Assignment 1

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Problem 1

Loading packages:

```
library(dplyr)
library(ggplot2)
library(tidyr)
library(broom)
library(knitr)
```

A. Read in democracy using the readr function read_csv. I need to use the argument na="." because missing values are recorded as "."

```
democracy <- read.csv(file = "democracy.csv", stringsAsFactors = FALSE,
                      na.strings = ".")
```

B.

```
democracy_by_variable <-
  democracy %>%
  gather(variable, value, -COUNTRY, -CTYNAME, -REGION, -YEAR)

dem_summary_stats <-
  democracy_by_variable %>%
  group_by(variable) %>%
  summarise(min = min(value, na.rm = TRUE),
            mean = mean(value, na.rm = TRUE),
            sd = sd(value, na.rm = TRUE),
            max = max(value, na.rm =TRUE))
```

```
kable(dem_summary_stats)
```

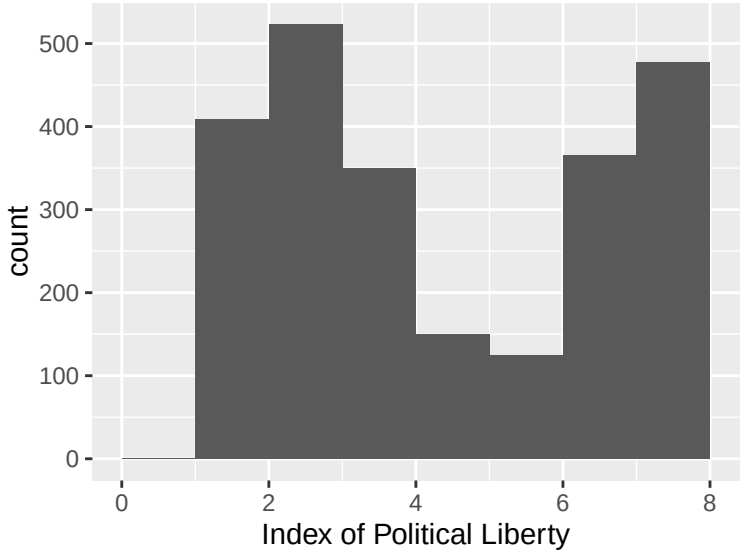
variable	min	mean	sd	max
BRITCOL	0.00	0.2433349	0.4291476	1.00
CATH	0.00	37.1991275	38.2807940	99.00
CIVLIB	1.00	4.0762818	1.9732405	7.00
EDT	0.03	4.8533925	3.1173053	12.81
ELF60	0.00	0.3994587	0.2965374	0.93
GDPW	480.00	8876.9592826	8016.9287248	37903.00
MOSLEM	0.00	19.7358943	34.0430019	99.90
NEWC	0.00	0.4561318	0.4981322	1.00
OIL	0.00	0.1000969	0.3001656	1.00

variable	min	mean	sd	max
POLLIB	1.00	3.8595248	2.2326768	7.00
REG	0.00	0.3986912	0.4896883	1.00
STRA	0.00	0.3751818	0.6979135	5.00

D. To plot a histogram with each value of POLLIB in its own bin, either adjust the binwidth parameter of geom_histogram or turn POLLIB into a factor.

```
ggplot(democracy, aes(x = POLLIB)) +
  geom_histogram(binwidth = 1) +
  xlab("Index of Political Liberty")
```

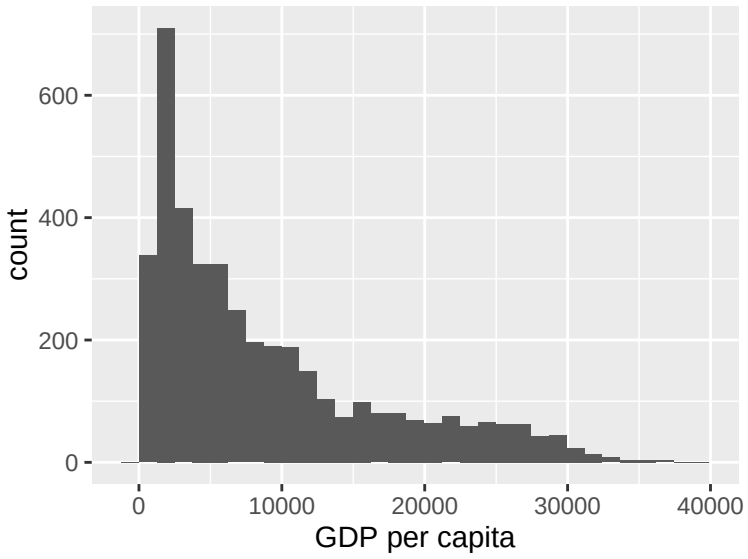
```
## Warning: Removed 1727 rows containing non-finite values (stat_bin).
```



E. A histogram of GDP per capita is

```
ggplot(democracy, aes(x = GDPW)) +
  geom_histogram() +
  xlab("GDP per capita")
```

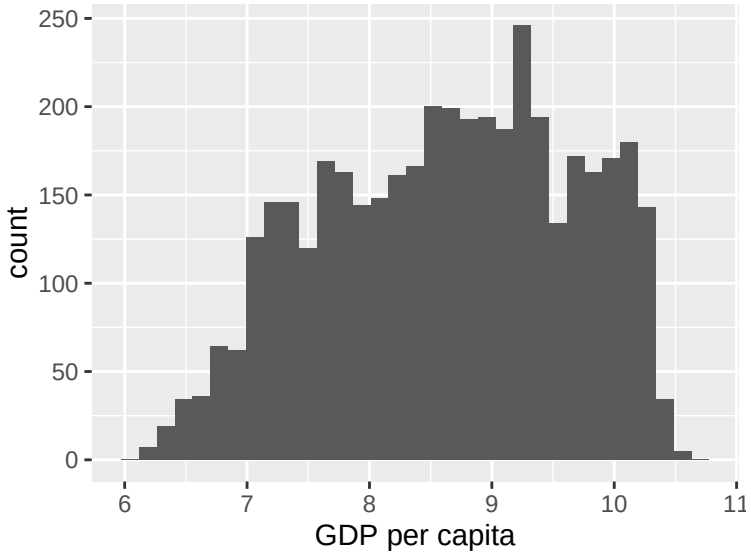
```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



F. A histogram of log GDP per capita is

```
ggplot(democracy, aes(x = log(GDPW))) +
  geom_histogram() +
  xlab("GDP per capita")
```

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

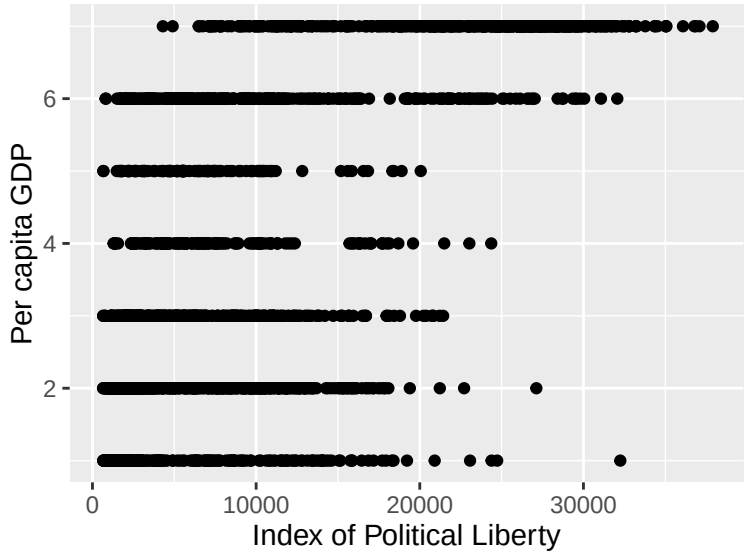


G. Create a scatterplot of political liberties against GDP per capita

```
ggplot(democracy, aes(x = GDPW, y = POLLIB)) +
  geom_point() +
```

```
  ylab("Per capita GDP") +
  xlab("Index of Political Liberty")
```

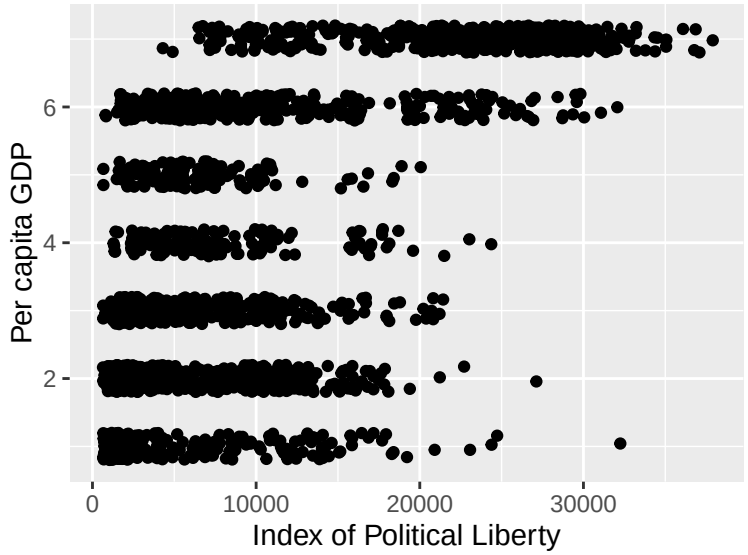
```
## Warning: Removed 1727 rows containing missing values (geom_point).
```



Create the same scatterplot while jittering the points

```
ggplot(democracy, aes(x = GDPW, y = POLLIB)) +
  geom_jitter(height = 0.5) +
  scale_y_continuous("Per capita GDP") +
  scale_x_continuous("Index of Political Liberty")
```

```
## Warning: Removed 1727 rows containing missing values (geom_point).
```



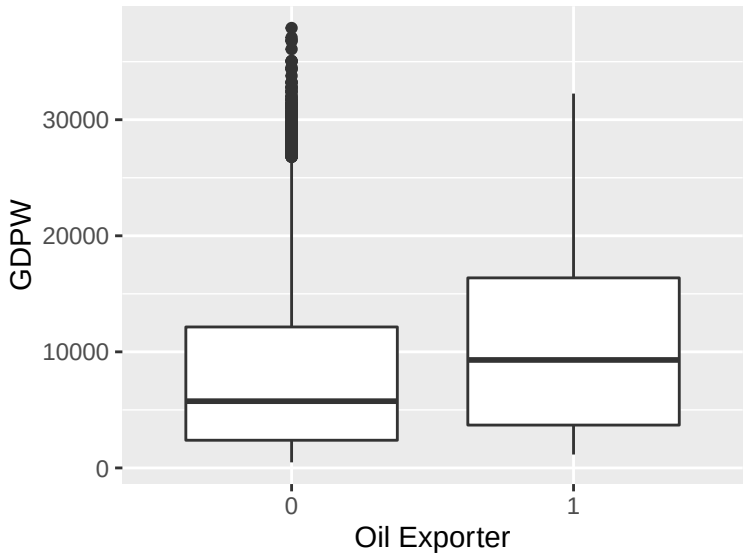
I. Create a scatterplot of political liberties against log GDP per capita

```
ggplot(democracy, aes(x = log(GDPW), y = POLLIB)) +
  geom_jitter(height = 0.5) +
  scale_y_continuous("Per capita GDP") +
  scale_x_continuous("Index of Political Liberty")
```

```
## Warning: Removed 1727 rows containing missing values (geom_point).
```

J. A boxplot of GDP per capita for oil producing and non-oil producing nations is

```
ggplot(democracy, aes(x = factor(OIL), y = GDPW)) +
  geom_boxplot() +
  scale_x_discrete("Oil Exporter")
```



K. The average GDP per captical of countries at least 40% Catholic countries was 1.2 times higher than those which were less than 40% Catholic.

```
catholic_gdpw <- filter(democracy, CATH > 40)$GDPW %>% mean(na.rm = TRUE)
catholic_gdpw
```

```
## [1] 10295.13
```

```
all_gdpw <- mean(democracy$GDPW, na.rm = FALSE)
all_gdpw
```

```
## [1] 8876.959
```

```
catholic_gdpw / all_gdpw
```

```
## [1] 1.159758
```

L. The GDP per capita in countries with greater than 60% ethnolinguistic fractionalization, less than 60%, and missing ethnolinguistic fractionalization is shown in the following table:

```
elf_summary <- democracy %>%
  mutate(high_elf60 = ELF60 > 0.6) %>%
  group_by(high_elf60) %>%
  summarise(gdpw_mean = mean(GDPW))
kable(elf_summary)
```

high_elf60	gdpw_mean
FALSE	11803.780
TRUE	3590.939
NA	7767.245

M. The median years of education for all countries by year:

```
ed_year <- democracy %>%
  group_by(YEAR) %>%
  summarize(ed_mean = median(EDT, na.rm = TRUE))
```

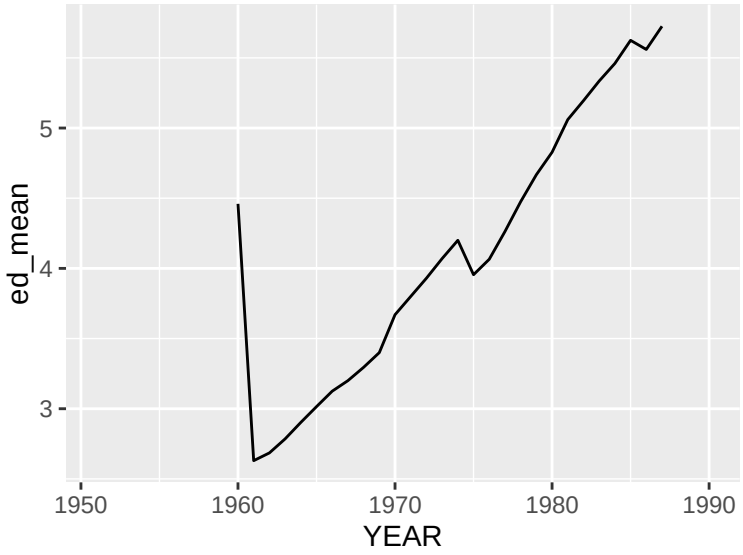
```
kable(ed_year)
```

YEAR	ed_mean
1951	NA
1952	NA
1953	NA
1954	NA
1955	NA
1956	NA
1957	NA
1958	NA
1959	NA
1960	4.4600
1961	2.6300
1962	2.6850
1963	2.7850
1964	2.9025
1965	3.0150
1966	3.1250
1967	3.2000
1968	3.2950
1969	3.4000
1970	3.6700
1971	3.8000
1972	3.9300
1973	4.0700
1974	4.2000
1975	3.9550
1976	4.0650
1977	4.2625
1978	4.4750
1979	4.6675
1980	4.8275
1981	5.0600
1982	5.1950
1983	5.3350
1984	5.4600
1985	5.6250
1986	5.5600

YEAR	ed_mean
1987	5.7250
1988	NA
1989	NA
1990	NA

```
ggplot(ed_year, aes(x = YEAR, y = ed_mean)) +
  geom_line()
```

```
## Warning: Removed 12 rows containing missing values (geom_path).
```

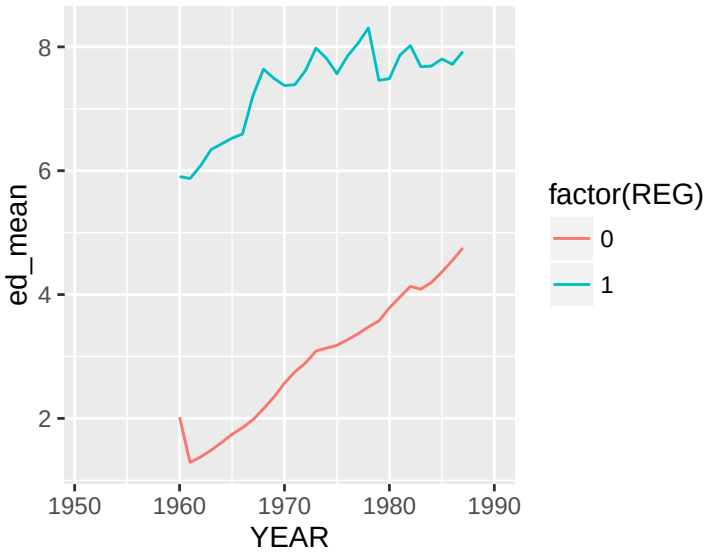


O.

```
ed_year_dem <- democracy %>%
  group_by(YEAR, REG) %>%
  summarize(ed_mean = median(EDT, na.rm = TRUE))
```

```
ggplot(ed_year_dem, aes(x = YEAR, y = ed_mean, col = factor(REG))) +
  geom_line()
```

```
## Warning: Removed 24 rows containing missing values (geom_path).
```



N. Venezuela was the country closest (in this case, equal) to the median of the average years of education in 1985.

```
democracy %>%
  filter(YEAR == 1985, ! is.na(EDT)) %>%
  mutate(med_edt_diff = abs(EDT - median(EDT))) %>%
  filter(med_edt_diff == min(med_edt_diff)) %>%
  select(CTYNAME, EDT)
```

```
##     CTYNAME   EDT
## 1 Venezuela 5.625
```

Q. The 25th and 75th percentiles of the ethnolinguist fractionalization (ELF60) for new and old countries (NEWC) is shown in the table below:

```
dem_elf_tabl <-
democracy %>%
  filter(! is.na(ELF60)) %>%
  mutate(`Country Type` = ifelse(as.logical(NEWC), "new", "old")) %>%
  group_by(`Country Type`) %>%
  summarise(elf60_p25 = quantile(ELF60, probs = 0.25),
            elf60_p75 = quantile(ELF60, probs = 0.75))
kable(dem_elf_tabl)
```

Country Type	elf60_p25	elf60_p75
new	0.42	0.75
old	0.06	0.44

Problem 2

```
data("anscombe")
anscombe2 <- anscombe %>%
    mutate(obs = row_number()) %>%
    gather(variable_dataset, value, - obs) %>%
    separate(variable_dataset, c("variable", "dataset"), sep = 1L) %>%
    spread(variable, value) %>%
    arrange(dataset, obs)
```

A.

```
results1 <- anscombe2 %>%
  group_by(dataset) %>%
  summarize(mean_x = mean(x, na.rm = TRUE),
            sd_x = sd(x, na.rm = TRUE),
            mean_y = mean(y, na.rm = TRUE),
            sd_y = sd(y, na.rm = TRUE),
            cor_xy = cor(x,y))
results2 <- anscombe2 %>%
  group_by(dataset) %>%
  do(tidy(lm(y ~ x, data = .))) %>%
  filter(term == "x") %>%
  dplyr::select(estimate, std.error)
all_results <- left_join(results1, results2)
```

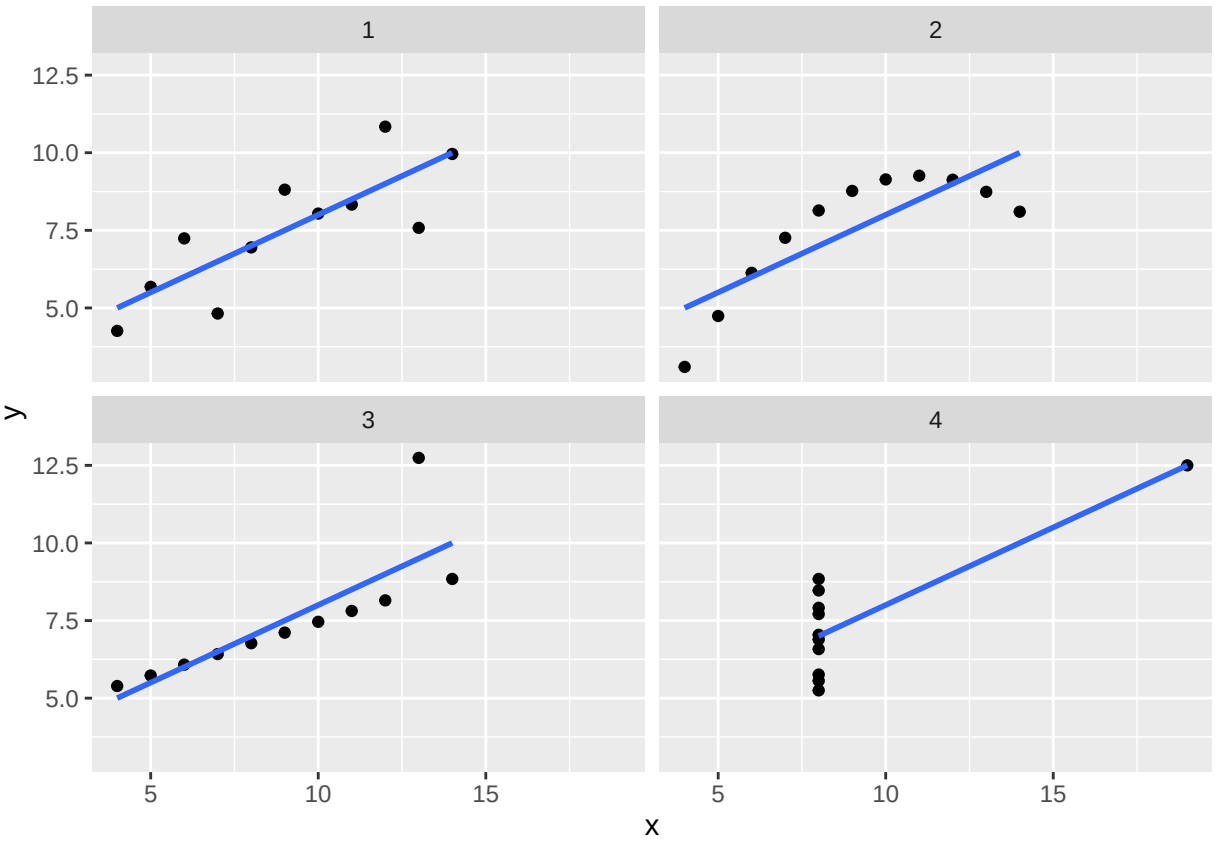
```
## Joining by: "dataset"
```

```
kable(all_results)
```

dataset	mean_x	sd_x	mean_y	sd_y	cor_xy	estimate	std.error
1	9	3.316625	7.500909	2.031568	0.8164205	0.5000909	0.1179055
2	9	3.316625	7.500909	2.031657	0.8162365	0.5000000	0.1179637
3	9	3.316625	7.500000	2.030424	0.8162867	0.4997273	0.1178777
4	9	3.316625	7.500909	2.030578	0.8165214	0.4999091	0.1178189

B.

```
ggplot(anscombe2, aes(x = x, y = y)) +
  geom_point() +
  geom_smooth(method = "lm", se = FALSE) +
  facet_wrap(~ dataset)
```



Problem 3

Load the data into R from the csv file:

```
sprinters <- read.csv("sprinters.csv")
```

A. The referenced paper only used data from the Olympics 2004 and before. Create a new dataset named sprinters_orig with only those observations.

```
sprinters_orig <-
  filter(sprinters,
         year <= 2004,
         olympics == 1)
```

B. Run the regressions

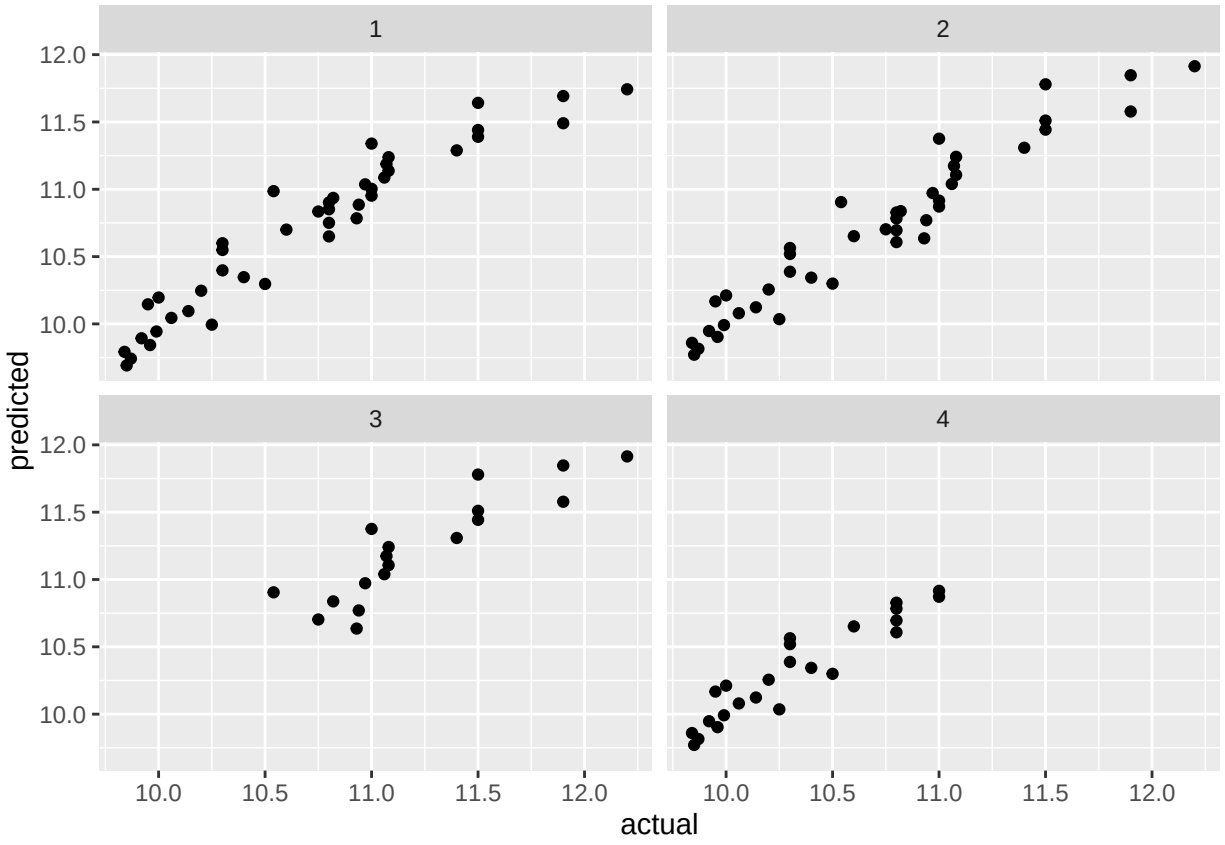
```
library("dplyr")
mod1 <- lm(time ~ year + women, data = sprinters_orig)
mod2 <- lm(time ~ year * women, data = sprinters_orig)
mod3 <- lm(time ~ year, data = filter(sprinters_orig, women == 1))
```

```
mod4 <- lm(time ~ year, data = filter(sprinters_orig, women == 0))
models_list <- list(mod1, mod2, mod3, mod4)
```

C.

```
models_data <- NULL
for (i in 1:length(models_list)) {
  mod <- i
  model <- models_list[[i]]
  data <- models_list[[i]]$model
  augmented_data <- augment(model, data)
  actual_values <- augmented_data$time
  predicted_values <- augmented_data$.fitted
  res <- data.frame(actual = actual_values,
                    predicted = predicted_values,
                    model = mod)
  models_data <- rbind(models_data, res)
}
```

```
ggplot(models_data, aes(x = actual, y = predicted)) +
  geom_point() +
  facet_wrap(~ model)
```



```
models_data <- mutate(models_data, resid = actual - predicted)
models_data <- mutate(models_data, sq_resid = resid^2)
models_data %>%
  group_by(model) %>%
  summarise(rmse = sqrt(mean(sq_resid))) %>%
  filter(model == 2)
```

```
## Source: local data frame [1 x 2]
##
##   model      rmse
##   (int)     (dbl)
## 1     2 0.1624051
```

```
newdata <-
  filter(sprinters,
         year >= 2004)
models_data2 <- data.frame(
  actual = newdata$time,
  predicted = predict(mod2, newdata = newdata))
models_data2 <- mutate(models_data2, resid = actual - predicted)
models_data2 <- mutate(models_data2, sq_resid = resid^2)
models_data2 %>%
  summarise(rmse = sqrt(mean(sq_resid)))
```

```
##        rmse
## 1 0.2274526
```