

ATHENS UNIVERSITY OF ECONOMICS & BUSINESS DEPARTMENT OF MANAGEMENT, SCIENCE & TECHNOLOGY MSc BUSINESS ANALYTICS

"Data Warehousing & Visualization"

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Business Case

Auto+ is an upcoming auto auction-sales company which is planning to open its first warehouse/dealership, in the USA, at the beginning of 2016. To minimize the market entry risk, Auto+ asked our consulting company, OS Intelligence S.A., to provide them with a market analysis report of the car auctions market, in specific states of the USA, for the first half of 2015, as well as with visualization tools for better understanding and future use by the company.

Report's Targets

To provide Auto+ with useful insights about the preferences of the average used car auction sales customer in the USA as well as, suggest top car models to be supplied and best location to get their warehouse/dealership registered in, based on these preferences.

Data Source

The dataset is called "used-car-auction-prices" and is provided in the following URL: https://www.kaggle.com/tunguz/used-car-auction-prices, by www.kaggle.com. The dataset includes historical data for used car auction sales in the USA for three months in 2014 & seven months in 2015.

The dataset has the following 16 columns:

- year : The construction year of the car
- make: The manufacturer of the car
- model: The model of the car
- trim: The trim of the car
- body: The body type of the car
- transmission: Whether the car is automatic or manual
- vin: A unique code for the car
- state: The state where the car was sold
- condition: The condition of the car
- odometer: The total number of miles the car has completed
- color: The exterior color of the car
- interior: The interior color of the car
- seller: The name of the seller
- mmr: The Manheim Market Report (MMR) is the premier indicator of wholesale price
- sellingprice: The price that the car was sold
- saledate: The date when the car was sold

We used R-studio to have a quick insight of our data set. Using the summary function, we analyzed each column to find the variable type, minimum/maximum and mean values. Moreover, we observed each column for missing values.

Summary Function

```
summary(car[.-c(18:20)])
    autoID
                                 Length: 558837
                                                                          Length: 558837
                                                      Lenath: 558837
Min.
                 Min.
                         :1982
1st Qu.:139710
                  1st Qu.:2007
                                  Class :character
                                                      Class :character
                                                                          Class :character
Median :279419
                  Median :2012
                                 Mode :character
                                                      Mode
                                                            :character
                                                                          Mode :character
       :279419
Mean
                  Mean
                         :2010
3rd Qu.:419128
                  3rd Ou.: 2013
       :558837
                  Max.
                         :2015
Max.
                    transmission
                                            vin
                                                                                   condition
    body
                                                                state
                    Length:558837
Length: 558837
                                                                                 Min. :1.000
1st Qu.:2.700
                                                                                       :1.000
                                        Length:558837
                                                             Length:558837
Class :character
                    Class :character
                                        Class :character
                                                             Class :character
      :character
                          :character
                                              :character
                                                                  :character
                                                                                 Median :3.600
                                                                                 Mean
                                                                                        :3.425
                                                                                 3rd Qu.:4.200
                                                                                 Max.
NA's
                                                                                        .5 000
                                                                                        :11794
   odometer
                     color
                                        interior
                                                              seller
                 Length: 558837
                                      Length:558837
                                                          Length: 558837
                                                                               Min.
                                                                                            25
Min.
                                      Class :character
1st Qu.: 28371
                  Class :character
                                                          Class :character
                                                                               1st Qu.:
                                                                                         7100
Median : 52254
                 Mode :character
                                      Mode :character
                                                          Mode :character
                                                                               Median : 12250
         68320
                                                                                        13769
Mean
                                                                               Mean
3rd Qu.: 99109
                                                                               3rd Qu.: 18300
       :999999
                                                                               Max.
                                                                                      :182000
Max.
NA'S
       :94
 sellingprice
                    saledate
                                       sales_time
Min.
                 Length:558837
                                      Length:558837
Min. :
1st Qu.:
          6900
                  Class :character
                                      Class :character
Median : 12100
Mean
       : 13611
3rd Qu.:
Max.
       : 230000
```

Missing Values Check

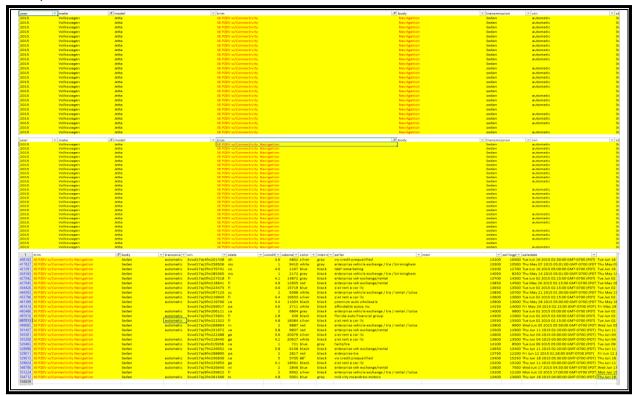
```
car$make[car$make==""] <- NA ;sum(is.na(car$make))</pre>
[1] 498
          el[car$model==""] <- NA ;sum(is.na(car$model))
Г17 517
car$trim[car$trim==""] <- NA ;sum(is.na(car$trim))
[1] 777</pre>
   -
car$bodvΓcar$bodv==""l <- NA :sum(is.na(car$bodv))
[1] 2925
            smission[car$transmission==""] <- NA ;sum(is.na(car$transmission))
[1] 12544
  car$vin[car$vin==""] <- NA ;sum(is.na(car$vin))
[1] 0
    ar$state[car$state==""] <- NA ;sum(is.na(car$state))
   car$color[car$color==""] <- NA ;sum(is.na(car$color))
[1] 3802
  car$interior[car$interior==""] <- NA ;sum(is.na(car$interior))</pre>
Γ17 7545
  car$seller[car$seller==""] <- NA ;sum(is.na(car$seller))
Γ17 Ø
   ar$saledate[car$saledate==""] <- NA ;sum(is.na(car$saledate))
> carəsu.c...
[1] 0
> sum(is.na(car))
 [1] 40496
```

The dataset includes 12 character-variables and 6 numeric-variables. Highest number of missing values is observed in the "transmission" variable with 12544 empty cells. We changed the label of column "year" to "construction" and we also added a new column "autoID" which indicates each unique sale.

Data Cleaning

We used Excel to clean our data. First, we observed that there were mismatched values in columns trim and body. Hence, we fixed this misplacement by transferring the mismatched values to the correct column and move all the remaining columns one column to the left.

Misplaced Values Relocation



Afterwards, we added a column named "autoID" which takes a unique numeric value for each row helping us to identify each individual sale.

AutoID Column Addition



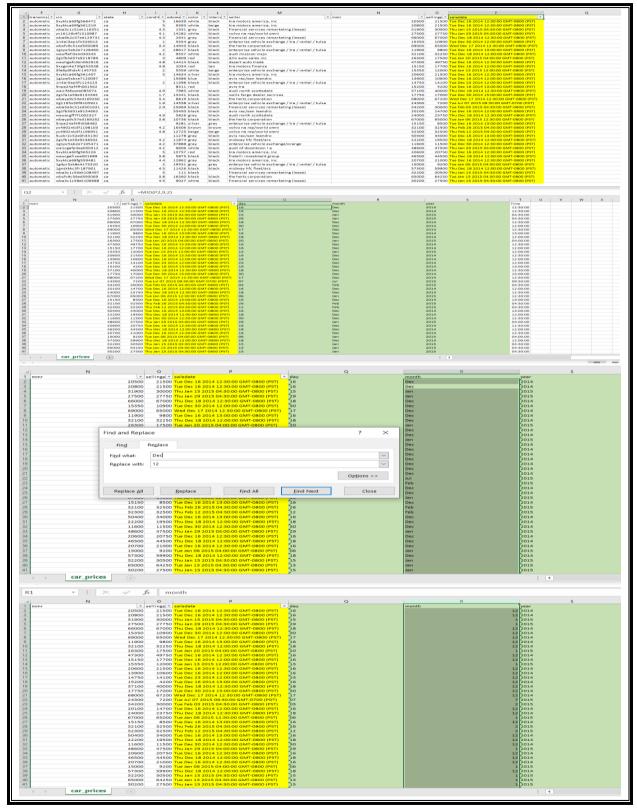
Moreover, we observed unknown values in columns "color" and "interior" which we changed to blanks.

Unknown Values Changed to Blanks

make v ninfiniti (infiniti		D	E	F	G H	1	j	K L	M	N		
Infiniti (C	w trim	w body	* transmis(* vin	▼ state	* condit *	odome * cc	olor "T interio"	seller	mmr	v sel	O Ilingsi v saleda
	G Sedan G Coupe G Sedan	G37 Journey G37 Sport G37 Journey	body G Sedan G Coupe G Sedan G Sedan G Coupe G Sedan	automatic jn1c	cv6ap1dm302069 ca	9 condit 9 8.7 4.3 4.1	21144 84 17523 84 19957 84 19729 84 13002 84	black	nissan infiniti It		23100	24250 Thu De 26500 Thu De 26500 Thu De 21750 Thu De 24500 Thu De 26500 Thu De
Infiniti (G Sedan	G37 Journey	G Seden	automatic jnlc	cv6ek5dm900518 ca cv6ap7dm300469 ca	4.3	1/523 84 19957 84	black beige	nissan infiniti It nissan infiniti It nissan infiniti It nissan infiniti It		25600 23300	21750 Thu De
Infiniti	G Sedan G Coupe	G37 Journey G37 Sport	G Sedan	automatic jnic	cv6apxdm714281 ca cv6ek2dm922699 ca		19729 84	beige black black	nissan infiniti It		23300	24500 Thu De
ntiniti (G Coupe Sonata	G37 Sport GLS	G Coupe Sedan	automatic jnlc automatic 5npe	cv6ek2dm922699 ca eb4ac7dh549834 ca	4.1	13002 å4 36564 å4	black beige	nissan infiniti It hyundai motor finance		26100 12450	26500 Thu De 12400 Tue Jan
nfiniti (G Sedan	G37 Journey	G Sedan			3.9 4.7	17203 84		nissan infiniti It		23900	24750 Wed D
lercedes-Benz (C-Class M	C250 M37	Coupe Sedan	automatic widd	dei4hh9de004804 ce	4.2	20705 å4	t" black	mercedes-benz financial services		26700	25750 Thu De 33500 Thu Jan
ofiniti (G Coupe	G37x	G Coupe	automatic jn1b	by1apOdm518625 ca cv6el1dm980179 ca dhf2eb5da710377 ca	4.6 4.2 4.7 4.1 2.5 3.3			nissan north america inc. nissan infiniti it		33900 21600	23500 Thu De
Ancorder-Rena 6	E-Class	E350 Sport BlueTEC		automatic wdd	fhf2eb5da710377 ca	4.7	28463 54 16486 84 10972 84 38131 55 59042 84 21826 84 48744 84	black			36900 25600 46700 21600 19300 14350 13100	
Aercedes-Benz (C-Class C-Class G Sedan G Sedan	C250 C63 AMG	Coupe Coupe G Sedan G Sedan 2.5 Sedan Hatchback	automatic wdd	1912eb5da710377 ca dgg4hbxd970359 ca dgg7hb6dg060457 ca cv6ar0dm754449 ca cv6arxdm752904 ca lai3ap5dn426516 ca lai3cp7dc403583 ca buder2fd143388 ca	4.1	16486 84	black	mercedes-benz financial services mercedes-benz financial services mercedes-benz usa the hertz corporation the hertz corporation nissan-infiniti it nissan-infiniti it		25600	36250 Thu De 23500 Thu Jar 36500 Thu Pel 20000 Thu De 18801 Thu Jar 14500 Wed D 15250 Tue De 9500 Tue De 13000 Tue De
Mercedes-Benz G nfiniti	G Sedan	G37x G37x	G Sedan	automatic jn1c	cv6ar0dm754449 ca	3.3	38131 84	black	the hertz corporation		21600	20000 Thu De
ofiniti (G Sedan	G37x	G Sedan	automatic jnlc	cvGarxdm752904 ca	3	59042 å4	black	the hertz corporation		19300	18801 Thu Jan
lissan l	Leaf		2.5 Sedan Hatchback	automatic 1n4s	araapson426516 ca az0cp7dc403583 ca	4	21826	black black	nissan-infiniti It		14350	14500 Wed D
oyota (Corolla	SL LE				1	48744 å4	gray	fox rent a car tra			9500 Tue De
lissan I	Rogue Altima	5	SUV	jn8a	as5mt2dw525715 ca	4.1		gray black black	nissan motor acceptance corporation nissan-infiniti it		13200	
issan A oyota 1	Altima Tundra	Tundra	2.5 Sedan CrewMax Cab	automatic 1n4s automatic 5tfer	lai3ap7dc157978 ca em5f11dx062107 ca	3.8 4.2	26637 å4 102345 å4	black	nissan-infiniti It wheels exchange IIc		14150 18850	14500 Wed D 18500 Wed D
issan /	Altima		2.5 Sedan	automatic 1n4s	lal3ap9dc233006 ca	4.1	5997 84	beige	nissan-infiniti It		15700	17250 Tue De
ovota 1	Tundra	Tundra	CrewMax Cab	automatic Stfer	m5f14dx062358 ca	4.1 4.5	82186 å4	t" beige	wheels exchange IIc			
lissan S	Sentra Tacoma Altima	S Base	Sedan Access Cab	automatic 5tftx	ab7ap9di735283 ca x4cnxdx028456 ca	3.8	27457 84 31326 84		nissan motor acceptance corporation		11950 16950	11250 Tue De
lissan	Altima					8.7	31326 84 26221 84 60564 84 26165 84 24954 84 28311 84 36541 84 39825 84	gray black gray black black black	nissan motor acceptance corporation ger flest services for itself/servicer nissan-infiniti it wheels exchange lic nissan-infiniti it vocations it night bid trading to inc financial services remarkating (lesse)		16950 14200 15200 16650 14250 9275	15500 Tue De
ubaru P	Forester	2.5X PZEV	2.5 Sedan SUV Sedan Sedan Sedan	automatic Jf2st automatic 1n4t automatic 1vwl	lal3ap2dn433729 ca haba32dn434616 ca lal3ap2dn471000 ca ubh7a81dc025977 ca ccn7ap1dla40815 ca uggafc1cn055417 ca kshbli659c448049 ca uds9c56c2784810 ca kske/s50c6437319 ca	3.5	60564 84	gray	wheels exchange lic		15200	20250 Wed D 11250 Tue De 18500 Tue De 15500 Tue De 15500 Tue De 14000 Wed D 17250 Tue De 11100 Tue De 9000 Tue De 9000 Tue De 29000 Thu Ja 43500 Thu De 33750 Thu F 9400 Wed D
ubaru I Iissan / Iolkswagen I Iissan / udi /	Altima Passat	3.5 SL SE 1.6 5 Plus	Sedan	automatic 1n4	bl3ap2dn471000 ca	4.4	26165 å4	black	nissan-infiniti It		16650	17250 Tue De
olkswagen i	Passat Versa	1.6.5 Plus	Sedan	automatic 1vwl	.bh7a31dc025977 ca .cn7ap1di846815 ca	3.9 3.5 4.8 4.7	24954 84 28511 84	black	vw credit nissan-infiniti it		14250 9275	11100 Tue De 9000 Tue De
udi /	Versa A6	3.0T Premium quattro	Sedan	automatic wau	aggafc1cn055417 ca	8.5	36541 84	beige	high bid trading co inc		29800	29000 Thu De
	M3	Base	Convertible	automatic wba	skb8c59cc448049 cs	4.8	39825 å4	gray black	financial services remarketing (lease) financial services remarketing (lease)		29800 58100	58500 Thu Jan
	ma		Curiverciale	automatic wbsi	sdx9c56ce784810 ca skc8c50cc435719 ca	2.4		black	bmw of bakersfield		42800 41800	33750 Thu Fe
ord t	Escape	XLS	suv	automatic 1fms	scuOc79cka91865 ca	2.4 3.8	97572 å4	gray	wheels exchange IIc			9400 Wed D
hrysler 1	Town and Country Transit Connect	Touring Cargo Van XLT	Minivan	automatic 2c4r	orc1bg0cr359597 ca 0ls7bn9ct088250 ca	2	88694 84 50382 84	beige	wheels exchange IIc lease plan usa		10250 13550	8700 Wed D
lyundai	Santa Fe	SE	SUV	automatic nmo	2h4ag9cg121238 ca hp0jaxcr146051 ca	4.1	30188 åt	gray	hyundai buybacks		14000 12200	12500 Tue De
lyundai 1 ord 1	Fusion Transit Connect	SEL Careo Van XLT	Sedan	automatic 3fah	zh4ag9cg121238 ca hp0jaxcr146051 ca Dis7bn1ct108619 ca	4.1 4.1 1.9	30188 84 39057 84 70018 84	gray gray tan	hyundai buybacks wheels exchange lic wheels exchange lic		12200	12500 Tue De 10800 Wed D 11000 Wed D
ord 1	Transit Connect	Cargo Van XLT	Minivan	automatic nm0	Jis7bn1ct108619 cm	1.9	70018 å4	gray	wheels exchange IIc		12000	11000 Wed 0
В		D.		F	G H	1 1 1	J 🗆	K L	M	N		0
take Y	model	v trim	▼ body	" transmis: " vin		* condit *		olor "T interic		mmr	▼ sel	
nfiniti (G Sedan	G37 Journey	G Sedan G Coupe	automatic jn1c	v state v/sap1dm302069 ca v/sap6m900518 ca v/sap7dm300469 ca v/sap7dm300469 ca v/sap8dm30049 ca v/sap8dm30044 ca v/sa	3.7 4.3	21144 17523 19957 19729 13002 36564 17203 20705	black black	seller w missan infiniti It hyundai motor finance insisan infiniti missan infiniti mercedes-benz financia services missan infiniti mercese-benz financia services missan northi mercica inc.		23100	24250 Thu De
ofiniti (G Sedan G Coupe G Sedan	G37 Sport G37 Journey		automatic inle	cv6ek5dm900518 cs	4.3	17523	black	nissen infiniti It		25600 23300	26500 Thu De
	G Sedan	G37 Journey	G Sedan	automatic inic	cv6apxdm714281 ca	4.1 4.2 4.1 9.9 4.7 4.2 4.6 4.2 4.7	19729	beige	nissan infiniti It		23300	Ilingo Y saleda 24250 Thu De 26500 Thu De 21750 Thu De 26500 Thu De 26500 Thu De 12400 Tue Jai 24750 Wed D 25750 Thu De 35500 Thu Ja 23500 Thu Ja 23500 Thu Ja 23500 Thu Ja
nfiniti (G Coupe	G37 Sport	G Coupe	automatic jn1r	cv6ek2dm922699 ca	4.1	13002	black	nissan infiniti It		26100	26500 Thu De
nfiniti nfiniti tyundai infiniti Aercedes-Benz infiniti infiniti	G Sedan G Coupe Sonata G Sedan	G37 Journey G37 Sport GLS G37 Journey	G Sedan G Coupe Sedan G Sedan	automatic jnlc automatic jnlc automatic 5npr automatic jnlc automatic wdd	eb4ac7dh549834 ca	3.9	36564	beige beige black black black	hyundai motor finance		23300 26100 12450 23900 26700 33900	12400 Tue Jan
Aercedes-Raes	G Sedan C-Class	C250	G Sedan Coupe	automatic inlo	dgi4hb9dg004804 ca	4.7	20705	beige	mercedes-benz financial services		25900 26700	25750 Thu D
nfiniti	M	C250 M37	Coupe Sedan	automatic in1b	bylapOdm513625 ca	4.6	20705 10808	black	nissan north america inc.		33900	33500 Thu Ja
nfiniti (G Coupe	G37x	G Coupe	automatic jnlc	cv6el1dm980179 ca	4.2	46120	black	nissan north america inc. nissan infiniti it mercedes-benz financial services		21600	25500 Thu De
Aercedes-Benz (Aercedes-Benz (t-class C-Class	E350 Sport BlueTEC C250	Sedan	automatic wdd	dhf2eb5da710377 ca dgj4hbxdf967359 ca	4.7	28463 16486		mercedes-benz financial services		36900 25600	36250 Thu De 23500 Thu Ja
Aercedes-Benz (C-Class	C63 AMG	Coupe	automatic wdd	dgj7hb6dg060457 ca	2.5	10972	black black	mercedes-benz financial services mercedes-benz usa		46700	36500 Thu Fe
nfiniti (G Sedan	G37x	G Sedan	automatic in1c	cv6ar0dm754449 ca	3.3	38131	black			21600	20000 Thu De
	G Sedan	G37x	G Sedan	automatic inic	cv6arxdm752904 ca	2.5 3.3 3	38131 59042 24498	black	the hertz corporation		19300	18801 Thu Ja
lissan I	Leaf	SI.	G Sedan 2.5 Sedan Hatchback Sedan SuV 2.5 Sedan	automatic 1n4	cv6sr0dm754449 co cv6sradm2732004 ca lai3ap5dn426516 ca lai3ap5dn426516 ca lai3ap7dc143588 ca s55mt2dw525715 ca lai3ap7dc157978 ca em5f11dx062107 ca lai3ap3dc13a006 ca	4	21826	black black black black gray black black	the bests corporation nissae-infiniti it nissae-infiniti it fox rent a car tra nissae-infoniti renta car tra nissae motor acceptance corporation		14350 13100 10600 13200 14150 18850	15250 Tue De
lissan li oyota d lissan li	Altima Leaf Corolla Rogue Altima Tundra	SL LE	Sedan	automatic 5vft	bu4ee7dp143368 ca	1	21826 48744 40924 26637 102345	gray	fox rent a car tra		10600	18801 Thu Ja 14500 Wed D 15250 Tue De 9500 Tue De 18000 Tue De 14600 Wed D 18500 Wed D 17250 Tue De 20250 Wed D
lissan	Rogue	5	SUV	jn8a	es5mt2dw525715 ca	4.1	40924	black	nissan motor acceptance corporation nissan-infiniti it wheels exchange lic		13200	13000 Tue De
lissan A	Altima	Tundra	2.5 Sedan CrewMax Cab	automatic 1n4	al3ap7dc157978 ca	4.1 3.8 4.2 4.1 4.5	26637	black	nissan-infiniti It		14150	14500 Wed D
oyota 1	Tundra Altima	Janora		automatic Stfer automatic 1n4s	em5f11dx062107 ca lai3ap9dc233006 ca	4.2	102345 5997	gray beige	wheels exchange lic nissan-infiniti It		18850 15700	17250 Tue De
oyota 1	Tundra	Tundra	2.5 Sedan CrewMax Cab	automatic Stfer	em5f14dx062358 ca	4.5	82186	beige black	wheels exchange IIc		19900	20250 Wed D 11250 Tue De
lissan 8	Sentra	S	Sedan	3n1a	lab7ap9d1735283 ca	3.8	27457	black	nissan motor acceptance corporation		11950	11250 Tue De
lissan /	Tacoma Altima	Base	Access Cab 2.5 Sedan	automatic 1n4s	x4cnxdx028456 ca lai3ap2dn433729 ca	4.5 3.7	31326 26221	gray black	ge fleet services for itself/servicer nissan-infiniti It		16950 14200	18500 Tue De 15500 Tue De
ubaru 8	Forester	2.5X PZEV	SUV	automatic if2st	shaac3dh434616 ca	3.5 4.4	60564	gray	wheels exchange IIc		15200	
		3.5 SL	Testan			4.4	26165	black				17250 Tue De
olkswagen i	Passat	5£ 1.6 S Plus	Sedan Sedan	automatic 1vwl	.0h7a31dc025977 ca	1	24954	black	vw credit		14250	11100 Tue De
udi .	Passat Versa A6	3.0T Premium quattro	Sedan Sedan Sedan	automatic was	bb15ap2dn471,000 ca bb17aB1d0259977 ca Lcn7ap1dl846815 ca uggsfc1cn055417 ca sbb8c59cc448049 ca ds9c56ce784810 ca sbc8c50cc435719 ca vsub73fc8up1865 ca	3.9 3.5 4.8 4.7 2.4 3.8	36541	gray black black black beige	nissan-infiniti It vw credit nissan-infiniti It high bid trading co inc financial services remarketing (lease) financial services remarketing (lease) brow of bakerafield wheels exchange Ic		14250 9275 29800 58100 42800 41800	14000 Wed D 17250 Tue De 11100 Tue De 9000 Tue De 29000 Thu De 58500 Thu Ja 43500 Thu De 33750 Thu Fe 9400 Wed D
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MW I	M3	Dase	Convertible	automatic wbs	.dx9c56ce784810 ca	4.7	20850	gray black black	financial services remarketing (lease)		42800	43500 Thu De
ord (Escape	XLS	suv	automatic wbai	akc8c50cc435719 ca ncu0c79cka91865 ca	2.4	27709 97573	black	omw of bakersfield wheels exchange lic		41800 8325	33750 Thu Fe 9400 Wed 0
hrysler	Town and Country	Touring	Miniven			3.8	88024	gray beige			10250	8700 Wed D
ord	Transit Connect	Cargo Van XLT	Minivan	automatic nm0	rc1bg0cr359597 ca 0ls7bn9ct088250 ca	3		gray			13550	12000 Wed 0
Chrysler 1 Ford 1 Tyundal 5	Santa Fe Fusion	SE SEL	SUV	automatic 5xyz automatic 3fah	zh4ag9cg121238 ca hg0jaxcr146051 ca	4.1 4.1 1.9	30188 39057	gray gray tan	hyundai buybacks wheels exchange lic		14000 12200	12500 Tue De 10800 Wed D
ord f	Transit Connect	Cargo Van XLT	Minivan	automatic 3fah automatic nm0	hpOjaxcr146051 ca Ols7bn1ct108619 ca	19	70018	gray	wheels exchange IIc wheels exchange IIc		12200	10800 Wed 0
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8	С	D	E	F	G H	1 1	1	K L	M	N		0
ake = m	nodel	* trim	▼ body	* transmist * vin	▼ state	* condit * c	odome = co	lor v interic	seller	mmr	v sell	lings = saleda
rundai Sc	Sonata 3 Series	SE B28I SULEV	Sedan Sedan	automatic wba3	e24af4fh001562 ca 8c1c50ek108497 ca		8311 red 111 blo	s se-	avis tra financial services remarketing (lease)		15200 82200	100 Tue De 30500 Thu Ja
	Cruze	1LT	Sedan	1g1p	ec5ab6e7128803 ca	,	38261 wh	ite å€"	avis tra		11450	
rw 6	5 Series	1LT 650i	Coupe	automatic wbay	oc5sb6e7128805 ca ym9c53ed248064 ca	4	9837 bla	sck å€"	financial services remarketing (lease)		62000	61500 Thu De
rw 6 finiti G	S Series 3 Sedan	650i G37 Journey	Convertible G Sedan	automatic wbay	yp9c5xed169285 ca v6ap7dm710348 ca v6ap1dm300757 ca dh4ae5dh323156 ca pk5ha1df005483 ca	3.8	19499 sil	ver åc	the hertz corporation		63000 22400	62000 Thu Fe 23000 Tue De
finiti G	3 Sedan	G37 Journey	G Sedan	automatic jn1cv	v6ap1dm300757 ca	4.3 3.6 4.4 2.8	28668 gri 17232 wh	ite 8€"	nissan infiniti It nissan infiniti It		23600	24500 Thu De
undai El ercedes-Benz SL	lantra	GLS	Sedan	automatic Snpd	dh4ae5dh323156 ca pk5haldf065483 ca	3.6	40079 sil	ver å€"	enterprise veh exchange/rental		11250	11300 Thu De
INI Co	SLK-Class Cooper	SLK350 Base	Convertible Hatchback	automatic wddp	px5ha1dH065483 ca vsu3c55dt677990 ca	2.8	8470 bla 7273 bla	er ac	mercedes-benz finc wholesale advantage brow mini financial services		44700 15300	57000 Thu Ja 15000 Thu De
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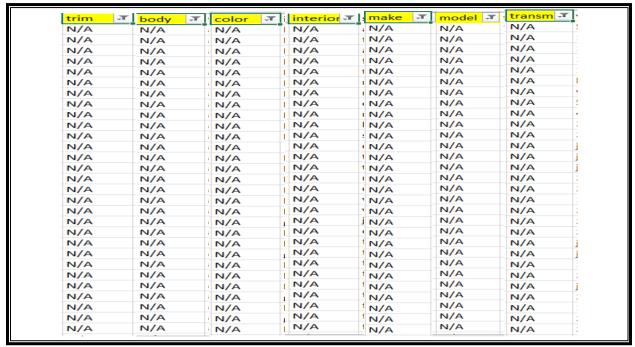
Furthermore, we split column "saledate" into 4 columns "saleD", "saleM", "saleY" and "sales_time" to be more usable and changed values of column "saleM" to numeric.

Splitting of column "saledate"



Finally, we changed blanks with N/A values for the variables we are planning to use as Dimensions on our Fact Table later.

Replacement of Blanks by N/A Values

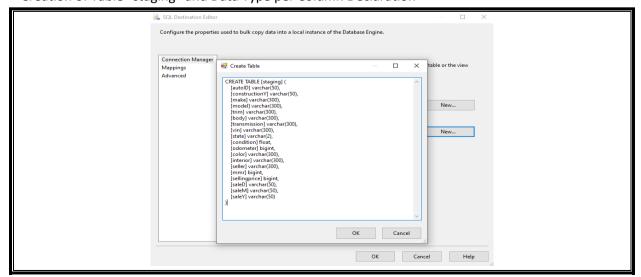


Data Import

First, we created a relational database in SQL Server called "used_cars". Then, in Visual Studio, we created a Data Flow Task called "Import CSV" which includes a Flat-file Source and an SQL Server Destination. The Flat-file Source was imported with the cleaned CSV file of our dataset.

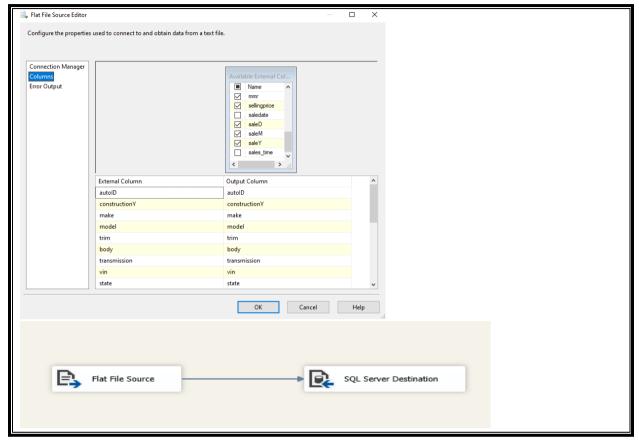
We connected SQL Server Destination to the Flat-file Source in order to connect our CSV directly to the database "used_cars" in SQL Server and used it to create a new table called "staging" in our database. By creating table "staging", we declared the data types of our columns.





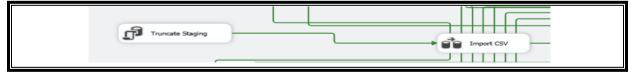
Finally, we chose the columns we will use in our report, connected the Flat-file Source to the SQL Server Destination and imported the CSV file to the "staging" table.

Selection of Columns and Connection of Flat-file Source to SQL Server Destination

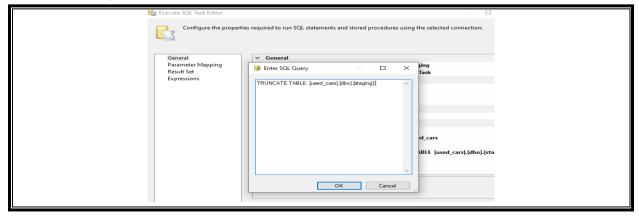


Furthermore, we connected the "Import CSV" process, with an SQL Execute Task, that would truncate our "staging" table each time we execute the data flow.

Connection of "Truncate Staging" to "Import CSV



Truncate Query Execution



Afterwards, we defined the dimensions and measures for the fact table. After consideration, we decided that the following columns will be used as dimensions:

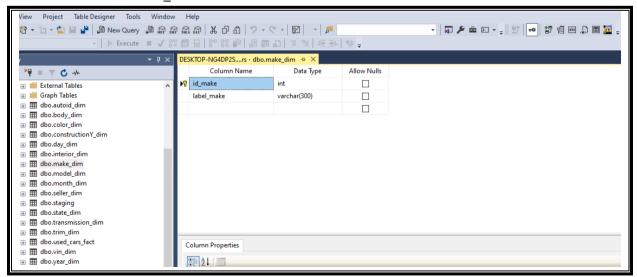
- autoid
- constructionY
- make
- model
- trim
- body
- transmission
- color
- interior
- state
- vin
- seller
- saleD
- saleM
- saleY

and the following will be used as measures:

- sellingprice
- mmr
- condition
- odometer

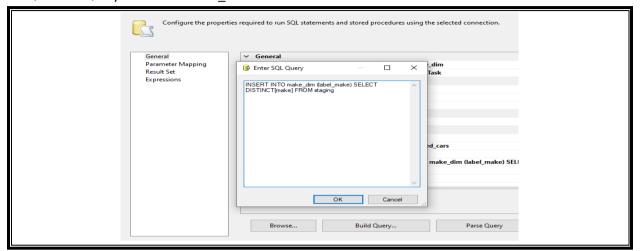
To implement that, we created a new table for each dimension. In the following image we demonstrate the construction of a dimension table with a primary key and a column called "label_make" to insert the values of column make. The same procedure was followed for all the other Dimensions.

Creation of Table "make dim"



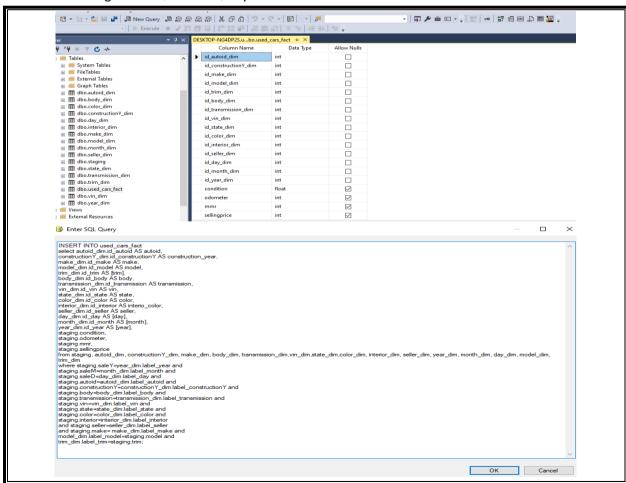
Afterwards, in Visual Studio, we created an Execute SQL Task for each dimension which contains the SQL Query that inserts values into our dimension tables and connected each one of them with the "Import CSV".

SQL Insert Query for Table "make dim"

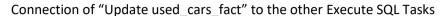


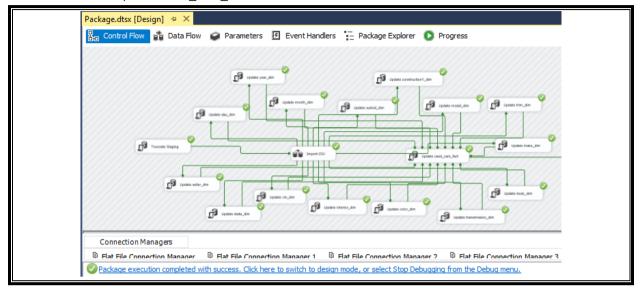
Finally, we created the fact table called "used_cars_fact" which contains as foreign keys the primary keys of each dimension and the 4 measures we described before.

Fact Table Design and SQL Insert Query

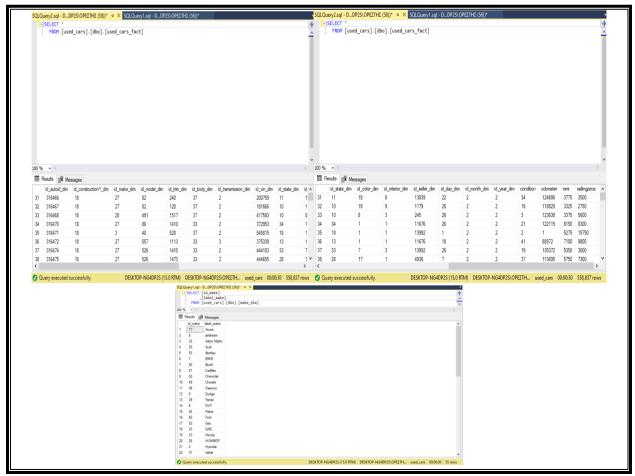


Afterwards, in Visual Studio, we created an Execute SQL Task for fact table which contains the SQL Query that inserts values into our fact table and connects it with each one dimension's SQL Execute Task. The final running structure of our control flow in Visual Studio is the following:



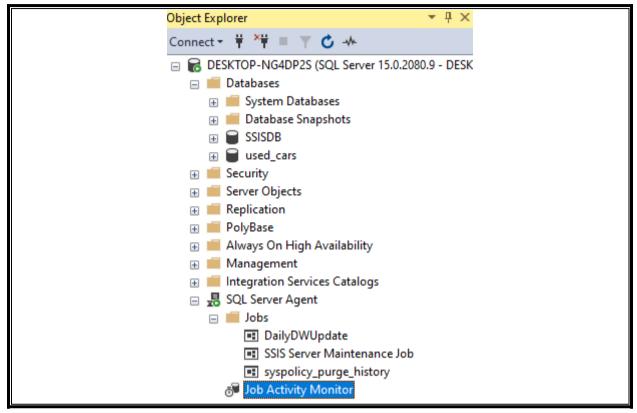


After executing the control flow, we can observe that every table is filled with values. By running a select statement in MSSQL we can assure that. We demonstrate the results of one dimension and of the fact table.



Finally, we deployed an SSIS Package which is responsible to execute the Visual from the SQL Server daily at 2 am.

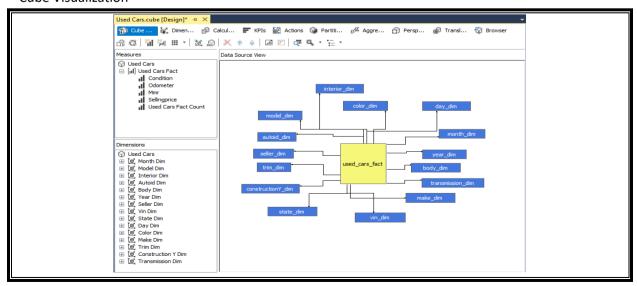
Job Activity Monitor Creation



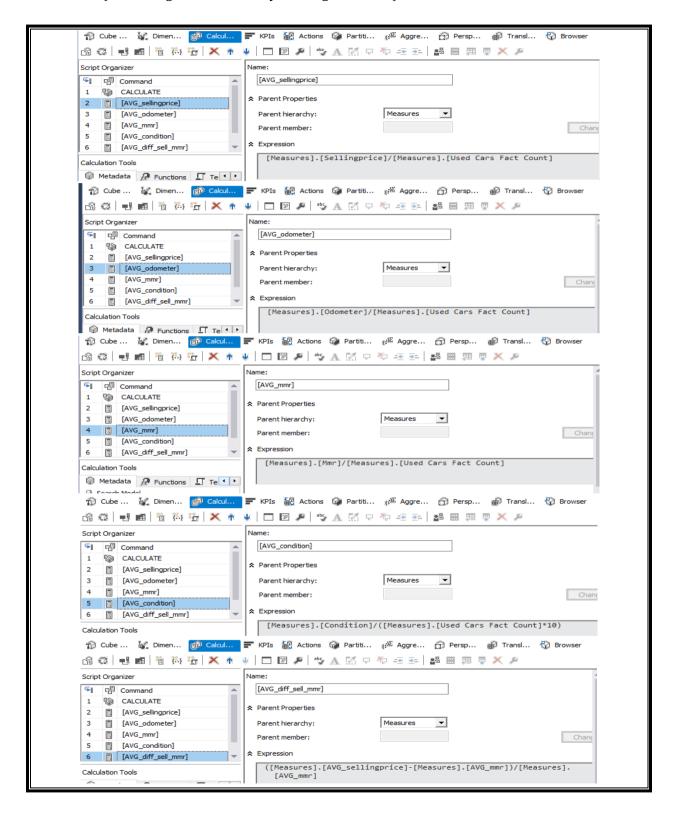
Data Cube Deployment

We created a Multidimensional Analysis Services project in SSIS and connected it to our SQL Server relational database to create a cube with the help of Cube Wizard. Our final cube Schema is the following:

Cube Visualization

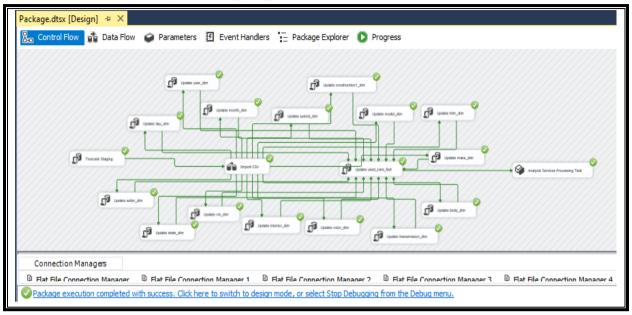


We matched dimensions and measures of our database to the Cube and calculated some extra measures (the averages of our already existing measures) to use them later in our visualizations.



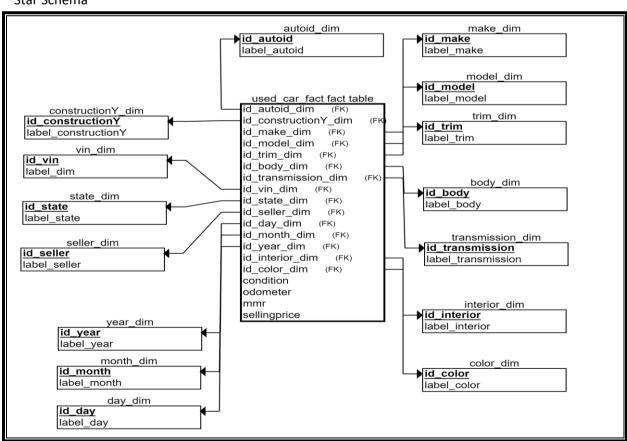
We connected the Cube to our Visual flow via an Analysis Services Processing Task.

Connection of ASPT to "Update used_cars_fact"



Finally, we connected our Cube to Power BI to visualize our data. The star schema of our database is the following:

Star Schema

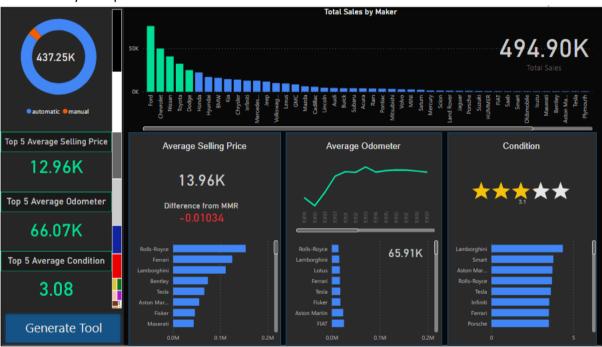


Business Analysis

Step 1

Using Power BI, we created a visualization about the car auctions market and presented the most important features of it for the first 7 months of 2015. On the top, we created a stacked column chart which presented the Total and Top 5 Sales by Maker. The Total Sales reached 494.90k and the Top 5 Makers by Sales are Ford (76k), Chevrolet(50k), Nissan(40k), Toyota(32k) and Dodge(25k). The Top 5 constitutes 45% of the market's Total Sales and are mostly USA and Japan produced cars which indicates that US citizens prefer the domestic car makers market but also, the well-established names of Japanese cars' brands. Also, this indicates that it is easier for Autoto be supplied cars created by the Top 5 makers as there is greater supply and competitive prices for them in the US used cars market. Moreover, it is observed that, from the Total of Sales, the vast majority consists of automatic cars (437.25k) against manual cars (15.07k) which indicates the preference of US citizens to automatic cars. Finally, the most preferred colors in descending order are black, white, silver, gray, blue and red.

Market Analysis Report

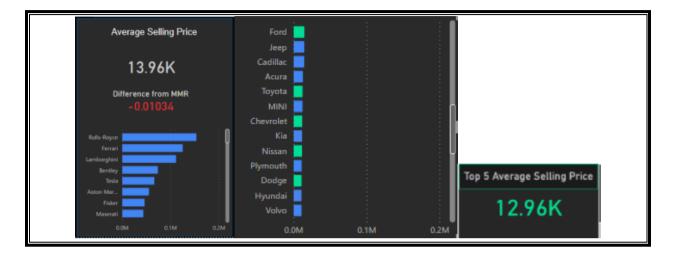


Furthermore, we studied the sales market by 3 competitive factors:

- Average Selling Price
- Average Odometer
- Average Condition

Average Selling Price: In this tab, is presented the Average Selling Price of the market and its difference from the MMR indicator while on the left is presented the Average Selling Price for the Top 5 makers. It is observed that the market values luxury cars the most as Rolls-Royce, Ferrari and Lamborghini are the highest priced cars while the Top 5 Sales cars are found mostly in the mid of the list. The Average Selling Price of the Top 5 is \$12.96k and is lower from the general

Average Price by \$1k. This indicates that the Top 5 are in favor of the average US citizen in terms of average price and that selling price plays a critical role in the customer's final decision. Finally, the difference between the Average Selling Price and the MMR indicator for the Total of the market, as well as, per maker presents almost zero difference which indicates low goodwill from the auction of used cars.



Average Odometer: In this Tab, is presented the Average Odometer the cars of used cars market have completed and their correlation to the year the cars were constructed while on the left is presented the Average Odometer for the Top 5 makers. It is observed that the Average Odometer is highly negatively correlated to the construction year as it is getting higher while the construction year is ascending. There is a small number of outliers from 1984 and 1986 with very low mileage in contrast to their construction year but we can assume they are abandoned or unused cars. The Top 5 presents 66.07k on Average which is higher from the general average by 0.16k. The customers, on average, prefer cars close to 65.91k miles (the Average Odometer value) which indicates that they prefer cars with medium mileage. Chevrolet, Dodge and Toyota are most preferred as the construction year ascends, and this is why the Average Odometer of Top 5 is higher than the Average Odometer of general.



<u>Average Condition</u>: In this Tab, is presented the Average Condition of the cars while on the left is presented the Average Condition for the Top 5 makers. It is observed that the average car is in condition 3.1 in a scale 1-5. The Top 5 cars present an average of 3.08 Condition which is lower to the Average Condition by 0.02. This indicates that Customers prefer cars with at least a good rating of Condition.



In conclusion, Customers, on average, prefer cars that balance between mileage and condition but it is observed that a higher priority is given to selling price. The Customers are willing to purchase a car with average odometer and condition close to market's average, while they prefer cars lower to average selling price by at least 1k.

Step 2

To get a more detailed view on the top 5 Makers' cars, we created a tool that allows the user to compare models and trims from the Top 5 Makers. Users can choose their makers on the top of the page, models and trims on the lists left and right of the page and color on the bottom of the page. Additionally, they can observe the distribution of prices per maker, model and trim from the bar charts on the left and right bottom of the page. In this way, users can easily identify key differences on the selling price, mileage and condition and get supplied makers, models and trims that are closer to their customer preferences. Additionally, the user is able to visualize their car's color choosing from a list of top 6 more applied colors. We used this tool in order to choose the best models from each maker and consult our customer on the best fit models they need to be supplied for their entry into the market.



Similarly to Step 1, we observed the models of higher selling amount per maker and compared them to the average selling price, average odometer and average condition of the market. It is observed that:

- For maker **Chevrolet** the top 2 models based on Sales are Impala (average selling price = 8.23k, average odometer = 80.41k, average condition = 2.5/5) and Malibu (average selling price = 9.22k, average odometer = 67.61k, average condition = 2.89/5).
- For maker **Dodge** the top 2 models based on Sales are Grand Caravan (average selling price = 11.62k, average odometer = 64.70k, average condition = 2.59/5) and Charger (average selling price = 13.29k, average odometer = 63.24k, average condition = 2.60/5).
- For maker **Ford** the top 2 models based on Sales are F150 (average selling price = 19.20k, average odometer = 70.83k, average condition = 3.25/5) and Fusion (average selling price = 12.46k, average odometer = 46.87k, average condition = 3.51/5).
- For maker **Nissan** the top 2 models based on Sales are Altima (average selling price = 11.51k, average odometer = 49.04k, average condition = 3.25/5) and Maxima (average selling price = 13.31k, average odometer = 62.79k, average condition = 3.09/5).
- For maker **Toyota** the top 2 models based on Sales are Camry (average selling price = 11.24k, average odometer = 66.05k, average condition = 3.08/5) and Corolla (average selling price = 9.34k, average odometer = 64.07k, average condition = 2.91/5).

We created a scorecard to evaluate the Top Models:

	Average Selling Price	Average Odometer	Average Condition	~	х	Total Total(✔)-Total(X)
Chevrolet Impala	~~	х	х	2	2	0
Chevrolet Malibu	~~	~	х	3	1	2

Dodge Grand Caravan	*	~	х	2	1	1
Dodge Charger	х	~	х	1	2	-1
Ford F150	xx	х	~	1	3	-2
Ford Fusion	~	~	~	3	0	3
Nissan Altima	~	*	*	3	0	3
Nissan Maxima	х	~	*	2	1	1
Toyota Camry	~	~	*	3	0	3
Toyota Corolla	**	~	х	3	1	2

✓: Model is close to average Customer's preference

X: Model is far from average Customer's preference

✓ ✓: Model is close to average Customer's preference and preference plays a critical role on Customer's final decision*

XX: Model is far from average Customer's preference and preference plays a critical role on Customer's final decision*

*Low selling price plays a critical role on Customer's final decision as we concluded in Step 1

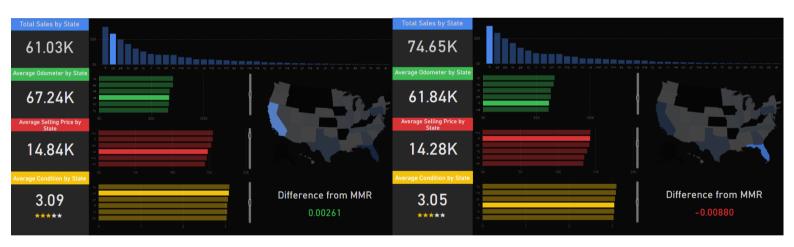
In conclusion, it is suggested that Auto+ could get supplied of models Chevrolet Malibu, **Dodge** Grand Caravan, **Ford** Fusion, **Nissan** Altima, **Nissan** Maxima, **Toyota** Camry and **Toyota** Corolla as they perform the highest on our scoreboard and it is believed that **Ford** Fusion, **Nissan** Altima and **Toyota** Camry will outperform the other models on level of Sales as the higher and most balanced performers in terms of average selling price, average odometer and average condition of our scorecard.

Step 3

To decide about the best location to open the store, we created a report based on the Total Sales per State. It is observed that California State is the best choice for our client. While Florida is observed to be the highest on Total Sales among other states (74.65k), California State presents a high number of Total Sales (61.03k) and lower performance on our key factors in comparison to the car models we advised our customer to supply. More in detail, California's average selling price is 14.84k in comparison to our stock's selling price of 11.24k, California's average odometer is 67.24 in comparison to our stock's odometer of 60.16k and California's average condition is 3.09 in comparison to our stock's condition of 3.04. Moreover, the average MMR of California is +0.00261 which indicates a small profit on each car sale based on California's average selling

price. The low average selling price of our client's stock is giving them the opportunity to sell on higher price and on a margin of +3.6k until California's market average selling price is reached.





CALIFORNIA FLORIDA