Introduction

Rolling Thunder Bicycles company, a small company that manufactures custom bicycles. Based on provided data files to solve the problem, we assume that the data is true and reliable. As for four scenarios, this report begins with a brief problem statement and provides detailed solutions with results.

Scenario1: Root Cause Exploration and Overall Cost Estimation

1.1 Goal target

1. Identify possible root cause

2. Provide information to VP

3.Take appropriate measurements to solve the problem

4. Estimate cost concerning solutions

1.2 Assumption

Assumption 1. We only replace the frame of the recalled bicycles, because it is very expensive to replace a new one.

Assumption 2. The salary of each employee involved in replacement operation after recalling is $20 per bicycle and they are the same as those responsible for the corresponding order.

Assumption 3. The shipping price is double for each bicycle. Half of the cost goes to subsidize consumers**.**

1.3 Data analysis

1.3.1 We use 4M to analysis and sum all the probable reasons here

Methods: Construction; Head tube angle; Seat tube angle; Water bottle; Paint ID; Store ID;

Machine: No data

Man: Frame Assembler; Employee ID; Painter; Letter Style ID

Material: Chain stay; Top tube; Component ID

We guessed that problems happened in the man, because if problems happened on other fields, there need to be more than **those** complaints.

1.3.2 Diagram

CustomerID	ModelType	PaintID	FrameSize	OrderDate	StartDate	ShipDate	ShipEmployee	FrameAssembler	Painter	Construction
288	Mountain full	15	19.5	14-08-10	14-08-15	14-08-22	89097	51512	15293	TIG Welded
875	Mountain full	15	21	14-10-26	14-10-29	14-10-31	29387	51512	89097	TIG Welded
2281	Mountain full	14	16.5	14-11-19	14-11-28	14-12-04	87295	51512	93736	TIG Welded
18043	Mountain full	8	19.5	14-11-29	14-12-12	14-12-14	29387	51512	89097	TIG Welded
26160	Mountain full	9	16.5	14-12-05	14-12-19	14-12-25	87295	51512	89097	TIG Welded
29422	Mountain full	2	19.5	14-05-24	14-05-27	14-06-04	89097	51512	89097	TIG Welded
29577	Mountain full	10	14.5	14-05-25	14-05-30	14-06-01	29387	51512	15293	TIG Welded
40505	Mountain	2	18	14-12-10	14-12-25	14-12-31	87295	51512	93736	TIG Welded
40523	Mountain	7	18	14-07-10	14-07-10	14-07-17	87295	51512	89097	TIG Welded
40539	Mountain	13	19.5	14-07-20	14-07-22	14-07-25	51512	51512	89097	TIG Welded
40579	Mountain	9	16.5	14-06-03	14-06-06	14-06-08	15293	51512	87295	TIG Welded
40686	Mountain full	8	21	14-08-17	14-08-18	14-08-20	89097	51512	12512	TIG Welded
40791	Mountain full	10	18	14-11-12	14-11-18	14-11-20	29387	51512	89097	TIG Welded
40796	Mountain full	11	18	14-04-29	14-05-02	14-05-08	87295	51512	29387	TIG Welded
41008	Mountain full	2	19.5	14-10-14	14-10-16	14-10-18	29387	51512	29387	TIG Welded

1.3.2 Solutions

By analyzing the data in the table, I find the three possible similaries of each other

ModelType = Mountain and Mountain full(Because there are many similarities between these two bikes, so I want to choose both of them)

Construction = TIG Welded

FrameAssembler = 51512

So, I recommend that we take these three factors into account. And we use those three factors as a standard to find specific bicycles to recall and repair it. According to this standard, I choose period from Order time initially from **4/29/2014-12/31/2014**. Then, extend a month each time and find the cost and change of total cost. As we assume before, labor cost is **$30** per hour and time to repair a bicycle is **40** minutes. For each repair, we give assembler **$20**.

$$\text{Cost for recall} = \text{ship fee} * 2 + \text{Frame price} + \text{Labour cost}$$

	Total cost	number	Difference between total cost	Difference between number	rate of change
2014/4/29-2014/12/31	27853.7	29			
2014/3/29-2014/12/31	33376.27	35	5522.57	6	0.2
2014/2/28-2014/12/31	37772.52	40	4396.25	5	0.13
2014/1/29-2014/12/31	40486.49	43	2713.97	3	0.071
2013/12/29-2014/12/31	43699.91	48	3213.42	5	0.079
2013/11/29-2014/12/31	48789.7	54	5089.79	6	0.116

Before time 2014/1/29 -2014/12/29 the difference between total cost is decreasing, and after this time, the difference between total cost is increasing, so the critical point is this time.

Consequently, **the overall estimated cost for all recalled bicycle is $40486.49**

Scenario2: Sales Trend from 1998 to 2013 and ARIMA-based Prediction

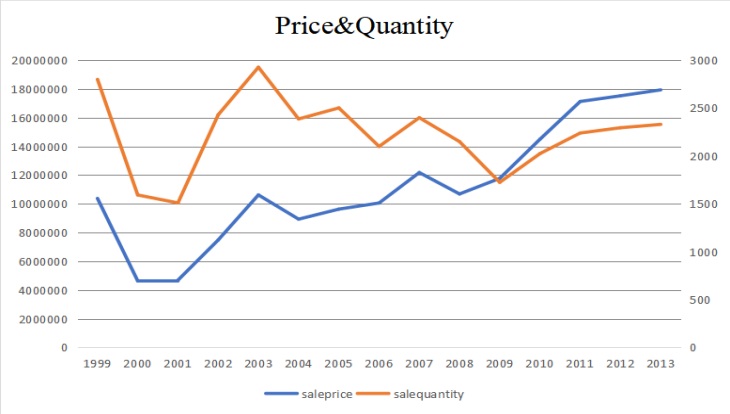
2.1 Goal Target

1.Analyze the sales trend from 1999 to 2013 and the factors that lead to those situations.

2.Provide market strategy and market forecasting for the next stage of development.

3.I find almost 10 dimensions here, and I give some dimensions with obvious trend.

2.2 General sales trend analysis



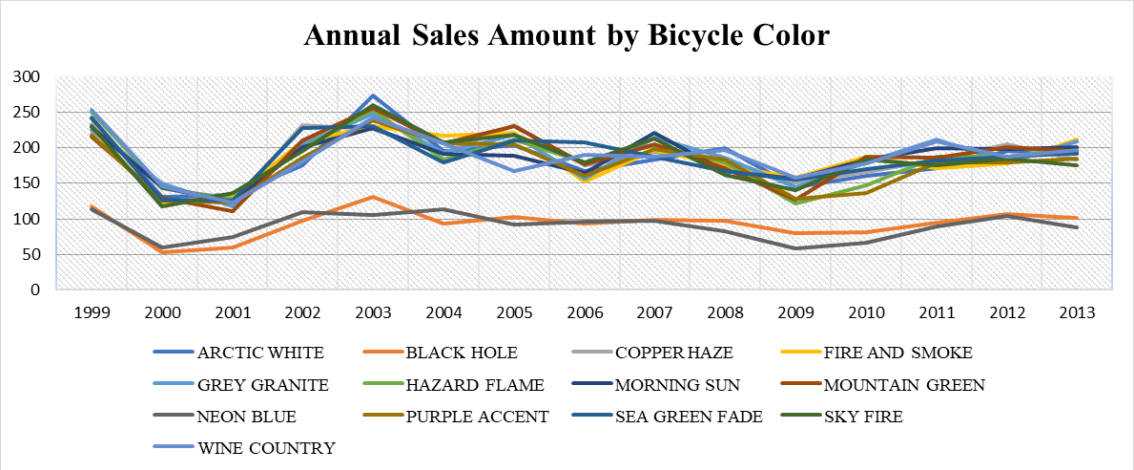
Findings: There are three low tides of sales quantities among 13 years, because of Economic crises in 2000 and 208, and 911 terrorists attack in 2001. And sales quantities achieved a large

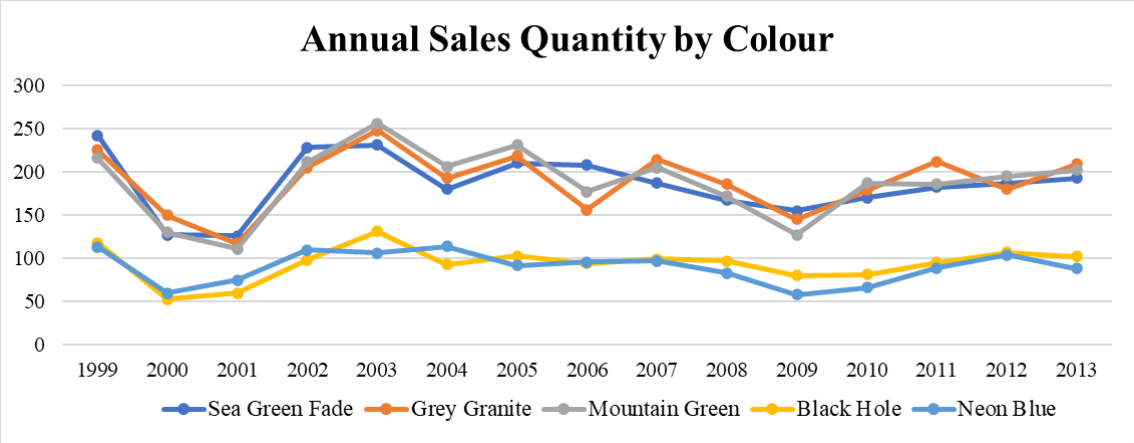
growth after 2008. Meanwhile, the total Sale price is obviously increased with only short periodical decreasing. The increase of sales quantity is less than the increase of total sales price, which means people have stronger and stronger purchasing power and needs for bicycle.

Strategy: Look for areas with faster population growth and faster economic development, and put more bikes into the market in these areas

2.3 Specific sales trend analysis

2.3.1 Annually and Monthly Sales Trend by Bicycle Color





Prediction for next five years based on ARIMA

Color	Year				
	2014	2015	2016	2017	2018
Arctic White	94	98	102	96	96
Black Hole	85	91	90	93	91
Copper Haze	185	186	185	193	196
Fire and Smoke	181	181	180	179	178
Grey Granite	181	181	180	181	180
Hazard Flame	197	191	191	193	194
Morning Sun	189	191	194	194	195
Mountain Green	185	183	188	192	194
Neon Blue	183	179	180	181	180
Purple Accent	191	181	184	192	193
Sea Green Fade	185	184	185	186	187
Sky Fire	185	195	198	193	189
Wine Country	186	187	192	188	187

Findings:

Most colors are not very different among customers' favor except for two special colors which are *black hole* and *neon blue*. Also, no color has been the top seller for more than two years, which means popular color is different from years to years.

Strategy:

1. Reduce the production and design of *black hole* and *neon blue*

2. Predict the next year's fashion colors and focus on cool colors such as green and grey.

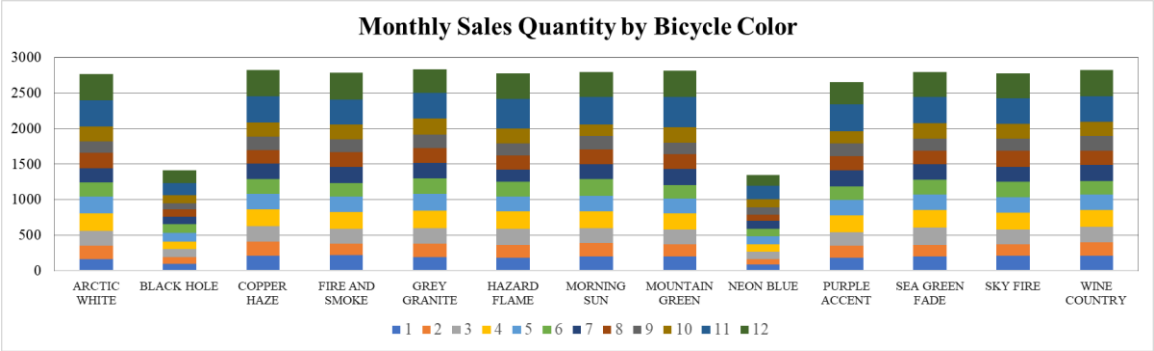


Figure 2 Monthly Sales Quantity by Bicycle Color

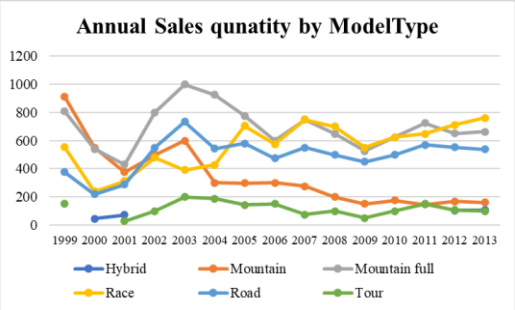
Findings:

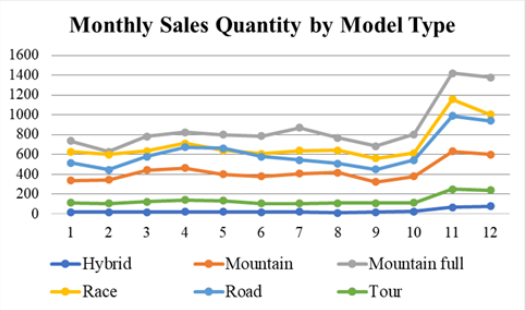
November and December have significantly higher sales Quantity than the other months. The probable cause is that there are many American holidays among these two months and bicycle may be a good holiday gift. Shopping holiday, such as Black holiday, may also a factor.

Strategy:

1. Improve storage of bike for November and December, and stimulate consumption like giving discount.

2.3.2 Annually and Monthly Sales Trend by Model Type





Findings:

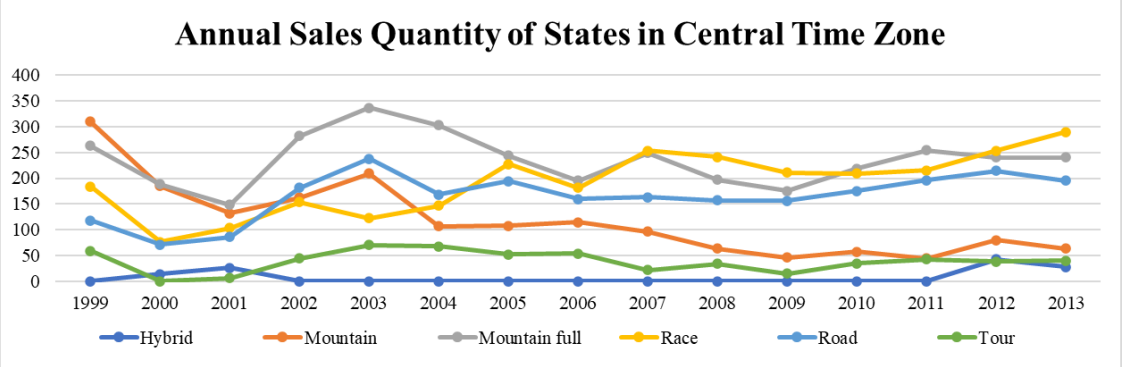
After financial crisis in 2018, sales quantities of all Model Type are increased. From 2009-2013, sales quantities of *race, mountain full*, and *road* are significantly higher than those of three other Model Type. People may choose mountain full to substitute Mountain to some degree. Hybrid is not welcome, so it only sales in 4 years. Racing bikes have a promising market.

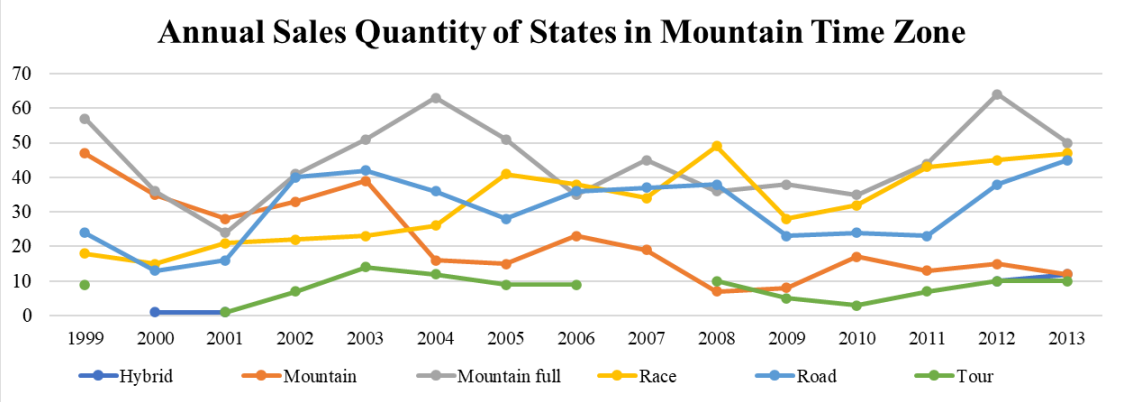
In February and September, there is a sales bottleneck. On the contrast, in November and December, sales increase significantly. We find that sales quantities: *mountain full* > *Race* > *Road* > *Mountain* > *Tour* > *Hybrid*

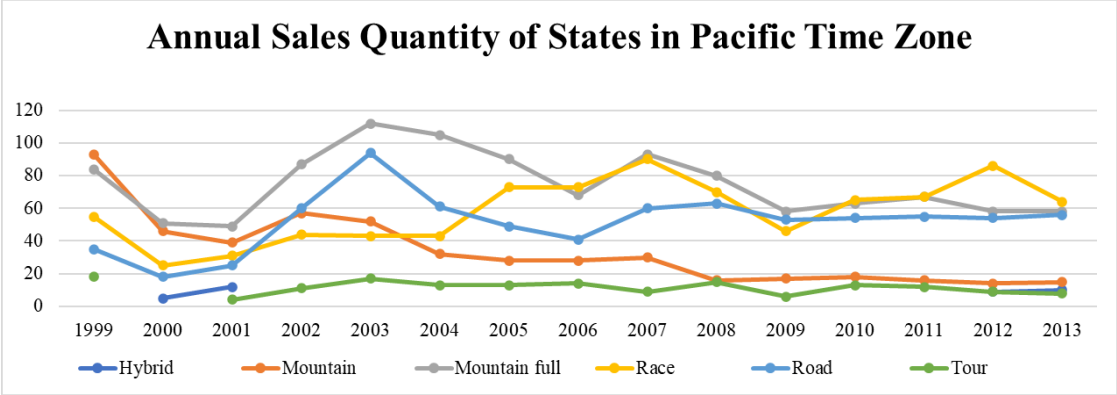
Strategy:

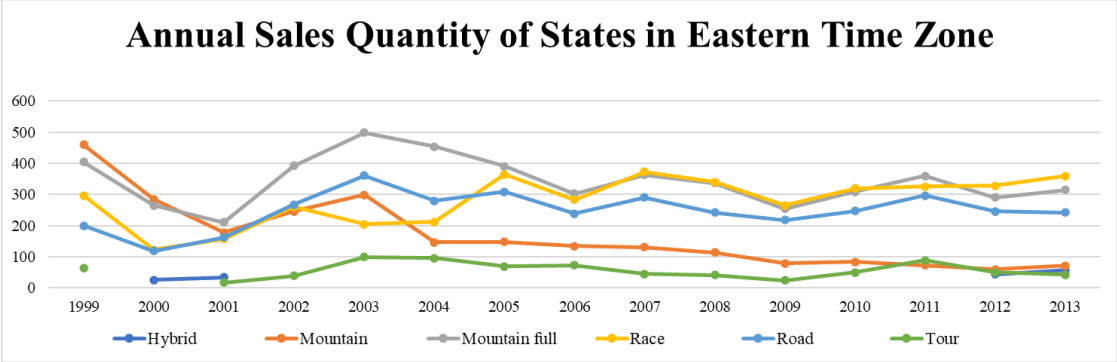
1.Maintain sales quantities of mountain full bike, and focus more on the design and development of Race Bicycle products.

2.3.3 Annually and Monthly Sales Trend by Time Zone









Findings:

In each time zone, sales quantities of *race*, *mountain full*, and *road* are significantly higher than those of three other Model Type. And in every time zone, sales quantity of *mountai*n bicycles are decreasing from 1999-2013 and *tour* bicycles are not popular all 14 years. Sales quantity in central time zone is the highest, and sales quantity in Central Time zone is the second highest, because of high population and advanced economy. Sales quantity in Mountain time zone is the lowest.

Strategy:

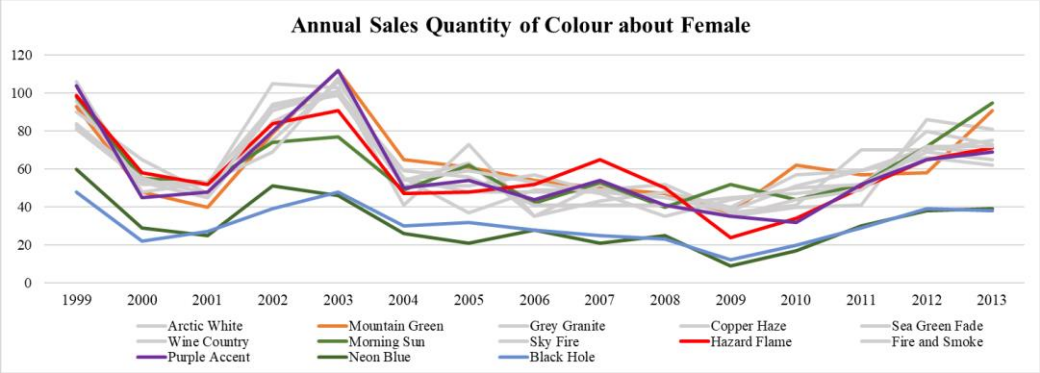
1.In Central time zone: Increase the sales quantity of *Race* bicycles. Maintain sales quantity of *mountain full* and *road* bicycles. Decrease sales quantity of other model types.

2. In Mountain time zone: Increase the sales quantity of *Race* and *road* bicycles. Decrease sales quantity of other model types.

3. In Pacific time zone: Maintain sales quantity of other model type. Decrease sales quantity of *Race.*

4. In Western tome zone: Increase the sales quantity of *mountain full* and *race*. Maintain sales quantity of *road*. Decrease sales quantity of other model types.

2.3.3 Annually and Monthly Sales Trend by Man and Woman

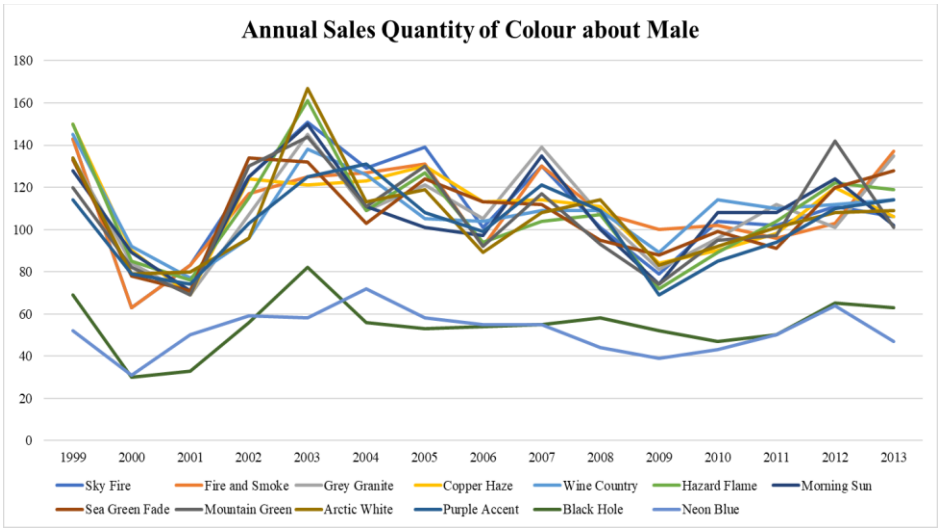


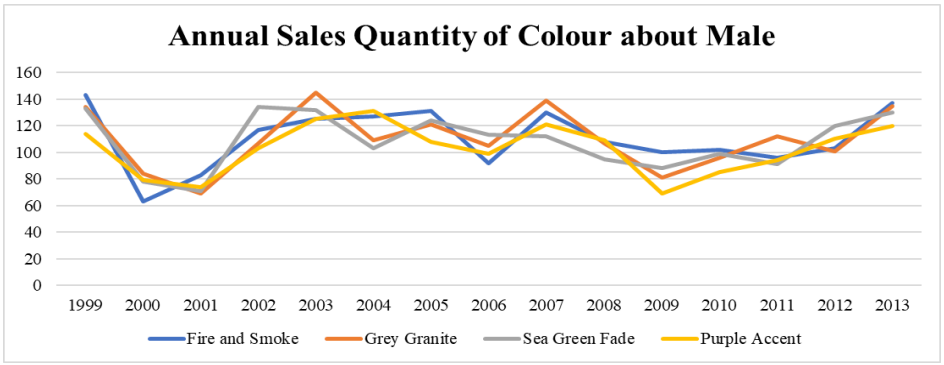
Findings:

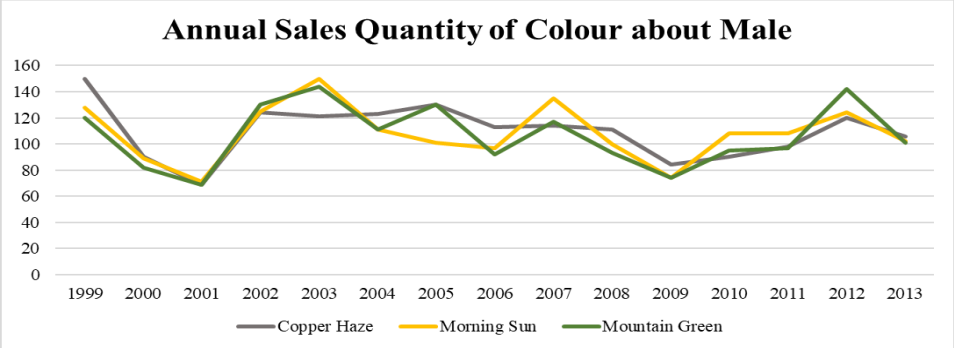
Most of colors of bicycles bought by Female keep increasing from 2009-2013, and we think that it will keep increasing then. Female will have good consumption power for bicycles in the future. However, Black Hole and Neon Blue seems to be not popular among female. On the contrary, bright-colored bicycles are becoming more popular among female.

Strategy:

1.Enhance the bicycles design with bright colors, such as *Purple Accent*, *Hazard Flame*, and *Morning Sun*. Target women as customers and increase the popularity among female.







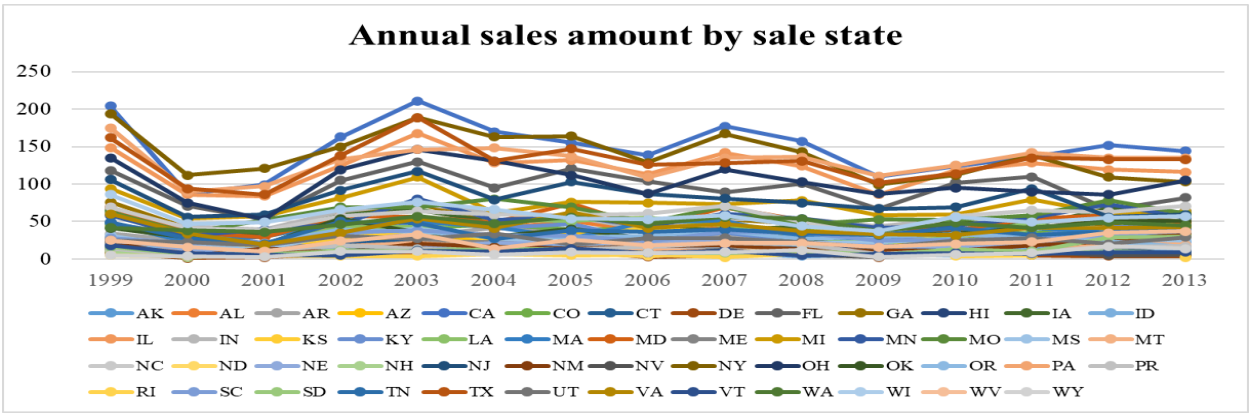
Findings:

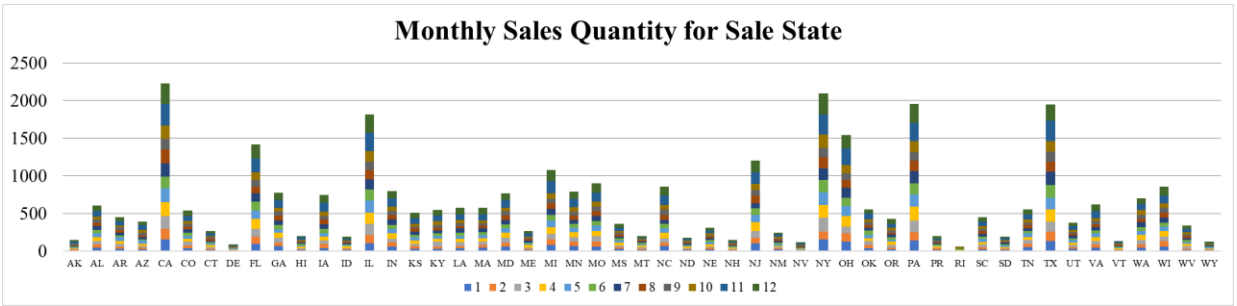
The number of bicycle sales is much higher among men than women. Men prefer deep colors, such as darker shades of gray. The sales quantity of bicycle with *Fire and smoke*, *Grey Granite*, *Sea Green Fade* color may increase. However, *Black Hole* and *Neon Blue* seems to be not popular among male, too. The probable reason is that the color scheme has never been in line with people's aesthetic.

Strategy:

1.Enhance the bicycles design with dark colors, such as *Fire and smoke*, *Grey Granite*, *Sea Green Fade*. Target male as customers and increase the popularity among male.

2.3.4 Annually and Monthly Sales Trend by Sale State





Prediction for next five years based on ARIMA

Sale State	Year				
	2014	2015	2016	2017	2018
CA	149	152	156	158	160
IL	121	123	124	126	127
NY	139	139	136	142	144
PA	133	132	133	131	132
TX	129	130	134	135	137

Findings:

From figure 3, In general, sales amount in each state peaked in 2003 and 2008, and picked up since 2009. Sales condition is better in states with those who have relatively good economic conditions. California has the highest sales amount probably because they have the largest population. The next four on are Illinois, New York, Pennsylvania and Texas, which also have good sales quantity.

On month level, sales quantity of each state meets the peak in November, and in December has the second higher sales quantity.

Annually Sales total Price by Sale State has generally increased year by year, except for a few years of decline. So, we predict that it will keep increasing then.

Strategy:

1.We should pay more attention to the business of some states with better economic condition and higher power of consumption including California, Illinois, New York, Pennsylvania and Texas etc.

2. Strengthen market publicity, improve brand competitiveness and after-sale service guarantee ability in the above-mentioned cities.

Scenario 3: Range Narrowing Search for Most Likely Bicycle

3.1 Goal target

1. Narrow the range of males, and provide information for police to find identity of the male.

2. Try to find the most efficient way for finding

3.2 Assumption

Assumption 1. The data in the database is real and valid.

Assumption 2. The bike was badly damaged and we couldn’t get any details about the length and angle of the vehicle.

Assumption 3. The bike was not modified. The bicycle parameters are consistent with those in the original database.

3.3 Find the male

3.3.1 List information we have known:

a. Gender: male

b. State: CA

c. Order date: 1998-now

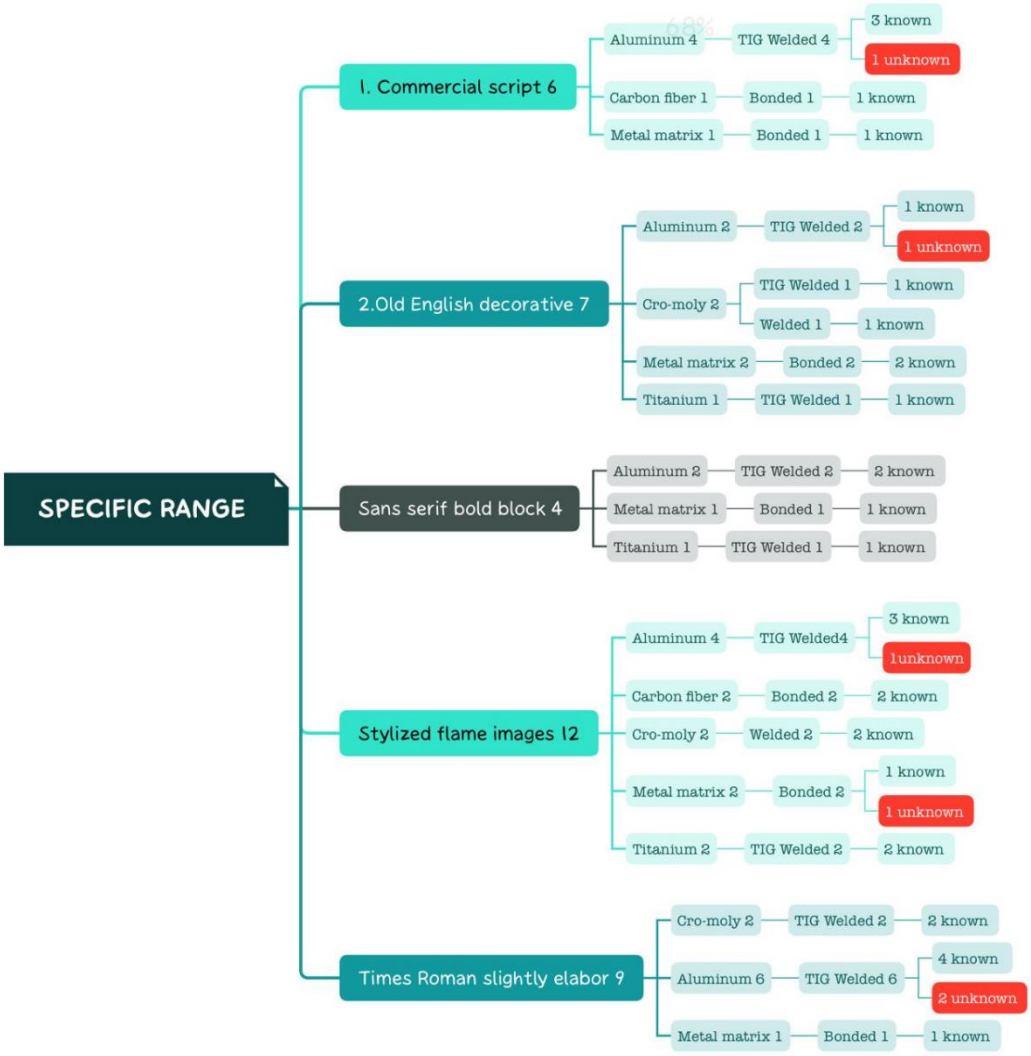
d. Bike color: white

e. Bike Type: Rolling thunder road bike

3.3.2 Method to find the male

We use the data of *ModelType* and *Orderdate* in *Bicycle* table and *ColorList* in *Pain*t table to find the possible bicycles. We know that an accident on the road involving a bicycle rider who right now is hospitalized and uncouscious. As, we assume before, the bike was badly damaged and we couldn't get any details about the length and angle of the vehicle. Given this situation, we use three parameters, that is, ***Material, Construction* and *Discription***. As a result, there are 32 bicycles (There are another six bikes that don not have customer information, so we do not take them in consideration. *SerialNumber*=49651, 49659, 49812, 51776, 51863, 52073).

3.3.3 Result



From the diagram, we find that if we ask police to give us information about there thress dimensions, we can narrow bicycle to a very small range.

Scenario 4: Application of QR model and ABC in inventory management

4.1 Goal target

1. Cut the cost by 8% of company

2. Lead time improvement

3.Find out points we can optimized to help further improvement

4.2 Assumption

1. Shipping cost is average shipping cost in past 5 years.

2. Component cost is average component cost in past 5 year.

3. When we meet dirty data, we drop the data

4. The 8% of total estimated cost is total inventory cost

4.3 Cost calculation and analysis

4.3.1 fixed cost

(1) Salary

Total Salary is **$532,000.00 per year** from database

(2) Component cost

We extract data in *PurchaseItem.PricePaid, PurchaseItem.Quantity*, PurchaseOrder.Discount. Sum ((PurchaseItem.PricePaid*PurchaseItem.Quantity)-PurchaseOrder.Discount)/ 5 (years) is the total component cost. As a result, total component cost is **$399243.04 per year.**

(3) Shipping cost

We extract data in *PurchaseOrder.OrderDate*, *PurchaseOrder.ShippingCost* in Table *PurchaseOrder*. Then we calculate Sum (*PurchaseOrder.ShippingCost)*/5 (years). As a result, total shipping cost is **$3680.00 per year**.

4.3.2 Inventory cost

We extract the data in *QuantityOnHand*, *EstimatedCost* in Table *Component*. There is some negative data, and consider these data as wrong data because the quantity of components in stock couldn't be negative. Therefore, we change all these data to 0. Next, we suppose warehouse outer time as *OrderDate* in Table *Bicycle*, which the material has begun to deliver and we suppose warehouse entry time is *ReceiveDate* in Table *PurchaseOrder*, which means as soon as we receive the Component, we stock it. And (warehouse outer amount-warehouse entry amount) means that for each component we use all warehouse outer amount minus warehouse entry amount. These data can be extracted when we receive component and receive order from assemblers and so we can get actual amount we have during a period of time.

Then we can calculate Inventory cost by following formula:

Sum ((warehouse outer amount -warehouse entry amount) * Component.EstimatedCost)/ (warehouse outer time -warehouse entry time) (years)*8%=**$1755701.60 per year**

Total cost=$532,000.00+$399243.04+$3680.00+$1755701.60=2690624.64 per year

Fixed cost=$532,000.00+$399243.04+$3680.00=$934923.04 per year

As, we can see from the above, QR model will suitable for other components we have not included.

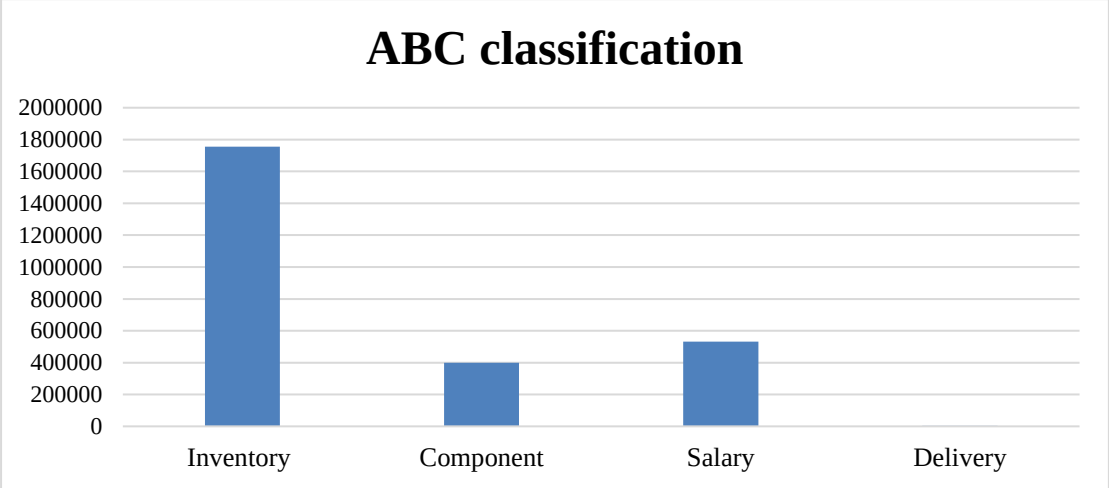
4.4 Lead time analysis

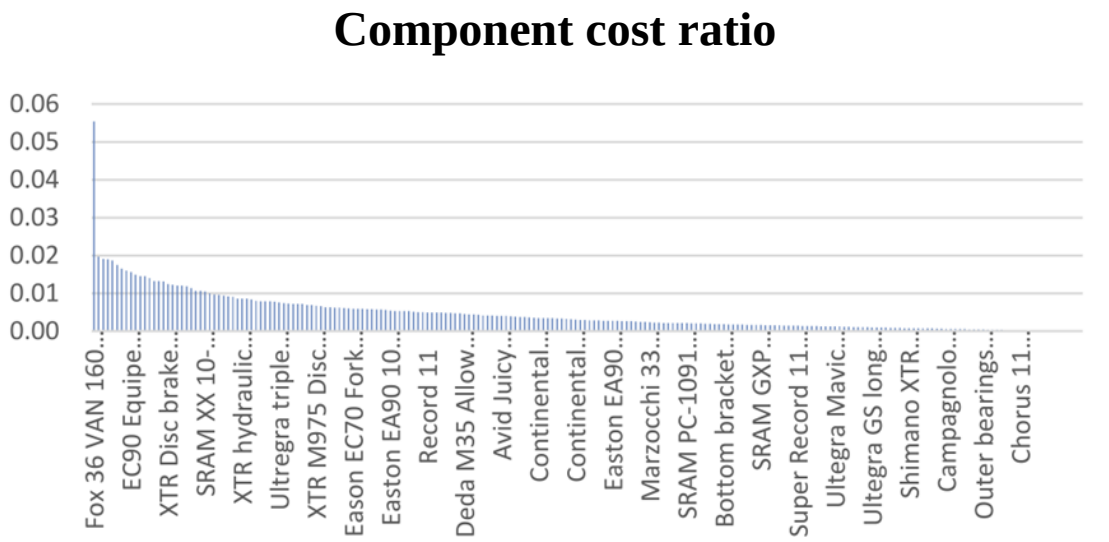
We use the data of average five years to estimate lead time.

Lead time=ship time-order time There are 96716 days and the order number is 11132. So, lead time is **8.69 days （Total lead time）**

4.5 Data analysis

4.5.1 ABC classification





As you can see from the graph, we choose ten components here

*Fox 36 VAN 160 RC2 1.5 taper all-mountain 160 mm travel 26 inch w/*headset, Easton *EC90 SL Fork carbon, XTR Disc brake levers, SRAM XX 10-speed cassette 11-32, XTR hydraulic disc brakes with lever/pair, Ultregra triple STI 10 speed carbon, XTR M975 Disc DT Swiss XR 350, Eason EC70 Fork Aluminum, Record 11, Deda M35 Allow handle bar*, whose cost contains about **13.57%** of total inventory cost.

4.5.2 QR Model application

Assumption:

a. **95%** of the service level

b. The selected 10 components almost take the **13.57%** of the inventory cost which is **$238248.71 per year**. And corresponding fixed cost is **13.57%** of fixed cost, which is **$126869.06 per year**.

c. The selected 10 components' lead time is **8.12** days

Calculation formula and results

AVG=Average daily demand faced by the distributor

STD=Standard deviation of daily demand faced by the distributor

L=replenishment lead time from supplier to the distributor in days

h=Cost of holding one unit of the product for one days at the distributor

D=items per day: constant demand rate

$$\boldsymbol{safety\ stock}: \boldsymbol{s = z \times STD \times \sqrt{L}}$$

$$\boldsymbol{Order\ quantity}: \boldsymbol{Q = \sqrt{\frac{2K \times AVG}{h}}}$$

$$\boldsymbol{Record\ level}: \boldsymbol{R = L \times AVG + Z \times STD \times \sqrt{L}}$$

$$\boldsymbol{New\ total\ cost = (s \times h + \frac{Q \times h}{2} + \frac{K \times D}{Q}) \times 365}$$

New total cost=**$310,350.09**

Cost reduced rate of total: **($365117.76-$310,350.09)/ $365117.76=14.9%**

Cost reduced rate of Inventory: **$54767.67/$238248.71=23.5%**

4.5 Time and Analysis and future Data Acquisition Point

4.5.1 Time we have already know

According to database, we analyze the entire company's supply chain find the time. We assumed that we only choose data from the 2010-2015.

Firstly, we assume the time of purchase order. It is time that employees buy component from supplier and deliver them into warehouse. According to data from table *Purchaseorder*, we use *Receivetime* minus *Ordertime* to find the average time of total purchase orders. Time here is **9.46 days.**

Secondly, we assume time from warehouse to assemblers' working place. We find that each Frame assemblers only need to assemble two or three bicycle each day, so we think that long time between start date and order date is used for delivering and preparing raw material. According to data from table *Bicycle*, we use *Startdate* minus *Orderdate* find the average time. Time here is **4.46 days**.

Thirdly, we analyze time between start time and ship time. According to data from table *Bicycle*, we use *Orderdate* minus *shipdate* to find the average time. Time here is **4.23 days**.

At last, we find the time it takes for a bicycle to be delivered to a customer. We compare *Transdate* from table *Customertransaction* and *shipdate* from *Bicycle*. We are surprised to find that the time customer received the bike was almost the same day as the bike began to ship. Time here is smaller than **1 days.**

So, the time here we need to essentially focus is the **second part**.

4.5.2 Further data acquisition points and analyze

For First part

We can predict sales and prices for components near stock locations. We choose the cheaper components near the stock location for purchase. After taking into account shipping costs, components can also be shipped to more distant warehouses. Doing so can also reduce costs.

For Second part

We need the specific information of warehousing, such as the **exactly time of entering the warehouse**, **batch number**, **quantity**, and the corresponding information of **leaving the warehouse.** These can help us manage warehouse more precisely and reduce ship time.

We may need **supplier address**, **warehouse rent**, **detailed warehouse address** and **customer distribution**, etc to achieve the purpose of cost reduction. Warehouse location has a significant impact on transportation and storage costs

For third part

We can collect bike assembly **speed**, **cycle time**, **worker productivity**, and time at each step from receiving an order to delivery, which helps reduce balance delays.

We also find that assemblers' load is not heavy to some degree, we may can give them some bonus for speeding up the production.

Lastly, it is important to improve the data quality and accuracy in the next few years.

Appendix A Customer information in Senario3

CustomerID	Phone	Gender	Address	CityID	FirstName	LastName	ZipCode	City	OrderDate	State	ColorName
2443	(808) 842-6020	M	2278 Railroad Avenue	443	Rudolph	Napodano	90631	La Habra	06-06-19	CA	Arctic White
2969	(209) 361-7298	M	2907 Executive Park Drive	229	Edward	Lobeck	92803	Anaheim	98-10-10	CA	Arctic White
7519	(213) 905-6766	M	7947 Greenfield Lane	15219	Salurnino	Valentin	93615	Cutler	98-09-22	CA	Arctic White
8281	(714) 534-2702	M	4515 Oxford Way	6629	Samuel	Blair	95694	Winters	09-09-14	CA	Arctic White
10753	(310) 334-6965	M	3540 Indian Lake Road	596	Thomas	Sarp	91730	Rancho Cucamonga	02-12-20	CA	Arctic White
11908	(207) 228-2592	M	5929 Harbor Drive	6291	John	Antenucci	93546	Mammoth Lakes	00-11-19	CA	Arctic White
11984	(419) 533-2697	M	7836 Shoreside Drive	6289	David	Holland	90265	Malibu	00-09-21	CA	Arctic White
12034	(904) 113-5842	M	7165 Bayshore Drive	6090	Robert	Kowalski	92014	Del Mar	00-09-10	CA	Arctic White
16593	(305) 284-2444	M	6608 Cumberland Hills Drive	650	Murray	Dryer	94806	San Pablo	01-05-17	CA	Arctic White
19232	(314) 602-4259	M	3019 Cline Avenue	16491	Willard	Shaffar	92548	Homeland	03-04-21	CA	Arctic White
19500	(619) 578-6968	M	1516 Whisper Woods Road	318	Marc	Nusbaum	94520	Concord	07-07-30	CA	Arctic White
24699	9128670204	M	2710 Sandy Hill Rd	19113	Scott	Labriola	96019	Shasta Lake	04-03-06	CA	Arctic White
24770	3022053582	M	2653 W Lee Rd	755	David	Frankel	93286	Woodlake	04-06-03	CA	Arctic White
25075	3177655285	M	6313 Albright Ave	476	Jas	Kane	95953	Live Oak	04-01-08	CA	Arctic White
25466	9728701527	M	5367 Richards St	324	Dwight	Combest	92628	Costa Mesa	98-07-18	CA	Arctic White
26080	7164552206	M	3664 Admirals Walk	507	Robert	Gilg	93640	Mendota	04-01-12	CA	Arctic White
26157	7320166036	M	7352 Dale Dr	558	Robert	Kowalczyk	95965	Oroville	04-02-28	CA	Arctic White
26926	7170504027	M	292 Bassett St	18908	Robert	Acevedo	94957	Ross	13-11-02	CA	Arctic White
28848	(804) 862-0773	M	8058 Summitview Rd	433	Lawrence	Poallo	95077	Interlaken	06-06-15	CA	Arctic White
30594	(570) 844-6066	M	7011 168th St	680	Joseph	Van Harssel	91733	South El Monte	07-11-10	CA	Arctic White
30877	(504) 897-8935	M	968 Nathans Way	6030	Dennis	Bipat	93921	Carmel-by-the-Sea	07-06-13	CA	Arctic White
31800	(715) 327-4794	M	2301 S 12th St	605	John	King	94063	Redwood City	98-09-24	CA	Arctic White
32424	(631) 844-7908	M	6887 Van Alst St	15563	Glen	Milks	95431	Eldridge	09-11-05	CA	Arctic White
32503	(828) 594-9240	M	8318 Rommel Ave	15134	Robert	Kim	95428	Covelo	08-02-22	CA	Arctic White
35181	(619) 174-1275	M	8756 Bryant Ave	5858	Leonard	Finn	92109	San Diego	10-12-05	CA	Arctic White
36521	(510) 102-1491	M	1418 Dennis Ave	524	Victor	Cardoso	94556	Moraga	11-10-28	CA	Arctic White
38354	(831) 004-8912	M	8511 Garford Rd	22571	Warren	Anderson	93608	Cantua Creek CDP	12-02-07	CA	Arctic White
39981	(559) 266-8482	M	2361 Ensign Ave	30913	Benedict	Di Benedetto	93601	Nipinnawasee CDP	13-12-20	CA	Arctic White
40084	(707) 729-7025	M	8603 Arlington Pl	20526	Diamante	Norton	95625	Allendale CDP	13-08-26	CA	Arctic White
40311	(925) 444-8976	M	6490 Dakin Rd	14170	John	Lee	94565	Bay Point	13-01-20	CA	Arctic White
41940	(415) 890-0242	M	8567 King Ave	30863	Timothy	Grossman	94946	Nicasio CDP	14-07-28	CA	Arctic White
42150	(805) 694-1354	M	877 Foch Blvd	412	Philip	Terry	93434	Guadalupe	14-12-25	CA	Arctic White
49651									13-01-20		
49659									13-04-23		
49812									13-11-02		
51776									14-09-08		
51863									14-07-28		
52073									14-12-25		

Appendix B SQL Used in Report

/*SQL for Scenario 1*/

SELECT Bicycle.FrameAssembler, Bicycle.OrderDate, Bicycle.ShipDate, Bicycle.ListPrice, Bicycle.SalePrice, Bicycle.ShipPrice, Bicycle.FramePrice, Bicycle.ComponentList
FROM Bicycle
WHERE ((Bicycle.FrameAssembler)=51512) AND ((Bicycle.Modeltype='Mountain') or

(Bicycle.Modeltype='Mountain full')) AND Bicycle.Construction='TIG Welded';

/*SQL for Scenario 2*/

Select Sum(Bicycle.SalePrice) as SalePrice, COUNT(Bicycle.SerialNumber) as SalesQuantity，Left(Bicycle.OrderDate,4) as year
From Bicycle
Where Left(Bicycle.OrderDate,4)>=1999 and Left(Bicycle.OrderDate,4)<=2013
Group By Left(Bicycle.OrderDate,4)

Select Sum(Bicycle.SalePrice) as SalePrice,Left(Bicycle.OrderDate,4) as [year], Bicycle.Salestate
From Bicycle
Where (((Left(Bicycle.OrderDate,4))>=1999 And (Left(Bicycle.OrderDate,4))<=2013))
Group by Left(Bicycle.OrderDate,4),Bicycle.Salestate;

SELECT Count(Paint.ColorName) as 111,Left(Bicycle.OrderDate,4) as year, Paint.ColorName
FROM Paint INNER JOIN Bicycle ON Paint.PaintID = Bicycle.PaintID
Where Left(Bicycle.OrderDate,4)>=1999 and Left(Bicycle.OrderDate,4)<=2013
GROUP BY Left(Bicycle.OrderDate,4), Paint.ColorName

Select Customer.gender,Paint.ColorName,Left(Bicycle.OrderDate,4)
From Paint INNER JOIN ((City RIGHT JOIN Customer ON City.CityID = Customer.CityID) INNER JOIN Bicycle ON Customer.CustomerID = Bicycle.CustomerID) ON Paint.PaintID = Bicycle.PaintID
WHERE (((Left([Bicycle].[OrderDate],4))>=1999 And(Left([Bicycle].[OrderDate],4))<=2013))

select SaleState, OrderDate

from Bicycle;

select ModelType, OrderDate

from Bicycle;

/*SQL for Scenario 3*/

Select *

From Paint, LetterStyle, Bicycle, TubeMaterial, BikeTubes, ModelSize

Where Bicycle.SaleState="CA" and Paint.ColorList="WHITE" and Bicycle.ModelType="Road" andPaint.PaintID=Bicycle.PaintID and LetterStyle.LetterStyle=Bicycle.LetterStyleID and Bicycle.SerialNumber=BikeTubes.SerialNumber and ModelSize.ModelType="Road" and BikeTubes.TubeID=TubeMaterial.TubeID and ModelSize.TopTube=Bicycle.TopTube and Bicycle.OrderDate>=#1/1/1998#

/*SQL for Scenario 4*/

Select Component.ComponentID, Component.EstimatedCost, Component.QuantityOnHand, PurchaseItem.Quantity, PurchaseItem.QuantityReceived, BikeParts.Quantity, Bicycle.OrderDate

From Component, PurchaseItem, BikeParts, Bicycle

Where Component.ComponentID=PurchaseItem.ComponentID and Component.ComponentID= BikeParts.ComponentID and Bicycle.SerialNumber=BikeParts.SerialNumber;

SELECT *

FROM PurchaseOrder INNER JOIN (Component INNER JOIN PurchaseItem ON Component.ComponentID = PurchaseItem.ComponentID) ON PurchaseOrder.PurchaseID = PurchaseItem.PurchaseID
WHERE (((Component.QuantityOnHand)>0) AND ((Component.Description)="Fox 36 VAN 160 RC2 1.5 taper all-mountain 160 mm travel 26 inch w/headset") AND ((PurchaseOrder.OrderDate)>=#1/1/2010# And (PurchaseOrder.OrderDate)<=#1/1/2015#)) OR (((Component.Description)=" XTR Disc brake levers ")) OR (((Component.Description)=" SRAM XX 10-speed cassette 11-32")) OR (((Component.Description)=" XTR hydraulic disc brakes with lever/pair "))OR (((Component.Description)=" Ultregra triple STI 10 speed carbon "))OR (((Component.Description)=" XTR M975 Disc DT Swiss XR 350"))OR (((Component.Description)=" Eason EC70 Fork Aluminum "))OR (((Component.Description)=" Record 11"))OR (((Component.Description)=" Deda M35 Allow handle bar "))OR (((Component.Description)=" Easton *EC90 SL Fork carbon* "))

SELECT DISTINCT Bicycle.SerialNumber, Bicycle.OrderDate, Bicycle.StartDate, Bicycle.ShipDate, DateDiff("d",Bicycle.OrderDate,Bicycle.ShipDate) as leadtime

FROM Bicycle INNER JOIN BikeParts ON Bicycle.SerialNumber = BikeParts.SerialNumber

WHERE (((Bicycle.OrderDate)>=#1/1/2010# And (Bicycle.OrderDate)<=#12/31/2014#) AND

((Bicycle.StartDate)>=#1/1/2010# And (Bicycle.StartDate)<=#12/31/2014#) AND

((Bicycle.ShipDate)>=#1/1/2010# And (Bicycle.ShipDate)<=#12/31/2014#))