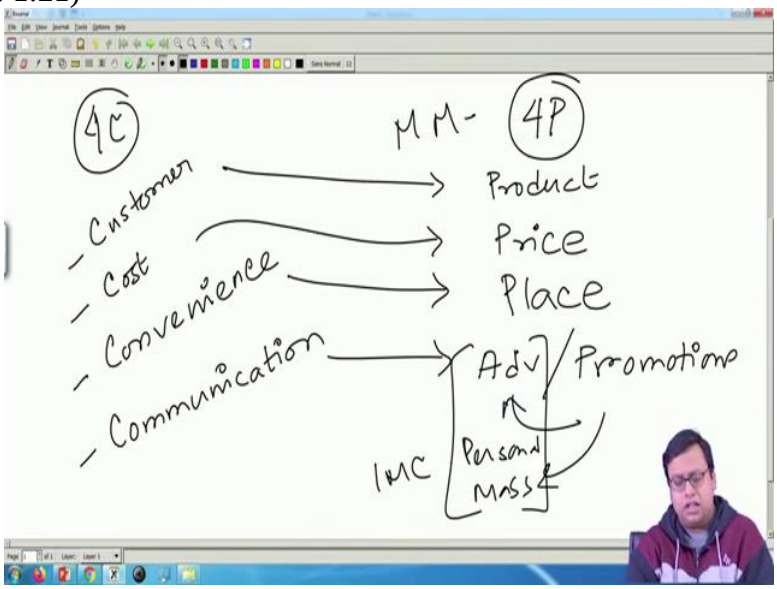
Marketing Analytics
Professor Swagato Chatterjee
Vinod Gupta School of Management
Indian Institute of Technology, Kharagpur
Lecture 29
Marketing Mix Models and Advertising Models

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 in this week we will discuss about marketing mix models and advertising models. So, we have actually crossed quite a path in marketing analytics and we have fairly understood about what consumer wants, what kind of willingness to pay they have. So, micro level analysis of a customer has been done properly.

Now, we will move a little bit ahead of a micro level analysis of the customer and we will do a little bit of macro level cost analysis. For example, we will try to see that how, let us say your marketing decisions that you take, that affects customer. Now, when we talk about marketing mix, we have to go to basics of marketing, marketing 101 and we try to say that okay so the mark, a particular customer or customer segment is defined by four Cs.

(Refer Slide Time: 1:21)



So, these four Cs are basically the customer. So, that defines who this customer is, what kind of product they are looking for, and what is their age, what is their attitude, what is their psychological aspects, whether they look for adventure or whether they look for something else.

Let us say whether they look for some traditional products or whether they are look for ethnic products and etc, all of these things define a customer.

Now, the whole profile, if you close eyes, you have to be able to see the customer in front of your eye, that is the description of the customer. Then comes that what is the cost that they are willing to bear, how much cost they are willing to bear? And that costs include many things. That cost include the cost in terms of the price that they are paying, the cost in terms of the information search. So, for example, a person who is a little bit probably older or probably not tech savvy, might find it difficult to for information search in an online environment.

So, the cost of information search will also be included for them. On the other hand, a person who has mobility issues might find it problematic or costly to go from his store, from his house to a retail store. So, that travel cost is also a cost that you have to include. These particular costs, they are not paying you directly but those costs are also part of the game. So, these are all the costs that comes into the picture. And then comes the convenience that they are asking for.

So, whether they are asking for doorstep delivery or whether they are asking for certain features, the first-hand information of certain things, for example, new arrivals information or the first-hand, whether they are asking for and all of these things comes under the convenience, the extra added benefits that they are asking for in terms of which will not improve the consumption of the original product, but which will be an add-on on the consumption of the original product.

The value provided will be an add-on on the consumption of the original product. So, customer cost convenience and the next part is basically communication. So, what is the language that they understand? What kind of, by language I am not saying that okay, English or Hindi or Bengali. By language, I mean to say what kind of information, what kind of text, what kind of messages that they understand.

For example, if you are trying to target the bottom of pyramid customers who are let us say, less educated let us say or they have, the percentage of BOP customers who are highly educated might be less or who are English speaking might be less. Now, if you try to cater those customers using English language based advertisements or packaging us like that, which are very

informative, which they cannot process, then that is a problem in terms of the communication because that is not something that they seek for, in the communication.

So, this is the definition of the customers and we call it four Cs. And then to cater to this, the marketing mix comes up which is basically 4 Ps and this 4 Ps, each of these P is actually cater to each of the C. For example, customer is getting catered by the first P which is the product. So, you create the product by thinking about the customer, you create your whole product idea, what kind of product features will be there, what kind of features will not be there.

So, what customers value is something based on which you create the product. We have dealt a little bit of this in the first 2-3 this things, first 2-3 modules, where we discussed about what consumers want. A new product design will be more towards that. So, that part we have already done. Now, the next part is comes the cost which comes here as price. So, how much money that you are willing to pay? How much price you will be charging?

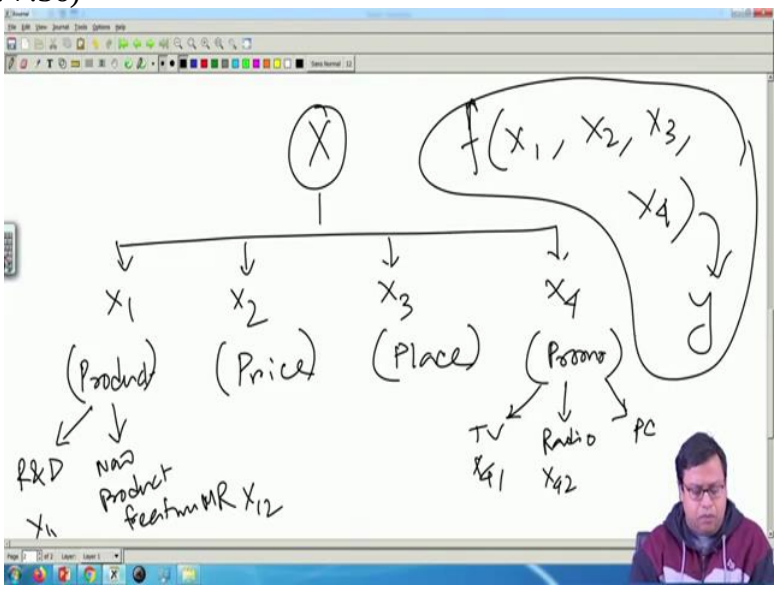
So, based on his cost, if his cost is high, if his associated costs are high, for example, the travel cost is high or the information search cost is high, you have to reduce your price, your price and cost of the consumer should have a balance with each other. So, that is something that comes the next which is the price. Again, we had done quite a few assignments or videos on pricing, we will do more.

And then comes the convenience and here comes the place. So, exactly where will you sell it? Will you sell it at his doorstep? Will you sell it at a retail store? Will you sell it in an online store and then deliver it to its doorstep? How will you take the returns? Will you let us say if you are a retail company, then returns is also an important factor. So, how will you take the returns? Will you take the returns from his doorstep again? Will you take the returns from a small shop where he goes and just drops it? Or whether you will want to take the return in the warehouse directly?

So, all of these combinations and etcetera, so which price, which place, which product, all this combination creates the marketing mix. And the last one is the communication. Basically, what kind of advertisements or promotions. So, promotions will majorly include advertisements and also other types of communication. So, integrated marketing communications will come here.

So, it can be advertisement, it can be personal communication, it can be mass communication and et cetera, et cetera, all of these things comes under the promotion. So, four P is basically, product, price, place and promotion. Now, why this the marketing analytics comes into this picture? This is the basic thing. So, what does the marketing analytics comes into this picture?

(Refer Slide Time: 7:36)



Marketing analytics is basically there is a decision that you have to take. So, we have already discussed about this. Now, I am coming about the marketing analytics portion of this particular decision. Now, in marketing analytics you have to take certain decisions where you have let us say x budget and there is a basic allocation problem. You want to know out of this X, I can break it into X1, X2, X3, and X4, and X1 goes to product, X2 goes to basically let us say price, X3 goes to place and X4 goes to let us say promotion or advertisements.

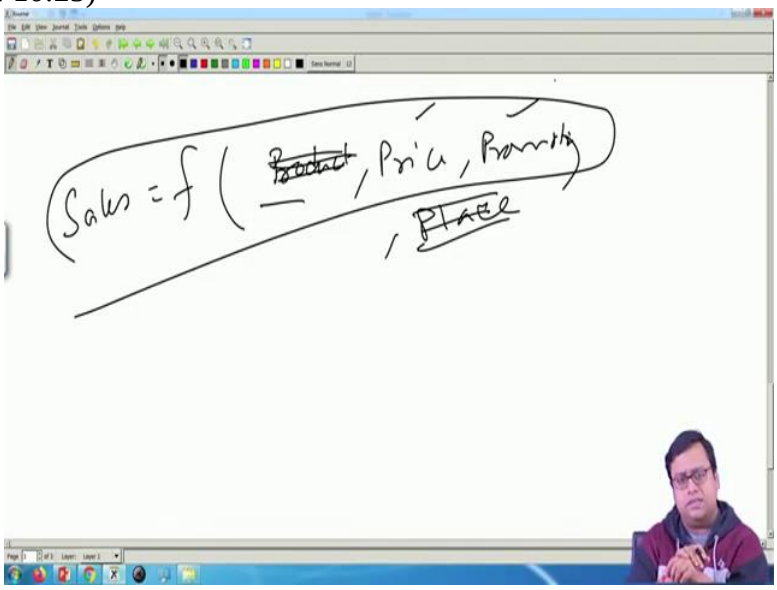
Now, how I will combine this X1, X2? What function of X1, X2, X3, X4, how I can find out this which will lead to my sales or profit or margin whatever is my Y variable and then how I can maximize this by changing the combinations of X1, X2, X3, X4. This is the basic allocation problem based on which this marketing mix problem lies. And you have to also decide that okay there are the, when I talk about product, how will I put money on product?

I can put money on R&D, I can put money on let us say some new product feature development, new product feature understanding, feature market research let us say, new product is a market search. Similarly, in promotion, I can do TV ad, I can do a radio ad, I can do personal

communication, all of these combinations are existing. So, it is not exactly X1, X2, X3, X4, it will be basically X11, X12, X41, X42, and so on. So, I can break it as much as possible.

And this particular problem is something that you try to derive that what kind of problem you are facing, you might try to derive. So, now given this kind of a problem is there you have to the measure the, all the optimization function ultimately then will depend on one single thing, that how this Y which is a function of X1, X2, X3, X4, how this functional form is. Whether this functional form is concave so that I can find out the optimization formula. So, what is this F function is something that I would try to focus on. So, exactly what is the functional form.

(Refer Slide Time: 10:25)



So, in most of the cases in marketing we take this particular Y as the sales. We say Y as sales and we say Y as a function of various things. So, Y is a function of let us say as I told, the product, price, promotion and place. Now, in most of the cases this product is something that has already been decided. Only in case of new product development and etc, the product comes in but in most cases product has already been decided, we cannot do much on the product, in the short term at least.

So, product is not taken care of, that is fine. So, price, promotion and place. And oftentimes the place decisions, where I will put or in what margin I will give to my, so if you put money on a place, that means what? You are actually investing on actually in the supply chain of that

particular product to make sure the product comes from my manufacturer shop to manufacturer's factory to the consumer's doorstep. This is where the place decisions comes in.

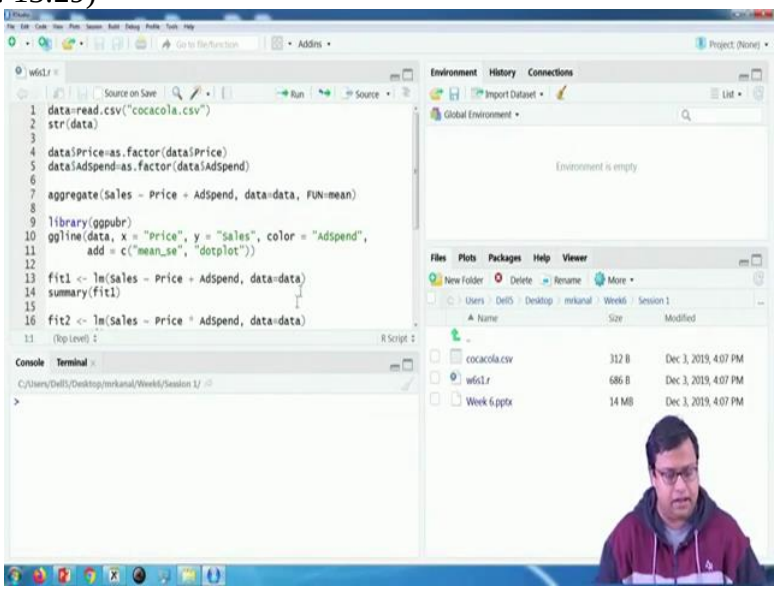
So, where will I put my warehouse? Where will I put my retail store? In the retail store in which aisle I will put my product, all of these decisions are place decisions so that I can ensure that I put money on those places such that people come and buy or they purchase this particular product. Now, these places are basically what then?

These places are basically the rent that you pay to warehouses or let us say the margin that you pay to your channel partners, if there are channel partners, let us say retailer and you are a FMCG product manufacturer, how much money, how much margin you will pay to a particular retailer so that he puts your product in a favorable position, all these decisions are actually place decisions.

Now, the problem is this place decisions are also not very, I would say variable. They are more or less constant, they do not vary very fast. So, oftentimes we majorly focus on sales as a function of price and promotion and this is where we actually. So, you as a marketing manager can say that okay, I have 100, let us say 1 crore rupees of budget and I can put that on my promotion in terms of advertisements or I can reduce the price, I can put a sales promotion, which one will work? Whether the sales promotion will work or how much if I put let us say 20 percent here and 80 percent there or if I put 70 percent here and 30 percent there, which combination will work is something that I want to know.

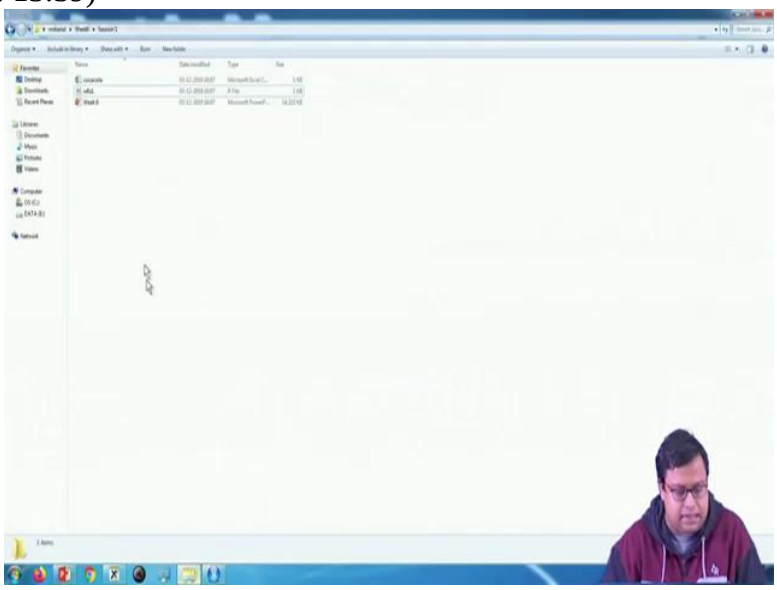
So, the first job to start with is to try to find out sales as a function of price and promotion. So, price and advertisement spend. So, advertisement spend can be advertising campaigns and etc. So, this is something a basic problem we will try to solve in our first particular video. Okay.

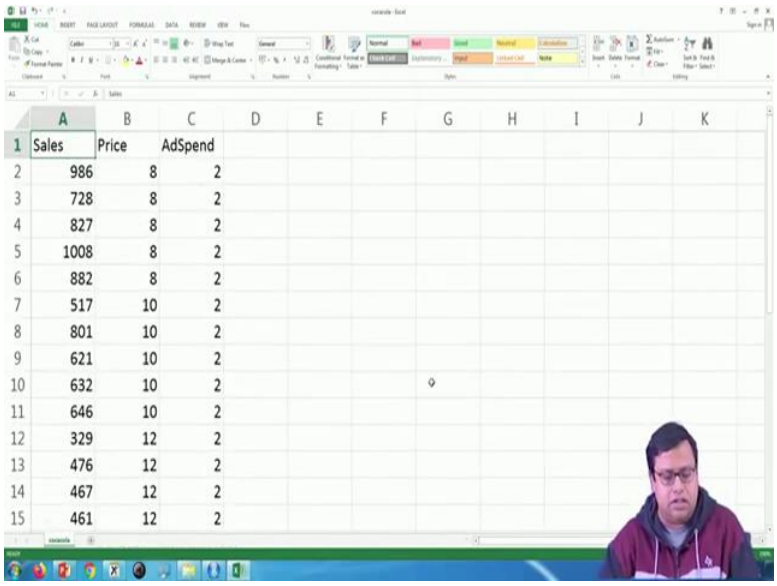
(Refer Slide Time: 13:29)



So, for, to check that particular problem we have to go to week 6 season 1 dot R file. So, this is the file that we will discuss about today.

(Refer Slide Time: 13:39)





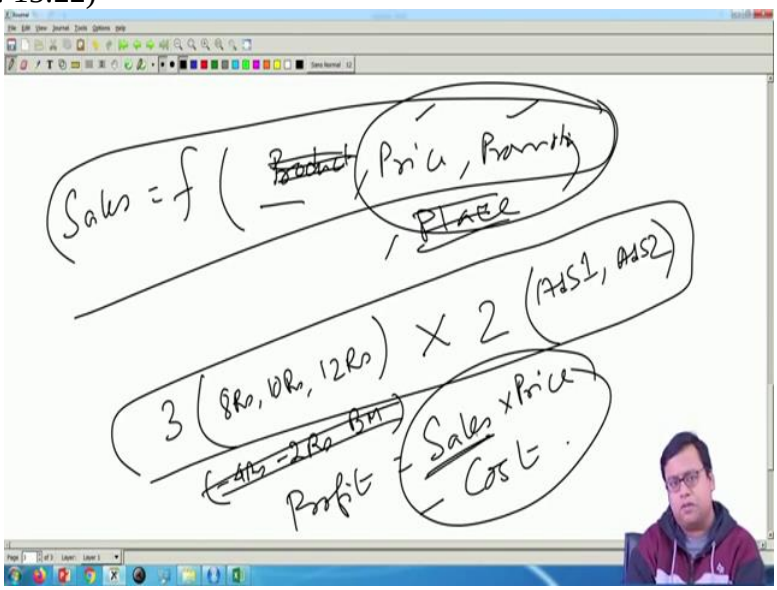
	A	B	C
1	Sales	Price	AdSpend
2	986	8	2
3	728	8	2
4	827	8	2
5	1008	8	2
6	882	8	2
7	517	10	2
8	801	10	2
9	621	10	2
10	632	10	2
11	646	10	2
12	329	12	2
13	476	12	2
14	467	12	2
15	461	12	2

So, before I go ahead, you will also see that there is a CSV file called Coca Cola. So, please double click on that CSV file and I want to discuss about this particular data set. So, the data set is very simple. What happened is Coca-Cola actually planned to open a new product actually and they was not sure that what should be the price and what should be the other details of this product. So, they actually chose 30 retail stores where they have given various different kind of price for this particular product.

So, the prices were actually let us say 8 rupees, 10 rupees and 12 rupees. So, there are three types of prices that are there, 8 rupees, 10 rupees and 12 rupees. And the ad spend, the advertisements that the campaign that they did were of two types, 1 and 2. So, when there was advertisement two, they spent around 4000 rupees per retail store Rs. 5000 per retail store and when the advertisement was one, they spent around Rs. 300 per retail store.

And the number of product that was sold was this sales. So, this sales is actually the sales volume in terms of the units. So, how many units of that particular product was sold, and those values are there. And they want to know that what combination of price and what combination of advertisement expenditure will give them the best results. So, this was the basic problem. So, this is a new product, so you have to do certain amount of advertisement. So, that is why in normal case what we do is that this is a classic 3 by 2 problem.

(Refer Slide Time: 15:22)



So, if you see carefully that this particular case there are three cases where 8 rupees, 10 rupees and 12 rupees into two advertisement spends, ADS1 and ADS2, these are the, this kind of orthogonal experimental design is what you have catered. Orthogonal means that there is no correlation between this price and this advertisement spend, that is number one and for each price there is different kinds of data which has different kinds of advertisement spend.

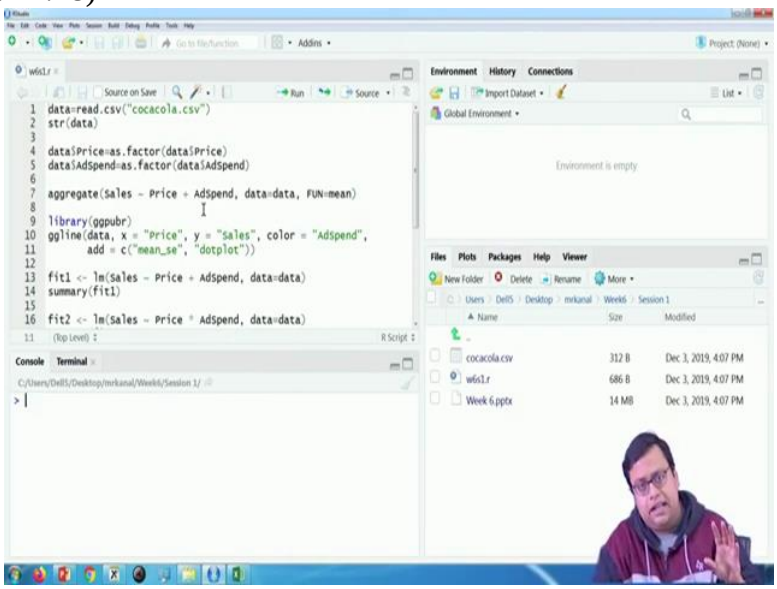
So, for 8 rupees and ad spend 1, ad spend 2 is there; for 10 rupees, ad spend 1, ad spend 2 is there and 12 rupees, ad spend 1, ad spend 2 is there. So, 3 into 2, 6 such conditions and actually I think for each condition there were five retail stores. So, total 30. So, sometimes we also take into account the benchmark. So, here I do not know what is the benchmark of let us say this particular product. So, I can say that okay, this is this is my benchmark price.

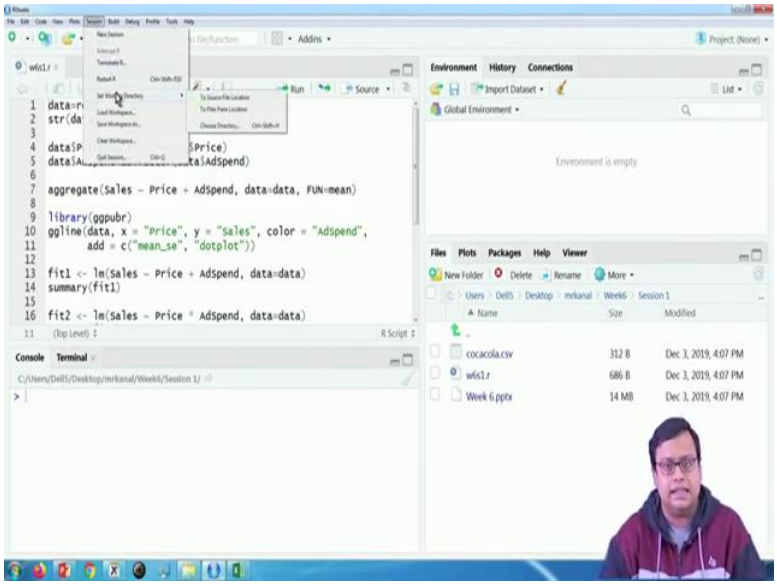
This is 2 rupees discount and this is 4 rupees discount or something like that. So, sometimes we also consider benchmark to do this, but here we are not considering benchmark, we are considering like this because this is a new product being introduced and there is not a particular price or promo, the sales promotion has not been given here. Now, as usual, this is a function of as I told, so sales is a function of price and promotion, sales is a function of price and promotion.

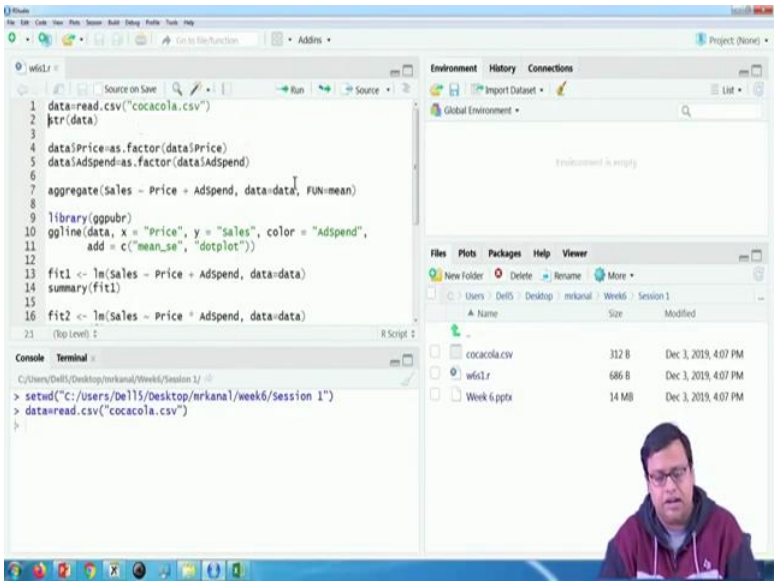
So, sales is a function of price and promotion, you have to decide that at what price and what level of promotion the sales is maximizing. And oftentimes, we do not want to optimize sales, probably I want to optimize profit. So, if it is profit, then it has to be sales into basically sales

into your price minus all the costs that is involved here. So, this is something that we have to optimize, then we have to find out this particular thing and then we have to do this optimization. So, all of these things are there in this particular problem.

(Refer Slide Time: 17:48)

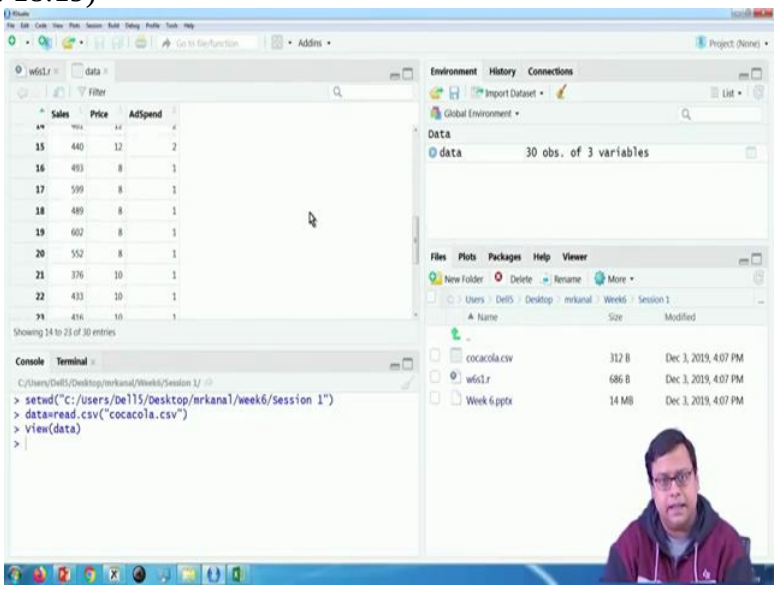


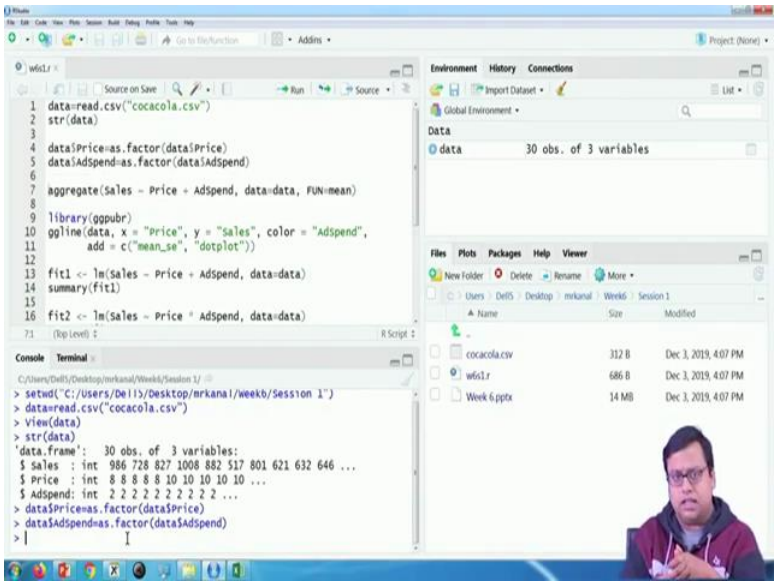




So, the first job in this particular problem is read the data. So, how to read the data? So first, you have to check whether the data file and this R file are lying in the same folder or not. If it is lying in the same folder, go to session, set working directory to source file location and then reduce data. You can reduce directly using this particular import data set button as well. The data looks like this, it has been already shown.

(Refer Slide Time: 18:19)





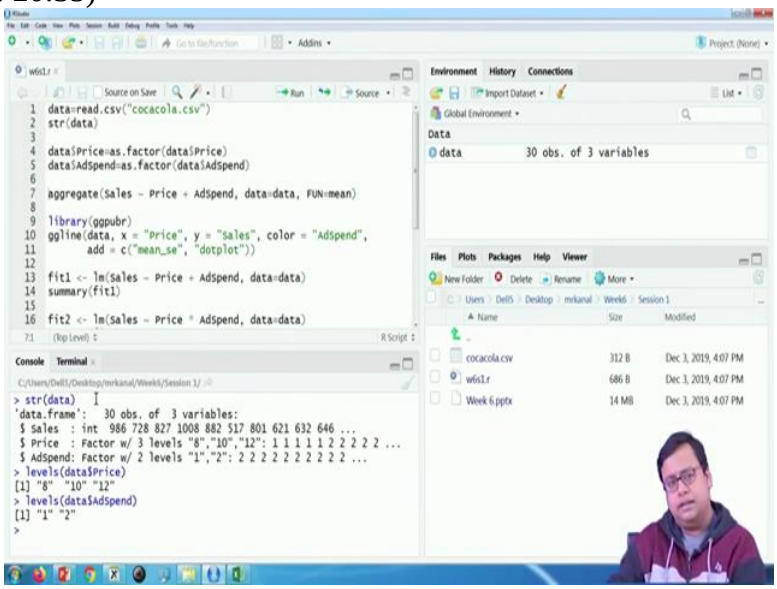
So, this is how the data basically looks like. Now, if the data looks like this, the next step is to check the structure of the data. The structure of the data says there are three columns. One is sales column, one is price column, and one is ad spend column 2 and 1. Now, I want to do a 3 by 2. So, I am not, currently, at this current position, I am not saying that the price can be 8.5 rupees or 12.32 rupees. So, all these middle values are not there. There are three options that are there for the price 8, 10 and 12, that is all.

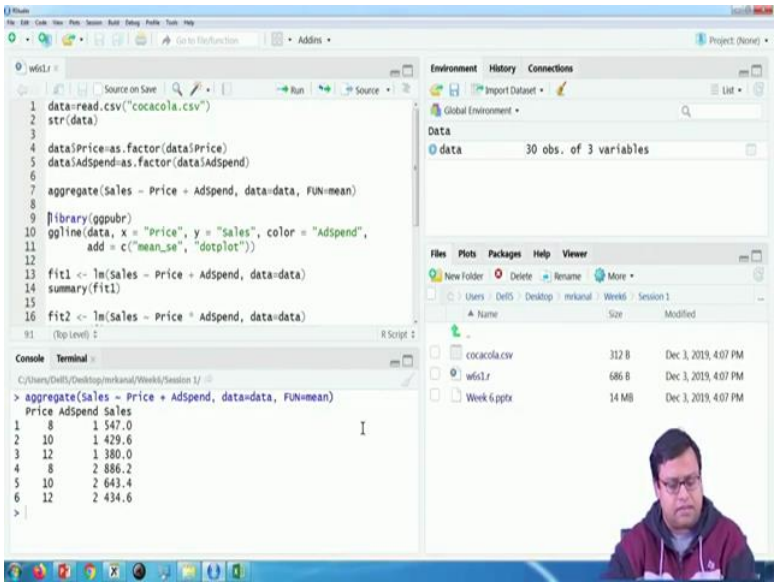
So, that is why I will treat them as probably categorical variable rather than a continuous variable because if I treated them as a continuous variable the analysis processes will think that okay there is some price possible which is 8.2, 8.3 or something like that and based on that the analysis will happen, which is not the case right now. On the other hand ad spend also will have absolutely two categories, ad spend 1 and ad spend 2 and ad spend 1, the actual spend is 3000 rupees per retail store and when it is ad spend 2, it is basically 5000 rupees per retail store, if I am not wrong, it is 5000 rupees per retail store. Yes.

So, then I will change these two variables to their factor form. So, what will I write? I write data dollar price equal to as dot factor data dollar price. So, pick up data dollar price means the price column of the data data set and then change it to factor form and then put it back in my data dollar price, that means in the price column of my data set named data. So, I will run this. Similarly, the same thing I am doing here, I am using ad spend.

So, I am changing the price variable and the advertisement expenditure variable to a factor form. To a factor form why? Because now, they should not have any other options other than the given options. So, if I want to see the structure of the data right now, so I just paste control L to clear up the console.

(Refer Slide Time: 20:35)





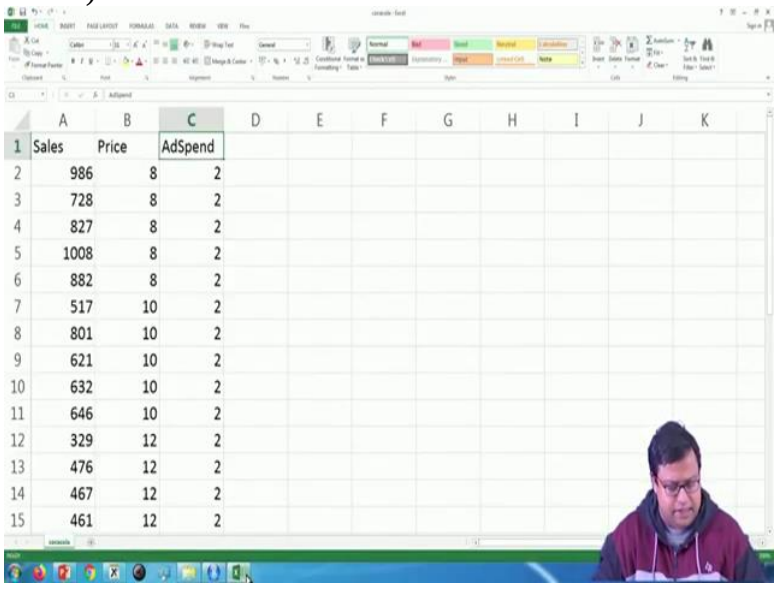
So, structure of the data right now, I will have to and you see the structure is that sales is integer and my price and advertisement spend are both basically factor variable. Price has factor with three levels. The levels are 8, 10 and 12. So, you can also see it like this, levels, within bracket

data, dollar, price and it will say that okay I have three levels 8, 10 and 12. And advertisement spend has two levels 1 and 2, ad spend has two level 1 and 2. So, this is there.

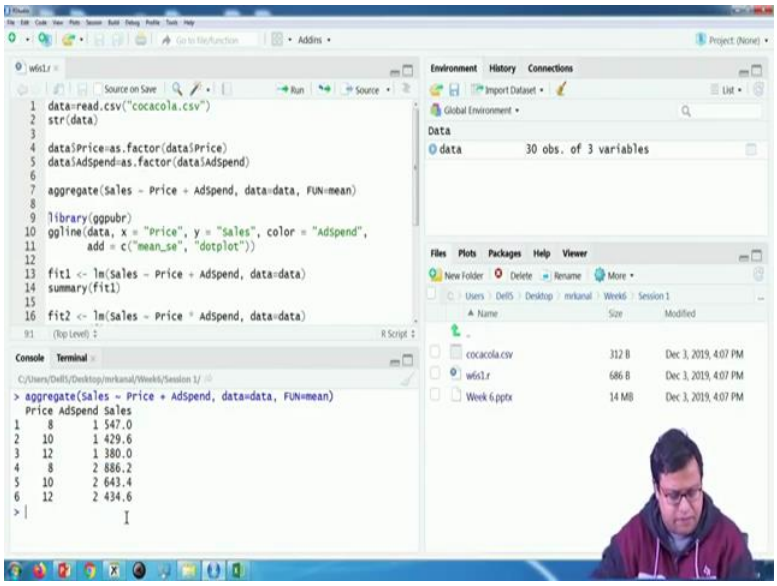
Now, next is what? Next I want to see a little bit of the basic thing, a basic expert analysis that what is the average sales or the average let us say average when the advertisement is 1 or 2 or when the price is 8, 10 or 12. What is the average thing? So, what did I write? I write the aggregate function. You can also use DPLYR if you know. Aggregate sales tilda price plus ad spend, data is equal to data and FUN, that means function is equal to mean.

So, you share, for every price and every ad spend you pick up the sales from the data data set and then give me the mean. So, if that is done this is further result comes up and we have to understand this one properly. You see that when I, I will actually put these values here.

(Refer Slide Time: 22:17)

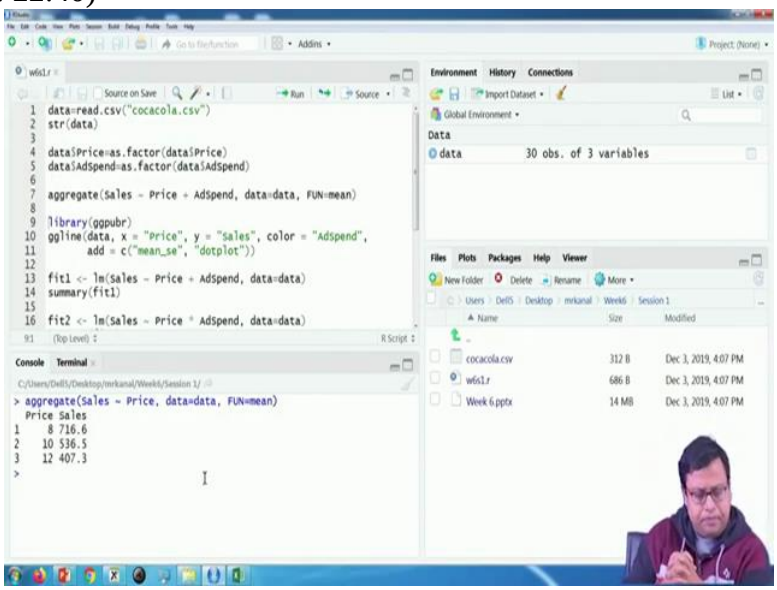


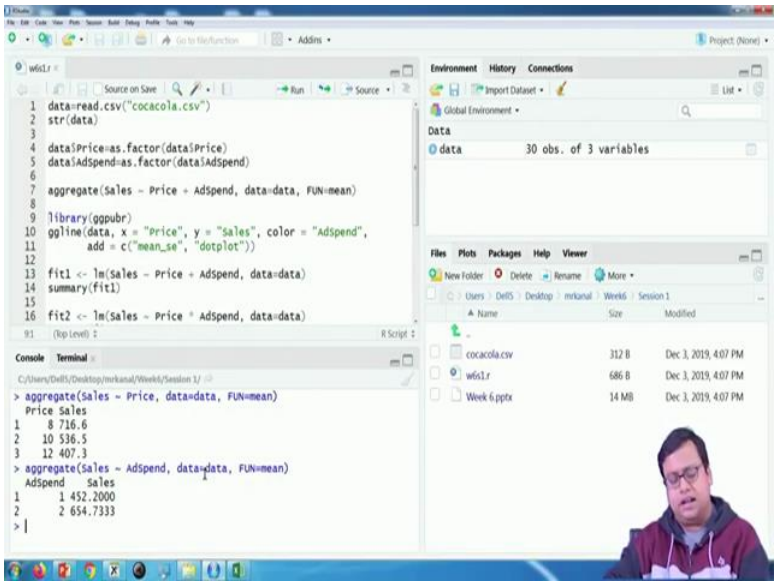
	A	B	C	D	E	F	G	H	I	J	K
1	Sales	Price	AdSpend								
2	986	8	2								
3	728	8	2								
4	827	8	2								
5	1008	8	2								
6	882	8	2								
7	517	10	2								
8	801	10	2								
9	621	10	2								
10	632	10	2								
11	646	10	2								
12	329	12	2								
13	476	12	2								
14	467	12	2								
15	461	12	2								



Let us say the price, if I carefully see, the price is 8, 10 and 12 and the ad spend is 1 and then this is 8, 10 or 12. So, first job is let us say before I go ahead and show you this thing, let us say I do it only for the price, only for price.

(Refer Slide Time: 22:40)

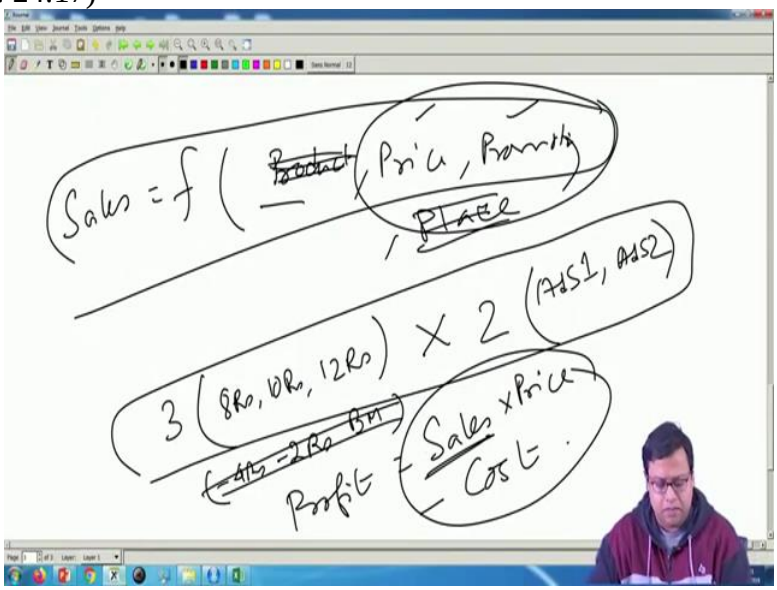




So, what do I see here? When the price is 8, the sale, summary sales is 716. So, as price increases from 8 to 10, 10 to 12, the average sales is dropping from 716 to 536 to 407 units. So, this is obvious because price goes up, sales comes down. So, this is more or less whatever we expected. Similar thing if I do it for ad spend, if I do it for ad spend, ad spend expenditure goes from 3000 rupees per retail store to 5000 rupees per retail store, the sales value also goes up from 452.2 in an average to 654.733 in an average. So, the ad spend goes up, the sales goes up.

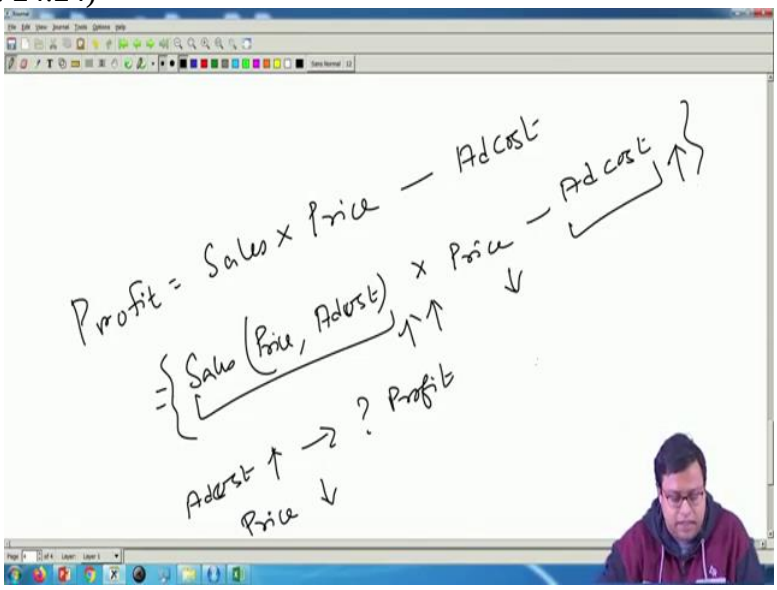
So these are the two obvious results. So, there is nothing new here. So, we all know that okay, so if I reduce price, my sales will go up; if I increase my ad spend, my sales will go up. But we have to think about that if you are a profit maximizer, there is a dilemma. Because see, if you, price goes up means what? Advertisement spend goes up means sales goes up, but advertisement goes up means cost.

(Refer Slide Time: 24:17)



So, in this particular equation, if you see carefully, profit is equal to I will just draw another.

(Refer Slide Time: 24:24)

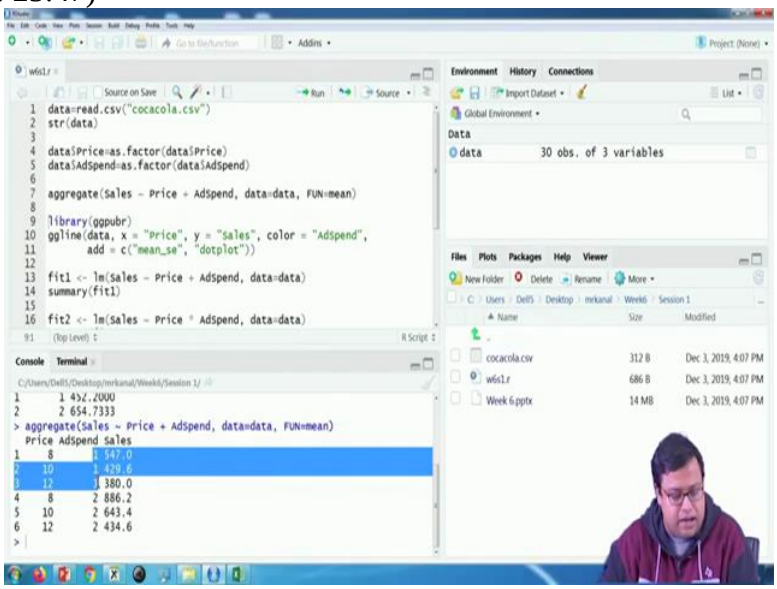


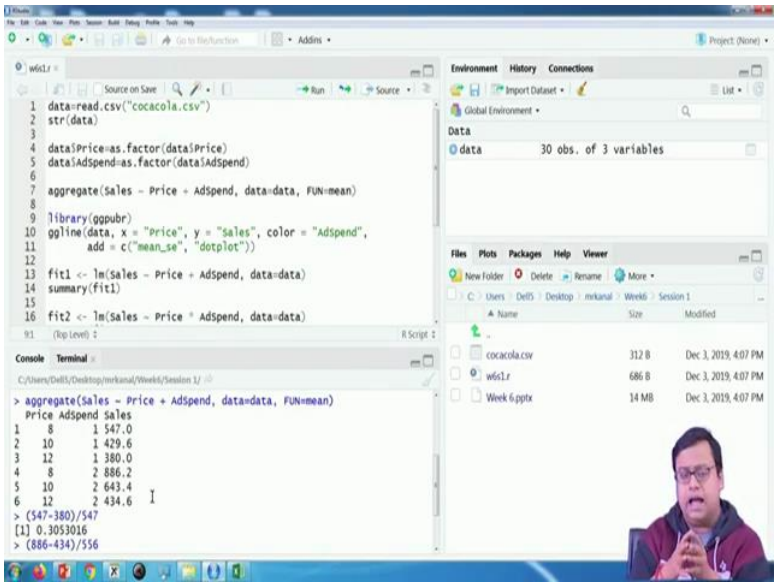
So, profit is equal to sales into price minus ad cost

assuming that since promotion does not have any cost, right now, we are assuming that no extra cost other than the loss of revenue, there is no extra cost from sales promotion. So, then now sales is a function of basically price and ad cost, this into price minus ad cost .this is my problem. Now, if you see that if ad cost goes up, if ad cost goes up, then this part goes up.

But this part also goes up. So, I am not sure what happens to profit, there is a dilemma and that is why the optimization comes in. Again, when price goes down, this part goes down, but this part goes up. Again, there is a dilemma and I do not know which one is optimal. So, then I have to find out the functional form and I have to solve it. So, here, I am trying to find out that functional form only.

(Refer Slide Time: 25:47)





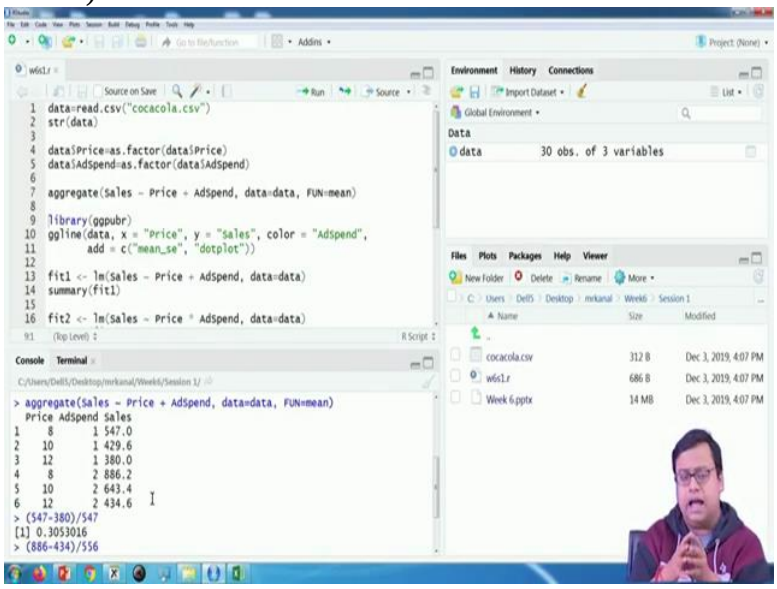
So, next what I do is I just run the aggregate with price and ad spend, both. And if I run this, I see another interesting picture. You see that if the ad spend is 1, from 8 to 12 the sales is going down. When the ad spend is one. So, the first three cases, when the advertisement expenditure is

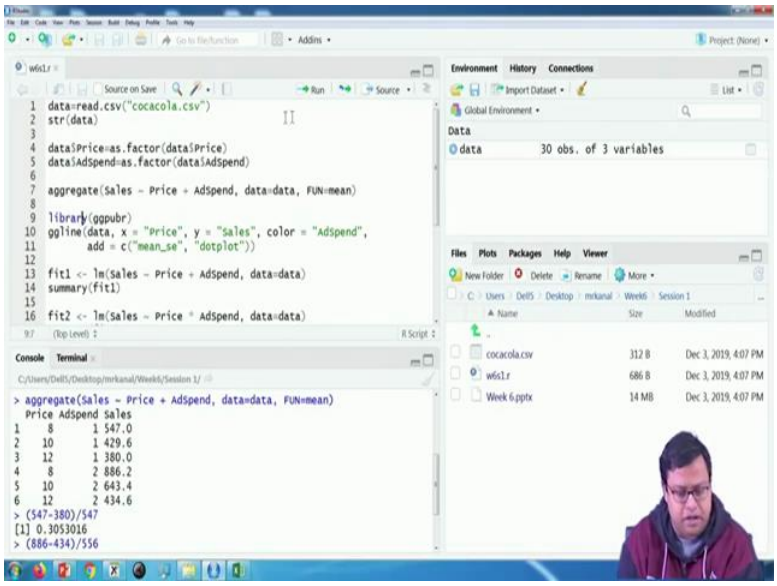
one, for the first three cases, the sales volume coming down from 547 to 380. So, 547 to 380 is a drop of around 160 volume.

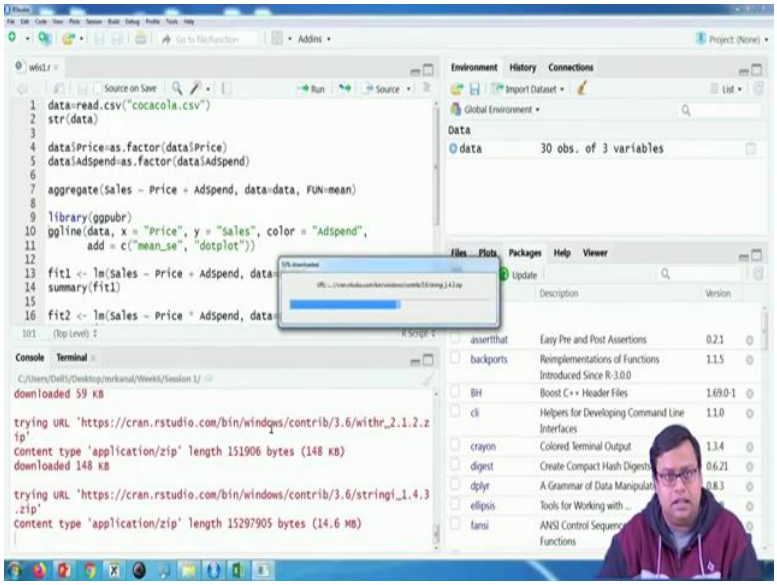
So, 160 of 540, if I consider that, so let us say 547 minus 380 divided by 547, it is a 30 percent drop for the first case, but the second case it is almost 50 percent drop. 886 minus 434 divided by 886. It is almost 51 percent drop in the second case. So, you see, this guy from 886 it is dropping to 434. So, I am trying to say here that when ad spend is 1 and you increase price, so for lower advertisement expenditure the drop of sales will not be that much in comparison to higher advertisement expenditure.

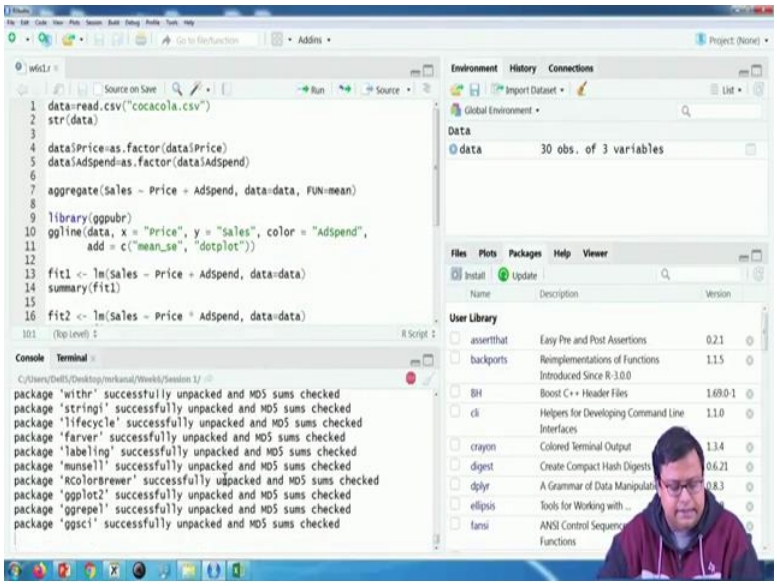
When you are doing higher advertisement expenditure you should give lower price. If you are not giving lower price you will be losing much more opportunity than in comparison to when you are doing a lower advertisement costs. So, this is something that we will try to bring in in the picture.

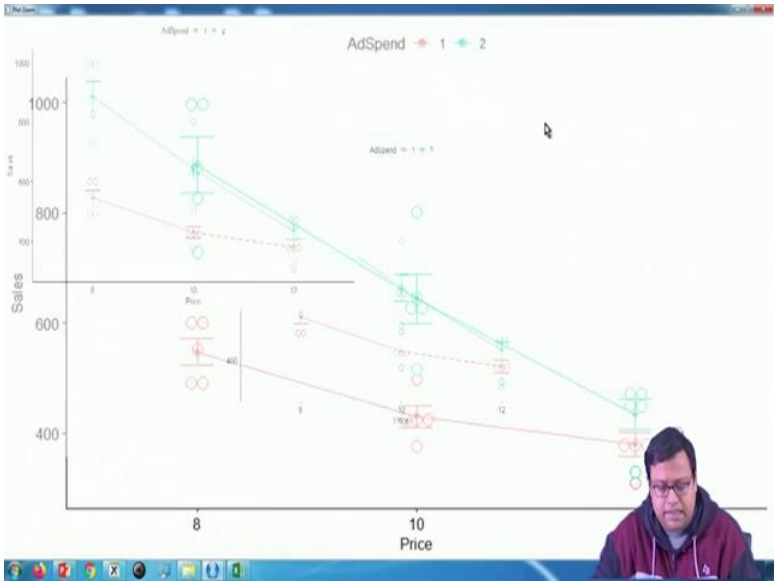
(Refer Slide Time: 27:43)

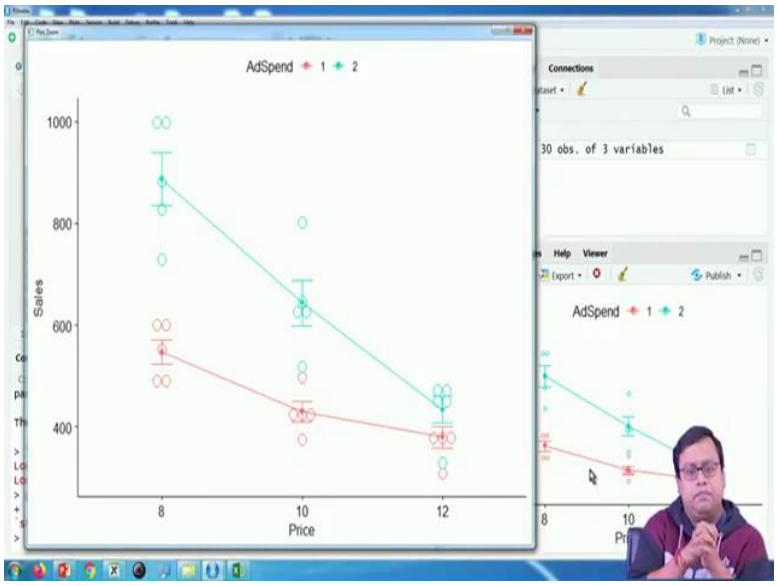



w6s1.r
data=read.csv("cocacola.csv")
str(data)
data$Price=as.factor(data$Price)
data$AdSpend=as.factor(data$AdSpend)
aggregate(Sales ~ Price + AdSpend, data=data, FUN=mean)
library(ggpubr)
ggline(data, x = "Price", y = "Sales", color = "AdSpend",
add = c("mean_se", "dotplot"))
fit1 <- lm(Sales ~ Price + AdSpend, data=data)
summary(fit1)
fit2 <- lm(Sales ~ Price * AdSpend, data=data)
Environment History Connections
Data
data 30 obs. of 3 variables
Console Terminal
> aggregate(Sales ~ Price + AdSpend, data=data, FUN=mean)
Price AdSpend Sales
1 8 1 547.0
2 10 1 429.6
3 12 1 380.0
4 8 2 886.2
5 10 2 643.4
6 12 2 434.6
> (547-380)/547
[1] 0.3053016
> (886-434)/556
cocacola.csv 312 B Dec 3, 2019, 4:07 PM
w6s1.r 686 B Dec 3, 2019, 4:07 PM
Week 6.pptx 14 MB Dec 3, 2019, 4:07 PM


w6s1.r
data=read.csv("cocacola.csv")
str(data)
data$Price=as.factor(data$Price)
data$AdSpend=as.factor(data$AdSpend)
aggregate(Sales ~ Price + AdSpend, data=data, FUN=mean)
library(ggpubr)
ggline(data, x = "Price", y = "Sales", color = "AdSpend",
add = c("mean_se", "dotplot"))
fit1 <- lm(Sales ~ Price + AdSpend, data=data)
summary(fit1)
fit2 <- lm(Sales ~ Price * AdSpend, data=data)
Environment History Connections
Data
data 30 obs. of 3 variables
Console Terminal
downloaded 59 KB
trying URL 'https://cran.rstudio.com/bin/windows/contrib/3.6/withr_2.1.2.zip'
Content type 'application/zip' length 151906 bytes (148 KB)
downloaded 148 KB
trying URL 'https://cran.rstudio.com/bin/windows/contrib/3.6/stringi_1.4.3.zip'
Content type 'application/zip' length 15297905 bytes (14.6 MB)
assertthat Easy Pre and Post Assertions 0.2.1
backports Reimplementations of Functions Introduced Since R-3.0.0 1.1.5
BH Boost C++ Header Files 1.69.0-1
cli Helpers for Developing Command Line Interfaces 1.1.0
crayon Colored Terminal Output 1.3.4
digest Create Compact Hash Digests 0.6.21
dplyr A Grammar of Data Manipulation 0.8.3
ellipsis Tools for Working with ... 0.3.0
fansi ANSI Control Sequence Functions 0.4.1


data=read.csv("cocacola.csv")
str(data)
data$Price=as.factor(data$Price)
data$AdSpend=as.factor(data$AdSpend)
aggregate(Sales ~ Price + AdSpend, data=data, FUN=mean)
library(ggpubr)
ggline(data, x = "Price", y = "Sales", color = "AdSpend",
add = c("mean_se", "dotplot"))
fit1 <- lm(Sales ~ Price + AdSpend, data=data)
summary(fit1)
fit2 <- lm(Sales ~ Price * AdSpend, data=data)
Environment History Connections
Data
data 30 obs. of 3 variables
Console Terminal
package 'withr' successfully unpacked and MD5 sums checked
package 'stringi' successfully unpacked and MD5 sums checked
package 'lifecycle' successfully unpacked and MD5 sums checked
package 'farver' successfully unpacked and MD5 sums checked
package 'labeling' successfully unpacked and MD5 sums checked
package 'munsell' successfully unpacked and MD5 sums checked
package 'RColorBrewer' successfully unpacked and MD5 sums checked
package 'ggplot2' successfully unpacked and MD5 sums checked
package 'ggrepel' successfully unpacked and MD5 sums checked
package 'ggsci' successfully unpacked and MD5 sums checked


AdSpend 1 2
Sales
1000
800
600
400
8
10
Price

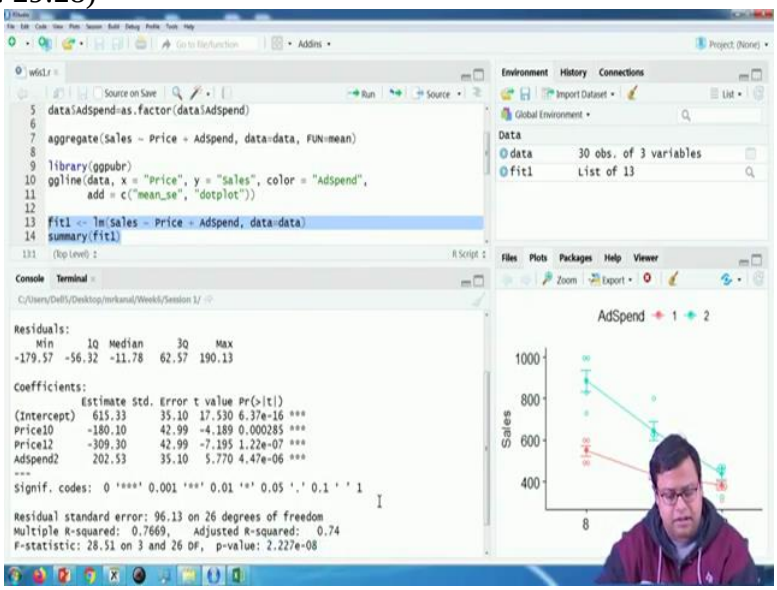


To give a pictorial view of this, I will use a library called ggpubr and if it is not there, I will quickly install it ggpubr. So, I am installing the library right now it will take probably one minute for me depending on the internet speed and etc and once that is installed I will just draw this thing. So, once I draw this I will see the pictorial form, whatever I told right now in a better way. So, you see, this is the picture.

So, if I see the picture carefully, I can see, okay I will just make it a little bit short and then I will drag it Okay. Now carefully see the picture. The picture says that, there is two lines basically. The first line is the green line is ad spend 2, at the top it is written the green line and the red line is ad spend 1 so in ad spend 2's case, the drop is significant. But in ad spend 1 it is still dropping, but it is not so much significant drop. It is a slow drop.

In case of ad spend 2, it is a high drop. And this is something which talks about a interaction effect, we do a regression that if these guys will actually, if I extrapolate interaction effect will happen when these two lines actually join somewhere. So, if I just extrapolate after 12 it will join at a particular point and that will give me an idea that this guy have a interaction effect.

(Refer Slide Time: 29:28)



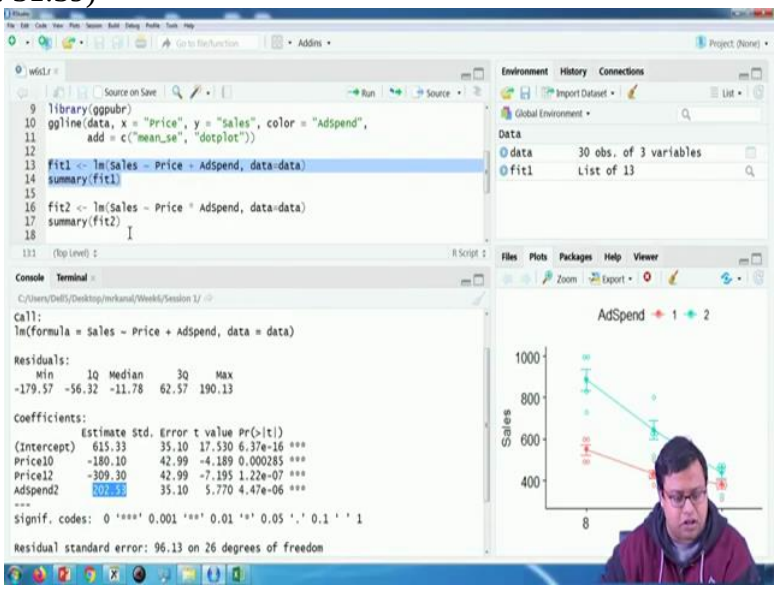
So, to check that what I do is, I first run a linear regression, normal linear regression with sales and price and ad spend as my, now remember price and ad spend, both are factor variable here. So, for both of them one of the factor, one of the categories will be dropped because of multicollinearity issues, we have talked about this before and the other ones will be populated. So, if I just run this, the result comes up like this.

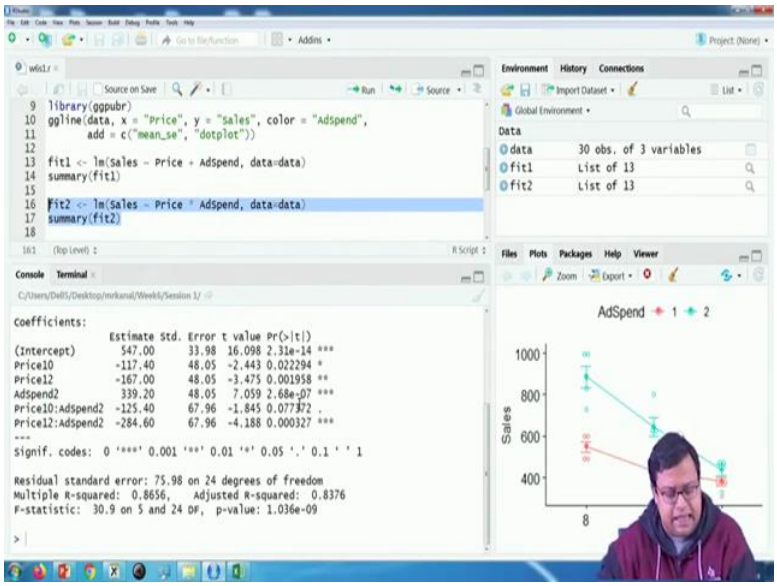
You will carefully see that okay so, my adjusted R square is 0.04, my P value is much lower than 0.05. So, I can look at this data and the result says that, so see price 8 has been dropped. So, all the data, other two values that has been given here are price 10 is in comparison to price 8 and price 12 is also in comparison to price 8. So, both are significant, both values are lower than 0.05.

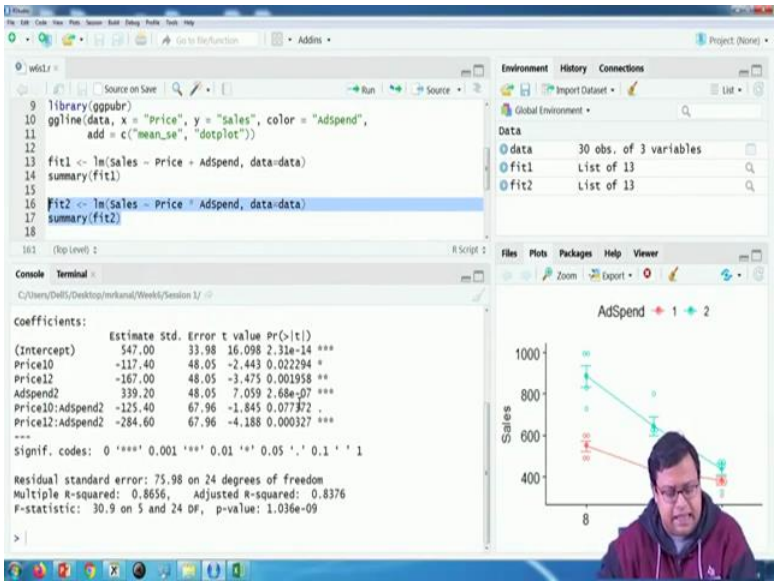
And it is saying that when you price 10 rupees your average after controlling for advertisement spend, if you price 10 rupees instead of 8 rupees your sales drop by 180 units. And if you price 12 rupees in comparison to 8 rupees your sales drop by 309 units. On the other hand, if you increase your advertisement spend from 3000 to 5000 rupees per retail store, the expenditure goes up by, the sales goes up by 200. So, if you see that 200 into 8, if I price by chance at 8 rupees and advertisement expenditure is high let us say, so extra how much I earned? 200 product.

So, 200 products into 8 rupees is 1600 rupees, but the advertisement expenditure difference is 3000 to 5000, 2000 rupees. So, that is not probably a good option, that ad spend 2 and price 8. There can be other options available. So, we will see that. And actually probably that is one of the best options, we will see that, we will see that.

(Refer Slide Time: 31:39)





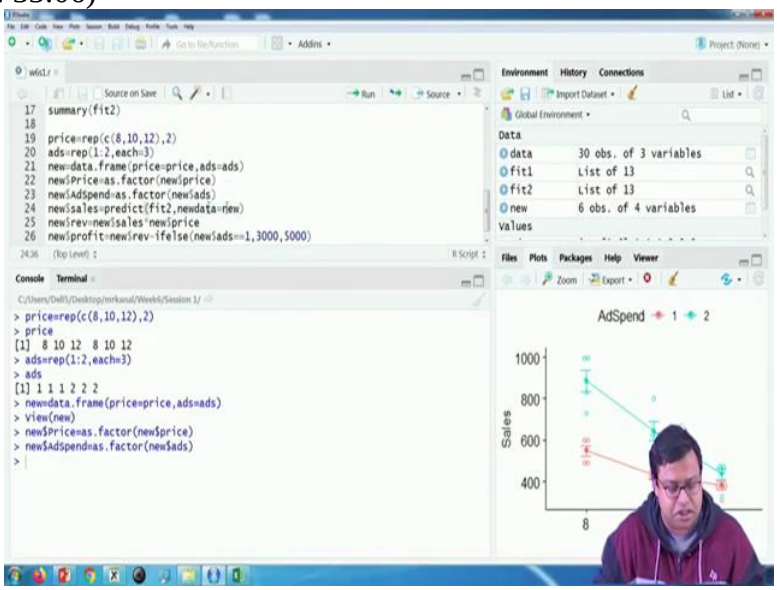


And then I will also see that what is the fit 2. That means, I am introducing the interaction effect. The only thing that I changed here is this plus sign becomes a multiplication sign. So, if I just run that, you will see that this interaction effect is for ad spend 2, price 10 it is not significant but ad spend 2 price 12, it is very significant. So, from price 12 to price 8 if you see the jump then that jump is highly significant depending on what kind of ad expenditure you are doing, ad expenditure 1 or ad expenditure 2.

So, this is the function that I will use later to predict my sales or profit. Now, remember, I cannot do a normal linear optimization here because or a gradient descent kind of optimization here because all my price and advertisement expenditure are actually a single value. I cannot price 8.3, 8.5 or something like that. So, do I have to do something like a integer programming kind of thing?

So, in other words, in a simpler term, I have to find out all possible combinations, 8 rupees, ad spend 1; 8 rupees, ad spend 2; 10 rupees ad spend 1; 10 rupees ad spend 2; 12 rupees ad spend 1; 12 rupees ad spend 2 for all these six combinations I have to see what is the sales? What is the profit and which one has the highest profit? This is something that I have to calculate.

(Refer Slide Time: 33:06)

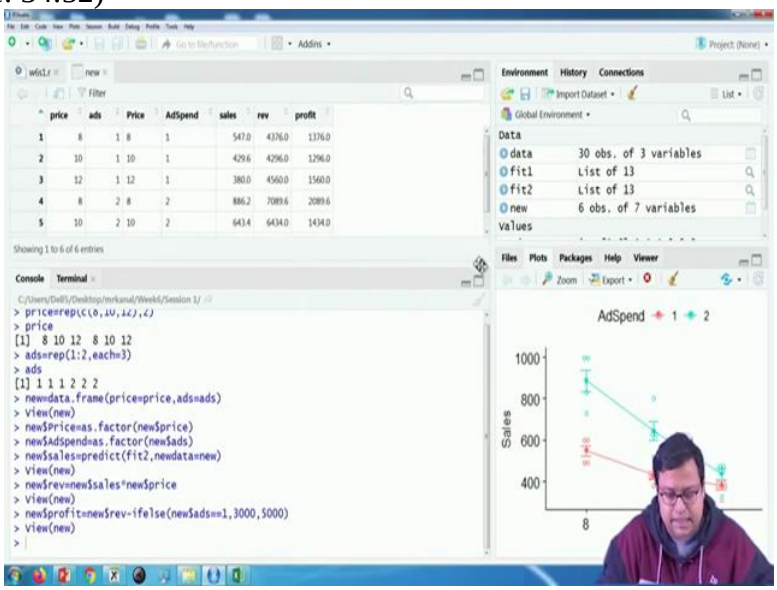


So, what I do is next is I create this price is repeat 8, 10, 12 twice. So, if I just run this price becomes like this 8, 10, 12, 8, 10, 12 and ads is 1 and 2 repeat thrice. So, basically ads are 111, 222 and I put these two guys in a new data set called New. So, the new data set looks like this 8, 10, 12, 8, 10, 12, and 111. So, all the six combinations are created. Now, based on these combinations, I will change them through their factor form and the names has to be similar to the model.

Price P was capital, ad spend was like this and it was a factor variable. So, I created these two variables. And based on these two variables, you would see here I am using the predict function of LM. In the linear regression there is a predict function to predict using the model no. So, this is the model name. The model name is fit 2 and the new data is equal to new. The new data set that I have created, whose name is new will be used as my data for the prediction.

So, that I predict and put it in that sales case generated for all the six observations and that is populated in the new data. So, now if I click the new data, you will see that okay, these are the original ones, these are the factor forms-price and ad spend and this is the corresponding sales predictions that I have. Now, this is the sales predictions then how much is the revenue? Sales into price, simple. So, this is the revenue that I generate. And what is the ad cost? The profit is revenue minus, if ad spend is equal to 1, then minus 3000. If ad spend is equal to 2 then it is 5000.

(Refer Slide Time: 34:52)



So, I just run this and find out the profit and the profit looks like this. Now, if you carefully see the profit you will see that obviously, the price at 8 rupees or ad spend 2 giving me the, so the one that I told that that will give me lesser profit, actually that is giving me the highest profit. All other combinations are giving me lower profit, the closest combination. And what is another interesting thing to see is here, when the ad spend is 2, the lowest price is giving me the highest profit, but when ad spend is 1 the highest price is giving me the highest profit.

So, this is a twing because there is an interaction and the distance and the effect of price and advertisement spend are different. So,you have to, if you want to maximize your profit, depending on what kind of advertisements you are doing, you should do different kind of pricing and that is what I am trying to show here that the pricing will depend on other things also or the other things will depend on pricing. So, there is a interplay that is happening.

And this says that, that the profit goes highest when you are doing advertisement of 2, that means high, 5000 rupees per retail store and your price is 8 rupees per unit product. On the other hand, if by chance if you reduce the advertisement spend, you have to increase the price. So, the price should be 12 rupees. So, something like that, which is a interesting situation that gets created.

So, here I am talking about marketing, a basic marketing mix model where marketing mix means various items of the marketing means, which is product, price, promotion, place will interplay with each other and a basic example has been given here. We will go ahead with some complex,

more complex examples in the later videos. Thank you for being with me, and I will come back with more complex problems in the next video. Thank you.