Project: Predictive Analytics Capstone

Complete each section. When you are ready, save your file as a PDF document and submit it here: https://coco.udacity.com/nanodegrees/nd008/locale/en-us/versions/1.0.0/parts/7271/project

Task 1: Determine Store Formats for Existing Stores

1. What is the optimal number of store formats? How did you arrive at that number?
   - The optimal number of store formats is 3.
   - Information based off the K-Means Cluster Assessment Report from the K-Centroids Diagnostics tool shows that at 3 store formats, the AR (0.708) & CH (31.02) Indices median level is the highest compared to all other formats. The AR & CH plots reflect that the 3 store format may not have the tightest box & whisker plot, but the high value median suggest that the 3 store format is optimal.

K-Means Cluster Assessment Report

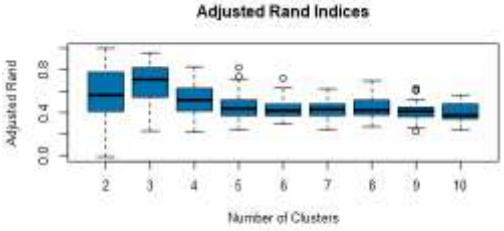
Summary Statistics

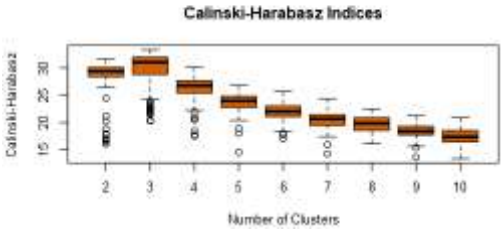
Adjusted Rand Indices:

	2	3	4	5	6	7	8
Minimum	-0.0152	0.2276	0.2198	0.2392	0.2903	0.2399	0.2674
1st Quartile	0.4196	0.5498	0.4171	0.3733	0.3714	0.3754	0.3784
Median	0.562	0.7083	0.5162	0.4366	0.4184	0.4288	0.4228
Mean	0.533	0.678	0.5246	0.4563	0.4341	0.4254	0.4398
3rd Quartile	0.7656	0.8173	0.6249	0.5156	0.4768	0.4774	0.5136
Maximum	1	0.9583	0.8277	0.8215	0.7202	0.6221	0.6977
	9	10					
Minimum	0.2232	0.2398					
1st Quartile	0.3626	0.3412					
Median	0.4117	0.3743					
Mean	0.41	0.3984					
3rd Quartile	0.4501	0.4736					
Maximum	0.6294	0.5636					

Calinski-Harabasz Indices:

	2	3	4	5	6	7	8
Minimum	16.1	20.27	17.55	14.58	17.03	14.3	16.11
1st Quartile	28.42	28.82	25.46	22.79	21.1	19.5	18.57
Median	29.39	31.02	26.77	23.95	22.02	20.66	19.85
Mean	28.21	29.65	26.21	23.67	21.98	20.48	19.72
3rd Quartile	30.07	31.96	27.68	24.8	23.01	21.45	20.89
Maximum	31.58	33.31	30.09	26.78	25.65	24.37	22.5
	9	10					
Minimum	13.64	13.4					
1st Quartile	17.76	16.43					
Median	18.39	17.36					
Mean	18.47	17.46					
3rd Quartile	19.31	18.55					
Maximum	21.24	20.87					

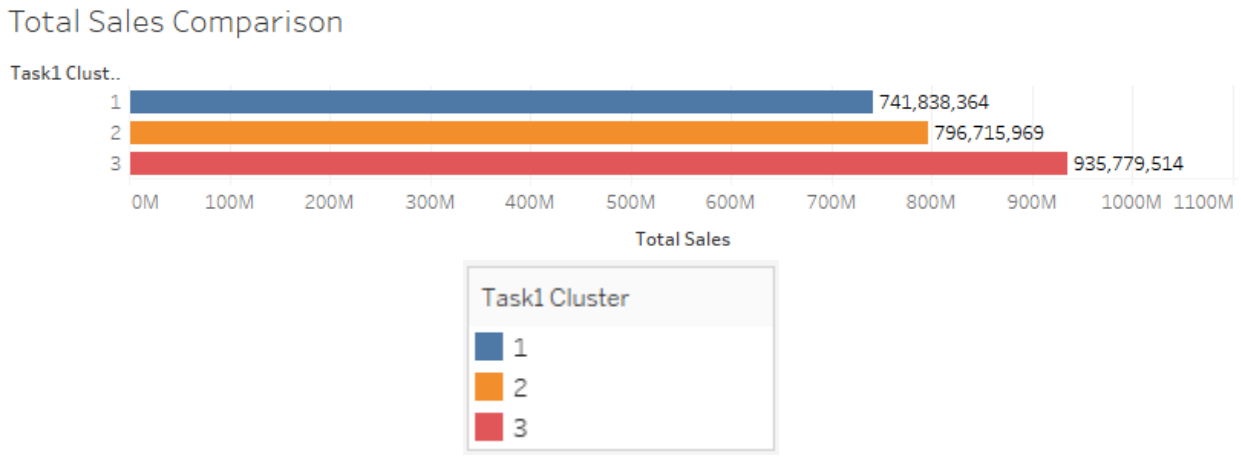




2. How many stores fall into each store format?
   - The number of stores that fall into each store format are as follows:
     - Cluster 1 = 23
     - Cluster 2 = 29
     - Cluster 3 = 33

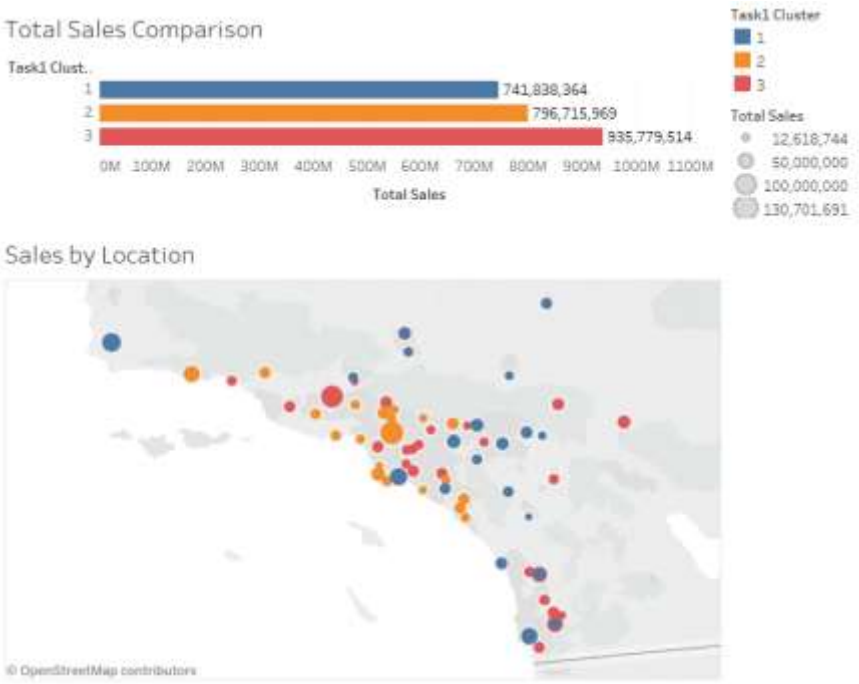
Cluster	Size	Ave Distance	Max Distance	Separation
1	23	2.320539	3.55145	1.874243
2	29	2.540086	4.475132	2.118708
3	33	2.115045	4.9262	1.702843

3. Based on the results of the clustering model, what is one way that the clusters differ from one another?
   - Based on the results of the clustering model, the one way that the clusters differ from each other is the amount of total sales. Cluster 3 has the highest sum of total sales compared to Cluster 1 & Cluster 2.



4. Please provide a Tableau visualization (saved as a Tableau Public file) that shows the location of the stores, uses color to show cluster, and size to show total sales.
   - Below is a visualization that shows the location of the stores with distinctions in color, size of total sales, and location.

https://public.tableau.com/views/Task1Dashboard_0/Dashboard1?:embed=y&:display_count=yes&publish=yes



Task 2: Formats for New Stores

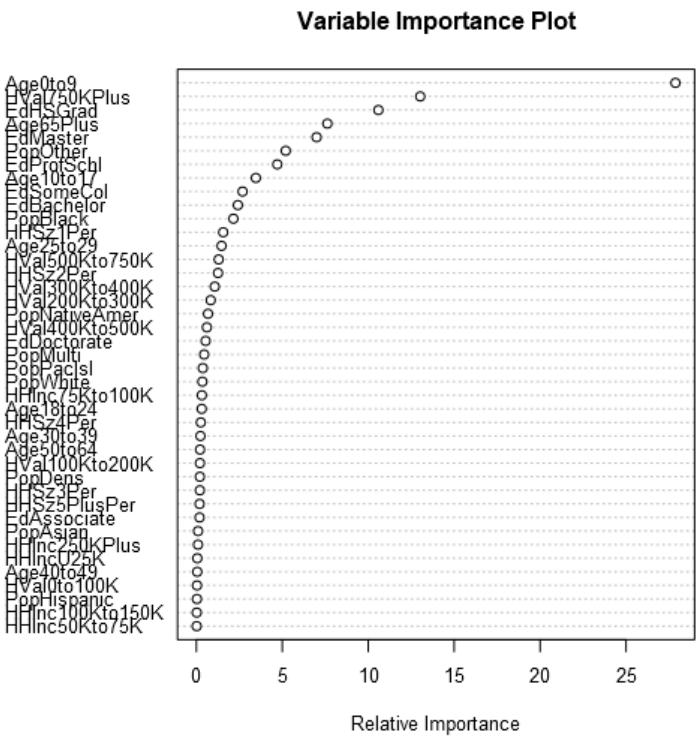
1. What methodology did you use to predict the best store format for the new stores? Why did you choose that methodology? (Remember to Use a 20% validation sample with Random Seed = 3 to test differences in models.)
   - With having the Boosted Model, Decision Tree, and Forest Model compared to each other through the Model Comparison Tool, the Boosted Model methodology was chosen to predict the best store format.
   - Both the Boosted Model & Forest Model had the same accuracy. The Boosted Model F1 score was higher than the Forest Model. This was the justification to select the Boosted Model as best to predict the store format.

Model Comparison Report

Fit and error measures

Model	Accuracy	F1	Accuracy_1	Accuracy_2	Accuracy_3
Boosted	0.8235	0.8543	0.8000	0.6667	1.0000
DecisionTree	0.7059	0.7327	0.6000	0.6667	0.8333
Forest	0.8235	0.8251	0.7500	0.8000	0.8750

2. What are the three most important variables that help explain the relationship between demographic indicators and store formats? Please include a visualization.
   - The three most important variables that help explain the relationship between demographic indicators and store formats are:
     - Age0to9
     - HVal750K
     - EdHSGrad



3. What format do each of the 10 new stores fall into? Please fill in the table below.

Store Number	Segment
S0086	3
S0087	2
S0088	3
S0089	2
S0090	2
S0091	1
S0092	2
S0093	1
S0094	2
S0095	2

Task 3: Predicting Produce Sales

1. What type of ETS or ARIMA model did you use for each forecast? Use ETS (a,m,n) or ARIMA (ar,i,ma) notation. How did you come to that decision?

- The following ETS model was used: ETS (M,N,M) with no dampening.
- After evaluating the TS Plot report, the seasonality trend is increasing implying that multiplicatively should be applied (M).
- The trend line is not clear and shows no true sign of pattern, (N).
- The error shows variation and is irregular, multiplicatively should be applied (M).
- A holdout sample of 6 months was used.

Summary of Time Series Exponential Smoothing Model ETS

Method:
ETS(M,N,M)

In-sample error measures:

ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
-62800.6583899	948208.5360249	762227.3150084	-0.4074302	3.3572352	0.4254973	0.1075188

Information criteria:

AIC	AICc	BIC
1275.8636	1292.6636	1299.5079

- The ARIMA (1,0,0)(1,1,0)[12] model was used.
- A holdout sample of 6 months was used.

Summary of ARIMA Model ARIMA

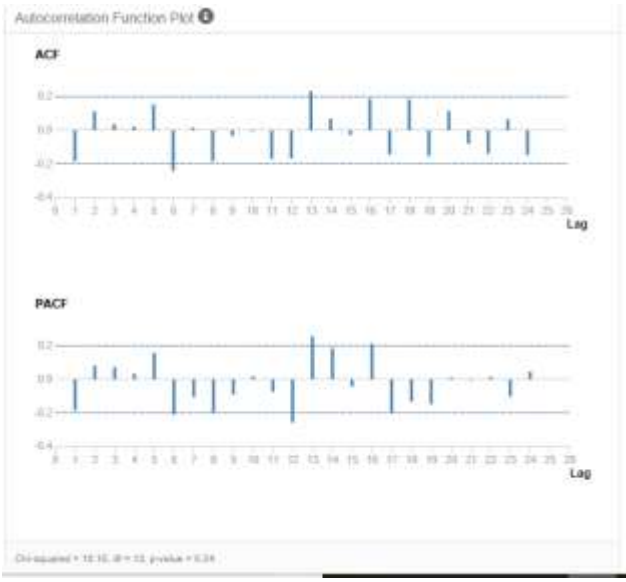
Method: ARIMA(1,0,0)(1,1,0)[12]

Information Criteria:

AIC	AICc	BIC
880.4445	881.4445	884.4411

In-sample error measures:

ME	RMSE	MAE	MPE	MAPE	MASE	ACF1
-102530.8278988	1042209.8520798	738087.5531171	-0.5465069	3.3006311	0.4120218	-0.1854462



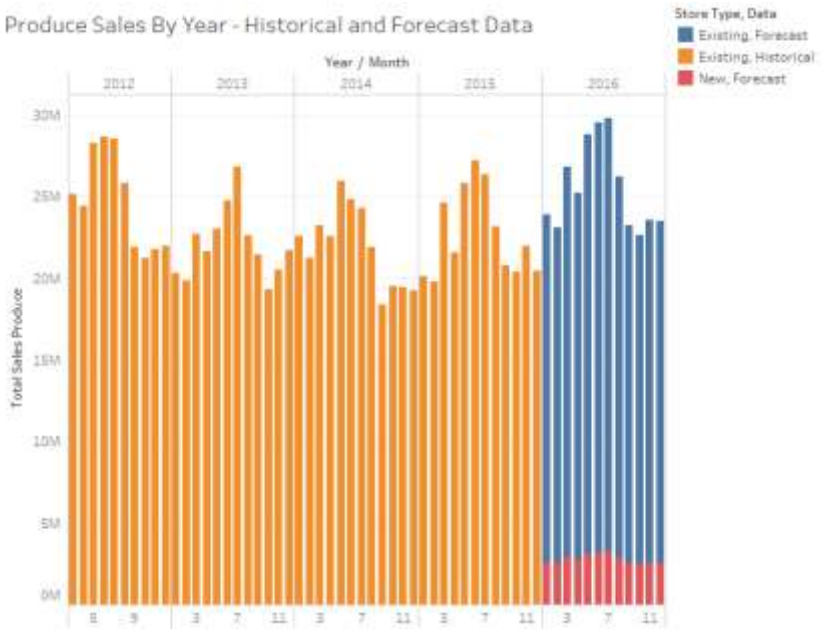
- Comparing the ETS model to the ARIMA model, the ETS model accuracy is more favorable than the ARIMA model.
- ETS RMSE value (948208.54) is lower than the ARIMA RMSE value (1042209.85).
- The ETS (M,N,M) model was selected for forecasting.

2. Please provide a table of your forecasts for existing and new stores. Also, provide visualization of your forecasts that includes historical data, existing stores forecasts, and new stores forecasts.

    - Below is a table of forecast sales for existing stores and new stores.

Month	Year	Existing Store Sales Forecast	New Store Sales Forecast
1	2016	21,298,345	2,600,355
2	2016	20,571,970	2,505,199
3	2016	23,883,412	2,889,940
4	2016	22,472,417	2,743,927
5	2016	25,650,806	3,110,814
6	2016	26,326,884	3,191,155
7	2016	26,541,048	3,219,370
8	2016	23,362,180	2,852,752
9	2016	20,677,598	2,543,602
10	2016	20,177,927	2,477,331
11	2016	20,984,723	2,569,170
12	2016	20,943,790	2,535,482

https://public.tableau.com/views/ProduceSalesByYear-HistoricalandForecastData/Dashboard1?:embed=y&:display_count=yes&publish=yes



Before you submit

Please check your answers against the requirements of the project dictated by the rubric. Reviewers will use this rubric to grade your project.