Bibitor LLC Inventory Analysis Case Study

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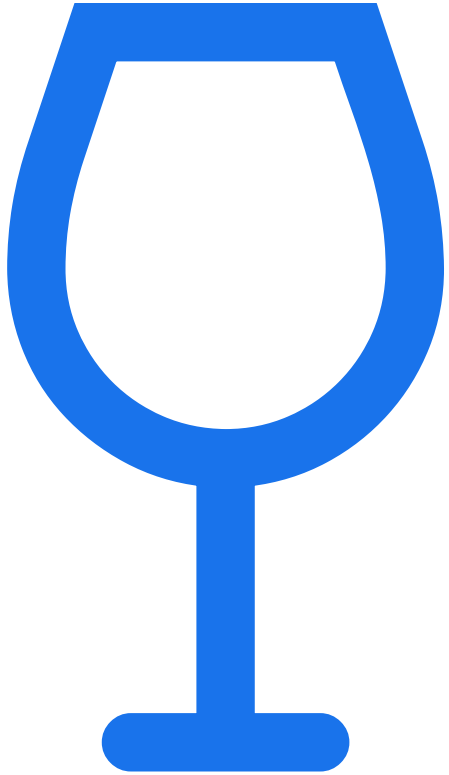
2024-08-19

Case Background

- Bibitor, LLC* is a liquor store chain in the fictional state of Lincoln.
- Major retailer with approximately 80 locations and total sales in excess of $450 million.
- Bibitor has asked the team to complete due diligence on their wine and spirits business looking at data for their beginning and ending inventory, purchases and sales for a 12-month period.



Data

Provided with **6 Data Tables** collected and recorded internally by Bibitor LLC:

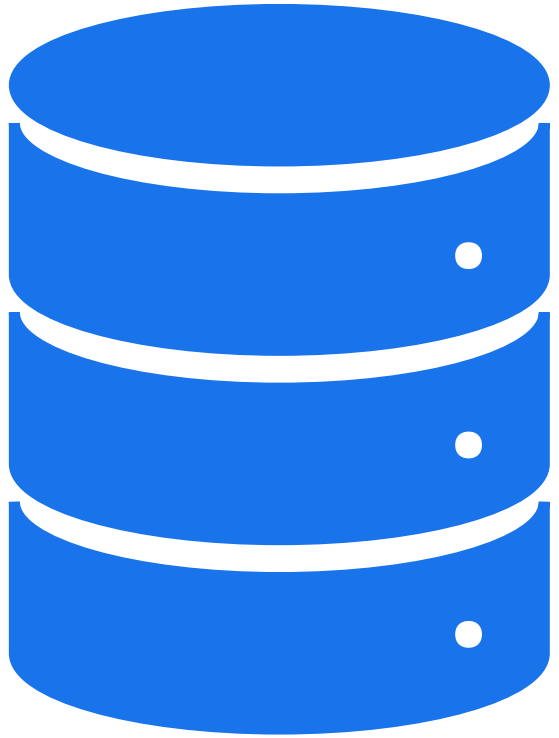
- *SalesDec* – Sales Info
- *PurchasesDec* – Purchasing Info
- *VendorInvoicesDec* – Vendor Info
- *EndInvDec* – Ending Inventory
- *BegInvDec* – Beginning Inventory
- PricingPurchasesDec – Product Pricing

Tools and Software

DB Browser for SQLite – Database Management System (DBMS) to run queries on the data

Microsoft Excel – Spreadsheet for file conversion and minor data cleaning/organization

Tableau – Visualization Tool for creating storytelling dashboards



Exploratory Data Analysis (EDA)

Descriptive Analysis – looking to identify trends and relationships from historical business data

Case Analysis Procedure:

1. Collection and Cleaning
2. Exploration
3. Transformation
4. Visualization
5. Analysis and Interpretation

1 – Collection and Cleaning

Preparation for Exploration and Analysis

1. Download all files from company website
2. Rename data files appropriately
3. Clean Excel files (remove duplicates, trimming cells, etc.)
4. Convert files into CSV Format
5. Create new SQLite Database on DB Browser
6. Import CSV files into new Database

2 – Exploration

Adventure 1

Let's explore the total freight costs

Condition: Filter for transactions greater than $100 that have a quantity of less than 1000 units.

Question: Which vendor number has the highest total freight costs from transactions that apply to these conditions?

Adventure 1 - Query and Results

```
SELECT
VendorNumber as vendor_number,
SUM(freight) as freight_cost
FROM
VendorInvoicesDec
WHERE Dollars > '100'
AND Quantity <= '1000'
GROUP BY vendor_number
ORDER BY freight_cost DESC
```

	vendor_number	freight_cost
1	2561	3176.81
2	9206	1735.74
3	17031	1573.25
4	5992	1367.37
5	1273	1319.77
6	1655	1299.13
7	90047	1274.31
8	4380	1117.27
9	90024	1086.12
10	5455	937.21
11	8150	935.52
12	98450	856.02
13	9625	854.31
14	9744	796.44
15	90032	778.25
16	4848	760.58
17	1601	755.43
18	2496	744.34

- Query the *VendorInvoicesDec* Table
- Set up conditions, GROUP BY, ORDER BY
- Table shows that Vendor Number **2561** has the highest freight cost of **$3176.81** from transactions that satisfy these conditions.

Adventure 2 – Left Join

Question: *What is the total count of products that have their ending inventory recorded?*

Perform a left join on the beginning and ending inventory data tables

*Note – SQLite does not have a built-in left join function, so we used the following procedure:

1. Perform a left outer join between the tables (Temporary Table 1)
2. Perform an inner join between the tables (Temporary Table 2)
3. Use UNION to combine both temporary tables created in steps 1 and 2

Adventure 2 – Query and Results

InventoryId	Store	City	Brand	Description	Size	onHand	Price	endDate
Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter
10_HORNSEY_1001	10	HORNSEY	1001	Baileys 50mL 4 Pack	50mL 4 Pk	0	5.99	2016-12-31
10_HORNSEY_1003	10	HORNSEY	1003	Crown Royal VAP Glass+Coastr	750mL	73	22.99	2016-12-31
10_HORNSEY_10058	10	HORNSEY	10058	F Coppola Dmd Ivry Cab Svgn	750mL	24	14.99	2016-12-31
10_HORNSEY_10062	10	HORNSEY	10062	B de Beauchene CDR Rouge	750mL	15	8.99	2016-12-31
10_HORNSEY_10164	10	HORNSEY	10164	Andre Bourgogne Pnt Nr RSV	750mL	19	15.99	2016-12-31
10_HORNSEY_1019	10	HORNSEY	1019	Drambuie Glass Pack	750mL	11	26.99	2016-12-31
10_HORNSEY_10227	10	HORNSEY	10227	Due Torri Pnt Nr del Venezie	750mL	7	9.99	2016-12-31
10_HORNSEY_10236	10	HORNSEY	10236	Layer Cake Malbec Mendoza	750mL	34	11.95	2016-12-31
10_HORNSEY_10238	10	HORNSEY	10238	Layer Cake Primitivo Puglia	750mL	18	15.99	2016-12-31
10_HORNSEY_10239	10	HORNSEY	10239	Cannonball Cab Svgn Cal	750mL	10	13.99	2016-12-31
10_HORNSEY_10254	10	HORNSEY	10254	Beringer Classic Chard	750mL	13	6.99	2016-12-31
10_HORNSEY_10266	10	HORNSEY	10266	Klinker Brick Old Vine Znfdl	750mL	51	15.99	2016-12-31
10_HORNSEY_1028	10	HORNSEY	1028	Amaretto di Amore VAP	750mL	9	9.99	2016-12-31
10_HORNSEY_10283	10	HORNSEY	10283	M D 20/20 Orange Jubilee	750mL	36	3.99	2016-12-31
10_HORNSEY_10296	10	HORNSEY	10296	Alamos Slcn Malbec Mendoza	750mL	12	15.99	2016-12-31
10_HORNSEY_1031	10	HORNSEY	1031	Avion Tasting Flight 3/375mL	375mL 3 Pk	6	49.99	2016-12-31
10_HORNSEY_10357	10	HORNSEY	10357	Gnarly Head Chard Cal	750mL	16	7.99	2016-12-31
10_HORNSEY_1036	10	HORNSEY	1036	Jameson Trilogy Pack	200mL 3 Pk	1	39.99	2016-12-31
10_HORNSEY_10372	10	HORNSEY	10372	Hazlitt Red Cat Finger Lakes	750mL	0	7.99	2016-12-31
10_HORNSEY_10380	10	HORNSEY	10380	Santa Cristina Pnt Grigio	750mL	10	10.99	2016-12-31
10_HORNSEY_10414	10	HORNSEY	10414	Le Cirque Rose	750mL	4	13.99	2016-12-31
10_HORNSEY_10415	10	HORNSEY	10415	Le Pive Rose Gris	750mL	8	14.99	2016-12-31
10_HORNSEY_10420	10	HORNSEY	10420	Barefoot Moscato Cal	750mL	25	4.99	2016-12-31
10_HORNSEY_10421	10	HORNSEY	10421	Barefoot Moscato Cal	1.5L	1	10.99	2016-12-31
10_HORNSEY_10422	10	HORNSEY	10422	Mirassou Pnt Grigio Cal	750mL	24	9.99	2016-12-31
10_HORNSEY_10443	10	HORNSEY	10443	Kung Fu Girl Riesling	750mL	30	11.99	2016-12-31
10_HORNSEY_10451	10	HORNSEY	10451	Line 39 Cab Svgn Lake Cnty	750mL	13	9.99	2016-12-31
10_HORNSEY_10453	10	HORNSEY	10453	Line 39 Svgn Bl Lake County	750mL	44	9.99	2016-12-31
10_HORNSEY_10469	10	HORNSEY	10469	Easton Svgn Bl Sierra Foothl	750mL	10	16.99	2016-12-31
10_HORNSEY_10472	10	HORNSEY	10472	Clos du Bois Pnt Nr Cal	750mL	37	8.99	2016-12-31

```sql
--create left outer join temp table
CREATE TABLE Temp.left_outer_Inv as
SELECT a.*
FROM
EndInvDec a
LEFT OUTER JOIN BegInvDec b
ON a.InventoryId = b.InventoryId;

-- create inner join temp table
CREATE TABLE TEMP.inner_join_inv as
SELECT
a.*
FROM EndInvDec a
INNER JOIN BegInvDec b
ON a.InventoryId = b.InventoryId;

--  between outer join and inner join temp tables
CREATE TABLE TEMP.combined_Inv as
SELECT
*
FROM Temp.left_outer_Inv
UNION
SELECT
*
FROM Temp.inner_join_inv
```

- The combined table provides the ending inventory counts of all inventory items, including items that do not have a record of their beginning inventory count.
- There are a total of 224,489 products that have their ending inventory recorded.

```sql
SELECT
COUNT(*)
FROM
TEMP.combined_Inv
```

	COUNT(*)
1	224489

3 – Transformation

Case 1 – Identify Vendor Activity

Focus efforts strategically on key supplier relationships:

Section 1.1 – Critical Vendor Billings

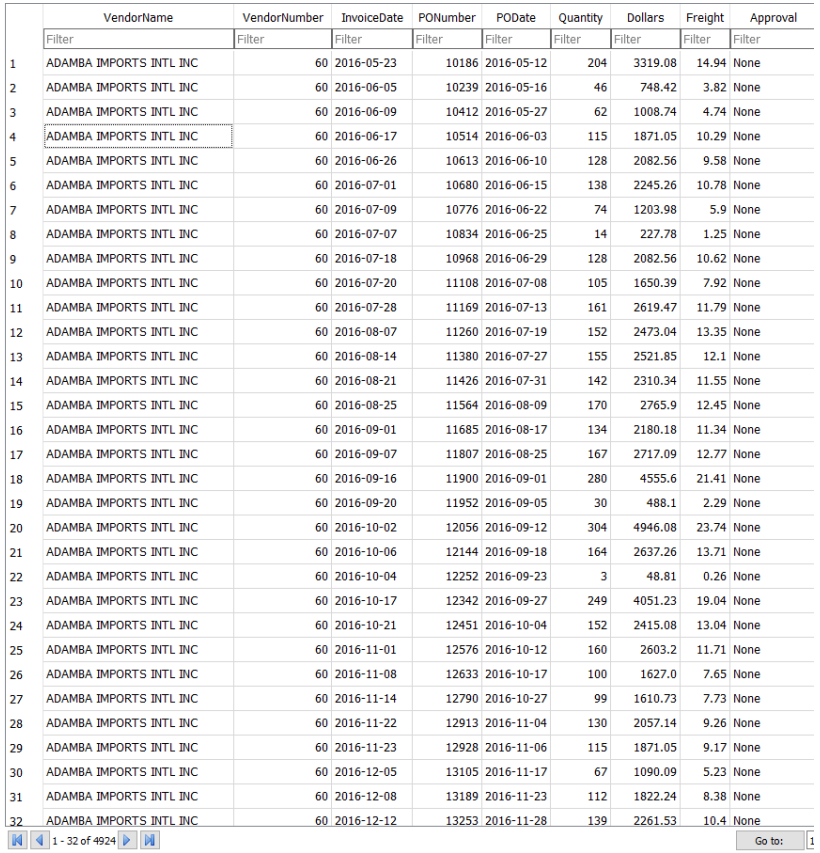
Section 1.2 – Top Vendors

Section 1.1– Critical Vendor Billings

Let's identify and monitor vendor activity to focus efforts strategically on key supplier relationships.

Section 1.1 – Queries and Results

- Aggregate table that includes all critical vendor billings and their associated purchasing activity.
- Critical vendors assumed to have more than $1000 purchased.



	VendorName	VendorNumber	InvoiceDate	PONumber	PODate	Quantity	Dollars	Freight	Approval
	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter	Filter
1	ADAMBA IMPORTS INTL INC	60	2016-05-23	10186	2016-05-12	204	3319.08	14.94	None
2	ADAMBA IMPORTS INTL INC	60	2016-06-05	10239	2016-05-16	46	748.42	3.82	None
3	ADAMBA IMPORTS INTL INC	60	2016-06-09	10412	2016-05-27	62	1008.74	4.74	None
4	ADAMBA IMPORTS INTL INC	60	2016-06-17	10514	2016-06-03	115	1871.05	10.29	None
5	ADAMBA IMPORTS INTL INC	60	2016-06-26	10613	2016-06-10	128	2082.56	9.58	None
6	ADAMBA IMPORTS INTL INC	60	2016-07-01	10680	2016-06-15	138	2245.26	10.78	None
7	ADAMBA IMPORTS INTL INC	60	2016-07-09	10776	2016-06-22	74	1203.98	5.9	None
8	ADAMBA IMPORTS INTL INC	60	2016-07-07	10834	2016-06-25	14	227.78	1.25	None
9	ADAMBA IMPORTS INTL INC	60	2016-07-18	10968	2016-06-29	128	2082.56	10.62	None
10	ADAMBA IMPORTS INTL INC	60	2016-07-20	11108	2016-07-08	105	1650.39	7.92	None
11	ADAMBA IMPORTS INTL INC	60	2016-07-28	11169	2016-07-13	161	2619.47	11.79	None
12	ADAMBA IMPORTS INTL INC	60	2016-08-07	11260	2016-07-19	152	2473.04	13.35	None
13	ADAMBA IMPORTS INTL INC	60	2016-08-14	11380	2016-07-27	155	2521.85	12.1	None
14	ADAMBA IMPORTS INTL INC	60	2016-08-21	11426	2016-07-31	142	2310.34	11.55	None
15	ADAMBA IMPORTS INTL INC	60	2016-08-25	11564	2016-08-09	170	2765.9	12.45	None
16	ADAMBA IMPORTS INTL INC	60	2016-09-01	11685	2016-08-17	134	2180.18	11.34	None
17	ADAMBA IMPORTS INTL INC	60	2016-09-07	11807	2016-08-25	167	2717.09	12.77	None
18	ADAMBA IMPORTS INTL INC	60	2016-09-16	11900	2016-09-01	280	4555.6	21.41	None
19	ADAMBA IMPORTS INTL INC	60	2016-09-20	11952	2016-09-05	30	488.1	2.29	None
20	ADAMBA IMPORTS INTL INC	60	2016-10-02	12056	2016-09-12	304	4946.08	23.74	None
21	ADAMBA IMPORTS INTL INC	60	2016-10-06	12144	2016-09-18	164	2637.26	13.71	None
22	ADAMBA IMPORTS INTL INC	60	2016-10-04	12252	2016-09-23	3	48.81	0.26	None
23	ADAMBA IMPORTS INTL INC	60	2016-10-17	12342	2016-09-27	249	4051.23	19.04	None
24	ADAMBA IMPORTS INTL INC	60	2016-10-21	12451	2016-10-04	152	2415.08	13.04	None
25	ADAMBA IMPORTS INTL INC	60	2016-11-01	12576	2016-10-12	160	2603.2	11.71	None
26	ADAMBA IMPORTS INTL INC	60	2016-11-08	12633	2016-10-17	100	1627.0	7.65	None
27	ADAMBA IMPORTS INTL INC	60	2016-11-14	12790	2016-10-27	99	1610.73	7.73	None
28	ADAMBA IMPORTS INTL INC	60	2016-11-22	12913	2016-11-04	130	2057.14	9.26	None
29	ADAMBA IMPORTS INTL INC	60	2016-11-23	12928	2016-11-06	115	1871.05	9.17	None
30	ADAMBA IMPORTS INTL INC	60	2016-12-05	13105	2016-11-17	67	1090.09	5.23	None
31	ADAMBA IMPORTS INTL INC	60	2016-12-08	13189	2016-11-23	112	1822.24	8.38	None
32	ADAMBA IMPORTS INTL INC	60	2016-12-12	13253	2016-11-28	139	2261.53	10.4	None

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```
CREATE TABLE TEMP.vendor_purchasing_activity as
SELECT
VendorName,
VendorNumber,
InvoiceDate,
PONumber,
PODate,
PayDate,
Dollars
FROM
VendorInvoicesDec
WHERE
Dollars > 1000
```

Case 1.2– Top Vendors

TOP 10 VENDORS BY DOLLARS

TOP 10 VENDORS BY QUANTITY

Case 1.2– Queries and Results

	VendorName	VendorNumber	total_quantity
	Filter	Filter	Filter
1	DIAGEO NORTH AMERICA INC	3960	5459788
2	JIM BEAM BRANDS COMPANY	12546	2737165
3	MARTIGNETTI COMPANIES	4425	2640411
4	CONSTELLATION BRANDS INC	1392	2325892
5	E & J GALLO WINERY	3252	1858260
6	PERNOD RICARD USA	17035	1647558
7	BACARDI USA INC	480	1427075
8	SAZERAC CO INC	8004	1417727
9	M S WALKER INC	9552	1372841
10	ULTRA BEVERAGE COMPANY LLP	9165	1077527

	VendorName	VendorNumber	total_dollars
	Filter	Filter	Filter
1	DIAGEO NORTH AMERICA INC	3960	5493102587531.88
2	MARTIGNETTI COMPANIES	4425	1509405512404.64
3	JIM BEAM BRANDS COMPANY	12546	1287949729633.19
4	PERNOD RICARD USA	17035	809522221793.42
5	CONSTELLATION BRANDS INC	1392	726257609544.82
6	BACARDI USA INC	480	557893932459.11
7	E & J GALLO WINERY	3252	454770994611.19
8	M S WALKER INC	9552	299088140718.08
9	ULTRA BEVERAGE COMPANY LLP	9165	285462131731.23
10	SAZERAC CO INC	8004	279415426257.5

```sql
/*Top 10 vendors by quantity*/
CREATE TABLE TEMP.cl_Prep_top10_quantity as
SELECT
VendorName,
VendorNumber,
SUM(Quantity) as total_quantity
FROM
VendorInvoicesDec
GROUP BY VendorName, VendorNumber
ORDER BY total_quantity DESC
LIMIT 10

/*Top 10 vendors by dollars*/
CREATE TABLE TEMP.cl_Prep_top10_dollars as
SELECT
VendorName,
VendorNumber,
SUM(Dollars) as total_dollars
FROM
VendorInvoicesDec
GROUP BY VendorName, VendorNumber
ORDER BY total_dollars DESC
LIMIT 10
```

- **Diageo North America** is the top vendor by both dollars and quantity.
- There is a variance in the placing of top 10 vendors when comparing dollars purchased and quantity purchased.

Case 2 – Days in Inventory

Identify trends in the timing for inventory purchased versus its corresponding sale.

Find the **days in inventory** for all products being purchased and sold.

Case 2 – Query and Results

```
/* Calculate days in inventory for each InventoryID */
CREATE TABLE c2_Prep_days_in_inventory as
SELECT
sql.InventoryId,
sql.PurchasePrice,
sql.total_quantity_purchased,
sq2.start_quantity,
sq2.end_quantity,
sq2.average_inv,
(sq2.average_inv/((sq2.start_quantity + sql.total_quantity_purchased - sq2.end_quantity)*sql.PurchasePrice))*365 as days_in_inventory
FROM
(SELECT
InventoryId,
PurchasePrice,
SUM(Quantity) as total_quantity_purchased
FROM
PurchasesDec
GROUP BY InventoryId
) as sql
INNER JOIN
(SELECT
b.InventoryId,
b.onHand as start_quantity,
e.onHand as end_quantity,
(b.onHand + e.onHand)/CAST(2 as REAL) as average_inv
FROM
BegInvDec b
INNER JOIN
EndInvDec e
ON b.InventoryId = e.InventoryId
GROUP BY b.InventoryId) as sq2
ON sql.InventoryId = sq2.InventoryId
GROUP BY sql.InventoryId
ORDER BY days_in_inventory DESC
```

	InventoryId	PurchasePrice	total_quantity_purchased	start_quantity	end_quantity	average_inv	days_in_inventory
	Filter	Filter	Filter	Filter	Filter	Filter	Filter
1	16_LUNDY_3012	0.74	3	117	100	108.5	2675.84459459459
2	36_LEWES_8282	0.71	12	62	61	61.5	2432.01516793066
3	9_BLACKPOOL_4141	0.71	120	0	108	54.0	2313.38028169014
4	4_EANVERNESS_3702	0.71	1	83	64	73.5	1889.26056338028
5	56_BEGGAR'S HOLE_6879	0.74	120	117	196	156.5	1882.74555042848
6	26_KNIFE'S EDGE_3607	0.72	130	16	120	68.0	1325.8547008547
7	53_HILLFAR_3562	0.77	116	164	210	187.0	1266.32653061225
8	50_MOUNTMEND_12086	9.65	24	21	44	32.5	1229.27461139896
9	36_LEWES_5818	0.78	1	165	111	138.0	1174.12587412587
10	43_WOLFORD_24033	3.15	1	10	10	10.0	1158.73015873016
11	22_SHARNWICK_5054	1.42	120	7	113	60.0	1101.60965794769
12	29_AYLESBURY_6879	0.74	1	120	76	98.0	1074.17417417417
13	15_WANBORNE_21382	9.08	12	21	32	26.5	1065.25330396476
14	48_NORFOLK_3568	0.79	1	177	113	145.0	1030.67185978578
15	26_KNIFE'S EDGE_2672	1.8	132	0	120	60.0	1013.88888888889
16	52_GRAYCOTT_8096	1.54	121	28	130	79.0	985.475051264525
17	39_EASTHALLOW_8027	1.55	2	114	91	102.5	965.483870967742
18	26_KNIFE'S EDGE_3837	0.72	140	23	123	73.0	925.173611111111
19	17_OLDHAM_4897	3.28	1	104	93	98.5	913.427337398374
20	6_GOULCREST_6879	0.74	120	120	162	141.0	891.632016632017
21	30_CULCHETH_6879	0.74	120	119	161	140.0	885.308385308385
22	44_PORTHCRAWL_35075	7.58	12	12	23	17.5	842.678100263852
23	48_NORFOLK_3571	1.47	2	130	98	114.0	832.533013205282
24	37_PAETHSMOUTH_5536	1.15	120	43	130	86.5	831.949934123847
25	61_AETHELNEY_6859	4.69	84	36	113	74.5	828.282059092293
26	4_EANVERNESS_5381	0.73	120	137	163	150.0	797.872340425532
27	79_BALLYMENA_35075	7.58	12	11	22	16.5	794.525065963061
28	50_MOUNTMEND_24921	10.4	24	11	34	22.5	789.663461538461
29	36_LEWES_8172	0.71	139	20	115	67.5	788.652368758003
30	56_BEGGAR'S HOLE_5308	0.75	6	107	61	84.0	786.153846153846
31	30_CULCHETH_3568	0.79	124	214	211	212.5	773.073856274295
32	24_PALPERROTH_3547	2.2	121	25	129	77.0	751.470588235294

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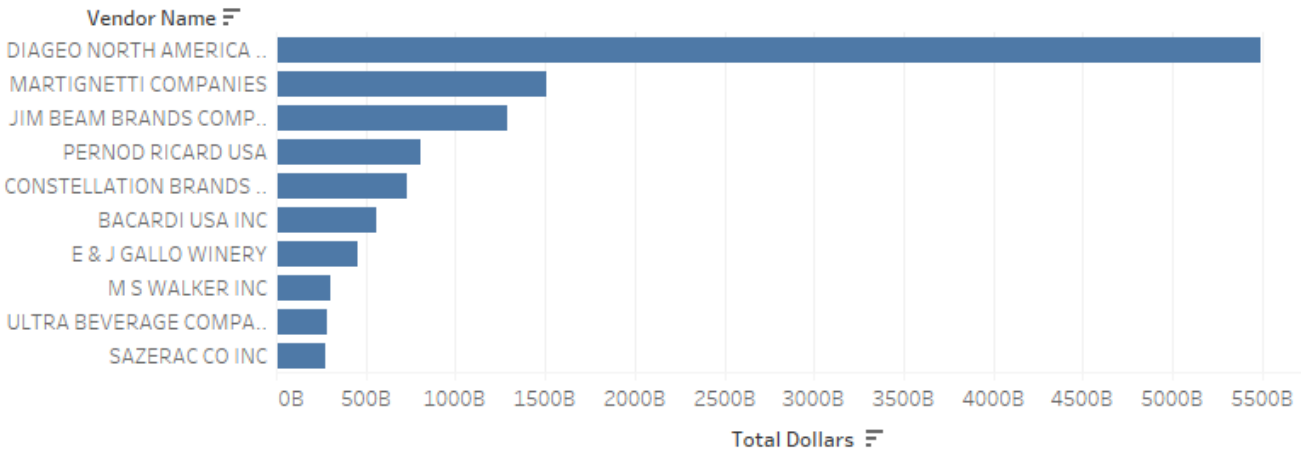
- Query Output shows the days in inventory for every InventoryID found in the Purchases table.
- Inventory days = 365 x (Average inventory / COGS)

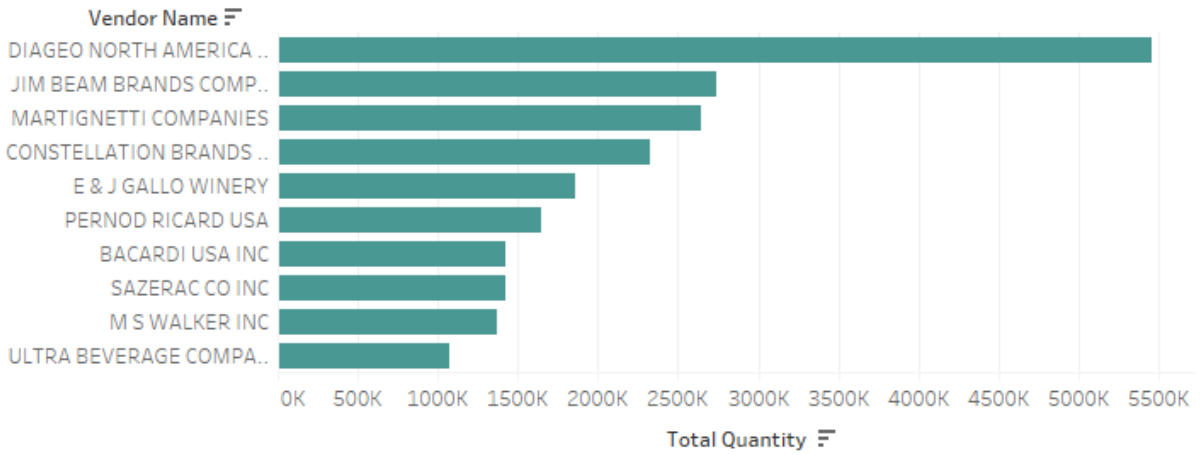
4 – Visualization

Bibitor LLC Phase 2 - 2016 Inventory Dashboard

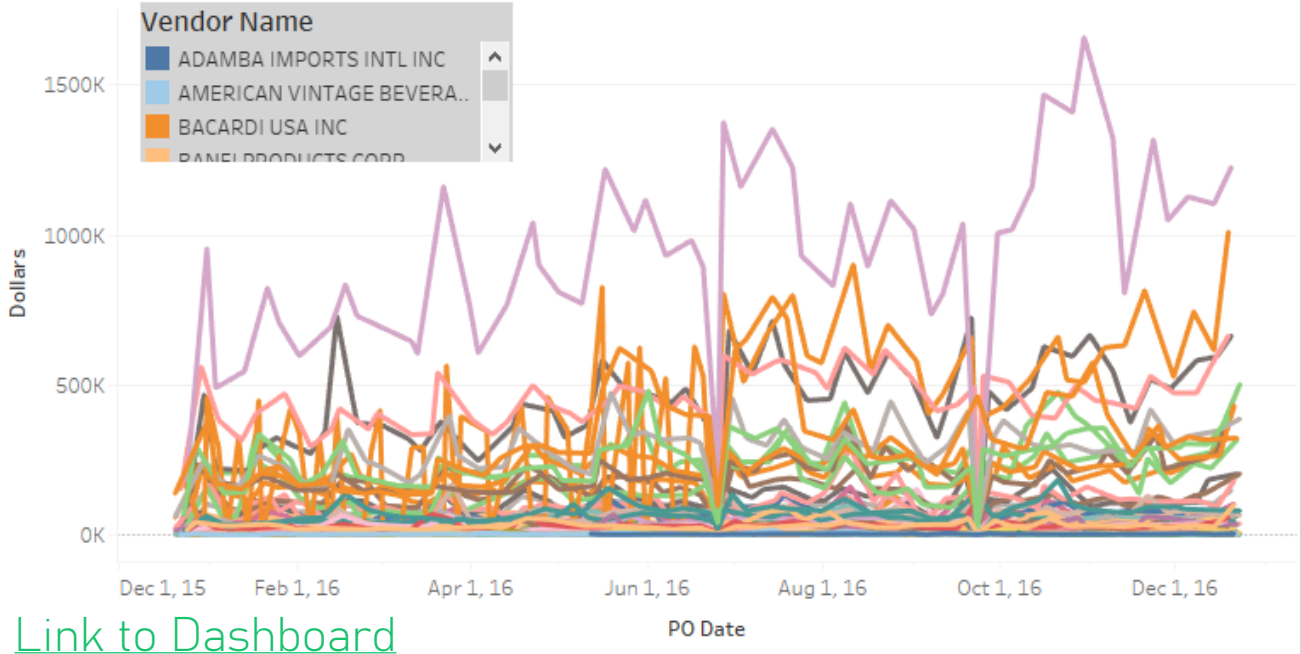
Top 10 Vendors by Purchase Dollars



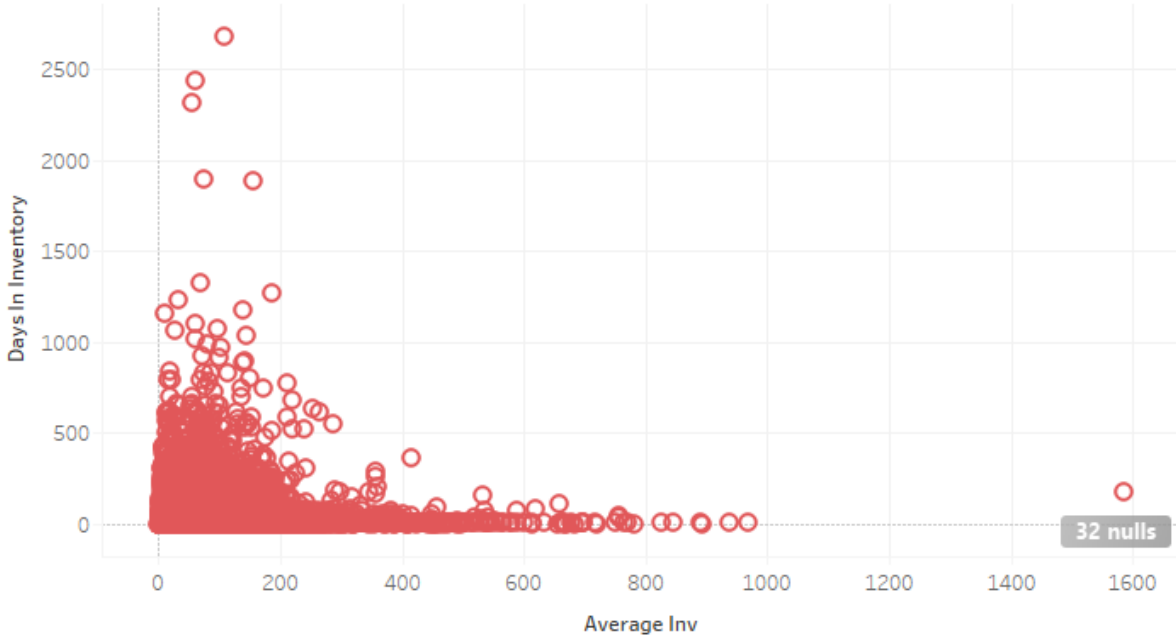
Top 10 Vendors by Quantity Purchased



Critical Vendor Purchasing Activity



Days in Inventory vs Average Inventory



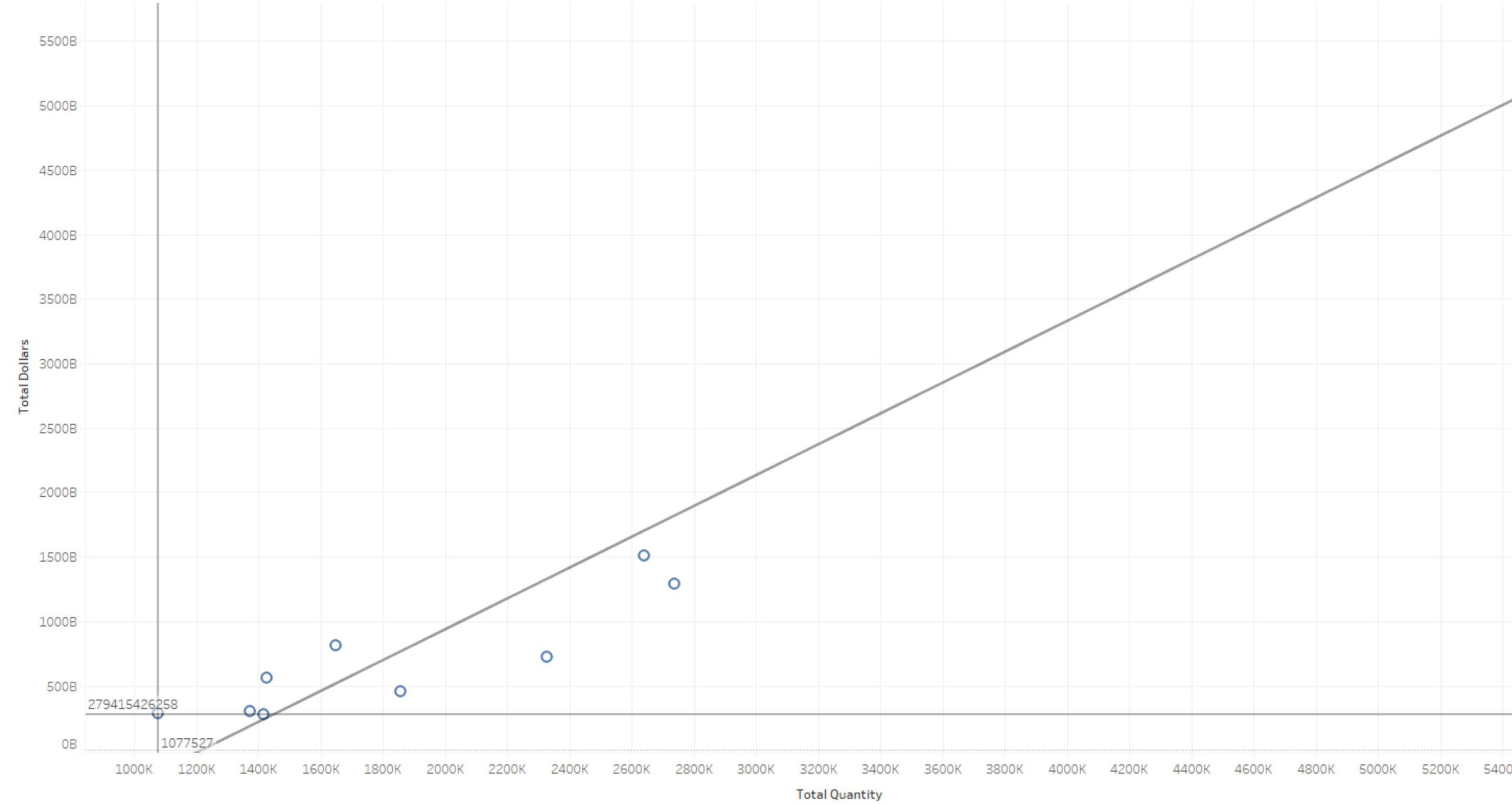
Link to Dashboard

5 – Analysis and Interpretation

Regression Analysis

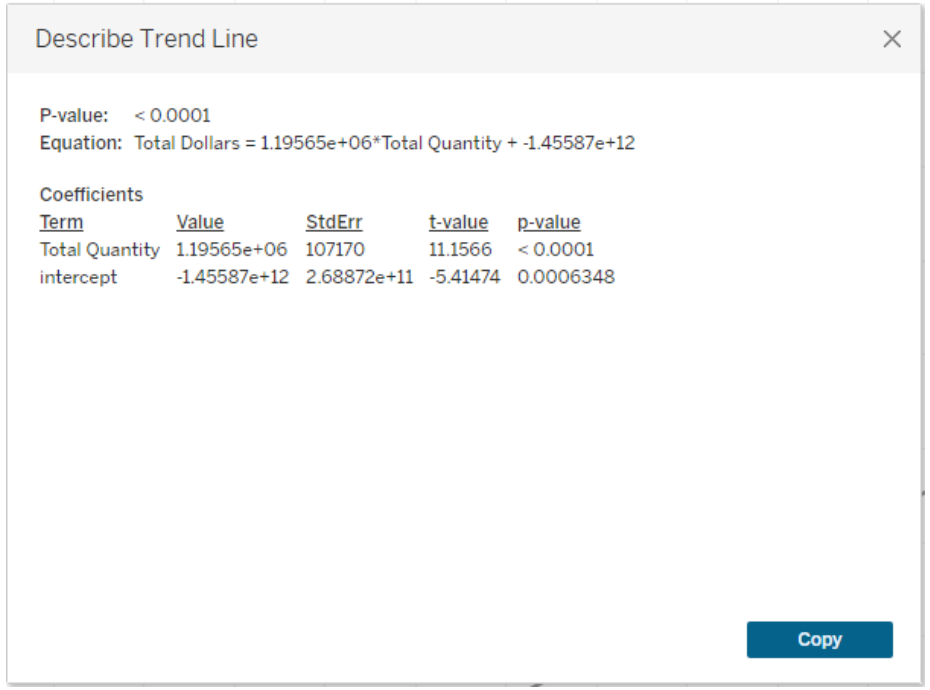
- A1 - Dollars Purchased and Quantity Purchased
- A2 - Days in Inventory and Average Inventory

Total Quantity Purchased vs Total Dollars Purchased

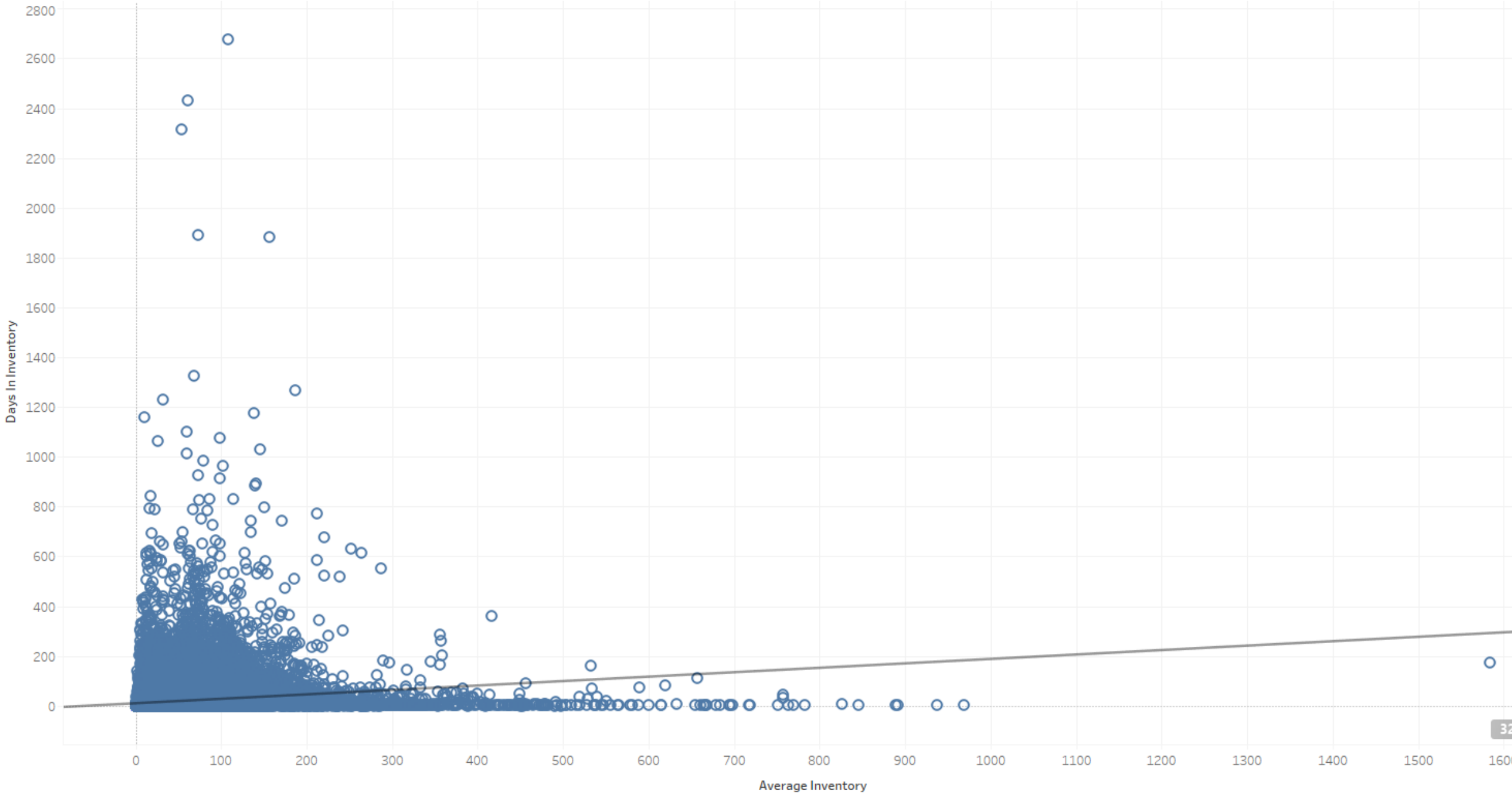


A1 – Regression Results

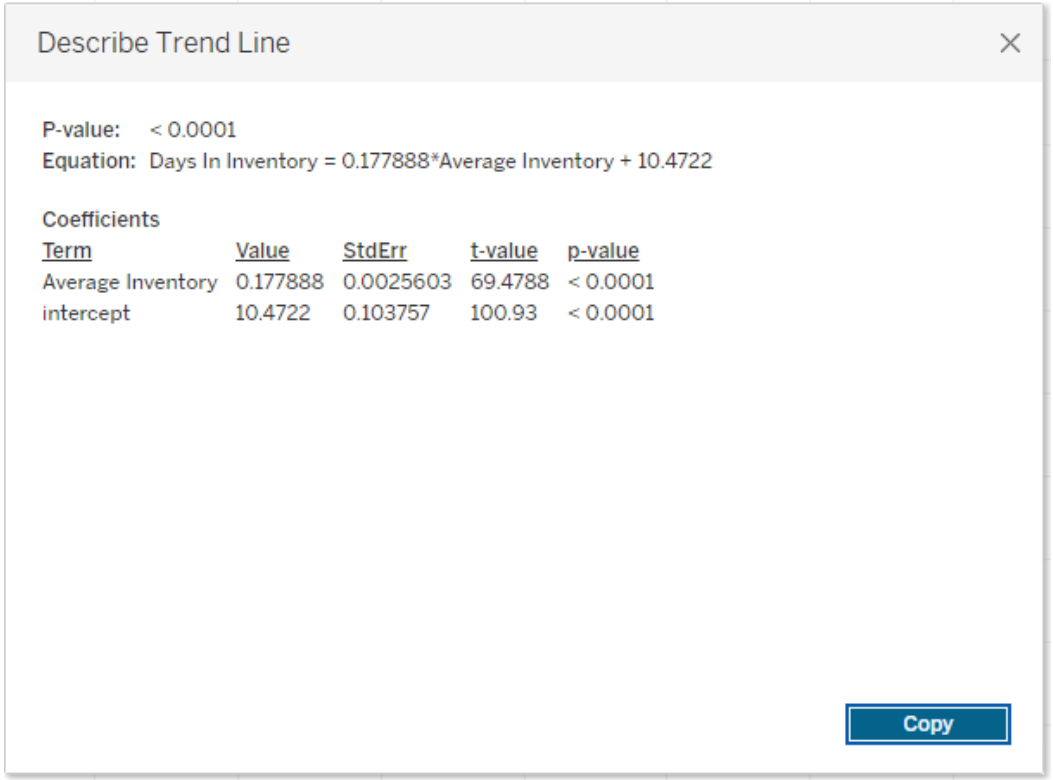
- R squared – 0.939609
- Quantity Purchased and Dollars Purchased are positively correlated.
- $p < 0.05$, quantity purchased has a significant impact on total dollars purchased.



Average Inventory vs Days in Inventory



A2 – Regression Results



- R squared – 0.0302284
- There is a **weak** correlation between average inventory and days in inventory.
- $p < 0.001$, indicating the evidence provided by the model is accurate.