Marketing Analytics
Professor Swagato Chatterjee
Vinod Gupta School of Management
Indian Institute of Technology, Kharagpur
Lecture 31
Marketing Mix Models and Advertising Models (Contd.)

Hello, everybody, welcome to Marketing Analytics course. This is Dr. Swagato Chatterjee from VGSOM, IIT Kharagpur, who is taking this course for you. We are in week 6 and we are discussing about various kinds of advertising models. So, in the last class, we have discussed about the adstock model. So, we told that advertising has a long term impact. Any advertisement that you do, will have a long term impact, and that will slowly wear out over time, and then when you again give some other advertisements it will again jump up.

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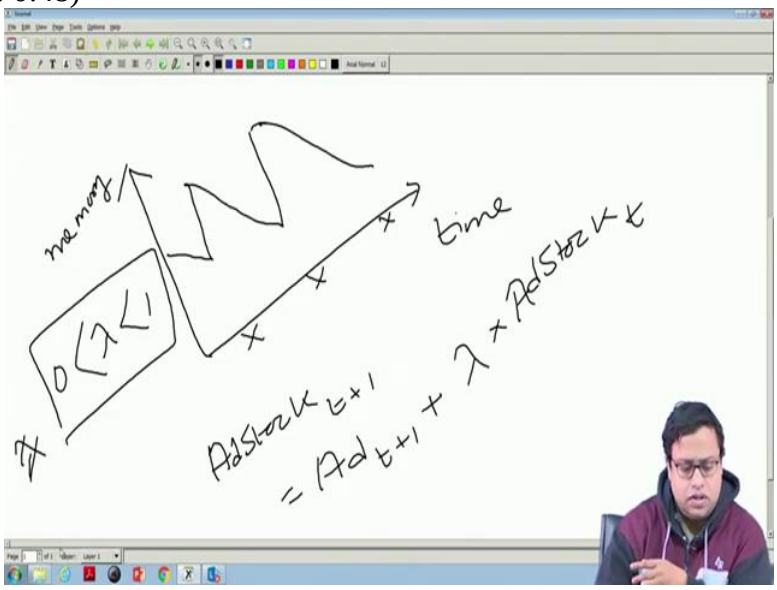

So, if you remember, in the last class, we told that if this is your memory and this is your time period, at various points let us say, this is one time period when you are giving 1 ad. This is another time period when you are giving another ad and this is the time period when you are giving an ad. The guys will actually come up like this. So, first it will slowly come down, and then go up and then come down. And then again go up and then again come down. So, something like this is happens.

So, now this coming down part is actually a decay effect that happens. And we told that the $Adstock_{t+1} = Ad_{t+1} + \lambda * Adstock_t$. And this lambda that I am talking about, this lambda is

generally between 0 and 1. So, lambda is between 0 and 1. So, that is why this is a decay effect that happens in case of advertisements. Now, today, we will actually talk about situations where you are not giving one single ad.

You do multiple ads and that those ads are coming up in multiple channels. So, it is something called integrated marketing communication where we actually do some amount of marketing expenditure, advertisement expenditure in multiple channels and each of these channels will have their own effect. They might not properly, so sometimes there might be interaction effect between themselves and sometimes there might not be any interaction effects between themselves.

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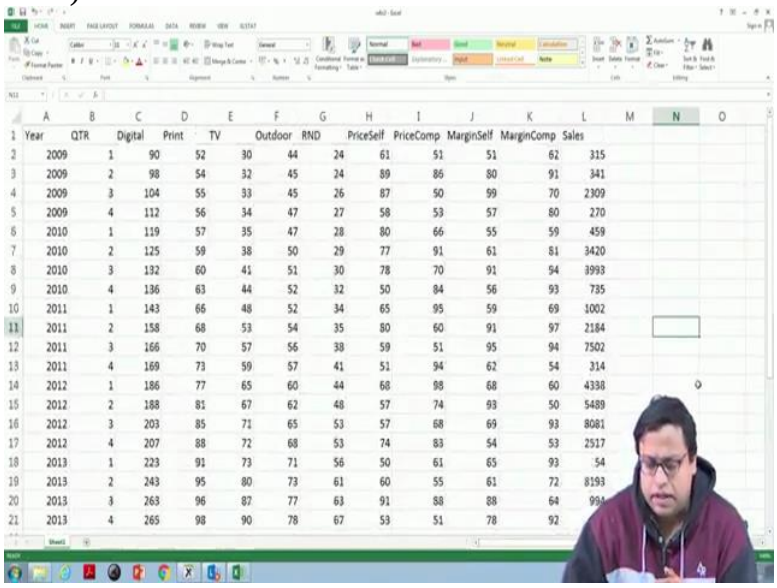

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
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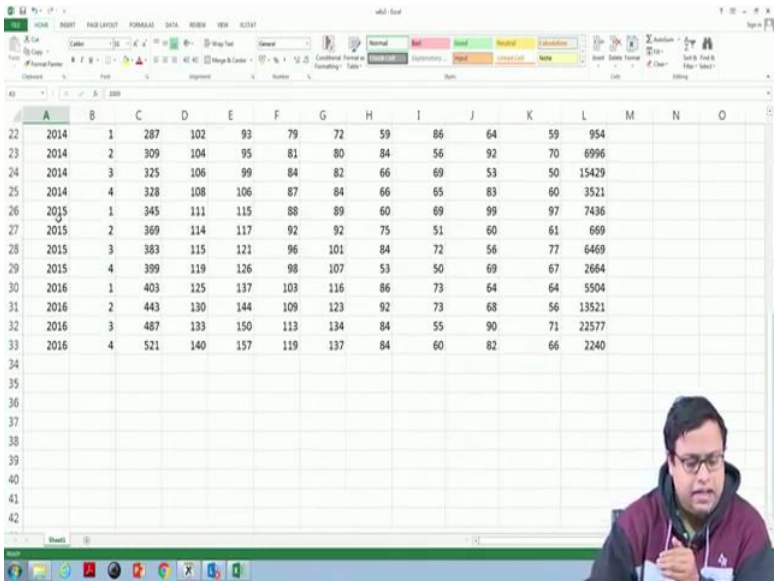

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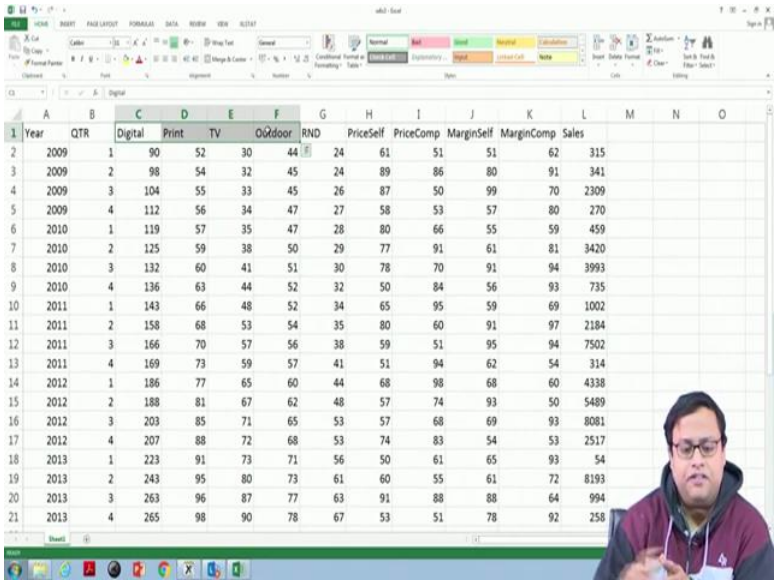
24	2014	3	325	106	99	84	82	66	69	53	50	15429
25	2014	4	328	108	106	87	84	66	65	83	60	3521
26	2015	1	345	111	115	88	89	60	69	99	97	7436
27	2015	2	369	114	117	92	92	75	51	60	61	669
28	2015	3	383	115	121	96	101	84	72	56	77	6469
29	2015	4	399	119	126	98	107	53	50	69	67	2664
30	2016	1	403	125	137	103	116	86	73	64	64	5504
31	2016	2	443	130	144	109	123	92	73	68	56	13521
32	2016	3	487	133	150	113	134	84	55	90	71	22577
33	2016	4	521	140	157	119	137	84	60	82	66	2240



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So, the dataset that we have in today's class, looks like this. So, the dataset has sales of multiple time period. If you check the dataset carefully, I will just put it on and then make it a bigger okay. So, now you will see that there is a sales data here and there is year here, quarter number here. So, year means 2009 till 2016 the data is there, then quarter number 1, 2, 3, 4, then again 1, 2, 3, 4, those quarter numbers are there. And then these are the 4 channels where expenditure has been done.

The first channel is called digital. Then the next channel is called print. Third is called TV and forth is called outdoor. So, what is digital? Digital media is all these online media where you can give your ads. For example, let us say you can give your ads in a Google advert, you can give

your ad in Facebook, you can give your ad in Instagram, and you can pay Google, Facebook on Instagram for showing your ad. Those ads can be of different types also. There is something called pay per click or pay per impression. So, what is pay per click and what is pay per impression?

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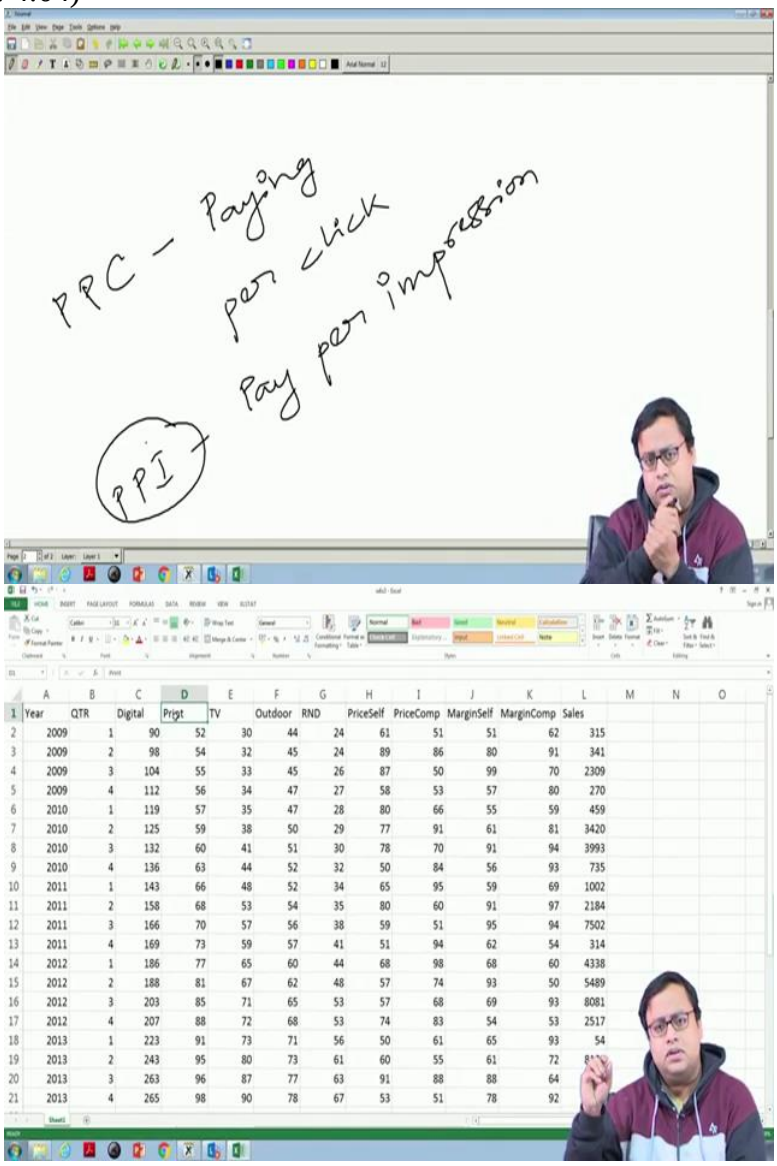

So, when you give a digital ad, there are two types of things that you want to have. One is called pay per click, PPC, where I am talking about how much I will be paying per click and then pay per impression. So, how much I will be paying per impression?

So, when which one is more important? So we actually focus on pay PI when our objective is not to engage the customer but only to create an awareness generation. Sometimes that awareness leads to interest, interest leads to certain amount of engagement at a later point of time. But that interest generation does not happen in one go. It might take 1, 2, 3 steps. 1, 2, 3 repeated ads to create those interests so that the engagement happens.

So, a new brand let us say if it is a new product or new brand that has launched, then you might want to generate the interest and to generate the interest slowly you want multiple impressions, multiple times the customer should see you. Now, if the customer want to see or you want the customer to see your ads multiple times then that is called pay per impression where you are paying per impression basis because the number, more the impressions are, the better it is for you.

But oftentimes, let us say if you are a already established brand then the question comes is that okay, I am already established brand, customers already have some amount of interest on me. So, why will I want to then create more number of impressions? I directly want the action. I want the customers to do something, to engage. That is called pay per click. In those kind of situations we go for pay per click where only when customers click on your ad or customers do something with your ad, that is the moment we in generally pay to the Facebook or Google or Instagram.

So, that is called pay per click. So, there are two models PPI or PPC. Whatever be the model, you can do certain amount of expenditure in the digital. The next one is print. Print media can be all kinds of print media. For example, let us say newspaper is one print media obviously. Another print media can be magazines, where you put your ad on magazines, let us say business magazines or education oriented magazine, technology oriented magazines. So, those are hard copies actually.

So, those will be print media. So, people actually, it has been seen that many many, I would say newspapers actually do not make money based on subscriptions. So, if I remember correctly, there were I walked with one of the printing house, one of the major printing houses of India, they told that each of their newspaper, the cost of production of one single newspaper is around 8 rupees, 10 rupees, 12 rupees, depending on how fat it is and which day it is, how much color combination are there, et cetera et cetera, it comes to be 10 rupees, 12 rupees, each piece.

On the other hand, they sell it for 4 rupees, 5 rupees per month, per day. So, each copy is around 3 to 5 rupees. So, then for each copy, they are making a loss. They are making a loss, 3 to 5 rupees loss. 3 to 5 rupees is the price. So, they are making up to let us say, 7 to 9 rupees loss for each price. And do you remember? In the pricing problem we actually did this kind of analysis. I told that there were let us say razors and blades. So, people were making losses in razors because they know, for each eraser sold, there will be 50 blades which will also be sold and they are making profit on that blades.

And that is why they are making losses in, so whatever is the production cost, they are selling the razors at a lower cost than the production cost and still they are getting huge volume and with that volume, they are also getting huge volume of blades and from the blades, they are making prices. So, similar business model is there in newspaper also. Newspaper makes lot of lot of money from the print media where they are saying that okay if my cost is 10 rupees and if my price is let us say 3 rupees or 4 rupees, then I am making 8 rupees loss.

And my demand is a function of only price, not my cost. My demand is only function of my price. So, at 3 rupees I get let us say 1 lakh circulation, so for then 1 lakh circulation now I have a huge media. So, how much loss I am making? 1 lakh circulation, each is 8 rupees, that means 8 lakhs is per day loss from the production. Now, if I have to generate more than 8 lakh revenue from selling my advertisement space, now let us say if you ask a company that okay you can reach 1 lakh customers on a particular one day, let us say around if you give an ad around 5 percent of those customers will actually purchase.

Let us say around 20 percent of the customers sees your ad and then out of this 20 percent, another let us say 10 percent of the 20 percent will purchase, so 2 percent will purchase. So, 1 lakh's 2 percent is 2000 customers will ultimately purchase from me. And 2000 customers who will be purchasing from you, if it is a high ticket product, then let us say you are generating around let us say 20 lakhs rupees. Okay, so let us it is 10000 rupees. So, I do not know. So, 100 rupees is 2 lakhs then, 2000 customers; 1000 rupees is 20 lakhs; if it is 10,000 rupees product, let us say a mobile phone then you are earning 2 crore rupees.

And you are probably happy. If you want 2 crore rupees, you are probably happy to spend 10 percent of that in your marketing. So, you spend 20 lakhs on this particular ad. So, remember for

one single ad they can gain 20 lakhs rupees where their loss is 8 rupees lakh. So, they are making up more profit, additional net profit is 12 rupees lakh. So, similar kind of stuff they do and then that is how they make the profit. Now, we can do this digital media based advertisement also.

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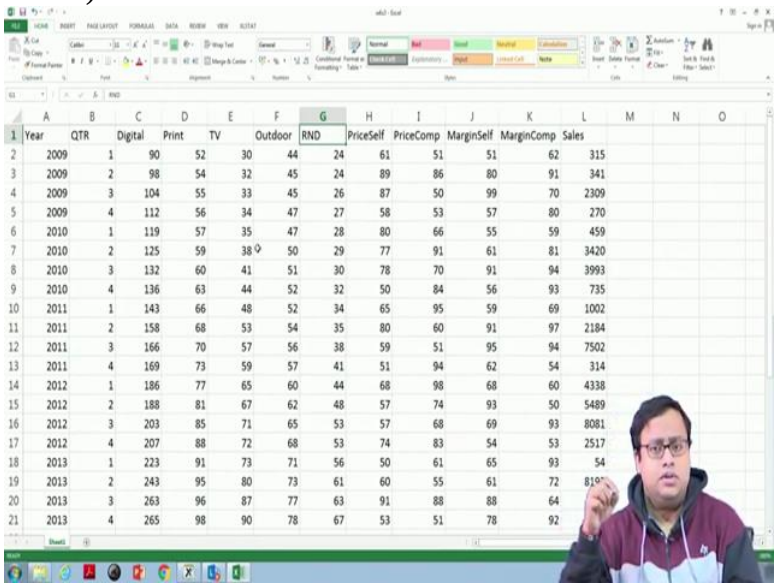

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Now, there are other advertisement. For example, TV. We all know TV ads. TV ads are of let us say 10 seconds, 5 seconds, 20 seconds slot is given within a particular program, and then you give that ad. For multiple rounds of that particular ad, generally the prices reduces, the unit prices reduces and let us say there are another type of pricing, another type of ads, which is outdoor ads, which is like big banners and let us say the ads that you put on, let us say, on cars and buses, and let us say auto rickshaw.

At the back of that you put certain banners or pasteits and et cetera. So, all of these things will incur some cost. Some cost in printing, some cost in actually making them, some cost in buying the space, the banner space. You will see that at various places a huge banner is there and only a phone number is written on that particular banner, nothing else. So, you have to call that phone number and actually book that particular space if you want to give any ad.

So, those are also there, outdoor. So, here all of these things will create a stock. As I told that multiple impressions will lead to certain amount of interest, multiple level of interest will lead to certain amount of action or sales. So, each of them will create a stock. And these stocks might be

having different effect on the sales. The digital stock, and the TV stock might have a different effect, they might not have a similar effect.

So, I cannot always combine all of them in advertisement expenditure total advertisement expenditure, and then create a total advertisement stock. That might not be a good way or right way to deal with this kind of a problem. I might want to deal with them separately. And then we can actually think about more tougher problems where interaction effects are also there. For example, let us say digital and let us say, TV goes hand. So, it might not be, there might be a complimentary relationship.

For example, let us say who, those who are for example, if you take an example of me, I am. At one point of time I used to watch TV and print. So, those were the major sources when you could have reached me. So, now slowly I stopped watching TV and I focused on digital because I become busy, my working life is online and et cetera, et cetera. So, you can see that many people and then there are radio and et cetera.

For example, there is a working professional who works in IT Company. Probably a easier way to reach him will be digital ad, digital ad in multiple platforms and et cetera, digital ad in probably even in hot star instead of a TV and digital ad in let us say and then probably radio ads also. So, during his commute he might listen to radio while he is traveling or a while he is driving a car or let us say riding an Ola or Uber he might listen to radio.

So, all I am trying to say is that there are certain combination which goes together for a certain segment, certain other combination goes together with certain other segment. For example, if you want to target my dad, my dad could be better targeted if you can target with print because he still reads newspaper and probably you can also target him through TV ad because he watches a few of the news channels and some programs and etc and probably outdoor ads as well.

So, all I am trying to say here is that different target segment might have different combinations of these channels which might be used to target them. Now, if that is the case, if there are different products, different segments are there, customer segments are there and you have to do different stuff to target them, then there might be some interaction effects. For example, to impact me if TV and print, there might be a additional effect.

Digital might have a higher impact, print might have a lower impact. But if you give digital and let us say I do not know, digital and outdoor, then digital will have a effect, outdoor will have some effect and then digital into outdoor, the interaction effect that we were discussing in the regression context might also have some impact on me. So, those kinds of difficulties, those kind of complexities can be brought in the model, when you are dealing all of these channels separately.

Similar operation is for R&D. R&D expenditure is actually the, so if you remember we are doing marketing mix here. Marketing mix is what? Product, price, place and promotion. So, I talked about promotion, now comes to the product. So, to do a product development or product improvement, you have to do R&D. Now, you can also invest on R&D to improve the performance of the product.

Now, if you invest on R&D, the outcome of R&D will not come in one day. The outcome of R&D will take some time to actually work. So, if that is the case, if it takes certain time to work, then R&D will also act something like the adstock models, where R&D also will create a stock on it and then it will slowly improve over time, slowly decay if you do not put any more R&D and then again if you put certain brand again it goes up and etc.

So, R&D expenditure also works like the normal promotional this thing. And at this moment, we are considering that all effects are actually straight line effects. So, it can be a decay effect also. It can be a S curve kind of effect also. So, that kind of complexity can be brought in also which means that if you do some expenditure on price, on let us say print media or digital media or R&D, initially for very low investment, nothing happens.

Then you do a little bit more investment, it goes up and then you do very high investment, it again saturates it cannot be higher than a certain level. So, it is S curve rather than a linear curve. So, that can also be considered. And the last part which I am going to discuss is called let us say the place and the price. Now, price if you remember, in the last class, we talked about price is related to the elasticity and elasticity is defined by this.

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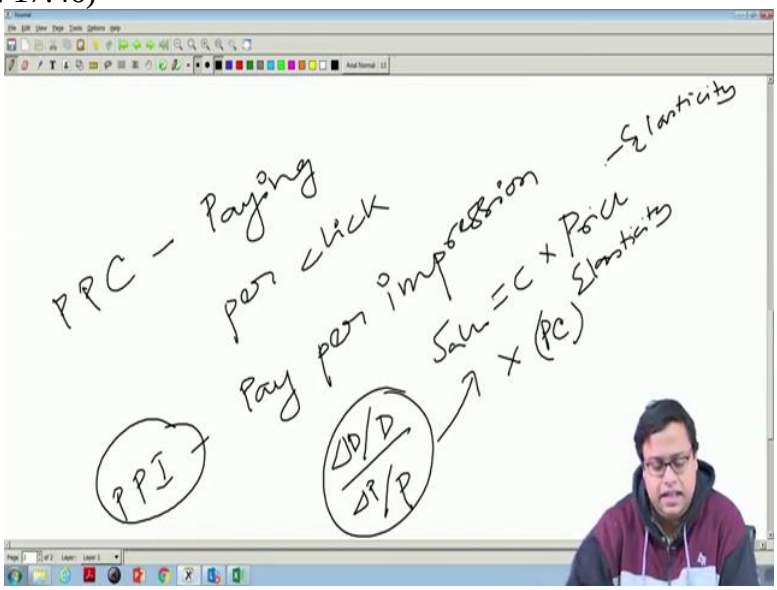

Elasticity is defined by let us say delta d by d by delta p by p. Now, if delta p is positive in the denominator, then delta d will be negative. So, that is why this elasticity will come as negative. So, when we are doing our this thing, when we are doing our price, the impact of price on sales, that is why we take that sales is some constant. And how from here we get this we have discussed in the last class, some constant into price to the power minus elasticity. This we have discussed in the last class.

Now, this is a case when the price is your price. Now, remember, if the price of your competitor increases, then what happens to your demand? We call it cross elasticity. Cross elasticity means the price of your competitor, how the change of the price of your competitor impacts the demand of you. That means, let us say if you are P&G and there is HUL's product, HUL increase that price by 5 rupees, how that impacts P&G's sales is something is called cross elasticity.

Now, cross elasticity is positive. So, change in price will improve your demand. So, then for other's price, so price of competitor, PC I am mentioning, it is PC to the power elasticity. It is not negative anymore, it is positive. So, that is something we can deal with. So, I have in my dataset, the price of myself, price of my competitor for each of the time periods, the average price. And then I know the sales also, so I can forecast my sales.

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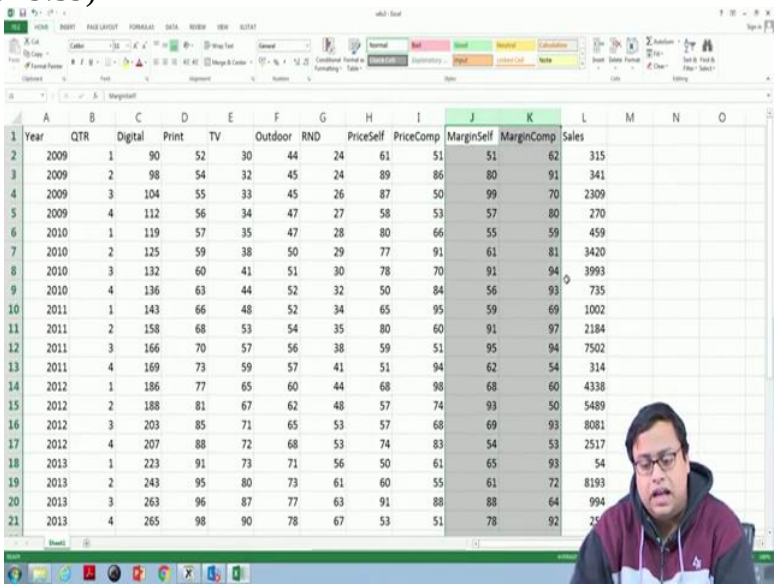

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Similarly, for place. Where will I want to put my product? Now, one easy measurement of where you want to put your product is the margin that you want to give. Now, this margin, the higher the margin the more attractive that place is, this is a very straightforward reasoning. So, if you say that if this particular place, location where if I want to put my product in that location, if that location is very attractive, I am ready to pay more money to get that product in that particular shelf.

So, that is something that now if, ideally in all normal situations which you think as attractive, your competitor might also think as attractive, you and your competitor might actually compete for the same spot in the retail store if it is a FMCG product or if it is some other product for the same spot or for the same location you are trying to fight. Now, if you are trying to fight how will you fight in this kind of case?

If I am a retailer and if there is HUL and P&G and both are saying that okay, this is my product, you put here and you get 5 rupees for each sales. Now, what will I say? I will say that okay, both are given 5 rupees, I am indifferent, I will actually go for that one which has a little bit higher brand name. Now, if the both of them are more or less same brand name, I will be in different. Now, if your brand name is low, you might have to pay a little bit more to be in that particular rack.

So, that is the margin. So, here the data has been given I think in the form of actual amount of absolute value of the margin that is being given and the margin of you and your competitor is given. Now, remember, your margin goes up. So, elasticity of margin the same concept, so your margin goes up, your sales goes up. So, in that case, the elasticity of margin will be positive because delta D by D by delta M by M will be positive.

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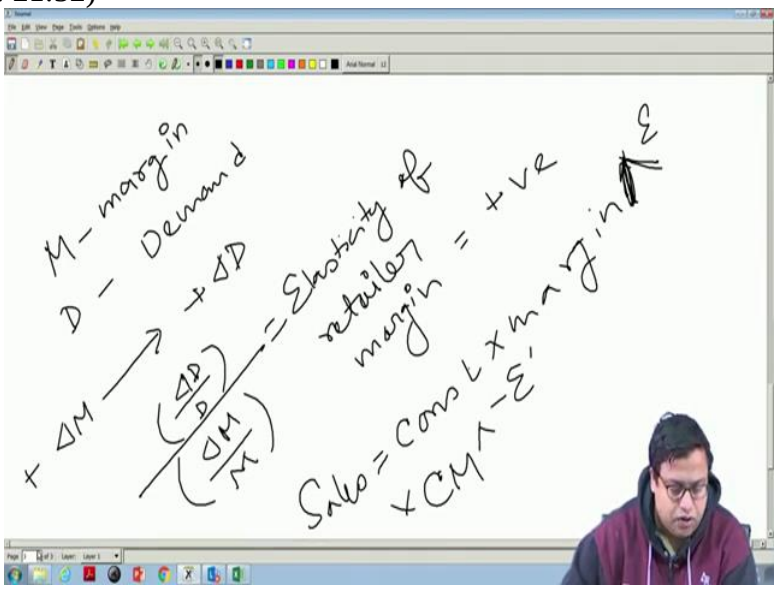

What I am going to say is, let us say M is your margin and D is your demand, positive delta M will lead to positive delta D. That means, delta d by d divided by delta m by m , this is the elasticity of the margin, retailer margin. This is has to be positive. Fair enough? So, if that has to be positive, the retailer margin is positive in this case, then my sales will be, my sales will be some constant into margin to the power elasticity E Okay. Now, margin to the power elasticity.

So, that is something that I am saying and the moment it is competitor's margin, CM let us say, CM to the power minus elasticity E dash. E dash because it is the competitor's margin's elasticity.

So, that, all these things can be brought up. Now, if all these things can be brought up, then what are the various formulas that we have? Then I will write down the various formulas.

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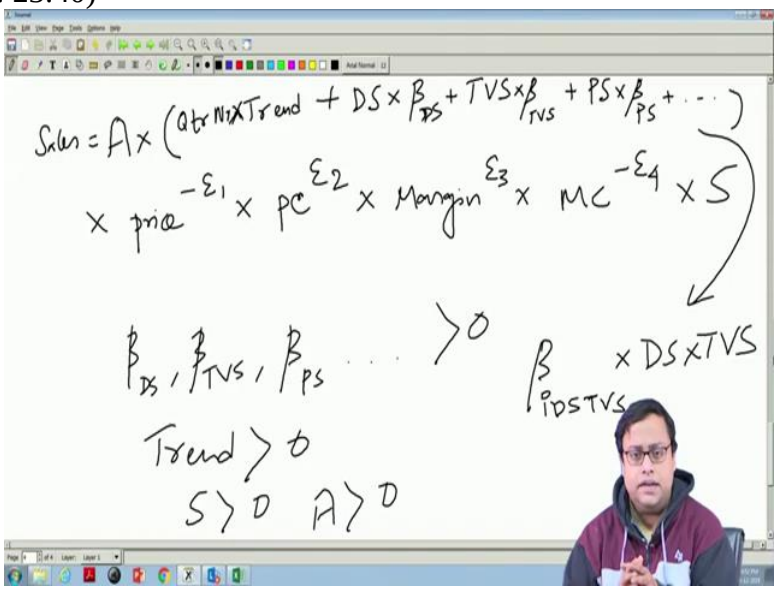

So, remember then I can write down, sales is equal to some constant A into this part is big, I will write lots of stuff here, into price to the power minus elasticity 1, that is my price's elasticity into price of competitor to the power elasticity E2 into margin to the power E3 into margin of competitor to the power E4 into the seasonal index, that is a seasonal index. Seasonal index means, for quarter 1, it is something; for quarter to, it is something; for quarter 3 it is something; for quarter 4 it is something.

Then here I am saying that this is quarter number into trend, if you remember the formula was like that. Quarter number into trend plus digital stock into digital effect or not DA, I will write DE. Digital stock into digital effect plus, so some beta basically. So, forget about digital effect, it is some beta, beta DS okay, then digital stock, then it was TV stock into beta TVS plus then it was print.

So, print stock into beta print S and so on, the other 2. Now, if you remember this beta DS, beta TVS, beta PS, all of these things has to be greater than 0, they has to be positive. Otherwise we will not give ad. And trend might positive also. And elasticities can be anything, positive negative we will try to see how the results are. The seasonal component has to be positive because sales cannot be negative, A has to be positive.

And then another thing that comes into the pictures is that, let us say if you want to bring in the interaction terms, somehow you decided that I will bring in the interaction terms, then here, it

will also write let us say, beta interaction of DS and TVS, let us say digital and TV into DS into TVS, digital stock into TV stock

So, you can bring in the interaction terms in the model as well. So, this is something that we are going to do in the next video.

We will actually create the sales based on this formula. Carefully remember this formula. So, we will try to create our model based on this formula and then we will find out that how we will estimate beta 1, beta 2, beta 3 etc using the same thing that we did. Now, remember we have done all of this stuff using Excel. Now, everything, all this optimization using Excel becomes a difficult calculation.

So, that is why we will do this particular set of calculations using R. So, that is all for me in this particular video. I will see you in the next video and we will solve this particular problem in terms of marketing mix modeling. We will create this formula. If I have this formula, then I can do optimization to see that if I have 1 lakh rupees in my hand, how much to put on DS, how much to put on TV, how much to put on print? We did it in the last class.

But the main, I would say, agenda is to find out this objective function formula. So, that objective function formula we will use R programming to solve it in the next video. Thank you for being with me. I will meet you in the next video.