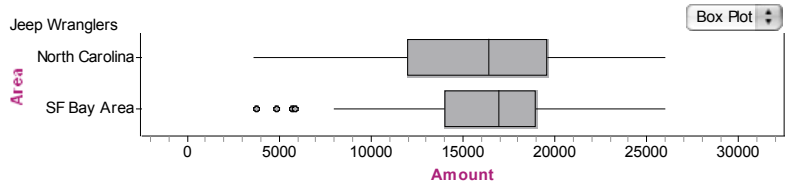


Math 200
Prof Gregory
11 am section
The Car Project: Jeep Wranglers East and West
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Crab salad vs. barbeque, silicon vs. soy beans, politically correct liberals vs. Christian conservatives—aren't these the usual stereotypes that spring to mind when we think of the San Francisco Bay Area in comparison to Greensboro, North Carolina? How about used cars—in particular, Jeep Wranglers? Do they, too, fit stereotypical patterns in the two locales? We expected cars to be on average rather more expensive on the West coast, and we expected them to be on the whole newer. To test our expectations, we compared Jeep Wranglers in the two areas listed at a well-known national venue for used cars (<http://www.cars.com/go/index.jsp>), 72 of them in Greensboro and 58 in San Francisco, looking at the usual variables of price, miles, and age, as well as available colors. We also considered price as predicted by the other two variables. The patterns in the data confirmed our predictions, but the differences between the two areas turned out to be smaller than we anticipated. Why?

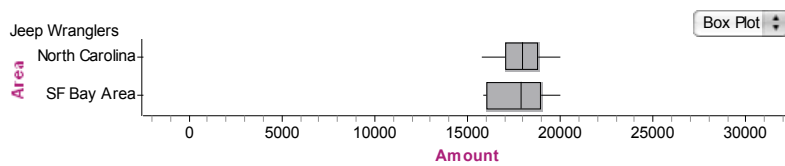
First, let's line up the data and look at the distributions. On average, Jeep Wranglers are more expensive in the Bay Area, the median being more than \$500 higher. What's more, there's a generally smaller variation in price in the Bay Area, which makes the cheapest cars in SF outliers, though they are no cheaper than the cheapest cars in North Carolina. Interestingly, the most expensive Wranglers are about the same in the two areas.



Jeep Wranglers		Area		Row
		North Carolina	SF Bay Area	Summary
Amount		15497.226	15956.151	15708.73
		62	53	115
		5556.0114	4975.683	5278.5805
		705.61415	683.46262	492.23017
		10	5	15
		3650	3800	3650
		11995	13995	12888
		16410	16950	16900
		19635	18995	18995
		25999	25991	25999

S1 =
S2 =
S3 =
S4 =
S5 =
S6 =
S7 =
S8 =
S9 =
S10 =

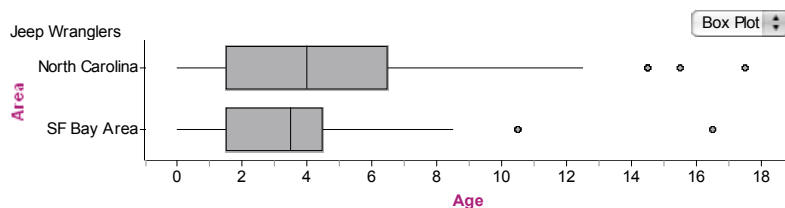
Generalizing over both populations together, we find that most people (nearly 90%) are asking between 15 and 20 thousand for their Wranglers.



Jeep Wranglers		Area
		Summary
Amount		15708.73
		115
		5278.5805
		492.23017
		15

S1 =
S2 =
S3 =
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S5 =

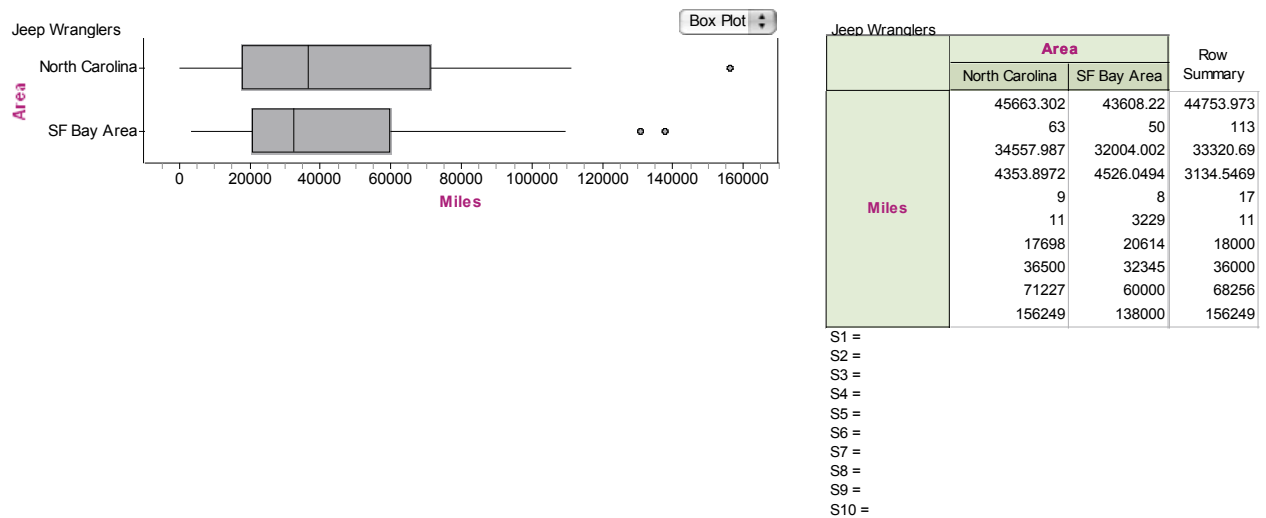
Though the difference is relatively small (less than 3%), the Bay Area cars are on average more expensive, but why? Perhaps it is because they are also on average *newer*, the median age being about 6 months less. Again, there is a wider variation in ages in North Carolina, Q3 being a full two years higher. Moreover, the upper fence—a standard measure of extreme values in a data set (indicated by the end of the horizontal line in a boxplot)—is more than 3 years higher in North Carolina than in SF. Most people in both areas sell their Wranglers before they are five years old.



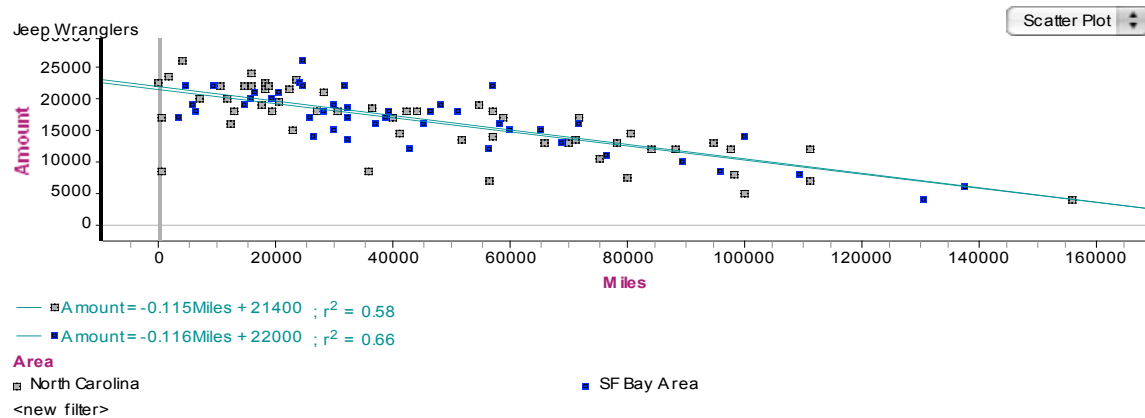
Jeep Wranglers		Area		Row
		North Carolina	SF Bay Area	Summary
Age		4.6180556	3.6034483	4.1653846
		72	58	130
		3.9258022	2.9879269	3.5614149
		0.46266023	0.39233402	0.31235675
		0	0	0
		0	0	0
		1.5	1.5	1.5
		4	3.5	3.5
		6.5	4.5	5.5
		17.5	16.5	17.5

S1 =
S2 =

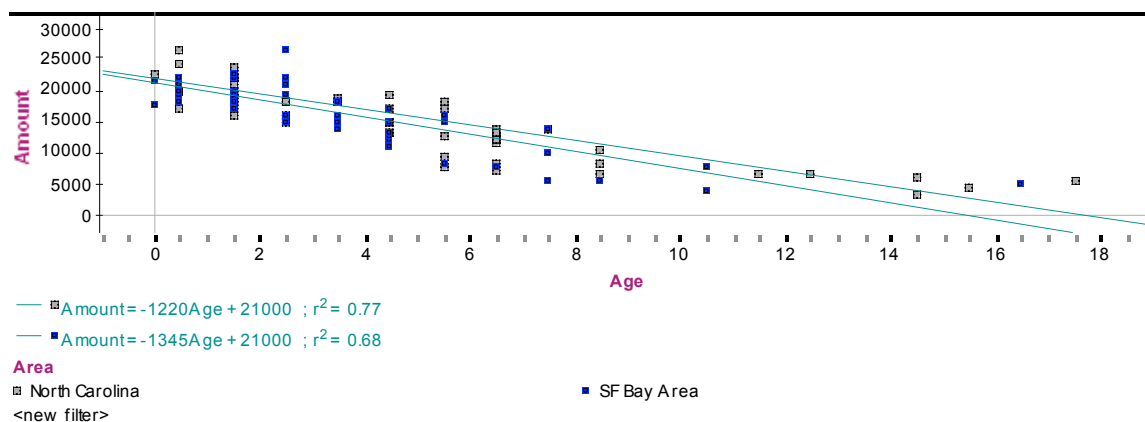
Perhaps the higher average price in SF can be accounted for by the lower average miles of the cars, more than 400 miles fewer. And again there is a smaller variation in the SF distribution of miles, Q3 in North Carolina being more than 10,000 miles higher than in SF. Still, the upper fence in the two areas is just about the same, both having outliers of more than 130,000 miles, testimony to the extraordinary longevity of these famously rugged vehicles.



We get a little more insight when we look at the values of the variables in correlation to each other. For instance, price as predicted by miles is almost exactly the same in the two areas, except that the base price starts out \$600 higher in SF. For each additional mile, price decreases about twelve cents. The variation from the model is slightly less well explained in North Carolina, suggesting perhaps that price there is not as much controlled by miles as it is in SF.

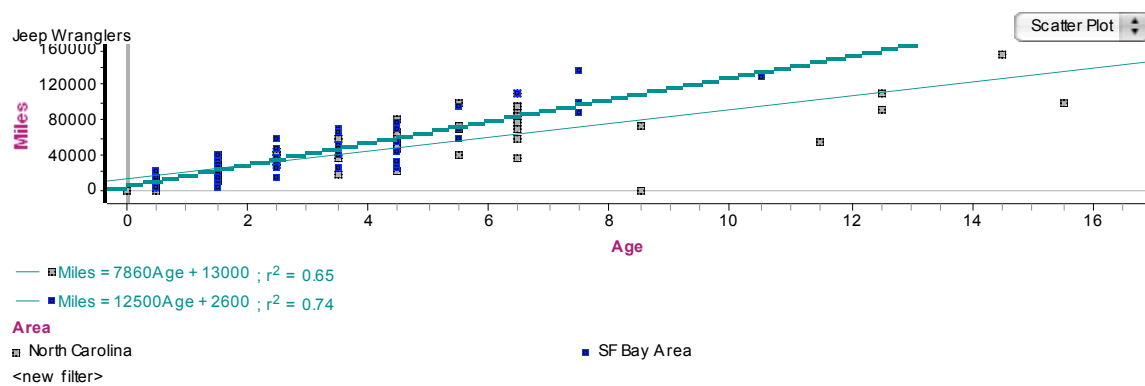


But if we consider price as predicted by Age, we see a more noticeable difference between North Carolina and the Bay Area, with the latter on average losing more value with each additional year of age, about \$1000 more, a not insignificant amount. The proportion of variability explained is nearly 10% higher for the North Carolina vehicles. Perhaps there is a correlation between this difference and the difference in how quickly the cars lose value as they age, but it is not easy to explain what it is or obvious why it occurs.

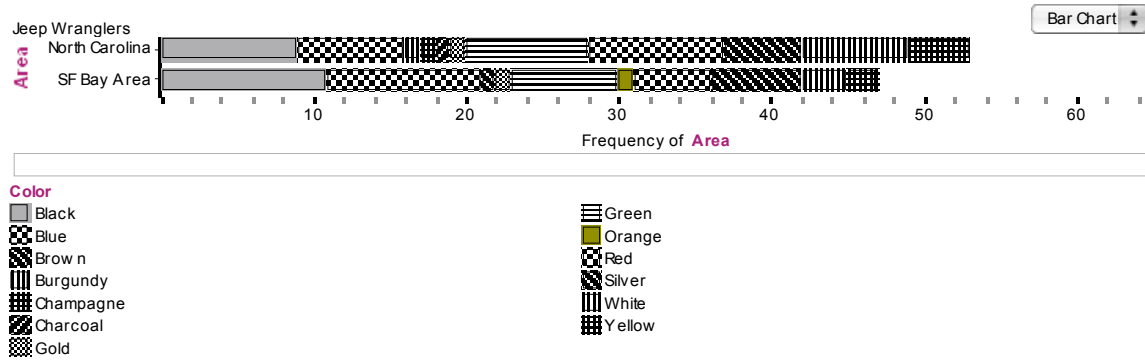


The clearest light is shed, perhaps, when we consider miles as a function of the age of the car. Here the data show that for every year of age a significantly higher number of miles are added to the vehicles in the SF Bay Area (12,500) when compared to

North Carolina (7860). And this pattern of data predicts that the lowest number of miles on a used Jeep is in North Carolina more than four times what it is in SF. We already saw that on average the cars sold in SF have fewer miles on them. This suggests that people in North Carolina get more miles out of their Jeeps before they sell them, but people in SF put more miles on their Jeeps each year they own them. Jeeps are sold sooner in SF, perhaps in part because otherwise they tend to have too many miles.



Shifting gears a bit, differences in colors of the cars show an interesting pattern. In general, a significantly higher percentage (45%) of Wranglers in the Bay Area are dark (black or blue); conversely, a significantly higher percentage (70%) of Wranglers in Greensboro are colored (other than black or blue). The data are easier to see in a summary chart than in a ribbon plot, but the general pattern is clear: a Jeep Wrangler is more likely to be black or blue in the Bay Area than in North Carolina. In fact, the relative risk of a Jeep being one of those colors is 1.5 times higher in the West.



It's not easy to account for this difference, although the higher average summer temperatures in North Carolina might be one possibility. Or perhaps it related to some feature of the owners. Further research might illuminate this issue, since Cars.com does not offer data on variables of buyers or sellers.

Jeep Wranglers		Color										Row Summary
		Black	Blue	Brown	Burgundy	Champagne	Charcoal	Gold	Green	Orange		
Area	North Carolina	9	7	0	1	1	1	1	8	0	53	
		0.16981132	0.13207547	0	0.018867925	0.018867925	0.018867925	0.018867925	0.1509434	0	1	
	SF Bay Area	11	10	1	0	0	0	1	7	1	47	
		0.23404255	0.21276596	0.021276596	0	0	0	0.021276596	0.14893617	0.021276596	1	
Column Summary		20	17	1	1	1	1	2	15	1	100	
		0.2	0.17	0.01	0.01	0.01	0.01	0.02	0.15	0.01	1	

S1 =
S2 =

What conclusions, if any, can we draw from the patterns of these data?

Generally, if you live in North Carolina you can sell your Wrangler older and with more miles on it (but for slightly less money) than if you live in San Francisco. Jeeps for sale in the Bay Area are newer and have fewer miles (adding more miles with each year of age), but cost a little more. And, for reasons that further research might reveal, in North Carolina you're more likely to drive a Jeep with bright colors. Can these observations add, then, to our stereotypes about the two regions? Perhaps this question is best answered by the intrepid reader.

