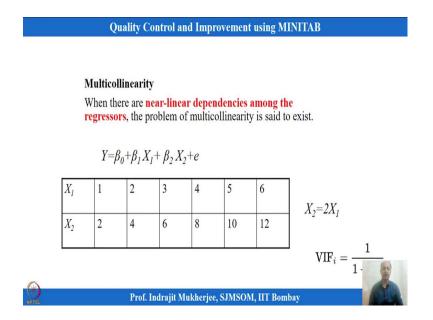
Quality Control and Improvement with MINITAB Prof. Indrajit Mukherjee Shailesh J. Mehta School of Management Indian Institute of Technology, Bombay

Lecture - 27 Multicollinearity, Best Subset Regression, Multiple Regression, Basics on Design of Experiment

Hello and welcome to our session 27 on Quality Control and Improvement with MINITAB. I am Professor Indrajit Mukherjee from Shailesh J Mehta School of Management, IIT Bombay. So, previous session what we are doing is that, we are discussing about the multiple regression and multicollinearity problems like that. So, we will take another examples to again emphasize on the importance of how to tackle Multicollinearity like that ok.

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So multicollinearity, what we have explained is that relationship between X variables that exist, and that can distort the relationship between what is and we are not able to generalize the equations which can be used in reality for prediction like that ok. So, we need to deal with this and variation inflation factor that we have to calculate and try to see that it is not more than 5.

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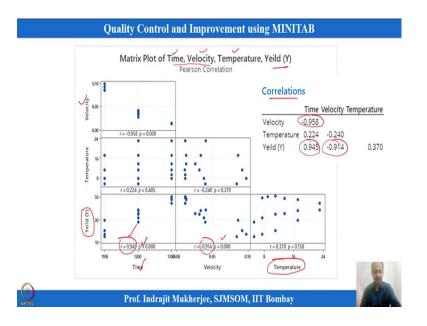
And, if it is more than 5 then we have to adopt some other means to deal with that. And how to deal with that? That we have mentioned over here. That means, highly correlated variables, one of them will we can take and the other ones can be eliminated. And, we can attempt stepwise regression method which takes care of which can suggest that which are the variables to be taken and we can reconfirm the multicollinearity exist or not in the final models like that ok.

And, we can also see best subset regression where multiple options exist because we do not want to stop only considering what stepwise regression gives. Because, some sometimes what happens say, alternate model is easy to control in real life; that means, those variables are easy to control which is suggested.

And if it is fine, if we have to sacrifice some amount of R square values or something like that, that is not a constraint for us in production processes, but variables which are very difficult to control and stepwise regression keeps those variables in the final equation then it becomes difficult for us to change that one, if we adopt that one, so in that case it becomes difficult. So, best subset regression gives you some more options to select the variables like that.

Then, appropriate methods like partial least square regression, principal component regression all these things can be adopted ok.

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So, we will take one more examples where we have variables like, yield is the Y characteristics and this depends on time, velocity and temperature. These are the variable X that was considered to be significant or potential variables and we want to get a model out of this regression model out of this. All are continuous variable over here, so in this case.

And when we did the correlation analysis of this correlation analysis, what we observe is that velocity is highly correlated with time variables over here and then we can see that yield is highly correlated with time, velocity over here. So, but this P-Value will indicate whether which of the variable is highly correlated.

So, yield is one of the variables. So this seems to be significant over here, velocity is also significant over here, but temperature does not seem to be significantly influencing the yields over here ok. And, what we can see is that temperature with time is not significant, temperature with velocity is also not significant ok.

So, velocity with time is highly correlated, this with time velocity and time is highly correlated over here. So, this correlation matrix gives you some preliminary information, what is expected means when we run the regression analysis, what is expected in all these variables. So what we can see is that time and velocity are two variables which are highly correlated, so one we have to adopt over here. So how do we select which one to adopt over here? So, maybe when we do a trial and error basis.

If we have to select the variables the policy may be that, because yield is the correlation coefficient is 945 for time and for velocity is 914 maybe this variable we should select like that ok. Time may be the only variable and replace the velocity with the time like that.

So, yield has to be regressed with time and, if temperature is significant then we will include that one. So anyhow, this is the suggested one of the guidelines. So, which is highly correlated with the Y variable, we can select that one. And, we want to see that what happens if we select stepwise regression what happens like that.

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So, this is the data set C11 to C20. This is the data set that we are having and we want to; we want to implement this.

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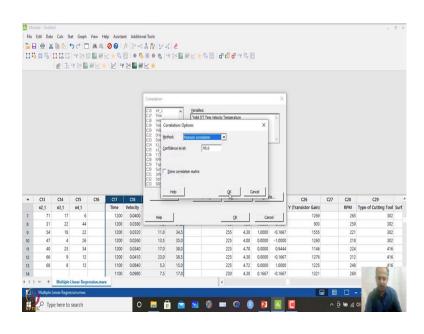
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So, what we have done is that basic statistics over here we have gone to correlation.

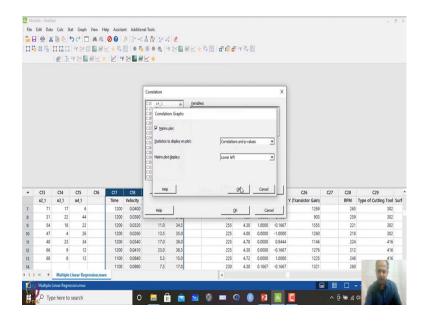
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And then we have identified which are the variables over here. We want to understand the relationship. So, yield is the first variable time, velocity and temperature. (Refer Slide Time: 05:02)

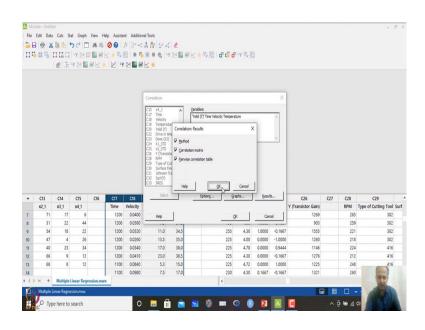


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And, in options what we have given, Pearson correlation we want to see. And then in graphs what we want is that correlation with P-Values.

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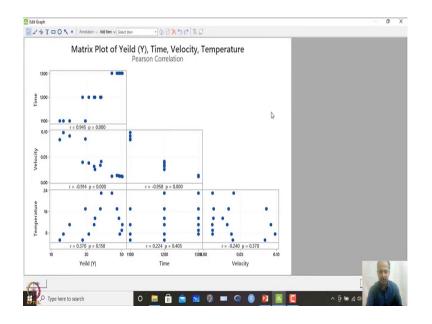


And if I click ok, and results what we have mentioned is we can also see pairwise correlation table.

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	400 005 - C13 x2_1 71 31 54 47 40 66	C14 x3_1 17 22 18 4 23	C15 x4_1 6 44 22 26 34 12	C16	Time 1200 1200 1200 1200 1200 1200	Velocity 0.0400 0.0380 0.0320 0.0260 0.0260 0.0340 0.0410	Temperature 5.3 7.5 11.0 13.5 17.0 23.0	Yelld (Y) 28.0 31.5 34.5 35.0 38.0 38.5	C21	Drive in time (X1) 225 195 225 225 225 225 225	Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667	Y (Transistor Gain) 1269 903 1555 1260 1146 1276	C27	RPM 265 259 221 218 224 212	Type of Cutting Too 300 300 300 300 416 416 416 416	2 2 2 2 6 6
	400 005 - C13 x2_1 71 31 54 47 40 66	C14 x3_1 17 22 18 4 23 9 8	C15 x4_1 6 44 22 26 34 12		Time 1200 1200 1200 1200 1200 1200 1200 1100	Velocity 0.0400 0.0380 0.0320 0.0260 0.0260 0.0340 0.0410 0.0840	Temperature 5.3 7.5 11.0 13.5 17.0 23.0 5.3	Yelld (Y) 28.0 31.5 34.5 35.0 38.0 38.0 38.5 15.0	C21	Drive in time (Xt) 225 195 225 225 225 225 225 225 225 225	Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30 4.72	X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000	Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225	27	RPM 265 259 221 218 224 212 248	Type of Cutting Too 300 300 300 300 416 416 416 416	2 2 2 6 6
	ала Alcone C13 X2_1 71 31 54 47 40 66 68 0 H +	C14 x3_1 17 22 18 4 23 9 8 Muttiple	C15 x4_1 6 44 22 26 34 12 12 12		Time 1200 1200 1200 1200 1200 1200 1200 1100	Velocity 0.0400 0.0380 0.0320 0.0260 0.0260 0.0340 0.0410 0.0840	Temperature 5.3 7.5 11.0 13.5 17.0 23.0 5.3	Yelld (Y) 28.0 31.5 34.5 35.0 38.0 38.0 38.5 15.0	C21	Drive in time (Xt) 225 195 255 225 225 225 225 225 225 225 225 2	Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30 4.72	X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000	Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225 1321		RPM 265 259 221 218 224 212 248 260	Type of Cutting Too 300 300 300 300 300 410 410 410 410	2 2 2 6 6
	ала Alcone C13 X2_1 71 31 54 47 40 66 68 0 H +	C14 x3_1 17 22 18 4 23 9 8	C15 x4_1 6 44 22 26 34 12 12 12		Time 1200 1200 1200 1200 1200 1200 1200 1100	Velocity 0.0400 0.0380 0.0320 0.0260 0.0260 0.0340 0.0410 0.0840	Temperature 5.3 7.5 11.0 13.5 17.0 23.0 5.3 7.5	Yeild (Y) 28.0 31.5 34.5 35.0 38.0 38.5 15.0 17.0		Drive in time (Xt) 225 195 255 225 225 225 225 225 225 225 225 2	Dose (X2) 4.60 4.30 4.30 4.30 4.70 4.30 4.72 4.30	X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000	Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225		RPM 265 259 221 218 224 212 248	Type of Cutting Too 300 300 300 300 410 410 410 410 410	2 2 2 6 6

(Refer Slide Time: 05:16)



And if you click ok, this is the; this is the diagram that I have shown in the PPT slides like that. So, this shows relationship between yield and other variables. Yield is highly related with time, the P-Value is point near to 0 and velocity is also highly related with yield over here, but temperature does not seem to be significantly influencing over here.

So, this is the relationship and time is having a high time is not having a correlation with temperature over here ok, and velocity is having no correlation with temperature, but velocity is having a correlation with time over here. So that is reflected over here, temperature and time. So, this is highly 0.958 is the minus 0.958 is the.

(Refer Slide Time: 06:03)

			Basic Stat Regressio ANOVA		, ,	Fitted Lin Regressio	on		2 Fit	Regression Model	P LY X E	8						
	relation: Yeil	d (Y), Tin	DOE Control C Quality To		. 12	Nonlinea Stability	ar Regression Study		Y Pr	Model the rel	ationship be							
-	rrelation		Reliability		. 2		nal Regression east Squares		Ci	ctorial Plo continuous p interaction an entour Plo response if n inface Plot	d polynomia	d one respon al terms, or tr	se. Easily inc ansform the	lude				1
	1000 0000	Matr	Time Seri Tables Nonparar Equivalen Power an	metrics	, la	Binary Lo	itted Line Plot ogistic Regression Logistic Regressic I Logistic Regress Regression	on	* Re	sponse Optimizer								
	900 4.10 6.00 6.00	r=0.945 p=		1														
	eloc(ty	r=0.545 p=		1	I	CI8	C19	C20 -	621	())	C3	C24	C25	C/6	C77	C28	(29)	
	a.u.	r=0.945 p=		1 C16	C17 Time	C18 Velocity	C19 Temperature	C20 g Yeild (Y)	C21	C22 Drive in time (X1)	C23 Dose (X2)	C24 X1_STD	C25 x2_STD	C26 Y (Transistor Gain)	Q27	C28 RPM	C29 Type of Cutting Too	d Su
	A10- A10- A10- A10- A10- A10- A10- A10-	r=0.545 p=	C15	C16			Temperature		C21						C27			
	A10 005	r=0.545 p= C14 x3_1	C15	C16	Time	Velocity	Temperature 5.3	Yeild (Y)	C21	Drive in time (X1)	Dose (X2)	X1_STD	x2_STD	Y (Transistor Gain)	Q7	RPM	Type of Cutting Too	2
	A10 000 C13 X2_1 71	c14 x3_1 17	C15 x4_1 6	C16	Time 1200	Velocity 0.0400	Temperature 5.3 7.5	Yeild (Y) 28.0	C21	Drive in time (X1) 225	Dose (X2) 4.60	X1_STD 0.0000	x2_STD 0.6667	Y (Transistor Gain) 1269	Q7	RPM 265	Type of Cutting Too 302	2
7	A10 000 C13 X2_1 71 31	c14 x3_1 17 22	C15 x4_1 6 44	C16	Time 1200 1200	Velocity 0.0400 0.0380	Temperature 5.3 7.5 11.0	Yeild (Y) 28.0 31.5	C21	Drive in time (X1) 225 195	Dose (X2) 4.60 4.30	X1_STD 0.0000 -1.0000	x2_STD 0.6667 -0.1667	Y (Transistor Gain) 1269 903	Q7	RPM 265 259	Type of Cutting Too 303 303 303	2
7 B 9 0	410 600 600 71 71 31 54	r+0345 p+ C14 x3_1 17 22 18	C15 x4_1 6 44 22	C16	Time 1200 1200 1200	Velocity 0.0400 0.0380 0.0320	Temperature 5.3 7.5 11.0 13.5	Yeild (Y) 28.0 31.5 34.5	C21	Drive in time (X1) 225 195 255	Dose (X2) 4.60 4.30 4.30	X1_STD 0.0000 -1.0000 1.0000	x2_STD 0.6667 -0.1667 -0.1667	Y (Transistor Gain) 1269 903 1555	Q7	RPM 265 259 221	Type of Cutting Too 300 300 300 300 300	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
7 B 9 0	430 Kiyoos C13 x2_1 71 31 54 47	<pre>ci4 x3_1 17 22 18 4</pre>	C15 x4_1 6 44 22 26	C16	Time 1200 1200 1200 1200	Velocity 0.0400 0.0380 0.0320 0.0260	Temperature 5.3 7.5 11.0 13.5 17.0	Yeild (Y) 28.0 31.5 34.5 35.0	C21	Drive in time (X1) 225 195 255 225	Dose (X2) 4,60 4,30 4,30 4,00	X1_STD 0.0000 -1.0000 1.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000	Y (Transistor Gain) 1269 903 1555 1260	Q7	RPM 265 259 221 218	Type of Cutting Too 300 300 300 300 300	2 2 2 2 2 5 5
7 8 9 10 11 12	**************************************	<pre>r+0345 p- r+0345 p- r</pre>	C15 x4_1 6 44 22 26 34	C16	Time 1200 1200 1200 1200 1200	Velocity 0.0400 0.0380 0.0320 0.0260 0.0340	Temperature 5.3 7.5 11.0 13.5 17.0 23.0	Yeild (Y) 28.0 31.5 34.5 35.0 38.0	C21	Drive in time (X1) 225 195 255 225 225	Dose (X2) 4,60 4,30 4,30 4,00 4,70	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444	Y (Transistor Gain) 1269 903 1555 1260 1146	Q27	RPM 265 259 221 218 224	Type of Cutting Too 300 300 300 300 416 416 416	2 2 2 5 5 5
+ 7 8 9 10 11 12 13 14	*** All 0 cos- C13 X2_1 71 31 54 47 40 66	C14 x3_1 17 22 18 4 23 9 8	C15 x4_1 6 44 22 26 34 12 12	C16	Time 1200 1200 1200 1200 1200 1200 1200 1100	Velocity 0.0400 0.0380 0.0320 0.0260 0.0340 0.0410	Temperature 5.3 7.5 11.0 13.5 17.0 23.0 5.3	Yeild (Y) 28.0 31.5 34.5 35.0 38.0 38.5	C21	Drive in time (Xt) 225 195 255 225 225 225 225	Dose (X2) 4,60 4,30 4,30 4,00 4,70 4,30	X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667	Y (Transistor Gain) 1269 903 1555 1260 1146 1276	Q7	RPM 265 259 221 218 224 212	Type of Cutting Too 300 300 300 300 416 416 416 416	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2

So, this is so what we can do is that we can go to stepwise regression. So I will use stepwise regression over here.

(Refer Slide Time: 06:09)

	relation: Yei																	
		ld (Y), Time				R	egression						×					
-		EAR REGRESS		. Valar	iter Terr		1 Pull strength	Responses										
CO	rrelation	n: Yeild (r), 11m	e, veloc	ity, ien	ipera a	2 Wrelength	Yeld (Y)					^	1				
_							5 Y						~					*
		Matrix	Plot of Y	eild (Y), T	ime, Vela		7 x2	Continuou	predictors:									
				Pearson	Correlation	n lo		Time Velo	sty Temperature				^	1				
	1000			1			12 x1_1											
	2 100						13 x2_1 14 x3_1						Y					
	Ē						15 x4_1 17 Time	Categorica	predictors:									
	100-	r=0.945 p=	0.000				18 Velocity 19 Temperature						^	1				
		• •		1			20 Yeld (r) 22 Drive in time (
	605	• • •					23 Dose (X2) 24 X1_STD						v					
	C13	C14	CIS	C16	C17	CIR	25 x2_STD 26 Y (Transistor (Model	Options	1 ~	ing	Description	C26	C27	C28	C29	
	x2_1	x3_1	x4_1		Time	Veloc	28 RPM ¥	J	Googen	Upoorga		grig	Stepwise	ransistor Gain)		RPM	Type of Cutting	Tool Sur
-	71	17	6		1200	0.0	Select		Validation	Graphs	Bet	ults	Storage	1269		265		302
7		22	44		1200	0.0								903		259		302
	31		22		1200	0.0	Help					QK	Cancel	1555		221		302
8	31 54	18			1200	0.0/200		33.0		663	4,00	quan	1.0000	1260		218		302
8 9 10	31 54 47	4	26					38.0		225	4.70	0.0000	0.9444	1146		224		416
8 9 10 11	31 54 47 40	4	34		1200	0.0340												
8 9 10 11 12	31 54 47 40 66	4 23 9	34 12		1200	0.0410	23.0	38.5		225	4.30	0.0000	-0.1667	1276		212		416
7 8 9 10 11 12 13 14	31 54 47 40	4	34				23.0			225 225 230	4.30 4.72 4.30	0.0000	-0.1667 1.0000 -0.1667	1276 1225 1321		212 248 260	-	416

(Refer Slide Time: 06:11)

i M	initab - Uni	titled					Regression: Stepwise	X					8 ×
Cor	rrelation: Y	ata Calc S Calc S Ca	5 ↔ □ □ 4 1 ≥ 0 4 4 ≥ 0 • x BONLMWX	#4 8 9 8 4	Ø Ø ≪ ★ ₩ ₩ ₩ ₩	fx 3 10 1 1 ≥ 1	Temperature						•
	Trender			eild (Y), 1	ime, Vela	ocity,							*
	100-				Correlatio	n	E = Indude term in every model [= Indude term in the initial model	L					
	100-	r=0.545 p	0.000				Alpha to remove: 0.15						
	elocity Se	·** •		1									¥
+	C13	C14	C15	C16	C17	CIE			C26	C27	C28	C29	
	x2_1	x3_1	x4_1		Time	Veloc			ransistor Gain		RPM	Type of Cutting Tool	
7	7		6		1200	0.0			126		265		
8	3		44		1200	0.0			903		259		
9	5		22		1200	0.0			155		221		
10	4		34		1200	0.0	Herardhy		126		218		
11	6		12		1200		₩ Qisplay the table of model selection details		127		212		
12	6		12		1100	0.0			122		248		
14					1100		Details about the method		132		260		
H 4	ры н	Multiple	Linear Regi	ression.mw			Digplay the graph of R-squared vs step					-	
1	Multip	le Linear Regro	ssion mwx				Help dt Cano	. 1		₩ ₩			
1	Vor	vpe here to	easeh								ê 🐿 🕼	4	
NP	TEL.	spe nere to	search				· <u> </u>			~	5- m 1/3		

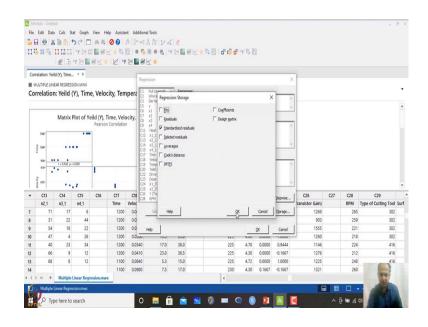
So, fit regression model, and here only thing I have to do is that I have to introduce stepwise regression over here, and click ok.

(Refer Slide Time: 06:18)

Con	elation: Vel	ld (Y), Time	Y X			5								7					
B 1	ULTIPLE LIN	EAR REGRESS	ION.MWX	e. Velo	tity. Tem		gression: Validation	Yaldation	method:	K-fold cross-	validation		×						
	relation			eild (Y), 1	lime, Velo	ocity,		Numbe	er of folds ()	ows of each fold Q: number generator:	I.	2345							
	1000-			Pearsor	i Correlation				rows of ear	ch fold by ID column	1.								
	1930 - • · 4.10	r=0.945 p=	0.000			_													
	605	•••		ŀ															۳.
+	C13	C14	CIS	C16	C17	C18		□ Store	ID column 1	for K-fold cross-validatio	n			C26	C27	C28	C29		-
+	8			C16	C17 Time	C18 Veloc		∏ Store	ID column t	for K-fold cross-validatio	n			C26 Transistor Gain)	C27	C28 RPM	C29 Type of Cutting	fool Su	r rt
→ 7	C13	C14	C15	C16	Time 1200	Veloc 0.0	Select	☐ Store	ID column t	for K-foid cross-validatio	n			'ransistor Gain) 1269	Q7	RPM 265	Type of Cutting	302	
* 7 8	C13 x2_1 71 31	C14 x3_1 17 22	C15 x4_1 6 44	C16	Time	Veloc 0.0 0.0	Select	∏ Store	ID column t	for K-fold cross-validatio	n			Transistor Gain) 1269 903	C27	RPM 265 259	Type of Cutting	302 302	
	C13 x2_1 71 31 54	C14 x3_1 17	C15 x4_1 6 44 22	C16	Time 1200 1200 1200	Veloc 0.0 0.0 0.0	Select Help	j ∏ §tore	ID column t	for K-fold cross-validatio		×	Cancel	ransistor Gain) 1269 903 1555	C27	RPM 265 259 221	Type of Cutting	302 302 302	
8 9 10	C13 x2_1 71 31 54 47	C14 x3_1 17 22 18 4	C15 x4_1 6 44 22 26	C16	Time 1200 1200 1200 1200	Veloc 0.0 0.0 0.0 0.0	Help		ID column 1		_13		-	ransistor Gain) 1269 903 1555 1260	Q7	RPM 265 259 221 218	Type of Cutting	302 302 302 302	
8	6 C13 x2_1 71 31 54 47 40	C14 x3_1 17 22 18 4 23	C15 x4_1 6 44 22 26 34	C16	Time 1200 1200 1200 1200 1200	Veloc 0.0 0.0 0.0 0.0 0.0 0.0340	нер 17.0	38.0	ID column t	225	4.70	0.0000	0.9444	ransistor Gain) 1269 903 1555 1260 1146	27	RPM 265 259 221 218 224	Type of Cutting	302 302 302 302 302 416	
8 9 10 11 12	C13 x2_1 71 31 54 47 40 66	C14 x3_1 17 22 18 4 23 9	C15 x4_1 6 44 22 26 34 12	C16	Time 1200 1200 1200 1200 1200 1200	Veloc 0.0 0.0 0.0 0.0 0.0 0.0340 0.0410	Help 17.0 23.0	38.0 38.5	ID column f	225 225	4.70	0.0000	0.9444	ransistor Gain) 1269 903 1555 1260 1146 1276	Q7	RPM 265 259 221 218 224 212	Type of Cutting	302 302 302 302 416 416	
8 9 10 11	6 C13 x2_1 71 31 54 47 40	C14 x3_1 17 22 18 4 23	C15 x4_1 6 44 22 26 34	C16	Time 1200 1200 1200 1200 1200	Veloc 0.0 0.0 0.0 0.0 0.0 0.0340	нер 17.0	38.0	: ID column t	225	4.70	0.0000	0.9444	ransistor Gain) 1269 903 1555 1260 1146	C27	RPM 265 259 221 218 224	Type of Cutting	302 302 302 302 302 416	

And then validation we can pair wise validation as usual.

(Refer Slide Time: 06:21)



And also storage we can save the residual standard as residual over here, and I click ok.

(Refer Slide Time: 06:29)

File		d																Ø
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_			_	en.	121.11	CLE	9 D. ×											
Regr	ession Anal	ysis: Yeild	• X															
-		AR REGRESS																
Reg	ression	Analysi	is: Yeild	(Y) ver	rsus Tim	e, Velo	ity, Tempe	erature										
	ethod																	2
0	oss-validati	on 10-foli	d															
St	epwise S	election	of Terms															
a	o enter = 0).15, a to re	emove = 0	.15														
					N													
R	gression	Equation	n		G													
	-	Equation -130.7 + 0.		+ 0.351 Ter	×.													
Y	sid (Y) =	-130.7 + 0.	1340 Time		nperature	C19	610	C70	(21	<i>m</i>	622	624	635	C16	C17	C10	630	
Y	eld (Y) =	-130.7 + 0.	1340 Time C15	+ 0.351 Ter C16	nperature C17	C18 Velocity	C19	C20 5	C21	C22 Drive in time O/1	C23	C24	C25	C26 V (Transister Gain)	C27	C28	C29	
¥1	c13 x2_1	-130.7 + 0. C14 x3_1	1340 Time		C17 Time	Velocity	Temperature	Yeild (Y)	C21	Drive in time (X1)	Dose (X2)	X1_STD		Y (Transistor Gain)	C 27	RPM	Type of Cutting To	iol Sur
¥1	eld (Y) =	-130.7 + 0.	1340 Time C15		nperature C17				C21				x2_STD		Q7		Type of Cutting To 34	
Yı + 7 B	c13 x2_1 71	-130.7 + 0. C14 x3_1 17	1340 Time C15 x4_1 6		C17 Time 1200	Velocity 0.0400	Temperature 5.3	Yeild (Y) 28.0	C21	Drive in time (X1) 225	Dose (X2) 4.60	X1_STD 0.0000	x2_STD 0.6667	Y (Transistor Gain) 1269	C27	RPM 265	Type of Cutting To 30 31	iol Sur
Y .	c13 x2_1 71 31	-130.7 + 0. C14 x3_1 17 22	1340 Time C15 x4_1 6 44		C17 Time 1200 1200	Velocity 0.0400 0.0380	Temperature 5.3 7.5	Yeild (Y) 28.0 31.5	C21	Drive in time (X1) 225 195	Dose (X2) 4.60 4.30	X1_STD 0.0000 -1.0000	x2_STD 0.6667 -0.1667	Y (Transistor Gain) 1269 903	Q7	RPM 265 259	Type of Cutting To 30 30 30 30 30	101 Sur 02 02
Yr + 7 8 9 0	c13 x2_1 71 31 54	-130.7 + 0. C14 x3_1 17 22 18	1340 Time C15 x4_1 6 44 22		C17 Time 1200 1200 1200	Velocity 0.0400 0.0380 0.0320	Temperature 5.3 7.5 11.0	Yeild (Y) 28.0 31.5 34.5	C21	Drive in time (X1) 225 195 255	Dose (X2) 4.60 4.30 4.30	X1_STD 0.0000 -1.0000 1.0000	x2_STD 0.6667 -0.1667 -0.1667	Y (Transistor Gain) 1269 903 1555	Q7	RPM 265 259 221	Type of Cutting To 30 30 30 30 30 30 30 30 30 30 30 30 30	101 Sur 02 02 02
Ye * 7 8 9 00 11	c13 x2_1 71 31 54 47	-130.7 + 0. C14 x3_1 17 22 18 4	1340 Time C15 x4_1 6 44 22 26		C17 Time 1200 1200 1200 1200	Velocity 0.0400 0.0380 0.0320 0.0260	Temperature 5.3 7.5 11.0 13.5	Yeild (Y) 28.0 31.5 34.5 35.0	C21	Drive in time (X1) 225 195 255 225	Dose (X2) 4,60 4.30 4.30 4.00	X1_STD 0.0000 -1.0000 1.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000	Y (Transistor Gain) 1269 903 1555 1260	Q7	RPM 265 259 221 218	Type of Cutting To 3 3 3 3 3 3 4	101 Sur 02 02 02 02
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Yr * 7 8 9 0 11 2 3	c13 x2_1 71 31 54 47 40 66	-130.7 + 0. C14 x3_1 17 22 18 4 23 9	1340 Time C15 x4_1 6 44 22 26 34 12		C17 Time 1200 1200 1200 1200 1200 1200	Velocity 0.0400 0.0380 0.0320 0.0260 0.0260 0.0340 0.0410	Temperature 5.3 7.5 11.0 13.5 17.0 23.0	Yeild (Y) 28.0 31.5 34.5 35.0 38.0 38.5	C21	Drive in time (X1) 225 195 225 225 225 225 225	Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667	Y (Transistor Gain) 1269 903 1555 1260 1146 1276	27	RPM 265 259 221 218 224 212	Type of Cutting To 3 3 3 3 3 3 4 4 4 4 4 4	101 Sur 02 02 02 02 16 16
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And let us try to see which are the variables will go in the model and which will go out of the model ok. So, what happened is that, it has identified time and temperature.

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	x2_1	x3_1	x4_1		Time		Temperature			Drive in time (X1)		X1_STD		Y (Transistor Gain)			Type of Cutting Tool	SI
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So, initially we are thinking that it is not so highly correlated, but this is not so significant 0.05, just above the cross line that is 0.05 that is the cut off over here. So, it is the analysis over here says that, we have to take into consideration time and temperature, that is the best model that is coming out of this.

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And, the R square adjusted value is 90 point something like that and 10 fold cross-validation more or less close.

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So this model seems to be adequate, if I consider that alpha level of significance is 0.1, in that case we can also consider temperature as significant variable we may retain this one.

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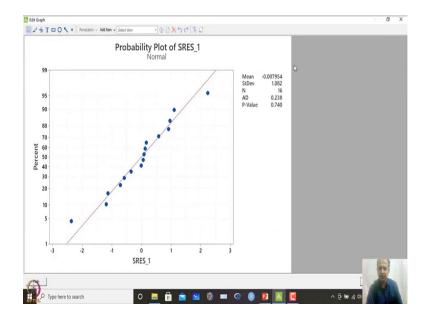
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So, let us try to see what about the normality distributions of this residual over here.

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•	C13			C16				C20 g							C 27		Type of Cutting Too	
+ 7	C13 x2_1	x3_1	x4_1	C16	Time	Velocity	Temperature	C20 g Yeild (Y)		Drive in time (X1)	Dose (X2)	X1_STD	x2_STD	Y (Transistor Gain)	C 27	RPM	Type of Cutting Too 30.	2
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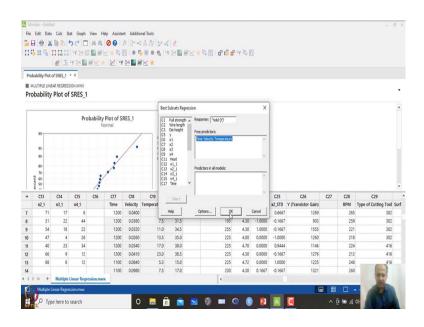


So, last residual will be normality we can check, and in this case 0.74, so there is not much problem with the normality assumptions over here. And, we do not have any problem over here.

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So, in this case normality is not a constraint. So, in this case we can also see, when I use best subset regression which is the best model it is giving, so I have taken yield over here and we have taken all the three variables.

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And if I click ok, then what happens let us try to see. And we can just paste it copy as a picture over here so then we can paste it in excel and try to see what happens ok. So, we can adopt, we will try to see what happens if we select, so excel we are opening one excel sheet ok. So, let us do that one and we can paste it over here.

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So, when we are pasting it over here. What, observations we have that we want to see. So, over here this is time variable over here, this is temperature and this is the velocity over here. With one variable what we are seeing mallow Cp is about 4, R square adjusted is 88.5.

When I take consider only time as the variables like that ok, but mallow Cp is higher than the number of variables plus 1. So this is not recommended. Second one is also not recommended with one variable, third one what we are seeing, time and temperature it is mallow Cp is less than the number of variables plus 1, so 3 is 2 is less than 3. So, this seems to be adequate, this one of the suggested model over here.

And we are getting R square value of 92 which is higher than the earlier one. And, what we are getting is that R square adjusted is also high over here. And, prediction is also more or less same what we are getting over here, only thing is that when we adopt this one tenfold cross-validation also we can check ok. 5.9 is quite high, so this goes away and last one is considering all models, we want to deduce this one.

So last one does not, we do not see the last one. So, mallow Cp suggest that this is the one when time and temperature can be considered like that. So, so that is also suggested by stepwise regression what we have seen like that.

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o a T c t i u m t r Var. R-5a R-5a fadil R-5a meth Mallows Cn. S a v a + C13 C44 C45 C16 C17 C48 C49 (20 C2) C22 C23 C24 C25 C26 C27 C28 x2,3 x3,3 x4,3 Time Velocity Temperature Velid (Y) Drive In time (X1) Dose (X2) X1,310 x4,310 Y (Vitanistar Gain) R5M	Type of Cutting Tool	RPM	(Transistor Gain)	x2_STD	X1_STD	Dose (X2)	Drive in time (X1)		Yeild (Y)	i u t r v e Ct9 Temperature	i m S P C18 Velocity	C17 Time		C15 x4_1	C14 x3_1	C13 x2_1	
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So in this case, again I am doing this. So, if we select this one fit regression model over here.

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And in this case, time and temperature. So, I am removing this one and these are the two variables.

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And stepwise regression, I will not use now. So, in this case I have already identified the variables.

(Refer Slide Time: 09:51)

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	esponse i Wars R-Sr			nrech Ma	llows Co.		CS y CG x1 C7 x2 C3 x3 C9 x4 C12 x1, C13 x2, C14 x3, C15 x4, C15 x4, C17 Tm C18 Vek C19 Ter C20 Tel C22 Drin C23 Dat C23 x2, C34 x2, C34 x2, C34 x2, C34 x2, C34 x2, C34 x2, C34 x3, C35 x4, C35 x			Besiduals for plots: Residuals plots C Individual plots I tylinda plots	t of residuals r			-				*
+	C13	C14	C15	C16	C17	C18	C25 x2 C26 Y (C28 RP						epwise	C26	C27	C28	C29	1
	x2_1	x3_1	x4_1		Time	Veloc	C28 101					-	thuse	ransistor Gain)	RPM	Type of Cutting T	ool Surf
7	71	17	6		1200	0.0	5	Se	ect				prage	126)	265	5	302
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11	40	23	34		1200	0.034	10	17.0	38.0	225	4.70	0.0000	0.9444	114		224		416
12	66	9	12		1200			23.0	38.5	225	4.30	0.0000	-0.1667	1276		212		416
13	68	8	12		1100	0.084	10	5.3	15.0	225	4.72	0.0000	1.0000	122		248	3	416
14					1100	0.098	10	7.5	17.0	230	4.30	0.1667	-0.1667	132		260		1
	1.	Multiple inear Regree	ssion mwx	ession.mws		(0		Â	 Image: Constraint of the second second	ର 🛽	2		x		□ ≜ •• ĝ		

And, I want to see all graphs, whether it is and this residual can be a standardized residual over here, so if I click ok.

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And, validation we have already careful cross-validation we have given.

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And if you click ok, what happens is that, this is the final equation minus 130.7 and plus time it is positively correlated and second one temperature is also positively correlated like that.

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So now, temperature is retained over here, although the P-Value is not so significant over here. We can also just eliminate and see whether that model performs in any way, because we have a variable to enter and exit we have given a alpha value of 0.15, so that is why this model, it has come in the model when we have done stepwise regression. But we can retain this one, because this is very close to 0.05.

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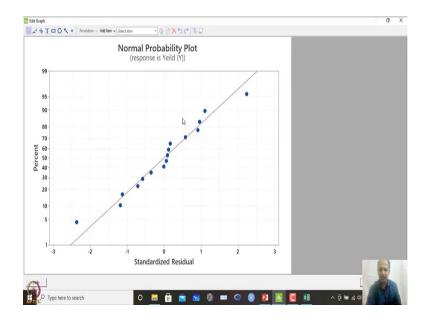
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Fi	its and Dia Obs Yelld 4 46 x2_1 71 31 54 47 40 66 68 > H	agnosti (V) I C14 X3_1 17 222 18 4 4 23 9 8 8 Multiph	cs for Un it Resid 2 702 C15 X4_1 6 44 22 26 34 12 12	Std Resi	d 44 0 C17 Time 1200 1000 100	C18 Velocity 0.0400 0.0380 0.0320 0.0260 0.0340 0.0410 0.0840	C19 Temperature 5.3 7.5 11.0 13.5 17.0 23.0 5.3	Yeild (Y) 28.0 31.5 34.5 35.0 38.0 38.0 38.5 15.0	C21	Drive in time (Xt) 225 195 225 225 225 225 225 225 225 225 225 2	Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30 4.72	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000	Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225		RPM 265 259 221 218 224 212 212 248	Type of Cutting Tor 30 30 30 30 30 41 41 41 41 41	02 02 02 02 16

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4	30 20 10 5 C13 x2_1	C14 x3_1	x4_1	C16	Time	Velocity	Temperature	Yeild (Y)		-2-		Dose (X2)	X1_STD	x2_STD	Y (Transistor Gain)		RPM	Type of Cuttin	
•	30 20 10 5 C13 x2_1 71	C14 x3_1 17	x4_1 6	CI6	Time 1200	Velocity 0.0400	Temperature 5.3	Yeild (Y) 28.0		-2 - C22	225	Dose (X2) 4.60	X1_STD 0.0000	x2_STD 0.6667	Y (Transistor Gain) 1269		RPM 265	Type of Cuttin	302
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	30 20- 10 5 C13 x2_1 71 31 54	C14 x3_1 17 22 18	x4_1 6 44 22	C16	Time 1200 1200 1200	Velocity 0.0400 0.0380 0.0320	Temperature 5.3 7.5 11.0	Yeild (Y) 28.0 31.5 34.5		-2 - C22	225 195 255	Dose (X2) 4.60 4.30 4.30	X1_STD 0.0000 -1.0000 1.0000	x2_STD 0.6667 -0.1667 -0.1667	Y (Transistor Gain) 1269 903 1555		RPM 265 259 221	Type of Cuttin	302 302 302
	30 20- 10 5 C13 x2_1 71 31	C14 x3_1 17 22 18 4	x4_1 6 44	CI6	Time 1200 1200	Velocity 0.0400 0.0380	Temperature 5.3 7.5	Yeild (Y) 28.0 31.5		-2 - C22	225 195	Dose (X2) 4.60 4.30	X1_STD 0.0000 -1.0000	x2_STD 0.6667 -0.1667	Y (Transistor Gain) 1269 903 1555 1260		RPM 265 259	Type of Cuttin	302 302
	30 20- 10 5 C13 x2_1 71 31 54 47	C14 x3_1 17 22 18	x4_1 6 44 22 26	CI6	Time 1200 1200 1200 1200	Velocity 0.0400 0.0380 0.0320 0.0260	Temperature 5.3 7.5 11.0 13.5	Yeild (Y) 28.0 31.5 34.5 35.0		-2 - C22	225 195 255 225	Dose (X2) 4.60 4.30 4.30 4.00	X1_STD 0.0000 -1.0000 1.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000	Y (Transistor Gain) 1269 903 1555 1260 1146		RPM 265 259 221 218	Type of Cuttin	302 302 302 302 302
	30 20 10 5 C13 x2_1 71 31 54 47 40	C14 x3_1 17 22 18 4 23	x4_1 6 44 22 26 34	C16	Time 1200 1200 1200 1200 1200	Velocity 0.0400 0.0380 0.0320 0.0260 0.0340	Temperature 5.3 7.5 11.0 13.5 17.0	Yelld (Y) 28.0 31.5 34.5 35.0 38.0		-2 - C22	225 195 255 225 225	Dose (X2) 4.60 4.30 4.30 4.00 4.70	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444	Y (Transistor Gain) 1269 903 1555 1260 1146 1276		RPM 265 259 221 218 224	Type of Cuttin 9 1 4 2	302 302 302 302 302 416

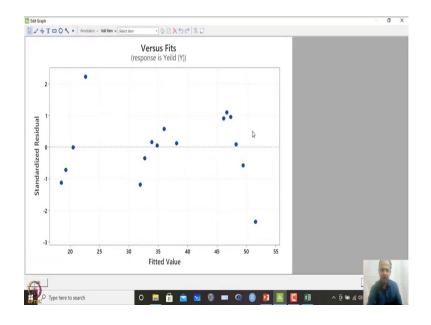
And, we can see that normal distribution assumptions over here that seems to be satisfactory as all the points.

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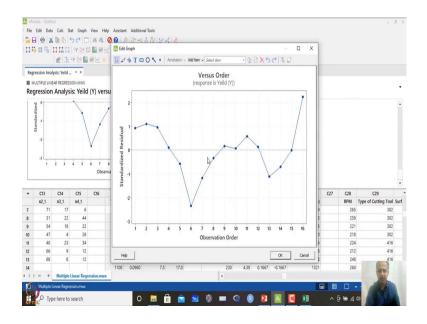
So this graphically when we see seems to be satisfactory points on the line. So, but we can cross check that one.

(Refer Slide Time: 10:55)



Even the residual versus fit plot also does not show any abnormality or patterns like that, so maybe Breusch Pagan test will also confirm this one.

(Refer Slide Time: 11:01)



And also there is no as such abnormalities in auto correlation, what we observe some trend or something is not observed it is on both side of the 000 point like that.

(Refer Slide Time: 11:14)

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+	C13	C14	C15	C16	C17		f-Fit Test for Po	iccon	C21	C22	C23	C24	C25	C26	C27	C28	C29	
	x2_1	x3_1	x4_1		Time					Drive in time (X1)	Dose (X2)	X1_STD		Y (Transistor Gain)		RPM	Type of Cutting Tool	
	71	17	6		1200	0.0400	5.3	28.0		225	4.60	0.0000	0.6667	1269		265	302	
	31	22	44		1200	0.0380	7.5	31.5		195	4.30	-1.0000	-0.1667	903		259	302	
3		18	22		1200	0.0320	11.0	34.5		255	4.30	1.0000	-0.1667	1555		221	302	
3	54					0.0260	13.5	35.0		225	4.00	0.0000	-1.0000	1260		218	302	1
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B 9 0	47 40	23	34		1200	0.0340	17.0	38.0		225	4.70					224	416	
8 9 10 11 12	47 40 66	23	34 12		1200 1200	0.0410	23.0	38.5		225	4.30	0.0000	-0.1667	1276		212	416	5
8 9 10 11 12 13	47 40	23	34		1200 1200 1100	0.0410 0.0840	23.0 5.3	38.5 15.0		225 225	4.30 4.72	0.0000	-0.1667 1.0000	1276 1225		212 248		5
7 8 9 10 11 12 13 14 4	47 40 66	23 9 8	34 12 12	ession.mwx	1200 1200	0.0410	23.0	38.5		225	4.30	0.0000	-0.1667	1276		212	416	5

So in this case, what is expected is that it should confirm the normality and other assumptions over here.

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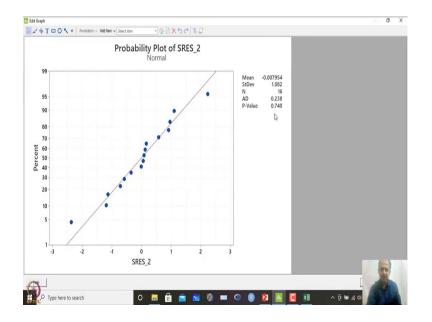
_		e F	•Y ≥ β		Ø 0 ≤ ★ % 	图 # F	6 HE 4	F 考 4		8K *	与图 I c	P c <mark>0</mark> c	P 4 8 E	1							
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	x2_1	x3_1	x4_1		Time	Velocity	Tempe									Y (Transistor Gain)		RPM	Type of Cutting	Tool S	ırt
7	71	17	6		1200	0.0400		Help					OK	Cancel	0.6667	1269		265		302	
8	31	22	44		1200	0.0380	1	7.5	31.5	-		195	\$ 4.30	-1.0000	-0.1667	903		259		302	
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10	47	4	26		1200	0.0260		13.5	35.0			225	4.00	0.0000	-1.0000	1260		218		302	
11	40	23	34		1200	0.0340		17.0	38.0			225	4.70	0.0000	0.9444	1146		224		416	
12	66	9	12		1200	0.0410		23.0	38.5			225	4.30	0.0000	-0.1667	1276		212		416	
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So we can just check this one and the last row will be the last column will be the variables residuals that we have to check.

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Probability	ty Plot of			81.*					۶K I	24 🕅 🗗 🐻 (1 Y 10	2					-	D
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+ C1		C14	C15	C16	C17	C18	C19	C20 m	C21	C22	C23	C24	C25	C26	C27	C28	C29	Γ
×2,	U	x3_1	x4_1		Time	Velocity	Temperature	Yeild (Y)		Drive in time (X1)	Dose (X2)	X1_STD	x2_STD	Y (Transistor Gain)		RPM	Type of Cutting Tool	SL
					1200	0.0400	5.3	28.0		225	4.60	0.0000	0.6667	1269		265	302	
	71	17	6				7.5	31.5		195	4.30	-1.0000	-0.1667	903		259	302	
	31	17	44		1200	0.0380								1555				
3			44		1200 1200	0.0380	11.0	34.5		255	4.30	1.0000	-0.1667	1000		221	302	
3	31	22	44					34.5 35.0		225	4.00	0.0000	-0.1667	1260		218	302 302	
0	31 54	22 18	44		1200 1200 1200	0.0320	11.0			225 225		0.0000	-1.0000 0.9444	1260 1146		218 224		
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7 8 9 0 11 2 3	31 54 47 40	22 18 4 23	44 22 26 34		1200 1200 1200	0.0320 0.0260 0.0340	11.0 13.5 17.0	35.0 38.0		225 225	4.00 4.70	0.0000	-1.0000 0.9444	1260 1146		218 224	302 416	
8 9 0 11 2	31 54 47 40 66	22 18 4 23 9	44 22 26 34 12		1200 1200 1200 1200	0.0320 0.0260 0.0340 0.0410	11.0 13.5 17.0 23.0	35.0 38.0 38.5		225 225 225	4.00 4.70 4.30	0.0000 0.0000 0.0000	-1.0000 0.9444 -0.1667	1260 1146 1276		218 224 212	302 416 416	

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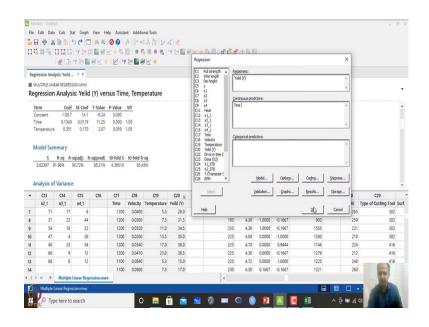
So, in this case it is coming out to be 0.7 seems to be satisfactory ok. So, in this case you have to practically also think that whether to retain the last variables or to remove, but R square adjusted as has improved what was observed.

So, R square adjusted has improved. If I consider only one variable, maybe R square adjusted will be low. So in case, I consider one variable as time as the only variable, so in this case we can do that.

(Refer Slide Time: 11:47)

			Basic Stat Regressio ANOVA DOE			Fitted Lin Regressio				an	Y Υ ^C	8						
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			Equivalen			Poisson	Regression	,										
-	odel Sum s 3.62397 9 nalysis of	R-sq R- 1.96%	sq(adj) R 90.72%			10-fold R 85.4												
Ar	S 3.62397 9	R-sq R- 1.96%	sq(adj) R 90.72%	sq(pred)	10-fold S	10-fold R		C20 12	C21	C22	C23	C24	C25	C26	Q7	C28	C29	
Ar	s 3.62397 9 nalysis of	R-sq R- 1.96% Varianc	sq(adj) R 90.72%	sq(pred) 1 85.21%	10-fold S 4.39510	10-fold R 85.4 C18	15%		C21	C22 Drive in time (X1)		C24 X1_STD	x2_STD	C26 Y (Transistor Gain)	Q27	C28 RPM	C29 Type of Cutting Too	ol Si
Ar	s 3.62397 9 nalysis of C13	R-sq R- 1.96% Varianc C14	sq(adj) R 90.72% C15	sq(pred) 1 85.21%	10-fold S 4.39510 C17	10-fold R 85.4 C18 Velocity 0.0400	C19 Temperature 5.3	Yeild (Y) 28.0	C21	Drive in time (X1) 225	Dose (X2) 4.60	X1_STD 0.0000	x2_STD 0.6667	Y (Transistor Gain) 1269	C27	RPM 265	Type of Cutting Too 302	2
Ar	S 3.62397 9 nalysis of C13 x2_1 71 31	R-sq R- 1.96% Varianc C14 x3_1 17 22	sq(adj) R 90.72% C15 x4_1 6 44	sq(pred) 1 85.21%	0-fold S 4.39510 C17 Time 1200 1200	10-fold R 85.4 C18 Velocity 0.0400 0.0380	C19 Temperature 5.3 7.5	Yeild (Y) 28.0 31.5	C21	Drive in time (X1) 225 195	Dose (X2) 4.60 4.30	X1_STD 0.0000 -1.0000	x2_STD 0.6667 -0.1667	Y (Transistor Gain) 1269 903	C27	RPM 265 259	Type of Cutting Too 303 303	2
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So, we can just consider time as the only variable, so fit regression model instead of temperature I will remove this one. So, I just keep a note of this R square adjusted is around 90, this is around 85 R square predicted and tenfold cross-validation earlier was around 85.

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So, 90 and 85 approximately that is the range what we are getting.

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And, when we do this here you see R square adjusted is also low lower than the earlier one. So, it depends on the practical sense of your, whether to adopt the variable or whether to remove the variable which is not significant like that that depends on the process engineers or somebody who is knowledgeable about that whether to retain that one or to eliminate that one. And, there is no lack of fit as such that is observed over here.

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Fi	C13 x2_1	(Y) C14 X3_1	Fit R	isid Std	C16	C17 ime	C18 Velocity	Temperature	Yeild (Y)	C21	Drive in time (X1)	Dose (X2)	X1_STD	x2_STD	Y (Transistor Gain)	C27	RPM	Type of Cutting Too	
Fi	Dbs Veild 16 20 C13 x2_1 71	(Y) C14 X3_1	Fit R	IS 6	C16	C17 ime 1200	C18 Velocity 0.0400	Temperature 5.3	Yeild (Y) 28.0	(21	Drive in time (X1) 225	Dose (X2) 4.60	X1_STD 0.0000	x2_STD 0.6667	Y (Transistor Gain) 1269	Q7	RPM 265	Type of Cutting Too 30	22
Fi	Dbs Veild 16 20 C13 x2_1 71 31	(Y) C14 X3_1	Fit R/ C x/ 17 22	esid Std 0.00 15 15 6 44	C16	C17 ime 1200 1200	C18 Velocity 0.0400 0.0380	Temperature 5.3 7.5	Yeild (Y) 28.0 31.5	C21	Drive in time (X1) 225 195	Dose (X2) 4.60 4.30	X1_STD 0.0000 -1.0000	x2_STD 0.6667 -0.1667	Y (Transistor Gain) 1269 903	Q27	RPM 265 259	Type of Cutting Too 30. 30.)2)2
Fi	C13 x2_1 71 31 54	(Y) C14 X3_1	Fit R/ C x/ 17 22 18	esid Std 2.00 15 6 44 22	C16	C17 ime 1200 1200 1200	C18 Velocity 0.0400 0.0380 0.0320	Temperature 5.3 7.5 11.0	Yeild (Y) 28.0 31.5 34.5	C21	Drive in time (Xt) 225 195 255	Dose (X2) 4.60 4.30 4.30	X1_STD 0.0000 -1.0000 1.0000	x2_STD 0.6667 -0.1667 -0.1667	Y (Transistor Gain) 1269 903 1555	Q7	RPM 265 259 221	Type of Cutting Too 30, 30, 30, 30,	02 02 02
Fi	Obs Veild 14 20 C13 21 71 31 54 47	(Y) C14 x3_1	Fit R/ C X4 17 22 18 4	sid Std 5.00 5.00 5.00 6 44 22 26	C16	C17 ime 1200 1200 1200 1200	C18 Velocity 0.0400 0.0380 0.0320 0.0260	Temperature 5.3 7.5 11.0 13.5	Yelld (Y) 28.0 31.5 34.5 35.0	C21	Drive in time (Xt) 225 195 255 225	Dose (X2) 4.60 4.30 4.30 4.00	X1_STD 0.0000 -1.0000 1.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000	Y (Transistor Gain) 1269 903 1555 1260	Q7	RPM 265 259 221 218	Type of Cutting Too 30. 30. 30. 30. 30. 30.	02 02 02 02
Fi	Dbs Veild 14 20 C13 31 54 47 40 40	(Y) C14 x3_1	Fit Ro C x4 17 22 18 4 23	sid Std 15 6 44 22 26 34	C16	C17 ime 1200 1200 1200 1200 1200	C18 Velocity 0.0400 0.0380 0.0320 0.0260 0.0340	Temperature 5.3 7.5 11.0 13.5 17.0	Yelld (Y) 28.0 31.5 34.5 35.0 38.0	C21	Drive in time (X1) 225 195 255 225 225 225	Dose (X2) 4,60 4,30 4,30 4,00 4,70	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444	Y (Transistor Gain) 1269 903 1555 1260 1146	Q7	RPM 265 259 221 218 224	Type of Cutting Too 30. 30. 30. 30. 41.	02 02 02 02
Fi	Dbs Weild 14 30 C13 71 31 54 47 40 66 66	(Y) C14 x3_1	Fit R/ C X4 17 22 18 4	sid Std 15 (44) 22 (34) 12	C16	C17 ime 1200 1200 1200 1200 1200 1200	C18 Velocity 0.0400 0.0380 0.0320 0.0260 0.0340 0.0340	Temperature 5.3 7.5 11.0 13.5 17.0 23.0	Yelld (Y) 28.0 31.5 34.5 35.0 38.0 38.5	C21	Drive in time (Xt) 225 195 225 225 225 225 225 225	Dose (X2) 4.60 4.30 4.30 4.00 4.00 4.70 4.30	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667	Y (Transistor Gain) 1269 903 1555 1260 1146 1276	C27	RPM 265 259 221 218 224 212	Type of Cutting Too 30, 30, 30, 30, 30, 41, 41, 41, 41,	02 02 02 02 16
Fi	Dbs Veild 14 20 C13 31 54 47 40 40	(Y) C14 x3_1	Fit R0 C X4 17 22 18 4 23 9	sid Std 15 6 44 22 26 34	C16	C17 ime 1200 1200 1200 1200 1200 1200 1200 120	C18 Velocity 0.0400 0.0380 0.0320 0.0260 0.0340 0.0410 0.0840	Temperature 5.3 7.5 11.0 13.5 17.0 23.0 5.3	Yelld (Y) 28.0 31.5 34.5 35.0 38.0 38.0 38.5 15.0	C21	Drive in time (Xt) 225 195 255 225 225 225 225 225 225 225	Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30 4.72	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000	Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225	C27	RPM 265 259 221 218 224 212 212 248	Type of Cutting Too 30. 30. 30. 30. 41.	02 02 02 02 16
Fi	Dbs Weild 14 30 C13 31 31 54 47 40 66 68	(Y) C14 X3_1	Fit R/ C X4 17 22 18 4 23 9 8	sid Std 15 6 44 22 26 34 12 12 12	Resid	C17 ime 1200 1200 1200 1200 1200 1200	C18 Velocity 0.0400 0.0380 0.0320 0.0260 0.0340 0.0340	Temperature 5.3 7.5 11.0 13.5 17.0 23.0	Yelld (Y) 28.0 31.5 34.5 35.0 38.0 38.5	C21	Drive in time (XI) 225 255 225 225 225 225 225 225 225 22	Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30 4.72	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667	Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225	Q7	RPM 265 259 221 218 224 212	Type of Cutting Too 30, 30, 30, 30, 30, 41, 41, 41, 41,	02 02 02 02 16
Fi	Dbs Veild 14 200 C13 21 711 311 54 477 400 666 68 8 H +	(Y) C14 x3_1	Fit R/ C x/ 17 22 18 4 23 9 8 9 8 9	stid Std 15 6 44 22 26 34 12 12 12 12	Resid	C17 ime 1200 1200 1200 1200 1200 1200 1200 120	C18 Velocity 0.0400 0.0380 0.0320 0.0260 0.0340 0.0410 0.0840	Temperature 5.3 7.5 11.0 13.5 17.0 23.0 5.3	Yelld (Y) 28.0 31.5 34.5 35.0 38.0 38.0 38.5 15.0	C21	Drive in time (Xt) 225 195 255 225 225 225 225 225 225 225	Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30 4.72	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000	Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225 1321		RPM 265 259 221 218 224 212 248 260	Type of Cutting Too 30, 30, 30, 30, 30, 41, 41, 41, 41,	02 02 02 02 16
Fi	Dbs Weild 14 30 C13 31 31 54 47 40 66 68	(Y) C14 x3_1	Fit R/ C x/ 17 22 18 4 23 9 8 9 8 9	stid Std 15 6 44 22 26 34 12 12 12 12	Resid	C17 ime 1200 1200 1200 1200 1200 1200 1200 120	C18 Velocity 0.0400 0.0380 0.0320 0.0260 0.0340 0.0410 0.0840	Temperature 5.3 7.5 11.0 13.5 17.0 23.0 5.3	Yelld (Y) 28.0 31.5 34.5 35.0 38.0 38.0 38.5 15.0	C21	Drive in time (XI) 225 255 225 225 225 225 225 225 225 22	Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30 4.72	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000	Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225		RPM 265 259 221 218 224 212 212 248	Type of Cutting Toc 30 30 30 30 30 41 41 41 41 41	02 02 02 02 16

So this is lack of fit. So, linear model seems to be adequate so we can adopt this one. So, you have to think from practical aspects like that. So, multicollinearity problem when we are considering, both the variables over here, so if I consider both the variables, and in that case we are not getting any multicollinearity issue over here.

			Basic Stat Regressic ANOVA DOE			Fitted Lin Regressio		,	Fit R	971, 573 470 470 4 egression Nodel Subsets	# 4Y XD [8						
I MU	ession Anal JUTIPLE LINE ression	AR REGR	Control C Quality T Reliability	ools	. 2	Stability S		,	⊷Y Pred i Facto Conf									
Cre	ethod oss-validati		Multivari Time Seri Tables Nonparat Equivaler	es metrics	ليا الأ الأ	Binary Lo Ordinal L Nominal	tted Line Plot gistic Regression ogistic Regressio Logistic Regress	n •		laid Contour Plot onse Optimizer								
Yei	efficient	-133.0		d Sample Si		Poisson F	Regression	,										
Yei Co Ter	efficient	-133.0 -	Coef T-1	d Sample Si Value P-V .8 49 0	alue VIF			,										
Yei Co Ter	rm C13	-133.0 - s Coef SE -133.0 C14	Coef T- 15.7 C15	d Sample Si Value P-V	alue VIF	C18	C19	C20 12	C21	C22 Drive in time (VI)	C23	C24	C25	C26 V (Transistor Gain)	C27	C28	C29 Tune of Cutting Top	
Yei Co Ter	rm C13 x2_1	-133.0 - S Coef SE -133.0 C14 x3_1	Coef T-1	d Sample Si Value P-V .8 49 0	alue VIF 000 C17 Time	C18 Velocity	C19 Temperature	Yeild (Y)	(21	Drive in time (X1)	Dose (X2)	X1_STD	x2_STD	Y (Transistor Gain)	Q7	RPM	Type of Cutting Too	
Yei Co Ter	rm C13	-133.0 - s Coef SE -133.0 C14	Coef T-1 15.7 C15 x4_1	d Sample Si Value P-V .8 49 0	alue VIF	C18	C19		C21						Q7			2
Yei Co Ter	rm c13 x2_1 71	-133.0 + S Coef SE -123.0 C14 x3_1 17	Coef T-1 15 7 C15 x4_1 6	d Sample Si Value P-V .8 49 0	C17 Time 1200	C18 Velocity 0.0400	C19 Temperature 5.3	Yeild (Y) 28.0	C21	Drive in time (X1) 225	Dose (X2) 4.60	X1_STD 0.0000	x2_STD 0.6667	Y (Transistor Gain) 1269	Q7	RPM 265	Type of Cutting Too 302	2
Yei	rm c13 x2_1 71 31	-133.0 + IS Coef SE -133.0 C14 X3_1 17 22	Coef T- 15.7 C15 x4_1 6 44	d Sample Si Value P-V .8 49 0	alue VIF 000 C17 Time 1200 1200	C18 Velocity 0.0400 0.0380	C19 Temperature 5.3 7.5	Yeild (Y) 28.0 31.5	C21	Drive in time (X1) 225 195	Dose (X2) 4.60 4.30	X1_STD 0.0000 -1.0000	x2_STD 0.6667 -0.1667	Y (Transistor Gain) 1269 903	Q7	RPM 265 259	Type of Cutting Too 303 303	2
Yei	rm c13 x2_1 71 31 54	-133.0 + IS Coef SE -133.0 C14 x3_1 17 22 18	Coef T-1 15.7 C15 x4_1 6 44 22	d Sample Si Value P-V .8 49 0	alue VIF 000 C17 Time 1200 1200 1200	C18 Velocity 0.0400 0.0380 0.0320	C19 Temperature 5.3 7.5 11.0	Yeild (Y) 28.0 31.5 34.5	C21	Drive in time (Xt) 225 195 255	Dose (X2) 4.60 4.30 4.30	X1_STD 0.0000 -1.0000 1.0000	x2_STD 0.6667 -0.1667 -0.1667	Y (Transistor Gain) 1269 903 1555	Q7	RPM 265 259 221	Type of Cutting Too 303 303 303	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
Yei	rm c13 x2_1 71 31 54 47	-133.0 + IS Coef SE -123.0 C14 X3_1 17 22 18 4	Coef T-1 15.7 C15 x4_1 6 44 22 26	d Sample Si Value P-V .8 49 0	alue VIF 000 C17 Time 1200 1200 1200	C18 Velocity 0.0400 0.0380 0.0320 0.0260	C19 Temperature 5.3 7.5 11.0 13.5	Yeild (Y) 28.0 31.5 34.5 35.0	C21	Drive in time (X1) 225 195 255 225	Dose (X2) 4,60 4,30 4,30 4,00	X1_STD 0.0000 -1.0000 1.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000	Y (Transistor Gain) 1269 903 1555 1260	Q7	RPM 265 259 221 218	Type of Cutting Too 300 300 300 300 300 300 300	2 2 2 2 6
Yei	id (Y) = befficient rm C13 x2_1 71 31 54 47 40	-133.0 + -133.0	Coef T-1 15 7 C15 x4_1 6 44 22 26 34	d Sample Si Value P-V .8 49 0	alue VIF 000 C17 Time 1200 1200 1200 1200 1200	C18 Velocity 0.0400 0.0380 0.0320 0.0260 0.0340	C19 Temperature 5.3 7.5 11.0 13.5 17.0	Yelld (Y) 28.0 31.5 34.5 35.0 38.0	C21	Drive in time (X1) 225 195 255 225 225	Dose (X2) 4.60 4.30 4.30 4.00 4.70	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444	Y (Transistor Gain) 1269 903 1555 1260 1146	27	RPM 265 259 221 218 224	Type of Cutting Too 300 300 300 300 416	2 2 2 6 6
Yei Co Ter	id (Y) = cefficient m cta x2_1 71 31 54 47 40 66	-133.0 + -133.0	Coef T-1 15 7 C15 x4_1 6 44 22 26 34 12	d Sample Si Value P-V .8 49 0	alue VIF 000 C17 Time 1200 1200 1200 1200 1200 1200	C18 Velocity 0.0400 0.0380 0.0260 0.0340 0.0340	C19 Temperature 5.3 7.5 11.0 13.5 17.0 23.0	Yelld (Y) 28.0 31.5 34.5 35.0 38.0 38.5	C21	Drive in time (X1) 225 195 255 225 225 225 225	Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -1.0000 0.9444 -0.1667	Y (Transistor Gain) 1269 903 1555 1260 1146 1276	27	RPM 265 259 221 218 224 212	Type of Cutting Too 300 300 300 300 416 416 416 416	2 2 2 6 6

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So, this time and temperature if we consider both of them.

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Regre	ession Anal	lysis: Yeild	i	* X				Regression		_				_	×						
-	ULTIPLE LINE							-													
Reg	ression	Analy	/sis:	: Yeild	(Y) ve	ersus Tim	e	C11 Heat C12 x1_1		Responses: Yeld (Y)					~	1					
								C13 x2_1 C14 x3_1 C15 x4_1													
Me	ethod							C17 Time		Continuous	madetace				_						
Cro	oss-validati	ion 10-fr	fold					C18 Velocity C19 Temper	rature	Time Temp		_			0	1					
								C20 Yeld (Y C22 Drive in	() n time (
Re	gression	Equation Equation	ion					C23 Dose () C24 X1_STD	(2)						~						
																1					
Yei	id (Y) =	-133.0+1	0.139	195 Time				C25 x2_STD													
Yei	iid (Y) =	-133.0 + 1	0.139	195 Time				C25 x2_STD C26 Y (Tran C28 RPM) relistor (Categorical	predictors:					1					
	efficient		0.139	195 Time				C25 x2_STD C26 Y (Tran C28 RPM C29 Type of C30 Surface	o rsistor (é Cuttir e Finish	Categorical	predictors:				^	1					
	efficient				Value F	-Value VIF		C25 x2_STU C26 Y (Tran C28 RPM C29 Type of C30 Surface C31 Johnso C32 Sgrt(Y)) rsistor (é Cuttir e Finish in Trare	Categorical	predictors:				Â	1					
Co	efficient	ts	SE Co	oef T-V	Value F	-Value VIF		C25 x2_STU C26 Y (Tran C28 RPM C29 Type of C30 Surface C31 Johnso C32 Sert(Y) C33 SRES C34 SRES 1	o nsistor (é Cuttir e Finish in Trare	Categorical	predctors:				0]					*
Co	efficient rm C13	Coef : -123.0 C14	SE Co	Coef T-1		0.000 C17	CIE	C25 x2_STC C26 Y (Tran C28 RPM C29 Type of C30 Surface C31 Joinso C32 Sqrt(Y) C33 SRES_ C35 SRES_ C35 SRES_ C35 SRES_	o rsistor (é Cuttir e Finish in Trare 1 2	Categorical		Options	co	dra	Stepwise	C26	C27	C28	C29		*
Co	cta x2_1	Coef : .123.0 C14 x3_1	SE Co	Coef T-1	-R 40	0.000 C17 Time	Cit	C25 x2_STC C26 Y (Tran C28 RPM C29 Type of C30 Surface C31 Johnso C32 Sqrt(Y) C33 SRES C34 SRES_1 C35 SRES_1	o nsistor (é Cuttir e Finish in Trare	Categorical	Model				-	ransistor Gain)	C27	RPM	C29 Type of Cutt	ing Tool	v
Co <u>Ter</u> (~~	ctaor ctaor x2_1 71	ts <u>Coef</u> : 133.0 C14 x3_1 17	SE Co	Coef T-1 15 7 C15 x4_1 6	-R 40	C17 Time 1200	C18 Veloc	C25 x2_STC C26 Y (Tran C28 RPM C29 Type of C30 Surface C31 Johnso C32 Sqrt(7) C33 SRES C34 SRES_ C36 SRES_ C36 SRES_ Selec	o nsistor (é Cuttir e Finish in Trare	Categorical		Optiogs Graphs		ding	Stepwise	ransistor Gain) 1269	C27	RPM 265	Type of Cut	ting Tool 302	surf
Co <u>Ter</u> 7 8	cta rm cta x2_1 71 31	Coef : .133.0 C14 x3_1 17 22	SE Co 1' 7 2	Coef T-1 15 7 C15 x4_1 6 44	-R 40	C17 Time 1200 1200	C18 Veloc 0.0 0.0	C25 x2_STC C26 Y (Tran C28 RPM C29 Type of C30 Surface C31 Jointoo C32 Sert(Y) C33 SRES_ C34 SRES_ C36 SRES_ C36 SRES_ SRES_	o nsistor (é Cuttir e Finish in Trare	Categorical	Model		Be	suits	-	ransistor Gain) 1269 903	Q7	RPM 265 259	Type of Cut	ting Tool 302 302	* Surf
Co <u>Ter</u> (~ *	C13 x2_1 71 31 54	ts <u>Coef</u> : 133.0 C14 x3_1 17 22 18	SE Cc 11 2 2 8	Coef T-1 15 7 C15 x4_1 6 44 22	-R 40	0 000 C17 Time 1200 1200 1200	C18 Veloc 0.0 0.0 0.0	C25 x2_STC C36 Y (Tran C38 RPM C29 Type of C30 Surface C31 Johnso C32 Sort(Y) C33 SRES_ C35 SRES_ C36 SRES_ Selec Help	o esistor (f Cuttir e Finish in Trare 2 3 v		Model	Graphs	Be	gits	Storage Cancel	ransistor Gain) 1269 903 1555	C27	RPM 265 259 221	Type of Cutt	ting Tool 302 302 302 302	v
Co <u>Ter</u> (~~ + 7 8 9 0	C13 x2_1 71 31 54 47	ts .133.0 C14 x3_1 17 22 18 4	SE Cc 11 2 8 4	Coef T-1 15.7 C15 x4_1 6 44 22 26	-R 40	0 000 C17 Time 1200 1200 1200 1200	C18 Veloc 0.0 0.0 0.0 0.0	C25 x2 5TC C26 Y (Tran C28 R/M C29 Type of C30 Surface C30 Surface C31 Johnson C32 Sort(Y) C33 Set5 C35 Set5_ C35 Set5_ C35 Set5_ Setec Help	o esistor (f Cuttir e Fnish in Trare 2 3 v t	33.0	Model	Graphs		QK N	Storage Cancel	ransistor Gain) 1269 903 1555 1260	Q7	RPM 265 259 221 218	Type of Cut	ting Tool 302 302 302 302 302	* Surf
Co Ter 7 8 9 0	C13 x2_1 71 31 54 47 40	ts Coef : 133.0 C14 x3_1 17 22 18 4 23	SE CC 11 2 2 8 8 4 3	Coef T-V 15.7 C15 x4_1 6 44 22 26 34	-R 40	C17 C17 Time 1200 1200 1200 1200 1200 1200	C18 Veloc 0.0 0.0 0.0 0.0 0.0	C25 x2 5TC C26 Y (Tran C28 RPH C29 Type of C29 Type of C29 Surface C30 Surface C31 Johnso C32 Sert(Y) C33 Set5_ C35 Set5_S Set	o posistor (d Cuttir e Phish in Trate 1 2 3 v t 1 1 1 1 1 1 1 1 1 1 1 1 1	33.0	Model	graphs 225	Be 4.70	QK 0.0000	Storage Cancel	ransistor Gain) 1269 903 1555 1260 1146	27	RPM 265 259 221 218 224	Type of Cutt	ting Tool 302 302 302 302 302 416	Surf
Co Ter 7 8 8 9 0 0	rm c13 x2_1 71 31 54 47 40 66	ts .133.0 C14 x3_1 17 22 18 4	SE CC 11 2 2 8 8 4 3	Coef T-1 15.7 C15 x4_1 6 44 22 26 34 12	-R 40	C17 Time 1200 1200 1200 1200 1200 1200 1200	C18 Veloc 0.0 0.0 0.0 0.0 0.0 0.0	C25 x2_5TC C26 Y (Tran C28 R/H C29 Type of C29 Type of C29 Surface C35 Surface	d Guttr e Finish in Trate 1 2 3 v t 1 1 7 0 2 3 v 1 2 3 v 1 2 3 v 1 2 3 v 1 2 3 v 1 2 3 v 1 1 1 1 1 1 1 1 1 1 1 1 1	33.0 38.0 38.5	Model	Graphs 225 225 225	4.70 4.30	QK 0.0000 0.0000 0.0000	Storage Cancel 11.0000 0.9444 -0.1667	ransistor Gain) 1269 903 1555 1260 1146 1276	Q7	RPM 265 259 221 218 224 212	Type of Cut	ting Tool 302 302 302 302 416 416	surf
Co Ter 7 8 9 0	C13 x2_1 71 31 54 47 40	ts Coef : 133.0 C14 x3_1 17 22 18 4 23	SE CC 11 2 2 8 8 4 3	Coef T-V 15.7 C15 x4_1 6 44 22 26 34	-R 40	C17 C17 Time 1200 1200 1200 1200 1200 1200	C18 Veloc 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	C25 x2 5TC C26 Y (Tran C28 RPH C29 Type of C29 Type of C29 Surface C30 Surface C31 Johnso C32 Sert(Y) C33 Set5_ C35 Set5_S Set	0 sister (6 Cutter e Fnish in Trare 2 3 v 12 3 v 17.0 23.0 5.3	33.0	Model	graphs 225	Be 4.70	QK 0.0000	Storage Cancel	ransistor Gain) 1269 903 1555 1260 1146	Q7	RPM 265 259 221 218 224	Type of Cut	ting Tool 302 302 302 302 302 416	sur

And variation inflation factor is around 1.05, so which is quite satisfactory.

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Regr	ression Anah	ysis: Yeild	* x														
E M	ULTIPLE UNE	AR REGRESS	ION MWX														
Reg	gression	Analysi	is: Yeild	(Y) versus	ime, Tem	perature											
M	lethod																
	ross-validati																
D.		Equation	1														
R	egression																
			240 Time 4	0.251 Temperat	-												
			1340 Time 4	0.351 Temperat													
Ye	eid (Y) =	-130.7 + 0.1	1340 Time 4	0.351 Temperat		à											
Ye		-130.7 + 0.1	1340 Time 4	0.351 Temperat		à											
Ye	eld (Y) =	-130.7 + 0.1				à											
Ye	eid (Y) =	-130.7 + 0.1		0.351 Temperat T-Value P-Val	e VIF	\$											
Ye	eld (Y) = oefficient erm	-130.7 + 0. s Coef	SE Coef	T-Value P-Val	e VIF	c19	C20 g	C21	C22	C23	C24	C25	C26	(27	C28	C29	
	eid (Y) = coefficient erm C13 x2_1	-130.7 + 0. S Coef -130.7 C14 x3_1	SE Coef	T-Value P-Val .0.24 0.0 C16 C1 Tim	e VIF n C18 e Velocity	C19 Temperature	Yeild (Y)	C21	Drive in time (X1)	Dose (X2)	X1_STD	x2_STD	Y (Transistor Gain)	Q27	RPM	Type of Cutting Too	
	eid (Y) = coefficient erm C13 x2_1 71	-130.7 + 0. s <u>Coef</u> -130 7 C14 x3_1 17	SE Coef 14.1 C15 x4_1 6	T-Value P-Val .0.74 0.0 C16 C1 Tim	e VIF 0 C18 e Velocity 100 0.040	C19 Temperature 5.3	Yeild (Y) 28.0	C21	Drive in time (X1) 225	Dose (X2) 4.60	X1_STD 0.0000	x2_STD 0.6667	Y (Transistor Gain) 1269	C27	RPM 265	Type of Cutting Too 30.	2
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Type of Cutting T	RPM		H Generalstein Caleb		X1_STD	Dose (X2)	Drive in time (X1)			Temperature	Velocity	Time		x4_1	x3_1	x2_1	
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And, so whether to include both the variables or not to include both the variables, that is the judgment that you have to take. But, I will suggest to retain this one because this is improving R square adjusted and also tenfold cross-validation and R square predicted is also improving so we can retain this one ok.

So, but there is no black and white scenario using regression like that. So it depends on the process engineers and then see the predictive behaviors and then we try to adopt whichever model is very close ok. Suggested model over here is, we can include time and temperature both the variables. But if you go by significance, in that case temperature may be dropped and we stick to time only that is the only variable ok.

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,	3.62397 91.96% Analysis of Varia C22	90.72% nce C23	85.214 C24	4.3951 C25	0 85.45% C26	C27 C28	C29	C30 5			C33	C34	C35	C36	C37	
	3.62397 91.96% Analysis of Varian C22 Drive in time (X1)	90.72% nce C23 Dose (X2)	85.219 C24 X1_STD	4.3951 C25 x2_STD	C26 Y (Transistor Gain)	RPM	Type of Cutting Tool	Surface Finish	Johnson Trans (Y)	Sqrt(Y)	C33	C34	C35	C36	C37	
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•	3.62397 91.96% Analysis of Varia C22 Drive in time (X1) 225 195	90.72% nce C23 Dose (X2) 4.60 4.30	85.215 C24 X1_STD 0.0000 -1.0000	C25 K2_STD 0.6667 -0.1667	C26 Y (Transistor Gain) 1269 903	RPM 26	Type of Cutting Tool 302 302 302	Surface Finish 52.26 50.52	Johnson Trans (Y) 1.98000 1.06984	Sqrt(Y) 7.22911 7.10774	C33	C34	C35	C36	C37	
+ 7 8 9	3.62397 91.90% Analysis of Varia C22 Drive in time (X1) 225 195 255	90.72% nce C23 Dose (X2) 4.60 4.30	C24 X1_STD 0.0000 -1.0000 1.0000	C25 x2_STD 0.6667 -0.1667 -0.1667	C26 Y (Transistor Gain) 1269 903 1555	RPM 26 25 22	Type of Cutting Tool 5 302 9 302 1 302	Surface Finish 52.26 50.52 45.58	Johnson Trans (Y) 1.98000 1.06984 0.43932	Sqrt(Y) 7.22911 7.10774 6.75130	C33	C34	C35	C36	C37	
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	3.62397 91.96% Analysis of Varial C22 Drive in time (XI) 225 225 225 225 225 225 225 225 225 22	90.72% C23 Dose (X2) 4.60 4.30 4.30 4.30 4.70 4.30 4.72	C24 X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.1667	C25 x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1146 1225	RPM 266 255 222 21 222 21 222 21 24	Type of Cutting Tool 5 302 9 302 1 302 3 302 4 416 2 416 3 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	C33	C34	C35	C36	C37	
→ 7 8 9 10 11 12 13 14	3.62397 91.96% Analysis of Varial C22 Drive in time (XI) 225 225 225 225 225 225 225 225 225 22	90.72% C23 Dose (X2) 4.60 4.30 4.30 4.30 4.30 4.30 4.30 4.30 91e Linear R	C24 X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.1667 regression.m	C25 x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1146 1225	RPM 266 255 222 21 222 21 222 21 24	Type of Cutting Tool 3 302 3 302 3 302 3 302 3 302 3 302 3 302 3 302 4 416 4 416 4 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536		C34			C37	

So, this is one scenario. And, we can have in regression some other scenarios like that we can place this is the example, I want to place over here. Maybe, we will delete this one residual over here. So, this is one example that we are taking, so RPN type of cutting tool and surface finish this is the variable surface finish is Y and RPM is the continuous variable and there can be a categorical variable, that means, or type of the cutting tool.

So, here the number is categorical. It can take two values, 302 and 416 like that. So this is the two types of tool. So this is categorical variable basically, so this is no I cannot say 302 is greater than 416 like that. So this cannot be arranged in ascending order, descending order. So this is like color, different types of color. So, this is categorical variable we have to treat, and regression has an option to deal with categorical variable also.

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	3.62397 91.96%	Power R-sq(adj) 90.72%	and Sample R-sq(pred 85.219) 10-fold		on	,										
	S R-sq	Power R-sq(adj) 90.72%	and Sample R-sq(pred) 10-fold	S 10-fold R-sq	C27 C	,	629	C30 m	C31 m	C32	C33	C34	C35	C36	C37	
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A	<u>S R-sq 1</u> 3.62397 91.96% nalysis of Varian C22	Power R-sq(adj) 90.72% ce C23	and Sample R-sq(pred 85.219	 10-fold 4.3951 C25 	S 10-fold R-sq 0 85.45% C26	C27 C						C33	C34	C35	C36	C37	
AI	S R-sq 1 3.62397 91.96% malysis of Varian C22 Drive in time (Xt) C	Power R-sq(adj) 90.72% cce c23 Dose (X2)	end Sample R-sq(pred 85.219 C24 X1_STD	0 10-fold 6 4.3951 C25 x2_STD	S 10-fold R-sq 0 85.45% C26 Y (Transistor Gain)	C27 C	M	Type of Cutting Tool	Surface Finish	Johnson Trans (Y)	Sqrt(Y)	C33	C34	C35	C36	C37	
AI	S R-sq 1 3.62397 91.96% analysis of Varian C22 Drive in time (Xt) D 225	Power R-sq(adj) 90.72% cce c23 Dose (X2) 4.60	C24 C24 C24 C24 C24 C24 C24 C24 C24 C24	0 10-fold 6 4.3951 C25 x2_STD 0.6667	S 10-fold R-sq 0 85.45% C26 Y (Transistor Gain) 1269	C27 C	PM 265	Type of Cutting Tool 302	Surface Finish 52.26	Johnson Trans (Y) 1.98000	Sqrt(Y) 7.22911	C33	C34	C35	C36	C37	
A1	S R-sq 1 3.62397 91.96% analysis of Varian C22 Drive in time (X1) D 225 195	Power R-sq(adj) 90.72% cce c23 Dose (X2) 4.60 4.30	and Sample R-sq(pred 85.211 C24 X1_STD 0.0000 -1.0000	0 10-fold 4.3951 C25 x2_STD 0.6667 -0.1667	S 10-fold R-sq 0 85.45% C26 Y (Transistor Gain) 1269 903	C27 C	PM 265 259	Type of Cutting Tool 302 302	Surface Finish 52.26 50.52	Johnson Trans (Y) 1.98000 1.06984	Sqrt(Y) 7.22911 7.10774	C33	C34	C35	C36	C37	
A1	s R-sq 3.62397 91,964 analysis of Varian c22 Drive in time (X1) C 225 195 225 225 225 225	Power R-sq(adj) 90.72% C23 C23 C23 C23 C23 C23 C23 C23	c24 X1_STD 0.0000 1.0000	0 10-fold 6 4.3951 C25 x2_STD 0.6667 -0.1667 -0.1667	S 10-fold R-sq 0 85,45% Y (Transistor Gain) 1269 903 1555	C27 C	M 265 259 221 218 224	Type of Cutting Tool 302 302 302	Surface Finish 52.26 50.52 45.58	Johnson Trans (V) 1.98000 1.06984 0.43932	Sqrt(Y) 7.22911 7.10774 6.75130	C33	C34	C35	C36	C37	
An + 1 7 3 0 0	s R-sq 1 3.62397 91,96% analysis of Varian C22 Drive in time (XI) C 225 195 255 225 225 225 225	Power R-sq(adj) 90.72% CC2 C23 Cose (X2) 4.60 4.30 4.30 4.30 4.00	end Sample R-sq(pred 85.211 C24 X1_STD 0.0000 -1.0000 1.0000 0.0000) 10-fold 6 4.3951 C25 x2_STD 0.6667 -0.1667 -0.1667 -1.0000	S 10-fold R-sq 0 85.45% C26 Y (Transistor Gain) 1269 903 1555 1260	C27 C	M 265 259 221 218	Type of Cutting Tool 302 302 302 302	Surface Finish 52.26 50.52 45.58 44.78	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179	C33	C34	C35	C36	C37	
An + 1 7 3 0 0 1 1 2	s R-sq 3.62397 91,96% analysis of Varian 225 225 225 225 225 225 225 225 225	Power R-sq(adj) 90.72% CC2 C23 Dose (X2) 4.60 4.30 4.30 4.30 4.70 4.30 4.72	and Sample R-sq(pred 85.21% C24 X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.0000	0 10-fold 6 4.3951 82_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000	5 10-fold R-sq 0 85.45% 226 Y (Transistor Gain) 1269 903 1555 1260 1466 1276 1225	C27 C	M 265 259 221 218 224	Type of Cutting Tool 302 302 302 302 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	C33	C34	C35	C36	C37	
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So, surface finish is Y over here. So what we can do is that stat go to stat regression, fit regression and fit regression model over here.

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Regre	ssion Analysis: Yei	ld * >					Regressio	on							x						
-	ILTIPLE LINEAR REGR						_														
Regi	ression Anal	ysis: Ye	eild (Y	() ver	sus Tir	ne, Te	C6 x1 C7 x2	^	Responses: Surface Fin				_		_						
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3.				(pred) 15.21%			C20 Ye C22 Dr C23 Dc C24 X1 C25 X2	eld (Y) rive in time (ose (V2) 1_STD 2_STD	Categorical p						^						
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And, instead of this variables over here I can just use continuous variable and categorical predictor also we can include in the regression model over here. So in this case, what we will do is that, we will we will incorporate the response as surface finish which is the actual variable and then continuous predictor over here is RPN and then categorical predictor over here is will be type of cutting tool over here.

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So, in this case stepwise regression we can use and we can see which variables will go in and which will go out. So same significance level we have used.

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And, in models we have included both the variables and included the constant term also, validation also we have taken, cross-validations over here.

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And results, what we can do is that we can see all results over here. And here, there is a options of Durbin Watson statistics which has to be compared with tabulated value, then we can use this one. So, I am not using because I can convert into R I can go to R and model that one and see Breusch Pagan test and also the DW test and corresponding P-Values.

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What I will do is that, standardized residual I will save over here again.

(Refer Slide Time: 15:45)

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	S R-sq	R-sq(adj)	R-sq(prec			C20 Yel C22 Driv		Residuals versus fits								
			R-sq(prec 85.21			C20 Yel C22 Driv C23 Dos C24 X1		 ✓ Residuals versus fits ✓ Residuals versus order 	-	^						
	S R-sq 3.62397 91.96%	R-sq(adj) 90.72%				C20 Yel C22 Driv C23 Dos C24 X1		IF Residuals versus fits IF Residuals versus order C Fogr in one	ł	~						
	S R-sq	R-sq(adj) 90.72%				C20 Yel C22 Driv C23 Dos C24 X1		 ✓ Residuals versus fits ✓ Residuals versus order 		< >						
A	S R-sq 3.62397 91.96%	R-sq(adj) 90.72%				C20 Yel C22 Driv C23 Dos C24 X1 C25 X2 C26 Y (1 C28 RP C29 Typ C30 Sar C31 Xe		IF Residuals versus fits IF Residuals versus order C Fogr in one	~	^ 2	C33	C34	C35	C36	C37	
A	S R-sq 3.62397 91.96% Analysis of Varia	R-sq(adj) 90.72% nce C23	85.21 C24	6 4.3951	o c	C20 Yel C22 Driv C23 Dos C24 X1, C25 X2, C26 Y C C28 RP C29 Typ C30 Sur C31 Joh C31 Joh C32 Sar		IF Residuals versus fits IF Residuals versus order C Fogr in one		^ ↓ se 2 M	C33	C34	C35	C36	C37	c
A	S R-sq 3.62397 91.96% Analysis of Varia C22	R-sq(adj) 90.72% nce C23	85.21 C24	6 4.3951 C25 x2_STD 0.6667	o c	C20 Yel C22 Driv C23 Dos C24 X1, C25 X2, C26 Y C C28 RP C29 Typ C30 Sur C31 Joh C31 Joh C32 Sar	Select	IF Residuals versus fits IF Residuals versus order C Fogr in one	✓ spv		C33	C34	C35	C36	C37	c
A	S R-sq 3.62397 91.96% Analysis of Varia C22 Drive in time (X1)	R-sq(adj) 90.72% nce C23 Dose (X2)	85.21 C24 X1_STD	 4.3951 C25 x2_STD 0.6667 -0.1667 	o c	C20 Yel C22 Driv C23 Dos C24 X1, C25 X2, C26 Y C C28 RP C29 Typ C30 Sur C31 Joh C31 Joh C32 Sar	Select	IF Residuals versus fits IF Residuals versus order C Fogr in one	✓ spv	m	C33	C34	C35	C36	C37	c
A	s R-sq 3.62397 91.96% Analysis of Varia C22 Drive in time (X1) 225 195 255	R-sq(adj) 90.72% nce C23 Dose (X2) 4.60 4.30 4.30	85.21 C24 X1_STD 0.0000 -1.0000 1.0000	 4.3951 C25 x2_STD 0.6667 -0.1667 -0.1667 	o c	C20 Yel C22 Driv C23 Dos C24 X1, C25 X2, C26 Y C C28 RP C29 Typ C30 Sur C31 Joh C31 Joh C32 Sar	Select	Repduels years fits Repduels years ofter C Ray in one Repduels versus the variables:	✓ spv	(Y) 911 1774 cel i130	C33	C34	C35	C36	C37	c
	s R-sq 3.62397 91.96% Analysis of Varia C22 Drive in time (X1) 225 195 255 225	R-sq(adj) 90.72% nce C23 Dose (X2) 4.60 4.30 4.30 4.30	85.21 C24 X1_STD 0.0000 -1.0000 1.0000	4.3951 C25 x2_STD 0.6667 -0.1667 -1.0000	o c	C20 Yell C22 Driv C33 Dois C34 X1_ C35 X2_ C36 X4 C38 X4 C48 X4 C	Help	Resolute yervan file Pageballs versus order C frags nois Resolute versus the variables:	v spr pra cancel Car	(Y) 911 1774 cel 1130 wood179	C33	C34	C35	C36	C37	c
	S R-sq 3.62397 91.96% Analysis of Varia C22 Drive in time (X1) 225 195 225 225 225	R-sq(adj) 90.72% nce C23 Dose (X2) 4.60 4.30 4.30 4.30 4.30	85.21 C24 X1_STD 0.0000 -1.0000 0.0000 0.0000	C25 x2_STD 0.6667 -0.1667 -1.0000 0.9444	o c	C30 Yeli C32 Driv C33 Dois C44 X1_ C35 Yel C36 YCI C36 YCI C36 YCI C38 RPI C39 Typ C39 Typ C39 Typ C30 Sar C31 Joh C32 Sar S Help Tzov 1146	Help	Restant years for To Regulate wears offer Crogn noe Reptaint wears the vanishes: Dig. 416 33.50	cancel Can -0.7057	(Y) 911 1774 130 009179 5.78792	C33	C34	C35	C36	C37	c
A	s R-sq 3.62397 91.96% Analysis of Varia C22 Drive in time (X1) 225 195 225 225 225 225 225	R-sq(adj) 90.72% nce C23 Dose (X2) 4.60 4.30 4.30 4.30 4.30	85.211 C24 X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000	C25 x2_STD 0.6667 -0.1667 -1.0000 0.9444 -0.1667	o c	C30 Yeli C32 Drit C33 Dois C44 X1_ C35 Y2 C35 YC C35 YC C35 YC C35 YC C30 Sur C31 Joh C32 Sgr Help revor 1146 1276	Help 224 212	P Reduct years for P Reduct years for P regulative was offer Optimized Repticular years for writights 416 33.50 416 31.22		(Y) 911 774 130 5.78792 5.58838	C33	C34	C35	C36	C37	c
A +	S R-sq 3.62397 91.96% Analysis of Varia C22 Drive in time (X1) 225 195 225 225 225	R-sq(adj) 90.72% nce C23 Dose (X2) 4.60 4.30 4.30 4.30 4.30	85.21 C24 X1_STD 0.0000 -1.0000 0.0000 0.0000	C25 x2_STD 0.6667 -0.1667 -1.0000 0.9444	o c	C30 Yeli C32 Driv C33 Dois C44 X1_ C35 Yel C36 YCl C38 RPh C39 Typ C30 Syr C31 Joh C32 Syr C31 Joh C32 Syr Syr Help Tzov 1146	Help	Restant years for To Regulate wears offer Crogn noe Reptaint wears the vanishes: Dig. 416 33.50	cancel Can -0.7057	(Y) 911 774 130 5.78792 5.58838 6.12536	C33	C34	C35	C36	C 37	

And then graphically what we want to see, normal plot, residual plot, and order of the data. Plots like that.

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Re	c22 C22 Drive in time (X1)	c23 Dose (X2)	C24 X1_STD	x2_STD	C26 Y (Transistor Gain)	C27 C28 RPM	Type of Cutting Tool 5 302	Surface Finish	Johnson Trans (Y)	Sqrt(Y)	SRES	C34	C35	C36	C37	
Re + D	c22 Orive in time (X1) 225	C23 Dose (X2) 4.60	C24 X1_STD 0.0000	x2_STD 0.6667 -0.1667 -0.1667	C26 Y (Transistor Gain) 1269	C27 C28 RPM 2	Type of Cutting Tool 5 302 9 302	Surface Finish 52.26	Johnson Trans (Y) 1.98000	Sqrt(Y) 7.22911	SRES 0.74661 -0.11129 0.50963	C34	C35	C36	C37	
Re + D	c22 C22 Drive in time (X1) 225 195	C23 Dose (X2) 4.60 4.30	C24 X1_STD 0.0000 -1.0000	x2_STD 0.6667 -0.1667	C26 Y (Transistor Gain) 1269 903	C27 C28 RPM 2 2	Type of Cutting Tool 5 302 9 302 1 302	Surface Finish 52.26 50.52	Johnson Trans (Y) 1.98000 1.06984	Sqrt(Y) 7.22911 7.10774	SRES 0.74661 -0.11129	C34	C35	C36	C37	
Re - - 7	c22 C22 Drive in time (X1) 225 195 255	C23 Dose (X2) 4.60 4.30 4.30	C24 X1_STD 0.0000 -1.0000 1.0000	x2_STD 0.6667 -0.1667 -0.1667	C26 Y (Transistor Gain) 1269 903 1555	C27 C28 RPM 2 2 2 2	Type of Cutting Tool 5 302 9 302 1 302 8 302	Surface Finish 52.26 50.52 45.58	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156	Sqrt(Y) 7.22911 7.10774 6.75130	SRES 0.74661 -0.11129 0.50963	C34	C35	C36	C37	
Re 	C22 C22 Drive in time (XI) 225 195 255 225	tion C23 Dose (X2) 4.60 4.30 4.30 4.00	C24 X1_STD 0.0000 -1.0000 1.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000	C26 Y (Transistor Gain) 1269 903 1555 1260	C27 C28 RPM 2 2 2 2 2 2	Type of Cutting Tool 5 302 302 9 302 302 1 302 302 8 302 302 4 416 416	Surface Finish 52.26 50.52 45.58 44.78	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179	SRES 0.74661 -0.11129 0.50963 0.17507	C34	C35	C36	C37	
Re 	c22 C22 Drive in time (X1) 225 195 255 225 225 225	tion C23 Dose (X2) 4.60 4.30 4.30 4.00 4.70	C24 X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000	C26 Y (Transistor Gain) 1269 903 1555 1260 1146	C27 C28 RPM 2 2 2 2 2 2 2 2 2 2	Type of Cutting Tool 5 302 9 302 1 302 8 302 4 416 2 416	Surface Finish 52.26 50.52 45.58 44.78 33.50	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792	SRES 0.74661 -0.11129 0.50963 0.17507 0.88643 0.43635 1.34504	C34	C35	C36	C37	
Re 	c22 C22 Drive in time (X1) 225 195 255 225 225 225 225 225	tion C23 Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30	C24 X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -1.0000 0.9444 -0.1667	C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1276	C27 C28 RPM 2 2 2 2 2 2 2 2 2 2 2 2 2	Type of Cutting Tool 5 302 9 302 1 302 8 302 4 416 2 416 8 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838	SRES 0.74661 -0.11129 0.50963 0.17507 0.88643 0.43635	C34	C35	C36	C37	

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	Coefficients Term Constant	Coef 12.48 C23	SE Coef	T-Value 3.53 C25	0.003	C27 C28 RPM	C29 Type of Cutting Tool			C32 Sqrt(Y)	C33 SRES	C34	C35	C36	C37	
	Coefficients Term Constant C22	Coef 12.48 C23	SE Coef 3.54 C24	T-Value 3.53 C25	0.003 C26		Type of Cutting Tool	Surface Finish	Johnson Trans (Y)			C34	C35	C36	C37	
	Coefficients Term Constant C22 Drive in time (X1)	Coef 12.48 C23 Dose (X2)	SE Coef 3.54 C24 X1_STD	T-Value 3.53 C25 x2_STD	0.003 C26 Y (Transistor Gain)	RPM	Type of Cutting Tool	Surface Finish	Johnson Trans (Y) 1.98000	Sqrt(Y)	SRES	C34	C35	C36	C37	
	Coefficients Term Constant C22 Drive in time (X1) 225 195 255	Coef 12.48 C23 Dose (X2) 4.60 4.30 4.30	SE Coef 3.54 C24 X1_STD 0.0000 -1.0000 1.0000	T-Value 3.53 C25 x2_STD 0.6667 -0.1667 -0.1667	0.003 C26 Y (Transistor Gain) 1269 903 1555	RPM 26 25 22	Type of Cutting Tool 3 3 3 3 3 3 3 3 3 3 3 3 3	Surface Finish 52.26 50.52 45.58	Johnson Trans (Y) 1.98000 1.06984 0.43932	Sqrt(Y) 7.22911 7.10774 6.75130	SRES 0.74661 -0.11129 0.50963	C34	C35	C36	C37	
	Coefficients Term Constant C22 Drive in time (XI) 225 195 225 225	Coef 12.48 C23 Dose (X2) 4.60 4.30 4.30 4.30	SE Coef 3.54 C24 X1_STD 0.0000 -1.0000 1.0000 0.0000	T-Value 3.53 c25 x2_STD 0.6667 -0.1667 -0.1667 -1.0000	0.003 C26 Y (Transistor Gain) 1269 903 1555 1260	RPM 26 25 22 21	Type of Cutting Tool 3 302 3 302 3 302 3 302	Surface Finish 52.26 50.52 45.58 44.78	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179	SRES 0.74661 -0.11129 0.50963 0.17507	C34	C35	C36	C37	
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	Coefficients Term Constant Drive in time (X1) 225 195 255 225 225 225	Coef 12.48 C23 Dose (X2) 4.60 4.30 4.30 4.30 4.00 4.70 4.30	SE Coef 3.54 C24 X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000	T-Value 3.53 C25 x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667	0.003 C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1276	RPM 26 25 22 21 21 22 21	Type of Cutting Tool 5 302 9 302 1 302 3 302 4 416 2 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838	SRES 0.74661 -0.11129 0.50963 0.17507 0.88643 0.43635	C34	C35	C36	C37	
	Coefficients Term Constant C22 Drive in time (X1) 225 195 255 225 225 225 225 225	Coef 12.48 C23 Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30 4.72	SE Coef 3.54 C24 X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.0000	T-Value 3.53 C25 x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000	0.003 C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225	RPM 266 255 222 211 222 21 222 21 24	Type of Cutting Tool 302 302 302 302 302 302 40 416 2416 3416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	SRES 0.74661 -0.11129 0.50963 0.17507 0.88643 0.43635 1.34504	C34	C35	C36	C37	
	Coefficients Term Constant C22 Drive in time (XI) 225 225 225 225 225 225 225 225 225 22	Coef 12.48 C23 Dose (X2) 4.60 4.30 4.30 4.30 4.70 4.30 4.72 4.30	SE Coef 3.54 C24 X1_STD 0.0000 -1.0000 1.0000 0.00000 0.0000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.0000000 0.00000000	T-Value 3.53 C25 x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	0.003 C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1276	RPM 26 25 22 21 21 22 21	Type of Cutting Tool 302 302 302 302 302 302 404 416 3416 3416 3416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838	SRES 0.74661 -0.11129 0.50963 0.17507 0.88643 0.43635 1.34504	C34	C35	C36	637	
	Coefficients Term Constant C22 Drive in time (XI) 225 225 225 225 225 225 225 225 225 22	Coef 12.48 C23 Dose (X2) 4.60 4.30 4.30 4.30 4.70 4.30 4.72 4.30	SE Coef 3.54 C24 X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.0000	T-Value 3.53 C25 x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	0.003 C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225	RPM 266 255 222 211 222 21 222 21 24	Type of Cutting Tool 302 302 302 302 302 302 40 416 2416 3416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	SRES 0.74661 -0.11129 0.50963 0.17507 0.88643 0.43635 1.34504	C34	C35	C36	637	

So, if you click ok what happens is that, it its suggest selection process and then what we have selected like that by default. And, these are the two for 302 types of cutting tool, this is the surface finish is related to RPM, this is the equation, and for 416 it will give a different equation.

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	416	-12.932	0.512	-25.23	0.000 1.00											
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	Model Summary <u>S R-sq</u> 1.14572 97.77%		R-sq(pred 97.05		s 10-fold R-sq 10 97.02%											
	S R-sq	R-sq(adj) 97.50%														
	S R-sq 1.14572 97.77%	R-sq(adj) 97.50%				C27 C28	C29	C30 5	G1 g	C32	C33	C34	C35	C36	C37	
	S R-sq 1.14572 97.77% Analysis of Variar C22 Drive in time (X1)	R-sq(adj) 97.50% nce C23	97.059 C24 X1_STD	C25 x2_STD	0 97.02% C26 Y (Transistor Gain)	RPM	Type of Cutting Too	Surface Finish	Johnson Trans (Y)	Sqrt(Y)	SRES	C34	C35	C36	C37	
•	<u>S R-sq</u> 1.14572 97.77% Analysis of Variat C22 Drive in time (Xt) 225	R-sq(adj) 97.50% nce C23	97.054 C24	6 1.221 C25	C26 Y (Transistor Gain) 1269	RPM		Surface Finish				C34	C35	C36	C37	
•	s R-sq 1.14572 97.77% Analysis of Variat C22 Drive in time (Xt) 225 195	R-sq(adj) 97.50% C23 Dose (X2)	97.059 C24 X1_STD	C25 x2_STD 0.6667 -0.1667	C26 Y (Transistor Gain) 1269 903	RPM 2	Type of Cutting Too 55 303 59 303	Surface Finish 52.26 50.52	Johnson Trans (Y) 1.98000 1.06984	Sqrt(Y) 7.22911 7.10774	SRES 0.74661 -0.11129	C34	C35	C36	C37	
+ 7 8	<u>S R-sq</u> 1.14572 97.77% Analysis of Variat C22 Drive in time (Xt) 225	R-sq(adj) 97.50% C23 Dose (X2) 4.60	97.059 C24 X1_STD 0.0000	C25 K2_STD 0.6667	C26 Y (Transistor Gain) 1269	RPM 2	Type of Cutting Too 303	Surface Finish 52.26 50.52 45.58	Johnson Trans (Y) 1.98000	Sqrt(Y) 7.22911	SRES 0.74661	C34	C35	C36	C37	
+ 7 8 9	S R-sq 1.14572 97.776 Analysis of Variar C22 Drive in time (XI) 225 195 255 225	R-sq(adj) 97.50% C23 Dose (X2) 4.60 4.30	97.054 C24 X1_STD 0.0000 -1.0000	C25 x2_STD 0.6667 -0.1667 -1.0000	C26 Y (Transistor Gain) 1269 903	RPM 2 2	Type of Cutting Too 55 303 59 303	Surface Finish 52.26 50.52 45.58	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156	Sqrt(Y) 7.22911 7.10774	SRES 0.74661 -0.11129 0.50963 0.17507	C34	C35	C36	C37	
+ 7 8 9	S R-sq 1.14572 97.776 Analysis of Variat C22 Drive in time (XI) 225 195 225 225 225	R-sq(adj) 97.50% C23 Dose (X2) 4.60 4.30	97.05 C24 X1_STD 0.0000 -1.0000 1.0000	C25 x2_STD 0.6667 -0.1667	10 97.02% C26 Y (Transistor Gain) 1269 903 1555 1260 1146	RPM 2 2 2 2 2	Type of Cutting Too 55 303 59 303 21 303	Surface Finish 52.26 50.52 45.58 44.78 33.50	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575	Sqrt(Y) 7.22911 7.10774 6.75130	SRES 0.74661 -0.11129 0.50963 0.17507 0.88643	C34	C35	C36	C37	
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So, categorical variables, different levels that we have selected, each levels we will have a different equation with the continuous variable. So, this is shown over here.

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And, the coefficients are also given over here, so based on which we have developed the regression equation. And, VIC, variation inflation factors is approximated, so that is not an issue. So, these two variables type of cutting tool and also RPN both are significant over here. And, about R square adjusted value is 97.5 and cross-validation is 97.02, so very close. So, this model seems to be very accurate.

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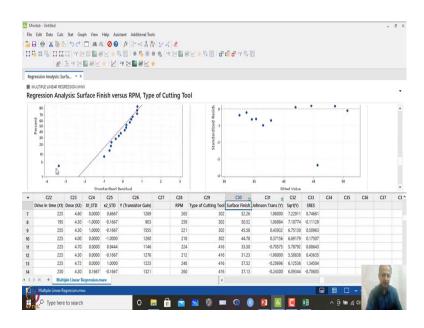
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And, what we are getting is that no lack of fit is observed over here.

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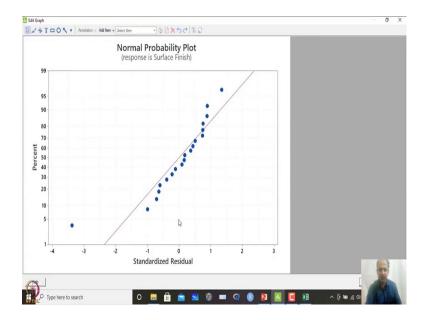
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	R Large residual 99 T C22 Drive in time (X1)	C23 Dose (X2)	Normal (respons C24 X1_STD	Probabil e is Surface C25 x2_STD	(12 Plot 2 Finish) C26 Y (Transistor Gain)	RPN	C29 Type of Cutting Too	Surface Finish	(response is C31 g Johnson Trans (Y)	C32 Sqrt(Y)	C33 SRES	C34	C35	C36	C37	
	R Large residual 99 - C22 Drive in time (X1) 225	C23 Dose (X2) 4.60	Normal (respons C24 X1_STD 0.0000	Probabil e is Surface C25 x2_STD 0.6667	C26 Y (Transistor Gain) 1269	RPN	C29 Type of Cutting Too 65 302	Surface Finish	(response is C31 g Johnson Trans (V) 1.98000	C32 Sqrt(Y) 7.22911	C33 SRES 0.74661	C34	C35	C36	C37	
	R Large residual 99 1 C22 Drive in time (X1) 225 195	C23 Dose (X2) 4.60 4.30	Normal (respons C24 X1_STD 0.0000 -1.0000	Probabil e is Surface c25 x2_STD 0.6667 -0.1667	C26 Y (Transistor Gain) 1269 903	RPN	C29 Type of Cutting Too 65 302 59 302	Surface Finish 52.26 50.52	(response is C31 Z Johnson Trans (Y) 1.98000 1.06984	C32 Sqrt(Y) 7.22911 7.10774	C33 SRES 0.74661 -0.11129	C34	C35	C36	C37	
	R Large residual 99 T C22 Drive in time (XI) 225 195 255	C23 Dose (X2) 4.60 4.30 4.30	Normal (respons C24 X1_STD 0.0000 -1.0000 1.0000	Probabil E is Surface x2_STD 0.6667 -0.1667	C26 Y (Transistor Gain) 1269 903 1555	RPN	C29 Type of Cutting Too 65 300 59 300 21 300	Surface Finish 2 52.26 2 50.52 2 45.58	(response is C31 Johnson Trans (Y) 1.98000 1.06984 0.43932	C32 Sqrt(Y) 7.22911 7.10774 6.75130	C33 SRES 0.74661 -0.11129 0.50963	C34	C35	C36	C37	
r 8	R Large residual 99 1 C22 Drive in time (XI) 225 195 225 225	C23 Dose (X2) 4.60 4.30 4.30 4.30	Normal (respons C24 X1_STD 0.0000 -1.0000 1.0000 0.0000	Probabil E is Surface x2_STD 0.6667 -0.1667 -0.1667 -1.0000	C26 Y (Transistor Gain) 1269 903 1555 1260	RPh	C29 Type of Cutting Too 65 300 59 300 21 300 18 300	Surface Finish 2 52.26 2 50.52 2 45.58 2 44.78	(response is C31 Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156	C32 Sqrt(Y) 7.22911 7.10774 6.75130 6.69179	C33 SRES 0.74661 -0.11129 0.50963 0.17507	C34	C35	C36	C37	
	R Large residual 99 1 C22 Drive in time (XI) 225 255 225 225	C23 Dose (X2) 4.60 4.30 4.30 4.00 4.70	Normal (respons C24 X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000	Probabil e is Surface x2_STD 0.6667 -0.1667 -1.0000 0.9444	ty Plot Finish) C26 Y (Transistor Galn) 1269 903 1555 1260 1146	RPN	C29 Type of Cutting Too 65 300 59 300 21 300 18 300 24 410	Surface Finish 2 52.26 2 50.52 2 45.58 2 44.78 5 33.50	(response is C31 Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575	C32 Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792	C33 SRES 0.74661 -0.11129 0.50963 0.17507 0.88643	C34	C35	C36	C37	
1	R Large residual 99 1 C22 Drive in time (XI) 225 195 225 225	C23 Dose (X2) 4.60 4.30 4.30 4.30	Normal (respons C24 X1_STD 0.0000 -1.0000 1.0000 0.0000	Probabil E is Surface x2_STD 0.6667 -0.1667 -0.1667 -1.0000	C26 Y (Transistor Gain) 1269 903 1555 1260	RPN	C29 Type of Cutting Too 65 300 59 300 21 300 18 300 24 410	Surface Finish 2 52.26 2 50.52 2 45.58 2 44.78 5 33.50 5 31.23	(response is C31 Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156	C32 Sqrt(Y) 7.22911 7.10774 6.75130 6.69179	C33 SRES 0.74661 -0.11129 0.50963 0.17507	C34	C35	C36	C37	
7	R Large residual 99 1 C22 Drive in time (XI) 225 195 255 225 225 225	C23 Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30	Normal (respons C24 X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000	Probabil e is Surface x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667	C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1276	RPh	C29 Type of Cutting Too 59 300 59 300 21 300 21 300 24 416 24 416 416 416 416 416 416 416 41	Surface Finish 2 52.26 2 50.52 2 45.58 2 45.58 2 44.78 5 33.50 5 31.23 5 37.52	(response is C31 g Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000	C32 Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838	C33 SRES 0.74661 -0.11129 0.50963 0.17507 0.88643 0.43635	C34	C35	C36	C37	

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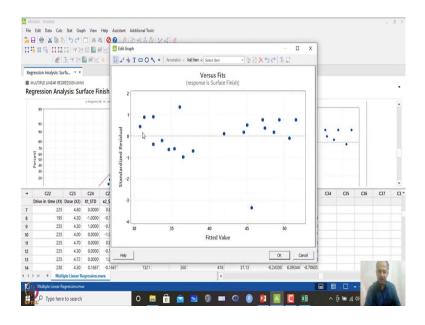
Only thing is that, we have to check whether normality assumptions is violated.

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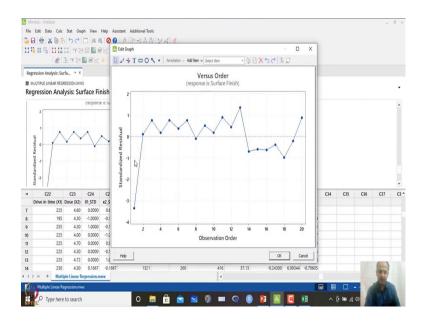
So, here what you see, is maybe there is a problem with normality over here. One point is over here, some has gone outside like that, so we have to test that one.

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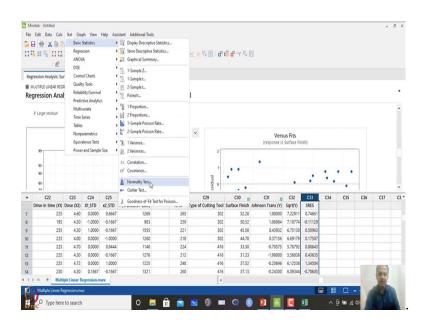
And, heteroscedasticity does not seem to be a problem because it seems to be random.

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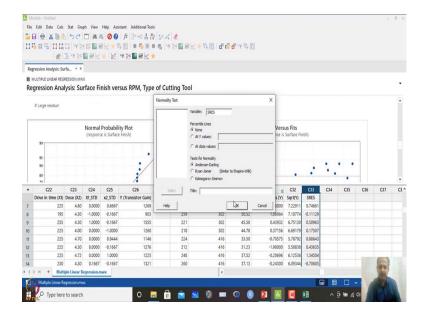


And, also we can see that this one may not be auto correlation is not so significant. So, these two checks can be done, but what we want to see normality, so this C 33 column will tell me whether normality assumptions is violated or not.

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(Refer Slide Time: 17:17)

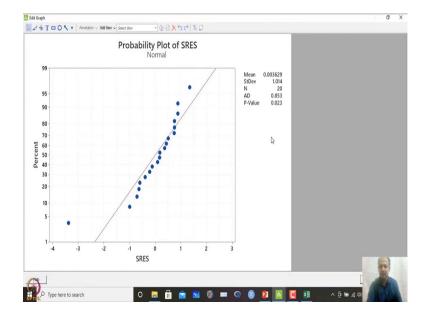


So what I will do is that, basic stat and normality test and what we will do is that, normality residual we can check and try to see what happens.

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Normality test and what we observe over here for the residuals is that P-Value is less than 0.05. That indicates that there is a problem of normality issue over here of the residuals.

So, in this case, directly the Y characteristics needs some transformation and we have Box-Cox transformation and also Johnson transformation, both the options are there.

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10		225	4.00	0.0000	-1.0000	1260		218	302	44.78	0.37156	6.69179						
11		225	4.70	0.0000	0.9444	1146		224	416	33.50	-0.70575	5.78792						
12		225	4.30	0.0000	-0.1667	1276		212	416	31.23	-1.98000	5.58838						
13		225	4.72	0.0000	1.0000	1225		248	416	37.52	-0.20696	6.12536						
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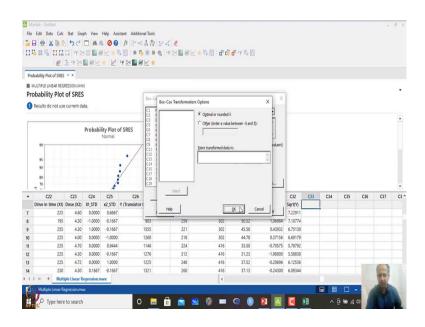
So, in this case what we will do is that, first we will see whether Box-Cox transformation works for this, for the Y variable. So what we will do, control chart Box-Cox transformation.

(Refer Slide Time: 17:51)

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11	2					1146		224		416	33.50	-0.70575	5.78792						
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And, for this surface finish we have taken this variable over here. Subgroup size is 1 selected.

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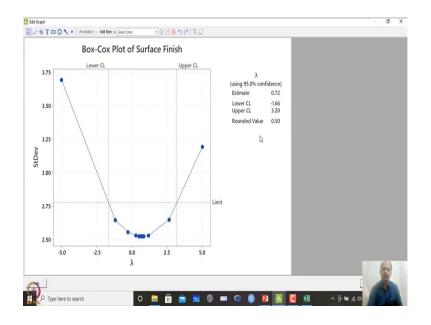


And in options optimal or rounded value of alpha just mention that one.

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,	C22 Drive in time (X1) 225	Dose (X2) 4.60	X1_STD 0.0000	x2_STD 0.6667	Y (Transistor Gain 1269)	RPM 265	Type of Cutting Tool 302	Surface Finish 52.26	Johnson Trans (Y) 1.98000	Sqrt(Y) 7.22911	C33	C34	C35	C36	C37	
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7 B 9	C22 Drive in time (X1) 225 195 255	Dose (X2) 4.60 4.30 4.30	X1_STD 0.0000 -1.0000 1.0000	x2_STD 0.6667 -0.1667 -0.1667	Y (Transistor Gain 1261 903 1555	3	RPM 265 259 221	Type of Cutting Tool 302 302 302	Surface Finish 52.26 50.52 45.58	Johnson Trans (Y) 1.98000 1.06984 0.43932	Sqrt(Y) 7.22911 7.10774 6.75130	C33	C34	C35	C36	C37	
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7 B 9 0	C22 Drive in time (X1) 225 195 255 225 225	Dose (X2) 4,60 4,30 4,30 4,00 4,70	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444	Y (Transistor Gain 126) 903 1555 1260 1140	0 9 8 5 5	RPM 265 259 221 218 224	Type of Cutting Tool 302 302 302 302 416	Surface Finish 52.26 50.52 45.58 44.78 33.50	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792	C33	C34	C35	C36	C37	
r 8 0 1 2	C22 Drive in time (X1) 225 195 225 225 225 225	Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -1.0000 0.9444 -0.1667	Y (Transistor Gain 1266 903 1553 1266 1146 1146 1276	0 8 5 5 5	RPM 265 259 221 218 224 212	Type of Cutting Tool 302 302 302 302 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838	C33	C34	C35	C36	C37	
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And when we when you just click that option, what happens is that it suggest you that rounded value is 0.5; that means, lambda is approximately we can take as 0.5, although the actual value is 0.72, but we can take a rounded value of which is lying within the confidence interval over here.

So, 0.5 we are selecting over here as rounded value. So, I have taken a square root transformation over here. So, 0.5 means Y to the power 0.5 means, square root transformation that is suggested ok.

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Bo	x-Cox Plot of Surface	Contre	ol Charts		Stability Stu	idv		Predict									
8	MULTIPLE LINEAR REGR	Qualit	y Tools	,				Factorial Plots									
-	x-Cox Plot of	Reliab	ility/Surviva	()	Orthogonal	Regression	i										•
	a contrict of	Predic	tive Analyti	cs)	2 Partial Least	t Squares		Surface Plot									
-		Multiv	variate	,	Binary Fitte	d Line Plot	-	Overlaid Contour Plot									*
	Be	Time !	Series			stic Regression											
		Tables		,		istic Regression											
	3.75	Nonpo	arametrics		- Long	gistic Regression											
		Equiva	alence Tests	,													
	3.50	Power	r and Sampl	e Size 🔹	Poisson Reg	Lower CL	-1.65										
	StDev				1	Upper CL Rounded Value	320 0.50										
+	C22	C23	C24	C25	C26	C27	C28	C29	C30 g	C31	C32	C33	C34	C35	C36	C37	C3
	Drive in time (X1) Do	ose (X2)	X1_STD	x2_STD	Y (Transistor G	ain)	RPM	Type of Cutting Tool			Sqrt(Y)						
7	225	4.60	0.0000	0.6667	1	269	265	302	52.26	1.98000	7.22911						
в	195	4.30	-1.0000	-0.1667		903	259	302	50.52	1.06984	7.10774						
9	255	4.30	1.0000	-0.1667	1	555	221	302	45.58	0.43932	6.75130						
0	225	4.00	0.0000	-1.0000	1	260	218	302	44.78	0.37156	6.69179						
11	225	4.70	0.0000	0.9444	1	146	224	416	33.50	-0.70575	5.78792						
	225	4.30	0.0000	-0.1667	1	276	212	416	31.23	-1.98000	5.58838						
	225	4.72	0.0000	1.0000	1	225	248	416	37.52	-0.20696	6.12536					-	
12		4.30	0.1667	-0.1667	1	321	260	416	37.13	-0.24300	6.09344					600	
12 13	230							1.1								1000	
12 13 14		Linear R	egression.n	IWX				4								1000	
12 13 14 4			-	IWX				4	_				₩			E.	

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	x Plot of Surface Fi	Y X									_						
	TIPLE LINEAR REGRESSIO				Regression						×						
-	Cox Plot of Sur			_	06 x1 ^ C7 x2 C8 x3 C9 x4	Responses: 'Sqrt(Y)'					<u>^</u>						
	Box-C	ox Plot of Su		sh Upper CL	C11 Heat C12 x1_1 C13 x2_1 C14 x3_1 C15 x4_1 C15 x4_1 C17 Tme C18 Velocity	Centinuous (RPM	oredictors:				^						
	3.50				C19 Temperature C20 Yeld (Y) C22 Drive in time (C23 Dose (X2) C24 X1_STD	Categorical p					^						
StDev	8.25			1	C25 x2_STD C26 Y (Transistor (C28 RPM C29 Type of Cuttr C30 Surface Firsth						v						,
4 StDev	C22 C		C25	/	C26 Y (Transistor (C28 RPM		Model	Optiogs	Coging	Stepwise	 	C33	C34	C35	C36	C37	¢
t StDev	C22 C2 ive in time (X1) Dose	(X2) X1_STD	x2_STD	/	C26 Y (Transistor C C28 RPM C29 Type of Cuttr C30 Surface Pinish C31 Johnson Trare C32 Sqrt(Y) Y						m	C33	C34	C35	C36	C37	c
* Dri 7	C22 C2 ive in time (Xt) Dose 225	(X2) X1_STD 4.60 0.0000	x2_STD 0.6667	/	C26 Y (Transistor (C28 RPM C29 Type of Cuttir C30 Surface Finish C31 Johnson Trare		Model Validation	Optiogs	Coging Besuits	Stepwise Storage	(911	C33	C34	C35	C36	C37	c
t StDev	C22 C2 ive in time (Xt) Dose 225 195	(X2) X1_STD	x2_STD	/	C26 Y (Transistor (C28 RPM C29 Type of Cuttr C30 Surface Pinish C31 Johnson Trans C32 Sert(Y) V				Besults	Storage.	(Y) 911 1774	C33	C34	C35	C36	C37	C
* Dri 7 8	C22 C2 ive in time (X1) Dose 225 195 255	(X2) X1_STD 4.60 0.0000 4.30 -1.0000	x2_STD 0.6667 -0.1667	/	C26 Y (Transistor C C28 RPM C29 Type of Cuttr C30 Surface Pinish C31 Johnson Trare C32 Sqrt(Y) Y	610					(Y) 911 1774	C33	C34	C35	C36	C37	c
* Dri 7 2 9	C22 C2 ive in time (Xt) Dose 225 195 255 225	X1_STD 4.60 0.0000 4.30 -1.0000 4.30 1.0000	x2_STD 0.6667 -0.1667 -0.1667	/	C26 Y (Transistor (C28 RPM C28 Type of Cutter C30 Surface Finish C31 Johnson Tran C32 Sert(Y) v Select Help	¢10 224	Yalidation	Graphs	Besuits	Storage. Cancel	(Y) 1911 1774 1130	C33	C34	C35	C36	C37	c
* Dri 7 8 9 10	C22 C2 ive in time (X1) Dose 225 195 255 225 225 225	X1_STD 4.60 0.0000 4.30 -1.0000 4.30 1.0000 4.00 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000	/	C26 Y (Transistor (C28 RPM C29 Type of Cutter C30 Surface Finah C31 Johnson Trans C32 Sert(Y) v Select Help		Yaldation	graphs 900	Besults <u>B</u> K	Cancel	(Y) 911 1774 130 009179	C33	C34	C35	C36	C37	c
* Dri 7 8 9 10 11	C22 C2 ive in time (X1) Dose 225 195 225 225 225 225 225 225	X1_STD 4.60 0.0000 4.30 -1.0000 4.30 1.0000 4.00 0.0000 4.70 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444	/	C26 Y (Transistor C28 R94) C28 R94 C29 Type of Cutter C30 Surface Printh C31 Johnson Trant C32 Sert(Y) * Help rzov 1146	224	<u>Yaldation</u>	graphs 900	Besults <u>BK</u> 33.50	Storage. Cancel 0.57150 -0.70575	(Y) 911 7774 130 000179 5.78792	C33	C34	C35	C36	C37	

With square root transformation, then what have what we have to do is, that regress variables fit. Instead of surface finish what we will do is that, we will mention that let us go for square root transformation of Y that values and do all the analysis same analysis over here. So, regression analysis over here.

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Per	gression Analysis: Sqr			N . K.	DE DE												
	MULTIPLE UNEAR REGR																
-				rsus RP	M, Type of Cut	ting Tool											
	gression rata	y 5151 5 4		545 14	in, type of eac	ang loor											
N	Method																
C	Categorical predictor	coding (1	, 0)														
C	Cross-validation	10)-fold														
S	Stepwise Selectio	n of Terr	ns		D												
					D												
	<mark>Stepwise Selectic</mark> a to enter = 0.15, a t				D												
a	a to enter = 0.15, a t	o remove			ß												
a		o remove			ß												
a R	a to enter = 0.15, a t	o remove		C25	C26		28	C29	C30 g	C31 (2)	C32 12	C33	C34	C35	C36	C37	
a R	a to enter = 0.15, a t Regression Equal	o remove tion C23	= 0.15			C27 C		C29 Type of Cutting Tool				C33 SRES	C34	C35	C36	C37	
a R	a to enter = 0.15, a t Regression Equat	o remove tion C23	= 0.15 C24		C26	C27 C							C34	C35	C36	C37	
a R •	a to enter = 0.15, a t Regression Equal C22 Drive in time (X1)	c23 Dose (X2)	C24 X1_STD	x2_STD	C26 Y (Transistor Gain)	C27 C	PM	Type of Cutting Tool	Surface Finish	Johnson Trans (Y)	Sqrt(Y)	SRES	C34	C35	C36	C37	
a R *	a to enter = 0.15, a t Regression Equal C22 Drive in time (XI) 225 195 255	c23 Dose (X2) 4.60	C24 X1_STD 0.0000	x2_STD 0.6667	C26 Y (Transistor Gain) 1269 903 1555	C27 C	PM 265	Type of Cutting Tool 302	Surface Finish 52.26 50.52 45.58	Johnson Trans (Y) 1.98000	Sqrt(Y) 7.22911	SRES 0.41734 -0.29723 0.65615	C34	C35	C36	C37	
a R •	a to enter = 0.15, a t Regression Equal C22 Drive in time (XI) 225 195 255 225	c remove cion C23 Dose (X2) 4.60 4.30	C24 X1_STD 0.0000 -1.0000	x2_STD 0.6667 -0.1667	C26 Y (Transistor Gain) 1269 903	C27 C	PM 265 259	Type of Cutting Tool 302 302	Surface Finish 52.26 50.52	Johnson Trans (Y) 1.98000 1.06984	Sqrt(Y) 7.22911 7.10774	SRES 0.41734 -0.29723 0.65615 0.33606	C34	C35	C36	C37	
a R •	a to enter = 0.15, a t Regression Equal C22 Drive in time (XI) 225 195 225 225 225	c23 C23 Dose (X2) 4.60 4.30	C24 X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444	C26 Y (Transistor Gain) 1269 903 1555 1260 1146	C27 C	PM 265 259 221 218 224	Type of Cutting Tool 302 302 302 302 416	Surface Finish 52.26 50.52 45.58 44.78 33.50	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990	C34	C35	C36	C37	
a R * *	225 225 225 225 225 225 225	C23 C23 Dose (X2) 4.60 4.30 4.30 4.30 4.30 4.30	C24 X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667	C26 Y (Transistor Gain) 1269 903 1555 1260 1260 1146 1276	C27 C	PM 265 259 221 218 224 212	Type of Cutting Tool 302 302 302 302 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566	C34	C35	C36	C37	
a R * * 0 1 2 3	c22 Drive in time (X1) 225 255 225 225 225 225 225 225	C23 C23 Dose (X2) 4.60 4.30 4.30 4.00 4.30 4.30 4.72	C24 X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -1.0000 0.9444 -0.1667 1.0000	C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1146 11275	C27 C	PM 265 259 221 218 224 212 248	Type of Cutting Tool 302 302 302 302 416 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566 1.71032	C34	C35	C36	C37	
a R +	225 225 225 225 225 225 225	C23 C23 Dose (X2) 4.60 4.30 4.30 4.30 4.30 4.30	C24 X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667	C26 Y (Transistor Gain) 1269 903 1555 1260 1260 1146 1276	C27 C	PM 265 259 221 218 224 212	Type of Cutting Tool 302 302 302 302 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566	C34	C35	C36	C37	
a R * * 0 1 2 3	a to enter = 0.15, a t Regression Equal C22 Drive in time (XI) 225 255 225 225 225 225 225 225 225 22	C23 C23 Dose (X2) 4.60 4.30 4.30 4.00 4.30 4.30 4.72	C24 X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1146 11275	C27 C	PM 265 259 221 218 224 212 248	Type of Cutting Tool 302 302 302 302 416 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566 1.71032	C34	C35	C36	637	

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	ssion Analysis: 5du	(Y * X															
a MUP	LTIPLE LINEAR REGRE	ESSION MW.	ĸ														
Regr	ression Analy	sis: Sq	rt(Y) ver	rsus RP	M, Type of Cut	ting Too	bl										
Mc	del Summary																
	S R-sq	R-sn/ad) R-sq(pr	red) 50-	fold S 10-fold R-sq												
0.	.0848366 98.00%	97.76			04384 97.33%												
An	alysis of Varian	ce D															
	urce	.4	dj SS Ad	ALANC E.	Value P-Value												
-	gression	2 5			16.42 0.000												
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Erro	C22	C23	12235 0.0 C24	C25	C26	C27	C28	C29	C30 m	C31 .	C32 m	C33	C34	C35	C36	C37	_
		623			Y (Transistor Gain)	cer	RPM	Type of Cutting Tool				SRES	634	CSJ	C30	631	
	rive in time (X1)	ase (Y2)	X1 STD				in m										
	rive in time (X1) E		X1_STD 0.0000		1269		265	302	52.26	1,98000	7.22911	0.41734					
7 8	rive in time (X1) E 225 195	Dose (X2) 4.60 4.30	X1_STD 0.0000 -1.0000	0.6667	1269 903		265 259	302	52.26 50.52	1.98000 1.06984	7.22911	0.41734					
7	225	4.60	0.0000	0.6667	903												
7 B	225 195	4.60 4.30	0.0000	0.6667	903 1555		259	302	50.52	1.06984	7.10774	-0.29723					
7 B 9	225 195 255	4.60 4.30 4.30	0.0000 -1.0000 1.0000	0.6667 -0.1667 -0.1667	903 1555		259 221	302 302	50.52 45.58	1.06984 0.43932	7.10774 6.75130	-0.29723 0.65615					
7 8 9 0	225 195 255 225	4.60 4.30 4.30 4.00	0.0000 -1.0000 1.0000 0.0000	0.6667 -0.1667 -0.1667 -1.0000	903 1555 1260 1146 1276		259 221 218	302 302 302	50.52 45.58 44.78	1.06984 0.43932 0.37156	7.10774 6.75130 6.69179	-0.29723 0.65615 0.33606					
7 8 9 0 11	225 195 255 225 225	4.60 4.30 4.30 4.00 4.70	0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000 0.0000	0.6667 -0.1667 -0.1667 -1.0000 0.9444	903 1555 1260 1146 1276 1225		259 221 218 224	302 302 302 416	50.52 45.58 44.78 33.50	1.06984 0.43932 0.37156 -0.70575	7.10774 6.75130 6.69179 5.78792	-0.29723 0.65615 0.33606 0.87990					
7 8 9 0 11 2	225 195 255 225 225 225	4.60 4.30 4.30 4.00 4.70 4.30	0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000	0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667	903 1555 1260 1146 1276 1225		259 221 218 224 212	302 302 302 416 416	50.52 45.58 44.78 33.50 31.23	1.06984 0.43932 0.37156 -0.70575 -1.98000	7.10774 6.75130 6.69179 5.78792 5.58838	-0.29723 0.65615 0.33606 0.87990 0.08566 1.71032					

And, here also we see that R square adjusted 97.

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Re	gression Analysis: Sc	rt(Y × ×														
8	MULTIPLE UNEAR REG	RESSION MW	x													
Re	egression Ana	lysis: Sq	rt(Y) ve	rsus RP	M, Type of Cut	ting Tool										
	416 Sqrt(Y)	3.178 + 0	01134 RPM													
	Coefficients															
	Term	Coef		T-Value	P-Value VIF											
	Constant	4.194	0.262	16.01	0.000											
	RPM	0.01134	0.00111	10.24	0.000 1.00											
				10.2.4	0.000 1.00											
	Type of Cutting Tool															
				-26.76	0.000 1.00											
	Type of Cutting Tool 416	-1.0157														
	Type of Cutting Tool 416 Model Summar	-1.0157	0.0379	-26.76	0.000 1.00	01 0	C 20	610		611	C 11		C 1	01	637	
	Type of Cutting Tool 416 Model Summary C22	-1.0157 C23	0.0379 C24	-26.76 C25	0.000 1.00 C26	C27 C2		C30 g		C32 g	C33 SRES	C34	C35	C36	C37	
•	Type of Cutting Tool 416 Model Summary C22 Drive in time (Xt)	-1.0157 C23 Dose (X2)	0.0379 C24 X1_STD	-26.76 C25	0.000 1.00 C26 Y (Transistor Gain)	RPI	Type of Cutting To	Surface Finish	Johnson Trans (Y)	Sqrt(Y)	C33 SRES 0.41734	C34	C35	C36	C37	
+	Type of Cutting Tool 416 Model Summary C22	-1.0157 C23	0.0379 C24	-26.76 C25 x2_STD	0.000 1.00 C26	RPI		2 Surface Finish 2 52.26	Johnson Trans (Y) 1.98000		SRES	C34	C35	C36	C37	
* 7 8	Type of Cutting Tool 416 Model Summary C22 Drive in time (X1) 225	-1.0157 C23 Dose (X2) 4.60	0.0379 C24 X1_STD 0.0000	-26.76 C25 x2_STD 0.6667	0.000 1.00 C26 Y (Transistor Gain) 1269	RPI	Type of Cutting To 265 30	Surface Finish 2 52.26 2 50.52	Johnson Trans (Y) 1.98000 1.06984	Sqrt(Y) 7.22911	SRES 0.41734	C34	C35	C36	C37	
+ 7 8 9	Type of Cutting Tool 416 Model Summary C22 Drive in time (X1) 225 195	-1.0157 C23 Dose (X2) 4.60 4.30	0.0379 C24 X1_STD 0.0000 -1.0000	-26.76 C25 x2_STD 0.6667 -0.1667	0.000 1.00 C26 Y (Transistor Gain) 1269 903 1555	RPI	Type of Cutting To 265 30 259 30	Surface Finish 2 52.26 2 50.52 2 45.58	Johnson Trans (Y) 1.98000 1.06984 0.43932	Sqrt(Y) 7.22911 7.10774	SRES 0.41734 -0.29723	C34	C35	C36	C37	
+ 7 8 9	Type of Cutting Tool 416 Model Summary C22 Drive in time (XI) 225 195 255	-1.0157 C23 Dose (X2) 4.60 4.30	0.0379 C24 X1_STD 0.0000 -1.0000 1.0000	-26.76 C25 x2_STD 0.6667 -0.1667 -0.1667	0.000 1.00 C26 Y (Transistor Gain) 1269 903 1555	RPI	Type of Cutting To 265 30 259 30 221 30	al Surface Finish 2 52.26 2 50.52 2 45.58 2 44.78	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156	Sqrt(Y) 7.22911 7.10774 6.75130	SRES 0.41734 -0.29723 0.65615	C34	C35	C36	C37	
+ 7 8 9 0	Type of Cutting Tool 416 Model Summar C22 Drive in time (XI) 225 195 255 225	-1.0157 C23 Dose (X2) 4.60 4.30 4.30	0.0379 C24 X1_STD 0.0000 -1.0000 1.0000 0.0000	-26.76 C25 x2_STD 0.6667 -0.1667 -0.1667 -1.0000	0.000 1.00 C26 Y (Transistor Gain) 1269 903 1555 1260	RPI	Type of Cutting To 265 30 259 30 221 30 218 30	Surface Finish 2 52.26 2 50.52 2 45.58 2 44.78 6 33.50	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179	SRES 0.41734 -0.29723 0.65615 0.33606	C34	C35	C36	C37	
* 7 8 9 0 11 2	Type of Cutting Tool 416 Model Summar C22 Drive in time (XI) 225 195 255 225 225 225	-1.0157 C23 Dose (X2) 4.60 4.30 4.30 4.30 4.70	0.0379 C24 X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000	-26.76 c25 x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444	0.000 1.00 C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1276	RPI	Type of Cutting To 265 30 259 30 221 30 218 30 224 41	Surface Finish 2 52.26 2 50.52 2 45.58 2 44.78 6 33.50 6 31.23	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990	C34	C35	C36	C37	
* 7 8 9 10 11 12 13	Type of Cutting Tool 416 Model Summary C22 Drive in time (X1) 225 195 235 225 225 225 225 225	-1.0157 C23 Dose (X2) 4.60 4.30 4.30 4.30 4.30 4.70 4.30	0.0379 C24 X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000	-26.76 c25 x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667	0.000 1.00 C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1276	RPI	Type of Cutting To 265 30 259 30 221 30 218 30 224 41 212 41	Surface Finish 2 52.26 2 50.52 2 45.58 2 44.78 6 33.50 6 31.23 6 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566 1.71032	C34	C35	C36	C37	
	Type of Cutting Tool 416 Model Summarr C22 Drive in time (Xt) 225 235 225 225 225 225 225 225 225 225	-1.0157 C23 Dose (X2) 4.60 4.30 4.30 4.30 4.30 4.70 4.30	0.0379 C24 X1_STD 0.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	-26.76 c25 x2_STD 0.6667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	0.000 1.00 C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1146 1275	RPI	Type of Cutting To 265 30 259 30 221 30 218 30 224 41 212 41 213 41 214 41	Surface Finish 2 52.26 2 50.52 2 45.58 2 44.78 6 33.50 6 31.23 6 37.52 6 37.13	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566 1.71032	C34	C35	C36	637	
* 7 8 9 10 11 12 13 14	Type of Cutting Tool 416 Model Summarn 225 2255 2255 2255 2255 2255 2255 225	-1.0157 C23 Dose (X2) 4.60 4.30 4.30 4.30 4.30 4.30 4.30 4.30 4.3	0.0379 C24 X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.1667 regression.m	-26.76 c25 x2_STD 0.6667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	0.000 1.00 C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1146 1275	RPI	Type of Cutting To 265 30 259 30 221 30 218 30 224 41 212 41 213 41 214 41 215 41 216 41 217 41 218 41 219 41 210 41 211 41 212 41 213 41 214 41	Surface Finish 2 52.26 2 50.52 2 45.58 2 44.78 6 33.50 6 31.23 6 37.52 6 37.13	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566 1.71032 -0.43188			C36	637	
* 7 8 9 10 11 12 13 14	Type of Cutting Tool 416 Model Summarr C22 Drive in time (Xt) 225 235 225 225 225 225 225 225 225 225	-1.0157 C23 Dose (X2) 4.60 4.30 4.30 4.30 4.30 4.30 4.30 4.30 4.3	0.0379 C24 X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.1667 regression.m	-26.76 c25 x2_STD 0.6667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	0.000 1.00 C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1146 1275	RPI	Type of Cutting To 265 30 259 30 221 30 218 30 224 41 212 41 213 41 214 41 215 41 216 41 217 41 218 41 219 41 210 41 211 41 212 41 213 41 214 41	Surface Finish 2 52.26 2 50.52 2 45.58 2 44.78 6 33.50 6 31.23 6 37.52 6 37.13	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566 1.71032 -0.43188	C34		C36	37	

And so it has regressed square root of Y with the variable.

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1	302 Sqrt(Y)	4.194+0	.01134 RPM														
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	Coefficients Term	Coef	SE Coef	T-Value	P-Value VIF												
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	Coefficients Term Constant C22 Drive in time (XI) 225	Coef 4.194 C23 Dose (X2) 4.60	SE Coef 0.262 C24 X1_STD 0.0000	T-Value 16.01 C25 x2_STD 0.6667	0.000 C26 Y (Transistor Gain) 1269	C27	RPM 265	Type of Cutting Tool 302	Surface Finish 52.26	Johnson Trans (Y) 1.98000	Sqrt(Y) 7.22911	SRES 0.41734	C34	C35	C36	C37	
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	Coefficients Term Constant C22 Drive in time (XI) 225 255 225 225 225 225 225 225 225 22	Coef 4.194 C23 Dose (X2) 4.60 4.30 4.30 4.30 4.00 4.70 4.30 4.72	SE Coef 0.262 C24 X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000 0.0000 0.0000	T-Value 16.01 C25 x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000	0.000 C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225	27	RPM 265 259 221 218 224 212 212 248	Type of Cutting Tool 302 302 302 302 416 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566 1.71032	C34	C35	C36	C37	
* * 0 1 2 3 4	Coefficients Term Constant C22 Drive in time (XI) 2255 255 225 225 225 225 225 225 225 2	Coef 4.194 C23 Dose (X2) 4.60 4.30 4.30 4.30 4.30 4.70 4.30 4.72 4.30	SE Coef 0.262 C24 X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	T-Value 16.01 C25 x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	0.000 C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1276	27	RPM 265 259 221 218 224 212	Type of Cutting Tool 302 302 302 302 416 416 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566 1.71032	C34	C35	C36	C37	
+ + 0 1 2 3	Coefficients Term Constant C22 Drive in time (XI) 2255 255 225 225 225 225 225 225 225 2	Coef 4,194 C23 Dose (X2) 4,60 4,30 4,30 4,30 4,70 4,30 4,72 4,30 1,52 4,30	SE Coef 0.262 C24 X1_STD 0.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.1667 egression.m	T-Value 16.01 C25 x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	0.000 C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225	C27	RPM 265 259 221 218 224 212 212 248	Type of Cutting Tool 302 302 302 302 416 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566 1.71032 -0.43188	C34		C36	C37	

And only one with the variable RPN over here. So this both the variables are significant.

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+ 7 8	Pure Error Total C22 Drive in time (X1) 225 195 255	1 0 19 6 C23 Nose (X2) 4.60 4.30	C24 X1_STD 0.0000 -1.0000 1.0000	C25 x2_STD 0.6667 -0.1667 -0.1667	C26 Y (Transistor Gain) 1269 903 1555		RPM 265 259 221	Type of Cutting Tool 302 302 302	Surface Finish 52.26 50.52 45.58	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156	Sqrt(Y) 7.22911 7.10774 6.75130	SRES 0.41734 -0.29723 0.65615	C34	C35	C36	C37	
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* 7 8 9 10 11 12 13	Pure Error Total	1 0 19 6 C23 Nose (X2) 4.60 4.30 4.30 4.30 4.70 4.72	00715 0.1 11658 C24 X1_STD 0.0000 1.0000 0.0000 0.0000 0.0000 0.0000	C25 x2_STD 0.6667 -0.1667 -1.0000 0.9444 -0.1667 1.0000	C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225		RPM 265 259 221 218 224 212 212 248	Type of Cutting Tool 302 302 302 302 416 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566 1.71032	C34	C35	C36	3	17
* 7 8 9 0 11 2 3 4	Pure Error Total C22 Drive in time (XI) D 225 25 25 25 25 25 25 25 25 25 25	1 0 19 6 C23 Nose (X2) 4.60 4.3	00715 0.1 11658 C24 X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	C25 x2_STD 0.6667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	C26 Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225		RPM 265 259 221 218 224 212 212 248	Type of Cutting Tool 302 302 302 302 416 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566 1.71032 -0.43188			C36	C37	
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And, the equations is given, lack of fit is not prominent.

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•	C22	C2		C24	C25	C26	C27 C28		C29	C30 👩				634				
	C22 Drive in time ((1) Dose	X2)	X1_STD	x2_STD	Y (Transistor Gain)	RPM	1 T)	pe of Cutting Tool	Surface Finish	Johnson Trans (Y)	Sqrt(Y)	SRES	CS4				
,	C22 Drive in time ((1) Dose	X2)	X1_STD 0.0000	x2_STD 0.6667	Y (Transistor Gain) 1269	RPM	1 T) 265	pe of Cutting Tool 302	Surface Finish 52.26	Johnson Trans (Y) 1.98000	Sqrt(Y) 7.22911	SRES 0.41734	0.54				
7	C22 Drive in time ((1) Dose 25 95	x2) 1.60 1.30	X1_STD 0.0000 -1.0000	x2_STD 0.6667 -0.1667	Y (Transistor Gain) 1269 903	RPM 2	1 T) 265 259	ype of Cutting Tool 302 302	Surface Finish 52.26 50.52	Johnson Trans (Y) 1.98000 1.06984	Sqrt(Y) 7.22911 7.10774	SRES 0.41734 -0.29723	CA	- Chi			
7 B 9	C22 Drive in time (2 1	(1) Dose 25 95 55	X2) 1.60 1.30	X1_STD 0.0000 -1.0000 1.0000	x2_STD 0.6667 -0.1667 -0.1667	Y (Transistor Gain) 1269 903 1555	RPM 2 2	1 T) 265 259 221	ype of Cutting Tool 302 302 302	Surface Finish 52.26 50.52 45.58	Johnson Trans (Y) 1.98000 1.06984 0.43932	Sqrt(Y) 7.22911 7.10774 6.75130	SRES 0.41734 -0.29723 0.65615					
7 8 9	C22 Drive in time (2 1 2 2 2	 Dose 25 95 55 25 	x2) 1.60 1.30 1.30	X1_STD 0.0000 -1.0000 1.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000	Y (Transistor Gain) 1269 903 1555 1260	RPM 2 2 2 2 2 2 2 2 2 2	1 T) 265 259 221 218 218	pe of Cutting Tool 302 302 302 302 302	Surface Finish 52.26 50.52 45.58 44.78	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179	SRES 0.41734 -0.29723 0.65615 0.33606					
7 B 9 0	C22 Drive in time (2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	 Choice Choice	x2) 1.60 1.30 1.30 1.00	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444	Y (Transistor Gain) 1269 903 1555 1260 1146	RPN 22	1 Ty 265 259 221 218 224	ype of Cutting Tool 302 302 302 302 416	Surface Finish 52.26 50.52 45.58 44.78 33.50	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990					
7 B 9 0 11 2	C22 Drive in time (2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	(1) Dose 25 95 55 25 25 25	x2) 1.60 1.30 1.30 1.00 1.70 1.30	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667	Y (Transistor Gain) 1269 903 1555 1260 1146 1276	RPM	1 Ty 265 259 221 221 221 2224 2224 2224 2224 2224 2	ype of Cutting Tool 302 302 302 302 302 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566					
7 B 9 0 11 2 3	C22 Drive in time (2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	(1) Dose 25 95 55 25 25 25 25 25 25	x2) 1.60 1.30 1.30 1.00 1.70 1.30 1.72	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000	Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225	RPN 22	I Ty 265 2 259 2 218 2 212 2 212 2 212 2 213 2 214 2 215 2	ype of Cutting Tool 302 302 302 302 416 416 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566 1.71032					
7 8 9 10 11 12 13 14	C22 Drive in time (2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	(1) Dose 25 55 25 25 25 25 25 25 30	x2) 1.60 1.30 1.30 1.30 1.70 1.30 1.72 1.30	X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.1667	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	Y (Transistor Gain) 1269 903 1555 1260 1146 1276	RPN 22	1 Ty 265 259 221 221 221 2224 2224 2224 2224 2224 2	ype of Cutting Tool 302 302 302 302 416 416 416 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566					
7 B 9 0 11 2 3 4	C22 Drive in time (2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	(1) Dose 25 55 25 25 25 25 25 25 30	x2) 1.60 1.30 1.30 1.30 1.70 1.30 1.72 1.30	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225	RPN 22	I Ty 265 2 259 2 218 2 212 2 212 2 212 2 213 2 214 2 215 2	ype of Cutting Tool 302 302 302 302 416 416 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566 1.71032					
* 7 8 9 10 11 12 13 14 4	C22 Drive in time (2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	(1) Dose 25 55 25 25 25 25 25 25 30	x2) 1.60 1.30 1.30 1.30 1.70 1.30 1.72 1.30	X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.1667	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225	RPN 22	I Ty 265 2 259 2 218 2 212 2 212 2 212 2 213 2 214 2 215 2	ype of Cutting Tool 302 302 302 302 416 416 416 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566 1.71032 -0.43188				-	2
	C22 Drive in time (2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	(1) Dose 25 95 55 25 25 25 25 30 30 90 90 90 90 90 90 90 90 90 90 90 90 90	x2) 1.60 1.30 1.30 1.30 1.70 1.30 1.72 1.30 1.72 1.30	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.1667 gression.m	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225	RPM 2	I Ty 265 2 259 2 218 2 212 2 212 2 212 2 213 2 214 2 215 2	ype of Cutting Tool 302 302 302 302 416 416 416 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52 37.13	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536 6.09344	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566 1.71032 -0.43188					

So in this case, one out layer is recorded over here as it is minus 3 point more than plus or minus 2.

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•	30 20	e (X1)	C23 Dose (X2)	C24 X1_STD	C25 x2_STD	C26 Y (Transistor Gain)		C28 RPM			s C3			C33 SRES	C34	C35	C36	C37	
	30 20 10 C22	e (X1) 225							C29		h Johnson				C34	C35	C36	C37	
,	30 20 10 C22		Dose (X2)	X1_STD	x2_STD 0.6667 -0.1667	Y (Transistor Gain)		265 259	C29 Type of Cutting Tool	Surface Finis	h Johnson 1 6 2	Trans (Y) 1.98000 1.06984	Sqrt(Y) 7.229 7.10774	SRES 0.41734 -0.29723	C34	C35	C36	C37	
	30 20 10 C22	225 195 255	Dose (X2) 4.60 4.30 4.30	X1_STD 0.0000 -1.0000 1.0000	x2_STD 0.6667 -0.1667 -0.1667	Y (Transistor Gain) 1269 903 1555		265	C29 Type of Cutting Tool 302 302 302	Surface Finis 52.2 50.5 45.5	h Johnson 1 6 2 8	Trans (Y) 1.98000 1.06984 0.43932	Sqrt(Y) 7.22907 7.10774 6.75130	SRES 0.41734 -0.29723 0.65615	C34	C35	C36	C37	
r 3	30 20 10 C22	225 195	Dose (X2) 4.60 4.30	X1_STD 0.0000 -1.0000	x2_STD 0.6667 -0.1667	Y (Transistor Gain) 1269 903		265 259	C29 Type of Cutting Tool 302 302	Surface Finis 52.2 50.5	h Johnson 1 6 2 8	Trans (Y) 1.98000 1.06984	Sqrt(Y) 7.22907 7.10774 6.75130	SRES 0.41734 -0.29723	C34	C35	C36	C37	
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7 3 0 1	30 20 10 C22	225 195 255 225 225 225 225	Dose (X2) 4,60 4,30 4,30 4,00 4,70 4,30	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -1.0000 0.9444 -0.1667	Y (Transistor Gain) 1269 903 1555 1260 1146 1276		265 259 221 218	C29 Type of Cutting Tool 302 302 302 302 302	Surface Finis 52.2 50.5 45.5 44.7 33.5 31.2	h Johnson 1 6 2 8 8 8 0 3	Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000	Sqrt(Y) 7.229 7.10774 6.75130 6.69179	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566	C34	C35	C36	C37	
1	30 20 10 C22	225 195 255 225 225 225 225 225 225	Dose (X2) 4,60 4,30 4,30 4,00 4,70 4,30 4,72	X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000	Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225		265 259 221 218 224 212 212 248	C29 Type of Cutting Tool 302 302 302 302 416	Surface Finis 52.2 50.5 45.5 44.7 33.5 31.2 37.5	h Johnson ' 6 2 8 8 8 0 3 2	Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575	Sqrt(Y) 7.229 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990	C34	C35	C36	C37	
	30 20 10 C22	225 195 255 225 225 225 225 225 225 225 230	Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30 4.72 4.30	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.1667	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	Y (Transistor Gain) 1269 903 1555 1260 1146 1276		265 259 221 218 224 212	, C29 Type of Cutting Tool 302 302 302 302 416 416	Surface Finis 52.2 50.5 45.5 44.7 33.5 31.2 37.5	h Johnson ' 6 2 8 8 8 0 3 2	Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000	Sqrt(Y) 7.22907 7.10774 6.75130 6.69179 5.78792 5.58838	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566	C34	C35	C36	(37	
+ 7 8 9 0 11 2 3 4	30 20 10 C22	225 195 255 225 225 225 225 225 225 225 230	Dose (X2) 4,60 4,30 4,30 4,00 4,70 4,30 4,72	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.1667	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225		265 259 221 218 224 212 212 248	229 Type of Cutting Tool 302 302 302 302 416 416 416	Surface Finis 52.2 50.5 45.5 44.7 33.5 31.2 37.5	h Johnson ' 6 2 8 8 8 0 3 2	Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.229 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566 1.71032	C34	C35	C36	C37	

So in this case, what we have to see is that, again there is a after this transformation there is a residual that is generated over here.

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Regr		Data Calc C	Basic Regn ANO DOE Cont Quali Relial			stant Additional Tools Image: Display Descriptive State Store Descriptive State Image: Display Descriptive State Graphical Summary Image: Display Descriptive State Store Descriptive State Image: Display Descriptive State Graphical Summary Image: Display Descriptive State Store Descriptive State Image: Display Descripting State Store Descring	atistics	★ \$\$ 10	n co ou st s	4 12								•
	99 95 90		Multi Time Table	variate Series		P 1 Proportion 1 2 Proportions 1 3 ample Poisson P 1 2 Sample Poisson P		2			•			:				*
	80 - 10 -			alence Tests r and Sample		 1 Variance 2 Variances 11 Correlation O² Covariance Normality Test Outlier Test 		Standardized Residual	•	•.•	. •							
+		22	C23	C24	C25			C29	C30		C31 n	C32 m	C33	C34	C35	C36	C37	C3 -
1	Drive in	time (X1)	Dose (X2)	X1_STD	x2_STD	λ Goodness-of-Fit Ter	R for Poisson	Type of Cutting To	ol Surface Fin	ish John	son Trans (Y)	Sqrt(Y)	SRES					
7		225	4.60	0.0000	0.6667	1269	265	31			1.98000	7.22911	0.41734					
8		195	4.30	-1.0000	-0.1667	903	259	31			1.06984	7.10774	-0.29723					
9		255	4.30	1.0000	-0.1667	1555	221	3			0.43932	6.75130	0.65615					
10		225	4.00	0.0000	-1.0000	1260	218	31			0.37156	6.69179 5.78792	0.33606					
11		225	4.70	0.0000	-0.1667	1146	224		16 33 16 31		-0.70575	5.58838	0.08566					
12		225	4.50	0.0000	-0.1667	1276	212			.23	-1.98000	6.12536	1.71032					
13		225	4.72	0.1667	-0.1667	1225	248			.52	-0.20696	6.09344				-	0	
14 (4 (1))	н			egression.m		1321	200		4	.19	-0.24300	0.09344	-0.45100				-R	
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Let us try to check whether the correction has happened with Box-Cox transformation or this is not adequate. So, in this case what we will do is that, we will see the residual over here and try to see ok.

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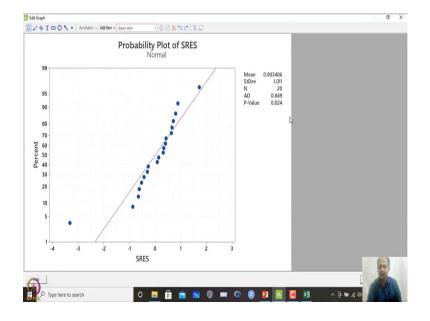
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3	×0.	C23	C24	C25	C26	Select	1	 Anderson-Darling C Ryan-Joiner (Simila) 	to Shapiro-Wilk)			C32 🕫	C33	C34	C35	C36	C37	÷
•	0		C24 X1_STD		C26 Y (Transistor Gain)	Select		Anderson-Darling Ryan-Joiner (Simla Kolmogorov-Smirnov	to Shapiro-Wilk)		s (Y)	Sqrt(Y)	C33 SRES	C34	C35	C36	C37	
•	C22 re in time (X1) 225	Dose (X2) 4.60	X1_STD 0.0000	x2_STD 0.6667	Y (Transistor Gain) 1269	Select Help	J	Anderson-Darling Ryan-Joiner (Simla Kolmogorov-Smirnov	OK D	Cancel	s (Y) 8000	Sqrt(Y) 7.22911	SRES 0.41734	C34	C35	C36	C37	
+ Driv	C22 c22 re in time (XI) 225 195	Dose (X2) 4.60 4.30	X1_STD 0.0000 -1.0000	x2_STD 0.6667 -0.1667	Y (Transistor Gain) 1269 903		259	Anderson-Darling Nyan-Joiner (Simila Kolmogorov-Smirnov Title: [ок 🔊		s (M) 8000 1.06984	Sqrt(Y) 7.22911 7.10774	SRES 0,41734 -0.29723	C34	C35	C36	C37	
+ Driv	C22 re in time (X1) 225 195	Dose (X2) 4,60 4,30 4,30	X1_STD 0.0000 -1.0000 1.0000	x2_STD 0.6667 -0.1667 -0.1667	Y (Transistor Gain) 1269 903 1555		221	Anderson-Darling C Ryan-Joiner (Simila C Kolmogorov-Smirnov Title: [302 302	ок [,] 50.52 45.58		s (Y) 8000 1.06984 0.43932	Sqrt(Y) 7.22911 7.10774 6.75130	SRES 0.41734 -0.29723 0.65615	C34	C35	C36	C37	
* Driv 7 0 8 0	C22 re in time (Xt) 225 195 255 225	Dose (X2) 4.60 4.30 4.30 4.00	X1_STD 0.0000 -1.0000 1.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000	Y (Transistor Gain) 1269 903 1555 1260		221 218	Anderson-Darling C Ryan-Joiner (Simila C Kolmogorov-Smirnov Title: [302 302 302	OK 50.52 45.58 44.78		s (Y) 8000 1.06984 0.43932 0.37156	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179	SRES 0.41734 -0.29723 0.65615 0.33606	C34	C35	C36	C37	
+ Driv 7 0 8 0 0 1	C22 re in time (XI) 225 195 255 225 225	Dose (X2) 4.60 4.30 4.30 4.00 4.70	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444	Y (Transistor Gain) 1269 903 1555 1260 1146		221 218 224	Anderson-Darling C Ryan-Jainer (Simila Kolmoparov-Smirnov Title:	OK 50.52 45.58 44.78 33.50	-	s (Y) 8000 1.06984 0.43932 0.37156 0.70575	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990	C34	C35	C36	C37	
+ Driv 7 33 00 11 22	00 C22 192 192 225 225 225 225 225 225 225 2	Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667	Y (Transistor Gain) 1269 903 1555 1260 1146 1276		221 218 224 212	(* Anderson-Darling (* Ryan-Joher (* Kolmogorou-Smimov Title: 302 302 302 302 416 416	ок 50.52 45.58 44.78 33.50 31.23	-	s (Y) 8000 1.06984 0.43932 0.37156 0.70575 1.98000	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566	C34	C35	C36	C37	
* Driv 7 0 8 0 0 1 1 2 3 0	222 re in time (XI) 225 225 225 225 225 225 225 225 225 22	Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30 4.72	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000 0.0000	x2_STD 0.6667 -0.1667 -1.0000 0.9444 -0.1667 1.0000	Y (Transistor Gain) 1269 903 1555 1260 1146 1276 1225		221 218 224 212 248	(* Anderson-Daring (* Ryan-Joher (Simila (* Kainoparev Smirov Title: 3002 3002 3002 416 416 416	ок 50.52 45.58 44.78 33.50 31.23 37.52	-	s (Y) 8000 1.06984 0.43932 0.37156 0.70575 1.98000 0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566 1.71032	C34	C35	C36	C37	
+ Driv 7 33 00 11 22	222 195 225 225 225 225 225 225 225 225 225 2	Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30 4.72	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.1667	x2_STD 0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	Y (Transistor Gain) 1269 903 1555 1260 1146 1276		221 218 224 212	(* Anderson-Darling (* Ryan-Joher (* Kolmogorou-Smimov Title: 302 302 302 302 416 416	ок 50.52 45.58 44.78 33.50 31.23	-	s (Y) 8000 1.06984 0.43932 0.37156 0.70575 1.98000	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	SRES 0.41734 -0.29723 0.65615 0.33606 0.87990 0.08566	C34	C35	C36	C37	

So, let me just check this is stat basic stat, normality test over here, so I will go to the last variable, that is recorded.

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•					Y (Transistor Gain)	RPM	Type of Cutting Tool	Surface Finish		Sqrt(Y)	SRES					
	Drive in time (X1)		X1_STD			265	202	62.26	1 00000	7 33011						
,	Drive in time (X1) 225	4.60	0.0000	0.6667	1269	265			1.98000	7.22911	0.41734					
	Drive in time (X1) 225 195	4.60 4.30	0.0000			265 255 221	302	50.52	1.06984	7.10774	0.41734 -0.29723 0.65615					
7 B 9	Drive in time (X1) 225	4.60	0.0000	0.6667	1269 903 1555	255	302 302	50.52 45.58			-0.29723					
+ 7 8 9 0	Drive in time (X1) 225 195 255	4.60 4.30 4.30	0.0000 -1.0000 1.0000	0.6667 -0.1667 -0.1667	1269 903 1555	255	302 302 302	50.52 45.58 44.78	1.06984 0.43932	7.10774 6.75130	-0.29723 0.65615					
7 3 0	Drive in time (X1) 225 195 255 225	4.60 4.30 4.30 4.00	0.0000 -1.0000 1.0000 0.0000	0.6667 -0.1667 -0.1667 -1.0000	1269 903 1555 1260	255 221 218	302 302 302 416	50.52 45.58 44.78 33.50	1.06984 0.43932 0.37156	7.10774 6.75130 6.69179	-0.29723 0.65615 0.33606					
1	Drive in time (X1) 225 195 255 225 225	4.60 4.30 4.30 4.00 4.70	0.0000 -1.0000 1.0000 0.0000 0.0000	0.6667 -0.1667 -0.1667 -1.0000 0.9444	1269 903 1555 1260 1146 1276	255 221 218 224	302 302 302 416 416	50.52 45.58 44.78 33.50 31.23	1.06984 0.43932 0.37156 -0.70575	7.10774 6.75130 6.69179 5.78792	-0.29723 0.65615 0.33606 0.87990					
1	Drive in time (X1) 225 195 255 225 225 225	4.60 4.30 4.30 4.00 4.70 4.30	0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000	0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667	1269 903 1555 1260 1146 1276	255 221 218 224 212 214	302 302 302 416 416 416	50.52 45.58 44.78 33.50 31.23 37.52	1.06984 0.43932 0.37156 -0.70575 -1.98000	7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	-0.29723 0.65615 0.33606 0.87990 0.08566					
	Drive in time (XI) 225 195 225 225 225 225 225 225 225 225 225 2	4,60 4,30 4,30 4,00 4,70 4,30 4,72	0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.1667	0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	1269 903 1555 1260 1146 1276 1225	255 221 216 224 212 246	302 302 302 416 416 416	50.52 45.58 44.78 33.50 31.23 37.52	1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	-0.29723 0.65615 0.33606 0.87990 0.08566 1.71032					

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And then I see what is the value of the P-Value. So, P-Value is again less than 0.05. So again there is a problem and that the problem is not resolved, so error is not coming out to be normal, so in this case again it is not white noise. So, in this case what we have to do is that we have to so then what I have done is that I have gone for Johnson's transformation, family of transformation so Johnson's transformation.

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+	C22	C23	C24	C25	1	Acceptance Sampling by	Attributes		C30 g	C31 x	C32 👩	C33	C34	C35	C36	C37	(
C	vrive in time (X1) D	ose (X2)	X1_STD	x2_STD		Acceptance Sampling by	Variables	, ig Tool	Surface Finish	Johnson Trans (Y)	Sqrt(Y)						
7	225	4.60	0.0000	0.6667	6	Multi-Vari Chart		302	52.26		7.22911						
8	195	4.30	-1.0000	-0.1667		Variability Chart		302	50.52		7.10774						
9	255	4.30	1.0000	-0.1667		Symmetry Plot		302	45.58		6.75130						
	225	4.00	0.0000	-1.0000	-	1600		302	44.78		6.69179						
	225	4.70	0.0000	0.9444		1146	224	416	33.50		5.78792						
11		4.30	0.0000	-0.1667		1276	212	416	31.23		5.58838						
11	225			1,0000		1225	248	416	37.52		6.12536 6.09344					(
11 12 13	225	4.72	0.0000														
11 12 13 14	225 230	4.30	0.1667	-0.1667		1321	260		37113		0.00044					100	
10 11 12 13 14 4 Þ	225 230 H + Multipl	4.30 e Linear R	0.1667 egression.m	-0.1667		1321	260	4	5115							and a	-
11 12 13 14	225 230	4.30 e Linear R	0.1667 egression.m	-0.1667		1321	260		5115							T	

So, what I have done is that basic stat, sorry this is quality tools, and in that case Johnson's transformation is there.

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Prob	ability Plot of SR															
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	Results do not a		e	Single column: Subgroups acros	Surface Finish'											
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	90 80 70 C22 Drive in time ()	C17 Time Select Help C10 Dose (X2) 25 4.60	× [x2_STD Y	(Transistor Gain)	RPM T	ype of Cutting Tool	urface Finish	Johnson Trans (Y)	Sqrt(Y)	C33	C34	C35	C36	C37	
	90 80 70 C22 Drive in time () 21	C17 Time Select Help C10 Dose (X2) 25 4.60 95 4.30	× [x2_STD Y 0.6667	(Transistor Gain) 1269	RPM T 265	Type of Cutting Tool 5 302	Surface Finish 52.26	Johnson Trans (Y) 1.98000	Sqrt(Y) 7.22911	C33	C34	C35	C36	C37	
	90 00 70 C22 Drive in time () 2: 11	C17 Time Select Help C10 Dose (X2) 25 4.60 95 4.30 55 4.30	× X1_STD 0.0000 -1.0000	x2_STD Y 0.6667 -0.1667	(Transistor Gain) 1269 903	RPM T 265 259	Type of Cutting Tool 5 302 302	52.26 50.52	Johnson Trans (Y) 1.98000 1.06984	Sqrt(Y) 7.22911 7.10774	C33	C34	C35	C36	C37	
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Ī	90 90 90 00 00 00 00 00 00 00 00 00 00 0	C17 Tere Select Hep C5 4.60 95 4.30 55 4.30 25 4.00 25 4.70	× (x1_STD 0.0000 -1.0000 1.0000 0.0000	x2,5TD Y 0.6667 -0.1667 -1.0000	(fransistor Gain) 1269 903 1555 1260	RPM T 265 259 221 218	Type of Cutting Tool 302 302 302 302 302 302	Surface Finish 52.26 50.52 45.58 44.78	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179	C33	C34	C35	C36	C37	
	90 90 22 Drive in time () 21 11 22 22 21 22 21	C17 Tree Select Help C19 Dose (X2) 25 4.60 95 4.30 25 4.00 25 4.70 25 4.30	× [X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000	x2_STD Y 0.6667 -0.1667 -1.0000 0.9444	(Transistor Gain) 1269 903 1355 1355 1356 1146	RPM T 265 259 221 218 224	Type of Cutting Tool 3 302 302 302 302 302 416	Surface Finish 52.26 50.52 45.58 44.78 33.50	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792	C33	C34	C35	C36	C37	
	99- 60- 70- 22 Drive in time (D 22 11- 22 22 22 22 22 22 22 22 22	C17 Tree Select Help C19 Dose (X2) 25 4.60 95 4.30 25 4.00 25 4.70 25 4.30	× X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000 0.0000	x2_STD Y 0.6667 -0.1667 -1.0000 0.9444 -0.1667	(Transistor Gain) 1269 903 1555 1260 1146 1276	RPM T 265 259 221 218 224 224 212	Type of Cutting Tool 3 302 302 302 302 416 416	turface Finish 52.26 50.52 45.58 44.78 33.50 31.23	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	C33	C34	C35	C36	C37	

And in this case, I have reported that place it into single column data are arranged where the data is. So, I will say surface finish is the data and store in which column. So, I have mentioned over here as C31.

So, when you click that one C31 over here, so in this case what happens is that, if I click ok.

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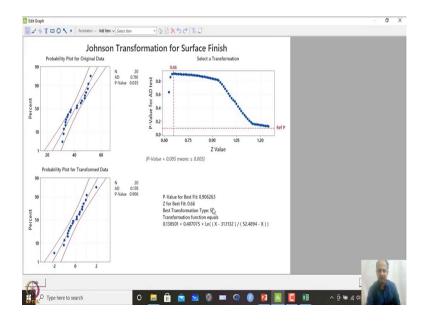
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	90 60 70 C22 Drive in time (Xt) 225	Help	X1_STD 0.0000	0.6667	(Transistor Gain) 1269	OK Cancel RPM 265	Type of Cutting Tool 302	Surface Finish 52.26	Johnson Trans (Y) 1.98000	Sqrt(Y) 7.22911	C33	C34	C35	C36	C37	
7	90 00 00 00 00 00 00 00 00 00	Help Dose (X2)	X1_STD	0.6667	/ (Transistor Gain) 1269 903	OK Cancel RPM 265 259	Type of Cutting Tool	Surface Finish 52.26 50.52	Johnson Trans (Y) 1.98000 1.06984	Sqrt(Y) 7.22911 7.10774	C33	C34	C35	C36	C37	
7	90 00 70 C22 Drive in time (X1) 225 195 255	Help Dose (X2) 4.60	X1_STD 0.0000 -1.0000 1.0000	0.6667	(Transistor Gain) 1269	OK Cancel RPM 265	Type of Cutting Tool 302	Surface Finish 52.26	Johnson Trans (Y) 1.98000 1.06984 0.43932	Sqrt(Y) 7.22911 7.10774 6.75130	C33	C34	C35	C36	C37	
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7 8 9 10	90 90 22 C22 Drive in time (XI) 225 195 225 225 225 225 225	Help Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30	X1_STD 0.0000 -1.0000 1.0000 0.0000	0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667	(fransistor Gain) 1269 903 1355 1260 1146 1276	ОК Салові 265 259 221 218 224 212	Type of Cutting Tool 302 302 302 302	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838	C33	C34	C35	C36	C37	
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7 8 9 10 11 12 13	90 90 22 C22 Drive in time (XI) 225 195 225 225 225 225 225	Help Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000	0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667	(fransistor Gain) 1269 903 1355 1260 1146 1276	ОК Салові 265 259 221 218 224 212	Type of Cutting Tool 302 302 302 302 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	C33	C34	C35	C36	C37	
7 8 9 10 11 12 13 14	90 90 72 72 0 0 0 0 0 0 0 0 0 0 0 0 0	Help Dose (X2) 4.60 4.30 4.30 4.30 4.70 4.30 4.72	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.1667	0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	(Transistor Gain) 1269 903 1555 1260 1146 1146 1146 11276 1225	0K Cancel 265 259 221 218 224 212 218 224 212 248	Type of Cutting Tool 302 302 302 302 416 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	C33	C34	C35	C36	C37	
+ 7 8 9 10 11 12 13 14 4	90 90 72 72 0 0 0 0 0 0 0 0 0 0 0 0 0	Help Dose (X2) 4.60 4.30 4.30 4.30 4.70 4.30 4.72 4.30 de Linear Ro	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.1667 rgression.m	0.6667 -0.1667 -0.1667 -1.0000 0.9444 -0.1667 1.0000 -0.1667	(Transistor Gain) 1269 903 1555 1260 1146 1146 1146 11276 1225	0K Cancel 265 259 221 218 224 212 218 224 212 248	Type of Cutting Tool 302 302 302 302 416 416 416 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	C33	C34			C37	

And options what we have given is that 0.1 is the value to select the best fit, so in this case ok.

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	C22	C23	C24	6. 00 000 (P. Volue + 0.00 C25	Z Value 05 meters & 0.005) C26	105 120 C27 C28	C29	C30 5	G1 x	C32 g	C33	C34	C35	C36	C37	
		C23	C24 X1_STD	6. 00 000 (P. Volue + 0.00 C25	Z Value 55 metre & 0.005)	1.05 1.20	C29 Type of Cutting Tool				C33	C34	C35	C36	C37	
	C22 Drive in time (Xt) 225	C23 Dose (X2) 4.60	X1_STD 0.0000	(P-Volur + 0.0) C25 x2_STD 0.6667	Z Value 25 meters ± 0.000 C26 Y (Transistor Gain) 1269	tós 120 C27 C28 RPM 265	Type of Cutting Tool 302	Surface Finish 52.26	Johnson Trans (Y) 1.98000	Sqrt(Y) 7.22911	C33	C34	C35	C36	C37	
	C22 Drive in time (X1) 225 195	C23 Dose (X2) 4.60 4.30	X1_STD	(P-Volue = 0.00 C25 x2_STD 0.6667 -0.1667	Z Value 25 meters 4 00050 C26 Y (Transistor Gain) 1269 903	tós 120 C27 C28 RPM 265 255	Type of Cutting Tool 302 302	Surface Finish	Johnson Trans (Y) 1.98000 1.06984	Sqrt(Y) 7.22911 7.10774	C33	C34	C35	C36	C37	
	C22 Drive in time (Xt) 225 195 255	C23 Dose (X2) 4.60 4.30 4.30	X1_STD 0.0000 -1.0000 1.0000	6 00 6 00	Z Value C26 Y (Transistor Gain) 1269 903 1555	tös täb C27 C28 RPM 265 255 221	Type of Cutting Tool 302 302 302	Surface Finish 52.26 50.52 45.58	Johnson Trans (V) 1.98000 1.06984 0.43932	Sqrt(Y) 7.22911 7.10774 6.75130	C33	C34	C35	C36	C37	
	C22 Drive in time (Xt) 225 195 255 225	C23 Dose (X2) 4.60 4.30 4.30 4.00	X1_STD 0.0000 -1.0000	(P-Volue = 0.00 C25 x2_STD 0.6667 -0.1667	Z Value C26 Y (Transistor Gain) 1269 903 1555	tós 120 C27 C28 RPM 265 255	Type of Cutting Tool 302 302 302	Surface Finish 52.26 50.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179	C33	C34	C35	C36	C37	
7 3)	C22 Drive in time (Xt) 225 195 255 225 225 225	C23 Dose (X2) 4.60 4.30 4.30 4.00 4.70	X1_STD 0.0000 -1.0000 1.0000	 asterna (19) (P) Volur + 0.00 (C25) (K2_STD) (0.6667) (0.6677) 	Z Value 25 means 4 00050 7 (Transistor Gain) 1269 903 1555 1260 1146	tis tis C27 C28 RPM 265 255 221 216 224 214 224	Type of Cutting Tool 302 302 302 302 416	Surface Finish 52.26 50.52 45.58	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792	C33	C34	C35	C36	C37	
1	C22 Drive in time (Xt) 225 195 255 225	C23 Dose (X2) 4.60 4.30 4.30 4.00 4.70	X1_STD 0.0000 -1.0000 1.0000 0.0000	6. 000 (P. Volue + 0.00 C25 K2_STD 0.6667 -0.1667 -0.1667 -1.0000	Z Value C26 Y (Transistor Gain) 1269 903 1555 1260	tós tás C27 C28 RPM 265 255 221 216	Type of Cutting Tool 302 302 302 302 416	Surface Finish 52.26 50.52 45.58 44.78	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179	C33	C34	C35	C36	C37	
1	C22 Drive in time (Xt) 225 195 255 225 225 225	C23 Dose (X2) 4.60 4.30 4.30 4.00 4.70 4.30	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000	 asterna (19) (P) Volur + 0.00 (C25) (K2_STD) (0.6667) (0.6677) 	2 Value 5 meter s c 0000 Y (Transistor Gain) 1269 903 1555 1260 1146 1276	tis tis C27 C28 RPM 265 255 221 216 224 214 224	Type of Cutting Tool 302 302 302 302 416 416	Surface Finish 52:26 50:52 45:58 44:78 33:50	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792	C33	C34	C35	C36	C37	
1	C22 Drive in time (Xt) 225 195 2255 225 225 225 225 225 225	C23 Dose (X2) 4,60 4,30 4,30 4,30 4,00 4,70 4,30 4,72	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000	 accession accession	2 Value 5 meter s c 0000 Y (Transistor Gain) 1269 903 1555 1260 1146 1276	tis tis C27 C28 RPM 265 255 221 216 224 212 214	Type of Cutting Tool 302 302 302 302 416 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	C33	C34	C35	C36	C37	
* * 0 1 2 3 4	C22 Drive in time (Xt) 225 195 225 225 225 225 225 225 225 225 225 2	C23 Dose (X2) 4,60 4,30 4,30 4,30 4,00 4,70 4,30 4,72	X1_STD 0.0000 -1.0000 1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.1667	 assistantial assistantial (P. Volue + 0.02 C25 x2_STD 0.6667 -0.1667 -0.1667 -0.1667 1.0000 -0.1667 -0.1667 -0.1667 	2 Value 5 mener s 2000 Y (Transistor Galn) 1269 903 1555 1260 1146 1276 1225	tió tảo C27 C28 RPM 265 221 216 224 212 248	Type of Cutting Tool 302 302 302 302 416 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536	C33	C34	C35	C36	C37	
1	C22 Drive in time (Xt) 225 195 225 225 225 225 225 225 225 225 225 2	C23 Dose (X2) 4.60 4.30 4.30 4.30 4.70 4.30 4.72 4.30 iple Linear R	X1_STD 0.0000 -1.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.1667 tegression.m	 assistantial assistantial (P. Volue + 0.02 C25 x2_STD 0.6667 -0.1667 -0.1667 -0.1667 1.0000 -0.1667 -0.1667 -0.1667 	2 Value 5 mener s 2000 Y (Transistor Galn) 1269 903 1555 1260 1146 1276 1225	tió tảo C27 C28 RPM 265 221 216 224 212 248	Type of Cutting Tool 302 302 302 302 416 416 416 416	Surface Finish 52.26 50.52 45.58 44.78 33.50 31.23 37.52	Johnson Trans (Y) 1.98000 1.06984 0.43932 0.37156 -0.70575 -1.98000 -0.20696	Sqrt(Y) 7.22911 7.10774 6.75130 6.69179 5.78792 5.58838 6.12536		C34		C36	637	

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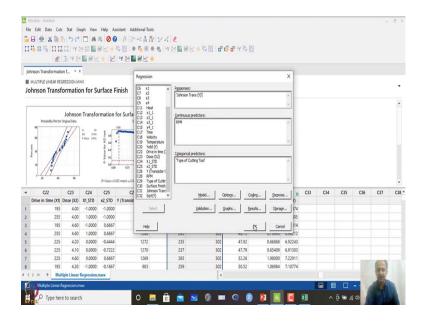
So, it will give you the transformation that is required. So, this is the transformed equation transform function over here that is given L n what you see the last over here and this is transforming the variable. So initially P-Value is less than point the original data is less than 0.05 and after transformation P-Value is coming out to be 0.906; that means it has done a rightful transformations.

Now we have to only confirm. And, this is saved over here Johnson's transformation is saved over here in C31 column. Now, what we will do is that, with this column we will regress with RPN and type of over here.

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•		C23	C24 X1_STD	(P-Volue + 0) (25	6/5 6/0 Z Value 005 metri 6 0 005)	1.05	1,20					C33	C34	C35	C36	C37	• C38
	C22 Drive in time (X1) D 195	C23 ose (X2) 4.00	X1_STD -1.0000	(P-Volue + 0) C25 x2_STD -1.0000	6/5 6/6 Z Value 005 meters 4 0005) C26 Y (Transistor Gain) 1004	1.05	1.20 C28	C59	Surface Finish 42.00	Johnson Trans (Y) 0.15364	Sqrt(Y) 6.48074	C33	C34	C35	C36	C37	v C38
1	C22 Drive in time (X1) D	C23 lose (X2)	X1_STD -1.0000 1.0000	(P-Volue + 0) (25 x2_STD	675 690 Z Value 005 meter & 0005 C26 Y (Transistor Gain)	1.05	C28 RPM	C29 Type of Cutting Tool	Surface Finish	Johnson Trans (Y) 0.15364	Sqrt(Y) 6,48074 6,48305	C33	C34	C35	C36	C37	C38
1 2	C22 Drive in time (X1) D 195	C23 ose (X2) 4.00	X1_STD -1.0000 1.0000 -1.0000	(P-Volue + 0) C25 x2_STD -1.0000	6/5 8/0 Z Value 005 meets 4 0005 Y (Transistor Gain) 1004 1636 852	1.05	C28 RPM 225	C29 Type of Cutting Tool 302	Surface Finish 42.00 42.03 50.10	Johnson Trans (V) 0.15364 0.15592 0.98224	Sqrt(Y) 6.48074 6.48305 7.07814	C33	C34	C35	C36	C37	¢
1 2 3	C22 Drive in time (X1) D 195 255 195 255	C23 ose (X2) 4.00 4.00	X1_STD -1.0000 1.0000 -1.0000 1.0000	(P-Volue = 0 (P-Volue = 0 C25 x2_STD -1.0000 -1.0000 0.6667 0.6667	615 640 Z Value 005 menns 60005 V (Transistor Gain) 1004 1636 852 1506	1.05	225 200 250 245	C29 Type of Cutting Tool 302 302 302 302 302	Surface Finish 42.00 42.03 50.10 48.75	Johnson Trans (Y) 0.15364 0.15592 0.98224 0.76990	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212	C33	C34	C35	C36	C37	C38
1 2 3 4	C22 Drive in time (X1) D 195 255 195 255 225	C23 lose (X2) 4.00 4.00 4.60	X1_STD -1.0000 1.0000 -1.0000 1.0000 0.0000	(P-Volue = 0 (P-Volue = 0 x2_STD -1.0000 0.6667 0.6667 -0.4444	6/5 6/6 Z Value 005/means ± 0000 Z Value C26 Y (Transistor Gain) 1004 1636 852 1506 1272	1.05	120 C28 RPM 225 200 250 245 235	C29 Type of Cutting Tool 302 302 302	Surface Finish 42.00 42.03 50.10 48.75 47.92	Johnson Trans (Y) 0.15364 0.15592 0.98224 0.76990 0.66868	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212 6.92243	C33	C34	C35	C36	C37	C38
1 2 3 4 5 6	C22 Drive in time (X1) D 195 255 195 255 225 225	C23 ose (X2) 4.00 4.00 4.60 4.60 4.20 4.10	X1_STD -1.0000 1.0000 -1.0000 1.0000 0.0000 0.0000	(P-Volue + 0) (P-Volue + 0) (P	2 6/5 6/6 2 Value 005 metrix 4 0000 2 Value 2	1.05	228 RPM 225 200 250 245 235 237	C29 Type of Cutting Tool 302 302 302 302 302 302 302 302	Surface Finish 42.00 42.03 50.10 48.75 47.92 47.79	Johnson Trans (Y) 0.15364 0.15592 0.98224 0.76990 0.66868 0.65409	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212 6.92243 6.91303	C33	C34	C35	C36	C37	C38
1 2 3 4 5 6	C22 Drive in time (X) D 195 255 195 255 225 225 225 225 225	C23 tose (X2) 4.00 4.00 4.60 4.60 4.20 4.10 4.60	X1_STD -1.0000 -1.0000 1.0000 0.0000 0.0000 0.0000	(P-Volue + 0) (P-Volue + 0) (P	eis eie 2 Value 2 Va	1.05	225 200 250 245 235 237 265	C29 Type of Cutting Tool 302 302 302 302 302 302 302 302 302 302	Surface Finish 42.00 42.03 50.10 48.75 47.92 47.79 52.26	Johnson Trans (Y) 0.15364 0.15592 0.98224 0.76990 0.66668 0.65409 1.98000	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212 6.92243 6.91303 7.22911	C33	C34	C35	C36	C37	C38
1 2 3 4 5 6 7	C22 Drive in time (Xt) D 195 255 195 255 255 225 225 225 225 225 195	C23 vose (X2) 4.00 4.60 4.60 4.20 4.10 4.60 4.30	X1_STD -1.0000 1.0000 -1.0000 1.0000 0.0000 0.0000 -1.0000	(P-Volue + 0) C25 x2_STD -1.0000 0.6667 0.6667 -0.4444 -0.7222 0.6667 -0.1667	2 6/5 6/6 2 Value 005 metrix 4 0000 2 Value 2	1.05	228 RPM 225 200 250 245 235 237	C29 Type of Cutting Tool 302 302 302 302 302 302 302 302	Surface Finish 42.00 42.03 50.10 48.75 47.92 47.79 52.26	Johnson Trans (Y) 0.15364 0.15592 0.98224 0.76990 0.66668 0.65409 1.98000	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212 6.92243 6.91303	C33	C34	C35	C36	C37	C38
1 2 3 4 5 6 7 8	C22 Drive in time (Xt) D 195 255 195 255 255 225 225 225 225 225 195	C23 vose (X2) 4.00 4.60 4.60 4.20 4.10 4.60 4.30	X1_STD -1.0000 -1.0000 1.0000 0.0000 0.0000 0.0000	(P-Volue + 0) C25 x2_STD -1.0000 0.6667 0.6667 -0.4444 -0.7222 0.6667 -0.1667	eis eie 2 Value 2 Va	1.05	225 200 250 245 235 237 265	C29 Type of Cutting Tool 302 302 302 302 302 302 302 302 302 302	Surface Finish 42.00 42.03 50.10 48.75 47.92 47.79 52.26 50.52	Johnson Trans (Y) 0.15364 0.15592 0.98224 0.76990 0.66668 0.65409 1.98000	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212 6.92243 6.91303 7.22911	C33	C34	C35	C36	C37	C38
+ 1 2 3 4 5 6 7 8 4	C22 Drive in time (Xt) D 195 255 195 255 255 225 225 225 225 225 195	C23 ose (X2) 4.00 4.00 4.60 4.60 4.10 4.10 4.60 4.30 ose Linear	X1_STD -1.0000 1.0000 -1.0000 1.0000 0.0000 0.0000 -1.0000 -1.0000 Regression.r	(P-Volue + 0) C25 x2_STD -1.0000 0.6667 0.6667 -0.4444 -0.7222 0.6667 -0.1667	eis eie 2 Value 2 Va	1.05	225 200 250 245 235 237 265	C29 Type of Cutting Tool 302 302 302 302 302 302 302 302 302 302	Surface Finish 42.00 42.03 50.10 48.75 47.92 47.79 52.26 50.52	Johnson Trans (Y) 0.15364 0.15592 0.98224 0.76990 0.66668 0.65409 1.98000	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212 6.92243 6.91303 7.22911	C33	C34		C36	C37	C38

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So, what we will do is that we will go to regression, regression analysis, fit regression, instead of this square root what we will do is that we will use Johnson's transform variable and other things remain same. So, I will click ok.

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	egression Equ	ation C23			C26 Y (Transistor Gain)	C27 C28 RPM	C29 Type of Cutting Tool			C32 g Sqrt(Y)	CAL	C34	C35	C36	C37	¥ C38
•	tegression Equ	ation C23	C24				Type of Cutting Tool					C34	C35	C36	C37	v C38
•	c22 C22	c23 Dose (X2)	C24 X1_STD	x2_STD	Y (Transistor Gain)	RPM	Type of Cutting Tool 5 302	Surface Finish	Johnson Trans (Y)	Sqrt(Y)	SRES	C34	C35	C36	C37	C38
•	C22 C22 Drive in time (X1) 195	C23 Dose (X2) 4.00	C24 X1_STD -1.0000	x2_STD -1.0000	Y (Transistor Gain) 1004	RPM 2	Type of Cutting Tool 5 302 0 302	Surface Finish 42.00	Johnson Trans (Y) 0.15364	Sqrt(Y) 6.48074	SRES -1.19021	C34	C35	C36	C37	C 38
•	C22 C22 Drive in time (X1) 195 255	C23 Dose (X2) 4.00 4.00	C24 X1_STD -1.0000 1.0000	x2_STD -1.0000 -1.0000	Y (Transistor Gain) 1004 1636	RPM 2	Type of Cutting Tool 5 302 0 302 0 302	Surface Finish 42.00 42.03	Johnson Trans (Y) 0.15364 0.15592	Sqrt(Y) 6.48074 6.48305	SRES -1.19021 1.48612	C34	C35	C36	C37	C38
•	cz2 Crive in time (X1) 195 255 195 255 225	C23 Dose (X2) 4.00 4.00 4.60	C24 X1_STD +1.0000 1.0000 -1.0000	x2_STD -1.0000 -1.0000 0.6667	Y (Transistor Gain) 1004 1636 852 1506 1272	RPM 2 2 2	Type of Cutting Tool 5 302 0 302 0 302 5 302	Surface Finish 42.00 42.03 50.10	Johnson Trans (Y) 0.15364 0.15592 0.98224	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212 6.92243	SRES -1.19021 1.48612 -0.43980 -0.76768 -0.16721	C34	C35	C36	C37	C38
• 1 2 3 1	czz Crive in time (X1) 195 255 195 255	C23 Dose (X2) 4.00 4.60 4.60	C24 X1_STD -1.0000 -1.0000 1.0000	x2_STD -1.0000 -1.0000 0.6667 0.6667	Y (Transistor Gain) 1004 1636 852 1506	RPM 2 2 2 2	Type of Cutting Tool 5 302 0 302 0 302 5 302 5 302 5 302	Surface Finish 42.00 42.03 50.10 48.75	Johnson Trans (Y) 0.15364 0.15592 0.98224 0.76990	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212	SRES -1.19021 1.48612 -0.43980 -0.76768 -0.16721	C34	C35	C36	C37	C38
• 1 2 3 1 5 5	cz2 Crive in time (X1) 195 255 195 255 225	C23 Dose (X2) 4.00 4.60 4.60 4.60 4.20	C24 X1_STD -1.0000 1.0000 -1.0000 0.0000	x2_STD -1.0000 -1.0000 0.6667 0.6667 -0.4444	Y (Transistor Gain) 1004 1636 852 1506 1272	RPM 2 2 2 2 2 2 2	Type of Cutting Tool 5 302 302 0 302 302 5 302 302 5 302 302 7 302 302	Surface Finish 42.00 42.03 50.10 48.75 47.92 47.79 52.26	Johnson Trans (Y) 0.15364 0.15592 0.98224 0.76990 0.66868	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212 6.92243	SRES -1.19021 1.48612 -0.43980 -0.76768 -0.16721 -0.42110	C34	C35	C36	C37	C38
• 1 2 3 4 5 6 7	c22 Drive in time (X1) 195 255 195 255 225 225 225	C23 Dose (X2) 4.00 4.60 4.60 4.60 4.20 4.10	C24 X1_STD -1.0000 1.0000 -1.0000 0.0000 0.0000	x2_STD -1.0000 -1.0000 0.6667 0.6667 -0.4444 -0.7222	Y (Transistor Gain) 1004 1636 852 1506 1272 1270	RPM 2 2 2 2 2 2 2 2 2 2 2	Type of Cutting Tool 5 302 0 302 0 302 5 302 5 302 7 302 5 302 7 302 9 302	Surface Finish 42.00 42.03 50.10 48.75 47.92 47.79	Johnson Trans (V) 0.15364 0.15592 0.98224 0.76990 0.66868 0.65409	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212 6.92243 6.91303 7.22911	SRES -1.19021 1.48612 -0.43980 -0.76768 -0.16721 -0.42110	C34	C35	C36	C37	C38
+	C22 C22 Drive in time (X1) 195 255 195 225 225 225 225 225 195	C23 Dose (X2) 4.00 4.60 4.60 4.60 4.20 4.10 4.60	C24 X1_STD -1.0000 -1.0000 -1.0000 0.0000 0.0000 -1.0000 -1.0000	x2_STD -1.0000 -1.0000 0.6667 0.6667 -0.4444 -0.7222 0.6667 -0.1667	Y (Transistor Gain) 1004 1636 852 1506 1272 1270 1269	RPM 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Type of Cutting Tool 5 302 0 302 0 302 5 302 5 302 7 302 5 302 5 302 7 302 5 302	Surface Finish 42.00 42.03 50.10 48.75 47.92 47.79 52.26	Johnson Trans (Y) 0.15364 0.15592 0.98224 0.76990 0.66868 0.65409 1.98000	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212 6.92243 6.91303 7.22911	SRES -1.19021 1.48612 -0.43980 -0.76768 -0.16721 -0.42110 2.14214	C34	C35	C36	C37	 C38
+ 1 2 3 4 5 6 7 8	tegression Equ 222 Drive in time (xt) 195 255 255 225 225 225 225 225 2	223 Dose (X2) 4.00 4.60 4.60 4.60 4.20 4.10 4.60 4.30 tiple Linear	C24 X1_STD -1.0000 1.0000 1.0000 0.0000 0.0000 -1.0000 Regression.	x2_STD -1.0000 -1.0000 0.6667 0.6667 -0.4444 -0.7222 0.6667 -0.1667	Y (Transistor Gain) 1004 1636 852 1506 1272 1270 1269	RPM 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Type of Cutting Tool 5 302 0 302 0 302 5 302 5 302 7 302 5 302 7 302 9 302	Surface Finish 42.00 42.03 50.10 48.75 47.92 47.79 52.26	Johnson Trans (Y) 0.15364 0.15592 0.98224 0.76990 0.66868 0.65409 1.98000	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212 6.92243 6.91303 7.22911	SRES -1.19021 1.48612 -0.43980 -0.76768 -0.16721 -0.42110 2.14214 -1.03456				C37	 C38
+ 1 2 3 4 5 6 7 8	tegression Equ cz 201vie in the 0x0 1195 255 255 225 225 225 225 225 225 225 2	223 Dose (X2) 4.00 4.60 4.60 4.60 4.20 4.10 4.60 4.30 tiple Linear	C24 X1_STD -1.0000 -1.0000 0.0000 0.0000 0.0000 -1.0000 r1.0000 Regression.	x2_STD -1.0000 -1.0000 0.6667 0.6667 -0.4444 -0.7222 0.6667 -0.1667	Y (Transistor Gain) 1004 1636 852 1506 1527 1272 1270 1269 903	RPM 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Type of Cutting Tool 5 302 0 302 0 302 5 302 5 302 7 302 5 302 7 302 9 302	Surface Finish 42.00 42.03 50.10 48.75 47.92 47.79 52.26 50.52	Johnson Trans (Y) 0.15364 0.15592 0.98224 0.76990 0.66868 0.65409 1.98000	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212 6.92243 6.91303 7.22911	SRES -1.19021 1.48612 -0.43980 -0.76768 -0.16721 -0.42110 2.14214 -1.03456				C37	 C38

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	MULTIPLE LINEAR RE	GRESSION MI	vx													
Re	egression An	alysis: Jo	hnson	Trans (Y) versus RPM,	Type of Cuttin	Iool									
	Regression Equ															
	Type of															
1	Cutting															
	Tool															
	302 Johnson	Trans (f) =	-5.267+	0.02544 RPI	м											
		0	6 724 +													
	416 Johnson	Trans (Y) =	-0-124 +	U.UZSAA KPI	M											
	416 Johnson Coefficients	Trans (Y) =	-0.724 *	0.02544 8.91	м											
-	Coefficients Term	Coe	SE Coef	T-Value	P-Value VIF											
-	Coefficients Term Constant	Coe -5.267	5E Coef	T-Value -6.27	P-Value VIF 0.000	617 616			-	C 11	(1)	-	01	01	637	
	Coefficients Term Constant C22	Coe -5.267 C23	f SE Coef 0.840 C24	T-Value -6.27 C25	P-Value VIF 0.000 C26	C27 C28	C29 Type of Cutting Tool	C30 g		C32 g	C33 SRES	C34	C35	C36	C37	
	Coefficients Term Constant	Coe -5.267 C23	5E Coef	T-Value -6.27 C25	P-Value VIF 0.000	C27 C28 RPM 225	Type of Cutting Tool			C32 5 Sqrt(Y) 6,48074	C33 SRES -1,19021	C34	C35	C36	C37	
	Coefficients Term Constant C22 Drive in time (X1)	Coe -5.267 C23 Dose (X2)	f SE Coef 7 0.840 C24 X1_STD	T-Value -6.27 C25 x2_STD	P-Value VIF 0.000 C26 Y (Transistor Gain)	RPM	Type of Cutting Tool 302	Surface Finish	Johnson Trans (Y)	Sqrt(Y)	SRES	C34	C35	C36	C37	
	Coefficients Term Constant C22 Drive in time (X1) 195	Coe -5.267 C23 Dose (X2) 4.00	f SE Coef 0.840 C24 X1_STD -1.0000	T-Value -6.27 C25 x2_STD -1.0000	P-Value VIF 0.000 C26 Y (Transistor Gain) 1004	RPM 225	Type of Cutting Tool 302 302	Surface Finish 42.00	Johnson Trans (Y) 0.15364	Sqrt(Y) 6.48074	SRES -1.19021	C34	C35	C36	C37	
	Coefficients Term Constant C22 Drive in time (X1) 195 255	Coe -5.267 C23 Dose (X2) 4.00 4.00	f SE Coef 7 0.840 C24 X1_STD +1.0000 1.0000	T-Value -6.27 c25 x2_STD -1.0000 -1.0000	P-Value VIF 0.000 C26 Y (Transistor Gain) 1004 1636	RPM 225 200	Type of Cutting Tool 302 302 302	Surface Finish 42.00 42.03 50.10	Johnson Trans (Y) 0.15364 0.15592	Sqrt(Y) 6.48074 6.48305	SRES -1.19021 1.48612	C34	C35	C36	C37	
	Coefficients Term Constant C22 Drive in time (X1) 195 255 195	Coe -5.267 C23 Dose (X2) 4.00 4.00 4.00	f SE Coef 7 0.840 C24 X1_STD -1.0000 1.0000 -1.0000	T-Value -6.27 x2_STD -1.0000 -1.0000 0.6667	P-Value VIF 0.000 C26 Y (Transistor Gain) 1004 1636 852	RPM 225 200 250	Type of Cutting Tool 302 302 302 302 302	Surface Finish 42.00 42.03 50.10 48.75	Johnson Trans (Y) 0.15364 0.15592 0.98224	Sqrt(Y) 6.48074 6.48305 7.07814	SRES -1.19021 1.48612 -0.43980	C34	C35	C36	C37	
	Coefficients Term Constant C22 Drive in time (X1) 195 255 195 255	Coe -5.267 C23 Dose (X2) 4.00 4.00 4.60 4.60	f SE Coef 7 0.840 C24 X1_STD -1.0000 1.0000 1.0000	T-Value -6.27 x2_STD -1.0000 -1.0000 0.6667 0.6667	P-Value VIF 0.000 C26 Y (Transistor Gain) 1004 1636 852 1506	RPM 225 200 250 245	Type of Cutting Tool 302 302 302 302 302 302	Surface Finish 42.00 42.03 50.10 48.75	Johnson Trans (Y) 0.15364 0.15592 0.98224 0.76990	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212	SRES -1.19021 1.48612 -0.43980 -0.76768	C34	C35	C36	C37	
	Coefficients Term Constant C22 Drive in time (X1) 195 255 195 255 255 225	Coe -5.267 C23 Dose (X2) 4.00 4.60 4.60 4.60 4.20	f SE Coef 0.840 C24 X1_STD -1.0000 1.0000 1.0000 0.0000	T-Value -6.27 C25 x2_STD -1.0000 -1.0000 0.6667 0.6667 -0.4444	P-Value VIF 0.000 C26 Y (Transistor Gain) 1004 1636 852 1506 1272	RPM 225 200 250 245 245 235	Type of Cutting Tool 302 302 302 302 302 302 302 302	Surface Finish 42.00 42.03 50.10 48.75 47.92	Johnson Trans (Y) 0.15364 0.15592 0.98224 0.76990 0.66868	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212 6.92243	SRES -1.19021 1.48612 -0.43980 -0.76768 -0.16721	C34	C35	C36	C37	
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	Coefficients Term Constant Drive in time (X1) 195 255 255 225 225 225 225 225 225 225 2	Coe -5.267 Dose (X2) 4.00 4.00 4.60 4.60 4.10 4.60	f SE Coef 0.840 C24 X1_STD -1.0000 -1.0000 0.0000 0.0000 0.0000 -1.0000 -1.0000	T-Value -6,27 c25 x2_STD -1,0000 -1,0000 0,6667 0,6667 -0,4444 -0,7222 0,6667 -0,1667	P-Value VIF 0.000 C26 Y (Transistor Gain) 1004 1036 852 1506 1272 1270 1269	RPM 225 200 250 245 235 235 237 265	Type of Cutting Tool 302 302 302 302 302 302 302 302 302 302	Surface Finish 42.00 42.03 50.10 48.75 47.92 47.79 52.26 50.52	Johnson Trans (V) 0.15364 0.15592 0.98224 0.76990 0.66868 0.65409 1.98000	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212 6.92243 6.91303 7.22911	SRES -1.19021 1.48612 -0.43980 -0.76768 -0.16721 -0.42110 2.14214	C34	C35	C36	C37	
	Coefficients Term Constant Drive in time (X1) 195 255 255 225 225 225 225 225 225 225 2	Coe -5.267 C23 Dose (X2) 4.00 4.60 4.60 4.60 4.10 4.60 4.30 Itiple Linear I	f SE Coef 0.840 C24 X1_STD -1.0000 -1.0000 0.0000 0.0000 0.0000 -1.0000 c.0000 c.0000 c.0000	T-Value -6,27 c25 x2_STD -1,0000 -1,0000 0,6667 0,6667 -0,4444 -0,7222 0,6667 -0,1667	P-Value VIF 0.000 C26 Y (Transistor Gain) 1004 1036 852 1506 1272 1270 1269	RPM 225 200 250 245 235 235 237 265	Type of Cutting Tool 302 302 302 302 302 302 302 302 302 302	Surface Finish 42.00 42.03 50.10 48.75 47.92 47.79 52.26 50.52	Johnson Trans (V) 0.15364 0.15592 0.98224 0.76990 0.66868 0.65409 1.98000	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212 6.92243 6.91303 7.22911	SRES -1.19021 1.48612 -0.43980 -0.76768 -0.16721 -0.42110 2.14214 -1.03456	C34		C36	C37	

And we will get a residual over here and we will get the equation. So, after Johnston's transformed variable with RPN, this is given for 302 and 416 types of tools like that.

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D.	egression Analysis: Jol	_	_		I LEBL											
	MULTIPLE UNEAR REG															
-				Trans ()) versus RPM,	Tuno of Cuttin	a Tool									
	egression Ana	iysis: Jo	Juison	frans () versus kpivi,	Type of Cutum	g 1001									
	Model Summary															
	S R-sq 0.271870 92.12%			red) 10-h .69% 0.30	old S 10-fold R-sq 2815 88.49%											
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	Source Regression RPM Type of Cutting Too Error	2 1 1 1 17	14.6796 3.8030 10.6112 1 1.2565	7.3398 3.8030 0.6112 0.0739	99.30 0.000 51.45 0.000 43.56 0.000											
	Source Regression RPM Type of Cutting Too Error C22	2 1 1 17 C23	14.6796 3.8030 10.6112 1 1.2565 C24	7.3398 3.8030 0.6112 0.0739 C25	99.30 0.000 51.45 0.000 43.56 0.000 C26	Q7 Q8	C29	C30 5			G3	C34	C35	C36	C37	c
	Source Regression RPM Type of Cutting Too Error C22 Drive in time (X1)	2 1 1 17 C23 Dose (X2)	14.6796 3.8030 10.6112 1 1.2565 C24 X1_STD	7.3398 3.8030 0.6112 0.0739 C25 x2_STD	99.30 0.000 51.45 0.000 43.56 0.000 C26 Y (Transistor Gain)	RPM	Type of Cutting Tool	Surface Finish	Johnson Trans (Y)	Sqrt(Y)	SRES	C34	C35	C36	C37	(
	Source Regression RPM Type of Cutting Too Error C22 Drive in time (X1) 1 195	2 1 1 17 C23 Dose (X2) 4.00	14.6796 3.8030 10.6112 1 1.2565 C24 X1_STD -1.0000	7.3398 3.8030 0.6112 0.0739 C25 x2_STD -1.0000	99.30 0.000 51.45 0.000 43.56 0.000 C26 Y (Transistor Gain) 1004	RPM 225	Type of Cutting Tool 302	Surface Finish 42.00	Johnson Trans (Y) 0.15364	Sqrt(Y) 6,48074	SRES -1.19021	C34	C35	C36	C37	(
	Source Regression RPM Type of Cutting Too Error C22 Drive in time (X1) 195 255	2 1 17 C23 Dose (X2) 4.00 4.00	14.6796 3.8030 10.6112 1 1.2565 C24 X1_STD -1.0000 1.0000	7.3398 3.8030 0.6112 0.0739 C25 x2_STD -1.0000 -1.0000	99.30 0.000 51.45 0.000 143.56 0.000 C26 Y (Transistor Gain) 1004 1636	RPM 225 200	Type of Cutting Tool 302 302	Surface Finish 42.00 42.03	Johnson Trans (Y) 0.15364 0.15592	Sqrt(Y) 6,48074 6,48305	SRES +1.19021 1.48612	C34	C35	C36	C37	(
•	Source Regression RPM Type of Cutting Too Error C22 Drive in time (X1) 195 255 195	2 1 1 17 C23 Dose (X2) 4.00	14.6796 3.8030 10.6112 1 1.2565 C24 X1_STD -1.0000 1.0000 -1.0000	7.3398 3.8030 0.6112 0.0739 C25 x2_STD -1.0000	99.30 0.000 51.45 0.000 43.56 0.000 Y (Transistor Gain) 1004 1636 852	RPM 225	Type of Cutting Tool 302 302 302	Surface Finish 42.00	Johnson Trans (Y) 0.15364 0.15592 0.98224	Sqrt(Y) 6.48074 6.48305 7.07814	SRES -1.19021 1.48612 -0.43980	C34	C35	C36	C37	c
•	Source Regression RPM Type of Cutting Too Error C22 Drive in time (X1) 195 255	2 1 17 C23 Dose (X2) 4.00 4.00 4.00	14.6796 3.8030 10.6112 1 1.2565 C24 X1_STD -1.0000 1.0000 1.0000	7.3398 3.8030 0.6112 0.0739 C25 x2_STD -1.0000 -1.0000 0.6667	99.30 0.000 51.45 0.000 143.56 0.000 C26 Y (Transistor Gain) 1004 1636	RPM 225 200 250	Type of Cutting Tool 302 302	Surface Finish 42.00 42.03 50.10	Johnson Trans (Y) 0.15364 0.15592	Sqrt(Y) 6,48074 6,48305	SRES +1.19021 1.48612	C34	C35	C36	C37	c
	Source Regression RPM Type of Cutting Too Error C22 Drive in time (XI) 195 255 195	2 1 17 C23 Dose (K2) 4.00 4.60 4.60	14.6796 3.8030 10.6112 1 1.2565 C24 X1_STD -1.0000 1.0000 1.0000 0.0000	7.3398 3.8030 0.6112 0.0739 c25 x2_STD -1.0000 0.6667 0.6667	99.30 0.000 51.45 0.000 43.56 0.000 Y (Transistor Gain) 1004 1636 852 1506	RPM 225 200 250 245	Type of Cutting Tool 302 302 302 302	Surface Finish 42.00 42.03 50.10 48.75	Johnson Trans (Y) 0.15364 0.15592 0.98224 0.76990	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212	SRES -1.19021 1.48612 -0.43980 -0.76768	C34	C35	C36	C37	(
	Source Regression RPM Type of Cutting Too Error C22 Drive in time (XI) 195 2255 195 2255 225	2 1 1 17 C23 Dose (X2) 4.00 4.00 4.60 4.60 4.60	14.6796 3.8030 10.6112 1 1.2565 C24 X1_STD -1.0000 1.0000 1.0000 0.0000	7.3398 3.8030 0.6112 0.0739 c25 x2_STD -1.0000 -1.0000 0.6667 -0.4444	99.30 0.000 51.45 0.000 43.56 0.000 Y (Transistor Gain) 1004 1636 852 1506 1272	RPM 225 200 250 245 245 235	Type of Cutting Tool 302 302 302 302 302 302	Surface Finish 42.00 42.03 50.10 48.75 47.92	Johnson Trans (V) 0.15364 0.15592 0.98224 0.76990 0.66868	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212 6.92243	SRES -1.19021 1.48612 -0.43980 -0.76768 -0.16721	C34	C35	C36	C37	(
	Source Regression RPM Type of Cutting Too Error C22 Drive in time (X1) 195 255 195 255 225 225	2 1 1 17 C23 Dose (X2) 4.00 4.00 4.60 4.60 4.60 4.60 4.10	14.6796 3.8030 10.6112 1 1.2565 C24 X1_STD -1.0000 1.0000 0.0000 0.0000 0.0000	7.3398 3.8030 0.6112 0.0739 C25 x2_STD -1.0000 -1.0000 0.6667 -0.4444 -0.7222	99.30 0.000 51.45 0.000 C26 Y (Transistor Gain) 1004 1636 852 1506 1506 1272 1270	RPM 225 200 250 245 235 235 237	Type of Cutting Tool 302 302 302 302 302 302 302 302 302	Surface Finish 42.00 42.03 50.10 48.75 47.92 47.79	Johnson Trans (V) 0.15364 0.15592 0.98224 0.76990 0.66868 0.65409	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212 6.92243 6.91303 7.22911	SRES -1.19021 1.48612 -0.43980 -0.76768 -0.16721 -0.42110	C34	C35	C36	C37	(
•	Source Regression RPM Type of Cutting Too Error C22 Drive in time (X1) 1955 2255 195 2255	2 1 1 17 C23 Dose (X2) 4.00 4.00 4.60 4.60 4.20 4.10 4.30	14.6796 3.8030 10.6112 1.2565 C24 X1_STD -1.0000 1.0000 0.0000 0.0000 0.0000	7.3398 3.8030 0.6112 0.0739 C25 x2_STD -1.0000 -1.0000 0.6667 -0.4444 -0.7222 0.6667 -0.1667	99.30 0.000 51.45 0.000 C26 Y (Transistor Gain) 1004 1636 852 1506 1507 1272 1270 1269	RPM 225 200 250 245 235 235 237 265	Type of Cutting Tool 302 302 302 302 302 302 302 302 302	Surface Finish 42.00 42.03 50.10 48.75 47.92 47.79 52.26 50.52	Johnson Trans (Y) 0.15364 0.15592 0.98224 0.76990 0.66868 0.65409 1.98000	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212 6.92243 6.91303 7.22911	SRES -1.19021 1.48612 -0.43980 -0.76768 -0.16721 -0.42110 2.14214	C34	C35	C36	C37	c
•	Source Regression RPM Type of Cutting Too Error C22 Drive in time (X1) 1955 2255 195 2255	2 1 1 17 C23 Dose (X2) 4.00 4.00 4.60 4.60 4.20 4.10 4.60 4.30 iple Linear	14.6796 3.8030 10.6112 1 1.2565 C24 X1_STD -1.0000 1.0000 0.0000 0.0000 -1.0000 Regression.	7.3398 3.8030 0.6112 0.0739 C25 x2_STD -1.0000 -1.0000 0.6667 -0.4444 -0.7222 0.6667 -0.1667	99.30 0.000 51.45 0.000 C26 Y (Transistor Gain) 1004 1636 852 1506 1507 1272 1270 1269	RPM 225 200 250 245 235 235 237 265	Type of Cutting Tool 302 302 302 302 302 302 302 302 302 302	Surface Finish 42.00 42.03 50.10 48.75 47.92 47.79 52.26 50.52	Johnson Trans (Y) 0.15364 0.15592 0.98224 0.76990 0.66868 0.65409 1.98000	Sqrt(Y) 6.48074 6.48305 7.07814 6.98212 6.92243 6.91303 7.22911	SRES -1.19021 1.48612 -0.43980 -0.76768 -0.16721 -0.42110 2.14214 -1.03456	C34		C36	C37	(

And, what we observe is that 91 percent R square adjusted 88, so very close.

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	Pure Error Total	1 19 C23	0.0706 15.9362 C24 X1_STD	0.0705 C25 x2_STD			RPM	C29 Type of Cutting Tool	Surface Finish	Johnson Trans (Y)	C32 p Sqrt(Y)	SRES	C34	C35	C36	C37	
•	Pure Error Total	1 19 C23	0.0706 15.9362 	0.0706 C25	C26 Y (Transistor Gain) 1004		RPM 225		Surface Finish 42.00	Johnson Trans (Y) 0.15364			C34	C35	C36	C37	
	Pure Error Total C22 Drive in time (XI)	1 19 C23 Dose (X2) 4.00	0.0706 15.9362 C24 X1_STD -1.0000 1.0000	0.0705 C25 x2_STD -1.0000 -1.0000	C26 Y (Transistor Gain) 1004 1636		RPM 225 200	Type of Cutting Tool 302 302	Surface Finish 42.00 42.03	Johnson Trans (Y) 0.15364 0.15592	Sqrt(Y) 6,48074 6,48305	SRES -1.19021 1.48612	C34	C35	C36	C37	
•	Pure Error Total C22 Drive in time (X1) 1 195	1 19 C23 Dose (X2) 4.00	0.0706 15.9362 C24 X1_STD -1.0000 -1.0000	0.0705 C25 x2_STD -1.0000 0.6667	C26 Y (Transistor Gain) 1004 1636 852		RPM 225 200 250	Type of Cutting Tool 302	Surface Finish 42.00 42.03 50.10	Johnson Trans (Y) 0.15364	Sqrt(Y) 6.48074 6.48305 7.07814	SRES -1.19021 1.48612 -0.43980	C34	C35	C36	C37	
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So, this is quite acceptable and in this case there is no lack of fit and both the variables are significant that is observed over here. Categorical as well as RPM over here.

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So, in this case residual we can check, whether the correction has happens some positive things has happened over here.

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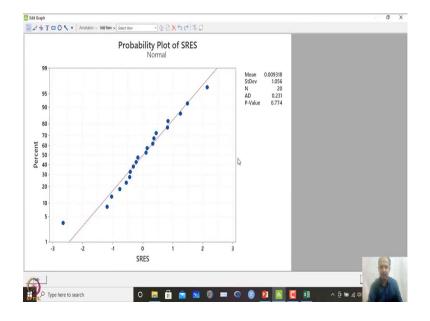
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So, I am going to normality test over here, and what I do is that I go to the last residual values and I click ok.

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	ercent : 5 8		C24 X1_STD -1.0000		C26 Y (Transistor Gain) 1004	C27 C28 RPM 225	C29 Type of Cutting Tool 302			C32 5 Sqrt(Y) 6.48074	C33 SRES -1.19021	C34	C35	C36	C37	(
	C22 Drive in time (X1)	Dose (X2)	X1_STD	x2_STD	Y (Transistor Gain)	RPM	Type of Cutting Tool	Surface Finish	Johnson Trans (Y)	Sqrt(Y)	SRES	C34	C35	C36	C37	•
	C22 Drive in time (X1) 195	Dose (X2) 4.00	X1_STD -1.0000	x2_STD -1.0000	Y (Transistor Gain) 1004	RPM 225	Type of Cutting Tool 302 302	Surface Finish 42.00	Johnson Trans (Y) 0.15364	Sqrt(Y) 6.48074	SRES -1.19021	C34	C35	C36	C37	(
	C22 Drive in time (X1) 195 255	Dose (X2) 4.00 4.00	X1_STD -1.0000 1.0000	x2_STD -1.0000 -1.0000	Y (Transistor Gain) 1004 1636	RPM 225 200	Type of Cutting Tool 302 302	Surface Finish 42.00 42.03	Johnson Trans (Y) 0.15364 0.15592	Sqrt(Y) 6,48074 6,48305	SRES -1.19021 1.48612	C34	C35	C36	C37	(
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And, what I observe is that, when I have done this transformation suddenly this problem has gone so; that means the normality problem of the error residual has gone. So, when I am using Johnson's transformation this has happened. When I have used Johnson's transformation this is giving results like that.

So, which one Box-Cox or Johnson you have to try out and figure out that whichever gives you error as white noise, so that has to be adopted like that. So, this is one of the

example, when categorical variable is also considered in the model and we are able to address that one.

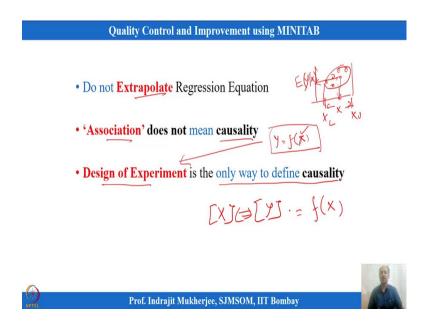
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	coci	SE COEL	T-Value P	-value	VIF	Analysis of	vai	lance			
Constant	-121.3	55.4	-2.19	0.049		Source	DF	Adj SS	Adj MS	F-Value	P-Value
Time	0.1269	0.0422	3.01	0.011	12.23	Regression	3	1953.42	651.140	45.88	0.000
Velocity	-19	108	-0.18	0.863	12.32	Time	1	128.34	128.340	9.04	0.011
Temperature	0.348	0.177	1.97	0.073	1.06	Velocity	1	0.44	0.441	0.03	0.863
	0.0.10	•••••		0.072		Temperature	1	54.89	54.895	3.87	0.073
						Error	12	170.29	14.191		
						Total	15	2123.71			
Model S	umma	ry									
S	R-sq R-	sq(adj) R	-sq(pred)								
3.76707 91	1.98%	89.98%	84.16%								
				-							

So, categorical variable and how to address in case there is a non normal situation in multiple regression, how it is to be addressed that we can see ok.

And, how to select the variables in case we are in dilemma which variable. So we have talked about stepwise regression. So, this regression is an important aspects which can suggest that which are the variables or potential variables can be considered in experimentation.

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So, but we have to understand that regression does not say we cannot extrapolate regression equation. So, whatever regression that experiment is happening; that means, this is y and this is the range of x domain within which we have got the information; that means, data are collected over here and these are the observations over here.

So, I can only restrict to this region and predict. So, for a given value of x, at a given value of x what is the predicted value of expected value of y. So, expectation of y for a given x can be only calculated within the domain or within the range of x over here. So, x we can say upper bound and x lower bound within this, so no extrapolation is generally preferred in regression equation ok.

And, association does not mean, that means, y is related with x function of x, does not mean that it is a real variable that impacts y. So, certain scenarios can be, there is a relationship between two variables which are not physically any way connected but there can be high correlation.

So, many examples can be cited like that. So, it does not mean that there is a causality. So regression does not prove causality. So, design of experiment is the only way to define causalities like that. So, to understand causalities between the variables we have to intentionally induce variation by changing, the factors changing the factors or variables that we are interested into and try to understand what is the functional relationship. So, the best appropriate way to develop the functional relationship is by design of experiments. So, there is no other alternative. So, regression with historical data does not give you proper association or causality cannot be proved based on that ok.

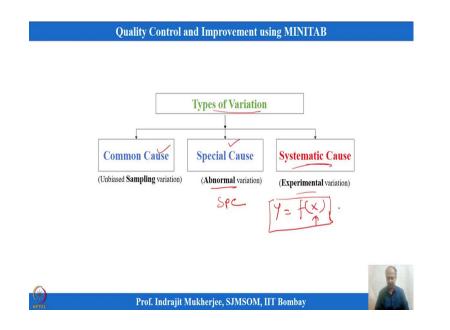
So, then what is the option, then what is the option for quality improvements. Then the options we have identified, few variables based on regressions. So there are variables X, X matrix over here, and I have collected also y variable information. So, how do I connect these two and this connection and develop the function. So, I need a function over here, that will explain the variability of y over here. So, what is required is that systematic way of variation is required, systematic way.

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And then what comes is statistical experimentation which is the improvement phase. Until and unless I have a right function I cannot improve. I cannot reach to the global optimal point like that or setting points like that ok. So, design of experiment is the stepping stone for improvement phase like that.

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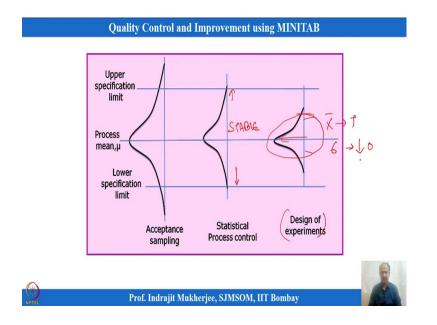


So, basic things that our understanding over here is that, there are types of variability types of variation we have already spoken about it and some basic information I am providing over here which we can think of as recap. So, there are common cause variability in the process, there are special cause abnormal variability which are easy to detect based on SPCprocess control chart.

And, then what we do is that, to understand the functional relationship between y and x, we have to do it a systematic change in we have to induce variability we have to induce variability by changing the factor, by changing the factor x over here. And, if we can do that systematically what happens is that we can generate a function and the function can be optimized.

That function, we know this is the real equation between the in the process. This is the empirical relationship that exists and this is based on systematic theoretically strong models that we have developed over here. Then we can use optimization technique just to reach to the global optimal point like that. So, we are interested into and for that design of experiment is most preferred like that ok.

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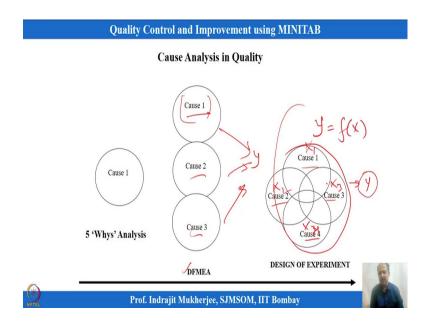


So, design of experiment what we are seeing over here is basically reducing the common cause variability. So, this can be applied when the process is in statistical control. So, when the process is in stable process, so whenever it is stable process we say and it is in statistical control then only we can go for design of experiment, because we want to reduce the common cause variability further, because more and more I reduce the variability, so accuracy and precision both improves over here.

So, we are interested in being and variance both aspects like that, what we have seen in capability analysis also. So, for that what is required reduced for the variability requires design of experiments. So, for that we need to, so that helps, statistical design of experiment helps us to bring the mean to target value and also the reduced variability near to 0.

So, we want minimum variability over here. So, various design of experiment techniques are proposed and huge amount of resource is available for design of experiments. So you can see. But, preliminary book that you can see is Montgomery's book which is which can be a good resource of learning initial steps like that, but there are other books also you can see, so there are many other books which you can see like that. Amitava Mitra is one of the books where design of experiment is detailed ok.

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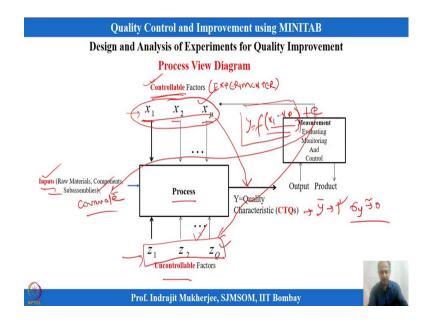
And, so this is one of the techniques. And also, I want to recap that one of the concepts that if you have variability, that means, causes and this is impacting my y and causes are interlinked also somewhat they are interlinked with each other and they together can impact the y like this. So this is the scenario like this.

This is one of the variable X1 this is one of the variable X2, X3 and this is X4 over here, and they are interrelated with their in this what you are seeing and they are not completely independent over here what is observed over here.

So, if they are completely independent in that case, we can understand that what is the level of X that will deliver the optimal y over here. So, this is possible, but this is not possible when we are having a complex relationship between multiple X's over here and together they can impact the y, that can be scenario.

So, it can be scenarios which is not possible to identify. So, by simple other analysis like, design failure mode and effect analysis or process failure mode and effect analysis that is not possible by that ok. So, complex relationship and developing the function, when we are developing the functions over here only design of experiments can help.

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So, design of experiments can help. And, before we go into details of design of experiment this process p information is again I am recapping over here. There will be certain control variables which is in the hand of experimenters. So, experimenter will change this control variable basically.

So when you go to a process what you observe is that, you will see the operator is changing some of the variables, not all variables, some of the key variables which is possible to control. So, these are the variables X1 to Xp which is known as controllable variables.

Design of experiment is all about controllable variable, most of the time we deal with controllable variables. There will be some inputs and I also talked about covariates which can influence the outcomes over here, and that can also be considered in the model when we are doing experimentation we can also consider the covariates as a variable which will vary.

We cannot control that one, but influence of that has to be considered when we are developing the mathematical models or something like that. Or we can deal with that, so covariates also we can see ok. And, there will be some uncontrollable factor; that means, it is uneconomical to control. And sometimes we do not have any information enough information about the some of the variables, because you cannot build a perfect model like that y is a function of all Xp variables X1 to Xps like that. There will be some amount of error in the model because of this noise variables over here, because of this noise variable. So, we do not get a perfect function.

Because all the variables that is impacting the process is some of the variables are unknown to us. So, in that case, these unknown as noise variables or and the influence of that is very less because we have identified most of this. So, these are the variables and some of them are controllable, some of them are covariates over here, so we have knowledge about that.

So, and there will be some noise variable which we do not have any control or we do not have enough information about these variables like that ok. So, we want to; we want to get a setting so in design of experiment, what we are trying to do is that this is control variable, so it is in our hand to control. So, we want to get a combination of this combination of this that will optimize my Y CTQ.

And y will be the average value of y should be close to the target value, and the variability of y that is that we will generate is very close to 0 values like that. That means there is no as such variability we want to develop. So, our objective of design of experiment is twofold objective; one is which are the variables impacting y, and then if these are the variables which is significantly impacting y, what can be the combination or setting conditions of this Xp variables that is impacting over here, which I can control.

So that I get the y exactly to the target value defined by the designer and also the variability near the target value is near to 0 like that. So, that is the overall objective of design of experiments. So, and another objective is to develop the functional relationship so that we can optimize like that.

So, whenever I have a function, I can optimize. So, I need a function. So, function to need a function I need what are the Xp variables which is controllable which is significantly contributing to the variability in y; that means, this is and there will be some error that can be because of this noise variables which are not considered and which is difficult to control and uneconomical to control.

This can also be impact with these errors may also be impacted by these covariates which are influencing the , but we do not have any control on that. So, I can only control this Xp variables, I do not have any control on the inputs over here and the uncontrollable variables over here. So, most of the time we try to get the best combination of X1 to Xp that in presence of this noise and in presence of covariates or inputs variability that we are experiencing in the process like that ok.

So this is all about what we will try to understand in design of experiments and how to do the experiments that we will try to understand over here. There are different ways of doing experimentation, different designs are available, and we will see some very few of them. So that that is our objective in experimentation, so that we will cover in our next session ok.

Thank you for listening.