Body Performance based on Physical Condition

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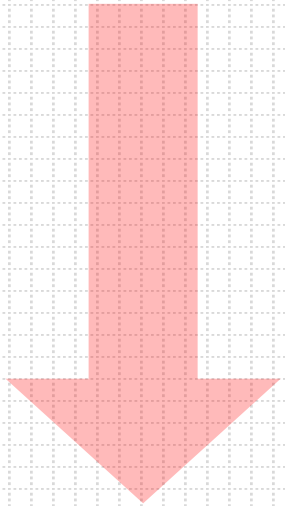
Abstract

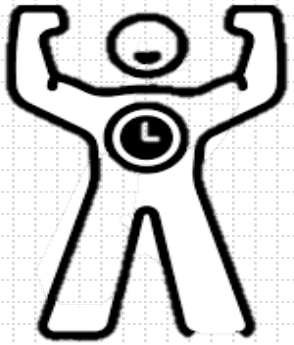
- **The Physical Condition Affects the Body's Performance.**
  - **Reduced nonessential body fat contributes to muscular and cardiorespiratory endurance, speed, and agility development (NSCA, 2017)**
  - Physical performance can be assessed by muscle strength, balance ability, and mobil ity. Several studies have reported that **higher BMI is associated with reduced levels of physical performance.**(Shen et al, 2015)
  - BMI is positively related to SBP(Systolic Blood pressure) and DBP(diastolic blood pressure)(Linderman, 2018)

- **Body mass index = weight / height^2 = kg/m^2**

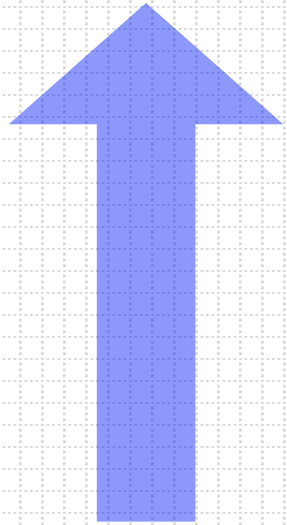


Body Fat %

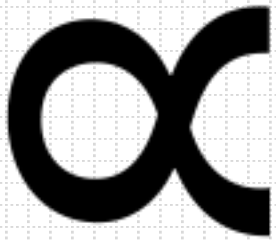
Body Mass Index
(BMI)



Body
Performance



Body Mass Index
(BMI)



Diastolic/Systolic Blood Pressure

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118

New Notebook

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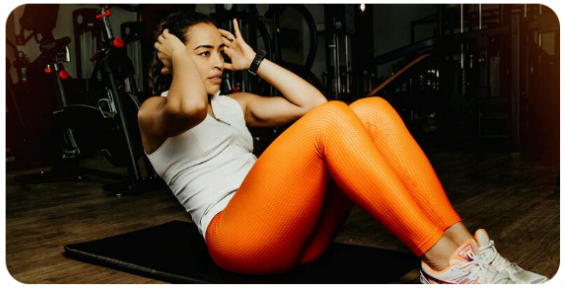
Body performance Data

multi class classification



BigData MarketC

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Athletic | individual/group | Leisure | personal | CSV | for free

Measurement data for each physical fitness measurement item

National Sports Promotion Agency

KSPO 국민체육진흥공단 Korea Sports Promotion Foundation

type CSV · price for free · Data update cycle Yearly

2022.02.08 update 12965 7411

grade 4.1 rate 5 RATE Attention 50

데이터 상담소

Dataset

(13393,12)

Basic Info

1. Age: 20 ~ 64
2. Gender: F, M

Physical Condition

3. height_cm
4. weight_kg
5. body fat_%
6. diastolic: diastolic blood pressure
7. Systolic: systolic blood pressure

Body Performance

8. gripForce
9. sit and bend forward_cm
10. sit-ups counts
11. Broad jump_cm

Class

12. class: A, B, C, D (A : best)

Categorical

Goal

1. Predict the Body Performance Class based on the observed data

→ K- nearest Neighbors

2. Predict body performance ability based on Physical Condition

Linear Regression & correlation

→ Physical Condition(BMI , Body fat %) vs. body performance

3. Predict Blood Pressure level based on BMI level

Linear Regression & correlation

→ Blood Pressure Level (SBP, DBP) vs. BMI level

Data Preprocessing

Cleaning/formatting → **Transformation** → **Reduction**

- Null value
- Data Type
- Encoding
- Add Features

- Scaling
- Attribution Selection

- Dimensionality Reduction(PCA)

Formatting & Cleaning

1-a. Rename the columns

	age	gender	height_cm	weight_kg	body fat_%	diastolic	systolic	gripForce	sit and bend forward_cm	sit-ups counts	broad jump_cm	class
0	27.0	M	172.3									
1	25.0	M	165.0									
2	31.0	M	179.6									
3	32.0	M	174.5									
4	28.0	M	173.8									
...	...	...	...									
13388	25.0	M	172.1									
13389	21.0	M	179.7									
13390	39.0	M	177.2									
13391	64.0	F	146.1									
13392	34.0	M	164.0									

13393 rows × 12 columns

	age	gender	height_cm	weight_kg	fat	diastolic	systolic	gripForce	sit_bend	situp	jump	CLASS
0	27.0	M	172.3	75.24	21.3	80.0	130.0	54.9	18.4	60.0	217.0	C
1	25.0	M	165.0	55.80	15.7	77.0	126.0	36.4	16.3	53.0	229.0	A
2	31.0	M	179.6	78.00	20.1	92.0	152.0	44.8	12.0	49.0	181.0	C
3	32.0	M	174.5	71.10	18.4	76.0	147.0	41.4	15.2	53.0	219.0	B
4	28.0	M	173.8	67.70	17.1	70.0	127.0	43.5	27.1	45.0	217.0	B
...	...	...	...	...	...	...	...	...	...	...	...	...
13388	25.0	M	172.1	71.80	16.2	74.0	141.0	35.8	17.4	47.0	198.0	C
13389	21.0	M	179.7	63.90	12.1	74.0	128.0	33.0	1.1	48.0	167.0	D
13390	39.0	M	177.2	80.50	20.1	78.0	132.0	63.5	16.4	45.0	229.0	A
13391	64.0	F	146.1	57.70	40.4	68.0	121.0	19.3	9.2	0.0	75.0	D
13392	34.0	M	164.0	66.10	19.5	82.0	150.0	35.9	7.1	51.0	180.0	C

13393 rows × 12 columns

1-b. Check the Null Data / Data Type

```
age          0
gender       0
height_cm    0
weight_kg    0
fat          0
diastolic    0
systolic     0
gripForce    0
sit_bend     0
situp        0
jump         0
CLASS        0
dtype: int64
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 13393 entries, 0 to 13392
Data columns (total 12 columns):
 #   Column      Non-Null Count  Dtype
---  ------      --------------  -----
 0   age         13393 non-null  float64
 1   gender      13393 non-null  object
 2   height_cm   1339
 3   weight_kg   1339
 4   fat         1339
 5   diastolic   1339
 6   systolic    1339
 7   gripForce   1339
 8   sit_bend    1339
 9   situp       1339
 10  jump        1339
 11  CLASS       1339
dtypes: float64(10),
memory usage: 1.2+ M
```

1-c. Unique value of non-numeric data

```
array(['M', 'F'], dtype=object)
```

```
array(['C', 'A', 'B', 'D'], dtype=object)
```

	age	gender	fat	diastolic	systolic	gripForce	sit_bend	situp	jump	CLASS	BMI
0	27.0	1	21.3	80.0	130.0	54.9	18.4	60.0	217.0	1	25.3
1	25.0	1	15.7	77.0	126.0	36.4	16.3	53.0	229.0	3	20.5
2	31.0	1	20.1	92.0	152.0	44.8	12.0	49.0	181.0	1	24.2
3	32.0	1	18.4	76.0	147.0	41.4	15.2	53.0	219.0	2	23.3
4	28.0	1	17.1	70.0	127.0	43.5	27.1	45.0	217.0	2	22.4
...	...	...	...	...	...	...	...	...	...	...	...
13388	25.0	1	16.2	74.0	141.0	35.8	17.4	47.0	198.0	1	24.2
13389	21.0	1	12.1	74.0	128.0	33.0	1.1	48.0	167.0	0	19.8
13390	39.0	1	20.1	78.0	132.0	63.5	16.4	45.0	229.0	3	25.6
13391	64.0	0	40.4	68.0	121.0	19.3	9.2	0.0	75.0	0	27.0
13392	34.0	1	19.5	82.0	150.0	35.9	7.1	51.0	180.0	1	24.6

13393 rows × 11 columns

1-e. Add Feature

BMI = weight_kg / (height_m)^2

(height_m) = (height_cm) * 0.01

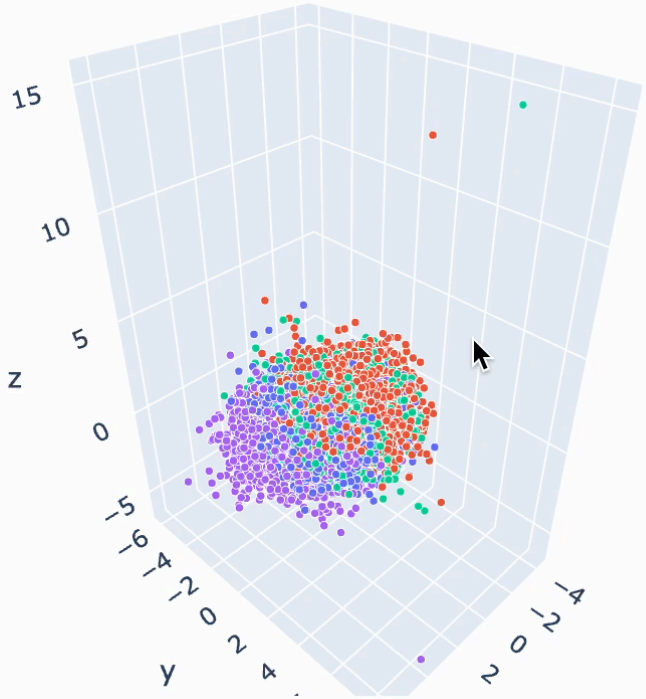
Transformation

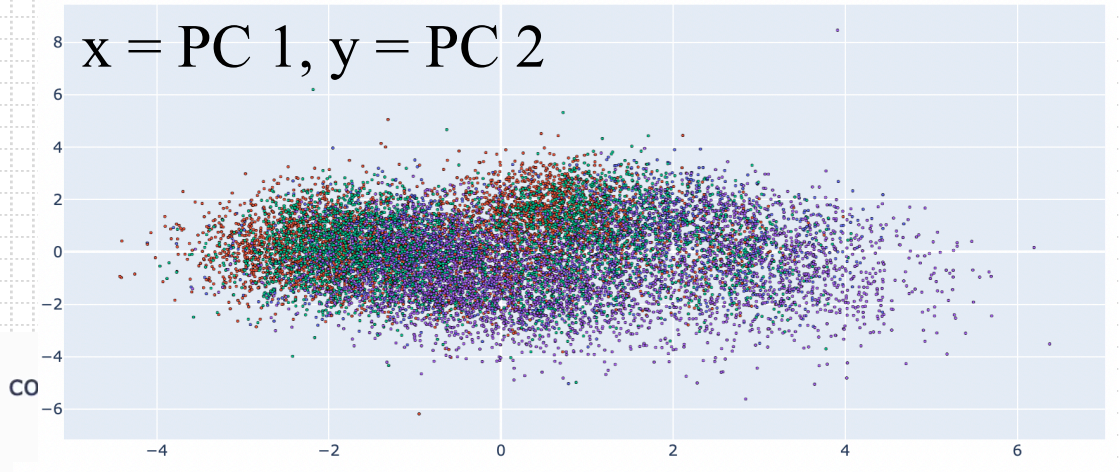
Data Scaling

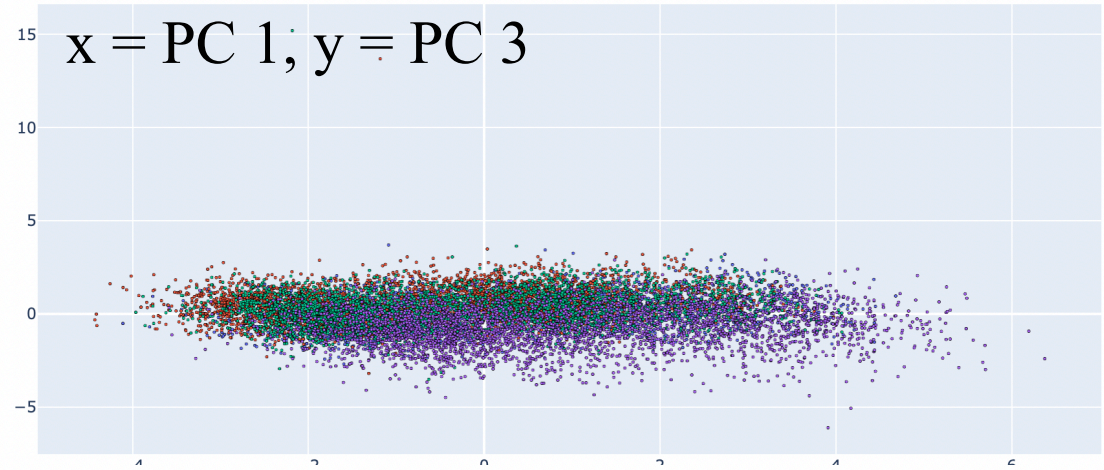
	age	gender	fat	diastolic	systolic	gripForce	sit_bend	situp	jump	CLASS	BMI
0	27.0	1	21.3	80.0	130.0	54.9	18.4	60.0	217.0	1	25.3
1	25.0	1	15.7	77.0	126.0	36.4	16.3	53.0	229.0	3	20.5
2	31.0	1	20.1	92.0	152.0	44.8	12.0	49.0	181.0	1	24.2
3	32.0	1	18.4	76.0	147.0	41.4	15.2	53.0	219.0	2	23.3
4	28.0	1	17.1	70.0	127.0	43.5	27.1	45.0	217.0	2	22.4
...	...	...	...	...	...	...	...	...	...	...	...
13388	25.0	1	16.2	74.0	141.0	35.8	17.4	47.0	198.0	1	24.2
13389	21.0	1	12.1	74.0	128.0	33.0	1.1	48.0	167.0	0	19.8
13390	39.0	1	20.1	78.0	132.0	63.5	16.4	45.0	229.0	3	25.6
13391	64.0	0	40.4	68.0	121.0	19.3	9.2	0.0	75.0	0	27.0
13392	34.0	1	19.5	82.0	150.0	35.9	7.1	51.0	180.0	1	24.6

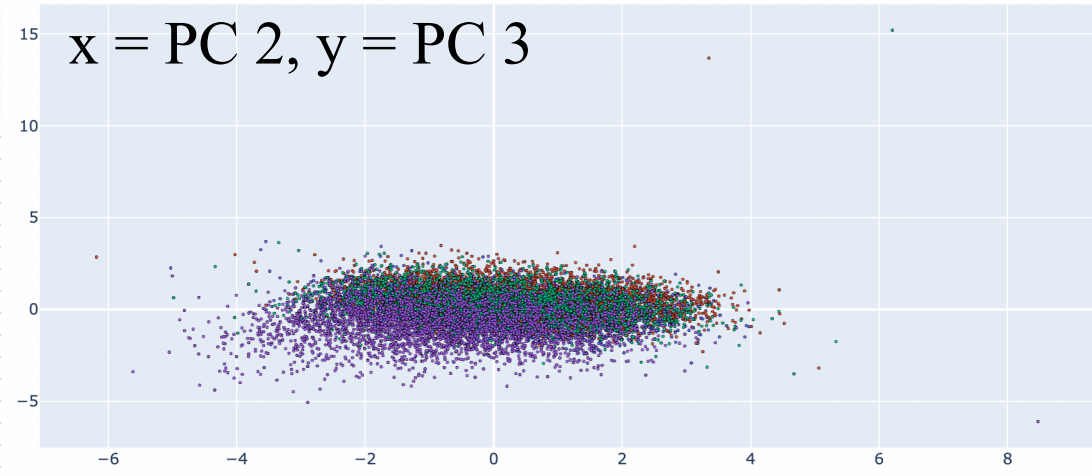
13393 rows × 11 columns

Dimensionality Reduction









Principle Component Analysis (PCA)

A	B	C	D

Split Train v. Test Data

```
from sklearn.model_selection import train_test_split
```

```
X.shape, y.shape
```

```
((13393, 9), (13393,))
```

```
# 20% of the data will be used as the test sets
# shuffle = true; so data will be randomly selected
# random_state = 20; so i could get same random sample everytime i re-run the codes
X_train, X_test, Y_train, Y_test = train_test_split(X, y, test_size = 0.2, shuffle = True, random_state = 20)

print(X_train.shape, Y_train.shape)
print(X_test.shape, Y_test.shape)
```

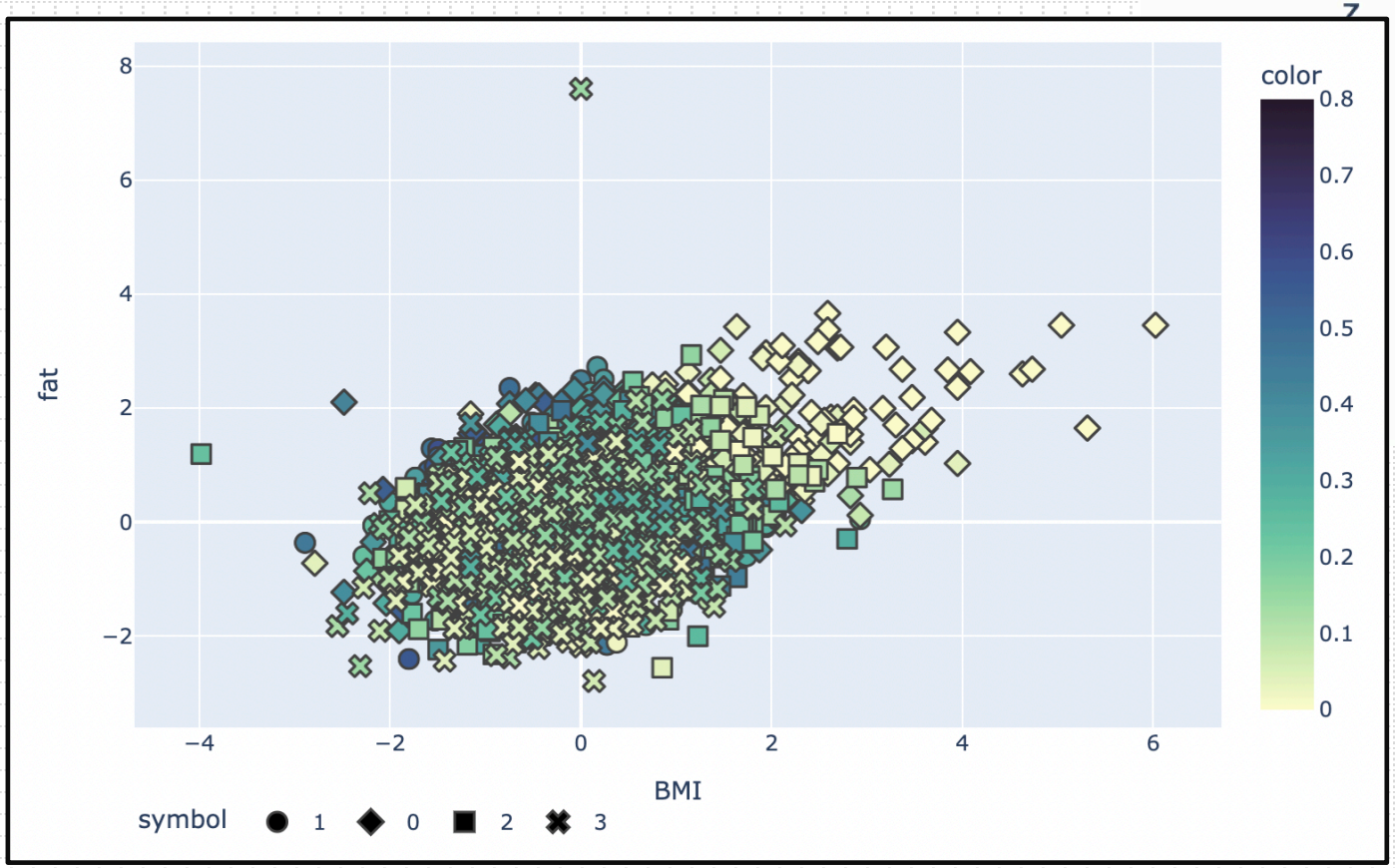
```
(10714, 9) (10714,)
(2679, 9) (2679,)
```

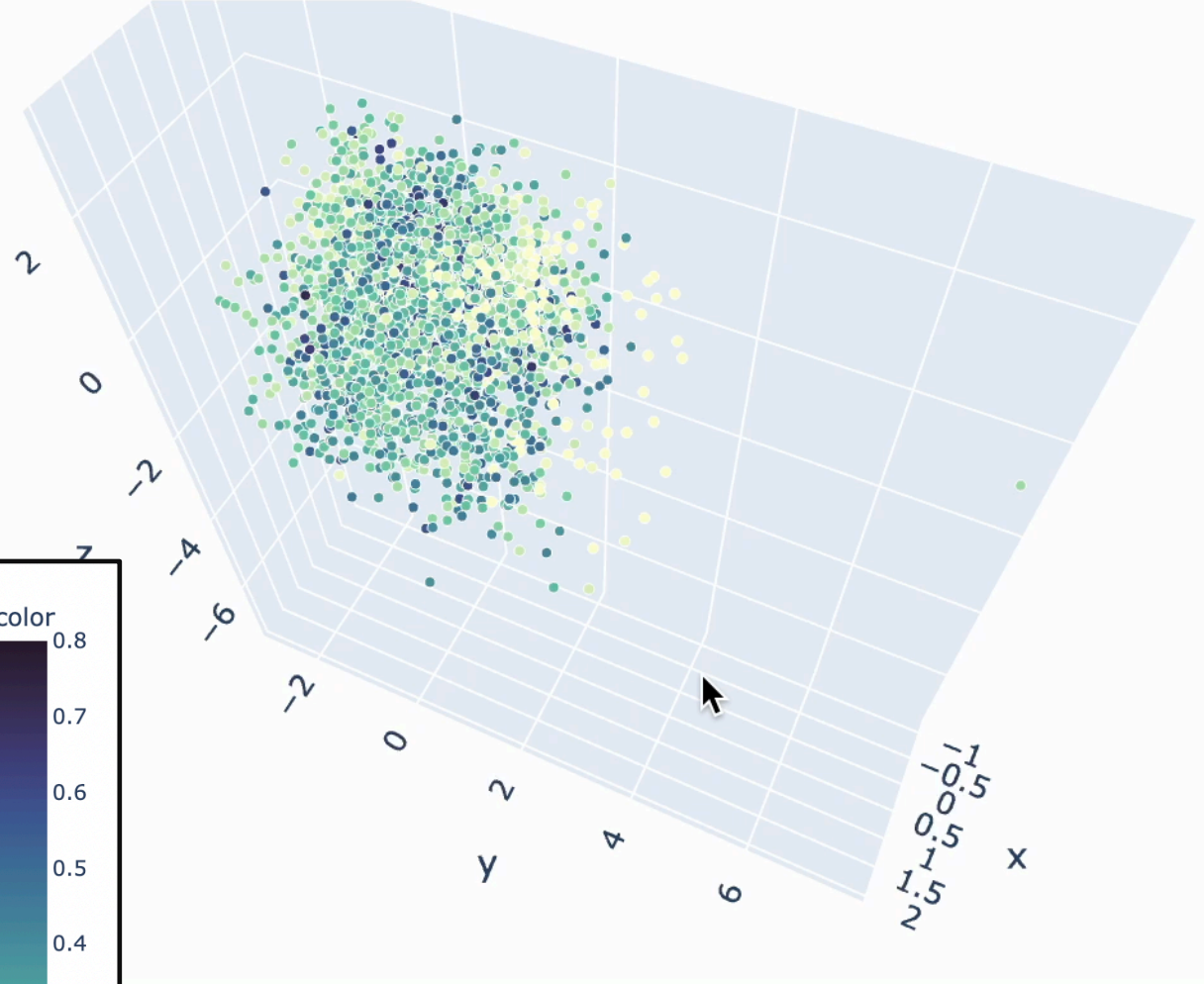
1. Predict the body performance class

K- Nearest Neighbors

```
Knn Model Accuracy : 0.63
```

n_neighbors = 50



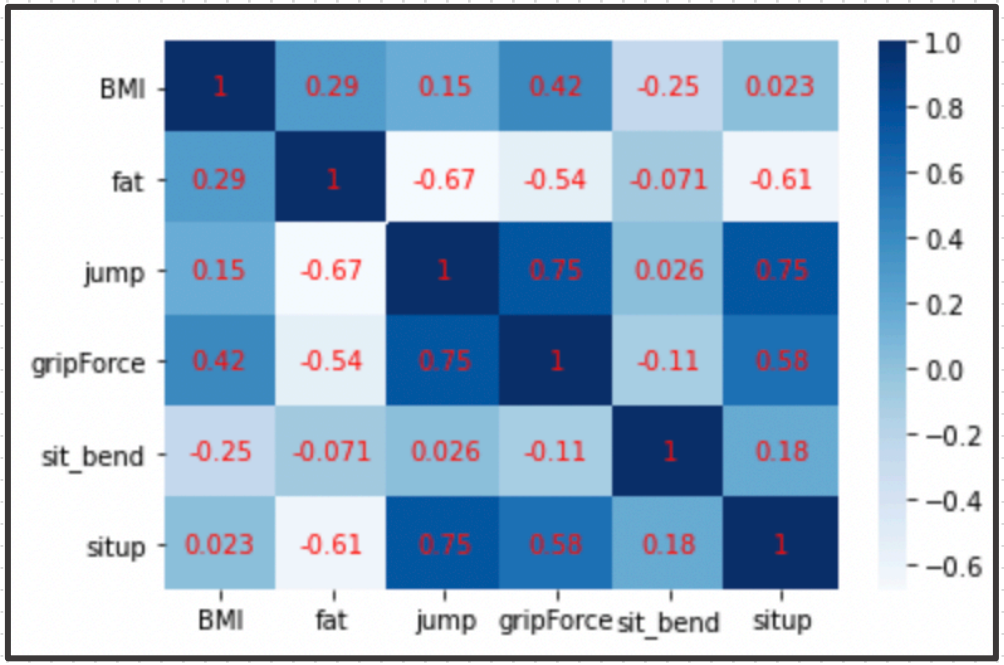


A : ✕	B : ●	C : ◆	D : ■

2. Which Physical Condition affects more on body performance

Correlation (before Linear Regression)

	BMI	fat	jump	gripForce	sit_bend	situp
BMI	1.000000	0.288373	0.151664	0.415636	-0.249520	0.022758
fat	0.288373	1.000000	-0.673273	-0.541788	-0.071225	-0.608912
jump	0.151664	-0.673273	1.000000	0.746853	0.026487	0.748273
gripForce	0.415636	-0.541788	0.746853	1.000000	-0.112577	0.576669
sit_bend	-0.249520	-0.071225	0.026487	-0.112577	1.000000	0.177153
situp	0.022758	-0.608912	0.748273	0.576669	0.177153	1.000000



BMI vs. Body Performance

```
BMI          1.000000
gripForce    0.415636
fat          0.288373
sit_bend     0.249520
jump         0.151664
situp        0.022758
Name: BMI, dtype: float64
```

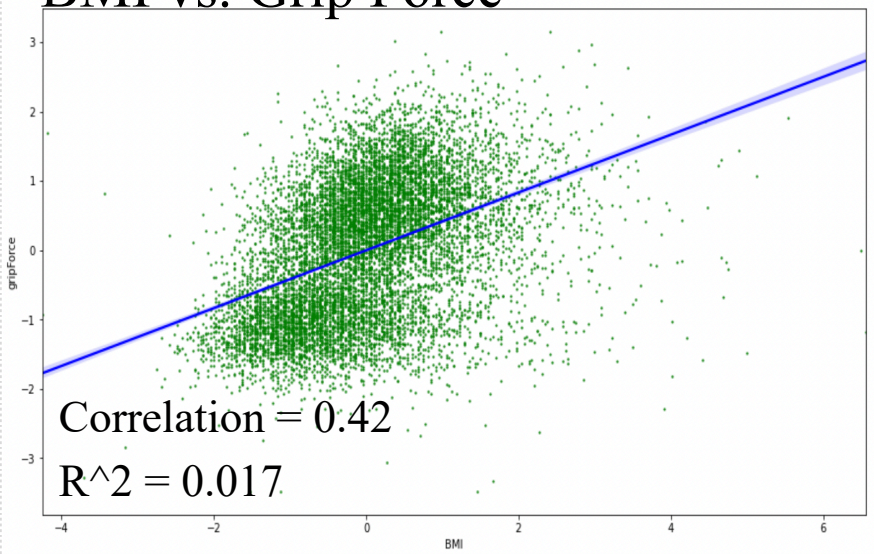
Body Fat % vs. Body Performance

```
fat          1.000000
jump         0.673273
situp        0.608912
gripForce    0.541788
BMI          0.288373
sit_bend     0.071225
Name: fat, dtype: float64
```

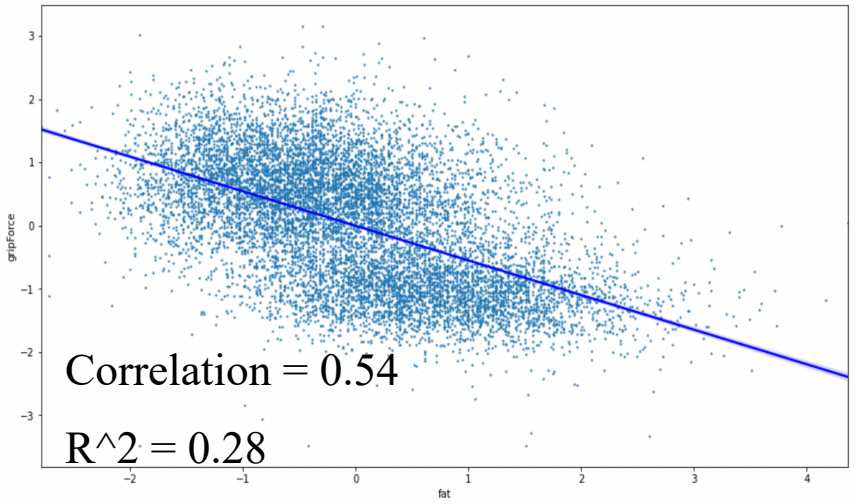
2. Physical Condition affects on body performance

Linear Regression

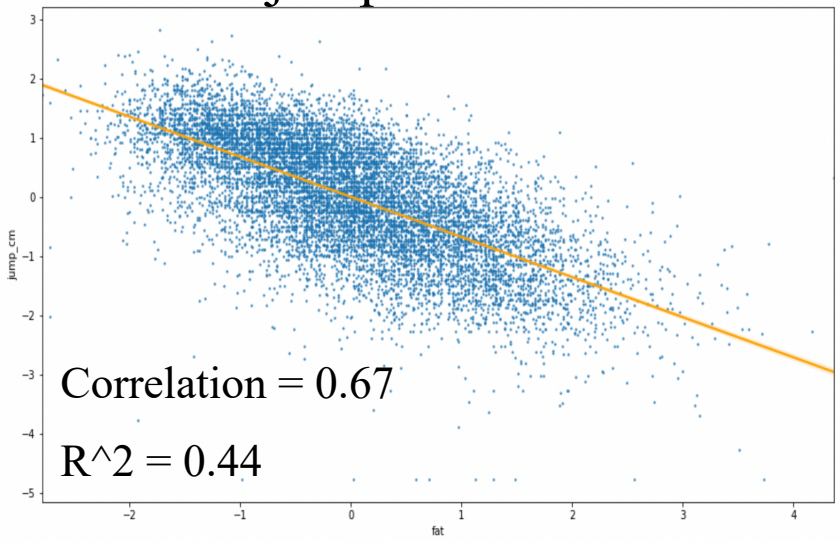
BMI vs. Grip Force



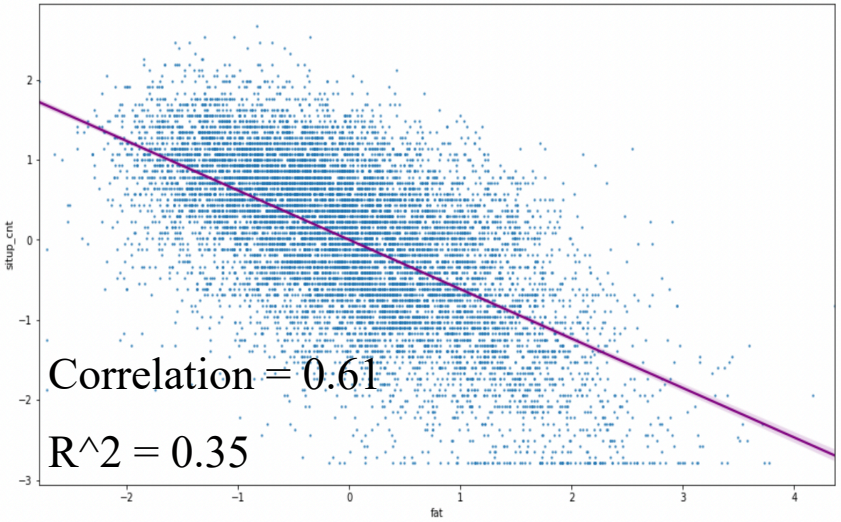
Fat % vs. Grip Force



Fat % vs. jump



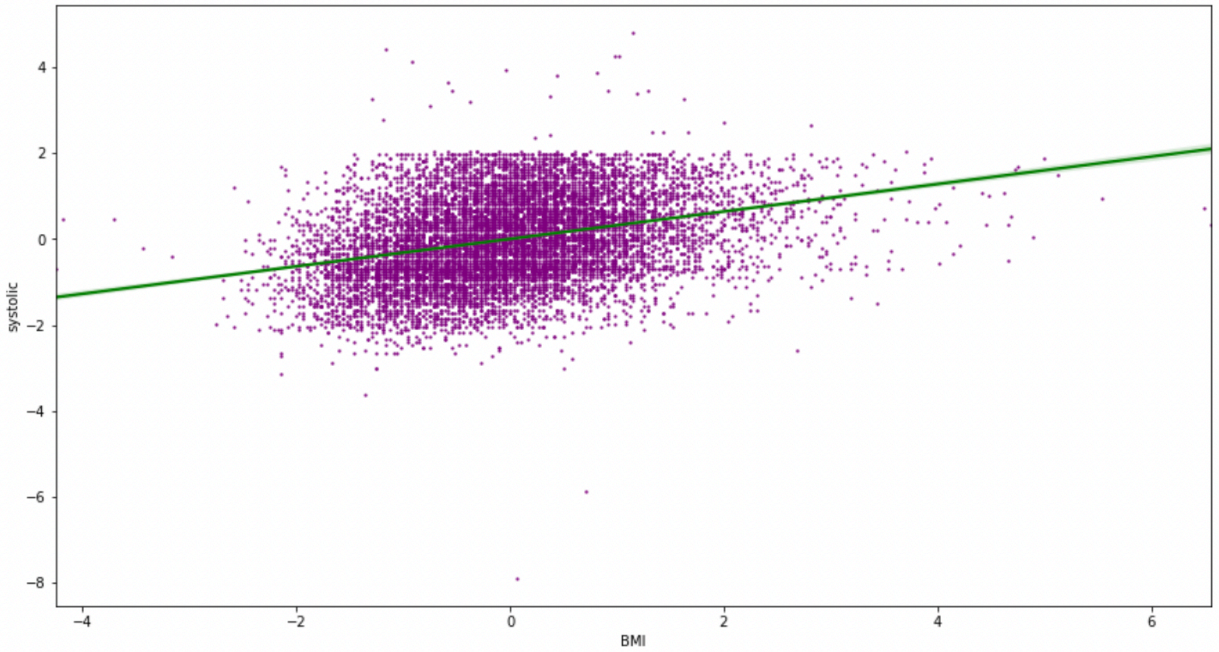
Fat % vs. Sit Up



3. BMI is positively related to SBP and DBP

Linear Regression & Correlation
Blood Pressure vs. BMI

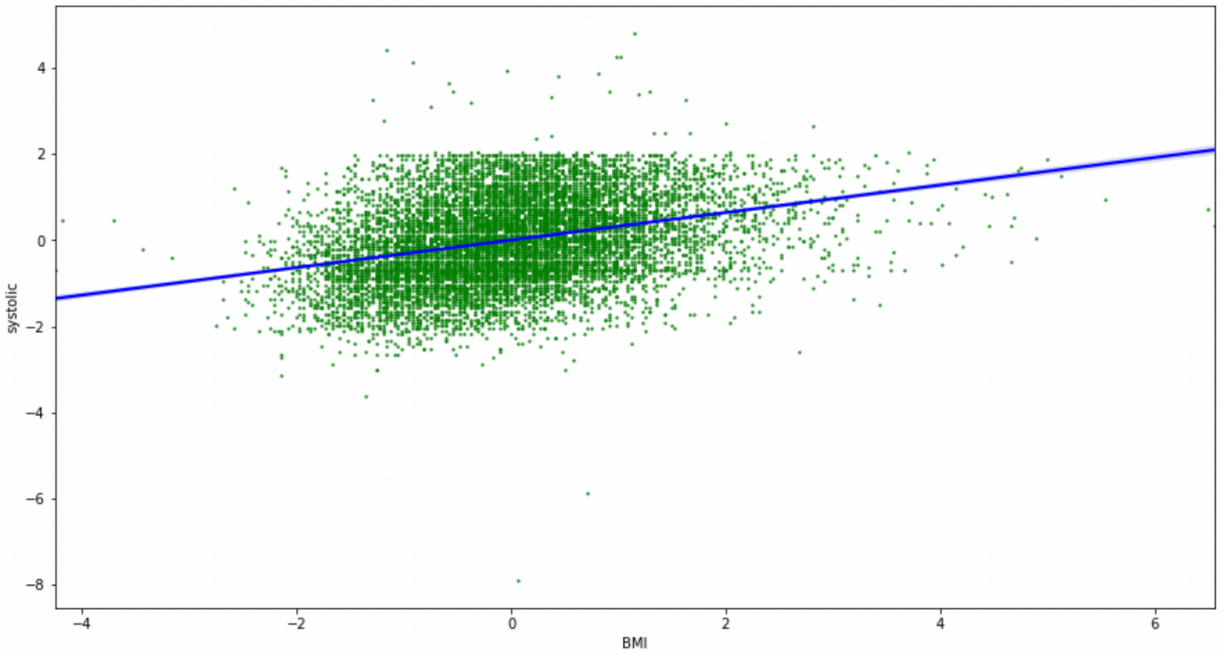
x = **systolic** blood pressure, y = BMI



Correlation = 0.32

R^2 = 0.11

x = **diastolic** blood pressure, y = BMI



Correlation = 0.26

R^2 = 0.075

Conclusion

- Predict the Body Performance based on the observed data
  - → PCA results; CLASS(A,B,C,D) are not distinctive
  - → KNN model accuracy; 63% accuracy

- Predict Body Performance Ability based on Physical Condition
  - → Correlation; up to 67%
  - → Linear Regression Model; Coefficient of Determination: < 0.50
- Predict the blood pressure level based on BMI level
  - → Correlation; up to 32%
  - → Linear Regression Model; Coefficient of Determination : 0.11
  - → Would be better if I used another algorithm to predict

KSPF needs to upgrade their Class Determining system, since neither the classes are distinctive, nor the standard of classification is explicit.

Software & Relevant ToolBox

- **Jupiter Notebook**
  - Python

- **Library Used**
  - Numpy, Pandas
  - Plotly
  - Sklearn

References

- https://www.kaggle.com/datasets/kukuroo3/body-performance-data

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