Marketing Analytics
Prof. Swagato Chatterjee
Vinod Gupta School of Management
Indian Institute of Technology, Kharagpur
Lecture 33
Marketing Mix Models and Advertising Models (Continue)

Hello everybody. Welcome to Marketing Analytics Course. This is Doctor Swagato Chatterjee from VGSOM, IIT, Kharagpur, who is taking this course for you. We are in the last phase of week 6 and this particular video we will talk about Media Data. So, how to decide that in which kind of, so I have decided that, I have some added expenditure and based on the marketing mix models and et cetera. I decided that x amount of money would be spend on digital.

Now, let say, or TV let say, and there are lots of TV programs that is running up. As I told in the last video that TV programs you give 30 seconds ads and 20 seconds ads and et cetera. And there are certain rates and as the popularity of that particular this thing goes up, as the popularity of the particular program goes up, based on the popularity, based on the demographics; based on various others factors they decide how much they will actually charge per second. So, those charges are there.

Now, my problem is that I have been given x amount of money and I have to make sure that maximum impression happens. Now, TV is purely impression, no engagement, so maximum impression happens and I also maximize my cost, minimize my cost.

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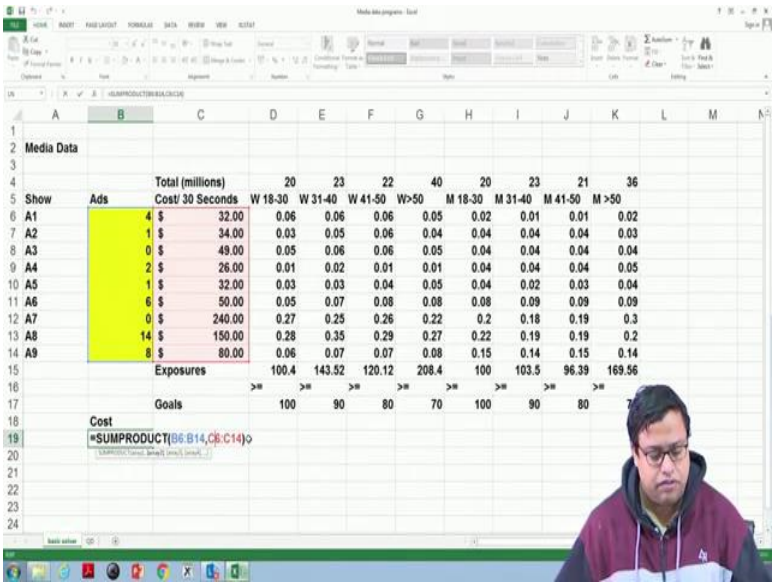
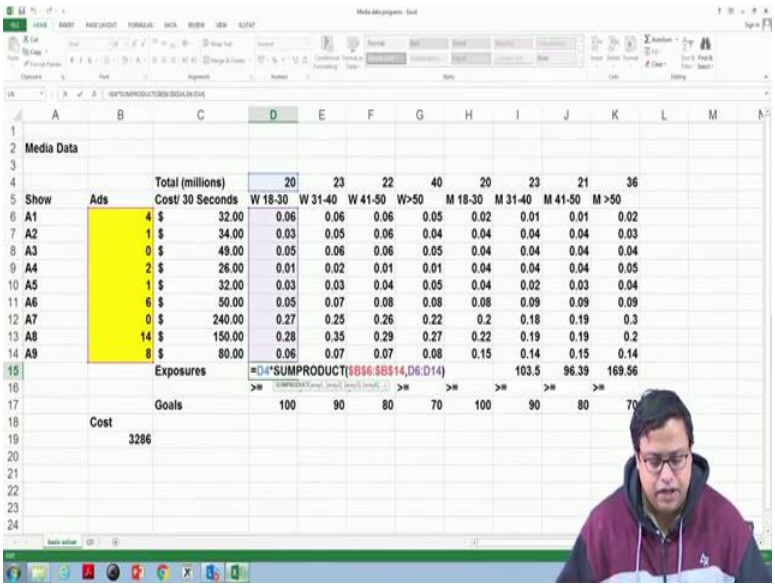


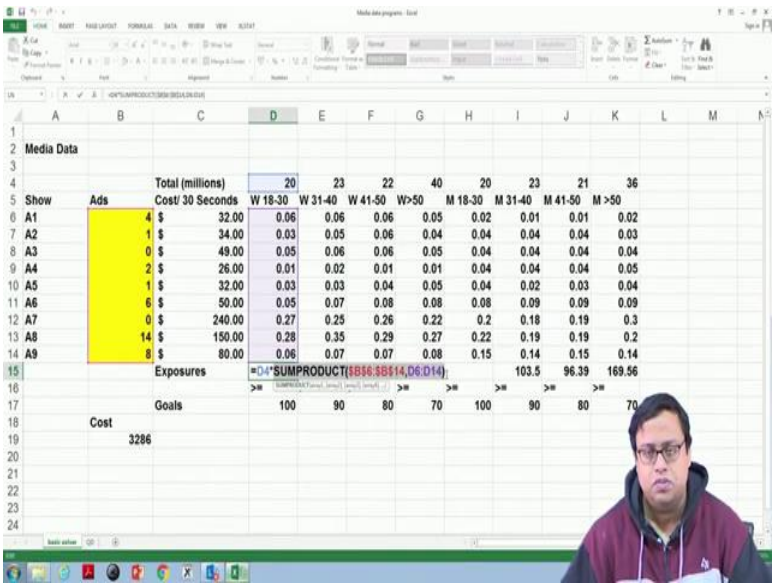


Media Data

Show	Ads	Cost/ 30 Seconds	Total (millions)	20	23	22	40	20	23	21	36
				W 18-30	W 31-40	W 41-50	W>50	M 18-30	M 31-40	M 41-50	M >50
A1	4	$ 32.00		0.06	0.06	0.06	0.05	0.02	0.01	0.01	0.02
A2	1	$ 34.00		0.03	0.05	0.06	0.04	0.04	0.04	0.04	0.03
A3	0	$ 49.00		0.05	0.06	0.06	0.05	0.04	0.04	0.04	0.04
A4	2	$ 26.00		0.01	0.02	0.01	0.01	0.04	0.04	0.04	0.05
A5	1	$ 32.00		0.03	0.03	0.04	0.05	0.04	0.02	0.03	0.04
A6	6	$ 50.00		0.05	0.07	0.08	0.08	0.08	0.09	0.09	0.09
A7	0	$ 240.00		0.27	0.25	0.26	0.22	0.2	0.18	0.19	0.3
A8	14	$ 150.00		0.28	0.35	0.29	0.27	0.22	0.19	0.19	0.2
A9	8	$ 80.00		0.06	0.07	0.07	0.08	0.15	0.14	0.15	0.14
			Exposures	=D4*SUMPRODUCT($B$6:$B$14,D6:D14)					103.5	96.39	169.56
				>=			>=	>=	>=	>=	>=
			Goals	100	90	80	70	100	90	80	70

Cost

3286

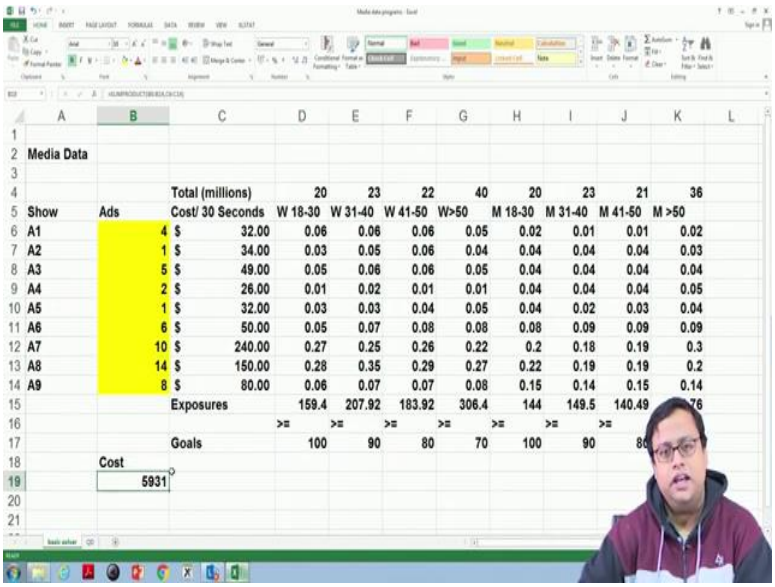


Media Data

Show	Ads	Cost/ 30 Seconds	Total (millions)	20	23	22	40	20	23	21	36
				W 18-30	W 31-40	W 41-50	W>50	M 18-30	M 31-40	M 41-50	M >50
A1	4	$ 32.00		0.06	0.06	0.06	0.05	0.02	0.01	0.01	0.02
A2	1	$ 34.00		0.03	0.05	0.06	0.04	0.04	0.04	0.04	0.03
A3	0	$ 49.00		0.05	0.06	0.06	0.05	0.04	0.04	0.04	0.04
A4	2	$ 26.00		0.01	0.02	0.01	0.01	0.04	0.04	0.04	0.05
A5	1	$ 32.00		0.03	0.03	0.04	0.05	0.04	0.02	0.03	0.04
A6	6	$ 50.00		0.05	0.07	0.08	0.08	0.08	0.09	0.09	0.09
A7	0	$ 240.00		0.27	0.25	0.26	0.22	0.2	0.18	0.19	0.3
A8	14	$ 150.00		0.28	0.35	0.29	0.27	0.22	0.19	0.19	0.2
A9	8	$ 80.00		0.06	0.07	0.07	0.08	0.15	0.14	0.15	0.14
			Exposures	=D4*SUMPRODUCT($B$6:$B$14,D6:D14)					103.5	96.39	169.56
				>=			>=	>=	>=	>=	>=
			Goals	100	90	80	70	100	90	80	70

Cost

3286

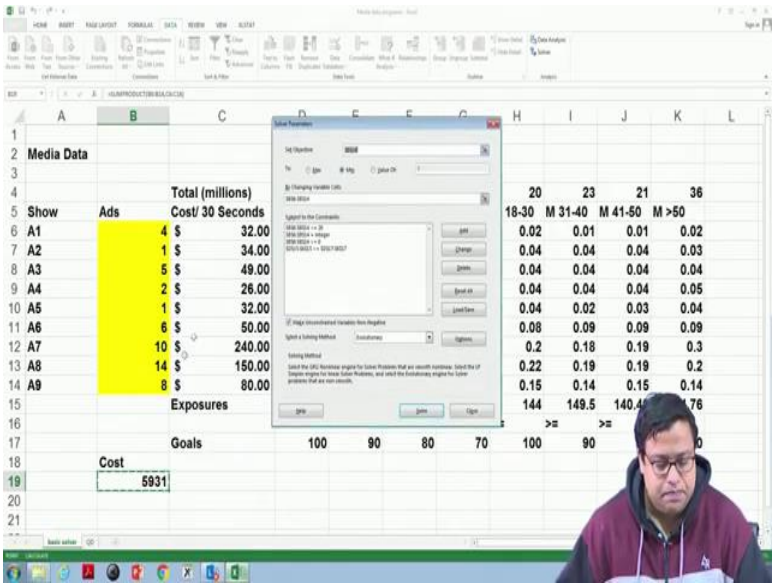


Media Data

Show	Ads	Cost/ 30 Seconds	Total (millions)	20	23	22	40	20	23	21	36
				W 18-30	W 31-40	W 41-50	W>50	M 18-30	M 31-40	M 41-50	M >50
A1	4	$ 32.00		0.06	0.06	0.06	0.05	0.02	0.01	0.01	0.02
A2	1	$ 34.00		0.03	0.05	0.06	0.04	0.04	0.04	0.04	0.03
A3	5	$ 49.00		0.05	0.06	0.06	0.05	0.04	0.04	0.04	0.04
A4	2	$ 26.00		0.01	0.02	0.01	0.01	0.04	0.04	0.04	0.05
A5	1	$ 32.00		0.03	0.03	0.04	0.05	0.04	0.02	0.03	0.04
A6	6	$ 50.00		0.05	0.07	0.08	0.08	0.08	0.09	0.09	0.09
A7	10	$ 240.00		0.27	0.25	0.26	0.22	0.2	0.18	0.19	0.3
A8	14	$ 150.00		0.28	0.35	0.29	0.27	0.22	0.19	0.19	0.2
A9	8	$ 80.00		0.06	0.07	0.07	0.08	0.15	0.14	0.15	0.14
			Exposures	159.4	207.92	183.92	306.4	144	149.5	140.49	176
				>=	>=	>=	>=	>=	>=	>=	
			Goals	100	90	80	70	100	90	80	

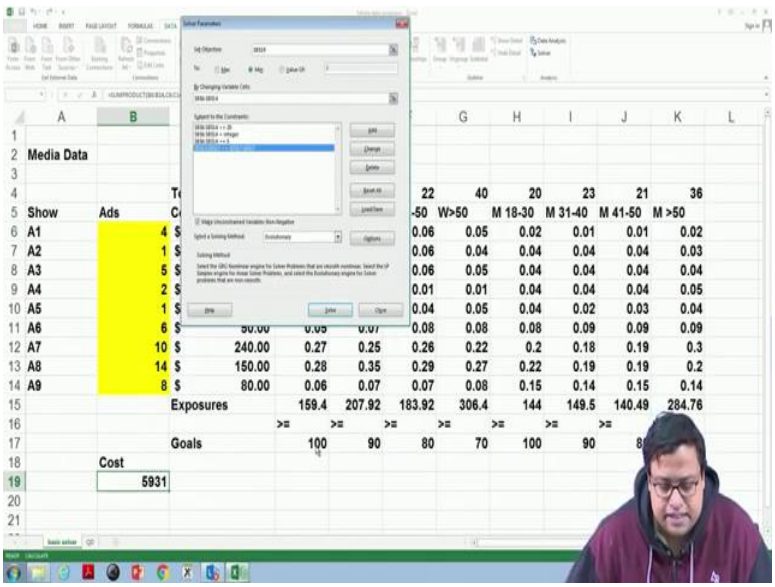
Cost

5931



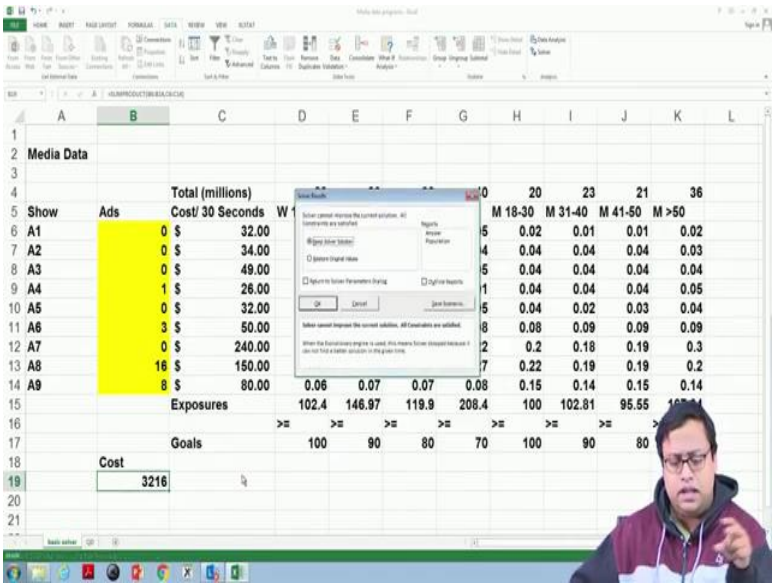
Media Data

	Show	Ads	Cost/ 30 Seconds	Total (millions)				20	23	21	36
								18-30	M 31-40	M 41-50	M >50
6	A1	4	$ 32.00					0.02	0.01	0.01	0.02
7	A2	1	$ 34.00					0.04	0.04	0.04	0.03
8	A3	5	$ 49.00					0.04	0.04	0.04	0.04
9	A4	2	$ 26.00					0.04	0.04	0.04	0.05
10	A5	1	$ 32.00					0.04	0.02	0.03	0.04
11	A6	6	$ 50.00					0.08	0.09	0.09	0.09
12	A7	10	$ 240.00					0.2	0.18	0.19	0.3
13	A8	14	$ 150.00					0.22	0.19	0.19	0.2
14	A9	8	$ 80.00					0.15	0.14	0.15	0.14
15			Exposures					144	149.5	140.4	.76
16									>=	>=	
17			Goals	100	90	80	70	100	90		0
18		Cost									
19		5931									
20											
21											



Media Data

	Show	Ads	Cost/ 30 Seconds					22	40	20	23	21	36
								-50	W>50	M 18-30	M 31-40	M 41-50	M >50
6	A1	4	$					0.06	0.05	0.02	0.01	0.01	0.02
7	A2	1	$					0.06	0.04	0.04	0.04	0.04	0.03
8	A3	5	$					0.06	0.05	0.04	0.04	0.04	0.04
9	A4	2	$					0.01	0.01	0.04	0.04	0.04	0.05
10	A5	1	$					0.04	0.05	0.04	0.02	0.03	0.04
11	A6	6	$	50.00	0.05	0.07		0.08	0.08	0.08	0.09	0.09	0.09
12	A7	10	$	240.00	0.27	0.25	0.26	0.22	0.2	0.18	0.19	0.19	0.3
13	A8	14	$	150.00	0.28	0.35	0.29	0.27	0.22	0.19	0.19	0.19	0.2
14	A9	8	$	80.00	0.06	0.07	0.07	0.08	0.15	0.14	0.15	0.14	
15			Exposures		159.4	207.92	183.92	306.4	144	149.5	140.49	284.76	
16					>=	>=	>=	>=	>=	>=	>=		
17			Goals		100	90	80	70	100	90	8		
18		Cost											
19		5931											
20													
21													



Media Data

	Show	Ads	Cost/ 30 Seconds	Total (millions)				20	23	21	36
								M 18-30	M 31-40	M 41-50	M >50
6	A1	0	$ 32.00					0.02	0.01	0.01	0.02
7	A2	0	$ 34.00					0.04	0.04	0.04	0.03
8	A3	0	$ 49.00					0.04	0.04	0.04	0.04
9	A4	1	$ 26.00					0.04	0.04	0.04	0.05
10	A5	0	$ 32.00					0.04	0.02	0.03	0.04
11	A6	3	$ 50.00					0.08	0.09	0.09	0.09
12	A7	0	$ 240.00					0.2	0.18	0.19	0.3
13	A8	16	$ 150.00					0.22	0.19	0.19	0.2
14	A9	8	$ 80.00	0.06	0.07	0.07	0.08	0.15	0.14	0.15	0.14
15			Exposures	102.4	146.97	119.9	208.4	100	102.81	95.55	
16				>=	>=	>=	>=	>=	>=	>=	
17			Goals	100	90	80	70	100	90	80	
18		Cost									
19		3216									
20											
21											

So, this is something that is a problem that I have right now. Check the data set. The data set has 9 source A1 to A9 and these are the number of ads that you give on those shows. So, this is something is the decision variable, this is something is the decision variable, you decide later part of time how much ads to give, how much how much ads not to give. And this is the per 30 seconds cost of those ads, so each ad will cost 32 dollars. So, then what is the total cost?

The total cost is nothing but some product of B6 to B14, then into C6 to C14. This cost is something that you try to minimize. Now, what else is given? For every program you know that what is the demographic profile? So, the demographic profile of the all the observers of that particular channel, let say these are various programs in 1 single channel. So, if you have more complex data where you have profiles for different channels, then this might, this particular same problem can be a little bit more difficult and we can deal it with are rather than excel.

But right now I am giving you a simple formula, simple problem and simple solution, so while all this program watchers are from the same this thing and this is women 18 to 30 years old, women 31 to 40 years old, 41 to 50 years old, higher than 50 years old and hit the same thing for men. And these many people, these many millions of people at they are in each of the segment, so 20 million people are there in this segment, 23 million in this segment in USA, let say. That is the, I would say demographic profile.

Now, out of this 20 million people, 6 percent watches this particular, 6 percent in this particular segment also watches A1 program, 6 percent this groups watches A1 program and 5 percent watches. On other hand 2, 1, 1, 2, this is the percentage for male. So, these particular program I can say that it is a female dominated program, in an average female watches 6 to, 5 to 6 percent male watches 1 to 2 percent.

On other hand let say this 1 is 3, 5, 6, 4 and then 4, 4, 4, 3 more or less both cases it is same. On the other hand there are certain products I can practically say that, for example, this 1 everybody watches is the popular, very popular this is further more popular everybody watches this. 30 percent watches this 19 percent, 18 percent and that is why this is popularity the price is also high very high.

On the other hand I can show you certain ones, where let us say this 1, this is a probably a male preferred kind of a program, while male watches 15 percent 14 percent, but women does not watch at as much. So, this is the demographic profile of the audience. Now, if I give

basically 4 ads here, then what will be the level of exposure, the level of exposure is, for each ad it is some product of B6 to B14. What is B6 to B14? B6 to B14 is this column comma D6 to D14 that means this ads into D4.

So, let us say I have given 4 ads, so I have given 4 ads in A1, that means 0.06 percent of this 20 million people has seen fourth times, 3 percent of this 20 million has seen 1 times, 5 percent of this 20 million people have not seen, 1 percent of 20 million people have seen 2 times and so on. That means this column into this column into this value is the total number of exposure for people who are women in 18 to 30 years old that means in this segment. To that thing is written here, D4 into some product of B6 to B14, D6 to D14.

And the same thing, I have dragged it up so, B6 to B14 even constant even when I drag, so that I put F4 signs here. And then for each of them it is like that, E4 into some product B6 to B14 comma E6 to E14. Similarly, here it is some product B6 to B14, I6 to I14 into I4 and so on. Now, these are my exposures and somebody told that this is my goal, this many exposures I have to reach at least. So, currently based on the values I am reaching all the exposures. But I am over shooting the exposure limits.

So, let us say here if I write 5, here if I write 10, then I am practically over shooting the exposure limits, my cost is very high, I have to optimize this. How do I optimize this? I go to data, solver. See, the objective function is B19, this particular sale, which I try to minimize by changing B6 to B14, fair enough. Now, what are the these things? 1 is B6 to B14 has to be integer, then B6 to B14 has to be between 0 and 20, I have taken the upper limit and lower limit because it is integer, I have to put this integer programming I have to put upper limit and lower limit.

And D15 to K15 that means basically these values ,exposure values has to be higher than D17 to K17, that means the goals values, the exposure values has to be higher than the goals values. I select the method as evolutionary and I try to solve it. And it is time to solve it, already I have reached 3, 2, 2, 2 and I will actually wait for some time to let it solve, and see how it goes. So, what it does? It will again change these values, the values which are in yellow cells, and try to find out what is the maximum lowest cost.

So, 3, 2, 1, 6 is something that I have already reached and let us say whether if I will wait for 1 more minute and see that whether I can reach further lower level or not. Now, if by chance the demographic profiles were different, let us say this, if these are all from the so. So, that gave me the ads, so this is the ads that I got. So, give all lots of ads here, and do not give ads

in other places and you are getting some amount of exposures. And if you drawn 1 more time it might give you some other results, but more or less your cost will be similar.

So, that is, now if the demographic profiles are different, if the demographic profiles for different channels are different or different countries are different, then you have to bring in those kind of complexities in the modelling also, but effectively, what you have to do? You have to put the values, number of ads you want to put in various channels or various programs in various channels. Find out how much is your final exposure, goal exposure, whether the final exposure is higher than the goal exposure, minimize your cost and then change that thing.

So, you can do all of this stuff in a function as we deal in the last video also. It might be a little bit difficult in coding, but if you have a coder in hand or in often case marketing analytics professionals will have some entry level data scientists in their hand, so if you can put them, they will be creating that or if you know a basic level of coding what we have learnt in this particular course, you can do it on your own as well.

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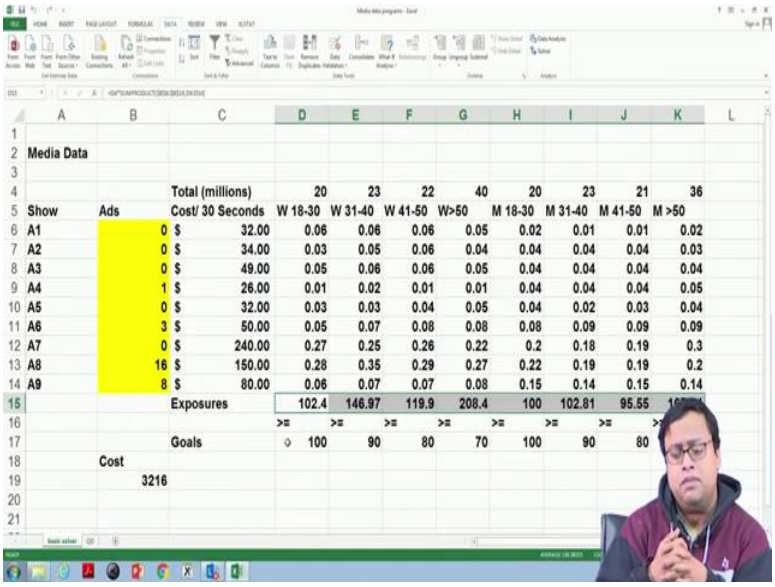
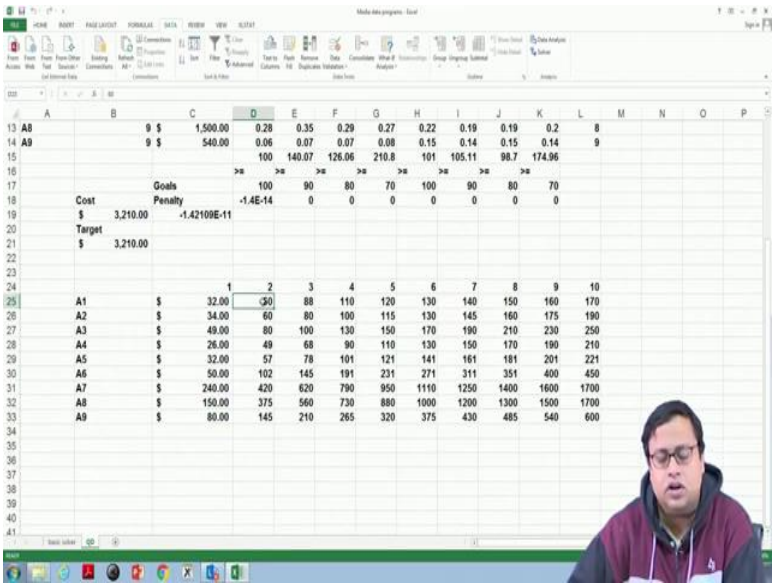
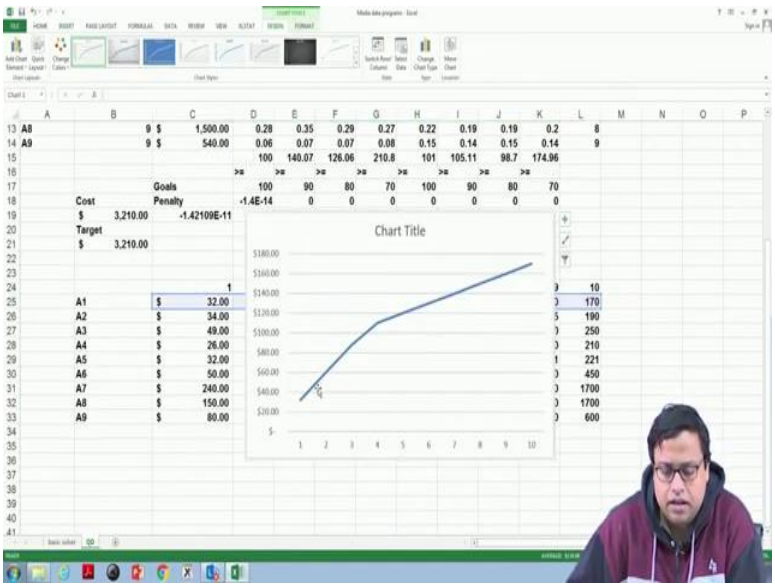


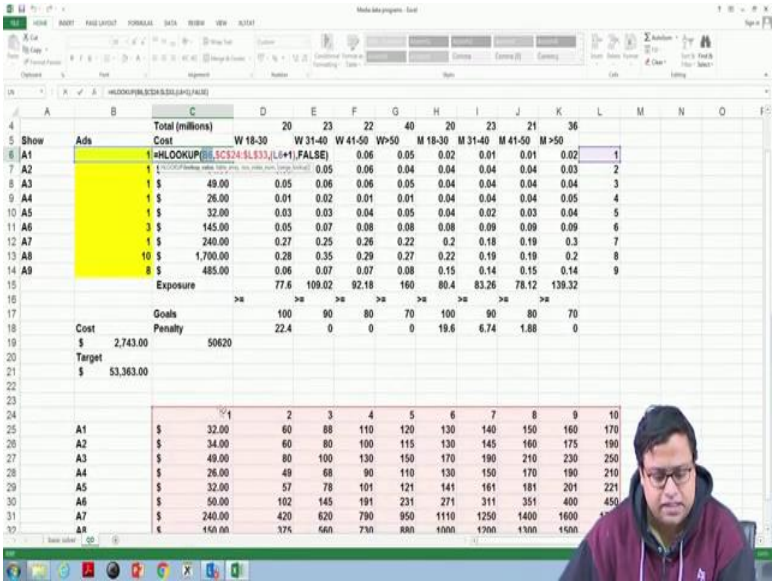
	A	B	C	D	E	F	G	H	I	J	K	L
1												
2	Media Data											
3												
4			Total (millions)	20	23	22	40	20	23	21	36	
5	Show	Ads	Cost/ 30 Seconds	W 18-30	W 31-40	W 41-50	W>50	M 18-30	M 31-40	M 41-50	M >50	
6	A1	0	$ 32.00	0.06	0.06	0.06	0.05	0.02	0.01	0.01	0.02	
7	A2	0	$ 34.00	0.03	0.05	0.06	0.04	0.04	0.04	0.04	0.03	
8	A3	0	$ 49.00	0.05	0.06	0.06	0.05	0.04	0.04	0.04	0.04	
9	A4	1	$ 26.00	0.01	0.02	0.01	0.01	0.04	0.04	0.04	0.05	
10	A5	0	$ 32.00	0.03	0.03	0.04	0.05	0.04	0.02	0.03	0.04	
11	A6	3	$ 50.00	0.05	0.07	0.08	0.08	0.08	0.09	0.09	0.09	
12	A7	0	$ 240.00	0.27	0.25	0.26	0.22	0.2	0.18	0.19	0.3	
13	A8	16	$ 150.00	0.28	0.35	0.29	0.27	0.22	0.19	0.19	0.2	
14	A9	8	$ 80.00	0.06	0.07	0.07	0.08	0.15	0.14	0.15	0.14	
15			Exposures	102.4	146.97	119.9	208.4	100	102.81	95.55		
16				>=	>=	>=	>=	>=	>=	>=	>=	
17			Goals	100	90	80	70	100	90	80		
18		Cost										
19		3216										
20												
21												



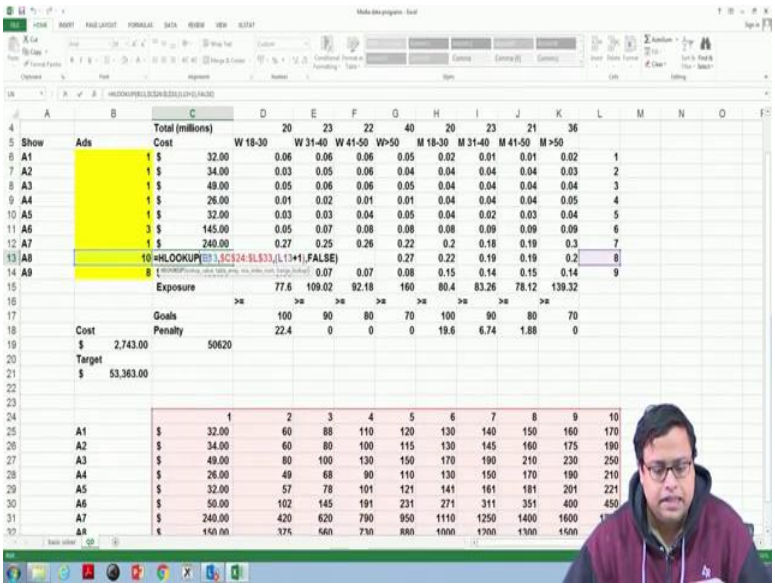
A8		9	$	1,500.00	0.28	0.35	0.29	0.27	0.22	0.19	0.19	0.2	8		
A9		9	$	540.00	0.06	0.07	0.07	0.08	0.15	0.14	0.15	0.14	9		
					100	140.07	126.06	210.8	101	105.11	98.7	174.96			
					>=	>=	>=	>=	>=	>=	>=	>=			
				Goals	100	90	80	70	100	90	80	70			
	Cost			Penalty	-1.4E-14	0	0	0	0	0	0	0			
	$	3,210.00		-1.42109E-11											
	Target														
	$	3,210.00													
				1	2	3	4	5	6	7	8	9	10		
	A1		$	32.00	60	88	110	120	130	140	150	160	170		
	A2		$	34.00	60	80	100	115	130	145	160	175	190		
	A3		$	49.00	80	100	130	150	170	190	210	230	250		
	A4		$	26.00	49	68	90	110	130	150	170	190	210		
	A5		$	32.00	57	78	101	121	141	161	181	201	221		
	A6		$	50.00	102	145	191	231	271	311	351	400	450		
	A7		$	240.00	420	620	790	950	1110	1250	1400	1600	1700		
	A8		$	150.00	375	560	730	880	1000	1200	1300	1500	1700		
	A9		$	80.00	145	210	265	320	375	430	485	540	600		

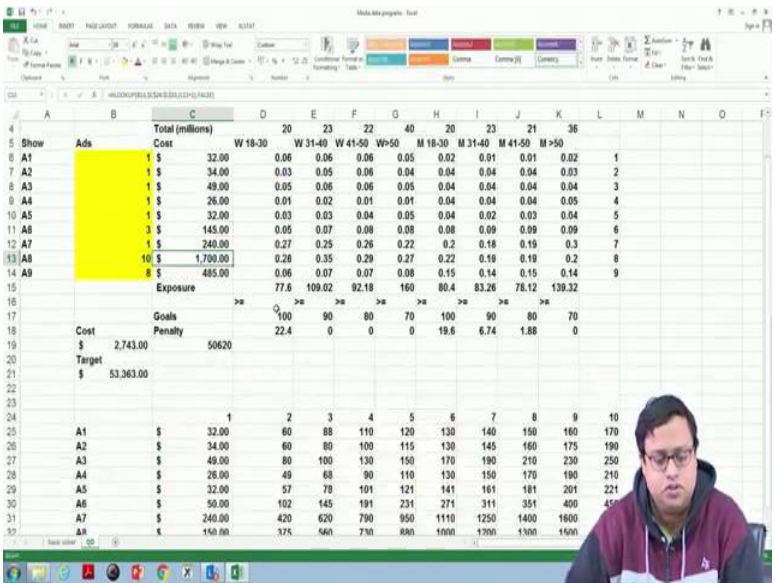


A8		9	$	1,500.00	0.28	0.35	0.29	0.27	0.22	0.19	0.19	0.2	8		
A9		9	$	540.00	0.06	0.07	0.07	0.08	0.15	0.14	0.15	0.14	9		
					100	140.07	126.06	210.8	101	105.11	98.7	174.96			
					>=	>=	>=	>=	>=	>=	>=	>=			
				Goals	100	90	80	70	100	90	80	70			
	Cost			Penalty	-1.4E-14	0	0	0	0	0	0	0			
	$	3,210.00		-1.42109E-11											
	Target														
	$	3,210.00													
				1									10		
	A1		$	32.00									170		
	A2		$	34.00									190		
	A3		$	49.00									250		
	A4		$	26.00									210		
	A5		$	32.00									221		
	A6		$	50.00									450		
	A7		$	240.00									1700		
	A8		$	150.00									1700		
	A9		$	80.00									600		



				Total (millions)	20	23	22	40	20	23	21	36			
Show	Ads			Cost	W 18-30	W 31-40	W 41-50	W>50	M 18-30	M 31-40	M 41-50	M >50			
A1		1		=HLOOKUP($B6,$C$24:$L$33,(L6+1),FALSE)	0.06	0.05	0.02	0.01	0.01	0.02	1				
A2		1			0.05	0.06	0.04	0.04	0.04	0.03	2				
A3		1	$	49.00	0.05	0.06	0.06	0.05	0.04	0.04	0.04	0.04	3		
A4		1	$	26.00	0.01	0.02	0.01	0.01	0.04	0.04	0.04	0.05	4		
A5		1	$	32.00	0.03	0.03	0.04	0.05	0.04	0.02	0.03	0.04	5		
A6		3	$	145.00	0.05	0.07	0.08	0.08	0.08	0.09	0.09	0.09	6		
A7		1	$	240.00	0.27	0.25	0.26	0.22	0.2	0.18	0.19	0.3	7		
A8		10	$	1,700.00	0.28	0.35	0.29	0.27	0.22	0.19	0.19	0.2	8		
A9		8	$	485.00	0.06	0.07	0.07	0.08	0.15	0.14	0.15	0.14	9		
				Exposure	77.6	109.02	92.18	160	80.4	83.26	78.12	139.32			
					>=	>=	>=	>=	>=	>=	>=	>=			
				Goals	100	90	80	70	100	90	80	70			
	Cost			Penalty	22.4	0	0	0	19.6	6.74	1.88	0			
	$	2,743.00		50620											
	Target														
	$	53,363.00													
				1	2	3	4	5	6	7	8	9	10		
	A1		$	32.00	60	88	110	120	130	140	150	160	170		
	A2		$	34.00	60	80	100	115	130	145	160	175	190		
	A3		$	49.00	80	100	130	150	170	190	210	230	250		
	A4		$	26.00	49	68	90	110	130	150	170	190	210		
	A5		$	32.00	57	78	101	121	141	161	181	201	221		
	A6		$	50.00	102	145	191	231	271	311	351	400	450		
	A7		$	240.00	420	620	790	950	1110	1250	1400	1600			
	A8		$	150.00	375	560	730	880	1000	1200	1300	1500			





Now comes the contrary part. So, let us say I am saying that the 2 complexities, 2 level of complexities I am bringing in. I am saying that the cost for 1 ad is whatever I told you before, what for 2 ads it is not a linear, so if I just try to plot this, you will see that they are slowly coming down. The marginal rate of increase is probably negative. So, this is something it is slowly curve type. The scales the, there is economies of scale, the more you give ad the less per unit cost is there, that is why the you might want to give more ads.

And this I am keeping it between 1 to 10, I do not have data more than 10. So, this is the cost that has been given to me. Same problem exactly everything remain same. Another thing that I bring in is a penalty. So, I am not saying that the exposure always hardcore, it has to meet the goals, your exposure can be a little bit, this is your exposure, lower than the goals. But if it is that, if that is the case, then you will have, your penalty is that much.

So, if you check here, so here this value is basically, if D15 is greater than D17, if D15 is greater than D17, then there is no penalty otherwise the difference will be put here. And then the total penalty value is, so I will just change these values little bit. I will copy these values and paste it here, so 0 is not allowed probably. 16 is also not allowed, 1 to 10. 1 and has to be given and so on. So, this I will change actually, so then, so let us say these are the starting values and so then these are, this is what I have actually is my penalty and then corresponding for each missing thousand rupees will be charged, so that is your penalty.

So, then the total cost is, the cost that you incur for giving the ad plus the penalty that is your target. And this is something that you have to minimize. So, this is what we are saying that your ending is not hard and fast. The number, you might want to let us say not expo, not achieve the required exposure in 1 particular segment, that is okay, but you will have some penalty. If you are okay to take the penalty, it is not an issue. But if you are not ok to take the penalty, then you have to reach the goal for each of this segments.

Now, here I have done a little bit wrong, what I have done is, I have written HLOOKUP B6, B6 means this value, into C2 to L14, HLOOKUP means first, so B6 it will actually find out in this first column, how many first row basically. If in this case it is 1, so it will find out in this column, if in next case it is 10, so it will find out in this column and so on. So, HLOOKUP means row wise finding out, then in from which row it will pick up the value? L6 plus 1, so L6 is, it is the first guy, so it is for A1, so A that is why it is 1.

1 plus 1 comes up to be 2 that means from the second row you will get the value here. For this case, let us say this is 10, B3, B13 is 10, so, then this particular column is what you find out and L13 is 8, 8 plus 1 is 9, so that means you are trying to find out from the ninth row. So, 10 matching happened then 1, 2, 3, 4, 5, 6, 7, 8, 9, the value should come up to be, so not 9, wait a minute, yeah 9. 1, 2, 3, 4, 5, 6, 7, 8, 9, yeah the value that should come up to be 1700 and 1700 is the value that is being shown here. So, that is.

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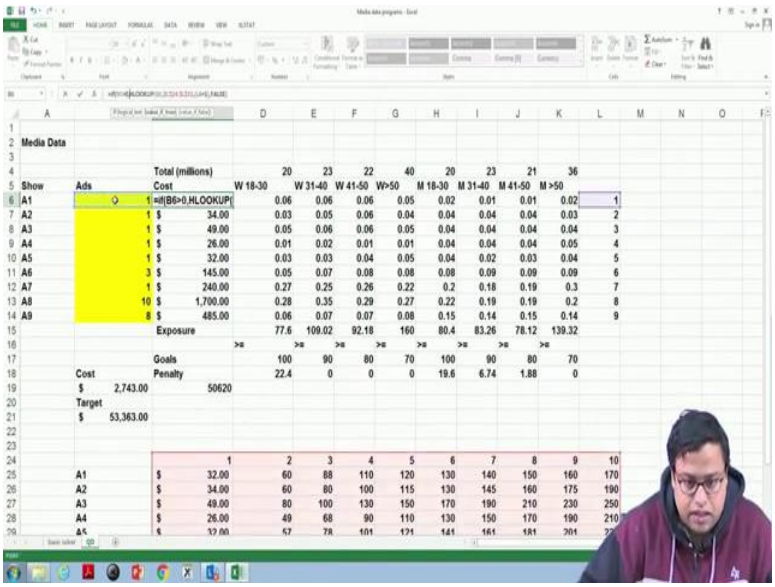

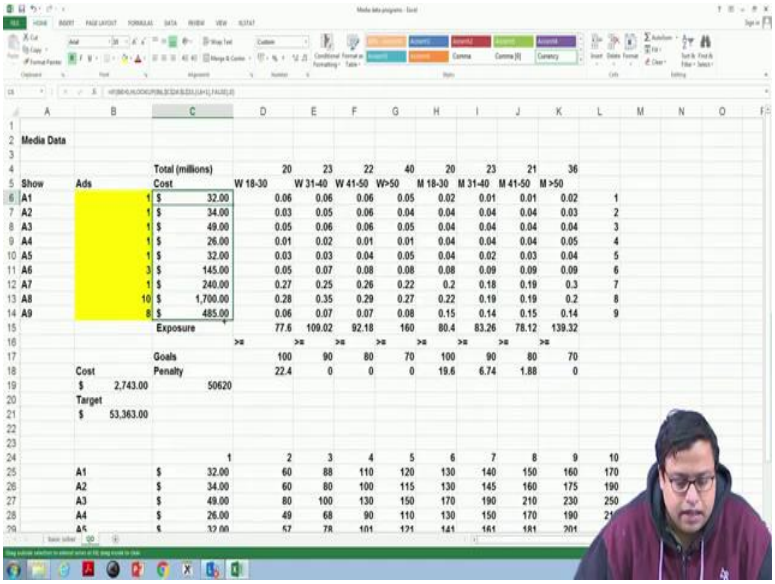

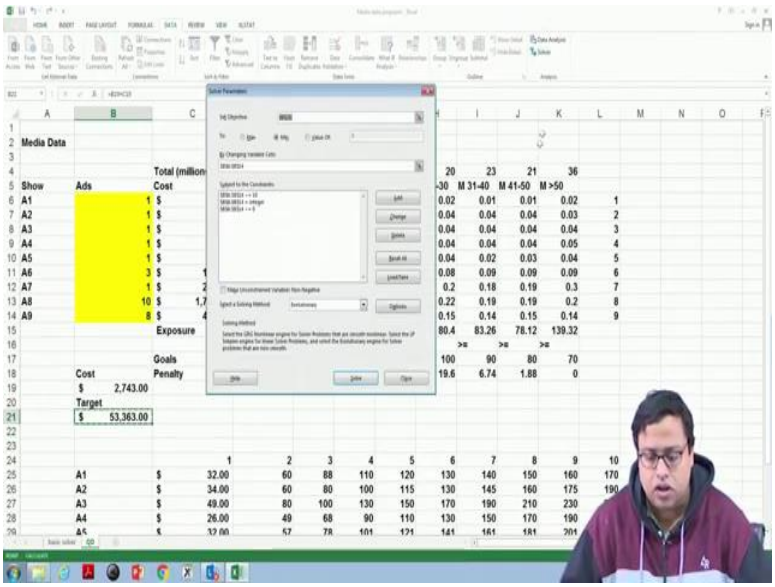

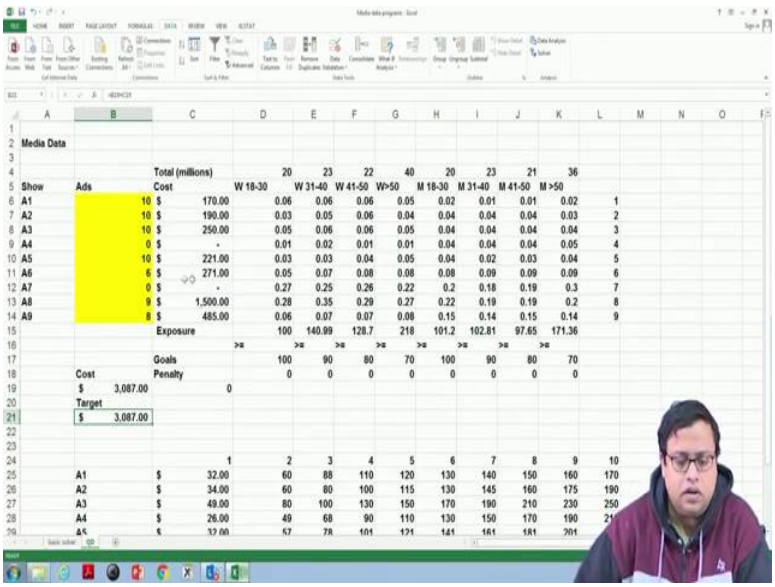

But by chance if this ad is 0, then you have to take the cost to be 0 that I forgot to take. So, if this is greater than 0 then only this applies otherwise the cost is 0. So that is something that I have written. Fair enough. Now, if it is 0 then no issues it is 0, fair enough, it is working. So, now my job is to max, minimize this target value. So, what do I do? I go to data, solver minimize B21 by changing B6 to B14, same thing, this guy should be between 0 to 10 and integer. Fair enough, evolutionary.

So, I try to solve it, already it got dropped to, so I will continue a little bit more 3217 to 3192. I will continue further. Let say if it further drops or not, I have reached to 3172, 3147, so it is running right now, and I can probably stop at later point of time, it has come down pretty good 3087 or something. 3087, see and if I further continue a little bit more, let see any other cases why you can further reduce. So, no, 3087, till now. I am not seeing anything lower than that. So, we will stop here. Fair enough.

So,okay, now if that is a solution see 10, 10, 10, 0 for this one, 0 for this one and some values I am getting the cost as 3087 and there is no penalty. So that is how you can deal with the penalty values also and you can find out that in for which kind of product how much money to put. And you can check for other models also, for example, let say, so here we are assume all this things are the add effects, here the impression is the only thing, we are not considering the sales but we can also consider the sales.

Let us say I say that this is impression, but in this group impression, 100 impression will lead to 5 percent sales and 5 sales and here 90 impression will lead to 12 sales let say. So, then correspondingly I will, I can find out that how much is the exposure, how much is the sales and I can say that let us optimize sales rather than optimize price, or reduce cost or something like that. So, I can make this whatever, based on my objective functions I can make things whatever level of complexity I want to bring in and based on that I can find out that what I want to put, how much money so that my all my goals and etcetera. that I have in my life, while doing advertisement modeling works fine.

So, that is all for advertisement modeling. In the next week we will come up with a very interesting topic called detail level analytics, detail level marketing analytics and we will start with recommendation engine and then we will do market basket analysis. These are the 2 topics which are very interesting and we will do, deal with that in the next week. Thank you very much for being with me and I will see you in the next week.