Exercise from chap01ex.ipynb, exclude the prefilled book demo code

```
from os.path import basename, exists



def download(url):
    filename = basename(url)
    if exists(filename):
        from urllib.request import urlretrieve

        local, _ = urlretrieve(url, filename)
        print("Downloaded " + local)


download("https://github.com/AllenDowney/ThinkStats2/raw/master/code/
thinkstats2.py")
download("https://github.com/AllenDowney/ThinkStats2/raw/master/code/
thinkplot.py")
download("https://github.com/AllenDowney/ThinkStats2/raw/master/code/
nsfg.py")
```

```
Downloaded thinkstats2.py
Downloaded thinkplot.py
Downloaded nsfg.py
```

```
download("https://github.com/AllenDowney/ThinkStats2/raw/master/code/
2002FemPreg.dct")
download(

"https://github.com/AllenDowney/ThinkStats2/raw/master/code/2002FemPre
g.dat.gz"
)
```

```
Downloaded 2002FemPreg.dct
Downloaded 2002FemPreg.dat.gz
```

Read NSFG data into a Pandas DataFrame.

```
import nsfg

preg = nsfg.ReadFemPreg()
```

```
C:\Users\gyanr\gyan-python-workspace\DSC-530\nsfg.py:68:
FutureWarning: A value is trying to be set on a copy of a DataFrame or
```

```
Series through chained assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never
work because the intermediate object on which we are setting values
always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try
using 'df.method({col: value}, inplace=True)' or df[col] =
df[col].method(value) instead, to perform the operation inplace on the
original object.


  df.birthwgt_lb.replace(na_vals, np.nan, inplace=True)
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  df.birthwgt_oz.replace(na_vals, np.nan, inplace=True)
C:\Users\gyanr\gyan-python-workspace\DSC-530\nsfg.py:70:
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  df.hpagelb.replace(na_vals, np.nan, inplace=True)
C:\Users\gyanr\gyan-python-workspace\DSC-530\nsfg.py:72:
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```

```
original object.


  df.babysex.replace([7, 9], np.nan, inplace=True)
C:\Users\gyanr\gyan-python-workspace\DSC-530\nsfg.py:73:
FutureWarning: A value is trying to be set on a copy of a DataFrame or
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df[col].method(value) instead, to perform the operation inplace on the
original object.


  df.nbrnaliv.replace([9], np.nan, inplace=True)
```

exercise 1.1 start from here:

Select the `birthord` column, print the value counts, and compare to results published in the codebook

```
birthord = preg['birthord']

preg['totalwgt_lb'].describe()
```

```
count    9038.000000
mean        7.265628
std         1.408293
min         0.125000
25%         6.500000
50%         7.375000
75%         8.125000
max        15.437500
Name: totalwgt_lb, dtype: float64
```

We can also use `isnull` to count the number of nans.

```
preg.birthord.isnull().sum()
```

```
4445
```

Select the `prglngth` column, print the value counts, and compare to results published in the codebook

```
preg.prglngth.value_counts().sort_index()
```

```
prglngth
0       15
1        9
2       78
3      151
4      412
5      181
6      543
7      175
8      409
9      594
10     137
11     202
12     170
13     446
14      29
15      39
16      44
17     253
18      17
19      34
20      18
21      37
22     147
23      12
24      31
25      15
26     117
27       8
28      38
29      23
30     198
31      29
32     122
33      50
34      60
35     357
36     329
37     457
38     609
39    4744
40    1120
41     591
42     328
43     148
44      46
45      10
46       1
47       1
48       7
```

```
50       2
Name: count, dtype: int64
```

To compute the mean of a column, you can invoke the `mean` method on a Series. For example, here is the mean birthweight in pounds:

```
preg.totalwgt_lb.mean()

7.265628457623368
```

Create a new column named totalwgt_kg that contains birth weight in kilograms. Compute its mean. Remember that when you create a new column, you have to use dictionary syntax, not dot notation.

```
preg['totalwgt_kg'] = preg.totalwgt_lb*0.45359237
preg.totalwgt_kg.mean()

3.295633631632828
```

`nsfg.py` also provides `ReadFemResp`, which reads the female respondents file and returns a `DataFrame`:

```
download("https://github.com/AllenDowney/ThinkStats2/raw/master/code/
2002FemResp.dct")
download("https://github.com/AllenDowney/ThinkStats2/raw/master/code/
2002FemResp.dat.gz")

Downloaded 2002FemResp.dct
Downloaded 2002FemResp.dat.gz

resp = nsfg.ReadFemResp()
```

`DataFrame` provides a method `head` that displays the first five rows:

```
resp.head()

   caseid  rscrinf  rdormres  rostscrn  rscreenhisp  rscreenrace
age_a  \
0    2298        1         5         5            1          5.0
27
1    5012        1         5         1            5          5.0
42
2   11586        1         5         1            5          5.0
43
3    6794        5         5         4            1          5.0
15
4     616        1         5         4            1          5.0
20
```

```
   age_r  cmbirth  agescrn  ...  pubassis_i      basewgt
adj_mod_basewgt  \
0     27      902       27  ...           0  3247.916977
5123.759559
1     42      718       42  ...           0  2335.279149
2846.799490
2     43      708       43  ...           0  2335.279149
2846.799490
3     15     1042       15  ...           0  3783.152221
5071.464231
4     20      991       20  ...           0  5341.329968
6437.335772

      finalwgt  secu_r  sest  cmintvw  cmlstyr  screentime   intvlngth

0  5556.717241       2    18     1234     1222    18:26:36  110.492667

1  4744.191350       2    18     1233     1221    16:30:59   64.294000

2  4744.191350       2    18     1234     1222    18:19:09   75.149167

3  5923.977368       2    18     1234     1222    15:54:43   28.642833

4  7229.128072       2    18     1233     1221    14:19:44   69.502667


[5 rows x 3087 columns]
```

Select the `age_r` column from `resp` and print the value counts. How old are the youngest and oldest respondents?

```
resp.age_r.value_counts().sort_index()

age_r
15    217
16    223
17    234
18    235
19    241
20    258
21    267
22    287
23    282
24    269
25    267
26    260
27    255
28    252
29    262
30    292
```

```
31    278
32    273
33    257
34    255
35    262
36    266
37    271
38    256
39    215
40    256
41    250
42    215
43    253
44    235
Name: count, dtype: int64
```

We can use the `caseid` to match up rows from `resp` and `preg`. For example, we can select the row from `resp` for `caseid` 2298 like this:

```
resp[resp.caseid==2298]

   caseid  rscrinf  rdormres  rostscrn  rscreenhisp  rscreenrace  
age_a  \
0    2298        1         5         5            1          5.0
27

   age_r  cmbirth  agescrn  ...  pubassis_i      basewgt  
adj_mod_basewgt  \
0     27      902       27  ...           0  3247.916977
5123.759559

      finalwgt  secu_r  sest  cmintvw  cmlstyr  screentime   intvlngth

0  5556.717241       2    18     1234     1222    18:26:36  110.492667


[1 rows x 3087 columns]
```

And we can get the corresponding rows from `preg` like this:

```
preg[preg.caseid==2298]

      caseid  pregordr  howpreg_n  howpreg_p  moscurrp  nowprgdk  
pregend1  \
2610    2298         1        NaN        NaN       NaN       NaN
6.0
2611    2298         2        NaN        NaN       NaN       NaN
6.0
2612    2298         3        NaN        NaN       NaN       NaN
```

```
6.0
2613    2298         4        NaN        NaN       NaN       NaN
6.0

      pregend2  nbrnaliv  multbrth  ...  religion_i  metro_i
basewgt  \
2610       NaN       1.0       NaN  ...           0        0
3247.916977
2611       NaN       1.0       NaN  ...           0        0
3247.916977
2612       NaN       1.0       NaN  ...           0        0
3247.916977
2613       NaN       1.0       NaN  ...           0        0
3247.916977

      adj_mod_basewgt     finalwgt  secu_p  sest  cmintvw  totalwgt_lb
\
2610      5123.759559  5556.717241       2    18      NaN       6.8750

2611      5123.759559  5556.717241       2    18      NaN       5.5000

2612      5123.759559  5556.717241       2    18      NaN       4.1875

2613      5123.759559  5556.717241       2    18      NaN       6.8750


      totalwgt_kg
2610     3.118448
2611     2.494758
2612     1.899418
2613     3.118448

[4 rows x 245 columns]
```

How old is the respondent with `caseid` 1?

```
resp[resp.caseid==1].age_r

1069    44
Name: age_r, dtype: int64
```

What are the pregnancy lengths for the respondent with `caseid` 2298?

```
preg[preg.caseid==2298].prglngth

2610    40
2611    36
2612    30
2613    40
Name: prglngth, dtype: int64
```

What was the birthweight of the first baby born to the respondent with `caseid` 5012?

```
preg[preg.caseid==5012]
```

```
      caseid  pregordr  howpreg_n  howpreg_p  moscurrp  nowprgdk
pregend1  \
5515    5012         1        NaN        NaN       NaN       NaN
6.0

      pregend2  nbrnaliv  multbrth  ...  religion_i  metro_i
basewgt  \
5515       NaN       1.0       NaN  ...           0        0
2335.279149

      adj_mod_basewgt    finalwgt  secu_p  sest  cmintvw  totalwgt_lb
\
5515       2846.79949  4744.19135       2    18      NaN          6.0


      totalwgt_kg
5515     2.721554

[1 rows x 245 columns]
```

```
preg[(preg.caseid==5012) & (preg.pregordr==1)].totalwgt_lb
```

```
5515    6.0
Name: totalwgt_lb, dtype: float64
```

```
preg.describe()
```

```
             caseid      pregordr   howpreg_n  howpreg_p
moscurrp  \
count  13593.000000  13593.000000  352.000000  349.00000  352.000000

mean    6216.526595      2.349150   15.144886    1.34384    4.647727

std     3645.417341      1.577807   13.922211    0.47567    2.527523

min        1.000000      1.000000    0.000000    1.00000    0.000000

25%     3022.000000      1.000000    5.000000    1.00000    2.000000

50%     6161.000000      2.000000    9.000000    1.00000    5.000000

75%     9423.000000      3.000000   23.000000    2.00000    7.000000

max    12571.000000     19.000000   99.000000    2.00000    9.000000


       nowprgdk      pregend1   pregend2     nbrnaliv    multbrth  ...
\
count  3.000000  13241.000000  18.000000  9144.000000  163.000000  ...

mean   3.666667      4.650177   4.055556     1.022419    1.834356  ...

std    4.618802      1.849790   1.696787     0.190098    1.630208  ...

min    1.000000      1.000000   1.000000     1.000000    1.000000  ...

25%    1.000000      3.000000   3.000000     1.000000    1.000000  ...

50%    1.000000      6.000000   4.000000     1.000000    1.000000  ...

75%    5.000000      6.000000   6.000000     1.000000    1.000000  ...

max    9.000000      9.000000   6.000000     5.000000    5.000000  ...


         religion_i  metro_i       basewgt  adj_mod_basewgt
finalwgt  \
count  13593.000000  13593.0  13593.000000     13593.000000
13593.000000
mean       0.003016      0.0   4216.271164      5383.982581
8196.422280
std        0.058727      0.0   3982.680473      5640.499431
9325.918114
min        0.000000      0.0     64.577101        71.201194
118.656790
25%        0.000000      0.0   2335.445237      2798.048902
3841.375308
50%        0.000000      0.0   3409.648504      4127.220642
6256.592133
75%        0.000000      0.0   4869.941451      5795.692880
9432.360931
max        2.000000      0.0  99707.832014    157143.686687
261879.953864

             secu_p          sest  cmintvw  totalwgt_lb  totalwgt_kg
count  13593.000000  13593.000000      0.0  9038.000000  9038.000000
mean       1.487310     44.083352      NaN     7.265628     3.295634
std        0.499857     24.110403      NaN     1.408293     0.638791
min        1.000000      1.000000      NaN     0.125000     0.056699
25%        1.000000     25.000000      NaN     6.500000     2.948350
50%        1.000000     45.000000      NaN     7.375000     3.345244
75%        2.000000     65.000000      NaN     8.125000     3.685438
max        2.000000     84.000000      NaN    15.437500     7.002332

[8 rows x 245 columns]
```

End of exercise 1.1

Exercise 1.2: Create a file named chap01ex.py and write code that reads the respondent file, 2002FemResp.dat.gz

```python
# Value counts for 'pregnum'

import nsfg

# Load the datasets
resp = nsfg.ReadFemResp()
preg = nsfg.ReadFemPreg()

# Print the value counts for 'pregnum' variable in the 'resp' dataset
print("Value counts for 'pregnum' in the 'resp' dataset:")
print(resp['pregnum'].value_counts())

# Create a dictionary mapping caseid to a list of indices into the pregnancy DataFrame
preg_map = nsfg.MakePregMap(preg)

# Create a new column in 'resp' dataset representing the number of records in the pregnancy DataFrame for each caseid
resp['preg_count'] = resp['caseid'].map(lambda x: len(preg_map.get(x, [])))

# Compare 'pregnum' for each respondent with the number of records in the pregnancy
comparison_result = resp['pregnum'] == resp['preg_count']

# Print the result
print("\nComparison result:")
print(comparison_result.value_counts())
```

```
Value counts for 'pregnum' in the 'resp' dataset:
pregnum
0     2610
2     1432
1     1267
3     1110
4      611
5      305
6      150
7       80
8       40
```

```
9       21
10       9
11       3
12       2
14       2
19       1
Name: count, dtype: int64

Comparison result:
True    7643
Name: count, dtype: int64

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  df.birthwgt_lb.replace(na_vals, np.nan, inplace=True)
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```

```
original object.


  df.hpagelb.replace(na_vals, np.nan, inplace=True)
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  df.babysex.replace([7, 9], np.nan, inplace=True)
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using 'df.method({col: value}, inplace=True)' or df[col] =
df[col].method(value) instead, to perform the operation inplace on the
original object.


  df.nbrnaliv.replace([9], np.nan, inplace=True)
```

Summary:

For most respondents, the recorded number of pregnancies in the 'resp' dataset aligns with the actual number of pregnancy records in the pregnancy dataset. The absence of False values in the comparison result suggests that there are no inconsistencies between the reported number of pregnancies and the actual number of pregnancy records for any respondent. In summary, based on the comparison result, the 'pregnum' variable in the 'resp' dataset appears to be consistent with the number of pregnancy records in the pregnancy dataset, indicating a high level of data integrity and reliability in the reported pregnancy information.

End of exercise 1.2

```python
from scipy.stats import ttest_ind

# Extracting the 'totalwgt_lb' column and 'pregordr' column
totalwgt_lb = preg.totalwgt_lb
pregordr = preg.pregordr
```

```
# Separating first babies and others
first_babies = totalwgt_lb[pregordr == 1]
others = totalwgt_lb[pregordr > 1]

# Calculating means and standard deviations for both groups
mean_first_babies = first_babies.mean()
mean_others = others.mean()
std_first_babies = first_babies.std()
std_others = others.std()


# Independent two-sample t-test
t_statistic, p_value = ttest_ind(first_babies, others,
equal_var=False)

# Cohen's d
cohens_d = (mean_first_babies - mean_others) / (((std_first_babies**2
+ std_others**2) / 2)**0.5)

print("Mean weight of first babies:", mean_first_babies)
print("Mean weight of others:", mean_others)
print("Cohen's d:", cohens_d)
print("p-value:", p_value)

print("Mean weight of first babies:", mean_first_babies)
print("Mean weight of others:", mean_others)
```

```
Mean weight of first babies: 7.204107733975324
Mean weight of others: 7.301399825021872
Cohen's d: -0.06904986139204121
p-value: nan
Mean weight of first babies: 7.204107733975324
Mean weight of others: 7.301399825021872
```

2-1 (Based on the results in this chapter, suppose you were asked to summarize what you learned about whether first babies arrive late…)

Mean pregnancy length for first babies is 38.601;

for other babies it is 38.523.

the standard deviation is 2.7 weeks

(Which summary statistics would you use if you wanted to get a story on the evening news? Which ones would you use if you wanted to reassure an anxious patient?)

Although standard deviation makes sense, it would be appropriate to highlight key summary statistics that capture the overall distribution of baby weights. The mean (average) weight of all babies is 7.27 pounds, with a standard deviation of 1.41 pounds. The range of weights spans from 0.13 to 15.44 pounds. This information provides a general overview of baby weights and could be emphasized to give viewers a sense of the typical weight range and variation.

End of exericse 2-1

2-4 (Using the variable totalwgt_lb, investigate whether first babies are lighter or heavier than others…)

```python
import math
import matplotlib.pyplot as plt
import nsfg


def read_data():
    preg = nsfg.ReadFemPreg()

    live = preg[preg.outcome == 1]
    firsts = live[live.birthord == 1]
    others = live[live.birthord != 1]

    return live, firsts, others


def calculate(live, firsts, others):


    mean1 = firsts.totalwgt_lb.mean()
    mean2 = others.totalwgt_lb.mean()
    print(f'Mean of First {mean1=} , others {mean2}')

    var1 = firsts.totalwgt_lb.var()
    var2 = others.totalwgt_lb.var()
    print(f'Variance of First {var1=} , others {var2}')

    # calculate Choen D
    diff = mean1 - mean2
    n1, n2 = len(firsts.totalwgt_lb), len(firsts.totalwgt_lb)
    pooled_var = (n1 * var1 + n2 * var2) / (n1 + n2)
    d = diff / math.sqrt(pooled_var)
    print('Cohen d', d)

    plt.hist(firsts.totalwgt_lb, label='first baby', alpha=0.5)
    plt.hist(others.totalwgt_lb, label='other babies', alpha=0.5)
    plt.legend(loc='best')
    plt.show()


def main(script):
    live, firsts, others = read_data()
    calculate(live, firsts, others)

if __name__ == '__main__':
    main('test')
```

```
Mean of First mean1=7.201094430437772 , others 7.325855614973262
Variance of First var1=2.018027300915786 , others 1.9437810258964716
Cohen d -0.088643675877677717
```

```
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always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try
using 'df.method({col: value}, inplace=True)' or df[col] =
df[col].method(value) instead, to perform the operation inplace on the
original object.


  df.birthwgt_lb.replace(na_vals, np.nan, inplace=True)
C:\Users\gyanr\gyan-python-workspace\DSC-530\nsfg.py:69:
FutureWarning: A value is trying to be set on a copy of a DataFrame or
Series through chained assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never
work because the intermediate object on which we are setting values
always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try
using 'df.method({col: value}, inplace=True)' or df[col] =
df[col].method(value) instead, to perform the operation inplace on the
original object.


  df.birthwgt_oz.replace(na_vals, np.nan, inplace=True)
C:\Users\gyanr\gyan-python-workspace\DSC-530\nsfg.py:70:
FutureWarning: A value is trying to be set on a copy of a DataFrame or
```
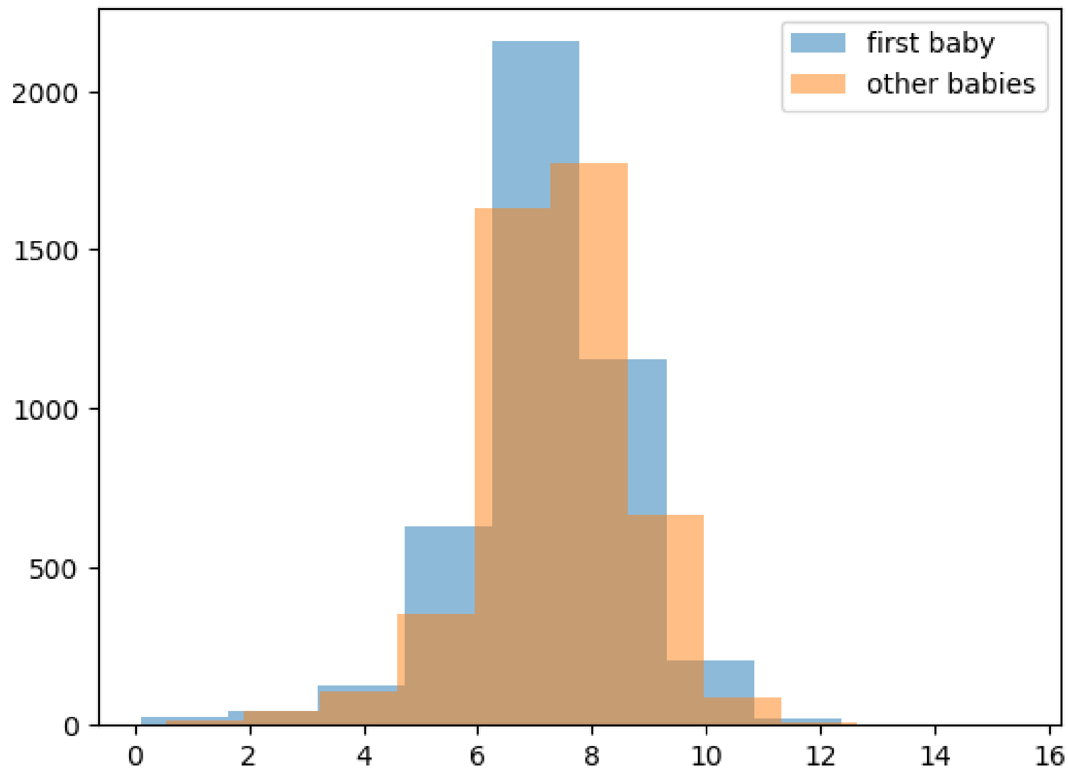

```
Series through chained assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never
work because the intermediate object on which we are setting values
always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try
using 'df.method({col: value}, inplace=True)' or df[col] =
df[col].method(value) instead, to perform the operation inplace on the
original object.


  df.hpagelb.replace(na_vals, np.nan, inplace=True)
C:\Users\gyanr\gyan-python-workspace\DSC-530\nsfg.py:72:
FutureWarning: A value is trying to be set on a copy of a DataFrame or
Series through chained assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never
work because the intermediate object on which we are setting values
always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try
using 'df.method({col: value}, inplace=True)' or df[col] =
df[col].method(value) instead, to perform the operation inplace on the
original object.


  df.babysex.replace([7, 9], np.nan, inplace=True)
C:\Users\gyanr\gyan-python-workspace\DSC-530\nsfg.py:73:
FutureWarning: A value is trying to be set on a copy of a DataFrame or
Series through chained assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never
work because the intermediate object on which we are setting values
always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try
using 'df.method({col: value}, inplace=True)' or df[col] =
df[col].method(value) instead, to perform the operation inplace on the
original object.


  df.nbrnaliv.replace([9], np.nan, inplace=True)
```



Mean

First babies 7.201094430437772

Others 7.325855614973262

Variance

First babies 2.0180273009157768

Others 1.9437810258964572

Difference in lbs -0.12476118453549034

Difference in oz -1.9961789525678455

Difference relative to mean (%age points) -1.7171423678372415

Cohen d -0.088672927072602

first babies is slightly lighter (~2 oz) than others, but the difference is just a fraction of the first babies mean (less than 2%). However, Based on the Cohen-D value, the variation on baby weight is bigger than the variation in pregnancy length