Problem Set 2

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```
knitr::opts_chunk$set(
  echo = TRUE,
  eval = TRUE,
  fig.align = 'center',
  message = FALSE,
  warning = FALSE)

# load packages
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.4     v readr     2.1.5
## 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     1.3.0
## 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 become errors
```

1. https://github.com/kelliehaddon/PSet2
2. See script below.

```
library(tidyverse)

# open my data
gspace = read_csv('greenspace_data_share.csv') # added quotes around the file name

# summarize average urban greenspace by region
table =
  gspace |>
  group_by(Major_Geo_Region) |> # missing pipe
  summarize(
    obs = n(), # missing comma
    avg = mean(annual_avg_2020), # missing underscore between avg_2020
    weighted_avg = mean(annual_weight_avg_2020) # missing underscore between weighted_avg
  )

# output as table
knitr::kable(table, digits = 1) # added library knitr to access kable function and changed object from
```

Major_Geo_Region	obs	avg	weighted_avg
Africa	154	0.3	0.2
Asia	569	0.3	0.3
Europe	128	0.3	0.3
Latin America and the Caribbean	120	0.3	0.3
Northern America	58	0.3	0.3
Oceania	9	0.3	0.3

3. The greenspace data covers 1,038 urban areas.

```
count(gspace)
```

```
## # A tibble: 1 x 1
##       n
##   <int>
## 1  1038
```

4.

```
# code
```

5. a. 62 urban areas scored `High` or above for greenspace in 2015.

```
high2015 = filter(gspace, indicator_2015 == 'High')
count(high2015)
```

```
## # A tibble: 1 x 1
##       n
##   <int>
## 1    62
```

b. 240 urban areas scored `Exceptionally Low` at any point in the years covered.

```
exlow = filter(gspace,
               indicator_2010 == 'Exceptionally Low' |
                 indicator_2015 == 'Exceptionally Low' |
                 indicator_2020 == 'Exceptionally Low' |
                 indicator_2021 == 'Exceptionally Low')
count(exlow)
```

```
## # A tibble: 1 x 1
##       n
##   <int>
## 1   240
```

c. 225 urban areas in arid climate became greener from 2010 to 2020.

```
less_arid = filter(gspace,
              Climate_region == "Arid" &
                annual_weight_avg_2010 < annual_weight_avg_2020)
count(less_arid)
```

```
## # A tibble: 1 x 1
##       n
##   <int>
## 1   225
```

6. 128 urban areas became less green from 2010 to 2021. These observations were not concentrated in a particular geographic or climate region. The top geographic and climate regions only exceeded the second most common geographic and climate regions by about 10 urban areas. Europe had the most urban areas fitting this criteria at 47, followed by Asia at 35 and Africa at 25. The country with the most urban areas fitting this criteria was Russia at 13 followed by the United States and India, both at 8. Temperate climates were the most popular among these areas at 45, followed by continental climates at 36.

```
less_green = filter(gspace, annual_avg_2010 > annual_avg_2021)
count(less_green)
```

```
## # A tibble: 1 x 1
##       n
##   <int>
## 1   128
```

```
count(less_green, Major_Geo_Region)
```

```
## # A tibble: 5 x 2
##   Major_Geo_Region                    n
##   <chr>                           <int>
## 1 Africa                             25
## 2 Asia                               35
## 3 Europe                             47
## 4 Latin America and the Caribbean    12
## 5 Northern America                    9
```

```
print(n = 120, count(less_green, Country))
```

```
## # A tibble: 56 x 2
##    Country                          n
##    <chr>                        <int>
##  1 Afghanistan                      1
##  2 Angola                           3
##  3 Argentina                        3
##  4 Austria                          1
##  5 Bangladesh                       3
##  6 Belarus                          1
##  7 Bhutan                           1
##  8 Bolivia                          1
```

```
##  9 Brazil                              4
## 10 Cameroon                            1
## 11 Canada                              1
## 12 Chile                               2
## 13 China                               4
## 14 Comoros                             1
## 15 Cote d'Ivoire                       1
## 16 Democratic Republic of the Congo    3
## 17 Denmark                             1
## 18 Estonia                             1
## 19 Ethiopia                            1
## 20 Finland                             1
## 21 France                              2
## 22 Germany                             7
## 23 Ghana                               1
## 24 Guinea-Bissau                       1
## 25 Iceland                             1
## 26 India                               8
## 27 Indonesia                           5
## 28 Islamic Republic of Iran            3
## 29 Kyrgyzstan                          1
## 30 Latvia                              1
## 31 Lithuania                           1
## 32 Macedonia                           1
## 33 Mauritius                           1
## 34 Mexico                              1
## 35 Moldova                             1
## 36 Mozambique                          1
## 37 Namibia                             1
## 38 Nepal                               1
## 39 Netherlands                         1
## 40 Nigeria                             6
## 41 Norway                              1
## 42 Paraguay                            1
## 43 Poland                              4
## 44 Russian Federation                 13
## 45 Sweden                              1
## 46 Tajikistan                          1
## 47 Thailand                            1
## 48 Timor-Leste                         1
## 49 Turkey                              1
## 50 Uganda                              1
## 51 Ukraine                             3
## 52 United Kingdom                      5
## 53 United Republic of Tanzania         1
## 54 United States of America            8
## 55 Uzbekistan                          4
## 56 Zambia                              2
```

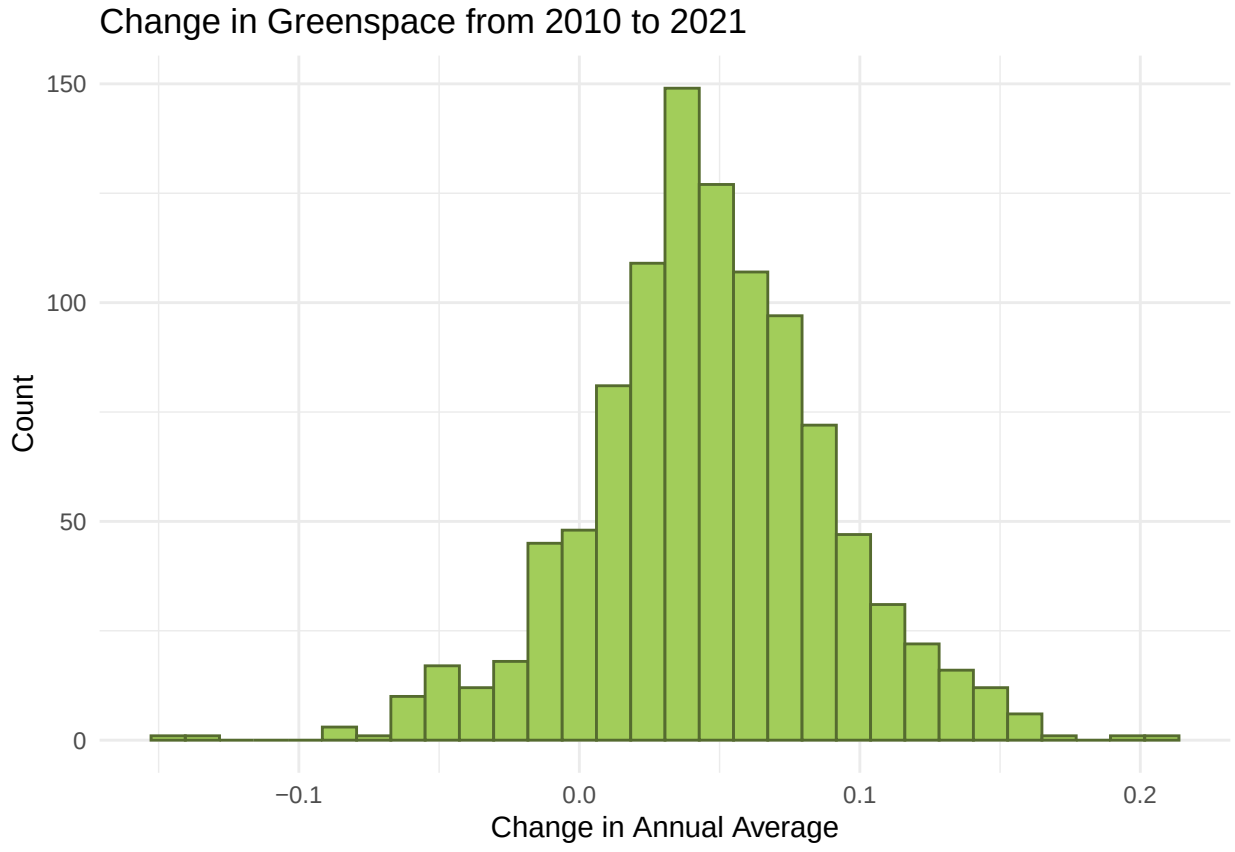
```
count(less_green, Climate_region)
```

```
## # A tibble: 5 x 2
##   Climate_region     n
##   <chr>          <int>
```

```
## 1 Arid              12
## 2 Continental       36
## 3 Polar              1
## 4 Temperate         45
## 5 Tropical          34
```

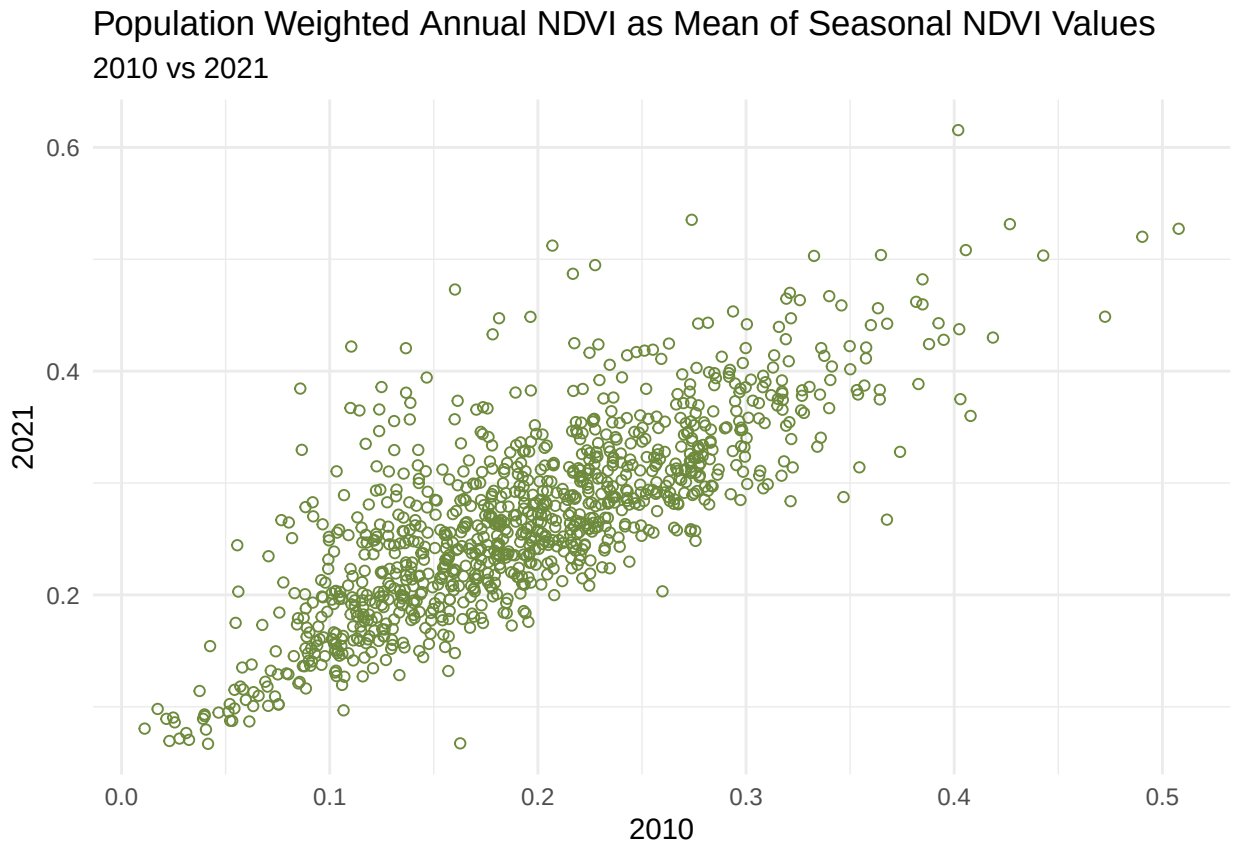
7. See figure below.

```
gspace = mutate(gspace,
                change = annual_avg_2021 - annual_avg_2010)


change_plot = ggplot(gspace) +
  geom_histogram(aes(change),
                 fill = 'darkolivegreen3',
                 color = 'darkolivegreen') +
  labs(x = 'Change in Annual Average',
       y = 'Count',
       title = 'Change in Greenspace from 2010 to 2021') +
  theme_minimal()

print(change_plot)
```



8. See figure below.

```
scatter = ggplot(gspace)+
  geom_point(aes(x = annual_weight_avg_2010,
                 y = annual_weight_avg_2021),
             color = 'darkolivegreen4',
             shape = 1) +
  labs(x = '2010',
       y = '2021',
       title = 'Population Weighted Annual NDVI as Mean of Seasonal NDVI Values',
       subtitle = '2010 vs 2021') +
  theme_minimal()

print(scatter)
```



BONUS OPPORTUNITY: See figure below.

```
gspace = mutate(gspace,
                change3 = annual_weight_avg_2021 - annual_weight_avg_2010)

gspace<-mutate(gspace,
                change4=case_when(
                  between(change3,0,1) ~ 'Added_Greenspace',
                  between(change3,-1,0) ~ 'Lost_Greenspace'))

scatterec = ggplot(gspace)+
  geom_point(aes(x = annual_weight_avg_2010,
```

```
                y = annual_weight_avg_2021,
                color = change4),
            shape = 1) +
  labs(x = '2010',
       y = '2021',
       title = 'Population Weighted Annual NDVI as Mean of Seasonal NDVI Values',
       subtitle = '2010 vs 2021') +
  guides(color = guide_legend(title = '')) +
  geom_abline(intercept = 0, slope = 1) +
  scale_color_manual(values = c("darkolivegreen3", "burlywood4", "grey50"),
                     breaks = c("Added_Greenspace", "Lost_Greenspace")) +
  theme_minimal()

print(scatterec)
```