RefinedFinal

December 30, 2020

1 Final Project 3401 Clarke

Research Question: How has the City of Boulder's Budget changed over the period of time between 2016-2019? What has the trend been for increasing and decreasing budgets? has there been a steady tread in spending?

Hypothesis: I think that in the period of time between 2016 and 2019 there will be a steady rise of budget concentration around public transporation and safety. As the University grows there must be a focus around student coummter transportation and student safety on and off campus.

Motivation: As a resident of the city of Boulder for four years now and maybe more, I would like to know what the treds are for the budgets of boulder

At first I was going to look at the city of Boulders Budget was going to impact snow removal. But look at other data points, it maybe interesting to see how much money they have started spending as the population of Boulder, and then what are they spending it on?. As a resident of the city of Boulder for four years now and maybe more, I would like to know what the trends are for the budgets of Boulder between 2016 (this is the earliest accounts payable available) to 2020. We can aslo use the US Census data.

I'll mearge all of the census data and then meage together the acounts payable data.

Accounts payable data between 2016-2020 (https://bouldercolorado.gov/open-data/accounts-payable/)

US Census data for Boulder CO betwee, 2016-2019. (https://data.census.gov/cedsci/table?q=Boulder%20Co&tid=

2 Reading in Data

As We are reading in the data let's make tables for the total spenditure in each department. We will have 4 different tables after this.

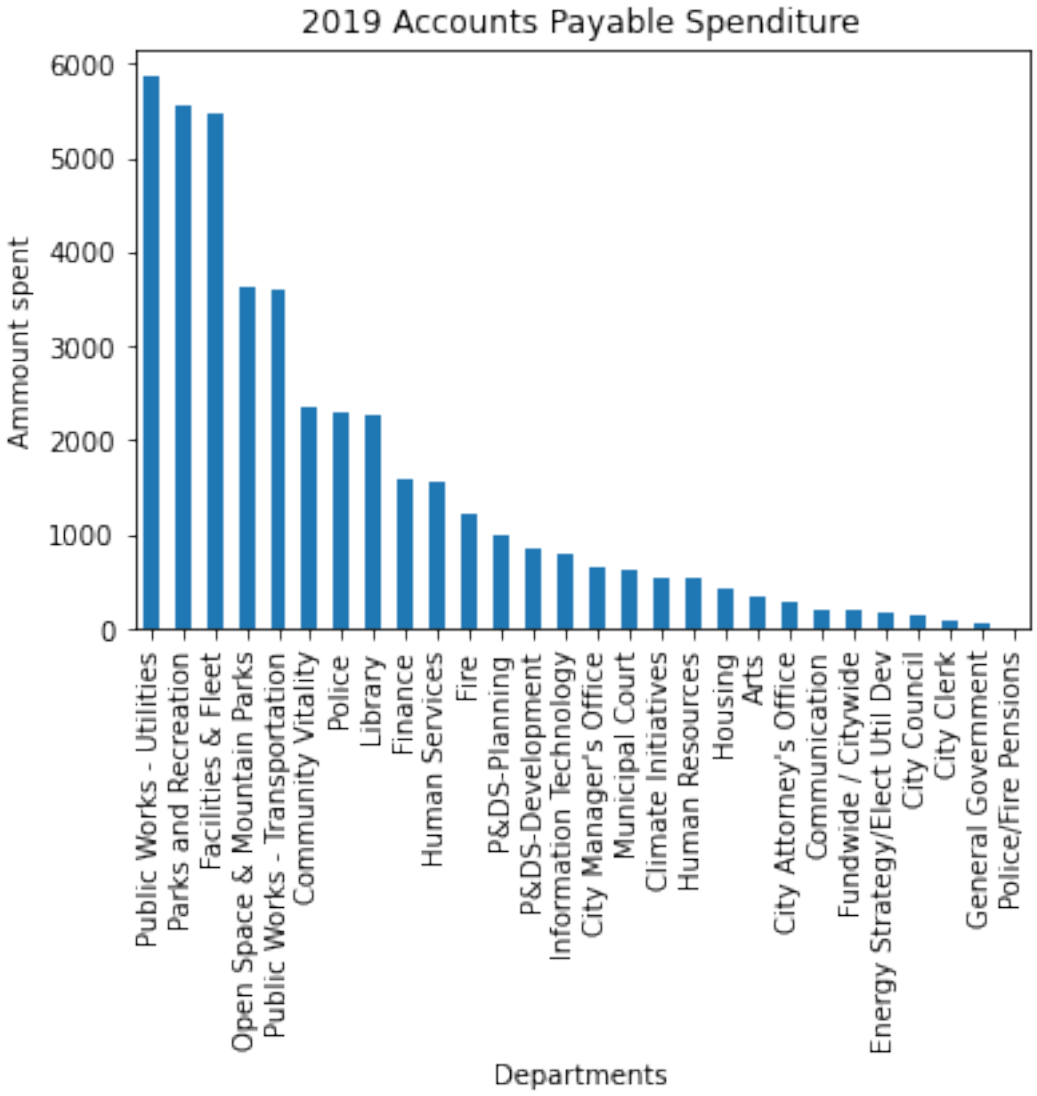
[28]:
```
import pandas as pd

AP2019 = pd.read_csv("accounts_payable_2019.csv")
#AP2019
```

The below plot shows the ammount of transactions in each department in 2019.

[3]:
```
ax = AP2019["department_desc"].value_counts().plot(kind = 'bar')
```

```
# how do i get total transactions over time?
ax.set(title = "2019 Accounts Payable Spenditure", xlabel = "Departments",␣
 ↪ylabel = "Ammount spent")
```

[3]:
```
[Text(0.5, 1.0, '2019 Accounts Payable Spenditure'),
 Text(0.5, 0, 'Departments'),
 Text(0, 0.5, 'Ammount spent')]
```

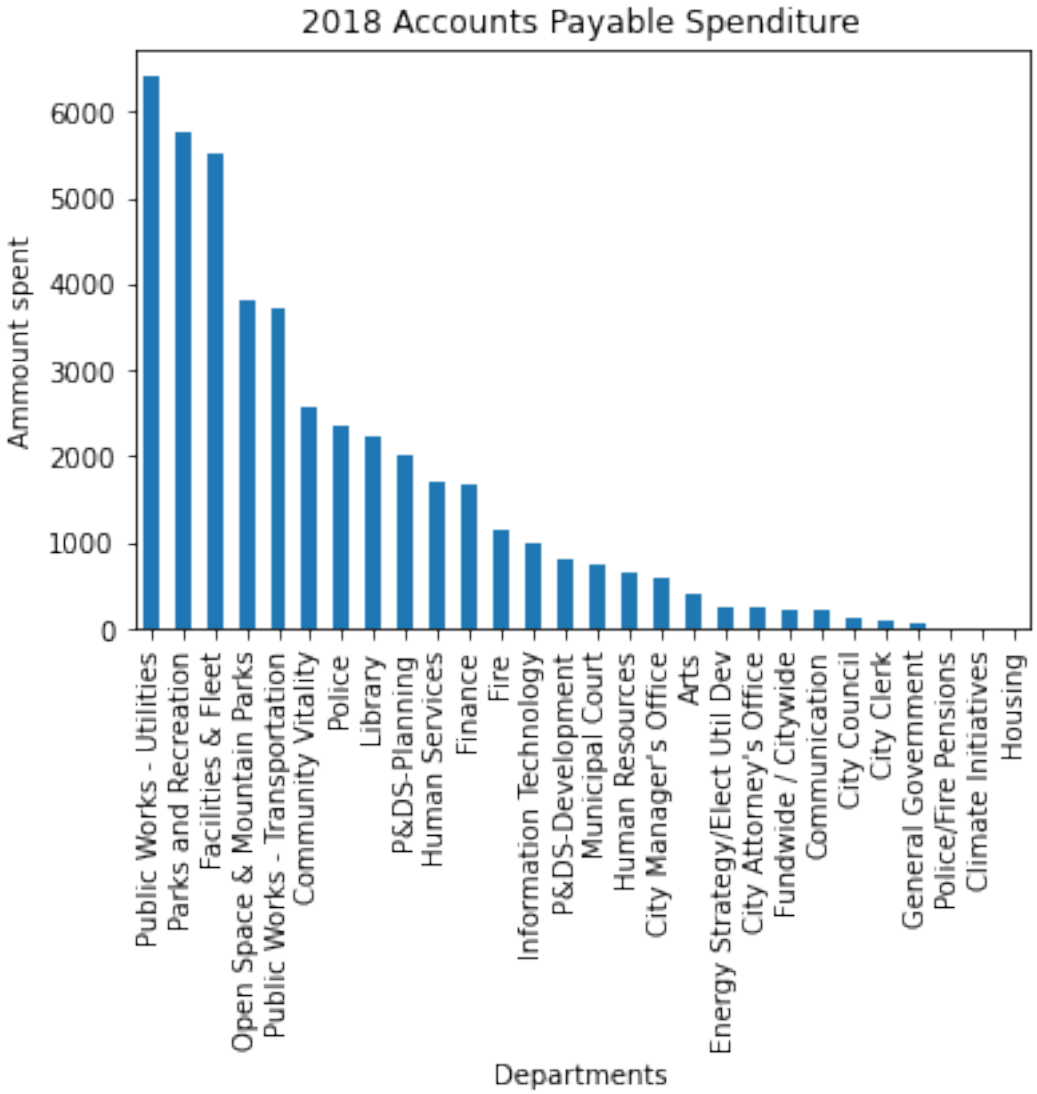


[29]:
```
AP2018 = pd.read_csv("accounts_payable_2018.csv")
#AP2018.head()
```

[30]:
```
ax = AP2018["department_desc"].value_counts().plot(kind = 'bar')
```

```
# how do i get total transactions over time?
ax.set(title = "2018 Accounts Payable Spenditure", xlabel = "Departments",␣
↪ylabel = "Ammount spent")
```

[30]:
```
[Text(0.5, 1.0, '2018 Accounts Payable Spenditure'),
 Text(0.5, 0, 'Departments'),
 Text(0, 0.5, 'Ammount spent')]
```

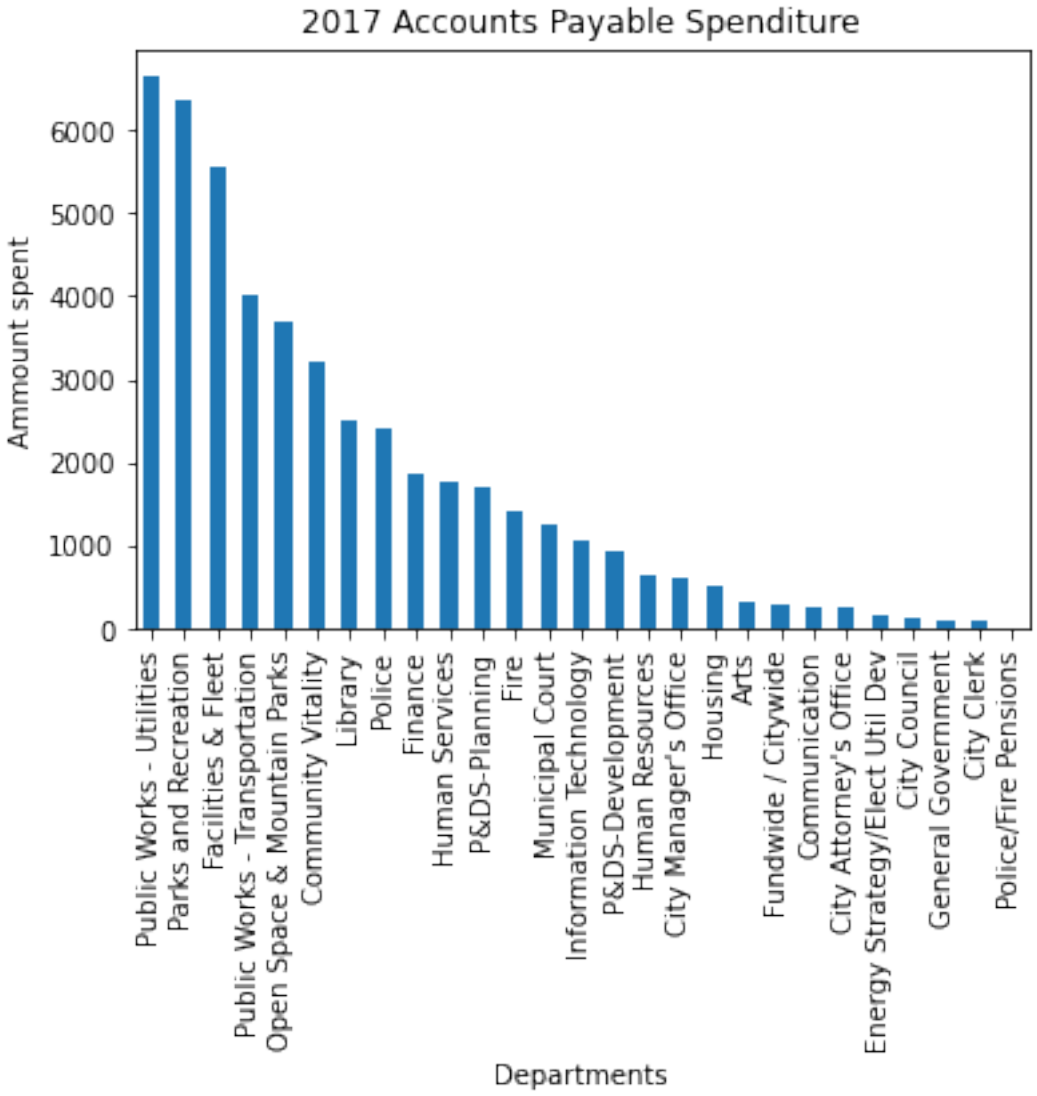


[31]:
```
AP2017 = pd.read_csv("accounts_payable_2017.csv")
#AP2017
```

[32]:
```
ax = AP2017["department_desc"].value_counts().plot(kind = 'bar')
```

```
# how do i get total transactions over time?
ax.set(title = "2017 Accounts Payable Spenditure", xlabel = "Departments",␣
↪ylabel = "Ammount spent")
```

[32]:
```
[Text(0.5, 1.0, '2017 Accounts Payable Spenditure'),
 Text(0.5, 0, 'Departments'),
 Text(0, 0.5, 'Ammount spent')]
```

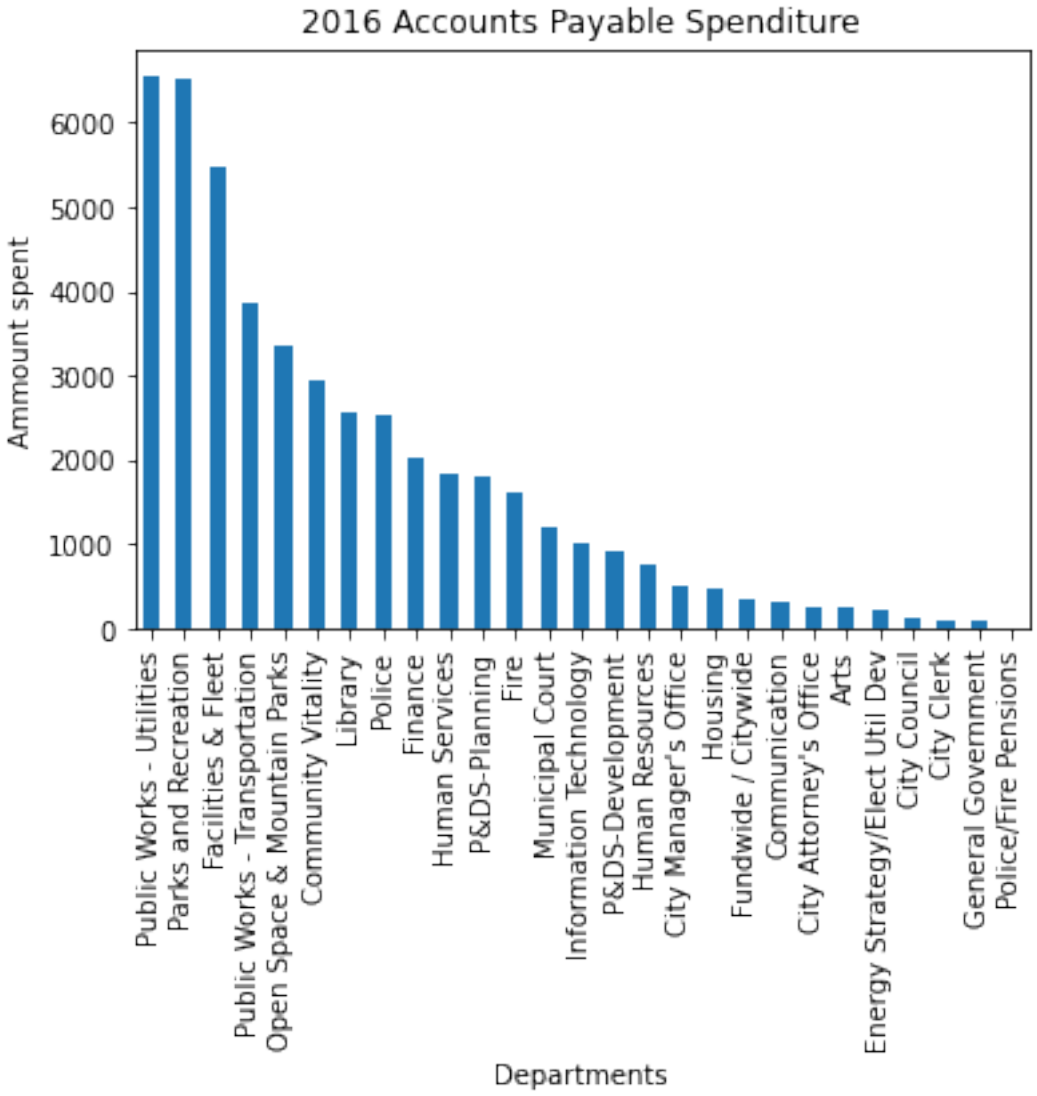


[33]:
```
AP2016 = pd.read_csv("accounts_payable_2016.csv")
#AP2016.head()
```

[34]:
```
ax = AP2016["department_desc"].value_counts().plot(kind = 'bar')
```

```
# how do i get total transactions over time?
ax.set(title = "2016 Accounts Payable Spenditure", xlabel = "Departments",␣
↪ylabel = "Ammount spent")
```

[34]:
```
[Text(0.5, 1.0, '2016 Accounts Payable Spenditure'),
 Text(0.5, 0, 'Departments'),
 Text(0, 0.5, 'Ammount spent')]
```



Now that all of the accounts payable data is in, we must input the population estimate data

[35]:
```
Pop2019 = pd.read_csv("2019PopulationEstimate.csv")

#Pop2019.head(1)
```

[36]:
```
Pop2018 = pd.read_csv("2018PopulationEstimate.csv")
#Pop2018.head(1)
```

[37]:
```
Pop2017 = pd.read_csv("2017PopulationEstimate.csv")
#Pop2017.head(1)
```

[38]:
```
Pop2016 = pd.read_csv("2016PopulationEstimate.csv")
Pop2016.head(1)
```

[38]:
```
              Label Boulder County, Colorado!!Total!!Estimate  \
0  Total population                                    322,226

  Boulder County, Colorado!!Total!!Margin of Error  \
0                                            *****

  Boulder County, Colorado!!Male!!Estimate  \
0                                  161,728

  Boulder County, Colorado!!Male!!Margin of Error  \
0                                            ±737

  Boulder County, Colorado!!Female!!Estimate  \
0                                    160,498

  Boulder County, Colorado!!Female!!Margin of Error
0                                             ±737
```

Now that we have all of our data in we must merge together all of the Accounts payable together, and then population together.

[15]:
```
# first lets filter out only the data we need from each population data
Pop2019.iloc[0, :2] # so this is what we want from each data frame. But how␣
 ↪will we know Whcih populations are which?
```

[15]:
```
Label                                          Total population
Boulder County, Colorado!!Total!!Estimate                326,196
Name: 0, dtype: object
```

2.1 Preliminary Findings

Based on my graphs with the accounts payable, it looks like spending may have trended downward from 2016 to 2019. On first obervations with the census population it looks like the population has been steadily rising.

2.2 Statment of Hypothesis

If the population of Boulder is on a steady rise between the year 2016 and 2019, then the budget for the city of boulder for public transportation would also rise based on the ammount of people

there are to transport, and the more ergency for the roads in Boulder to be drivable.

3 Phase 2

Research Question: How has Boulder County spent its money in the past 4 years? Does this pertain to the population growth with in the community? Are there items that were prioritized and now being funded less?

The origional research question was focused on how the Boulder County budget has changed over the past 4 years, and how the county is spending its money. Now I want to understand if the population growth might correlate to this.

Here is some information on the budget from the City of Boulder https://bouldercolorado.gov/budget/budget-faqs

Let's group together all of the budget spenditure into one graph

I realzied that in my preliminary findings that I was graphing the ammount of times that they had logged transactions for each department, not the amount of money they spent in each department.

3.1 Account Totals

Let's use a pivot table to aggagate the values of each transaction for the departments to show their spending in each department. The index will be the department, and the values will be the transction ammount. We will use the aggfunc of 'sum' to determine the totals.

For each pivot table, label it "totals 20XX" so that we know what each amount comes from

[39]:
```
# we have to count up all the transaction ammounts and put them with each␣
 ↪departmtent
totals16pivot = pd.pivot_table(data = AP2016,
                               index = 'department_desc',
                               values = 'transaction_amount',
                               aggfunc = 'sum')
totals16pivot.columns = [ "Total 2016"]

#totals16 = AP2016["department_desc"].value_counts()

# this was just a graph to visualize what they have paid most.

# ax = totals16pivot.plot(kind = 'bar', figsize = (5,5), title = "Spending␣
 ↪2016")
# ax.set(xlabel = 'Department')
# ax.set(ylabel = 'Ammount')

totals16pivot.head()
```

[39]:

department_desc	Total 2016
Arts	780691.05

```
City Attorney's Office   187298.00
City Clerk               107326.88
City Council              59149.80
City Manager's Office    392524.85
```

[21]:
```
# Just curious to see how many department there are that are listsed.
departmetns16 = AP2016["department_desc"].unique()
len(departmetns16)
```

[21]:
```
28
```

[40]:
```
totals17pivot = pd.pivot_table(data = AP2017,
                               index = 'department_desc',
                               values = 'transaction_amount',
                               aggfunc = 'sum')
totals17pivot.columns = [ "Total 2017"]


totals17pivot.head()
```

[40]:
```
                        Total 2017
department_desc
Arts                     957020.47
City Attorney's Office   159172.31
City Clerk               171415.03
City Council              74678.82
City Manager's Office    415356.12
```

[41]:
```
totals18pivot = pd.pivot_table(data = AP2018,
                               index = 'department_desc',
                               values = 'transaction_amount',
                               aggfunc = 'sum')
totals18pivot.columns = [ "Total 2018"]

totals18pivot.head()
```

[41]:
```
                        Total 2018
department_desc
Arts                     918959.30
City Attorney's Office   172353.02
City Clerk               193388.54
City Council              71878.36
City Manager's Office    428946.44
```

[42]:
```
totals19pivot = pd.pivot_table(data = AP2019,
                               index = 'department_desc',
                               values = 'transaction_amount',
```

```
                                aggfunc = 'sum')

totals19pivot.columns = [ "Total 2019"]
totals19pivot.head()
```

[42]:

department_desc	Total 2019
Arts	1069331.88
City Attorney's Office	256281.86
City Clerk	179750.73
City Council	78389.12
City Manager's Office	531766.43

Now that we have all the pivot tables with the ammounts spent in each department, let's combine all of them to compare each years spending. We will combine them by using concat. This will give our rows as departments and our columns as the totals for each year.

Then let's graph it to see where the spending was the most, and when it was.

[43]:
```
# we'll use axis 1 for columns
APtotals = pd.concat([totals19pivot, totals18pivot, totals17pivot,␣
 ↪totals16pivot], axis = 1)
APtotals.index.name = "Departments"

APtotals
#interesting that 2017 and 2016 didn't have any climate initatives
```

[43]:

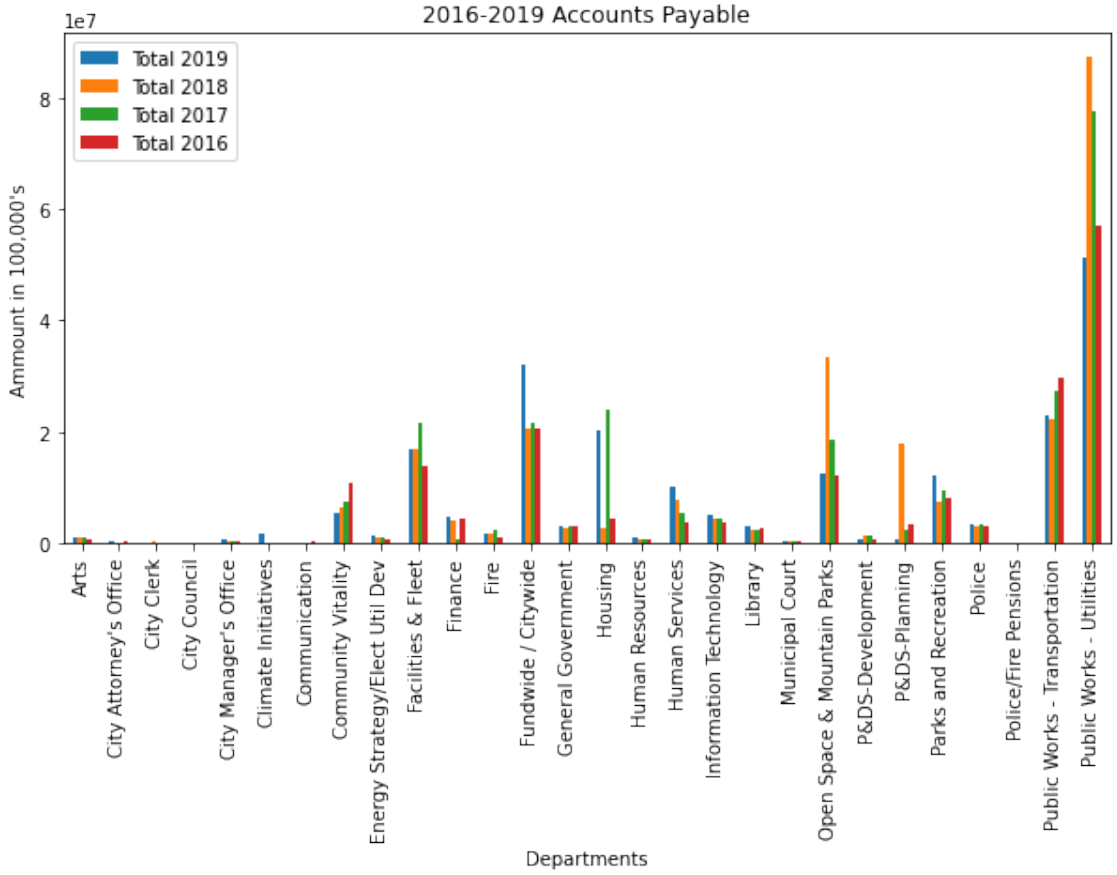
Departments	Total 2019	Total 2018	Total 2017	\
Arts	1069331.88	918959.30	957020.47	
City Attorney's Office	256281.86	172353.02	159172.31	
City Clerk	179750.73	193388.54	171415.03	
City Council	78389.12	71878.36	74678.82	
City Manager's Office	531766.43	428946.44	415356.12	
Climate Initiatives	1833204.78	1872.26	NaN	
Communication	120709.96	132230.33	176400.38	
Community Vitality	5319121.68	6308404.62	7475597.55	
Energy Strategy/Elect Util Dev	1391472.94	885779.56	914238.77	
Facilities & Fleet	16968546.99	16728318.66	21738282.30	
Finance	4858542.91	4100910.28	752858.18	
Fire	1814506.02	1713520.59	2232476.78	
Fundwide / Citywide	31957187.64	20733830.13	21540185.91	
General Government	3038830.33	2870443.72	3037362.35	
Housing	20330193.03	2585630.08	23930060.14	
Human Resources	1025229.01	602323.48	669453.79	
Human Services	10010240.81	7660753.08	5340727.88	
Information Technology	4954368.86	4406416.68	4452965.46	
Library	3008296.87	2328695.73	2476737.36	

```
Municipal Court                  298537.70    269709.38    323082.46
Open Space & Mountain Parks    12616074.20  33422207.54  18634845.64
P&DS-Development                 669145.47   1295710.26   1452293.47
P&DS-Planning                    715331.01  17720531.93   2364971.53
Parks and Recreation           12098789.56   7359708.46   9611363.36
Police                          3346876.87   2887448.56   3412848.25
Police/Fire Pensions              82690.95     84923.61    133126.02
Public Works - Transportation  23094989.92  22373086.40  27351964.86
Public Works - Utilities       51340014.29  87222883.75  77491344.25

                                Total 2016
Departments
Arts                             780691.05
City Attorney's Office           187298.00
City Clerk                       107326.88
City Council                      59149.80
City Manager's Office            392524.85
Climate Initiatives                    NaN
Communication                    269784.45
Community Vitality             10651703.24
Energy Strategy/Elect Util Dev   767317.73
Facilities & Fleet             13986484.20
Finance                         4544260.47
Fire                            1126647.99
Fundwide / Citywide            20611012.72
General Government              3052009.04
Housing                         4535054.64
Human Resources                  680752.57
Human Services                  3674551.26
Information Technology          3796077.11
Library                         2675848.61
Municipal Court                  340567.99
Open Space & Mountain Parks    12234431.24
P&DS-Development                 733917.55
P&DS-Planning                   3480881.73
Parks and Recreation            8213662.13
Police                          3142954.37
Police/Fire Pensions              46295.09
Public Works - Transportation  29505443.91
Public Works - Utilities       56967626.23
```

Now graph it.

[44]:
```
APtotals.plot(kind = 'bar', figsize =(10,5), title = "2016-2019 Accounts␣
 ↪Payable", ylabel = "Ammount in 100,000's")
#APtotals
```

[44]: <AxesSubplot:title={'center':'2016-2019 Accounts Payable'},
xlabel='Departments', ylabel="Ammount in 100,000's">



3.2 Findings About Accounts Payable

In the image above it has been apparent that there is a spike in many departments in 2018. The department that Boulder spends the most money on is public works-utilities. Then Transporatation, and Open space and mountian parks.

4 Populaiton Growth

For the population, lets put the totals in one column and the associated year in another. Apparently in the Population data from the CDC there is a common in the values, so we have to remove this.

This way we can make a data frame out of it. Then plot the increase in popultion in a line chart.

To make the dataframe, I am extracting on ly the total estimate for each year, and then putting that into a dataframe.

[46]:
```
# how to remove the commoa from numbers
est2019 = Pop2019["Boulder County, Colorado!!Total!!Estimate"][0].
 ↪replace(',',"")
est2018 = Pop2018["Boulder County, Colorado!!Total!!Estimate"][0].
 ↪replace(',',"")
est2017 = Pop2017["Boulder County, Colorado!!Total!!Estimate"][0].
 ↪replace(',',"")
est2016 = Pop2016["Boulder County, Colorado!!Total!!Estimate"][0].
 ↪replace(',',"")


PopDict = {"total population estimate": [est2016,est2017, est2018,est2019],
           "year":[2016,2017,2018,2019]}
PopDF = pd.DataFrame(PopDict)
PopDF
PopDF["total population estimate"] = PopDF["total population estimate"].
 ↪astype(int)
PopDF
```

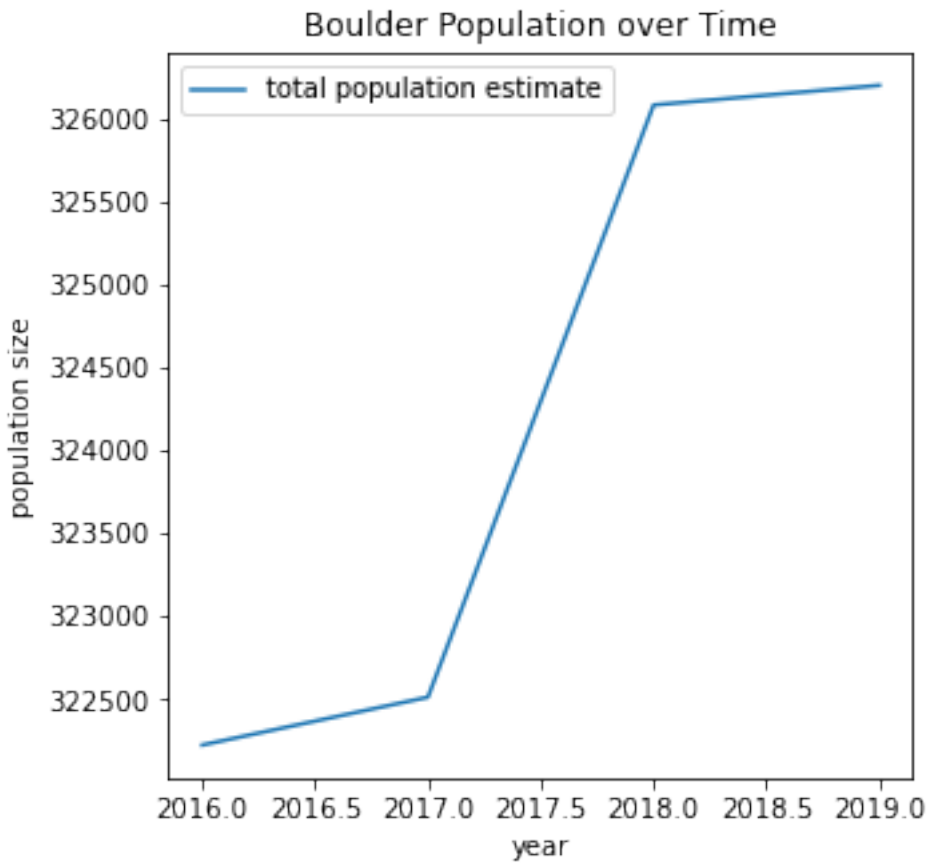
[46]:

	total population estimate	year
0	322226	2016
1	322514	2017
2	326078	2018
3	326196	2019

Now graph the total population estimate.

[47]:
```
ax  = PopDF.plot(kind = 'line', x = "year", y = "total population estimate",␣
 ↪figsize = (5,5))
ax.set(title = "Boulder Population over Time", ylabel = "population size")
```

[47]:
```
[Text(0.5, 1.0, 'Boulder Population over Time'),
 Text(0, 0.5, 'population size')]
```



Now that we have the total population over time. Can we average it out and see the percentage increse over time?

Create an average increase column that is 2016 divided by all the other population numbers. We will do the((population / 2016 pop) -1) x 100. we will subtract 1 because 2016/2016 will be one, and we want the difference of increase. Then multiply by 100 so that we get ther precentage in numbers.

Then put the averages into a seperate data frame with the associated year, called avgDF. Then let's plot it.

[48]:
```
PopDF["average population increase" ] =((PopDF["total population estimate"]/␣
↪PopDF["total population estimate"][0]) -1 ) * 100

PopDF
```

[48]:

	total population estimate	year	average population increase
0	322226	2016	0.000000
1	322514	2017	0.089378
2	326078	2018	1.195434
3	326196	2019	1.232055

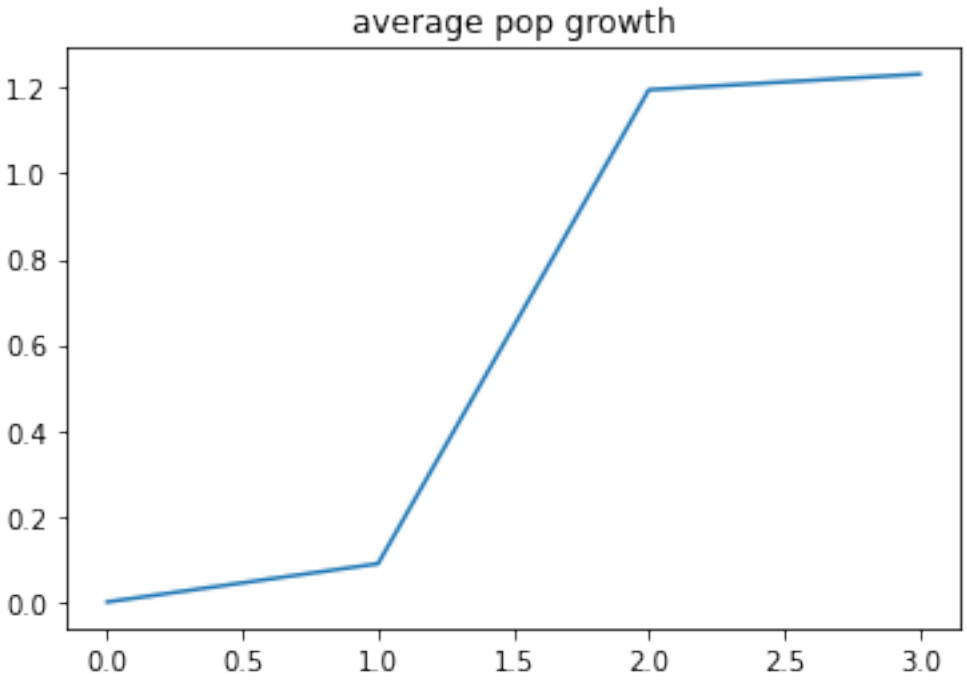
[49]:
```
# Let's make a new DF with just the year and average increase
avgDF = pd.DataFrame(data = PopDF, columns = ["average population␣
 ↪increase","year"])
#avgDF.set_index(keys = PopDF["year"])
avgDF
```

[49]:

	average population increase	year
0	0.000000	2016
1	0.089378	2017
2	1.195434	2018
3	1.232055	2019

[50]:
```
# plt.figure()
# x = avgDF['year']
# y = avgDF['average population increase']
# plt.plot(x,y)
avgDF["average population increase"].plot(kind = 'line', title = 'average pop␣
 ↪growth')
```

[50]: <AxesSubplot:title={'center':'average pop growth'}>



It is interesting that there is a rise by at least 1% of the population between 2017 and 2018. Again this is an estiamte by the census about how they think the population has risen. This can also correlate to some of the rises in spending for some of the departments.

It would be nice to see the averages for each department in the AP Totals,as it concerns against the population let's look at public safety and public works.

4.0.1 Population versus Budget uses

As we have seen from the above data, there was an nestimated 1% jump in Boulder's population in 2018. What does this mean for account items for Boulder. Where else has there been a jump in spending in 2018? It is pretty obvious that there was a jump in 2018 for Open spaces, Public Works - utilities, and P&DS Planning.

Let's take a closer look at all of thoes. For this we will need to flip our data frame so that our departments are columns and the year is the row. I used dataframe.T which is transpose, but you can also use dataframe.transpose()

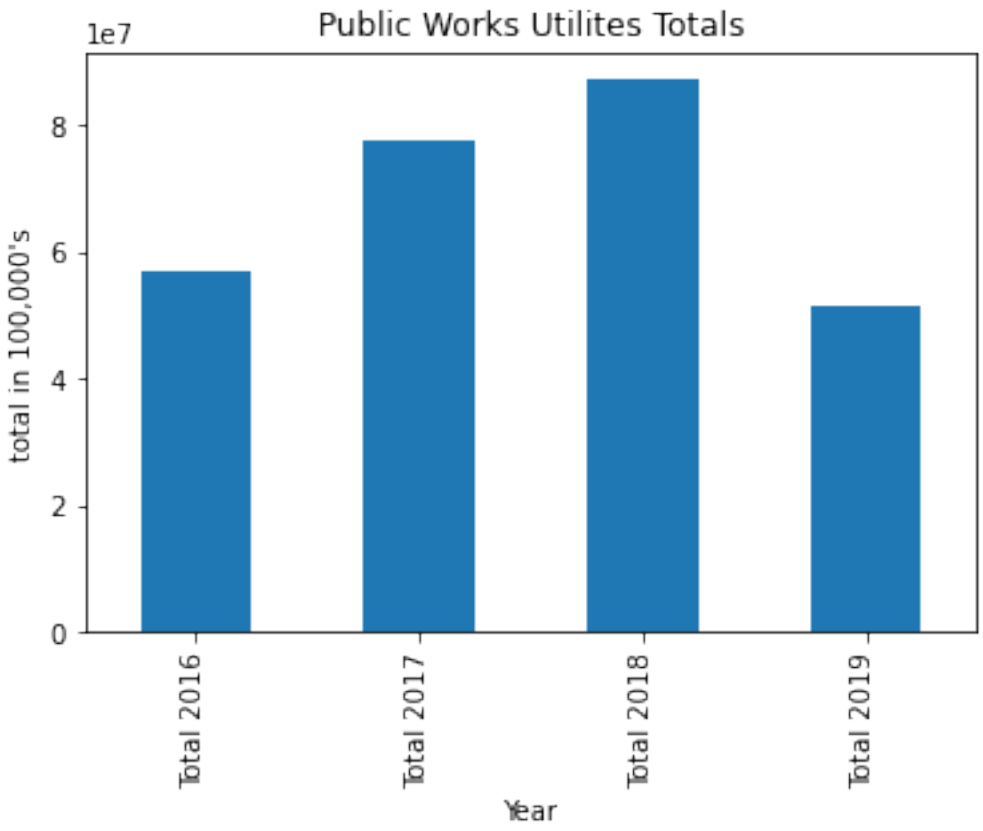
[51]:
```
# let's try to transpose  it,
# so T is transpose where it will flip columns and rows.

YearTranspose = APtotals.T
YearTranspose.index.name = "year"
YearTranspose
```

[51]:
```
Departments        Arts  City Attorney's Office  City Clerk  City Council  \
year
Total 2019   1069331.88              256281.86   179750.73      78389.12
Total 2018    918959.30              172353.02   193388.54      71878.36
Total 2017    957020.47              159172.31   171415.03      74678.82
Total 2016    780691.05              187298.00   107326.88      59149.80

Departments  City Manager's Office  Climate Initiatives  Communication  \
year
Total 2019              531766.43           1833204.78      120709.96
Total 2018              428946.44              1872.26      132230.33
Total 2017              415356.12                  NaN      176400.38
Total 2016              392524.85                  NaN      269784.45

Departments  Community Vitality  Energy Strategy/Elect Util Dev  \
year
Total 2019          5319121.68                      1391472.94
Total 2018          6308404.62                       885779.56
Total 2017          7475597.55                       914238.77
Total 2016         10651703.24                       767317.73

Departments  Facilities & Fleet  …     Library  Municipal Court  \
year                            …
Total 2019          16968546.99  …  3008296.87        298537.70
Total 2018          16728318.66  …  2328695.73        269709.38
Total 2017          21738282.30  …  2476737.36        323082.46
Total 2016          13986484.20  …  2675848.61        340567.99
```

```
Departments  Open Space & Mountain Parks  P&DS-Development  P&DS-Planning  \
year
Total 2019                   12616074.20         669145.47      715331.01
Total 2018                   33422207.54        1295710.26    17720531.93
Total 2017                   18634845.64        1452293.47     2364971.53
Total 2016                   12234431.24         733917.55     3480881.73

Departments  Parks and Recreation      Police  Police/Fire Pensions  \
year
Total 2019            12098789.56  3346876.87              82690.95
Total 2018             7359708.46  2887448.56              84923.61
Total 2017             9611363.36  3412848.25             133126.02
Total 2016             8213662.13  3142954.37              46295.09

Departments  Public Works - Transportation  Public Works - Utilities
year
Total 2019                     23094989.92              51340014.29
Total 2018                     22373086.40              87222883.75
Total 2017                     27351964.86              77491344.25
Total 2016                     29505443.91              56967626.23

[4 rows x 28 columns]
```

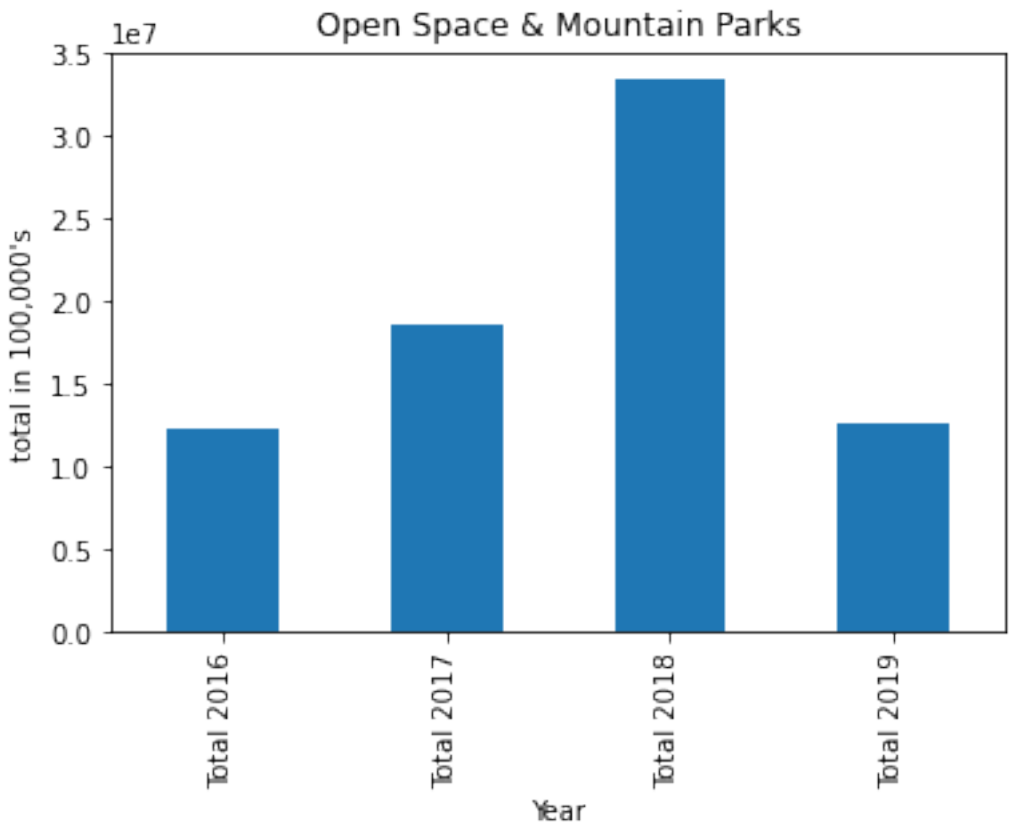
[52]:
```
# now that it is flipped we can graph just certain columns
# the [::-1] will reverse the index for us.

YearTranspose["Public Works - Utilities"][::-1].plot(kind = 'bar', title  =␣
↪"Public Works Utilites Totals",
                                                     ylabel = "total in␣
↪100,000's",
                                                     xlabel = "Year")
```

[52]:
```
<AxesSubplot:title={'center':'Public Works Utilites Totals'}, xlabel='Year',
ylabel="total in 100,000's">
```



[53]:
```
YearTranspose["Open Space & Mountain Parks"][::-1].plot(kind = 'bar', title  =␣
↪"Open Space & Mountain Parks",
                                                        ylabel = "total in␣
↪100,000's",
                                                        xlabel = "Year")
```

[53]:
```
<AxesSubplot:title={'center':'Open Space & Mountain Parks'}, xlabel='Year',
ylabel="total in 100,000's">
```



Both the open space and public works accounts payable, show spike in activity during 2018. Let's load our population numbers into to our YearTranspose DF.

[57]:
```
# let's see if we can combine some of this data to make a population and␣
 ↪spenditure table
# we can just add a column to the Year Transpose for the population estimates

# I think i have to move something around in the POP DF
# YearPop
# YearPop["Pop"] = PopDF["total population estimate"]
yearList = ["Total 2016","Total 2017","Total 2018","Total 2019"]
# YearPop

# DF = pd.DataFrame(YearPop)
# DF

newDF = PopDF["total population estimate"]
newDF = pd.DataFrame(newDF)
newDF["year"] = yearList
newDF
#["year"] = yearList
```

[57]:
```
   total population estimate        year
0                     322226  Total 2016
1                     322514  Total 2017
2                     326078  Total 2018
3                     326196  Total 2019
```

[60]:
```
# maybe using concat will help us
PopAPTotals =pd.merge(YearTranspose,
                      newDF,
                      on = ["year"])
PopAPTotals
#PopAPTotals.drop(axis = 1, columns = ["Est Population", "est pop"])
```

[60]:

	year	Arts	City Attorney's Office	City Clerk	City Council
0	Total 2019	1069331.88	256281.86	179750.73	78389.12
1	Total 2018	918959.30	172353.02	193388.54	71878.36
2	Total 2017	957020.47	159172.31	171415.03	74678.82
3	Total 2016	780691.05	187298.00	107326.88	59149.80

	City Manager's Office	Climate Initiatives	Communication
0	531766.43	1833204.78	120709.96
1	428946.44	1872.26	132230.33
2	415356.12	NaN	176400.38
3	392524.85	NaN	269784.45

	Community Vitality	Energy Strategy/Elect Util Dev	…	Municipal Court
0	5319121.68	1391472.94	…	298537.70
1	6308404.62	885779.56	…	269709.38
2	7475597.55	914238.77	…	323082.46
3	10651703.24	767317.73	…	340567.99

	Open Space & Mountain Parks	P&DS-Development	P&DS-Planning
0	12616074.20	669145.47	715331.01
1	33422207.54	1295710.26	17720531.93
2	18634845.64	1452293.47	2364971.53
3	12234431.24	733917.55	3480881.73

	Parks and Recreation	Police	Police/Fire Pensions
0	12098789.56	3346876.87	82690.95
1	7359708.46	2887448.56	84923.61
2	9611363.36	3412848.25	133126.02
3	8213662.13	3142954.37	46295.09

	Public Works - Transportation	Public Works - Utilities
0	23094989.92	51340014.29
1	22373086.40	87222883.75
2	27351964.86	77491344.25

```
3                    29505443.91                56967626.23

   total population estimate
0                      326196
1                      326078
2                      322514
3                      322226

[4 rows x 30 columns]
```

Now that we have all the data totals in one data frame called PopAPTotals, we can now plot things based on their growth. Let's plot Public works utilities with the total population estimate.

So I realized that I'm dealing with millions of dollars againts only 300,000 people. So how do we alter it so that we can see the average spike for these totals. Do we create another column that has the average increase.

[62]:
```
PopAPTotals["average Utilites"] = ((PopAPTotals["Public Works - Utilities"]/␣
 ↪PopAPTotals["Public Works - Utilities"][3]) - 1) *100
PopAPTotals
```

[62]:
```
          year        Arts  City Attorney's Office  City Clerk  City Council  \
0  Total 2019  1069331.88                256281.86   179750.73      78389.12
1  Total 2018   918959.30                172353.02   193388.54      71878.36
2  Total 2017   957020.47                159172.31   171415.03      74678.82
3  Total 2016   780691.05                187298.00   107326.88      59149.80

   City Manager's Office  Climate Initiatives  Communication  \
0              531766.43           1833204.78      120709.96
1              428946.44              1872.26      132230.33
2              415356.12                  NaN      176400.38
3              392524.85                  NaN      269784.45

   Community Vitality  Energy Strategy/Elect Util Dev  …  \
0         5319121.68                      1391472.94  …
1         6308404.62                       885779.56  …
2         7475597.55                       914238.77  …
3        10651703.24                       767317.73  …

   Open Space & Mountain Parks  P&DS-Development  P&DS-Planning  \
0                  12616074.20         669145.47      715331.01
1                  33422207.54        1295710.26    17720531.93
2                  18634845.64        1452293.47     2364971.53
3                  12234431.24         733917.55     3480881.73

   Parks and Recreation      Police  Police/Fire Pensions  \
0           12098789.56  3346876.87              82690.95
1            7359708.46  2887448.56              84923.61
```

```
2            9611363.36  3412848.25             133126.02
3            8213662.13  3142954.37              46295.09

   Public Works - Transportation  Public Works - Utilities  \
0                    23094989.92               51340014.29
1                    22373086.40               87222883.75
2                    27351964.86               77491344.25
3                    29505443.91               56967626.23

   total population estimate  average Utilites
0                     326196         -9.878614
1                     326078         53.109563
2                     322514         36.026985
3                     322226          0.000000

[4 rows x 31 columns]
```

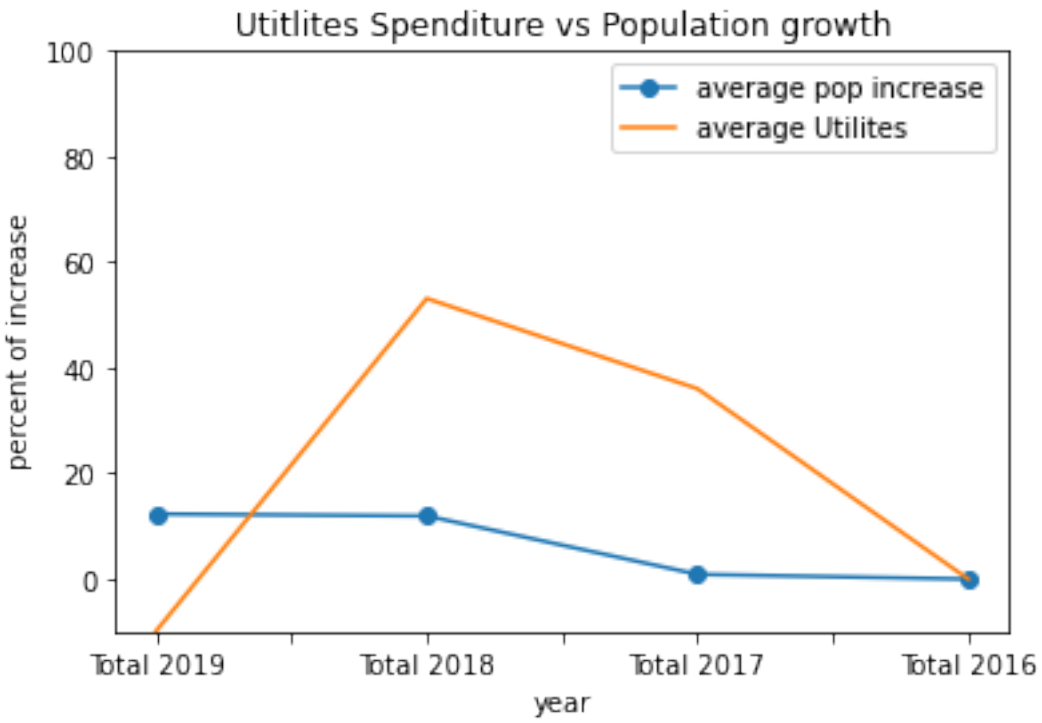
[70]:
```
PopAPTotals["average pop increase"] = ((PopAPTotals["total population␣
↪estimate"]/ PopAPTotals["total population estimate"][3])-1)*1000

PopAPTotals["average pop increase"]
```

[70]:
```
0    12.320545
1    11.954343
2     0.893783
3     0.000000
Name: average pop increase, dtype: float64
```

For the average utilites, I did the percentage increase from 2016, and for the average pop increase I multiplied it by 1000 so that it would show up on the scale for our graph. Normaly the actual percentage would be around 1% so this was needed to show growth.

[64]:
```
import numpy as np
import matplotlib.pyplot as plt

ax = PopAPTotals[['year','average pop increase']].plot(x = 'year', linestyle =␣
↪'-', marker = 'o')
PopAPTotals[['year', 'average Utilites']].plot(x = 'year',kind = 'line', ax =␣
↪ax)
ax.set_ylim([-10, 100])
ax.set(title =  "Utitlites Spenditure vs Population growth", xlabel = 'year',␣
↪ylabel = ' percent of increase')
```

[64]:
```
[Text(0.5, 1.0, 'Utitlites Spenditure vs Population growth'),
 Text(0.5, 0, 'year'),
 Text(0, 0.5, ' percent of increase')]
```



This grpah depicts that as there as a spike in population in 2018, there was also a spike in the city spending money on Public works utilites. It would be intersting to also compare more items to population increase. So let's also percentage out transpotation, and P&DS Planning, and add that to the graph.

[68]:
```
PopAPTotals["Transportation avg"] = ((PopAPTotals["Public Works -␣
↪Transportation"]/ PopAPTotals["Public Works - Transportation"][3])-1)*100
PopAPTotals["Transportation avg"]
```

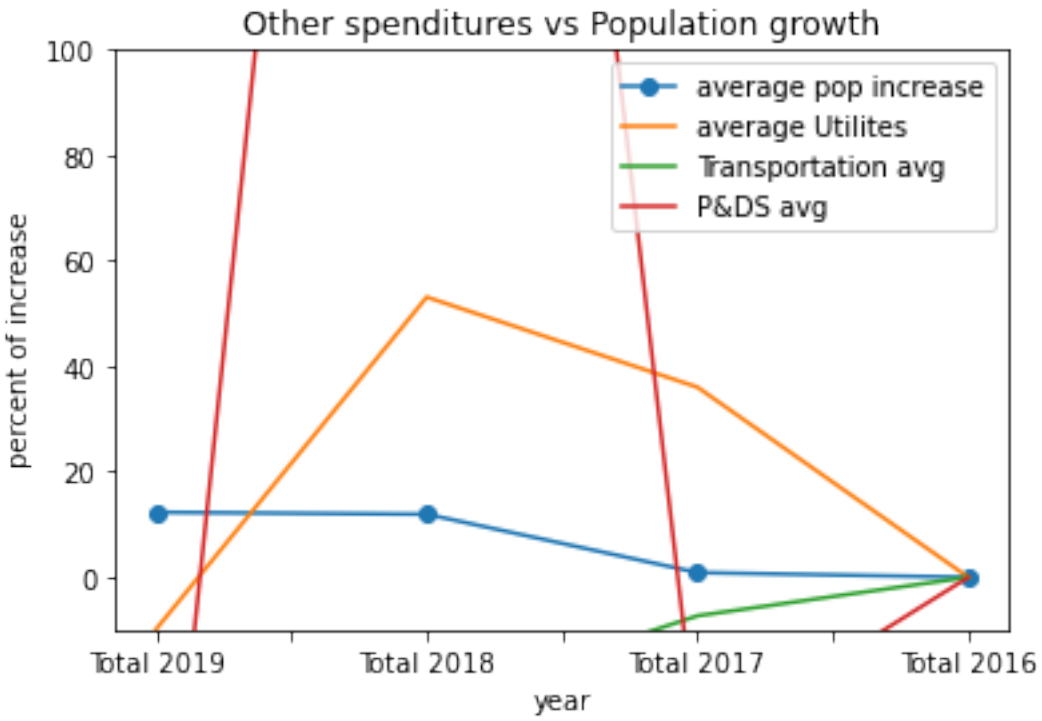
[68]:
```
0   -21.726343
1   -24.173022
2    -7.298582
3     0.000000
Name: Transportation avg, dtype: float64
```

[69]:
```
PopAPTotals["P&DS avg"] = ((PopAPTotals["P&DS-Planning"]/␣
↪PopAPTotals["P&DS-Planning"][3])-1)*100
PopAPTotals["P&DS avg"]
```

[69]:
```
0    -79.449718
1    409.081701
2    -32.058262
3      0.000000
Name: P&DS avg, dtype: float64
```

[73]:
```
ax = PopAPTotals[['year','average pop increase']].plot(x = 'year', linestyle =␣
↪'-', marker = 'o')
PopAPTotals[['year', 'average Utilites','Transportation avg', 'P&DS avg']].
↪plot(x = 'year',kind = 'line', ax = ax)
ax.set_ylim([-10, 100])
ax.set(title =  "Other spenditures vs Population growth", xlabel = 'year',␣
↪ylabel = ' percent of increase')
```

[73]:
```
[Text(0.5, 1.0, 'Other spenditures vs Population growth'),
 Text(0.5, 0, 'year'),
 Text(0, 0.5, ' percent of increase')]
```



After getting the percentage increase for transportion and P&DS planning, we can see that there are some items that suffered, that could have been in the public's interest, and others that spiked with the population growth.

4.1 Conclusions

The origional research question was to find out how has Boulder spent its money in the past 4 years? Does this pertain to the population growth within the community? Are there items that were prioritized and now being funded less?

As we can see in the Other spenditures vs Population growth graph, there are some deprtments that were funded more, and substantily, while others tanked. I only chose a couple of departments to focus on that I thought were in the publics best interest. The transpotation department had a

24% decrease in spending in 2018, the year that the popultion in Boulder increased by over a 1% or about 4,000 people. Transpotion was a deprtment that was a priority but now being funded less.

Looking at another department in the publics interest was Public works - Utilties. This is such things as gas and electricity. This department saw over a 50% increase in spending in 2018. To be expected form a department that contributes greatly to the living population in Boulder.

To me it is suprising to see that there are some deparmtnets, like the police and community vitality, that have been funded less. Referencing the 2016-2019 Accounts Payable graph, the orange bars tells us what was spent in 2018 and where.

In this notebook, I showed the population increse, and where the population had an estimate spike. Using the Boulder's accounts payable excel spreadsheet, I graphed the total spending in each department, and took the most important to the community and compared that with the growth in population.

There may be an estimate budget on the city of Boulder's website, that can show us where they planned to spend their money. We could then compare that to how they actually did, in accourdance to the population growth.

The end result showed us how Boulder spent their money, and it what department they thought needed to be spent. This could be in contridiction to the growth of the population, or it could have correlated with it.