Baez-Pitch-Selection

February 4, 2025

[1]:

```
## Chris Kellogg

## ##########################################################################
## ##########################################################################
##
## Python Refresher
##
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##
## This is a refresher of data analysis and visualization using Python.
##
## With the dataset that you choose, perform the following steps:
##
## 1. Write a summary of your data and identify at least two questions to
##    explore visually with your data.
##
## 2. Create a histogram or bar graph from your data.
##
## 3. Create a boxplot from your data.
##
## 4. Create a bivariate plot from your data.
##
## 5. Create any additional visualizations that will help to answer the
##    question(s) you want to answer.
##
## 6. Summarize your results and make a conclusion. Explain how you arrived
##    at this conclusion and how your visualizations support your conclusion.
##
```

[2]:

```
##
## load necessary packages
##

# import and alias Pandas
import pandas as pd
```

```python
# import and alias NumPy
import numpy as np

# import and alias the plotting package
import matplotlib.pyplot as plt

# import from pybaseball API
import pybaseball
from pybaseball import  playerid_lookup
from pybaseball import  statcast_batter
```

[3]:

```python
##
## read and clean up Javy Báez's Season Batting Stats
## -- downloaded from Baseball Reference web page
## -- https://www.baseball-reference.com/players/b/baezja01.shtml
##

# read the Season Batting Stats file
seasons = pd.read_csv('BaezSeasonBatting.csv')

# drop the sub-total rows from the year he was traded
seasons = seasons.query(
    'Year not in (2014, 2021) or Tm == "TOT"'
)

# keep only the fields we want
seasons = pd.DataFrame(seasons[[
    'Year',
    'PA',
    'AB',
    'HR',
    'BB',
    'SO',
    'BA',
    'OBP',
    'SLG',
    'OPS',
    'OPS+'
]])

# preview the season batting stats
seasons
```

[3]:

```
   Year   PA   AB  HR  BB   SO     BA    OBP    SLG    OPS  OPS+
1  2015   80   76   1   4   24  0.289  0.325  0.408  0.733   102
2  2016  450  421  14  15  108  0.273  0.314  0.423  0.737    94
3  2017  508  469  23  30  144  0.273  0.317  0.480  0.796   102
```

```
4   2018  645  606  34  29  167  0.290  0.326  0.554  0.881   129
5   2019  561  531  29  28  156  0.281  0.316  0.531  0.847   115
6   2020  235  222   8   7   75  0.203  0.238  0.360  0.599    59
7   2021  547  502  31  28  184  0.265  0.319  0.494  0.813   117
10  2022  590  555  17  26  147  0.238  0.278  0.393  0.671    91
11  2023  547  510   9  24  125  0.222  0.267  0.325  0.593    63
12  2024  289  272   6  12   69  0.184  0.221  0.294  0.516    44
```

[4]:

```python
##
## get Javy Báez's MLBAM player ID
##

# look up player id
playerid_lookup('Báez', 'Javier')
```

```
Gathering player lookup table. This may take a moment.
```

[4]:

```
  name_last name_first  key_mlbam key_retro key_bbref  key_fangraphs  \
0      báez     javier     595879  baezj001  baezja01          12979

   mlb_played_first  mlb_played_last
0            2014.0           2024.0
```

[5]:

```python
##
## get a list all regular-season pitches thrown to Javy Báez in his career
##

# get data from the pybaseball API
javy_baez_career = statcast_batter('2015-01-01', '2024-12-31', 595879)

# keep only the pitches thrown during regular-season games
pitches = javy_baez_career.query('game_type == "R"')

# keep only the fields we want
pitches = pd.DataFrame(pitches[[
    'game_year',
    'pitch_type',
    'release_speed',
    'release_spin_rate',
    'description',
    'zone',
    'type',
    'bb_type',
    'plate_x',
    'plate_z'
]])

# rename the year column
```

```
pitches.rename(columns={"game_year": "Year"}, inplace=True)

# mark pitches as fastballs and curveballs where appropriate
pitches['fastball'] = pitches['pitch_type'].apply(
    lambda x: 1 if x in ("FF", "SI", "FC") else 0
)
pitches['breaking_ball'] = pitches['pitch_type'].apply(
    lambda x: 1 if x in ("CU", "KC", "CS", "SL", "ST", "SV") else 0
)

# drop pitches where important info is missing
pitches.dropna(subset=[
    'pitch_type',
    'release_speed',
    'zone',
    'plate_x',
    'plate_z',
    'release_spin_rate'
], inplace=True)

# preview the pitches
pitches
```

Gathering Player Data

[5]:

```
      Year pitch_type  release_speed  release_spin_rate      description  \
38    2020         CH           85.9             1534.0    hit_into_play
39    2020         SI           89.5             2153.0             ball
40    2020         CH           85.5             1629.0    called_strike
41    2020         FF           95.0             2202.0             ball
42    2020         FF           94.9             2127.0             foul
…    …        …            …                …              …
7591  2021         SI           92.1             1854.0  swinging_strike
7592  2021         FF           93.1             2131.0             ball
7593  2021         FF           96.9             2231.0             ball
7594  2021         CU           74.0             2314.0  swinging_strike
7595  2021         CU           77.5             2241.0    called_strike

      zone type     bb_type  plate_x  plate_z  fastball  breaking_ball
38    12.0    X  line_drive     1.05     2.81         0              0
39    12.0    B         NaN     1.25     3.38         1              0
40     9.0    S         NaN     0.62     1.88         0              0
41    14.0    B         NaN     1.63     1.77         1              0
42     7.0    S         NaN    -0.46     2.11         1              0
…    …  …         …      …      …       …            …
7591   4.0    S         NaN    -0.34     2.40         1              0
7592  11.0    B         NaN    -0.20     4.94         1              0
```

```
7593  12.0    B         NaN     1.16     3.05          1              0
7594  14.0    S         NaN     1.31     1.30          0              1
7595   1.0    S         NaN    -0.47     2.89          0              1

[15715 rows x 12 columns]
```

[6]:

```
##
## get the aggregate info for all pitches
##

# get the count for each year
pitch_data = pitches \
    .groupby(['Year']) \
    .agg(
        pitch_count = ('pitch_type', 'count')
    ) \
    .reset_index()

# preview the pitches data
pitch_data
```

[6]:

```
   Year  pitch_count
0  2015          279
1  2016         1510
2  2017         1784
3  2018         2160
4  2019         1935
5  2020          905
6  2021         2069
7  2022         2092
8  2023         1961
9  2024         1020
```

[7]:

```
##
## get the aggregate info for fastballs
##

# get the mean velocity and count for each year
fastball_data = pitches \
    .query('fastball == 1') \
    .groupby(['Year']) \
    .agg(
        mean_fb_velo = ('release_speed', 'mean'),
        fb_count = ('pitch_type', 'count')
    ) \
    .reset_index()
```

```
# preview the fastball data
fastball_data
```

```
[7]:    Year  mean_fb_velo  fb_count
     0  2015     93.405263       171
     1  2016     92.846911       874
     2  2017     93.121673       992
     3  2018     92.904718      1187
     4  2019     93.051683      1099
     5  2020     92.624580       476
     6  2021     93.222592      1111
     7  2022     92.772956       954
     8  2023     93.215733      1017
     9  2024     93.280591       474
```

```
[8]: ##
     ## get the aggregate info for breaking balls
     ##

     # get the mean spin rate and count for each year
     breaking_ball_data = pitches \
         .query('breaking_ball == 1') \
         .groupby(['Year']) \
         .agg(
             mean_bb_spin = ('release_spin_rate', 'mean'),
             bb_count = ('pitch_type', 'count')
         ) \
         .reset_index()

     # preview the breaking ball data
     breaking_ball_data
```

```
[8]:    Year  mean_bb_spin  bb_count
     0  2015   2141.298701        77
     1  2016   2343.246696       454
     2  2017   2378.603741       588
     3  2018   2404.890039       773
     4  2019   2485.948678       643
     5  2020   2545.185915       355
     6  2021   2473.761836       697
     7  2022   2467.678490       874
     8  2023   2455.187679       698
     9  2024   2487.671946       442
```

```
[9]: ##
     ## merge the aggregates to the season data
     ##
```

```python
# add pitch data onto the season data
df = pd.merge(
    seasons,
    pitch_data,
    how = 'left',
    on = ['Year']
)

# add fastball data onto the season data
df = pd.merge(
    df,
    fastball_data,
    how = 'left',
    on = ['Year']
)

# add breaking ball data onto the list of 1000-pitch seasons
df = pd.merge(
    df,
    breaking_ball_data,
    how = 'left',
    on = ['Year']
)

# add columns for fastballs and breaking balls as percentage
df['fb_percent'] = df.fb_count / df.pitch_count
df['bb_percent'] = df.bb_count / df.pitch_count

# keep only the fields we want
df = pd.DataFrame(df[[
    'Year',
    'PA',
    'BA',
    'OBP',
    'OPS',
    'OPS+',
    'mean_fb_velo',
    'mean_bb_spin',
    'pitch_count',
    'fb_count',
    'fb_percent',
    'bb_count',
    'bb_percent'
]])

df
```

[9]:

```
   Year   PA     BA    OBP    OPS  OPS+  mean_fb_velo  mean_bb_spin  \
0  2015   80  0.289  0.325  0.733   102     93.405263   2141.298701
1  2016  450  0.273  0.314  0.737    94     92.846911   2343.246696
2  2017  508  0.273  0.317  0.796   102     93.121673   2378.603741
3  2018  645  0.290  0.326  0.881   129     92.904718   2404.890039
4  2019  561  0.281  0.316  0.847   115     93.051683   2485.948678
5  2020  235  0.203  0.238  0.599    59     92.624580   2545.185915
6  2021  547  0.265  0.319  0.813   117     93.222592   2473.761836
7  2022  590  0.238  0.278  0.671    91     92.772956   2467.678490
8  2023  547  0.222  0.267  0.593    63     93.215733   2455.187679
9  2024  289  0.184  0.221  0.516    44     93.280591   2487.671946

   pitch_count  fb_count  fb_percent  bb_count  bb_percent
0          279       171    0.612903        77    0.275986
1         1510       874    0.578808       454    0.300662
2         1784       992    0.556054       588    0.329596
3         2160      1187    0.549537       773    0.357870
4         1935      1099    0.567959       643    0.332300
5          905       476    0.525967       355    0.392265
6         2069      1111    0.536974       697    0.336878
7         2092       954    0.456023       874    0.417782
8         1961      1017    0.518613       698    0.355941
9         1020       474    0.464706       442    0.433333
```

[10]:

```
##
## subset the data for just the specific question we want to address
##

# keep only the fields we want
df = pd.DataFrame(df[[
    'Year',
    'OPS+',
    'bb_percent'
]])

df
```

[10]:

```
   Year  OPS+  bb_percent
0  2015   102    0.275986
1  2016    94    0.300662
2  2017   102    0.329596
3  2018   129    0.357870
4  2019   115    0.332300
5  2020    59    0.392265
6  2021   117    0.336878
7  2022    91    0.417782
8  2023    63    0.355941
```

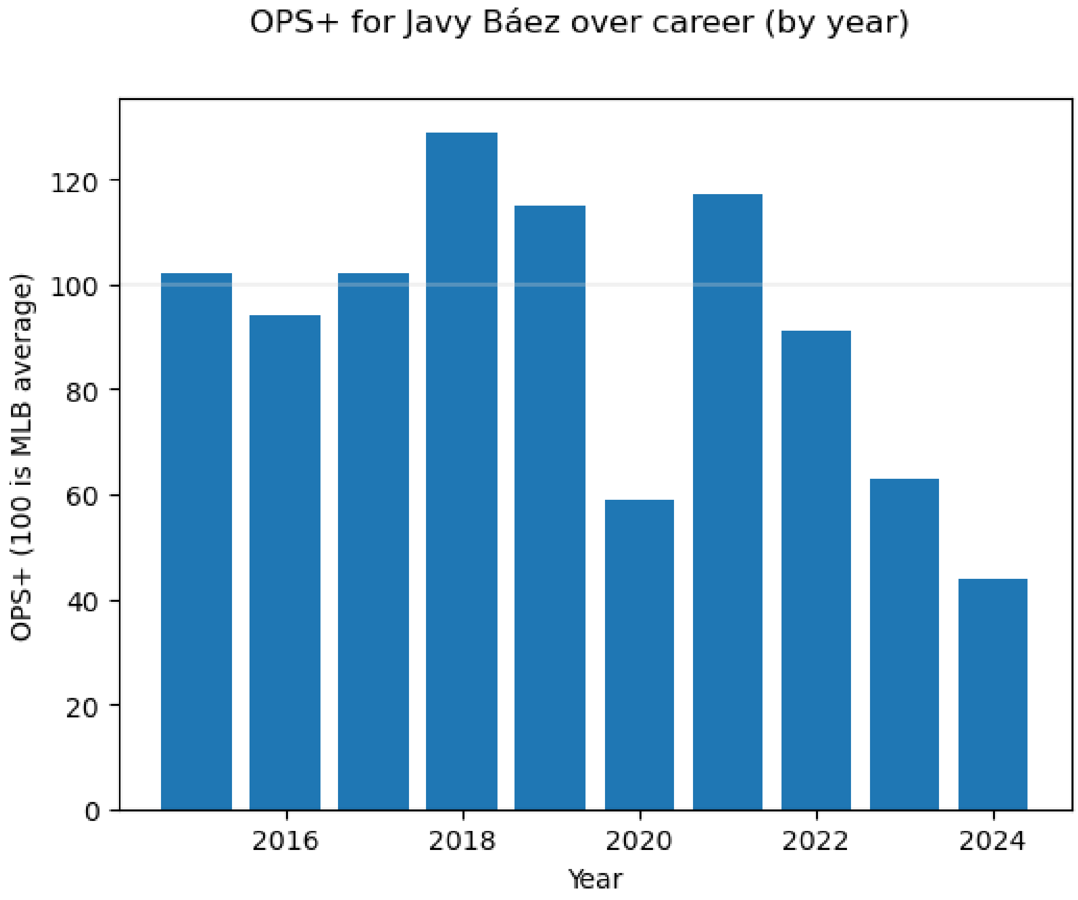
```
9  2024    44    0.433333
```

[11]:

```
##
## 1. Write a summary of your data and identify at least two questions to
##    explore visually with your data.
##

# I've been a Cubs fan for about 40 years or so, and they've only won the
# World Series once in that time.  One of the most exciting players on that
# winning team was Javier Báez.  He was a good hitter, and many Cubs fans were
# disappointed when Báez was traded by the Cubs instead of being signed to a
# contract extension in 2021.  In the three seasons since the trade, Báez has
# been a much worse hitter than he was during his time in Chicago, often
# looking overmatched and swinging at pitches that are unhittable.  I built a
# data set (from Baseball Reference and Statcast data) to see whether the
# decline in performance can be explained by the selection and quality of
# pitches thrown to Báez.

## ##############################################################################
# Q. In three years since 2021, are MLB pitchers throwing Javier Báez more
#    breaking pitches, explaining his decline in performance?
## ##############################################################################
```

[12]:

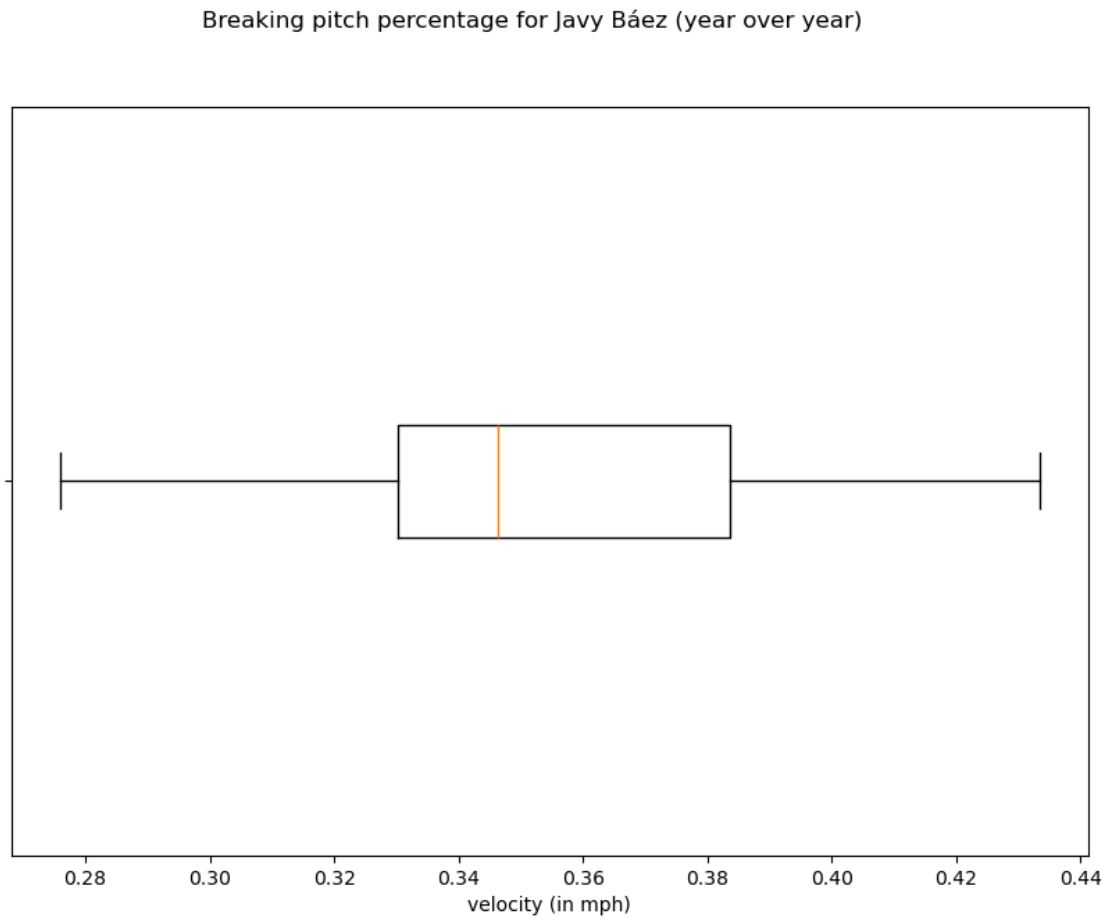
```
##
## 2. Create a histogram or bar graph from your data.
##

# plot the OPS+ for each year
plt.bar(df['Year'], df['OPS+'])

# add a chart title
plt.suptitle('OPS+ for Javy Báez over career (by year)')

# add the axis labels
plt.xlabel('Year')
plt.ylabel('OPS+ (100 is MLB average)')

# add the MLB average
plt.axhline(y = 100, color = 'lightgray', alpha=0.3)

# show the plot
plt.show()
```



[13]:

```
##
## 3. Create a boxplot from your data.
##

# box plot the mean fastball velocity
fig = plt.figure(figsize =(10, 7))
ax = fig.add_subplot(111)
plt.boxplot(df.bb_percent, vert = 0)

# add a chart title
plt.suptitle('Breaking pitch percentage for Javy Báez (year over year)')

# remove y-axis labels
ax.set_yticklabels([''])
plt.ylabel('')

# add the x-axis label
plt.xlabel('velocity (in mph)')
```

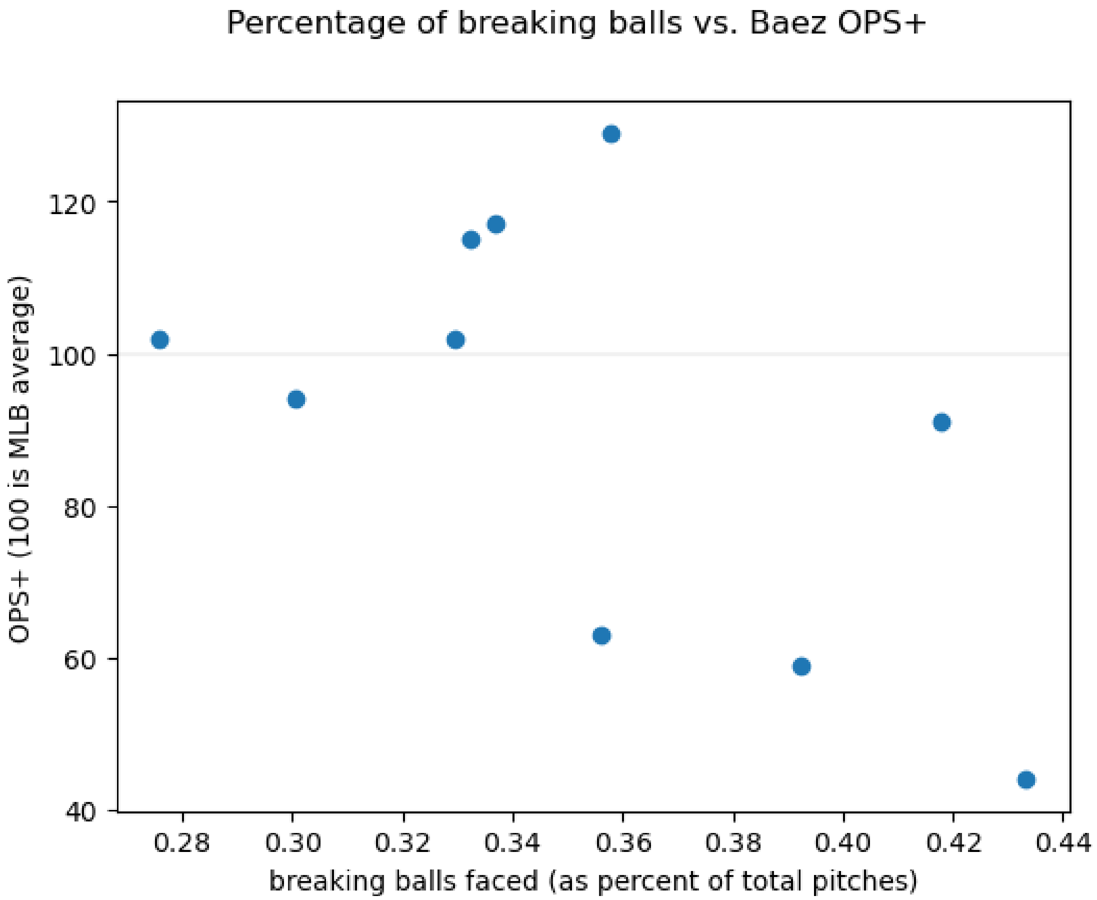
```
# show plot
plt.show()
```



[14]:

```
##
## 4. Create a bivariate plot from your data.
##

# plot the percentage of breaking balls against OPS+
plt.scatter(df['bb_percent'], df['OPS+'])

# add a chart title
plt.suptitle('Percentage of breaking balls vs. Baez OPS+')

# add the x-axis label
plt.xlabel('breaking balls faced (as percent of total pitches)')
plt.ylabel('OPS+ (100 is MLB average)')
```

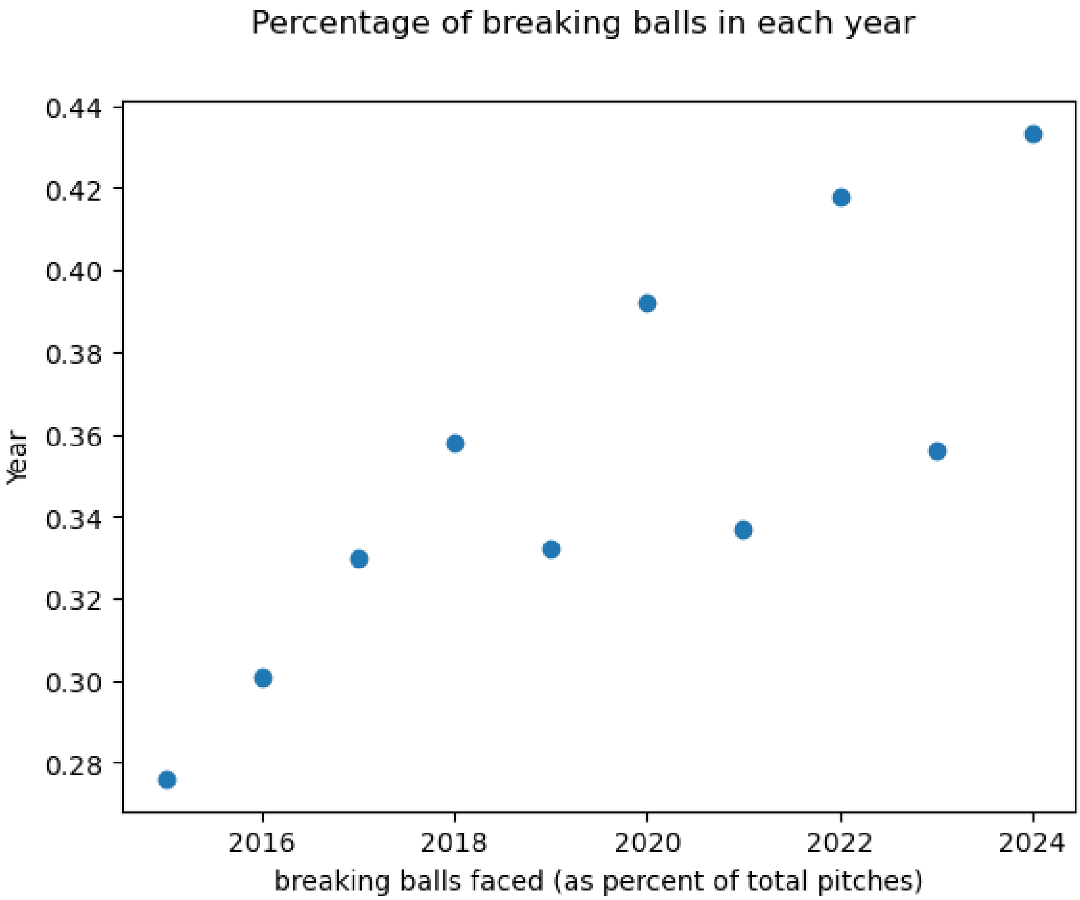
```
# add the MLB average
plt.axhline(y = 100, color = 'lightgray', alpha=0.3)

# show plot
plt.show()
```



[15]:

```
##
## 5. Create any additional visualizations that will help to answer the
##    question(s) you want to answer.
##

# plot the percentage of breaking balls in each year
plt.scatter(df['Year'], df['bb_percent'])

# add a chart title
plt.suptitle('Percentage of breaking balls in each year')

# add the x-axis label
```

```
plt.xlabel('breaking balls faced (as percent of total pitches)')
plt.ylabel('Year')

# show plot
plt.show()
```



[16]:
```
##
## 6. Summarize your results and make a conclusion. Explain how you arrived
##    at this conclusion and how your visualizations support your conclusion.
##

# Based on the bar chart above, we can see that Báez's OPS+ (sort of an
# overall measure of offensive value, normalized against the mean performance
# of all MLB hitters) has been declining sharply since the 2021 season, when
# he was traded from the Cubs.  From the box-and-whisker plot, we can see that
# the percentage of breaking balls thrown by MLB pitcher to Báez has varied
# widely over his career, and from the first scatter plot, it's pretty evident
# that Báez generally performs worse offensively when the pitch mix includes
# more breaking balls.  The second scatter plot suggests that MLB pitchers
# have discovered this, throwing more breaking balls to Báez as his career
# has progressed.

# In three years since 2021, MLB pitchers have thrown Javier Báez a higher
# percentage of breaking pitches than in any other three-year stretch,
# including the two highest percentages during his career.  On top of that,
# he's seen the highest percentage of breaking balls this season.

## ############################################################################
# A. It's safe to say that in three years since 2021, MLB pitchers are
#    throwing Javier Báez more breaking pitches, at least partially explaining
#    his decline in performance.
## ############################################################################
```