Forward Selection and Best Subset Regression for Semiconductor Yield Enhancement

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Abstract

Quick yield enhancement using limited data is essential for semiconductor industry. This is extremely critical to catch up with today's short product life cycle and global competition. There are several commercial available packages for data mining and yield analysis. However, most of tools focus on identifying critical parameters from huge data base. If number of parameters is much larger than number of sample, new method of data analysis is necessary. In this paper, we have demonstrated using forward selection and best subset regression method to identify critical parameters from huge suspected process parameters with limited number of wafer lots. Follow up design of experiment lot confirmed critical parameter selection was a success and provided optimal process condition. Yield was improved shortly after new technology was introduced to production. Critical data interpretation technique during analysis will be discussed also.

Analysis examples:

Forward selection. Alpha-to-Enter: 0.05

Response is Yield on 20 predictors, with N = 176

Step	1	2	3	4	5
Constant	12.0298	11.4356	13.5473	1.4726	0.4013
DNIT11-SPACER (DMP01)	-0.02328	-0.02202	-0.02359	-0.02346	-0.02373
T-Value	-12.98	-16.44	-24.19	-27.63	-28.78
P-Value	0.000	0.000	0.000	0.000	0.000
PCONTACT (PIV01) X Overlay		-4.27	-5.90	-4.96	-5.15
T-Value		-11.87	-20.35	-17.54	-18.48
P-Value		0.000	0.000	0.000	0.000
EPOLY12 (EPO09)			-0.0263	-0.0198	-0.0181
T-Value			-12.64	-9.87	-9.04
P-Value			0.000	0.000	0.000
DWETOX14 (DME01)				0.00286	0.00321
T-Value				7.48	8.39
P-Value				0.000	0.000
Ptrench11(PCD01)					-0.73
T-Value					-3.58
P-Value					0.000

Best Subsets Regression:

Response is Yield-UIS

Vars	R-Sq	R-Sq(adj)	Mallows C-p	S	Ptrench11(PCD01)	DNIT11-SPACER (DMP01)	DWETOX14 (DME01)	EPOLY12 (EPO09)	PCONTACT (PIV01) X Overlay	FMET ALL1TI (FRS01)
1	49.2	48.9	708.0	0.21827		X				
1	28.3	27.8	1070.6	0.25936					X	
2	72.0	71.7	315.0	0.16250		X			X	
2	69.4	69.0	360.0	0.16988		X	X			
3	85.5	85.2	83.4	0.11733		X		X	X	
3	82.8	82.5	129.2	0.12759		X	X		X	
4	89.1	88.8	23.4	0.10213		X	X	X	X	
4	86.1	85.8	74.9	0.11519		X		X	X	X
5	89.8	89.5	12.1	0.098775	X	X	X	X	X	
5	89.3	88.9	21.9	0.10150		X	X	X	X	X

6	90.2	89.9	7.0	0.097055	X X X X X X