Quality Control and Improvement with MINITAB Prof. Indrajit Mukherjee Shailesh J. Mehta School of Management Indian Institute of Technology, Bombay

Lecture - 06 Importance of Pareto Chart and Cause and Effect Diagram

Hello everyone, welcome back to session 6 on Quality Control and Improvement using MINITAB. I am Prof. Indrajit Mukherjee from Shailesh J Mehta School of Management, IIT Bombay. So, last session, what we are doing is that visualization of some tools which is helpful in quality.

And some inference what we can draw out of the data set we have seen by using histogram. We have also seen using box plot and those things we have tried to understand how plotting can be done in MINITABs like that.

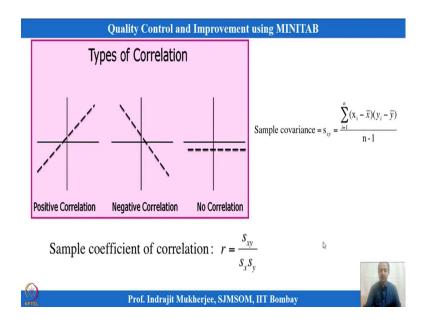
(Refer Slide Time: 00:53)

Quality Control and Improvement using MINITAB

MINITAB 19 INTERFACE & ILLUSTRATION



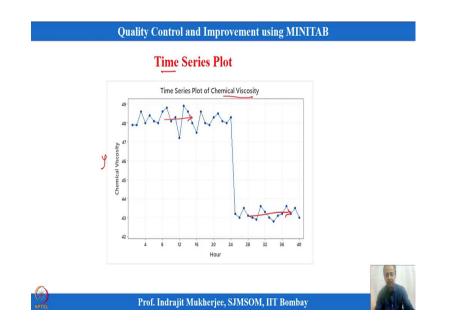
(Refer Slide Time: 00:56)



So, and also we have seen the scatter plot – how to draw scatter plots like that, where relationship between two variables we can try to understand by plotting those things, and also we how to calculate correlation using MINITAB, covariance using MINITAB. And we have seen that even if you do it calculators also, the values are very close in excel, also we can do that.

And in this session, some more quality tools which are extensively used also can be seen, but before that, we can also see some plotting types of graphs which can be used in chemical processes like that where time is one of the dimensions where the data how the data is moving how the centering is moving, how the center of the process is moving like that, that can also be plotted like that.

(Refer Slide Time: 01:43)

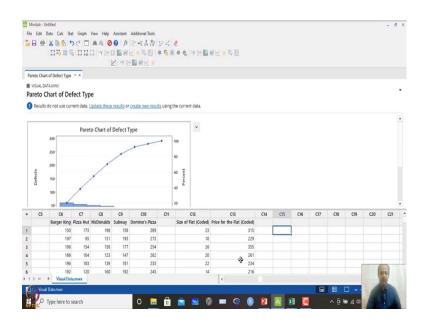


So, one of the important plotting technique which is also used when time is one of the dimensions like that, it is known as time series plots because time is one of the dimension over here. And this will be the variables that are monitoring, maybe CTQ with respect to time.

And in this plot, this is chemical viscosity which is plotted using MINITAB like that. What you can see over here is that the average or accuracy of the process is more or less over here, but suddenly it has dropped on the 24th observation, and the average is moved over here like that.

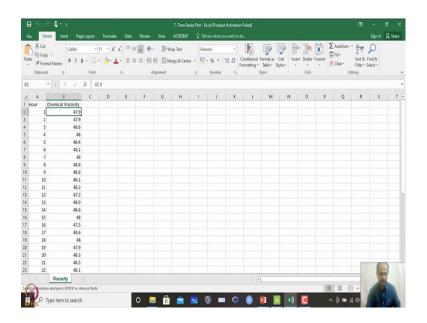
So, centering of the or the CTQ values are drastically drifted from one location to the other location with respect to time like that. So, I can monitor with respect to time and plot that one. Let me illustrate with an example over here how these types of time series plot is done in MINITAB.

(Refer Slide Time: 02:36)



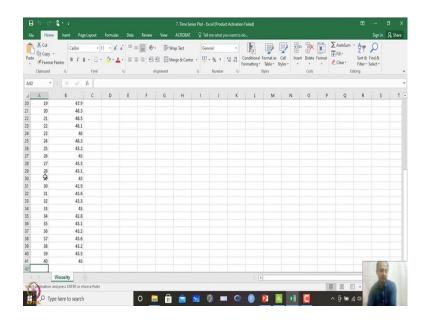
So, in this case what I will do is that I will use the same MINITAB worksheet which we are doing visualization data like this. So, I have kept the same file over here and what I will do, is that I will copy-paste some information data over here which is having time series like that.

(Refer Slide Time: 02:51)



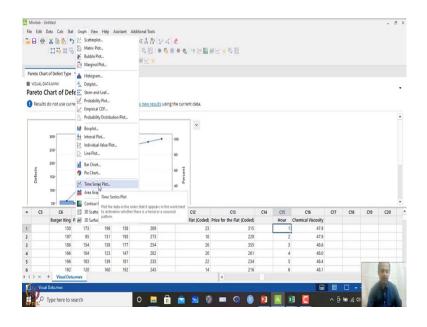
So, this is the hourly and chemical information that is there. And I want to copy because this first hour, second hour like this, the data is like that with respect to time.

(Refer Slide Time: 03:03)



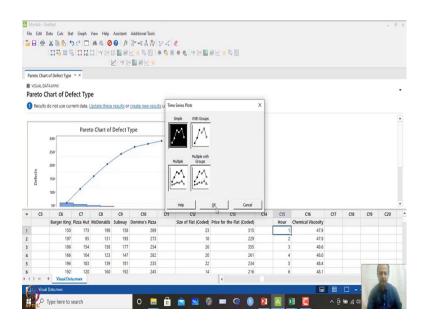
So, this is done with respect to time. So, 40th observation is the latest information that I am having over here ok. And the first information who is taken an hour 1, we can say this is coded hours so what we can think of. You start the process, and first hour you have recorded this one viscosity, second hour you have recorded this viscosity 47.9 like that. So, these things if you copy this one from here, and you paste it in MINITAB.

(Refer Slide Time: 03:30)



And then what you can do is that, you can just try time series plot. How do I do that? So, in graph, there is option of time series plot like that.

(Refer Slide Time: 03:40)



So, if you click this one, and then there will be options like that, multiple graphs can also be plotted which one example. We will take, but I am using a simple plot first of all. So, I will click ok.

(Refer Slide Time: 03:48)

	Data Calc Sta	00	₩ 44 0 [] Y ≥	6 f x	Additional Tools		k ¥ ⊠≣ ≋	上 🕈 🛱 🕅									a ×
Pareto Cha	rt of Defect Type	~ X															
I VISUAL D	ATA.MWX																
Pareto	Chart of De	fect Typ	e		Time Serie	es Plot: Simple					×						•
stogged	300 - 250 - 200 - 150 -		to Chart of		C1 Lay C3 May C7 Pazz C3 Md C9 Sub C10 Db C10 Db C10 C15 Ho C15 Ho C16 Ch	er Thidness ks in Quality Cou ger King a Hut Jonalds maty mino's Pizza e of Fiat (Coded) or for the Flat (Co ur emical Viscosity Select	Series: Chemical Viscosity Ime/Scale Multiple Graphs	Labels Dgta Option		Qata View							•
	50	-		_	_												٣
+ C5	C6	C7	C8	C9	¢ He			QK		Cancel		C16	C17	C18	C19	C20	ľ
	Burger King 150		McDonalds 198	Subway 158	Domino's Pizza 289	Size	of Flat (Coded) Pri 23	ice for the Flat	(Coded) 315	-	Hour C	hemical Viscosity 47.9					
1 2	150		198		289		18		229		2	47.9					
3	186		158				26		355		3	48.6					
4	166		123		282		20		261		4	48.0					
5	196	183	139	181	235		22		234		5	48.4					
6	192		160	192	245		14		216		6	48.1				20	
нарн	+ Visual Dat	la.mwx						K								-	
J Visu	al Data.mwx													- 🗆		1	1
P P	Type here to	search			0 📄	1	🎫 🔞			2			^ ĝ	· • a 4			

So, what is the series I want to plot? This is the chemical viscosity I want to plot that, I will indicate over here, but double-clicking this one.

(Refer Slide Time: 03:57)

Pareto Cha															
	art of Defect Type	~ X													
VISUAL D					Time Se	eries Plot: Time/Sca	le		×						•
	Chart of De				Time	Aver and Tides G	ridines Reference Ines								
Result	ts do not use cur	rent data. 🔱	odate these	results or	1696	Layer Thickness	Time Scale		1						
					C3	Marks in Quality Co Burger King	u C Index								*
		Pareto	Chart of	Defect T		Pizza Hut McDonalds	C Galendar C Clock								
	300				C9 C10	Subway Domino's Pizza	(Stamp								
	250			~	C12 C13	Size of Flat (Code: Price for the Flat (Cc Stamp columns (1-5, mile most inst)	:							
	200		1	/	C15 C16	Hour Chemical Viscosity	Hour	^							
						Colonical viscosity									
ects			/			Critinical Viscosity		v							
Defects	150 -	/	/			Critical Harvary		v							
Defects	150 -	/	/					v							
Defects	50	/	/			Select		v							۲
Defects	100- 50- C6	07	C8	C9		Select		~ 		C16	C17	C18	C19	C20	
- CS	100- 50- C6 Burger King	Pizza Hut	AcDonalds	Subway		Select		са 315		hemical Viscosity	C17	C18	C19	C20	¥
	100- 50- C6				2	Select	23 18	Car 315 229			C17	C18	C19	C20	•
• C5	100- 50- C6 Burger King 150	Pizza Hut 1 173	AcDonalds 198	Subway 158	2	Select Help		315		hemical Viscosity 47.9	C17	C18	C19	C20	*
• CS	100- 50- C6 Burger King 150 197	Pizza Hut / 173 95	McDonalds 198 131	Subway 158 195	2 2 2 2 2	Select Help 99 73	18	315 229	1	hemical Viscosity 47.9 47.9	C17	C18	C19	C20	•
• C5	100- 50- C6 Burger King 150 197 186	Pizza Hut 173 95 154	McDonalds 198 131 158	Subway 158 195 177	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Select Help 73 54	18 26	315 229 355	1	hemical Viscosity 47.9 47.9 48.6	C17	C18	C19	C20	

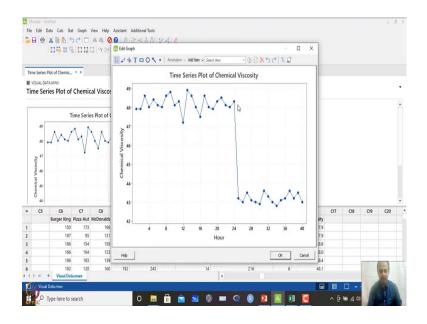
Then I will go to time and scale over here, one stamp option is there. Here what I will do is that I will use hour as the information which will be plotted in x-axis like that, and then I will click ok. So, there can be many more options what you can do over here.

(Refer Slide Time: 04:16)

File	- -	ata Calc Sta X 🗎 🏠 📢	00	₩ 44 (0 13 44 ≥	0 fx	Additional Tools		€ # # \Y ⊠ ■	e k * 4 8								- 6	9 ×
Tim	e Series F	lot of Chemic.	• X															
B 1	ISUAL DAT	AMWX																
Tir	ne Ser	ies Plot of	Chemi	cal Viscos	sity													
																		٨
		1	'ime Seri	es Plot of (Chemical	Viscosity												
	45 Chemical Viscosity 47 55 54 54 54 54 54 54 54 54 54 54 54 54	M	W	\mathcal{N}	~													
•	CS	C6	C7	C8	C9	C10	C11	C12	C13		C14	C15	C16	C17	C18	C19	C20	4
			Pizza Hut 173			Domino's Pizza		Size of Flat (Coded)		(Coded) 315		Hour	Chemical Viscosity 47.9					
		150	95		158	289		23		229		2	47.9					
		186	154			254		26		355		3	48.6					
		100	104			234		20		261		4	48.0					
2 3		166				282							46.0					
2 3 4		166			101	225				22.4		6	10.1					
2 3 4 5		196	183	139		235		22		234		5						
2 3 4	ры -		183 120	139				22		234 216		5					and a	1
2 3 4 5	þ. H	196 192	183 120	139											-		P-10	-

So, but I am not exploring that much, just wanted to see the data in time series plot.

(Refer Slide Time: 04:18)



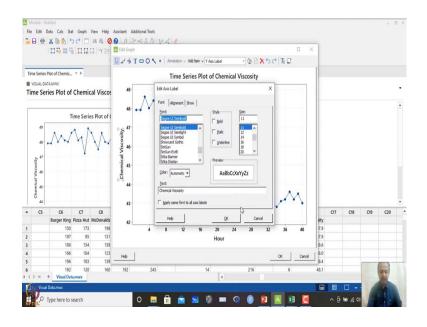
So, if you click ok over here, and then you can see the same graphs what I have copy pasted in the PPTs like that. So, this is the same graph you see. So, hour is on this axis.

(Refer Slide Time: 04:25)

	X 🖻 🙃 🕯		13 4Y 🖂	👪 Edit Graph		• Annotation	 Add item v 	X Avis Label	• 🕸 🖻	×50		<				
Time Series	Plot of Chemic	. • x				Time	Series Plo	t of Chemie	al Viscosity	,						
Time Ser	ries Plot of	Chemi	cal Viscos	49	\mathcal{N}	Edit Axis Label	Show			×						•
7 Chemical Viscosity 2 Presestry 2 Chemical Viscosity 2 Chemical Viscosity		W	es Plot of (44- 43-		Eont: Expose Lis Semial Seope Lis Semial Seope Lis Semial Senoural Gothis SmSun SmSun Exits Sitisa Banner Sitisa Banner Sitisa Banner Sitisa Banner Sitisa Banner Sitisa Banner Sitisa Banner Sitisa Banner Sitisa Disolar Mour Hour	ki n ht v		Stee: 11 12 14 16 18 20 v cXxYyZz		,					
+ C5	C6 Burger King	C7	C8			Нер	1	QK	Ca	ncel		C17 sity	C18	C19	C20	
1	150		198	42-	à	8 1	2 16		24 28	32	36 40	7.9				
2	197		131			•		20 Hote	24 20		30 40	7.9				
	186	154	158					01000				8.6				
3	166	104	123	Help							OK Cancel	1 8.0				
4										_	UK Cance	8.4				
	196	183	139													

And then which can be changed also.

(Refer Slide Time: 04:28)

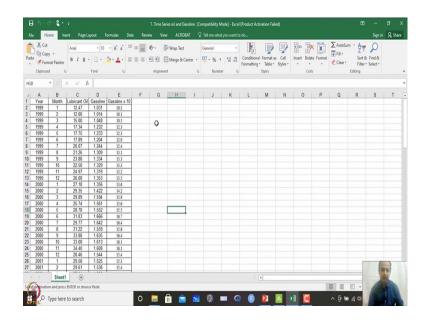


And this is the chemical viscosity y-axis that you can see which can also be changed like that ok. How it helps is that just by seeing the series just by giving the data is not possible to make an interpretation. Here it is clearly visible at a given time point 24 and 25th observation what has happened is that drastically the centering of the data has changed with respect to time.

So, many of the times what we experience is that with respect to time how the accuracy and precision is changing like that. So, variability of the data during certain time point and variability of the data after some improvement has been done. So, those things can be done in quality also.

So, one CTQ is monitored before improvements and after improvements. So, if there is drastic shift in the accuracy level or precision level that will be reflected in the time series plot like that. So, this is possible. And we want to see let us say I take another example from this.

(Refer Slide Time: 05:20)



So, to make some inference out of this. So, this is another example taken from book. And this is year wise and month wise information and then lubricants oil price how it is changing, gasoline price how it is changing like that. So, somebody who has a doubt that price of gasoline is not changing as compared to the lubricant oil price like that.

So, people are not changing equivalently when it is going down lubricant oil price, gasoline price should go down, so it is not happening like that. So, somebody is claiming like that. So, whether it is true or not that we want to see like that ok. So, this is the data set and we want to draw a time series of this data set. And we want to compare the time series to time series like that. So, what I will do is that I will copy the same data set over here.

(Refer Slide Time: 06:08)

🔠 Minita																			-	8 ×
File Ec		Data Calc Stat		scatter Scatter Matrix Bubble Margin	plot Plot Plot	Assistant A	金品 静			'Y 🔀 🗖	er i	k 🖏 🕅								
I VISU	LO	s Plot of Chemic ATAMWX eries Plot of (Tin	1	Probab Empirio	nd-Leaf lity Plot	on Plot	osity			×										•
	43	M	. 111	Boxplo Interval	L., Plot., val Value Plot.															
Viscosit	46			Bar Cha Pie Cha																
Cher	45		M 3	Area Gr					-											
	44	C6	67	Contou 3D Scat			C10	C11	-	C12	1	C13	C14	C15	C16	C17	C18	C19	C20	Ŧ
-		Burger King F			ace Plot		no's Pizza	cii	Size of		Price fo	r the Flat (Coded)	614	Hour	Chemical Viscosity	CIT	Year	Month	Lubricant	Oil
1		150		173	198	158	289			21	3	315		1	47.9		1999	1	1	2.47
2		197		95	131	195	273			11	3	229		2	47.9		1999	2	1	2.00
3		186		154	158	177	254			20		355		3			1999	3		5.00
4		166		104	123	147	282			20		261		4			1999	4		7,34
5		196		183	139	181	235			23		234		\$			1999	4	-	7.75
6 H 4 5 H	n Visu	+ Visual Data. al Data.mwx		120	160	192	245			14	4	216		6	48.1		1999	-	-	
NPTE	þ	Type here to se	arch				0 🔒	-		M () =	• @ ®	23		×11 🧧		100 / 100			1

And you can draw individual plots like that. So, what you see is that with respect to time. So, graph time series what we can do is that.

(Refer Slide Time: 06:16)

File		Data Calc Sta		M H 0	0 fx	3* -1 A P		€ # # 'Y ⊵	8 K ¥ 1								- 8
Tim	e Series	Plot of Chemic	v x														
-	ne Ser	ies Plot of	Chemic	al Viscos	ity												2
							Time	Series Plots			×						
Г		т	ime Serie	es Plot of C	hemical	Viscosity		imple With Groups									
	Chemical Viscosity		V	A ~				utiple Multiple with Groups	OK 2	Cancel							
•	CS	C6	C7	C8	C9	C10 Domino's Pizza	C11	C12		13	C14	C15	C16	C17	C18	C19 Month	C20 Lubricant O
1		Burger King 150	173	198	Subway 158	289		Size of Flat (Coded) 23	Price for th	315		Hour	Chemical Viscosity 47.9		Year 1999	Month	12.4
2		197	95	131	195	273		18		229		2			1999	2	
3		186	154	158	177	254		26		355		3			1999	3	
		166	104	123	147	282		20		261		4	48.0		1999	4	
5		196	183	139	181	235		22		234		5	48.4		1999	4	17.7
6		192	120	160	192	245		14		216		6	48.1		1999		-
4	D H Visual	+ Visual Dat Data.mwx	a.mwx						4							-	
	Q	Type here to s	search			0 冒	-	💼 🖬 🔮		Q 🛛	22		1		90 / de		16

Time series plot over here, simple time series I do over here.

(Refer Slide Time: 06:19)

			00	# # @	0 fx	Additional Tools 음악 - 3: 유 왕 / 날 4 노 ★ 작 왕 왕 # 卷 4 📓 윤 노 ★		8K * \$	10								
Tim	e Serie	s Plot of Chemic.	. * X														
_		ATAMWX									_						•
Tin	ne Se	eries Plot of	Chemic	al Viscos	sity	Time Series Plot:	Simple				×						
	Chemical Viscosity	, M	fime Serie	es Plot of C	Themical	C7 Pizzi Hut C8 McCondig C9 Submay C10 Dominols F C12 Size of Re C13 Floor C16 Hour C16 Hour C16 Hour C16 Year C19 Manth C10 Lubroant C10 Lubroant C10 Lubroant C10 Sosher C12 Gasohe X	IZZA (Coded) scosity J. <u>TrefScale.</u> M. <u>Multiple Graph</u>	jak s Dgta C	zis	Qata Vew							•
+	CS	C6	C7	C8	C9	c Help			× _	Cancel		C16	C17	C18	C19	C20	T
		Burger King	Pizza Hut	McDonalds	Subway	Domino's Pizza	Size of Flat (Coded) Price for the	Flat (Coded)		Hour	Chemical Viscosity		Year	Month	Lubricant C	ál.
1		150	173	198	158	289	2	3	315		1	47.9		1999	1	12.4	7
2		197	95	131	195	273	1	8	229		2	47.9		1999	2	12.0	0
3		186	154	158	177	254	2		355		3	48.6		1999	3	15.0	0
4		166	104	123	147	282	2	0	261		4	48.0		1999	4	17.3	4
5		196	183	139	181	235	2	2	234		5	48.4		1999	4	17.3	5
6		192		160	192	245	1		216		6	48.1		1999		90	
E	Visi	+ Visual Dat al Data.mex Type here to :				0 📑 🖥	A A A A	•	<u>ହ</u> 🚯				- @ ₩				

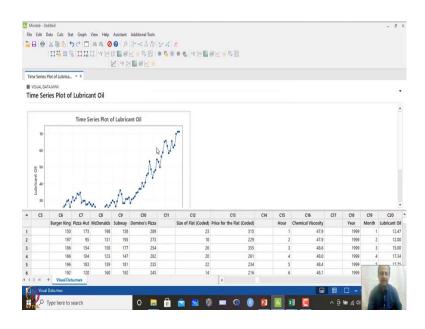
And then in that case lubricant oil and I paste the timing over here.

(Refer Slide Time: 06:22)

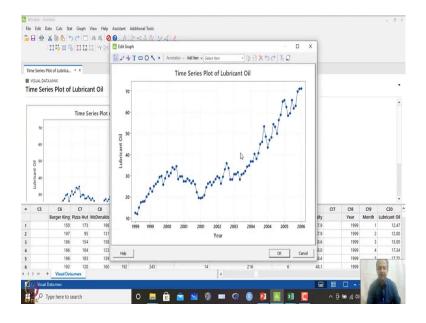
Time Ser				2 4Y 2	E 10											
	ries Plot of Chemic.	. • ×														
-	Series Plot of	f Chemic	al Viscos	ity	Time	e Series Plot:	: Time/Scale				×					
					Time	Axes an	nd Ticks Gridlin	es Reference Ine	1			-				
	a	W	es Plot of C	3	0000000	3 McDonali 9 Subway 10 Domino? 12 Size of F	ut Ids	C Index C Galendar C Clock G Stamp		Seat's.						
Chemical V	45 - 45 - 44 -					15 Hour 16 Chemica 18 Year 19 Month 20 Lubricar	r the Flat (Cr al Viscosity nt Ol e e x 10	Year	: (1-3, innermost	× .						
Chemical Viscosity	45 45 23 C6	C7	C8	C9		15 Hour 16 Chemica 18 Year 19 Month 20 Lubricar 21 Gasoline 22 Gasoline Selec	r the Flat (Cr al Viscosity nt Ol e e x 10	-	(1-3, innermost	N V	Canzel	C16	C17	C18	C19	C20
Chemical Viscosity	es es cs C6 Burger King	Pizza Hut	McDonalds	Subway		15 Hour 16 Chemica 18 Year 19 Month 20 Lubricar 21 Gasoline 22 Gasoline Selec Help	r the Flat (Cr al Viscosity nt Ol e e x 10	Year	(1-3, innermost	×	Cancel	Chemical Viscosity		Year		Lubricant
Chemical Viscosity	25 C6 Burger King 150	Pizza Hut 173	McDonalds 198	Subway 158		15 Hour 16 Chemica 18 Year 19 Month 20 Lubricar 21 Gasolne Selec Help 289	r the Flat (Cr al Viscosity nt Ol e e x 10	Year 23	(1-3, innermost	۲ ۲ ۲ ۲ ۲	Cancel	Chemical Viscosity		Year 1999	Month 1	Lubricant
Chemical Viscosity	25 C6 Burger King 150 197	Pizza Hut 173 95	McDonalds 198 131	Subway 158 195		15 Hour 16 Ohemica 18 Year 19 Month 20 Lubricar 21 Gasolne 22 Gasolne Help 289 273	r the Flat (Cr al Viscosity nt Ol e e x 10	23 18	(1-3, intermost	2× 5 315 229	Cancel	Chemical Viscosity 1 47.1 2 47.1		Year 1999 1999		Lubricant 12.
Chemical Viscosity	25 C6 Burger King 150 197 186	Pizza Hut 173 95 154	McDonalds 198 131 158	Subway 158 195 177		15 Hour 16 Ohemicz 18 Year 19 Month 20 Lubricar 21 Gasoline Solid Help 289 273 254	r the Flat (Cr al Viscosity nt Ol e e x 10	Year 23 18 26	(1-3, intermost	2K 315 229 355	Cancel	Chemical Viscosity 1 47.1 2 47.1 3 48.0		Year 1999 1999 1999	Month 1	Lubricant 12. 12. 12.
Chemical Viscosity	25 C6 Burger King 150 197	Pizza Hut 173 95 154 104	McDonalds 198 131	Subway 158 195		15 Hour 16 Ohemica 18 Year 19 Month 20 Lubricar 21 Gasolne 22 Gasolne Help 289 273	r the Flat (Cr al Viscosity nt Ol e e x 10	23 18	(1-3, intermost	2× 5 315 229	Cancel	Chemical Viscosity 1 47.1 2 47.1 3 48.1		Year 1999 1999	Month 1	Lubricant 12.

I change the stamp and I make it let us say year over here and I click that one and I click OK.

(Refer Slide Time: 06:31)

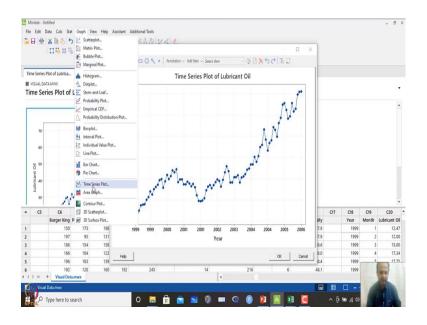


(Refer Slide Time: 06:32)



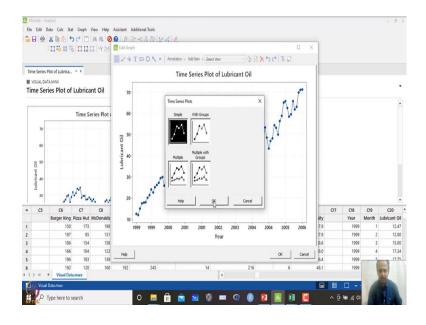
So, I get the trend of this data set, and I see that there is increasing trend that you can see over here time series plot of the data and quite obvious that with respect to year. With respect to time what is happening is that price is increasing like that.

(Refer Slide Time: 06:50)



Similarly what we can do is that we can also see plots over here. Again I can draw a plot time series plot over here.

(Refer Slide Time: 06:52)

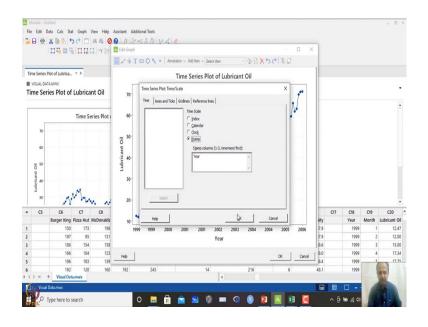


(Refer Slide Time: 06:54)

			4Y 🔀 🛛	624	T	O S • Arnot	tation v	Add Item v S	elect Rem		1	X Sd	T	0 ×					
ime Series Pl	lot of Lubrica	×					Time	Series P	lot of Lu	ubricant	Oil								
VISUAL DATA							_												
ime Seri	ies Plot of L	ubricant	Oil	70		Time Series Plot: Sim	nple						X	200					
						C1 Layer Thidness	_	Series:						*1					
		Time Serie	s Plot	60			Cou	Gasolne			_	A	1	1.					
		rine verie				C3 Marks in Quality C6 Burger King C7 Pizza Hut C8 McDanalds C9 Subway							ľ						
70				- 50															
				lio 30		C10 Domino's Pizza C12 Size of Flat (Co	aded)												
60				Int		C13 Price for the Fi													
						C15 Hour													
				20Lic 40		C16 Chemical Visco C18 Year		Ţme/Scale.		Labels	1	Data View	1						
10 SO			-	Lubricant Oil & &		C16 Chemical Visco C18 Year C19 Month	isity .					Qata View	-						
cant Oil				_		C16 Chemical Visco C18 Year C19 Month C20 Lubricant Oil C21 Gasoline	isity .	Ţime/Scale. Multiple Graph		Labels		Qata View	-						
ubricant Oil & &				Lubrica 8		C16 Chemical Visco C18 Year C19 Month C20 Lubricant OI	isity .					Qata View							
ant O	N	Mm	~	_	ie -	C16 Chemical Visco C18 Year C19 Month C20 Lubricant Oil C21 Gasoline	isity .					Qata Wew							
Lubricant O	AM C6	Man	~	30	ie -	C16 Chemical Visco C18 Year C19 Month C20 Lubricant Ol C21 Gasoline C22 Gasoline x 10	isity .					Data Wew.				C17	C18	C19	C20
S Lubricant O	C6 Burger King Pi			30		C16 Chemical Visco C18 Year C19 Month C20 Lubricant Ol C21 Gasoline x 10 Select	isity .								sity	C17	C18 Year		C20 Lubricant O
S Lubricant O		zza Hut Mc 173		30		C16 Chemical Visco C18 Year C19 Month C20 Lubricant Oil C21 Gasolne C22 Gasolne x 10 Select Help	isity .	Multiple Graph					2005	2006	7.9	C17			
S Lubricant O	Burger King Pi 150 197	zza Hut Mc 173 95	Donalds 198 131	30	1	C16 Chemical Visco C18 Year C19 Month C20 Lubricant Oil C21 Gasolne C22 Gasolne x 10 Select Help	sity .	Multiple Graph	s D	gta Options.		Cancel		2006	7.9 7.9	C17	Year 1999 1999		Lubricant O 12.4 12.0
S Lubricant O	Burger King Pi 150 197 186	zza Hut Mc 173 95 154	Donalds 198 131 158	30	1	C16 Chemical Visco C18 Year C19 Month C20 Lubricant Oil C21 Gasolne C22 Gasolne x 10 Select Help	sity .	Multiple Graph	5 D	gta Options.		Cancel		2005	7.9	C17	Year 1999	Month 1	Lubricant O 12.4 12.0 15.0
S Lubricant O	Burger King Pi 150 197 186 166	zza Hut Mc 173 95 154 104	Donalds 198 131 158 123	30 20 10	1	C16 Chemical Visco C18 Year C19 Month C20 Lubricant Oil C21 Gasolne C22 Gasolne x 10 Select Help	sity .	Multiple Graph	5 D	gta Options.		Cancel		2006	7.9 7.9 8.6 8.0	C17	Year 1999 1999 1999 1999	Month 1 2	Lubricant O 12.4 12.0 15.0 17.3
S Lubricant O	Burger King Pi 150 197 186	zza Hut Mc 173 95 154	Donalds 198 131 158	30	1	C16 Chemical Visco C18 Year C19 Month C20 Lubricant Oil C21 Gasolne C22 Gasolne x 10 Select Help	sity .	Multiple Graph	s D 2002 Year	gta Options.		Cancel	2005		7.9 7.9 8.6	C17	Year 1999 1999 1999	Month 1 2	Lubricant O 12.4 12.0 15.0

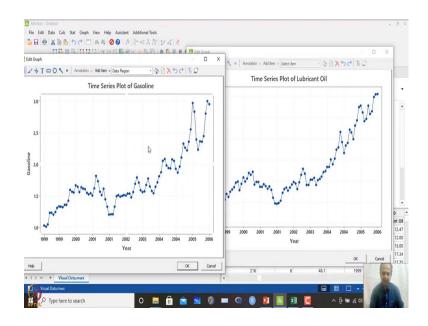
So, in this case, what I can do is that gasoline price also I can plot. So, with respect to time axis will be same because it is with respect to year.

(Refer Slide Time: 07:00)



So, I can plot this one also.

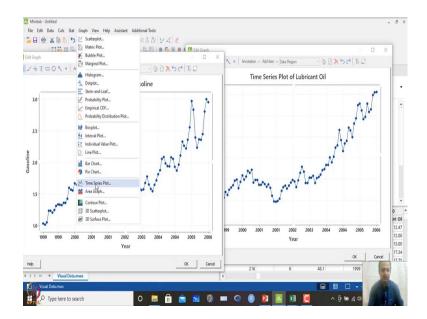
(Refer Slide Time: 07:04)



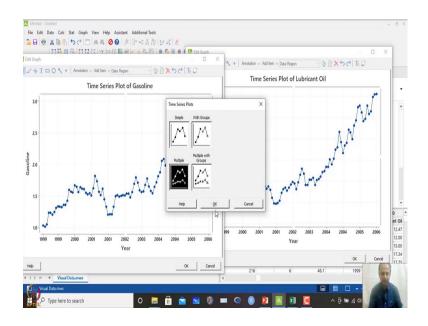
So, here also what we see is that, we can see that both the graphs is showing an increasing trend. So, in my mind, what comes is that one is increasing other is also increasing like that ok. So, when you do it in separate graphs and place side by side in that case because the unit of measurement is very different, here it is a unit varies from 1 to 3, and here the unit varies from 10 to 70 like that so in this case ok.

So, if you want to plot simultaneously one with the other like that in same graphs, what is the possibility we have?

(Refer Slide Time: 07:35)

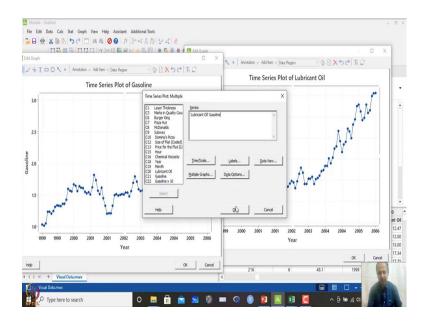


(Refer Slide Time: 07:37)



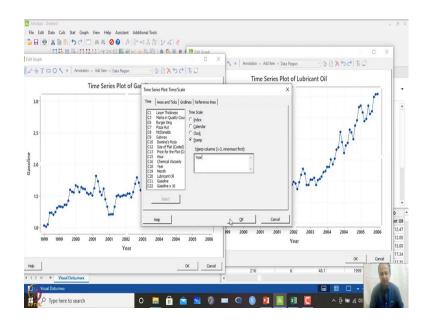
So, in graphs if you go to time series and then multiple graphs, you have options over here to see that both the series is like that.

(Refer Slide Time: 07:43)



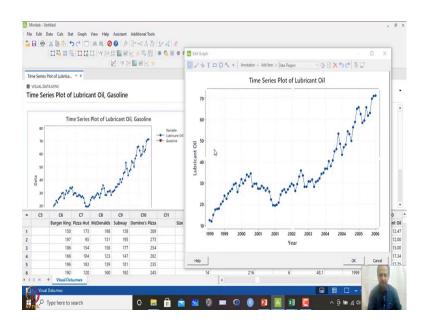
So, if you do like that and say lubricant oil and gasoline price I want to plot that in same and year remains same.

(Refer Slide Time: 07:50)



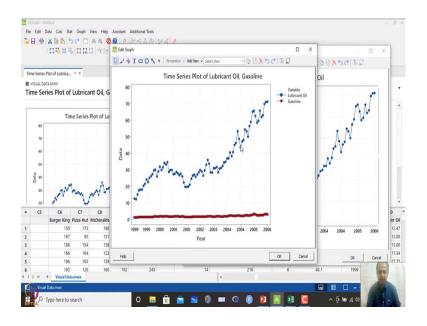
So, the same year I will use stamp over here and I use a year as the basis of this. So, this will be stamped like that. So, then you click ok over here what you will see is that you will find that this is not required.

(Refer Slide Time: 08:04)



So, this is the graph where both the plots are done.

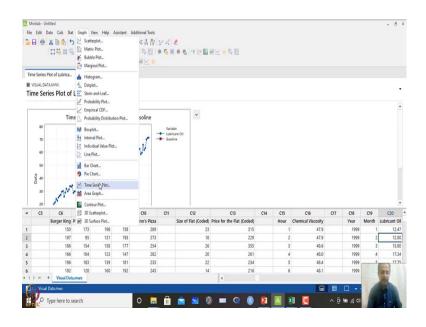
(Refer Slide Time: 08:08)



And the problem with this graph is that you see lubricant price is changing, but earlier graph what we have seen that oil price, gasoline price is also changing. But it is not showing like that because the axis that the MINITAB is using is very different because this is in a range of 1 to 2 scales or something like that and this is in a range of 10 to 70 like that. So, this will not match like that.

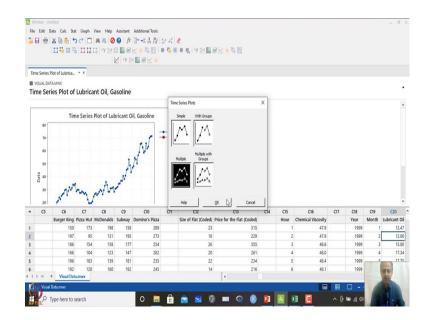
So, what we can do is that we can multiply this. So, this data set what I have done is that this gasoline price was multiplied with 10 and this is the only I have changed the scale only I have changed the scale, so that easy to plot like that and compare those two plots like that.

(Refer Slide Time: 09:00)

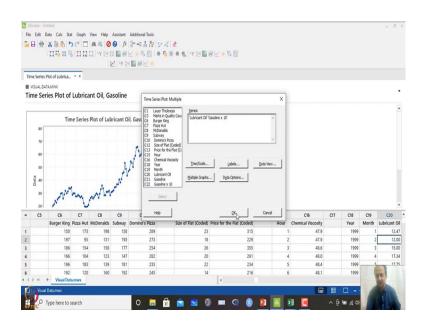


So, instead of what I have done is that instead of this type of plot what I will do is that, I will just use multiplication of 10 and then try to compare the graphs like that. So, in this case, whether both are changing in the similar direction or not that is the concern what people are raising questions, that one is increasing other is increasing, but when is one is decreasing other is not decreasing. So, they are saying that company is doing some manipulation over here. So, we want to prove that.

(Refer Slide Time: 09:22)

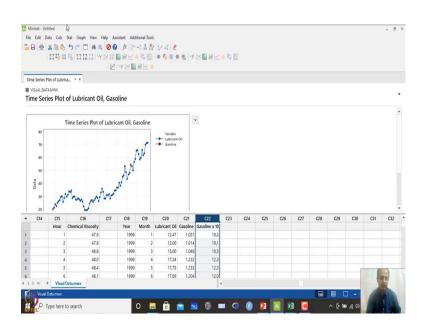


(Refer Slide Time: 09:25)



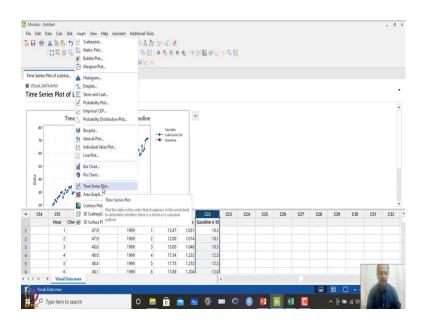
So, over here what we can do is that again we can do go to time series, and what we can do multiple time series like that instead of. So, I will remove this one. So, I will place delete this one, and then I will place lubricant oil, and gasoline multiplied by 10. So, in same, so I have just changed the scale over here.

(Refer Slide Time: 09:40)

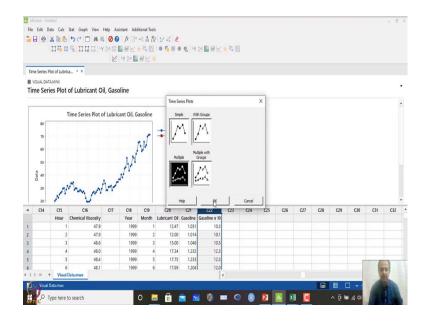


So, in this case, what you can see is that if you go on the right hand side, so this multiplied by 10 I have copy pasted this information over here complete information. So, I will plot lubricants and also gasoline multiplied by 10.

(Refer Slide Time: 09:50)



(Refer Slide Time: 09:53)



So, in this case, what I will do is that, I will go to time series, and then I will go to multiple chart and I will click ok.

(Refer Slide Time: 09:55)

Lubrica • ×															
										N.					
	nt Oil, Gas	oline								6					
			-	ieries Plot: Multiple	1				×						
Time Series	Plot of Lubr	icant Oil, G	C7 C8 C9 C10 C12 C13 C15 C16 C18 C19 C20 C21	Burger King Pizza Hut McDanalds Szibmay Domino's Pizza Size of Flat (Coderd) Price for the Flat (C Hour Chemical Viscosity Year Month Lubricant Oll Gasolne	Dre/Sc	ale	Labels	Qata Wes							
			-	Help			QK	Cance		637	C30	(30	C30	e14	C32
			Month	Lubricant Oil O	asoline Ga	soline x 10				Cer	660	629	050	Car	632
			1												
2	47.9	1999	2	12.00	1.014	10,1									
		1000	3	15.00	1.048	10.5									
3	48.6	1999													
3	48.6	1999		17.34	1.232	12.3									
3 4 5				17.34	1.232									_	
	5 C16 ur Chemical Visc	MMmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmmm	MMMMMMMM s C(6 C17 C(8 r Chemical Viscoility Vicar 1 47.9 1999	Time Series Plot of Lubricant Oil, Gase 0 0 0 0 0 0 0 0 Chemical Viscosity C18 0 Chemical Viscosity 1 1 Chemical Viscosity 1	C P Rath C P Rath	C P R2m ht C P R	C? Para M B PACOND C0 Deray M C0 Deray M	4 C/2 C/3 C/4 C/4	4 C7 RNA M. C8 C7 RNA M. C8 C7 RNA M. C8 C7 RNA M. C8 C8 C7 RNA M. C8 C8 C7 C16 C7 C16 C7 C18 Month Ubiticant OI C8 C9 California C18 C16 C7 C18 Month C18 C16 C7 C18 C16 C17 C18 C17 C	C/ Praint 4/ Con Mondali Con Con Con Mondali Con Con Con Mondali Con Con Con Mondali Con Con Con Con Mondali Con Con Con Con Mondali Con Con Con Con Con Con Con Con Con Con	C7 Page 14 d. McOvel C7 C7 Page 14 d. McOvel C7 C7 <t< td=""><td>C/2 Part Mit (C) C/2 C/2 C/2</td><td>Ci Prantint Ci Ci Prantint Ci Ci Ci</td></t<> <td>C7 Para M 00 Percovide C8 Percovide C9 Percovide</td> <td>Ci Ci Ci<</td>	C/2 Part Mit (C) C/2 C/2	Ci Prantint Ci Ci Prantint Ci Ci Ci	C7 Para M 00 Percovide C8 Percovide C9 Percovide	Ci Ci<

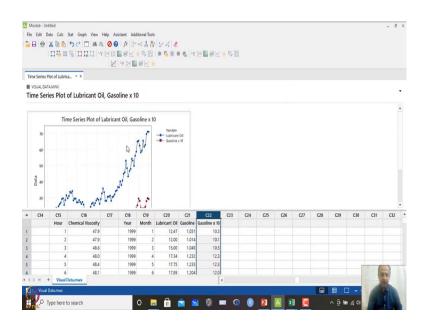
So, I will write lubricant and I will place gasoline multiplied by 10.

(Refer Slide Time: 10:02)

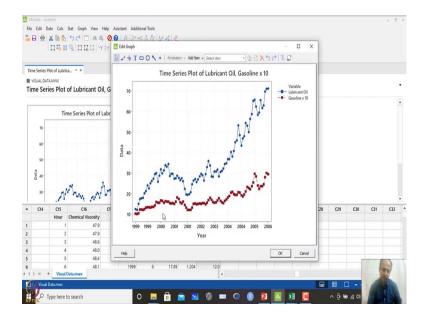
					3 K *											
VISUAL DA		a × × of Lubricant O	il, Gaso	line	Time Series Plo						×					
80 70 60 50	1	ïme Series Plot c	f Lubric	ant Oil, Ga	C1 Layer 1 C3 Marks 1 C6 Burger C7 Pizza H C8 McDon C9 Subwa C10 Domin C12 Size of C13 Price f C15 Hour	Thickness n Quality Cou King Lut alds	C Galendar C Clods C Stamp	umns (1-3, innerr	ost first):							
50 Data 20	M	m	bur	NTY	C19 Month C20 Lubric C21 Gasoli C22 Gasoli	ant Oil			×							
30	C15	C16	C17	C18	C19 Month C20 Lubric C21 Gasoli C22 Gasoli	ant Ol ne ne x 10			~	Cancel	C27	C28	C29	C30	C31	C32
30 20	C15 Hour	Chemical Viscosity	C17	C18 Year 1999	C19 Month C20 Lubric C21 Gasoli C22 Gasoli	ant Ol ne ne x 10	1.031	10.3	~ ~	Cancel	27	C28	C29	C30	C31	C32
30 20			C17	Year	C19 Month C20 Lubric C21 Gasoli C22 Gasoli	ant OI re re x 10 ect	1.031	10.3 10.1	~ ~	Cancel	C27	C28	C29	C30	C31	C32
30 20	Hour 1	Chemical Viscosity 47.9	C17	Year 1999	C19 Month C20 Lubric C21 Gasoli C22 Gasoli Help 1	ant Ol he re x 10 ect 12.47			~ 25	Cancel	27	C28	C29	C30	C31	C32
30 20	Hour 1 2	Chemical Viscosity 47.9 47.9	C17	Year 1999 1999	C19 Month C20 Lubric C21 Gasoli C22 Gasoli Help 1	ant Oll te x 10 ect: 12.47 12.00	1.014	10.1	~	Cancel		C28	C29	C30	C31	C32
30 20	Hour 1 2 3	Chemical Viscosity 47.9 47.9 48.6	C17	Year 1999 1999 1999	C19 Month C20 Lubric C21 Gasoli C22 Gasoli Help 1	ect 12.47 12.00 15.00	1.014 1.048	10.1 10.5	×	Cancel	C27	C28	C29	C30	C31	C32

Time stamp over here, year it is stamped already. So, in this case, I will click OK.

(Refer Slide Time: 10:06)



(Refer Slide Time: 10:08)



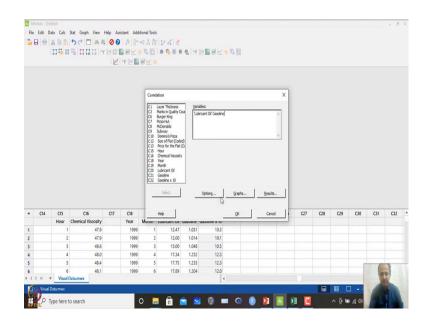
So, now, some fair comparison can be done. You see some amount of variability is increasing trend, not so much increasing what is seen in gasoline lubricant oil, but it is steadily increasing. So, what we can see the trend is also following a pattern, but the gap is quite high over here because the scale is different over here.

(Refer Slide Time: 10:37)

	Data Calc 1	Stat Graph View I Basic Statistics Regression		Displa		e Statistics	Lv	XBSK	- 34 NO									- 8
		ANOVA DOE Control Charts Quality Tools		1-Sam		ſy												
		Reliability/Survival Predictive Analytic Multivariate Time Series Tables Nonparametrics	s	2 Prop	d t portion portions sple Poissor sple Poissor		n	ita	b	\geq								
		Equivalence Tests Power and Sample		1 Varia	ances		Ne	Open Cti w Project Cti										
								and shares on	LAY.									
• CI-	4 C15	C16	C17	0 ² Covar A Norm - Outlie	iande ality corre relation	lation In the strength I Inship between t fest for Poisson. C20		orksheet Ctu of the linear	1+N C23	C24	(25	C26	627	C28	C29	C30	C31	C32
CI		C16 Chemical Viscosity	C17	0 ² Covar Norm → Outlie λ Goode	iande2 uality Corre tr Te Measu relation ness-of-Fit [*] C19	ire the strength a nship between t lest for Poisson	nd direction wo variables C21	of the linear		C24	C25	C26	C27	C28	C29	C30	G1	C32
			C17	α ² Covar Δ Norm → Outlie λ Goods C18	iande2 uality Corre tr Te Measu relation ness-of-Fit [*] C19	re the strength i nship between t fest for Poisson. C20	nd direction wo variables C21	of the linear		C24	C25	C26	C27	C28	C29	C30	C31	C32
		Chemical Viscosity 47.9 47.9	C17	σ² Covar Δ Norm • Outlie λ Good C18 Year 1999 1999	iandad. ality or Te Measure relation ness-of-Fit C19 Month 1 2	re the strength i nship between t fest for Poisson. C20 Lubricant Oil 12.47 12.00	rid direction C21 Gasoline 1.031 1.014	C22 Gasoline x 10 10.3 10.1		C24	C25	C26	C27	C28	C29	C30	C31	C32
		Chemical Viscosity 47.9 47.9 48.6	C17	0 ² Covar ▲ Norm → Outlie λ Good C18 Year 1999 1999	iando uilty or Te relation ness-of-Fit C19 Month 1	re the strength i nshib between t fest for Poisson. C20 Lubricant Oil 12.47 12.00 15.00	nd direction wo variables C21 Gasoline 1.031 1.014 1.048	C22 Gasoline x 10 10.3 10.1 10.5		C24	C25	C26	C27	C28	C29	C30	C31	C32
	Hour 1 2	Chemical Viscosity 47.9 47.9 48.6 48.0	C17	0 ² Covar ▲ Norm → Outlie → Outlie → Ct8 Year 1999 1999 1999	ianda. ality or Te Measure relationess-of-Fit C19 Month 1 2 3 4	re the strength i nship between t fest for Poisson. C20 Lubricant Oil 12.47 12.00 15.00 17.34	nd direction wo variables C21 Gasoline 1.031 1.014 1.048 1.232	C22 Gasoline x 10 10.3 10.1 10.5 12.3		C24	C25	C26	C27	C28	C29	C30	C31	C32
 C1 I I I I I I I 	Hour 1 2	Chemical Viscosity 47.9 47.9 48.6 48.0 48.4	C17	σ² Covar Δ Norm • Outlie λ Goodi C18 Year 1999 1999 1999 1999 1999 1999 1999 1999	ianda ality or Te Measure relation ct9 Month 1 2 3	re the strength i nship between the est for Poisson. C20 Lubricant Oil 12.47 12.00 15.00 17.34 17.75	rid direction wo variables C21 Gasoline 1.031 1.014 1.048 1.232 1.233	C22 Gasoline x 10 10.3 10.1 10.5 12.3 12.3		Q4	C25	C26	C27	C28	C29	C30	C31	C32
	Hour 1 2 3 4 5 6	Chemical Viscosity 47.9 47.9 48.6 48.0 48.4 48.4 48.1	C17	0 ² Covar ▲ Norm → Outlie → Outlie → Ct8 Year 1999 1999 1999	ianda. ality or Te Measure relationess-of-Fit C19 Month 1 2 3 4	re the strength i nship between t fest for Poisson. C20 Lubricant Oil 12.47 12.00 15.00 17.34	nd direction wo variables C21 Gasoline 1.031 1.014 1.048 1.232	C22 Gasoline x 10 10.3 10.1 10.5 12.3 12.3	C23	C24	C25	C26	Q7	C28	C29	C30	G1	C32
d b H	Hour 1 2 3 4 4 5 6 ¥ Visual D	Chemical Viscosity 47.9 47.9 48.6 48.0 48.4	C17	σ² Covar Δ Norm • Outlie λ Goodi C18 Year 1999 1999 1999 1999 1999 1999 1999 1999	ianda alfty alfty alfty Corre Meass relation ness-of-Fit C19 Month 1 2 3 4 5	re the strength i nship between the est for Poisson. C20 Lubricant Oil 12.47 12.00 15.00 17.34 17.75	rid direction wo variables C21 Gasoline 1.031 1.014 1.048 1.232 1.233	C22 Gasoline x 10 10.3 10.1 10.5 12.3 12.3	C23	C24	C25	C26	C27				G1	C32
4 b H	Hour 1 2 3 4 5 6	Chemical Viscosity 47.9 47.9 48.6 48.0 48.4 48.4 48.1	C17	σ² Covar Δ Norm • Outlie λ Goodi C18 Year 1999 1999 1999 1999 1999 1999 1999 1999	ianda alfty alfty alfty Corre Meass relation ness-of-Fit C19 Month 1 2 3 4 5	re the strength i nship between the est for Poisson. C20 Lubricant Oil 12.47 12.00 15.00 17.34 17.75	rid direction wo variables C21 Gasoline 1.031 1.014 1.048 1.232 1.233	C22 Gasoline x 10 10.3 10.1 10.5 12.3 12.3	C23	C24	C25	C26	C27	C28		C30	GI	C32

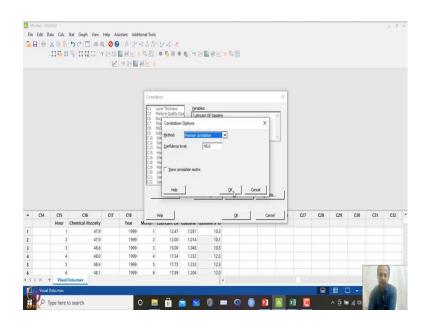
So, to verify whether both are changing simultaneously on the positive side, we can also see the correlation between these two data sets like that. So, what we can do is that, we can also see the correlations. And for that, what we can do is that, we can go to stat again – basic stat.

(Refer Slide Time: 10:47)



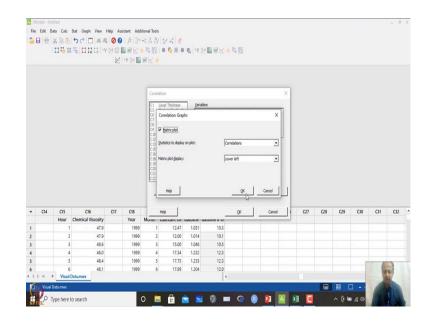
And I want to see let us say correlation between these two variables. So, lubricant and gasoline price I have just highlighted this one. Any of them can be placed first or second, it does not matter.

(Refer Slide Time: 10:55)

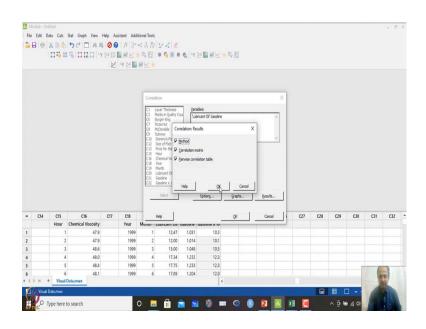


So, in this case option I want to see Pearson relationship between linear relationship I want to see so, but non-linear relationship kind of Spearman correlation can also be used for that. So, if it is I am having an anticipation that there can be non-linear relationship also. So, in that case, we can use the other one options also. So, I am using a linear relationship because more or less it is linear what we have seen. And so what we can do is that Pearson correlation.

(Refer Slide Time: 11:24)



(Refer Slide Time: 11:29)

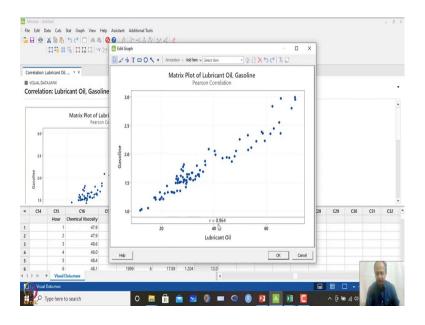


And then matrix plot of this. I want to see correlation. And then results what we can see is that this also is possible, what we can do.

(Refer Slide Time: 11:33)

File	8 2	ata Calc	Stat Graph View		<i>f</i> x]=	-2 人名	2/ 4 € # 1 <mark>0</mark> ∰ 4	F#a∏ \Y	×∎sk	* ⁴ 图									- 6	
Co	relation: L	ubricant Oi	* X																	
	ISUAL DATA	AMWX																		
Co	rrelatio	on: Lubi	ricant Oil, Gaso	line																,
																				ī
			Matrix Plot of Pears	Lubricar		oline														
	3.0						.17													
	25				N															
	0.5 Gasoline			•																
	Gas		1 1	:																
	15		And and	•																
1	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26	C27	C28	C29	C30	C31	C32	į
		Hour	Chemical Viscosity		Year	Month	Lubricant Oil		Gasoline x 10											
		1	47.9		1999	1	12.47	1.031	10.3											
		2	47.9		1999	2	12.00	1.014	10.1											
		3	48.6		1999	3	15.00	1.048	10.5											
		4	48.0		1999	4	17.34	1.232	12.3											
		5	48.4		1999	5	17.75	1.233	12.3									-	-	
		6	48.1		1999	6	17.89	1.204	12.0								-		-	
4	D H +	Visual	Data.mwx						4	1										
	Sec. 10	Data.mwx														III (1	and the	
í	Visual C																			

(Refer Slide Time: 11:35)

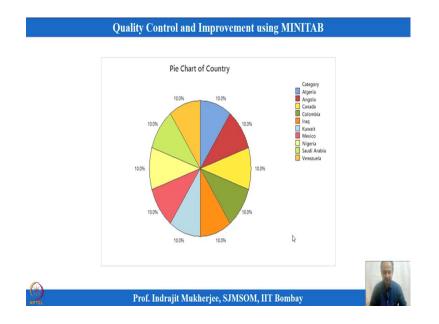


So, then what we will do is that from this data set, when you are plotting gasoline and the r correlation coefficient what we see is that about 0.964. So, you can see that high correlation exist between lubricant oil price and gasoline price like that. So, there is no doubt that when one is increasing, other is also increasing because there is a positive relationship and 0.96 means strong positive relationship basically.

So, our understanding on correlation relationship like that is showing you giving you some interpretation, and that will leading to this will lead to some inference out of this, that means, both the prices are increasing together and decreasing also together like that.

So, there is no as such ambiguity over here, or there is no we cannot blame the companies or something like that manipulating like that. There is a high correlation one is increasing other is also increasing like that. So that is another type of data what we can do in analysis over here which is known as time series part and core relations we have used to do that ok.

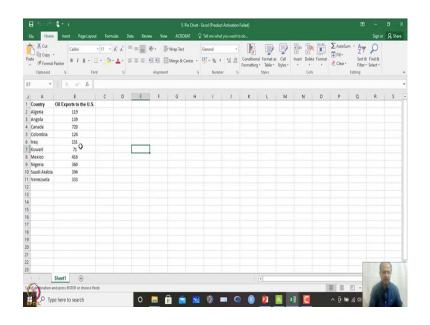
(Refer Slide Time: 12:37)



So, there are other possibilities also like if you have a categorical data like that. So, this is one of the example that we will use over here. We have multiple examples like that also. So, in this case, what happens is that country wise I have some data information of consumptions and in that case I want to see which country is consuming how much in one chart I want to see like that. It is not a continuous data one is categorical variable over here and one is having a numeric variables like that.

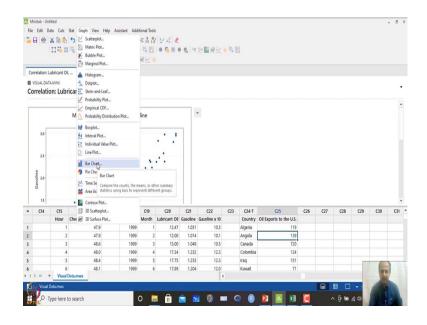
So, in that case, this pie chart and bar diagram are very useful like that. So, I will open a data set which is which can be used for demonstration like that.

(Refer Slide Time: 13:14)



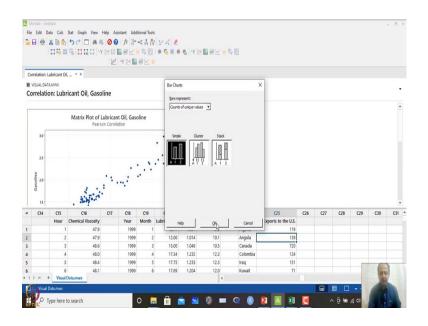
So, I am using a data set which is which shows the country information is given and oil export to US maybe in thousands of dollars like that. So, we can think of some coded data variable over here. So, I have a categorical variable, and I have a numerical variable or continuous variable over here. So, what we can do is that, we can just copy this one and I want to see graphically the distribution of this data.

(Refer Slide Time: 13:44)



And in that case, what I will do is that, I will copy paste this data set over here. And what I can do is that, I go to graph and then there is option of bar chart over here.

(Refer Slide Time: 13:51)



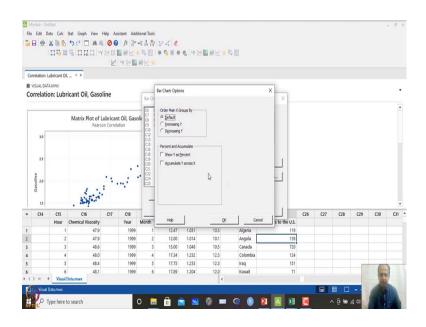
When you go to bar chart, simple bar chart, so count of unique values, so these are unique values. So, I am not taking anything else over here. So, this is the option I have to click.

(Refer Slide Time: 14:01)

		П 10 П	50°□## ©□□□□	20		41日日		# ∀⊵	8K*	4 10							
		Lubricant Oi	l, ♥ X														
-	rrelati		ricant Oil, Gasc	line		Bar Chart:	Counts of unit	que values, Simp	ole		×						
[Matrix Plot of Pears	.ubrica on Corre	nt Oil, Gasc lation	C7 Pizza C8 McDi C9 Subv	nalds nay ino's Pizza	Categorical Country	variables:		× 1						
	2.5 - 2.0 -		1.5			C13 Price C15 Hou C16 Che C18 Yea C19 Mon C20 Lube C21 Gas C22 Gas C22 Gas	nical Viscosit th icant Oil oline oline x 10	Chart Ops: Data View		Scale	Labels Dgta Options						
	15		A Martin	•			elect			La.							
+	C14	C15	C16	C17	C18	Help				QK	Cancel	C26	C27	C28	C29	C30	C31
		Hour	Chemical Viscosity		Year	Month Lu		Sasoline Gas			Oil Exports to the U.S.						
1		1	47.9		1999	1	12.47	1.031	10.3	Algeria	119						
2		2	47.9		1999	2	12.00	1.014	10.1	Angola Canada	139						
3		4	48.0		1999	4	17.34	1.232	12.3	Colombia	124						
5		5	48.4		1999	5	17.75	1.233	12.3	Iraq	151				_	_	_
6		6	48.1		1999	6	17.89	1.204	12.0	Kuwait	71						3
4	Þ. H	+ Visual	Datamwx						4							1	1

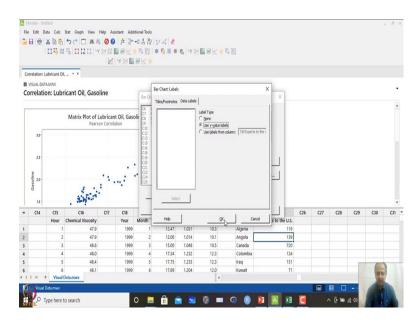
So, simple bar chart like that. So, categorical variable what we can do is that country is the option. So, it is automatically taking. So, I have you can also just type this one as country over here.

(Refer Slide Time: 14:14)



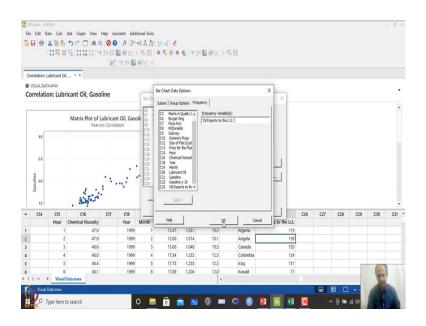
And chart option over here, nothing you have to do scaling and all is not required.

(Refer Slide Time: 14:18)



Data labels, if you want to see. So, I am using either you use none, or the frequency can be shown, so how many observations like that. So, this, this can be seen like that. So, what is the value of that like 139 for Angola, 139 will be plotted on top of that will be written on top of that on the y-axis ok.

(Refer Slide Time: 14:38)



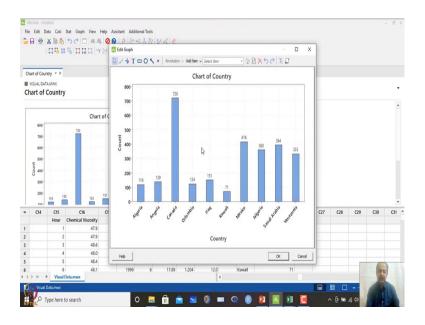
So, data option over here which is the data options. So, in this case, frequency can be used and I have taken oil export as the frequency variable over here.

(Refer Slide Time: 14:50)

I VISU	UAL DAT	ntry × × AMWX Country																	
I VISU	UAL DAT	AMWX																	
			/																
				Char	t of Cou	untry													
	800 - 700 -		720																
	600																		
tut	500																		
Count	400					455	R	164											
	5-10		_			455	100	394											
	300					255		and the second se											
		110 1	10	124	151	415		and the second se											
	300 - 200 -	—		124		71	360	333										-	
	300 · 200	CIS	CI	6	151 C17	71 C18	360 C19	C20	C21 Gasoline	C22 Gasoline x 10		24-T	C25 Oil Exports to the U.S.	C26	C27	C28	C29	C30	CI
,	300 - 200 -	—		6		71	360 C19	333			Co	untry	C25 Oil Exports to the U.S. 119	C26	C27	C28	C29	C30	G
	300 - 200 -	CIS	CI	6 Viscosity		C18 Year	360 C19	C20 Lubricant Ol	Gasoline	Gasoline x 10		eria	Oil Exports to the U.S.	C26	C27	C28	C29	C30	G
	300 - 200 -	C15 Hour	CI	6 Viscosity 47.9		71 C18 Year 1999	C19 Month	C20 Lubricant Oil 12.47	Gasoline 1.031	Gasoline x 10 10.3	Co Alge	eria gola	Oil Exports to the U.S. 119	C26	C27	C28	C29	C30	G
	300 - 200 -	C15 Hour 1 2	CI	6 Viscosity 47.9 47.9		C18 Year 1999 1999	C19 Month 1 2	220 Lubricant Oil 12.47 12.00 15.00	Gasoline 1.031 1.014	Gasoline x 10 10.3 10.1	Co Algi Ang Can	eria gola	Oil Exports to the U.S. 119 139	C26	C27	C28	C29	C30	G
	300 - 200 -	C15 Hour 1 2 3	CI	6 Viscosity 47.9 47.9 48.6		71 C18 Year 1999 1999 1999	C19 Month 1 2 3	C20 Lubricant Oil 12.47 12.00 15.00 17.34	Gasoline 1.031 1.014 1.048	Gasoline x 10 10.3 10.1 10.5	Co Algi Ang Can	eria gola nada ombia	Oil Exports to the U.S. 119 139 720	C26	C27	C28	C29	C30	G

So, in this case, if you click ok what will happen is that you will get this graph over here which shows bar diagram over here.

(Refer Slide Time: 14:52)



Canada is having the maximum over here -720 is the values, and others are like this. So, this can be plotted like this way also ok. So, this is bar diagram. So, in that case, you do not see that like histogram that all are congested means there is no gap between one bin with the other bin over here because this is discrete or categorical units on the x-axis.

So, in that case, this bar diagram will be will have some space in between like that. So, this is one of the reasons why we can differentiate which is a bar diagram, and which is a histogram like that. Histogram will not have any gap, but bar diagram will have this gap like that.

So, and this can also be placed in a different way like pie chart like that. So, this is the total amount. And how much percentage one is consuming as compared to the other one like that like market share when you are showing that one in a pie diagram also is possible. So, this same data I will plot in pie diagram which sometimes helps in a data interpretation. So, I want to see Algeria how much is the oil export as compared to the other one. So, some comparative analysis can also be done.

(Refer Slide Time: 15:59)

👪 Mini																			- 8	×
File		Data Calc	5		oh View Help As: Scatterplot Matrix Plot Bubble Plot Marginal Plot	sistant Addi	4 A B	? 2/ 26 @ ∰ % <mark>0</mark> ∰ 4	⊫ #a sy	X I SK	* \$2 8	1								
	SUAL DA	ntry ~ × TAMWX Countr	у		Histogram Dotplot Stern-and-Leaf Probability Plot Empirical CDF Probability Distribution	n Piot				v										•
	800 700 600 500			14 11	Boxplot Interval Plot Individual Value Plot Line Plot															
	200 · 200 ·	119	139		Bar Chart Pie Chart Time Ser Area Gra Compare the	e proportion o	360 of data in ea	384 333 ach category.												•
+	C14	C15		đ	3D Scatterplot		C19	C20	C21	C22	C23	C24-T	C25	C26	C27	C28	C29	C30	C31	P
		Hour	Cher	8	3D Surface Plot		Month			Gasoline x 10		Country	Oil Exports to the U.S.							
1			1		47.9	1999	1	12.47	1.031	10.3		Algeria	119							
2			2		47.9 48.6	1999	2		1.014	10.1		Angola	139							
3			3		48.0	1999	3		1.048	10.5		Canada Colombia	720							
4 5			4 5		48.0	1999	5		1.232	12.3		Iraq	124							
6			6		48.1	1999	6		1.204			Kuwait	71							
	Visual	+ Visua Data.mwx Type here	to sea				0		1			R 🚯	2 1 1	•		Ⅲ □ ∧ @ ‰				

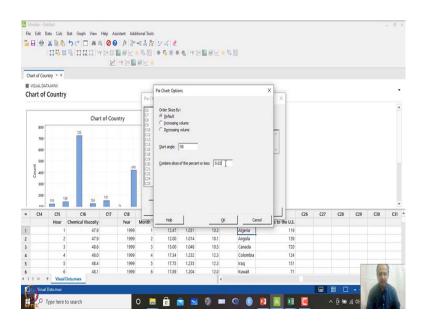
Then I use a different types of graph which is known as pie chart like that.

(Refer Slide Time: 16:04)

	8 2				YM		英国	₩ 4 2 非 7 <mark>0</mark> Ⅲ 非	₩	s k	* 称 图									
Cha	art of Cou	intry × ×																		
_	ISUAL DA																			
Ch	art of	Country	1				Pie Ch	art					×							
Г				Char	t of Cou	ntry	C7 C8	Burger King A Pizza Hut McDonalds		ougts of uniqualities from a f										*
	- 008 - 007 - 000 - 000 - 000 - 000 - 000 - 000	119	720	124	151	- 25	C10 C12 C13 C15 C16 C18 C19 C20 C21 C22 C24	Subway Domino's Pizza Size of Flat (Cod Price for the Flat Hour Chemical Viscost Year Wonth Lubricant Ol Gasoline x 10 Country Ol Exports to the ¥ Select	Categi Count De Optio Multiple Gra	ns Quin	Labels Dajta Optons		< y							
+	C14	C15	CI	6	C17	C18	-	нер			QK	Cano			C26	C27	C28	C29	C30	C31
		Hour	Chemical			Year	Month	Lubricant Oil G				y Oil Expo								
1		1		47.9		1999	1	12.47	1.031	10.3	Algeria			119						
2		2		47.9		1999	2	12.00	1.014	10.1	Angola			139						
3		-		48.6		1999	3	15.00	1.048	10.5	Canada			720						
4		4		48.0		1999	4	17.34	1.232	12.3	Colomb	la		124						
5		1		48.1		1999	6	17.75	1.204	12.5	Kuwait			71					6	3
4	W	Data.mwx	Data.mwx to search	-			0		N			1		×E			■ C ^ @ %■			-

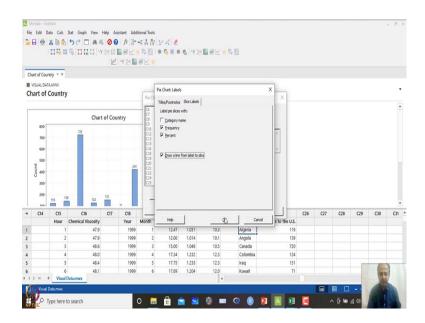
So, in this case, pie chart what we can do is that we have to identify what is the categorical variable which according to which we will stratify. So, I will mention country over here.

(Refer Slide Time: 16:15)



Similarly, pie option over here something we will keep it as default. So, MINITAB will keep it as default. So, combine slice this portion either we keep it 0 or we and this is MINITAB default 0.02 anything less than 0.02 will be combined together like that slide will be combined like that.

(Refer Slide Time: 16:35)



So, I am not going to I am using the default option over here. So, label, if you want to see the labels over here, I can click any of this.; frequency, you want to see percentage, I am interested in percentage. So, I want to see both frequency and percentage let us say. If

you want to see the names of that also that is possible, but we have. So, draw a line from label to slice that is also gives you some visual impact like that.

(Refer Slide Time: 16:57)

hart of Cou	antry × ×		12	чү 🖂 🛄	86*											
VISUAL DA					[Pie Chart: Data O	otions			x						
hart of	Country				Pie Ch	Subset Group O		auency		×						
800 - 700 - 600 - 500 -		Char 720	t of Cou	intry	C6 C7 C8 C9 C10 C12 C13 C15 C15 C16 C18 C19	C3 Marks in C C6 Burger Kr C7 Pizza Hut C8 McDonald C9 Subway C10 Domino's C12 Size of FI C13 Price for C15 Hour C15 Chemical	ng s Pizza at (Cod the Flat	Prequency variable() 'Oil Exports to the U		~ ~						
400 · 200 · 200 · 200 ·	130		151	416	C20 C21 C22 C24 C25	C18 Year C19 Month C20 Lubricant C21 Gasoline C22 Gasoline C25 Oll Expor	x 10 ts to th v									
300 · 200 ·	-	124		71	600000000000000000000000000000000000000	C19 Month C20 Lubricant C21 Gasoline C22 Gasoline	x 10 ts to th v				C26	C27	C28	(29	C30	(3)
300 · 200 ·	C15	C16 ternical Viscosity	151 C17	255 71 C18 Year	C20 C21 C22 C24 C25 Month	C19 Month C20 Lubricant C21 Gasoline C22 Gasoline C25 Ol Expor	x 10 ts to th v	QX	Cancel	s to the U.S.	C26	C27	C28	C29	C30	G
300 · 200 ·	C15	C16 hemical Viscosity 47.9		TI C18 Year 1999	01 02 04 05	C19 Month C20 Lubricant C21 Gasoline C22 Gasoline C25 OII Expor	x 10 ts to th v 1.031	0% 10.3	Cancel Algeria	119		C27	C28	C29	C30	C3
300 · 200 ·	C15 Hour C	C16 temical Viscosity 47.9 47.9		71 C18 Year 1999 1999	C21 C22 C24 C25 Month 1 2	C19 Month C20 Lubricant C21 Gasoline C22 Gasoline C25 Oil Expor Select Help 12,47 12,00	x 10 ts to th v 1.031 1.014	10.3	Algeria Angola	119		C27	C28	C29	C30	C3
300 · 200 ·	C15 Hour C 1 2 3	C16 hemical Viscosity 47.9 47.9 48.6		71 C18 Year 1999 1999 1999	C21 C22 C24 C25 Month 1 2 3	C19 Month C20 Lubricant C21 Gasoline C22 Gasoline C25 Oil Expor Select Help 12,47 12,00 15,00	x 10 ts to th v 1.031 1.014 1.048	10.3 10.1 10.5	Algeria Angola Canada	119 139 720		C27	C28	C29	C30	C3
300 · 200 ·	C15 Hour C 1 2 3 4	C16 hemical Viscosity 47.9 47.9 48.6 48.0		71 C18 Year 1999 1999 1999	C21 C22 C24 C25 Month 1 2 3 4	C19 Month C20 Lubricant C21 Gasoline C22 Gasoline C25 Oil Expor Select Help 12.47 12.00 15.00 17.34	x 10 ts to th v 1.031 1.014 1.048 1.232	10.3 10.1 10.5 12.3	Algeria Angola Canada Colombia	119 139 720 124		C27	C28	C29	C30	C3
300 · 200 ·	C15 Hour C 1 2 3	C16 hemical Viscosity 47.9 47.9 48.6		71 C18 Year 1999 1999 1999	C21 C22 C24 C25 Month 1 2 3	C19 Month C20 Lubricant C21 Gasoline C22 Gasoline C25 Oil Expor Select Help 12,47 12,00 15,00	x 10 ts to th v 1.031 1.014 1.048	10.3 10.1 10.5	Algeria Angola Canada	119 139 720		C27	C28	C29	C30	C

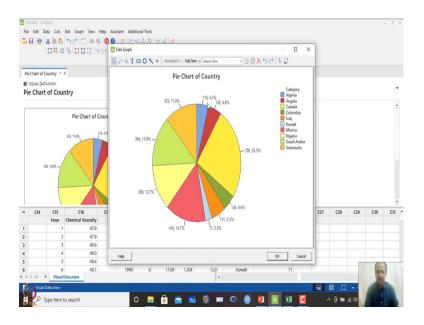
So, in this case, data options frequency over here. So, here already it is taken automatically. So, I will give again oil. If it is not there, you just double click that one. All oil exports is the variable which will be used for this pie diagram like that. I click OK over here and then I click again OK over here.

(Refer Slide Time: 17:16)

File	- -	Data Calc	Stat Graph View		fx 3=	-2 古 計 - 4 日 - 4 日	½ ≪ & ₩ <mark>%</mark> ₩		× - sk	* 15 8	8							- 0 ×
Pie	Chart of	Country ~	×															
_	Chart	t of Cou	ntry															
	1	894 13 <i>9</i> % ~	Pie Chart of 4	199, 429 199, 429 199, -		20, 25, 5%	Category Algeria Angola Canada Canada Iraq Navait Mexico Nigeria Sazul Ar	a										
+	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24-T	C25	C26	C27	C28	C29	C30	C31
		Hour	Chemical Viscosity		Year	Month			Gasoline x 10		Country	Oil Exports to the U.S.						
1		1	47.9		1999	1	12.47	1.031	10.3		Algeria	119						
2		2	47.9		1999	2	12.00	1.014	10.1		Angola	139						
3		3	48.6		1999	3	15.00	1.048	10.5		Canada	720						
4		4	48.0		1999	4	17.34	1.232	12.3		Colombia	124						
5		5	48.4		1999	5	17.75	1.233	12.3		Iraq	151				-	-	_
6		6	48.1		1999	6	17.89	1.204	12.0		Kuwait	71					101	
H d		+ Visual Data.mex	Data.mwx	_			_	_			_						-	
		Type here	to search			0		n n	0	•	20	😰 🔟 🗷			~ @ %a			

What you get is that this diagram you get over here.

(Refer Slide Time: 17:18)



So, not only the colour of this. So, this is Algeria, so it is having a frequency or value is 119. It is contributing about 4.2 percent. So, maximum contribution is let us say 12 point this is this may be 25.5 this is the biggest one slice that you can see. So, in a cake slice with different colours you can think of that.

And this is the way I can think of that which country is contributing how much like that for this specific scenario over here. So, in this case export scenario. So, in US who is contributing how much, so that we can differentiate like country wise also differentiation is possible like that ok. (Refer Slide Time: 18:05)

	at typ path ste shortcut More Copy to Copy Organize Delte Rename Organize	New item • New folder New	Properties History Open	Select all Select none Invert selection Select			
🕂 👻 🛧 🧮 « Pen driv	e Indrajit Oct 2020 → NPTEL Feb 2020 → Final Vi	ideo and Other Details Dece	mber 2020 > Weekwise	Final Slides for Lecture	> Week 1 > MINITAB Data File	~ Ö	🔎 Search MINITAB Data File
Pictures * ^	Name	Date modified	Type	Size			
CV 2015-20	1. Pareto Defect types	01-01-2021 21:57	Microsoft Excel 97	26 KB			
MINITAB Data File	8 2. Cause and Effect	24-12-2020 08:07	Microsoft Excel 97	26 KB			
Presynopsis Report			Microsoft Excel 97	29 KB			
Week 1	3. Histogram Motor Fuel Octane Rating	24-12-2020 08:24	Microsoft Excel W	10 KB			
	4. Box Plot Resturant Example	24-12-2020 08:16	Microsoft Excel 97	29 KB			
OneDrive	8 5. Pie Chart Bar Chart Alcohol Consump	24-12-2020 08:18	Microsoft Excel 97	22 KB			
This PC	1 5. Pie Chart	10.12.2020.10.02	Microsoft Excel W.,	9 KB			
3D Objects	5. Pie Chart Bar Chart Alc Type: Microsoft Excel 97-2		Microsoft Excel 97	23 KB			
Desktop	7. Time Series oil Size: 22.0 KB Date modified: 24-12-2021		Microsoft Excel 97	30 KB			
Documents	7. Time Series Place modified: 24-12-2020	0.08:18	Microsoft Excel W	9 KB			
Downloads							
Music							
Pictures							
Videos							
Local Disk (C:)							
New Volume (D:)							
New Volume (E:)							
INDRAJIT (G:)							
INDRAJIT (G:)							
Network							and a
THE WORK							

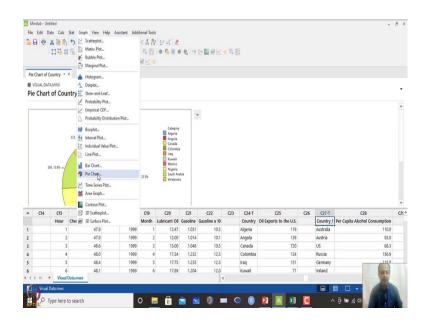
So, similarly, we can draw a another graphical interface over here.

(Refer Slide Time: 18:10)

te	Part Copy *	rs Font rs	= = = =	Aligner	Wrap Text I Merge & Center + I rent S	Seneral . % * % Number	• Con • Form	ditional For natting * T Styl	mat as Ce able - Style es	I Inset	Delete Form Cells	ΣAL at Co	ear *	AT Sort & Find	8
		× √ f Country													
1	A	B	C	D	E	F	G	н	1	J	K	L	М	N	0
	Country	Per Capita Alcohol Consumption													
	Australia Austria	110.0 93.0													
	US	68.3													
	Russia	156.9													
	Germany	115.8													
	Ireland	131.1													
	New Zealand	77.0													
-	India	58.9													
	UK	99.0													
-	Netherland	81.6													
	Trecontinents	01.0													
															(Card)
	She	et1 ④												-	N N
	She	(+) (170						1 (and the second second

So, this is same so, country wise per capita consumption. So, this also we can just illustrate again for your benefit like that.

(Refer Slide Time: 18:20)



I am just copy pasting this one. And in this case, and you see the variable name country is already taken. So, next time MINITAB automatically defines a new variable which is country dash underscore 1 like that. So, in this case, what happens is that MINITAB if there is a same name and MINITAB will automatically change the name and place it like that. So, this is a different variable, we will understand. So, again we will go to graph and then go to pie chart like that.

(Refer Slide Time: 18:45)



And instead of country, we will take country 1 like that and labels over here.

(Refer Slide Time: 18:50)

	1 1 1 13 13		Y M		# ¹⁰ 0 ∰ #	# 'Y ⊵∎	8K*)	¥ 🕅					
ntry ~ ×													
wx f Count	y			-					×				•
31				C12 C13 C15 C16 C18 C19 C20 C21 C22 C24 C24 C25	I Brequency I Bercent								
C15	C16	C17	C18			1	QK	D I		C26	C27-T	C28	C25
Hour Ch	emical Viscosity		Year	Month	Help				s to the U.S.			Capita Alcohol Consumption	
Hour Cr			1999	1	12.47	1.031	10.3	Algeria	119		Australia	110.0	
1	47.9												
1	47.9 47.9		1999	2	12.00	1.014	10.1	Angola	139		Austria	93.0	
1 2 3	47.9 47.9 48.6		1999 1999	3	15.00	1.048	10.5	Canada	720		US	68.3	
1	47.9 47.9		1999		15.00 17.34								
	33 39% ~	Pie Chart of C	Pie Chart of Country	NX Country Pie Chart of Country III 1180 199- 199	VX F Country Pie Chart of Country Pie Chart of Country U2	VX F Country Pic Chart of Country Pic Chart of Country III 118 194 - 194 200 III 118 194 - 194 200 III 118 194 - 194 200 III 118 194 200 III 118 194 200 III 118 194 200 III 118 194 200 III 118 194 200 III 118 III 118 IIII 118 III 118 III 118 III 11	Pic Chart Liels' Factor for Country Fie Chart of Country Fie Ch	Pic Chart of Country Pic Chart	Pic Cust Labels Pic Cust Cust Pic Cust Cust	Pic Chart of Country Pic Chart	Pic Chart of Country Pic Chart	Pic Chart of Country Pic Chart	Pic Chart of Country Pic Chart

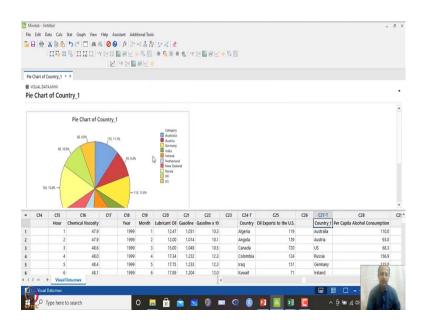
What we will do is that slice this is frequency is ok.

(Refer Slide Time: 18:55)

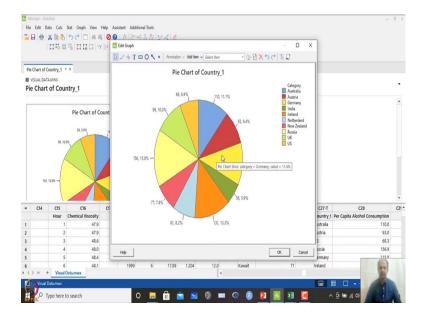
	* 1	Stat Graph View → → □ ▲ ■ □ □ □ ↓	N 200	fx 3ª	- 1 品 -	₩ 4	者 41 [· Y]	X I SK * I							
Pie Chart o	f Country 👻	×													
I VISUAL D						Pie Chart: Data	Dotions			×					
Pie Cha	rt of Cou	ntry			Pie Ch	Subset Group		quency			×				
	394, 13.0% ~~	Pie Chart of	Country	9%	C8 C9 C12 C12 C13 C15 C15 C15 C15 C15 C15 C15 C15 C15 C15	C15 Hour C16 Chemica C18 Year C19 Month C20 Lubrica C21 Gasolin C22 Gasolin C25 Oil Expo	t ds s Pizza lat (Cod the Flat if Viscost it Ol ts to the ta Alcoh v	Erequency variable			×				¥
+ C14	C15	C16	C17	C18	_	Help	1	QK	1 0	ancel			27·T	C28	C2
	Hour	Chemical Viscosity		Year	Month		_			ance	to the U.S.			pita Alcohol Consumption	
	1	47.9		1999	1	12.47	1.031	10.3	Algeria		119		tralia	110.0	
	2	47.9		1999	2	12.00	1.014	10.1	Angola		139	Aust	tria	93.0	
1	3	48.6		1999	3	15.00	1.048	10.5	Canada		720	US		68.3	
1	4	48.0		1999	4	17.34	1.232	12.3	Colombia		124	Rus		156.5	
5	5	48.4		1999	5	17.75	1.233	12.3	Iraq		151		many		
4 b H	+ Vienal			1999	0	17.89	1.204		Kowait		/1	reiz	ind	10	
6 1 4 5 H	6 + Visual al Data.mwx	48.1 Data.mwx		1999	6	17.89	1.204	12.0	Kuwait	22	71	irela	ind	-	

And then data options over here, frequency will be different. So, in this case, frequency will be per capita alcohol consumption let us say. And this click, I will click OK and OK.

(Refer Slide Time: 19:03)



(Refer Slide Time: 19:05)



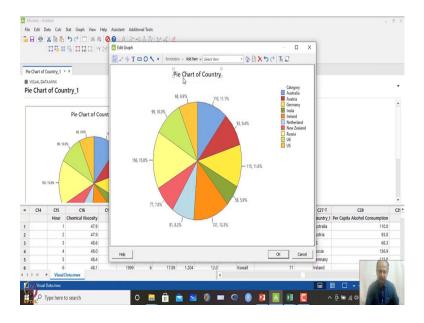
So, this will be the graph which will demonstrate that country wise.

(Refer Slide Time: 19:14)

	10					 Title: Pie Chart of Country_ * 	BX501	- 0 ×			
Pie Chart o	f Country_1	* ×			Pie Chart of	Country 1					
I VISUAL D	ATA.MWX				Edit Title	1-0	×				
Pie Cha	rt of Cou	ntry_1			Edit litle		~	Category Australia			•
					Font Algoment			Austria Germany			
,	99, 10 56, 15,8% -	Pie Chart of C	Count	156, 15.8% -	Eont: Serge Li Sembold Serge Li Sembold Serge Li Sembol Shorard Colte: Serdan Li Sembol Serdan Li Sembol Seta Danore Seta Danole v Seta Danole v S	Style	^	India Ireland Nethorland New Zealand Russia UK US			v
+ C14	C15	C16	CI						C27-T	C28	C25 *
	Hour	Chemical Viscosity			Help		Cancel			apita Alcohol Consumptio	
1	1	47.9			81, 8.2%	151, 13.3%			astralia	110	
2	2								ustria	93	
3	3	48.6							S	68	
4	4		Help	1			OK	Cancel	assia	156	
	5	48.4		_					ermany	115	
5		48.1		1999	5 17.89 1.204	12.0 Kuwait		71	ireland		

So, then I can change this graphical over here, and then this name I can change over here. So, this can be country like this. So, I can change this one.

(Refer Slide Time: 19:22)



So, all possibilities are there. So, I can change this one. And again I can copy this graph and place it like that. So, when I do that, I can do that. So, if I click OK, it will be changed like that ok. So, this is bar diagram and pie diagram which is also used in quality sometimes in certain scenarios like that whenever I have a categorical data, and I

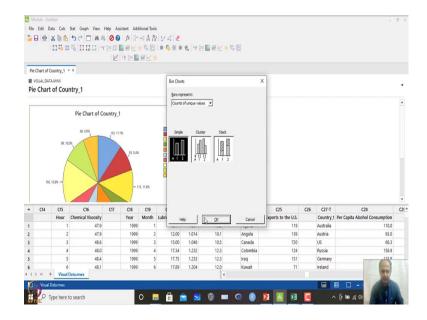
want to see the classifications like that. This is another option. The same thing also let us try to see one another diagram also used in this case which is known as Pareto diagram.

M 🚮	nitab - Un	ntitled														. 8
File	Edit C	Data Calc	Stat Gra	ph View Help As	sistant Add	itional Tools	5									
	9 9	X 🖻 🏠		Scatterplot Matrix Plot Bubble Plot Marginal Plot					×∎sk	* \$ E	8					
Pie	Chart of	Country_1	×	Histogram												
	ISUAL DA	TA.MWX		Dotplot												
Pie	Char	t of Cou														
			1.2×	Probability Plot Empirical CDF												
Г			PA	Probability Distributio	n Plot				~							
			640	Baxplot			Category									
				Interval Plot			Australia Austria									
		99, 10:	18, 11	Individual Value Plot			Germany									
			Z	Line Plot			Ireland	nt								
		A		Bar Chart			New Zea	land								
			0	Pie Crient			UK US									
	150	6. 15.8% -	M 201	Time Series Plot Area Graph		. 11.6%										
		1	4	Contour Plot											1	٣
٠	C14	C15	()			C19	C20	C21	C22	C23	C24-T	C25	C26	C27-T	C28	C25
		Hour	Chei 🗃	3D Surface Plot		Month			Gasoline x 10		Country	Oil Exports to the U.S.			Per Capita Alcohol Consumptio	
1		1		47.9	1999	1	12.47		10.3		Algeria	119		Australia	110	
2		2		47.9	1999	2					Angola	139		Austria	93	
3		3		48.6	1999	3					Canada Colombia	720		US Russia	68	
4		4													130	
5		5		48.4	1999	5					Iraq	151		Germany		5
6 H (ь н -	+ 100	Data.mwx	48.1	1999	6	17.89	1.204	12.0		Kuwait	71		Ireland	100	1
		_	Jata.mwx													
4	Visual	Data.mwx													II	
	0	Type here t	o search			0	1	â 🛛	4 🔞 🖬	. (D				0 m / 4	
NP	EL.	if periore i				~ <u>-</u>	•	-			~ •					

(Refer Slide Time: 19:57)

So, I want to see that. So, I have drawn the bar diagram what you see is that I have drawn the bar diagram over here.

(Refer Slide Time: 19:59)



(Refer Slide Time: 20:01)

Pie Ch	and the second se		
	hart of Country_1 ~ ×		
_	JAL DATA MWX		
Pie	Chart of Country_1	Bar Chart: Counts of unique values, Simple X	
	99, 100%	C13 Pice for the Fall C15 Hour C16 Oheneral Viscont C16 Viscont V	
	16 U.S	C39 North C C30 Lobration C C31 Lobration L C31 Lobration L C31 Lobration L C31 Lobration L Call Lobration L Lobration L Select Lobration L	
•	16 1150 17 C4 C5 C16 C7 C8	Cold Located Vil Cold Control Cold	C28 C
*	16.13.00 - 11	Cold Located Vil Cold Control Cold	
	15k 138	Col: Userial Col:	C28 Capita Alcohol Consumption
1	14: 11:80	Columnation Columnation Columnation Grand Quinters Solution Columnation Qual Quinters Solution Columnation Qual Verse Solution Solution Qual Verse Solution Methy Oper Columnation Qual Verse Methy Oper Columnation Qual Verse Methy Oper Columnation Qual Verse 1 12.47 1.031 10.3 Alogeria	C28 C Capita Alcohol Consumption 110.0
1 2	16, 1129 - C13 C16 C17 C18 Hour Chemical Viscolity Ver- 1 47.9 1999 2 2 47.3 1999	Column (o) Column (o)	C28 C Capita Akohol Consumption 110.0 93.0
1 2 3	194, 1136 C16 C17 C18 C14 C15 C16 C17 C18 Hour Chemical Viscolity Year 1999 2 47.9 1999 3 44.6 1999	Column Col Cal calceler Cal cal cal calceler Cal cal cal cal cal cal cal cal cal cal c	C28 C Capita Akohol Consumption 110.0 93.0 68.3

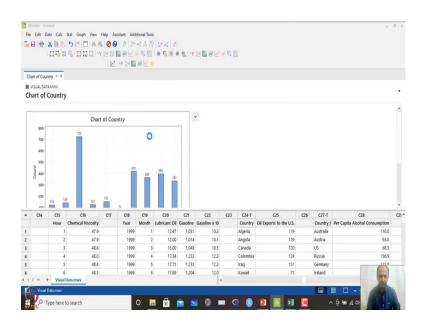
And, in this case simple bar diagram. So, this is country wise.

(Refer Slide Time: 20:06)

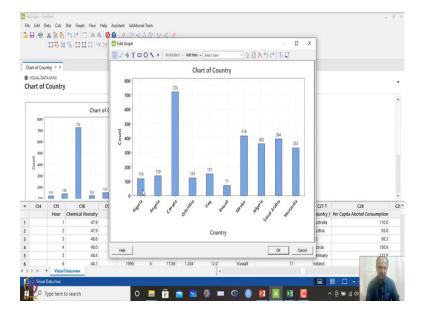
VISUAL DAT	Country_1 v x												
				6	Bar Chart: Data Op	tions			×				
le Chart	t of Country	y_1		Bar Ch	Subset Group Op		ч		×				
	99, 10.0%	Pie Chart of Counti	11 11.1%	C22	C3 Marks in Q C6 Burger King C7 Pizza Hut C8 McDonalds C9 Subway C10 Domino's IF C12 Size of Fla C13 Price for B C15 Hour C16 Chemical V	nzza t (Cod he Flat	I Exports to the U.S						
	15.0% -	X	-1	C24 C25 C27 C28	C18 Year C19 Month C20 Lubricant / C21 Gasoline C22 Gasoline x Select	DI			·				
156. C14	C15	C16 C17	7 C18	C25 C27 C28	C19 Month C20 Lubricant / C21 Gasoline C22 Gasoline x Select	DI	05	Cancel		C26	C27-T	C28	
	C15	emical Viscosity	7 C18 Year	C25 C27 C28	C19 Month C20 Lubricant / C21 Gasoline C22 Gasoline x Select Help		92	Cance		C26	Country_1	C28 Per Capita Alcohol C	
	C15 Hour Che	emical Viscosity 47.9	7 C18 Year 1999	C25 C27 C28 IS. 1 Month	C19 Month C20 Lubricant (C21 Gasoline x C22 Gasoline x Select Help 12.47	Di v	10.3	Algeria	119	C26	Country_1 Australia		110.0
	C15 Hour Che 1 2	emical Viscosity	7 C18 Year	C25 C27 C28	C19 Month C20 Lubricant / C21 Gasoline x C22 Gasoline x Select Help					C26	Country_1		
	C15 Hour Che	emical Viscosity 47.9 47.9	7 C18 Year 1999 1999	C25 C27 C28 IS. 1 Month 1 2	C19 Month C20 Lubricant C21 Gasoline x Select Help 12.47 12.00	DI V	10.3	Algeria Angola	119	C26	Country_1 Australia Austria		110.0 93.0
	C15 Hour Chi 1 2 3	emical Viscosity 47.9 47.9 48.6	7 C18 Year 1999 1999 1999	C25 C27 C28 IS. 1 Month 1 2 3	C39 Month C30 Lubricant C21 Gasoline x Select Help 12,47 12,00 15,00	DN 10 V	10.3 10.1 10.5	Algeria Angola Canada	119 139 720	C26	Country_1 Australia Austria US		110.0 93.0 68.3

And then let me see the data options what I have taken over here.

(Refer Slide Time: 20:11)



(Refer Slide Time: 20:13)



So, oil export like that. So, when you draw the bar diagram what happens is that you see that it is scattered it starts with lower value over here Algeria. So, this is randomly plotted like that. So, one suddenly has gone up. So, this is the maximum one. So, in this case, sequence of this is not showing means it is not starting from highest to lowest values like that.

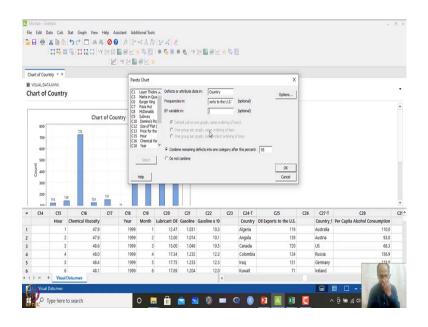
So, it takes arbitrarily any other. So, bar graphs can be drawn arbitrary like that. So, if you want to make it systematic like that, and see from which is contributing which country is maximum, then minimum like that.

Minitab - U		itat Graph View Help	Assistant	Additio	nal Tools									-	Ø
2 ⊟ ∲	X 🖻 🕅	Basic Statistics Regression ANOVA DOE	16				#₁ Y ⊵	Bek	* 14 8	8					
Chart of Cou	untry × ×	Control Charts	•												
VISUAL DA	TAMWX	Quality Tools	• #	Run Cha	t										
Chart of	Country	Reliability/Survival	•	Pareto Cl											•
		Predictive Analytics	• **	Cause-ar											
800		Multivariate Time Series Tables Nonparametrics	, W		Display d prioritize		of decreasing t efforts.	irequency to							
700		Equivalence Tests		Capabilit	y Sixpack			,							
600		Power and Sample Size	, 17	Tolerance	Intervals (N	ormal Distribu	ition)								
			N	Tolerance	Intervals (N	onnormal Dis	tribution)								
000 Count				Gage Stu	dy			,							
ලි 400 · 300 ·			8		tribute Agre Agreement		is Worksheet								
200	119 139	124 151	1			by Attributes by Variables		,							,
• C14	C15	C16 C17		Multi-Va	i Chart				C23	C24-T	C25	C26	C27-T	C28	C2
	Hour	Chemical Viscosity	19	Variability	Chart			× 10		Country	Oil Exports to the U.S.			Per Capita Alcohol Consumption	
	1	47.9	-		y Plot			10.3		Algeria	119		Australia	110.0	
1	2	47.9		1333	4	12.00	1.014	10.1		Angola	139		Austria US	93.0	
3	3	48.0		1999 1999	3	15.00	1.048	10.5		Canada Colombia	720		Russia	156.5	
5	4	48,4		1999	5	17.34	1.232	12.3		Iraq	124		Germany	136.5	
5	6	48.1		1999	6	17.89	1.204	12.0		Kuwait	71		Ireland		
4.5.11	+ Visual D	ata.mwx							l.	(Correct			. cibile	1	
View	I Data.mwx		-	-	_	-	_			-			E I		h. 1
	TO BOSTINIA					8		10							

(Refer Slide Time: 20:47)

So, in descending order if you want to see like that, so this can be also plotted like that in one diagram which is known as Pareto diagram. You may have heard of Pareto diagram and that is also an important tool in quality. So, this can be. So, it will start with highest to lowest like that. So, that is also possible. And this Pareto diagram is available in quality tools in MINITAB. And when you go to this quality tools, you have a Pareto chart option like that.

(Refer Slide Time: 21:09)



So, I will use the same graphically who is contributing maximum, how much percentage it is contributing. So, I will go to this Pareto chart option. And what I will do is that, I will go to that country defects this is category is given in let us say country over here. And frequency is given in this what we can take is oil export over here.

(Refer Slide Time: 21:33)



So, this is country and oil export like that. Combine this. Any options you can label this one, you can title that one that you can just see. So, I am combining anything more than

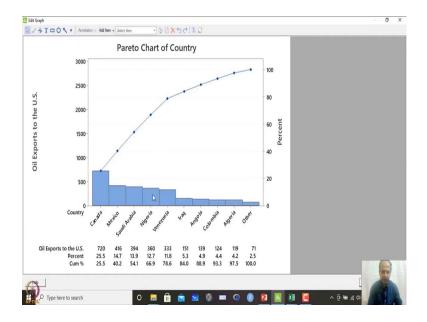
95 percent like that combined into one category like that. So, this is by default MINITAB text.

(Refer Slide Time: 21:45)

	9		Stat Graph View		$\int fx S_{B}^{\alpha}$	-11日 -11日	¥ ≪ ≷ ₩ ¹⁰ ₩ 1	F#a •Y	×∎øk	* 称图	1					8
Pare	to Chart o	of Country	× x													
	SUAL DATA	MWX														
Par	eto Ch	art of C	Country													
																1
			Pareto C	hart of C	ountry											
		300	0													
		250	0			-	100									
1	C N			~	-		80									
1	the	200	0	1	13		- 3									
	12 10	150	0.				60	Percent								
and the second second life	od x:	100					40	•								
ð	5		. É				20									
		50	°1		L		_									
•	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24-T	C25	C26	C27-T	C28	c
	C14		Chemical Viscosity	C17	Year		Lubricant Oil	Gasoline	Gasoline x 10		Country	Oil Exports to the U.S.	C26	Country_1	Per Capita Alcohol Consumption	c
	C14	Hour 1	Chemical Viscosity 47.9	C17	Year 1999	Month 1	Lubricant Oil 12.47	Gasoline 1.031	Gasoline x 10 10.3		Country Algeria	Oil Exports to the U.S. 119	C26	Country_1 Australia	Per Capita Alcohol Consumption 110.0	c
	C14	Hour 1 2	Chemical Viscosity 47.9 47.9	C17	Year 1999 1999	Month 1 2	Lubricant Oil 12.47 12.00	Gasoline 1.031 1.014	Gasoline x 10 10.3 10.1		Country Algeria Angola	Oil Exports to the U.S. 119 139	C26	Country_1 Australia Austria	Per Capita Alcohol Consumption 110.0 93.0	c
	C14	Hour 1 2 3	Chemical Viscosity 47.9 47.9 48.6	C17	Year 1999 1999 1999	Month 1 2 3	Lubricant Oil 12.47 12.00 15.00	Gasoline 1.031 1.014 1.048	Gasoline x 10 10.3 10.1 10.5		Country Algeria Angola Canada	Oil Exports to the U.S. 119 139 720	C26	Country_1 Australia Austria US	Per Capita Alcohol Consumption 110.0 93.0 68.3	c
	C14	Hour 1 2 3 4	Chemical Viscosity 47.9 47.9 48.6 48.0	C17	Year 1999 1999 1999 1999	Month 1 2 3 4	Lubricant Oil 12.47 12.00 15.00 17.34	Gasoline 1.031 1.014 1.048 1.232	Gasoline x 10 10.3 10.1 10.5 12.3		Country Algeria Angola Canada Colombia	Oil Exports to the U.S. 119 139 720 124	C26	Country_1 Australia Austria US Russia	Per Capita Alcohol Consumption 110.0 93.0 68.3 156.9	c
	C14	Hour 1 2 3	Chemical Viscosity 47.9 47.9 48.6	C17	Year 1999 1999 1999	Month 1 2 3	Lubricant Oil 12.47 12.00 15.00 17.34 17.75	Gasoline 1.031 1.014 1.048	Gasoline x 10 10.3 10.1 10.5		Country Algeria Angola Canada	Oil Exports to the U.S. 119 139 720	C26	Country_1 Australia Austria US	Per Capita Alcohol Consumption 110.0 93.0 68.3	c

So, when you click ok, what will happen is that this type of graph you will see.

(Refer Slide Time: 21:48)



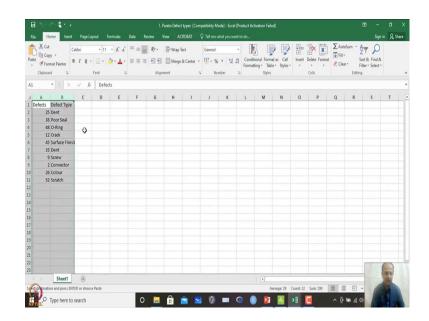
Where from the highest value to lowest value some descending order it will show, so Canada. And it will also show you what is the contribution, so Canada is contributing is about 25 percent of the exports like that. So, value is given, percentage is given, and cumulative percentage is given also.

So, what is cumulative percentage? That means, Mexico and Canada combined, how much they are contributing? About 40 percent like that. Then Mexico, Canada, Saudi Arab, it is about 54 percent. So, cumulative percentage will also be given over here. And overall total percentage will be 100 anywhere like that. So, this is the cumulative percentage axis what you see over here. So, this is moving like this. And this is the highest category.

And this analysis is sometimes used when we want to prioritize in quality that which type of problem I should tackle first, because there can be n types of problems which problem I should solve first to resolve the process to be excellent. So, in that case, which problem I should take.

So, if you see over here in this Pareto analysis also that 80 percent of the problem is contributed by 3, 80 percent of the exports is contributed over here by 5 countries like that up to Venezuela we can think of 78.6 approximately like that; others are contributing very less like that. So, 80 percent is contributed by 5, and rest of the 5 is contributing very less like that. So, that way we can interpret. And this Pareto chart analysis can also be used in quality analysis.

(Refer Slide Time: 23:22)

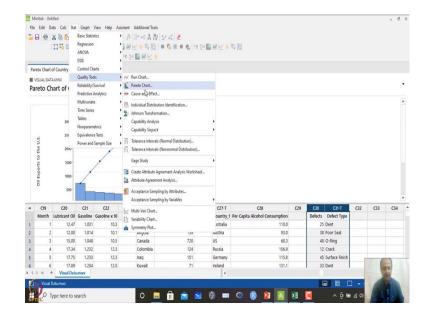


So, let me take an example to illustrate that one. So, let me take an example where I have defects, number of defects and types of defects. So, in a process you are getting some defects. And we are also categorizing and noting down what is the type of defect

basically. And then what we are doing is that when I have identified the types of defects and I take frequency so for that.

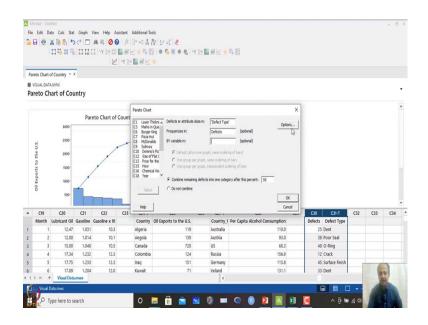
So, you can maintain charts like that in a month, what are the different categories of defect, and what are the frequency of that. So, this is the frequency and category. So, this can be copied. And when you place this one in MINITAB let us say there is this one.

(Refer Slide Time: 24:00)



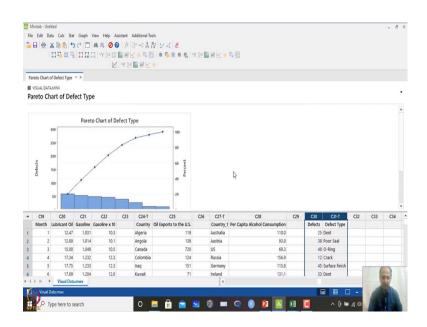
So, I want to I want to prioritize which type of problem I should address first in the process. So, this defect type which problem should be we should eliminate first ok, and find out the cause of this why this is happening like that. So, in quality also this tool is extensively used. So, and Pareto analysis can be used also over here like that.

(Refer Slide Time: 24:20)

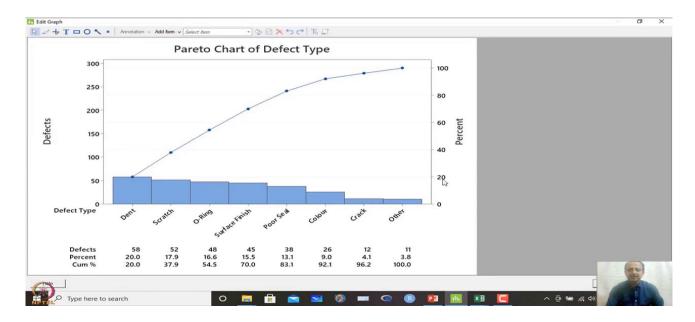


So, if you go to stat again quality tools like that and I want to do Pareto out of this, so instead of country what I will do is that I will go to defect types. And then what I will do frequency is given over here in this is defects, and then other options remain same. So, I am not concerned about that.

(Refer Slide Time: 24:36)



(Refer Slide Time: 24:38)

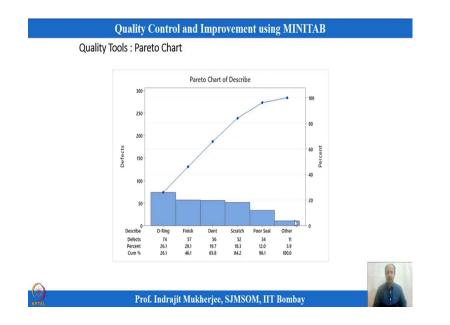


So, when you do this one, what you get is that this is the analysis that was done. So, dent is one of the problem which is contributing 20, and scratch and dent is contributing 37.9 approximately. And O-ring if you include this one about 54, so if you go up to so 80 percent of the problem is if you can eliminate this 3-4-5 types of defects that is coming you will eliminate most of the problems basically.

So, 80 percent of the problem can be solved, 80 percent of the problem will be not there if I can remove the causes for dents, scratches, O-rings problems, surface finish, poor seals like that. So, that will contribute I can element. Other things can be taken off later on like that they are not contributing so much.

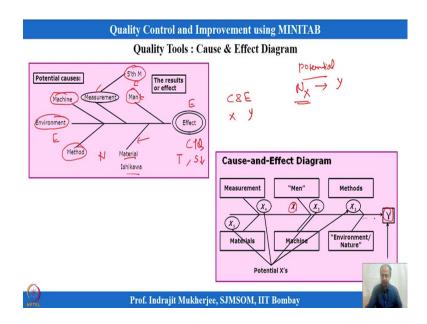
So, Pareto diagram gives you what types of defects are coming frequently which is having more frequency, let us tackle those types of problems first and find out the root cause of that and eliminate that root cause. And in quality we have extensive use of this Pareto charting techniques like that. It comes under 7 QC tools quality control tools like that. So, this is one of the tool an effective tool which can be used in our analysis well while we are dealing with quality like that ok.

(Refer Slide Time: 25:53)



So, this is another important chart over here Pareto tools that we have discussed over here, and what I told is that whenever there is a problem. So, whenever we have a defect type, we have segregated that one let us say. And then what we do is that there is another quality QC tools or quality control tools which is very important which is known as Cause-and-Effect Diagram like that.

(Refer Slide Time: 26:13)



MINITAB has an option also to plot the Cause-and-Effect Diagram over here ok. So, Cause-and-Effect means what over here. So, Cause-and-Effect means this is CTQ. You

can think of if something is going wrong in the CTQ what are the primary cause for that variation or cause that inaccuracy what is happening in the CTQ. So, I am interested to bring it to the target, and also I want variability to be very less towards 0 like that.

So, what are the primary, primary causes for this? So, it can be due to man-to-man problem that is coming. So, maybe skilled operator and unskilled operators like that in a process, maybe we are using a faulty instrument in measurements over here, or maybe the machines that is vibrating.

So that may be the reason, maybe environmental humidity condition and other conditions are influencing the process outcomes like that, maybe the method that we are using over here let us say paint shop and we are using spray types and different types of options are available. So, which method is more effective like that, so there can be that can also lead to variations like that in the final characteristics like that what we are interested CTQs ok.

Then the material can also change. So, material that we are using for processing like that, so that can also be this is known as Cause-and-Effect. So, these are the causes and this is the effect over here ok. So, this is C and E Diagram – Cause-and-Effect Diagram. So, 5 Ms and 1Es what you see over here; 5 Ms and 1 E is over here.

So, this type of Cause-and-Effect Diagram was given by Ishikawa. So, this is also known as Ishikawa diagram, Fishbone diagram. So, many definitions are there. But this shows a Cause-and-Effect Diagram. So, cause is X we can think off, and effect is y we can think of; y is the CTQ and X are the different causes which is influencing.

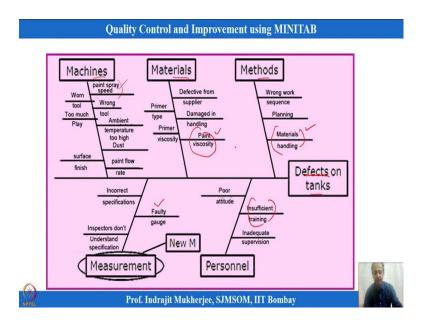
And this is very important, this tool is very important because this is used for experimentation also. Before we go for experimentation, what are the potential causes that means, which we know that clearly affects some evidence is there that these are the causes which affects the CTQs like that which will be considered.

There can be N number of causes over here and which can fall into any of this 5 M category or E categories like that and N number of variables that can. So, N variables maybe X variables over here that can impact my CTQ or that is Y over here.

So, out of this X condition and all are potential cause basically. Potential means we have some evidence that the influence is y; it is not like brainstorming. And you think about anything over here. So, there should be some evidence or either from engineering conceptualization or engineering concepts or designer indicates, or you have evidence in the process like scatter diagram what we have used that this variable impacts Y.

So, let us consider that variable for experimentation. So, this Cause-and-Effect Diagram is very effective when you select the variables like that for experimentation. So, this is an important tool 5 Ms and one Es. So, what you can see over here is given as X variables and how it is influencing Y variables over here.

(Refer Slide Time: 29:21)



So, one example we can just discuss over here. So, maybe defects in the tanks are coming. So, this may be material handling, the way methods it comes on the methods. So, this can be one of the cause over here. So, may be paint viscosity in materials, we have different types of paint. So, this can be one of the reason like that. These are all potential reasons what I am just indicating

So, from machines may be painting using spray speed. So, this may be one of the variables that impacts the defects or leads to defects. So, there are some evidence what people have seen or from engineering sense, they have some or process sense process people who are or maybe operator is telling that this is a factor which influences and creates defects in the tanks ok.

So, measuring, instrument faulty gauge if you are using gauge means instrument that is used to say ok or not ok like a type of scenario. So, in this case, maybe measurement is also influencing whether it indicates defects or no defects like that, or if it is faulty it will indicate more defects like that, so that can be one of the reason.

So, personal means insufficient training operators who are doing that inspection or they are not trained like that, they are misleading, they are giving which is not a defect they are indicating defects like that that can be one of the reason like that. So, these are all reasons causes what you see over here.

And we have to eliminate each and every causes, so that we do not get defects like that. So, a Cause-and-Effect will give you ideas of potential X that can be considered and we have to eliminate all those causes and block those causes, so that or minimize the effect of the causes. So, that there is little variation in the final outcome like that.

So, we will continue from here and then we will go ahead with other techniques which is important other techniques that is used also in quality of design, all quality or conformance like that ok. So, we will discuss about design failure mode effect analysis also.

And we will cover some more topics over here before we go to the actual quality control aspects and how MINITAB will help you to see behaviour of the process, and how to optimize the process means all those things will be discussed with subsequent lectures like that ok.

So, thank you for listening. We will stop over here. We will start from here in session 7.

Thank you.