research

August 10, 2021

[4]:
```
#https://baseballsavant.mlb.com/csv-docs#plate_x
from pybaseball import statcast
from pybaseball import playerid_lookup
from pybaseball import statcast_pitcher, pitching_stats
from pybaseball import statcast_batter, batting_stats_range, batting_stats
from pybaseball import team_ids, teams, team_batting, team_batting_bref
from pybaseball import cache, standings, get_splits
import pandas as pd
import os
import matplotlib
from matplotlib import pyplot as plt
from matplotlib.patches import Rectangle
import matplotlib.patches as mpatchess
cache.enable()

def Average(lst):
    return(sum(lst)/len(lst))

start_date = '2019-01-01' #yy/mm/dd
end_date = '2019-12-31'
data = statcast(start_date, end_date)
#print(data.head())

#### all stats from year 2020
#stats = batting_stats(2020)
#print(stats)
#print("================================ AARON JUDGE␣
↪================================")
#### Player lookup
#print(playerid_lookup('Judge', 'Aaron'))
#print()

#### Data on player
#player_data = statcast_batter('2016-04-01', '2017-07-15', player_id = 592450)
#print(player_data)
#df, player_info_dict = get_splits('judgeaa01', player_info = True)
#print(df)
```

```
#print()

##### Turns homeruns column to a list
#HRList = df['HR'].to_list()
#print("Home runs in the last 365 days for Arron Judge: ", HRList[4])

#### Team batting stats for only 2019 season
#dataTeam = team_batting(2019)
#print(dataTeam)
#teams = team_ids(2019)
#batting = team_batting(2019).add_prefix('batting.')
#teams.merge(batting, left_on=['yearID', 'teamIDfg'], right_on=['batting.
 ↪Season', 'batting.teamIDfg'])

#print("================================ TEAM DATA␣
 ↪================================")
#dataNYY = team_batting_bref('NYY', 2019)
#print(dataNYY)
#all_hits = dataNYY['HR'].to_list()
#total = 0
#for num in all_hits:
#    total += int(num)
#print("Total home runs for NYY: ", total)

print("================================ PITCH DATA NYY␣
 ↪================================ \n")
dataNYY = team_batting_bref('NYY', 2019)
players = dataNYY['Name'].to_list()
listPLayers = []    #### all NYY players
for playerName in players:
    name = playerName.split()
    listPLayers.append(name)

#### Stores players' ID in dict... Omits 2 players - no data
playerNums = {}
for player in listPLayers:
    playerName = player[0] + " " + player[1]
    playerLookUp = playerid_lookup(player[1], player[0])
    playerNum = playerLookUp['key_mlbam'].to_list()
    if len(playerNum) != 0:
        playerNums[playerName] = playerNum[0]   #### {'key': 'value'}

#print(data.columns.get_loc('plate_x'))     #### finds index
#print(data.columns.get_loc('plate_z'))
#print(data.columns.get_loc('sz_top'))
#print(data.columns.get_loc('sz_bot'))
#print(data.columns.get_loc('balls'))
```

```
#print(data.columns.get_loc('strikes'))

index = data.index
num_rows = len(index)

YankAtBats = []      #### all yank pitches
xPosList = []        #### all x positions
zPosList = []        #### all z positions
DescList = []        #### all descriptions of pitches
topSZ = []           #### top of strike zone - predetermined
botSZ = []           #### bottom of strike zone - predetermined
pType = []           #### pitch type
Names = []           #### batter name
Count_3_2 = []
i = 0
gardyT = []
gardyB = []
for x in range(num_rows):
    ID = (data.iloc[x]).iloc[6]
    name = [key for key, v in playerNums.items() if v == ID]
    if name != [] and name[0] in playerNums:
        Names.append(name[0])
        xPosList.append((data.iloc[x]).iloc[29])
        zPosList.append((data.iloc[x]).iloc[30])
        pType.append((data.iloc[x]).iloc[0])
        DescList.append((data.iloc[x]).iloc[9])
        topSZ.append((data.iloc[x]).iloc[50])
        botSZ.append((data.iloc[x]).iloc[51])
        if ((data.iloc[x]).iloc[24]) == 3 and ((data.iloc[x]).iloc[25]) == 2:␣
 ↪#### pulls out all 3-2 counts
            Count_3_2.append(1)
        else:
            Count_3_2.append(0)
        if name[0] == "Brett Gardner":
            gardyT.append((data.iloc[x]).iloc[50])
            gardyB.append((data.iloc[x]).iloc[51])
        atBat = [Names[i], xPosList[i], zPosList[i], pType[i], DescList[i]]
        YankAtBats.append(atBat)
        i += 1

#### Classifications
classification = []
j = 0
for yankPitch in YankAtBats:
    ## strike
    if (-0.71 < xPosList[j] < 0.71) and (botSZ[j] < zPosList[j] < topSZ[j]):
```

```
        if DescList[j] == "hit_into_play" or DescList[j] == "swinging_strike"␣
↪or DescList[j] == "foul" or DescList[j] == "swinging_strike_blocked" or␣
↪DescList[j] == "foul_tip":
            classification.append("strike, good") # swung
        else:
            classification.append("strike, bad")  # didn't swing
    ## not strike
    else:
        if DescList[j] == "hit_into_play" or DescList[j] == "swinging_strike"␣
↪or DescList[j] == "foul" or DescList[j] == "swinging_strike_blocked" or␣
↪DescList[j] == "foul_tip":
            classification.append("ball, bad")    # swung
        else:
            classification.append("ball, good")   # didn't swing
    YankAtBats[j].append(classification[j])
    j += 1

#### New data frame of all NYY pitches (size = 28512, last 53 bad)
newdf = pd.DataFrame(YankAtBats[0:len(YankAtBats)-53], columns = ['Name',␣
↪'xPos', 'zPos', 'Pitch Type', 'Given Description', 'Classification'])
print("FA - Fastball, CU - Curveball, FT - Two-seam Fastball, CH - Changeup,␣
↪\nFC - Cutter, SL - Slider, FS - Splitter, KN - Knuckleball,\nFF - Four-seam␣
↪Fastball \n")
print(newdf,"\n")
```

```
This is a large query, it may take a moment to complete

  0%|          | 0/225 [00:00<?, ?it/s]

Skipping offseason dates
Skipping offseason dates

100%|     | 225/225 [01:38<00:00,  2.28it/s]

============================== PITCH DATA NYY ==============================

FA - Fastball, CU - Curveball, FT - Two-seam Fastball, CH - Changeup,
FC - Cutter, SL - Slider, FS - Splitter, KN - Knuckleball,
FF - Four-seam Fastball

                    Name  xPos  zPos Pitch Type Given Description  \
0          Gleyber Torres -0.49  3.21         FT     hit_into_play
1          Gleyber Torres  0.39  1.85         SL     called_strike
2             Aaron Judge  0.31  2.99         FF   swinging_strike
3             Aaron Judge  0.77  1.03         FC              ball
4             Aaron Judge  0.83  1.81         FC     called_strike
…                      …   …   …        …                …
28454  Edwin Encarnacion -0.58  2.31         SL     hit_into_play
28455  Edwin Encarnacion -1.11  4.14         FF              ball
```

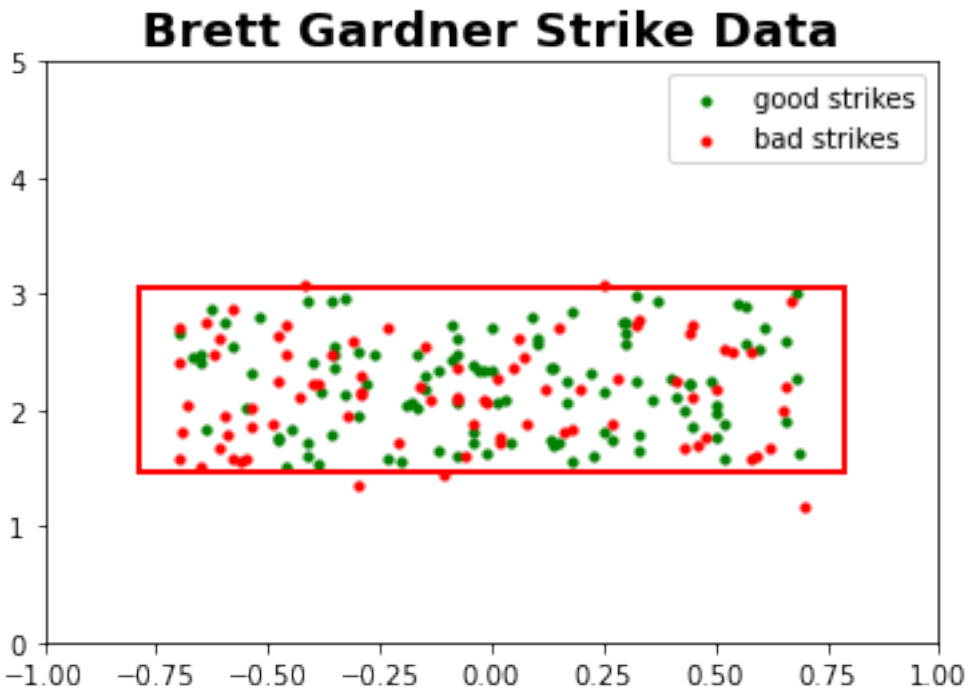
```
28456  Edwin Encarnacion -0.39  1.81         SL   swinging_strike
28457  Edwin Encarnacion  0.30  1.09         CH              ball
28458  Edwin Encarnacion  0.92  3.22         FT     called_strike

      Classification
0          ball, bad
1        strike, bad
2       strike, good
3          ball, good
4          ball, good
…                …
28454   strike, good
28455      ball, good
28456   strike, good
28457      ball, good
28458      ball, good

[28459 rows x 6 columns]
```

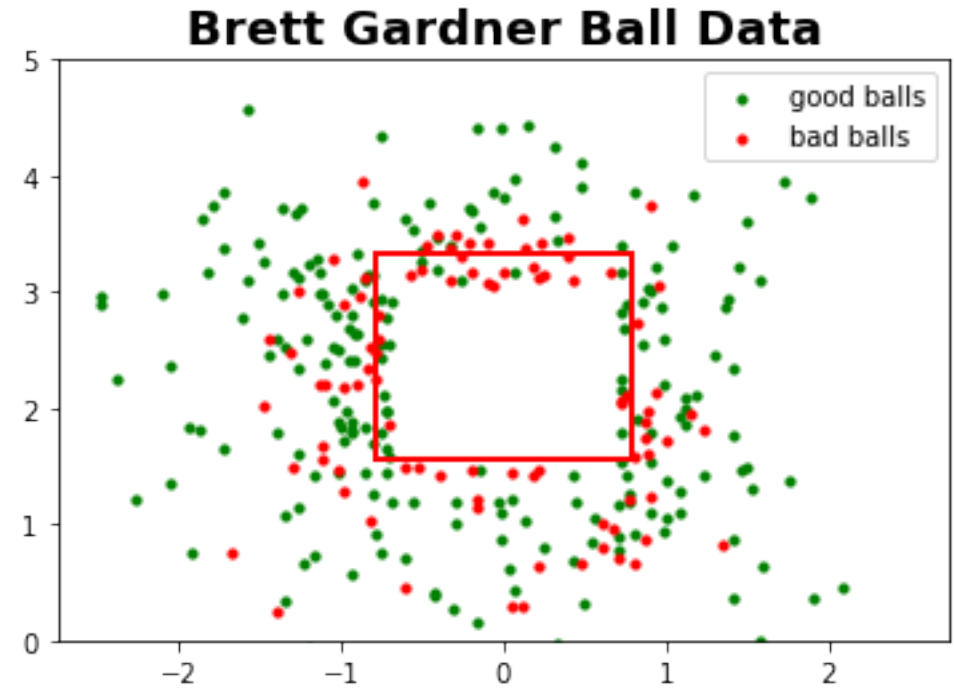
[34]:
```
#### BRETT GARDNER STATS
print("============================ BRETT GARDNER DATA␣
 ↪============================ \n")
avgTop = Average(gardyT)
avgBot = Average(gardyB)
Gardy = []
S_PitchCount = 0 # pitch count
S_Count = 0 # strike count
B_Count = 0 # ball count
goodStrikes = [] #list of tuples - (xpos, zpos)
badStrikes = []
goodBalls =[]
badBalls = []
for x in range(len(newdf)):  #### ************ add pitch coordinates as tuples␣
 ↪to color code plot ******
    if ((newdf.iloc[x]).iloc[0]) == "Brett Gardner":
        Gardy.append(newdf.loc[x, :].values.flatten().tolist())
        S_PitchCount += 1
        if ((newdf.iloc[x]).iloc[5]) == "strike, good" or ((newdf.iloc[x]).
 ↪iloc[5]) == "strike, bad":
            S_Count += 1
            if ((newdf.iloc[x]).iloc[5]) == "strike, good":
                goodStrikes.append(((newdf.iloc[x]).iloc[1], (newdf.iloc[x]).
 ↪iloc[2]))
            else:
                badStrikes.append(((newdf.iloc[x]).iloc[1], (newdf.iloc[x]).
 ↪iloc[2]))
```

```
        else:
            B_Count += 1
            if ((newdf.iloc[x]).iloc[5]) == "ball, good":
                goodBalls.append(((newdf.iloc[x]).iloc[1], (newdf.iloc[x]).
 ↪iloc[2]))
            else:
                badBalls.append(((newdf.iloc[x]).iloc[1], (newdf.iloc[x]).
 ↪iloc[2]))

#### Gardner Data Frame
GardyDF = pd.DataFrame(Gardy, columns = ['Name','xPos', 'zPos', 'Pitch Type',␣
 ↪'Given Description', 'Classification'])
#print(GardyDF.head(len(GardyDF.index)).to_string())
print("FA - Fastball, CU - Curveball, FT - Two-seam Fastball, CH - Changeup,␣
 ↪\nFC - Cutter, SL - Slider, FS - Splitter, KN - Knuckleball,\nFF - Four-seam␣
 ↪Fastball \n")
print(GardyDF)
print()

percent_Good = len(goodStrikes) / S_Count
percent_Bad = len(goodBalls) /  B_Count
print("% of "good" strikes: ", round(percent_Good,3) )
print("% of "good" balls:",  round(percent_Bad,3) )
print("(% good strikes) + (% good balls): ", round((percent_Good +␣
 ↪percent_Bad),3) )

#### Gardner Scatter Plot
#fig, ax = plt.subplots()
#plt.scatter(GardyDF['xPos'], GardyDF['zPos'])
#plt.xlabel("x position (ft)",fontweight ='bold', size=14)
#plt.ylabel("z position (ft)", fontweight ='bold',size=14)
#plt.title("Brett Gardner Pitch Data", fontweight ='bold',size=18)
#ax.add_patch(Rectangle((-0.79, 1.57), 1.58, 1.77,edgecolor =␣
 ↪'red',fill=False,lw=2))
#plt.show()

fig = plt.figure()
ax1 = fig.add_subplot(111)
ax1.set_xlim(-1,1)
ax1.set_ylim(0,5)
for x in range(len(goodStrikes)):
    p1 = ax1.scatter(goodStrikes[x][0],goodStrikes[x][1], s=10, c='g',␣
 ↪marker="o")
for y in range(len(badStrikes)):
    p2 = ax1.scatter(badStrikes[y][0], badStrikes[y][1], s=10, c='r',␣
 ↪marker="o")
```

```
plt.title("Brett Gardner Strike Data", fontweight ='bold',size=18)
plt.legend([p1,p2], ["good strikes", "bad strikes"])
ax1.add_patch(Rectangle((-0.79, avgBot), 1.58, avgTop-avgBot ,edgecolor =␣
 ↪'red',fill=False,lw=2))
plt.show()

fig = plt.figure()
ax2 = fig.add_subplot(111)
ax2.set_xlim(-2.75,2.75)
ax2.set_ylim(0,5)
for x in range(len(goodBalls)):
    p21 = ax2.scatter(goodBalls[x][0],goodBalls[x][1], s=10, c='g', marker="o")
for y in range(len(badBalls)):
    p22 = ax2.scatter(badBalls[y][0], badBalls[y][1], s=10, c='r', marker="o", )
plt.title("Brett Gardner Ball Data", fontweight ='bold',size=18)
plt.legend([p21,p22], ["good balls", "bad balls"])
ax2.add_patch(Rectangle((-0.79, 1.57), 1.58, 1.77,edgecolor =␣
 ↪'red',fill=False,lw=2))
plt.show()
```

```
============================ BRETT GARDNER DATA ============================

FA - Fastball, CU - Curveball, FT - Two-seam Fastball, CH - Changeup,
FC - Cutter, SL - Slider, FS - Splitter, KN - Knuckleball,
FF - Four-seam Fastball

              Name  xPos  zPos Pitch Type Given Description Classification
0    Brett Gardner  0.14  1.69         CH   swinging_strike   strike, good
1    Brett Gardner  0.18  2.85         FF              foul   strike, good
2    Brett Gardner -0.60  2.76         FF   swinging_strike   strike, good
3    Brett Gardner  1.50  3.60         FC              ball     ball, good
4    Brett Gardner  0.15  2.71         FF     called_strike    strike, bad
..             …   …   …        …                 …            …
486  Brett Gardner -0.08  2.61         FT              foul   strike, good
487  Brett Gardner -0.40  2.23         CU     called_strike    strike, bad
488  Brett Gardner -1.01  1.87         CU              ball     ball, good
489  Brett Gardner  1.41  2.35         FT              ball     ball, good
490  Brett Gardner -0.70  1.59         FF     called_strike    strike, bad

[491 rows x 6 columns]

% of "good" strikes:  0.568
% of "good" balls: 0.701
(% good strikes) + (% good balls):  1.269
```


Brett Gardner Strike Data
good strikes
bad strikes
5
4
3
2
1
0
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00


Brett Gardner Ball Data
good balls
bad balls
5
4
3
2
1
0
−2
−1
0
1
2

[39]:
```
#### ALL NYY PLAYER STATS
from IPython.core.display import display, HTML
class color:
   PURPLE = '\033[95m'
   CYAN = '\033[96m'
   DARKCYAN = '\033[36m'
   BLUE = '\033[94m'
   GREEN = '\033[92m'
   YELLOW = '\033[93m'
   RED = '\033[91m'
   BOLD = '\033[1m'
   UNDERLINE = '\033[4m'
   END = '\033[0m'

display(HTML("<style>.container { width:100% !important; }</style>"))
print("============================ NYY PLAYER STAT DATA␣
 ↪============================ \n")
nyyList = []
for yank in playerNums:
    num_pitches = 0
    num_strikes = 0
    num_balls = 0
    num_good_strikes = 0
    num_good_balls = 0
    for x in range(len(newdf)):
        if ((newdf.iloc[x]).iloc[0]) == yank:
            num_pitches += 1
            if ((newdf.iloc[x]).iloc[5]) == "strike, good" or ((newdf.iloc[x]).
 ↪iloc[5]) == "strike, bad":
                num_strikes += 1
                if ((newdf.iloc[x]).iloc[5]) == "strike, good":
                    num_good_strikes += 1
            else:
                num_balls += 1
                if ((newdf.iloc[x]).iloc[5]) == "ball, good":
                    num_good_balls += 1
    if num_strikes != 0 and num_balls != 0 and num_pitches >= 100:
        p_Good = num_good_strikes / num_strikes
        p_Bad = num_good_balls / num_balls
        nyyList.append([yank,round(num_pitches,3) ,round(num_strikes,3),␣
 ↪round(num_balls,3), round(p_Good,3),round(p_Bad,3),round((p_Good +␣
 ↪p_Bad),3)])

NYYDF = pd.DataFrame(nyyList, columns = ['Name','Pitches', 'Strikes', 'Balls',␣
 ↪'g_strike', 'g_ball', 'DS'])

ax = NYYDF.plot.barh(x='Name', y='g_strike', figsize=(12, 8)) # Bar graph plot
```

```
plt.title("Good Strikes", fontweight ='bold',size=18)
plt.ylabel('Name', fontweight='bold', size=12)
plt.axvline(x=0.699, color='r', linestyle='--') # Draws average line
ax2 = NYYDF.plot.barh(x='Name', y='g_ball', figsize=(12, 8)) # Bar graph plot
plt.title("Good Balls", fontweight ='bold',size=18)
plt.ylabel('Name', fontweight='bold', size=12)
plt.axvline(x=0.673, color='r', linestyle='--') # Draws average line

print(color.BOLD + "\t\t\t    Ordered by name" + color.END)
print(NYYDF.sort_values(by='Name', ascending=True), "\n")
print(color.BOLD + "\t\t\t Ordered by pitches" + color.END)
sort = NYYDF.sort_values(by='Pitches', ascending=False)
print(sort, "\n")
print(color.BOLD + "\t\t\t Ordered by good strikes" + color.END)
sort1 = NYYDF.sort_values(by='g_strike', ascending=False)
print(sort1, "\n")
print(color.BOLD + "\t\t\t Ordered by good balls" + color.END)
sort2 = NYYDF.sort_values(by='g_ball', ascending=False)
print(sort2, "\n")
print(color.BOLD + "\t\t\t   Ordered by discernment score" + color.END)
sort3 = NYYDF.sort_values(by='DS', ascending=False)
print(sort3, "\n")

g_strike_AVG = NYYDF["g_strike"].mean() #### Gets average of whole column
g_ball_AVG = NYYDF["g_ball"].mean()
print("Team Good Strike Average: ", round(g_strike_AVG,3), "\nTeam Good Ball␣
 ↪Average: ", round(g_ball_AVG,3))
```

```
<IPython.core.display.HTML object>
```

```
============================ NYY PLAYER STAT DATA ============================
```

Ordered by name

	Name	Pitches	Strikes	Balls	g_strike	g_ball	DS
11	Aaron Hicks	1151	399	752	0.657	0.726	1.383
7	Aaron Judge	2073	727	1346	0.693	0.724	1.417
13	Austin Romine	871	356	515	0.806	0.598	1.404
6	Brett Gardner	2544	991	1553	0.570	0.733	1.304
22	Breyvic Valera	205	78	127	0.744	0.724	1.468
10	Cameron Maybin	1154	445	709	0.649	0.722	1.372
12	Clint Frazier	976	382	594	0.725	0.742	1.468
2	DJ LeMahieu	2618	1021	1597	0.670	0.681	1.351
3	Didi Gregorius	1504	542	962	0.782	0.570	1.352
8	Edwin Encarnacion	2262	826	1436	0.688	0.698	1.385
0	Gary Sanchez	2053	647	1406	0.604	0.632	1.237
17	Giancarlo Stanton	395	121	274	0.612	0.686	1.298
4	Gio Urshela	1908	727	1181	0.761	0.556	1.317

9	Gleyber Torres	2551	953	1598	0.781	0.634	1.415
21	Greg Bird	206	76	130	0.632	0.677	1.309
16	Kendrys Morales	833	313	520	0.633	0.748	1.381
19	Kyle Higashioka	246	103	143	0.845	0.552	1.397
1	Luke Voit	2016	731	1285	0.804	0.715	1.520
20	Miguel Andujar	175	61	114	0.689	0.544	1.232
14	Mike Ford	657	245	412	0.649	0.748	1.397
5	Mike Tauchman	1288	491	797	0.731	0.755	1.486
18	Thairo Estrada	227	95	132	0.632	0.614	1.245
15	Tyler Wade	388	153	235	0.725	0.694	1.419

Ordered by pitches

	Name	Pitches	Strikes	Balls	g_strike	g_ball	DS
2	DJ LeMahieu	2618	1021	1597	0.670	0.681	1.351
9	Gleyber Torres	2551	953	1598	0.781	0.634	1.415
6	Brett Gardner	2544	991	1553	0.570	0.733	1.304
8	Edwin Encarnacion	2262	826	1436	0.688	0.698	1.385
7	Aaron Judge	2073	727	1346	0.693	0.724	1.417
0	Gary Sanchez	2053	647	1406	0.604	0.632	1.237
1	Luke Voit	2016	731	1285	0.804	0.715	1.520
4	Gio Urshela	1908	727	1181	0.761	0.556	1.317
3	Didi Gregorius	1504	542	962	0.782	0.570	1.352
5	Mike Tauchman	1288	491	797	0.731	0.755	1.486
10	Cameron Maybin	1154	445	709	0.649	0.722	1.372
11	Aaron Hicks	1151	399	752	0.657	0.726	1.383
12	Clint Frazier	976	382	594	0.725	0.742	1.468
13	Austin Romine	871	356	515	0.806	0.598	1.404
16	Kendrys Morales	833	313	520	0.633	0.748	1.381
14	Mike Ford	657	245	412	0.649	0.748	1.397
17	Giancarlo Stanton	395	121	274	0.612	0.686	1.298
15	Tyler Wade	388	153	235	0.725	0.694	1.419
19	Kyle Higashioka	246	103	143	0.845	0.552	1.397
18	Thairo Estrada	227	95	132	0.632	0.614	1.245
21	Greg Bird	206	76	130	0.632	0.677	1.309
22	Breyvic Valera	205	78	127	0.744	0.724	1.468
20	Miguel Andujar	175	61	114	0.689	0.544	1.232

Ordered by good strikes

	Name	Pitches	Strikes	Balls	g_strike	g_ball	DS
19	Kyle Higashioka	246	103	143	0.845	0.552	1.397
13	Austin Romine	871	356	515	0.806	0.598	1.404
1	Luke Voit	2016	731	1285	0.804	0.715	1.520
3	Didi Gregorius	1504	542	962	0.782	0.570	1.352
9	Gleyber Torres	2551	953	1598	0.781	0.634	1.415
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22	Breyvic Valera	205	78	127	0.744	0.724	1.468
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20	Miguel Andujar	175	61	114	0.689	0.544	1.232
8	Edwin Encarnacion	2262	826	1436	0.688	0.698	1.385
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16	Kendrys Morales	833	313	520	0.633	0.748	1.381
18	Thairo Estrada	227	95	132	0.632	0.614	1.245
21	Greg Bird	206	76	130	0.632	0.677	1.309
17	Giancarlo Stanton	395	121	274	0.612	0.686	1.298
0	Gary Sanchez	2053	647	1406	0.604	0.632	1.237
6	Brett Gardner	2544	991	1553	0.570	0.733	1.304

Ordered by good balls

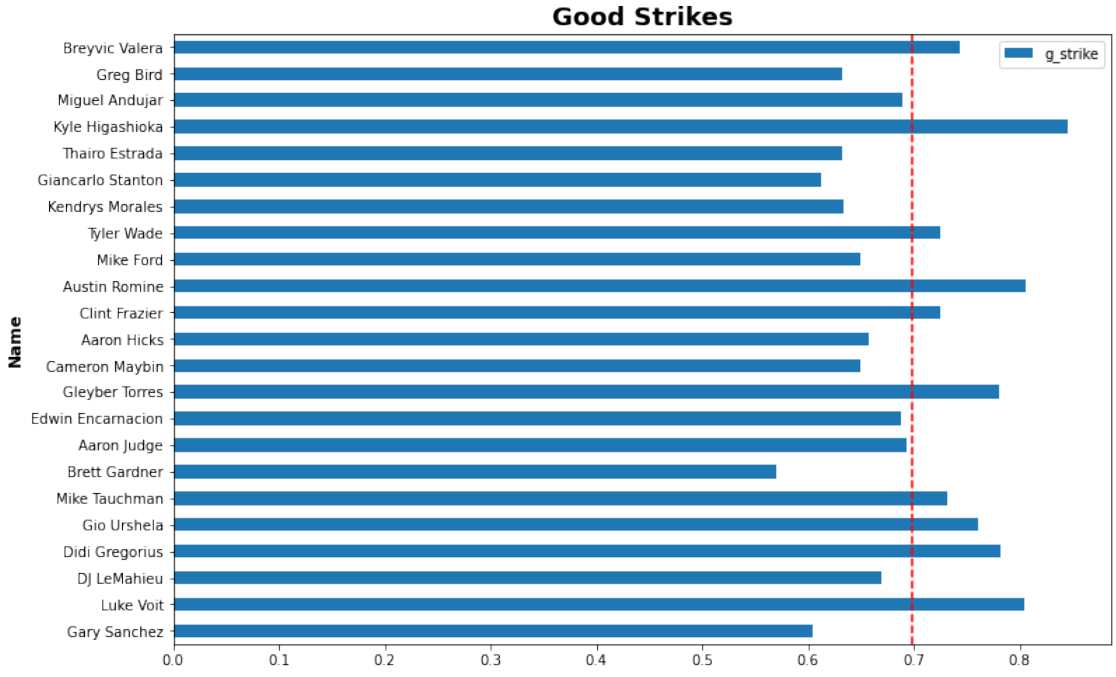
	Name	Pitches	Strikes	Balls	g_strike	g_ball	DS
5	Mike Tauchman	1288	491	797	0.731	0.755	1.486
16	Kendrys Morales	833	313	520	0.633	0.748	1.381
14	Mike Ford	657	245	412	0.649	0.748	1.397
12	Clint Frazier	976	382	594	0.725	0.742	1.468
6	Brett Gardner	2544	991	1553	0.570	0.733	1.304
11	Aaron Hicks	1151	399	752	0.657	0.726	1.383
7	Aaron Judge	2073	727	1346	0.693	0.724	1.417
22	Breyvic Valera	205	78	127	0.744	0.724	1.468
10	Cameron Maybin	1154	445	709	0.649	0.722	1.372
1	Luke Voit	2016	731	1285	0.804	0.715	1.520
8	Edwin Encarnacion	2262	826	1436	0.688	0.698	1.385
15	Tyler Wade	388	153	235	0.725	0.694	1.419
17	Giancarlo Stanton	395	121	274	0.612	0.686	1.298
2	DJ LeMahieu	2618	1021	1597	0.670	0.681	1.351
21	Greg Bird	206	76	130	0.632	0.677	1.309
9	Gleyber Torres	2551	953	1598	0.781	0.634	1.415
0	Gary Sanchez	2053	647	1406	0.604	0.632	1.237
18	Thairo Estrada	227	95	132	0.632	0.614	1.245
13	Austin Romine	871	356	515	0.806	0.598	1.404
3	Didi Gregorius	1504	542	962	0.782	0.570	1.352
4	Gio Urshela	1908	727	1181	0.761	0.556	1.317
19	Kyle Higashioka	246	103	143	0.845	0.552	1.397
20	Miguel Andujar	175	61	114	0.689	0.544	1.232

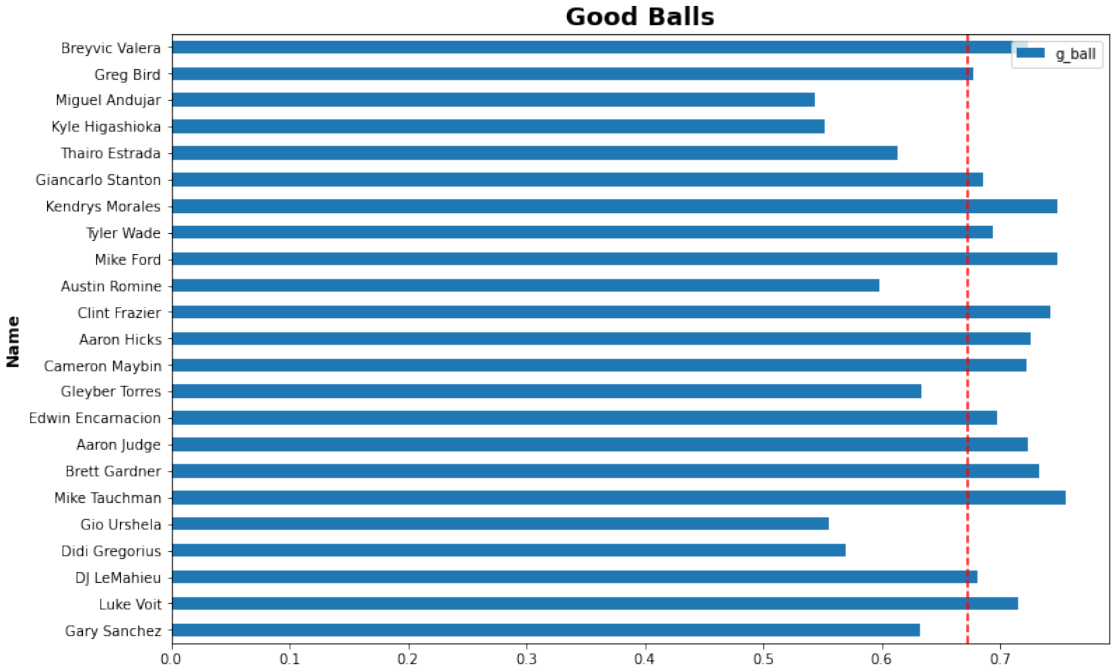
Ordered by discernment score

	Name	Pitches	Strikes	Balls	g_strike	g_ball	DS
1	Luke Voit	2016	731	1285	0.804	0.715	1.520
5	Mike Tauchman	1288	491	797	0.731	0.755	1.486
22	Breyvic Valera	205	78	127	0.744	0.724	1.468
12	Clint Frazier	976	382	594	0.725	0.742	1.468
15	Tyler Wade	388	153	235	0.725	0.694	1.419

7	Aaron Judge	2073	727	1346	0.693	0.724	1.417
9	Gleyber Torres	2551	953	1598	0.781	0.634	1.415
13	Austin Romine	871	356	515	0.806	0.598	1.404
19	Kyle Higashioka	246	103	143	0.845	0.552	1.397
14	Mike Ford	657	245	412	0.649	0.748	1.397
8	Edwin Encarnacion	2262	826	1436	0.688	0.698	1.385
11	Aaron Hicks	1151	399	752	0.657	0.726	1.383
16	Kendrys Morales	833	313	520	0.633	0.748	1.381
10	Cameron Maybin	1154	445	709	0.649	0.722	1.372
3	Didi Gregorius	1504	542	962	0.782	0.570	1.352
2	DJ LeMahieu	2618	1021	1597	0.670	0.681	1.351
4	Gio Urshela	1908	727	1181	0.761	0.556	1.317
21	Greg Bird	206	76	130	0.632	0.677	1.309
6	Brett Gardner	2544	991	1553	0.570	0.733	1.304
17	Giancarlo Stanton	395	121	274	0.612	0.686	1.298
18	Thairo Estrada	227	95	132	0.632	0.614	1.245
0	Gary Sanchez	2053	647	1406	0.604	0.632	1.237
20	Miguel Andujar	175	61	114	0.689	0.544	1.232

Team Good Strike Average: 0.699
Team Good Ball Average: 0.673





[44]:
```
#### ONLY 3-2 COUNT PITCHES
print("============================== NYY 3-2 COUNT DATA␣
 ↪============================== \n")
YankAtBats32 = []
for z in range(len(YankAtBats)):
    if Count_3_2[z] == 1:
        YankAtBats32.append(YankAtBats[z])

YankAtBats32df = pd.DataFrame(YankAtBats32[0:len(YankAtBats32)-5], columns =␣
 ↪['Name', 'xPos', 'zPos', 'Pitch Type', 'Given Description',␣
 ↪'Classification'])
#print(YankAtBats32df,"\n")

nyyList2 = []
for yank in playerNums:
    num_pitches = 0
    num_strikes = 0
    num_balls = 0
    num_good_strikes = 0
    num_good_balls = 0
    for x in range(len(YankAtBats32df)):
        if ((YankAtBats32df.iloc[x]).iloc[0]) == yank:
            num_pitches += 1
            if ((YankAtBats32df.iloc[x]).iloc[5]) == "strike, good" or␣
 ↪((YankAtBats32df.iloc[x]).iloc[5]) == "strike, bad":
```

```
                num_strikes += 1
                if ((YankAtBats32df.iloc[x]).iloc[5]) == "strike, good":
                    num_good_strikes += 1
            else:
                num_balls += 1
                if ((YankAtBats32df.iloc[x]).iloc[5]) == "ball, good":
                    num_good_balls += 1
    if num_strikes != 0 and num_balls != 0 and num_pitches >= 50:  #### min 50␣
 ↪pitches
        p_Good = num_good_strikes / num_strikes
        p_Bad = num_good_balls / num_balls
        nyyList2.append([yank,round(num_pitches,3) ,round(num_strikes,3),␣
 ↪round(num_balls,3), round(p_Good,3),round(p_Bad,3),round((p_Good +␣
 ↪p_Bad),3)])

YankAtBats32df = pd.DataFrame(nyyList2, columns = ['Name','Pitches', 'Strikes',␣
 ↪'Balls', 'g_strike', 'g_ball', 'DS'])
print(color.BOLD + "\t\t\t    Ordered by name" + color.END)
print(YankAtBats32df.sort_values(by='Name', ascending=True), "\n")
print(color.BOLD + "\t\t\t Ordered by pitches" + color.END)
sort = YankAtBats32df.sort_values(by='Pitches', ascending=False)
print(sort, "\n")
print(color.BOLD + "\t\t\t Ordered by good strikes" + color.END)
sort1 = YankAtBats32df.sort_values(by='g_strike', ascending=False)
print(sort1, "\n")
print(color.BOLD + "\t\t\t Ordered by good balls" + color.END)
sort2 = YankAtBats32df.sort_values(by='g_ball', ascending=False)
print(sort2, "\n")
print(color.BOLD + "\t\t\t   Ordered by discernment score" + color.END)
sort3 = YankAtBats32df.sort_values(by='DS', ascending=False)
print(sort3, "\n")
g_strike_AVG = YankAtBats32df["g_strike"].mean() #### Gets average of whole␣
 ↪column
g_ball_AVG = YankAtBats32df["g_ball"].mean()
print("Team Good Strike Average: ", round(g_strike_AVG,3), "\nTeam Good Ball␣
 ↪Average: ", round(g_ball_AVG,3))
```

```
============================ NYY 3-2 COUNT DATA ============================

                    Ordered by name
                 Name  Pitches  Strikes  Balls  g_strike  g_ball     DS
11        Aaron Hicks       72       27     45     0.852   0.533  1.385
7         Aaron Judge      130       58     72     0.879   0.625  1.504
6       Brett Gardner      137       86     51     0.953   0.333  1.287
10     Cameron Maybin       78       41     37     0.902   0.432  1.335
12      Clint Frazier       51       22     29     0.955   0.241  1.196
2         DJ LeMahieu      125       51     74     0.922   0.446  1.368
```

3	Didi Gregorius	69	34	35	1.000	0.314	1.314
8	Edwin Encarnacion	163	71	92	0.944	0.467	1.411
0	Gary Sanchez	126	53	73	0.943	0.288	1.231
4	Gio Urshela	65	28	37	0.964	0.432	1.397
9	Gleyber Torres	146	64	82	0.969	0.366	1.335
13	Kendrys Morales	58	28	30	0.929	0.500	1.429
1	Luke Voit	109	37	72	0.757	0.653	1.410
5	Mike Tauchman	81	33	48	0.939	0.521	1.460

Ordered by pitches

	Name	Pitches	Strikes	Balls	g_strike	g_ball	DS
8	Edwin Encarnacion	163	71	92	0.944	0.467	1.411
9	Gleyber Torres	146	64	82	0.969	0.366	1.335
6	Brett Gardner	137	86	51	0.953	0.333	1.287
7	Aaron Judge	130	58	72	0.879	0.625	1.504
0	Gary Sanchez	126	53	73	0.943	0.288	1.231
2	DJ LeMahieu	125	51	74	0.922	0.446	1.368
1	Luke Voit	109	37	72	0.757	0.653	1.410
5	Mike Tauchman	81	33	48	0.939	0.521	1.460
10	Cameron Maybin	78	41	37	0.902	0.432	1.335
11	Aaron Hicks	72	27	45	0.852	0.533	1.385
3	Didi Gregorius	69	34	35	1.000	0.314	1.314
4	Gio Urshela	65	28	37	0.964	0.432	1.397
13	Kendrys Morales	58	28	30	0.929	0.500	1.429
12	Clint Frazier	51	22	29	0.955	0.241	1.196

Ordered by good strikes

	Name	Pitches	Strikes	Balls	g_strike	g_ball	DS
3	Didi Gregorius	69	34	35	1.000	0.314	1.314
9	Gleyber Torres	146	64	82	0.969	0.366	1.335
4	Gio Urshela	65	28	37	0.964	0.432	1.397
12	Clint Frazier	51	22	29	0.955	0.241	1.196
6	Brett Gardner	137	86	51	0.953	0.333	1.287
8	Edwin Encarnacion	163	71	92	0.944	0.467	1.411
0	Gary Sanchez	126	53	73	0.943	0.288	1.231
5	Mike Tauchman	81	33	48	0.939	0.521	1.460
13	Kendrys Morales	58	28	30	0.929	0.500	1.429
2	DJ LeMahieu	125	51	74	0.922	0.446	1.368
10	Cameron Maybin	78	41	37	0.902	0.432	1.335
7	Aaron Judge	130	58	72	0.879	0.625	1.504
11	Aaron Hicks	72	27	45	0.852	0.533	1.385
1	Luke Voit	109	37	72	0.757	0.653	1.410

Ordered by good balls

	Name	Pitches	Strikes	Balls	g_strike	g_ball	DS
1	Luke Voit	109	37	72	0.757	0.653	1.410
7	Aaron Judge	130	58	72	0.879	0.625	1.504
11	Aaron Hicks	72	27	45	0.852	0.533	1.385

```
5       Mike Tauchman       81       33     48     0.939   0.521  1.460
13    Kendrys Morales       58       28     30     0.929   0.500  1.429
8   Edwin Encarnacion      163       71     92     0.944   0.467  1.411
2         DJ LeMahieu      125       51     74     0.922   0.446  1.368
4         Gio Urshela       65       28     37     0.964   0.432  1.397
10     Cameron Maybin       78       41     37     0.902   0.432  1.335
9      Gleyber Torres      146       64     82     0.969   0.366  1.335
6       Brett Gardner      137       86     51     0.953   0.333  1.287
3      Didi Gregorius       69       34     35     1.000   0.314  1.314
0        Gary Sanchez      126       53     73     0.943   0.288  1.231
12      Clint Frazier       51       22     29     0.955   0.241  1.196
```

Ordered by discernment score

```
                 Name  Pitches  Strikes  Balls  g_strike  g_ball     DS
7         Aaron Judge      130       58     72     0.879   0.625  1.504
5       Mike Tauchman       81       33     48     0.939   0.521  1.460
13    Kendrys Morales       58       28     30     0.929   0.500  1.429
8   Edwin Encarnacion      163       71     92     0.944   0.467  1.411
1           Luke Voit      109       37     72     0.757   0.653  1.410
4         Gio Urshela       65       28     37     0.964   0.432  1.397
11        Aaron Hicks       72       27     45     0.852   0.533  1.385
2         DJ LeMahieu      125       51     74     0.922   0.446  1.368
9      Gleyber Torres      146       64     82     0.969   0.366  1.335
10     Cameron Maybin       78       41     37     0.902   0.432  1.335
3      Didi Gregorius       69       34     35     1.000   0.314  1.314
6       Brett Gardner      137       86     51     0.953   0.333  1.287
0        Gary Sanchez      126       53     73     0.943   0.288  1.231
12      Clint Frazier       51       22     29     0.955   0.241  1.196

Team Good Strike Average:  0.922
Team Good Ball Average:  0.439
```

[45]:
```
#### ONLY FAST BALLS (2 and 4 seam)
print("============================ NYY FASTBALL DATA␣
 ↪============================ \n")
nyyList3 = []
for yank in playerNums:
    num_pitches = 0
    num_strikes = 0
    num_balls = 0
    num_good_strikes = 0
    num_good_balls = 0
    for x in range(len(newdf)):
        if ((newdf.iloc[x]).iloc[0]) == yank and (((newdf.iloc[x]).iloc[3]) ==␣
 ↪"FT" or ((newdf.iloc[x]).iloc[3]) == "FF"):
            num_pitches += 1
```

```
            if ((newdf.iloc[x]).iloc[5]) == "strike, good" or ((newdf.iloc[x]).
↪iloc[5]) == "strike, bad":
                num_strikes += 1
                if ((newdf.iloc[x]).iloc[5]) == "strike, good":
                    num_good_strikes += 1
            else:
                num_balls += 1
                if ((newdf.iloc[x]).iloc[5]) == "ball, good":
                    num_good_balls += 1
    if num_strikes != 0 and num_balls != 0 and num_pitches >= 100:  #### Only␣
↪using 100 here
        p_Good = num_good_strikes / num_strikes
        p_Bad = num_good_balls / num_balls
        nyyList3.append([yank,round(num_pitches,3) ,round(num_strikes,3),␣
↪round(num_balls,3), round(p_Good,3),round(p_Bad,3),round((p_Good +␣
↪p_Bad),3)])

FastBallsDF = pd.DataFrame(nyyList3, columns = ['Name','Pitches', 'Strikes',␣
↪'Balls', 'g_strike', 'g_ball', 'DS'])

print(color.BOLD + "\t\t\t    Ordered by name" + color.END)
print(FastBallsDF.sort_values(by='Name', ascending=True), "\n")
print(color.BOLD + "\t\t\t Ordered by pitches" + color.END)
sort = FastBallsDF.sort_values(by='Pitches', ascending=False)
print(sort, "\n")
print(color.BOLD + "\t\t\t Ordered by good strikes" + color.END)
sort1 = FastBallsDF.sort_values(by='g_strike', ascending=False)
print(sort1, "\n")
print(color.BOLD + "\t\t\t Ordered by good balls" + color.END)
sort2 = FastBallsDF.sort_values(by='g_ball', ascending=False)
print(sort2, "\n")
print(color.BOLD + "\t\t\t   Ordered by discernment score" + color.END)
sort3 = FastBallsDF.sort_values(by='DS', ascending=False)
print(sort3, "\n")
g_strike_AVG = FastBallsDF["g_strike"].mean() #### Gets average of whole column
g_ball_AVG = FastBallsDF["g_ball"].mean()
print("Team Good Strike Average: ", round(g_strike_AVG,3), "\nTeam Good Ball␣
↪Average: ", round(g_ball_AVG,3))
```

```
============================ NYY FASTBALL DATA ============================

                    Ordered by name
                Name  Pitches  Strikes  Balls  g_strike  g_ball     DS
11       Aaron Hicks      471      188    283     0.654   0.749  1.403
7        Aaron Judge      800      341    459     0.707   0.734  1.441
13     Austin Romine      352      151    201     0.834   0.672  1.506
6      Brett Gardner     1218      518    700     0.573   0.754  1.328
```

10	Cameron Maybin	459	201	258	0.726	0.752	1.478
12	Clint Frazier	424	178	246	0.669	0.793	1.461
2	DJ LeMahieu	1278	563	715	0.631	0.737	1.368
3	Didi Gregorius	628	256	372	0.734	0.548	1.283
8	Edwin Encarnacion	837	344	493	0.680	0.680	1.360
0	Gary Sanchez	788	301	487	0.671	0.639	1.310
17	Giancarlo Stanton	179	68	111	0.588	0.703	1.291
4	Gio Urshela	771	340	431	0.776	0.573	1.350
9	Gleyber Torres	1014	428	586	0.820	0.662	1.482
19	Greg Bird	102	42	60	0.524	0.700	1.224
16	Kendrys Morales	334	145	189	0.607	0.767	1.374
18	Kyle Higashioka	100	47	53	0.830	0.509	1.339
1	Luke Voit	810	336	474	0.821	0.762	1.583
14	Mike Ford	242	101	141	0.723	0.702	1.425
5	Mike Tauchman	612	292	320	0.740	0.825	1.565
15	Tyler Wade	166	68	98	0.721	0.786	1.506

Ordered by pitches

	Name	Pitches	Strikes	Balls	g_strike	g_ball	DS
2	DJ LeMahieu	1278	563	715	0.631	0.737	1.368
6	Brett Gardner	1218	518	700	0.573	0.754	1.328
9	Gleyber Torres	1014	428	586	0.820	0.662	1.482
8	Edwin Encarnacion	837	344	493	0.680	0.680	1.360
1	Luke Voit	810	336	474	0.821	0.762	1.583
7	Aaron Judge	800	341	459	0.707	0.734	1.441
0	Gary Sanchez	788	301	487	0.671	0.639	1.310
4	Gio Urshela	771	340	431	0.776	0.573	1.350
3	Didi Gregorius	628	256	372	0.734	0.548	1.283
5	Mike Tauchman	612	292	320	0.740	0.825	1.565
11	Aaron Hicks	471	188	283	0.654	0.749	1.403
10	Cameron Maybin	459	201	258	0.726	0.752	1.478
12	Clint Frazier	424	178	246	0.669	0.793	1.461
13	Austin Romine	352	151	201	0.834	0.672	1.506
16	Kendrys Morales	334	145	189	0.607	0.767	1.374
14	Mike Ford	242	101	141	0.723	0.702	1.425
17	Giancarlo Stanton	179	68	111	0.588	0.703	1.291
15	Tyler Wade	166	68	98	0.721	0.786	1.506
19	Greg Bird	102	42	60	0.524	0.700	1.224
18	Kyle Higashioka	100	47	53	0.830	0.509	1.339

Ordered by good strikes

	Name	Pitches	Strikes	Balls	g_strike	g_ball	DS
13	Austin Romine	352	151	201	0.834	0.672	1.506
18	Kyle Higashioka	100	47	53	0.830	0.509	1.339
1	Luke Voit	810	336	474	0.821	0.762	1.583
9	Gleyber Torres	1014	428	586	0.820	0.662	1.482
4	Gio Urshela	771	340	431	0.776	0.573	1.350
5	Mike Tauchman	612	292	320	0.740	0.825	1.565

3	Didi Gregorius	628	256	372	0.734	0.548	1.283
10	Cameron Maybin	459	201	258	0.726	0.752	1.478
14	Mike Ford	242	101	141	0.723	0.702	1.425
15	Tyler Wade	166	68	98	0.721	0.786	1.506
7	Aaron Judge	800	341	459	0.707	0.734	1.441
8	Edwin Encarnacion	837	344	493	0.680	0.680	1.360
0	Gary Sanchez	788	301	487	0.671	0.639	1.310
12	Clint Frazier	424	178	246	0.669	0.793	1.461
11	Aaron Hicks	471	188	283	0.654	0.749	1.403
2	DJ LeMahieu	1278	563	715	0.631	0.737	1.368
16	Kendrys Morales	334	145	189	0.607	0.767	1.374
17	Giancarlo Stanton	179	68	111	0.588	0.703	1.291
6	Brett Gardner	1218	518	700	0.573	0.754	1.328
19	Greg Bird	102	42	60	0.524	0.700	1.224

Ordered by good balls

	Name	Pitches	Strikes	Balls	g_strike	g_ball	DS
5	Mike Tauchman	612	292	320	0.740	0.825	1.565
12	Clint Frazier	424	178	246	0.669	0.793	1.461
15	Tyler Wade	166	68	98	0.721	0.786	1.506
16	Kendrys Morales	334	145	189	0.607	0.767	1.374
1	Luke Voit	810	336	474	0.821	0.762	1.583
6	Brett Gardner	1218	518	700	0.573	0.754	1.328
10	Cameron Maybin	459	201	258	0.726	0.752	1.478
11	Aaron Hicks	471	188	283	0.654	0.749	1.403
2	DJ LeMahieu	1278	563	715	0.631	0.737	1.368
7	Aaron Judge	800	341	459	0.707	0.734	1.441
17	Giancarlo Stanton	179	68	111	0.588	0.703	1.291
14	Mike Ford	242	101	141	0.723	0.702	1.425
19	Greg Bird	102	42	60	0.524	0.700	1.224
8	Edwin Encarnacion	837	344	493	0.680	0.680	1.360
13	Austin Romine	352	151	201	0.834	0.672	1.506
9	Gleyber Torres	1014	428	586	0.820	0.662	1.482
0	Gary Sanchez	788	301	487	0.671	0.639	1.310
4	Gio Urshela	771	340	431	0.776	0.573	1.350
3	Didi Gregorius	628	256	372	0.734	0.548	1.283
18	Kyle Higashioka	100	47	53	0.830	0.509	1.339

Ordered by discernment score

	Name	Pitches	Strikes	Balls	g_strike	g_ball	DS
1	Luke Voit	810	336	474	0.821	0.762	1.583
5	Mike Tauchman	612	292	320	0.740	0.825	1.565
13	Austin Romine	352	151	201	0.834	0.672	1.506
15	Tyler Wade	166	68	98	0.721	0.786	1.506
9	Gleyber Torres	1014	428	586	0.820	0.662	1.482
10	Cameron Maybin	459	201	258	0.726	0.752	1.478
12	Clint Frazier	424	178	246	0.669	0.793	1.461
7	Aaron Judge	800	341	459	0.707	0.734	1.441

```
14          Mike Ford      242      101     141     0.723   0.702  1.425
11        Aaron Hicks      471      188     283     0.654   0.749  1.403
16    Kendrys Morales      334      145     189     0.607   0.767  1.374
2          DJ LeMahieu     1278      563     715     0.631   0.737  1.368
8   Edwin Encarnacion      837      344     493     0.680   0.680  1.360
4          Gio Urshela      771      340     431     0.776   0.573  1.350
18    Kyle Higashioka       100       47      53     0.830   0.509  1.339
6       Brett Gardner     1218      518     700     0.573   0.754  1.328
0        Gary Sanchez      788      301     487     0.671   0.639  1.310
17  Giancarlo Stanton      179       68     111     0.588   0.703  1.291
3      Didi Gregorius      628      256     372     0.734   0.548  1.283
19          Greg Bird      102       42      60     0.524   0.700  1.224

Team Good Strike Average:  0.701
Team Good Ball Average:  0.702
```

[ ]:
```
# z strike zone is 1.75 to 3.42 feet
# x strike zone is -0.71 to 0.71 feet
# top: 3.34, bottom: 1.57 ---> (-0.79, 1.57), 1, 1.77
# bottom left corner ->(x,y), width, height
# https://www.baseballprospectus.com/news/article/14098/
 ↪spinning-yarn-the-real-strike-zone-part-2/
# https://www.geeksforgeeks.org/different-ways-to-create-pandas-dataframe/
# https://stackoverflow.com/questions/17812978/
 ↪how-to-plot-two-columns-of-a-pandas-data-frame-using-points
# https://www.statology.org/matplotlib-rectangle/
# https://stackoverflow.com/questions/57246963/
 ↪why-isnt-the-legend-in-matplotlib-correctly-displaying-the-colors
# https://pythonexamples.org/pandas-dataframe-sort-by-column/#2
# https://stackoverflow.com/questions/8924173/
 ↪how-do-i-print-bold-text-in-python/8930747
# https://www.geeksforgeeks.org/change-figure-size-in-pandas-python/
# IMPORTANT: Cell -> Current Outputs -> Toggle Scrolling
```

[43]:
```
#CU - Curveball, FT - Two-seam Fastball, CH - Changeup,
#FC - Cutter, SL - Slider, FS - Splitter, KN - Knuckleball,
#FF - Four-seam Fastball
FB = 0
CU = 0
CH = 0
FC = 0
SL = 0
FS = 0
KN = 0
for x in range(len(newdf)):
        if ((newdf.iloc[x]).iloc[3]) == "FT" or ((newdf.iloc[x]).iloc[3]) ==␣
 ↪"FF":
```

```
            FB += 1
        if ((newdf.iloc[x]).iloc[3]) == "CU":
            CU += 1
        if ((newdf.iloc[x]).iloc[3]) == "CH":
            CH += 1
        if ((newdf.iloc[x]).iloc[3]) == "FC":
            FC += 1
        if ((newdf.iloc[x]).iloc[3]) == "SL":
            SL += 1
        if ((newdf.iloc[x]).iloc[3]) == "FS":
            FS += 1
        if ((newdf.iloc[x]).iloc[3]) == "KN":
            KN += 1
print("FB: ", FB)
print("CU: ", CU)
print("CH: ", CH)
print("FC: ", FC)
print("SL: ", SL)
print("FS: ", FS)
print("KN: ", KN)
```

```
FB:  11909
CU:  2559
CH:  2915
FC:  1765
SL:  5583
FS:  581
KN:  0
```

[ ]: