Comprehensive Assessment due Jun 13, 2021 13:54 +03

This comprehensive assessment is available to verified learners only.

Background

The planet's surface temperature is increasing as greenhouse gas emissions increase, and this global warming and carbon cycle disruption is wreaking havoc on natural systems. Living systems that depend on current temperature, weather, currents and carbon balance are jeopardized, and human society will be forced to contend with widespread economic, social, political and environmental damage as the temperature continues to rise. In these exercises, we examine the relationship between global temperature changes, greenhouse gases and human carbon emissions using time series of actual atmospheric and ice core measurements from the National Oceanic and Atmospheric Administration (NOAA) and Carbon Dioxide Information Analysis Center (CDIAC).

Libraries and Data Import

```
library(tidyverse)
library(dslabs)
data(temp_carbon)
data(greenhouse_gases)
data(historic_co2)
```

IMPORTANT: These exercises use **dslabs** datasets that were added in a July 2019 update. Make sure your package is up to date with the command `install.packages("dslabs")`.

Question 1

3/3 points (graded)

Load the `temp_carbon` dataset from **dslabs**, which contains annual global temperature anomalies (difference from 20th century mean temperature in degrees Celsius), temperature anomalies over the land and ocean, and global carbon emissions (in metric tons). Note that the date ranges differ for temperature and carbon emissions.

Which of these code blocks return the latest year for which carbon emissions are reported?

Select ALL correct answers.

- [ ]
```
        temp_carbon %>%
.$year %>%
max()
```

- [x]
```
        temp_carbon %>%
filter(!is.na(carbon_emissions)) %>%
pull(year) %>%
max()
```

- [ ]
```
        temp_carbon %>%
filter(!is.na(carbon_emissions)) %>%
max(year)
```

- [x]
```
        temp_carbon %>%
filter(!is.na(carbon_emissions)) %>%
.$year %>%
max()
```

- [x]
```
        temp_carbon %>%
filter(!is.na(carbon_emissions)) %>%
select(year) %>%
max()
```

- [ ]
```
        temp_carbon %>%
filter(!is.na(carbon_emissions)) %>%
max(.$year)
```

✔

Submit You have used 1 of 2 attempts

Answers are displayed within the problem

Question 2

3/3 points (graded)

Inspect the difference in carbon emissions in `temp_carbon` from the first available year to the last available year.

What is the first year for which carbon emissions (`carbon_emissions`) data are available?

1751 ✔ **Answer:** 1751

1751

Answer Code

```
        temp_carbon %>%
filter(!is.na(carbon_emissions)) %>%
.$year %>%
min()
```

What is the last year for which carbon emissions data are available?

2014 ✔ **Answer:** 2014

2014

Answer Code

```
        temp_carbon %>%
filter(!is.na(carbon_emissions)) %>%
.$year %>%
max()
```

How many times larger were carbon emissions in the last year relative to the first year?

3285 ✔ **Answer:** 3285

3285

Answer Code

```
        carbon1 <- temp_carbon %>%
    filter(year == 1751) %>%
    .$carbon_emissions

carbon2 <- temp_carbon %>%
    filter(year == 2014) %>%
    .$carbon_emissions

carbon2/carbon1
```

Submit You have used 1 of 10 attempts

Answers are displayed within the problem

Question 3

3/3 points (graded)

Inspect the difference in temperature in `temp_carbon` from the first available year to the last available year.

What is the first year for which global temperature anomaly (`temp_anomaly`) data are available?

1880 ✔ **Answer:** 1880

1880

Answer Code

```
        temp_carbon %>%
    filter(!is.na(temp_anomaly)) %>%
    .$year %>%
    min()
```

What is the last year for which global temperature anomaly data are available?

2018 ✔ **Answer:** 2018

2018

Answer Code

```
        temp_carbon %>%
    filter(!is.na(temp_anomaly)) %>%
    .$year %>%
    max()
```

How many degrees Celsius has temperature increased over the date range? Compare the temperatures in the most recent year versus the oldest year.

0.93

✔ **Answer:** 0.93

0.93

Answer Code

```
        temp1 <- temp_carbon %>%
    filter(year == "1880") %>%
    .$temp_anomaly

temp2 <- temp_carbon %>%
    filter(year == "2018") %>%
    .$temp_anomaly

temp2 - temp1
```

Submit You have used 1 of 10 attempts

Answers are displayed within the problem

Question 4

1/1 point (graded)

Create a time series line plot of the temperature anomaly. Only include years where temperatures are reported. Save this plot to the object `p`.

Which command adds a blue horizontal line indicating the 20th century mean temperature?

```
p <- p + geom_vline(aes(xintercept = 0), col = "blue")
```

```
p <- p + geom_hline(aes(y = 0), col = "blue")
```

```
p <- p + geom_hline(aes(yintercept = 0, col = blue))
```

```
p <- p + geom_hline(aes(yintercept = 0), col = "blue")
```

✔

Answer Code

```
        p <- temp_carbon %>%
    filter(!is.na(temp_anomaly)) %>%
    ggplot(aes(year, temp_anomaly)) +
    geom_line()

p <- p + geom_hline(aes(yintercept = 0), col = "blue")
p
```

Submit You have used 1 of 2 attempts

Answers are displayed within the problem

Question 5

1/1 point (graded)

Continue working with `p`, the plot created in the previous question.

Change the y-axis label to be "Temperature anomaly (degrees C)". Add a title, "Temperature anomaly relative to 20th century mean, 1880-2018". Also add a text layer to the plot: the x-coordinate should be 2000, the y-coordinate should be 0.05, the text should be "20th century mean", and the text color should be blue.

Which of the following code blocks is correct?

```
p + ylab("Temperature anomaly (degrees C)") +
title("Temperature anomaly relative to 20th century mean, 1880-2018") +
geom_text(aes(x = 2000, y = 0.05, label = "20th century mean", col = "blue"))
```

```
p + ylim("Temperature anomaly (degrees C)") +
ggtitle("Temperature anomaly relative to 20th century mean, 1880-2018") +
geom_text(aes(x = 2000, y = 0.05, label = "20th century mean"), col = "blue")
```

```
p + ylab("Temperature anomaly (degrees C)") +
ggtitle("Temperature anomaly relative to 20th century mean, 1880-2018") +
geom_text(aes(x = 2000, y = 0.05, label = "20th century mean", col = "blue"))
```

```
p + ylab("Temperature anomaly (degrees C)") +
ggtitle("Temperature anomaly relative to 20th century mean, 1880-2018") +
geom_text(aes(x = 2000, y = 0.05, label = "20th century mean"), col = "blue")
```

```
p + ylab("Temperature anomaly (degrees C)") +
title("Temperature anomaly relative to 20th century mean, 1880-2018") +
geom_text(aes(x = 2000, y = 0.05, label = "20th century mean"), col = "blue")
```

Submit You have used 1 of 2 attempts

Answers are displayed within the problem

Question 6

3/3 points (graded)

Use the plot created in the last two exercises to answer the following questions. Answers within 5 years of the correct answer will be accepted.

When was the earliest year with a temperature above the 20th century mean?

1940 ✔ **Answer:** 1940

1940

When was the last year with an average temperature below the 20th century mean?

1976 ✔ **Answer:** 1976

1976

In what year did the temperature anomaly exceed 0.5 degrees Celsius for the first time?

1997 ✔ **Answer:** 1997

1997

Answer Code
Here is the full code for generating the correct plot:

```
        temp_carbon %>%
    ggplot(aes(year, temp_anomaly)) +
    geom_line() +
    geom_hline(aes(yintercept = 0), col = "blue") +
    ylab("Temperature anomaly (degrees C)") +
    geom_text(aes(x = 2000, y = 0.05, label = "20th century mean"), col = "blue") +
    xlim(c(1880, 2018)) +
    ggtitle("Temperature anomaly relative to 20th century mean, 1880-2018")
```

Submit You have used 1 of 10 attempts

Answers are displayed within the problem

Question 7

1.5/1.5 points (graded)
Add layers to the previous plot to include line graphs of the temperature anomaly in the ocean (`ocean_anomaly`) and on land (`land_anomaly`). Assign different colors to the lines. Compare the global temperature anomaly to the land temperature anomaly and

ocean temperature anomaly.

Which region has the largest 2018 temperature anomaly relative to the 20th century mean?

Land ✔ **Answer:** Land

Which region has the largest change in temperature since 1880?

Land ✔ **Answer:** Land

Which region has a temperature anomaly pattern that more closely matches the global pattern?

Ocean ✔ **Answer:** Ocean

Answer Code
Here is the full code for generating the correct plot:

```
     temp_carbon %>%
ggplot(aes(year, temp_anomaly)) +
geom_line() +
geom_line(aes(year, land_anomaly), col = "red") +
geom_line(aes(year, ocean_anomaly), col = "blue") +
ylab("Temperature anomaly (degrees C)") +
xlim(c(1880, 2018)) +
ggtitle("Temperature anomaly on land and ocean")
```

Submit You have used 1 of 2 attempts

Answers are displayed within the problem

The assessment continues on the following page. You will not need the temperature anomaly plot created above for future questions.