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BAM-DATA-FINAL / BAM_data-Copy_Reg2.ipynb

bryandj Bam Notebook Push History

2 contributors

13.5 MB

# Import Libraries

In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import scipy.stats as scs
import seaborn as sns
import plotly.express as px
from sklearn.ensemble import RandomForestClassifier
from sklearn.preprocessing import maxabs_scale
```

In [2]:

```
# <<< Story >>>

# A problem with BAM Scoring
# Why should I do this in the first place?
# First thing is putting these scores into ranks
# BAM Score is a singular value for a player
# What makes a good BAM Score?
# Turns out Vertical Jump....not important for dilineating BAM Scores
# Reaction Shuttle
# --> fast twitch agility
# 4 way agility
# #
```

# Import and Clean Data

In [3]:

```
df = pd.read_excel('dec16-OutboundForAnalysis.xlsx')
df.head()
```

Out[3]:

| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach | He |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1037 | 33.5 | 28.5 | 3.376 | 11.471 | 3.669 | 2003.0 | 72.75 | 94.0 | |
| **1** | 656 | 30.5 | 21.5 | 3.486 | 12.114 | 3.355 | 1865.0 | 82.00 | 104.5 | |
| **2** | 477 | 37.0 | 31.0 | 3.23 | 12.036 | 3.562 | 2005.0 | 81.50 | 99.0 | |
| **3** | 1200 | 29.0 | 23.0 | 3.37 | 12.509 | 3.173 | 1902.0 | 79.50 | 101.0 | |
| **4** | 1501 | 31.0 | 26.0 | 3.389 | 12.724 | 3.316 | 1903.0 | 77.00 | 101.5 | |

In [4]:

```
pd.set_option('display.max_columns', 30)

# to preview all columns
```

In [5]:

```
df.columns
```

```
Index(['BAMid', 'Approach Vertical', 'Vertical Jump', '3/4 Court sprint
```

Out[5]:

```
Index(['BAMid', 'Approach Vertical', 'Vertical Jump', '3/4 Court sprint
',
       '4-Way agility', 'Reaction Shuttle', 'BAMScore', 'Wingspan', 'Reac
h',
       'Height', 'Weight', 'Body Comp', 'Hand Length', 'Hand Width',
       'Unnamed: 14', 'Unnamed: 15'],
      dtype='object')
```

In [6]:

```
# dropped last 2 columns because they are messing up data

df.drop(columns=['Unnamed: 14','Unnamed: 15','Hand Length'],inplace=True)
```

In [7]:

```
df.head()
```

Out[7]:

| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach | He |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1037 | 33.5 | 28.5 | 3.376 | 11.471 | 3.669 | 2003.0 | 72.75 | 94.0 | |
| **1** | 656 | 30.5 | 21.5 | 3.486 | 12.114 | 3.355 | 1865.0 | 82.00 | 104.5 | |
| **2** | 477 | 37.0 | 31.0 | 3.23 | 12.036 | 3.562 | 2005.0 | 81.50 | 99.0 | |
| **3** | 1200 | 29.0 | 23.0 | 3.37 | 12.509 | 3.173 | 1902.0 | 79.50 | 101.0 | |
| **4** | 1501 | 31.0 | 26.0 | 3.389 | 12.724 | 3.316 | 1903.0 | 77.00 | 101.5 | |

# EDA and Rankings on each parameter

## Visualizing data to find obvious outliers

### Bam Score Rank : 1 = best | 5 = worst

### Paramater Ranks : 5 = best | 1 = worst

In [8]:

```
new_dict = {1:5,2:4,3:3,4:2,5:1}
new_dict
```

Out[8]:

```
{1: 5, 2: 4, 3: 3, 4: 2, 5: 1}
```

# EDA - (1) Approach Vertical

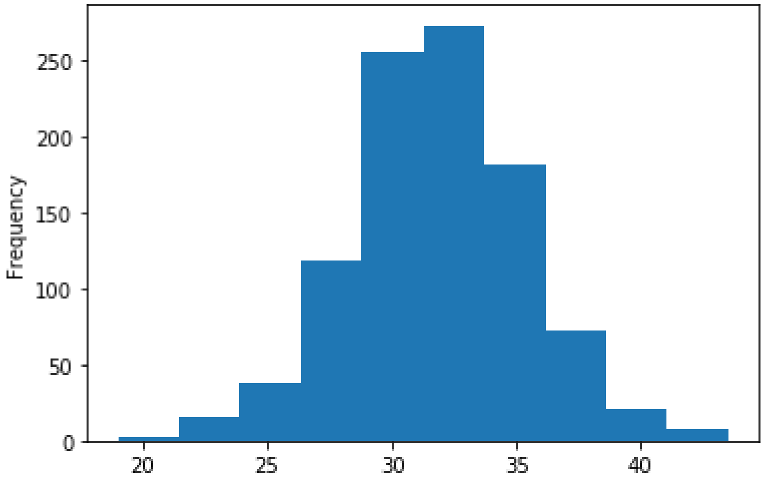
In [9]:

```
df['Approach Vertical'].plot('hist')
```

```
/Users/bryanjamieson/opt/anaconda3/envs/learn-env/lib/python3.6/site-packa
ges/ipykernel_launcher.py:1: FutureWarning:

`Series.plot()` should not be called with positional arguments, only keywo
rd arguments. The order of positional arguments will change in the future.
Use `Series.plot(kind='hist')` instead of `Series.plot('hist',)`.
```

Out[9]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd628432748>
```



In [10]:

```
df['Approach Vertical'].describe(),
```

Out[10]:

```
(count    986.000000
 mean      31.829615
 std        3.547985
 min       19.000000
 25%       29.500000
 50%       31.750000
 75%       34.000000
 max       43.500000
 Name: Approach Vertical, dtype: float64,)
```

In [11]:

```
approach_mu = df['Approach Vertical'].mean()
approach_std = df['Approach Vertical'].std()

min95 = approach_mu-2*approach_std
max95 = approach_mu+2*approach_std


def get_rank_approach_vertical(vert):
    if vert > approach_mu+1*approach_std:
        return 5
    if vert > approach_mu:
        return 4
    if vert > approach_mu - approach_std:
        return 3
    if vert > approach_mu - 2*approach_std:
        return 2
    return 1
```

In [12]:

```
df['approach_vertical_rank'] = df['Approach Vertical'].apply(get_rank_appr
df.head()
```

Out[12]:

|   | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach | He |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1037 | 33.5 | 28.5 | 3.376 | 11.471 | 3.669 | 2003.0 | 72.75 | 94.0 |  |

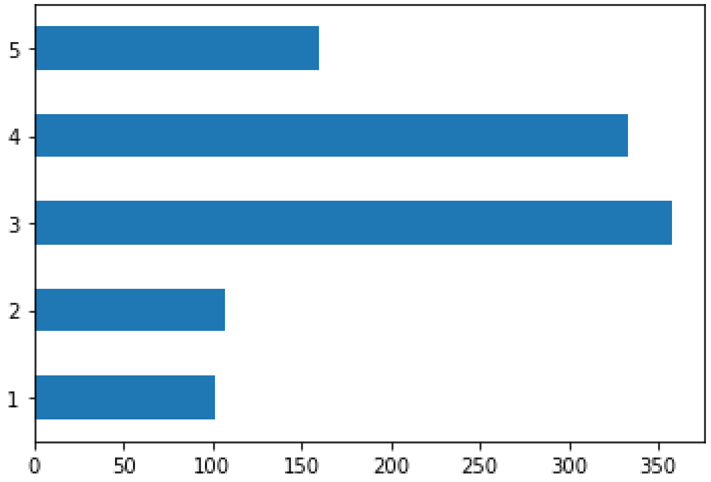
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1** | 656 | 30.5 | 21.5 | 3.486 | 12.114 | 3.355 | 1865.0 | 82.00 | 104.5 |
| **2** | 477 | 37.0 | 31.0 | 3.23 | 12.036 | 3.562 | 2005.0 | 81.50 | 99.0 |
| **3** | 1200 | 29.0 | 23.0 | 3.37 | 12.509 | 3.173 | 1902.0 | 79.50 | 101.0 |
| **4** | 1501 | 31.0 | 26.0 | 3.389 | 12.724 | 3.316 | 1903.0 | 77.00 | 101.5 |

In [13]:

```
av_rank_counts = pd.value_counts(df['approach_vertical_rank'].values, sort
av_rank_counts.plot.barh()
```

Out[13]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd608ae4160>
```



In [14]:

```
# Observation - Data looks normal and normally distributed but more weight
```

## EDA - (2) Vertical Jump

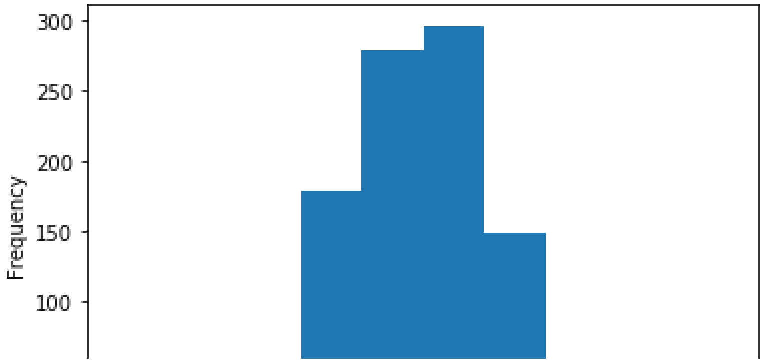
In [15]:

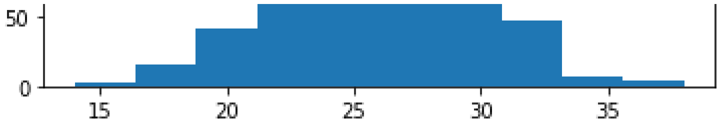
```
df['Vertical Jump'].plot('hist')
```

```
/Users/bryanjamieson/opt/anaconda3/envs/learn-env/lib/python3.6/site-packa
ges/ipykernel_launcher.py:1: FutureWarning:

`Series.plot()` should not be called with positional arguments, only keywo
rd arguments. The order of positional arguments will change in the future.
Use `Series.plot(kind='hist')` instead of `Series.plot('hist',)`.
```

Out[15]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd6390f01d0>
```





In [16]:

```
df['Vertical Jump'].describe(),
```

Out[16]:

```
(count    1019.000000
 mean       25.860157
 std         3.125301
 min        14.000000
 25%        24.000000
 50%        25.500000
 75%        28.000000
 max        38.000000
 Name: Vertical Jump, dtype: float64,)
```

In [17]:

```
vertical_mu = df['Vertical Jump'].mean()
vertical_std = df['Vertical Jump'].std()

min95 = vertical_mu-2*vertical_std
max95 = vertical_mu+2*vertical_std


def get_rank_vertical_jump(vert):
    if vert > vertical_mu+1*vertical_std:
        return 5
    if vert > vertical_mu:
        return 4
    if vert > vertical_mu - vertical_std:
        return 3
    if vert > vertical_mu - 2*vertical_std:
        return 2
    return 1
```

In [18]:

```
df['vertical_jump_rank'] = df['Vertical Jump'].apply(get_rank_vertical_jun
df.head()
```

Out[18]:

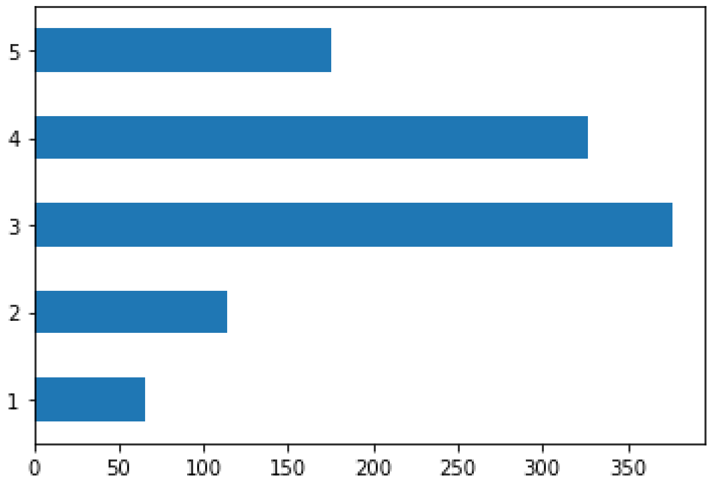
| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach | He |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1037 | 33.5 | 28.5 | 3.376 | 11.471 | 3.669 | 2003.0 | 72.75 | 94.0 | |
| **1** | 656 | 30.5 | 21.5 | 3.486 | 12.114 | 3.355 | 1865.0 | 82.00 | 104.5 | |
| **2** | 477 | 37.0 | 31.0 | 3.23 | 12.036 | 3.562 | 2005.0 | 81.50 | 99.0 | |
| **3** | 1200 | 29.0 | 23.0 | 3.37 | 12.509 | 3.173 | 1902.0 | 79.50 | 101.0 | |
| **4** | 1501 | 31.0 | 26.0 | 3.389 | 12.724 | 3.316 | 1903.0 | 77.00 | 101.5 | |

In [19]:

```
av_rank_counts_vert_jump = pd.value_counts(df['vertical_jump_rank'].values
av_rank_counts_vert_jump.plot.barh()
```

Out[19]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd608ac2668>
```



In [20]:

```
# Observations - Data looks normal and makes sense - more tall people in t
```

## EDA - (3) Reaction Shuttle

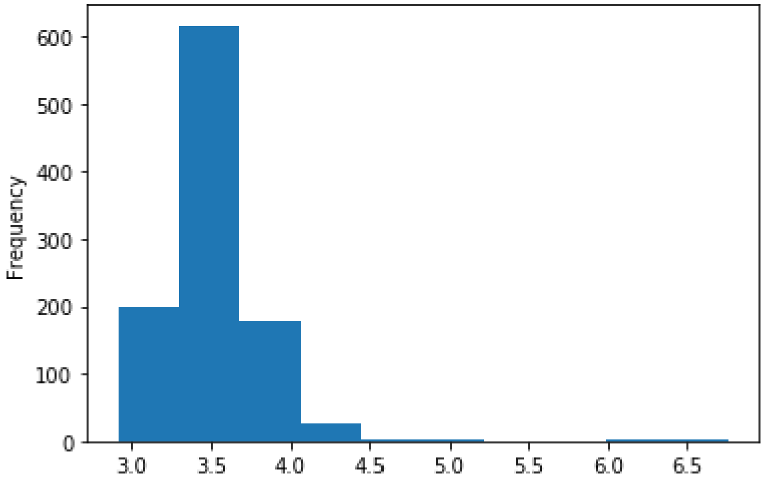
In [21]:

```
df['Reaction Shuttle'].plot('hist')
```

```
/Users/bryanjamieson/opt/anaconda3/envs/learn-env/lib/python3.6/site-packa
ges/ipykernel_launcher.py:1: FutureWarning:

`Series.plot()` should not be called with positional arguments, only keywo
rd arguments. The order of positional arguments will change in the future.
Use `Series.plot(kind='hist')` instead of `Series.plot('hist',)`.
```

Out[21]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd5f93d91d0>
```



In [22]:

```
df['Reaction Shuttle'].describe(),
```

Out[22]:

```
(count    1024.000000
 mean        3.505243
 std         0.278427
 min         2.914000
 25%         3.343750
 50%         3.484000
 75%          3.642250
 max          6.759000
 Name: Reaction Shuttle, dtype: float64,)
```

In [23]:

```
shuttle_mu = df['Reaction Shuttle'].mean()
shuttle_std = df['Reaction Shuttle'].std()

min95 = shuttle_mu-2*shuttle_std
max95 = shuttle_mu+2*shuttle_std


def get_rank_reaction_shuttle(shut):
    if shut > shuttle_mu+1*shuttle_std:
        return 5
    if shut > shuttle_mu:
        return 4
    if shut > shuttle_mu - shuttle_std:
        return 3
    if shut > shuttle_mu - 2*shuttle_std:
        return 2
    return 1
```

In [24]:

```
df['reaction_shuttle_rank'] = df['Reaction Shuttle'].apply(get_rank_reacti
df.head()
```

Out[24]:

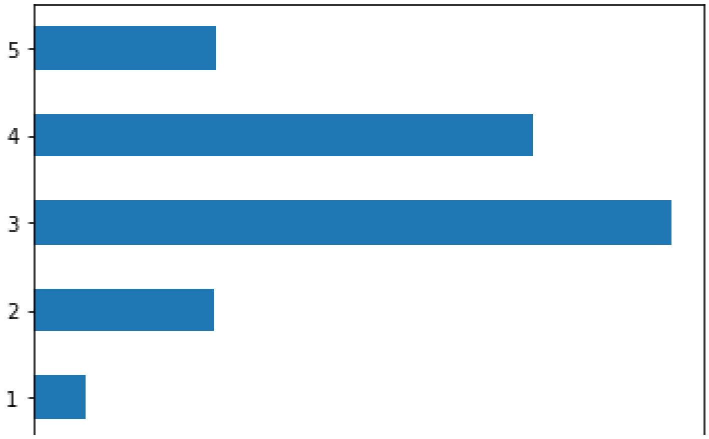
| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach | He |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1037 | 33.5 | 28.5 | 3.376 | 11.471 | 3.669 | 2003.0 | 72.75 | 94.0 | |
| **1** | 656 | 30.5 | 21.5 | 3.486 | 12.114 | 3.355 | 1865.0 | 82.00 | 104.5 | |
| **2** | 477 | 37.0 | 31.0 | 3.23 | 12.036 | 3.562 | 2005.0 | 81.50 | 99.0 | |
| **3** | 1200 | 29.0 | 23.0 | 3.37 | 12.509 | 3.173 | 1902.0 | 79.50 | 101.0 | |
| **4** | 1501 | 31.0 | 26.0 | 3.389 | 12.724 | 3.316 | 1903.0 | 77.00 | 101.5 | |

In [25]:

```
av_rank_counts_shuttle = pd.value_counts(df['reaction_shuttle_rank'].value
av_rank_counts_shuttle.plot.barh()
```

Out[25]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd608ab1be0>
```



In [26]:

```
# Observations - Lots of outliers. Took outliers out and balanced data
```

## EDA - (4) BAM Score

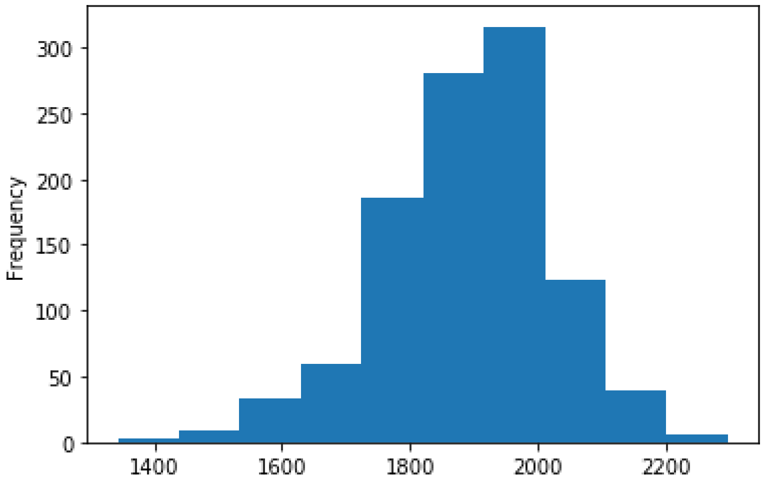
In [27]:

```
df['BAMScore'].plot('hist')
```

```
/Users/bryanjamieson/opt/anaconda3/envs/learn-env/lib/python3.6/site-packa
ges/ipykernel_launcher.py:1: FutureWarning:

`Series.plot()` should not be called with positional arguments, only keywo
rd arguments. The order of positional arguments will change in the future.
Use `Series.plot(kind='hist')` instead of `Series.plot('hist',)`.
```

Out[27]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd5e878a630>
```



In [28]:

```
df['BAMScore'].describe(),
```

Out[28]:

```
(count    1056.000000
 mean     1890.976326
 std       135.057644
 min      1343.000000
 25%      1811.000000
 50%      1899.500000
 75%      1981.250000
 max      2298.000000
 Name: BAMScore, dtype: float64,)
```

In [29]:

```
bam_mu = df['BAMScore'].mean()
bam_std = df['BAMScore'].std()

min95 = bam_mu-2*bam_std
max95 = bam_mu+2*bam_std


def get_rank_bam_score(bam):
    if bam > bam_mu+1*bam_std:
        return 5
    if bam > bam_mu:
        return 4
    if bam > bam_mu - bam_std:
        return 3
    if bam > bam_mu - 2*bam_std:
        return 2
    return 1
```

In [30]:

```
df['bam_score_rank'] = df['BAMScore'].apply(get_rank_bam_score)
df.head()
```

Out[30]:

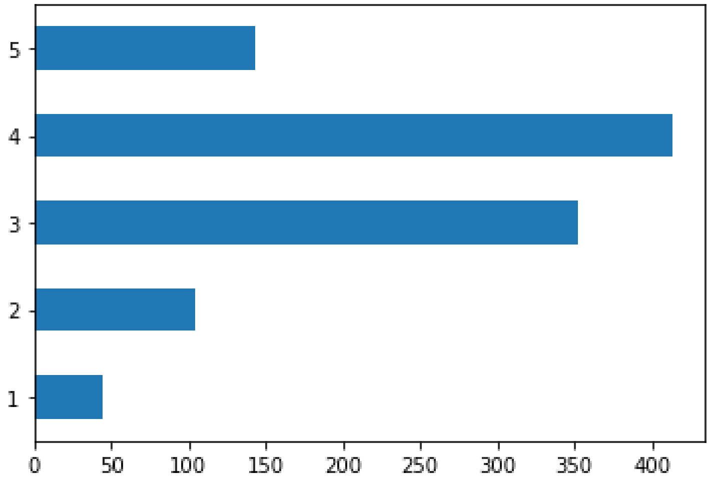
| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach | He |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1037 | 33.5 | 28.5 | 3.376 | 11.471 | 3.669 | 2003.0 | 72.75 | 94.0 | |
| **1** | 656 | 30.5 | 21.5 | 3.486 | 12.114 | 3.355 | 1865.0 | 82.00 | 104.5 | |
| **2** | 477 | 37.0 | 31.0 | 3.23 | 12.036 | 3.562 | 2005.0 | 81.50 | 99.0 | |
| **3** | 1200 | 29.0 | 23.0 | 3.37 | 12.509 | 3.173 | 1902.0 | 79.50 | 101.0 | |
| **4** | 1501 | 31.0 | 26.0 | 3.389 | 12.724 | 3.316 | 1903.0 | 77.00 | 101.5 | |

In [31]:

```
av_rank_bam_score = pd.value_counts(df['bam_score_rank'].values, sort=Fals
av_rank_bam_score.plot.barh()
```

Out[31]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd5f952b320>
```



In [32]:

```
# Observations - A lot of values in 4 and 3 rank - We see a very normal di
```

# EDA - (5) Wingspan

In [33]:

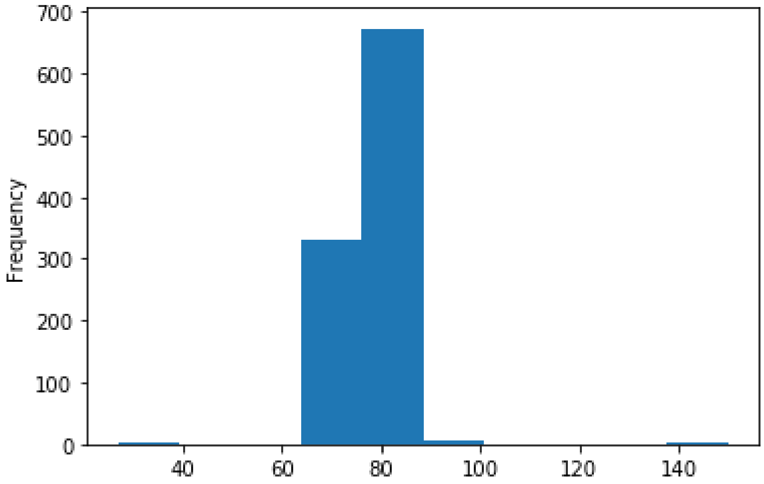
```
df['Wingspan'].plot('hist')
```

```
/Users/bryanjamieson/opt/anaconda3/envs/learn-env/lib/python3.6/site-packa
ges/ipykernel_launcher.py:1: FutureWarning:
```

```
`Series.plot()` should not be called with positional arguments, only keywo
rd arguments. The order of positional arguments will change in the future.
Use `Series.plot(kind='hist')` instead of `Series.plot('hist',)`.
```

Out[33]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd5e87d3668>
```



In [34]:

```
df['Wingspan'].describe(),
```

Out[34]:

```
(count    1012.000000
 mean       78.089797
 std         5.261419
 min        27.000000
 25%        75.500000
 50%        78.000000
 75%        80.500000
 max       150.000000
 Name: Wingspan, dtype: float64,)
```

In [35]:

```
wingspan_mu = df['Wingspan'].mean()
wingspan_std = df['Wingspan'].std()

min95 = wingspan_mu-2*wingspan_std
max95 = wingspan_mu+2*wingspan_std


def get_rank_wingspan(wing):
    if wing > wingspan_mu+1*wingspan_std:
        return 5
    if wing > wingspan_mu:
        return 4
    if wing > wingspan_mu - wingspan_std:
        return 3
    if wing > wingspan_mu - 2*wingspan_std:
        return 2
    return 1
```

In [36]:

```
df['wingspan_rank'] = df['Wingspan'].apply(get_rank_wingspan)
df.head()
```

Out[36]:

Approach Vertical 3/4 4- Reaction

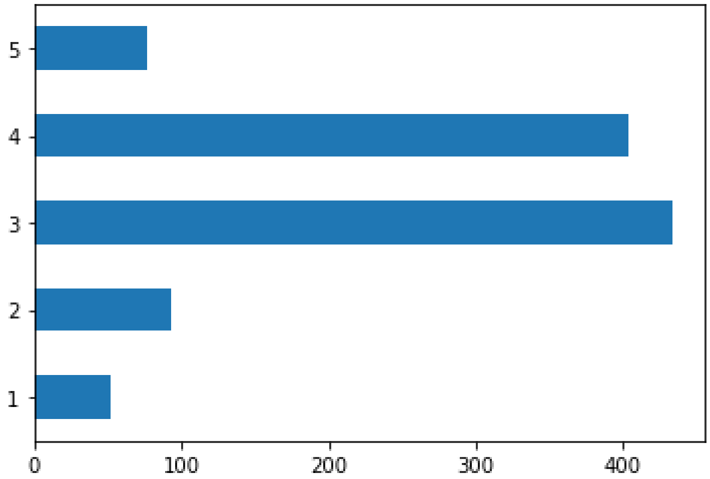
| | BAMid | Approach Vertical | Vertical Jump | Court sprint | Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach | He |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1037 | 33.5 | 28.5 | 3.376 | 11.471 | 3.669 | 2003.0 | 72.75 | 94.0 | |
| **1** | 656 | 30.5 | 21.5 | 3.486 | 12.114 | 3.355 | 1865.0 | 82.00 | 104.5 | |
| **2** | 477 | 37.0 | 31.0 | 3.23 | 12.036 | 3.562 | 2005.0 | 81.50 | 99.0 | |
| **3** | 1200 | 29.0 | 23.0 | 3.37 | 12.509 | 3.173 | 1902.0 | 79.50 | 101.0 | |
| **4** | 1501 | 31.0 | 26.0 | 3.389 | 12.724 | 3.316 | 1903.0 | 77.00 | 101.5 | |

In [37]:

```
av_rank_wingspan = pd.value_counts(df['wingspan_rank'].values, sort=False)
av_rank_wingspan.plot.barh()
```

Out[37]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd5d8c23550>
```



In [38]:

```
# Observation - Remove Low and high outliers. Data is normal.
# Data makes sense since taller basketball players typically have longer w
```

## EDA - (6) Reach

In [39]:

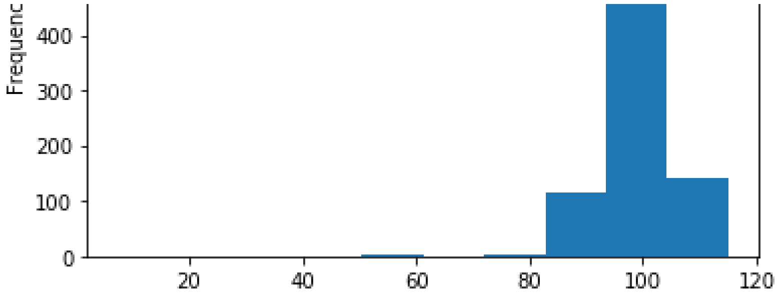
```
df['Reach'].plot('hist')
```

```
/Users/bryanjamieson/opt/anaconda3/envs/learn-env/lib/python3.6/site-packa
ges/ipykernel_launcher.py:1: FutureWarning:

`Series.plot()` should not be called with positional arguments, only keywo
rd arguments. The order of positional arguments will change in the future.
Use `Series.plot(kind='hist')` instead of `Series.plot('hist',)`.
```

Out[39]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd5e88717b8>
```

700
600
500
y



In [40]:

```
df['Reach'].describe(),
```

Out[40]:

```
(count    1012.000000
 mean       98.714180
 std         5.958459
 min         7.500000
 25%        95.500000
 50%        99.000000
 75%       102.000000
 max       115.000000
 Name: Reach, dtype: float64,)
```

In [41]:

```
reach_mu = df['Reach'].mean()
reach_std = df['Reach'].std()

min95 = reach_mu-2*reach_std
max95 = reach_mu+2*reach_std


def get_rank_reach(reach):
    if reach > reach_mu+1*reach_std:
        return 5
    if reach > reach_mu:
        return 4
    if reach > reach_mu - reach_std:
        return 3
    if reach > reach_mu - 2*reach_std:
        return 2
    return 1
```

In [42]:

```
df['reach_rank'] = df['Reach'].apply(get_rank_reach)
df.head()
```

Out[42]:

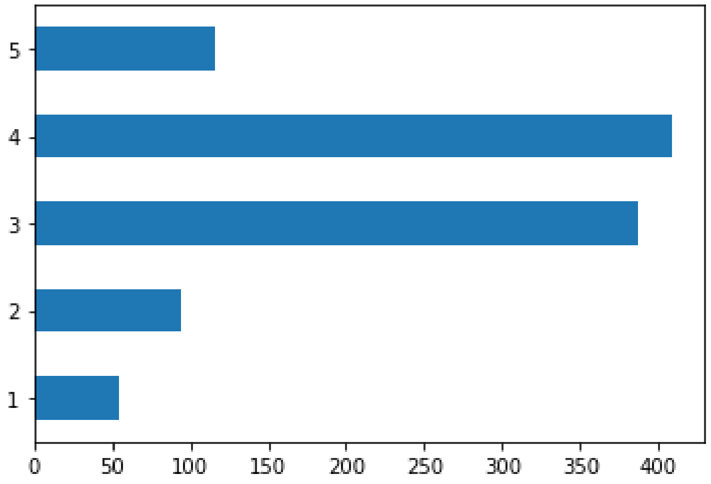
| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach | He |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1037 | 33.5 | 28.5 | 3.376 | 11.471 | 3.669 | 2003.0 | 72.75 | 94.0 | |
| **1** | 656 | 30.5 | 21.5 | 3.486 | 12.114 | 3.355 | 1865.0 | 82.00 | 104.5 | |
| **2** | 477 | 37.0 | 31.0 | 3.23 | 12.036 | 3.562 | 2005.0 | 81.50 | 99.0 | |
| **3** | 1200 | 29.0 | 23.0 | 3.37 | 12.509 | 3.173 | 1902.0 | 79.50 | 101.0 | |
| **4** | 1501 | 31.0 | 26.0 | 3.389 | 12.724 | 3.316 | 1903.0 | 77.00 | 101.5 | |

In [43]:

```
av_rank_reach = pd.value_counts(df['reach_rank'].values, sort=False)
av_rank_reach.plot.barh()
```

Out[43]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd5e8869e48>
```



In [44]:

```
# Observations - Low outliers - very extreme drop in reach between 80-90 a
```

# EDA - (7) Height

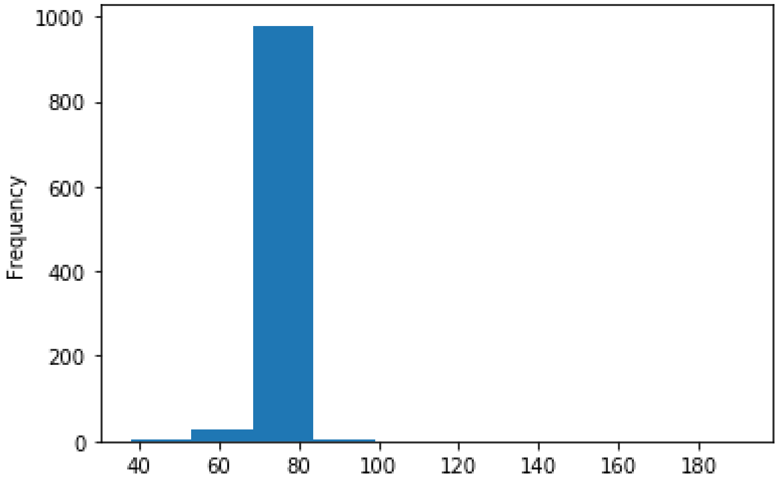
In [45]:

```
df['Height'].plot('hist')
```

```
/Users/bryanjamieson/opt/anaconda3/envs/learn-env/lib/python3.6/site-packa
ges/ipykernel_launcher.py:1: FutureWarning:

`Series.plot()` should not be called with positional arguments, only keywo
rd arguments. The order of positional arguments will change in the future.
Use `Series.plot(kind='hist')` instead of `Series.plot('hist',)`.
```

Out[45]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd6284527b8>
```



In [46]:

```
df['Height'].describe(),
```

Out[46]:

```
(count     1012.000000
```

Out[46]:

```
mean        75.094195
std          5.246045
min         37.875000
25%         72.500000
50%         75.000000
75%         77.500000
max        190.700000
Name: Height, dtype: float64,)
```

In [47]:

```python
height_mu = df['Height'].mean()
height_std = df['Height'].std()

min95 = height_mu-2*height_std
max95 = height_mu+2*height_std


def get_rank_height(height):
    if height > height_mu+1*height_std:
        return 5
    if height > height_mu:
        return 4
    if height > height_mu - height_std:
        return 3
    if height > height_mu - 2*height_std:
        return 2
    return 1
```

In [48]:

```python
df['height_rank'] = df['Height'].apply(get_rank_height)
df.head()
```

Out[48]:

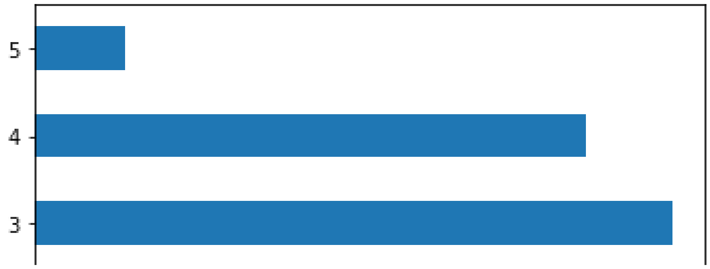
| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach | He |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1037 | 33.5 | 28.5 | 3.376 | 11.471 | 3.669 | 2003.0 | 72.75 | 94.0 | |
| **1** | 656 | 30.5 | 21.5 | 3.486 | 12.114 | 3.355 | 1865.0 | 82.00 | 104.5 | |
| **2** | 477 | 37.0 | 31.0 | 3.23 | 12.036 | 3.562 | 2005.0 | 81.50 | 99.0 | |
| **3** | 1200 | 29.0 | 23.0 | 3.37 | 12.509 | 3.173 | 1902.0 | 79.50 | 101.0 | |
| **4** | 1501 | 31.0 | 26.0 | 3.389 | 12.724 | 3.316 | 1903.0 | 77.00 | 101.5 | |

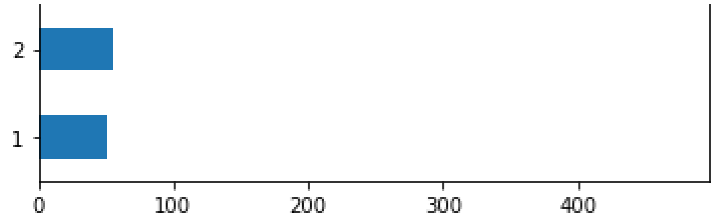
In [49]:

```python
av_rank_height = pd.value_counts(df['height_rank'].values, sort=False)
av_rank_height.plot.barh()
```

Out[49]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd648f07da0>
```





In [50]:

```
# Observations - Height makes sense. More people are taller.
```

## EDA - (8) Weight

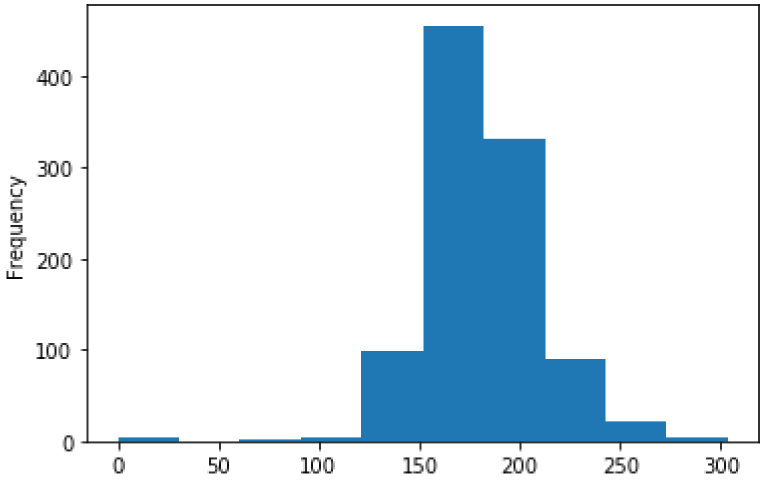
In [51]:

```
df['Weight'].plot('hist')
```

```
/Users/bryanjamieson/opt/anaconda3/envs/learn-env/lib/python3.6/site-packa
ges/ipykernel_launcher.py:1: FutureWarning:

`Series.plot()` should not be called with positional arguments, only keywo
rd arguments. The order of positional arguments will change in the future.
Use `Series.plot(kind='hist')` instead of `Series.plot('hist',)`.
```

Out[51]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd639280ef0>
```



In [52]:

```
df['Weight'].describe(),
```

Out[52]:

```
(count    1012.000000
 mean      180.735820
 std        28.646001
 min         0.000000
 25%       164.475000
 50%       178.400000
 75%       196.000000
 max       303.400000
 Name: Weight, dtype: float64,)
```

In [53]:

```
weight_mu = df['Weight'].mean()
weight_std = df['Weight'].std()

min95 = weight_mu-2*weight_std
max95 = weight_mu+2*weight_std
```

```
max95 = weight_mu+2*weight_std


def get_rank_weight(weight):
    if weight > weight_mu+1*weight_std:
        return 5
    if weight > weight_mu:
        return 4
    if weight > weight_mu - weight_std:
        return 3
    if weight > weight_mu - 2*weight_std:
        return 2
    return 1
```

In [54]:

```
df['weight_rank'] = df['Weight'].apply(get_rank_weight)
df.head()
```

Out[54]:

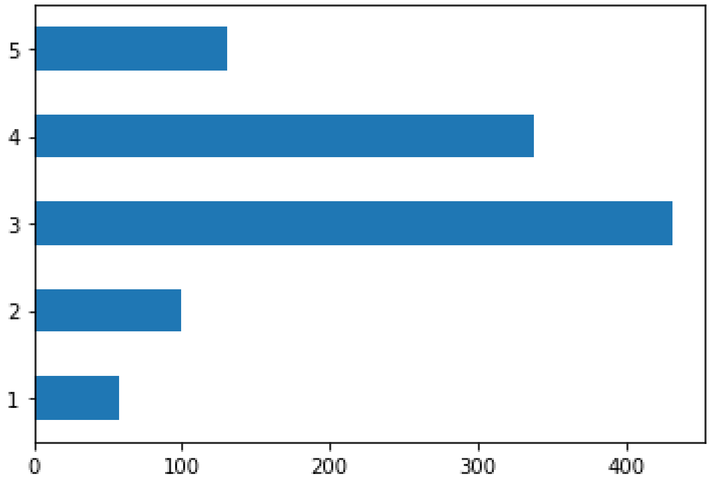
|   | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach | He |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1037 | 33.5 | 28.5 | 3.376 | 11.471 | 3.669 | 2003.0 | 72.75 | 94.0 | |
| **1** | 656 | 30.5 | 21.5 | 3.486 | 12.114 | 3.355 | 1865.0 | 82.00 | 104.5 | |
| **2** | 477 | 37.0 | 31.0 | 3.23 | 12.036 | 3.562 | 2005.0 | 81.50 | 99.0 | |
| **3** | 1200 | 29.0 | 23.0 | 3.37 | 12.509 | 3.173 | 1902.0 | 79.50 | 101.0 | |
| **4** | 1501 | 31.0 | 26.0 | 3.389 | 12.724 | 3.316 | 1903.0 | 77.00 | 101.5 | |

In [55]:

```
av_rank_weight = pd.value_counts(df['weight_rank'].values, sort=False)
av_rank_weight.plot.barh()
```

Out[55]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd608b92dd8>
```



In [56]:

```
# Observations - Removed low outliers. A lot of people in rank 3 that weig
```

## EDA - (9) Body Comp

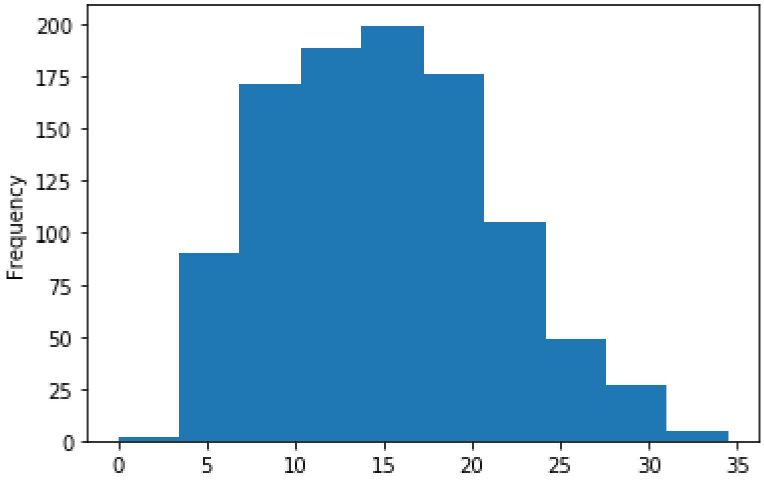
In [57]:

```
df['Body Comp'].plot('hist')
```

```
/Users/bryanjamieson/opt/anaconda3/envs/learn-env/lib/python3.6/site-packa
ges/ipykernel_launcher.py:1: FutureWarning:

`Series.plot()` should not be called with positional arguments, only keywo
rd arguments. The order of positional arguments will change in the future.
Use `Series.plot(kind='hist')` instead of `Series.plot('hist',)`.
```

Out[57]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd648fe6ef0>
```



In [58]:

```
df['Body Comp'].describe(),
```

Out[58]:

```
(count    1012.000000
 mean       14.979496
 std         6.191147
 min         0.000000
 25%        10.200000
 50%        14.700000
 75%        19.200000
 max        34.500000
 Name: Body Comp, dtype: float64,)
```

In [59]:

```
body_comp_mu = df['Body Comp'].mean()
body_comp_std = df['Body Comp'].std()

min95 = body_comp_mu-2*body_comp_std
max95 = body_comp_mu+2*body_comp_std


def get_rank_body_comp(body):
    if body > body_comp_mu+1*wingspan_std:
        return 5
    if body > body_comp_mu:
        return 4
    if body > body_comp_mu - body_comp_std:
        return 3
    if body > body_comp_mu - 2*body_comp_std:
        return 2
    return 1
```

In [60]:

```
df['body_comp_rank'] = df['Body Comp'].apply(get_rank_body_comp)
df.head()
```

Out[60]:

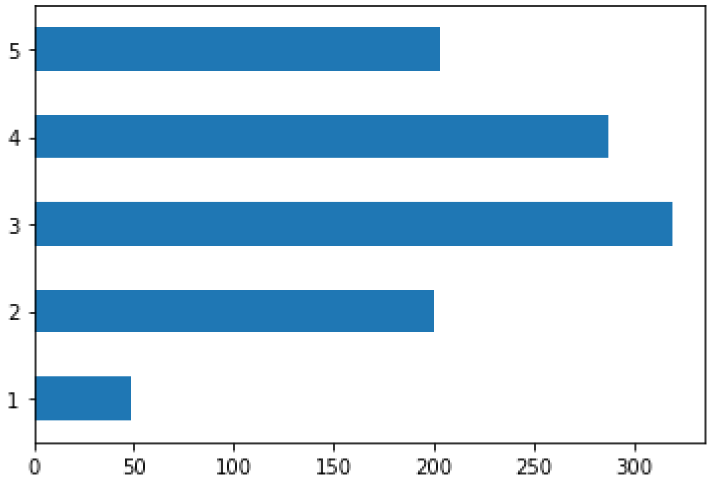
| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach | He |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1037 | 33.5 | 28.5 | 3.376 | 11.471 | 3.669 | 2003.0 | 72.75 | 94.0 | |
| **1** | 656 | 30.5 | 21.5 | 3.486 | 12.114 | 3.355 | 1865.0 | 82.00 | 104.5 | |
| **2** | 477 | 37.0 | 31.0 | 3.23 | 12.036 | 3.562 | 2005.0 | 81.50 | 99.0 | |
| **3** | 1200 | 29.0 | 23.0 | 3.37 | 12.509 | 3.173 | 1902.0 | 79.50 | 101.0 | |
| **4** | 1501 | 31.0 | 26.0 | 3.389 | 12.724 | 3.316 | 1903.0 | 77.00 | 101.5 | |

In [61]:

```
av_rank_body_comp = pd.value_counts(df['body_comp_rank'].values, sort=Fals
av_rank_body_comp.plot.barh()
```

Out[61]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd5e87b63c8>
```



In [62]:

```
# Observations - Looks normal, small number of people that have a low body
# Interesting because it's hard and not always accurate measuring body com
```

## EDA - (10) Hand Width

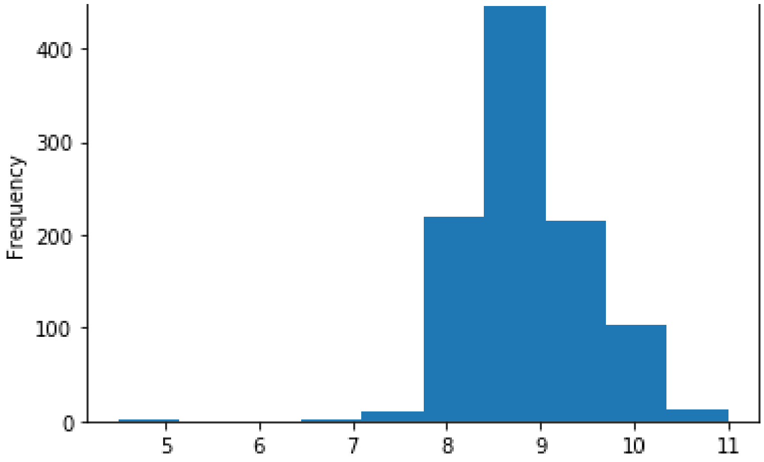
In [63]:

```
df['Hand Width'].plot('hist')
```

```
/Users/bryanjamieson/opt/anaconda3/envs/learn-env/lib/python3.6/site-packa
ges/ipykernel_launcher.py:1: FutureWarning:

`Series.plot()` should not be called with positional arguments, only keywo
rd arguments. The order of positional arguments will change in the future.
Use `Series.plot(kind='hist')` instead of `Series.plot('hist',)`.
```

Out[63]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd5f95e41d0>
```



In [64]:

```python
df['Hand Width'].describe(),
```

Out[64]:

```
(count    1009.000000
 mean        8.876189
 std         0.654095
 min         4.500000
 25%         8.500000
 50%         9.000000
 75%         9.250000
 max        11.000000
 Name: Hand Width, dtype: float64,)
```

In [65]:

```python
hand_width_mu = df['Hand Width'].mean()
hand_width_std = df['Hand Width'].std()

min95 = hand_width_mu-2*hand_width_std
max95 = hand_width_mu+2*hand_width_std


def get_rank_hand_width(handwidth):
    if handwidth > hand_width_mu+1*hand_width_std:
        return 5
    if handwidth > hand_width_mu:
        return 4
    if handwidth > hand_width_mu - hand_width_std:
        return 3
    if handwidth > hand_width_mu - 2*hand_width_std:
        return 2
    return 1
```

In [66]:

```python
df['hand_width_rank'] = df['Hand Width'].apply(get_rank_hand_width)
df.head()
```

Out[66]:

| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach | He |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1037 | 33.5 | 28.5 | 3.376 | 11.471 | 3.669 | 2003.0 | 72.75 | 94.0 | |
| **1** | 656 | 30.5 | 21.5 | 3.486 | 12.114 | 3.355 | 1865.0 | 82.00 | 104.5 | |
| **2** | 477 | 37.0 | 31.0 | 3.23 | 12.036 | 3.562 | 2005.0 | 81.50 | 99.0 | |

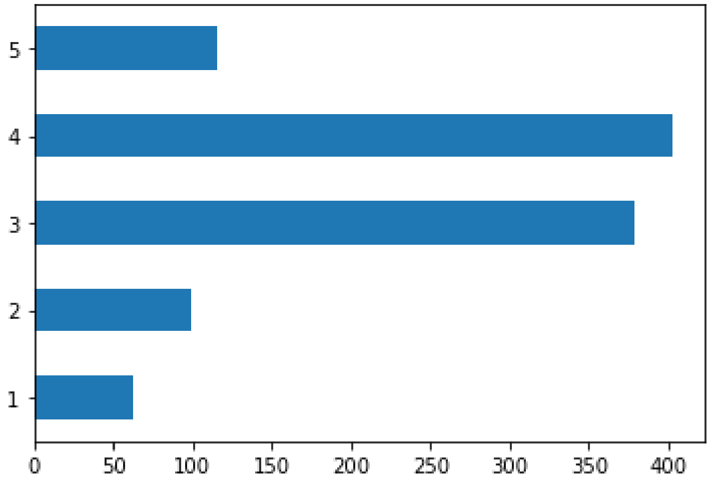
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **3** | 1200 | 29.0 | 23.0 | 3.37 | 12.509 | 3.173 | 1902.0 | 79.50 | 101.0 |
| **4** | 1501 | 31.0 | 26.0 | 3.389 | 12.724 | 3.316 | 1903.0 | 77.00 | 101.5 |

In [67]:

```
av_rank_hand_width = pd.value_counts(df['hand_width_rank'].values, sort=Fa
av_rank_hand_width.plot.barh()
```

Out[67]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd5e8912b70>
```



In [68]:

```
# Remove low outliers - normal.
```

# Cleaning Data

## Had to clean data for 3/4 Court Sprint and 4-Way Agility to be able to create ranks

## Found empty cells and filled with mean

# Cleaning - (11) 3/4 Court Sprint

In [69]:

```
#df['3/4 Court sprint  '] = df['3/4 Court sprint  '].astype(float)
```

In [70]:

```
for index,col in enumerate(df['3/4 Court sprint  ']):
    try:
        float(col)
    except ValueError:
        print (index,col)
# Found empty and blank values that we can't convert to a float so we need
```

```
371
377
391
417
616
653
```

```
879
968
```

In [71]:

```
df.loc[371, '3/4 Court sprint  ']
```

Out[71]:

```
' '
```

In [72]:

```
df['3/4 Court sprint  '] = df['3/4 Court sprint  '].replace(' ',np.NaN)
df['3/4 Court sprint  ']
```

Out[72]:

```
0       3.376
1       3.486
2       3.230
3       3.370
4       3.389
        ...
1054    3.424
1055    3.256
1056      NaN
1057      NaN
1058      NaN
Name: 3/4 Court sprint  , Length: 1059, dtype: float64
```

In [73]:

```
x = df.drop(columns=['BAMid', 'BAMScore','bam_score_rank','approach_vertic
       'reaction_shuttle_rank','wingspan_rank','reach_rank','height_rank',
y = df[['bam_score_rank']]
```

In [74]:

```
x.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1059 entries, 0 to 1058
Data columns (total 11 columns):
Approach Vertical     986 non-null float64
Vertical Jump         1019 non-null float64
3/4 Court sprint      1018 non-null float64
4-Way agility         1020 non-null object
Reaction Shuttle      1024 non-null float64
Wingspan              1012 non-null float64
Reach                 1012 non-null float64
Height                1012 non-null float64
Weight                1012 non-null float64
Body Comp             1012 non-null float64
Hand Width            1009 non-null float64
dtypes: float64(10), object(1)
memory usage: 91.1+ KB
```

In [75]:

```
x = x.replace(to_replace=['Nan','NAN'], value=np.nan)
```

In [76]:

```
x = x.fillna(x.mean())
# FORMULA = df.fillna(df.mean())
```

In [77]:

```
x.isnull().sum()
```

Out[77]:

```
Approach Vertical       0
Vertical Jump           0
3/4 Court sprint        0
4-Way agility          39
Reaction Shuttle        0
Wingspan                0
Reach                   0
Height                  0
Weight                  0
Body Comp               0
Hand Width              0
dtype: int64
```

# Cleaning - (12) 4-Way Agility

In [78]:

```
#df['4-Way agility'] = df['4-Way agility'].astype(float)
```

In [79]:

```
for index,col in enumerate(df['4-Way agility']):
    try:
        float(col)
    except ValueError:
        print (index,col)
```

```
377
391
417
430
529
534
616
653
879
986
```

In [80]:

```
df.loc[377,'4-Way agility']
```

Out[80]:

```
' '
```

In [81]:

```
df['4-Way agility'] = df['4-Way agility'].replace(' ',np.NaN)
df['4-Way agility']
```

Out[81]:

```
0       11.471
1       12.114
2       12.036
3       12.509
4       12.724
         ...
1054    12.654
1055    11.136
1056       NaN
1057       NaN
1058       NaN
Name: 4-Way agility, Length: 1059, dtype: float64
```

In [82]:

```
x = df.drop(columns=['BAMid', 'BAMScore','bam_score_rank','approach_vertic
        'reaction_shuttle_rank','wingspan_rank','reach_rank','height_rank',
y = df[['bam_score_rank']]
```

In [83]:

```
x.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1059 entries, 0 to 1058
Data columns (total 11 columns):
Approach Vertical      986 non-null float64
Vertical Jump          1019 non-null float64
3/4 Court sprint       1018 non-null float64
4-Way agility          1010 non-null float64
Reaction Shuttle       1024 non-null float64
Wingspan               1012 non-null float64
Reach                  1012 non-null float64
Height                 1012 non-null float64
Weight                 1012 non-null float64
Body Comp              1012 non-null float64
Hand Width             1009 non-null float64
dtypes: float64(11)
memory usage: 91.1 KB
```

In [84]:

```
x = x.replace(to_replace=['Nan','NAN'], value=np.nan)
```

In [85]:

```
x = x.fillna(x.mean())
# FORMULA = df.fillna(df.mean())
```

In [86]:

```
x.isnull().sum()
```

Out[86]:

```
Approach Vertical      0
Vertical Jump          0
3/4 Court sprint       0
4-Way agility          0
Reaction Shuttle       0
Wingspan               0
Reach                  0
Height                 0
Weight                 0
Body Comp              0
Hand Width             0
dtype: int64
```

## EDA (12) - 4-Way agility

In [87]:

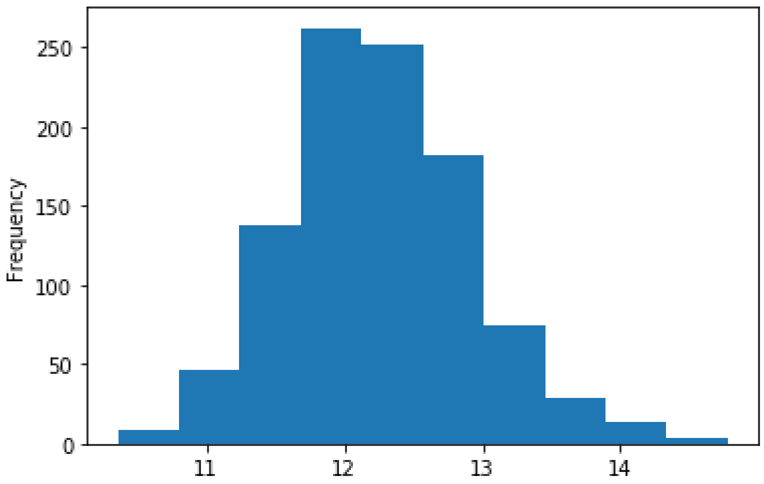
```
df['4-Way agility'].plot('hist')
```

```
/Users/bryanjamieson/opt/anaconda3/envs/learn-env/lib/python3.6/site-packa
ges/ipykernel_launcher.py:1: FutureWarning:

`Series.plot()` should not be called with positional arguments, only keywo
rd arguments. The order of positional arguments will change in the future.
Use `Series.plot(kind='hist')` instead of `Series.plot('hist',)`.
```

Out[87]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd6189f3710>
```

```
Out[87]: matplotlib.axes._subplots.AxesSubplot at 0x7fd01691e710
```



```
In [88]:  df['4-Way agility'].describe(),
```

```
Out[88]: (count    1010.000000
          mean       12.247189
          std         0.668387
          min        10.359000
          25%        11.779250
          50%        12.199000
          75%        12.676750
          max        14.775000
          Name: 4-Way agility, dtype: float64,)
```

```
In [89]:  fourway_mu = df['4-Way agility'].mean()
          fourway_std = df['4-Way agility'].std()

          min95 = fourway_mu-2*fourway_std
          max95 = fourway_mu+2*fourway_std


          def get_rank_fourway(four):
              if four > fourway_mu+1*fourway_std:
                  return 5
              if four > fourway_mu:
                  return 4
              if four > fourway_mu - fourway_std:
                  return 3
              if four > fourway_mu - 2*fourway_std:
                  return 2
              return 1
```

```
In [90]:  df['fourway_rank'] = df['4-Way agility'].apply(get_rank_fourway)
          df.head()
```

Out[90]:

| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach | He |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1037 | 33.5 | 28.5 | 3.376 | 11.471 | 3.669 | 2003.0 | 72.75 | 94.0 | |
| **1** | 656 | 30.5 | 21.5 | 3.486 | 12.114 | 3.355 | 1865.0 | 82.00 | 104.5 | |

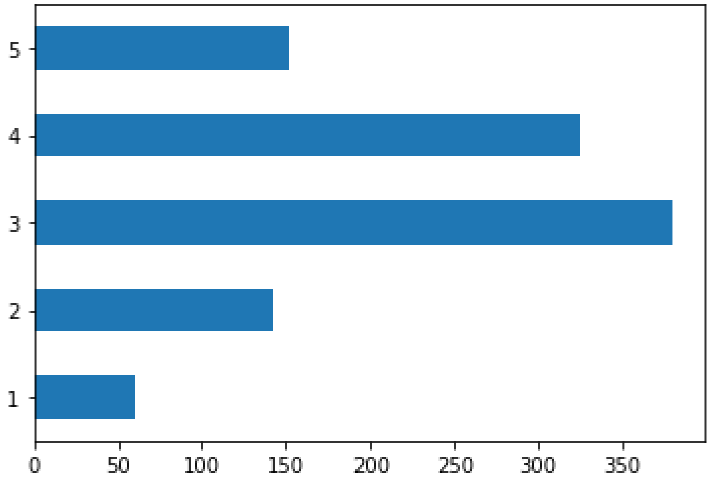
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **2** | 477 | 37.0 | 31.0 | 3.230 | 12.036 | 3.562 | 2005.0 | 81.50 | 99.0 |
| **3** | 1200 | 29.0 | 23.0 | 3.370 | 12.509 | 3.173 | 1902.0 | 79.50 | 101.0 |
| **4** | 1501 | 31.0 | 26.0 | 3.389 | 12.724 | 3.316 | 1903.0 | 77.00 | 101.5 |

In [91]:

```
av_rank_counts_fourway = pd.value_counts(df['fourway_rank'].values, sort=F
av_rank_counts_fourway.plot.barh()
```

Out[91]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd5f9518fd0>
```



In [92]:

```
# Observations - Data is extremely normal
```

## EDA - 3/4 Court Sprint

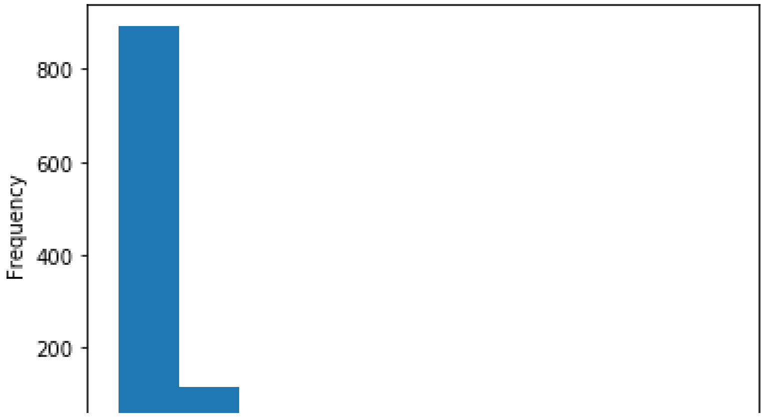
In [93]:

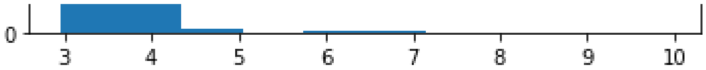
```
df['3/4 Court sprint  '].plot('hist')
```

```
/Users/bryanjamieson/opt/anaconda3/envs/learn-env/lib/python3.6/site-packa
ges/ipykernel_launcher.py:1: FutureWarning:

`Series.plot()` should not be called with positional arguments, only keywo
rd arguments. The order of positional arguments will change in the future.
Use `Series.plot(kind='hist')` instead of `Series.plot('hist',)`.
```

Out[93]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd628590b00>
```





In [94]:

```
df['3/4 Court sprint  '].describe(),
```

Out[94]:

```
(count    1018.000000
 mean        3.467047
 std         0.342199
 min         2.950000
 25%         3.335000
 50%         3.419000
 75%         3.545000
 max         9.954000
 Name: 3/4 Court sprint  , dtype: float64,)
```

In [95]:

```
courtsprint_mu = df['3/4 Court sprint  '].mean()
courtsprint_std = df['3/4 Court sprint  '].std()

min95 = courtsprint_mu-2*courtsprint_std
max95 = courtsprint_mu+2*courtsprint_std


def get_rank_courtsprint(court):
    if court > courtsprint_mu+1*courtsprint_std:
        return 5
    if court > courtsprint_mu:
        return 4
    if court > courtsprint_mu - courtsprint_std:
        return 3
    if court > courtsprint_mu - 2*courtsprint_std:
        return 2
    return 1
```

In [96]:

```
df['courtsprint_rank'] = df['3/4 Court sprint  '].apply(get_rank_courtspri
df.head()
```

Out[96]:

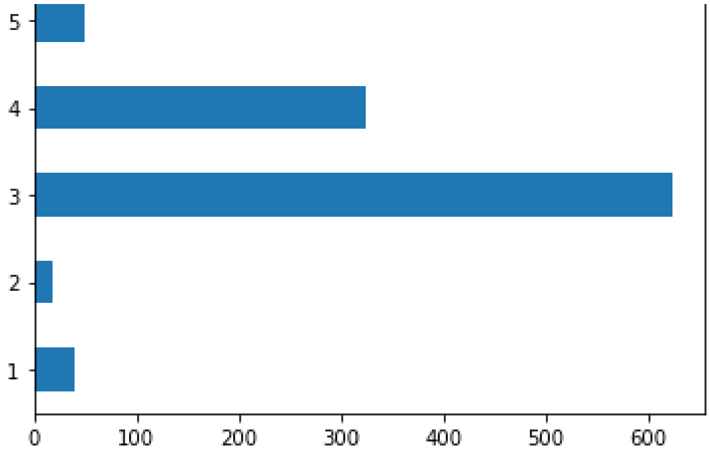
| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach | He |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1037 | 33.5 | 28.5 | 3.376 | 11.471 | 3.669 | 2003.0 | 72.75 | 94.0 | |
| **1** | 656 | 30.5 | 21.5 | 3.486 | 12.114 | 3.355 | 1865.0 | 82.00 | 104.5 | |
| **2** | 477 | 37.0 | 31.0 | 3.230 | 12.036 | 3.562 | 2005.0 | 81.50 | 99.0 | |
| **3** | 1200 | 29.0 | 23.0 | 3.370 | 12.509 | 3.173 | 1902.0 | 79.50 | 101.0 | |
| **4** | 1501 | 31.0 | 26.0 | 3.389 | 12.724 | 3.316 | 1903.0 | 77.00 | 101.5 | |

In [97]:

```
av_rank_counts_courtsprint = pd.value_counts(df['courtsprint_rank'].values
av_rank_counts_courtsprint.plot.barh()
```

Out[97]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fd628574588>
```



In [98]:

```
# Observations - Small range of times for 3/4 Court Sprint - but this make
# Removed outliers
```

## Data Transformation - Scale

https://towardsdatascience.com/scale-standardize-or-normalize-with-scikit-learn-6ccc7d176a02

## Splitting data into training and testing sets

In [99]:

```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(x,y, test_size = 0.2,
```

## Creating Random Forest Regression Model and fitting to training data

In [100…

```
scale = maxabs_scale(x, axis=0, copy=True)
print(scale)
```

```
[[0.77011494 0.75       0.33916014 ... 0.57481872 0.28405797 0.75      ]
 [0.70114943 0.56578947 0.35021097 ... 0.62096243 0.63478261 0.79545455]
 [0.85057471 0.81578947 0.32449267 ... 0.64765985 0.40289855 0.86363636]
 ...
 [0.73171528 0.68053045 0.34830688 ... 0.59570145 0.43418829 0.8069263 ]
 [0.73171528 0.68053045 0.34830688 ... 0.59570145 0.43418829 0.8069263 ]
 [0.73171528 0.68053045 0.34830688 ... 0.59570145 0.43418829 0.8069263 ]]
```

In [101…

```
print(scale.shape)

print(y.shape)
```

```
(1059, 11)
(1059, 1)
```

In [102…

```
from sklearn.ensemble import RandomForestRegressor
regressor = RandomForestRegressor(n_estimators = 10, random_state = 0)
regressor.fit(scale, y)
regressor.fit(scale, y)
```

```
/Users/bryanjamieson/opt/anaconda3/envs/learn-env/lib/python3.6/site-packa
ges/ipykernel_launcher.py:3: DataConversionWarning:

A column-vector y was passed when a 1d array was expected. Please change t
he shape of y to (n_samples,), for example using ravel().
```

Out[102…

```
RandomForestRegressor(n_estimators=10, random_state=0)
```

In [103…

```
regressor.score(scale, y)
```

Out[103…

```
0.9628462600196865
```

## Visualizing Random Forest Regression Results

# Random Forest Classifier

## Created a Random Forest Classifier to figure out the most important features in the model

In [104…

```
rf = RandomForestClassifier()
rf.fit (x,y)

#find string in data that is messing it up
```

```
/Users/bryanjamieson/opt/anaconda3/envs/learn-env/lib/python3.6/site-packa
ges/ipykernel_launcher.py:2: DataConversionWarning:

A column-vector y was passed when a 1d array was expected. Please change t
he shape of y to (n_samples,), for example using ravel().
```

Out[104…

```
RandomForestClassifier()
```

In [105…

```
#print(rf.columns)
print(rf.feature_importances_)
```

```
[0.11969479 0.11577657 0.15248385 0.17240661 0.1856637  0.03833461
 0.04260322 0.04425361 0.04880745 0.04675369 0.0332219 ]
```

# Feature Importance Analysis

In [106…

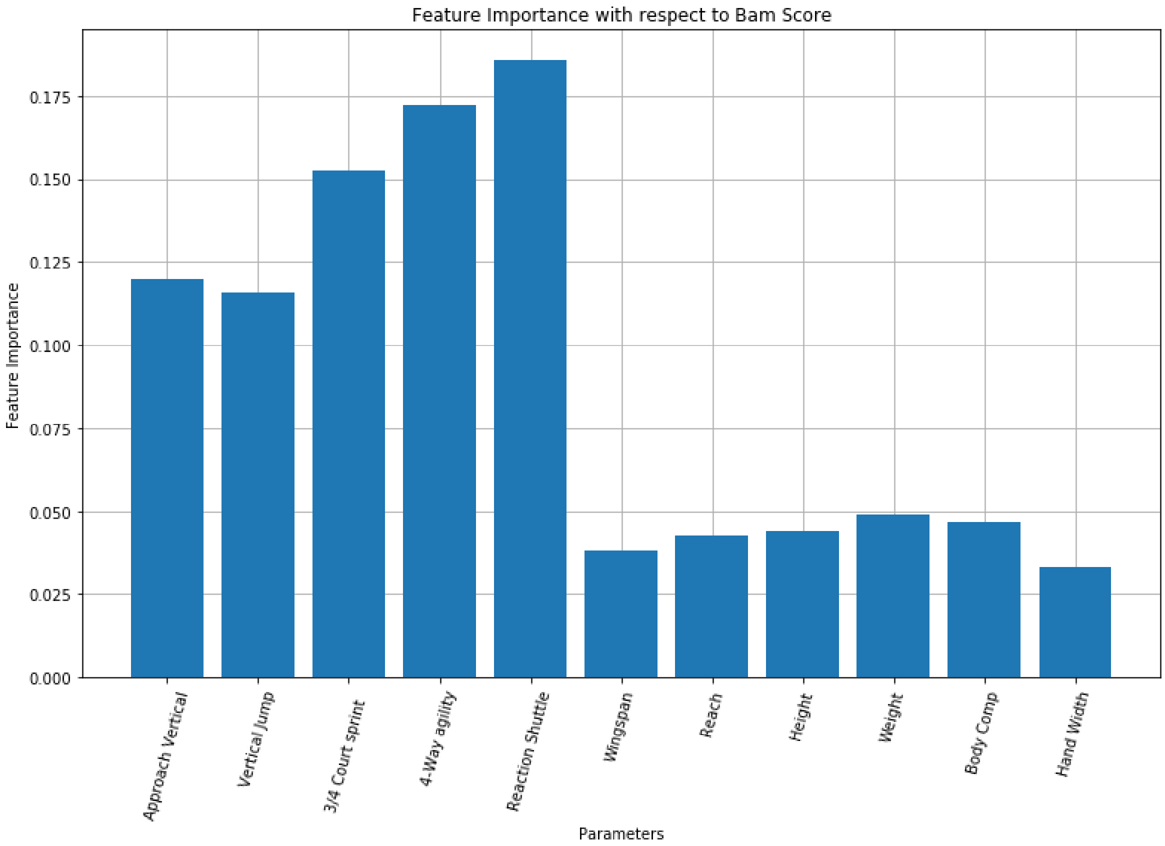
```
# This tells us which feature is the most important for BAM Score.
```

In [107…

```
values = rf.feature_importances_
names = x.columns
plt.figure(figsize=(13,8))
plt.grid(zorder=0)
plt.bar(names,values,zorder=2)
plt.xticks(rotation=75)
plt.show

plt.title('Feature Importance with respect to Bam Score')
plt.xlabel('Parameters')
plt.ylabel('Feature Importance')
```

Out[107…

```
Text(0, 0.5, 'Feature Importance')
```



In [108…

```
# Do this again and take out anthros because they are not factored into BA
```

In [109…

```
df_cleaned = x.copy()
```

In [110…

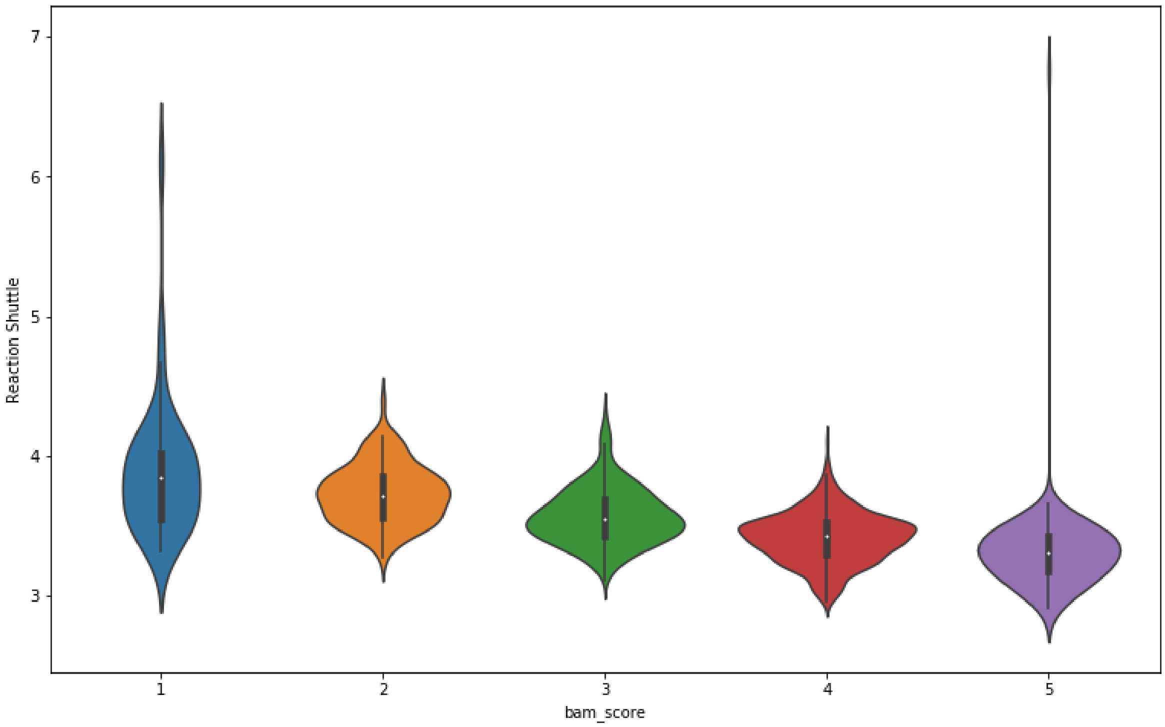
```
df_cleaned['bam_score'] = y
df_cleaned.head(2)
```

Out[110…

| | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | Wingspan | Reach | Height | Weight | Body Comp |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 33.5 | 28.5 | 3.376 | 11.471 | 3.669 | 72.75 | 94.0 | 70.0 | 174.4 | 9.8 |
| **1** | 30.5 | 21.5 | 3.486 | 12.114 | 3.355 | 82.00 | 104.5 | 79.5 | 188.4 | 21.9 |

In [111…

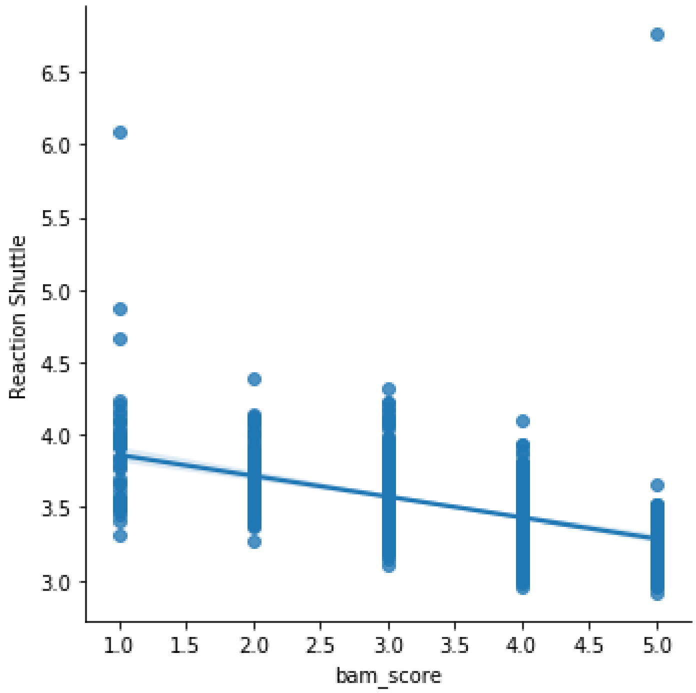
```
plt.figure(figsize=(13, 8))
sns.violinplot(x='bam_score', y='Reaction Shuttle', data=df_cleaned)
plt.show()
plt.show()
```



In [112…

```
plt.figure(figsize=(8, 5))
sns.lmplot(x='bam_score', y='Reaction Shuttle', data=df_cleaned)
plt.show()
```

```
<Figure size 576x360 with 0 Axes>
```



In [113…

```
#Observation - reaction shuttle is the highest dilineator for their rank
```

# Scatter Matrix to visualize trends

In [114…

```
ranked_columns = []

for col in df.columns:
    if col.endswith('rank'):
        ranked_columns.append(col)
ranked_columns
# We do scatter matrix to look for multicollinearity. AKA we want swarm of
# that means they are not dependant on the other variables.
```

Out[114…

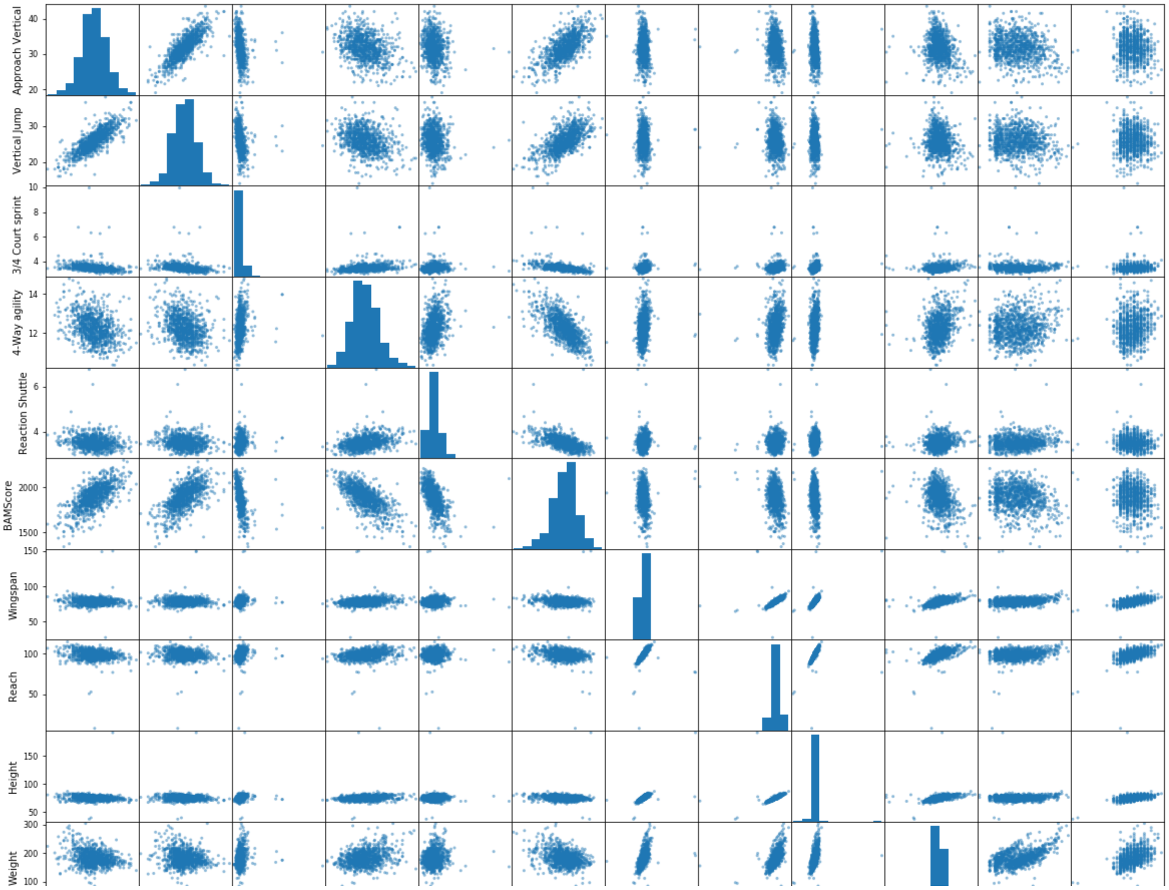
```
['approach_vertical_rank',
 'vertical_jump_rank',
 'reaction_shuttle_rank',
 'bam_score_rank',
 'wingspan_rank',
 'reach_rank',
 'height_rank',
 'weight_rank',
 'body_comp_rank',
 'hand_width_rank',
 'fourway_rank',
 'courtsprint_rank']
```

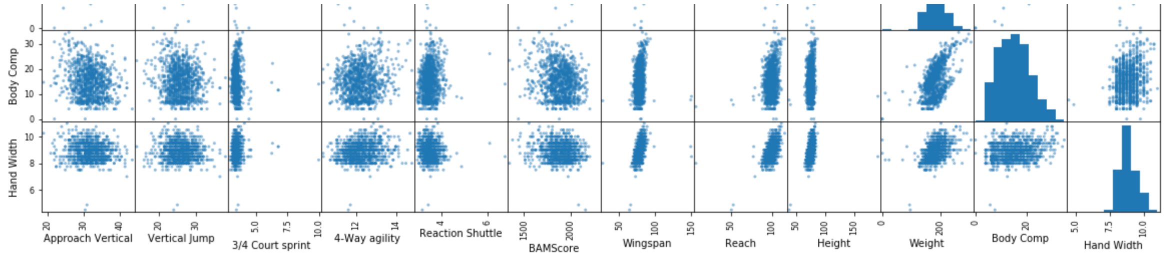
In [115…

```
# Endswith method has to reference a string. Formula is col.endswith('')
```

In [116…

```
# Make scatter matrix to visualize
pd.plotting.scatter_matrix(df.drop(columns=ranked_columns), figsize=(20,20
plt.show()

#df.drop('courtsprint_rank','fourway_rank')
```





In [117…

```
df.to_csv('BAM_Updated.csv',index=False)

# This is what I should import for the next notebook with my analysis
```

In [118…

```
df=pd.read_csv("BAM_Updated.csv")
df.head()
```

Out[118…

| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach | He |
|---|---|---|---|---|---|---|---|---|---|---|
| **0** | 1037 | 33.5 | 28.5 | 3.376 | 11.471 | 3.669 | 2003.0 | 72.75 | 94.0 | |
| **1** | 656 | 30.5 | 21.5 | 3.486 | 12.114 | 3.355 | 1865.0 | 82.00 | 104.5 | |
| **2** | 477 | 37.0 | 31.0 | 3.230 | 12.036 | 3.562 | 2005.0 | 81.50 | 99.0 | |
| **3** | 1200 | 29.0 | 23.0 | 3.370 | 12.509 | 3.173 | 1902.0 | 79.50 | 101.0 | |
| **4** | 1501 | 31.0 | 26.0 | 3.389 | 12.724 | 3.316 | 1903.0 | 77.00 | 101.5 | |

# Violin Plots for bam_score_rank with respect to each paramater

## Violin Plot for bam_score_rank with respect to Approach Vertical

In [119…

```
## This plot looks weird at:
### bam_score_rank 2, height_rank 2
### bam_score_rank 3, height_rank 2
### bam_score_rank 3, height_rank 1
## But this is ok and correct because there is not much data.
```

In [120…

```
df.loc[(df.bam_score_rank == 5) & (df.height_rank == 2)]
```

Out[120…

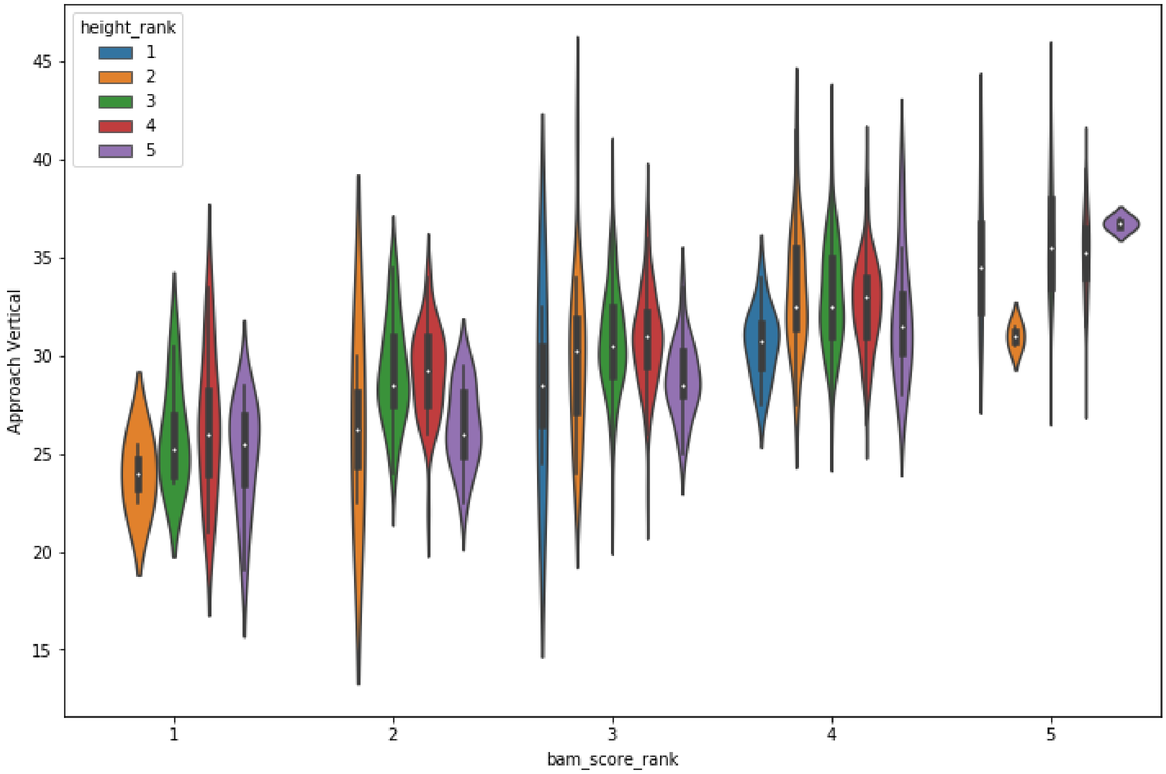
| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach |
|---|---|---|---|---|---|---|---|---|---|
| **61** | 339 | NaN | 30.0 | 3.1120 | 11.543 | 3.405 | 2048.0 | 73.0 | 90.5 |
| **654** | 1346 | 30.5 | 26.0 | 3.2125 | 12.807 | 6.759 | 2095.0 | 70.0 | 90.0 |
| **1055** | 651 | 31.5 | 26.5 | 3.2560 | 11.136 | 3.343 | 2029.0 | 74.0 | 91.5 |

In [121…

```
fig = px.violin(df, y="Approach Vertical", x="bam_score_rank", color='heig
                box=True, hover_data=df.columns)
fig.show()
```

In [122…

```
plt.figure(figsize = (12,8))
sns.violinplot(x='bam_score_rank', y='Approach Vertical',hue='height_rank'
plt.show()
```



In [123…

```
#Observation - positive correlation between BAM_SCORE_RANK and approach ve
# No correlation between approach vertical and height rank
# People with height 4 always have best approach vertical
```

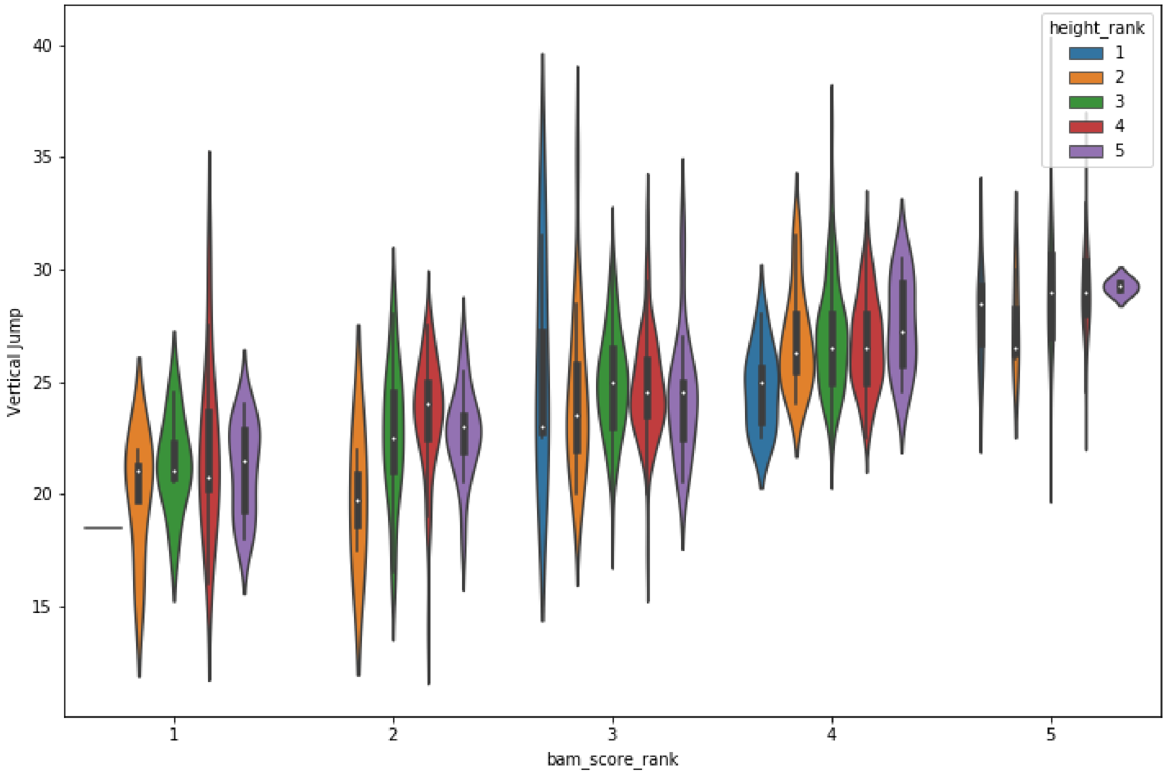
## Violin Plot for bam_score_rank with respect to Vertical Jump

In [124…

```
fig = px.violin(df, y="Vertical Jump", x="bam_score_rank", color='height_r
                box=True, hover_data=df.columns)
fig.show()

# https://plotly.com/python/violin/
```

In [125…

```
# Violin plot - different style

plt.figure(figsize = (12,8))
sns.violinplot(x='bam_score_rank', y='Vertical Jump',hue='height_rank',dat
plt.show()
```



## Violin Plots for bam_score_rank with respect to 3/4 Court sprint

In [126…

```
# Use this to find Index that outlier is in and add it to dropped rows
# df.loc[(df.bam_score_rank == 2) & (df.height_rank == 3)]
# Change bam score rank and height rank values to outliers I see in violi
```

In [127…

```
df.loc[(df.bam_score_rank == 5) & (df.height_rank == 3)].head()
```

Out[127…

| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach | H |
|---|---|---|---|---|---|---|---|---|---|---|
| **6** | 1508 | 32.0 | 27.5 | 3.210 | 11.276 | 3.047 | 2088.0 | 73.0 | 92.0 | |
| **30** | 929 | 32.5 | 28.0 | 3.357 | 11.297 | 3.213 | 2043.0 | 70.0 | 90.5 | |
| **36** | 1404 | 36.5 | 31.0 | 3.171 | 11.249 | 3.113 | 2139.0 | 78.0 | 98.0 | |
| **50** | 1242 | 35.5 | 26.5 | 3.305 | 11.368 | 3.241 | 2048.0 | 75.5 | 96.0 | |
| **67** | 985 | 29.0 | 22.0 | 3.388 | 12.119 | 3.458 | 2078.0 | 78.5 | 98.0 | |

In [128…

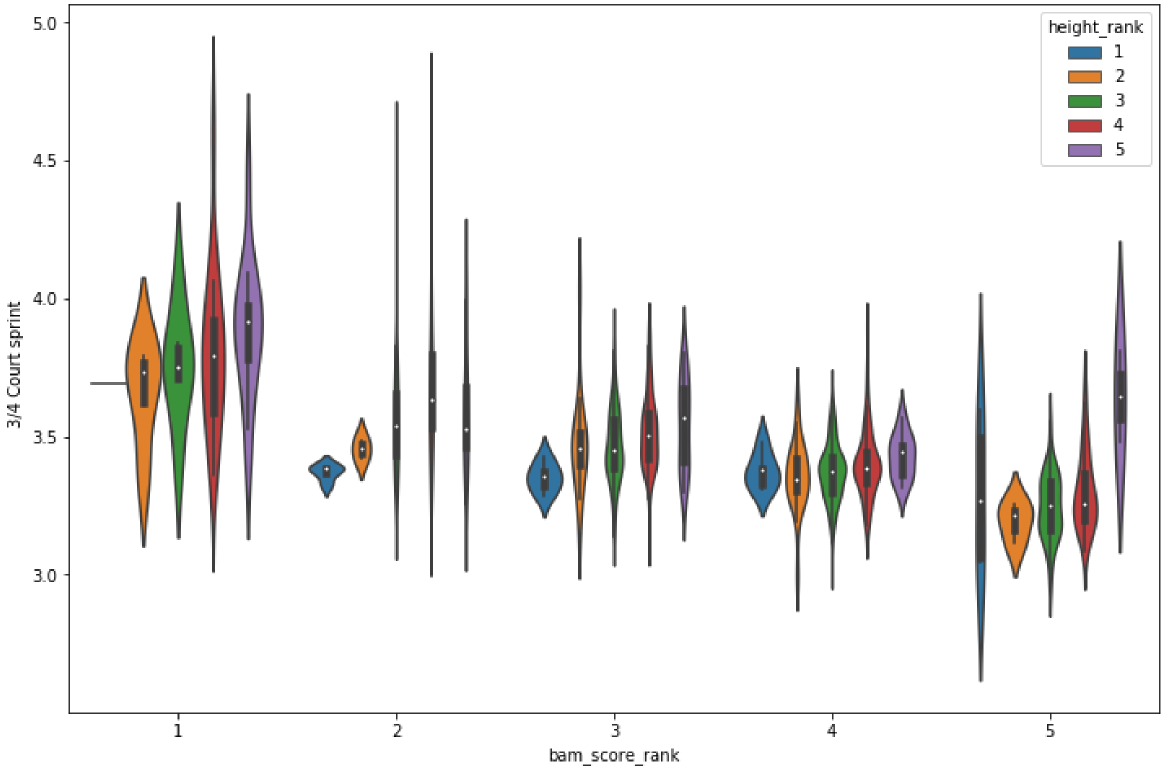
```
# Outliers removed
```

In [129…

```
dropped_rows_court_sprint = [233,511,18,124,971]
fig = px.violin(df.drop(index=dropped_rows_court_sprint), y="3/4 Court spr
                box=True, hover_data=df.columns)
fig.show()
fig.show()
```

In [130…

```
plt.figure(figsize = (12,8))
sns.violinplot(data=df.drop(index=dropped_rows_court_sprint), x='bam_score
                  y='3/4 Court sprint  ',hue='height_rank')
plt.show()
```



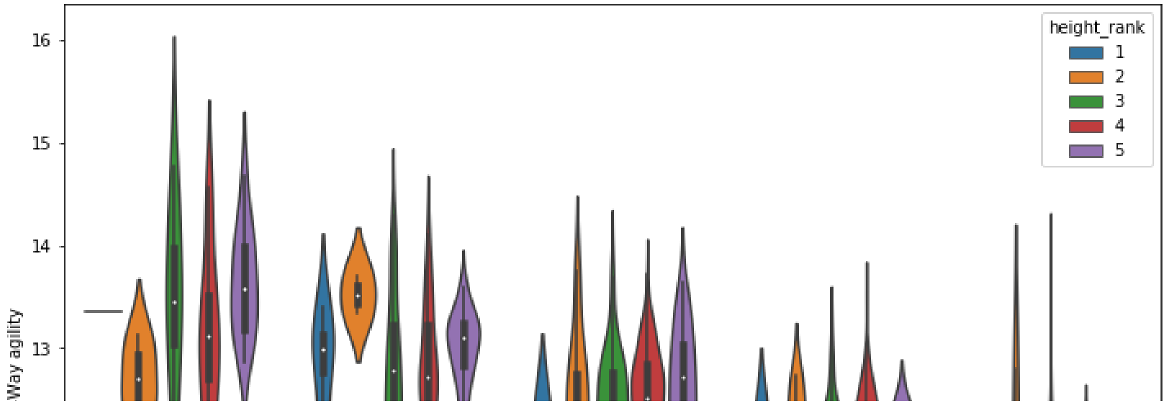
## Violin Plots for bam_score_rank with respect to 4-Way agility

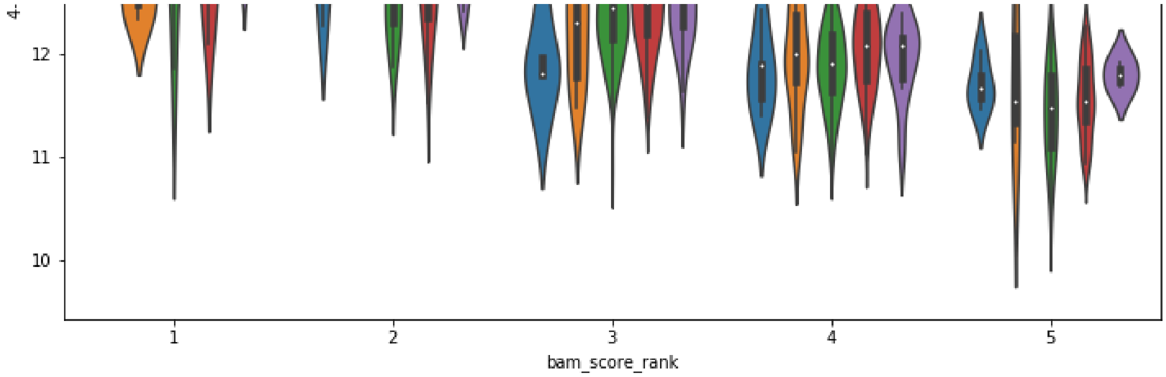
In [131…

```
fig = px.violin(df, y="4-Way agility", x="bam_score_rank", color='height_r
                   box=True, hover_data=df.columns)
fig.show()
```

In [132…

```
plt.figure(figsize = (12,8))
sns.violinplot(x='bam_score_rank', y='4-Way agility',hue='height_rank',dat
plt.show()
```





In [133…

```
# Vnext or drilldown to compare 3's (average) to 5's (bottom)
# What's the drilldown between height and reaction shuttle
```

## Violin Plots for bam_score_rank with respect to Reaction Shuttle

In [134…

```
df.loc[(df.bam_score_rank == 1) & (df.height_rank == 2)]
```

Out[134…

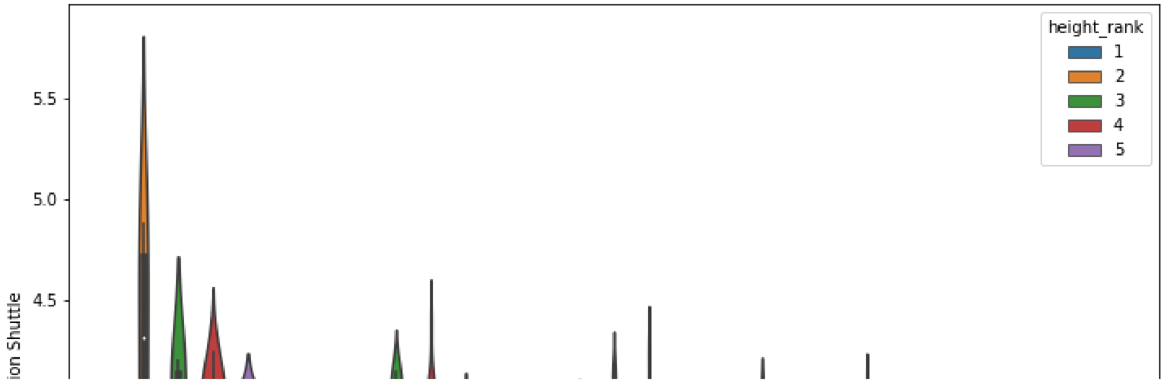
| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach |
|---|---|---|---|---|---|---|---|---|---|
| **204** | 571 | 22.5 | 16.0 | 3.762 | 12.522 | 3.552 | 1608.0 | 66.00 | 87.5 |
| **587** | 316 | NaN | 21.0 | 3.703 | 12.889 | 3.962 | 1542.0 | 76.00 | 91.0 |
| **634** | 269 | NaN | 21.0 | 3.795 | 12.340 | 4.667 | 1456.0 | 72.00 | 93.5 |
| **981** | 1479 | 25.5 | 22.0 | 3.388 | 13.134 | 4.875 | 1561.0 | 72.25 | 92.5 |

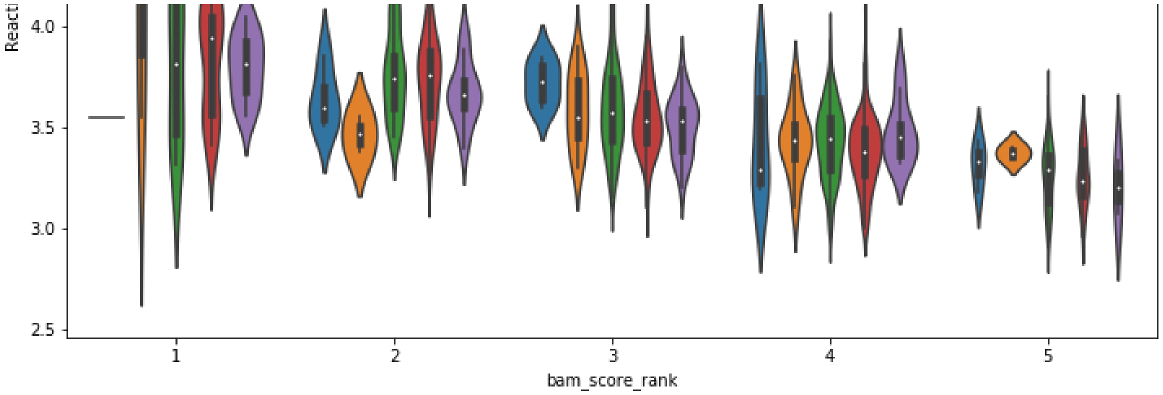
In [135…

```
dropped_rows_reaction_shuttle = [654,744]
fig = px.violin(df.drop(index = dropped_rows_reaction_shuttle), y="Reactio
                box=True, hover_data=df.columns)
fig.show()
```

In [136…

```
plt.figure(figsize = (12,8))
sns.violinplot(data = df.drop(dropped_rows_reaction_shuttle), x='bam_score
plt.show()
```





## Violin Plots for bam_score_rank with respect to Wingspan

In [137…

```
df.loc[(df.bam_score_rank == 4) & (df.height_rank == 3)]
```

Out[137…

| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach |
|---|---|---|---|---|---|---|---|---|---|
| **0** | 1037 | 33.5 | 28.5 | 3.376 | 11.471 | 3.669 | 2003.0 | 72.75 | 94.0 |
| **2** | 477 | 37.0 | 31.0 | 3.230 | 12.036 | 3.562 | 2005.0 | 81.50 | 99.0 |
| **8** | 413 | NaN | 34.0 | 3.263 | 12.644 | 3.498 | 1932.0 | 76.00 | 95.5 |
| **10** | 1283 | NaN | NaN | 3.396 | 11.387 | 3.384 | 1922.0 | 75.00 | 95.5 |
| **13** | 1016 | 35.0 | 28.0 | 3.512 | 12.407 | 3.619 | 1894.0 | 78.50 | 98.5 |
| **...** | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| **1021** | 576 | 35.5 | 26.0 | 3.423 | 12.289 | 3.460 | 1936.0 | 75.50 | 97.0 |
| **1026** | 1044 | 40.0 | 31.5 | 3.425 | 12.366 | 3.458 | 1995.0 | 76.50 | 96.0 |
| **1038** | 1204 | NaN | 31.0 | 3.268 | 11.797 | 3.476 | 1976.0 | 79.00 | 97.5 |
| **1045** | 1055 | 37.0 | 29.5 | 3.612 | 12.122 | 3.197 | 1985.0 | 73.50 | 95.0 |
| **1052** | 1275 | 30.5 | 30.5 | 3.327 | 12.053 | 3.333 | 1981.0 | 72.50 | 94.5 |

213 rows × 25 columns

In [138…

```
df.loc[(df.bam_score_rank == 4) & (df.height_rank == 5)]
```

Out[138…

| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach |
|---|---|---|---|---|---|---|---|---|---|
| **80** | 1300 | 32.0 | 26.5 | 3.363 | 11.110 | 3.364 | 2014.0 | 84.00 | 106.0 |
| **283** | 298 | 33.5 | 29.0 | 3.446 | 11.940 | 3.696 | 1913.0 | 80.00 | 103.0 |
| **335** | 828 | 39.0 | 30.5 | 3.470 | 12.104 | 3.369 | 2006.0 | 81.75 | 104.5 |
| **446** | 639 | 35.5 | 30.0 | 3.316 | 12.165 | 3.793 | 1919.0 | 85.00 | 107.0 |
| **484** | 281 | 30.5 | 24.5 | NaN | 11.670 | 3.518 | 1910.0 | 83.00 | 107.5 |

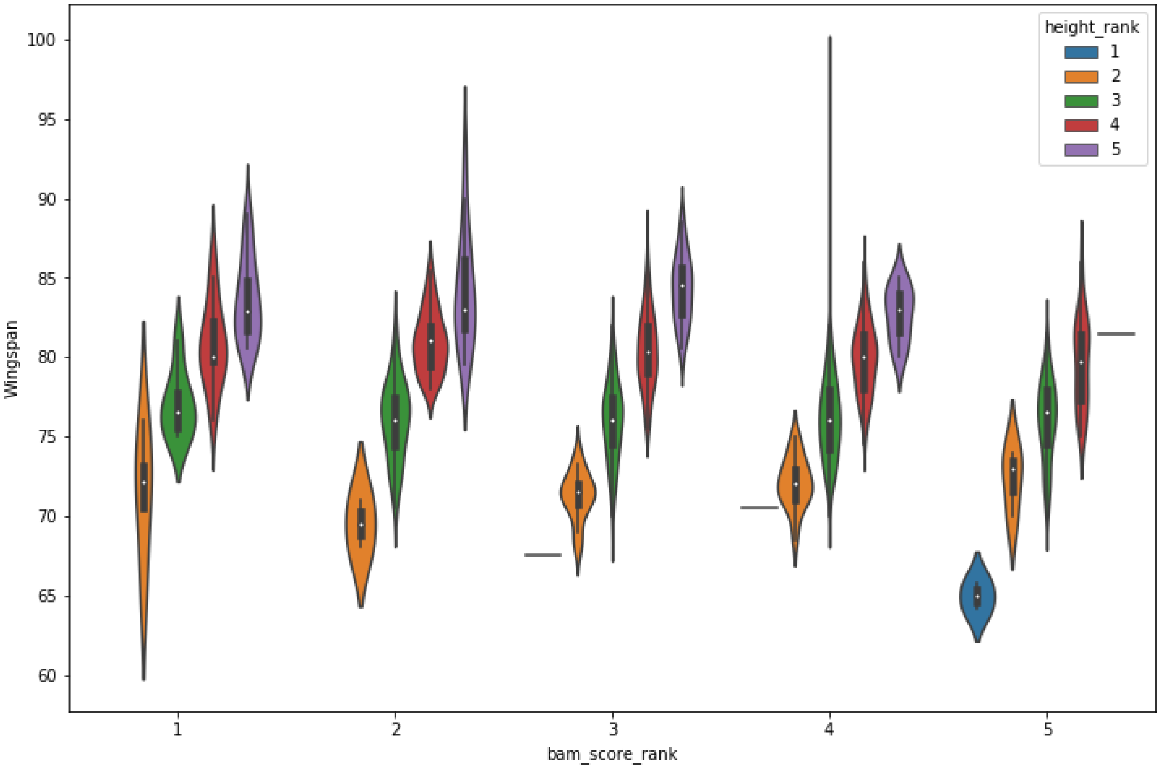
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **643** | 1498 | 31.5 | 25.5 | 3.492 | 12.408 | 3.325 | 1899.0 | 84.50 | 108.5 |
| **645** | 1122 | 31.5 | 29.5 | 3.355 | 12.285 | 3.446 | 1945.0 | 81.50 | 108.5 |
| **712** | 981 | 29.0 | 27.5 | 3.469 | 12.152 | 3.506 | 1929.0 | 84.00 | 105.0 |
| **961** | 426 | 28.0 | 25.5 | 3.386 | 12.060 | 3.322 | 1918.0 | 80.50 | 105.5 |
| **1051** | 1336 | 30.0 | 27.0 | 3.569 | 11.702 | 3.451 | 1909.0 | 83.00 | 104.0 |

In [139…

```
dropped_rows_wingspan = [282,489, 578]
fig = px.violin(df.drop(index = dropped_rows_wingspan), y="Wingspan", x="b
                box=True, hover_data=df.columns)
fig.show()
```

In [140…

```
plt.figure(figsize = (12,8))
sns.violinplot(data = df.drop(dropped_rows_wingspan), x='bam_score_rank',
               y='Wingspan',hue='height_rank')
plt.show()
```



## Violin Plots for bam_score_rank with respect to Reach

In [141…

```
df.loc[(df.bam_score_rank == 5) & (df.height_rank == 1) & (df.reach_rank =
```

Out[141…

| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach |
|---|---|---|---|---|---|---|---|---|---|
| **5** | 490 | 37.0 | 29.0 | NaN | NaN | NaN | 2208.0 | NaN | NaN |
| **143** | 869 | 34.5 | 29.5 | NaN | NaN | NaN | 2190.0 | NaN | NaN |

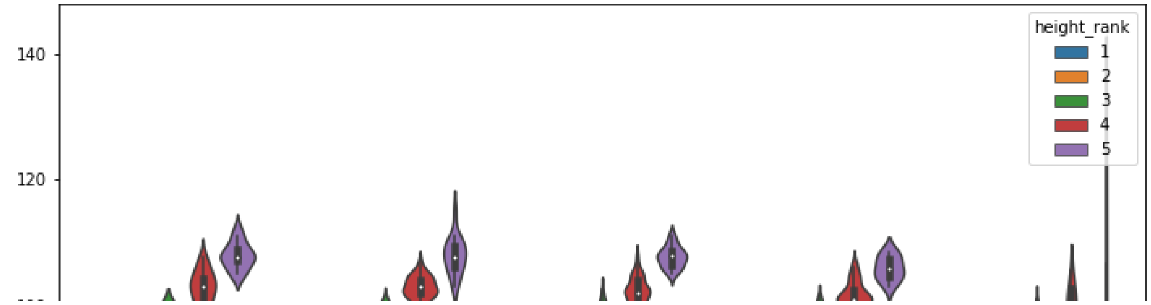
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **144** | 670 | 34.5 | 27.0 | NaN | NaN | NaN | 2140.0 | NaN | NaN |
| **157** | 787 | 31.5 | 25.5 | NaN | NaN | NaN | 2050.0 | NaN | NaN |
| **212** | 930 | 41.0 | 29.5 | NaN | NaN | NaN | 2280.0 | NaN | NaN |
| **219** | 886 | 30.5 | 25.5 | NaN | NaN | NaN | 2030.0 | NaN | NaN |
| **228** | 348 | 36.5 | 27.0 | NaN | NaN | NaN | 2162.0 | NaN | NaN |
| **340** | 380 | 30.5 | 24.0 | 3.463 | 11.615 | 3.174 | 2161.0 | 64.125 | 50.50 |
| **377** | 1262 | 37.0 | 29.5 | NaN | NaN | NaN | 2218.0 | NaN | NaN |
| **378** | 489 | 31.0 | 25.0 | 3.597 | 11.714 | 3.433 | 2086.0 | 65.750 | 52.75 |
| **391** | 1301 | 36.5 | 28.5 | NaN | NaN | NaN | 2192.0 | NaN | NaN |
| **425** | 234 | 34.0 | 29.5 | NaN | NaN | NaN | 2180.0 | NaN | NaN |
| **474** | 849 | 35.5 | 27.0 | NaN | NaN | NaN | 2152.0 | NaN | NaN |
| **682** | 650 | 31.0 | 25.5 | NaN | NaN | NaN | 2040.0 | NaN | NaN |
| **696** | 976 | 35.0 | 28.5 | NaN | NaN | NaN | 2178.0 | NaN | NaN |
| **748** | 1309 | 38.5 | 31.0 | 3.041 | 12.040 | 3.365 | 2095.0 | NaN | NaN |
| **817** | 540 | 30.5 | 26.5 | NaN | NaN | NaN | 2050.0 | NaN | NaN |
| **879** | 1146 | 33.5 | 28.5 | NaN | NaN | NaN | 2150.0 | NaN | NaN |
| **973** | 206 | 35.5 | 27.0 | NaN | NaN | NaN | 2152.0 | NaN | NaN |
| **977** | 554 | 33.0 | 29.0 | 3.072 | 11.460 | 3.294 | 2090.0 | NaN | NaN |
| **995** | 517 | 40.0 | 32.0 | NaN | NaN | NaN | 2298.0 | NaN | NaN |
| **1002** | 256 | 33.5 | 28.5 | NaN | NaN | NaN | 2150.0 | NaN | NaN |
| **1030** | 1018 | 40.0 | 27.0 | NaN | NaN | NaN | 2220.0 | NaN | NaN |

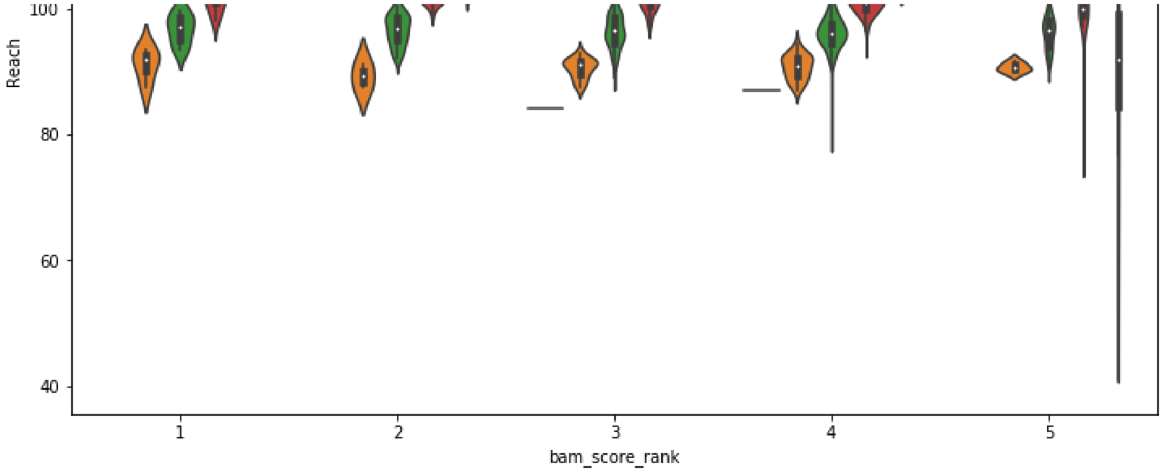
In [142…

```
dropped_rows_reach = [490, 340, 378]
fig = px.violin(df.drop(index=dropped_rows_reach), y="Reach", x="bam_score
                color='height_rank', box=True, hover_data=df.columns)
fig.show()
```

In [143…

```
plt.figure(figsize = (12,8))
sns.violinplot(data=df.drop(dropped_rows_reach), x='bam_score_rank', y='Re
               hue='height_rank')
plt.show()
```





## Violin Plots for bam_score_rank with respect to Height

In [144…

```
df.loc[(df.bam_score_rank == 5) & (df.height_rank == 1)]
```

Out[144…

| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach |
|---|---|---|---|---|---|---|---|---|---|
| **5** | 490 | 37.0 | 29.0 | NaN | NaN | NaN | 2208.0 | NaN | NaN |
| **143** | 869 | 34.5 | 29.5 | NaN | NaN | NaN | 2190.0 | NaN | NaN |
| **144** | 670 | 34.5 | 27.0 | NaN | NaN | NaN | 2140.0 | NaN | NaN |
| **157** | 787 | 31.5 | 25.5 | NaN | NaN | NaN | 2050.0 | NaN | NaN |
| **212** | 930 | 41.0 | 29.5 | NaN | NaN | NaN | 2280.0 | NaN | NaN |
| **219** | 886 | 30.5 | 25.5 | NaN | NaN | NaN | 2030.0 | NaN | NaN |
| **228** | 348 | 36.5 | 27.0 | NaN | NaN | NaN | 2162.0 | NaN | NaN |
| **340** | 380 | 30.5 | 24.0 | 3.463 | 11.615 | 3.174 | 2161.0 | 64.125 | 50.50 |
| **377** | 1262 | 37.0 | 29.5 | NaN | NaN | NaN | 2218.0 | NaN | NaN |
| **378** | 489 | 31.0 | 25.0 | 3.597 | 11.714 | 3.433 | 2086.0 | 65.750 | 52.75 |
| **391** | 1301 | 36.5 | 28.5 | NaN | NaN | NaN | 2192.0 | NaN | NaN |
| **425** | 234 | 34.0 | 29.5 | NaN | NaN | NaN | 2180.0 | NaN | NaN |
| **474** | 849 | 35.5 | 27.0 | NaN | NaN | NaN | 2152.0 | NaN | NaN |
| **682** | 650 | 31.0 | 25.5 | NaN | NaN | NaN | 2040.0 | NaN | NaN |
| **696** | 976 | 35.0 | 28.5 | NaN | NaN | NaN | 2178.0 | NaN | NaN |
| **748** | 1309 | 38.5 | 31.0 | 3.041 | 12.040 | 3.365 | 2095.0 | NaN | NaN |
| **817** | 540 | 30.5 | 26.5 | NaN | NaN | NaN | 2050.0 | NaN | NaN |
| **879** | 1146 | 33.5 | 28.5 | NaN | NaN | NaN | 2150.0 | NaN | NaN |
| **973** | 206 | 35.5 | 27.0 | NaN | NaN | NaN | 2152.0 | NaN | NaN |
| **977** | 554 | 33.0 | 29.0 | 3.072 | 11.460 | 3.294 | 2090.0 | NaN | NaN |
| **995** | 517 | 40.0 | 32.0 | NaN | NaN | NaN | 2298.0 | NaN | NaN |
| **1002** | 256 | 33.5 | 28.5 | NaN | NaN | NaN | 2150.0 | NaN | NaN |

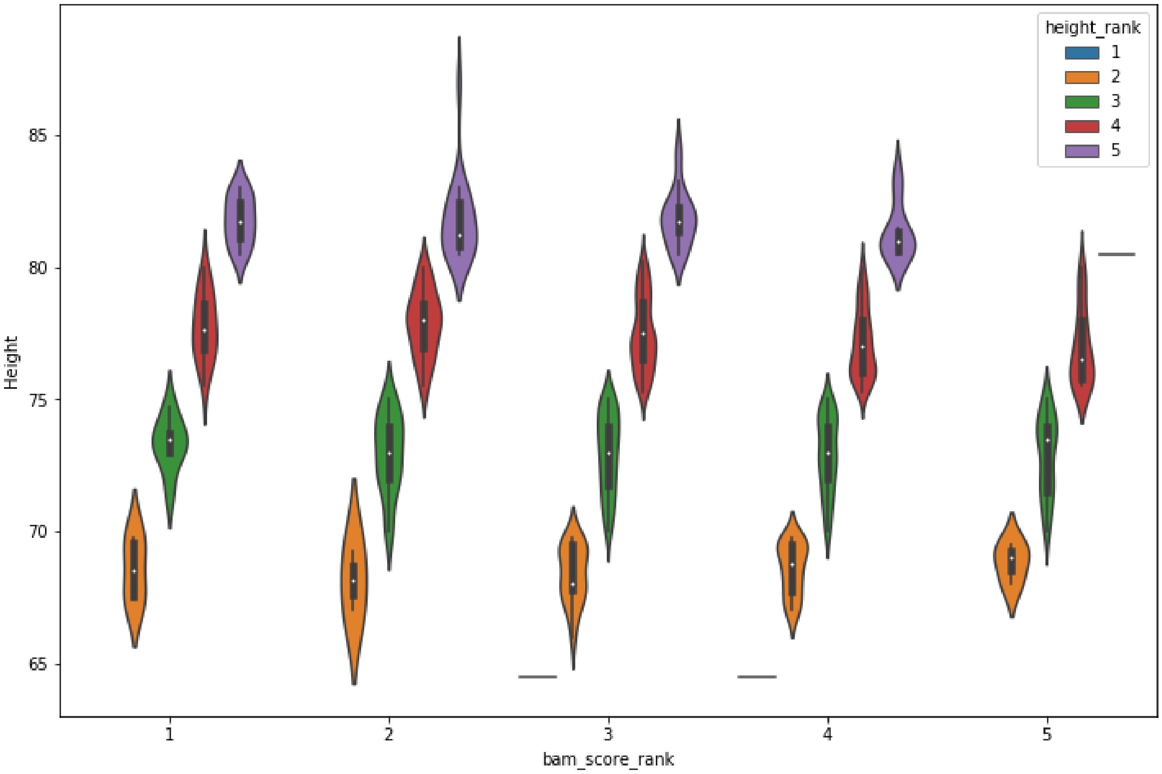
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1030** | 1018 | 40.0 | 27.0 | NaN | NaN | NaN | 2220.0 | NaN | NaN |

In [145…

```
dropped_rows_height = [282, 340, 378]
fig = px.violin(df.drop(index = dropped_rows_height), y="Height", x="bam_s
                color='height_rank', box=True, hover_data=df.columns)
fig.show()
```

In [146…

```
plt.figure(figsize = (12,8))
sns.violinplot(data = df.drop(dropped_rows_height), x='bam_score_rank',
               y='Height',hue='height_rank')
plt.show()
```



## Violin Plots for bam_score_rank with respect to Weight

In [147…

```
df.loc[(df.bam_score_rank == 4) & (df.height_rank == 5) & (df.weight_rank
```

Out[147…

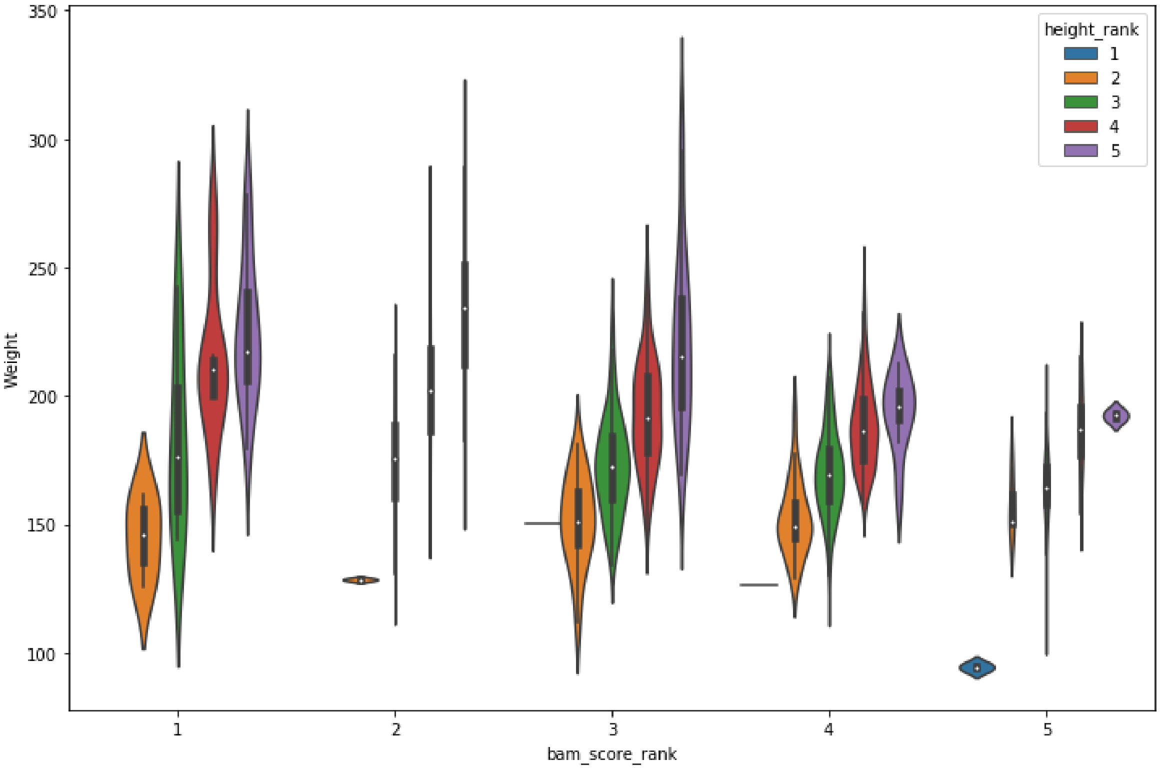
| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach | H |
|---|---|---|---|---|---|---|---|---|---|---|
| **80** | 1300 | 32.0 | 26.5 | 3.363 | 11.11 | 3.364 | 2014.0 | 84.0 | 106.0 | |

In [148…

```
dropped_rows_weight = [262,106,937,96,905,80]
fig = px.violin(df.drop(index = dropped_rows_weight), y="Weight",x="bam_sc
                color='height_rank',box=True, hover_data=df.columns)
fig.show()
fig.show()
```

In [149…

```
plt.figure(figsize = (12,8))
sns.violinplot(data = df.drop(dropped_rows_weight), x='bam_score_rank',
               y='Weight',hue='height_rank')
plt.show()
```



## Violin Plots for bam_score_rank with respect to Body Comp

In [150…

```
df.loc[(df.bam_score_rank == 2) & (df.height_rank == 5)]
```

Out[150…

|  | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach |
|---|---|---|---|---|---|---|---|---|---|
| **42** | 1371 | 26.0 | 23.5 | 3.684 | 13.133 | 3.631 | 1728.0 | 90.00 | 111.0 |
| **70** | 1502 | 24.5 | 22.0 | 3.683 | 12.868 | 3.534 | 1710.0 | 93.00 | 115.0 |
| **153** | 1172 | 29.0 | 23.0 | 4.051 | 13.260 | 3.441 | 1666.0 | 79.50 | 105.0 |
| **182** | 1409 | 24.0 | 21.5 | 3.612 | 13.191 | 3.637 | 1667.0 | 84.00 | 109.5 |
| **184** | 776 | 28.5 | 24.5 | 3.255 | 13.212 | 3.885 | 1747.0 | 86.25 | 110.0 |
| **221** | 675 | 24.5 | 18.0 | 3.386 | 13.281 | 3.675 | 1665.0 | 82.50 | 110.0 |
| **399** | 1454 | 27.5 | 23.0 | 3.602 | 13.461 | 3.704 | 1687.0 | 83.00 | 107.5 |
| **413** | 331 | 26.0 | 23.5 | 3.475 | 13.148 | 3.591 | 1746.0 | 83.00 | 107.5 |
| **480** | 336 | NaN | NaN | 3.465 | 12.445 | 3.548 | 1748.0 | 80.00 | 103.0 |
| **527** | 217 | 29.5 | 23.0 | 3.672 | 12.684 | 3.939 | 1684.0 | 79.50 | 103.5 |

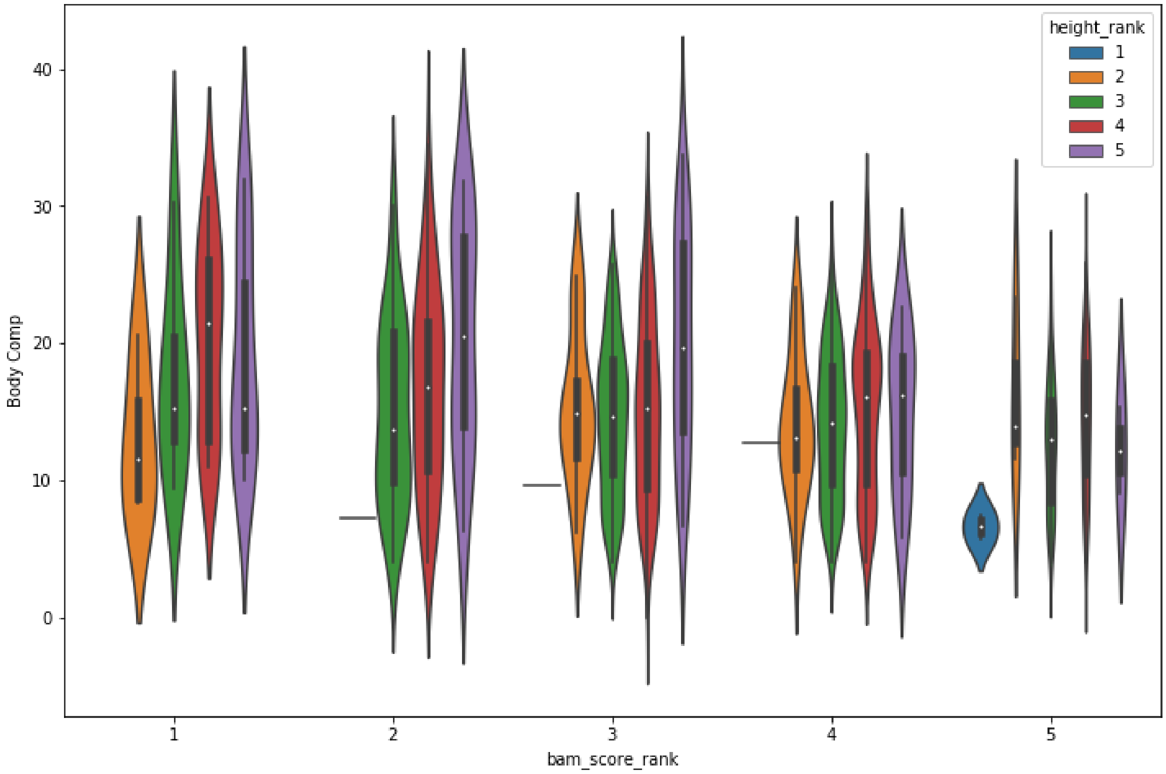
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **618** | 918 | 28.0 | 22.5 | 3.991 | 12.828 | 3.670 | 1647.0 | 83.00 | 105.5 |
| **624** | 1105 | 29.5 | 26.5 | 3.489 | 13.598 | 3.723 | 1742.0 | 84.00 | 106.5 |
| **665** | 652 | 26.0 | 21.0 | 3.871 | 13.032 | 3.392 | 1658.0 | 87.50 | 109.5 |
| **677** | 247 | 26.0 | 23.0 | 3.424 | 13.281 | 3.606 | 1746.0 | 81.50 | 106.0 |
| **819** | 1060 | 26.5 | 20.5 | 3.567 | 12.917 | 3.733 | 1678.0 | 82.50 | 107.5 |
| **906** | 1184 | 25.0 | 22.5 | 3.461 | 12.417 | 3.966 | 1687.0 | 86.00 | 109.0 |
| **975** | 371 | NaN | NaN | 3.476 | 12.781 | 3.646 | 1677.0 | 87.00 | 109.0 |
| **1032** | 1401 | 22.5 | 25.5 | 3.386 | 13.077 | 3.781 | 1725.0 | 81.50 | 107.5 |

In [151…

```
dropped_rows_body_comp = [262]
fig = px.violin(df.drop(index = dropped_rows_body_comp), y="Body Comp",
                x="bam_score_rank", color='height_rank',
                box=True, hover_data=df.columns)
fig.show()
```

In [152…

```
plt.figure(figsize = (12,8))
sns.violinplot(data=df.drop(dropped_rows_body_comp), x='bam_score_rank',
               y='Body Comp',hue='height_rank')
plt.show()
```



## Violin Plots for bam_score_rank with respect to Hand Width

In [153…

```
# Want to cut off anything below 6.5
# I know this by looking at the normal distribution
```

In [154…

```
df.loc[(df.bam_score_rank == 5) & (df.height_rank == 1)]
```

Out[154…

| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach |
|---|---|---|---|---|---|---|---|---|---|
| **5** | 490 | 37.0 | 29.0 | NaN | NaN | NaN | 2208.0 | NaN | NaN |
| **143** | 869 | 34.5 | 29.5 | NaN | NaN | NaN | 2190.0 | NaN | NaN |
| **144** | 670 | 34.5 | 27.0 | NaN | NaN | NaN | 2140.0 | NaN | NaN |
| **157** | 787 | 31.5 | 25.5 | NaN | NaN | NaN | 2050.0 | NaN | NaN |
| **212** | 930 | 41.0 | 29.5 | NaN | NaN | NaN | 2280.0 | NaN | NaN |
| **219** | 886 | 30.5 | 25.5 | NaN | NaN | NaN | 2030.0 | NaN | NaN |
| **228** | 348 | 36.5 | 27.0 | NaN | NaN | NaN | 2162.0 | NaN | NaN |
| **340** | 380 | 30.5 | 24.0 | 3.463 | 11.615 | 3.174 | 2161.0 | 64.125 | 50.50 |
| **377** | 1262 | 37.0 | 29.5 | NaN | NaN | NaN | 2218.0 | NaN | NaN |
| **378** | 489 | 31.0 | 25.0 | 3.597 | 11.714 | 3.433 | 2086.0 | 65.750 | 52.75 |
| **391** | 1301 | 36.5 | 28.5 | NaN | NaN | NaN | 2192.0 | NaN | NaN |
| **425** | 234 | 34.0 | 29.5 | NaN | NaN | NaN | 2180.0 | NaN | NaN |
| **474** | 849 | 35.5 | 27.0 | NaN | NaN | NaN | 2152.0 | NaN | NaN |
| **682** | 650 | 31.0 | 25.5 | NaN | NaN | NaN | 2040.0 | NaN | NaN |
| **696** | 976 | 35.0 | 28.5 | NaN | NaN | NaN | 2178.0 | NaN | NaN |
| **748** | 1309 | 38.5 | 31.0 | 3.041 | 12.040 | 3.365 | 2095.0 | NaN | NaN |
| **817** | 540 | 30.5 | 26.5 | NaN | NaN | NaN | 2050.0 | NaN | NaN |
| **879** | 1146 | 33.5 | 28.5 | NaN | NaN | NaN | 2150.0 | NaN | NaN |
| **973** | 206 | 35.5 | 27.0 | NaN | NaN | NaN | 2152.0 | NaN | NaN |
| **977** | 554 | 33.0 | 29.0 | 3.072 | 11.460 | 3.294 | 2090.0 | NaN | NaN |
| **995** | 517 | 40.0 | 32.0 | NaN | NaN | NaN | 2298.0 | NaN | NaN |
| **1002** | 256 | 33.5 | 28.5 | NaN | NaN | NaN | 2150.0 | NaN | NaN |
| **1030** | 1018 | 40.0 | 27.0 | NaN | NaN | NaN | 2220.0 | NaN | NaN |

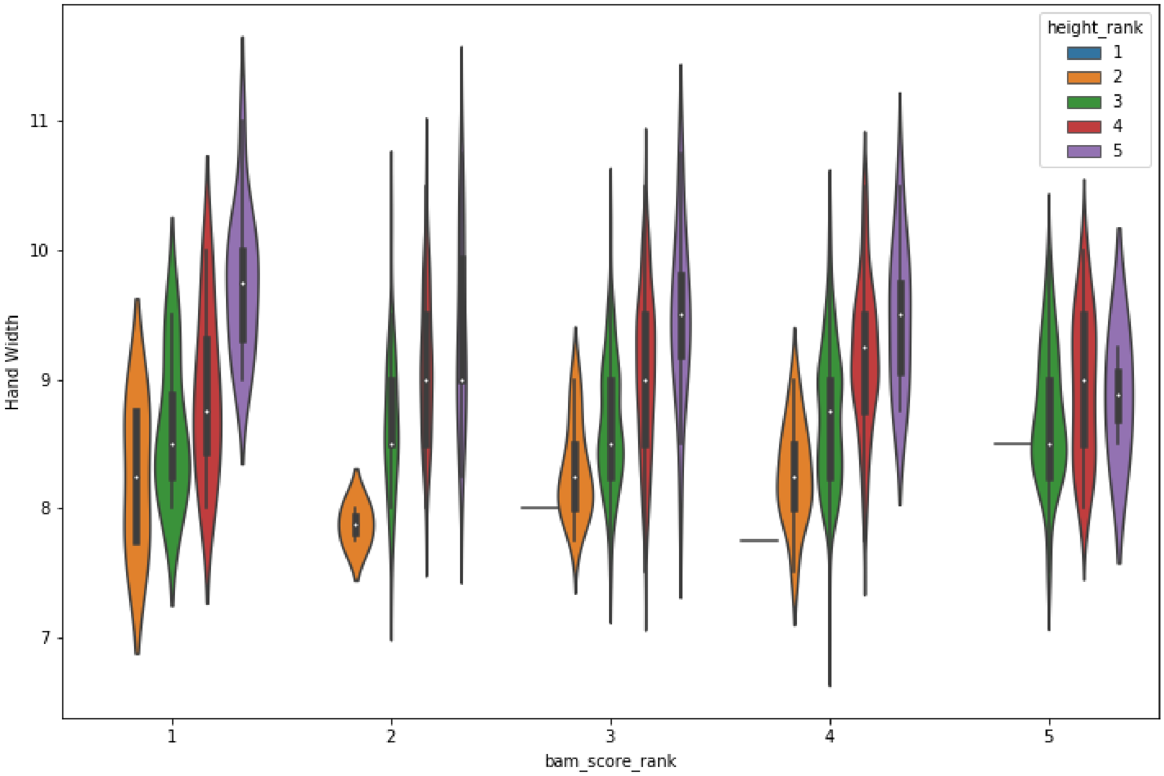
In [155…

```
dropped_rows_hand_width = [340,378]
fig = px.violin(df.drop(index = dropped_rows_hand_width), y="Hand Width",
                x="bam_score_rank", color='height_rank',
                box=True, hover_data=df.columns)
fig.show()
```

In [156…

```
plt.figure(figsize = (12,8))
sns.violinplot(data = df.drop(dropped_rows_hand_width), x='bam_score_rank'
               y='Hand Width',hue='height_rank')
```

```
plt.show()
```



# Jarque-Bera Test for each parameter

# Ran Jarque-Bera Test for each paramater

## Jarque-Bera test is a goodness-of-fit test thats tests whether the sample data has a skewness and kurtosis matching a normal distribution

In [157…

```
# Reaction Shuttle threshold identifier
#skewness = leaning data to one side #kurtosis = normal distribution
```

In [158…

```
rs_mu = df['Reaction Shuttle'].mean()
rs_std = df['Reaction Shuttle'].std()
print(rs_mu, rs_std)
lower_95 = rs_mu-2*rs_std
df.shape, df[df['Reaction Shuttle']>4.5].shape
#3.505 = mean, 0.278 = std
```

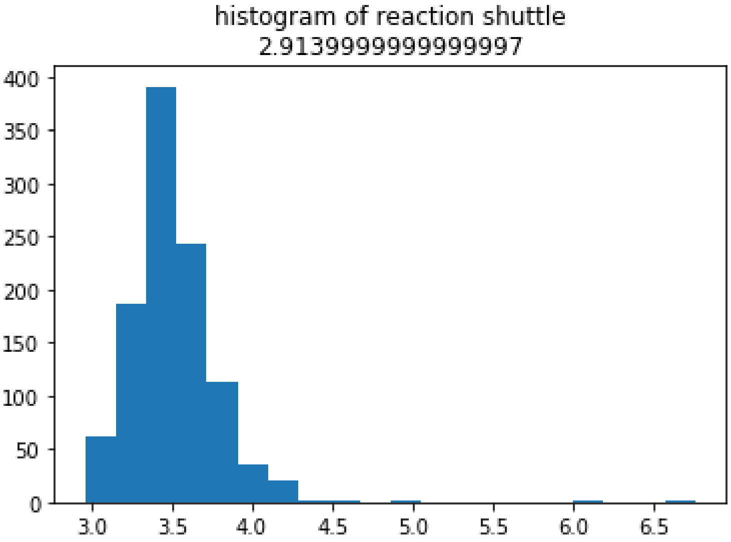
```
3.5052431640624997 0.2784274343866079
```

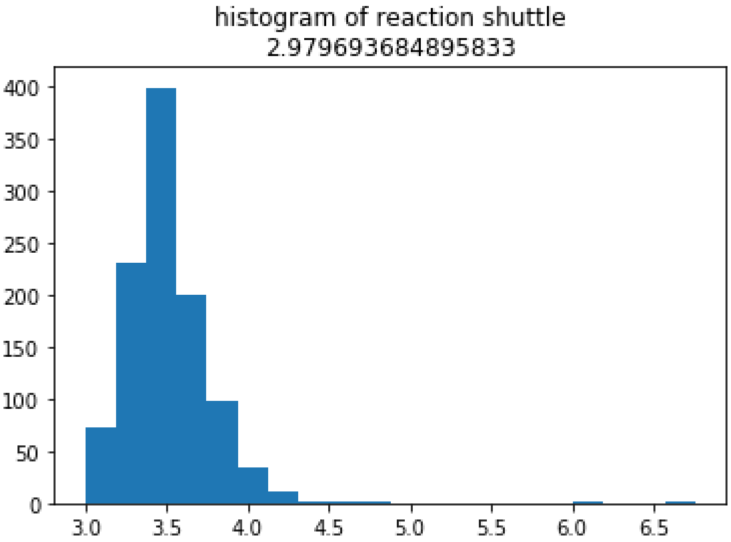
Out[158…

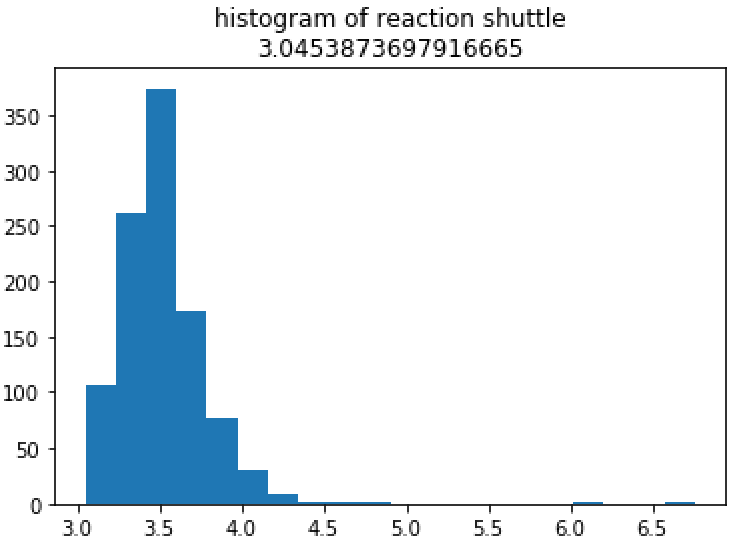
```
((1059, 25), (4, 25))
```

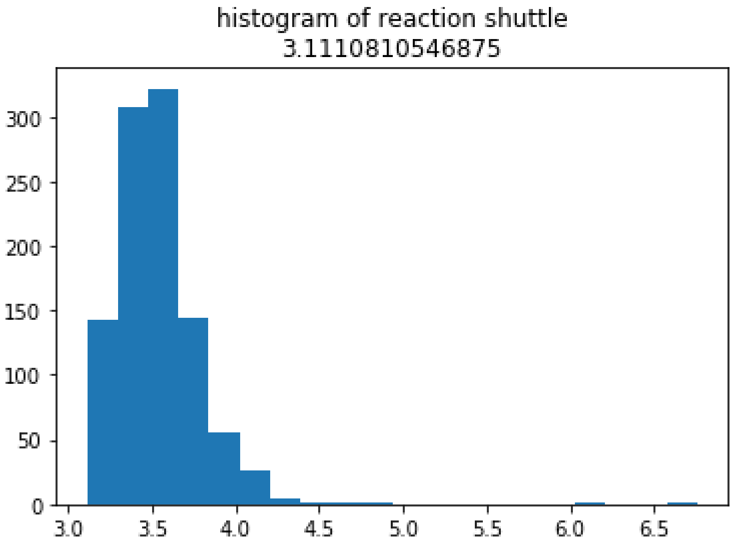
In [159…

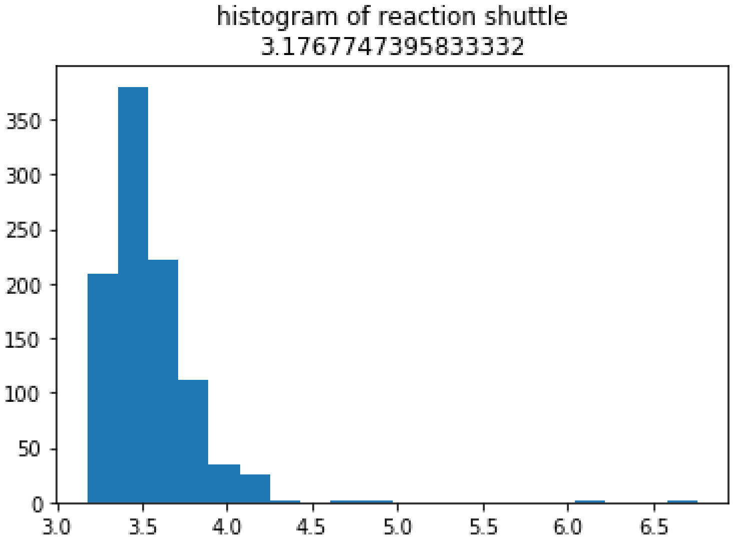
```
#testing the effectiveness of our model
# if data close to 0, data is normally distrubuted, if close to 1, skewnes
rs_min = df['Reaction Shuttle'].min()

jbs = []
thresholds = np.linspace(rs_min, rs_mu, 10)
thresholds = np.linspace(rs_min, rs_mu, 10)
for threshold in thresholds:
    vals = df[df['Reaction Shuttle'].fillna(rs_mu)>threshold]['Reaction Sh
    plt.hist(vals, bins=20)
    plt.title("histogram of reaction shuttle\n{}".format(threshold))
    plt.show()
    jb = scs.jarque_bera(vals)
    jbs.append(jb[0])
```

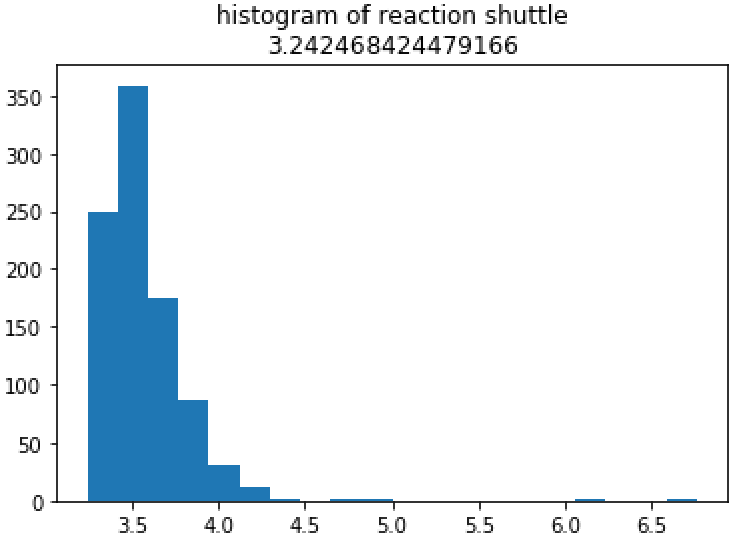

histogram of reaction shuttle
2.9139999999999997

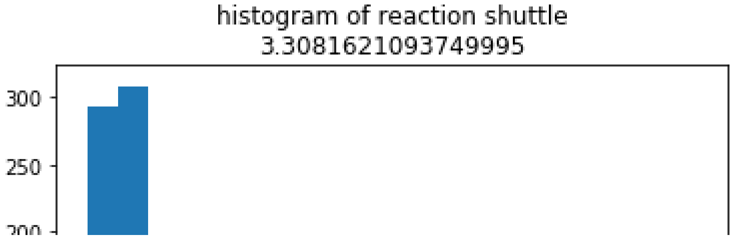

histogram of reaction shuttle
2.979693684895833

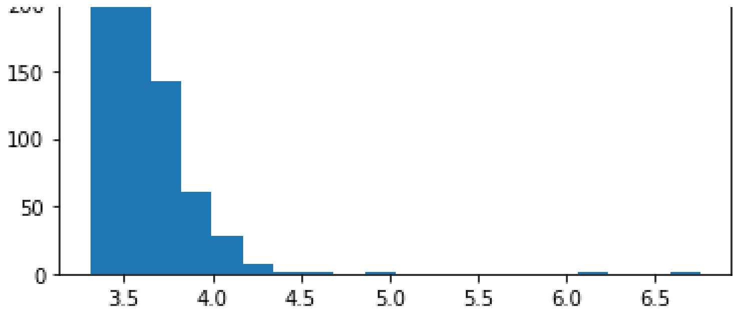

histogram of reaction shuttle
3.0453873697916665


histogram of reaction shuttle
3.1110810546875
300
250
200
150
100
50
0
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5

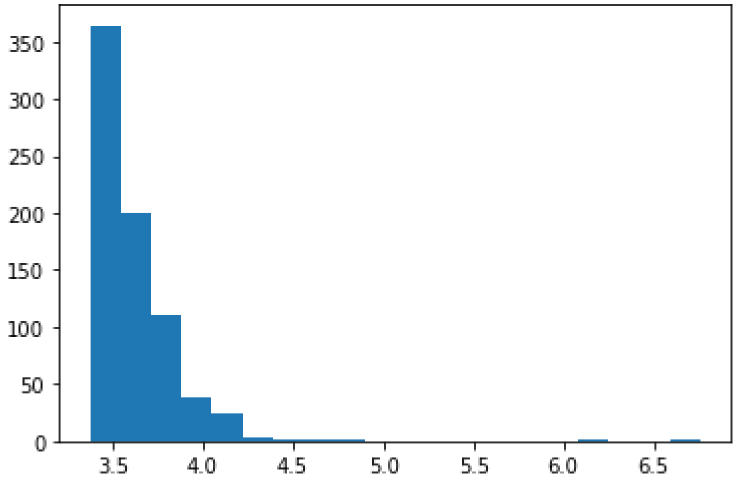

histogram of reaction shuttle
3.1767747395833332
350
300
250
200
150
100
50
0
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5


histogram of reaction shuttle
3.242468424479166
350
300
250
200
150
100
50
0
3.5
4.0
4.5
5.0
5.5
6.0
6.5

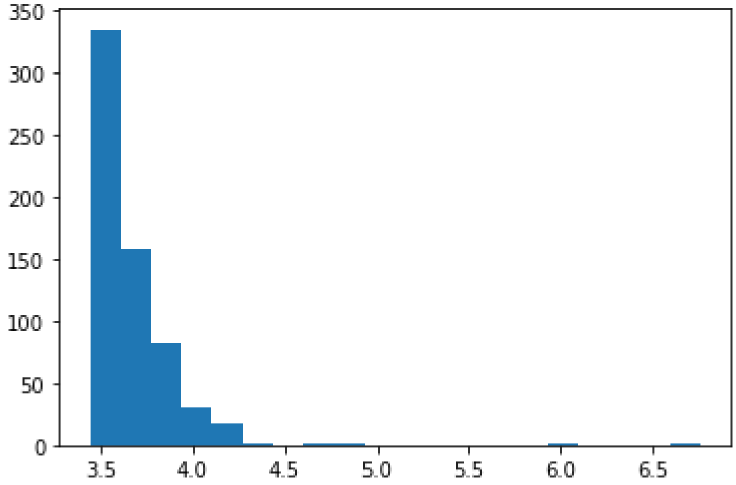

histogram of reaction shuttle
3.3081621093749995
300
250
200



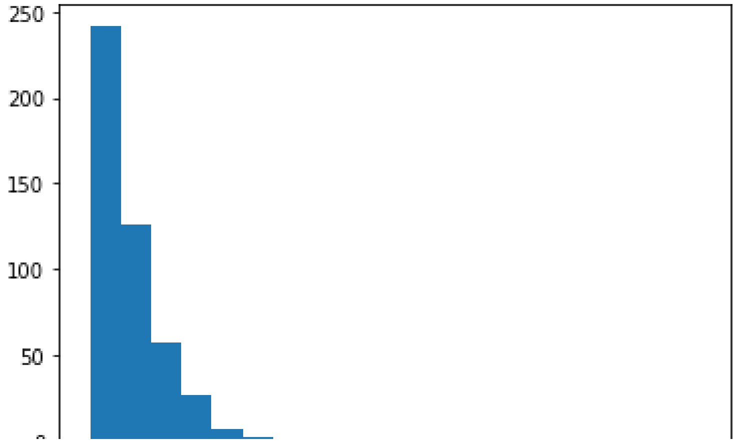
histogram of reaction shuttle
3.373855794270833



histogram of reaction shuttle
3.4395494791666663



histogram of reaction shuttle
3.5052431640624997

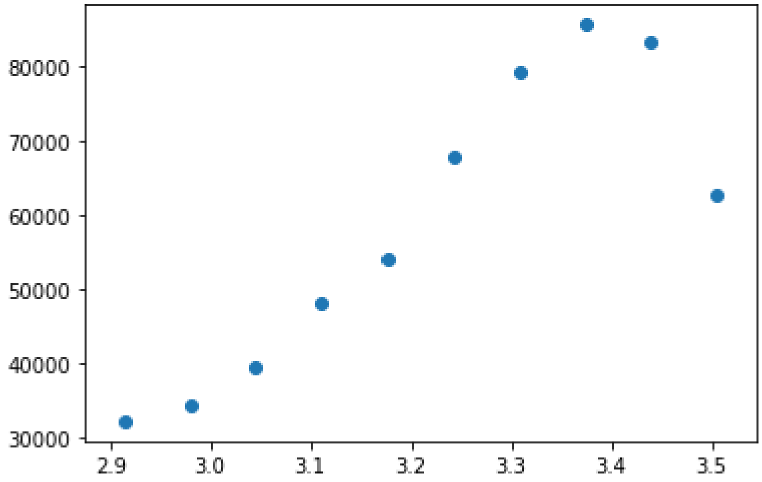


In [160…

```
plt.scatter(thresholds, jbs)
```

Out[160…

```
<matplotlib.collections.PathCollection at 0x7fd618fee4e0>
```



In [161…

```
# Conclusion - 2.914 threshold
```

In [162…

```
# Threshold Identifier App Vert
```

In [163…

```
av_mu = df['Approach Vertical'].mean()
av_std = df['Approach Vertical'].std()
print(av_mu, av_std)
lower_95 = av_mu-2*av_std
df.shape, df[df['Approach Vertical']>42].shape
```

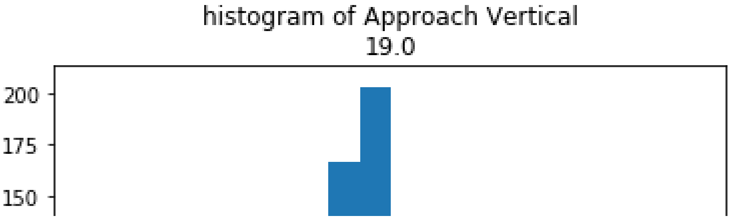
```
31.829614604462474 3.5479850939588244
```

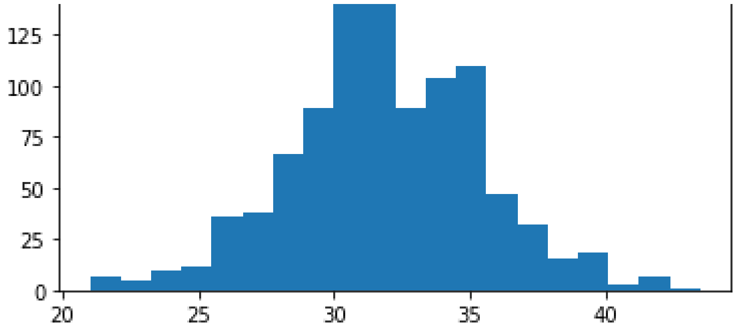
Out[163…

```
((1059, 25), (1, 25))
```

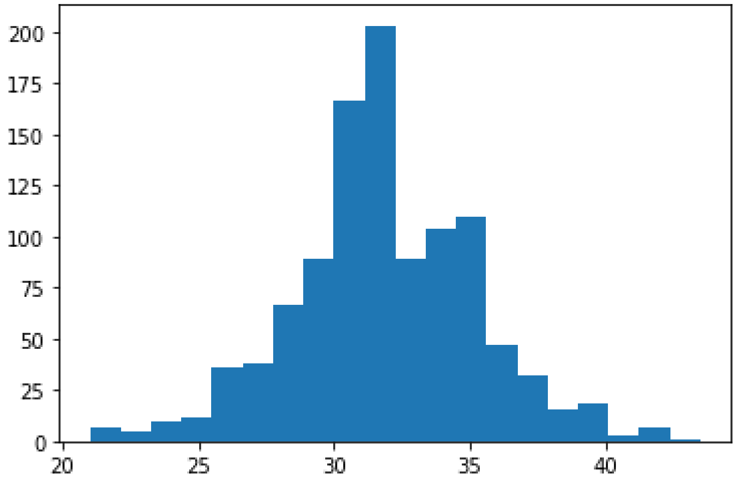
In [164…

```
av_min = df['Approach Vertical'].min()

jbs_1 = []
thresholds = np.linspace(av_min, av_mu, 10)
for threshold in thresholds:
    vals = df[df['Approach Vertical'].fillna(av_mu)>threshold]['Approach V
    plt.hist(vals, bins=20)
    plt.title("histogram of Approach Vertical\n{}".format(threshold))
    plt.show()
    jb_1=scs.jarque_bera(vals)
    jbs_1.append(jb_1[0])
```

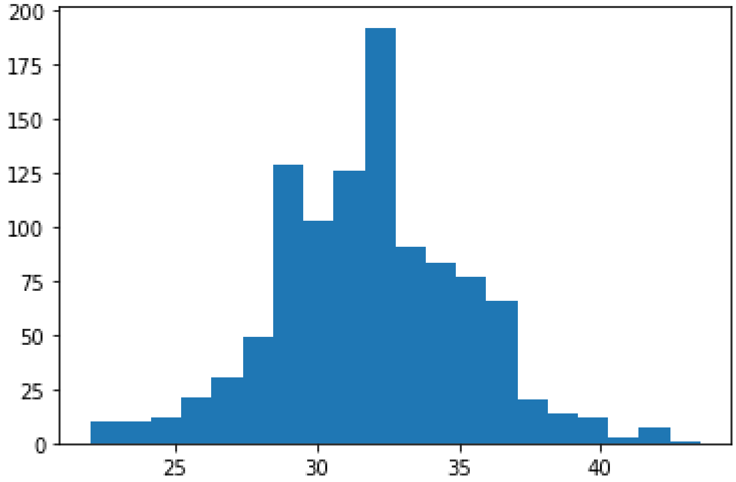




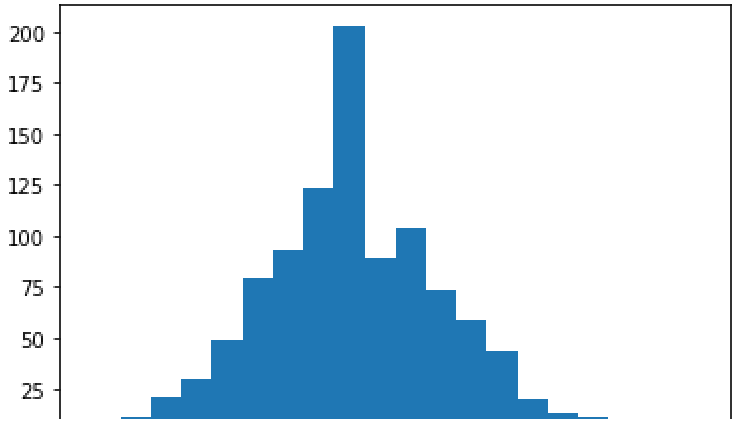
histogram of Approach Vertical
20.425512733829162

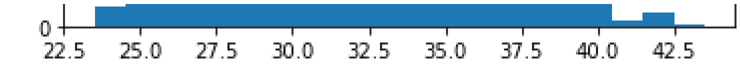


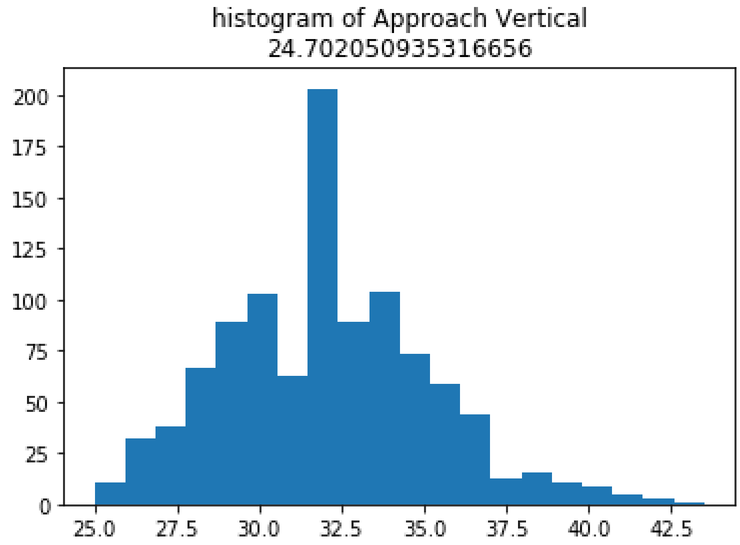
histogram of Approach Vertical
21.851025467658328

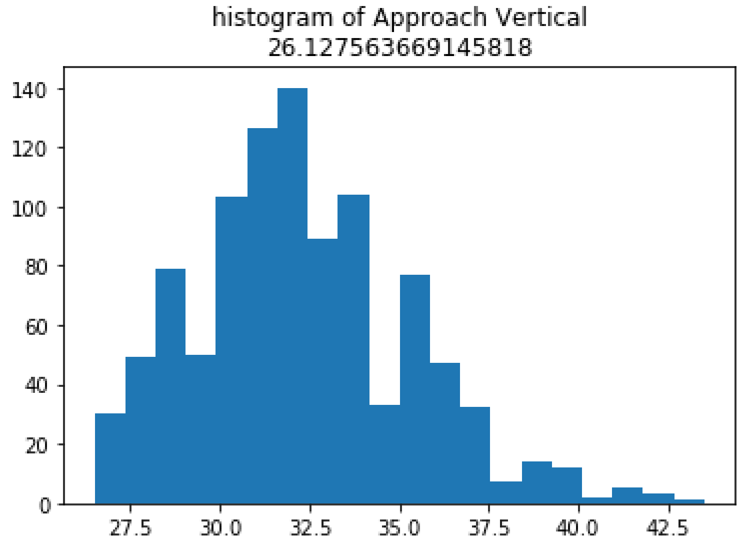


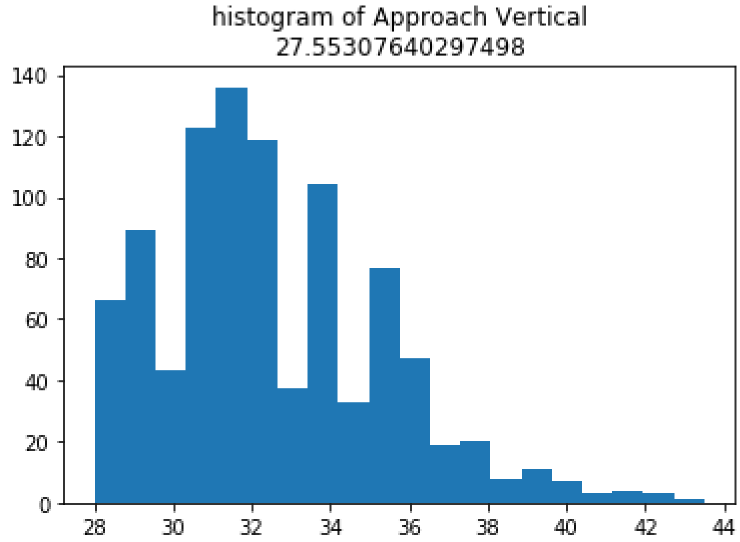
histogram of Approach Vertical
23.27653820148749

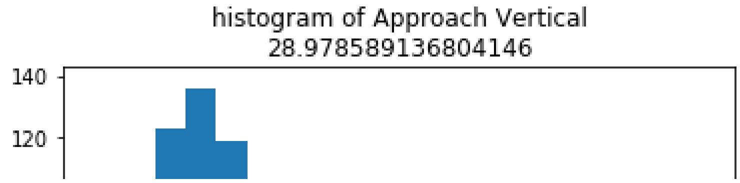


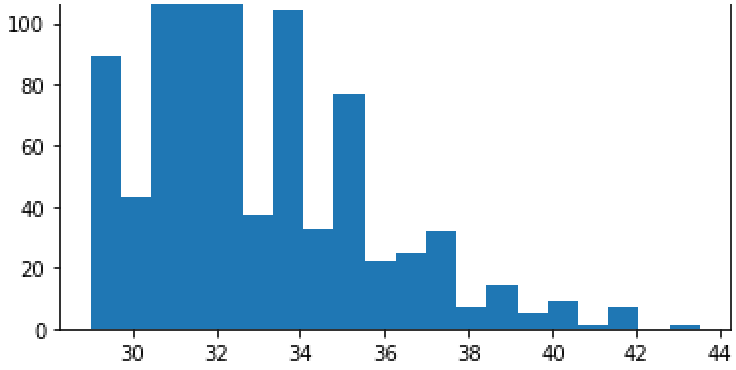

0
22.5
25.0
27.5
30.0
32.5
35.0
37.5
40.0
42.5

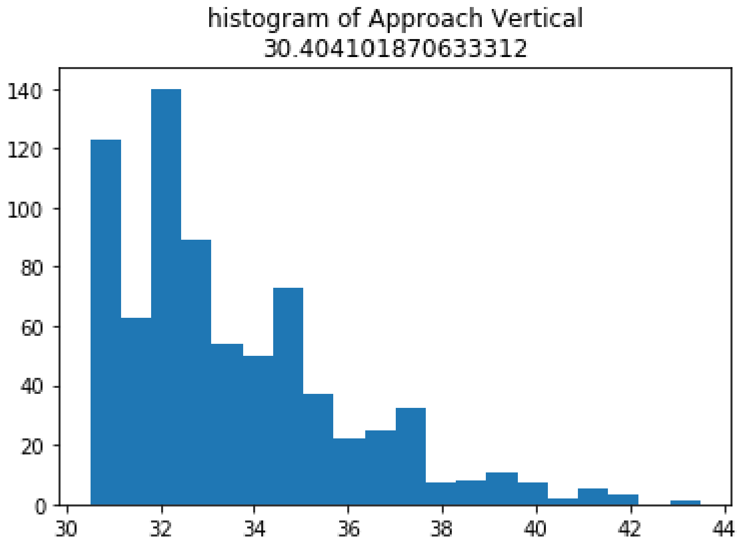

histogram of Approach Vertical
24.702050935316656
200
175
150
125
100
75
50
25
0
25.0
27.5
30.0
32.5
35.0
37.5
40.0
42.5

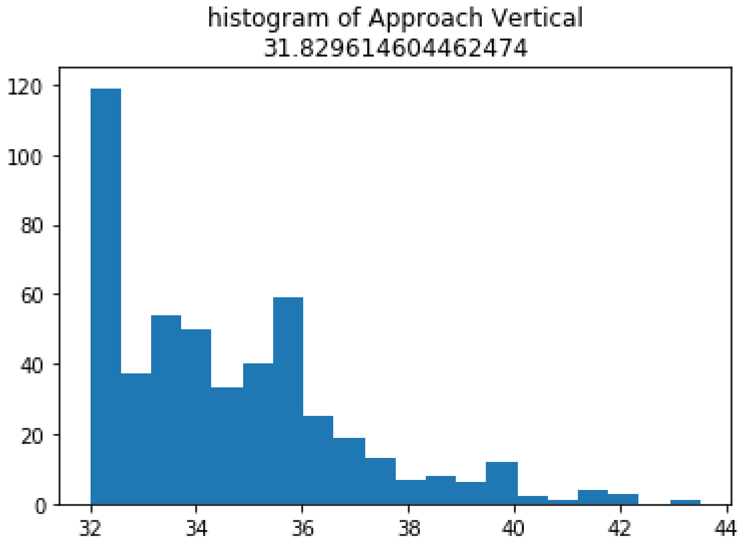

histogram of Approach Vertical
26.127563669145818
140
120
100
80
60
40
20
0
27.5
30.0
32.5
35.0
37.5
40.0
42.5


histogram of Approach Vertical
27.55307640297498
140
120
100
80
60
40
20
0
28
30
32
34
36
38
40
42
44


histogram of Approach Vertical
28.978589136804146
140
120





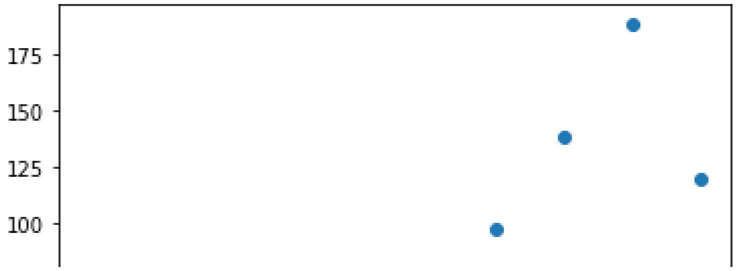


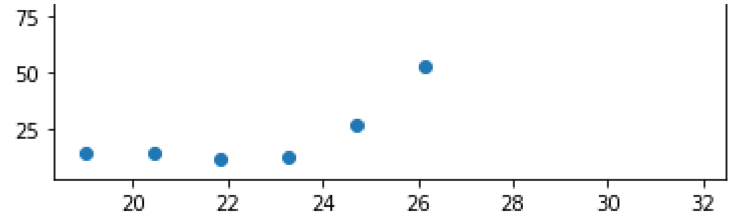
In [165…

```
plt.scatter(thresholds, jbs_1)
```

Out[165…

```
<matplotlib.collections.PathCollection at 0x7fd6498f5438>
```





In [166…

```
# 3 Vertical Jump
```

In [167…

```
vj_mu = df['Vertical Jump'].mean()
vj_std = df['Vertical Jump'].std()
print(vj_mu, vj_std)
lower_95 = vj_mu-2*vj_std
df.shape, df[df['Vertical Jump']>38].shape
```

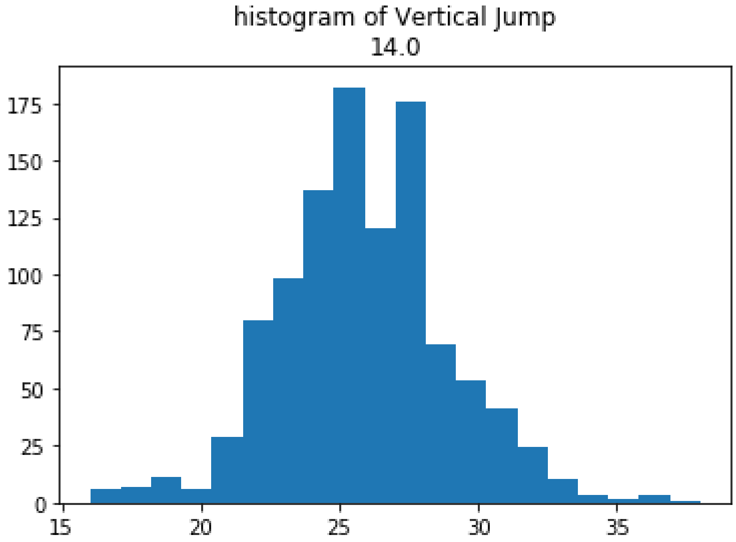
```
25.860157016683022 3.1253011446061882
```

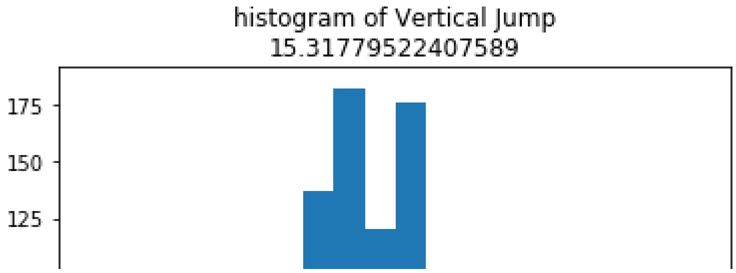
Out[167…

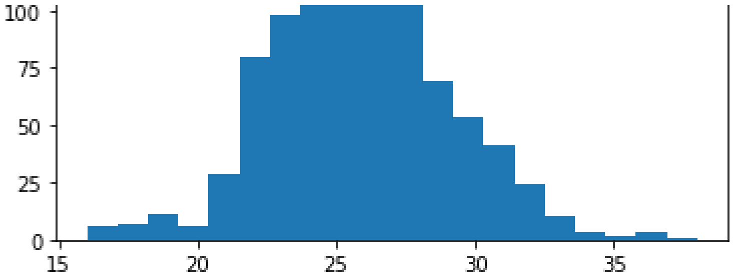
```
((1059, 25), (0, 25))
```

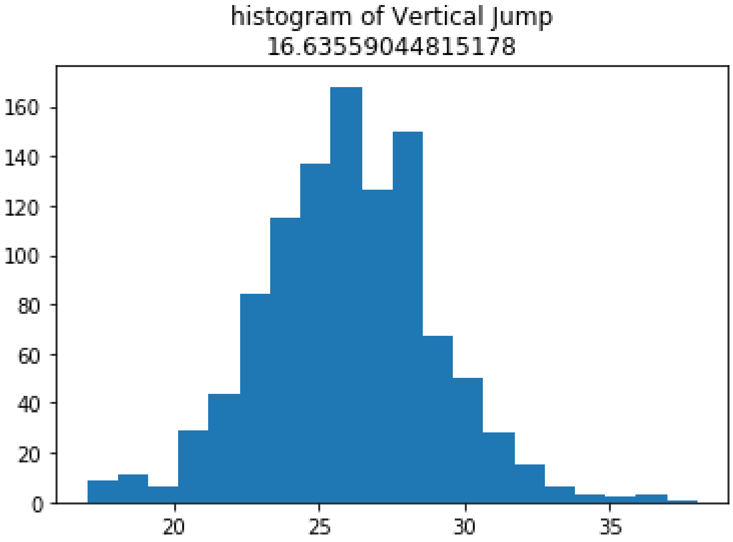
In [168…

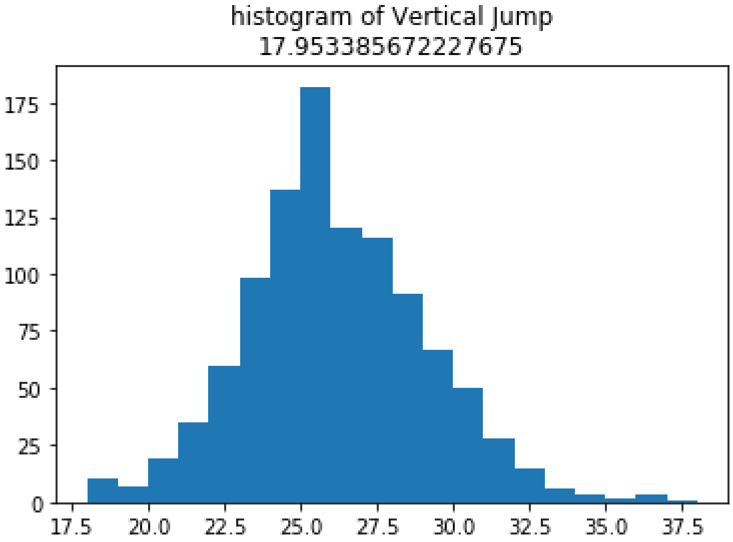
```
vj_min = df['Vertical Jump'].min()

jbs_2 = []
thresholds = np.linspace(vj_min, vj_mu, 10)
for threshold in thresholds:
    vals = df[df['Vertical Jump'].fillna(vj_mu)>threshold]['Vertical Jump'
    plt.hist(vals, bins=20)
    plt.title("histogram of Vertical Jump\n{}".format(threshold))
    plt.show()
    jb_2=scs.jarque_bera(vals)
    jbs_2.append(jb_2[0])
```

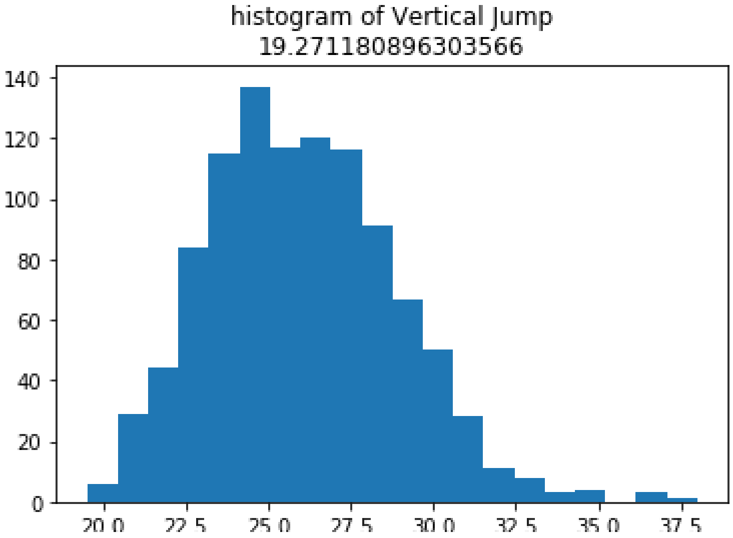


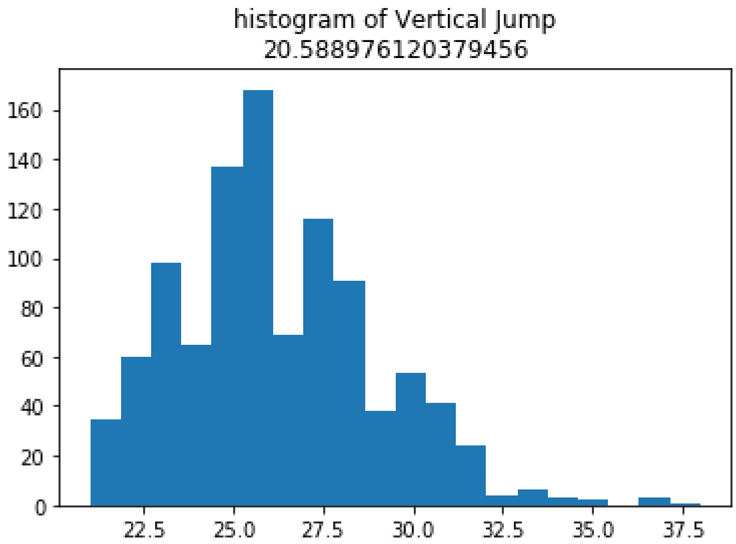


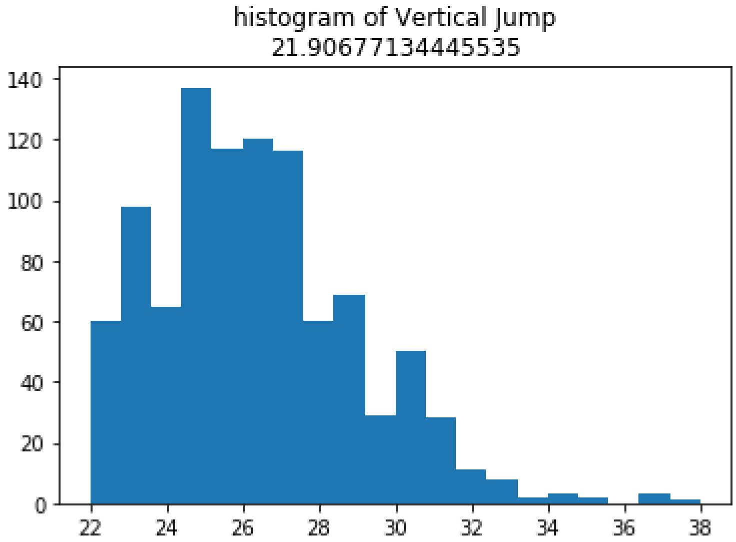

100
75
50
25
0
15
20
25
30
35

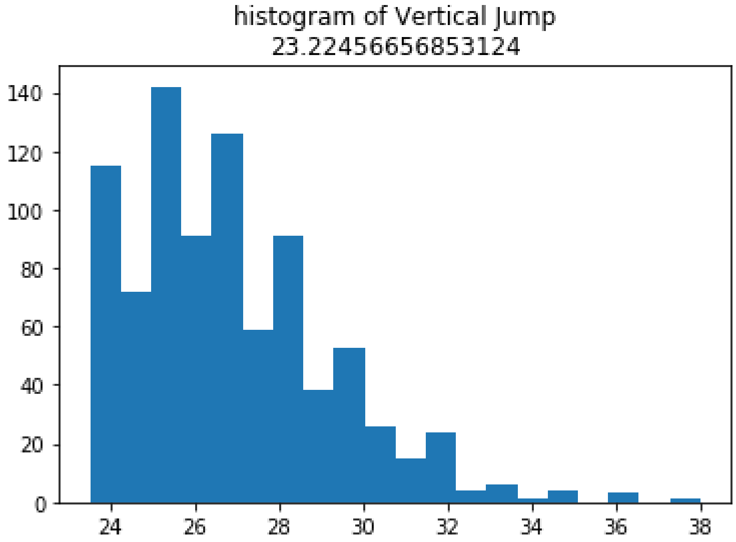

histogram of Vertical Jump
16.63559044815178
160
140
120
100
80
60
40
20
0
20
25
30
35

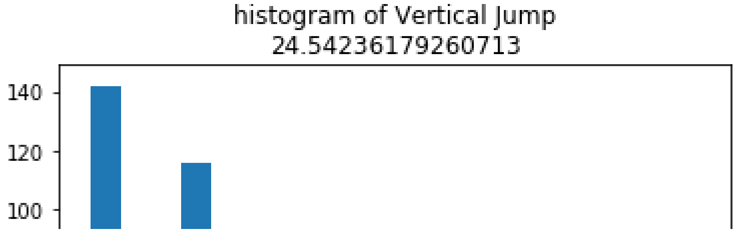

histogram of Vertical Jump
17.953385672227675
175
150
125
100
75
50
25
0
17.5
20.0
22.5
25.0
27.5
30.0
32.5
35.0
37.5

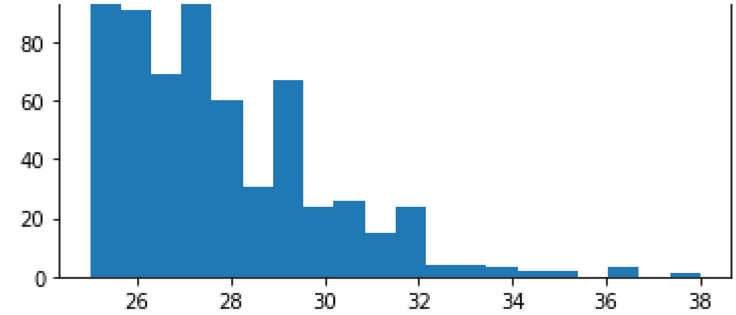

histogram of Vertical Jump
19.271180896303566
140
120
100
80
60
40
20
0
20.0
22.5
25.0
27.5
30.0
32.5
35.0
37.5

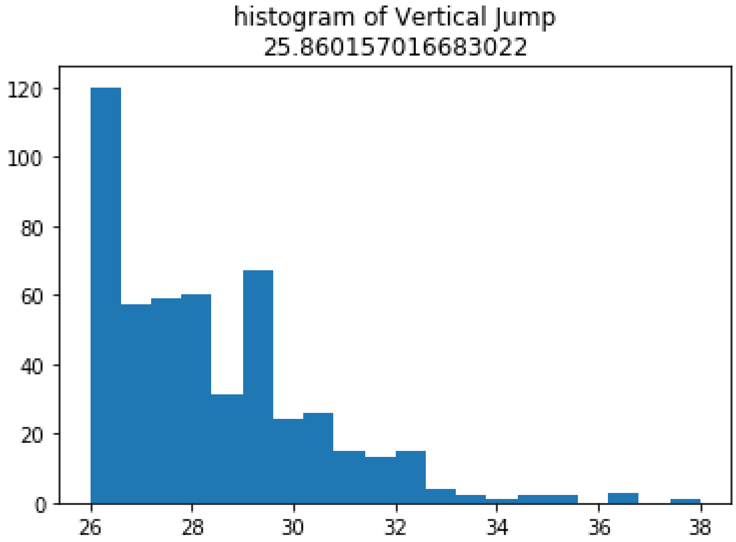

histogram of Vertical Jump
20.588976120379456


histogram of Vertical Jump
21.90677134445535


histogram of Vertical Jump
23.22456656853124


histogram of Vertical Jump
24.54236179260713



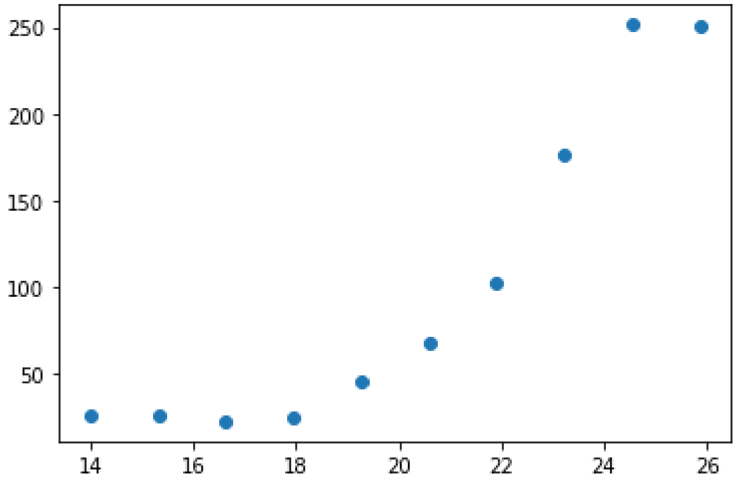

histogram of Vertical Jump
25.860157016683022

In [169…

```
plt.scatter(thresholds, jbs_2)
```

Out[169…

```
<matplotlib.collections.PathCollection at 0x7fd64955d5f8>
```



In [170…

```
# 4 3/4 court sprint
```

In [171…

```
cs_mu = df['3/4 Court sprint  '].mean()
cs_std = df['3/4 Court sprint  '].std()
print(cs_mu, cs_std)
lower_95 = cs_mu-2*cs_std
df.shape, df[df['3/4 Court sprint  ']>5].shape
```

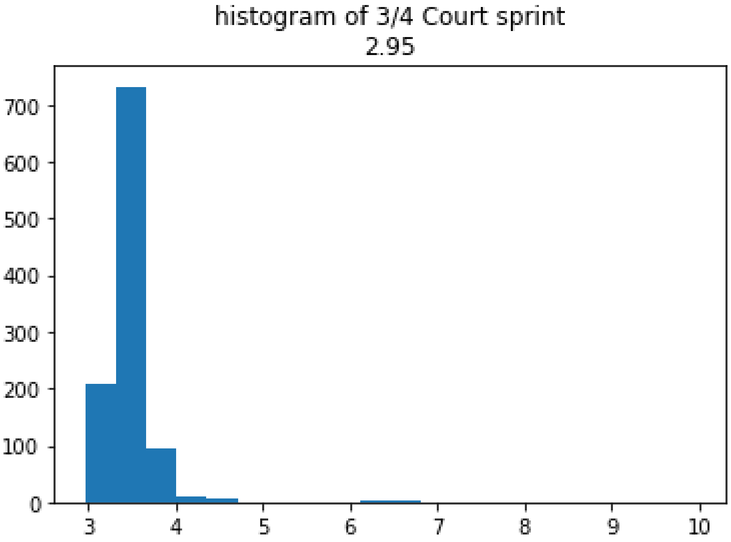
```
3.4670466601178784 0.3421985054646302
```

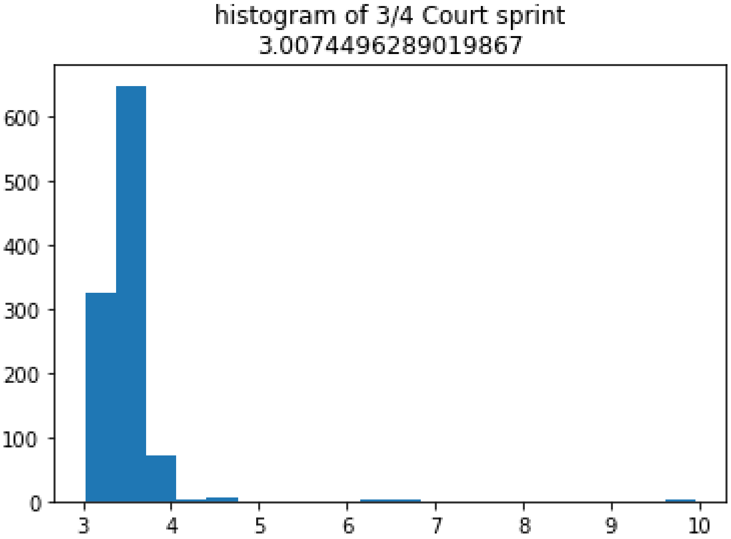
Out[171…

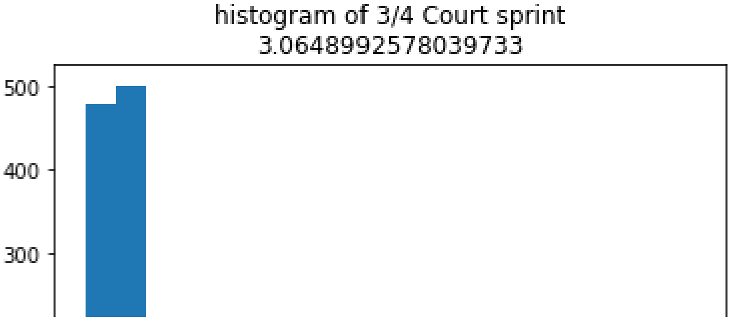
```
((1059, 25), (5, 25))
```

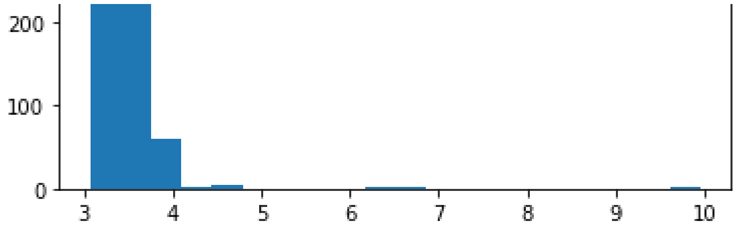
In [172…

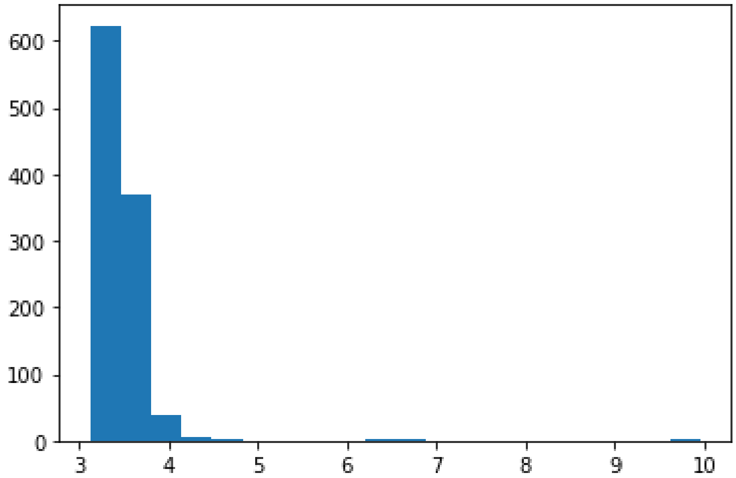
```
cs_min = df['3/4 Court sprint  '].min()

jbs_3 = []
thresholds = np.linspace(cs_min, cs_mu, 10)
for threshold in thresholds:
    vals = df[df['3/4 Court sprint  '].fillna(cs_mu)>threshold]['3/4 Court
    plt.hist(vals, bins=20)
    plt.title("histogram of 3/4 Court sprint\n{}".format(threshold))
    plt.show()
    jb_3=scs.jarque_bera(vals)
    jbs_3.append(jb_3[0])
```

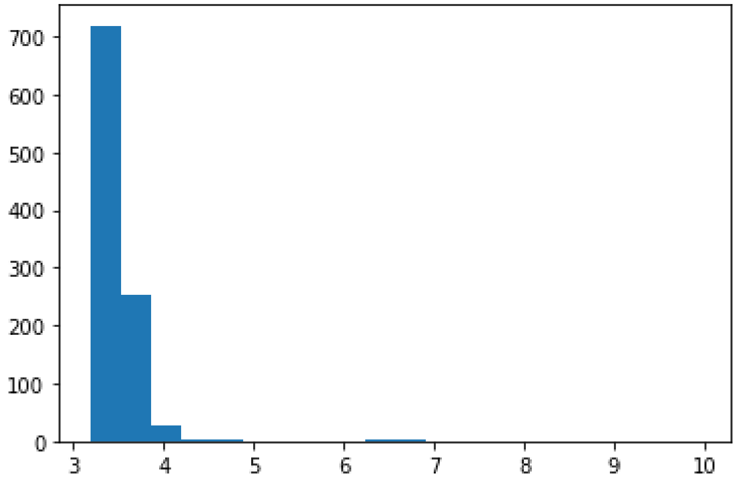

histogram of 3/4 Court sprint
2.95

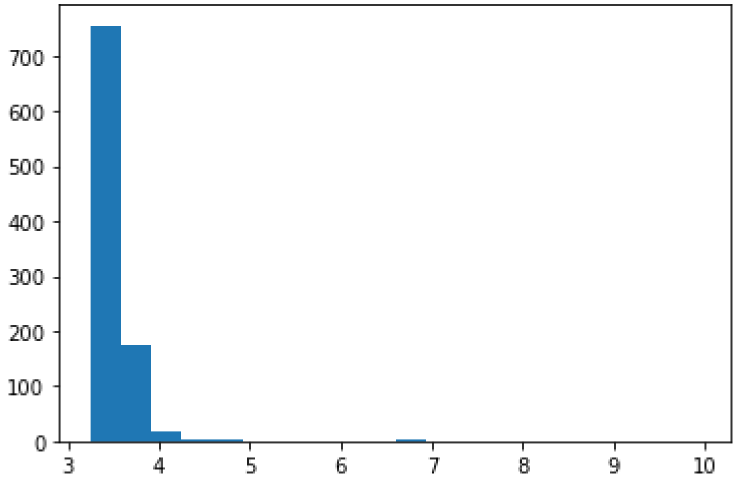

histogram of 3/4 Court sprint
3.0074496289019867


histogram of 3/4 Court sprint
3.0648992578039733



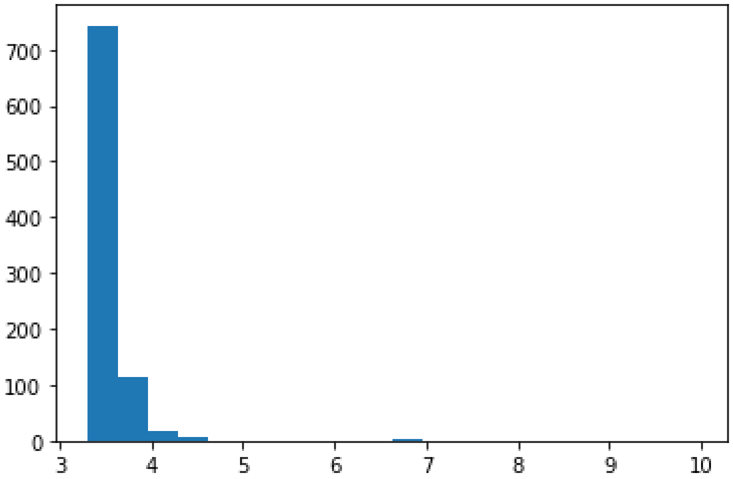

histogram of 3/4 Court sprint
3.1223488867059594


histogram of 3/4 Court sprint
3.179798515607946

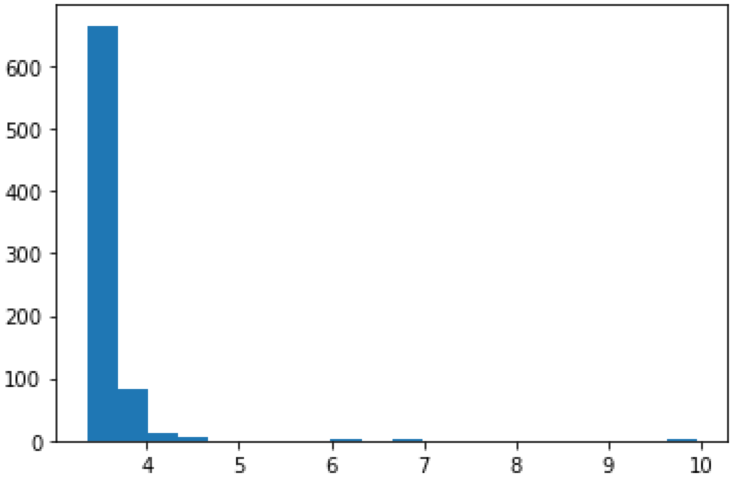

histogram of 3/4 Court sprint
3.2372481445099326

histogram of 3/4 Court sprint

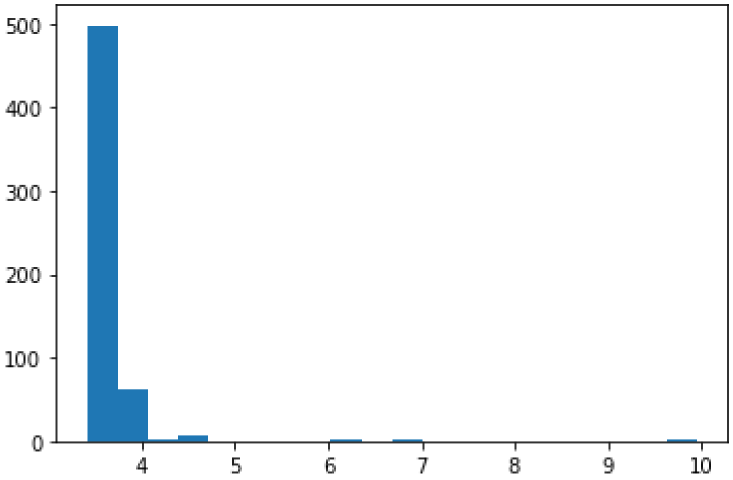
histogram of 3/4 Court sprint
3.294697773411919



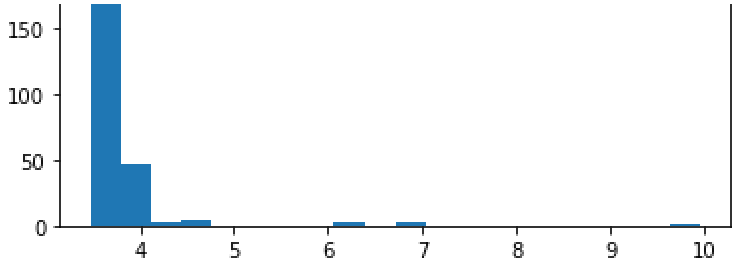
histogram of 3/4 Court sprint
3.3521474023139053



histogram of 3/4 Court sprint
3.409597031215892



histogram of 3/4 Court sprint
3.4670466601178784

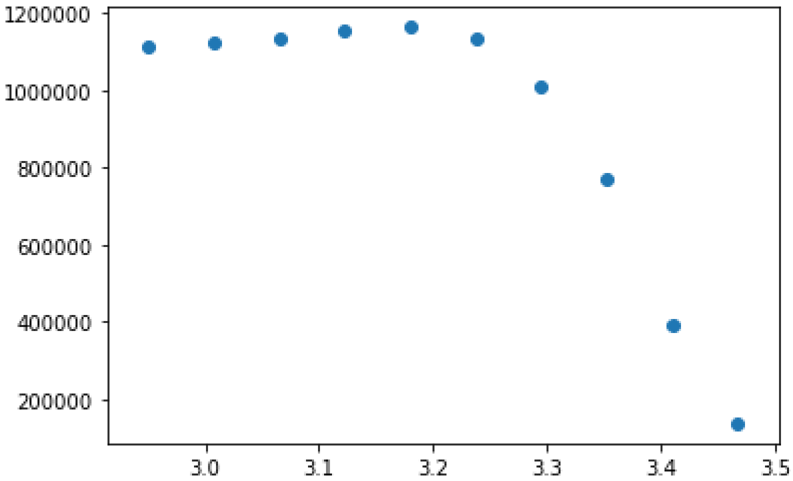


In [173…

```
plt.scatter(thresholds, jbs_3)
```

Out[173…

```
<matplotlib.collections.PathCollection at 0x7fd5f9e9b240>
```



In [174…

```
# 5 4 way agility
```

In [175…

```
wa_mu = df['4-Way agility'].mean()
wa_std = df['4-Way agility'].std()
print(wa_mu, wa_std)
lower_95 = wa_mu-2*wa_std
df.shape, df[df['4-Way agility']>14.25].shape
```

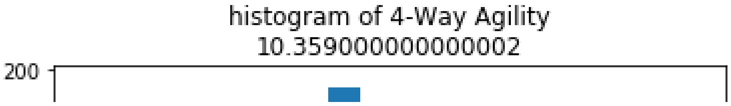
```
12.247189108910884 0.6683873176702257
```

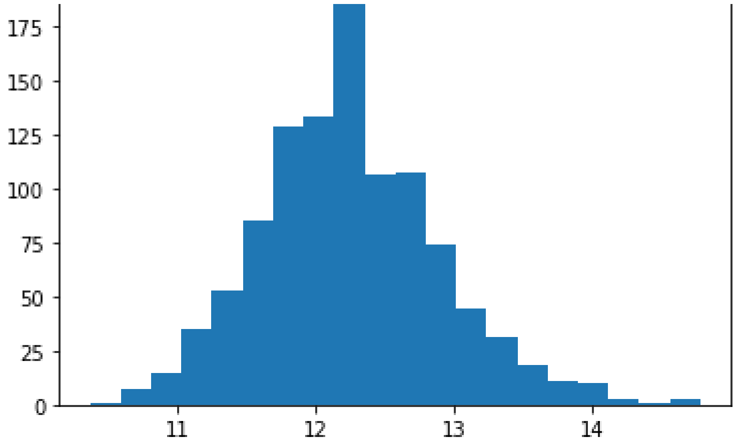
Out[175…

```
((1059, 25), (5, 25))
```

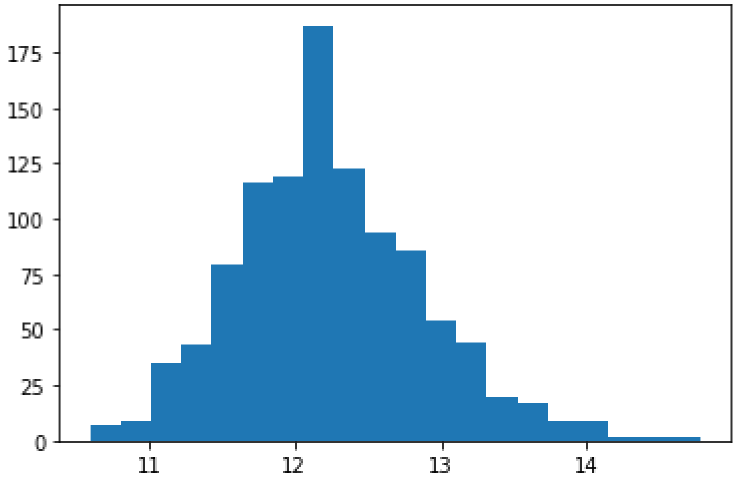
In [176…

```
wa_min = df['4-Way agility'].min()

jbs_4 = []
thresholds = np.linspace(wa_min, wa_mu, 10)
for threshold in thresholds:
    vals = df[df['4-Way agility'].fillna(wa_mu)>threshold]['4-Way agility'
    plt.hist(vals, bins=20)
    plt.title("histogram of 4-Way Agility\n{}".format(threshold))
    plt.show()
    jb_4=scs.jarque_bera(vals)
    jbs_4.append(jb_4[0])
```

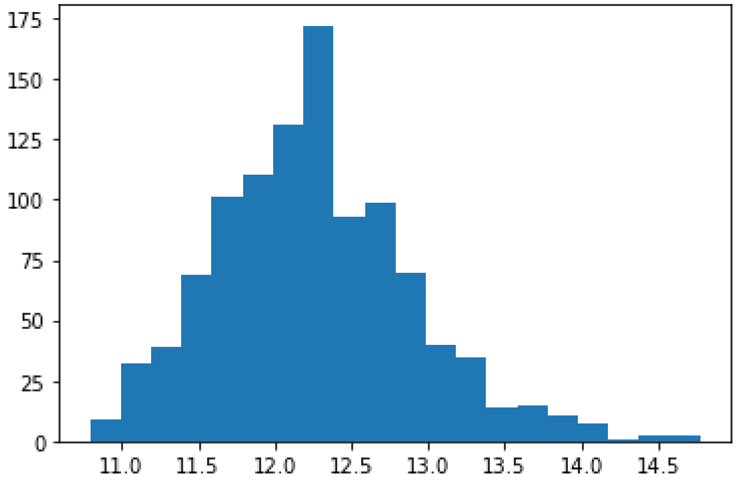




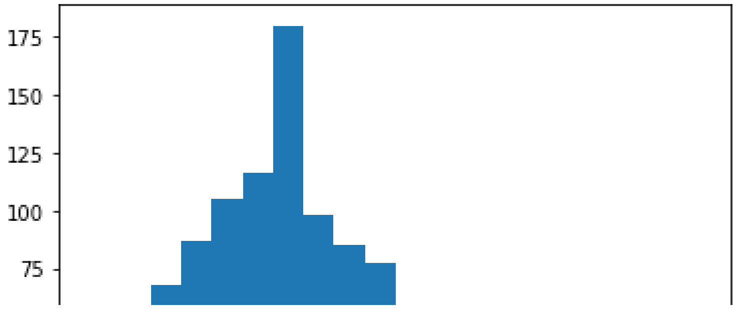
histogram of 4-Way Agility
10.568798789878988

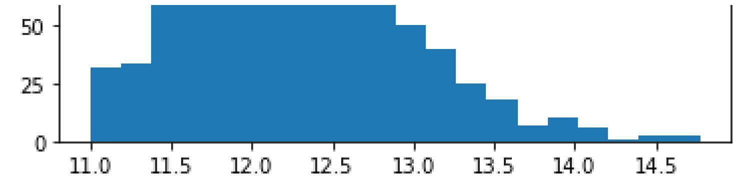


histogram of 4-Way Agility
10.778597579757976

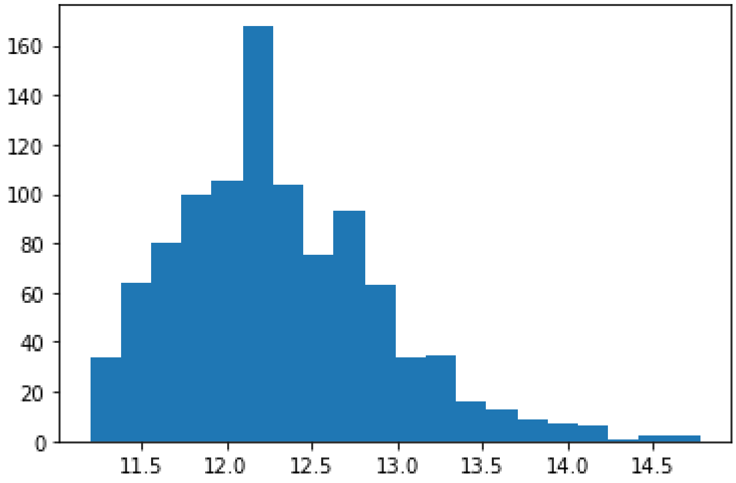


histogram of 4-Way Agility
10.988396369636963

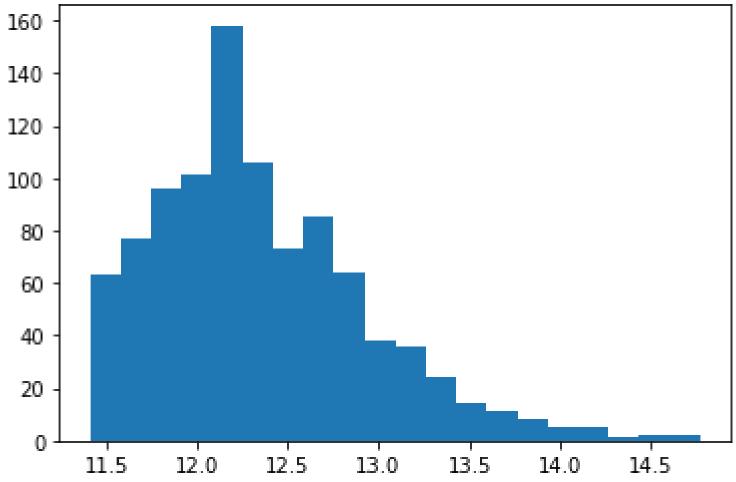




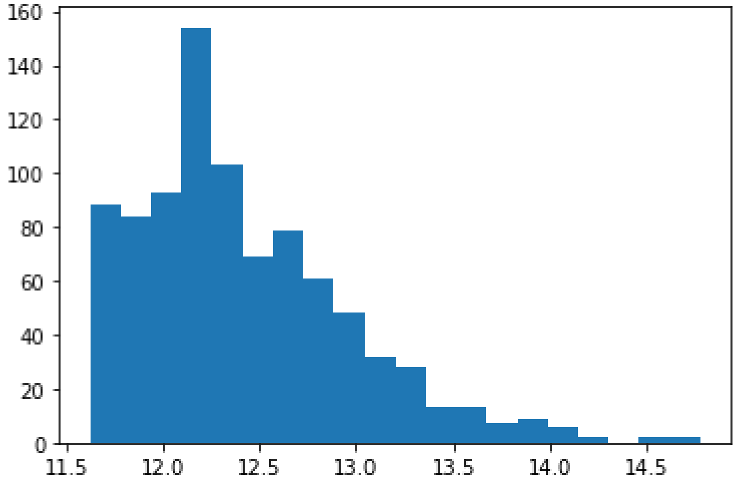
histogram of 4-Way Agility
11.198195159515949



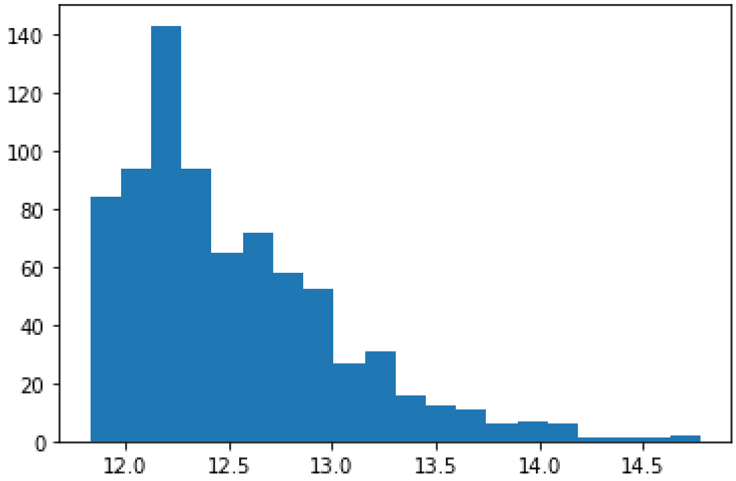
histogram of 4-Way Agility
11.407993949394937



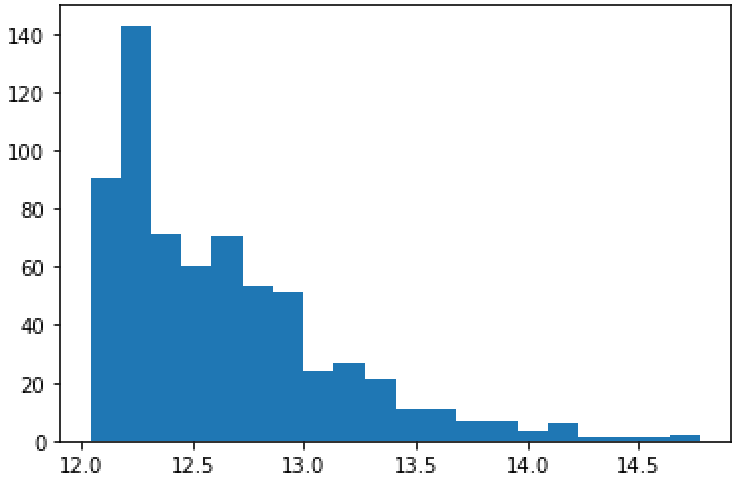
histogram of 4-Way Agility
11.617792739273924



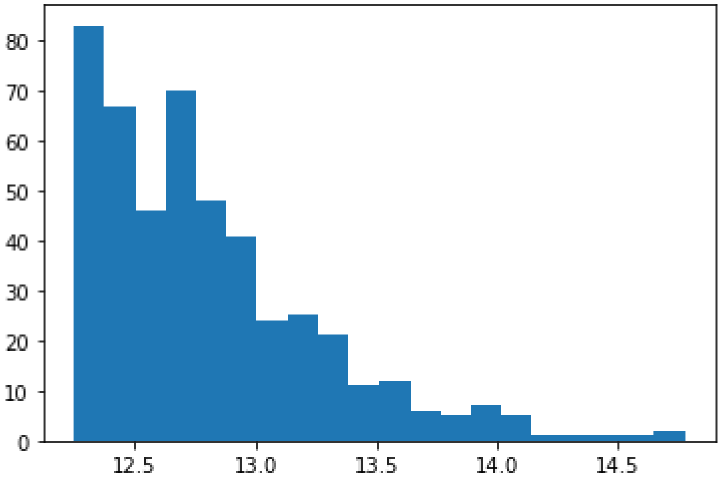
histogram of 4-Way Agility
11.82759152915291



histogram of 4-Way Agility
12.037390319031898



histogram of 4-Way Agility
12.247189108910884

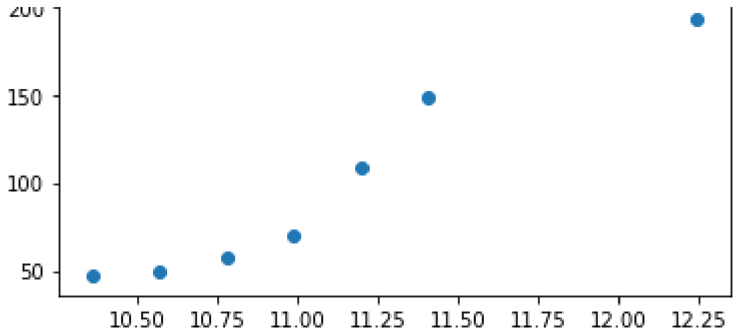


In [177…

```
plt.scatter(thresholds, jbs_4)
```

Out[177…

```
<matplotlib.collections.PathCollection at 0x7fd6091f8128>
```



In [178…

```
#6 Wingspan
```

In [179…

```
ws_mu = df['Wingspan'].mean()
ws_std = df['Wingspan'].std()
print(ws_mu, ws_std)
lower_95 = ws_mu-2*ws_std
df.shape, df[df['Wingspan']>100].shape
```

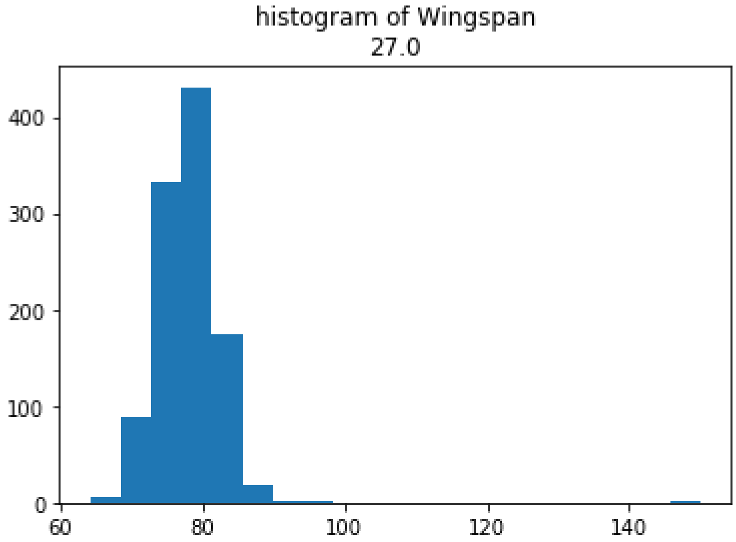
```
78.08979743083005 5.261419475728766
```

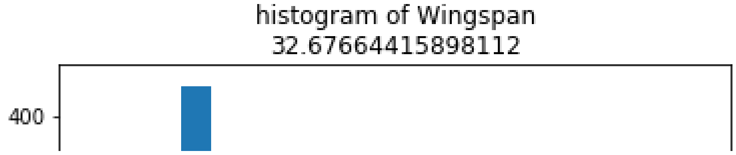
Out[179…

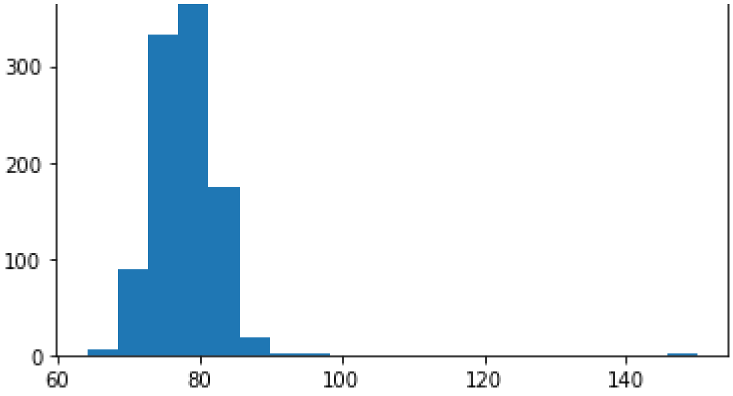
```
((1059, 25), (2, 25))
```

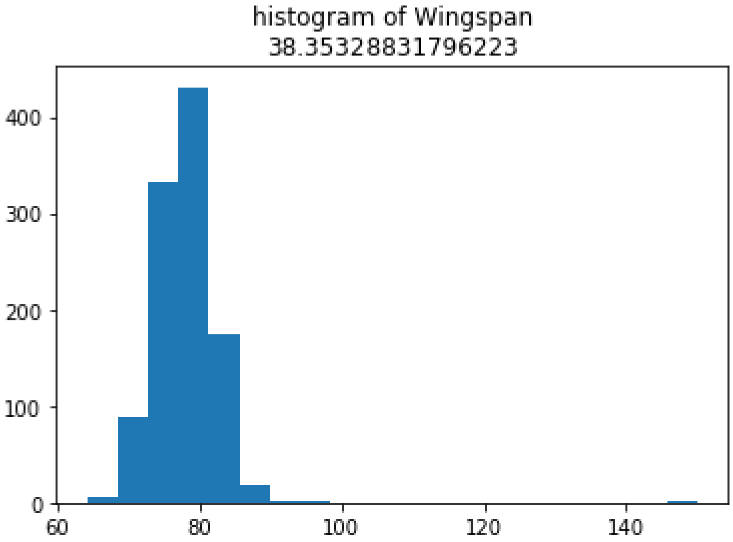
In [180…

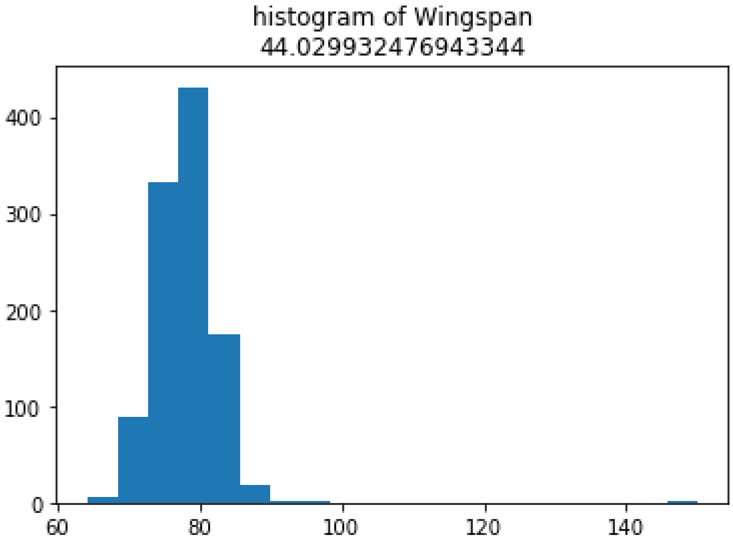
```
ws_min = df['Wingspan'].min()

jbs_5 = []
thresholds = np.linspace(ws_min, ws_mu, 10)
for threshold in thresholds:
    vals = df[df['Wingspan'].fillna(ws_mu)>threshold]['Wingspan'].fillna(w
    plt.hist(vals, bins=20)
    plt.title("histogram of Wingspan\n{}".format(threshold))
    plt.show()
    jb_5=scs.jarque_bera(vals)
    jbs_5.append(jb_5[0])
```

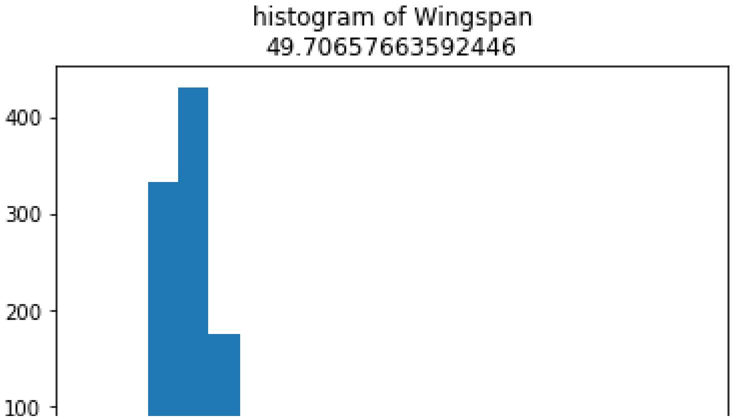


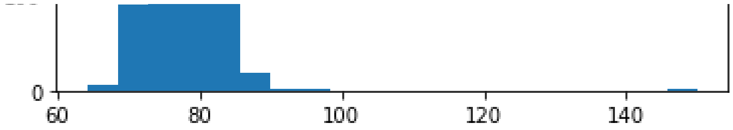



300
200
100
0
60
80
100
120
140

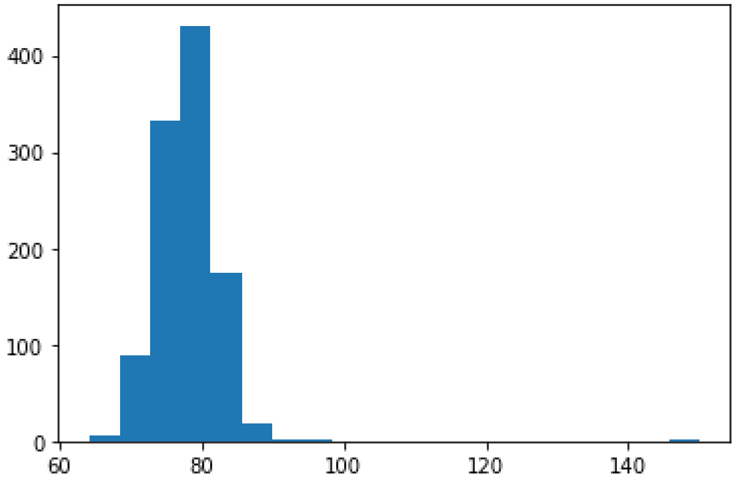

histogram of Wingspan
38.35328831796223
400
300
200
100
0
60
80
100
120
140


histogram of Wingspan
44.029932476943344
400
300
200
100
0
60
80
100
120
140

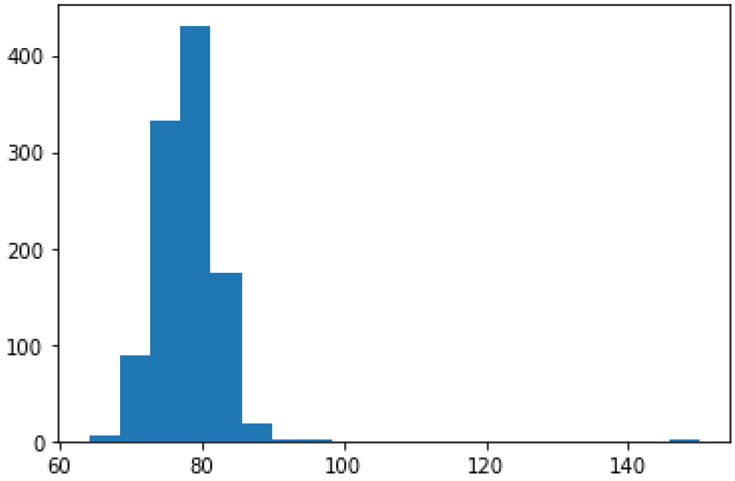

histogram of Wingspan
49.70657663592446
400
300
200
100



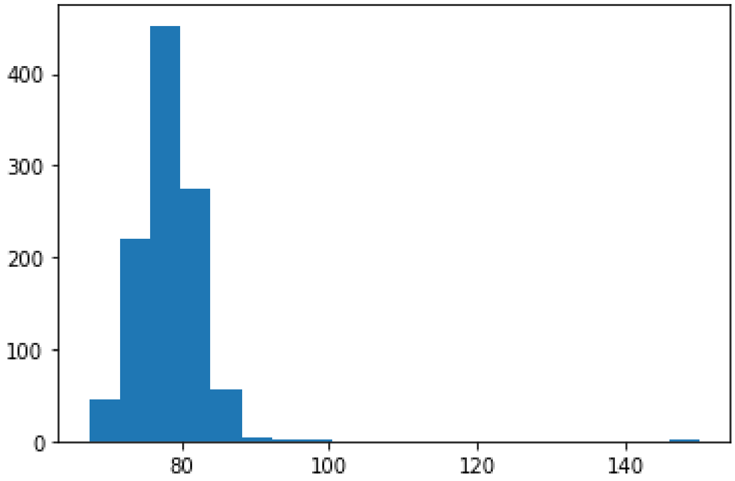
histogram of Wingspan
55.38322079490558



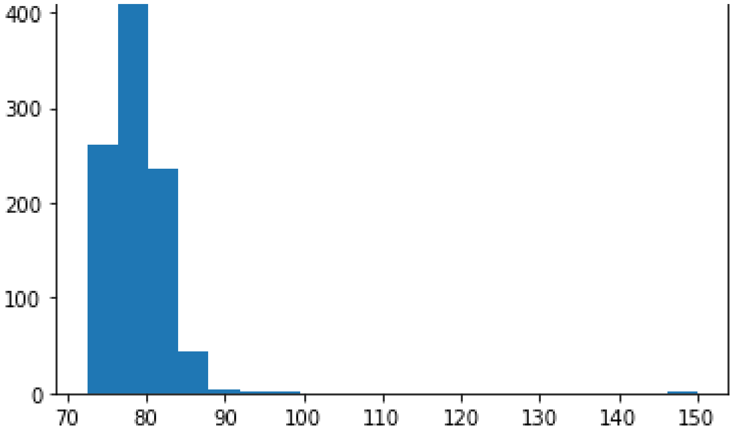
histogram of Wingspan
61.059864953886695

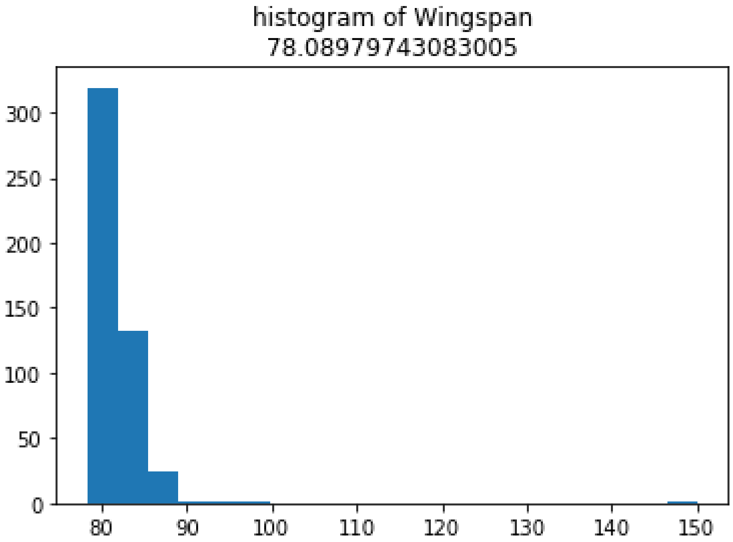


histogram of Wingspan
66.73650911286781



histogram of Wingspan
72.41315327184893



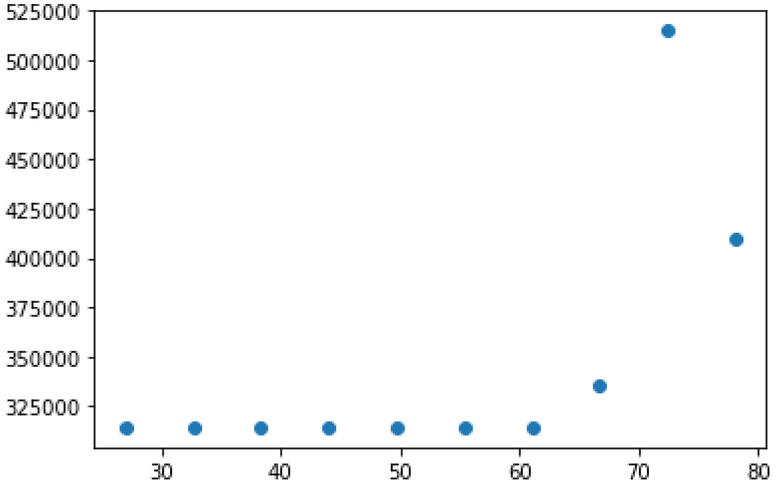


In [181…

```
plt.scatter(thresholds, jbs_5)
```

Out[181…

```
<matplotlib.collections.PathCollection at 0x7fd5f9b62a58>
```



In [182…

```
#7 Reach
```

In [183…

```
((df['Reach']>80)& (df['Reach']<115)).head()
```

Out[183…

```
0     True
```

```
1     True
2     True
3     True
4     True
Name: Reach, dtype: bool
```

In [184…

```python
re_mu = df['Reach'].mean()
re_std = df['Reach'].std()
print(re_mu, re_std)
lower_95 = re_mu-2*re_std
df.shape, df.loc[(df['Reach']>80) & (df['Reach']<115)].shape
```

```
98.71417984189723 5.95845856792728
((1059, 25), (1005, 25))
```

Out[184…

In [185…

```python
df.loc[df['Reach']>80]


# example of using .loc

# df.loc[(df['Reach'] > 80) & (df['Reach'] < 115) & (df['Wingspan'] > 75)]
```

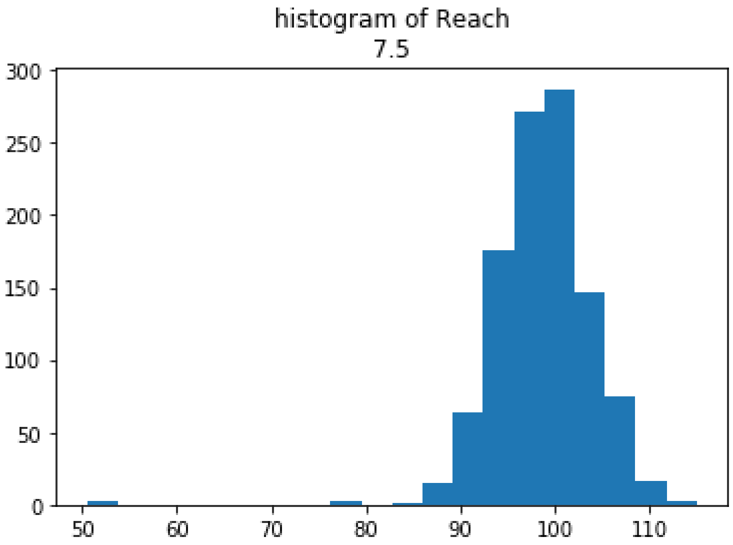
Out[185…

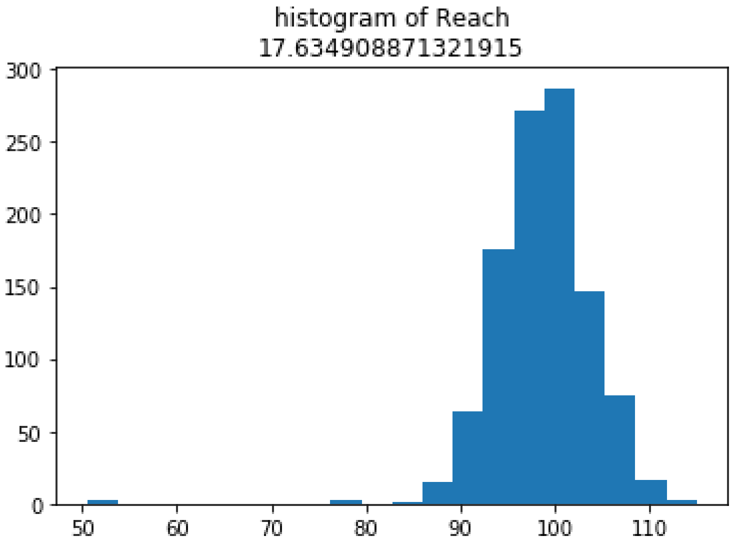
| | BAMid | Approach Vertical | Vertical Jump | 3/4 Court sprint | 4-Way agility | Reaction Shuttle | BAMScore | Wingspan | Reach |
|---|---|---|---|---|---|---|---|---|---|
| **0** | 1037 | 33.5 | 28.5 | 3.376 | 11.471 | 3.669 | 2003.0 | 72.75 | 94.0 |
| **1** | 656 | 30.5 | 21.5 | 3.486 | 12.114 | 3.355 | 1865.0 | 82.00 | 104.5 |
| **2** | 477 | 37.0 | 31.0 | 3.230 | 12.036 | 3.562 | 2005.0 | 81.50 | 99.0 |
| **3** | 1200 | 29.0 | 23.0 | 3.370 | 12.509 | 3.173 | 1902.0 | 79.50 | 101.0 |
| **4** | 1501 | 31.0 | 26.0 | 3.389 | 12.724 | 3.316 | 1903.0 | 77.00 | 101.5 |
| **...** | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| **1051** | 1336 | 30.0 | 27.0 | 3.569 | 11.702 | 3.451 | 1909.0 | 83.00 | 104.0 |
| **1052** | 1275 | 30.5 | 30.5 | 3.327 | 12.053 | 3.333 | 1981.0 | 72.50 | 94.5 |
| **1053** | 726 | 30.5 | 22.0 | 3.512 | 12.484 | 3.434 | 1828.0 | 80.00 | 103.0 |
| **1054** | 574 | 36.0 | 31.0 | 3.424 | 12.654 | 3.635 | 1917.0 | 72.00 | 88.0 |
| **1055** | 651 | 31.5 | 26.5 | 3.256 | 11.136 | 3.343 | 2029.0 | 74.00 | 91.5 |

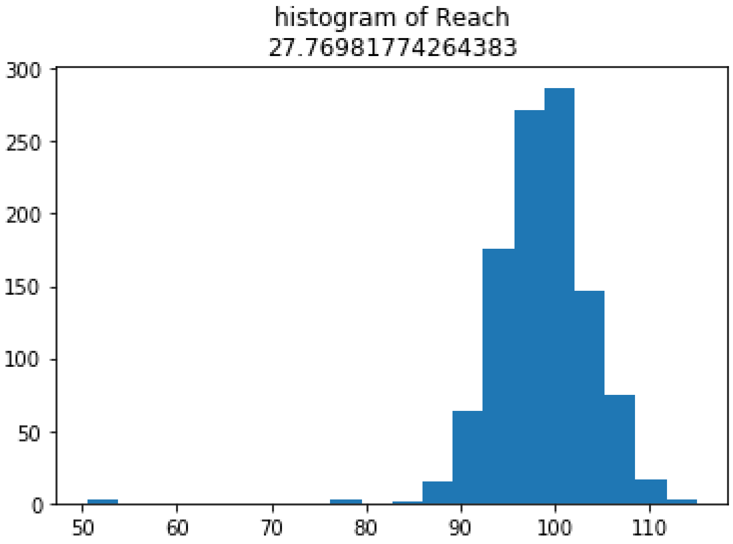
1006 rows × 25 columns

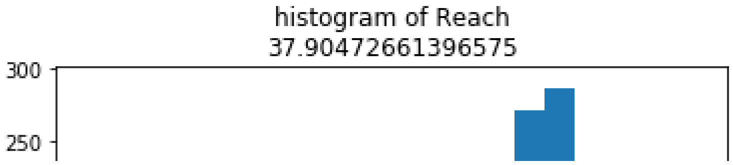
In [186…

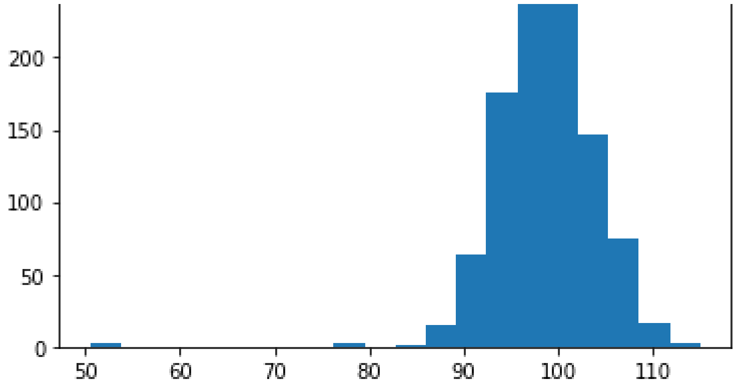
```python
re_min = df['Reach'].min()

jbs_6 = []
thresholds = np.linspace(re_min, re_mu, 10)
for threshold in thresholds:
    vals = df[df['Reach'].fillna(re_mu)>threshold]['Reach'].fillna(re_mu)
    plt.hist(vals, bins=20)
    plt.title("histogram of Reach\n{}".format(threshold))
    plt.show()
    jb_6=scs.jarque_bera(vals)
    jbs_6.append(jb_6[0])
```



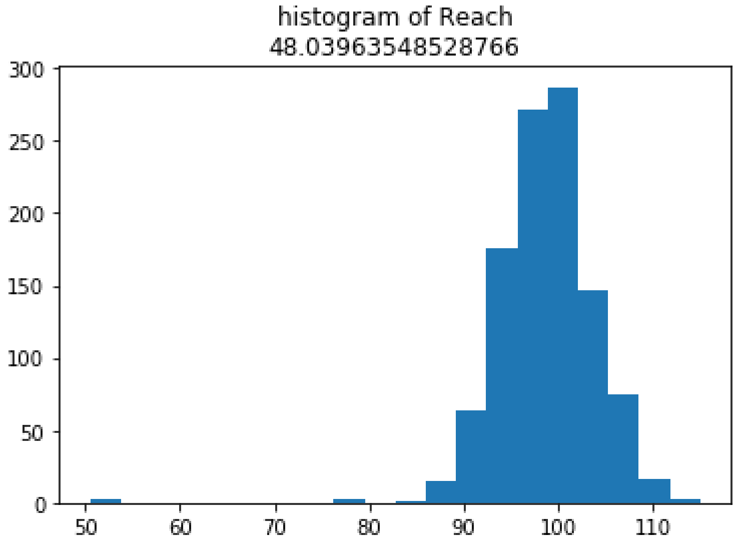




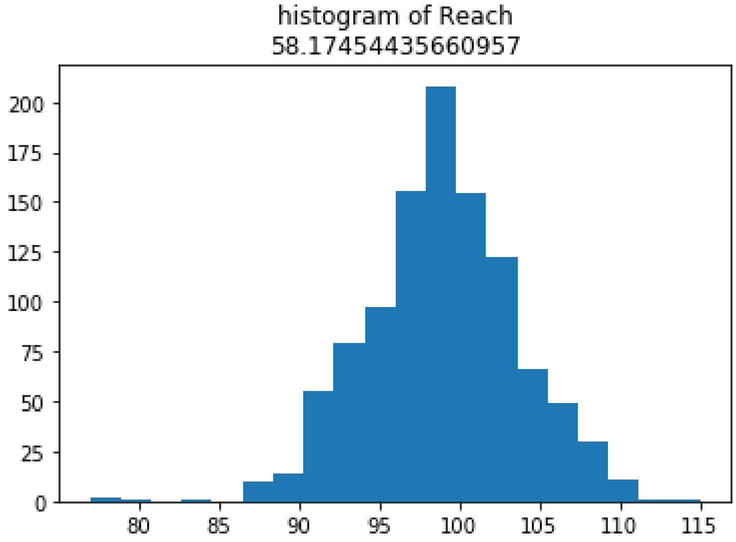




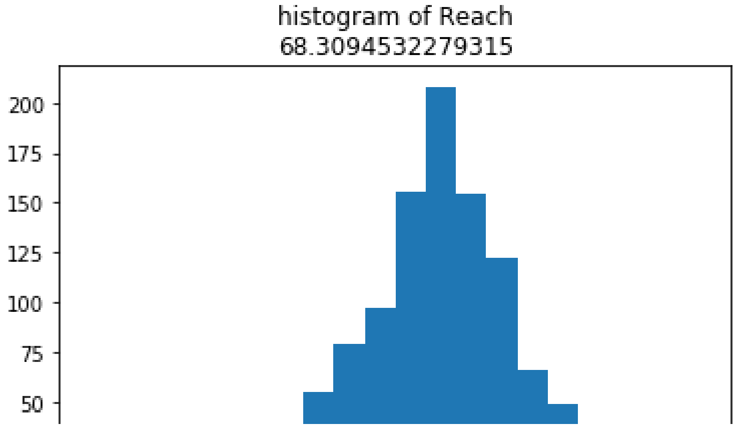
200
150
100
50
0
50
60
70
80
90
100
110



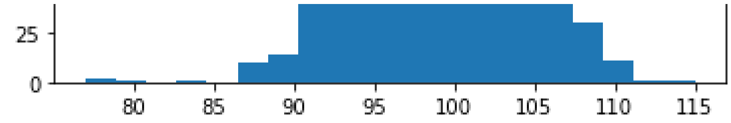
histogram of Reach
48.03963548528766
300
250
200
150
100
50
0
50
60
70
80
90
100
110

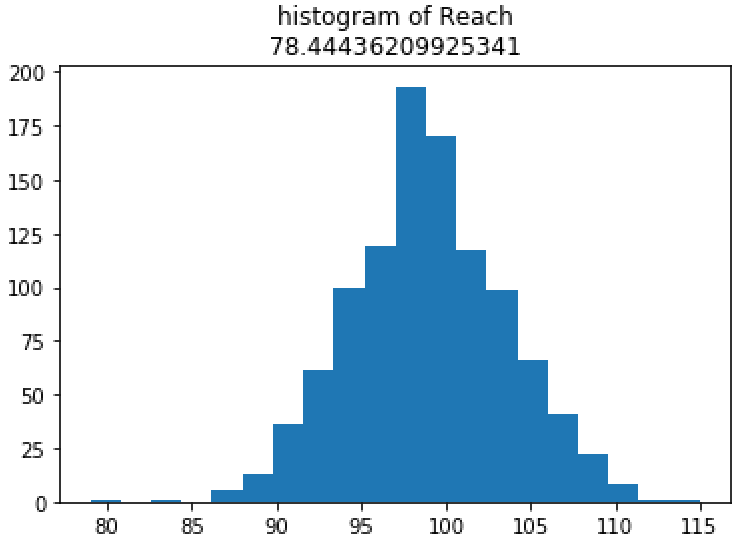


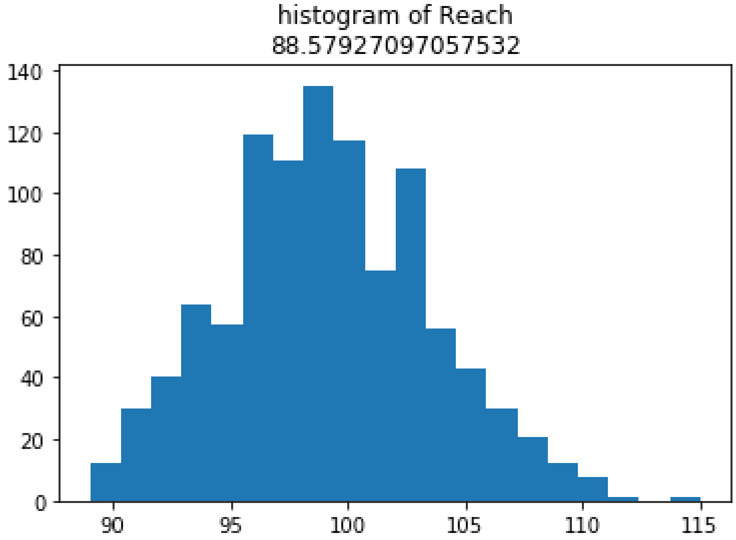
histogram of Reach
58.17454435660957
200
175
150
125
100
75
50
25
0
80
85
90
95
100
105
110
115

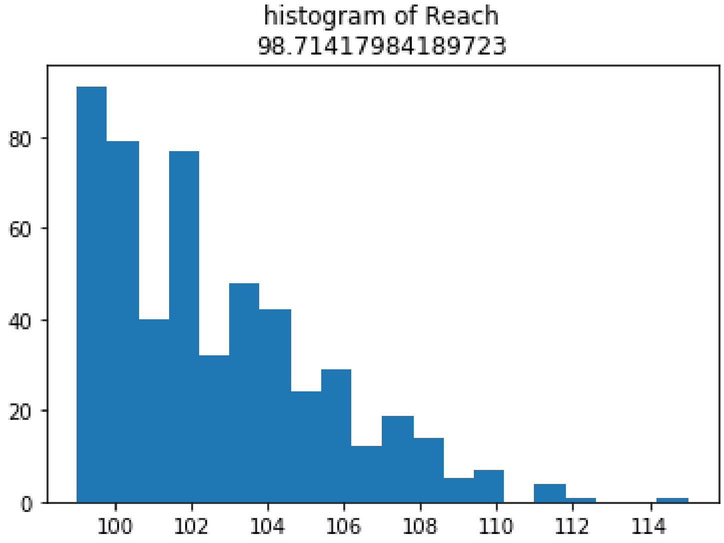


histogram of Reach
68.3094532279315
200
175
150
125
100
75
50







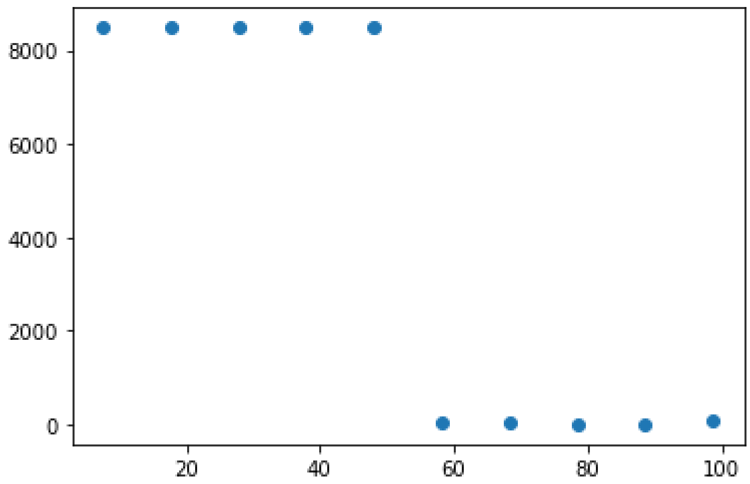


In [187…

```
plt.scatter(thresholds, jbs_6)
```

Out[187…

```
<matplotlib.collections.PathCollection at 0x7fd608d1ac18>
```



In [188…

```
#8 Height
```

In [189…

```
ht_mu = df['Height'].mean()
ht_std = df['Height'].std()
print(ht_mu, ht_std)
lower_95 = ht_mu-2*ht_std
df.shape, df[df['Height']>87].shape
```

```
75.09419466403162 5.246044529301447
```

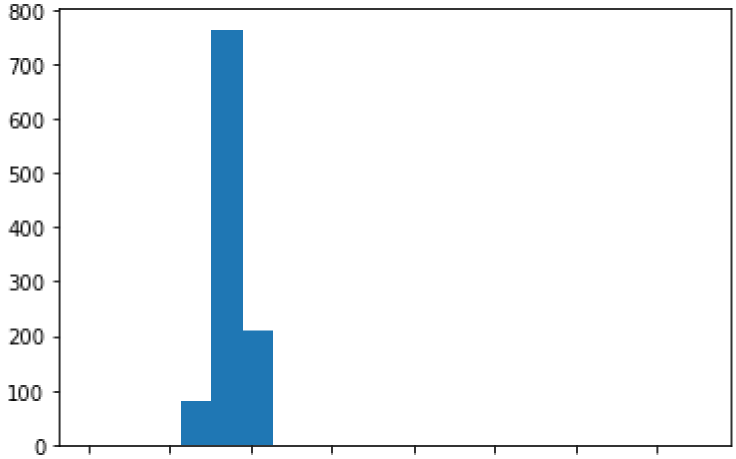
Out[189…

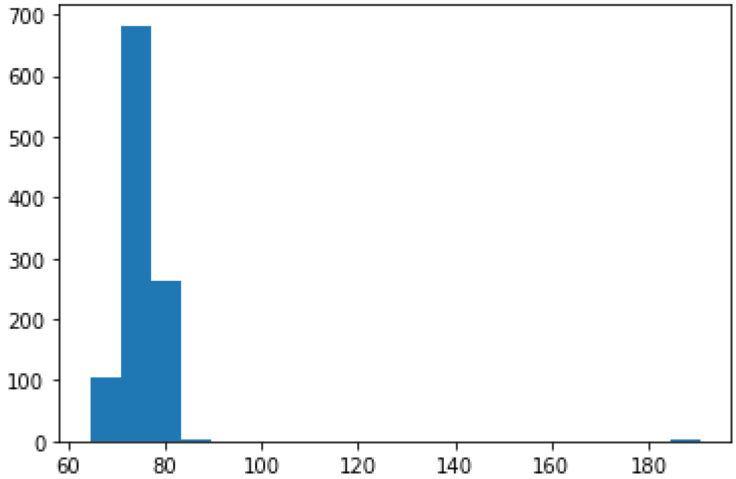
```
((1059, 25), (1, 25))
```

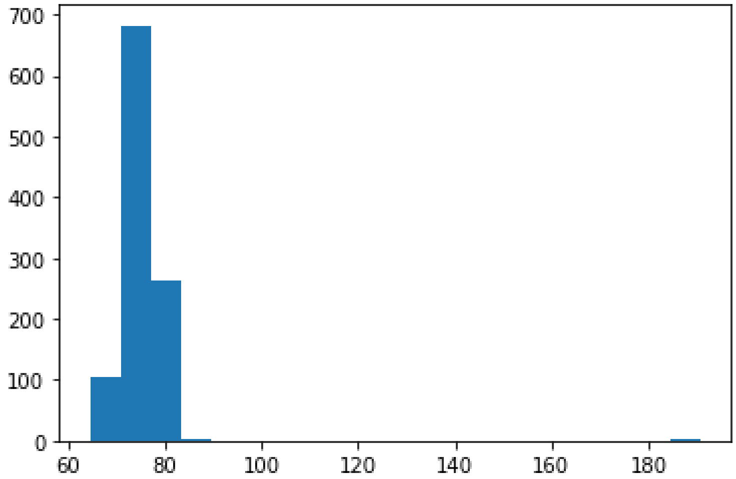
In [190…

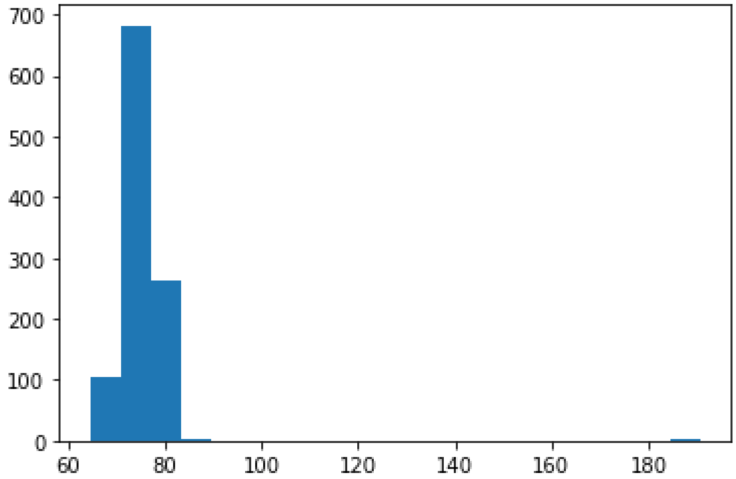
```
ht_min = df['Height'].min()

jbs_7 = []
thresholds = np.linspace(ht_min, ht_mu, 10)
for threshold in thresholds:
    vals = df[df['Height'].fillna(ht_mu)>threshold]['Height'].fillna(ht_mu
    plt.hist(vals, bins=20)
    plt.title("histogram of Height\n{}".format(threshold))
    plt.show()
    jb_7=scs.jarque_bera(vals)
    jbs_7.append(jb_7[0])
```

histogram of Height
37.875

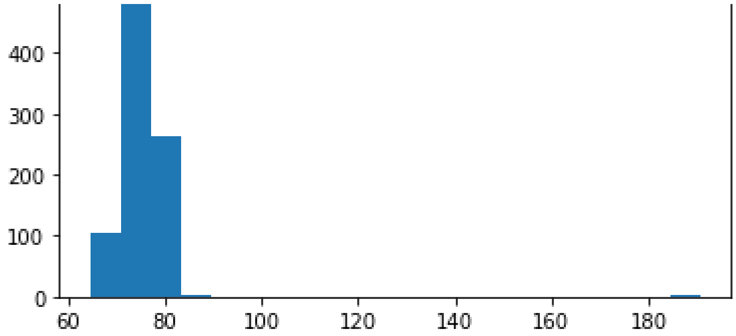



histogram of Height
42.01046607378129

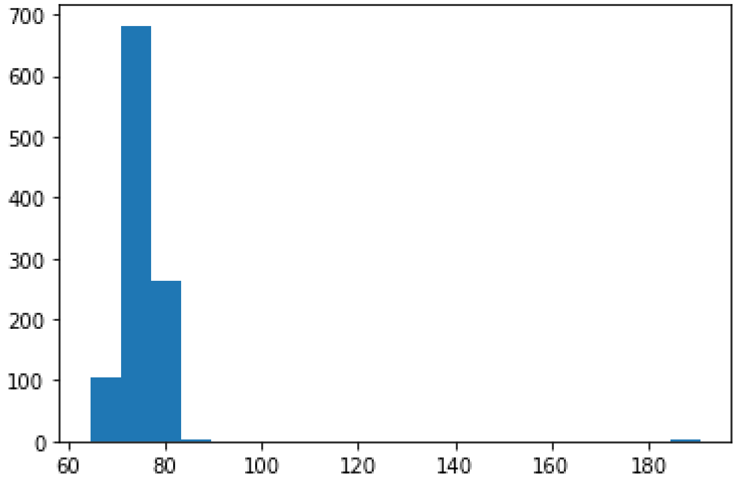

histogram of Height
46.14593214756258


histogram of Height
50.28139822134388

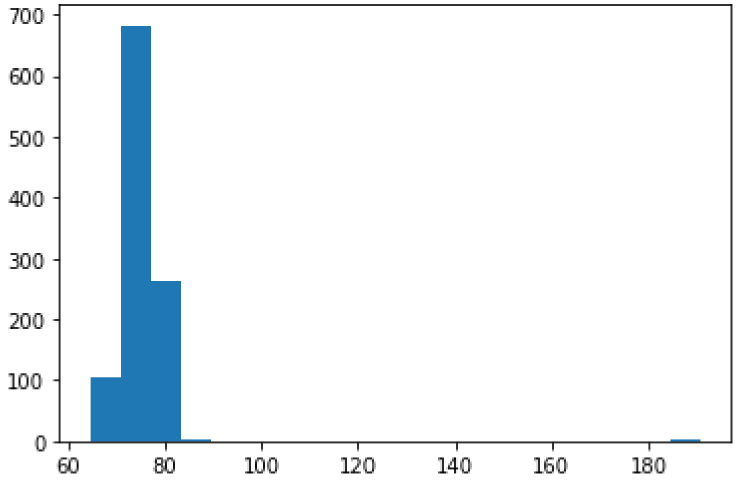
histogram of Height
54.416864295125166



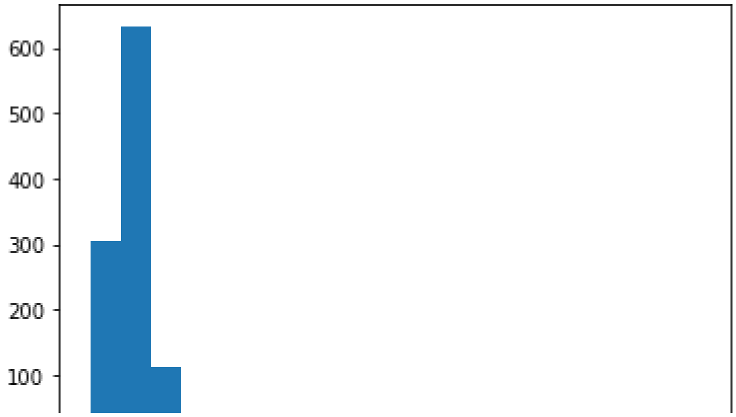
histogram of Height
58.55233036890645

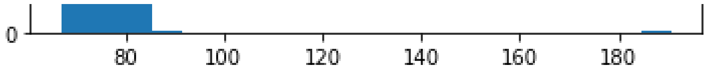


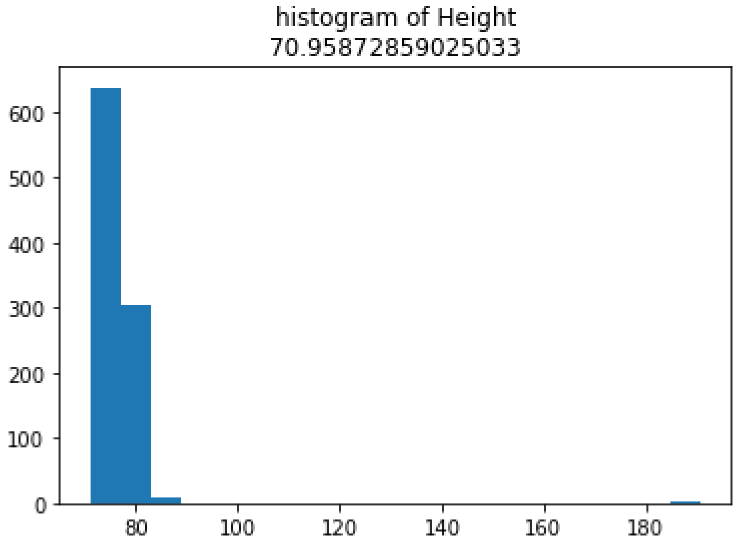
histogram of Height
62.68779644268775

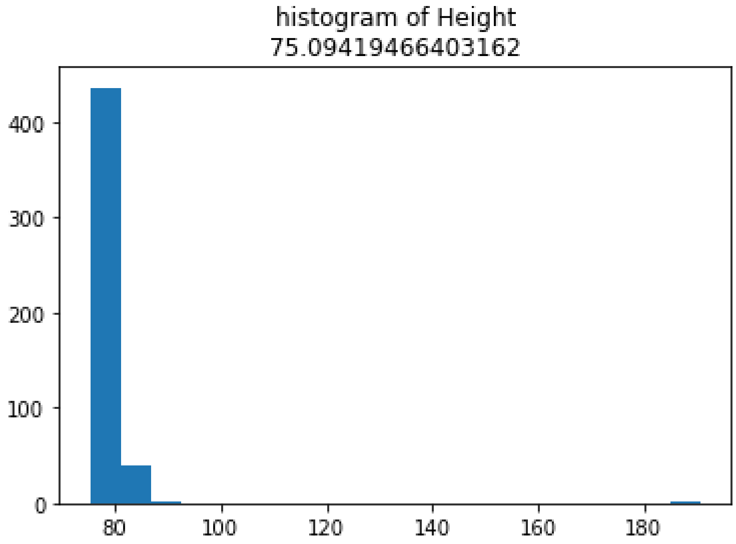


histogram of Height
66.82326251646904







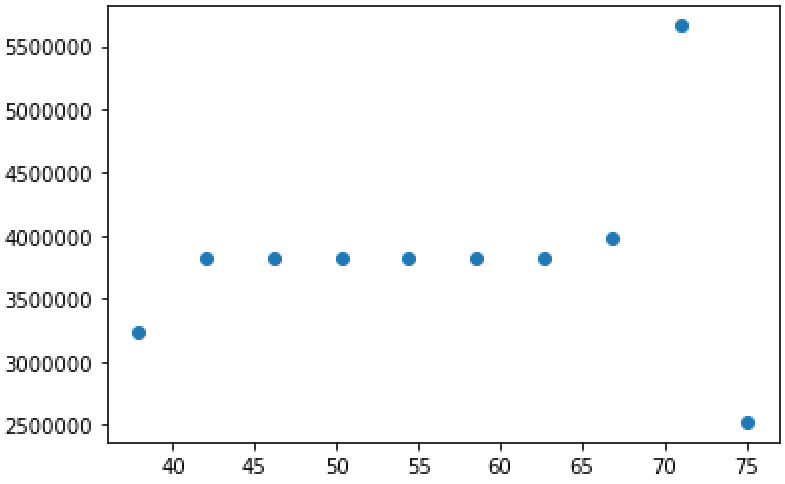


In [191…

```
plt.scatter(thresholds, jbs_7)
```

Out[191…

```
<matplotlib.collections.PathCollection at 0x7fd6394ae2b0>
```



In [192…

```
#9 Weight
```

```
#9 weight
```

In [193…

```
wt_mu = df['Weight'].mean()
wt_std = df['Weight'].std()
print(av_mu, av_std)
lower_95 = wt_mu-2*wt_std
df.shape, df[df['Weight']>280].shape
```

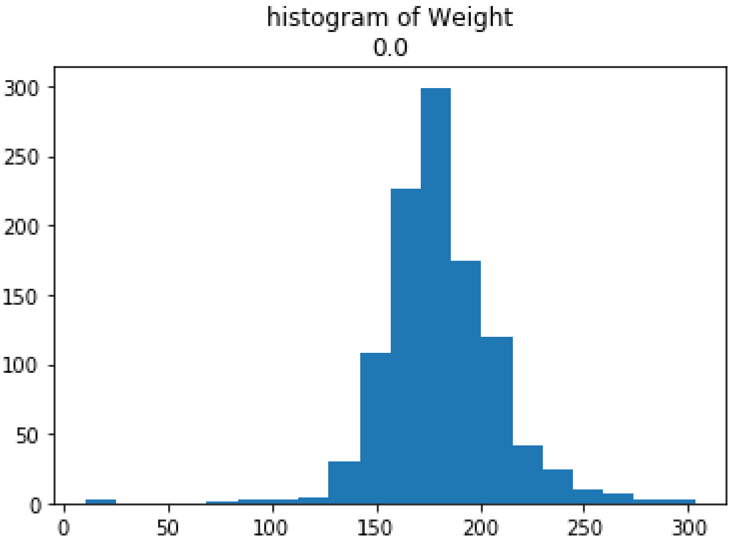
```
31.829614604462474 3.5479850939588244
```

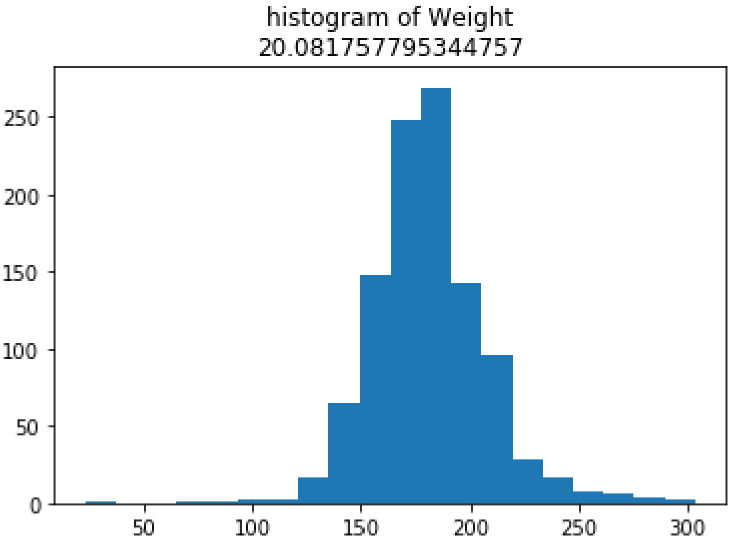
Out[193…

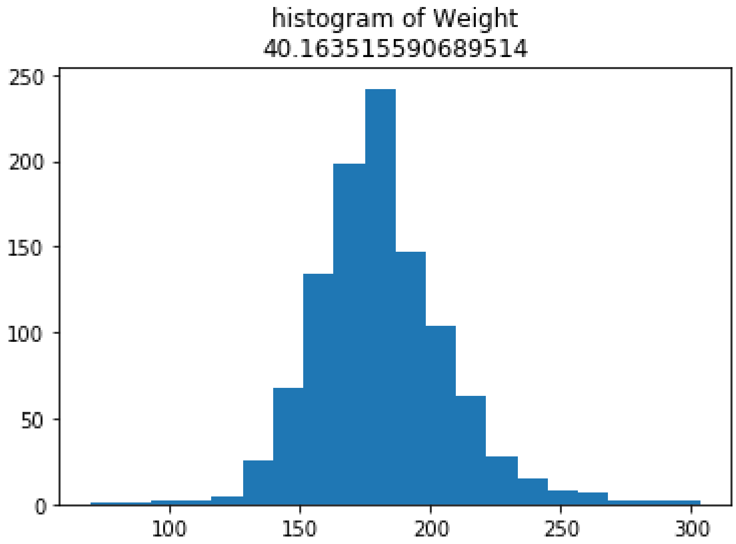
```
((1059, 25), (4, 25))
```

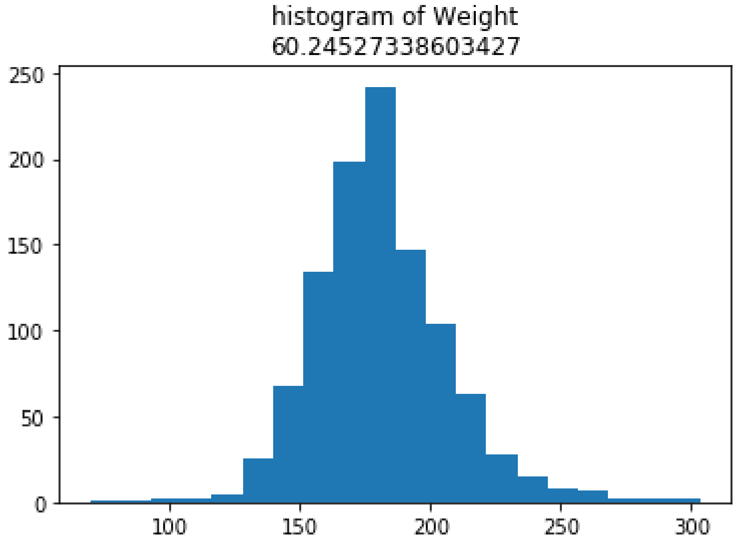
In [194…

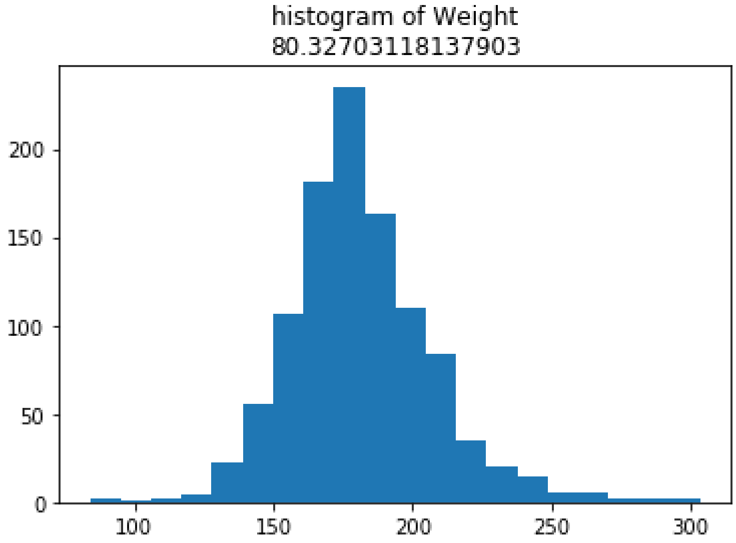
```
wt_min = df['Weight'].min()

jbs_8 = []
thresholds = np.linspace(wt_min, wt_mu, 10)
for threshold in thresholds:
    vals = df[df['Weight'].fillna(wt_mu)>threshold]['Weight'].fillna(wt_mu
    plt.hist(vals, bins=20)
    plt.title("histogram of Weight\n{}".format(threshold))
    plt.show()
    jb_8=scs.jarque_bera(vals)
    jbs_8.append(jb_8[0])
```

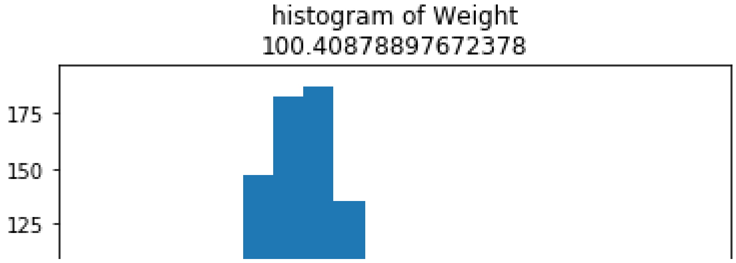


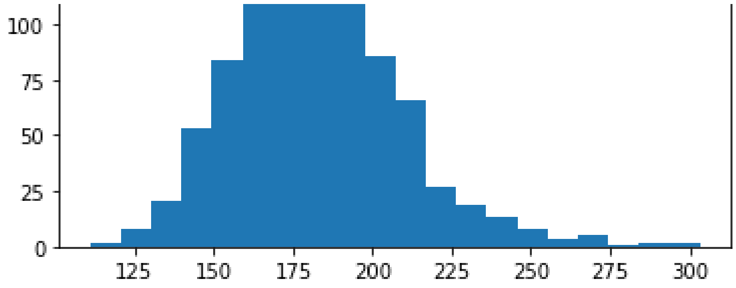


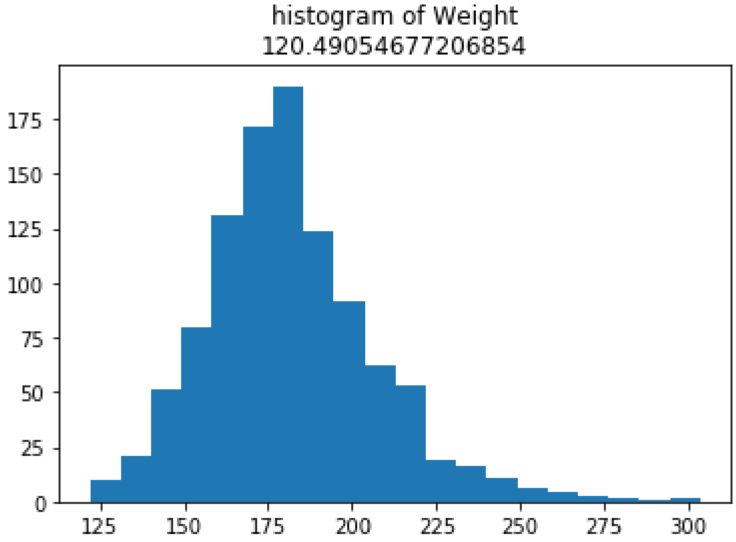

histogram of Weight
40.163515590689514
250
200
150
100
50
0
100
150
200
250
300

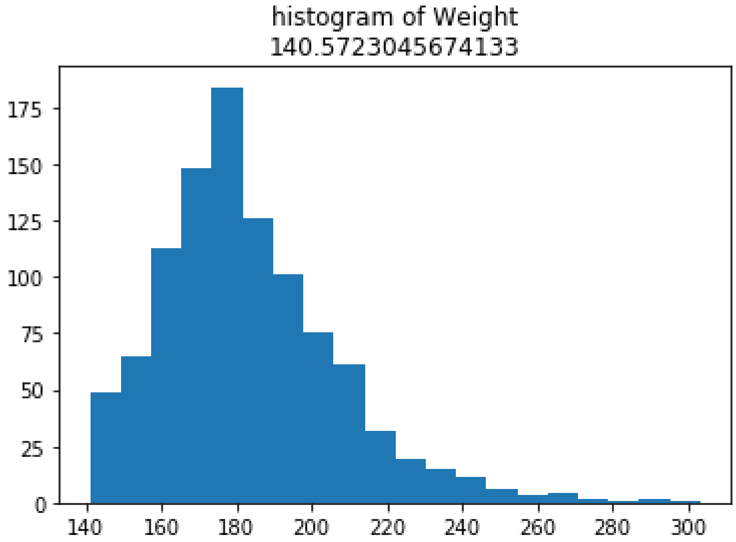

histogram of Weight
60.24527338603427
250
200
150
100
50
0
100
150
200
250
300

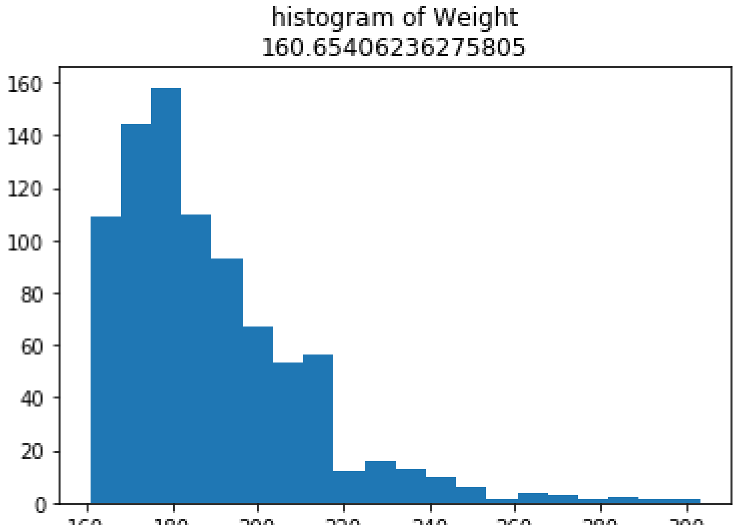

histogram of Weight
80.32703118137903
200
150
100
50
0
100
150
200
250
300

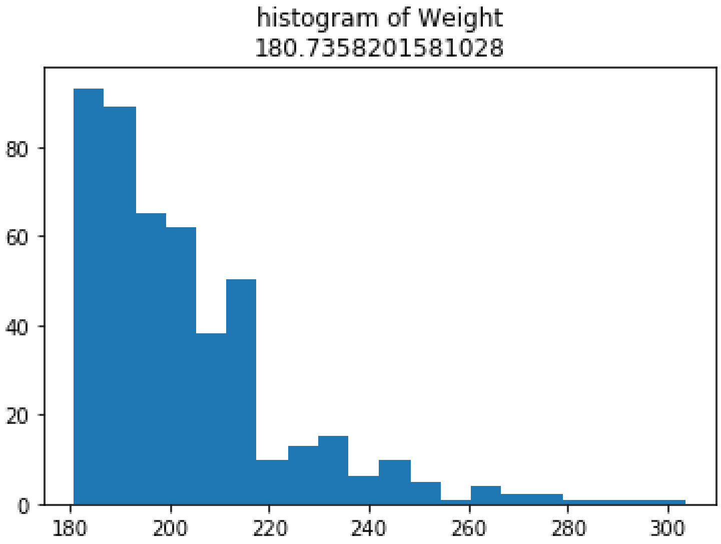

histogram of Weight
100.40878897672378
175
150
125


100
75
50
25
0
125
150
175
200
225
250
275
300


histogram of Weight
120.49054677206854
175
150
125
100
75
50
25
0
125
150
175
200
225
250
275
300


histogram of Weight
140.5723045674133
175
150
125
100
75
50
25
0
140
160
180
200
220
240
260
280
300


histogram of Weight
160.65406236275805
160
140
120
100
80
60
40
20
0
160
180
200
220
240
260
280
300

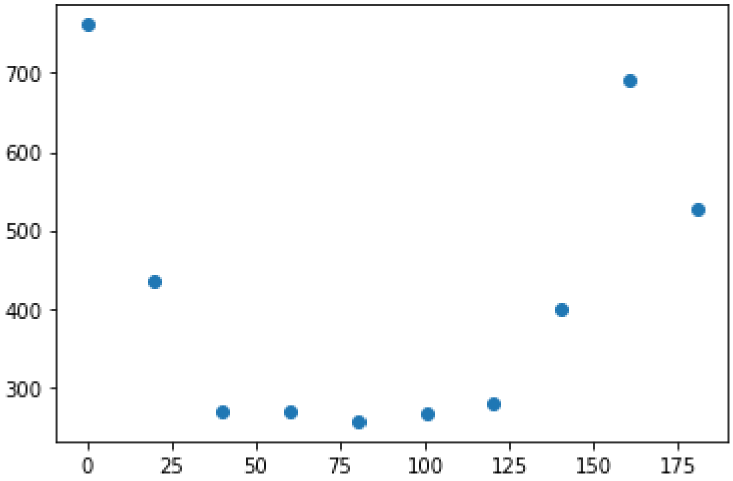


In [195…

```
plt.scatter(thresholds, jbs_8)
```

Out[195…

```
<matplotlib.collections.PathCollection at 0x7fd64959a828>
```



In [196…

```
#10 Body Comp
```

In [197…

```
bc_mu = df['Body Comp'].mean()
bc_std = df['Body Comp'].std()
print(bc_mu, bc_std)
lower_95 = bc_mu-2*bc_std
df.shape, df[df['Body Comp']>33].shape
```

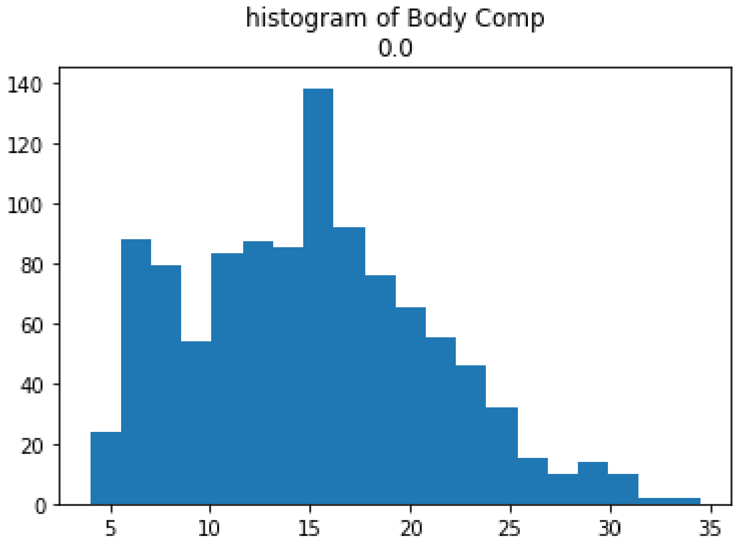
```
14.97949604743083 6.191146804644591
```

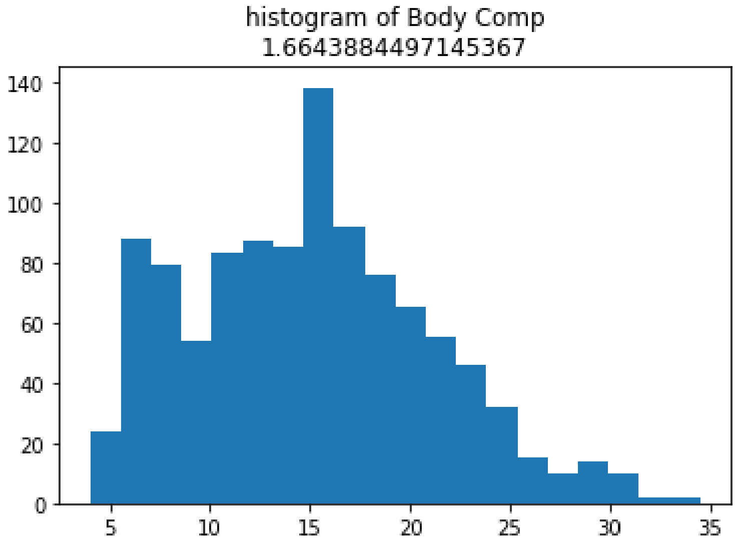
Out[197…

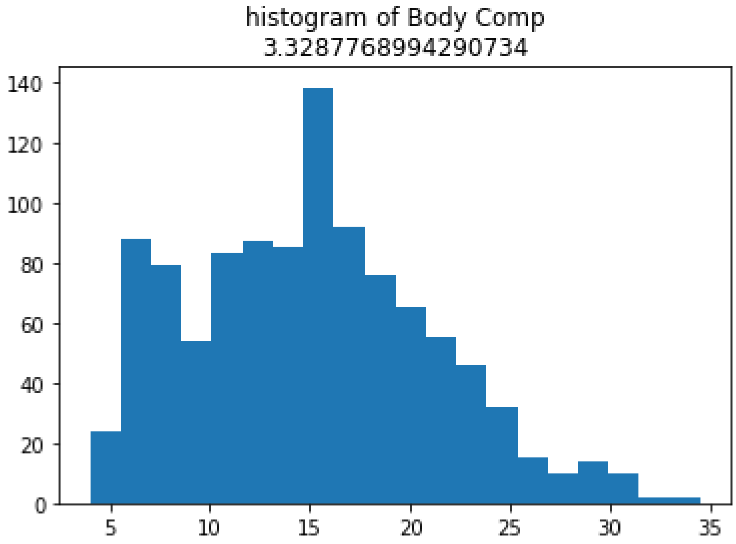
```
((1059, 25), (2, 25))
```

In [198…

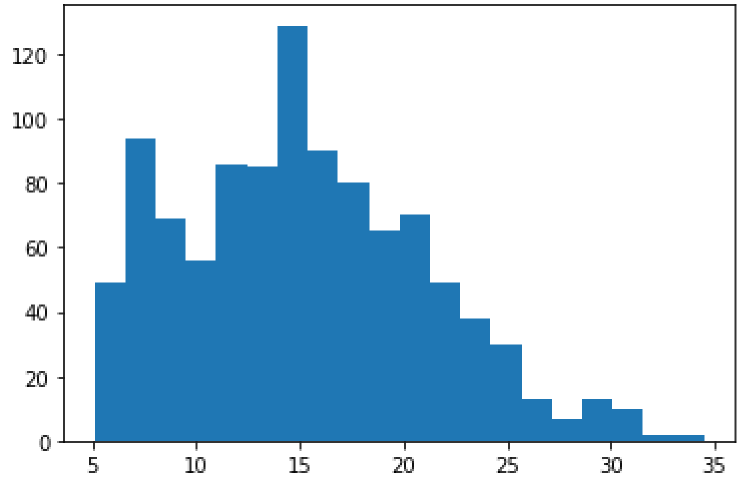
```
bc_min = df['Body Comp'].min()

jbs_9 = []
thresholds = np.linspace(bc_min, bc_mu, 10)
for threshold in thresholds:
    vals = df[df['Body Comp'].fillna(bc_mu)>threshold]['Body Comp'].fillna
    plt.hist(vals, bins=20)
    plt.title("histogram of Body Comp\n{}".format(threshold))
    plt.show()
    jb_9=scs.jarque_bera(vals)
    jbs_9.append(jb_9[0])
```



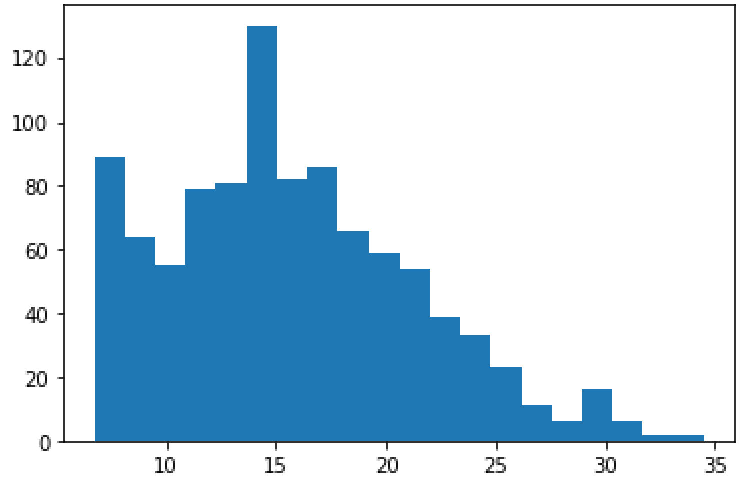




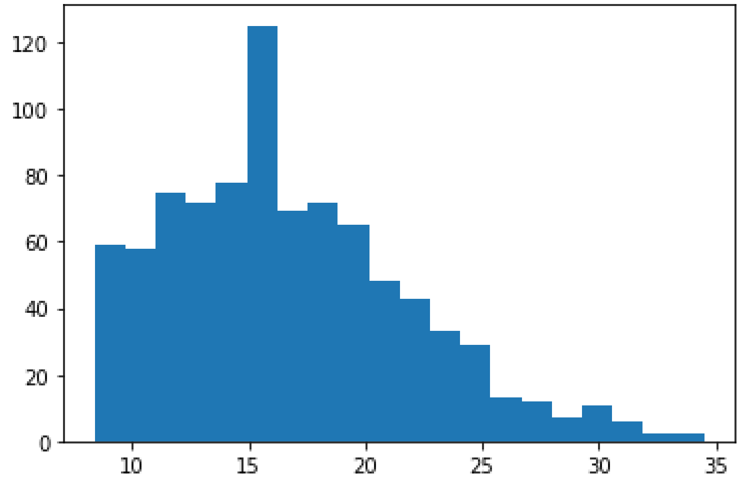
4.99316554914301



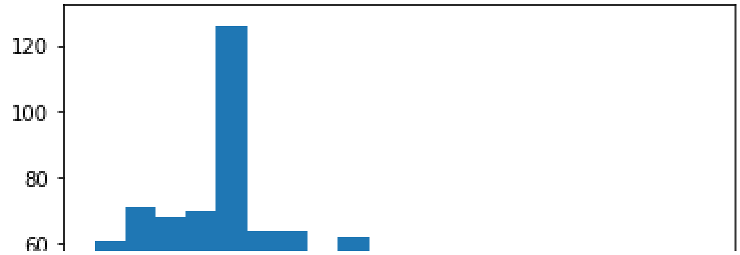
histogram of Body Comp
6.657553798858147

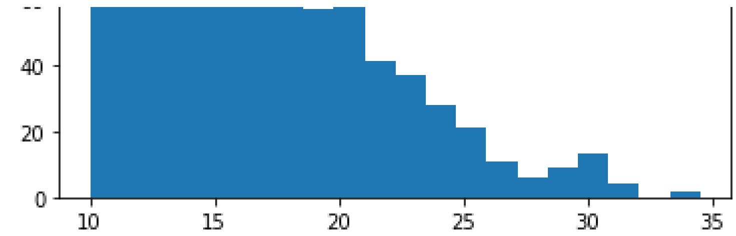


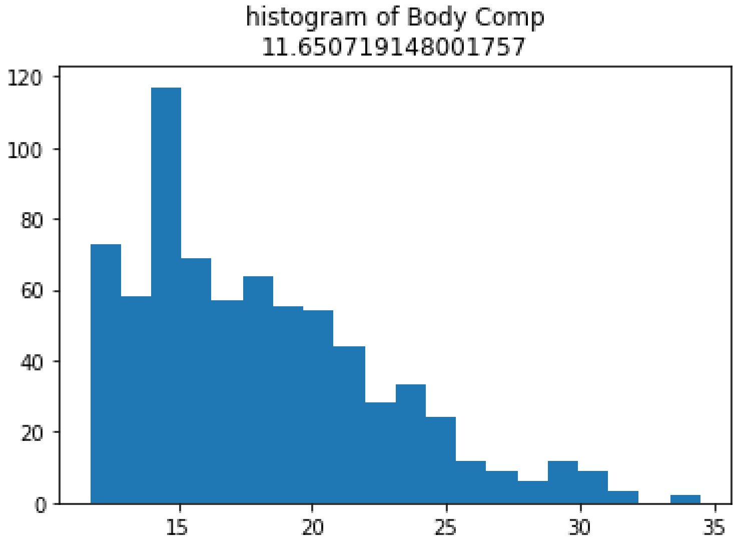
histogram of Body Comp
8.321942248572684

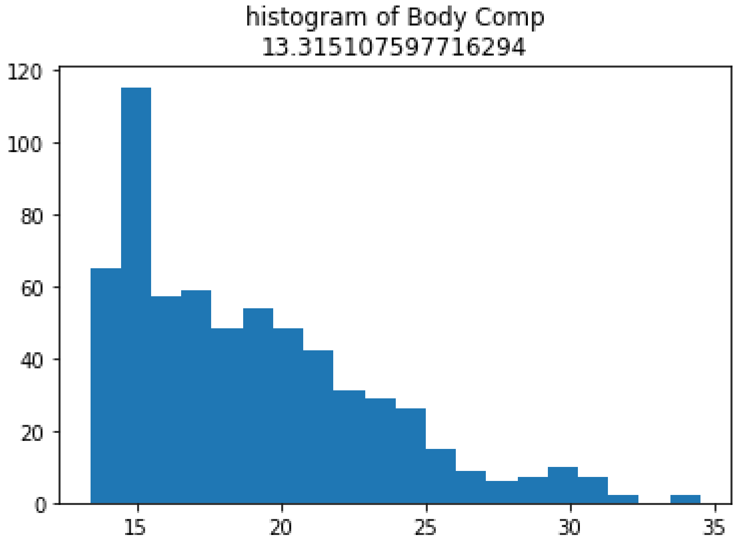


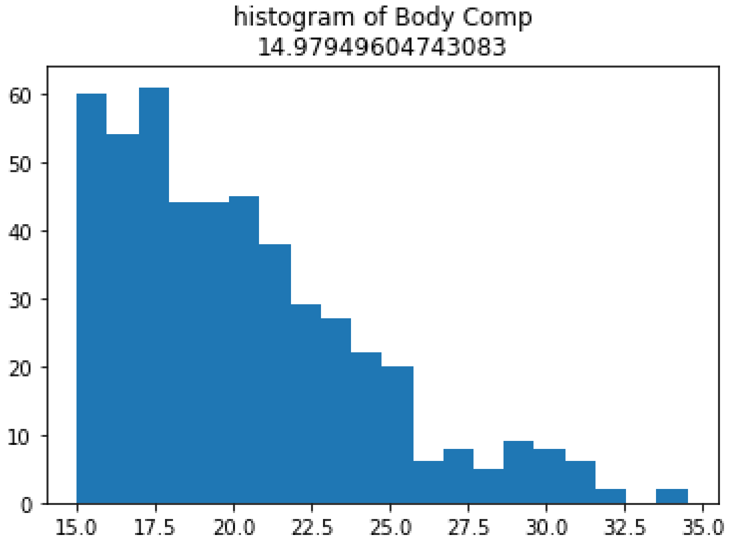
histogram of Body Comp
9.98633069828722




40
20
0
10
15
20
25
30
35


histogram of Body Comp
11.650719148001757
120
100
80
60
40
20
0
15
20
25
30
35


histogram of Body Comp
13.315107597716294
120
100
80
60
40
20
0
15
20
25
30
35

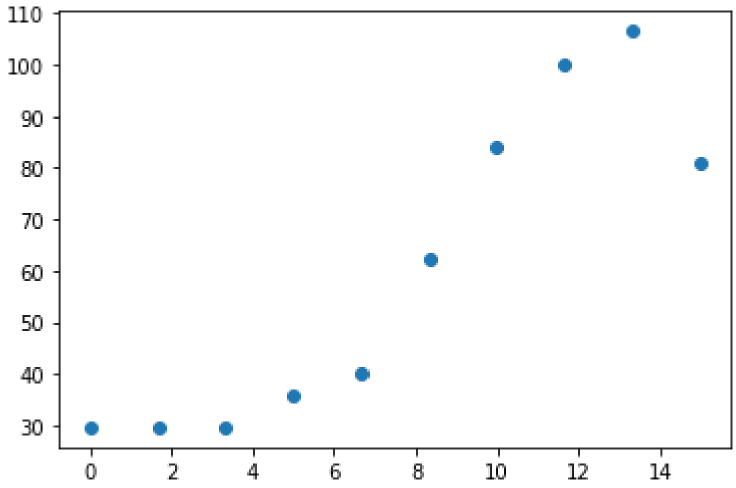

histogram of Body Comp
14.97949604743083
60
50
40
30
20
10
0
15.0
17.5
20.0
22.5
25.0
27.5
30.0
32.5
35.0

In [199…

```
plt.scatter(thresholds, jbs_9)
```

Out[199…

```
<matplotlib.collections.PathCollection at 0x7fd5d94cbbe0>
```



In [200…

```
# 11 Hand Width
```

In [201…

```
hw_mu = df['Hand Width'].mean()
hw_std = df['Hand Width'].std()
print(hw_mu, hw_std)
lower_95 = hw_mu-2*hw_std
df.shape, df[df['Hand Width']>11].shape
```

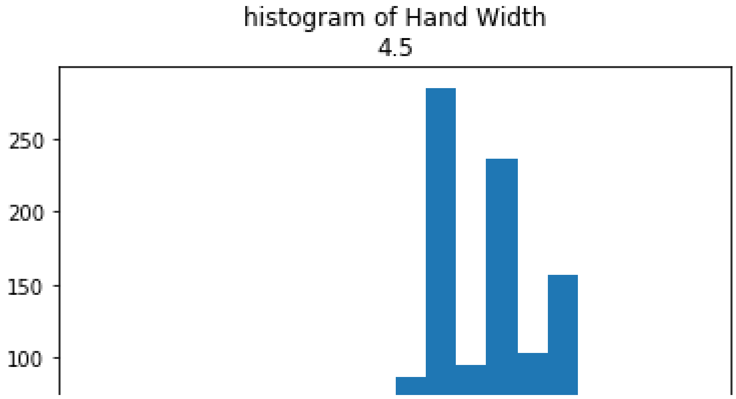
```
8.876189296333004 0.6540954411061081
```

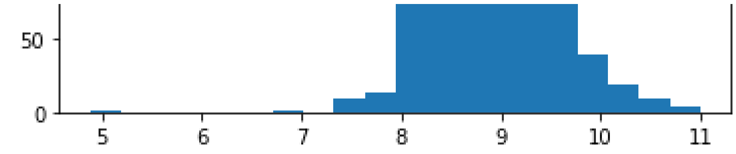
Out[201…

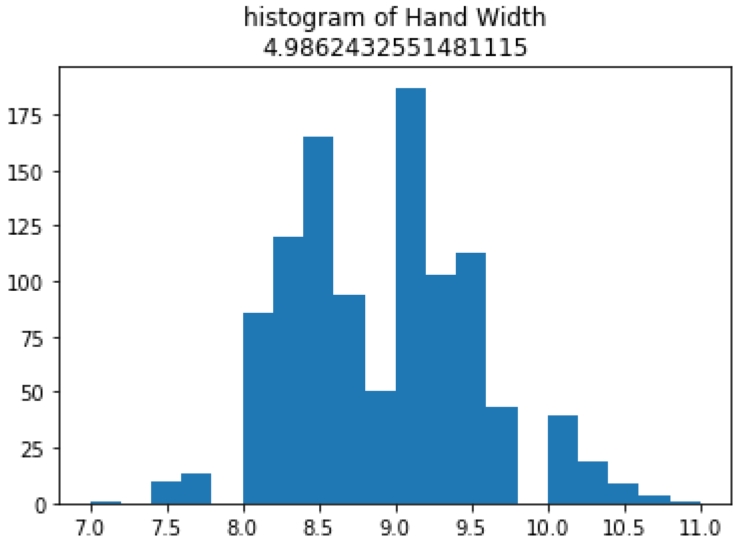
```
((1059, 25), (0, 25))
```

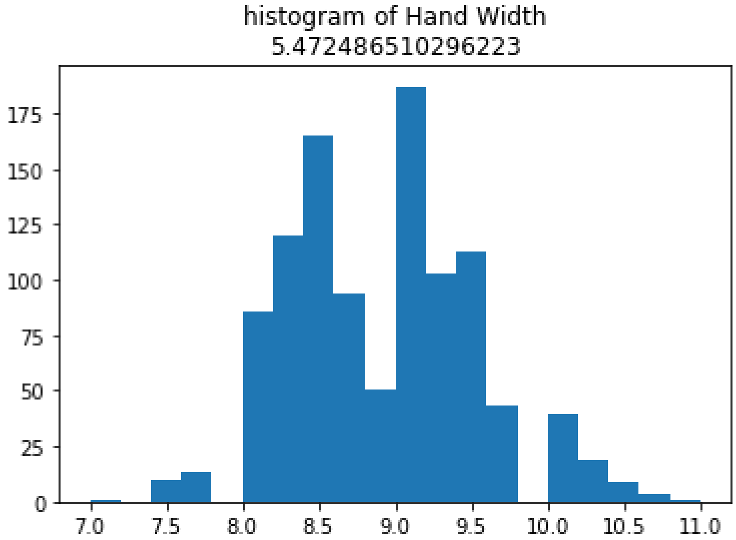
In [202…

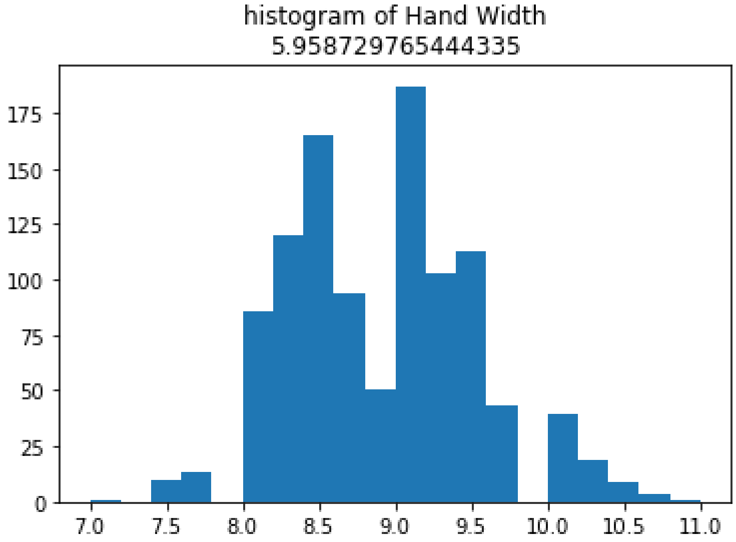
```
hw_min = df['Hand Width'].min()

jbs_10 = []
thresholds = np.linspace(hw_min, hw_mu, 10)
for threshold in thresholds:
    vals = df[df['Hand Width'].fillna(hw_mu)>threshold]['Hand Width'].fill
    plt.hist(vals, bins=20)
    plt.title("histogram of Hand Width\n{}".format(threshold))
    plt.show()
    jb_10=scs.jarque_bera(vals)
    jbs_10.append(jb_10[0])
```

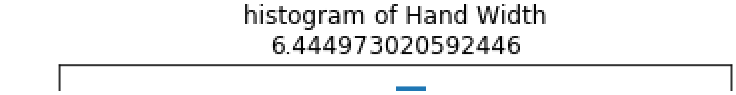


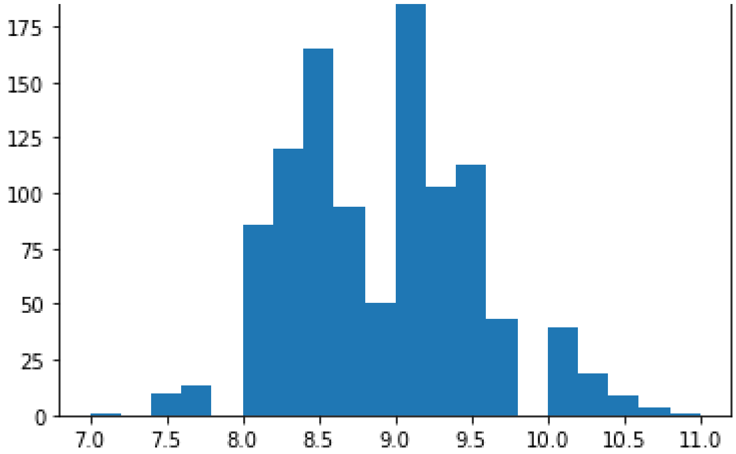

50
0
5
6
7
8
9
10
11


histogram of Hand Width
4.9862432551481115
175
150
125
100
75
50
25
0
7.0
7.5
8.0
8.5
9.0
9.5
10.0
10.5
11.0

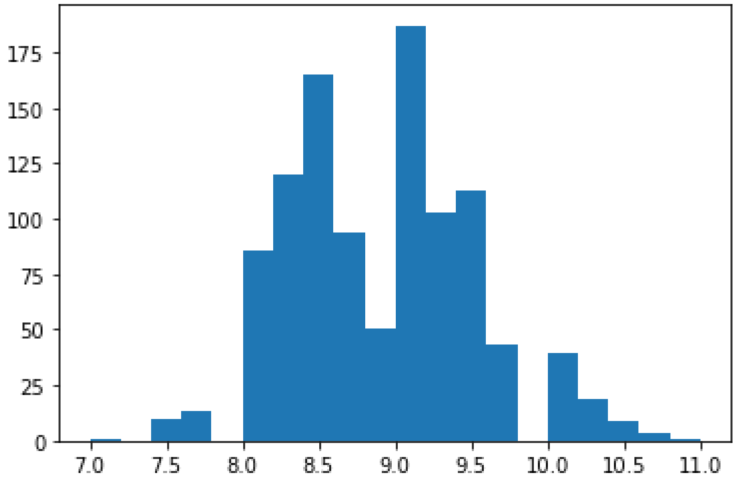

histogram of Hand Width
5.472486510296223
175
150
125
100
75
50
25
0
7.0
7.5
8.0
8.5
9.0
9.5
10.0
10.5
11.0


histogram of Hand Width
5.958729765444335
175
150
125
100
75
50
25
0
7.0
7.5
8.0
8.5
9.0
9.5
10.0
10.5
11.0

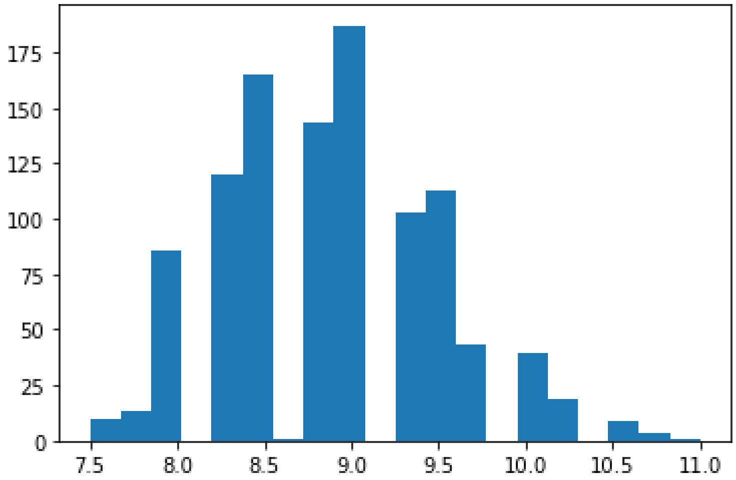

histogram of Hand Width
6.444973020592446



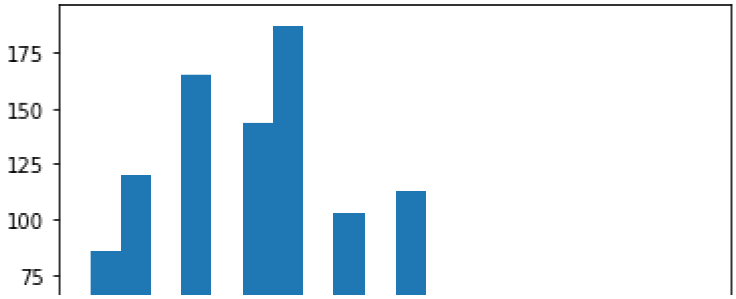
histogram of Hand Width
6.931216275740558

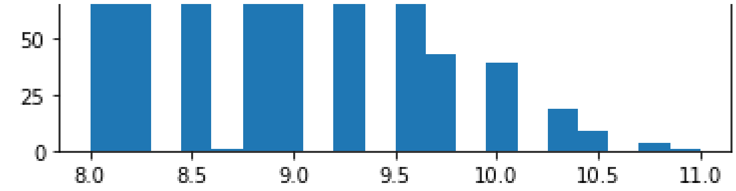


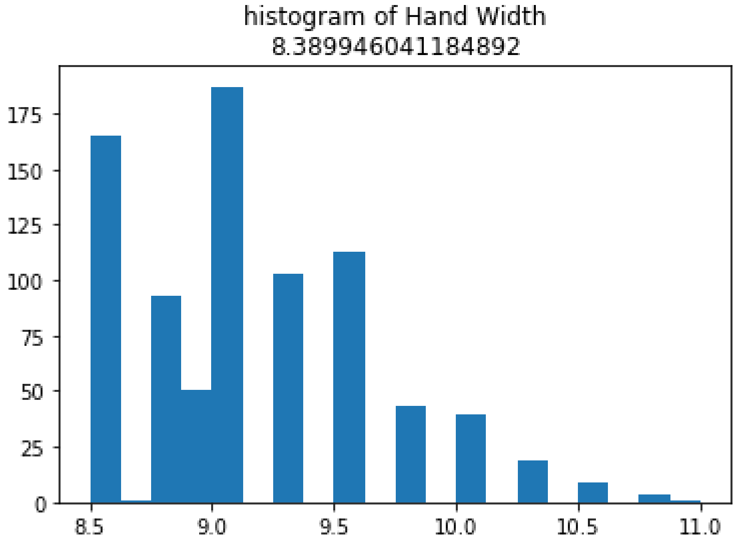
histogram of Hand Width
7.41745953088867

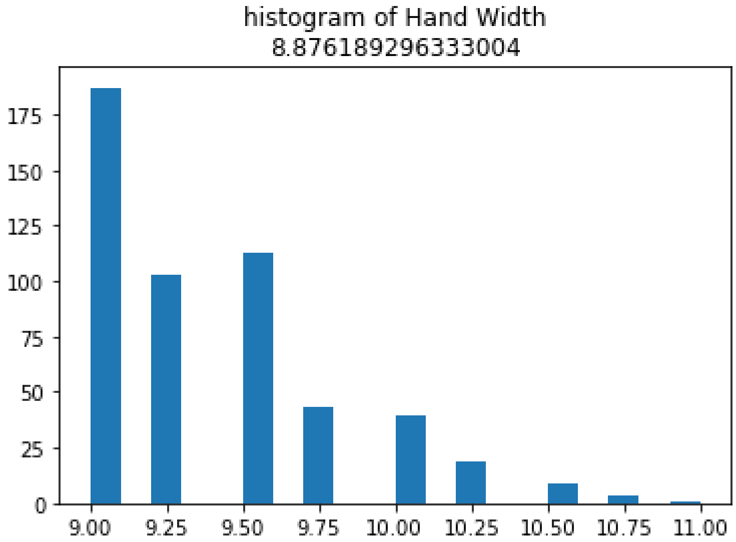


histogram of Hand Width
7.9037027860367814







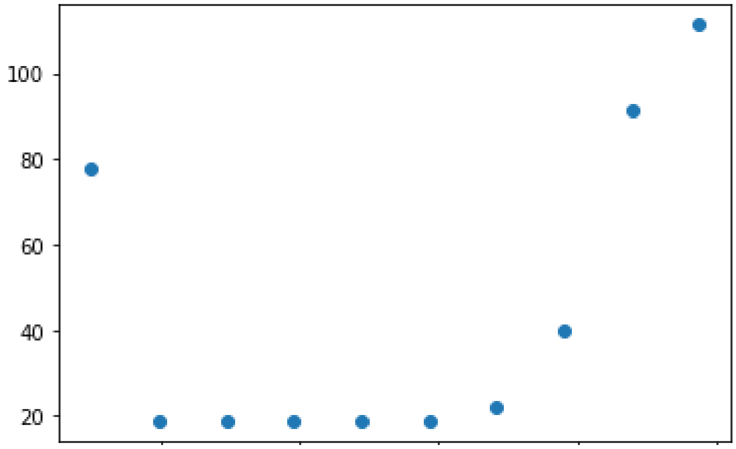


In [203…

```
plt.scatter(thresholds, jbs_10)
```

Out[203…

```
<matplotlib.collections.PathCollection at 0x7fd6091dedd8>
```



# K-Nearest Neighbor Classifier

In [204…

```
df.columns
```

Out[204…

```
Index(['BAMid', 'Approach Vertical', 'Vertical Jump', '3/4 Court sprint
',
       '4-Way agility', 'Reaction Shuttle', 'BAMScore', 'Wingspan', 'Reac
h',
       'Height', 'Weight', 'Body Comp', 'Hand Width', 'approach_vertical_r
ank',
       'vertical_jump_rank', 'reaction_shuttle_rank', 'bam_score_rank',
       'wingspan_rank', 'reach_rank', 'height_rank', 'weight_rank',
       'body_comp_rank', 'hand_width_rank', 'fourway_rank',
       'courtsprint_rank'],
      dtype='object')
```

In [205…

```
x.isna().sum()
```

Out[205…

```
Approach Vertical     0
Vertical Jump         0
3/4 Court sprint      0
4-Way agility         0
Reaction Shuttle      0
Wingspan              0
Reach                 0
Height                0
Weight                0
Body Comp             0
Hand Width            0
dtype: int64
```

In [206…

```
df.mean()

# Just to check that we have all means for columns
```

Out[206…

```
Approach Vertical            31.829615
Vertical Jump                25.860157
3/4 Court sprint              3.467047
4-Way agility                12.247189
Reaction Shuttle              3.505243
BAMScore                   1890.976326
Wingspan                     78.089797
Reach                        98.714180
Height                       75.094195
Weight                      180.735820
Body Comp                    14.979496
Hand Width                    8.876189
approach_vertical_rank        3.324835
vertical_jump_rank            3.406988
reaction_shuttle_rank         3.372993
bam_score_rank                3.479698
wingspan_rank                 3.339943
reach_rank                    3.414542
height_rank                   3.366383
weight_rank                   3.362606
```

```
body_comp_rank                3.372993
hand_width_rank               3.385269
fourway_rank                  3.346553
courtsprint_rank              3.306893
dtype: float64
```

In [207…

```
df.fillna(value=df.mean(), inplace=True)

# Inplace = true does it permanently, false does not
# Made mistake, should have cleaned this data in beggining and ran througl
```

In [208…

```
x = df[['Reaction Shuttle','4-Way agility', 'Vertical Jump','3/4 Court spr
y = df[['BAMScore']]

# Add more x param to increase r2 score
```

In [209…

```
# Which contributes the most to BAMScore
```

In [210…

```
from sklearn.model_selection import train_test_split

#https://scikit-learn.org/stable/modules/generated/sklearn.neighbors.KNeig
```

In [211…

```
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.10)
```

In [212…

```
display(x.head(2))
display(x_train.head(2))
display(x_test.head(2))

#
```

| | Reaction Shuttle | 4-Way agility | Vertical Jump | 3/4 Court sprint |
|---|---|---|---|---|
| **0** | 3.669 | 11.471 | 28.5 | 3.376 |
| **1** | 3.355 | 12.114 | 21.5 | 3.486 |

| | Reaction Shuttle | 4-Way agility | Vertical Jump | 3/4 Court sprint |
|---|---|---|---|---|
| **791** | 3.655 | 13.300 | 19.5 | 3.792 |
| **894** | 3.310 | 11.042 | 27.5 | 3.287 |

| | Reaction Shuttle | 4-Way agility | Vertical Jump | 3/4 Court sprint |
|---|---|---|---|---|
| **587** | 3.962 | 12.889 | 21.0 | 3.703 |
| **124** | 3.714 | 13.966 | 30.0 | 6.764 |

In [213…

```
from sklearn.neighbors import KNeighborsClassifier,KNeighborsRegressor
neigh = KNeighborsRegressor(n_neighbors=3)
neigh.fit(x_train, y_train)
```

Out[213…
```
KNeighborsRegressor(n_neighbors=3)
```

In [214…
```
neigh.score(x_test, y_test)

# 68-81%
```

Out[214…
```
0.6685952124585061
```

# Decision Tree Regressor

In [215…
```
from sklearn.tree import DecisionTreeRegressor # Import Decision Tree Regr
from sklearn.model_selection import train_test_split # Import train_test_s
from sklearn import metrics #Import scikit-learn metrics module for accura

# https://www.datacamp.com/community/tutorials/decision-tree-classificatio
```

## 1 - Relationship to anthros with protocols

## 2 - Just protocols

## 3 - Body majorments (anthros)

In [216…
```
print(x_train)
```

```
     Reaction Shuttle  4-Way agility  Vertical Jump  3/4 Court sprint
791             3.655         13.300      19.500000             3.792
894             3.310         11.042      27.500000             3.287
10              3.384         11.387      25.860157             3.396
337             4.131         12.268      24.500000             3.193
761             3.398         12.099      29.000000             3.319
..                ...            ...            ...               ...
141             3.582         12.487      24.000000             3.571
294             3.302         13.451      25.000000             3.568
432             3.194         11.830      26.500000             3.409
420             3.517         11.889      23.500000             3.386
191             3.280         11.893      28.000000             3.383

[953 rows x 4 columns]
```

## #1 All feature columns

In [217…
```
feature_cols = ['Approach Vertical',
                'Vertical Jump',
                '3/4 Court sprint  ',
                '4-Way agility',
                'Reaction Shuttle',
                'Wingspan',
                'Reach','Height',
                'Weight',
                'Body Comp',
                'Hand Width']
```

In [218…

```
x = df[feature_cols] # Features
y = df.BAMScore
```

In [219…

```
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.3, r
# 70% training and 30% test
```

In [220…

```
# Create Decision Tree Regressor object
clf = DecisionTreeRegressor()

# Train Decision Tree Classifer
clf = clf.fit(x_train,y_train)

#Predict the response for test dataset
y_pred = clf.predict(x_test)
```

In [221…

```
# Model Accuracy, how often is the classifier correct?
print("Accuracy:",clf.score(x_test,y_test))
```

```
Accuracy: 0.6598725146830748
```

# #2 Protocols

In [222…

```
feature_cols_no_bodycomp = ['Approach Vertical', 'Vertical Jump', '3/4 Cou
       '4-Way agility', 'Reaction Shuttle']
```

In [223…

```
x = df[feature_cols_no_bodycomp] # Features
y = df.BAMScore
```

In [224…

```
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.3, r
# 70% training and 30% test
```

In [225…

```
# Create Decision Tree Regressor object
clf = DecisionTreeRegressor()

# Train Decision Tree Classifer
clf = clf.fit(x_train,y_train)

#Predict the response for test dataset
y_pred = clf.predict(x_test)
```

In [226…

```
# Model Accuracy, how often is the classifier correct?
# cleaning of my data may effect this, accuracy will go up after cleaned i
print("Accuracy:",clf.score(x_test,y_test))
```

```
Accuracy: 0.7109337368717044
```

# #3 Only Anthros

In [227…

```
feature_cols_anthros = ['Wingspan', 'Reach', 'Height', 'Weight', 'Body Com
```

In [228…

```
x = df[feature_cols_anthros] # Features
y = df.BAMScore
```

In [229…

```
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size=0.3, r
# 70% training and 30% test
```

In [230…

```
# Create Decision Tree Regressor object
clf = DecisionTreeRegressor()

# Train Decision Tree Classifer
clf = clf.fit(x_train,y_train)

#Predict the response for test dataset
y_pred = clf.predict(x_test)
```

In [231…

```
# Model Accuracy, how often is the classifier correct?
print("Accuracy:",clf.score(x_test,y_test))
```

```
Accuracy: -0.36237601893660165
```

In [232…

```
# No correlation between athletic ability and body comp
# Reclean data in traintest models that were discovered in future
```

In [233…

```
!pwd
```

```
/Users/bryanjamieson/flatiron/BAM-DATA-FINAL
```