
}

ggplot() +
  geom_histogram(aes(x = permuted_coefs), fill = "darkgray", color = "white") +
  geom_vline(aes(xintercept = baseline_coef_Ideology), color = "black") +
  labs(x = "Permuted Coefficients for Ideology", y = "Count",
       title = "Permutation Inference for Stringency of Carbon Intensity Policy ~ Ideology
       subtitle = "Vertical line = real estimate; n = 1,000; coefficients generated by rot
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
p_value <- mean(abs(permuted_coefs) >= abs(baseline_coef_Ideology))
p_value
```

```
[1] 0
```

Stringency Regression - Energy Efficiency Policy

```
m11 <- lm(data = panel,
          EE_Score ~ Ideology + factor(State) + factor(Year))

summary(m11)
```

```
Call:
lm(formula = EE_Score ~ Ideology + factor(State) + factor(Year),
    data = panel)

Residuals:
    Min      1Q  Median      3Q     Max
-6.1236 -1.1833  0.0627  1.2143  4.6022
```

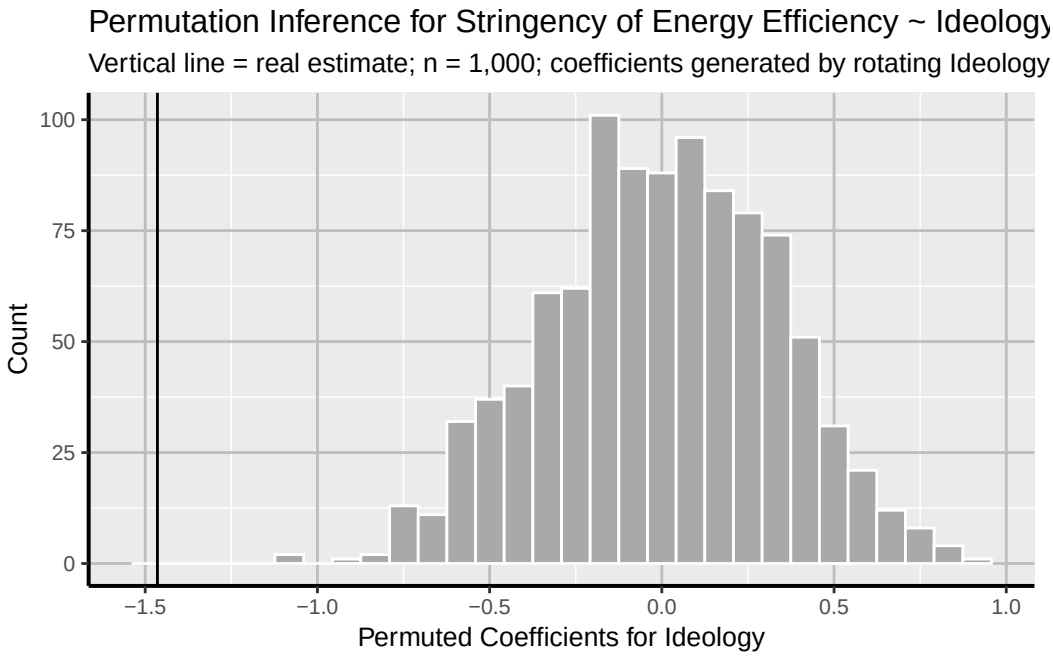
Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-2.37460	0.47488	-5.000	0.00000066883797816	***
Ideology	-1.46454	0.19947	-7.342	0.00000000000041747	***
factor(State)AL	3.55823	0.54579	6.519	0.00000000010894720	***
factor(State)AR	3.06017	0.54588	5.606	0.00000002640424526	***
factor(State)AZ	3.73020	0.54565	6.836	0.00000000001369627	***
factor(State)CA	6.86621	0.64095	10.713	< 0.0000000000000002	***
factor(State)CO	3.10346	0.57080	5.437	0.00000006719714373	***
factor(State)CT	5.48591	0.61948	8.856	< 0.0000000000000002	***
factor(State)DE	-0.44266	0.57544	-0.769	0.441918	
factor(State)FL	3.45248	0.54612	6.322	0.00000000038014194	***
factor(State)GA	1.49041	0.54553	2.732	0.006398	**
factor(State)HI	0.41753	0.60238	0.693	0.488378	
factor(State)IA	1.86404	0.55356	3.367	0.000786	***
factor(State)ID	2.04382	0.54771	3.732	0.000200	***
factor(State)IL	3.48536	0.56461	6.173	0.00000000095200374	***
factor(State)IN	1.15784	0.55771	2.076	0.038127	*
factor(State)KS	1.09577	0.54618	2.006	0.045085	*
factor(State)KY	1.47118	0.63951	2.300	0.021614	*
factor(State)LA	1.20713	0.54580	2.212	0.027204	*
factor(State)MA	3.54667	0.62693	5.657	0.00000001977955685	***
factor(State)MD	4.66366	0.60323	7.731	0.00000000000002466	***
factor(State)ME	2.74759	0.57474	4.781	0.00000199385797598	***
factor(State)MI	4.58582	0.54586	8.401	< 0.0000000000000002	***
factor(State)MN	5.82116	0.56067	10.383	< 0.0000000000000002	***
factor(State)MO	2.32261	0.54741	4.243	0.00002399123565194	***
factor(State)MS	0.22203	0.54552	0.407	0.684085	
factor(State)MT	0.66762	0.54560	1.224	0.221360	
factor(State)NC	4.95572	0.54857	9.034	< 0.0000000000000002	***
factor(State)ND	-0.68541	0.55204	-1.242	0.214663	
factor(State)NE	-1.01565	0.54556	-1.862	0.062925	.
factor(State)NH	1.95884	0.55241	3.546	0.000408	***
factor(State)NJ	2.76246	0.60255	4.585	0.00000508859474002	***
factor(State)NM	0.30066	0.58321	0.516	0.606292	
factor(State)NV	3.66404	0.56152	6.525	0.00000000010493398	***
factor(State)NY	4.75292	0.60060	7.914	0.00000000000000626	***
factor(State)OH	4.05548	0.54689	7.416	0.00000000000024728	***
factor(State)OK	2.94061	0.54805	5.366	0.00000009905680317	***
factor(State)OR	6.08782	0.57322	10.620	< 0.0000000000000002	***
factor(State)PA	2.90264	0.54811	5.296	0.00000014404823880	***
factor(State)RI	5.72239	0.57775	9.905	< 0.0000000000000002	***

```
factor(State)SC   1.60021    0.54565   2.933             0.003433 **
factor(State)SD   2.56156    0.54674   4.685  0.00000316084290968 ***
factor(State)TN   1.26021    0.54554   2.310             0.021077 *
factor(State)TX   3.56973    0.54776   6.517  0.00000000011066006 ***
factor(State)UT   2.59980    0.54711   4.752  0.00000229285869867 ***
factor(State)VA   2.78026    0.54800   5.073  0.00000046095816503 ***
factor(State)VT   4.74033    0.58509   8.102  0.00000000000000148 ***
factor(State)WA   5.01203    0.57841   8.665 < 0.0000000000000002 ***
factor(State)WI   5.27728    0.54644   9.657 < 0.0000000000000002 ***
factor(State)WV  -0.37142    0.55745  -0.666             0.505379
factor(State)WY   0.10140    0.54571   0.186             0.852630
factor(Year)1999  0.01785    0.36332   0.049             0.960815
factor(Year)2000  0.18501    0.36134   0.512             0.608741
factor(Year)2001  0.42737    0.36131   1.183             0.237137
factor(Year)2002  0.44628    0.36131   1.235             0.217041
factor(Year)2003  0.62593    0.36142   1.732             0.083583 .
factor(Year)2004  0.79181    0.36144   2.191             0.028689 *
factor(Year)2005  1.19141    0.36131   3.297             0.001008 **
factor(Year)2006  1.65368    0.36131   4.577  0.00000527630789331 ***
factor(Year)2007  2.70095    0.36195   7.462  0.00000000000017686 ***
factor(Year)2008  3.80740    0.36207  10.516 < 0.0000000000000002 ***
factor(Year)2009  4.60949    0.36848  12.509 < 0.0000000000000002 ***
factor(Year)2010  5.26686    0.37292  14.123 < 0.0000000000000002 ***
factor(Year)2011  5.92699    0.36411  16.278 < 0.0000000000000002 ***
factor(Year)2012  6.06793    0.36428  16.657 < 0.0000000000000002 ***
factor(Year)2013  6.20624    0.36350  17.074 < 0.0000000000000002 ***
factor(Year)2014  6.33325    0.36352  17.422 < 0.0000000000000002 ***
factor(Year)2015  6.55596    0.36555  17.935 < 0.0000000000000002 ***
factor(Year)2016  6.77267    0.36575  18.517 < 0.0000000000000002 ***
factor(Year)2017  8.18157    0.36544  22.388 < 0.0000000000000002 ***
factor(Year)2018  8.44023    0.36331  23.231 < 0.0000000000000002 ***
factor(Year)2019  8.39501    0.36164  23.214 < 0.0000000000000002 ***
factor(Year)2020  8.53289    0.36144  23.608 < 0.0000000000000002 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.807 on 1061 degrees of freedom
  (16 observations deleted due to missingness)
Multiple R-squared:  0.8328,    Adjusted R-squared:  0.8214
F-statistic: 73.38 on 72 and 1061 DF,  p-value: < 0.00000000000000022
```

```r
baseline_EE <- lm(data = panel,
         EE_Score ~ Ideology + factor(State) + factor(Year))

baseline_coef_Ideology <- coef(baseline_EE)["Ideology"]

n_permutations <- 1000
permuted_coefs <- numeric(n_permutations)

for(i in 1:n_permutations) {
  # Rotate ideologies within each state
  shuffled_data <- panel %>%
    group_by(State) %>%
    mutate(
      order = row_number(), # Preserves original order
      shift = sample(1:n(), 1), # Random shift for each state
      Ideology = Ideology[(order - shift) %% n() + 1] # Apply shift
    ) %>%
    ungroup()

  model <- lm(EE_Score ~ Ideology + factor(State) + factor(Year), data=shuffled_data)
  permuted_coefs[i] <- coef(model)["Ideology"]
}

ggplot() +
  geom_histogram(aes(x = permuted_coefs), fill = "darkgray", color = "white") +
  geom_vline(aes(xintercept = baseline_coef_Ideology), color = "black") +
  labs(x = "Permuted Coefficients for Ideology", y = "Count",
       title = "Permutation Inference for Stringency of Energy Efficiency ~ Ideology",
       subtitle = "Vertical line = real estimate; n = 1,000; coefficients generated by rot
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

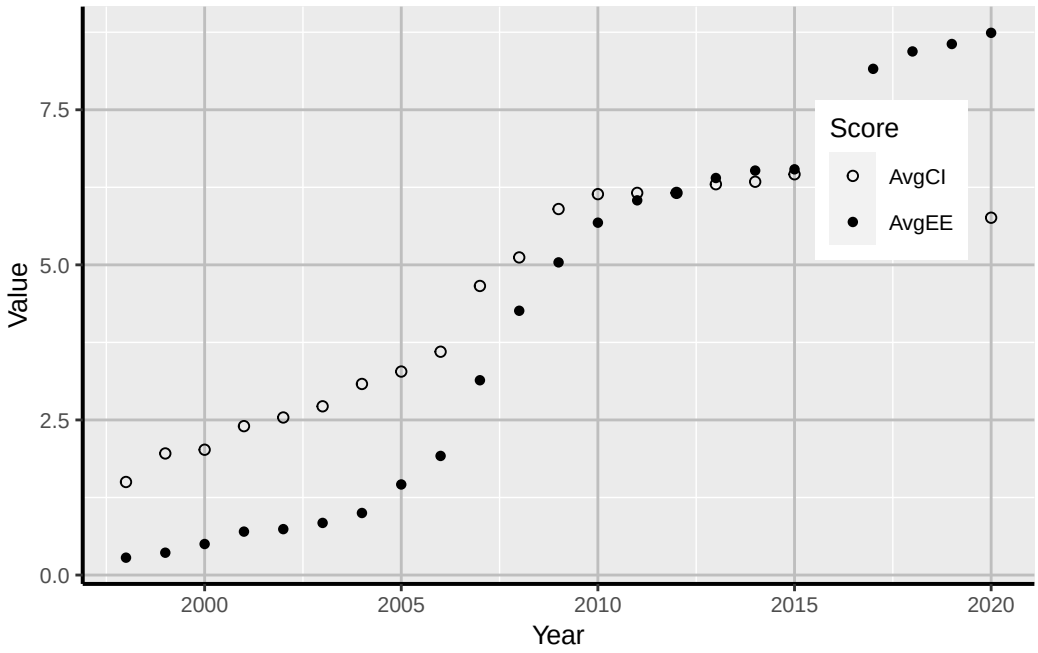



```
p_value <- mean(abs(permuted_coefs) >= abs(baseline_coef_Ideology))
p_value
```

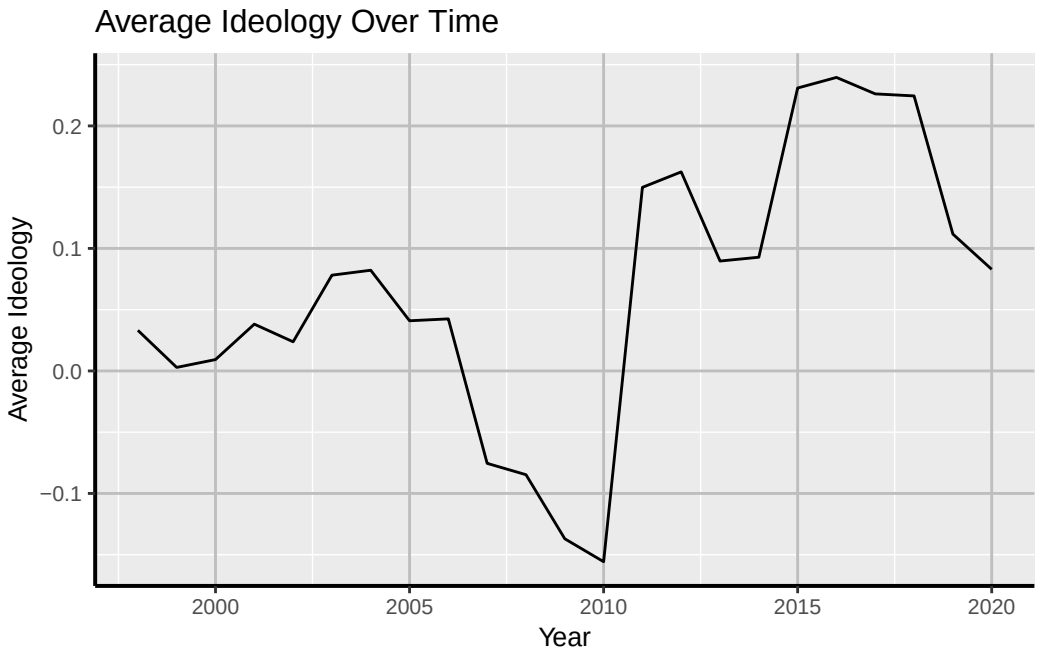
```
[1] 0
```

Figures

```
figure_data <- panel %>%
  group_by(Year) %>%
  summarise(AvgScore = mean(Score, na.rm = TRUE), AvgCI = mean(CI_Score, na.rm = TRUE),
            AvgEE = mean(EE_Score, na.rm = TRUE), AvgIdeology = mean(Ideology, na.rm=TRUE)

unpivoted_data <- figure_data

figure_data <- pivot_longer(figure_data, 2:5)
colnames(figure_data) <- c("Year", "Score", "Value")

ggplot(data = figure_data %>% filter(Score != "AvgScore") %>% filter(Score != "AvgIdeology
```




```
ggplot(data = unpivoted_data) +
  geom_line(aes(x = Year, y = AvgIdeology)) +
  labs(x = "Year", y = "Average Ideology",
       title = "Average Ideology Over Time")
```

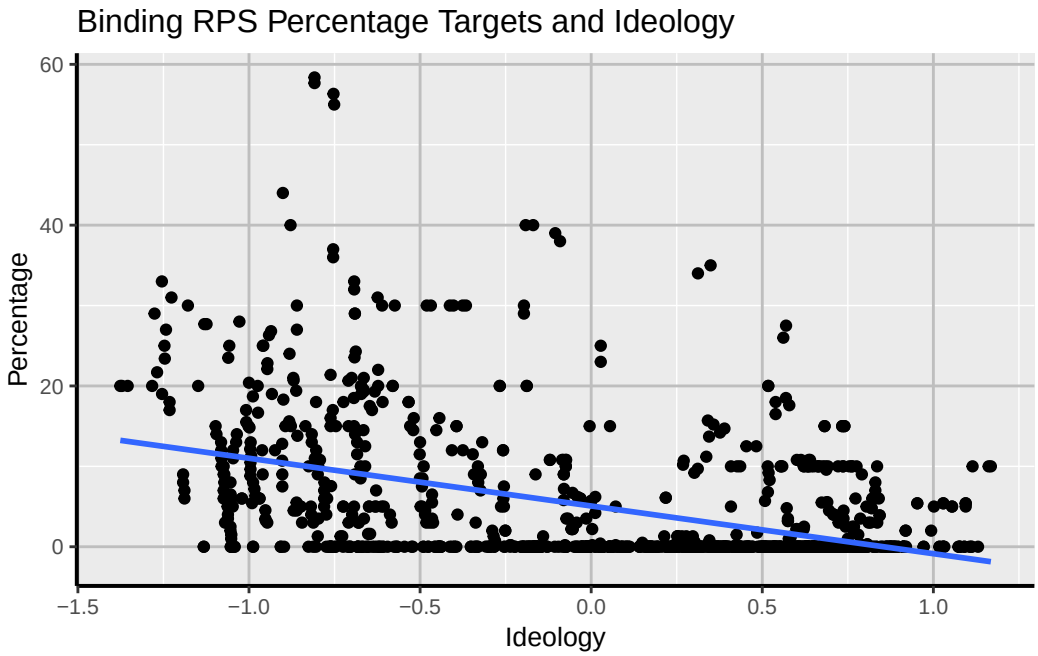



```
ggplot(data = panel, aes(x = Ideology, y = x_rps_targets_bindingonly)) +
  geom_point() + geom_smooth(method = lm, se = FALSE) + labs(x="Ideology", y="Percentage",
```

```
`geom_smooth()` using formula = 'y ~ x'
```

```
Warning: Removed 17 rows containing non-finite values (`stat_smooth()`).
```

```
Warning: Removed 17 rows containing missing values (`geom_point()`).
```

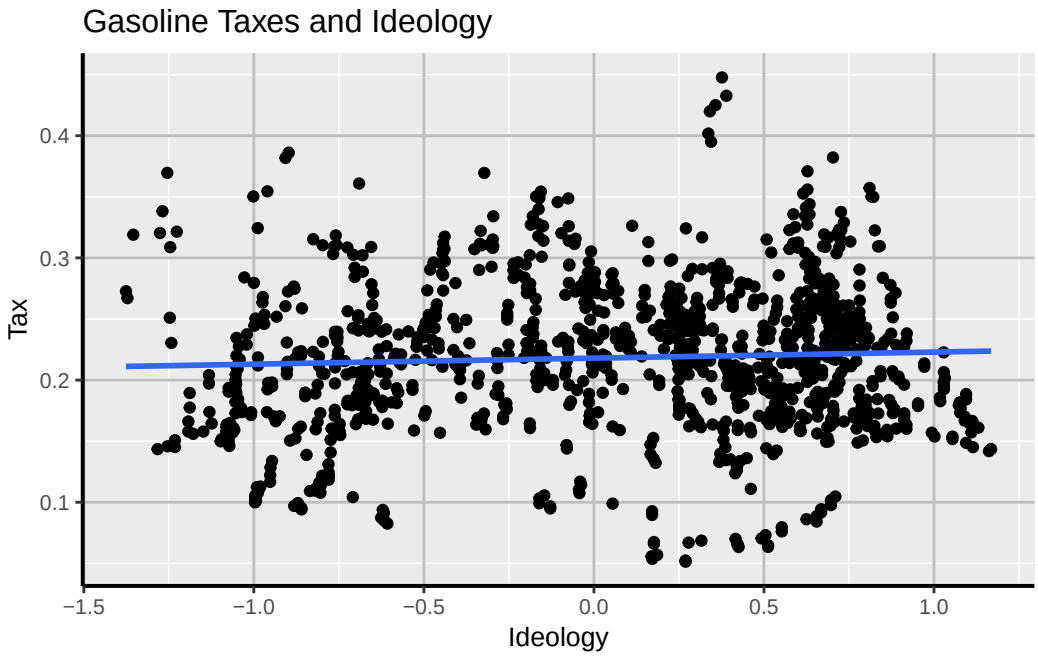



```
ggplot(data = panel, aes(x = Ideology, y = z_gasoline_tax)) +
  geom_point() + geom_smooth(method = lm, se = FALSE) + labs(x="Ideology", y="Tax",title =
```

```
`geom_smooth()` using formula = 'y ~ x'
```

```
Warning: Removed 19 rows containing non-finite values (`stat_smooth()`).
```

```
Warning: Removed 19 rows containing missing values (`geom_point()`).
```

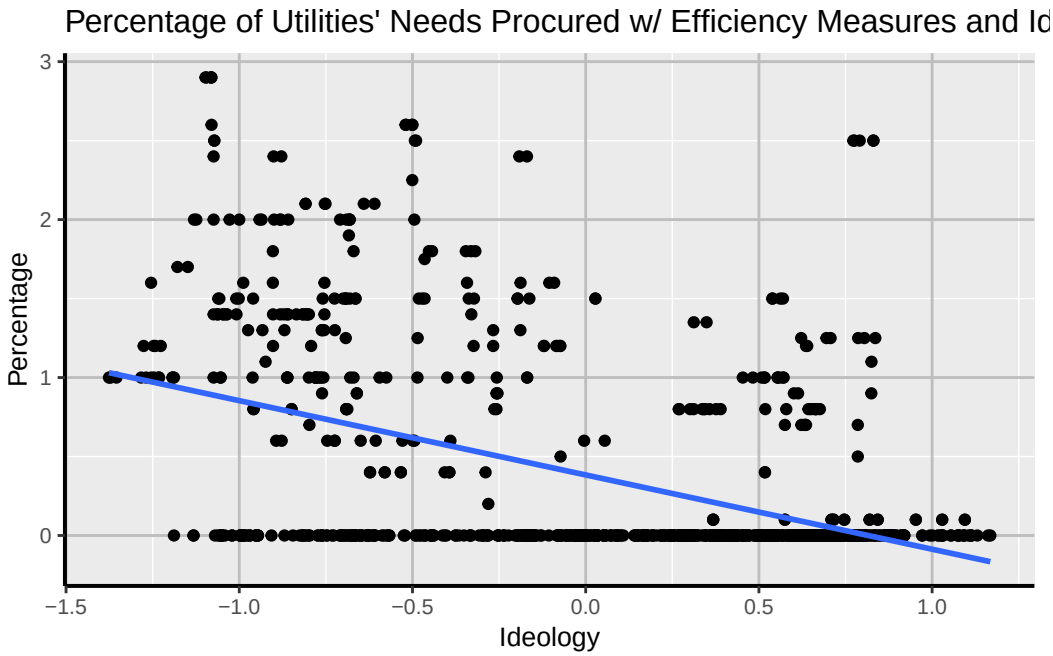



```
ggplot(data = panel, aes(x = Ideology, y = x_eers)) +
  geom_point() + geom_smooth(method = lm, se = FALSE) + labs(x="Ideology", y="Percentage",
```

```
`geom_smooth()` using formula = 'y ~ x'
```

```
Warning: Removed 115 rows containing non-finite values (`stat_smooth()`).
```

```
Warning: Removed 115 rows containing missing values (`geom_point()`).
```

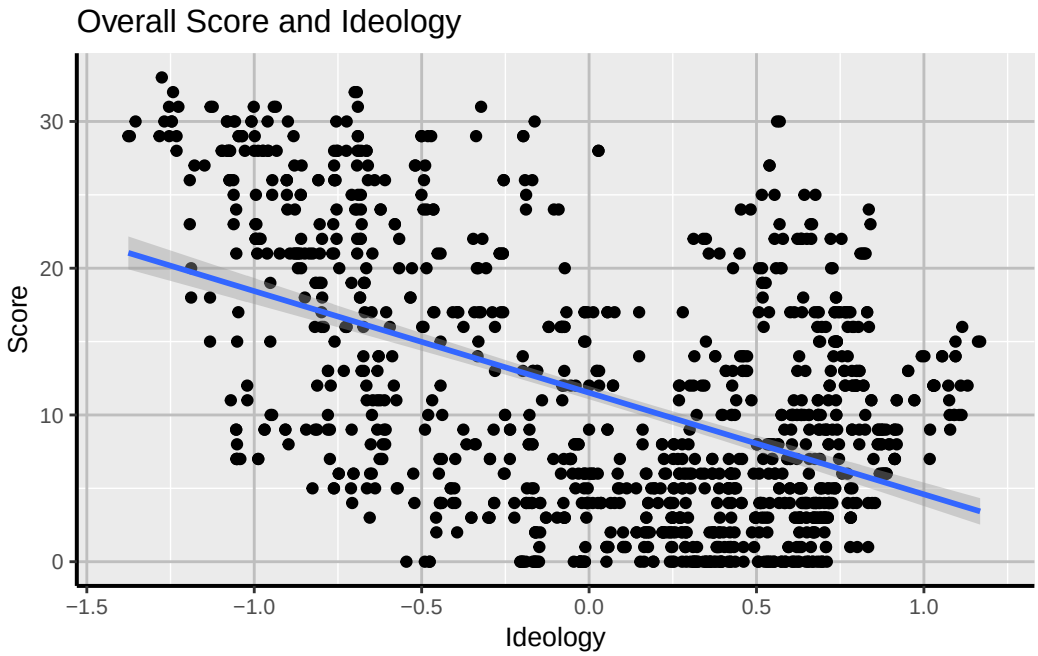



```
ggplot(data = panel, aes(x=Ideology, y=Score)) + geom_point() + geom_smooth(method = "lm",
```

```
`geom_smooth()` using formula = 'y ~ x'
```

```
Warning: Removed 16 rows containing non-finite values (`stat_smooth()`).
```

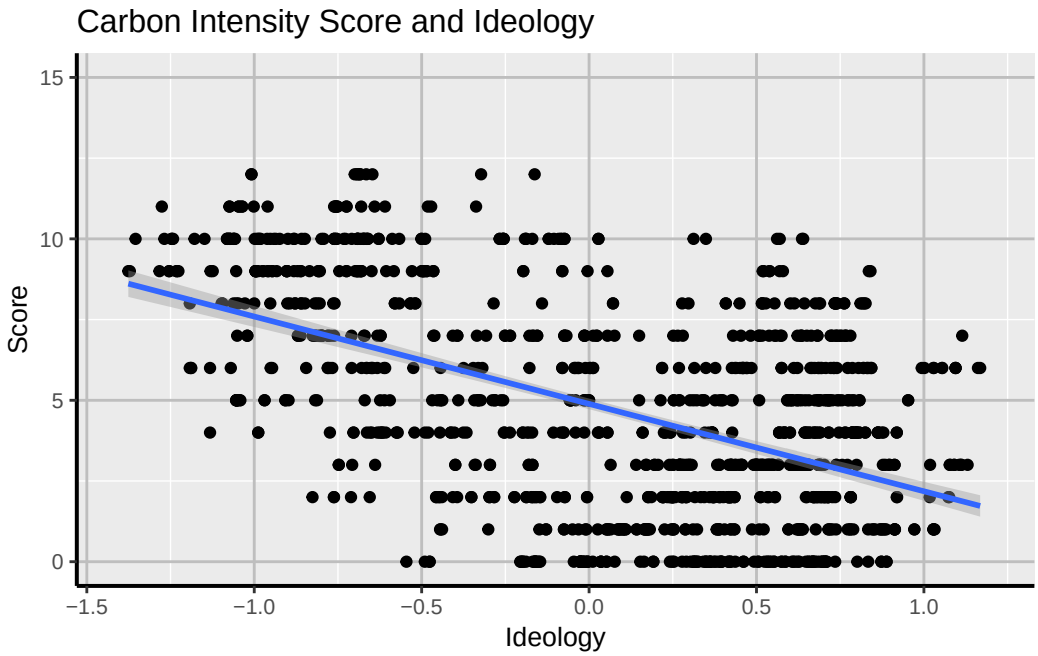
```
Warning: Removed 16 rows containing missing values (`geom_point()`).
```




```
ggplot(data = panel, aes(x=Ideology, y=CI_Score)) + geom_point() + geom_smooth(method = "l
```

```
`geom_smooth()` using formula = 'y ~ x'
```

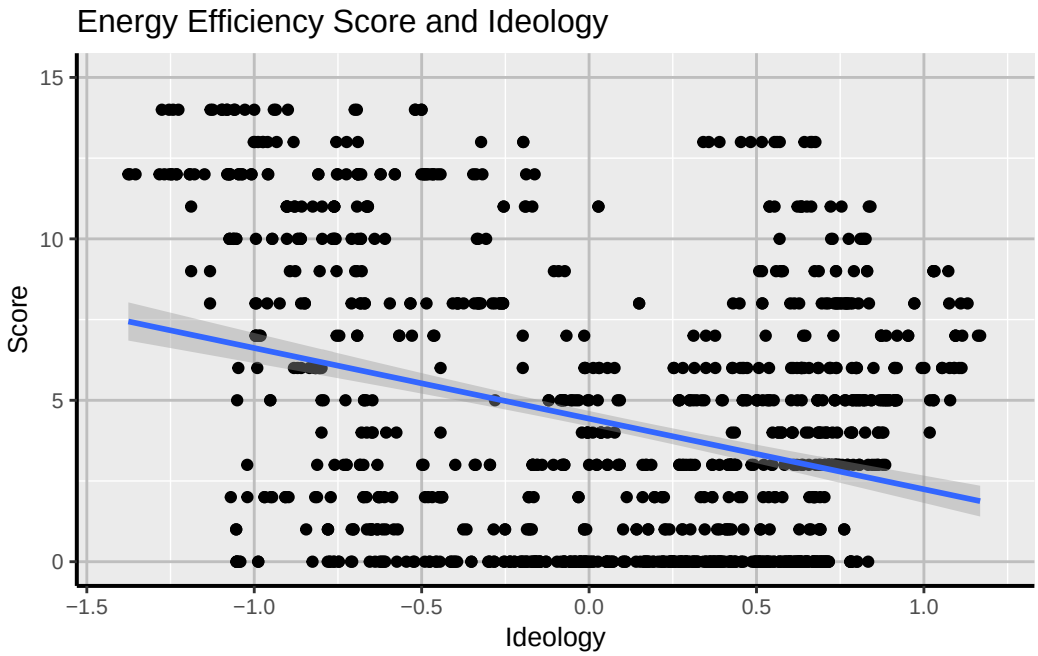
```
Warning: Removed 16 rows containing non-finite values (`stat_smooth()`).
Removed 16 rows containing missing values (`geom_point()`).
```




```
ggplot(data = panel, aes(x=Ideology, y=EE_Score)) + geom_point() + geom_smooth(method = "l
```

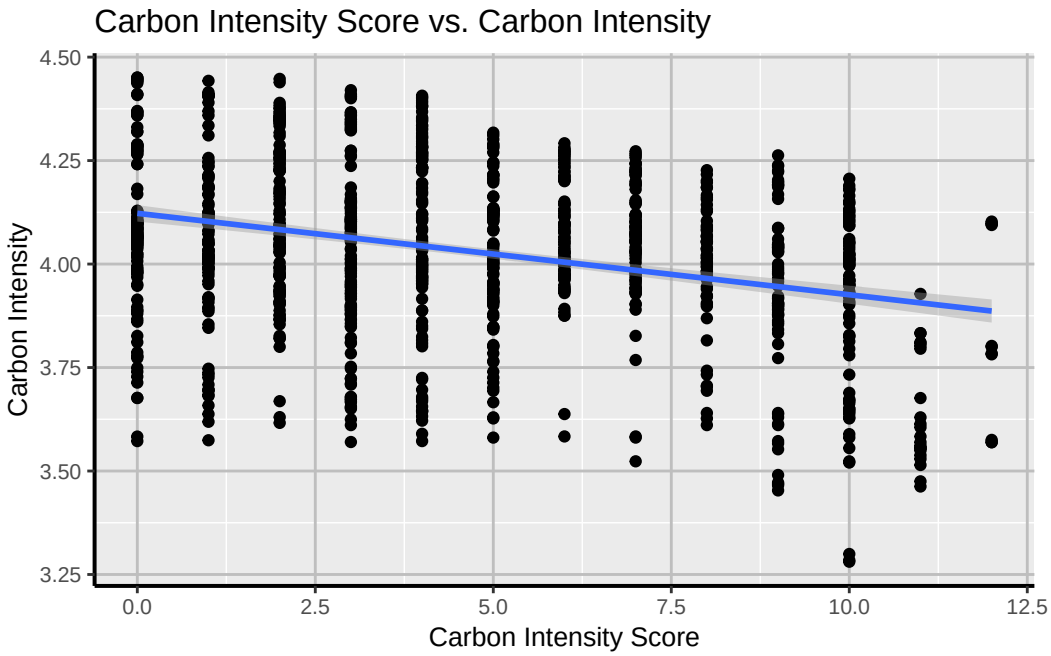
```
`geom_smooth()` using formula = 'y ~ x'
```

```
Warning: Removed 16 rows containing non-finite values (`stat_smooth()`).
Removed 16 rows containing missing values (`geom_point()`).
```



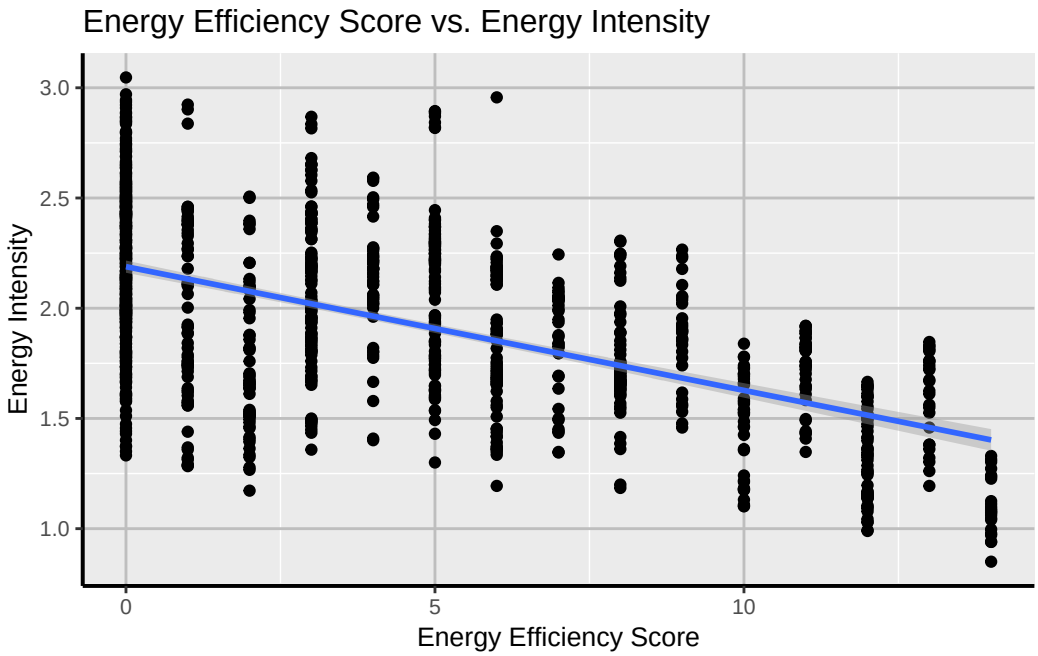

```
ggplot(data = panel, aes(x=CI_Score, y=log(CarbonIntensity))) + geom_point() + geom_smooth
```

```
`geom_smooth()` using formula = 'y ~ x'
```



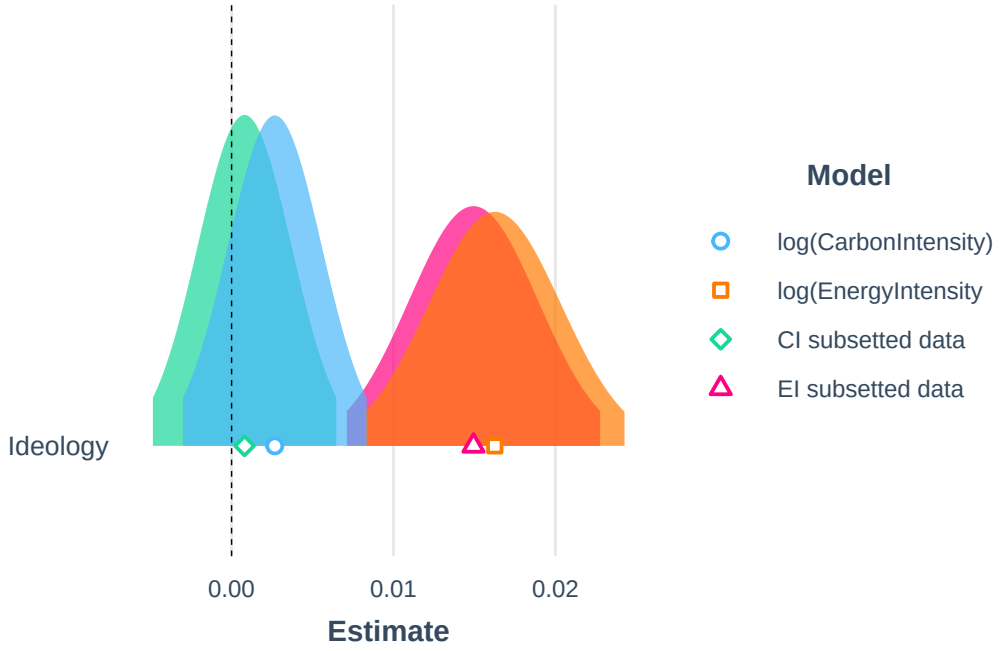

```
ggplot(data = panel, aes(x=EE_Score, y=log(EnergyIntensity))) + geom_point() + geom_smooth
```

```
`geom_smooth()` using formula = 'y ~ x'
```



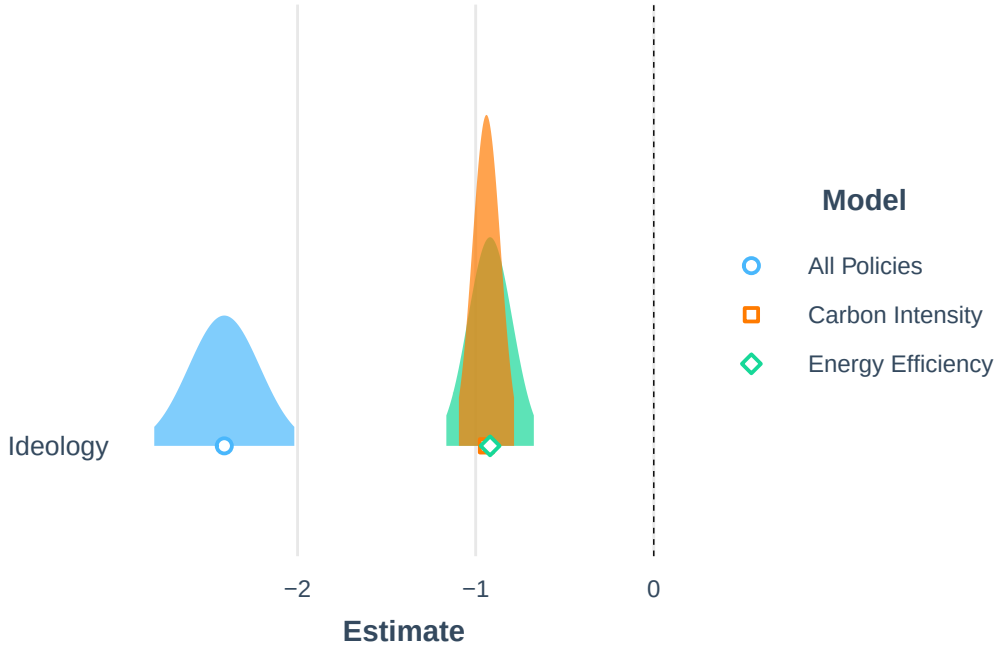

```
plot_summs(m1,m2,m3,m4,model.names = c("log(CarbonIntensity)", "log(EnergyIntensity", "CI
```

```
Registered S3 methods overwritten by 'broom':
  method            from
  tidy.glht         jtools
  tidy.summary.glht jtools
Loading required namespace: broom.mixed
Loading required namespace: broom.mixed
Loading required namespace: broom.mixed
Loading required namespace: broom.mixed
```




```
plot_summs(m9,m10,m11,model.names = c("All Policies", "Carbon Intensity", "Energy Efficien
```

```
Loading required namespace: broom.mixed
Loading required namespace: broom.mixed
Loading required namespace: broom.mixed
```




```
export_summs(m1, m2, m3, m4, model.names = c("log(CarbonIntensity)", "log(EnergyIntensity"
```

nergyIntensity	CI subsetted data	EI subsetted data
0.02 ***	0.00	
[0.01, 0.03]	[-0.01, 0.01]	
1134	1026	
0.98	0.97	

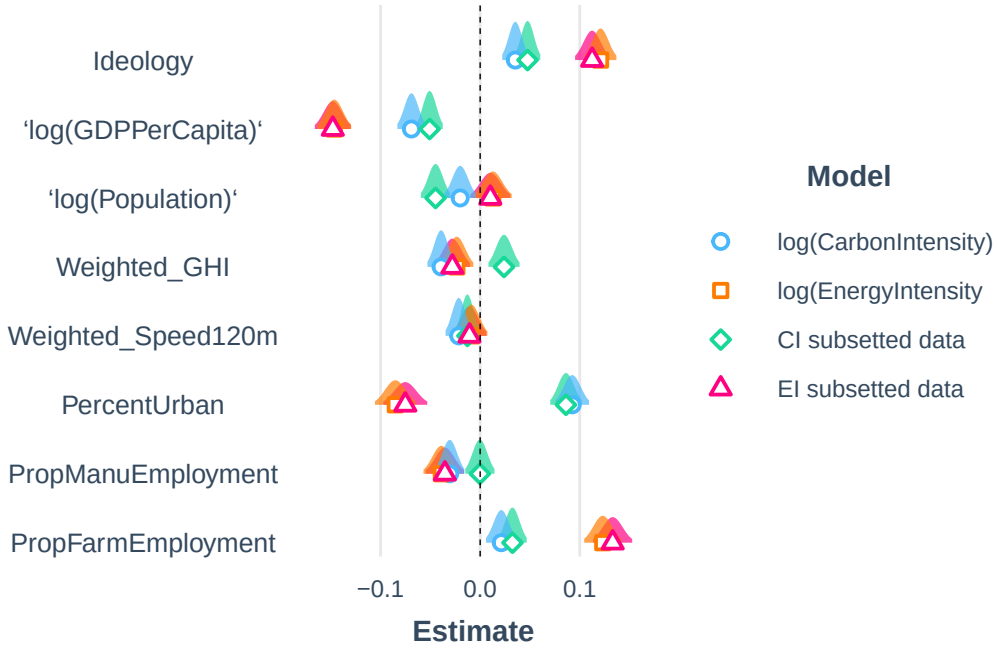
d and scaled by 1 standard deviation. The outcome variable is in its original units. Standard errors are heteroskedasticity robus

```
export_summs(m5,m6,m7,m8, model.names = c("log(CarbonIntensity)", "log(EnergyIntensity", "
             robust = "HC3", to.file = "pdf", scale = TRUE, error_format = "[{conf.low}, {
```

```
plot_summs(m5,m6,m7,m8,model.names = c("log(CarbonIntensity)", "log(EnergyIntensity", "CI
```

```
Loading required namespace: broom.mixed
Loading required namespace: broom.mixed
Loading required namespace: broom.mixed
```

```
Loading required namespace: broom.mixed
```




```
export_summs(m9,m10,m11,model.names = c("All Policies", "Carbon Intensity", "Energy Effici
```

nsity)	log(EnergyIntensity	CI subsetted data	EI subsetted data
2 ***	1.94 ***	4.04 ***	
3]	[1.92, 1.95]	[4.03, 4.05]	
4 ***	0.12 ***	0.05 ***	
5]	[0.11, 0.14]	[0.03, 0.06]	
7 ***	-0.15 ***	-0.05 ***	
5]	[-0.17, -0.13]	[-0.07, -0.04]	
2 **	0.01	-0.04 ***	
1]	[-0.01, 0.03]	[-0.05, -0.03]	
4 ***	-0.02 ***	0.02 **	
2]	[-0.03, -0.01]	[0.00, 0.03]	
2 ***	-0.01	-0.01 ***	
1]	[-0.02, 0.00]	[-0.02, -0.01]	
9 ***	-0.09 ***	0.09 ***	
1]	[-0.10, -0.07]	[0.07, 0.11]	
3 ***	-0.04 ***	-0.00	
2]	[-0.06, -0.02]	[-0.01, 0.01]	
2 **	0.12 ***	0.03 ***	
4]	[0.10, 0.14]	[0.02, 0.05]	
	1088	990	
9	0.69	0.22	

d and scaled by 1 standard deviation. The outcome variable is in its original units. Standard errors are heteroskedasticity robus

tensity	Energy Efficiency
94 ***	
76]	
89	

d and scaled by 1 standard deviation. The outcome variable is in its original units. Standard errors are heteroskedasticity robus