Doug Marcum - DSC 550 Original Analysis Case Study Final Documentation

Case Study: Analyze data to evaluate cereal information to predict consumer rating

This course has occurred at a time of global high stress, so this project is to be something lighthearted. I reviewed many medical, political, and sports focused datasets that all just seemed to serious. Luckily, I stumbled on the topic of cereal, an interesting and somewhat silly topic. The data for this case study is a list of numerous brands of cereal by multiple manufactures. While not all encompassing, the data is comprehensive enough to predict how a cereal might score with a consumer based on several variables/features.

Step by Step Graph Analysis:

Part 1

Data Source: https://www.kaggle.com/crawford/80-cereals

1. The originally data can be found on Kaggle.com. Load downloaded CSV file. Display first five rows to make certain data loaded properly and explore columns.

```
In [3]: df = pd.read_csv('cereal.csv')
        df.head()
```

Out[3]:

	name	mfr	type	calories	protein	fat	sodium	fiber	carbo	sugars	potass	vitamins	shelf	weight	cups	rating
0	100% Bran	N	C	70	4	1	130	10.0	5.0	6	280	25	3	1.0	0.33	68.402973
1	100% Natural Bran	Q	C	120	3	5	15	2.0	8.0	8	135	0	3	1.0	1.00	33.983679
2	All-Bran	K	C	70	4	1	260	9.0	7.0	5	320	25	3	1.0	0.33	59.425505
3	All-Bran with Extra Fiber	K	C	50	4	0	140	14.0	8.0	0	330	25	3	1.0	0.50	93.704912
4	Almond Delight	R	C	110	2	2	200	1.0	14.0	8	-1	25	3	1.0	0.75	34.384843

2. Variables* (See below for complete list)

3. Display dimensions and information of data frame

```
Shape: (77, 16)
Info:
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 77 entries, 0 to 76
Data columns (total 16 columns):
name        77 non-null object
mfr         77 non-null object
type        77 non-null object
calories    77 non-null int64
protein     77 non-null int64
fat         77 non-null int64
sodium      77 non-null int64
fiber       77 non-null float64
carbo       77 non-null float64
sugars      77 non-null int64
potass      77 non-null int64
vitamins    77 non-null int64
shelf       77 non-null int64
weight      77 non-null float64
cups        77 non-null float64
rating      77 non-null float64
dtypes: float64(5), int64(8), object(3)
memory usage: 9.8+ KB
None
```

4. Check for missing values

```
0 missing values for name
0 missing values for mfr
0 missing values for type
0 missing values for calories
0 missing values for protein
0 missing values for fat
0 missing values for sodium
0 missing values for fiber
0 missing values for carbo
0 missing values for sugars
0 missing values for potass
0 missing values for vitamins
0 missing values for shelf
0 missing values for weight
0 missing values for cups
0 missing values for rating
```

5. Run summary information on data (total, mean, min, max, freq, unique, etc.)

	calories	protein	fat	sodium	fiber	carbo	sugars	potass	vitamins	shelf	weight	cups	rati
count	77.000000	77.000000	77.000000	77.000000	77.000000	77.000000	77.000000	77.000000	77.000000	77.000000	77.000000	77.000000	77.0000
mean	106.883117	2.545455	1.012987	159.675325	2.151948	14.597403	6.922078	96.077922	28.246753	2.207792	1.029610	0.821039	42.6657
std	19.484119	1.094790	1.006473	83.832295	2.383364	4.278956	4.444885	71.286813	22.342523	0.832524	0.150477	0.232716	14.0472
min	50.000000	1.000000	0.000000	0.000000	0.000000	-1.000000	-1.000000	-1.000000	0.000000	1.000000	0.500000	0.250000	18.0428
25%	100.000000	2.000000	0.000000	130.000000	1.000000	12.000000	3.000000	40.000000	25.000000	1.000000	1.000000	0.670000	33.1740
50%	110.000000	3.000000	1.000000	180.000000	2.000000	14.000000	7.000000	90.000000	25.000000	2.000000	1.000000	0.750000	40.4002
75%	110.000000	3.000000	2.000000	210.000000	3.000000	17.000000	11.000000	120.000000	25.000000	3.000000	1.000000	1.000000	50.8283
max	160.000000	6.000000	5.000000	320.000000	14.000000	23.000000	15.000000	330.000000	100.000000	3.000000	1.500000	1.500000	93.7049

	name	mfr	type
count	77	77	77
unique	77	7	2
top	Muesli Raisins; Dates; & Almonds	K	C
freq	1	23	74

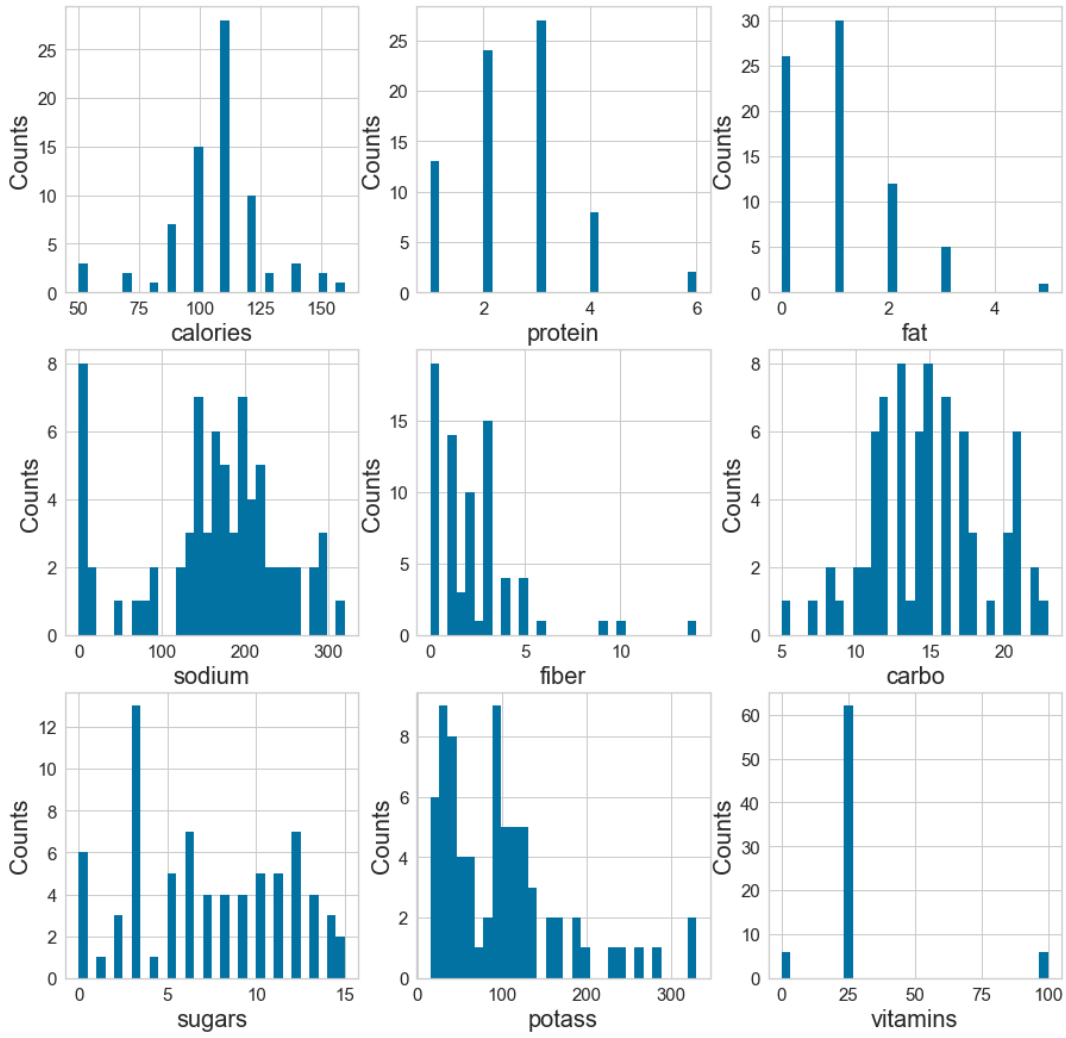
6. Fields showing -1 are not possible values for sugar, carbohydrates, and potassium. It is believed that these values may have been entered to replace previous NaN values. Since 0 is an acceptable value for these columns, cereals with -1 values are dropped.

7. Create 'score' variable, grouping cereals into 3 scoring possibilities

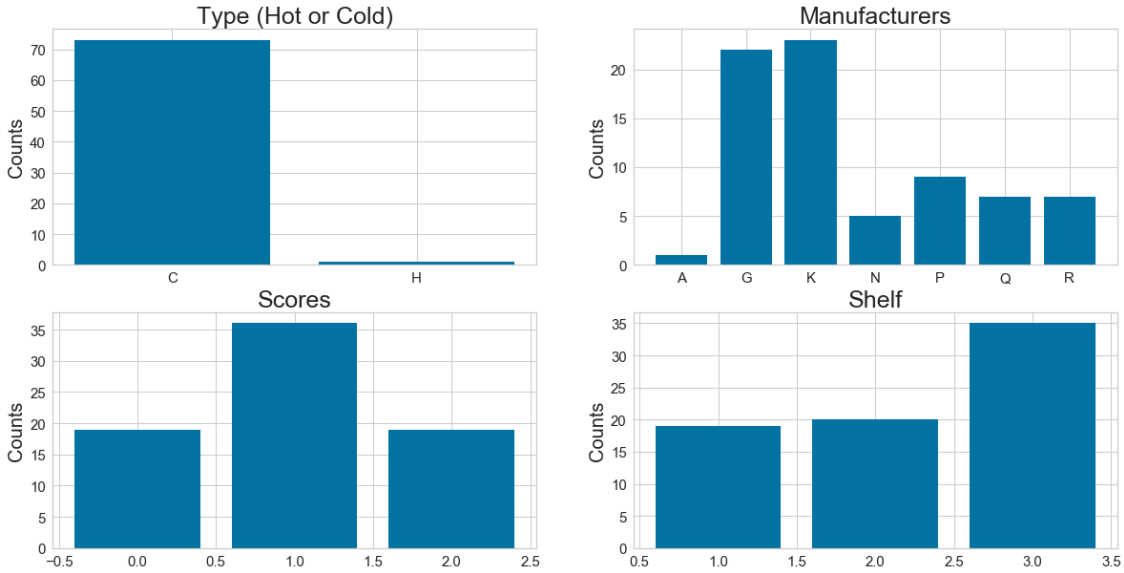
```
2 = Cereals with a consumer rating in the 75th or higher quantile
1 = Cereals with a consumer rating in the 25th - 75th quantile
0 = Cereals with a consumer rating in the 25th or lower quantile
```

From this, 'score' is the target and the other variables will be the features.

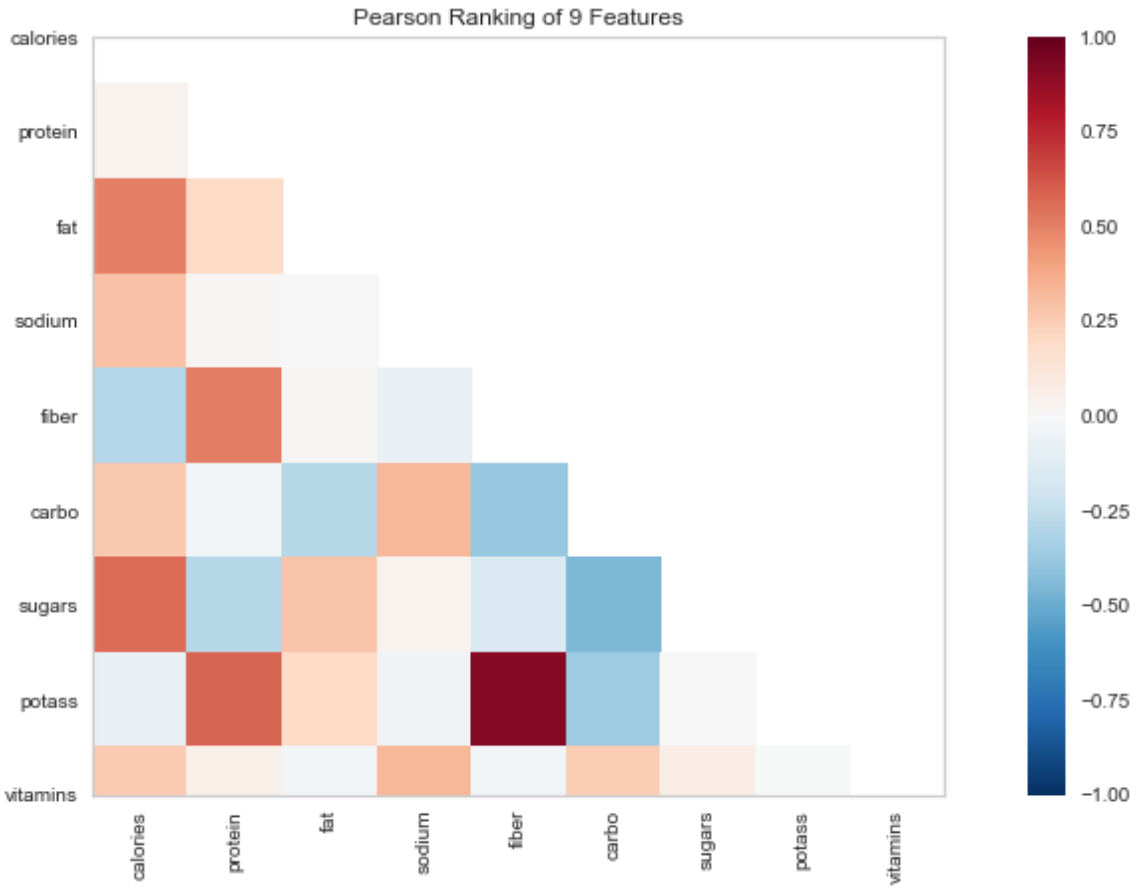
8. Plot histograms to display and explore data



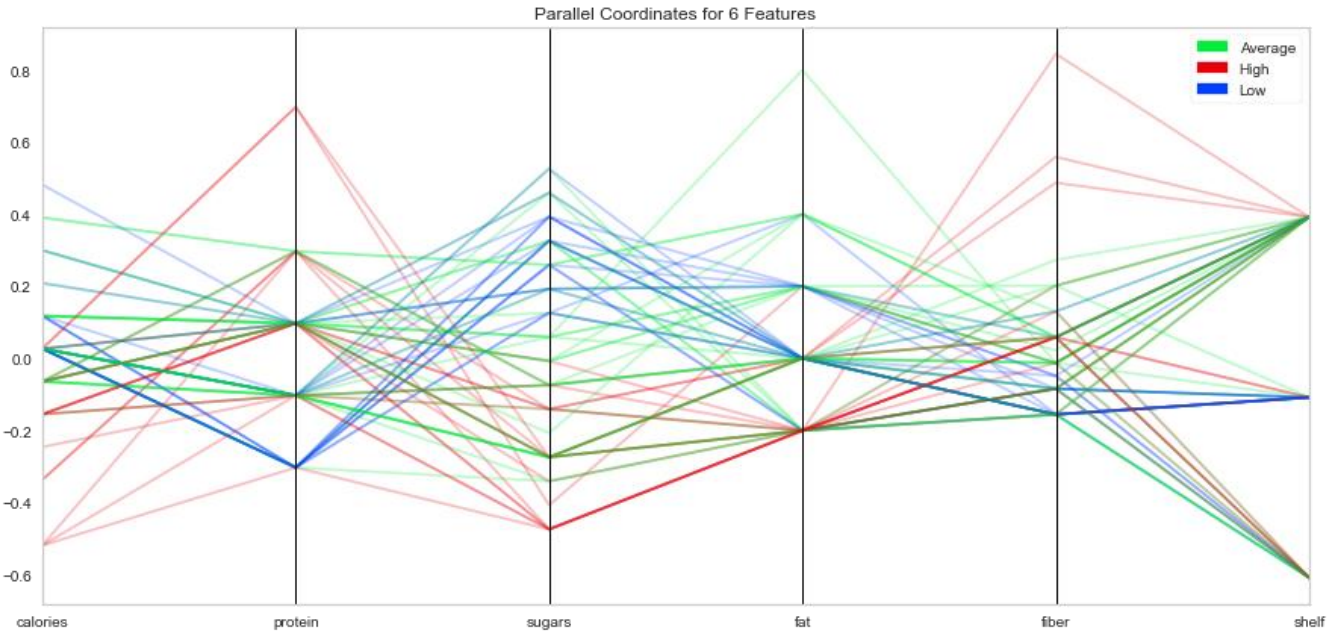
9. Plot box charts for data with fewer variables



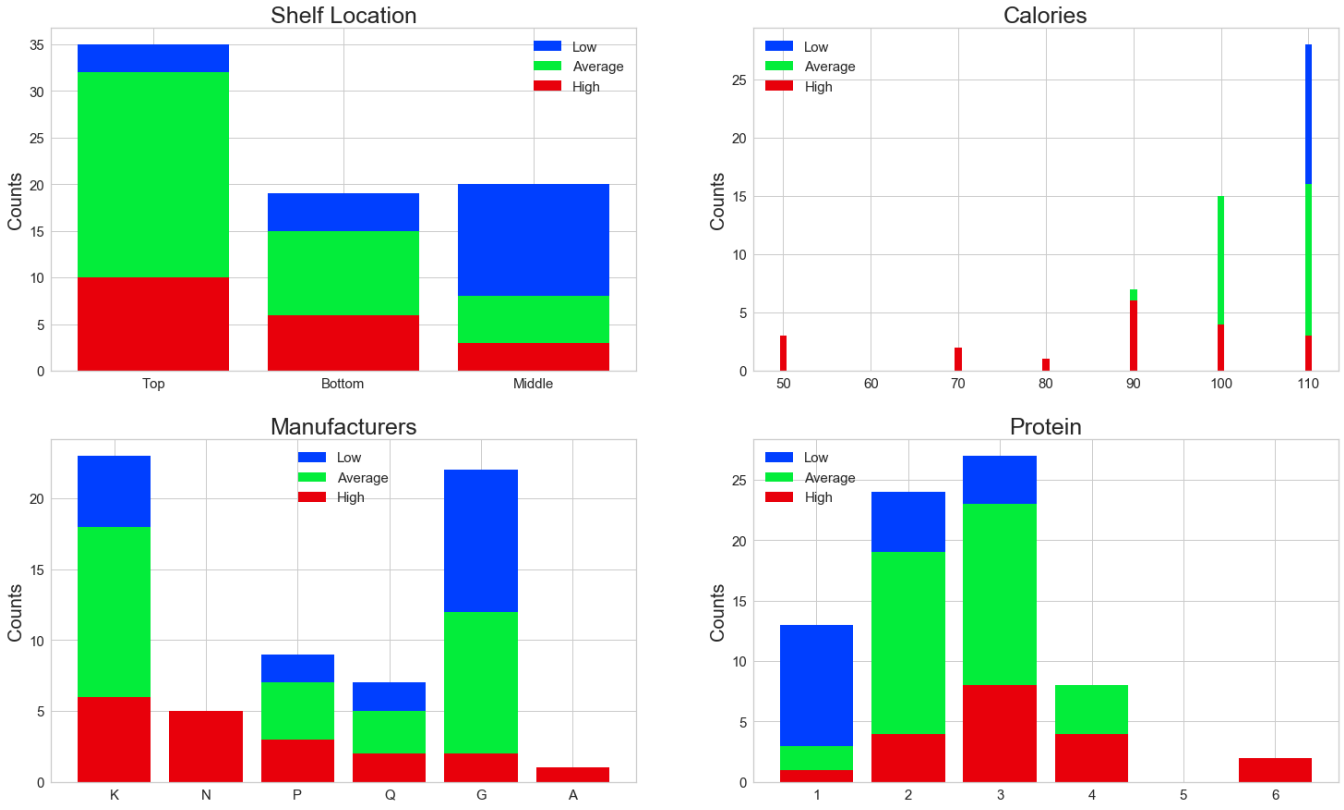
10. Use Pearson Ranking charts to see what data is correlated



11. Parallel Coordinates visualization is used to compare the distributions of numerical variables between cereals with high, average, and low scores.

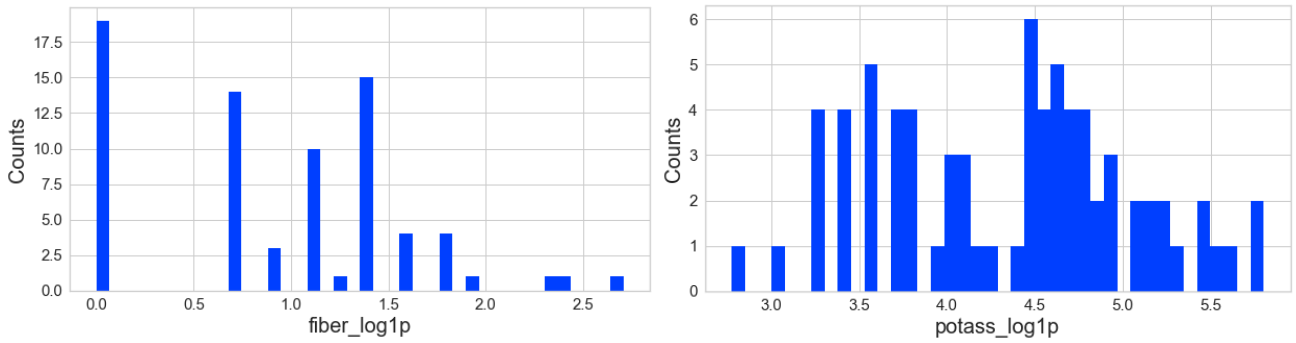


12. Stack Bar Charts are used to compare cereals of which scored high, average, and low based on the other variables.



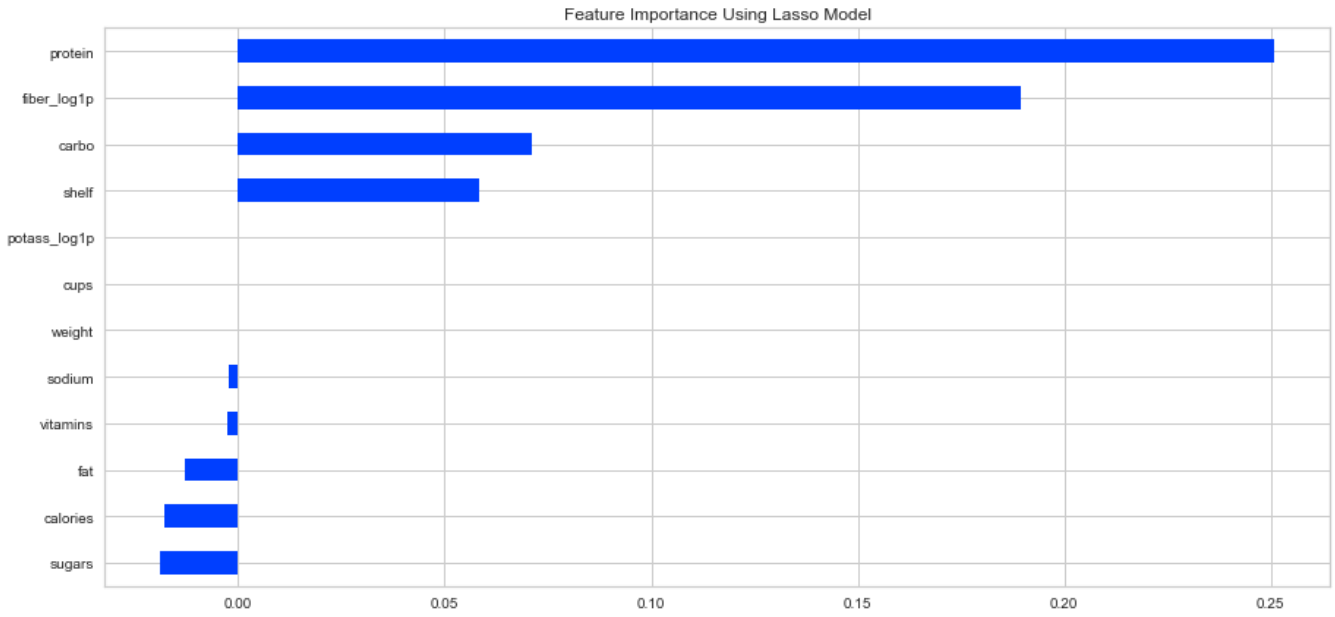
Part 2

13. Transform 'fiber' and 'potass' since both were skewed heavily in previous observation.



14. Perform feature reduction using LassoCV.

```
Best alpha using LassoCV: 0.020203
Best score using LassoCV: 0.825267
Total number of features before elimination: 12
Number of features eliminated: 3
Number of features remaining: 9
```



15. Convert categorical variables ('mfr', 'type') to numeric.

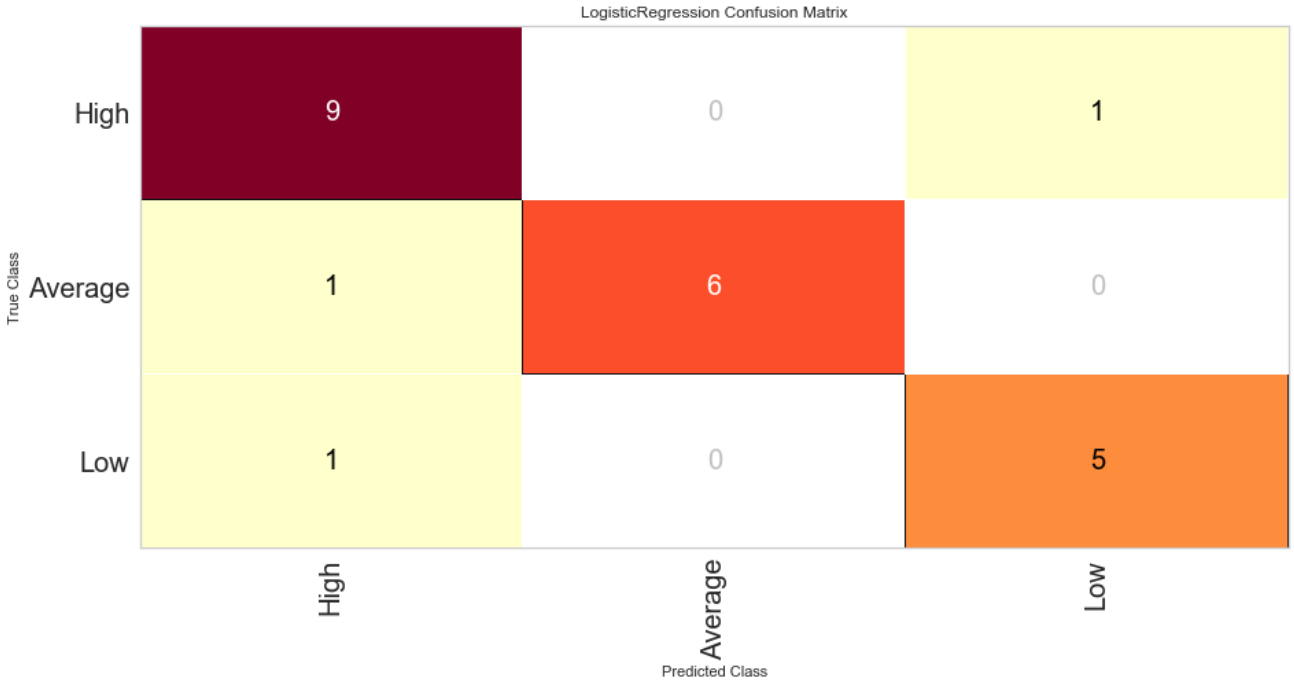
	mfr_A	mfr_G	mfr_K	mfr_N	mfr_P	mfr_Q	mfr_R	type_C	type_H
0	0	0	0	1	0	0	0	1	0
1	0	0	0	0	0	1	0	1	0
2	0	0	1	0	0	0	0	1	0
3	0	0	1	0	0	0	0	1	0
5	0	1	0	0	0	0	0	1	0

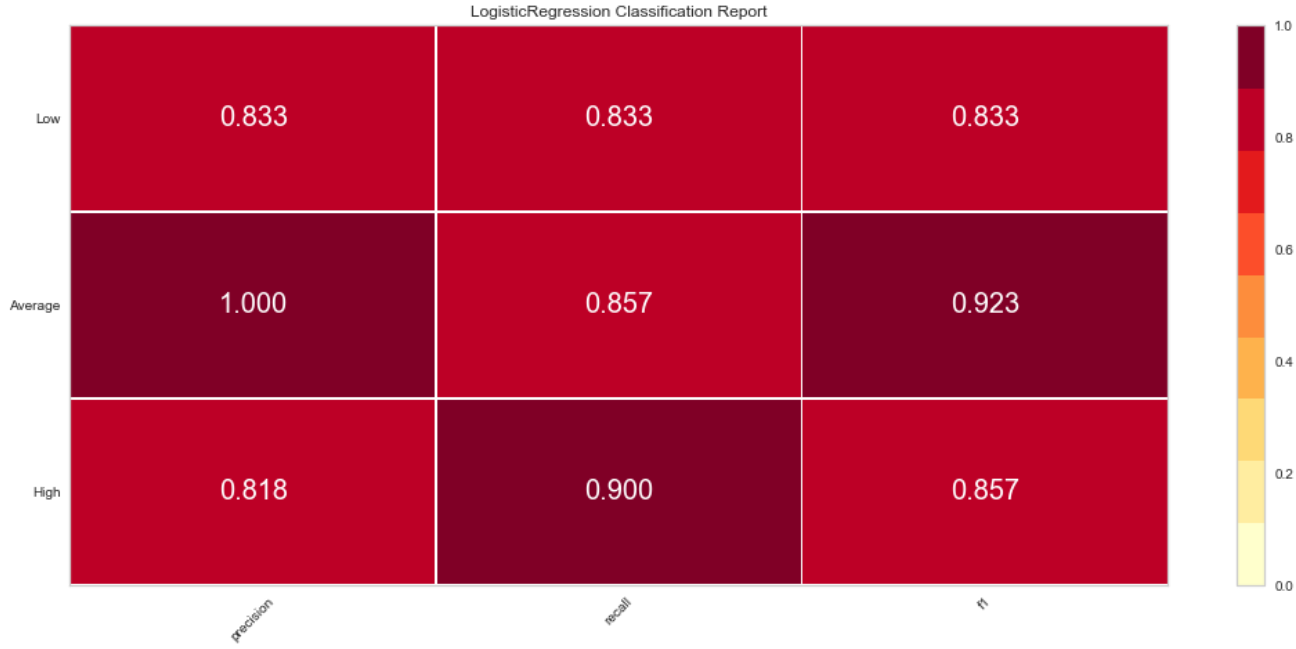
Part 3

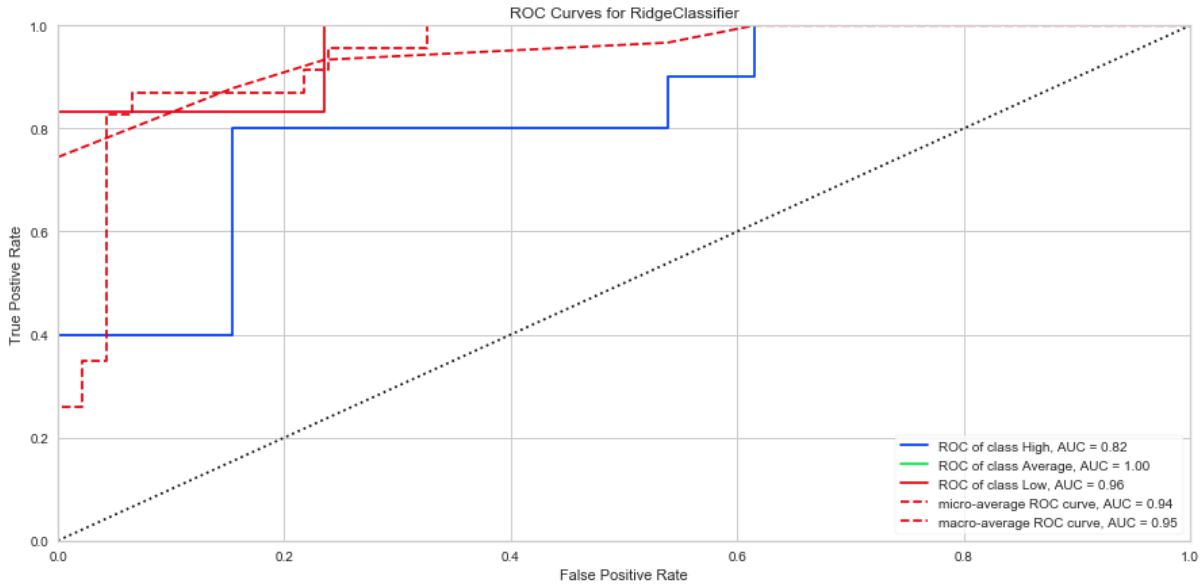
16. Training - Data is split into two sets: Training and Testing. (Testing Size of 30%)

```
Samples in training set:  51
Samples in testing set: 23

Counts of High, Average, and Low scores in the training set:
Average    26
Low        13
High       12
Name: scores, dtype: int64

Counts of High, Average, and Low scores in the validation set:
Average    10
High        7
Low         6
Name: scores, dtype: int64
```

17. Evaluation of logistic regression model using Confusion Matrix, Precisions, Recall, and F1 Score. ROC Curve evaluation was performed using Ridge regression. This classifier first converts the target values into {-1, 1} and then treats the problem as a regression task (multi-output regression in the multiclass case).







Conclusion

While the data set was limited in size, some interesting insights were still obtained through the analysis.

1. Cereal with the highest caloric values tend to score low, while those with higher scores tend to have lowest caloric values.
2. Cereals with high in grams of protein per serving scored higher than those with low grams of protein per serving.
3. In terms of product placement on grocery shelves, cereals with the lowest scores tend to be placed in the middle shelves. These shelves are typically at eye level and also easily seen by children.

In constructing the model and the reviewing the results, the features determined to have the most importance allowed for successful model. For each category, precision, recall, and F1 scores exceeded 0.81 and scored higher than 0.9 in a number of categories.

*Variables

```
name: name of cereal
mfr: manufacturer of cereal
    A = American Home Food Products
    G = General Mills
    K = Kellogg's
    N = Nabisco
    P = Post
    Q = Quaker Oats
    R = Ralston Purina
type:
    C = cold
    H = hot
calories: calories per serving
protein: grams of protein
fat: grams of fat
sodium: milligrams of sodium
fiber: grams of dietary fiber
carbo: grams of complex carbohydrates
sugars: grams of sugars
potass: milligrams of potassium
```

vitamins: vitamins and minerals - 0, 25, or 100, indicating the typical percentage of FDA recommended
shelf: display shelf (1 = bottom, 2 = middle, or 3 = top, counting from the floor)
weight: weight in ounces of one serving
cups: number of cups in one serving
rating: rating of cereals from Consumer Reports