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Frito Lay Representative:
Jeff Arndt
Replenishment Manager

Management Summary

The opportunities presented to us for our Senior Design project include: Design and create out of stock tools that are very user friendly and are able to historically scan data while predicting inventory shortfall @ Club/SKU level. More features of this project include determining what Inventory is needed by Club/ SKU and determine Delivery Frequency by Club.

We decided that only these opportunities fell into the scope of our project. After consolidating all of the available information into one database we cleaned some of the unnecessary tables out so that it would increase the efficiency of us analyzing the Spy Reports that can be generated on any product by their current database queries. We only analyzed two of the highest demanded product lines that Frito Lay current keeps in stock at Sam's clubs nationwide. These two products are Smart Mix and Variety Mix.

We created a Seasonal Adjustment and Linear Exponential Smoothing model into an excel file that could automatically do every club's analysis. This gave us extreme flexibility and had the best potential for creating a very user friendly tool that could automatically change based on a drop down box connected to each Sam's Club Number and corresponding Sales data. Anyone could copy and paste the sales data given in any Spy Report by product line into the first tab and have instant analysis at the touch of their fingers.

Background and Description of the Problem Situation

Frito-Lay North America

Frito Lay is a division of PepsiCo, the leading convenient food and Beverage Company in North America. Frito-Lay is PepsiCo's largest North American division. FLNA makes, markets, sells and distributes branded snack foods. These foods include Lay's potato chips, Doritos tortilla chips, Cheetos cheese flavored snacks, Tostitos tortilla chips, branded dips, Fritos corn chips, Ruffles potato chips, Quaker Chewy granola bars and SunChips multigrain snacks. FLNA branded products are sold to independent distributors and retailers. In addition, FLNA's joint venture with Strauss Group makes, markets, sells and distributes Sabra refrigerated dips. FLNA's net revenue was approximated 31% of its total net revenue during the fiscal year ended December 26, 2009 (fiscal 2009). Frito Lay is the leading convenient foods company in North America. They have control of roughly 65% of the salty snack market. They have No. 1 brands in categories ranging from potato chips to tortilla chips to corn chips to snack bars. Frito Lay generates $11 billion in annual sales. They have more than 48,000 Frito-Lay associates across every state and Canada, including more than 30 plants and more than 16,000 sales routes.

Frito Lay is headquartered in Plano, Texas, right outside Dallas. Frito Lay has a rich 70-year history: Frito Company founded in 1932, Lay's introduced in 1938, H.W. Lay and Frito companies merged in 1961, Frito-Lay and Pepsi-Cola merged to form PepsiCo in 1965. Frito Lay makes, move and sell their products "from seed to shelf."

They contract with farmers to produce patented varieties of corn and potatoes to ensure the highest-quality ingredients. They have 30+ plants and 200 distribution centers

across the U.S. and Canada. They have one of the largest private fleets in North America. They have a virtually unrivaled distribution system that enables us to differentiate their products in the marketplace. Frito Lay is known for their "Direct Store Delivery" System the largest DSD system in North America. Frito Lay delivers their chips directly to stores to ensure freshness and merchandize themselves, which gives us a tremendous competitive advantage in the marketplace. Their go-to-market system also includes warehouse distribution, giving us additional flexibility that helps drive their strong partnerships with their customers.

Sam's Club Representative

Matt contacted the Sam's Club Representative Jeff Arndt at Frito Lay Headquarters to see if he had a Senior Design Project for us to work on. He presented us with a cluttered outdated database and OOS tools that were difficult to understand and analyze.

Opportunities presented:

1. Revamp / Design existing Out of Stock Tools
    a. Make them user friendly
2. Using historical scan data predict inventory shortfall @ Club/SKU level
3. Determine what is the Inventory needed by Club/ SKU
4. Determine Delivery Frequency by Club
5. Solve for Negative Inventories

Project Goals:

1. Establish database criteria using information obtained from OOS report and incorporating the DC/Bin/Plant Inventory and future Orders/ Shipments.

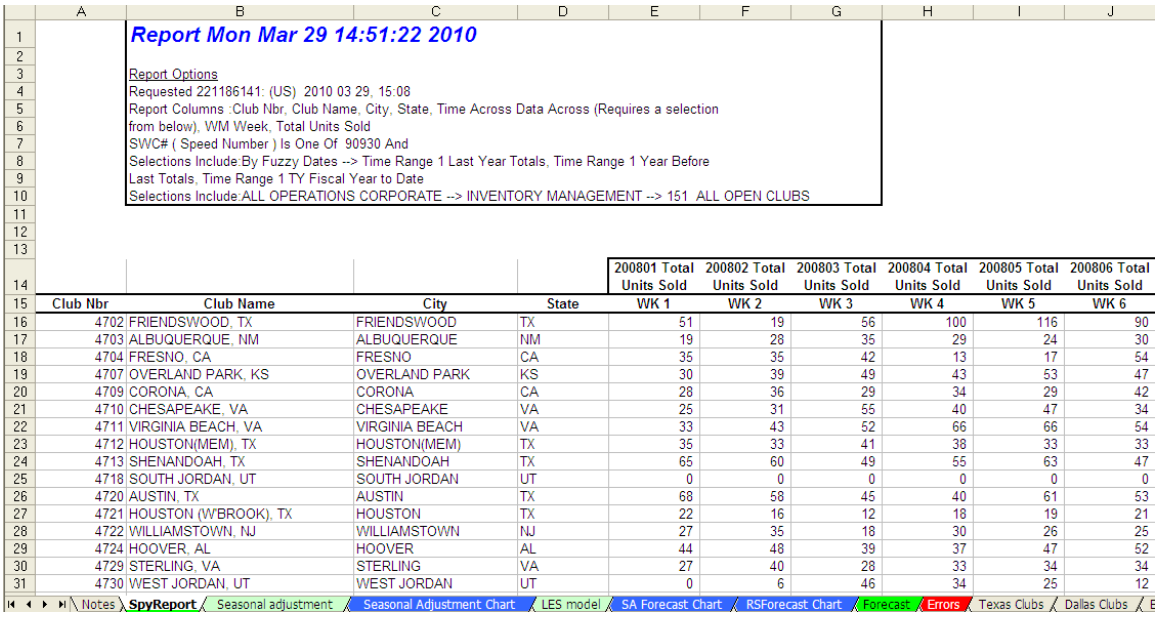
2. Design Canned Reports
3. Application functionality: Integration of Frito Lay and Wal-Mart Inc Data
    a. Consolidate all into one Data Base / Server
    b. Minimize Human Intervention: Filters / Clean Data / Automation
    c. Drop Data in server
        i. Select Report
        ii. Geo/National/ Building

Decision

After being presented with all of these goals we met with Dr. Barr and he decided that only some of these points fell into the scope of our project. The main points we focused on were Opportunities #'s 1, 2, 3, and 4. After updating their databases and cleaning those out we were ready to analyze the Spy Reports that can be generated on any product by their current database queries.

We decided to work on the two highest demanded product lines that Frito Lay current keeps in stock at Sam's clubs nationwide. These two products are Smart Mix and Variety Mix. Smart Mix and Classic Variety Mix can be found below.

The current spy report that Regional Sales Representatives as well as Frito Lay Sam's Club representatives use can be found below.



Report Mon Mar 29 14:51:22 2010

Report Options
Requested 221186141: (US) 2010 03 29, 15:08
Report Columns :Club Nbr, Club Name, City, State, Time Across Data Across (Requires a selection from below), WM Week, Total Units Sold
SWC# (Speed Number) Is One Of 90930 And
Selections Include:By Fuzzy Dates --> Time Range 1 Last Year Totals, Time Range 1 Year Before Last Totals, Time Range 1 TY Fiscal Year to Date
Selections Include:ALL OPERATIONS CORPORATE --> INVENTORY MANAGEMENT --> 151 ALL OPEN CLUBS

				200801 Total Units Sold	200802 Total Units Sold	200803 Total Units Sold	200804 Total Units Sold	200805 Total Units Sold	200806 Total Units Sold
Club Nbr	Club Name	City	State	WK 1	WK 2	WK 3	WK 4	WK 5	WK 6
4702	FRIENDSWOOD, TX	FRIENDSWOOD	TX	51	19	56	100	116	90
4703	ALBUQUERQUE, NM	ALBUQUERQUE	NM	19	28	35	29	24	30
4704	FRESNO, CA	FRESNO	CA	35	35	42	13	17	54
4707	OVERLAND PARK, KS	OVERLAND PARK	KS	30	39	49	43	53	47
4709	CORONA, CA	CORONA	CA	28	36	29	34	29	42
4710	CHESAPEAKE, VA	CHESAPEAKE	VA	25	31	55	40	47	34
4711	VIRGINIA BEACH, VA	VIRGINIA BEACH	VA	33	43	52	66	66	54
4712	HOUSTON(MEM), TX	HOUSTON(MEM)	TX	35	33	41	38	33	33
4713	SHENANDOAH, TX	SHENANDOAH	TX	65	60	49	55	63	47
4718	SOUTH JORDAN, UT	SOUTH JORDAN	UT	0	0	0	0	0	0
4720	AUSTIN, TX	AUSTIN	TX	68	58	45	40	61	53
4721	HOUSTON (W'BROOK), TX	HOUSTON	TX	22	16	12	18	19	21
4722	WILLIAMSTOWN, NJ	WILLIAMSTOWN	NJ	27	35	18	30	26	25
4724	HOOVER, AL	HOOVER	AL	44	48	39	37	47	52
4729	STERLING, VA	STERLING	VA	27	40	28	33	34	34
4730	WEST JORDAN, UT	WEST JORDAN	UT	0	6	46	34	25	12

Notes | SpyReport | Seasonal adjustment | Seasonal Adjustment Chart | LES model | SA Forecast Chart | RSForecast Chart | Forecast | Errors | Texas Clubs | Dallas Clubs

We hoped to create a extremely user friendly analysis of all 597 Sam's club at the push of a button, so that any RSR(Regional Sales Representative), RSM (Regional Sales Manager) or Sam's Club representative could look at their weekly sales in a very visual and easily manageable tool.

Analysis of the Situation

Our first approach focused on using existing Time Series Forecasting tools offered by Dr. Barr. This allowed us to enter in which ever club's sales data we wanted to analyze.

Smoothie: Time-Series Forecasting

Model Input Form

Enter model title:

Sams Club Sales Analysis

Input time-series data here, separated by blanks:

```
31    48    43    40    33    33    39    34    43    36
25    38    34    27    20    29    34    16    23    34
44    39    34    33    47    30    39    32    38    45
37    44    20    43    46    39    43    52    32    38
36    30    23    27    32    25    31    33    34    36
56    59    33    40    34    41    51    46    38    43
51    25    30    42    37    29    40    44    23    15
22    54    46    40    43    32    35    35    47    41
44    42    49    17
```

Enter number of observations for MSE calculation (0 = maximum) 0

Select forecasting model and parameters

- ○ Moving average: time periods = 4
- ○ Exponential smoothing (single): α [0,1] = 0.5
- ○ Smoothing with trend (double): α [0,1] = 0.5, β [0,1] = 0.3
- ○ Trend
- ○ Arithmetic mean
- ◉ Decomposition : Weekly

Run Smoothie

Smoothie: Time-Series Forecasting

Sams Club Sales Analysis

Original data:

```
31 27 31 29 40 31 40 36 26 29 29 37 36 41 41 20 43 30 30 21 29 27 16 22 26 27 41 34 38 41 31 48 43 40 33 33 39 34 43 36 25 38 34 27 20 29 34 16 23 34 44 39
34 33 47 30 39 32 38 45 37 44 20 43 46 39 43 52 32 38 36 30 23 27 32 25 31 33 34 36 56 59 33 40 34 41 51 46 38 43 51 25 30 42 37 29 40 44 23 15 22 54 46 40
43 32 35 35 47 41 44 42 49 17
```

./smoothie D 0 W

Smoothie output:

```
*** SMOOTHIE: INTERACTIVE TIME-SERIES FORECASTING ***


114 observations were read

Number of observations to use in the mean error calculation: MAX

        *** TIME SERIES DECOMPOSITION ***

This data is Weekly

Trend equation:  T = 30.389601 + 0.086956 * Period
Sample coefficient of determination (R-squared) = 0.989952

Season       Seasonal Index
------       --------------
Week 1             0.9649
Week 2             0.9378
Week 3             1.3283
Week 4             0.8396
Week 5             1.0856
Week 6             0.8922
Week 7             1.0644
Week 8             1.2632
Week 9             1.0333
Week 10            1.2186
Week 11            0.5521
Week 12            1.1845
Week 13            1.2615
Week 14            1.0704
Week 15            1.1820
Week 16            1.4260
Week 17            0.8759
Week 18            1.0388
Week 19            0.9784
Week 20            0.8079
Week 21            0.6188
Week 22            0.7287
Week 23            0.8640
Week 24            0.6717
Week 25            0.8282
Week 26            0.8809
Week 27            1.0787
Week 28            0.9961
Week 29            1.3215
Week 30            1.4052
Week 31            0.9060
Week 32            1.2528
Week 33            1.0965
Week 34            1.1420
Week 35            1.1643
Week 36            1.0972
Week 37            1.1549
Week 38            1.0077
Week 39            1.2687
Week 40            1.0597
Week 41            0.7359
Week 42            1.1079
Week 43            0.9854
Week 44            0.7832
Week 45            0.5779
Week 46            0.8344
Week 47            0.9775
Week 48            0.4608
Week 49            0.6594
Week 50            0.9697
Week 51            1.2521
Week 52            1.1065

Unmodified means used in seasonal index calculations
Mean irregular index = 1.005399
```

D E C O M P O S I T I O N S U M M A R Y

Period	Actual	Trend	Seasonal	Cyclical	Forecast	Error
27	41.000	32.737	1.079	0.995	35.315	5.685
28	34.000	32.824	0.996	0.995	32.696	1.304
29	38.000	32.911	1.321	0.999	43.492	-5.492
30	41.000	32.998	1.405	1.001	46.370	-5.370
31	31.000	33.085	0.906	0.998	29.975	1.025
32	48.000	33.172	1.253	0.996	41.558	6.442
33	43.000	33.259	1.096	0.993	36.468	6.532
34	40.000	33.346	1.142	0.992	38.083	1.917
35	33.000	33.433	1.164	0.995	38.927	-5.927
36	33.000	33.520	1.097	1.000	36.777	-3.777
37	39.000	33.607	1.155	0.999	38.814	0.186
38	34.000	33.694	1.008	0.996	33.955	0.045
39	43.000	33.781	1.269	0.998	42.857	0.143
40	36.000	33.868	1.060	0.998	35.891	0.109
41	25.000	33.955	0.736	0.995	24.988	0.012
42	38.000	34.042	1.108	1.002	37.714	0.286
43	34.000	34.129	0.985	1.006	33.632	0.368
44	27.000	34.216	0.783	1.002	26.798	0.202
45	20.000	34.303	0.578	1.004	19.823	0.177
46	29.000	34.390	0.834	1.005	28.696	0.304
47	34.000	34.477	0.977	1.003	33.700	0.300
48	16.000	34.563	0.461	0.999	15.926	0.074
49	23.000	34.650	0.659	1.001	22.849	0.151
50	34.000	34.737	0.970	1.004	33.684	0.316
51	44.000	34.824	1.252	1.004	43.604	0.396
52	39.000	34.911	1.106	1.004	38.629	0.371
53	34.000	34.998	0.965	1.001	33.769	0.231
54	33.000	35.085	0.938	0.998	32.903	0.097
55	47.000	35.172	1.328	1.001	46.721	0.279
56	30.000	35.259	0.840	1.008	29.604	0.396
57	39.000	35.346	1.086	1.011	38.373	0.627
58	32.000	35.433	0.892	1.007	31.614	0.386
59	38.000	35.520	1.064	1.000	37.807	0.193
60	45.000	35.607	1.263	0.995	44.978	0.022
61	37.000	35.694	1.033	0.998	36.882	0.118
62	44.000	35.781	1.219	1.004	43.602	0.398
63	20.000	35.868	0.552	1.004	19.804	0.196
64	43.000	35.955	1.185	1.004	42.590	0.410
65	46.000	36.042	1.261	1.006	45.466	0.534
66	39.000	36.129	1.070	1.003	38.671	0.329
67	43.000	36.216	1.182	0.999	42.808	0.192
68	52.000	36.303	1.426	0.999	51.768	0.232
69	32.000	36.390	0.876	0.999	31.875	0.125
70	38.000	36.477	1.039	0.997	37.891	0.109
71	36.000	36.563	0.978	1.001	35.775	0.225
72	30.000	36.650	0.808	1.008	29.611	0.389
73	23.000	36.737	0.619	1.006	22.732	0.268
74	27.000	36.824	0.729	1.001	26.832	0.168
75	32.000	36.911	0.864	0.998	31.893	0.107
76	25.000	36.998	0.672	1.001	24.852	0.148
77	31.000	37.085	0.828	1.004	30.713	0.287
78	33.000	37.172	0.881	1.002	32.746	0.254
79	34.000	37.259	1.079	1.003	40.192	-6.192
80	36.000	37.346	0.996	1.002	37.200	-1.200
81	56.000	37.433	1.321	0.997	49.468	6.532
82	59.000	37.520	1.405	0.993	52.724	6.276
83	33.000	37.607	0.906	0.994	34.071	-1.071
84	40.000	37.694	1.253	0.996	47.223	-7.223
85	34.000	37.781	1.096	0.997	41.425	-7.425
86	41.000	37.868	1.142	0.996	43.247	-2.247
87	51.000	37.955	1.164	0.996	44.192	6.808
88	46.000	38.042	1.097	0.990	41.738	4.262

Forecast based on trend and seasonal only
Mean squared error for periods 27 through 88 = 8.619248

It was a pretty straight forward approach but was not efficient enough for us to use for all 597 clubs for both products. That would have involved a lot of manual importing and exporting that did not provide our audience with an efficient tool that could be used by everyone.

The next approach we took was using SAS in the economic department. It was very tedious and tiring processes that eventually lead us to try a new approach. We were able to get some useful weekly analysis regarding the Means procedure. This was our first attempt to analyze weekly trends in the data.

The SAS System

The MEANS Procedure

Variable	N	Mean	Std Dev	Minimum	Maximum
Week1	592	33.6351351	16.7946284	0	106
Week2	592	33.7347973	17.9368776	0	127
Week3	592	33.8378378	17.6592312	0	100
Week4	592	36.3648649	18.430332	0	112
Week5	592	38.4138514	19.6932314	0	116
Week6	592	39.8023649	19.8763469	0	146
Week7	592	36.4915541	18.8552217	0	155
Week8	592	32.9408784	16.3100734	0	102
Week9	592	29.5523649	15.709739	0	117
Week10	592	37.2837838	18.8844704	0	115
Week11	592	36.2077703	18.9102182	0	158
Week12	592	37.2787162	19.1945693	0	130
Week13	592	37.152027	19.0501306	0	140
Week14	592	37.5608108	18.4020621	0	115
Week15	592	37.1942568	17.8610287	0	103
Week16	592	34.3969595	17.6478868	0	113
Week17	592	34.6064189	17.3763602	0	107
Week18	592	29.027027	14.8756588	0	87
Week19	592	33.7753378	17.7501517	0	122
Week20	592	31.9915541	16.4189522	0	92
Week21	592	31.4054054	16.4931767	0	113
Week22	592	31.5608108	16.586124	0	123

Week23	592	29.6942568	15.1984983	0	119
Week24	592	27.9239865	14.0624411	0	117
Week25	592	30.4408784	15.1572653	0	129
Week26	592	29.3581081	15.03859	0	108
Week27	592	30.6469595	16.0015447	-21	108
Week28	592	33.6570946	19.460724	0	135
Week29	592	36.6993243	21.8179857	0	163
Week30	592	39.8108108	22.1534722	0	179
Week31	592	41.0861486	23.0407792	0	162
Week32	592	35.9847973	18.9732586	0	134
Week33	592	35.1013514	18.651761	0	118
Week34	592	35	19.0371442	0	133
Week35	592	34.9831081	20.4125733	0	177
Week36	592	35.2466216	17.7201403	0	133
Week37	592	34.6756757	17.5500122	0	107
Week38	592	32.5219595	16.5113771	0	126
Week39	592	32.1722973	16.4310808	0	108
Week40	592	31.5912162	16.4735893	0	120
Week41	592	30.0591216	15.6315947	0	104
Week42	592	29.0743243	14.6272773	0	101
Week43	592	27.5743243	13.8576721	0	88
Week44	592	17.7027027	9.4205805	0	56
Week45	592	25.4459459	13.1655006	-3	71
Week46	592	23.9814189	12.7125446	-16	66
Week47	592	20.1689189	10.990929	0	70
Week48	592	10.8766892	6.167158	0	37
Week49	592	17.5304054	9.6308736	0	74
Week50	592	35.8733108	18.4369552	0	113
Week51	592	33.1756757	17.0304659	0	100
Week52	592	31.9864865	16.1686277	0	89
Week53	592	30.3125	15.1672675	0	84
Week54	592	32.4459459	16.3621385	0	101
Week55	592	32.9560811	17.1450889	0	101
Week56	592	31.7533784	16.8550099	0	133
Week57	592	32.339527	16.8221892	0	122

Week58	592	34.8800676	18.1793325	0	119
Week59	592	32.7415541	16.277597	0	104
Week60	592	32.4763514	16.5135267	0	107
Week61	592	33.285473	16.8370691	0	129
Week62	592	35.2195946	17.7213558	0	122
Week63	592	34.0641892	17.3444043	0	101
Week64	592	30.3986486	14.8621368	0	91
Week65	592	36.8817568	18.0880401	0	112
Week66	592	35.9932432	17.374543	0	98
Week67	592	37.9611486	18.0646567	0	100
Week68	592	35.9425676	17.257287	0	108
Week69	592	36.3158784	18.5151847	0	119
Week70	592	31.3074324	15.9103903	0	114
Week71	592	37.8902027	19.3272584	0	134
Week72	592	36.2398649	18.4115363	0	113
Week73	592	34.7077703	17.7115659	0	133
Week74	592	31.7364865	16.4001822	0	139
Week75	592	33.9932432	17.1097766	0	116
Week76	592	29.3969595	15.0258499	0	132
Week77	592	33.339527	16.1274931	0	87
Week78	592	32.5135135	16.3955904	0	111
Week79	592	32.0101351	14.9472813	0	113
Week80	592	36.785473	17.9401032	0	103
Week81	592	38.2820946	19.9936492	0	135
Week82	592	41.0945946	21.2651738	0	157
Week83	592	43.25	21.2123659	0	140
Week84	592	44.5489865	21.3395948	0	149
Week85	592	41.1993243	19.5299449	0	113
Week86	592	42.4679054	19.7798967	0	131
Week87	592	41.8209459	20.2869024	0	126
Week88	592	43.8006757	21.1751411	0	123
Week89	592	44.7601351	19.9903504	0	124
Week90	592	42.0439189	20.0488767	0	133
Week91	592	39.8716216	18.4623934	0	119
Week92	592	39.3243243	19.1210292	0	102

Week93	592	39.8783784	18.4071844	0	118
Week94	592	39.3277027	18.5228823	0	125
Week95	592	38.1689189	17.8191283	0	106
Week96	592	23.964527	11.5442396	0	81
Week97	592	35.4391892	16.4584187	0	97
Week98	592	34.7956081	16.3288057	0	96
Week99	592	29.2905405	13.9623634	0	88
Week100	592	16.3513514	8.4668078	0	52
Week101	592	24.6148649	11.9243377	0	82
Week102	592	52.4915541	23.8469442	0	155
Week103	592	50.9408784	23.4156488	0	177
Week104	592	44.2719595	21.3999547	0	137
Week105	592	43.3226351	20.5309134	0	130

We discovered that the standard deviation remained high as the average mean increased. We also noticed that there were certain weeks that were on average significantly lower. At the end of the year the average sales data dropped dramatically, also certain weeks of the year had significantly lower max sales. There was slight confusion when we discovered negative sales; we were unable to discover the route of this error. We think that it may be because of human error.

Our last approach, which finally pointed us in the right direction, was creating a Seasonal Adjustment and Linear Exponential Smoothing model into an excel file that could automatically do every club's analysis. This would give us extreme flexibility and had the best potential for creating a very user friendly tool that could automatically change based on a drop down box connected to each Sam's Club Number and corresponding Sales data.

Technical Description of the Model

In order to perform the necessary seasonal adjustments and fit exponential smoothing models, we used a spreadsheet program, specifically, Excel. The screen images, charts and graphs below are taken from spreadsheets which have been set up to illustrate multiplicative seasonal adjustments and linear exponential smoothing on the sales data we received from Frito Lay.

The forecasting process has three main steps:

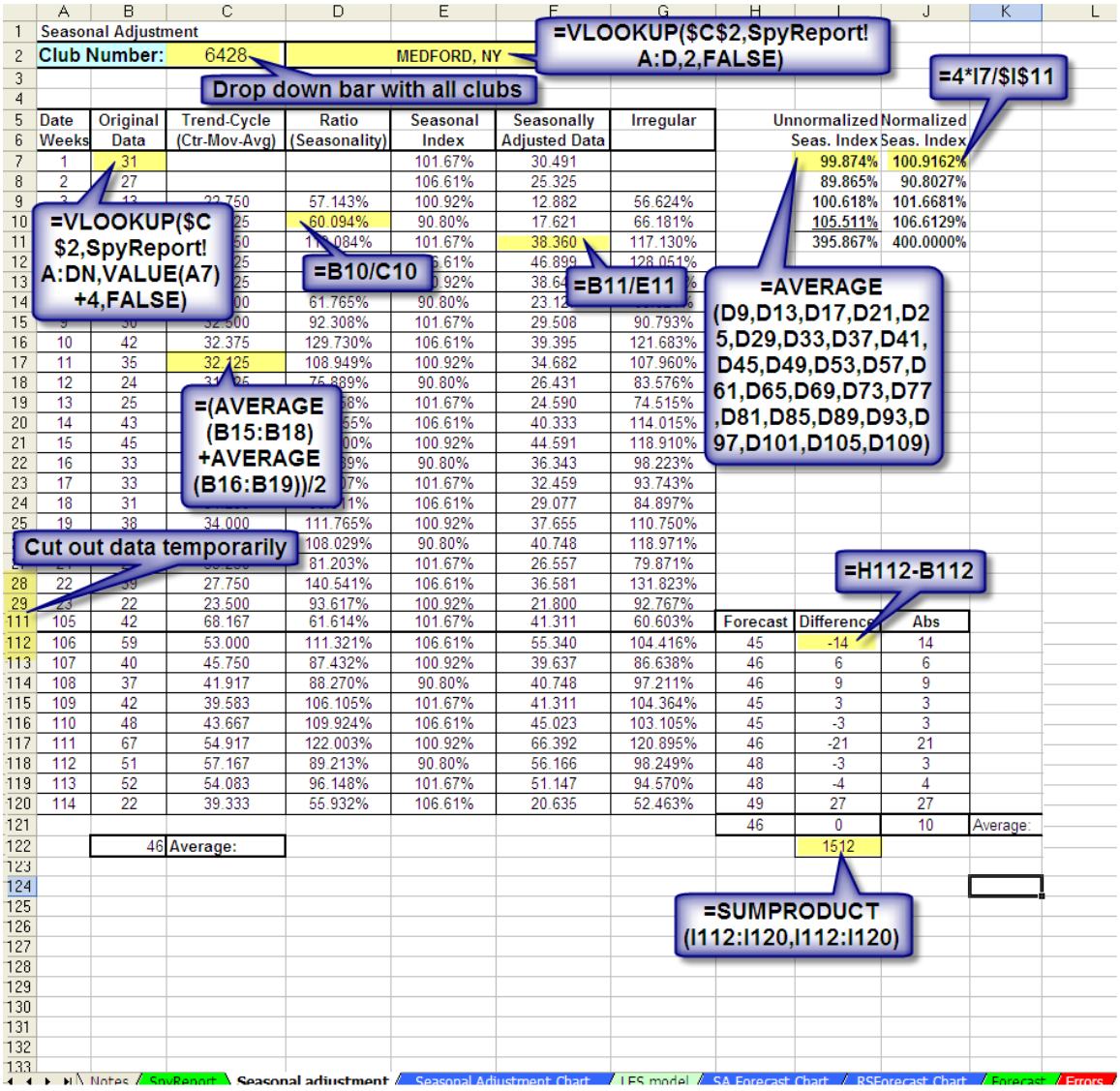
1. first the data was seasonally adjusted
2. then forecasts are generated for the seasonally adjusted data via linear exponential smoothing
3. finally the seasonally adjusted forecasts are "re-seasonalized" to obtain forecasts for the original series

The first step to create this seasonal adjustment is to compute a centered moving average. This can be done by simply taking the average of two one-year averages that are offset by one period relative to each other. The next step is to compute the ratio to moving average, which is the original data divided by the moving average in each period.

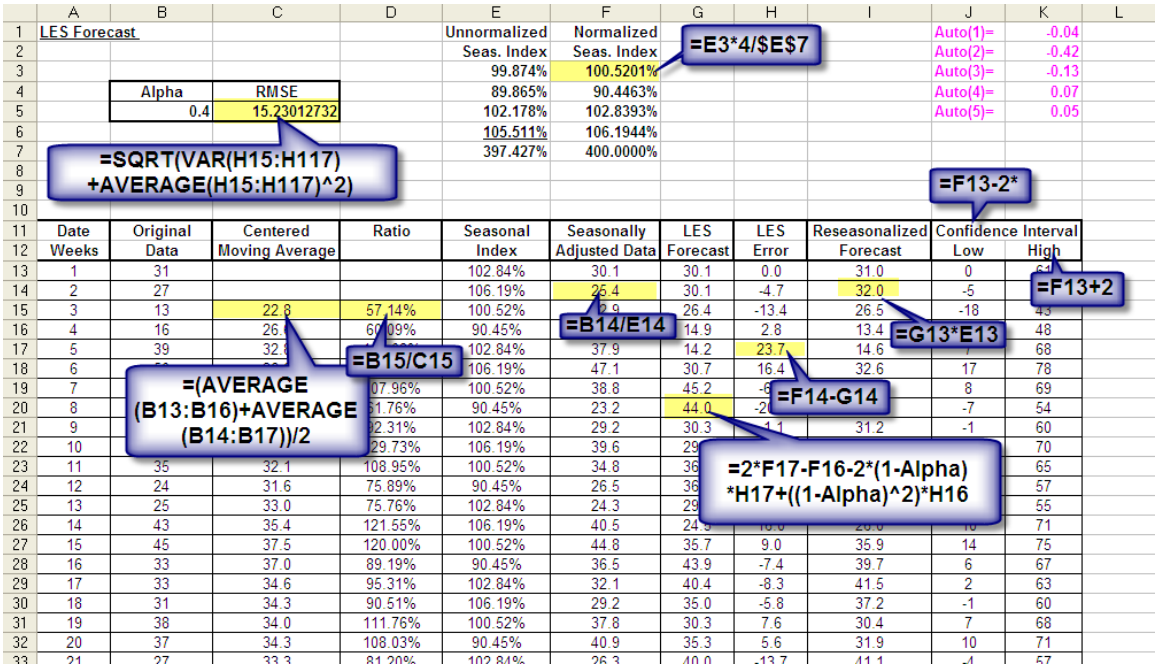
Moving Average: $MA(4) = .25Y_t + .25Y_{t-1} + .25Y_{t-2} + .25Y_{t-3} + .25Y_{t-4}$

The centered moving average and the seasonally adjusted data end up looking like this:

Note that the moving average typically looks like a smoothed version of the seasonally adjusted series.



All formulas were shown on the above image except for the Irregular column. This was created by setting G9=F9/C9. This means that Irregular = Seasonally Adjusted Data/Centered Moving Average.

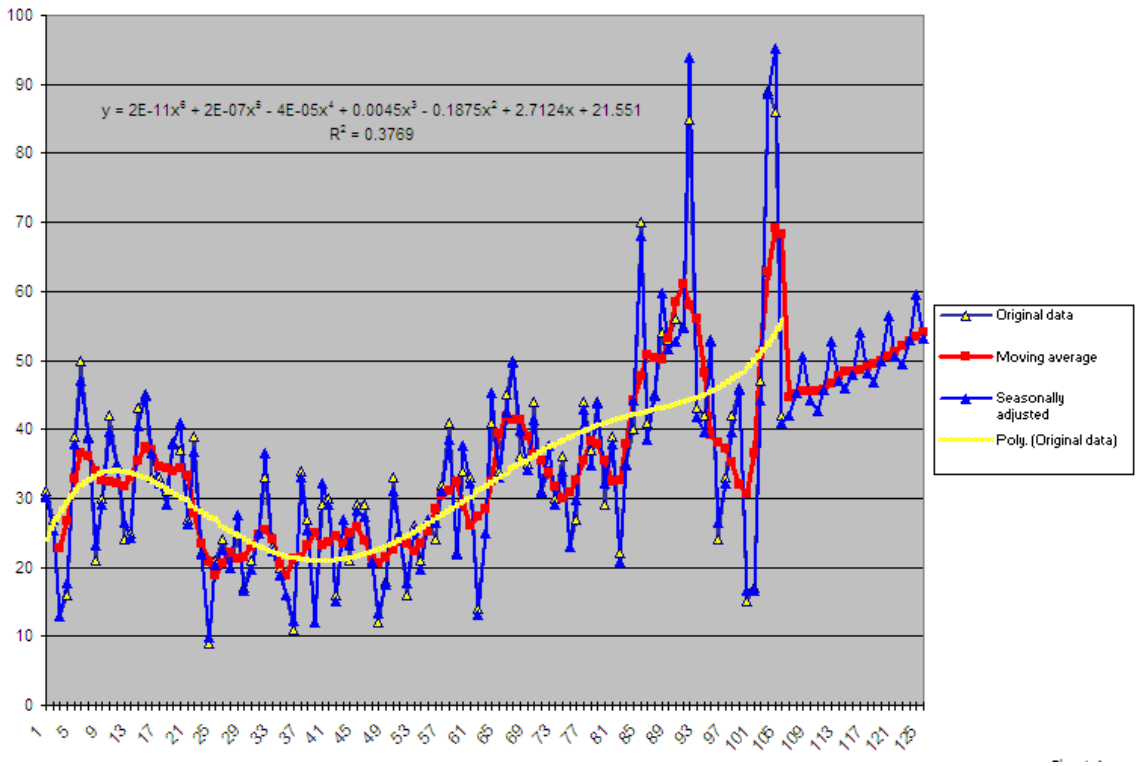


	A	B	C	D	E	F	G	H	I	J	K	L
1	LES Forecast				Unnormalized	Normalized				Auto(1)=	-0.04	
2					Seas. Index	Seas. Index				Auto(2)=	-0.42	
3					99.874%	100.5201%				Auto(3)=	-0.13	
4		Alpha	RMSE		89.865%	90.4463%				Auto(4)=	0.07	
5		0.4	15.23012732		102.178%	102.8393%				Auto(5)=	0.05	
6					105.511%	106.1944%						
7					397.427%	400.0000%						
8												
9												
10												
11	Date	Original	Centered	Ratio	Seasonal	Seasonally	LES	LES	Reseasonalized	Confidence Interval		
12	Weeks	Data	Moving Average		Index	Adjusted Data	Forecast	Error	Forecast	Low	High	
13	1	31			102.84%	30.1	30.1	0.0	31.0	0	61	
14	2	27			106.19%	25.4	30.1	-4.7	32.0	-5	57	
15	3	13	22.8	57.14%	100.52%	12.9	26.4	-13.4	26.5	-18	43	
16	4	16	26.1	61.09%	90.45%	17.7	14.9	2.8	13.4	8	48	
17	5	39	32.3	120.74%	102.84%	37.9	14.2	23.7	14.6	7	68	
18	6				106.19%	47.1	30.7	16.4	32.6	17	78	
19	7			107.96%	100.52%	38.8	45.2	-6		8	69	
20	8			61.76%	90.45%	23.2	44.0	-2		-7	54	
21	9			92.31%	102.84%	29.2	30.3	-1	31.2	-1	60	
22	10			129.73%	106.19%	39.6	29				70	
23	11	35	32.1	108.95%	100.52%	34.8	36				65	
24	12	24	31.6	75.89%	90.45%	26.5	36				57	
25	13	25	33.0	75.76%	102.84%	24.3	29				55	
26	14	43	35.4	121.55%	106.19%	40.5	24				71	
27	15	45	37.5	120.00%	100.52%	44.8	35.7	9.0	35.9	14	75	
28	16	33	37.0	89.19%	90.45%	36.5	43.9	-7.4	39.7	6	67	
29	17	33	34.6	95.31%	102.84%	32.1	40.4	-8.3	41.5	2	63	
30	18	31	34.3	90.51%	106.19%	29.2	35.0	-5.8	37.2	-1	60	
31	19	38	34.0	111.76%	100.52%	37.8	30.3	7.6	30.4	7	68	
32	20	37	34.3	108.03%	90.45%	40.9	35.3	5.6	31.9	10	71	
33	21	27	33.3	81.20%	102.84%	26.3	40.0	-13.7	41.1	-4	57	

The root mean squared average was created to analyze the error for the Linear Exponential Smoothing. The definition is located in the image above. Our Linear Exponential Smoothing model took into account the seasonally adjusted data as retrospect to the previous LES Error and alpha.

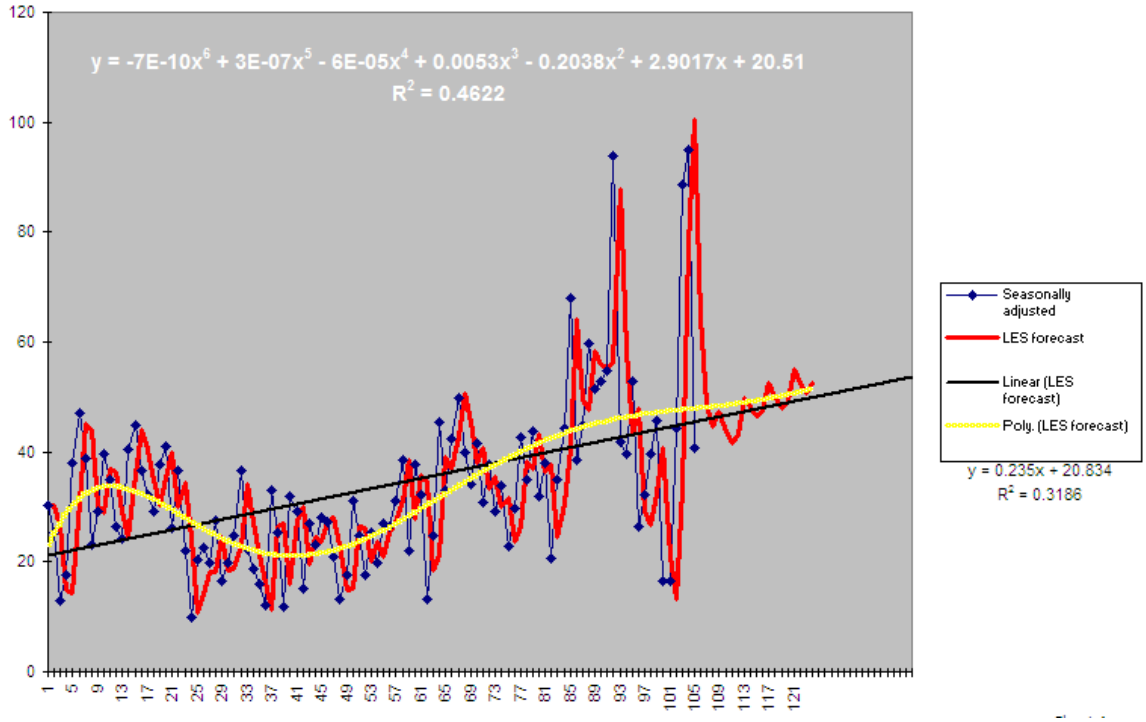
Analysis and Managerial Interpretation

The following graph is the first tool that we have developed to analyze the original data of the Sam's club weekly sales for the specific Club Number and location. The seasonally adjusted graph seems to map over the original data entirely.

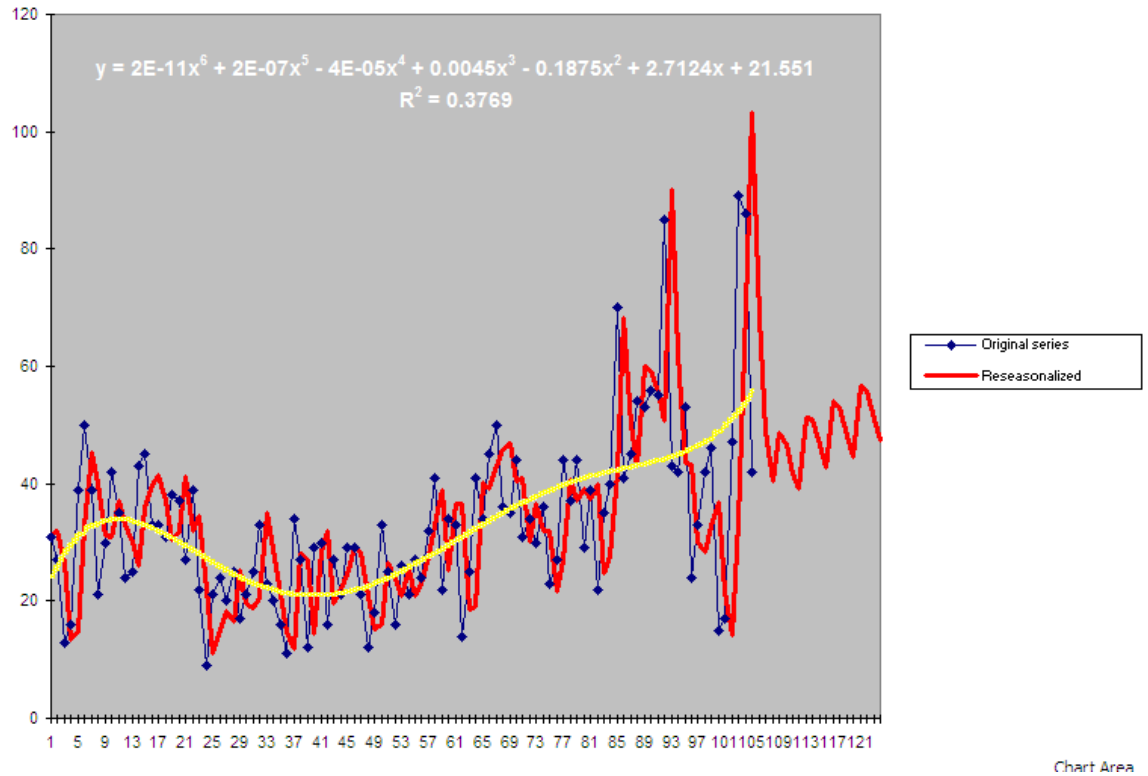


The moving average appears to be a less obtrusive way to look at the corresponding data. We can notice here that there appeared to be a large dip in the data weeks before each New Year. Some of these spikes are surges created from a specific event or holiday. Super bowl, New Year's, Labor Day weekend, Olympics, etc…

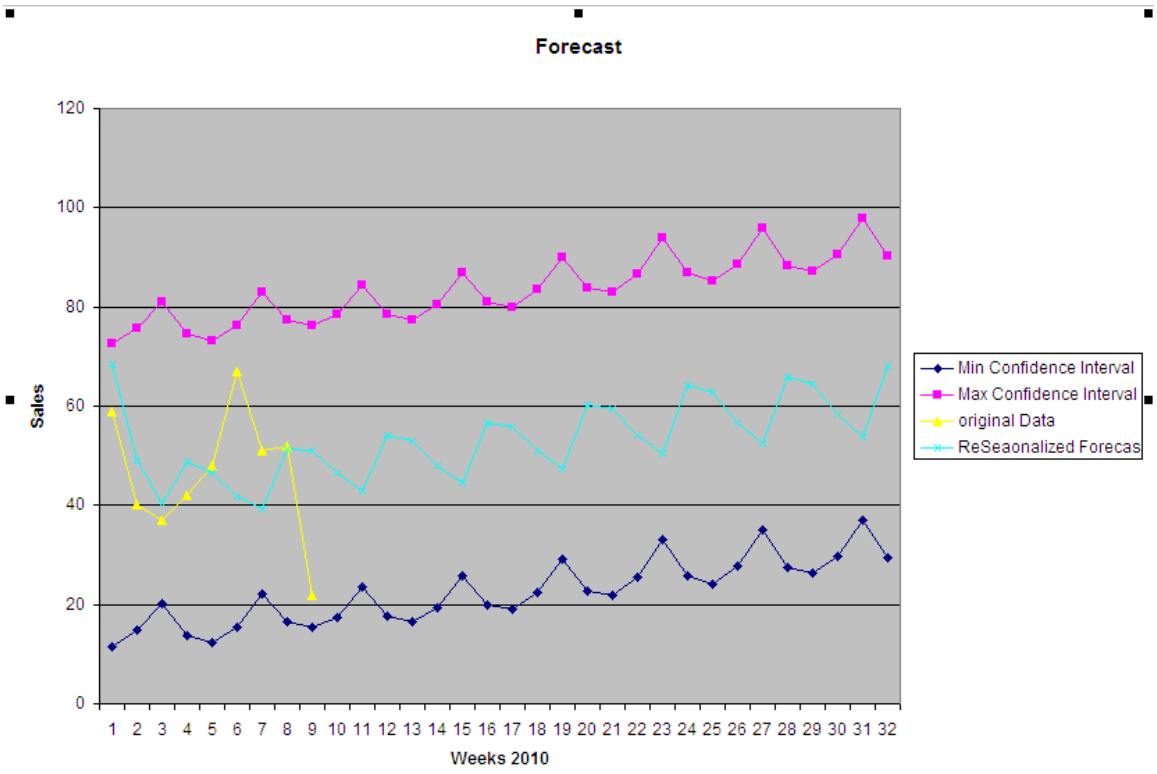
We noticed that the increase in audience for a specific show or sporting event on TV lead to an increase in weekly sales at Sam's Club. People tended to have more house parties and buy bigger bags of food that were typically sold at Sam's Club. We realized that most parties had a couple of Frito Lay products because they consumed the general majority of the Snack Industry. This gave us more variables to consider when doing our future forecast.



This graph leaves out the original data and compares the Seasonally Adjusted data to the Linear Exponential Smoothing data. We thought that we could better look at the trends if we incorporated a trend analysis as well as a polynomial trend analysis to the 6th order based on the LES Forecast.



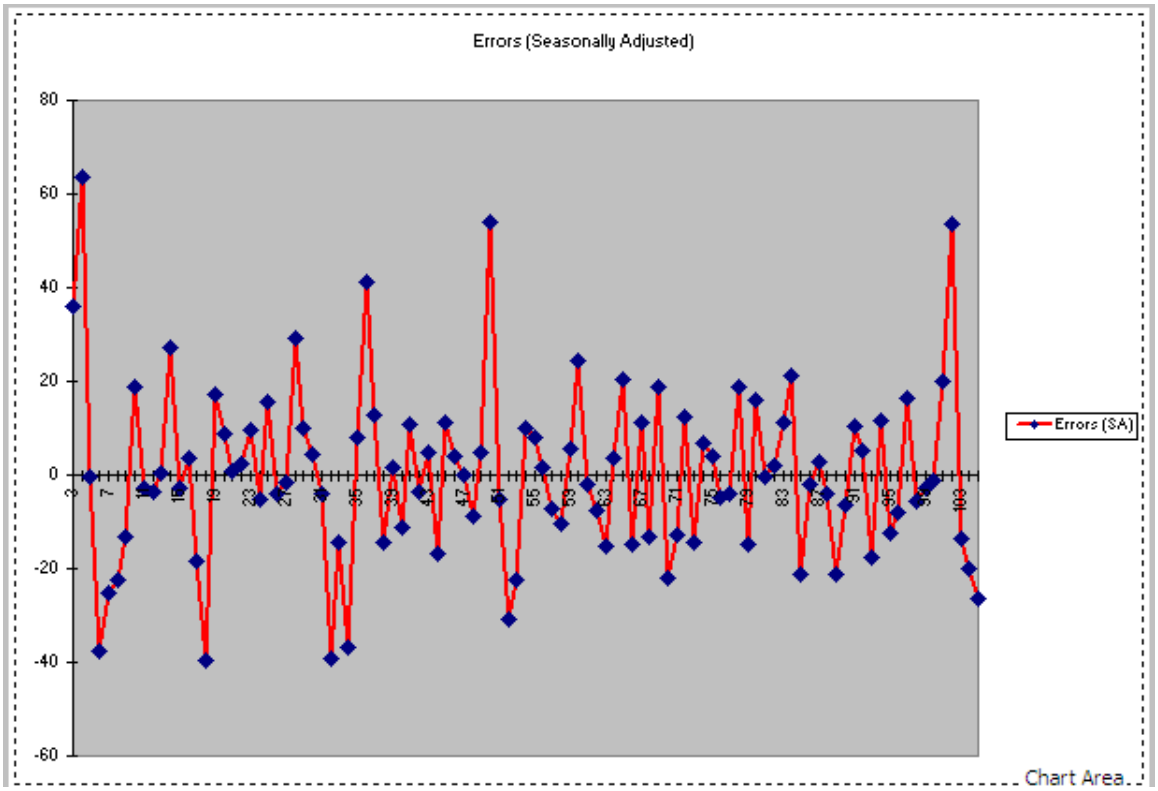
After re-seasonalizing the data we pushed out the horizon 3 weeks to see what its future forecast would look like. This was not the best graph to look at for future forecasting because it didn't have a direct comparison to the original data or the confidence intervals. This is why we created the below chart because it is very specific in its analysis purpose.



*You can see our example of the spike in sales the week of the super bowl.

This graph accurately shows how our Reseasonalized forecast stays in between the confidence intervals. We also noticed that this club seemed to stay in the same intervals as well. We found this type of analysis most useful when comparing direct forecast accuracy to original data. As well as analyzing trends

The Errors graph measures the accuracy of the Seasonally Adjusted Data. This gave us a chance to manage the scope of our forecasts so that we could reduce our errors per week. It also allowed us to analyze the weekly trend and see if these weekly spikes were caused by an outside variable that needed to be calculated into forecast.



Managerial Interpretation

On a managerial level, our analysis and findings, if taken seriously, can be used to help solve some of Frito Lay's current OOS issues that they are having with Sam's Club. Primarily, using the sales analysis' that we've created, Frito Lay managers, Sam's Club representatives, RSRs, RSMs, and anyone else in the replenishment department can access past sales data and get sales forecasts, complete with visual aids to help show relationships between data over trends of time. With this information readily available and extremely user friendly, product and/or sales reports can be created with the greatest of ease. Our findings will help Frito Lay set appropriate minimum inventory levels for specific SKUs at specific Clubs, and therefore hopefully avoid any further OOS fines. Along with establishing more efficient minimum inventory levels, proper delivery frequencies (by Club

and SKU) can also be calculated using the information provided by the analysis. To sum it all up, we found a way to process and analyze Frito Lay's past sales data and generate rather accurate forecasts and reports.

Conclusions and Critiques

As a whole, we found this project to be extremely successful and hopefully useful to Frito Lay. It is now easier for Frito employees to access and manipulate sales data in order to generate reports and forecasts. These forecasts, inside the confidence interval, will be very helpful when it comes to product replenishment. Appropriate individual (per SKU per Club) minimum inventory levels can be set for products that either sell out fast or stay on the shelf, so as to avoid fines by staying on top of local demand trends, which are not taken into account with the current inventory minimum of 11 units for all SKUs.

We think it would be greatly beneficial for Frito Lay to update their replenishment databases to the latest version of access. Their current version, which is 2003, is definitely something that will hurt them in the future. Technology is just going to keep advancing, and the only way to fully maximize their business potential is to have access to the best resources out there. We also recommend that Frito Lay keep farther back records of past sales data that they keep for analysis and forecasting. Currently they keep the past three years of data, which is what has been used for our forecasting models. However accurate these models are now, they would be more accurate, with more past data. Even keeping an additional two years, making the total five, would be a tremendous change.