Marketing Analytics

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Lecture 09

What Consumers Want (Contd.)

Hello, everybody, this is Professor Swagato Chatterjee from VGSoM, IIT, Kharagpur taking the Marketing Analytics course for you. This is week two and session three is something that we will start with. In session 1 and two, we talked about what customers want. In session 1 we have shown that how from customer review data you can find out the preferences of the customers.

And in session two we have started with briefing about Conjoint analysis that is another quantitative technique, which you can use to find out what are the various preferences of the customers and you can also get data about the preferences about various attributes and the attribute level. So, you can find out if you are, if somebody is trying to buy a let us say a laptop then how much is the preference for 2 GB RAM or 4 GB RAM or 8 GB RAM?

How 4 GB RAM and 8 GB RAM are different from each other, exactly attribute level preference you can probably try to find out. So, in this session we will in a hands on kind of way will try to see that how I can find out all of these things.

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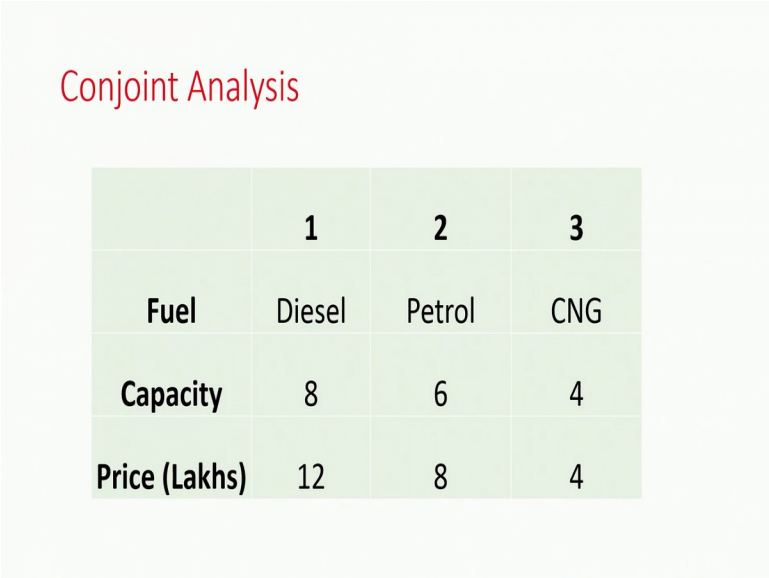

So, the first thing is, let us say, you are trying to buy a car. In this particular case, think that we are trying to buy a car and then you probably go and ask some people that what are the major features, major factors, aspects that they think are important when they are trying to buy a car. And I find out that the three things that people think are important 1 is fuel, 1 is capacity means sitting capacity and the third 1 is the price.

So, these are the three things, let us say that comes up to be important, and I also find out that there are three levels in this. So, I told that all of these things are to be mutually exclusive like fuel and capacity should not be compared with each other, and again capacity and price should not be compared with each other. Now, sometimes you can say that, okay, capacity and price might be related, when capacity goes up price goes up, that can be a problem.

So, if that is the case, then probably price will not be a good variable that we should take. On the other hand if you think that, okay even the diesel, the fuel type will change the engine type and engine type has different costs that will contribute towards the price, then that will also have an impact. So, it is better if you have taken something else instead of price or whatever be the case in this particular case, probably I have taken price, and these are the three levels.

My levels are very, I would say objective, concrete in nature, nothing is there where you can actually say that, okay there is some ambiguity, you know what is a diesel engine, you know what is a petrol engine, or you know what is a CNG and then we all know eight seater means it is a little bit bigger, what six seater means it is more of a, I would say probably Innova kind of a car and four seater might be something like Maruti Dzire kind of a car.

So, we all know, we have seen all of these things in this kind of price ranges and capacity ranges and fuels are pretty common to us. Now, there are three factors, and each factor has three levels. So, that will lead to 3*3*3 that means 27 combinations can be created out of these things.

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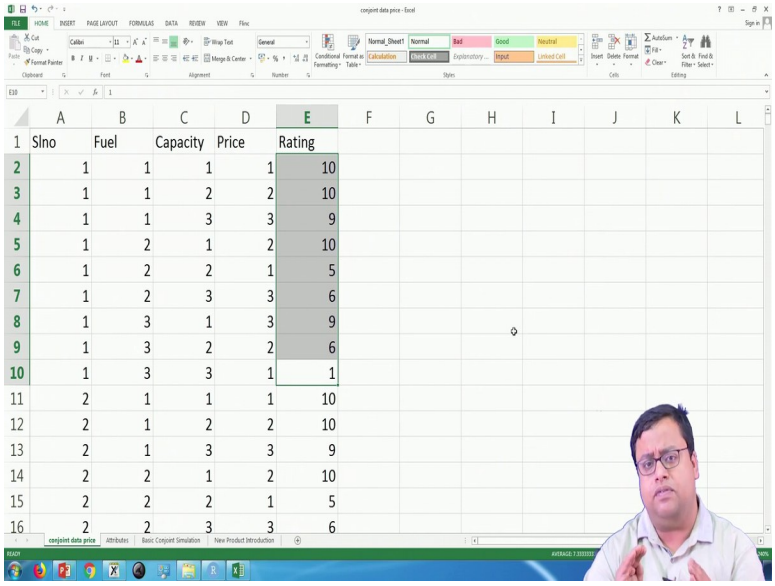

Slno	Fuel	Capacity	Price	Rating
1	1	1	1	10
1	1	2	2	10
1	1	3	3	9
1	2	1	2	10
1	2	2	1	5
1	2	3	3	6
1	3	1	3	9
1	3	2	2	6
1	3	3	1	1
2	1	1	1	10
2	1	2	2	10
2	1	3	3	9
2	2	1	2	10
2	2	2	1	5
2	2	3	3	6

So, what I do after knowing that is, I go and ask the customers how they preferred this thing. So, in your dataset there will be a conjoint data dot Excel file, conjoint data price dot Excel file and if you go to the first one, you will see in this file, I will just make it a little bit bigger. You will see in this particular file, there is serial number and then fuel capacity price and rating, these are the three things.

So, this is a rating based conjoint analysis. So, where we have given so, for example, for the first person, we have given 9 choices out of those 27 we have chosen 9, and we have chosen in such a way, this 9 when you are choosing you are not giving the full design, full factorial design. So, when you are giving the full factorial design, you will give 27 combinations to this guy.

But when you give 27 combinations to 1 person, it becomes very difficult for that person to rate. So, to differentiate one with the other, so he sometimes gives gibberish, or he follow a his own heuristic rather than a properly thought out rating. So that might actually impact the quality of the data that you are collecting.

So, instead of that we sometimes give a subset of the overall design and that subset will have an orthogonal design. Orthogonal design means that if I give this 9 choices and if I run this for this table, the table that I have selected, if I run a correlation for each column, it should be very close to zero like the fuel and the capacity should not be correlated, fuel and price should not be correlated and capacity and price could not be correlated.

So, this kind of a design is called orthogonal design and this is something that we are giving. So there are various ways to create orthogonal design out of the full factorial design, which means full factorial design means all the 27 choices. So, all possible choices and orthogonal design is a subset of that, where the correlation between 1 variable to another variable will be close to zero or absolutely zero.

So, that kind of design is called orthogonal design. There are softwares that we can use, and in a different session and probably a different video or different link, I will show you how to give, how to create this orthogonal design out of a full factorial design. But let us say I have created such kind of a design which is a subset of the whole part and I have given these 9 choices to 1 and this 1 guy, the person number one, serial number means here the person number.

The person number 1 has given rating for these 9 options these are the ratings in a 1 to 10 point scale, let 10 means most preferred and 1 means least preferred. He can also give ranking. Let us say instead of rating if you have given ranking, and 1 to 9 means 1 is most preferred 1 rank, and 9 is least preferred rank. Now, if we use ranking, then the only difference from rating and ranking is in the analysis part is you have to change the ranking to reverse ranking.

That means, if you have to change the 9 to 1 and 1 to 9, so anything which gets our 1 ranking should get highest rating and anything which gets the 9 ranking, that means lowest ranking, should get the lowest rating that means one, 9 ranking should lead to 1 so we will reverse it. So, all I have to do is 10 minus the rank whatever you have given. So, 10 minus 1 will give me 9 rating 10 minus 9 will give me 1 rating and so on. So, if we by chance, instead of rating I had ranking, I will just change it to a reverse code that is only thing that we have to do.

Why rating and ranking? Sometimes customers know that, ‘Okay, I prefer A over B, but I do not know how much?’ So, when I do not know how much then if you ask me to rate that becomes difficult sometimes. On the other hand rating if the options are more or less popular, they know they have used it before and etcetera. If there is much familiarity with the customer with the product category and accepted then, I think rating is a better option to go ahead with.

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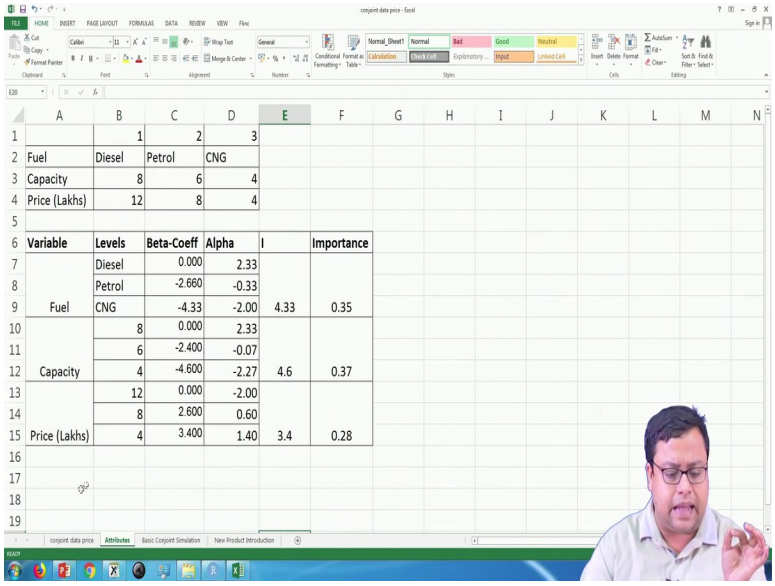

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1		1	2	3										
2	Fuel	Diesel	Petrol	CNG										
3	Capacity	8	6	4										
4	Price (Lakhs)	12	8	4										
5														
6	Variable	Levels	Beta-Coeff	Alpha	I	Importance								
7		Diesel	0.000	2.33										
8		Petrol	-2.660	-0.33										
9	Fuel	CNG	-4.33	-2.00	4.33	0.35								
10		8	0.000	2.33										
11		6	-2.400	-0.07										
12	Capacity	4	-4.600	-2.27	4.6	0.37								
13		12	0.000	-2.00										
14		8	2.600	0.60										
15	Price (Lakhs)	4	3.400	1.40	3.4	0.28								
16														
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So you ask each of the consumer that, ‘Okay, if I give you a car, which has fuel capacity as 1 that means fuel as 1 means diesel and then capacity is 1 that means it is also 8 seater and price of 12 lakhs.

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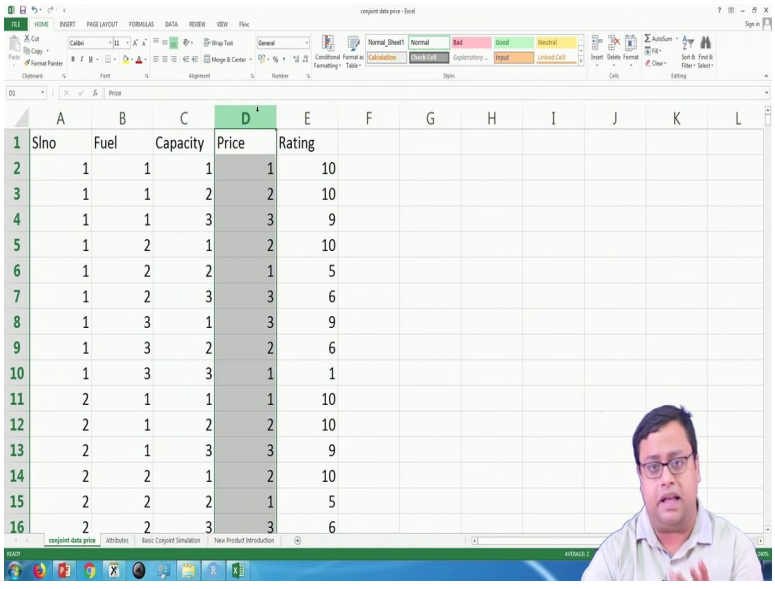

	A	B	C	D	E	F	G	H	I	J	K	L
1	Slno	Fuel	Capacity	Price	Rating							
2	1	1	1	1	10							
3	1	1	2	2	10							
4	1	1	3	3	9							
5	1	2	1	2	10							
6	1	2	2	1	5							
7	1	2	3	3	6							
8	1	3	1	3	9							
9	1	3	2	2	6							
10	1	3	3	1	1							
11	2	1	1	1	10							
12	2	1	2	2	10							
13	2	1	3	3	9							
14	2	2	1	2	10							
15	2	2	2	1	5							
16	2	2	3	3	6							

So, if this kind of car option I give you, how much will you rate that car or will you actually will be interested in buying that car and etcetera? So, this kind of data has been given. Now, the only thing that I have to do is, I have to find out how the rating is getting affected by these three guys. Now, here you see in the fuel, fuel 1, 2, 3 these are actually categories, these are not numbers.

So, if I do a regression, I have to use these three variables as categorical variables and I have to create dummy variables for them. So, I have to create for fuel 1 dummy, fuel 2 dummy, probably I can keep fuel 3 dummy as the reference point and then again capacity 1 dummy, capacity 2 dummy, capacity 3 becomes a reference point, and then I can also create price 1 dummy, price 2 dummy and price 3 becomes a reference point. So, any of these three things I can do.

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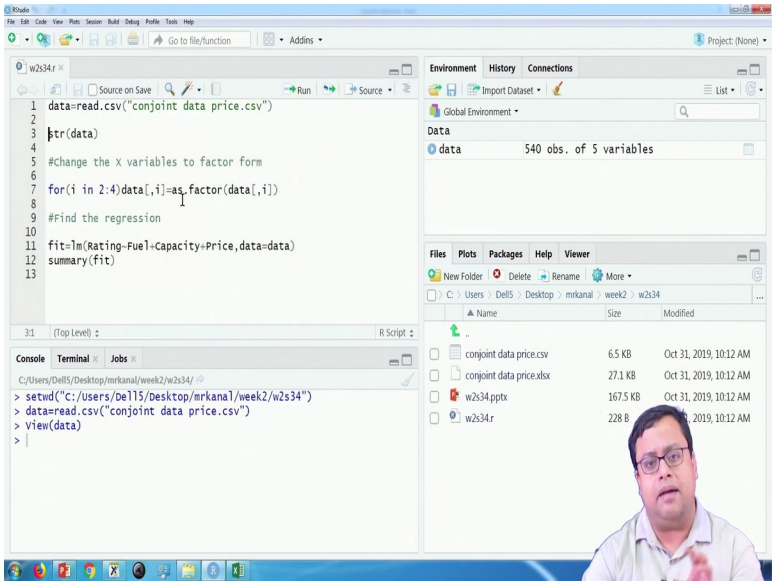

So, I will quickly do that in R, I have given you a week to S3 four dot r file. So, that file if you can open, that file is a CSV file also has been given that CSV file is nothing but the data part of this particular thing. So, if you just saved your working directory, put all the files that are there for this particular session in the same folder and then you set working directory to source file location and then you read this data, the data is nothing but 540 observations of whatever I have shown right now.

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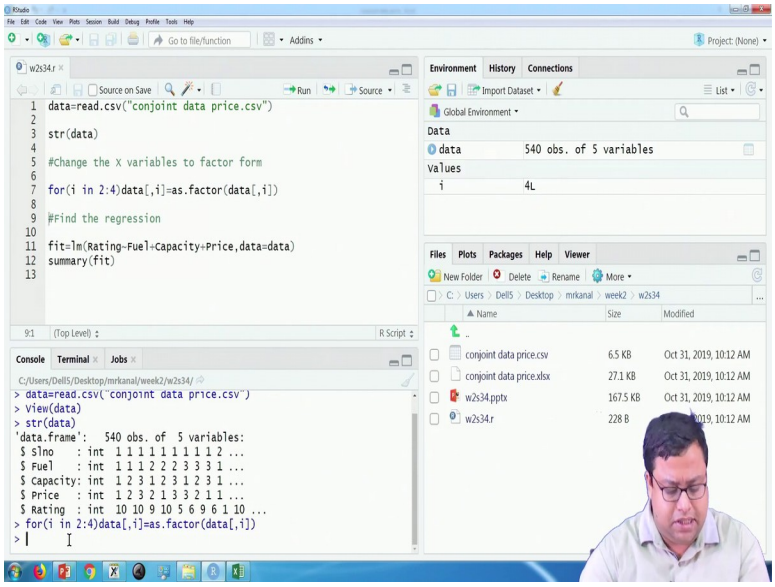

So, these 540 observations are actually data collected from 9 of observations, 9 options for 60 responded, so each responded is given 9 options. There are 60 respondents, which gives 540 observations. Now, this is also one of the strengths of Conjoint analysis, which can create lots of data from a small number of samples. So, 9 is, okay, somebody probably can even compare up to 12 or 13 or 15, something like that. It is okay, still okay.

So, let us say 16 options you are giving, and there are, let us say, 60 observe people, so 960 observations you are creating out of 60 people, you are getting 960 rows, and it is good enough to run a regression where you have 3 - 4 variables or probably let us say, 8 factors, 8 categories in total.

So, so that is a very big advantage of Conjoint analysis where you can create a lot of data from a smaller sample. So, I check the structure of this data, and the structure of the data says that obviously it is reading from a CSV file, CSV file does not know whether fuel capacity and price are, whether they are categorical variables or not, they are all in this case, they are all integer variables.

So, I first change them to categorical variable, factor variable in this particular case, and then I just run a regression, as simple as that, simple linear regression. So, what I do? I, in the line number four have written, for i varies from 2 to 4, why 2 to 4, because fuel capacity price these are the three things that i will change, they are from second column to fourth column, second column to fourth column, what will it do data comma i that means data, data is the

name of the data set, in this data set the ith column will be changed, how, whatever ith column was change it to its factor form and save it back.

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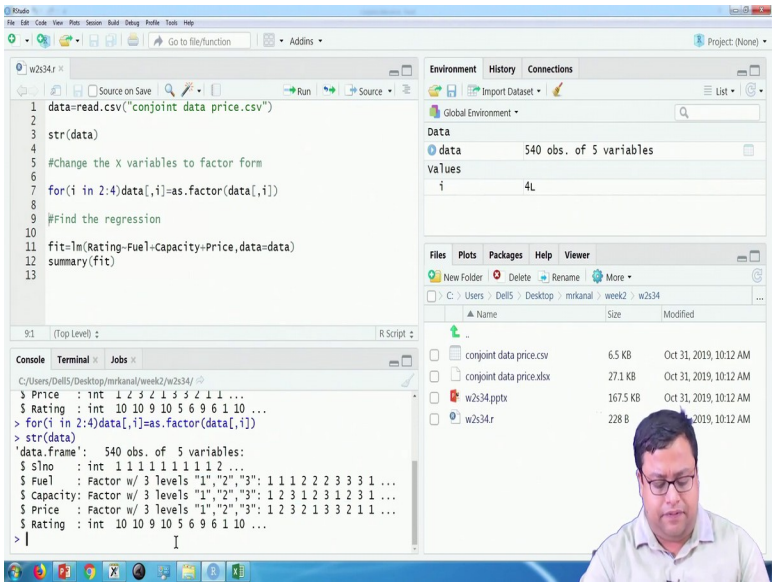

So, change that data's ith column to its factor form then save it back to data's ith column and do the same operation for i equal to 2, i equal to 3, i equal to 4. So, we just run a loop here, as simple as that. So, I run that and then I again check structure of data. And now I see that these guys have been changed to factor variables with levels as one, two and three, these are my three levels. So one, two, and three and 1 is level number one, 2 is level number two and 3 is level number three, so I am more or less okay. So now, only thing that I have left is, I run a regression.

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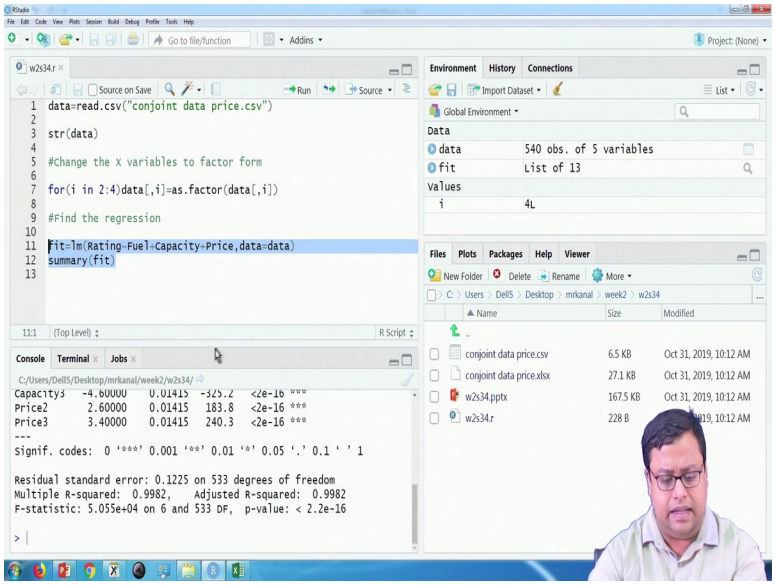

So, I run a regression where rating is my y variable, and fuel capacity and price all these three things are factor variables, these become my X variable. So, I just run a simple linear regression. So, you can probably run some other kind of regression, probably ordinal logistic regression or something like that, but for simplicity purpose, simple linear regression works.

So, see in this particular marketing research or analytics there, always you can bring in complexity, but the difference between being a very hardcore data scientist and being a , I would say business oriented analytics guy is the difference between this two is that there is always that dilemma, there is always a tug of war between how much complexity I will bring in, bring in this thing and how much of that will be useful.

So, if I am running this course and etcetera because it is difficult once you, once you run a few lines of coding, it becomes very easy to run things which are repetitive otherwise let us say if I try to do the same thing in Excel for three columns, I had to create six dummy variables one by one. So, I have to write ifelse six times, and then I have to run regression put all the X variables in one place, Y variable in one place and etcetera.

So there were lots of problems, and if the data size were bigger, then there was also a problem. So, that is why we are using R because R, yes, it is tough to learn initially, but once you learn probably a few bits of R, you do not have to become a data scientist to learn marketing analytics, you can learn few lines of coding. So, you see all the things that I am doing in this case is 12 lines of code and in there also comments are there probably four five lines of code.

So four, five lines of code is actually what you all need, and they are repetitive codes, this is the same code, I will copy and paste it and do something else as well. So, that is why I suggest that you try to do it in R, by small, small coding, and then you try to interpret it in Excel or in some other place, etcetera. So, here what I am doing is fuel capacity price are my three x variables, and rating is my y variable, I run a simple linear regression.

I am not doing much complex model because the return of those complexity is not much higher, whatever this simple linear regression can give, I will not get very extra, I would say very much different information by doing a little bit more sophisticated econometric technique. So, that is why I am leaving it here. So, if I run this regression, I get certain results, and this is the same result I just copied and pasted it here. So, that we can discuss.

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Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) 10.00000    0.01395   716.9   <2e-16 ***
Fuel2       -2.66667    0.01291  -206.5   <2e-16 ***
Fuel3       -4.33333    0.01291  -335.6   <2e-16 ***
Capacity2   -2.40000    0.01415  -169.7   <2e-16 ***
Capacity3   -4.60000    0.01415  -325.2   <2e-16 ***
Price2       2.60000    0.01415   183.8   <2e-16 ***
Price3       3.40000    0.01415   240.3   <2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1225 on 533 degrees of freedom
Multiple R-squared:  0.9982,    Adjusted R-squared:  0.99
F-statistic: 5.055e+04 on 6 and 533 DF,  p-value: < 2.2e-
```

So, this is the PPT. So, if you see that our f-statistic is five point, actually 5.055 which is pretty high, the p value corresponding to F-statistic is lower than 0.05, so we are happy with this regression. Our adjusted R-squared is very high 0.9982 that is also something that makes us happy, and then this is the regression that I get. Now, this is probably our data set that has been created, but in real life situation this much high adjusted R-squared might not be the something that we will get but as long as you are getting good enough, probably more than point 3, point 4 adjusted R-squared in terms of marketing it is good enough.

So this is subjective, in the lots of research papers, lots of works in marketing is done where the adjusted R-square is further lower, but that is okay. As long as it is a subjective decision,

somebody takes 0.2 as the cut off somebody takes 0.7 as the cut off and so you can take as per your wish, but lower than 0.2 is probably not something is good. Now, if I try to interpret these things, all my variables are coming significant, that is one thing.

So, all of them are coming significant, and then the next thing that I have to check is that here for each of the categorical variable fuel, capacity or price, fuel 1 has been taken as the reference capacity, 1 has been taken up the reference and price 1 has been taken as a reference. So, if fuel 1 is diesel if you remember diesel, petrol and CNG. So, diesel, in comparison to diesel petrol is preferred less , -0.266. But the least preferred 1 is CNG which is -4.33. There can be n number of reasons for that, I am not going into these details why but there are reasons for that. Then the most preferred is 12 capacity.

I think, no sorry 8 capacity and then capacity 2 means 6 seater, 6 capacity is little bit less preferred -2.4 and capacity 3 – 4 seater is further less preferred keeping everything else constant -4.6. So, it is not that 4 seater is less preferred but if I keep the price and fuel as constant let us say for the same price eight lakh rupees, will you prefer a four seater or eight seater depends on what kind of car you want to have but here in an overall level we try to find out that okay higher capacity is preferred as simple as that and then higher price is not preferred.

So, you will see that price 1 was if I am not wrong 12 lakh price 2 was eight lakhs price three was six lakhs or something like that. 12 eight and four. So, twelve is least preferred, 12 to 8 the preference increases by 2.6, and that to another price 3 which is 4 lakhs preference increases by 3.4. So, that is something that we are getting here.

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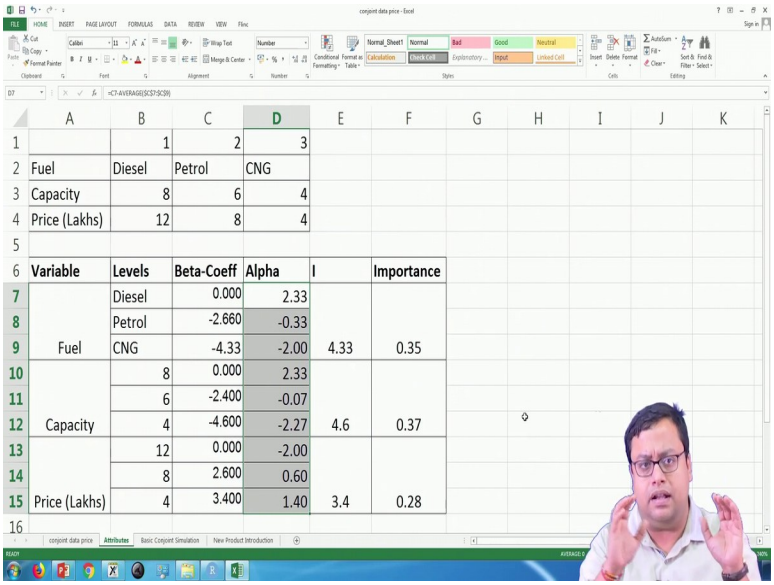

	A	B	C	D	E	F
1		1	2	3		
2	Fuel	Diesel	Petrol	CNG		
3	Capacity	8	6	4		
4	Price (Lakhs)	12	8	4		
5						
6	Variable	Levels	Beta-Coeff	Alpha	I	Importance
7		Diesel	0.000	2.33		
8		Petrol	-2.660	-0.33		
9	Fuel	CNG	-4.33	-2.00	4.33	0.35
10		8	0.000	2.33		
11		6	-2.400	-0.07		
12	Capacity	4	-4.600	-2.27	4.6	0.37
13		12	0.000	-2.00		
14		8	2.600	0.60		
15	Price (Lakhs)	4	3.400	1.40	3.4	0.28
16						

Now, I have just copied and pasted it here, same thing other than the I would say the intercept I have pasted the rest of the things. Now, I have to find many things that I can find out from this particular observation. So, one regression analysis and I can find out lots of stuff from this thing, and we will slowly do one by one to find out what are the various things that I can deal with.

The first thing that I want to know is which of these three attributes are important. Remember, we told that we could ask the customer that okay, 'Do you think fuel is important or capacity is important or price is important in a 1 to seven point scale, 1 means no important, seven means very high important'? They will give some rating and when they give some rating that it comes 5.8, 6.2, 5.9. I do not know which one is something which is bigger, which one is lower or something like that.

So, this is something that is more I would say from their preference, inherent preference it will come up, for example, you will see that if you do something wrong in fuel the change of preferences is 4.3. So, 0 to 0 is the upper limit, -4.3 is the lower limit, some people actually try to change all of these beta coefficients in such a way that each attribute are of similar levels.

So, they change it in such a way that each attribute, this is beta coefficient; the alpha coefficient will be such a way that each attribute coefficients alpha coefficients if you add them up, it should be zero. For example, I change it in such a way, such that if I add this three guys up, it is zero but the distance between 0 to this is still there, distance between -2.66 to -

4.3 is still there, and so on. So, how to do that? It is easy, you find out the average of these three guys and subtract it from each of the observation. So, C 7 minus average of C 7 to C 9.

And that is the same thing that I am doing for C 8 also and C 9 also. So, this is the alpha coefficients, which gives me that if I put all these three categories in the same level, if all these three variables in the same level, if they are equi-important, then how one factor can be compared with, another factor another level. So that is something that is the first job, and if you can plot it, this will give you part votes, but that is not something that we are right now focused on. I am more focused on the importance of each of the variables.

So, what is the importance? The importance is the difference between a function, the difference between the lowest coefficient and the highest coefficient under one categorical variable. So, let us say one categorical variable is the fuel lowest coefficient is 0, -4.33 and the highest coefficient is 0, what is the difference 4.33, so, that comes up here.

Similarly, here the lowest coefficient is 0 or sorry, -4.6, the highest is 0, what is the difference, 4.6? Here it is 0, 3.4, what is the difference? 3.4. So, each anything you do wrong at price and everything you do wrong in capacity, capacity will change the preference up to 4.6 here the change of preference can be up to 3.4 that is the unit, the maximum change that can happen.

Now, this important course is nothing but the individual values by the summation of the three values. So, this is nothing but E 7 by submission of E 7 to E 15. What is E 15? Just one minute, it should be E 15, exactly. So, these three, these three values, I find out 0.35, 0.37, 0.28 gives me an idea that capacity is something that is more important. The next important variable is fuel, and the third important variable is price.

So, I get a preference and these preferences are not coming from the customers mind or whatever they are saying probably it is coming from the customers mind we are getting the inherent preference that they do not know to give some preferences and from that, I can find out that these are the three important scores, they are not verbally saying because oftentimes what you verbally say is not how you behave. So, I am trying to get this data from the behavior. So that is number one.

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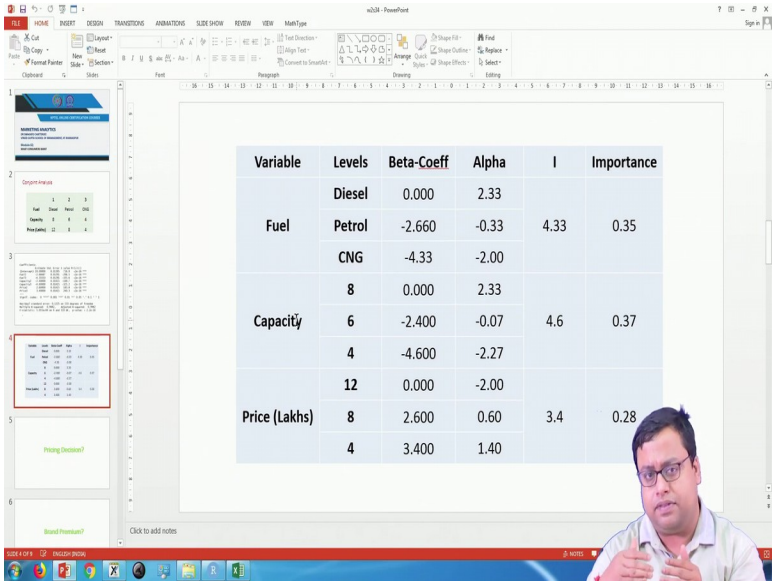

So, this is something that I have reported here also. Now, I will show you there are lots of different stuff that we can do using this Conjoint analysis and there are 3-4 things. The first thing that I will talk about is something called a brand pricing decision. So, how I can use this particular thing to decide a price of a product? So, one thing is simple here. So, let us say keeping everything same, keeping everything same if I change from capacity 6 seater to 4 seater, how much preferences dropped, the preference drop is -2.4 to -4.6. Fair now, so -2.4 to -4.6 means how much? It is actually -2.2.

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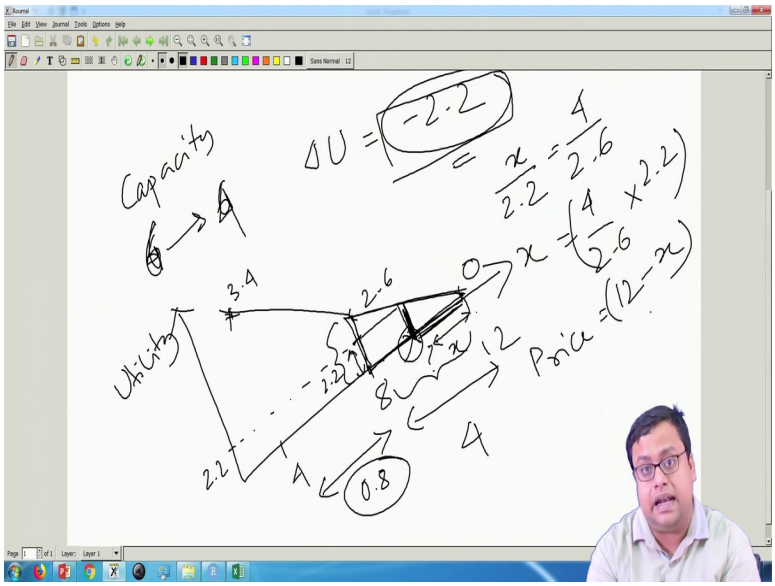

So, if I change my capacity from 4 to 6, oh sorry, from 6 to 4, the corresponding change that delta utility is -2.2, fair enough. Now, how I will price that, how I can compensate that by changing the price? So, price if you see carefully, the prices decision is something like that, that from let us say it was 8 lakhs. Now, I have to decide the price. So, in eight lakhs it is 2.6 and four lakhs it is 3.4. So, if I just draw this at 8 lakhs and 4 lakhs, this is price, this is utility or something like that.

So, the corresponding preferences are at 8 lakh it is 2.6, let us say this is 2.6, and this is 3.4, okay, and I have to, so what is the distance between them, the distance between them is probably 0.8, right, 0.8. So, I have to further extrapolate it, so if it is 8 lakhs, I have to further extrapolate it because I have to find out minus 2.2. So, it is an assumption then that below 4 lakhs also it will go in the same level.

So, for 4 lakh drop, the utility that you get is 0.8. So, how much do you have to drop, actually it will come to the negative part. So, this is probably not a good example. But I would try to say, let us say, your price was 12 lakh initially So, I will just change it quickly. So, let us say your price was, 12 lakhs initially, so at 12 lakhs, you are at 0. Fair enough? Now, you have to manage from minus 2.2.

So, from 0 to 2.6 drop happens. So, when you change from 12 lakhs to 8 lakhs, the utility drop happens from 0 to so, you gain utility 2.6, but you have to gain 2.2 because 2.2 is something that you are losing. So, how much will that thing be? So, if this is at 8 lakhs it is 2.6 and at 12 lakhs it is 0. So, this is the table, this is the equation, and you are trying to find out where this 2.2 comes, so let us say this is 2.2 correspondingly this is the point, and if you write a straight line, you try to find out what is the score? Right? What is this score?

So, how will I find out that, let us say this distance is x. How much is this distance? This distance is 2.2. So, can you check carefully, can I write x/2.2=4/2.6. So, this much, I would say this much divided by this much, so for the small, I would for the small triangle the ratio between the x and the height which is 2.2 is equal to for the bigger triangle, this much by this much, which is like 4 by 2.6.

So, then what is x? x=(4/2.6)*2.2, whatever is the value, and what is your optimal price that you can do? Your price is basically 12-x, whatever is the value so you can get a little bit of pricing by this. That is one way.

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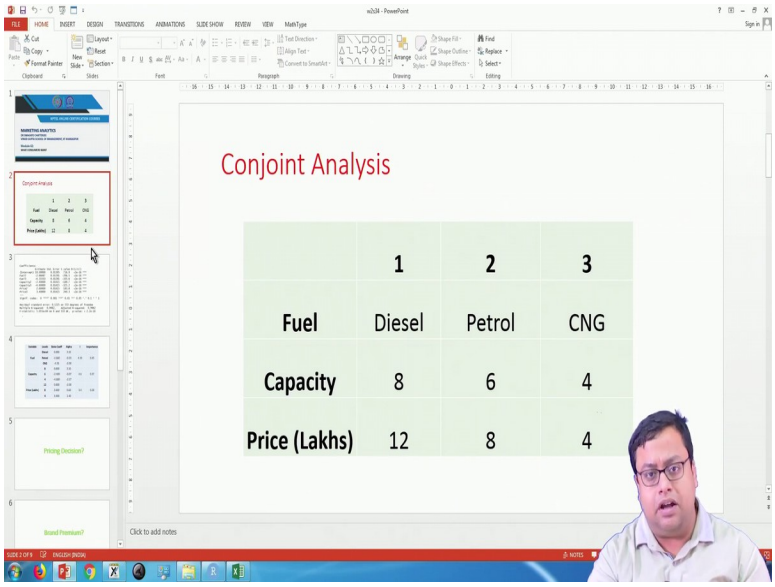

Another way I just told you that it might not have been a good decision to include price here. So, let us say instead of price you have taken something else, you have taken fuel capacity and let us say, I do not know the engine type or let us say, whether there is some power steering or not, or something like that, I do not know, some other variable you have taken which is not related to fuel not related to capacity.

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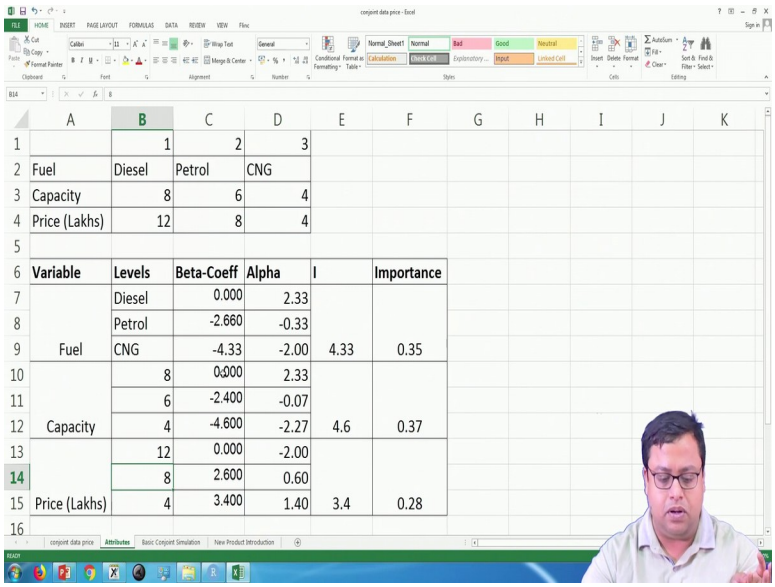
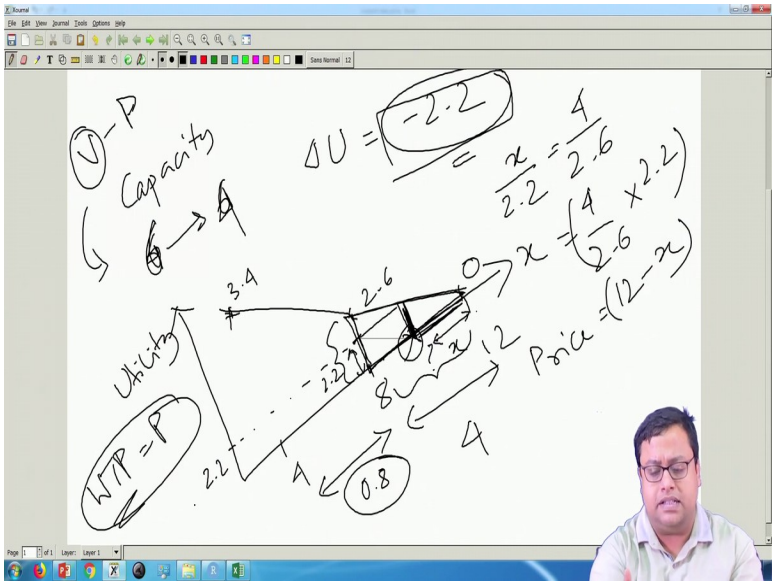


	A	B	C	D	E	F	G	H	I	J	K
1		1	2	3							
2	Fuel	Diesel	Petrol	CNG							
3	Capacity	8	6	4							
4	Price (Lakhs)	12	8	4							
5											
6	Variable	Levels	Beta-Coeff	Alpha	I	Importance					
7		Diesel	0.000	2.33							
8		Petrol	-2.660	-0.33							
9	Fuel	CNG	-4.33	-2.00	4.33	0.35					
10		8	0.000	2.33							
11		6	-2.400	-0.07							
12	Capacity	4	-4.600	-2.27	4.6	0.37					
13		12	0.000	-2.00							
14		8	2.600	0.60							
15	Price (Lakhs)	4	3.400	1.40	3.4	0.28					
16											



But instead of asking rating or ranking in the data set, you have asked willingness to pay, if you remember, what is the price, what is the best price that we can do? We can find out the optimal willingness to pay, willingness to pay of the customers , so customers will try to maximize V-P. We are trying to find out this V, instead of that we will find out the price component.

We will say that WTP, willingness to pay, is equal to my price. So, if I find out willingness to pay of the customer then it will actually give me directly how much they are monetarily rather than preference and etcetera, how much they are willing to pay for a certain attribute and attribute level. So, I directly asked willingness to pay, and they give me that monetary figure, and then I do the same regression.

Now, I get this particular equation as a function of, so all of these things is willingness to pay, if I have a new observation. Let us say a new car, and that car has diesel with capacity 6 and with price 2.6. So, I can directly, sorry, price 8 lakhs, so then I can directly find out what is the willingness not price, probably something else I do not know.

So category variable x3 which is 8, I think let say, so then I can directly find out what is his willingness to pay, his willingness to pay will be the coefficient is 10. So 10, if it is diesel, then it is 0, 10 plus 0, if it is 8 seater then again plus 0. So, again plus 0 and then if it is something else plus 2.6. So 12.6, so something like that. So, instead of asking the preference, I can directly ask the willingness to pay, and I can find out the price that they are willing to pay.

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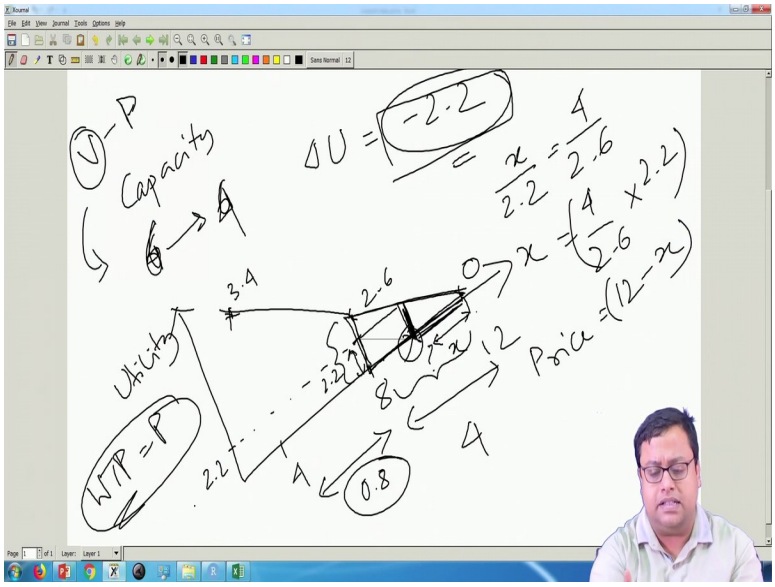

That is one way. Another way is if you by chance have taken price as one of the consideration, you can do this kind of a Maths ,a little bit to find out, it is an interpolation or extrapolation. By chance, if you are trying to find out that if your price is 12 and if you hwant to find out how much will be the price above 12, then you have to do extrapolation with an assumption that this point can be extrapolated this way.

And ,this point, this line can be extrapolated in this way. So, that is an assumption that you take, but you do extrapolation and find out what is the optimal price. In this case from 8 to 4 drop I could not do because then the price would have been negative, which is not a practical case. So, that is why we will stop this particular video. I will come back with the next video with further more applications of Conjoint analysis. Thank you.