Spend Analytics

Poultry Farm Data

Objective

- Analyse and classify the spend data for the procurement function of a company. This will enable the company to identify the scope for efficiency improvement and better strategic planning.
  1. Analyse the data and identify purchasing trends and patterns
  2. Cluster items that have similar purchasing patterns
  3. Identify the cost saving opportunities by using the data of procurement
  4. Make a report describing all the findings.

Spend Analytics - Process

About the data

- We started with generating a report on the data
  - Business
    - How much Value spent
    - How many Purchase Orders
    - Date Spread
  - Technical
    - Volume of data
    - Percentage Missing values
    - Percentage of Zero Values
    - Features with single value
- Tool Used - Python

Data Preprocessing

- Filtered out data and kept only for Year 2018 and 2019
- Removed 0 Gross Value Observations
- Removed features with
  - more than 90% Null value
  - single value only
- Imputed missing values for some features
- Tool used - Python

EDA

- We explored data to answer questions –
  - How much was spent ?
  - Who spends ?
  - What is bought ?
  - Get top N materials which are hight ticket items, contributing considerably towards the gross value.
- Tool Used –
  - Tableau
  - Have used a bit of Python too

Clustering - 1 of 4

- Important feature for Spend Analytics is –
  - Gross Value and Net Price
  - Frequency of buying the material
- We summarised the data on Material Name on these information –
  - Sum of Gross Value
  - Imputed the Number of times the material is bought
  - We used this data for clustering

Clustering - 2 of 4

- The purpose of clustering was to find common group of materials in terms of its Gross value and the number of times it is bought
- We explored both K-means and Hierarchical clustering
- We used elbow method to get the number of cluster
- Also explored combination of features for kmeans
- The selection criteria for the final kmean clustering was lesser inertia amongst them

Clustering - 3 of 4

- For Hierarchical clustering, the visual of the dendogram was not clear enough to decide on the number of cluster.
- Used 4 cluster for Hierarchical clustering also.
- Got almost similar results as the kmeans clustering.
- Finally used kmeans with 4 clusters for further analysis.

Clustering - 4 of 4

- Also used only top 24 materials contributing towards 80% of the Gross value.
- The cluster results were same as that when using all materials

- Tool Used - Python

Price Analysis and Dashboard

- The objective was to find opportunity of cost savings for the company.
- Started with analysing high value , high frequency materials
- Did detailed analysis for materials falling into 2 clusters
  - 2 from each of the 2 clusters – in total 4 materials

- Tool Used - Tableau

EDA

About the data (1 of 3)

- Total Gross value : Rs. 2399.68 Cr.
- Number of Purchase order : 42,596

Number of Company Codes	5
Number of Plants	116
Number of Storage Location	1108

Number of Material Codes	2757
Number of Material Description	7332
Number of Material Group	145

- No Vendor information provided

About the data – (2 of 3)

- 65 features
- 75349 Observations
- Columns with more than 90% Missing Values
- Columns with Single Value
- Columns with more than 90% 0 values

Column Name	Desciption	% Null Values	% Zero Values	Num Unique Values	DataType
Purch.Doc.	P.O. Number	0	0	42596	int64
Item	Line items	0	0	42	int64
Changed On	#N/A	0	0	210	datetime64[ns]
Short Text	Description	0	0	7332	object
Material	#N/A	2.12	0	2757	float64
CoCd	organisation code	0	0	5	int64
Plnt	Plant Code- who has send the requirement	0	0	116	object
SLoc	Storage location	17.03	0	1108	object
TrackingNo	request tracking number	93.46	0	135	object
Matl Group	Material Group	0	0	145	object
PO Quantity	distribute to this account assignment item	0	0	14990	float64
OUn	Base Unit of Measure informatio	0	0	31	object
OPU	Order Price Unit information	0	0	31	object
Conv.	Quantity Conversion information. Order quantity/order unit Order price qty./	0	0	1	int64
Eq. To	Counter information - the number of units of the base unit	0	0.02	2	int64
Net Price	Net Order Price information	0	0.18	8723	float64
Per	Price Unit information	0	0	89	int64
Net Value	net value of the item, after any discounts and surcharges are taken into acco	0	0.18	36669	float64
Gross value	Gross order value information. Order value = order quantity X order price.	0	0.18	36054	float64
GRT	GR Processing Time information. Number of workdays required after receivin	0	1	1	int64
Overdel. Tol.	#N/A	0	0.97	15	int64

About the Data - (3 of 3)

- The data is from 2012 (Only for July) till April 2019.
- Number of Purchase Order - year and month wise.

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
2012	0	0	0	0	0	0	1	0	0	0	0	0	1
2014	0	0	0	0	0	1	0	2	0	0	0	2	5
2015	0	1	0	0	0	0	0	0	0	0	0	0	1
2017	0	0	0	0	3	0	2	0	1	2	0	3	11
2018	2	1	1	4	2	5	3	7	16	29	71	2895	3034
2019	14931	12454	12134	168	0	0	0	0	0	0	0	0	39582
Total													42596

- Very few information from year 2012 till 2018(Nov).
- Continuity in Data from 2018 till April 2019(till 9th April).

Data Preprocessing

- Removed data from year 2012 till 2017
  - Retained Only for year 2018 and 2019.[54 observations removed]
- Removed 7 features because of more than 90% null values.
- Removed 17 features with only 1 unique value
- Imputed Null values for these columns -
  - Material – Null are Services – so created a new code
  - Storage Location, Profit Center,Mtyp,NCM Code – Filled Null with CoCd Mode information
  - Price Date – Filled with Changed On Dates.
- Cleaned Priority information, and mapped it with Priority(Material Required Within) and imputed its Null value.

1. How much is spent ?

Gross Value by date

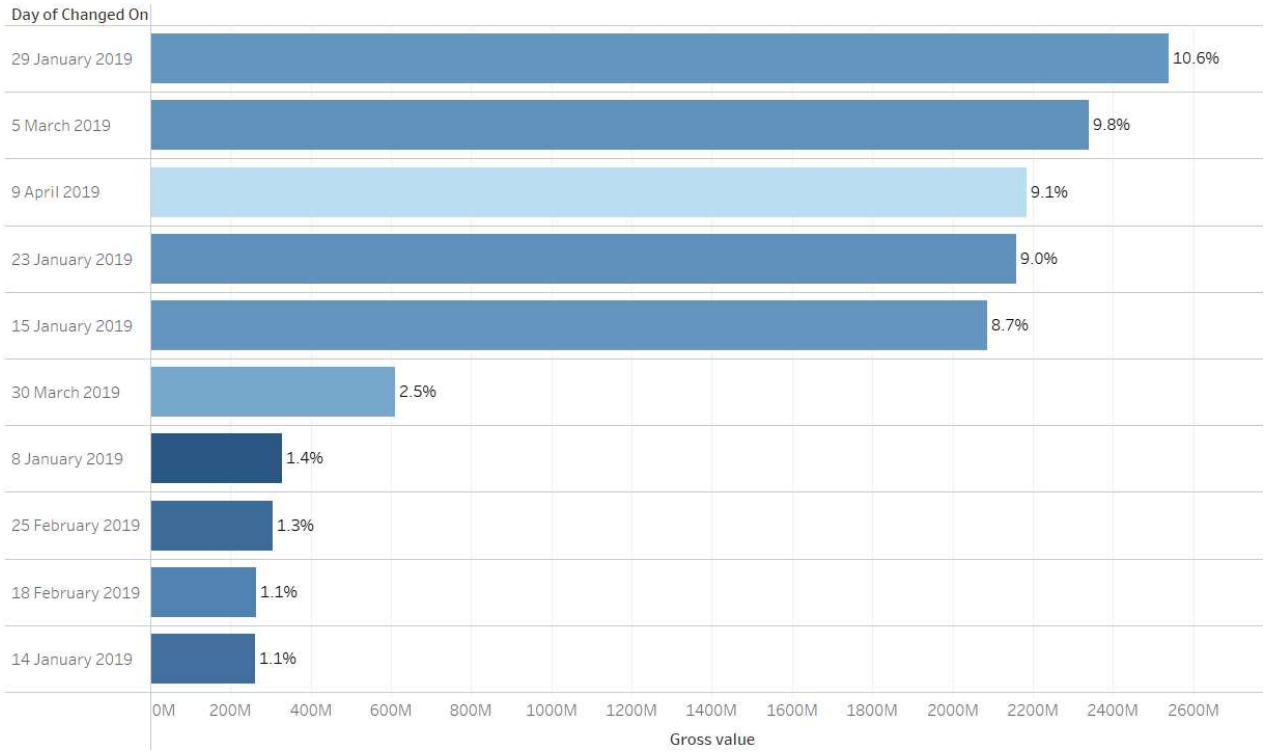
- Not much of buying in 2018.
- Few Days of high spending in 2019.

Year of C..	
2018	835,777,260
2019	23,123,722,109
Grand To..	23,959,499,370

Lets Shop!

- These 10 days in 2019 contribute 54.6% of all purchases (2018 and 2019) by value.

- The colour shade is by number of PO issued, darker shade means more.



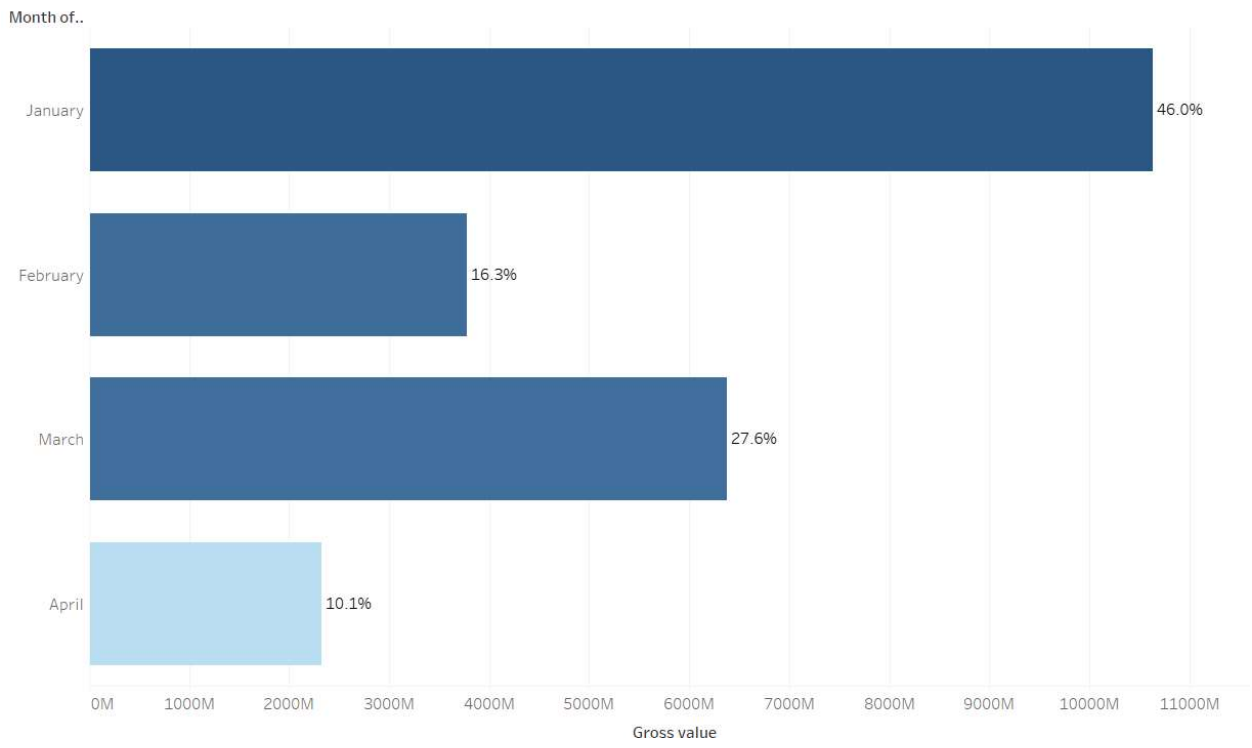
Gross Value by Year and Month

- The thickness of line is based on the number of purchase order.

Gross Value By Month(for 2019)

- January has 46% of the purchases done for 2019.

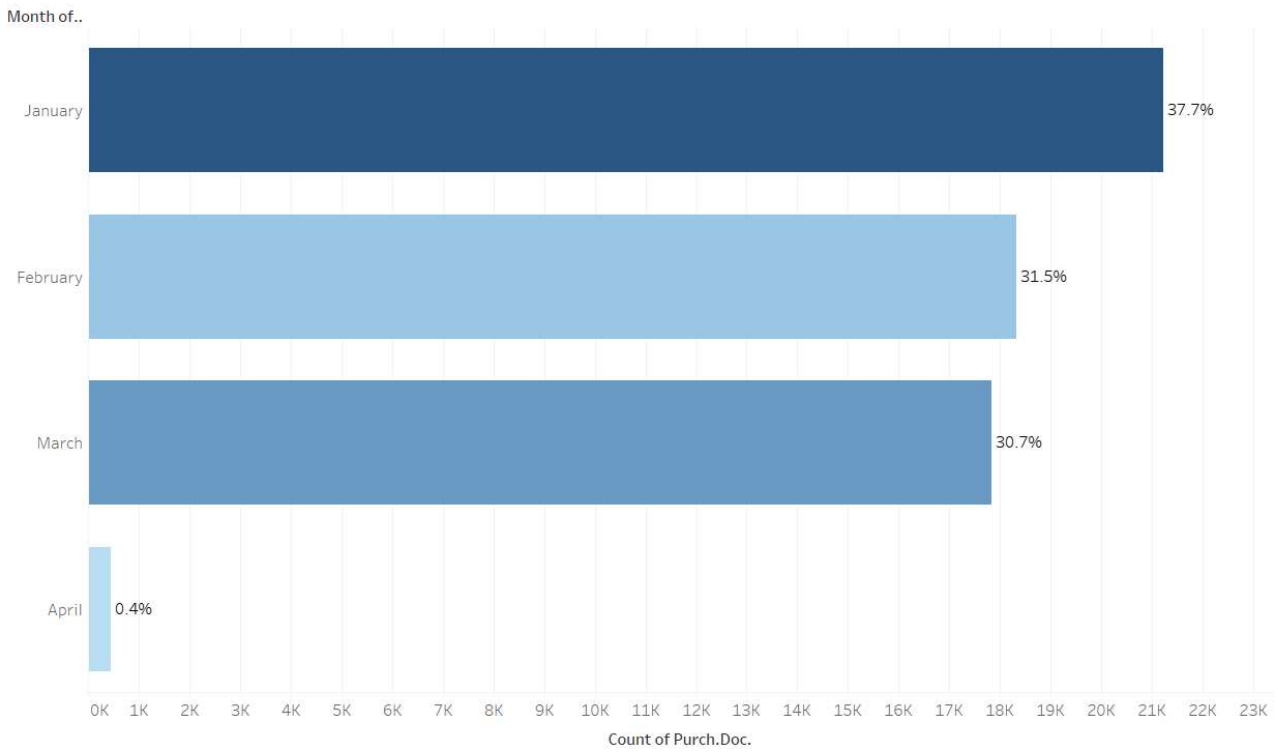
- The colour shade is by number of PO issued, darker shade means more.



Number of Purchase Order Issued By Month(for 2019)

- January has 37.7% of the po issued in 2019.
- For March, the number of PO issued is less but the value is more than February.

- The colour shade is by the Gross Value, darker shade means more.

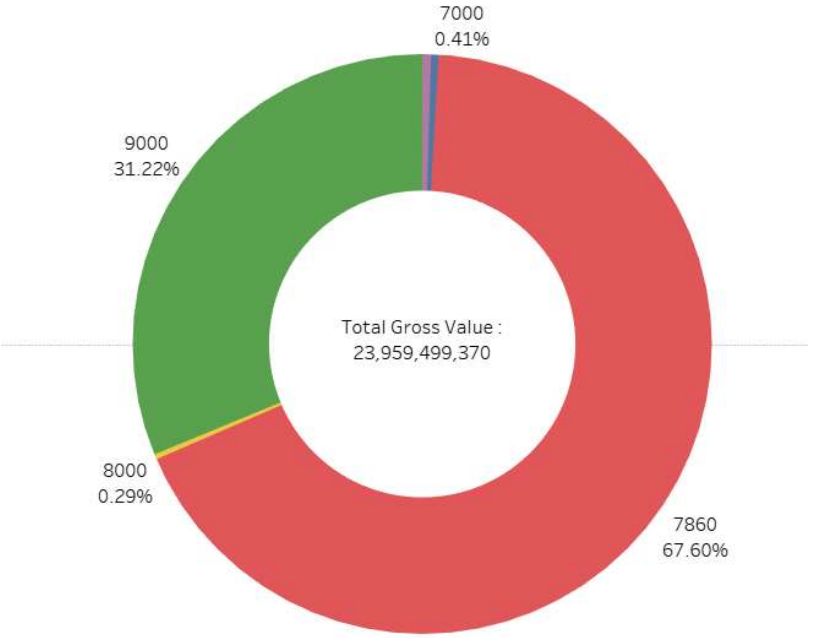


2. Who Buys ?

Buying by Company Code

- Gross Value by Company code
  - Company Code 7860 has 67.6% share.
  - Company Code 7860 and 9000 has 98.82% share.

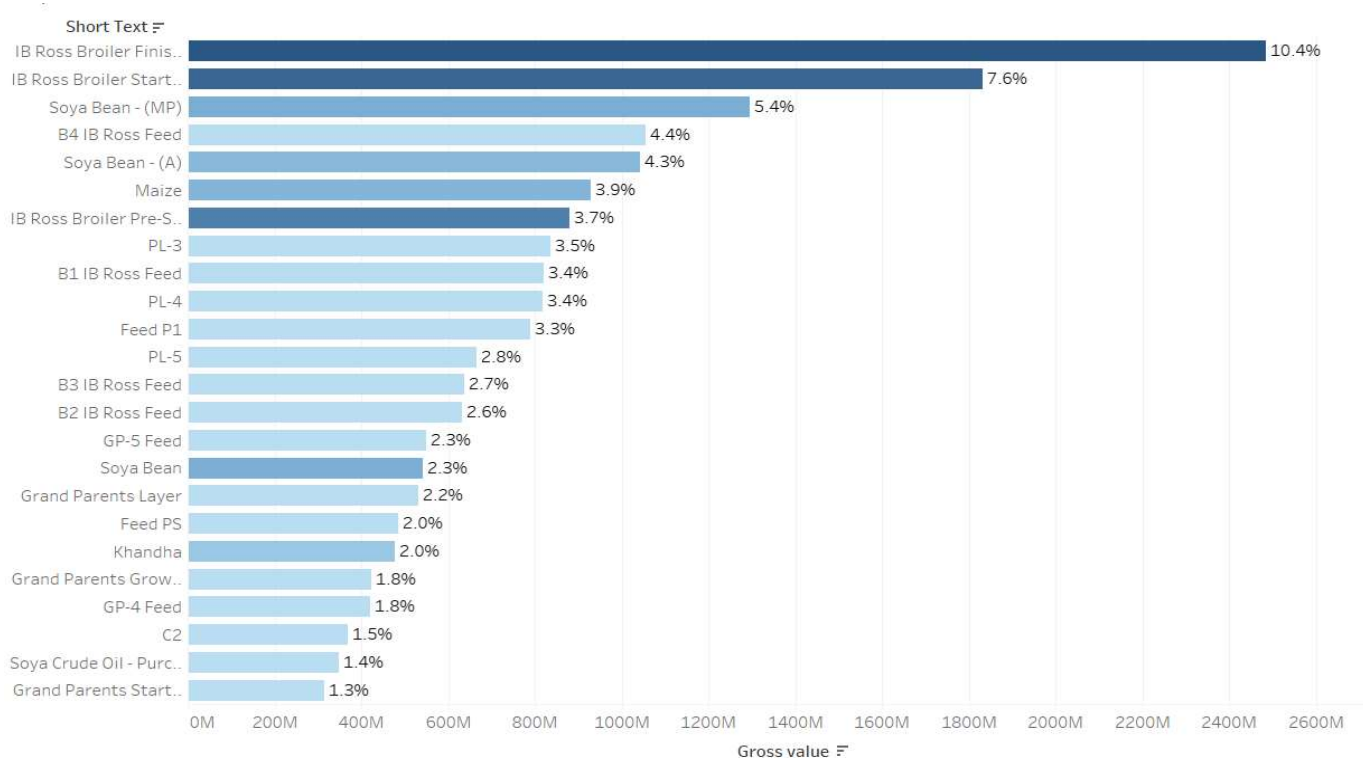
CoCd	Order_yr	Gross value
4500	2018	12052985.54
	2019	106330026.65
7000	2018	1306874.21
	2019	96037373.12
7860	2018	50211054.00
	2019	16145397250.33
8000	2019	68533700.00
9000	2018	772206346.61
	2019	6707423759.39



3. What is being Bought ?

What is being bought – (1 of 2)

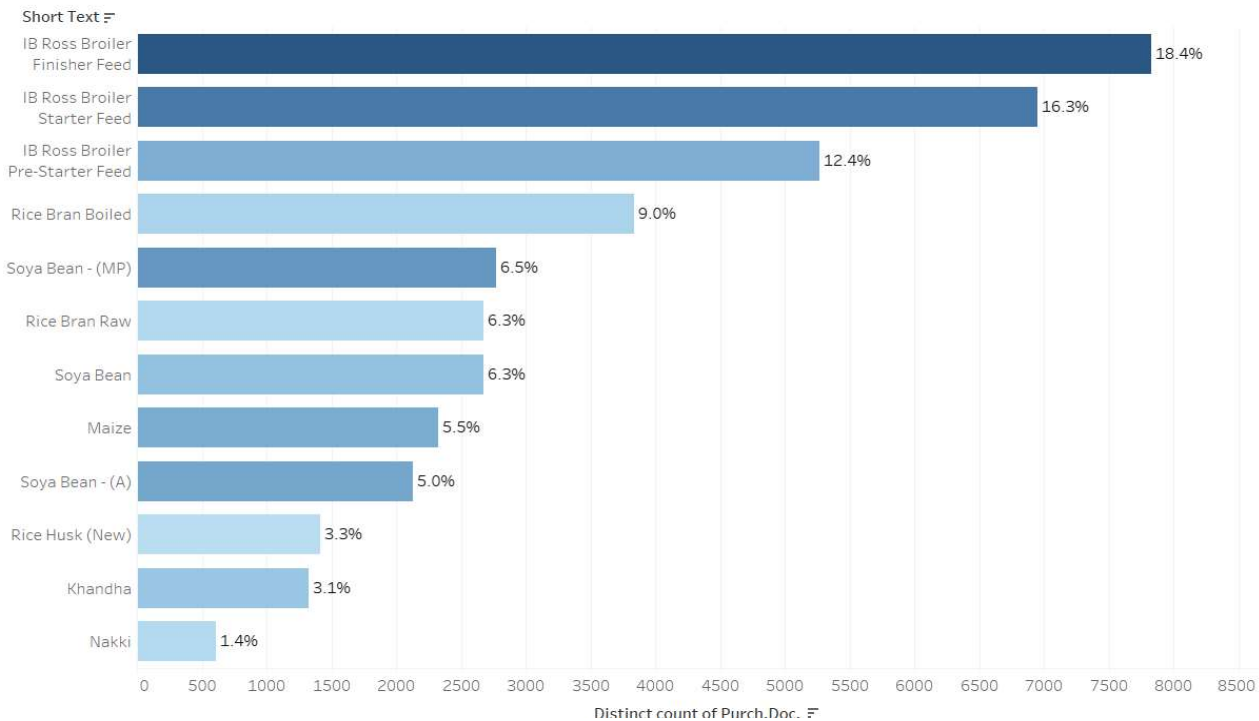
- Top 24 Material by Gross Value contributes 80% of the value.
- The colour shade is by number of PO issued,darker is more.



What is being bought – (2 of 2)

- Top 12 Material by Frequency, contributes 93.5% of the PO issued.

- The colour shade is by Gross Value,darker is more.

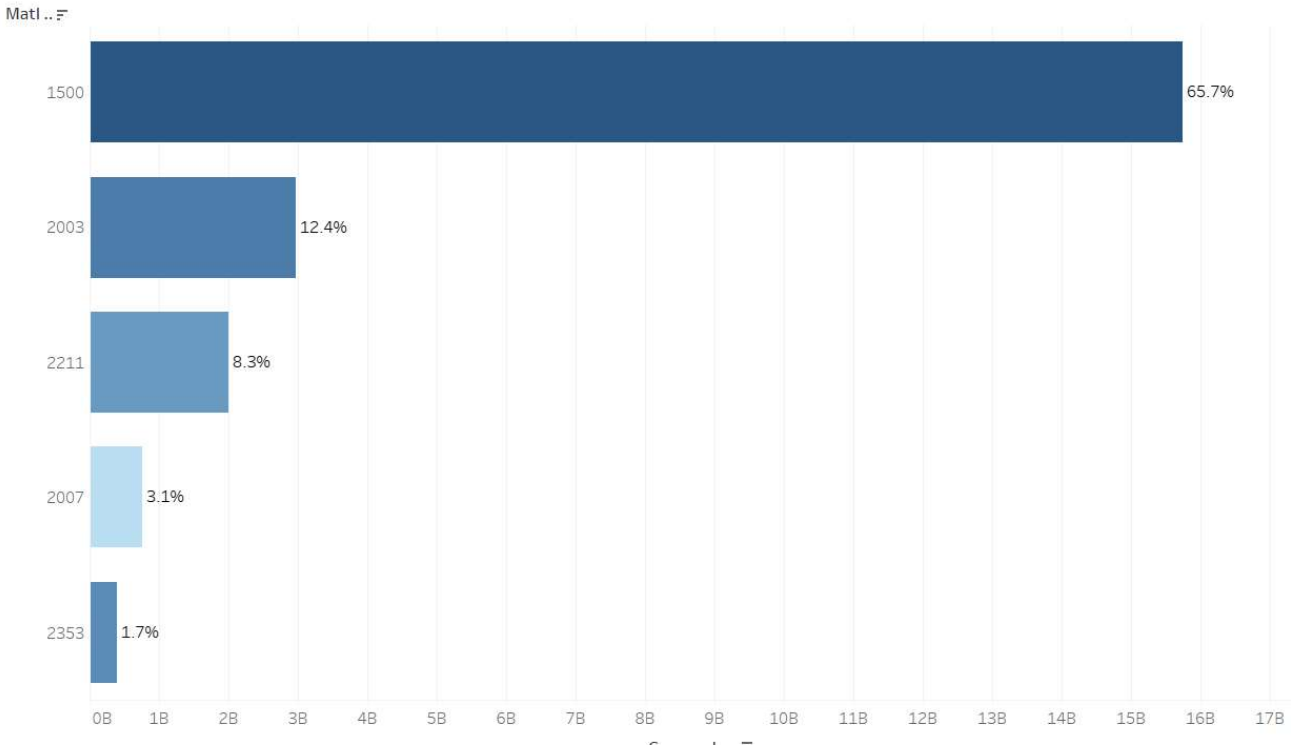


What is being bought – (3 of 3)

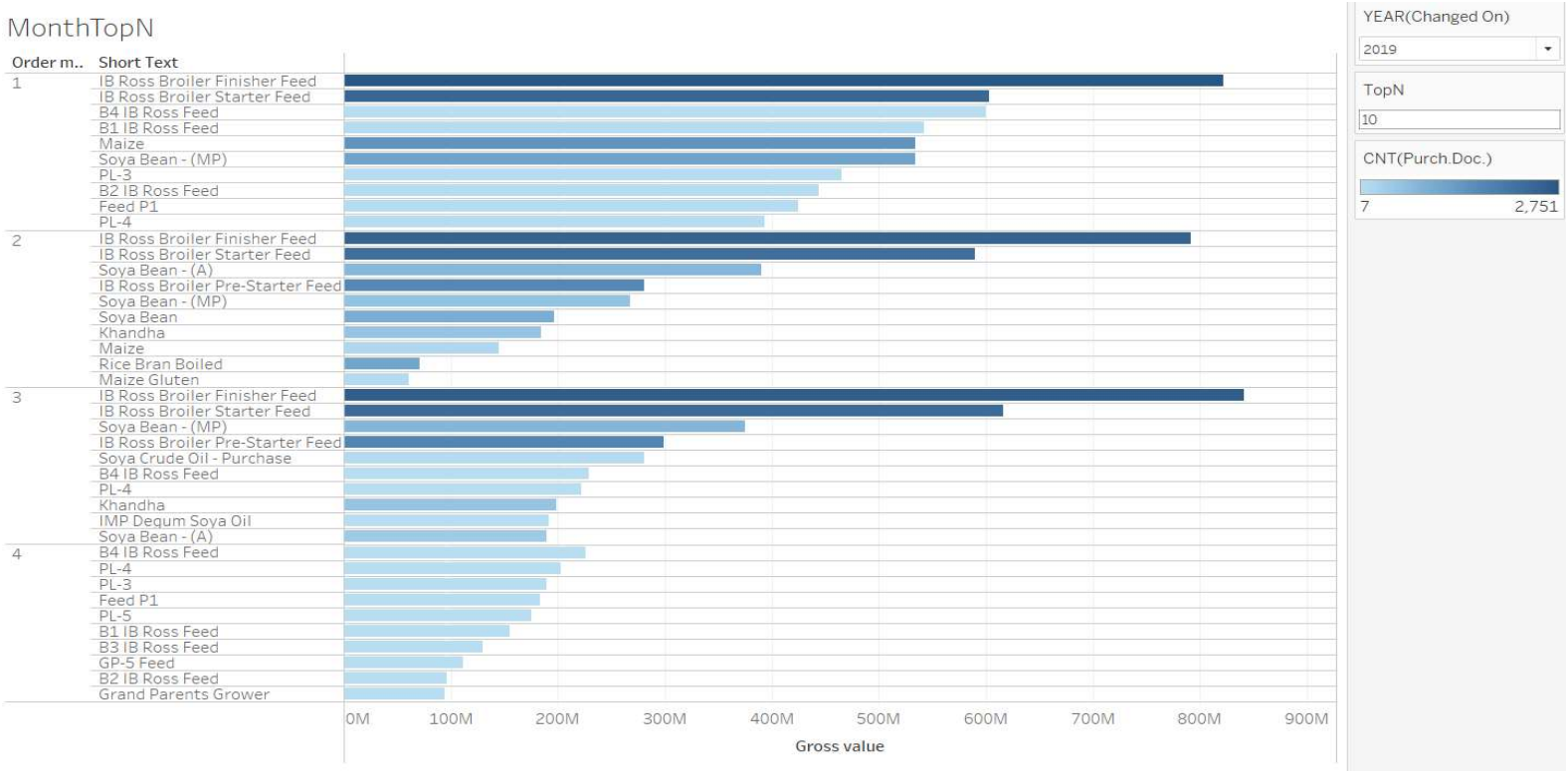
- Top 5 Material Group by Gross Value,contributes 91.2% of the value.
- Number of Material by Group -

Matl Gro..	
1500	49
2003	4
2007	4
2211	39
2353	3

- The colour shade is by number of PO issued,darker is more.

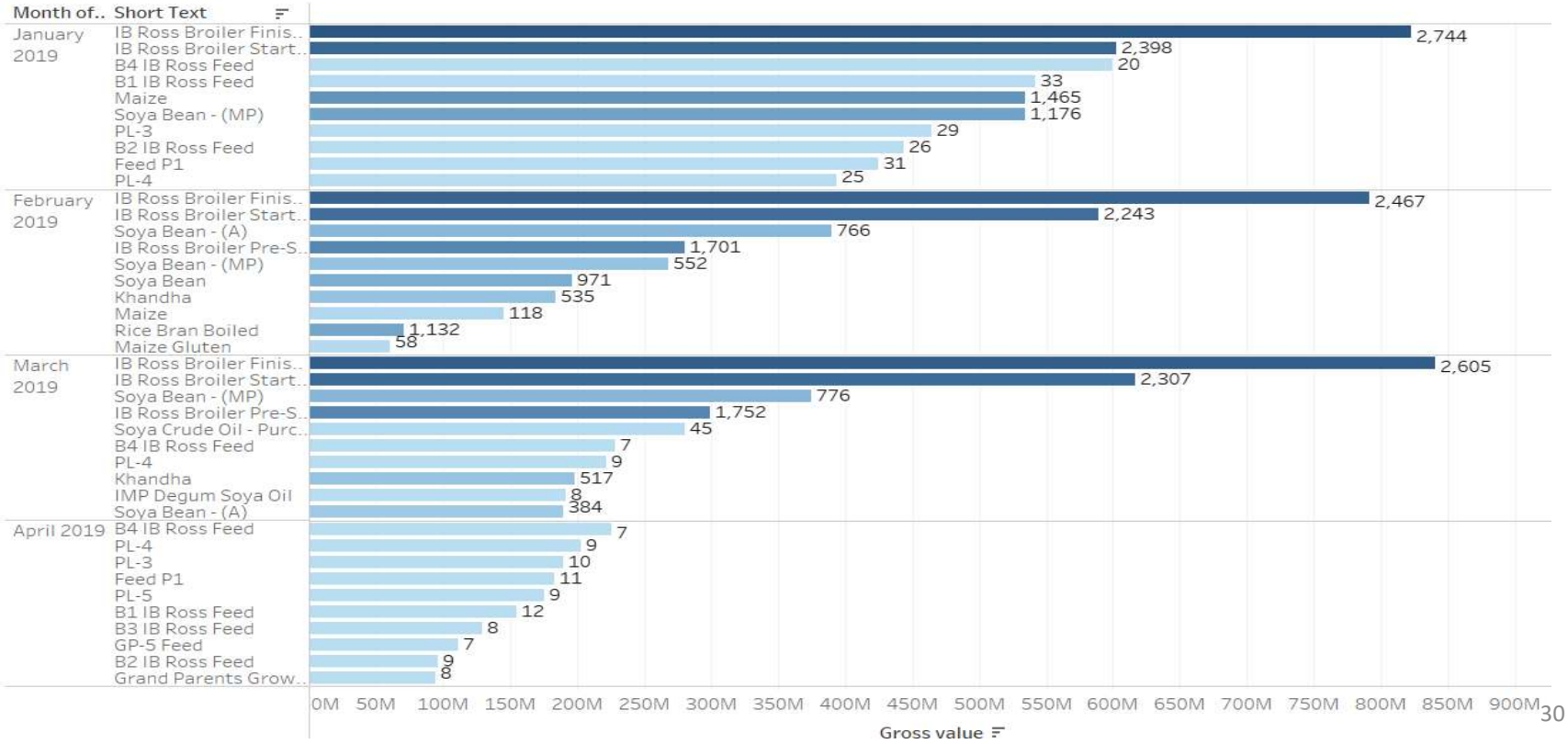


Top 10 by Gross Value – Year 2019 by Month



No Of PO Issued- Top 10 by Year 2019 and Month

The colour shade is by number of PO issued, darker is more.



Percentage of PO with single item

	For all materials	Top 24 Materials
Number of PO Issued	42579	21696
% PO with single item	76.4%	69.4%
% PO with more than 1 item	23.6%	30.6%

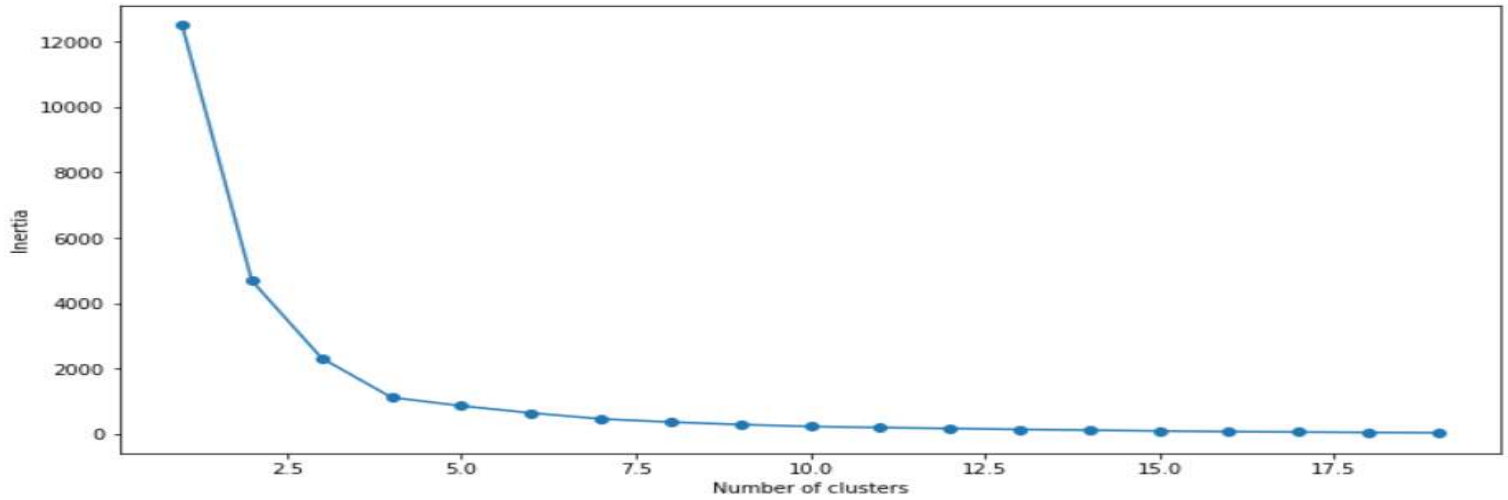
Spend Analytics - Cluster

Cluster

- Objective - Cluster items with similar purchasing patterns
- Data Used –
  - Removed Assets and Services Material Group
  - Summarised data by Material name (Short Text)
    - There are 6248 unique Material name
  - Computed these values for the Materials -
    I. Count number of times the item is bought
    II. Sum Gross Value
- Use this summarised data for clustering purpose.

Elbow Method

- Using Elbow method, get the number of clusters for kmeans.

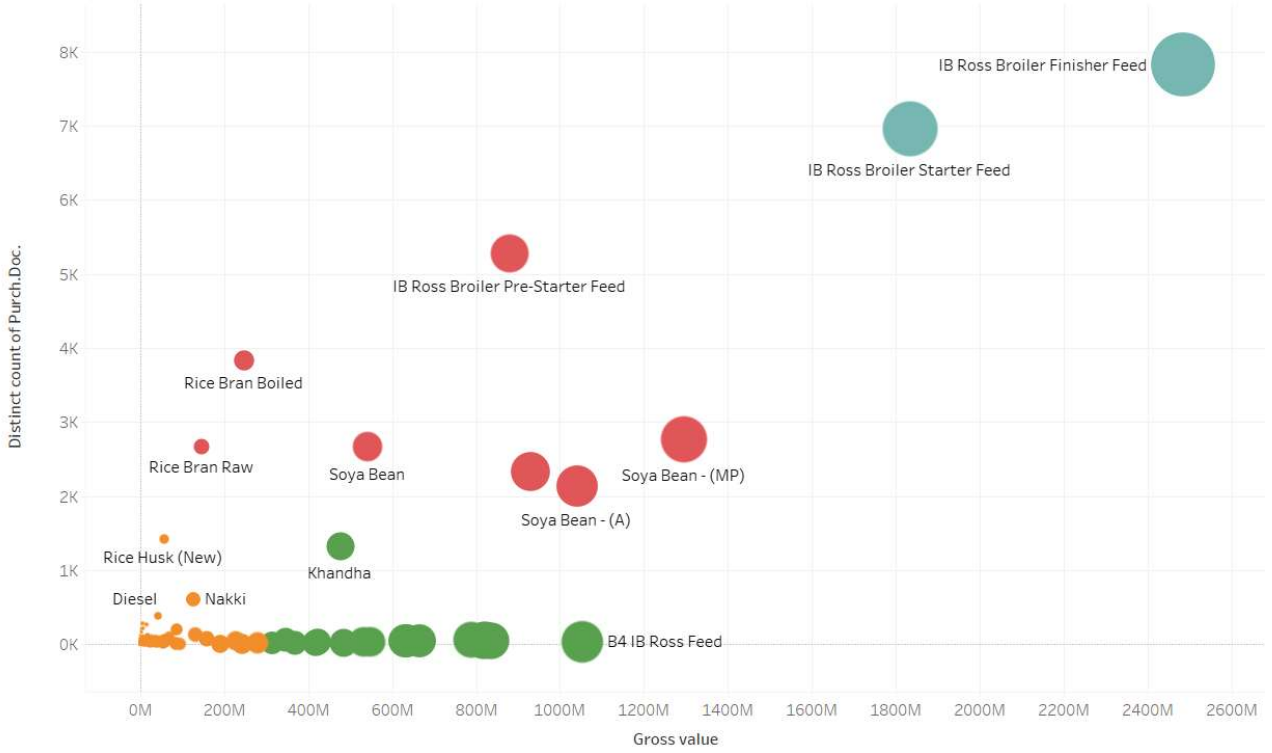


- The recommendation for number of cluster is 4.

Cluster - 4 clusters

Number of Materials per clusters -

ClusterNames	
1 High Freq High Value	2
2 Medium Freq Medium Value	7
3 Low Freq Low Value	17
4 Very Low Freq Very Low Va..	6,222

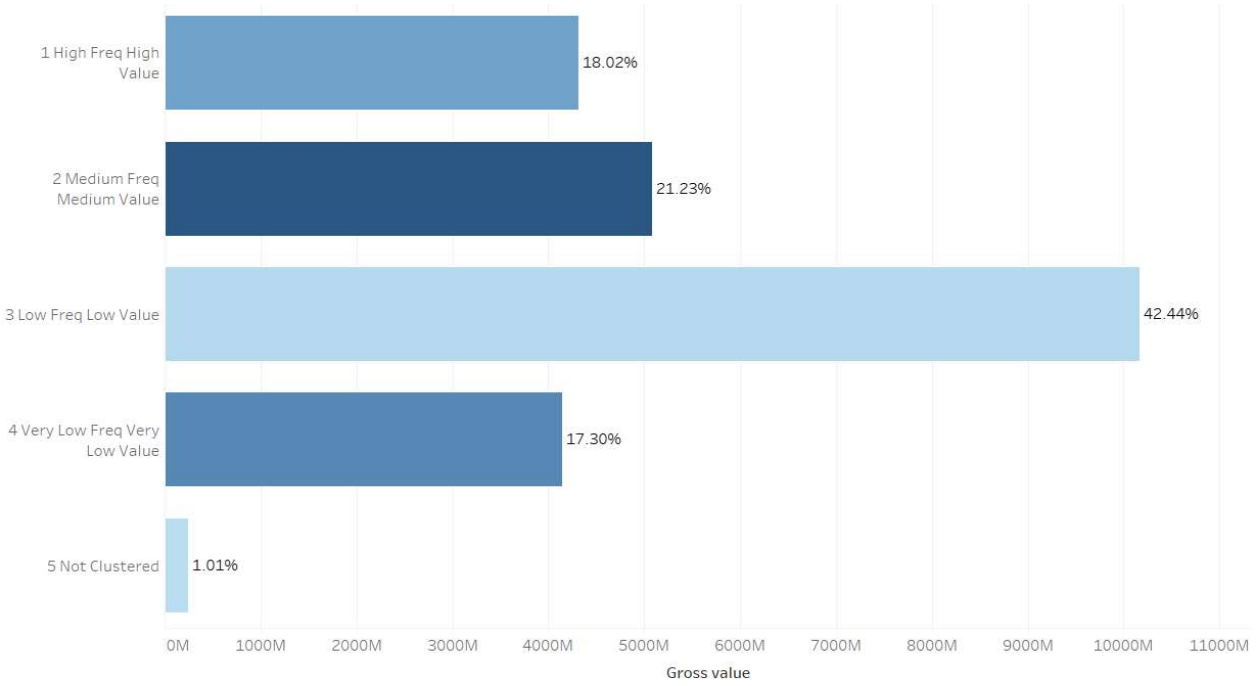


Cluster info

Cluster	Num Material In Cluster	Average Num Times Bought	Sum Gross Value	Average Per Unit Cost
Very Low Frequency Very Low Value	6222	3.47	666028.51	7716.94
Low Frequency Low Value	17	112.94	598180903.52	4166.76
Medium Frequency Medium Value	7	3098.86	726667416.12	15798.82
High Frequency High Value	2	7414.50	2158315090.94	29.67

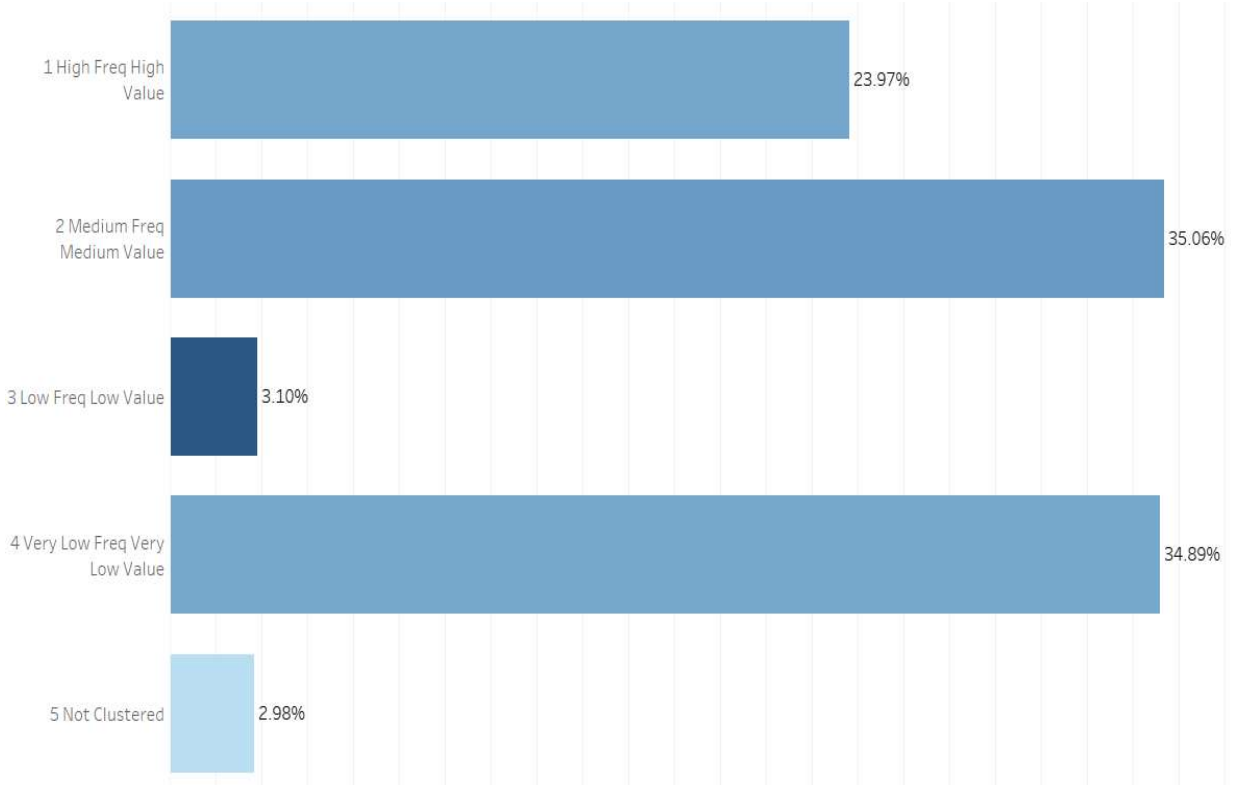
Cluster Details (1 of 4)

- The three clusters contribute 81.7% and the first two 39.25% of the total Gross Value.
- The colour shade is based on Number of PO Issued, lighter shade lower no of PO.



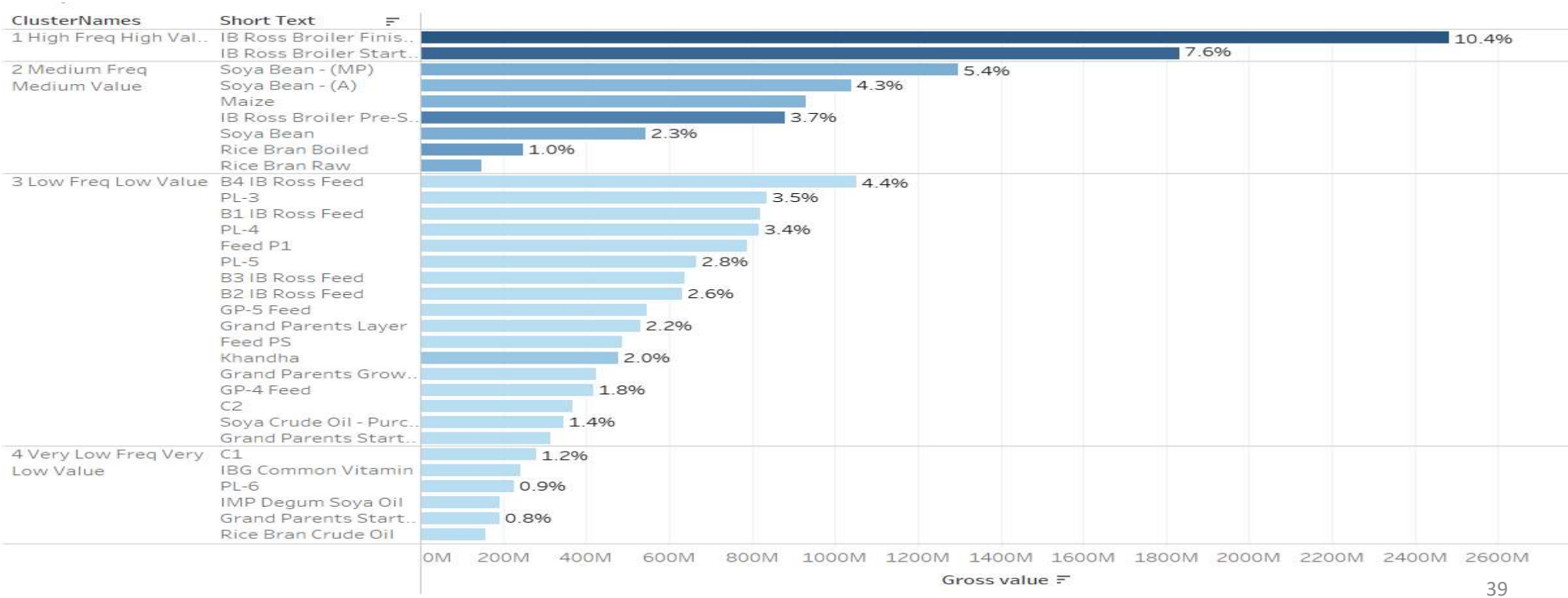
Cluster Details (2 of 4)

- The three clusters contribute 62.13% and the first two 59.03 of the total PO Issued.
- The colour shade is based on Gross Value, darker the higher.



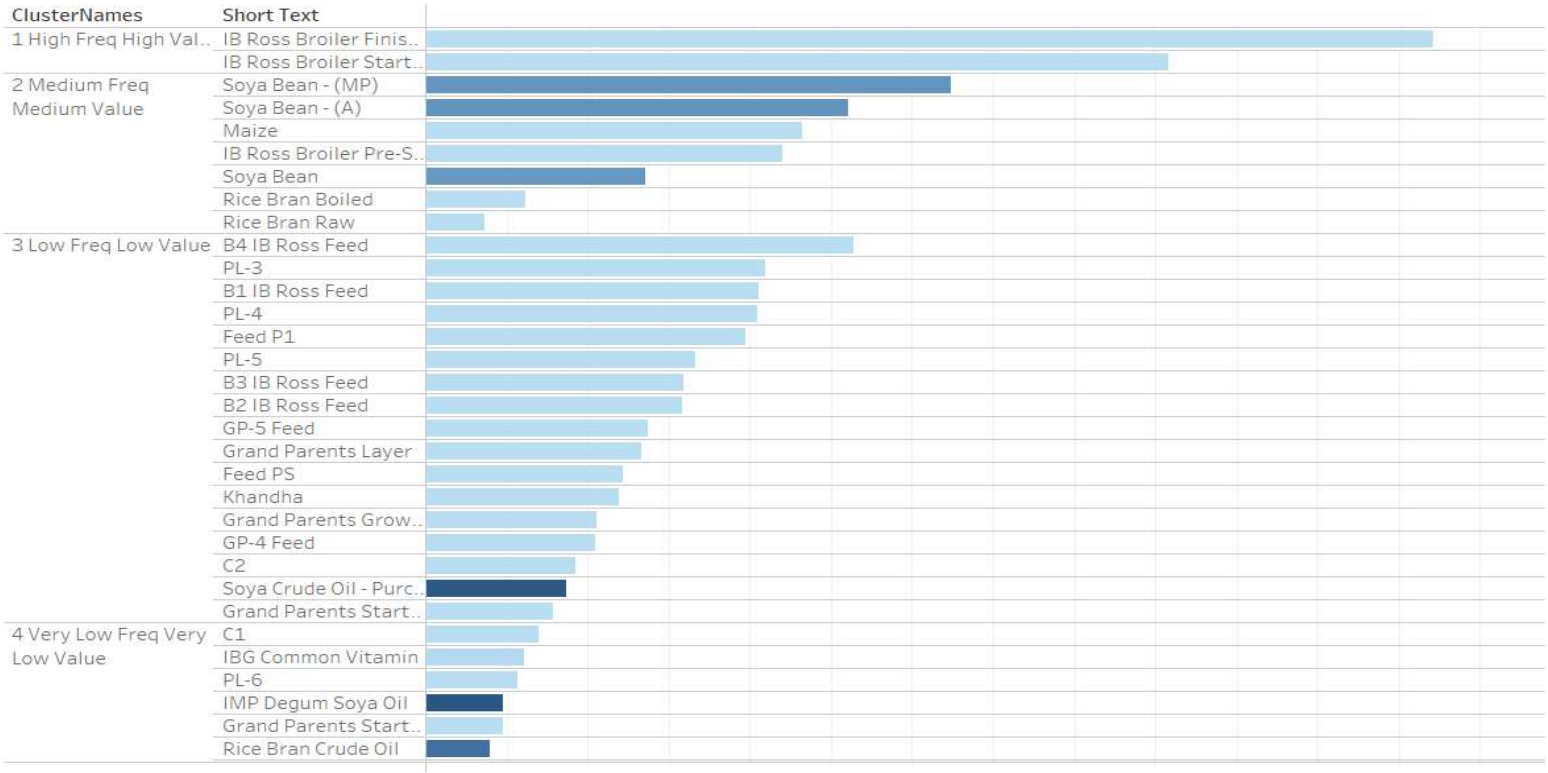
Cluster Details - 3 of 4

- Top Materials per group – By Value, colour shade by PO Quantity.



Cluster Details – 4 of 4

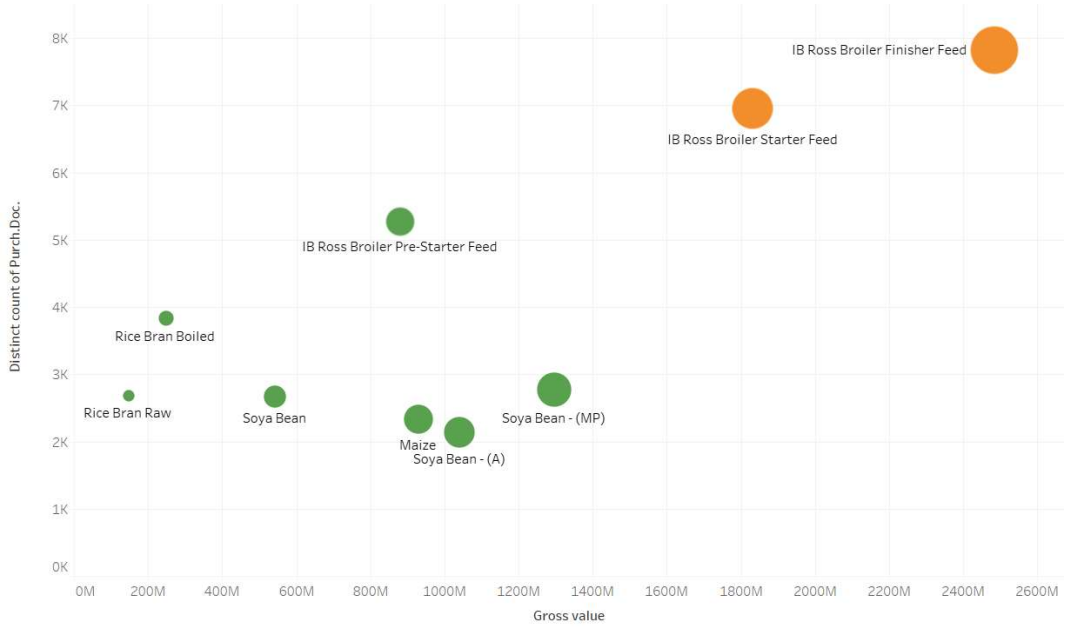
- Top Materials per group – By Value, colour shade by Net Price.



Cluster Analysis

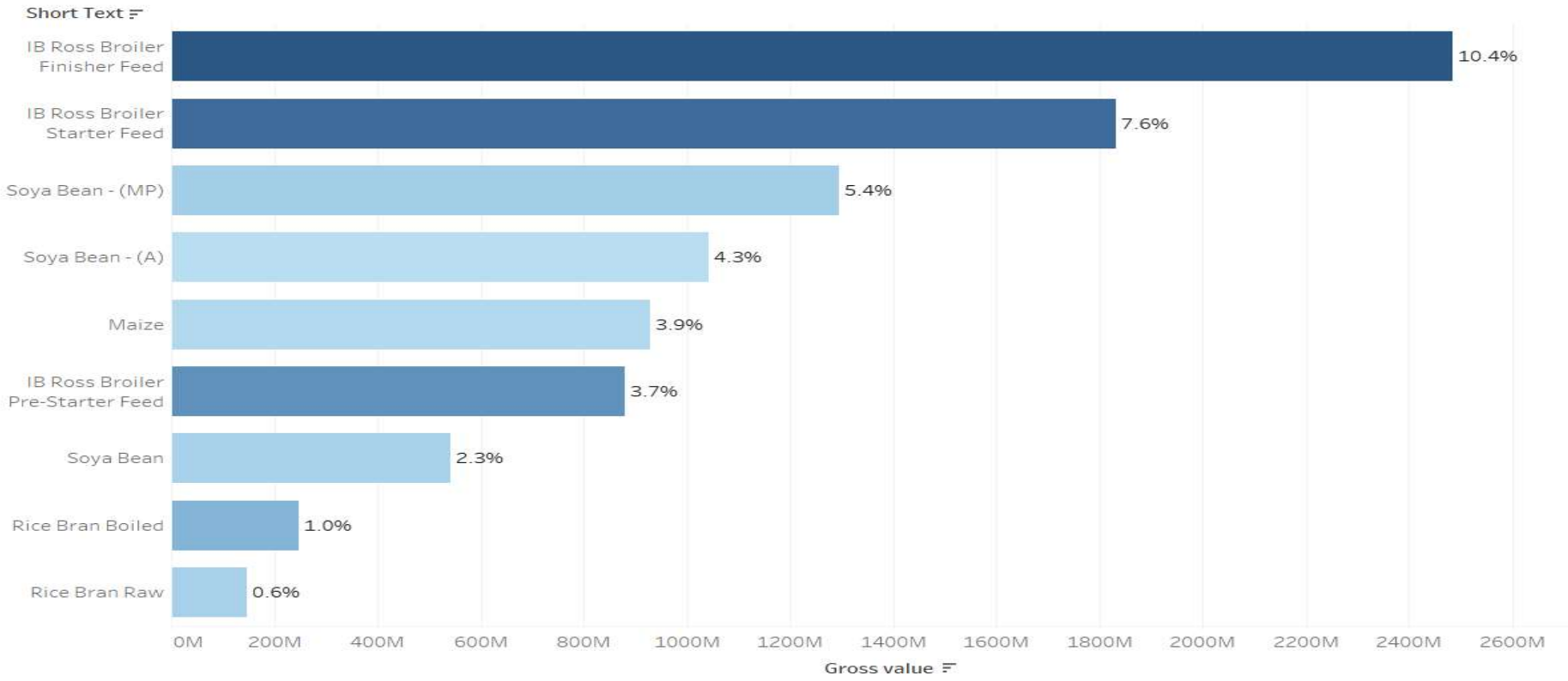
- Will ignore the low frequency low value and very low frequency and very low value group for cost saving analysis.

ClusterNames	
1 High Freq High Value	2
2 Medium Freq Medium Value	7
3 Low Freq Low Value	17
4 Very Low Freq Very Low Va..	6,222

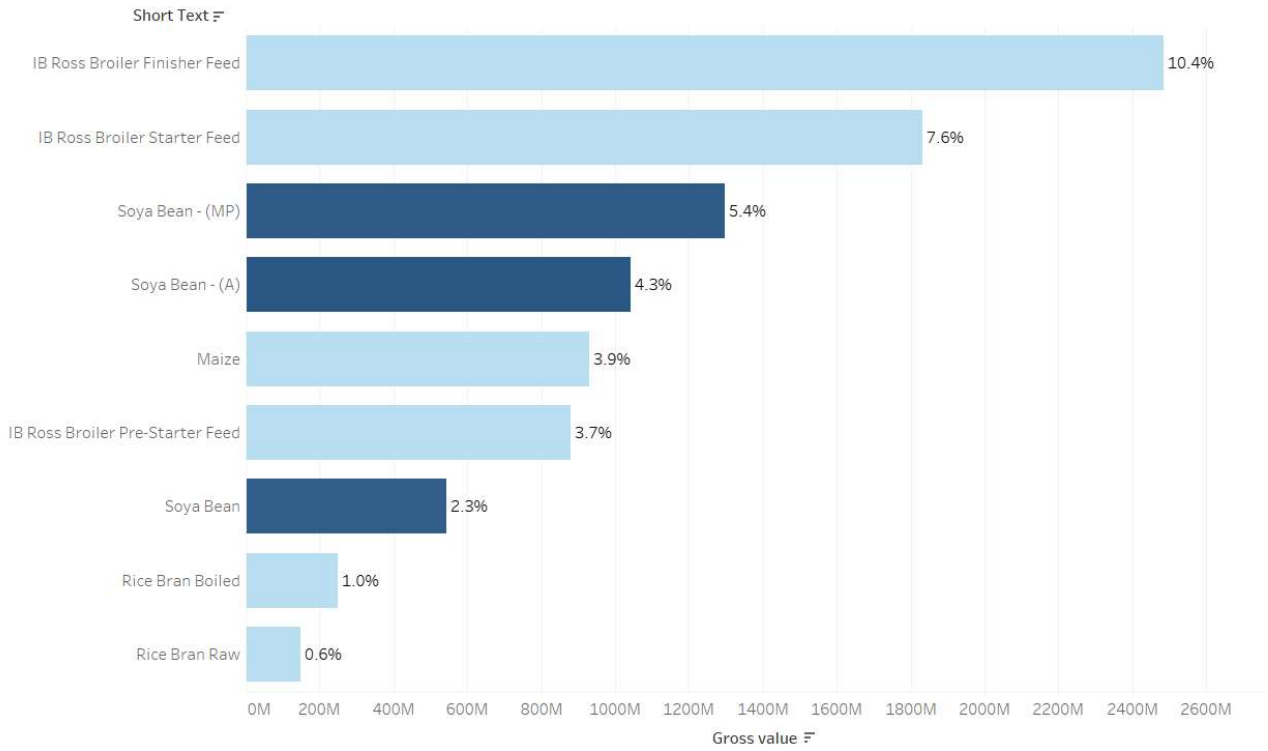


- The two clusters have 9 materials in it.

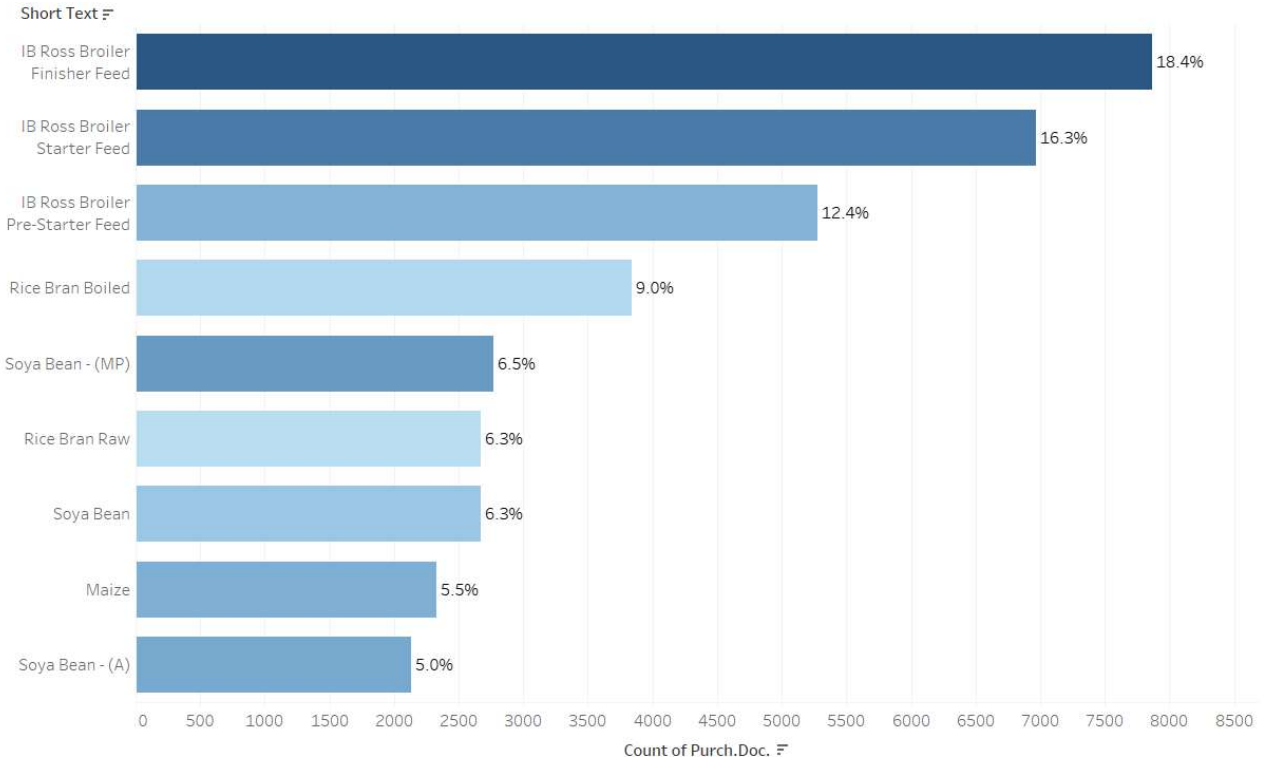
9 materials by percentage of total Gross value and colour shade by Count of PO



9 materials by percentage of total Gross value and colour shade by average price



9 materials by percentage of total PO issued and colour shade by Gross value



Cost Saving Opportunity

Analysis on 2 materials per cluster

- Analysing 2 material per cluster -
  - High Freq High Value
    - IB Ross Broiler Starter Feed
    - IB Ross Broiler Finisher Feed
  - Medium Freq Medium Value
    - Soya Bean (MP)
    - Maize

Ordering Trend – for IB Ross Broiler Starter Feed for March 2019

- Ordering many times in a single day
- 2307 PO raised in March 2019
- at various price points.

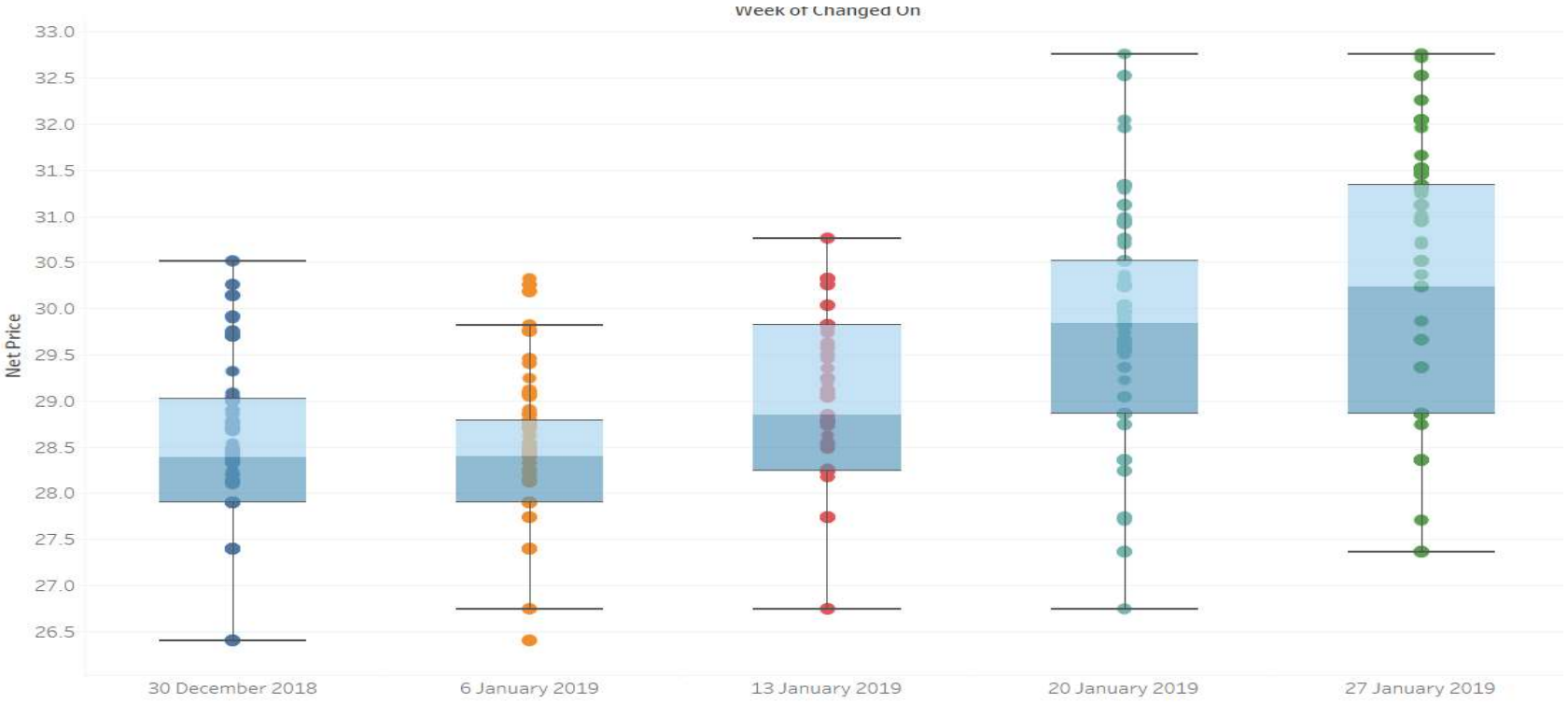
- The size of the circle is based on Gross value and Colour on PO Quantity.

Explore Price Variation

- We observe a lot of price variation on a monthly basis from the previous slide.
- Will need explore price variation in more detail on –
  - weekly
    - Use Box plot to show the variation in min, max and average prices over the week.
  - daily
    - Use line chart to show the daily price variation
- We do this for January 2019.

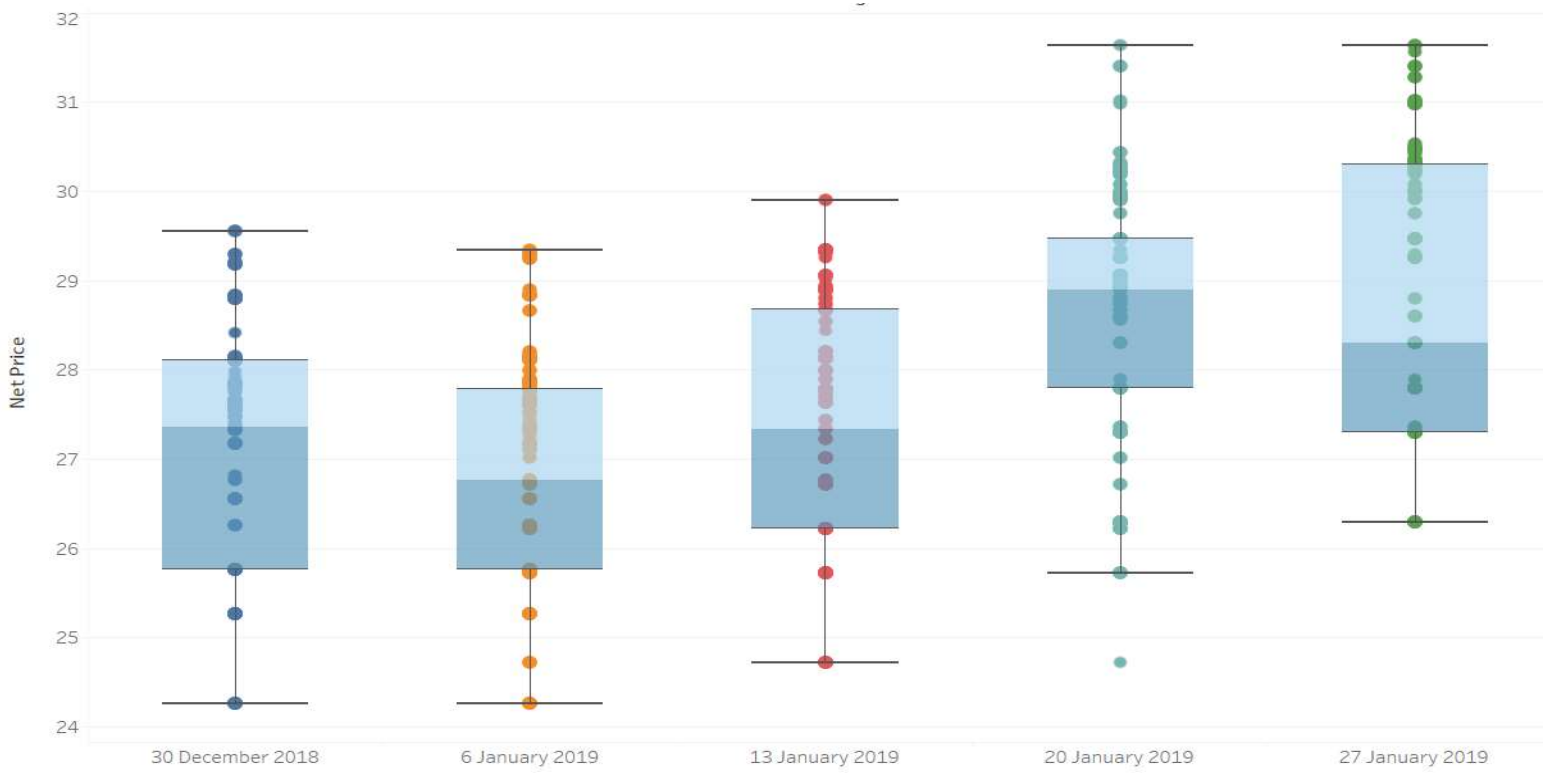
Weekly Price Variation for January 2019- (1 of 4)

- IB Ross Broiler Starter Feed - observe weekly price variations.



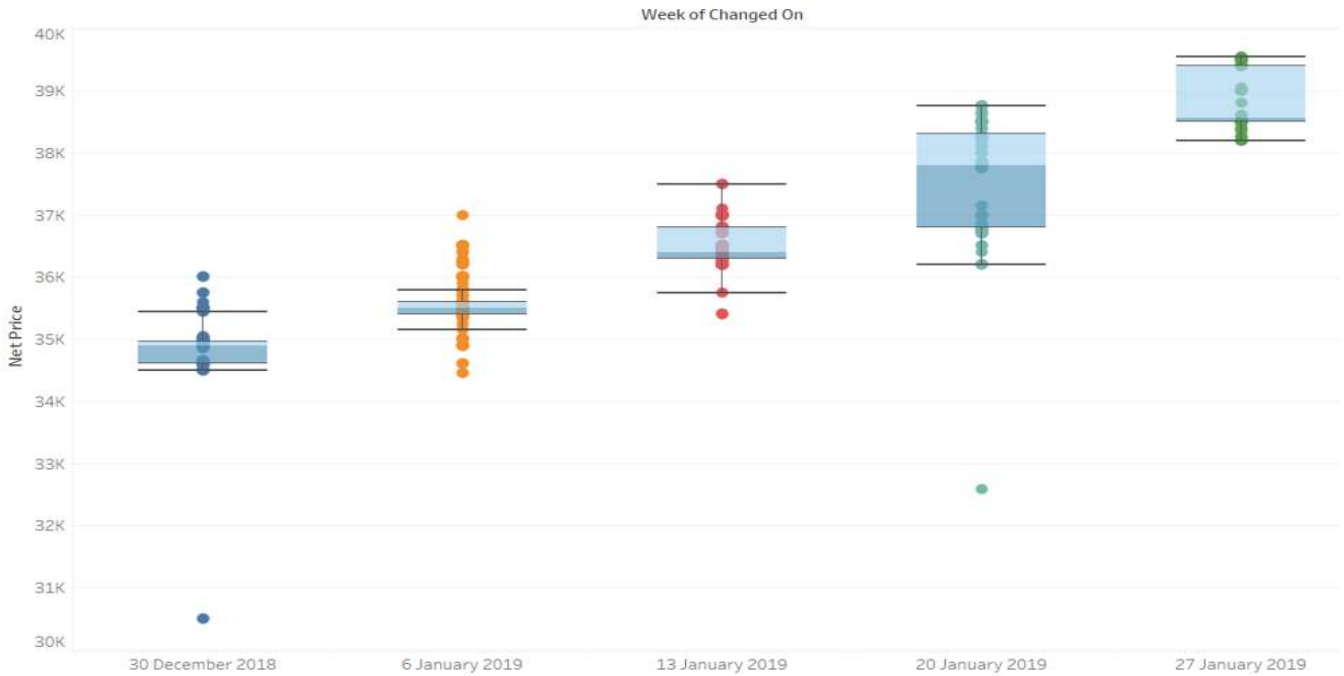
Weekly Price Variation for January 2019 – (2 of 4)

- IB Ross Broiler Finisher Feed – observe weekly price variations.



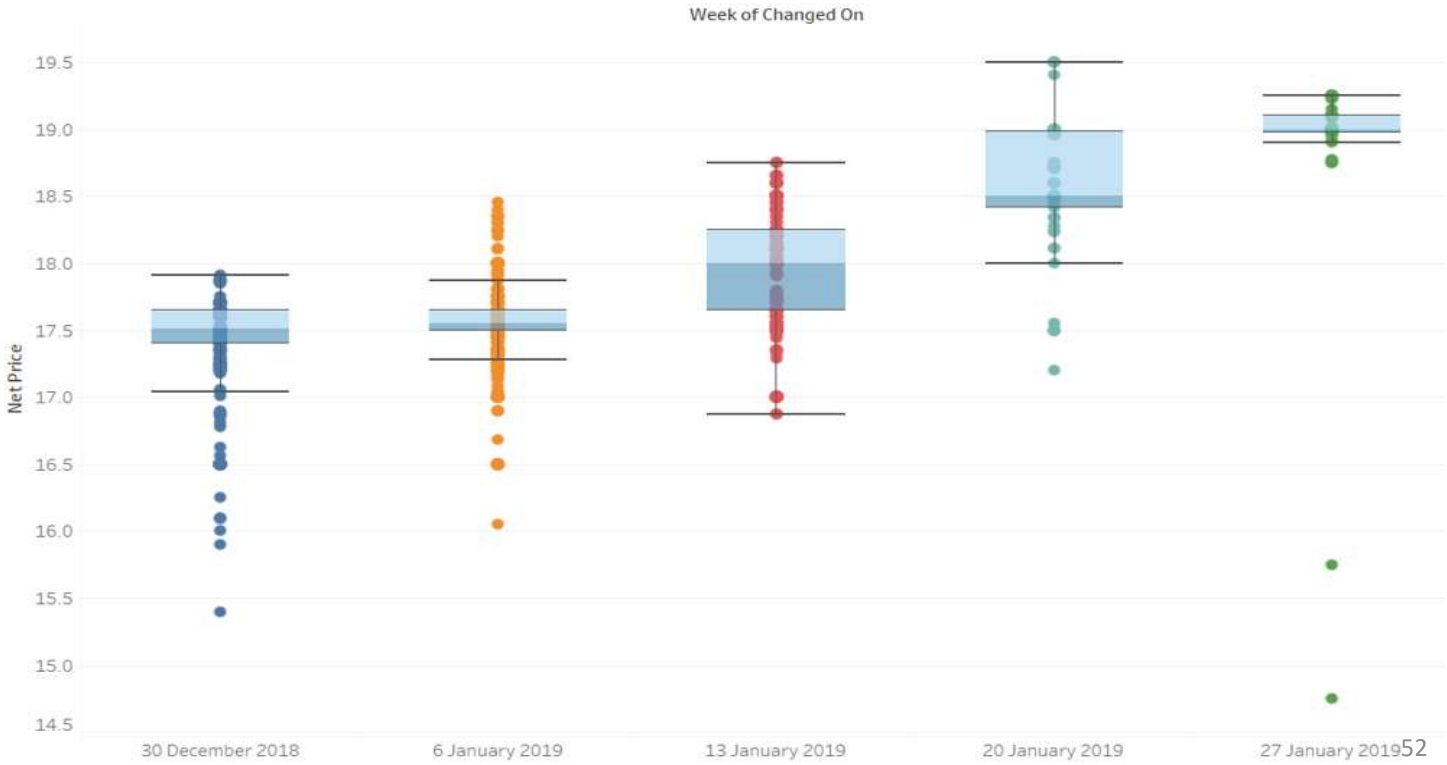
Weekly Price Variation for January 2019 - (3 of 4)

- Soya Bean(MP) - observe weekly price variations.



Weekly Price Variation for January 2019 – (4 of 4)

- Maize - observe weekly price variations.



Daily Buying Trend - Jan 2019 – (1 of 4)

High Freq High Value - IB Ross Broiler Starter Feed

Daily Buying Trend - Jan 2019 – (2 of 4)

High Freq High Value - IB Ross Broiler Finisher Feed

Daily Buying Trend - Jan 2019 – (3 of 4)

Medium Freq Medium Value - Soya Bean (MP)

Daily Buying Trend - Jan 2019 – (4 of 4)

Medium Freq Medium Value - Maize

Price Variations (1of 2)

- IB Ross Broiler Starter Feed

Month of..		
January	Gross value	602,549,009
	Avg. Net Price	29.07
	Min. Net Price	26.40
	Max. Net Price	32.76
	PO Quantity	20,620,000
	Distinct count of Pur..	2,398
February	Gross value	589,449,642
	Avg. Net Price	30.84
	Min. Net Price	27.36
	Max. Net Price	33.50
	PO Quantity	18,996,600
	Distinct count of Pur..	2,243
March	Gross value	616,486,158
	Avg. Net Price	31.03
	Min. Net Price	28.96
	Max. Net Price	33.16
	PO Quantity	19,805,400
	Distinct count of Pur..	2,307

IB Ross Broiler Finisher Feed

Month of..		
January	Gross value	822,027,775
	Avg. Net Price	27.68
	Min. Net Price	24.26
	Max. Net Price	31.64
	PO Quantity	29,519,500
	Distinct count of Pur..	2,744
February	Gross value	791,427,795
	Avg. Net Price	29.64
	Min. Net Price	26.30
	Max. Net Price	32.46
	PO Quantity	26,555,245
	Distinct count of Pur..	2,467
March	Gross value	840,746,559
	Avg. Net Price	29.92
	Min. Net Price	27.95
	Max. Net Price	32.14
	PO Quantity	27,983,200
	Distinct count of Pur..	2,605

Price Variations (2 of 2)

- Maize

Month of..		
January	Gross value	534,026,737
	Avg. Net Price	17.67
	Min. Net Price	14.75
	Max. Net Price	19.50
	PO Quantity	30,069,982
	Distinct count of Pur..	1,465
February	Gross value	145,182,847
	Avg. Net Price	19.62
	Min. Net Price	18.70
	Max. Net Price	20.96
	PO Quantity	7,051,347
	Distinct count of Pur..	118
March	Gross value	40,788,343
	Avg. Net Price	19.26
	Min. Net Price	18.81
	Max. Net Price	20.00
	PO Quantity	2,105,024
	Distinct count of Pur..	131

Soya Bean (MP)

Month of..		
January	Gross value	533,938,200
	Avg. Net Price	36,164.67
	Min. Net Price	30,500.00
	Max. Net Price	39,550.00
	PO Quantity	14,767
	Distinct count of Pur..	1,176
February	Gross value	267,981,450
	Avg. Net Price	38,653.30
	Min. Net Price	32,592.36
	Max. Net Price	39,600.00
	PO Quantity	6,939
	Distinct count of Pur..	552
March	Gross value	374,857,367
	Avg. Net Price	37,856.03
	Min. Net Price	37,300.00
	Max. Net Price	39,000.00
	PO Quantity	9,900
	Distinct count of Pur..	776

Pricing Observations

- We observe the prices of materials
  - Mostly going up as the month progresses.
  - Varies on a daily/weekly basis.

Cost Saving Opportunities – calculations for Jan 2019

- Savings for 4 items to be bought at minimum price :

JANUARY 2019				
	IB Ross Broiler Starter	**IB Ross Broiler Finisher**	**Maize**	**Soya Bean (MP)**
Gross Value	602549009	822027775	534026737	533938200
Avearge Net Price	29.07	27.68	17.67	36164.67
Min Net Price	26.4	24.26	14.75	30500
PO Quantity	20620000	29519500	30069982	14767
Min * PO Qty	544368000	716143070	443532235	450393500
Diff with Gross Val	58181009	105884705	90494503	83544700
Savings %	**9.66%**	**12.88%**	**16.95%**	**15.65%**

Cost Saving Opportunities - Recommendations

- Savings can be made if purchase is planned and materials bought in bulk at start of the month at minimum price.

- Bulk purchase – Expect discounts from suppliers
    - Can also save on costs related to –
        - Logistics
        - Vendor Transportation

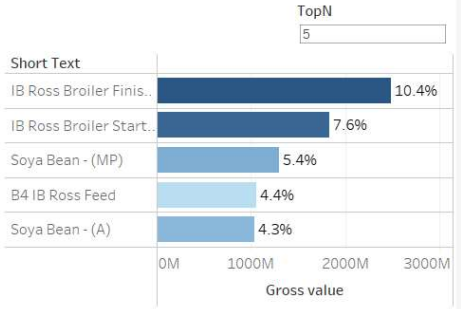
Dashboard

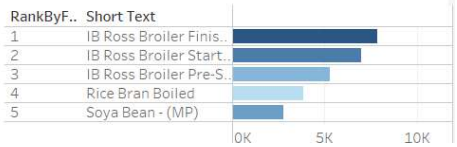
Dashboard

Total Gross Value :
23,959,499,370

Number of Purchase Doc
42,579

Co Cd	Changed On: Gross value 2018	Changed On: Gross value 2019	Changed On: Distinct count of Purch.Doc. 2018	Changed On: Distinct count of Purch.Doc. 2019
4500	12,052,986	106,330,027	20	357
7000	1,306,874	96,037,373	40	762
7860	50,211,054	16,145,397,250	464	14,782
8000		68,533,700		46
9000	772,206,347	6,707,423,759	2,510	23,635





Dashboard – Price Analysis