#### In [156]:

```
#Reading file
#Descriptive Statistics
# Part 1: presenting data set
import numpy as np
import pandas as pd
from subprocess import check_output
import matplotlib.pyplot as plt
import statsmodels.api as sm
from statsmodels.formula.api import ols
from statsmodels.graphics.factorplots import interaction_plot
from statsmodels.stats.anova import anova_lm
sales=pd.read_csv('/Users/sam/Desktop/MSBA 305/Term_paper/Sales_TransactionsWeek
ly_2.csv')
sales.describe()
```

#### Out[156]:

	WO	W1	W2	W3	W4	W5	
count	811.000000	811.000000	811.000000	811.000000	811.000000	811.000000	811.0
mean	8.902589	9.129470	9.389642	9.717633	9.574599	9.466091	9.720
std	12.067163	12.564766	13.045073	13.553294	13.095765	12.823195	13.34
min	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000
25%	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000
50%	3.000000	3.000000	3.000000	4.000000	4.000000	3.000000	4.000
75%	12.000000	12.000000	12.000000	13.000000	13.000000	12.500000	13.00
max	54.000000	53.000000	56.000000	59.000000	61.000000	52.000000	56.00

8 rows × 52 columns

#### In [157]:

```
#Grouping the data by Product_Code and the mean sales_mean=sales.groupby('Product_Code').mean() print(sales_mean)
```

	WO	W1	W2	W3	W4	W5	W6	W7	W8	W9	W42	W43
W44 W45 \												
Product_Code										• • •		
P1	11	12	10	8	13	12	14	21	6	14	4	7
8 10												
P10	22	19	19	29	20	16	26	20	24	20	14	17
11 24												
P100	13	6	7	9	9	15	13	6	7	10	10	16

11	8												
P101		26	51	45	47	40	36	38	28	38	45	33	45
29	36												
P102		34	41	22	32	36	27	44	33	22	38	36	35
27	24	_	_	_	_				_				_
P103	_	7	5	7	7	14	9	10	6	12	13	11	5
4 D104	6	4	4	-	5	2	7	_	_	-	7	2	_
P104 1	6	4	4	5	5	3	7	5	6	5	7	2	5
P105	U	2	3	3	2	5	4	5	7	5	3	3	2
6	3	2	3	J		3	-	3	,	3	3	3	2
P106		11	10	11	16	16	7	11	6	16	15	8	7
9	7												
P107		19	19	15	24	16	23	27	20	19	17	13	17
11	16												
P108		0	2	2	0	3	1	2	1	6	3	5	7
1	2												
P109	_	9	8	8	5	13	9	13	7	9	14	7	5
10	5	1.5	-	1 -	1 4	1.7	-	1.0	1.6		0		1.6
P11	1 1	15	7	15	14	17	7	10	16	11	8	11	16
12 P110	11	9	12	12	6	15	10	9	10	10	9	11	5
6	8	9	12	12	O	13	10	9	10	10	9	T T	5
P111	U	5	4	7	4	4	5	4	4	2	6	6	8
8	2	J	-	•	-	-	J	-	-	_	0 111	J	J
P112		31	36	32	51	39	33	35	46	57	34	40	28
46	36												
P113		22	26	31	37	32	25	28	33	40	27	37	28
27	34												
P114		7	6	7	8	10	12	7	10	11	14	8	5
11	10								_				_
P115	1 1	9	9	12	13	14	13	10	6	10	11	12	7
10 P116	14	13	7	8	8	7	12	9	11	11	9	10	8
4	7	13	,	0	0	,	12	9	11	11	9	10	0
P117	,	6	2	3	3	3	2	5	2	4	4	7	6
8	2	J	_				_	J	_	-	1	•	J
P118		16	13	10	10	16	15	9	5	13	13	5	7
6	8												
P119		30	40	46	33	28	41	34	33	44	49	26	24
43	38												
P12	_	3	4	1	6	4	3	7	3	5	3	4	2
4	5	2.7	2.5	0.7	2.0	2.1	4.0	2.0	27	2.7	2.0	0.7	4.6
P120	26	37	35	27	30	31	42	30	37	37	39	27	46
34 P121	26	7	10	8	10	11	10	9	9	11	7	4	12
6	4	,	10	0	10	11	10	9	9	11	/ • • •	4	12
P122	•	7	10	7	8	11	2	9	7	12	17	12	6
11	14	,		•	J		_		•	- <b>-</b>	_, , , ,	- <b>-</b>	J
P123		5	5	3	6	4	6	4	7	4	2	4	3
2	5												
P124		4	6	0	7	4	3	5	4	2	7	4	11
2	3												

P125	6	9	5	10	6	9	10	8	15	14	• • •	9	6
7 10													
• • • • • •	• •	• •	• •	• •	• •	• •	• •	• •	• •	• •	• • •	• • •	• • •
P81	14	6	13	5	8	13	7	5	7	4	• • •	6	6
12 11	0	0	1	0	0	0	0	0	0	0		1	1
P810 1 0	0	0	1	0	0	0	0	0	0	U	• • •	1	1
P811	5	1	3	5	4	4	4	2	2	3		0	4
4 5	2	2	0	0	•	1	0	•	2	2		0	1
P812 3 1	3	2	0	0	2	1	0	2	2	2	• • •	0	1
P813	1	1	1	3	2	2	5	5	1	3		0	5
2 1				_			_					_	_
P814 3 4	4	2	2	6	0	4	7	8	3	2	• • •	6	7
P815	0	0	1	0	0	2	1	0	0	1		0	1
1 0													
P816 4 2	0	1	0	0	1	2	2	6	0	1	• • •	3	3
P817	1	0	0	0	1	1	2	1	1	0		2	0
0 2													
P818 0 1	0	0	0	1	0	0	0	0	1	0	• • •	0	0
0 1 P819	0	1	0	0	0	0	0	0	0	0		0	0
0 0													
P82	10	12	17	13	14	8	7	10	4	7	• • •	7	7
7 7 P83	46	40	34	38	36	45	48	37	63	37		31	32
42 36	10	10	01			13	10	0 ,		0,		01	02
P84	29	26	31	39	28	44	32	42	41	42	• • •	25	23
37 37 P85	39	34	28	38	33	37	52	28	31	27		14	29
20 25	3,5	31	20	30	33	3 /	32	20	31	2,	•••	- 1	2,
P86	37	33	33	32	36	26	45	37	43	36	• • •	31	32
37 35 P87	30	38	35	39	37	42	40	35	40	<b>Δ</b> 1	• • •	31	25
23 27	30	30	33	3,7	3 /	12	40	33	40	41	• • •	31	23
P88	41	28	32	30	33	41	42	35	45	38	• • •	21	34
30 36 P89	24	26	44	31	37	37	38	30	35	/l Q		30	32
25 38	24	20	77	31	57	57	30	30	33	<b>4</b> 7	• • •	30	32
P9	14	9	10	7	11	15	12	7	13	12	• • •	11	5
13 3 P90	42	34	40	39	47	31	43	40	47	25	• • •	33	29
25 30	42	34	40	39	4 /	31	43	40	4 /	33	• • •	33	29
P91	10	11	7	13	5	9	16	10	9	6	• • •	7	8
8 12	26	2.6	<b>5</b> C	4.0	2.1	4.4	27	4.0	2.0	4.2		4.0	2.6
P92 32 40	26	36	56	40	31	44	37	40	38	43	• • •	42	26
P93	11	9	10	13	5	11	1	11	12	9		4	7
4 10	1 1	^	1 ^	^	_	1 1	_	_	_	^		1.0	1.0
P94	14 	9	10	9	5	11	6	6	6	9	• • •	10	10

11 7											
P95	12	15	15 1	3 17	12	9	9	11	12	• • •	9
9 10											
P96	31	35	36 4	4 36	38	36	39	47	39		30
32 28											
P97	29	37	36 4	0 33	29	27	49	38	43		35
24 30											
P98	4	2	4	4 7	2	3	4	4	4		6
5 4	-	2	4	<b>T</b> /	2	3	4	7	7	• • •	O
P99	16	11	9 2	1 9	5	12	15	11	9		6
	10	11	9 2	1 9	5	12	13	11	9	• • •	O
11 8											
	4 -	4 7	4.0	4.0			_				
	W46	W47	W48	W49	W50	₩5	1				
Product_Code											
P1	12	3	7	6	5	1	0				
P10	13	16	18	23	18	2	0				
P100	17	16	8	10	23	2	1				
P101	41	33	34	37	21	1	5				
P102	22	19			31		9				
P103	6	2			13		6				
P104	3	3			5		4				
P105	2	3			4		4				
P106	8	9			14	2	1				
P107	16	13			26		0				
P108	3	3			1		4				
P109	9	13			10		0				
P11	13	8			10	2	1				
P110	6	11			7		7				
P111	1	6	2	3	3		9				
P112	32	22	28	24	29	3	5				
P113	41	39	28	32	40	1	6				
P114	7	7	9	7	10		8				
P115	12	12	15	7	6	1	0				
P116	15	10	13	12	10		2				
P117	3	5			5		2				
P118	6	12			10		0				
P119	35	35			33		9				
P12	1	3			6		3				
P120	27				29		2				
P121	11	10			6		2				
P122	13	6			1		2				
P123	4	5			3		4				
P124	8	3			9		4				
P125	6	8	7	18	3		6				
• • •	• • •	• • •	• • •	• • •	• • •	• •	•				
P81	6	3	3	13	12	1	2				
D010	Λ	1	0	0	Λ		1				

P810

P811

P812

P813

P814

P815

P816

P817	2	0	0	0	4	3
P818	1	0	0	0	2	0
P819	0	0	0	0	0	1
P82	10	12	15	7	8	7
P83	34	31	31	26	26	33
P84	42	32	31	36	34	21
P85	36	46	34	36	31	16
P86	33	31	29	33	29	25
P87	36	24	40	23	20	24
P88	23	29	30	28	23	24
P89	25	29	28	28	12	28
P9	7	7	10	12	7	13
P90	40	37	36	29	27	18
P91	7	9	4	7	6	9
P92	40	29	34	30	30	19
P93	6	5	6	4	10	10
P94	10	11	9	10	6	9
P95	7	15	13	9	11	14
P96	30	41	40	39	38	21
P97	23	36	33	32	26	25
P98	7	2	5	4	5	5
P99	8	8	10	7	9	11

[811 rows x 52 columns]

# In [158]:

# Making DataFrames
sales\_df=pd.DataFrame(sales\_mean)
print(sales\_df)

	WO	W1	W2	W3	W4	<b>W</b> 5	W6	w7	W8	w9	W42	W43
W44 W45 \												
Product_Code										• • •		
P1	11	12	10	8	13	12	14	21	6	14	4	7
8 10												
P10	22	19	19	29	20	16	26	20	24	20	14	17
11 24												
P100	13	6	7	9	9	15	13	6	7	10	10	16
11 8												
P101	26	51	45	47	40	36	38	28	38	45	33	45
29 36												
P102	34	41	22	32	36	27	44	33	22	38	36	35
27 24												
P103	7	5	7	7	14	9	10	6	12	13	11	5
4 6												
P104	4	4	5	5	3	7	5	6	5	7	2	5
1 6												
P105	2	3	3	2	5	4	5	7	5	3	3	2
6 3												
P106	11	10	11	16	16	7	11	6	16	15	8	7
9 7												
P107	19	19	15	24	16	23	27	20	19	17	13	17
11 16												

P108	0	2	2	0	3	1	2	1	6	3		5	7
1 2		_	_	_				_				_	_
P109	9	8	8	5	13	9	13	7	9	14	• • •	7	5
10 5 P11	15	7	15	14	17	7	10	16	11	8		11	16
12 11	13	,	13		Ξ,	,	10	10		Ü	• • •		10
P110	9	12	12	6	15	10	9	10	10	9		11	5
6 8	_												
P111	5	4	7	4	4	5	4	4	2	6	• • •	6	8
8 2 P112	31	36	32	51	39	33	35	46	57	34		40	28
46 36	01	•	02	31			•	10	3,	0 1		10	20
P113	22	26	31	37	32	25	28	33	40	27		37	28
27 34	_	_	_	_			_					_	_
P114 11 10	7	6	7	8	10	12	7	10	11	14	• • •	8	5
P115	9	9	12	13	14	13	10	6	10	11		12	7
10 14								Ū					•
P116	13	7	8	8	7	12	9	11	11	9		10	8
4 7												_	
P117 8 2	6	2	3	3	3	2	5	2	4	4	• • •	7	6
8 2 P118	16	13	10	10	16	15	9	5	13	13		5	7
6 8	10	10	-0		10	13		J	10	10		3	,
P119	30	40	46	33	28	41	34	33	44	49		26	24
43 38													
P12	3	4	1	6	4	3	7	3	5	3	• • •	4	2
4 5 P120	37	35	27	30	31	42	30	37	37	39		27	46
34 26	37	33	2,	30	31		30	3,	3 /		• • •	2,	10
P121	7	10	8	10	11	10	9	9	11	7		4	12
6 4	_		_	_				_					_
P122 11 14	7	10	7	8	11	2	9	7	12	17	• • •	12	6
P123	5	5	3	6	4	6	4	7	4	2		4	3
2 5	_				_	_	_	•	_	_		_	_
P124	4	6	0	7	4	3	5	4	2	7		4	11
2 3	_		_		_								_
P125 7 10	6	9	5	10	6	9	10	8	15	14	• • •	9	6
•••													
• • • • •													
P81	14	6	13	5	8	13	7	5	7	4	• • •	6	6
12 11	0	0	1	0	0	0	0	0	0	0		1	1
P810 1 0	0	0	1	0	0	0	0	0	0	U	• • •	1	1
P811	5	1	3	5	4	4	4	2	2	3		0	4
4 5													
P812	3	2	0	0	2	1	0	2	2	2	• • •	0	1
3 1	1	1	1	2	2	2	_	5	1	<b>.</b>		0	E
P813 2 1	1	1	1	3	2	2	5	Э	1	3	• • •	0	5
P814	4	2	2	6	0	4	7	8	3	2		6	7

3 4												
P815	0	0	1	0	0	2	1	0	0	1	0	1
1 0 P816	0	1	0	0	1	2	2	6	0	1	3	3
4 2	U	1	U	U	1	2	2	O	U	1 •••	3	3
P817	1	0	0	0	1	1	2	1	1	0	2	0
0 2												
P818	0	0	0	1	0	0	0	0	1	0	0	0
0 1 P819	0	1	0	0	0	0	0	0	0	0	0	0
0 0	O	_	J	Ū	J	O	O	J	J	• • • •	Ū	J
P82	10	12	17	13	14	8	7	10	4	7	7	7
7 7												
P83	46	40	34	38	36	45	48	37	63	37	31	32
42 36 P84	29	26	31	39	28	44	32	42	41	42	25	23
37 37	2,5	20	31	<b>J</b>	20		32	12		12	23	23
P85	39	34	28	38	33	37	52	28	31	27	14	29
20 25								- <del>-</del>				
P86 37 35	37	33	33	32	36	26	45	37	43	36	31	32
P87	30	38	35	39	37	42	40	35	40	41	31	25
23 27												
P88	41	28	32	30	33	41	42	35	45	38	21	34
30 36	0.4	0.6	4.4	2.1	2.7	2.7	2.0	2.0	2.5	4.0	2.0	2.0
P89 25 38	24	26	44	31	37	37	38	30	35	49	30	32
P9	14	9	10	7	11	15	12	7	13	12	11	5
13 3												
P90	42	34	40	39	47	31	43	40	47	35	33	29
25 30 P91	10	11	7	13	5	9	16	10	9	6	7	8
8 12	10	11	,	13	J	9	10	10	9	0	,	0
P92	26	36	56	40	31	44	37	40	38	43	42	26
32 40												
P93	11	9	10	13	5	11	1	11	12	9	4	7
4 10 P94	14	9	10	9	5	11	6	6	6	9	10	10
11 7	14	,	10	,	3	11	O	O	J	J •••	10	10
P95	12	15	15	13	17	12	9	9	11	12	9	14
9 10												
P96	31	35	36	44	36	38	36	39	47	39	30	35
32 28 P97	29	37	36	40	33	29	27	49	38	43	35	30
24 30	2,5	3,	30	10	33	23	2,	10	30	13	33	30
P98	4	2	4	4	7	2	3	4	4	4	6	2
5 4						_					_	_
P99	16	11	9	21	9	5	12	15	11	9	6	8
11 8												
	W46	W4	7 W	48	W49	W50	W5	1				
Product_Code												
P1	12		3	7	6	5	1	.0				

P10	13	16	18	23	18	20
P100	17	16	8	10	23	21
P101	41	33	34	37	21	15
P102	22	19	32	26	31	29
P103	6	2	9	10	13	6
P104	3	3	3	5	5	4
P105	2	3	6	1	4	4
P106	8	9	8	13	14	21
P107	16	13	14	20	26	20
P108	3	3	3	4	1	4
P109	9	13	13	10	10	10
P11	13	8	17	10	10	21
P110	6	11	10	7	7	7
P111	1	6	2	3	3	9
P112	32	22	28	24	29	35
P113	41	39	28	32	40	16
P114	7	7	9	7	10	8
P115	12	12	15	7	6	10
P116	15	10	13	12	10	12
P117	3	5	3	4	5	2
P118	6	12	8	4	10	10
P119	35	35	24	29	33	19
P12	1	3	2	4	6	3
P120	27	38	37	27	29	32
P121	11	10	<i>57</i>	10	6	12
P122	13	6	9	1	1	12
			3	2	3	4
DIJI						
P123	4	5				
P124	8	3	2	2	9	4
P124 P125	8 6	3 8 •••	2 7	2 18	9 3	4 6
P124 P125  P81	8 6  6	3 8 	2 7 	2 18  13	9 3  12	4 6  12
P124 P125  P81 P810	8 6  6 0	3 8  3 1	2 7  3 0	2 18  13 0	9 3  12 0	4 6  12 1
P124 P125  P81 P810 P811	8 6  6 0 6	3 8  3 1 3	2 7  3 0 4	2 18  13 0 5	9 3  12 0 3	4 6  12 1 5
P124 P125  P81 P810 P811 P812	8 6  6 0 6 3	3 8  3 1 3 3	2 7  3 0 4 2	2 18  13 0 5 0	9 3  12 0 3 1	4 6  12 1 5 4
P124 P125  P81 P810 P811 P812 P813	8 6  6 0 6 3 1	3 8  3 1 3 3	2 7  3 0 4 2 3	2 18  13 0 5 0	9 3  12 0 3 1 4	4 6  12 1 5 4 4
P124 P125  P81 P810 P811 P812 P813 P814	8 6 0 6 3 1 4	3 8  3 1 3 1 8	2 7  3 0 4 2 3 4	2 18  13 0 5 0 1 16	9 3  12 0 3 1 4 7	4 6  12 1 5 4 4 11
P124 P125 P81 P810 P811 P812 P813 P814 P815	8 6 0 6 3 1 4 0	3 8  3 1 3 3 1 8 1	2 7  3 0 4 2 3 4 0	2 18  13 0 5 0 1 16 0	9 3  12 0 3 1 4 7 2	4 6 ••• 12 1 5 4 4 11
P124 P125 P81 P810 P811 P812 P813 P814 P815 P816	8 6 0 6 3 1 4 0 4	3 8  3 1 3 3 1 8 1 5	2 7  3 0 4 2 3 4 0 5	2 18  13 0 5 0 1 16 0 5	9 3  12 0 3 1 4 7 2 6	4 6  12 1 5 4 4 11 0 5
P124 P125 P81 P810 P811 P812 P813 P814 P815 P816 P817	8 6 0 6 3 1 4 0	3 8  3 1 3 3 1 8 1	2 7  3 0 4 2 3 4 0	2 18  13 0 5 0 1 16 0	9 3  12 0 3 1 4 7 2 6 4	4 6  12 1 5 4 4 11 0 5 3
P124 P125 P81 P810 P811 P812 P813 P814 P815 P816 P817 P818	8 6 0 6 3 1 4 0 4 2 1	3 8  3 1 3 3 1 8 1 5	2 7 3 0 4 2 3 4 0 5 0	2 18  13 0 5 0 1 16 0 5	9 3  12 0 3 1 4 7 2 6 4 2	4 6  12 1 5 4 4 11 0 5 3 0
P124 P125 P81 P810 P811 P812 P813 P814 P815 P816 P817 P818 P819	8 6 0 6 3 1 4 0 4 2 1 0	3 8  3 1 3 3 1 8 1 5 0 0	2 7 3 0 4 2 3 4 0 5 0 0	2 18  13 0 5 0 1 16 0 5 0	9 3  12 0 3 1 4 7 2 6 4	4 6  12 1 5 4 4 11 0 5 3
P124 P125 P81 P810 P811 P812 P813 P814 P815 P816 P817 P818 P819 P82	8 6 0 6 3 1 4 0 4 2 1 0	3 8  3 1 3 3 1 8 1 5 0 0 0	2 7  3 0 4 2 3 4 0 5 0 0 0	2 18  13 0 5 0 1 16 0 5 0 0 7	9 3  12 0 3 1 4 7 2 6 4 2 0 8	4 6  12 1 5 4 4 11 0 5 3 0 1 7
P124 P125 P81 P810 P811 P812 P813 P814 P815 P816 P817 P818 P819 P82 P83	8 6 0 6 0 6 3 1 4 0 4 2 1 0 10 34	3 8  3 1 3 3 1 8 1 5 0 0 0 12 31	2 7  3 0 4 2 3 4 0 5 0 0 0 15 31	2 18  13 0 5 0 1 16 0 5 0 0 7 26	9 3  12 0 3 1 4 7 2 6 4 2 0 8 26	4 6  12 1 5 4 4 11 0 5 3 0 1 7 33
P124 P125 P81 P810 P811 P812 P813 P814 P815 P816 P817 P818 P819 P82 P83 P84	8 6 0 6 3 1 4 0 4 2 1 0 10 34 42	3 8  3 1 3 3 1 8 1 5 0 0 0 12 31 32	2 7  3 0 4 2 3 4 0 5 0 0 0 0 15 31 31	2 18  13 0 5 0 1 16 0 5 0 0 7 26 36	9 3  12 0 3 1 4 7 2 6 4 2 0 8 26 34	4 6  12 1 5 4 4 11 0 5 3 0 1 7 33 21
P124 P125 P81 P810 P811 P812 P813 P814 P815 P816 P817 P818 P819 P82 P83 P84 P85	8 6 0 6 0 6 3 1 4 0 4 2 1 0 10 34 42 36	3 8  3 1 3 3 1 8 1 5 0 0 0 12 31 32 46	2 7  3 0 4 2 3 4 0 5 0 0 0 15 31 31 34	2 18  13 0 5 0 1 16 0 5 0 0 7 26 36 36	9 3  12 0 3 1 4 7 2 6 4 2 0 8 26 34 31	4 6  12 1 5 4 4 11 0 5 3 0 1 7 33 21 16
P124 P125 P81 P810 P811 P812 P813 P814 P815 P816 P817 P818 P819 P82 P83 P84 P85 P86	8 6 0 6 0 6 3 1 4 0 4 2 1 0 10 34 42 36 33	3 8  3 1 3 3 1 8 1 5 0 0 0 12 31 32	2 7  3 0 4 2 3 4 0 5 0 0 0 0 15 31 31	2 18  13 0 5 0 1 16 0 5 0 0 7 26 36	9 3  12 0 3 1 4 7 2 6 4 2 0 8 26 34	4 6  12 1 5 4 4 11 0 5 3 0 1 7 33 21
P124 P125 P81 P810 P811 P812 P813 P814 P815 P816 P817 P818 P819 P82 P83 P84 P85 P86 P87	8 6 0 6 0 6 3 1 4 0 4 2 1 0 10 34 42 36 33 36	3 8  3 1 3 3 1 8 1 5 0 0 0 12 31 32 46 31 24	2 7  3 0 4 2 3 4 0 5 0 0 0 0 15 31 31 34 29 40	2 18  13 0 5 0 1 16 0 5 0 0 7 26 36 36 33 23	9 3  12 0 3 1 4 7 2 6 4 2 0 8 26 34 31 29 20	4 6  12 1 5 4 4 11 0 5 3 0 1 7 33 21 16 25 24
P124 P125 P81 P810 P811 P812 P813 P814 P815 P816 P817 P818 P819 P82 P83 P84 P85 P86 P87 P88	8 6 0 6 0 6 3 1 4 0 4 2 1 0 10 34 42 36 33 36 23	3 8  3 1 3 1 8 1 5 0 0 0 12 31 32 46 31 24 29	2 7  3 0 4 2 3 4 0 5 0 0 0 15 31 31 34 29	2 18  13 0 5 0 1 16 0 5 0 0 7 26 36 36 33 23 28	9 3  12 0 3 1 4 7 2 6 4 2 0 8 26 34 31 29	4 6  12 1 5 4 4 11 0 5 3 0 1 7 33 21 16 25 24 24
P124 P125 P81 P810 P811 P812 P813 P814 P815 P816 P817 P818 P819 P82 P83 P84 P85 P86 P87 P88 P89	8 6 0 6 0 6 3 1 4 0 4 2 1 0 10 34 42 36 33 36	3 8  3 1 3 3 1 8 1 5 0 0 0 12 31 32 46 31 24	2 7  3 0 4 2 3 4 0 5 0 0 0 15 31 31 34 29 40 30	2 18  13 0 5 0 1 16 0 5 0 0 7 26 36 36 33 23	9 3 12 0 3 1 4 7 2 6 4 2 0 8 26 34 31 29 20 23	4 6  12 1 5 4 4 11 0 5 3 0 1 7 33 21 16 25 24
P124 P125 P81 P810 P811 P812 P813 P814 P815 P816 P817 P818 P819 P82 P83 P84 P85 P86 P87 P88	8 6 0 6 0 6 3 1 4 0 4 2 1 0 34 42 36 33 36 23 25	3 8  3 1 3 3 1 8 1 5 0 0 0 12 31 32 46 31 24 29 29	2 7  3 0 4 2 3 4 0 5 0 0 0 15 31 31 34 29 40 30 28	2 18  13 0 5 0 1 16 0 5 0 0 7 26 36 36 33 23 28 28 12	9 3 12 0 3 1 4 7 2 6 4 2 0 8 26 34 31 29 20 23 12	4 6  12 1 5 4 4 11 0 5 3 0 1 7 33 21 16 25 24 24 24 28 13
P124 P125 P81 P810 P811 P812 P813 P814 P815 P816 P817 P818 P819 P82 P83 P84 P85 P86 P87 P88 P89 P9	8 6 0 6 0 6 3 1 4 0 4 2 1 0 10 34 42 36 33 36 23 25 7	3 8  3 1 3 3 1 8 1 5 0 0 0 12 31 32 46 31 24 29 29 7	2 7  3 0 4 2 3 4 0 5 0 0 0 15 31 31 34 29 40 30 28 10	2 18  13 0 5 0 1 16 0 5 0 0 7 26 36 36 33 23 28 28	9 3 12 0 3 1 4 7 2 6 4 2 0 8 26 34 31 29 20 23 12 7	4 6  12 1 5 4 4 11 0 5 3 0 1 7 33 21 16 25 24 24 28
P124 P125 P81 P810 P811 P812 P813 P814 P815 P816 P817 P818 P819 P82 P83 P84 P85 P86 P87 P88 P89 P9	8 6 0 6 0 6 3 1 4 0 4 2 1 0 10 34 42 36 33 36 23 25 7 40	3 8  3 1 3 1 8 1 5 0 0 0 12 31 32 46 31 24 29 29 7 37	2 7  3 0 4 2 3 4 0 5 0 0 0 15 31 31 34 29 40 30 28 10 36 4	2 18  13 0 5 0 1 16 0 5 0 0 7 26 36 36 33 28 28 12 29	9 3 12 0 3 1 4 7 2 6 4 2 0 8 26 34 31 29 20 23 12 7 27 6	4 6  12 1 5 4 4 11 0 5 3 0 1 7 33 21 16 25 24 24 28 13 18

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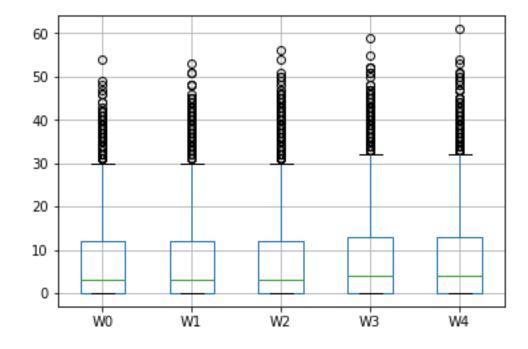
[811 rows x 52 columns]

# In [159]:

```
sales1=pd.read_csv('/Users/sam/Desktop/MSBA 305/Term_paper/Sales_TransactionsWee
kly_2_1.csv')
df = sales1.set_index('Product_Code')
df.boxplot()
```

# Out[159]:

<matplotlib.axes.\_subplots.AxesSubplot at 0x1c2af7f2e8>

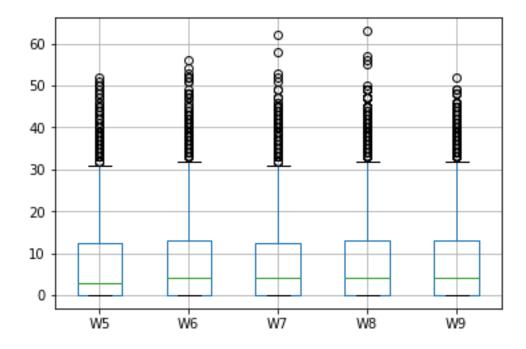


# In [160]:

```
sales2=pd.read_csv('/Users/sam/Desktop/MSBA 305/Term_paper/Sales_TransactionsWee
kly_2_2.csv')
df = sales2.set_index('Product_Code')
df.boxplot()
```

# Out[160]:

<matplotlib.axes.\_subplots.AxesSubplot at 0x1c28b5ac88>

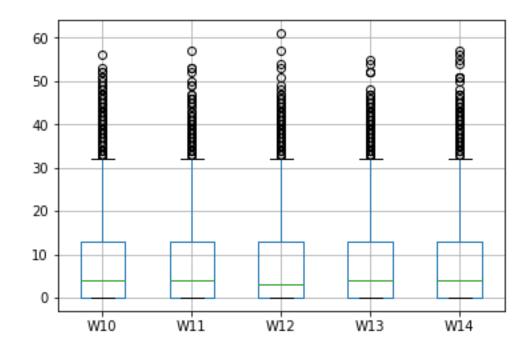


# In [161]:

```
sales3=pd.read_csv('/Users/sam/Desktop/MSBA 305/Term_paper/Sales_TransactionsWee
kly_2 _3.csv')
df = sales3.set_index('Product_Code')
df.boxplot()
```

#### Out[161]:

<matplotlib.axes. subplots.AxesSubplot at 0x1c289c9668>

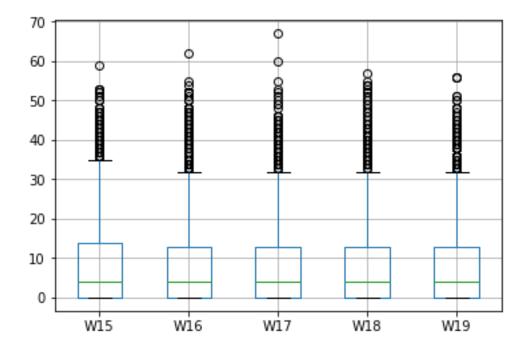


#### In [162]:

```
sales4=pd.read_csv('/Users/sam/Desktop/MSBA 305/Term_paper/Sales_TransactionsWee
kly_2_4.csv')
df = sales4.set_index('Product_Code')
df.boxplot()
```

#### Out[162]:

<matplotlib.axes. subplots.AxesSubplot at 0x1c2a07a748>

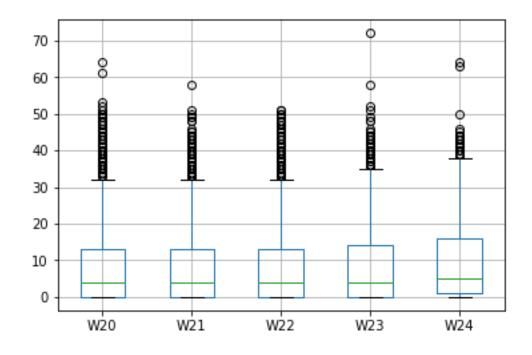


# In [163]:

```
sales5=pd.read_csv('/Users/sam/Desktop/MSBA 305/Term_paper/Sales_TransactionsWee
kly_2_5.csv')
df = sales5.set_index('Product_Code')
df.boxplot()
```

#### Out[163]:

<matplotlib.axes.\_subplots.AxesSubplot at 0x1c2ce32438>

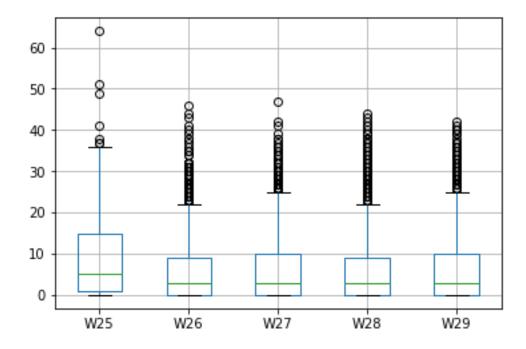


# In [164]:

```
sales6=pd.read_csv('/Users/sam/Desktop/MSBA 305/Term_paper/Sales_TransactionsWee
kly_2_6.csv')
df = sales6.set_index('Product_Code')
df.boxplot()
```

# Out[164]:

<matplotlib.axes.\_subplots.AxesSubplot at 0x1c2cd53b00>

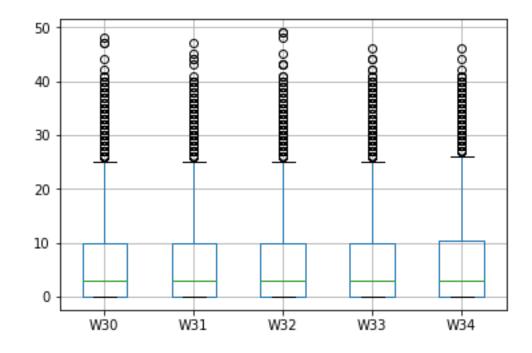


# In [165]:

```
sales7=pd.read_csv('/Users/sam/Desktop/MSBA 305/Term_paper/Sales_TransactionsWee
kly_2_7.csv')
df = sales7.set_index('Product_Code')
df.boxplot()
```

#### Out[165]:

<matplotlib.axes. subplots.AxesSubplot at 0x1c295c1b70>

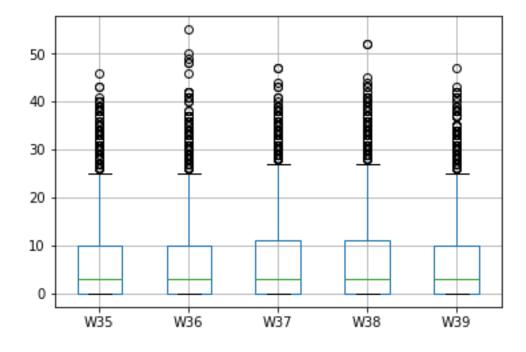


# In [166]:

```
sales8=pd.read_csv('/Users/sam/Desktop/MSBA 305/Term_paper/Sales_TransactionsWee
kly_2_8.csv')
df = sales8.set_index('Product_Code')
df.boxplot()
```

#### Out[166]:

<matplotlib.axes.\_subplots.AxesSubplot at 0x1c29dc53c8>

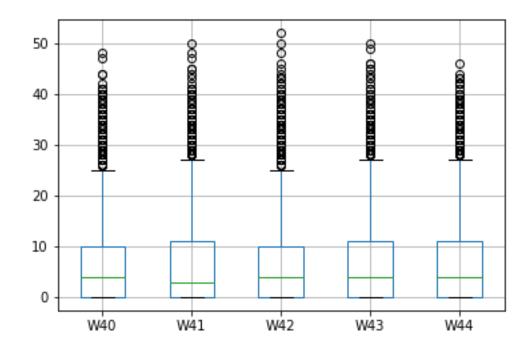


# In [167]:

```
sales9=pd.read_csv('/Users/sam/Desktop/MSBA 305/Term_paper/Sales_TransactionsWee
kly_2_9.csv')
df = sales9.set_index('Product_Code')
df.boxplot()
```

#### Out[167]:

<matplotlib.axes.\_subplots.AxesSubplot at 0x1c2b892438>

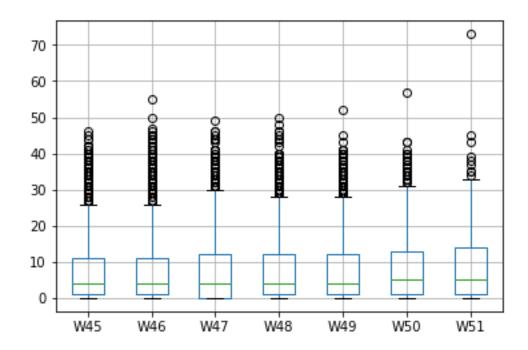


### In [168]:

```
sales10=pd.read_csv('/Users/sam/Desktop/MSBA 305/Term_paper/Sales_TransactionsWe
ekly_2_10.csv')
df = sales10.set_index('Product_Code')
df.boxplot()
```

# Out[168]:

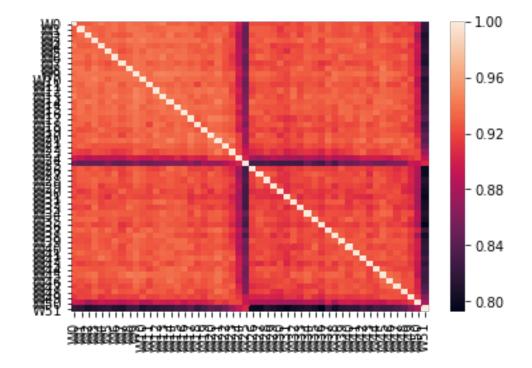
<matplotlib.axes.\_subplots.AxesSubplot at 0x1c2cfc2128>



### In [169]:

### Out[169]:

<matplotlib.axes.\_subplots.AxesSubplot at 0x1c2cf9edd8>



In [170]:

```
# represent correlation matrix using a heatmap
#Ref: https://stackoverflow.com/questions/39409866/correlation-heatmap
cmap = cmap=sns.diverging_palette(5, 250, as_cmap=True)
def magnify():
    return [dict(selector="th",
                 props=[("font-size", "7pt")]),
            dict(selector="td",
                 props=[('padding', "0em 0em")]),
            dict(selector="th:hover",
                 props=[("font-size", "12pt")]),
            dict(selector="tr:hover td:hover",
                 props=[('max-width', '200px'),
                        ('font-size', '12pt')])
]
corr.style.background gradient(cmap, axis=1)\
    .set properties(**{'max-width': '80px', 'font-size': '10pt'})\
    .set caption("Hover to magify")\
    .set precision(2)\
    .set table styles(magnify())
```

Out[170]:

# Hover to magify

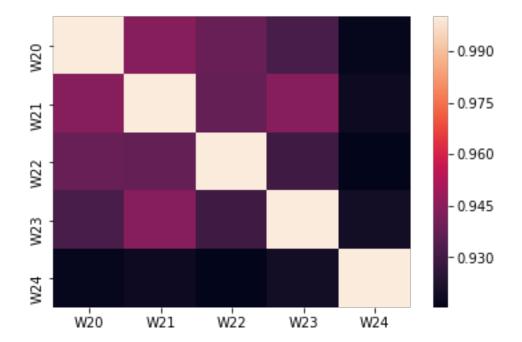
	wo	W1	W2	wз	W4	<b>W</b> 5	W6	W7	<b>W</b> 8	W9	W10	W11	W12	W13	W14	W15	W16	W17	W18	W19	W2
wo	1	0.93	0.93	0.93	0.94	0.93	0.94	0.93	0.94	0.94	0.94	0.93	0.94	0.95	0.93	0.93	0.93	0.93	0.93	0.93	0.9
W1	0.93	1	0.94	0.93	0.93	0.94	0.94	0.93	0.94	0.94	0.94	0.93	0.93	0.93	0.94	0.94	0.94	0.93	0.93	0.92	0.9
W2	0.93	0.94	1	0.94	0.93	0.94	0.93	0.93	0.93	0.94	0.94	0.94	0.93	0.93	0.94	0.93	0.93	0.94	0.92	0.92	0.9
W3	0.93	0.93	0.94	1	0.93	0.94	0.94	0.94	0.94	0.94	0.95	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.93	0.9
W4	0.94	0.93	0.93	0.93	1	0.93	0.93	0.93	0.93	0.94	0.94	0.93	0.93	0.93	0.93	0.93	0.94	0.93	0.93	0.94	0.9
<b>W</b> 5	0.93	0.94	0.94	0.94	0.93	1	0.94	0.92	0.93	0.94	0.93	0.94	0.94	0.94	0.94	0.94	0.94	0.93	0.93	0.93	0.9
W6	0.94	0.94	0.93	0.94	0.93	0.94	1	0.93	0.93	0.94	0.94	0.94	0.94	0.94	0.93	0.94	0.94	0.93	0.94	0.93	0.9
W7	0.93	0.93	0.93	0.94	0.93	0.92	0.93	1	0.93	0.94	0.94	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.92	0.9
<b>W</b> 8	0.94	0.94	0.93	0.94	0.93	0.93	0.93	0.93	1	0.94	0.94	0.94	0.93	0.94	0.93	0.94	0.94	0.93	0.94	0.92	0.9
W9	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	1	0.94	0.93	0.95	0.95	0.94	0.94	0.94	0.94	0.94	0.94	0.9
W10	0.94	0.94	0.94	0.95	0.94	0.93	0.94	0.94	0.94	0.94	1	0.94	0.94	0.94	0.94	0.93	0.94	0.94	0.93	0.93	0.9
W11	0.93	0.93	0.94	0.94	0.93	0.94	0.94	0.93	0.94	0.93	0.94	1	0.93	0.93	0.93	0.94	0.93	0.93	0.92	0.93	0.9
W12	0.94	0.93	0.93	0.94	0.93	0.94	0.94	0.93	0.93	0.95	0.94	0.93	1	0.94	0.93	0.94	0.93	0.94	0.94	0.94	0.9

W13	0.95	0.93	0.93	0.94	0.93	0.94	0.94	0.93	0.94	0.95	0.94	0.93	0.94	1	0.94	0.94	0.94	0.93	0.94	0.93	0.9
W14	0.93	0.94	0.94	0.94	0.93	0.94	0.93	0.93	0.93	0.94	0.94	0.93	0.93	0.94	1	0.93	0.94	0.93	0.93	0.93	0.9
W15	0.93	0.94	0.93	0.94	0.93	0.94	0.94	0.93	0.94	0.94	0.93	0.94	0.94	0.94	0.93	1	0.94	0.94	0.94	0.94	0.9
W16	0.93	0.94	0.93	0.94	0.94	0.94	0.94	0.93	0.94	0.94	0.94	0.93	0.93	0.94	0.94	0.94	1	0.93	0.93	0.93	0.9
W17	0.93	0.93	0.94	0.94	0.93	0.93	0.93	0.93	0.93	0.94	0.94	0.93	0.94	0.93	0.93	0.94	0.93	1	0.93	0.93	0.9
W18	0.93	0.93	0.92	0.94	0.93	0.93	0.94	0.93	0.94	0.94	0.93	0.92	0.94	0.94	0.93	0.94	0.93	0.93	1	0.93	0.9
W19	0.93	0.92	0.92	0.93	0.94	0.93	0.93	0.92	0.92	0.94	0.93	0.93	0.94	0.93	0.93	0.94	0.93	0.93	0.93	1	0.9
W20	0.92	0.93	0.93	0.93	0.93	0.93	0.93	0.92	0.93	0.93	0.93	0.93	0.94	0.93	0.93	0.94	0.93	0.94	0.94	0.93	1
W21	0.93	0.93	0.94	0.94	0.93	0.93	0.94	0.94	0.93	0.94	0.94	0.93	0.94	0.94	0.95	0.94	0.93	0.94	0.93	0.93	0.9
W22	0.93	0.93	0.93	0.92	0.93	0.93	0.93	0.92	0.92	0.93	0.93	0.93	0.94	0.93	0.93	0.93	0.93	0.94	0.93	0.93	0.9
W23	0.92	0.92	0.91	0.92	0.92	0.92	0.91	0.91	0.92	0.93	0.93	0.92	0.92	0.93	0.93	0.92	0.92	0.93	0.93	0.93	0.9
W24	0.9	0.89	0.88	0.89	0.89	0.89	0.89	0.89	0.9	0.9	0.89	0.89	0.9	0.9	0.9	0.91	0.89	0.91	0.9	0.9	0.9
W25	0.85	0.84	0.85	0.85	0.85	0.86	0.85	0.84	0.85	0.86	0.85	0.85	0.85	0.86	0.86	0.86	0.86	0.87	0.86	0.88	0.8
W26	0.92	0.93	0.92	0.93	0.92	0.92	0.92	0.92	0.93	0.93	0.93	0.92	0.92	0.92	0.94	0.93	0.93	0.92	0.92	0.92	0.9
W27	0.92	0.93	0.93	0.93	0.93	0.92	0.94	0.92	0.92	0.94	0.93	0.92	0.92	0.93	0.93	0.93	0.93	0.92	0.93	0.92	0.9
W28	0.92	0.93	0.93	0.93	0.93	0.93	0.93	0.92	0.93	0.94	0.93	0.92	0.93	0.92	0.93	0.92	0.92	0.93	0.93	0.92	0.9
W29	0.92	0.92	0.93	0.93	0.91	0.92	0.92	0.92	0.92	0.93	0.93	0.92	0.92	0.93	0.93	0.92	0.93	0.92	0.93	0.91	0.9
W30	0.92	0.91	0.92	0.93	0.92	0.92	0.92	0.93	0.92	0.92	0.92	0.92	0.93	0.92	0.92	0.92	0.92	0.91	0.93	0.92	0.9
W31	0.92	0.92	0.92	0.93	0.92	0.91	0.93	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.93	0.92	0.92	0.91	0.91	0.91	0.9
W32	0.92	0.93	0.93	0.93	0.92	0.93	0.92	0.92	0.93	0.93	0.93	0.93	0.94	0.94	0.93	0.93	0.93	0.91	0.92	0.92	0.9
W33	0.92	0.92	0.92	0.94	0.92	0.92	0.92	0.92	0.94	0.93	0.93	0.92	0.92	0.92	0.93	0.93	0.93	0.92	0.93	0.92	0.9
W34	0.93	0.92	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.92	0.93	0.93	0.94	0.93	0.93	0.93	0.92	0.93	0.92	0.9
W35	0.93	0.93	0.93	0.94	0.92	0.93	0.93	0.92	0.92	0.93	0.93	0.92	0.93	0.93	0.93	0.93	0.93	0.92	0.92	0.92	0.9
W36	0.92	0.92	0.93	0.92	0.92	0.92	0.93	0.91	0.92	0.93	0.92	0.92	0.93	0.93	0.93	0.93	0.93	0.92	0.92	0.92	0.9
W37	0.93	0.93	0.93	0.94	0.93	0.94	0.93	0.92	0.94	0.92	0.93	0.94	0.93	0.93	0.94	0.93	0.93	0.93	0.92	0.93	0.9
W38	0.93	0.92	0.92	0.93	0.93	0.93	0.92	0.93	0.93	0.94	0.94	0.93	0.94	0.93	0.93	0.92	0.92	0.92	0.92	0.91	0.9
W39	0.92	0.92	0.92	0.93	0.93	0.92	0.94	0.93	0.92	0.94	0.93	0.93	0.93	0.93	0.94	0.94	0.94	0.93	0.92	0.93	0.9
W40	0.93	0.93	0.92	0.94	0.93	0.93	0.93	0.92	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.92	0.92	0.9
W41	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.92	0.93	0.94	0.93	0.92	0.93	0.94	0.93	0.92	0.93	0.92	0.92	0.93	0.9
W42	0.92	0.93	0.93	0.93	0.94	0.93	0.93	0.92	0.93	0.94	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.94	0.93	0.94	0.9
W43	0.92	0.92	0.92	0.92	0.92	0.93	0.93	0.92	0.92	0.93	0.92	0.92	0.93	0.93	0.92	0.93	0.93	0.93	0.92	0.93	0.9
								_				_							_		

W44	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.92	0.93	0.93	0.92	0.93	0.93	0.94	0.93	0.94	0.92	0.92	0.93	0.9
W45	0.93	0.93	0.93	0.94	0.93	0.93	0.93	0.94	0.94	0.94	0.94	0.93	0.93	0.94	0.94	0.94	0.93	0.93	0.94	0.93	0.9
W46	0.93	0.92	0.93	0.93	0.92	0.92	0.92	0.93	0.93	0.94	0.93	0.92	0.93	0.93	0.94	0.93	0.93	0.92	0.93	0.92	0.9
W47	0.92	0.92	0.92	0.93	0.92	0.92	0.93	0.92	0.92	0.94	0.93	0.92	0.93	0.93	0.93	0.93	0.92	0.92	0.93	0.92	0.9
W48	0.92	0.92	0.92	0.93	0.93	0.92	0.93	0.93	0.93	0.93	0.92	0.93	0.93	0.93	0.92	0.93	0.92	0.93	0.92	0.92	0.9
W49	0.91	0.92	0.92	0.92	0.91	0.92	0.92	0.92	0.92	0.92	0.93	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.9
W50	0.9	0.9	0.87	0.89	0.9	0.89	0.89	0.89	0.89	0.9	0.89	0.89	0.9	0.9	0.9	0.9	0.89	0.9	0.9	0.9	0.9
W51	0.82	0.82	0.81	0.81	0.82	0.82	0.81	0.81	0.82	0.83	0.81	0.82	0.81	0.82	0.82	0.83	0.83	0.84	0.82	0.83	8.0

## In [171]:

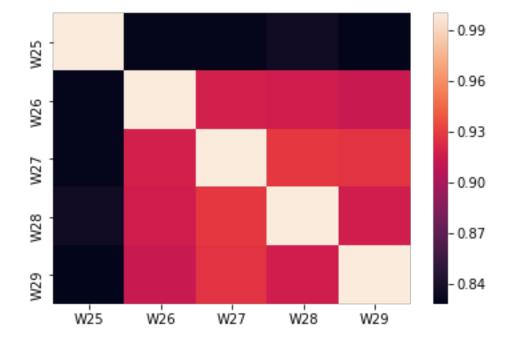
# Out[171]: <matplotlib.axes.\_subplots.AxesSubplot at 0x1c2f44bef0>



#### In [172]:

### Out[172]:

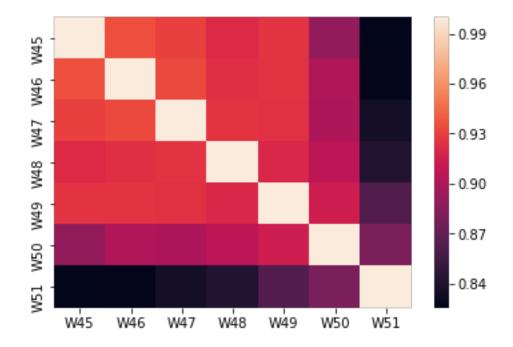
<matplotlib.axes.\_subplots.AxesSubplot at 0x1c2fe69828>



# In [173]:

#### Out[173]:

<matplotlib.axes. subplots.AxesSubplot at 0x1c2f5a3710>



#### In [174]:

EE=ols('W25~W0+W1+W2+W3+W4+W5+W6+W7+W8+W9+W10+W11+W12+W13+W14+W15+W16+W17+W18+W19+W20+W21+W22+W23+W24+W26+W27+W28+W29+W30+W31+W32+W33+W34+W35+W36+W37+W38+W39+W40+W41+W42+W43+W44+W45+W46+W47+W48+W49+W50+W51',data=sales).fit() table\_aov=sm.stats.anova\_lm(EE,typ=2) print (table\_aov)

	sum_sq	df	F	PR(>F)
WO	6.310168	1.0	0.596113	4.403052e-01
W1	51.968980	1.0	4.909440	2.700629e-02
W2	46.547358	1.0	4.397266	3.632693e-02
W3	3.719886	1.0	0.351413	5.534911e-01
W4	38.689844	1.0	3.654978	5.627817e-02
W5	53.303479	1.0	5.035508	2.512029e-02
W6	1.710073	1.0	0.161548	6.878481e-01
W7	10.368295	1.0	0.979479	3.226429e-01
W8	6.793122	1.0	0.641737	4.233332e-01
W9	54.335617	1.0	5.133013	2.375589e-02
W10	3.217965	1.0	0.303997	5.815498e-01
W6 W7 W8 W9	1.710073 10.368295 6.793122 54.335617	1.0 1.0 1.0	0.161548 0.979479 0.641737 5.133013	6.878481e-01 3.226429e-01 4.233332e-01 2.375589e-02

W11	33.657738	1.0	3.179601	7.496245e-02
W12	0.600620	1.0	0.056740	8.117895e-01
W13	8.693415	1.0	0.821255	3.651010e-01
W14	43.047918	1.0	4.066679	4.408891e-02
W15	8.066831	1.0	0.762063	3.829599e-01
W16	19.859386	1.0	1.876090	1.711843e-01
W17	1.050779	1.0	0.099266	7.527993e-01
W18	0.008272	1.0	0.000781	9.777064e-01
W19	283.901062	1.0	26.819753	2.863754e-07
W20	0.034059	1.0	0.003217	9.547809e-01
W21	2.881287	1.0	0.272191	6.020178e-01
W22	94.293174	1.0	8.907750	2.930797e-03
W23	85.396887	1.0	8.067329	4.627692e-03
W24	211.256548	1.0	19.957123	9.125264e-06
W26	36.228480	1.0	3.422456	6.470377e-02
W27	4.279678	1.0	0.404295	5.250709e-01
W28	21.303810	1.0	2.012542	1.564142e-01
W29	117.773592	1.0	11.125913	8.926835e-04
W30	26.863776	1.0	2.537785	1.115670e-01
W31	2.477310	1.0	0.234028	6.286925e-01
W32	89.497664	1.0	8.454724	3.747158e-03
W33	72.937287	1.0	6.890288	8.840906e-03
W34	0.477124	1.0	0.045073	8.319264e-01
W35	18.954798	1.0	1.790634	1.812496e-01
W36	10.459932	1.0	0.988136	3.205152e-01
W37	1.128848	1.0	0.106641	7.440915e-01
W38	36.154371	1.0	3.415455	6.497745e-02
W39	74.309770	1.0	7.019944	8.228381e-03
W40	3.492769	1.0	0.329957	5.658545e-01
W41	0.000254	1.0	0.000024	9.960945e-01
W42	2.651954	1.0	0.250527	6.168496e-01
W43	14.930653	1.0	1.410479	2.353485e-01
W44	34.302194	1.0	3.240482	7.223645e-02
W45	23.720487	1.0	2.240843	1.348234e-01
W46	0.891595	1.0	0.084228	7.717271e-01
W47	11.130165	1.0	1.051452	3.054996e-01
W48	14.341029	1.0	1.354778	2.448103e-01
W49	298.612073	1.0	28.209482	1.431565e-07
W50	63.673808	1.0	6.015179	1.440740e-02
W51	1477.774651	1.0	139.603390	1.085528e-29
Residual	8034.410644	759.0	NaN	NaN

#### In [175]:

```
sales=pd.read_csv('/Users/sam/Desktop/MSBA 305/Term_paper/Sales_Transactions_Dat
aset_Weekly.csv')
sales.describe()
```

#### Out[175]:

	W0	W1	W2	W3	W4	W5	
count	811.000000	811.000000	811.000000	811.000000	811.000000	811.000000	811.0
mean	8.902589	9.129470	9.389642	9.717633	9.574599	9.466091	9.720
std	12.067163	12.564766	13.045073	13.553294	13.095765	12.823195	13.34
min	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000
25%	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000
50%	3.000000	3.000000	3.000000	4.000000	4.000000	3.000000	4.000
75%	12.000000	12.000000	12.000000	13.000000	13.000000	12.500000	13.00
max	54.000000	53.000000	56.000000	59.000000	61.000000	52.000000	56.00

8 rows × 106 columns

#### In [176]:

```
# PCA: Principal component analysis (PCA) is a technique for redusing the data d imension by use of linear mapping so that the
```

# data variance in the low-dimensional map would be maximized.

# FastICA: FastICA is an efficient and popular algorithm for independent compone nt analysis. FastICA seeks an orthogonal

# rotation of prewhitened data, through a fixed-point iteration scheme, that maxi mizes a measure of non-Gaussianity

# of the rotated components.

# sparse PCA: Sparse principal component analysis (sparse PCA) is a specialised technique used in statistical analysis and,

# in particular, in the analysis of multivariate data sets. It extends the class ic method of PCA for the reduction

# of dimensionality of data by adding sparsity constraint on the input variables

# NMF or NNMF: Non-negative matrix factorization (NMF or NNMF), also non-negative matrix approximation is a group of algorithms

# in multivariate analysis and linear algebra where a matrix V is factorized int o (usually) two matrices W and H, with the

# property that all three matrices have no negative elements.

# LatentDirichletAllocation: is a generative statistical model that allows sets of observations to be explained by unobserved

# groups that explain why some parts of the data are similar.

# FactorAnalysis: aim to reduce the dimensionality of a set of data, but the app

```
# two techniques. Factor analysis is clearly designed with the objective to iden
tify certain unobservable factors from the
# observed variables, whereas PCA does not directly address this objectiveFactor
analysis is a statistical method used
# to describe variability among observed, correlated variables in terms of a pot
entially lower number of unobserved
# variables called factors. Factor analysis is related to principal component an
alysis (PCA), but the two are not identical.
# There has been significant controversy in the field over differences between t
he two techniques
# RandomProjection: In mathematics and statistics, random projection is a techni
que used to reduce the dimensionality
# of a set of points which lie in Euclidean space. Random projection methods are
powerful methods known for their simplicity
# and less erroneous output compared with other methods[citation needed]. Accord
ing to experimental results, random projection
# preserve distances well, but empirical results are sparse.
def dddraw(X reduced, name):
    import matplotlib.pyplot as plt
    from mpl toolkits.mplot3d import Axes3D
    # To getter a better understanding of interaction of the dimensions
    # plot the first three PCA dimensions
    fig = plt.figure(1, figsize=(8, 6))
    ax = Axes3D(fig, elev=-150, azim=110)
    ax.scatter(X reduced[:, 0], X reduced[:, 1], X reduced[:, 2], c=Y,cmap=plt.c
m.Paired)
    titel="First three directions of "+name
    ax.set title(titel)
    ax.set xlabel("1st eigenvector")
    ax.w_xaxis.set_ticklabels([])
    ax.set ylabel("2nd eigenvector")
    ax.w yaxis.set ticklabels([])
    ax.set zlabel("3rd eigenvector")
    ax.w zaxis.set ticklabels([])
    plt.show()
```

idaches taken to do so ale dillelent for the

# In [177]:

```
from sklearn.decomposition import PCA, FastICA,SparsePCA,NMF, LatentDirichletAll
ocation,FactorAnalysis
from sklearn.random_projection import GaussianRandomProjection,SparseRandomProje
ction
from sklearn.cluster import KMeans,Birch
import statsmodels.formula.api as sm
from scipy import linalg
from sklearn import preprocessing
from sklearn.preprocessing import MinMaxScaler,PolynomialFeatures
def rmsle(y_predicted, y_real):
    return np.sqrt(np.mean(np.power(np.log1p(y_predicted)-np.log1p(y_real), 2)))
def procenterror(y_predicted, y_real):
    return (np.mean(np.abs(y_predicted-y_real))/ np.mean(y_real) *100).round
()
```

```
n col=50
X = sales.drop(['Product Code','W25','Normalized 25'],axis=1)
def rmsle(y predicted, y real):
    return np.sqrt(np.mean(np.power(np.log1p(y_predicted)-np.log1p(y_real), 2)))
def procenterror(y_predicted, y_real):
     return np.round( np.mean(np.abs(y predicted-y real) )/ np.mean(y real) *100
,1)
Y=sales['W25']
X=X.fillna(value=0) #nasty NaN
#scaler = MinMaxScaler()
#scaler.fit(X)
#X=scaler.transform(X)
#poly = PolynomialFeatures(2)
#X=poly.fit transform(X)
names = [
         'PCA',
         'FastICA',
         'Gauss',
         'KMeans',
         'SparsePCA',
         'SparseRP',
         'Birch',
         'NMF',
       # 'LatentDietrich',
        ]
classifiers = [
    PCA(n components=n col),
    FastICA(n components=n col),
    GaussianRandomProjection(n components=3),
    KMeans(n_clusters=n_col),
    #SparsePCA(n components=n col),
    SparseRandomProjection(n components=n col, dense output=True),
    Birch(branching_factor=10, n_clusters=7, threshold=0.5),
    NMF(n components=n col),
  # LatentDirichletAllocation(n_topics=n_col),
]
correction= [1,1,0,0,0,0,0,0,0]
temp=zip(names,classifiers,correction)
print(temp)
for name, clf, correct in temp:
    Xr=clf.fit_transform(X,Y)
    dddraw(Xr, name)
    res = sm.OLS(Y,Xr).fit()
```

#print(res.predict(Xr).round()+correct) #show OLS prediction
#print('Ypredict',res.predict(Xr).round()+correct) #show OLS prediction

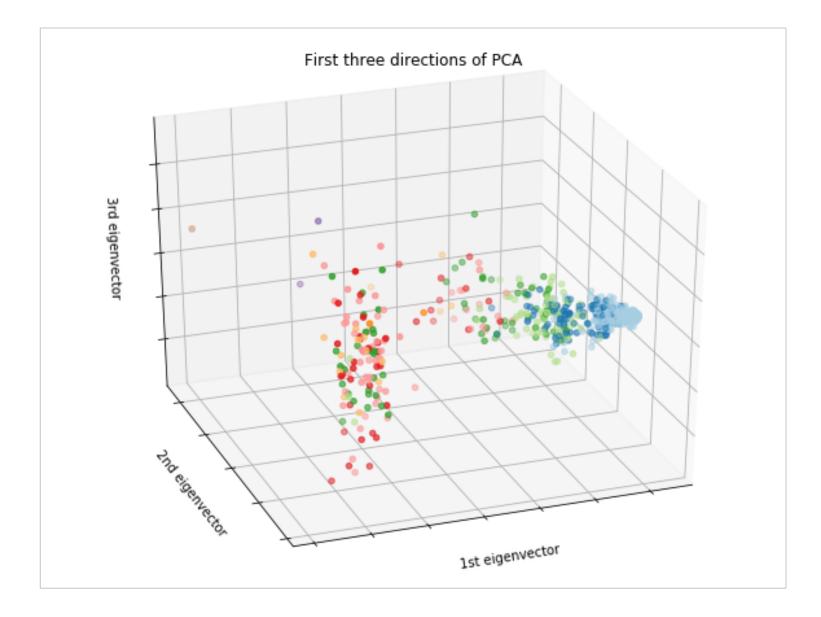
#print(res.summary()) # show OLS regression

print('Ypredict',res.predict(Xr).round()+correct\*Y.mean()) #show OLS predic
tion

print(name,'%error',procenterror(res.predict(Xr)+correct\*Y.mean(),Y),'rmsle'
,rmsle(res.predict(Xr)+correct\*Y.mean(),Y))

<zip object at 0x1c2d1254c8>

2503



Ypredict [ 8.89272503 1.89272503 5.89272503 8.89272503 11.8927250
3 5.89272503 7.89272503 12.89272503 22.89272503 13.89272503 1.8927
2503
 8.89272503 17.89272503 28.89272503 24.89272503 30.89272503 24.8927
2503
 21.89272503 8.89272503 6.89272503 4.89272503 2.89272503 21.8927
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 21.89272503 14.89272503 25.89272503 20.89272503 15.89272503 23.8927
2503
 4.89272503 4.89272503 10.89272503 25.89272503 24.89272503 26.8927
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2503
 31.89272503 21.89272503 21.89272503 23.89272503 26.89272503 27.8927

26.89272503	8.89272503	10.89272503	30.89272503	5.89272503	26.8927
2503					
	24.89272503	24.89272503	27.89272503	9.89272503	23.8927
2503	11 00070500	27 00272502	22 00272502	7 00272502	24 0027
22.892/2503	11.892/2503	27.89272503	23.892/2503	7.89272503	24.8927
25.89272503	0 00272502	22.89272503	24 00272502	8.89272503	20 0027
25.89272503	9.69272503	22.69272503	24.69272503	0.092/2503	30.6927
25.89272503	0 90272503	27.89272503	23 90272503	5.89272503	2/ 9927
25.03272303	J. 0 J Z 7 Z 3 0 3	27.07272303	23.07272303	3.07272303	24.0727
	23.89272503	11 89272503	4 89272503	30.89272503	30 8927
2503	23.07272303	11.07272303	4.07272303	30.07272303	30.0727
	23.89272503	21.89272503	22.89272503	25.89272503	18.8927
2503	23.07272303	21.07272303	22.07272303	23.07272303	10.0327
	24.89272503	8.89272503	9.89272503	13.89272503	28.8927
2503	21.09272303	0.03272303	J. 0 J Z 7 Z 3 0 3	13.03272303	20.0327
27.89272503	5.89272503	9.89272503	19.89272503	25.89272503	28.8927
2503	0,002,000	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			
7.89272503	4.89272503	2.89272503	14.89272503	16.89272503	3.8927
2503					
7.89272503	7.89272503	5.89272503	23.89272503	21.89272503	5.8927
2503					
6.89272503	11.89272503	3.89272503	9.89272503	22.89272503	28.8927
2503					
8.89272503	5.89272503	2.89272503	5.89272503	8.89272503	5.8927
2503					
2.89272503	20.89272503	22.89272503	21.89272503	23.89272503	27.8927
2503					
24.89272503	26.89272503	22.89272503	22.89272503	29.89272503	20.8927
2503					
29.89272503	23.89272503	21.89272503	29.89272503	24.89272503	11.8927
2503					
7.89272503	7.89272503	3.89272503	5.89272503	4.89272503	4.8927
2503					
	10.89272503	9.89272503	8.89272503	3.89272503	3.8927
2503					
6.89272503	4.89272503	5.89272503	7.89272503	4.89272503	9.8927
2503	0.00050500	6 00050500	11 00050500	05 00050500	05 0005
4.89272503	8.89272503	6.89272503	11.89272503	25.89272503	25.8927
2503	24 00272502	7 00072502	27 00272502	27 00272502	27 0027
25.89272503	24.89272503	7.89272503	27.89272503	27.89272503	27.8927
	22 00272502	28.89272503	21 00272502	25 00272502	22 0027
2503	23.09272303	20.09272303	31.092/2303	23.09272303	23.0921
	26 89272503	21.89272503	28 89272503	26 89272503	23 8927
2503	20.07272303	21.07272303	20.07272303	20.07272303	23.0727
	25.89272503	20.89272503	29.89272503	27.89272503	29.8927
2503		_0.00212000		_,.0,2,2500	
	28.89272503	3.89272503	23.89272503	7.89272503	14.8927
2503					. J
	24.89272503	4.89272503	20.89272503	5.89272503	1.8927
2503					- <del></del>
16.89272503	4.89272503	9.89272503	42.89272503	13.89272503	15.8927

2503					
11.89272503	0.89272503	0.89272503	0.89272503	0.89272503	0.8927
2503					
-0.10727497	0.89272503	0.89272503	-0.10727497	0.89272503	0.8927
2503					
0.89272503	0.89272503	0.89272503	0.89272503	0.89272503	-0.1072
7497					
	-0.10727497	0.89272503	-0.10727497	-0.10727497	0.8927
2503	0 10727407	0 00072502	0 00072502	0 00272502	1 0027
	-0.10727497	0.89272503	0.89272503	0.89272503	1.8927
2503 0.89272503	0 00272502	-0.10727497	0.89272503	0.89272503	0.8927
2503	0.69272503	-0.10/2/49/	0.89272303	0.89272303	0.6927
1.89272503	0 00272502	-0.10727497	0 00272502	-0.10727497	0.8927
2503	0.09272303	-0.10/2/49/	0.09272303	-0.10/2/49/	0.0327
-0.10727497	0.89272503	4.89272503	0.89272503	0.89272503	0.8927
2503	0.07272303	4.07272303	0.07272303	0.07272303	0.0727
0.89272503	0.89272503	23.89272503	50.89272503	26.89272503	9.8927
2503	0.03272303	23.03272303	30.03272303	20.09272303	3.0327
3.89272503	11.89272503	8.89272503	23.89272503	14.89272503	25.8927
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2503					

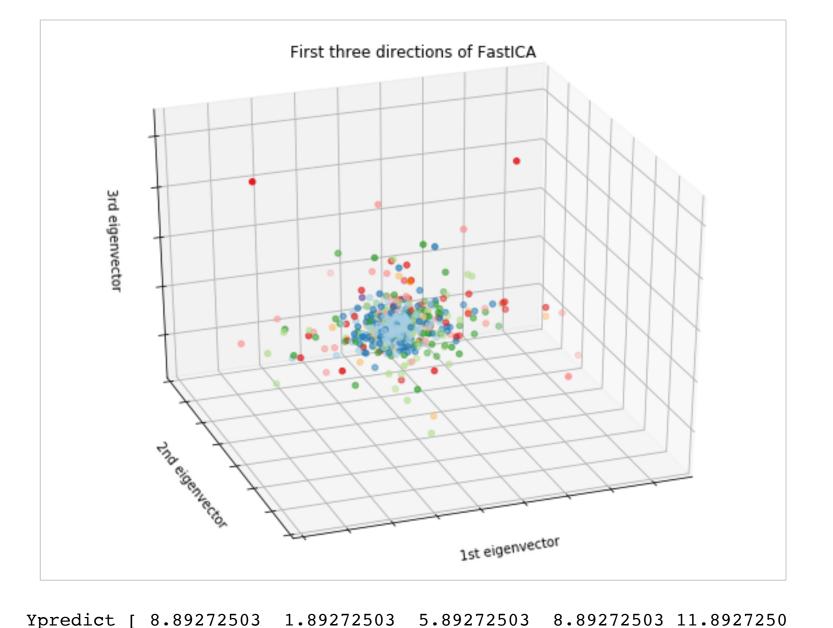
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7497					
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7497					
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	-0.10727497	0.89272503	0.89272503	0.89272503	1.8927
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0.89272503 7497	0.89272503	0.89272503	0.892/2503	-0.10727497	-0.10/2
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2503					
	-0.10727497	0.89272503	-0.10727497	1.89272503	-0.1072
7497					
7.89272503	4.89272503	4.89272503	3.89272503	5.89272503	8.8927
2503	2 00272502	2 00272502	2 00272502	12 00272502	15 0007
2.89272503 2503	2.89272503	3.89272503	3.072/2503	12.89272503	13.092/
19.89272503	24.89272503	7.89272503	2.89272503	19.89272503	12.8927
17.07212303	21.072/2303	, • 0 ) 2   2 3 0 3	2.072/2303	17.07212303	12.0721

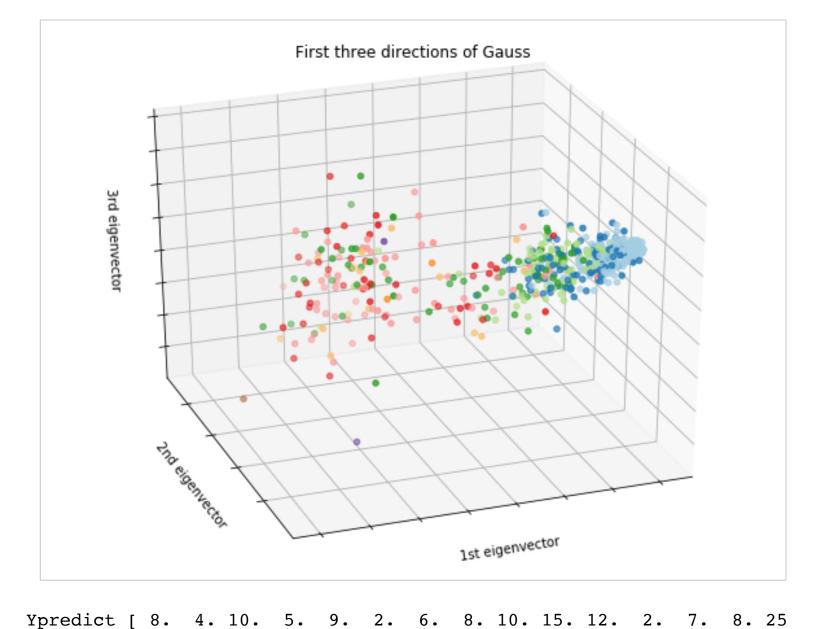
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2503					
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2503					
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2503					
	14.89272503	7.89272503	0.89272503	0.89272503	0.8927
2503					
	-0.10727497	0.89272503	0.89272503	0.89272503	0.8927
2503	1 00070502	0 00070502	1 00070500	0 00070500	0 0007
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2503 -0.10727497	0.89272503	0.89272503	1.89272503	0.89272503	0.8927
2503	0.09272303	0.09272303	1.092/2303	0.09272303	0.0927
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2503	10.09272303	11.092/2303	19.092/2303	12.092/2303	10.0927
	16.89272503	8.89272503	8.89272503	12.89272503	9.8927
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	-0.10727497	0.89272503	-0.10727497	0.89272503	-0.1072
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2503					
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7497	0.89272503	0.89272503	-0.10727497	0.89272503	-0.10/2
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2503	0.09272303	1.092/2303	0.09272303	22.09272303	3.0927
18.89272503	4.89272503	4.89272503	3.89272503	2.89272503	7.8927
2503	1.03272303	1.03272303	3.03272303	2.03272303	7.0527
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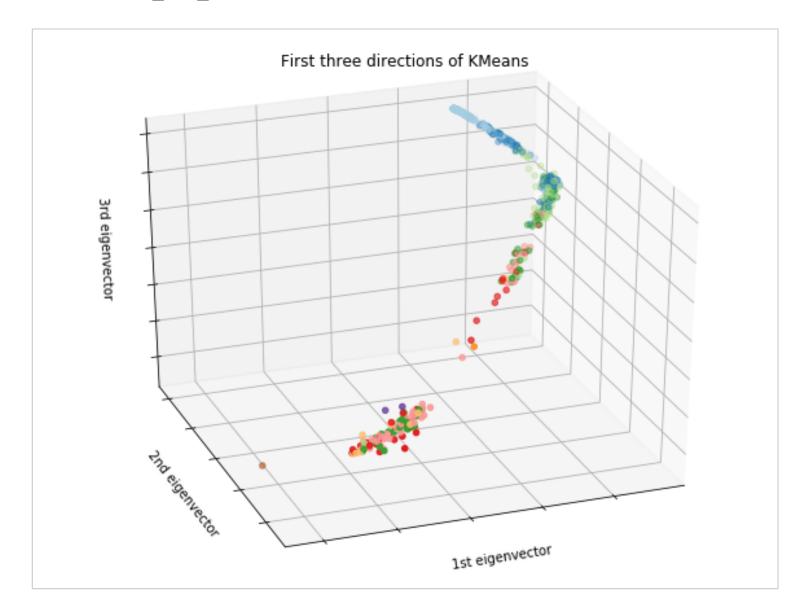
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Gauss %error 36.5 rmsle 0.6227288725192254

/anaconda3/lib/python3.6/site-packages/ipykernel\_launcher.py:16: Run timeWarning: invalid value encountered in log1p app.launch\_new\_instance()

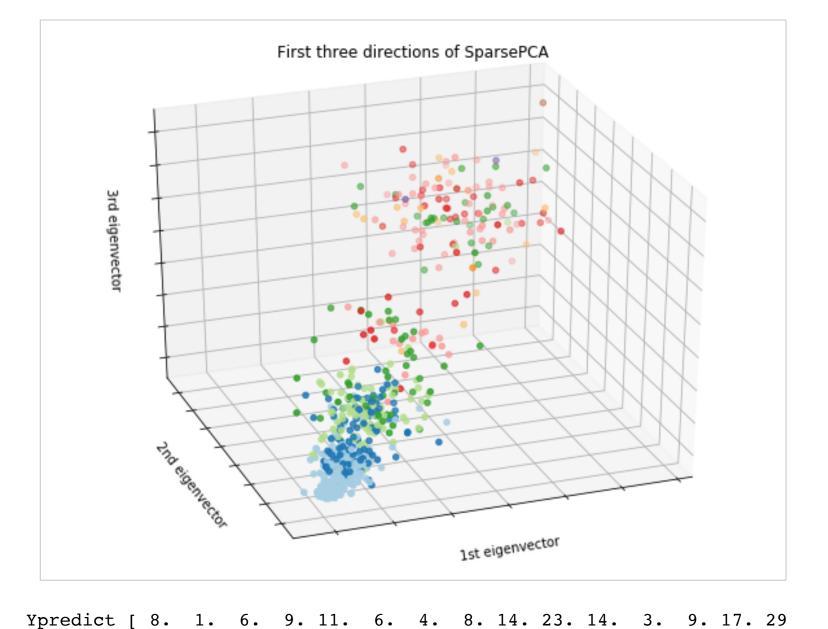


Ypredict [ 9. 4. 8. 10. 11. 6. 5. 9. 13. 21. 13. 4. 12. 16. 25 . 26. 28. 24. 4. 27. 22. 13. 21. 18. 13. 25. 20. 9. 11. 9. 7. 9. 12. 27. 26. 25. 25. 29. 27. 25. 27. 26. 30. 25. 22. 24. 25. 24. 26. 10. 18. 27. 20. 23. 25. 25. 22. 9. 24. 25. 17. 29. 23. 9. 26. 26. 10. 25. 26. 10. 30. 6. 23. 23. 24. 13. 8. 24. 25. 27. 22. 24. 21. 25. 22. 12. 25. 22. 18. 9. 11. 14. 29. 26. 6. 10. 20. 26. 24. 9. 25. 9. 4. 4. 13. 19.

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|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 9.       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 2.       | 20. | 8.  | 5.  | 3.  | 1.  | 0.  | 0.  | 2.  | 1.  | 0.  | 1.  | 6.  | 5.  | 5.  | 18. | 32. |
| 8.       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 39.      | 7.  | 20. | 28. | 22. | 25. | 29. | 31. | 25. | 8.  | 10. | 11. | 12. | 9.  | 11. | 10. | 10. |
| 11.      |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|          | 12. | 9.  | 12. | 5.  | 21. | 0.  | 22. | 3.  | 5.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 1.  |
| 0.       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 0.       | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 1.  | 1.  | 0.  | 0.  | 0.  | 0.  | 0.  |
| 1.       | •   | _   | 10  | _   | _   | •   | •   | •   | •   | •   | •   | •   | •   | •   |     | _   |
| 1.       | 0.  | 5.  | 12. | 7.  | 6.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 4.  | 1.  |
| 1.       | 1   | 0.  | 1   | 1   | 1   | 1   | 1   | 1   | 2   | 2   | 2   | _   | 1.0 | Е   | 1   | 4   |
| 1.<br>2. | Ι.  | 0.  | 4.  | 4.  | Τ.• | Ι.  | 1.  | 1.  | ٥.  | ۷.  | ۷.  | э.  | 10. | э.  | ⊥ • | 4.  |
| 1.       | ٥   | 0.  | Λ   | Λ   | 0   | Λ   | Ο   | 0.  | Ο   | Λ   | Λ   | Λ   | Λ   | Λ   | 1   | 5   |
| 1.       | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | ⊥•  | ٠.  |
| 1.       | 0.  | 1.  | 3.  | 1.  | 0 - | 1.  | 2.  | 4.  | 1.  | 0 - | 0 - | 0.  | 1.  | 2.  | 0.  | 7.  |
| 2.       |     | _ • | •   |     | •   | _ • |     | - • | _ • | •   | •   | •   | _ • |     | •   | , • |
| 5.       | 2.  | 1.  | 1.  | 1.  | 3.  | 1.  | 2.  | 1.  | 1.  | 1.  | 1.  | 1.  | 0.  | 0.  | 3.  | 0.  |
| 6.       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 2.       | 1.  | 3.  | 7.  | 3.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 0.  | 1.  | 1.  | 25. |
| 4.       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 20.      | 5.  | 3.  | 3.  | 2.  | 5.  | 6.  | 4.  | 10. | 2.  | 5.  | 2.  | 1.  | 5.  | 4.  | 4.  | 8.  |
| 2.       |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 5.       | 1.  | 5.  | 4.  | 4.  | 8.  | 3.  | 6.  | 1.  | 0.  | 4.  | 2.  | 4.  | 9.  | 1.  | 5.  | 1.  |
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| 0.       | ]   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
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KMeans %error 22.9 rmsle 0.3726247200598251



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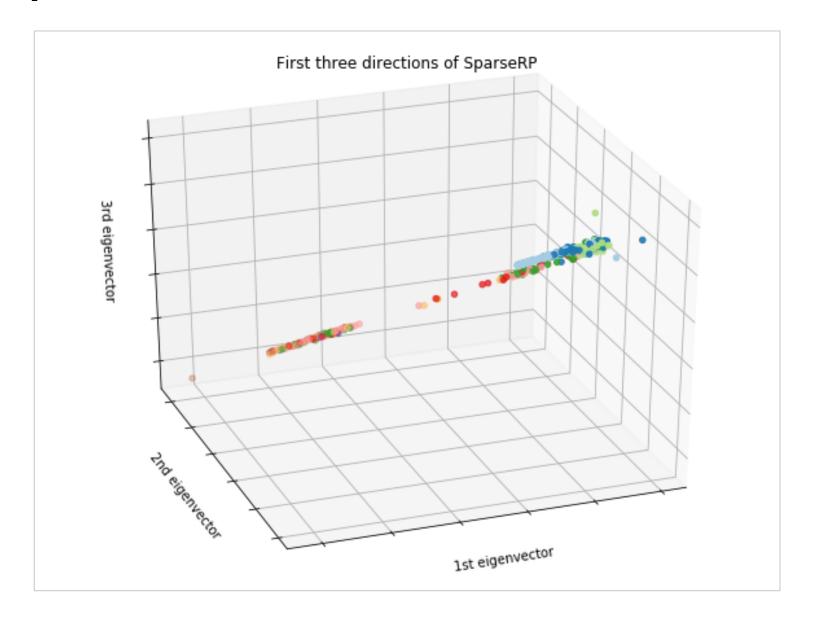
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2. 2. 2. 3. 1. 1. 3. 1. 0. 1. 1. 1. 3. 1. 5. 2. 4. 1. 1. 1. 5. 3. 2. 2. 1. 1. 1. 0. 0. 8. 1. 2. 1. 3. 7. 5. 1. 0. 0. 0. 0. 1. 1. 1. 1. 1. 24. 5. 19. 5. 5. 2. 7. 7. 4. 12. 3. 6. 1. 0. 5. 5. 5. 10. 6. 2. 6. 2. 7. 6. 3. 9. 4. 8. 2. 0. 4. 2. 5. 10. 1. 2. 1. 0.1

SparsePCA %error 24.6 rmsle 0.47242543127653946

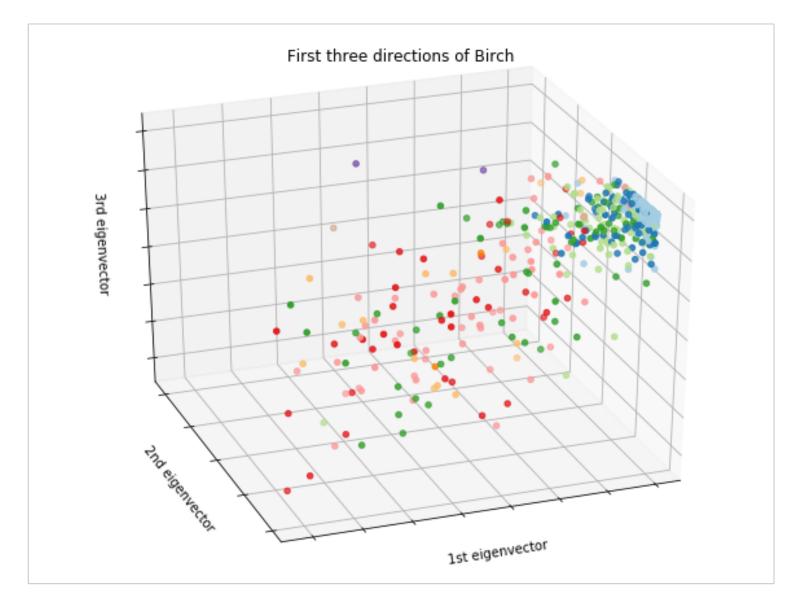


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14. 8. 22. 24. 21. 26. 29. 33. 25. 11. 33. 7. 7. 8. 8. 3. 7. 7. 18. 6. 20. 0.26. 2. 11. 11. 12. 7. 1. 7. 0. 1. 0. 0. 2. 2. 0. 0. 2. 0. 0. 0. 0. 0. 1. 0. 0. 0. 1. 2. 0. 0. 0. 3. 6. 0. 1. 9. 15. 10. 0. 0. 1. 0. 0. 0. 0. 0. 3. 2. 0. 0. 0. 1. 4. 7. 0. 0. 0. 0. 3. 1. 0. 4. 11. 2. 2. 2. 2. 1. 0. 1. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 1. 3. 1. 0. 0. 0. 3. 1. 0. 1. 1. 3. 1. 1. 0. 1. 4. 0. 0. 12. 1. 8. 0. 1. 0. 1. 1. 0. 2. 0. 0. 1. 0. 0. 0. 0. 5. 0. 8. 1. 0. 0. 0. 0. 0. 0. 1. 0. 0. 1. 9. 0. 0. 0. 0.18. 3. 1. 6. 5. 4. 9. 1. 6. 0. 0. 3. 19. 7. 4. 1. 9. 9. 1. 2. 1. 9. 2. 5. 4. 1. 5. 3. 7. 7. 0. 7. 0. 0. 1. 0.]

SparseRP %error 0.0 rmsle 1.0038462317057075e-12



Ypredict [ 9. 2. 5. 9. 12. 6. 4. 8. 13. 22. 15. 2. 9. 17. 29

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Birch %error 24.0 rmsle 0.41079050551266977
In [178]:
n_col=4
kolom=sales.Product Code
X = (sales.drop(['Product Code'],axis=1).T)[:51] #sales 51weeks
X.columns=kolom
def rmsle(y_predicted, y_real):
    return np.sqrt(np.mean(np.power(np.log1p(y_predicted)-np.log1p(y_real), 2)))
def procenterror(y predicted, y real):
      return np.round( np.mean(np.abs(y_predicted-y_real) )/ np.mean(y_real) *100
,1)
```

9. 6.

5. 17. 22. 10. 18.

9. 19. 10. 13. 13. 22. 14. 5. 4.

7. 14. 26. 28. 16. 11. 11. 20. 13. 17. 18. 17.

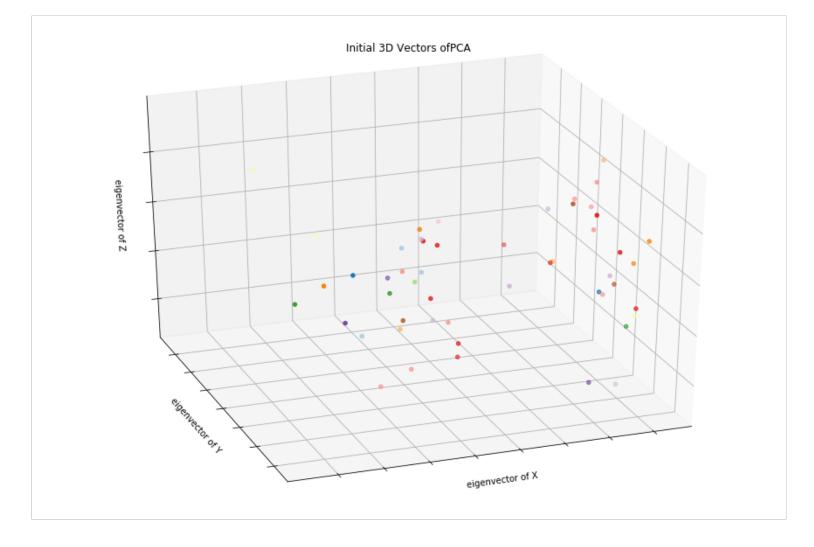
12.

26. 12.

Y=X['P33'1

```
X=X.fillna(value=0) #nasty NaN
methods = [
         'PCA',
         'FastICA',
         'Gauss',
         'KMeans',
         'SparsePCA',
         'SparseRP',
         'Birch',
         'NMF',
       # 'LatentDietrich',
        1
classifiers = [
    PCA(n components=n col),
    FastICA(n components=n col),
    GaussianRandomProjection(n components=3),
    KMeans(n clusters=n col),
    #SparsePCA(n components=n col),
    SparseRandomProjection(n components=n col, dense output=True),
    Birch(branching factor=10, n clusters=3, threshold=0.5),
    NMF(n components=n col),
  # LatentDirichletAllocation(n topics=n col),
]
correction= [1,1,0,0,0,0,0,0,0]
temp=zip(methods,classifiers,correction)
print(temp)
for method, clf,correct in temp:
    Xr=clf.fit transform(X,Y)
    V3(Xr, method)
    res = sm.OLS(Y,Xr).fit()
    #print(res.summary()) # show OLS regression
    #print(res.predict(Xr).round()+correct) #show OLS prediction
    #print('Ypredict',res.predict(Xr).round()+correct) #show OLS prediction
    print('Ypredict',res.predict(Xr).round()+correct*Y.mean()) #show OLS predic
tion
    print(method,'%error',procenterror(res.predict(Xr)+correct*Y.mean(),Y),'rmsl
e',rmsle(res.predict(Xr)+correct*Y.mean(),Y)) #
```

<zip object at 0x1c2f4edf88>



Ypredict [11.62745098 10.62745098 10.62745098 11.62745098 11.62745098 8 11.62745098

11.62745098 12.62745098 12.62745098 11.62745098 11.62745098 10.6274 5098

12.62745098 11.62745098 11.62745098 12.62745098 12.62745098 11.6274

13.62745098 12.62745098 12.62745098 12.62745098 12.62745098 13.6274 5098

15.62745098 14.62745098 9.62745098 9.62745098 9.62745098 10.6274 5098

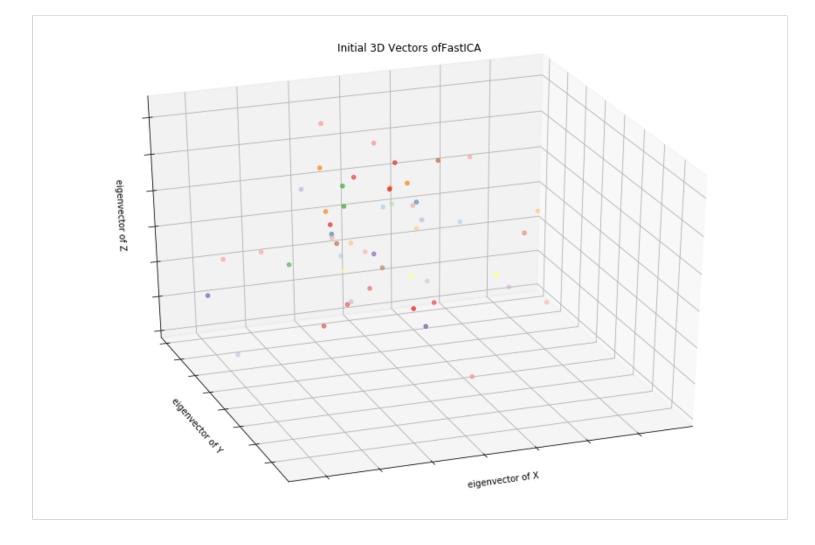
10.62745098 10.62745098 10.62745098 10.62745098 10.62745098 9.6274

10.62745098 10.62745098 10.62745098 10.62745098 10.62745098 10.6274

11.62745098 11.62745098 11.62745098 11.62745098 11.62745098 12.6274 5098

11.62745098 12.62745098 13.62745098]

PCA %error 22.7 rmsle 0.29086587715800943



Ypredict [11.62745098 10.62745098 10.62745098 11.62745098 11.62745098 8 10.62745098

11.62745098 12.62745098 12.62745098 11.62745098 11.62745098 10.6274 5098

12.62745098 11.62745098 11.62745098 12.62745098 12.62745098 11.6274

13.62745098 12.62745098 12.62745098 12.62745098 12.62745098 13.6274 5098

15.62745098 14.62745098 9.62745098 9.62745098 9.62745098 10.6274 5098

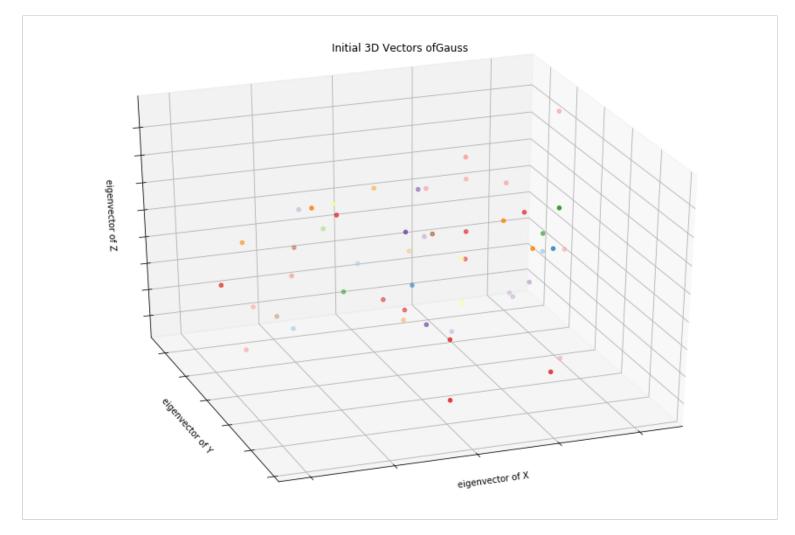
10.62745098 10.62745098 10.62745098 10.62745098 10.62745098 9.6274 5098

9.62745098 10.62745098 10.62745098 10.62745098 10.62745098 10.6274 5098

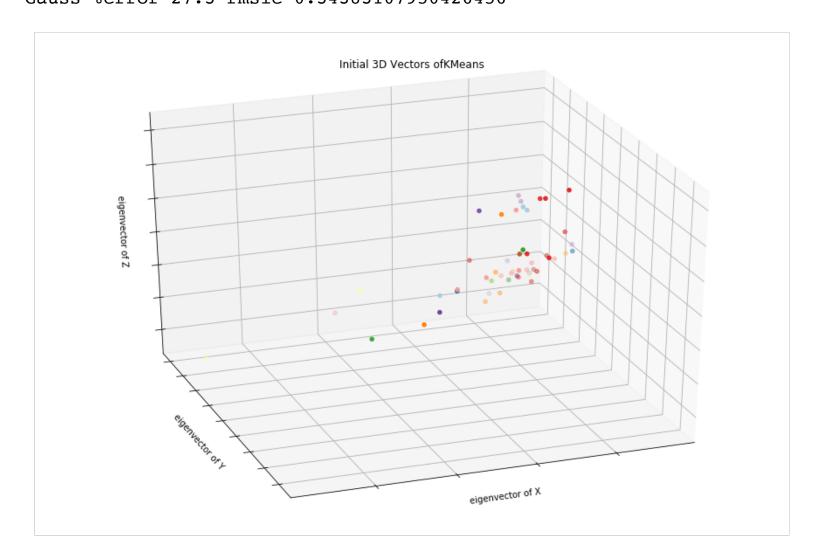
11.62745098 11.62745098 11.62745098 11.62745098 11.62745098 12.6274 5098

11.62745098 12.62745098 13.62745098]

FastICA %error 22.7 rmsle 0.2907674815926446

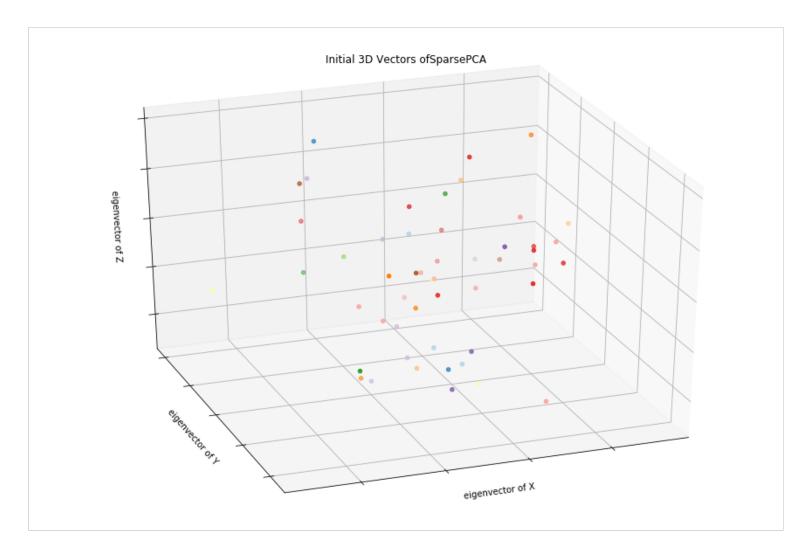


Ypredict [10. 14. 12. 11. 12. 14. 10. 13. 13. 13. 13. 12. 17. 11. 13
. 9. 13. 11.
12. 15. 15. 14. 13. 13. 13. 11. 10. 9. 9. 10. 10. 13. 8. 8. 11.
9. 12. 6. 11. 13. 10. 9. 10. 11. 10. 12. 7. 12. 11.]
Gauss %error 27.3 rmsle 0.34383107950426456



Ypredict [11. 11. 12. 12. 12. 12. 12. 12. 13. 11. 13. 12. 12. 12. 12. 12. 13. 13. 13. 13. 13.

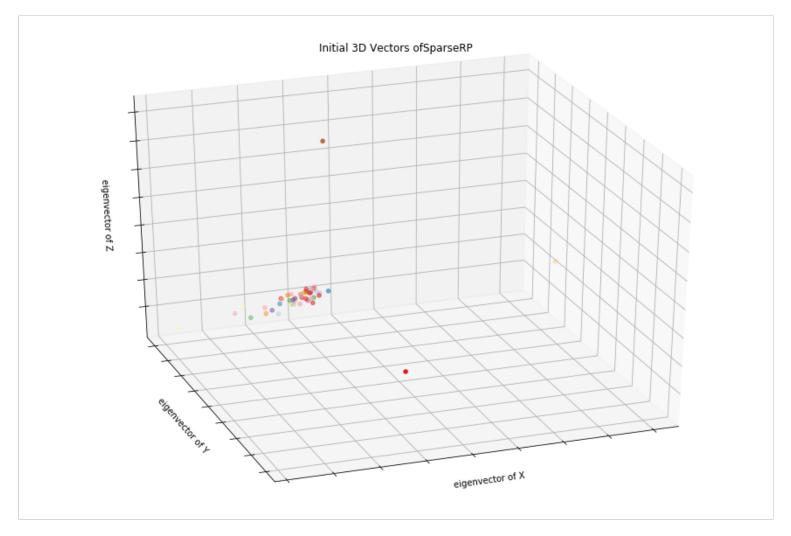
10. 11. 11. 10. 10. 11. 11. 12. 10. 11. 11. 12. 11. 12. 13.] KMeans %error 23.2 rmsle 0.2972499903151159



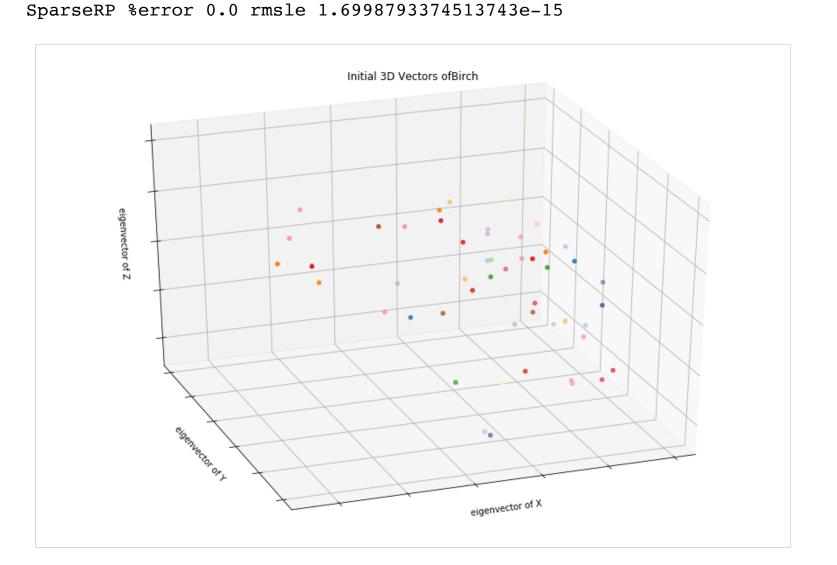
Ypredict [12. 14. 14. 12. 14. 13. 12. 13. 14. 14. 11. 11. 12. 12. 12. 13. 10. 14.

14. 12. 12. 12. 16. 12. 12. 8. 11. 8. 10. 10. 10. 9. 11. 11. 12. 13.

9. 11. 10. 7. 10. 11. 12. 11. 11. 10. 13. 9. 10. 11. 11.] SparsePCA %error 25.4 rmsle 0.316240501220898



Ypredict [15. 12. 11. 17. 10. 18. 11. 16. 8. 6. 11. 10. 18. 10. 14
. 13. 13. 12.
14. 10. 10. 11. 14. 11. 10. 17. 8. 13. 6. 16. 9. 4. 12. 10. 19.
9.
7. 5. 10. 8. 11. 5. 11. 13. 11. 11. 14. 15. 16. 17.]



```
Ypredict [12. 11. 10. 12. 12. 12. 13. 13. 13. 13. 11. 13. 13. 12
. 13. 13. 12.
 14. 13. 13. 13. 14. 16. 13. 9. 8. 9. 9. 10. 10. 10. 10. 10.
9.
 10. 10. 10. 10. 10. 11. 11. 11. 11. 12. 12. 11. 12. 13.]
Birch %error 22.7 rmsle 0.28949425013355634
In [179]:
from sklearn.linear_model import OrthogonalMatchingPursuit,RANSACRegressor,Logis
ticRegression, ElasticNetCV, HuberRegressor, Ridge, Lasso, LassoCV, Lars, BayesianRid
ge, SGDClassifier, LogisticRegressionCV, RidgeClassifier
from sklearn.svm import SVC
from sklearn.preprocessing import MinMaxScaler, PolynomialFeatures
from sklearn.model selection import GridSearchCV
from sklearn.neighbors import KNeighborsClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
param grid = {'C': [0.1,1, 10, 100, 1000], 'gamma': [1,0.1,0.01,0.001,0.0001], '
kernel': ['rbf']}
# import some data to play with
#X = df new[df new['split']==0]
X = X.drop(['P33'],axis=1)
def rmsle(y predicted, y real):
    return np.sqrt(np.mean(np.power(np.log1p(y_predicted)-np.log1p(y_real), 2)))
def procenterror(y predicted, y real):
     return np.round( np.mean(np.abs(y_predicted-y_real) )/ np.mean(y real) *100
,1)
#Y=df new[df new['split']==0]
#X=X.replace([np.inf, -np.inf], np.nan).fillna(value=0)
#print(X) #nasty NaN
#scaler = MinMaxScaler()
#scaler.fit(X)
#X=scaler.transform(X)
#poly = PolynomialFeatures(2)
#X=poly.fit transform(X)
methods = [
         #'ElasticNet',
         'SVC',
         'kSVC',
         'KNN',
         'DecisionTree',
         'RandomForestClassifier',
         #'GridSearchCV',
         'HuberRegressor',
```

```
Riage ,
         'Lasso',
         'LassoCV',
         'Lars',
         #'BayesianRidge',
         'SGDClassifier',
         'RidgeClassifier',
         'LogisticRegression',
         'OrthogonalMatchingPursuit',
         #'RANSACRegressor',
         ]
classifiers = [
    #ElasticNetCV(cv=10, random state=0),
    SVC(),
    SVC(kernel = 'rbf', random state = 0),
    KNeighborsClassifier(n neighbors = 1),
    DecisionTreeClassifier(),
    RandomForestClassifier(n estimators = 200),
    #GridSearchCV(SVC(),param_grid, refit = True, verbose = 1),
    HuberRegressor(fit intercept=True, alpha=0.0, max iter=100,epsilon=2.95),
    Ridge(fit intercept=True, alpha=0.0, random state=0, normalize=True),
    Lasso(alpha=0.05),
    LassoCV(),
    Lars(n nonzero coefs=10),
    #BayesianRidge(),
    SGDClassifier(),
    RidgeClassifier(),
    LogisticRegression(),
    OrthogonalMatchingPursuit(),
    #RANSACRegressor(),
correction= [0,0,0,0,0,0,0,0,0,0,0,0]
temp=zip(methods,classifiers,correction)
print(temp)
for method, clf,correct in temp:
    regr=clf.fit(X,Y)
    #print( method, '% errors', abs(regr.predict(X)+correct-Y).sum()/(Y.sum())*10
0)
    print(method,'%error',procenterror(regr.predict(X),Y),'rmsle',rmsle(regr.pre
dict(X),Y)
    from sklearn.metrics import classification report, confusion matrix, accurac
y_score,f1_score, precision_score, recall_score
    # Confusion Matrix
    print(method, 'Confusion Matrix')
    print(confusion matrix(Y, np.round(regr.predict(X) ) )
    print('--'*40)
    # Classification Report
    print('Classification Report')
    print(classification report(Y,np.round( regr.predict(X) ) ))
```

```
logreg_accuracy = round(accuracy_score(Y, np.round( regr.predict(X) ) ) * 10
0,2)
    print('Accuracy', logreg accuracy,'%')
<zip object at 0x1c2f576608>
SVC %error 0.0 rmsle 0.0
SVC Confusion Matrix
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Classification Report

# Accuracy

print('--'\*40)

|             | precision | recall | fl-score | support |
|-------------|-----------|--------|----------|---------|
|             |           |        |          |         |
| 4.0         | 1.00      | 1.00   | 1.00     | 1       |
| 5.0         | 1.00      | 1.00   | 1.00     | 2       |
| 6.0         | 1.00      | 1.00   | 1.00     | 2       |
| 7.0         | 1.00      | 1.00   | 1.00     | 1       |
| 8.0         | 1.00      | 1.00   | 1.00     | 3       |
| 9.0         | 1.00      | 1.00   | 1.00     | 2       |
| 10.0        | 1.00      | 1.00   | 1.00     | 8       |
| 11.0        | 1.00      | 1.00   | 1.00     | 10      |
| 12.0        | 1.00      | 1.00   | 1.00     | 3       |
| 13.0        | 1.00      | 1.00   | 1.00     | 4       |
| 14.0        | 1.00      | 1.00   | 1.00     | 4       |
| 15.0        | 1.00      | 1.00   | 1.00     | 2       |
| 16.0        | 1.00      | 1.00   | 1.00     | 3       |
| 17.0        | 1.00      | 1.00   | 1.00     | 3       |
| 18.0        | 1.00      | 1.00   | 1.00     | 2       |
| 19.0        | 1.00      | 1.00   | 1.00     | 1       |
|             |           |        |          |         |
| avg / total | 1.00      | 1.00   | 1.00     | 51      |

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Accuracy 100.0 %

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kSVC %error 0.0 rmsle 0.0
kSVC Confusion Matrix
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Classification Report
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      18.0
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      19.0
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                                    1.00
avg / total
                 1.00
                          1.00
                                    1.00
                                               51
```

-----

Accuracy 100.0 %

KNN %error 0.0 rmsle 0.0

KNN Confusion Matrix

| [[ | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-----|
| [  | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| Γ  | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 1 |

| [ | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
|---|---|---|---|---|---|---|---|----|---|---|---|---|---|---|---|-----|
| [ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0]  |
| [ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0]  |
| [ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0]  |
| [ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0]  |
| [ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0]  |
| [ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1]] |

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Classification Report

|             | precision | recall | f1-score | support |
|-------------|-----------|--------|----------|---------|
| 4.0         | 1.00      | 1.00   | 1.00     | 1       |
| 5.0         | 1.00      | 1.00   | 1.00     | 2       |
| 6.0         | 1.00      | 1.00   | 1.00     | 2       |
| 7.0         | 1.00      | 1.00   | 1.00     | 1       |
| 8.0         | 1.00      | 1.00   | 1.00     | 3       |
| 9.0         | 1.00      | 1.00   | 1.00     | 2       |
| 10.0        | 1.00      | 1.00   | 1.00     | 8       |
| 11.0        | 1.00      | 1.00   | 1.00     | 10      |
| 12.0        | 1.00      | 1.00   | 1.00     | 3       |
| 13.0        | 1.00      | 1.00   | 1.00     | 4       |
| 14.0        | 1.00      | 1.00   | 1.00     | 4       |
| 15.0        | 1.00      | 1.00   | 1.00     | 2       |
| 16.0        | 1.00      | 1.00   | 1.00     | 3       |
| 17.0        | 1.00      | 1.00   | 1.00     | 3       |
| 18.0        | 1.00      | 1.00   | 1.00     | 2       |
| 19.0        | 1.00      | 1.00   | 1.00     | 1       |
| avg / total | 1.00      | 1.00   | 1.00     | 51      |

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Accuracy 100.0 %

DecisionTree %error 0.0 rmsle 0.0

DecisionTree Confusion Matrix

| [[ | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0] |
|----|---|---|---|---|---|---|---|----|---|---|---|---|---|---|---|----|
| [  | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0] |
| [  | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0] |
| [  | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0] |
| [  | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0] |
| [  | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0] |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0] |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0] |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0] |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0] |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0] |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0] |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0] |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0] |

| [<br>[ | 0<br>0 | 0<br>0 | 0<br>0     | 0<br>0 | 0<br>0 | 0<br>0 | 0  | 0<br>0 | 0<br>0 | 0<br>0 | 0<br>0 | 0<br>0 | 0<br>0     | 0<br>0 | 2      | 0]<br>1]]  |  |
|--------|--------|--------|------------|--------|--------|--------|----|--------|--------|--------|--------|--------|------------|--------|--------|------------|--|
| <br>   |        |        |            |        |        |        |    |        |        |        |        |        |            |        |        |            |  |
| Cl     | ass    | ifi    | .cat       |        |        | _      |    |        |        |        | _      |        |            |        |        |            |  |
|        |        |        |            | р      | rec    | isi    | on |        | rec    | all    | Ι      | :1-S   | cor        | е      | su     | pport      |  |
|        |        |        | 4.0        |        |        | 1.     |    |        |        | .00    |        |        | 1.0        |        |        | 1          |  |
|        |        |        | 5.0<br>6.0 |        |        |        | 00 |        |        | .00    |        |        | 1.0<br>1.0 |        |        | 2          |  |
|        |        |        | 7.0        |        |        | 1.     |    |        |        | .00    |        |        | 1.0        |        |        | 1          |  |
|        |        |        | 8.0        |        |        | 1.     |    |        |        | .00    |        |        | 1.0        |        |        | 3          |  |
|        |        |        | 9.0        |        |        | 1.     | 00 |        | 1      | .00    |        |        | 1.0        | 0      |        | 2          |  |
|        |        |        | 0.0        |        |        | 1.     |    |        |        | .00    |        |        | 1.0        |        |        | 8          |  |
|        |        |        | 1.0        |        |        |        | 00 |        |        | .00    |        |        | 1.0<br>1.0 |        |        | 10<br>3    |  |
|        |        |        | 3.0        |        |        |        | 00 |        |        | .00    |        |        | 1.0        |        |        | 4          |  |
|        |        |        | 4.0        |        |        |        | 00 |        |        | .00    |        |        | 1.0        |        |        | 4          |  |
|        |        |        | 5.0        |        |        | 1.     | 00 |        | 1      | .00    |        |        | 1.0        | 0      |        | 2          |  |
|        |        |        | 6.0        |        |        |        | 00 |        |        | .00    |        |        | 1.0        |        |        | 3          |  |
|        |        |        | 7.0<br>8.0 |        |        |        | 00 |        |        | .00    |        |        | 1.0<br>1.0 |        |        | 3<br>2     |  |
|        |        |        | 9.0        |        |        |        | 00 |        |        | .00    |        |        | 1.0        |        |        | 1          |  |
|        |        |        |            |        |        |        |    |        |        |        |        |        |            |        |        |            |  |
| av     | g/     | to     | tal        |        |        | 1.     | 00 |        | 1      | .00    |        |        | 1.0        | 0      |        | 51         |  |
|        |        |        |            |        |        |        |    |        |        |        |        |        |            |        |        |            |  |
|        |        |        |            | _      |        |        |    |        |        |        |        |        |            |        |        |            |  |
|        |        |        | 10         |        |        | ٠ .    |    | 0 -    |        | 0      | ^ -    | 7      | - 0        | 0      |        |            |  |
|        |        |        |            |        |        |        |    |        | ror    |        |        |        |            | • 0    |        |            |  |
| [[     | 1      | 0      | 0          | 0      | 0      | 0      | 0  | 0      | 0      | 0      | 0      | 0      | 0          | 0      | 0      | 0 ]        |  |
| [      | 0      | 2      | 0          | 0      | 0      | 0      | 0  | 0      | 0      | 0      | 0      | 0      | 0          | 0      | 0      | 0 ]        |  |
| [      | 0      | 0      | 2          | 0      | 0      | 0      | 0  | 0      | 0      | 0      | 0      | 0      | 0          | 0      | 0      | 0]         |  |
| [      | 0      | 0      | 0          | 1      | 0      | 0      | 0  | 0      | 0      | 0      | 0      | 0      | 0          | 0      | 0      | 0]         |  |
| l<br>r | 0      | 0      | 0          | 0      | 3<br>0 | 0<br>2 | 0  | 0      | 0      | 0      | 0      | 0      | 0          | 0<br>0 | 0<br>0 | 0 ]<br>0 ] |  |
| ſ      | 0      | 0      | 0          | 0      | 0      | 0      | 8  | 0      | 0      | 0      | 0      | 0      | 0          | 0      | 0      | 0]         |  |
| [      | 0      | 0      | 0          | 0      | 0      | 0      | 0  | 10     | 0      | 0      | 0      | 0      | 0          | 0      | 0      | 0 ]        |  |
| [      | 0      | 0      | 0          | 0      | 0      | 0      | 0  | 0      | 3      | 0      | 0      | 0      | 0          | 0      | 0      | 0]         |  |
| [      | 0      | 0      | 0          | 0      | 0      | 0      | 0  | 0      | 0      | 4      | 0      | 0      | 0          | 0      | 0      | 0]         |  |
| l<br>r | 0      | 0      | 0          | 0      | 0      | 0      | 0  | 0      | 0      | 0<br>0 | 4<br>0 | 0<br>2 | 0          | 0<br>0 | 0      | 0 ]<br>0 ] |  |
| l<br>[ | 0      | 0      | 0          | 0      | 0      | 0      | 0  | 0      | 0      | 0      | 0      | 0      | 3          | 0      | 0      | 0]         |  |
| [      | 0      | 0      | 0          | 0      | 0      | 0      | 0  | 0      | 0      | 0      | 0      | 0      | 0          | 3      | 0      | 0]         |  |
| [      | 0      | 0      | 0          | 0      | 0      | 0      | 0  | 0      | 0      | 0      | 0      | 0      | 0          | 0      | 2      | 0 ]        |  |
| [      | 0      | 0      | 0          | 0      | 0      | 0      | 0  | 0      | 0      | 0      | 0      | 0      | 0          | 0      | 0      | 1]]        |  |
|        |        |        |            |        |        |        |    |        |        |        |        |        |            |        |        |            |  |
| Cl     | ass    | ifi    | cat        |        |        | _      |    |        |        |        |        |        |            |        |        |            |  |
|        |        |        |            | р      | rec    | isi    | on |        | rec    | all    | f      | 1-s    | cor        | е      | su     | pport      |  |
|        |        |        | 4.0        |        |        | 1.     | 00 |        | 1      | .00    |        |        | 1.0        | 0      |        | 1          |  |

|     |     |     | 5.0 |     |    | 1.  | 00  |     | 1    | .00 | )   |     | 1.0 | 0   |     |      | 2   |
|-----|-----|-----|-----|-----|----|-----|-----|-----|------|-----|-----|-----|-----|-----|-----|------|-----|
|     |     |     | 6.0 |     |    | 1.  | 00  |     | 1    | .00 | )   |     | 1.0 | 0   |     |      | 2   |
|     |     |     | 7.0 |     |    | 1.  | 00  |     | 1    | .00 | )   |     | 1.0 | 0   |     |      | 1   |
|     |     |     | 8.0 |     |    | 1.  | 00  |     | 1    | .00 | )   |     | 1.0 | 0   |     |      | 3   |
|     |     |     | 9.0 |     |    | 1.  | 00  |     | 1    | .00 | )   |     | 1.0 | 0   |     |      | 2   |
|     |     | 1   | 0.0 |     |    | 1.  | 00  |     | 1    | .00 | )   |     | 1.0 | 0   |     |      | 8   |
|     |     | 1   | 1.0 |     |    | 1.  | 00  |     | 1    | .00 | )   |     | 1.0 | 0   |     | 1    | . 0 |
|     |     | 1   | 2.0 |     |    | 1.  | 00  |     | 1    | .00 | )   |     | 1.0 | 0   |     |      | 3   |
|     |     | 1   | 3.0 |     |    | 1.  | 00  |     | 1    | .00 | )   |     | 1.0 | 0   |     |      | 4   |
|     |     | 1   | 4.0 |     |    | 1.  | 00  |     | 1    | .00 | )   |     | 1.0 | 0   |     |      | 4   |
|     |     | 1   | 5.0 |     |    | 1.  | 00  |     | 1    | .00 | )   |     | 1.0 | 0   |     |      | 2   |
|     |     | 1   | 6.0 |     |    | 1.  | 00  |     | 1    | .00 | )   |     | 1.0 | 0   |     |      | 3   |
|     |     | 1   | 7.0 |     |    | 1.  | 00  |     | 1    | .00 | )   |     | 1.0 | 0   |     |      | 3   |
|     |     | 1   | 8.0 |     |    | 1.  | 00  |     | 1    | .00 | )   |     | 1.0 | 0   |     |      | 2   |
|     |     | 1   | 9.0 |     |    | 1.  | 00  |     | 1    | .00 | )   |     | 1.0 | 0   |     |      | 1   |
|     |     |     |     |     |    |     |     |     |      |     |     |     |     |     |     |      |     |
| avç | g / | to  | tal |     |    | 1.  | 00  |     | 1    | .00 | )   |     | 1.0 | 0   |     | 5    | 51  |
|     |     |     |     |     |    |     |     |     |      |     |     |     |     |     |     |      |     |
|     |     |     |     |     |    |     |     |     |      |     |     |     |     |     |     |      |     |
|     |     |     |     | _   |    |     |     |     |      |     |     |     |     |     |     |      |     |
| Acc | cur | асу | 10  | 0.0 | 용  |     |     |     |      |     |     |     |     |     |     |      |     |
| Huk | oer | Reg | res | sor | %e | rro | r 0 | .0  | rms  | le  | 5.3 | 002 | 343 | 598 | 999 | 72e- | -05 |
| Huk | oer | Reg | res | sor | Co | nfu | sio | n N | 1atr | ix  |     |     |     |     |     |      |     |
| [[  | 1   | 0   | 0   | 0   | 0  | 0   | 0   | 0   | 0    | 0   | 0   | 0   | 0   | 0   | 0   | 0]   |     |
| [   | 0   | 2   | 0   | 0   | 0  | 0   | 0   | 0   | 0    | 0   | 0   | 0   | 0   | 0   | 0   | 0]   |     |
| [   | 0   | 0   | 2   | 0   | 0  | 0   | 0   | 0   | 0    | 0   | 0   | 0   | 0   | 0   | 0   | 0]   |     |
| [   | 0   | 0   | 0   | 1   | 0  | 0   | 0   | 0   | 0    | 0   | 0   | 0   | 0   | 0   | 0   | 0]   |     |

| ]] | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
|----|---|---|---|---|---|---|---|----|---|---|---|---|---|---|---|-----|
| [  | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0]  |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0]  |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1]] |

Classification Report

|      | precision | recall | f1-score | support |
|------|-----------|--------|----------|---------|
|      |           |        |          |         |
| 4.0  | 1.00      | 1.00   | 1.00     | 1       |
| 5.0  | 1.00      | 1.00   | 1.00     | 2       |
| 6.0  | 1.00      | 1.00   | 1.00     | 2       |
| 7.0  | 1.00      | 1.00   | 1.00     | 1       |
| 8.0  | 1.00      | 1.00   | 1.00     | 3       |
| 9.0  | 1.00      | 1.00   | 1.00     | 2       |
| 10.0 | 1.00      | 1.00   | 1.00     | 8       |
| 11.0 | 1.00      | 1.00   | 1.00     | 10      |
| 12.0 | 1.00      | 1.00   | 1.00     | 3       |

|     | 13.0    | 1.00 | 1.00 | 1.00 | 4  |
|-----|---------|------|------|------|----|
|     | 14.0    | 1.00 | 1.00 | 1.00 | 4  |
|     | 15.0    | 1.00 | 1.00 | 1.00 | 2  |
|     | 16.0    | 1.00 | 1.00 | 1.00 | 3  |
|     | 17.0    | 1.00 | 1.00 | 1.00 | 3  |
|     | 18.0    | 1.00 | 1.00 | 1.00 | 2  |
|     | 19.0    | 1.00 | 1.00 | 1.00 | 1  |
| avg | / total | 1.00 | 1.00 | 1.00 | 51 |

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Accuracy 100.0 %

Ridge %error 0.0 rmsle 8.429441615446194e-16

Ridge Confusion Matrix

| ] ] | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
|-----|---|---|---|---|---|---|---|----|---|---|---|---|---|---|---|-----|
| [   | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [   | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 ] |
| [   | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [   | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [   | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [   | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0]  |
| [   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0]  |
| [   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0]  |
| [   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0]  |
| [   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0]  |
| [   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1]] |

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Classification Report

|      | precision | recall | f1-score | support |
|------|-----------|--------|----------|---------|
|      |           |        |          |         |
| 4.0  | 1.00      | 1.00   | 1.00     | 1       |
| 5.0  | 1.00      | 1.00   | 1.00     | 2       |
| 6.0  | 1.00      | 1.00   | 1.00     | 2       |
| 7.0  | 1.00      | 1.00   | 1.00     | 1       |
| 8.0  | 1.00      | 1.00   | 1.00     | 3       |
| 9.0  | 1.00      | 1.00   | 1.00     | 2       |
| 10.0 | 1.00      | 1.00   | 1.00     | 8       |
| 11.0 | 1.00      | 1.00   | 1.00     | 10      |
| 12.0 | 1.00      | 1.00   | 1.00     | 3       |
| 13.0 | 1.00      | 1.00   | 1.00     | 4       |
| 14.0 | 1.00      | 1.00   | 1.00     | 4       |
| 15.0 | 1.00      | 1.00   | 1.00     | 2       |
| 16.0 | 1.00      | 1.00   | 1.00     | 3       |
| 17.0 | 1.00      | 1.00   | 1.00     | 3       |
| 18.0 | 1.00      | 1.00   | 1.00     | 2       |
| 19.0 | 1.00      | 1.00   | 1.00     | 1       |
|      |           |        |          |         |

Accuracy 100.0 %

Lasso %error 0.4 rmsle 0.0060108424195111365

Lasso Confusion Matrix

| ци | 550 | CO | III u | 210 | 11 1.1 | u cr | TA |    |   |   |   |   |   |   |   |     |
|----|-----|----|-------|-----|--------|------|----|----|---|---|---|---|---|---|---|-----|
| [[ | 1   | 0  | 0     | 0   | 0      | 0    | 0  | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0   | 2  | 0     | 0   | 0      | 0    | 0  | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0   | 0  | 2     | 0   | 0      | 0    | 0  | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0   | 0  | 0     | 1   | 0      | 0    | 0  | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0   | 0  | 0     | 0   | 3      | 0    | 0  | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0   | 0  | 0     | 0   | 0      | 2    | 0  | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0   | 0  | 0     | 0   | 0      | 0    | 8  | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0   | 0  | 0     | 0   | 0      | 0    | 0  | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0   | 0  | 0     | 0   | 0      | 0    | 0  | 0  | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0   | 0  | 0     | 0   | 0      | 0    | 0  | 0  | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0   | 0  | 0     | 0   | 0      | 0    | 0  | 0  | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0   | 0  | 0     | 0   | 0      | 0    | 0  | 0  | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0]  |
| [  | 0   | 0  | 0     | 0   | 0      | 0    | 0  | 0  | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0]  |
| [  | 0   | 0  | 0     | 0   | 0      | 0    | 0  | 0  | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0]  |
| [  | 0   | 0  | 0     | 0   | 0      | 0    | 0  | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0]  |
| [  | 0   | 0  | 0     | 0   | 0      | 0    | 0  | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1]] |

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Classification Report

| Classificati | on Report |        |          |         |
|--------------|-----------|--------|----------|---------|
|              | precision | recall | f1-score | support |
| 4.0          | 1.00      | 1.00   | 1.00     | 1       |
| 5.0          | 1.00      | 1.00   | 1.00     | 2       |
| 6.0          | 1.00      | 1.00   | 1.00     | 2       |
| 7.0          | 1.00      | 1.00   | 1.00     | 1       |
| 8.0          | 1.00      | 1.00   | 1.00     | 3       |
| 9.0          | 1.00      | 1.00   | 1.00     | 2       |
| 10.0         | 1.00      | 1.00   | 1.00     | 8       |
| 11.0         | 1.00      | 1.00   | 1.00     | 10      |
| 12.0         | 1.00      | 1.00   | 1.00     | 3       |
| 13.0         | 1.00      | 1.00   | 1.00     | 4       |
| 14.0         | 1.00      | 1.00   | 1.00     | 4       |
| 15.0         | 1.00      | 1.00   | 1.00     | 2       |
| 16.0         | 1.00      | 1.00   | 1.00     | 3       |
| 17.0         | 1.00      | 1.00   | 1.00     | 3       |
| 18.0         | 1.00      | 1.00   | 1.00     | 2       |
| 19.0         | 1.00      | 1.00   | 1.00     | 1       |
|              |           |        |          |         |
| avg / total  | 1.00      | 1.00   | 1.00     | 51      |

/anaconda3/lib/python3.6/site-packages/sklearn/linear\_model/ridge.py:154: UserWarning: Singular matrix in solving dual problem. Using le ast-squares solution instead.

warnings.warn("Singular matrix in solving dual problem. Using "
/anaconda3/lib/python3.6/site-packages/sklearn/linear\_model/coordina
te\_descent.py:491: ConvergenceWarning: Objective did not converge. Y
ou might want to increase the number of iterations. Fitting data wit
h very small alpha may cause precision problems.

ConvergenceWarning)

```
LassoCV %error 23.9 rmsle 0.3057257200919362
LassoCV Confusion Matrix
```

[[0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0]
[[0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0]
[[0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0]
[[0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0]
[[0 0 0 0 0 0 0 0 1 2 0 0 0 0 0 0 0]
[[0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0]
[[0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0]
[[0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0]
[[0 0 0 0 0 0 0 0 1 9 0 0 0 0 0 0 0]
[[0 0 0 0 0 0 0 0 1 3 0 0 0 0 0 0 0]
[[0 0 0 0 0 0 0 0 1 3 0 0 0 0 0 0 0]
[[0 0 0 0 0 0 0 0 0 1 3 0 0 0 0 0 0 0]
[[0 0 0 0 0 0 0 0 0 0 1 3 0 0 0 0 0 0 0]
[[0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
[[0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
[[0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
[[0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
[[0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
[[0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]
[[0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]

[0 0 0 0 0 0 0 0 1 0 0 0 0 0 0]

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Classification Report

|             | precision | recall | f1-score | support |
|-------------|-----------|--------|----------|---------|
|             |           |        |          |         |
| 4.0         | 0.00      | 0.00   | 0.00     | 1       |
| 5.0         | 0.00      | 0.00   | 0.00     | 2       |
| 6.0         | 0.00      | 0.00   | 0.00     | 2       |
| 7.0         | 0.00      | 0.00   | 0.00     | 1       |
| 8.0         | 0.00      | 0.00   | 0.00     | 3       |
| 9.0         | 0.00      | 0.00   | 0.00     | 2       |
| 10.0        | 0.00      | 0.00   | 0.00     | 8       |
| 11.0        | 0.06      | 0.10   | 0.08     | 10      |
| 12.0        | 0.03      | 0.33   | 0.05     | 3       |
| 13.0        | 0.00      | 0.00   | 0.00     | 4       |
| 14.0        | 0.00      | 0.00   | 0.00     | 4       |
| 15.0        | 0.00      | 0.00   | 0.00     | 2       |
| 16.0        | 0.00      | 0.00   | 0.00     | 3       |
| 17.0        | 0.00      | 0.00   | 0.00     | 3       |
| 18.0        | 0.00      | 0.00   | 0.00     | 2       |
| 19.0        | 0.00      | 0.00   | 0.00     | 1       |
|             |           |        |          |         |
| avg / total | 0.01      | 0.04   | 0.02     | 51      |

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Accuracy 3.92 %

Lars %error 19.1 rmsle 0.25835084881532167

Lars Confusion Matrix

 $\hbox{\tt [[0\ 0\ 0\ 0\ 0\ 0\ 1\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0\ 0]}$ 

[0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0]

[0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0]

[0 0 0 0 0 0 0 4 4 0 0 0 0 0 0]

 $[0 \ 0 \ 0 \ 0 \ 0 \ 1 \ 3 \ 6 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0]$ 

 $[ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 2 \ 1 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 ]$ 

 $[0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 1 \ 2 \ 1 \ 0 \ 0 \ 0 \ 0 \ 0]$ 

[0 0 0 0 0 0 0 0 0 3 0 0 0 0 0]

[0 0 0 0 0 0 0 0 1 0 1 0 0 0 0 0]

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## Classification Report

|             | precision | recall | f1-score | support |
|-------------|-----------|--------|----------|---------|
| 4.0         | 0.00      | 0.00   | 0.00     | 1       |
| 5.0         | 0.00      | 0.00   | 0.00     | 2       |
| 6.0         | 0.00      | 0.00   | 0.00     | 2       |
| 7.0         | 0.00      | 0.00   | 0.00     | 1       |
| 8.0         | 0.00      | 0.00   | 0.00     | 3       |
| 9.0         | 0.00      | 0.00   | 0.00     | 2       |
| 10.0        | 0.00      | 0.00   | 0.00     | 8       |
| 11.0        | 0.19      | 0.30   | 0.23     | 10      |
| 12.0        | 0.06      | 0.33   | 0.10     | 3       |
| 13.0        | 0.12      | 0.25   | 0.17     | 4       |
| 14.0        | 0.00      | 0.00   | 0.00     | 4       |
| 15.0        | 0.00      | 0.00   | 0.00     | 2       |
| 16.0        | 0.00      | 0.00   | 0.00     | 3       |
| 17.0        | 0.00      | 0.00   | 0.00     | 3       |
| 18.0        | 0.00      | 0.00   | 0.00     | 2       |
| 19.0        | 0.00      | 0.00   | 0.00     | 1       |
| avg / total | 0.05      | 0.10   | 0.06     | 51      |

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Accuracy 9.8 %

SGDClassifier %error 25.8 rmsle 0.3227944909108929

| SGDClassifier |   |   |   |   | Con | fus | ion | Ma | tri | X |   |   |   |   |
|---------------|---|---|---|---|-----|-----|-----|----|-----|---|---|---|---|---|
| [[            | 0 | 0 | 0 | 0 | 0   | 0   | 1   | 0  | 0   | 0 | 0 | 0 | 0 | 0 |

 $[ \hspace{.08cm} 0 \hspace{.08cm} 0 \hspace{.08cm} 0 \hspace{.08cm} 0 \hspace{.08cm} 0 \hspace{.08cm} 0 \hspace{.08cm} 1 \hspace{.08cm} 0 \hspace{.08cm} ]$ 

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[ 0
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[ 0
    0 0 0
           0
              0 1
                   0
                     0 0
                             0 0 0
                                        0]]
```

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Classification Report

|             | precision | recall | f1-score | support |
|-------------|-----------|--------|----------|---------|
| 4.0         | 0.00      | 0.00   | 0.00     | 1       |
| 5.0         | 0.00      | 0.00   | 0.00     | 2       |
| 6.0         | 0.00      | 0.00   | 0.00     | 2       |
| 7.0         | 0.00      | 0.00   | 0.00     | 1       |
| 8.0         | 0.00      | 0.00   | 0.00     | 3       |
| 9.0         | 0.00      | 0.00   | 0.00     | 2       |
| 10.0        | 0.16      | 1.00   | 0.27     | 8       |
| 11.0        | 0.00      | 0.00   | 0.00     | 10      |
| 12.0        | 0.00      | 0.00   | 0.00     | 3       |
| 13.0        | 0.00      | 0.00   | 0.00     | 4       |
| 14.0        | 0.00      | 0.00   | 0.00     | 4       |
| 15.0        | 0.00      | 0.00   | 0.00     | 2       |
| 16.0        | 0.00      | 0.00   | 0.00     | 3       |
| 17.0        | 0.00      | 0.00   | 0.00     | 3       |
| 18.0        | 0.00      | 0.00   | 0.00     | 2       |
| 19.0        | 0.00      | 0.00   | 0.00     | 1       |
| avg / total | 0.02      | 0.16   | 0.04     | 51      |

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Accuracy 15.69 %

RidgeClassifier %error 0.0 rmsle 0.0

RidgeClassifier Confusion Matrix

| [[ | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
|----|---|---|---|---|---|---|---|----|---|---|---|---|---|---|---|-----|
| [  | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0]  |
| [  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0]  |
| Г  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0  | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0.1 |

| [ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 ] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-----|
| [ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0]  |
| [ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0]  |
| [ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1]] |

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Classification Report

|         | precision | recall | f1-score | support |
|---------|-----------|--------|----------|---------|
| 4.0     | 1.00      | 1.00   | 1.00     | 1       |
| 5.0     | 1.00      | 1.00   | 1.00     | 2       |
| 6.0     | 1.00      | 1.00   | 1.00     | 2       |
| 7.0     | 1.00      | 1.00   | 1.00     | 1       |
| 8.0     | 1.00      | 1.00   | 1.00     | 3       |
| 9.0     | 1.00      | 1.00   | 1.00     | 2       |
| 10.0    | 1.00      | 1.00   | 1.00     | 8       |
| 11.0    | 1.00      | 1.00   | 1.00     | 10      |
| 12.0    | 1.00      | 1.00   | 1.00     | 3       |
| 13.0    | 1.00      | 1.00   | 1.00     | 4       |
| 14.0    | 1.00      | 1.00   | 1.00     | 4       |
| 15.0    | 1.00      | 1.00   | 1.00     | 2       |
| 16.0    | 1.00      | 1.00   | 1.00     | 3       |
| 17.0    | 1.00      | 1.00   | 1.00     | 3       |
| 18.0    | 1.00      | 1.00   | 1.00     | 2       |
| 19.0    | 1.00      | 1.00   | 1.00     | 1       |
| / total | 1.00      | 1.00   | 1.00     | 51      |

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avg

Accuracy 100.0 %

/anaconda3/lib/python3.6/site-packages/sklearn/metrics/classificatio n.py:1135: UndefinedMetricWarning: Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted samples.

'precision', 'predicted', average, warn\_for)

/anaconda3/lib/python3.6/site-packages/sklearn/linear\_model/stochast ic\_gradient.py:128: FutureWarning: max\_iter and tol parameters have been added in <class 'sklearn.linear\_model.stochastic\_gradient.SGDCl assifier'> in 0.19. If both are left unset, they default to max\_iter =5 and tol=None. If tol is not None, max\_iter defaults to max\_iter=1 000. From 0.21, default max\_iter will be 1000, and default tol will be 1e-3.

"and default tol will be 1e-3." % type(self), FutureWarning)