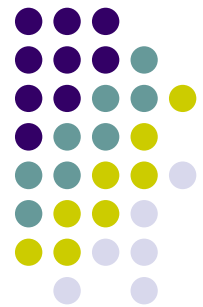


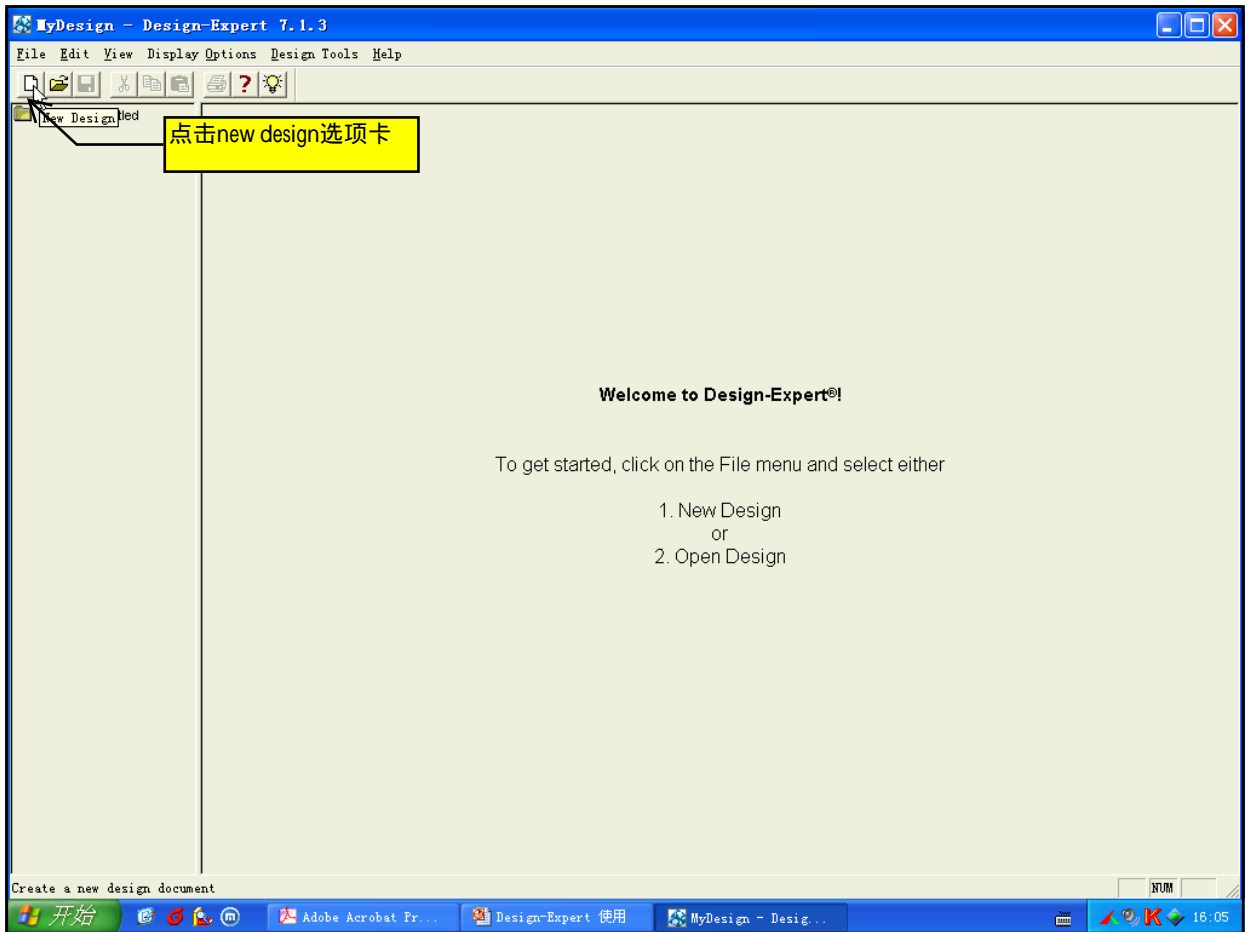
# Design-Expert 使用教程

qibk@163.com  
2008-07-19





- Design-Expert是全球顶尖级的实验设计软件。
- Design-Expert 是最容易使用、功能最完整、界面最具亲和力的软件。在已经发表的有关响应曲面（RSM）优化试验的论文中， Design-Expert是最广泛使用的软件。
- Plackett–Burman(PB)、Central Composite Design (CCD)、Box-Behnken Design(BBD)是最常用的实验设计方法。
- 本教程以BBD为例说明Design-Expert的使用， CCD， PB与此类似。



E:\绿色软件安装\DX7Trial\MyDesign.dxt - Design-Expert 7.1.3

File Edit View Display Options Design Tools Help

Combined  
Mixture  
Response Surface  
Factorial

## 2-Level Factorial Design

Design for 2 to 21 factors where each factor is varied over 2 levels. Useful for estimating main effects and interactions. Fractional factorials can be used for screening many factors to find the significant few. The color coding represents the design resolution: Green = Res V or higher, Yellow = Res IV, and Red = Res III.

点击Response Surface 选项卡

Number of Factors

Runs	4	8	16	32	64	128	256	512	7	8	9	10	11	12	13	14
4	$2^2$	$2^{3-1}_{III}$														
8		$2^3$	$2^{4-1}_{IV}$	$2^{5-2}_{III}$	$2^{6-3}_{III}$	$2^{7-4}_{III}$										
16			$2^4$	$2^{5-1}_{V}$	$2^{6-2}_{IV}$	$2^{7-3}_{IV}$	$2^{8-4}_{IV}$	$2^{9-5}_{III}$	$2^{10-6}_{III}$	$2^{11-7}_{III}$	$2^{12-8}_{III}$	$2^{13-9}_{III}$	$2^{14-10}_{III}$	$2^{15-11}_{III}$	$2^{16-12}_{III}$	$2^{17-13}_{III}$
32				$2^5$	$2^{6-1}_{VI}$	$2^{7-2}_{IV}$	$2^{8-3}_{IV}$	$2^{9-4}_{IV}$	$2^{10-5}_{IV}$	$2^{11-6}_{IV}$	$2^{12-7}_{IV}$	$2^{13-8}_{IV}$	$2^{14-9}_{IV}$	$2^{15-10}_{IV}$	$2^{16-11}_{IV}$	$2^{17-12}_{IV}$
64					$2^6$	$2^{7-1}_{VII}$	$2^{8-2}_{V}$	$2^{9-3}_{IV}$	$2^{10-4}_{IV}$	$2^{11-5}_{IV}$	$2^{12-6}_{IV}$	$2^{13-7}_{IV}$	$2^{14-8}_{IV}$	$2^{15-9}_{IV}$	$2^{16-10}_{IV}$	$2^{17-11}_{IV}$
128						$2^7$	$2^{8-1}_{VIII}$	$2^{9-2}_{VI}$	$2^{10-3}_{V}$	$2^{11-4}_{V}$	$2^{12-5}_{IV}$	$2^{13-6}_{IV}$	$2^{14-7}_{IV}$	$2^{15-8}_{IV}$	$2^{16-9}_{IV}$	$2^{17-10}_{IV}$
256							$2^8$	$2^{9-1}_{IX}$	$2^{10-2}_{VI}$	$2^{11-3}_{VI}$	$2^{12-4}_{VI}$	$2^{13-5}_{V}$	$2^{14-6}_{V}$	$2^{15-7}_{V}$	$2^{16-8}_{V}$	$2^{17-9}_{V}$
512								$2^9$	$2^{10-1}_{X}$	$2^{11-2}_{VII}$	$2^{12-3}_{VI}$	$2^{13-4}_{VI}$	$2^{14-5}_{VI}$	$2^{15-6}_{VI}$	$2^{16-7}_{VI}$	$2^{17-8}_{VI}$

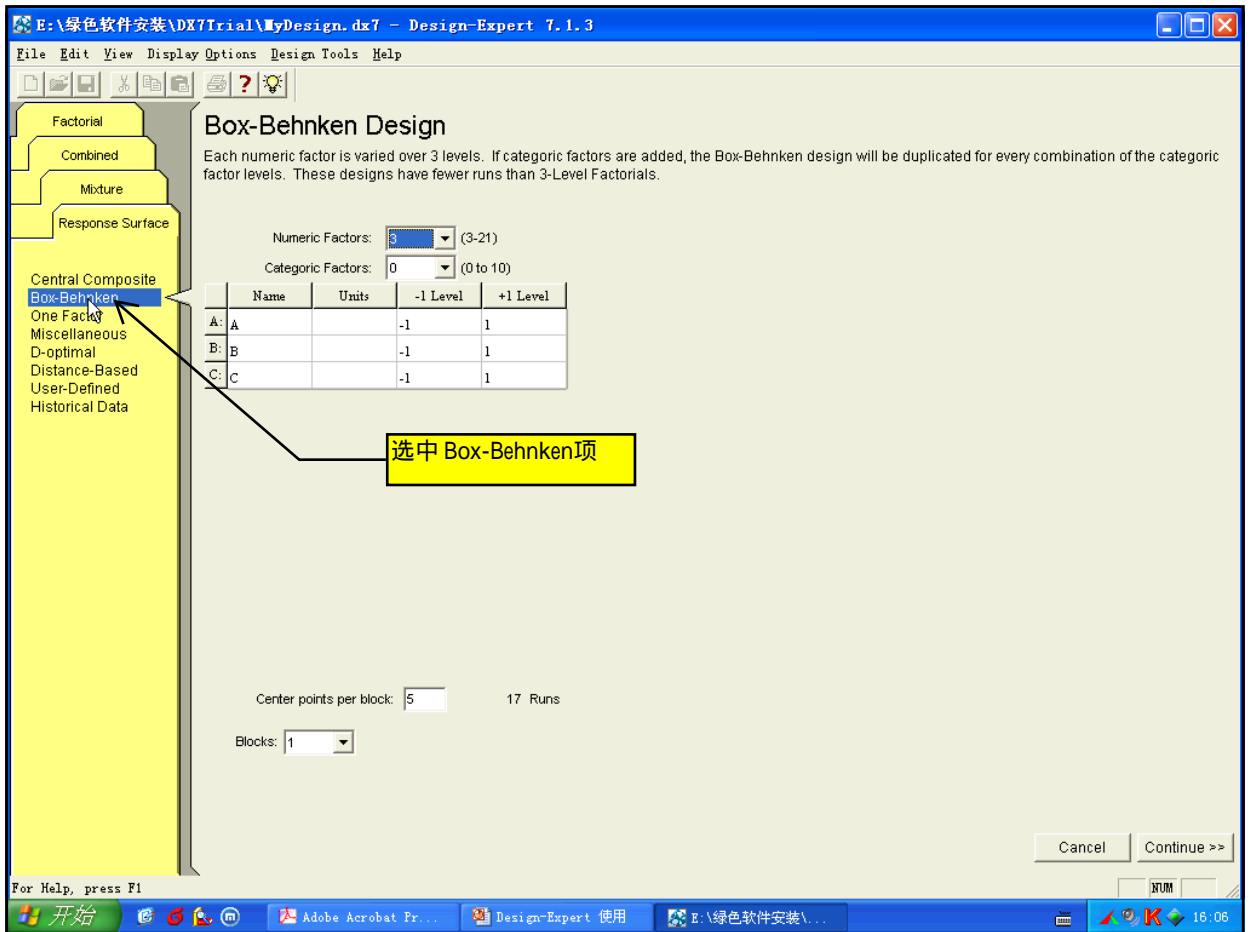
Replicates: 1 Blocks: 1 Center points per block: 0 Show Generators

Cancel Continue >>

For Help, press F1

开始 Adobe Acrobat Pr... Design-Expert 使用 E:\绿色软件安装\...

16:06



E:\绿色软件安装\DX7Trial\MyDesign.dx7 - Design-Expert 7.1.3

File Edit View Display Options Design Tools Help

Factorial  
Combined  
Mixture  
Response Surface

Central Composite  
Box-Behnken  
One Factor  
Miscellaneous  
D-optimal  
Distance-Based  
User-Defined  
Historical Data

### Box-Behnken Design

Each numeric factor is varied. When categorical factors are added, the Box-Behnken design will be duplicated for every combination of the categorical factor levels. These designs have fewer runs than 3-Level factorial designs.

要考察的因素名称

选择要考察的因素数

默认值 0

Numeric Factors: 4 (0 to 21)

Categorical Factors: 0 (0 to 10)

Name	Units	-1 Level	+1 Level
A: Glucose	g/L	0.25	0.75
B: Yeast extract	g/L	0.05	0.25
C: (NH4)2SO4	g/L	1	5
D: NaCl	g/L	0.25	0.75

因素的高值

因素的低值

因素的单位

默认值

Center points per block: 5 29 Runs

Blocks: 1

默认值

设置完后, 点击Continue

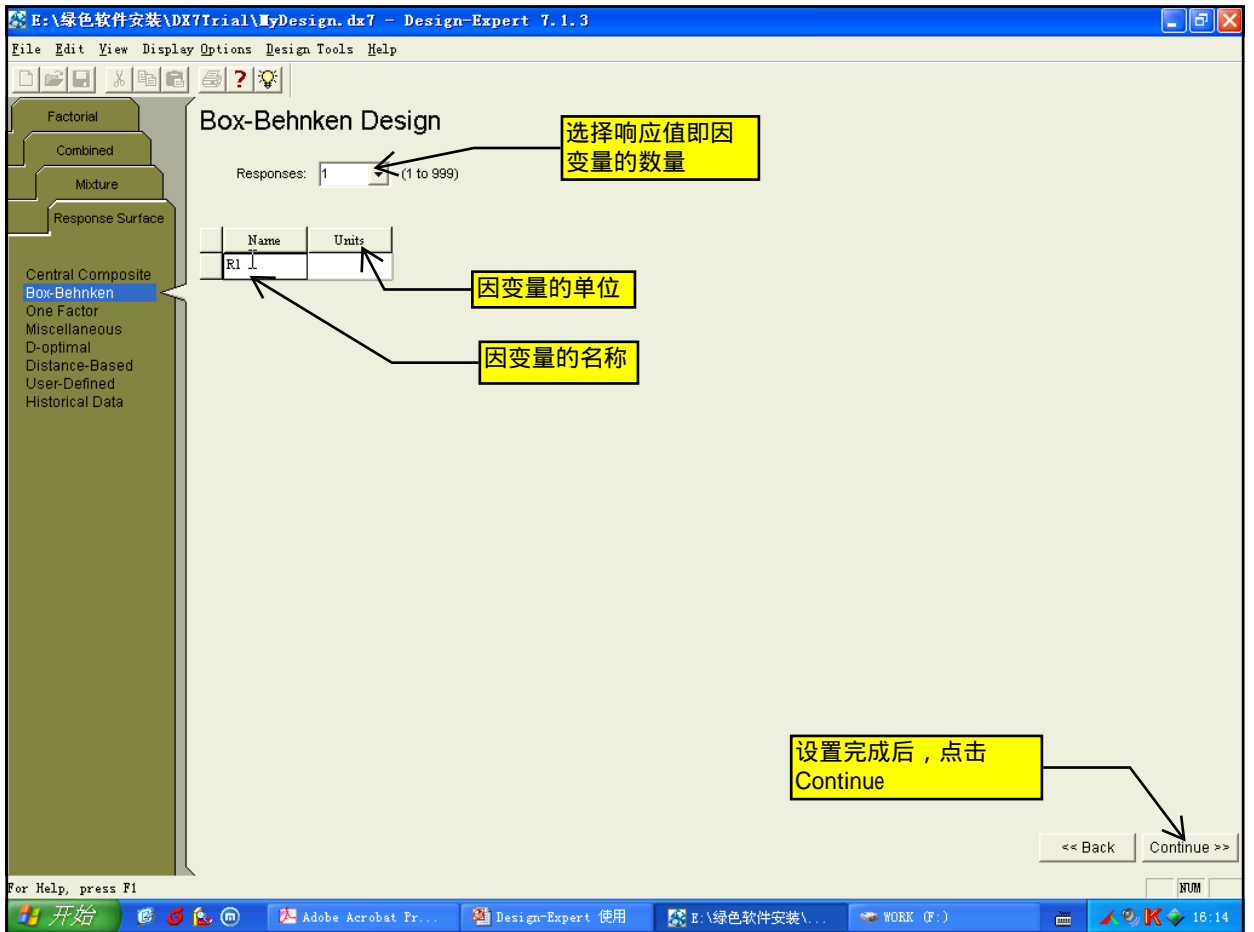
Cancel Continue >>

NUM

For Help, press F1

开始 Adobe Acrobat Pr... Design-Expert 使用 E:\绿色软件安装\...

16:11



E:\绿色软件安装\DX7Trial\MyDesign.dx7 - Design-Expert 7.1.3

File Edit View Display Options Design Tools Help

Notes for MyDesign

- Design (Actual)
  - Summary
  - Graph Columns
  - Evaluation
  - Analysis
  - Phenol degradation
  - Optimization
  - Numerical
  - Graphical
  - Point Prediction

Select	Std	Run	Factor 1 A:Glucose g/L	Factor 2 B:Yeast extrat g/L	Factor 3 C:(NH4)2SO4 g/L	Factor 4 D:NaCl g/L	Response 1 Phenol degrada %
	27	1	0.50	0.15	3.00	0.50	
	14	2	0.50	0.25	1.00	0.50	
	7	3	0.50	0.15	1.00	0.75	
	16	4	0.50	0.25	5.00	0.50	
	29	5	0.50	0.15	3.00	0.50	
	15	6	0.50	0.05	5.00	0.50	
	4	7	0.75	0.25	3.00	0.50	
	9	8	0.25	0.15	3.00	0.25	
	3	9	0.50	0.15	3.00	0.50	
	21	10	0.50	0.05	3.00	0.25	
	13	11	0.50	0.05	1.00	0.50	
	23	12	0.50	0.05	3.00	0.75	
	6	13	0.50	0.15	5.00	0.25	
	22	14	0.50	0.25	3.00	0.25	
	10	15	0.75	0.15	3.00	0.25	
	28	16	0.50	0.15	3.00	0.50	
	2	17	0.75	0.05	3.00	0.50	
	12	18	0.75	0.15	3.00	0.75	
	19	19	0.25	0.15	5.00	0.50	
	26	20	0.50	0.15	3.00	0.50	
	5	21	0.50	0.15	1.00	0.25	
	20	22	0.75	0.15	5.00	0.50	
	25	23	0.50	0.15	3.00	0.50	
	17	24	0.25	0.15	1.00	0.50	
	24	25	0.50	0.25	3.00	0.75	
	18	26	0.75	0.15	1.00	0.50	
	1	27	0.25	0.05	3.00	0.50	

各因素均为实际值的的试验设计

For Help, press F1

NUM

开始 Adobe Acrobat Pr... Design-Expert 使用 E:\绿色软件安装\... WORK (F.) 16:15



各因素的实际值转变为编码制的操作过程

E:\绿色软件安装\DX7Trial\Design.dx7 - Design-Expert 7.1.3

File Edit View Display Options Design Tools Help

Process Factors Actual

Mixture Components Coded

Responses in Original Scale

Responses in Transformed Scale

	Factor 2 B:Yeast extract g/L	Factor 3 C:(NH4)2SO4 g/L	Factor 4 D:NaCl g/L	Response 1 Phenol degrada %	
27	1	0.50	3.00	0.50	
14	2	0.50	1.00	0.50	
7	3	0.50	1.00	0.75	
16	4	0.50	5.00	0.50	
29	5	0.50	3.00	0.50	
15	6	0.50	5.00	0.50	
4	7	0.75	3.00	0.50	
9	8	0.25	3.00	0.25	
3	9	0.25	3.00	0.50	
21	10	0.50	0.05	3.00	0.25
13	11	0.50	0.05	1.00	0.50
23	12	0.50	0.05	3.00	0.75
6	13	0.50	0.15	5.00	0.25
22	14	0.50	0.25	3.00	0.25
10	15	0.75	0.15	3.00	0.25
28	16	0.50	0.15	3.00	0.50
2	17	0.75	0.05	3.00	0.50
12	18	0.75	0.15	3.00	0.75
19	19	0.25	0.15	5.00	0.50
26	20	0.50	0.15	3.00	0.50
5	21	0.50	0.15	1.00	0.25
20	22	0.75	0.15	5.00	0.50
25	23	0.50	0.15	3.00	0.50
17	24	0.25	0.15	1.00	0.50
24	25	0.50	0.25	3.00	0.75
18	26	0.75	0.15	1.00	0.50
1	27	0.25	0.05	3.00	0.50

Show process factor levels in coded units

NUM

开始 Adobe Acrobat Pr... Design-Expert 使用 E:\绿色软件安装\... WORK (F.) 16:16

E:\绿色软件安装\DX7Trial\MyDesign.dx7 - Design-Expert 7.1.3

File Edit View Display Options Design Tools Help

Notes for MyDesign

- Design (Coded)
  - Summary
  - Graph Columns
  - Evaluation
  - Analysis
  - Phenol degradation
  - Optimization
    - Numerical
    - Graphical
    - Point Prediction

Select	Std	Run	Factor 1 A: Glucose g/L	Factor 2 B: Yeast extrat g/L	Factor 3 C: (NH4)2SO4 g/L	Factor 4 D: NaCl g/L	Response 1 Phenol degrada %
	27	1	0.000	0.000	0.000	0.000	
	14	2	0.000	1.000	-1.000	0.000	
	7	3	0.000	0.000	-1.000	1.000	
	16	4	0.000	1.000	1.000	0.000	
	29	5	0.000	0.000	0.000	0.000	
	15	6	0.000	-1.000	1.000	0.000	
	4	7	1.000	1.000	0.000	0.000	
	9	8	-1.000	0.000	0.000	-1.000	
	3	9	-1.000	0.000	0.000	0.000	
	21	10	0.000	-1.000	0.000	-1.000	
	13	11	0.000	-1.000	-1.000	0.000	
	23	12	0.000	-1.000	0.000	1.000	
	6	13	0.000	0.000	1.000	-1.000	
	22	14	0.000	1.000	0.000	-1.000	
	10	15	1.000	0.000	0.000	-1.000	
	28	16	0.000	0.000	0.000	0.000	
	2	17	1.000	-1.000	0.000	0.000	
	12	18	1.000	0.000	0.000	1.000	
	19	19	-1.000	0.000	1.000	0.000	
	26	20	0.000	0.000	0.000	0.000	
	5	21	0.000	0.000	-1.000	-1.000	
	20	22	1.000	0.000	1.000	0.000	
	25	23	0.000	0.000	0.000	0.000	
	17	24	-1.000	0.000	-1.000	0.000	
	24	25	0.000	1.000	0.000	1.000	
	18	26	1.000	0.000	-1.000	0.000	
	1	27	-1.000	-1.000	0.000	0.000	

各因素转变为编码制

For Help, press F1

NUM

开始 Adobe Acrobat Pr... Design-Expert 使用 E:\绿色软件安装\... WORK (F:) 16:16

F:\使用指南\练习\Phenol degradation.dxd - Design-Expert 7.1.3

File Edit View Display Options Design Tools Help

Notes for Phenol degradation

Design (Actual)

- Summary
- Graph Columns
- Evaluation
- Analysis
- Yield (Analyzed)
- Optimization
- Numerical
- Graphical
- Point Prediction

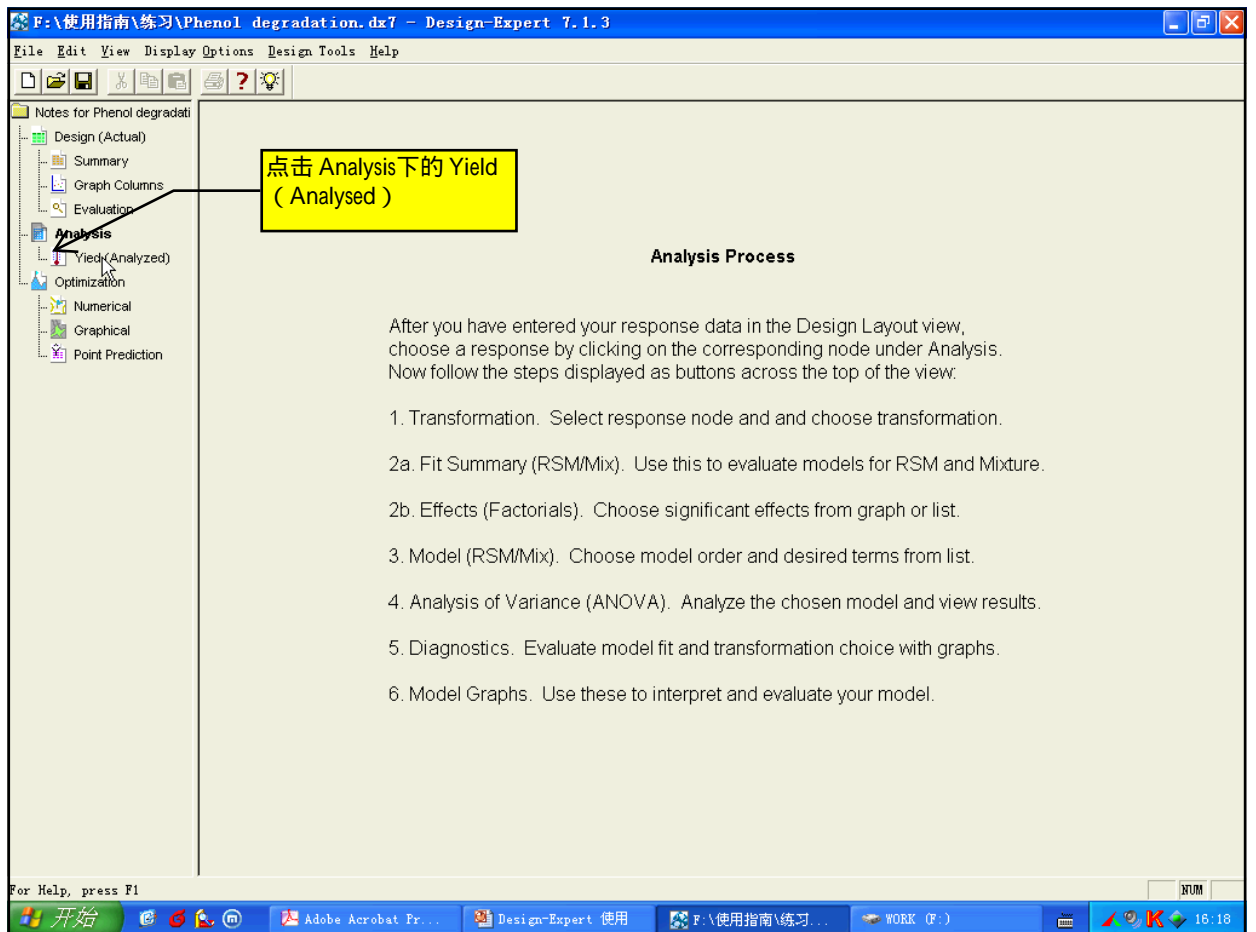
Select	Std	Run	Block	Factor 1 A:Glucose mg/L	Factor 2 B:Yeast Extrac g/L	Factor 3 C:Ammonium g/L	Factor 4 D:Sodium Chlo g/L	Response 1 Yield %
	1	25	Block 1	0.25	0.05	3.00	0.50	87.66
	2	14	Block 1	0.75	0.05	3.00	0.50	76.91
	3	15	Block 1	0.25	0.25	3.00	0.50	92
	4	21	Block 1	0.50	0.25	3.00	0.50	92.8
	5	4	Block 1	0.50	0.15	1.00	0.75	93.38
	6	11	Block 1	0.25	0.15	5.00	0.75	95.62
	7	26	Block 1	0.25	0.15	3.00	0.25	97.95
	8	7	Block 1	0.75	0.15	3.00	0.25	84.21
	9	6	Block 1	0.75	0.15	3.00	0.75	95.96
	10	23	Block 1	0.50	0.05	3.00	0.75	91.46
	11	27	Block 1	0.50	0.25	1.00	0.50	92.46
	12	18	Block 1	0.50	0.05	1.00	0.50	88.13
	13	29	Block 1	0.50	0.25	5.00	0.50	89.84
	14	19	Block 1	0.25	0.15	5.00	0.50	92.9
	15	12	Block 1	0.75	0.15	1.00	0.50	78.01
	16	24	Block 1	0.25	0.15	1.00	0.50	95.66
	17	19	Block 1	0.75	0.15	5.00	0.50	96.23
	18	24	Block 1	0.25	0.15	1.00	0.50	98
	19	28	Block 1	0.75	0.15	5.00	0.50	97.92
	20	2	Block 1	0.50	0.15	5.00	0.50	85.5
	21	10	Block 1	0.50	0.05	3.00	0.25	93.22
	22	20	Block 1	0.50	0.25	3.00	0.25	92.03
	23	17	Block 1	0.50	0.05	3.00	0.75	79.47
	24	1	Block 1	0.50	0.25	3.00	0.75	88.94
	25	8	Block 1	0.50	0.15	3.00	0.50	94.1
	26	13	Block 1	0.50	0.15	3.00	0.50	94.1
	27	5	Block 1	0.50	0.15	3.00	0.50	94.1

按照试验设计进行试验，记录每组因素组合的试验结果，填在Response列。

For Help, press F1

NUM

开始 Adobe Acrobat Pr... Design-Expert 使用 F:\使用指南\练习... WORK (F.) 16:18



F:\使用指南\练习\Phenol degradation.dx7 - Design-Expert 7.1.3

File Edit View Display Options Design Tools Help

1, Transform 选项卡, 取默认值

Notes for Phenol degradati

- Design (Actual)
  - Summary
  - Graph Columns
  - Evaluation
- Analysis
  - Yield (Analyzed)
  - Optimization
  - Numerical
  - Graphical
  - Point Prediction

To analyze this response, click on the above icons in succession.

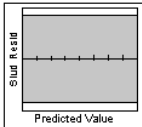
2, 点击 Fit summary 选项卡

Transformation

- None
- Square root
- Natural log
- Base 10 log
- Inverse sqrt
- Inverse
- Power
- Logit
- ArcSin sqrt

Equation

None (lambda = 1.0)

$$y' = y$$


Use with a typical response.

Response ranges from 76.91 to 98.  
Ratio of max to min is 1.27422

A ratio greater than 10 usually indicates a transformation is required. For ratios less than 3 the power transforms have little effect.

For Help, press F1

NUM

开始 Adobe Acrobat Pr... Design-Expert 使用 F:\使用指南\练习... WORK (F.) 16:18

F:\使用指南\练习\Phenol degradation.dx7 - Design-Expert 7.1.3

File Edit View Display Options Design Tools Help

了解一下Fit summary各项，再点击下一个Model选项卡

Notes for Phenol degradati

- Design (Actual)
  - Summary
  - Graph Columns
  - Evaluation
- Analysis
  - Yield (Analyzed)
  - Optimization
    - Numerical
    - Graphical
    - Point Prediction

Bookmarks

- Top
- Sum of Squares
- Lack of Fit
- R-Squared

Transform   Fit Summary   f(x)   Model   ANOVA   Diagnostics   Model Graphs

Response 1   Yield   Transform:   None

\*\*\* WARNING: The Cubic Model is Aliased! \*\*\*

**Sequential Model Sum of Squares [Type I]**

Source	Sum of Squares	df	Mean Square	F Value	p-value	Prob > F	
Mean vs Total	2.416E+005	1	2.416E+005				Suggested
Linear vs Mean	196.25	4	49.06	1.65	0.1943		
2FI vs Linear	141.22	6	23.54	0.74	0.6241		
Quadratic vs 2FI	235.96	4	58.99	2.46	0.0940		Suggested
Cubic vs Quadratic	288.20	8	36.03	4.51	0.0414		Aliased
Residual	47.94	6	7.99				
Total	2.425E+005	29	8361.14				

"Sequential Model Sum of Squares [Type I]": Select the highest order polynomial where the additional terms are significant and the model is not aliased.

**Lack of Fit Tests**

Source	Sum of Squares	df	Mean Square	F Value	p-value	Prob > F	
Linear	665.38	18	36.97	4.63	0.0333		
2FI	524.16	12	43.68	5.47	0.0239		
Quadratic	288.20	8	36.03	4.51	0.0414		Suggested
Cubic	0.000	0					Aliased
Pure Error	47.94	6	7.99				

For Help, press F1

NUM

开始   Adobe Acrobat Pr...   Design-Expert 使用   F:\使用指南\练习...   WORK (F...)   16:19



F:\使用指南\练习\Phenol degradation.dx7 - Design-Expert 7.1.3

File Edit View Display Options Design Tools Help

Transform Fit Summary f(x) Model ANOVA Diagnostics

Notes for Phenol degradati  
 Design (Actual)  
 Summary  
 Graph Columns  
 Evaluation  
 Analysis  
 Yield (Analyzed)  
 Optimization  
 Numerical  
 Graphical  
 Point Prediction

Use your mouse to right click on individual cells for definitions.

Response 1 Yield

ANOVA for Response Surface Quadratic Model

Analysis of variance table [Partial sum of squares - Type III]

Source	Sum of Squares	df	Mean Square	F Value	p-value Prob > F	
Model	573.43	14	40.96	1.71	0.1646	not significant
A-Glucose	14.50	1	14.50	0.60	0.4500	
B-Yeast Extract	17.78	1	17.78	0.74	0.4039	
C-Ammonium i	93.08	1	93.08	3.88	0.0691	
D-Sodium Chlo	52.36	1	52.36	2.18	0.1619	
AB	13.81	1	13.81	0.58	0.4608	
AC	6.17	1	6.17	0.26	0.6200	
AD	7.16	1	7.16	0.30	0.5936	
BC	1.02	1	1.02	0.043	0.8396	
BD	8.72	1	8.72	0.36	0.5564	
CD	8.18	1	8.18	0.34	0.5686	
A <sup>2</sup>	0.46	1	0.46	0.019	0.8914	
B <sup>2</sup>	202.18	1	202.18	8.42	0.0116	
C <sup>2</sup>	0.84	1	0.84	0.035	0.8543	
D <sup>2</sup>	2.266E-007	1	2.266E-007	9.436E-009	0.9999	
Residual	336.14	14	24.01			
Lack of Fit	288.20	8	36.03	4.51	0.0414	significant
Pure Error	47.94	6	7.99			
Cor Total	909.57	28				

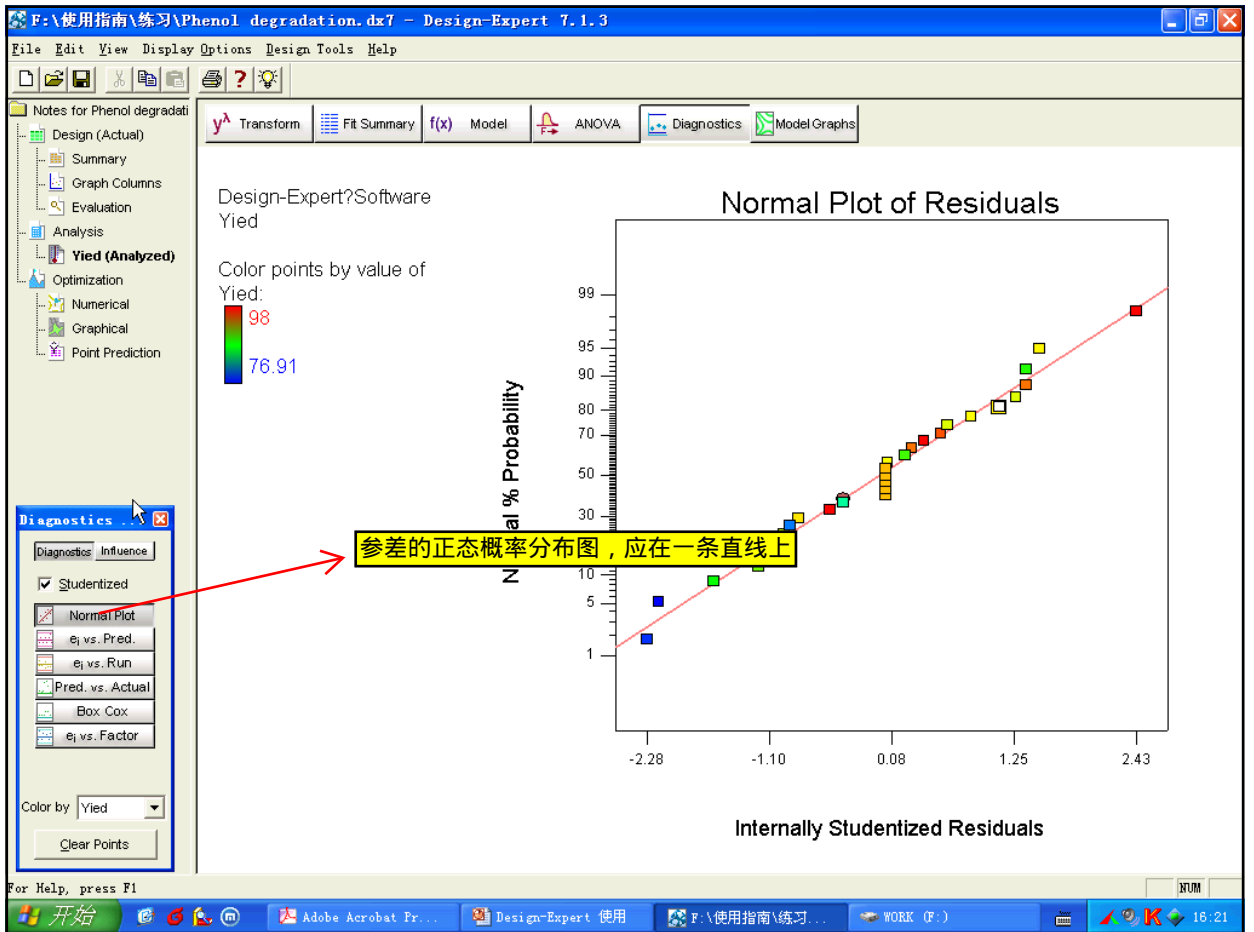
For Help, press F1

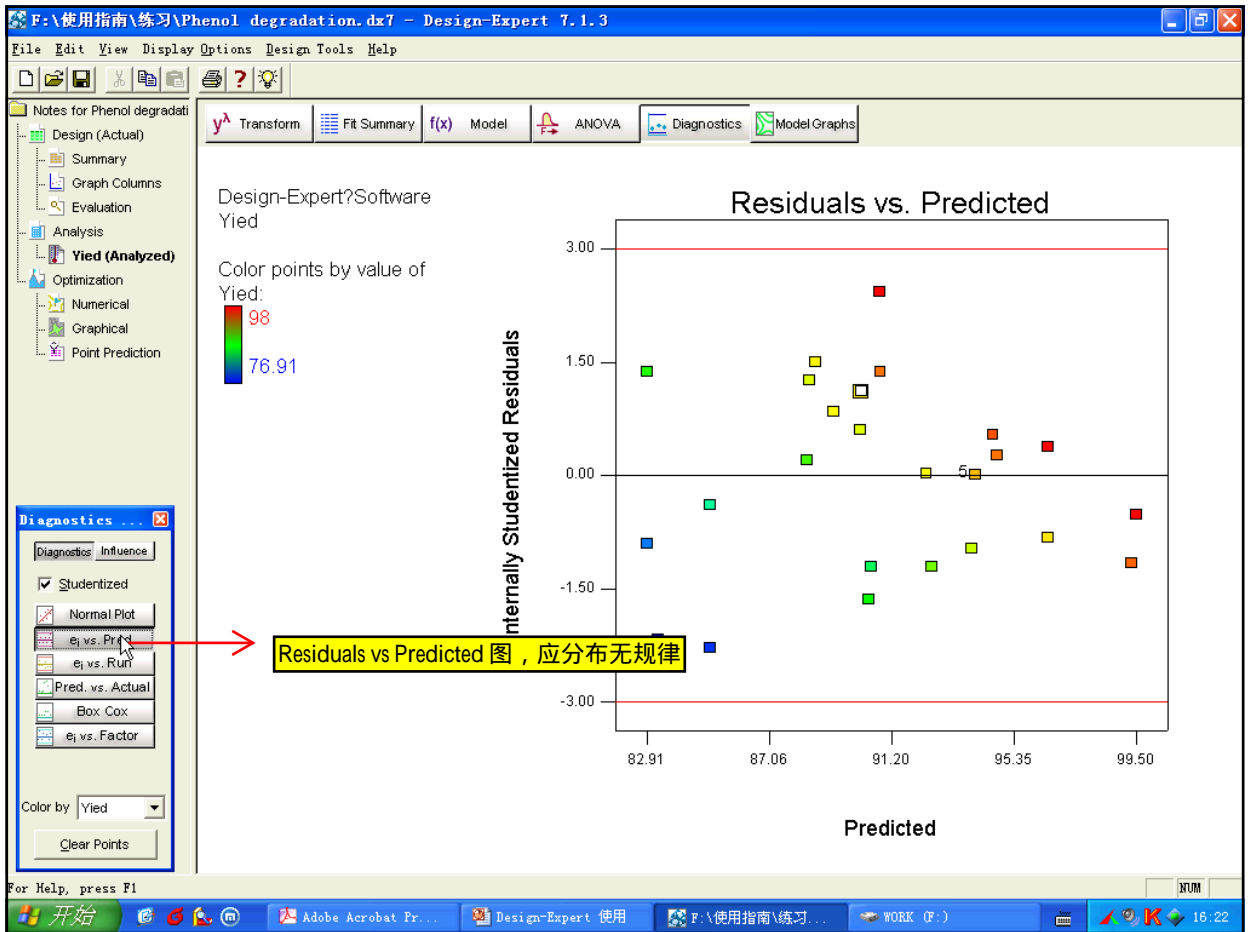
开始 Adobe Acrobat Pr... Design-Expert 使用 F:\使用指南\练习... WORK (F...) 16:21

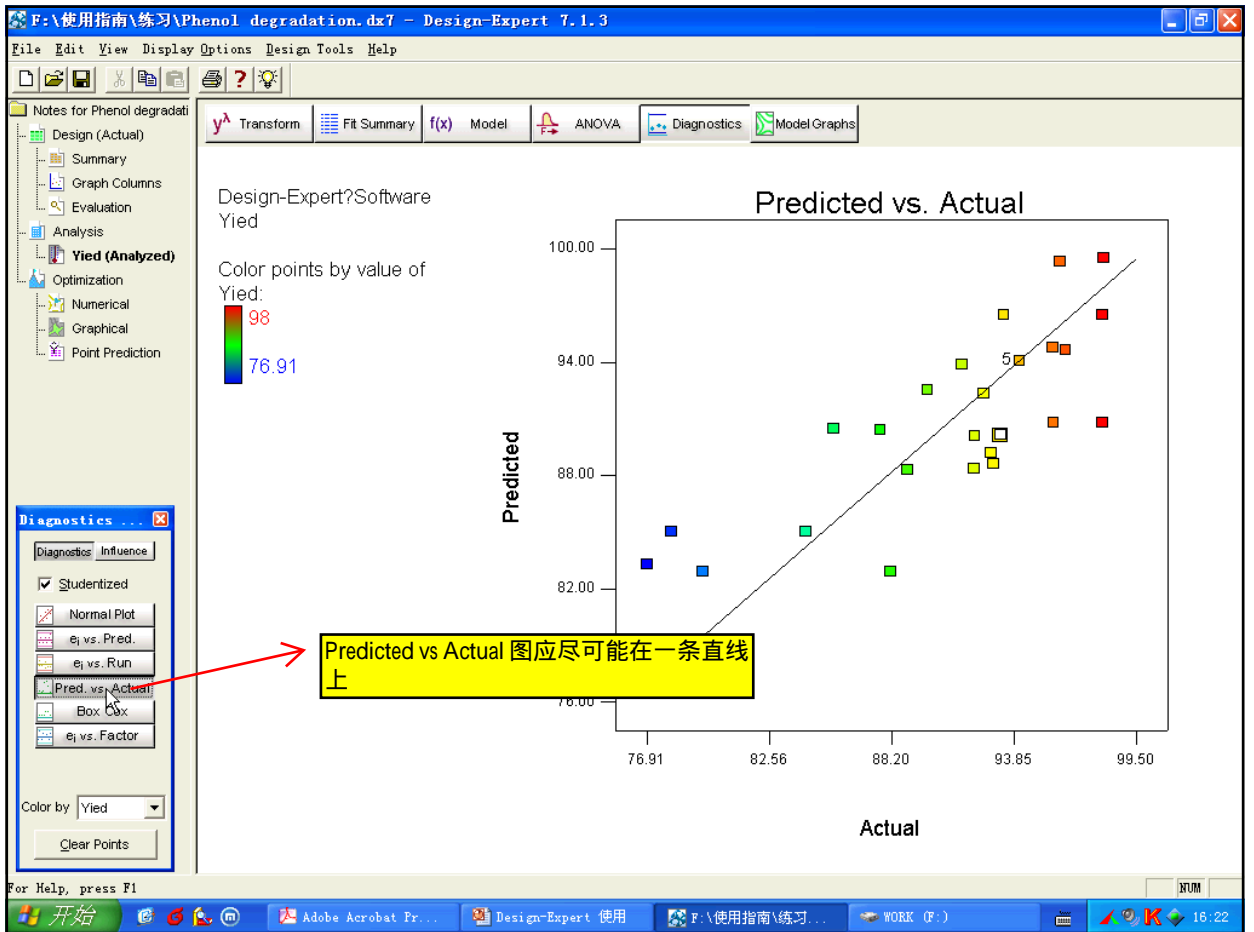
再点击Diagnostics选项卡

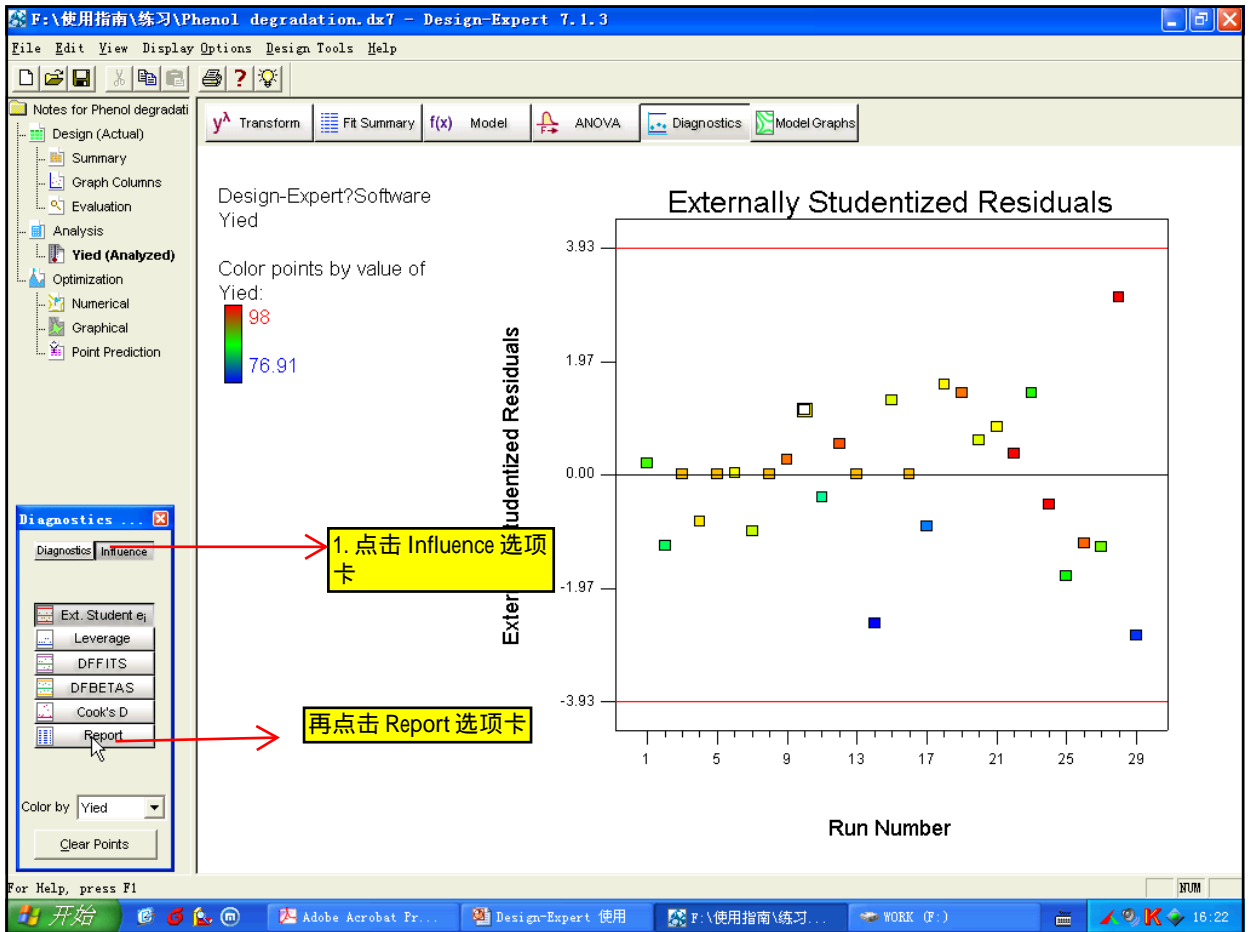
方差分析 (ANOVA)，方程的显著性检验、系数显著性检验、及回归方程。











再点击 Model graphs

F:\使用指南\练习\Phenol degradation.dx7 - Design-Expert 7.1.3

File Edit View Display Options Design Tools Help

Notes for Phenol degradati

- Design (Actual)
- Summary
- Graph Columns
- Evaluation
- Analysis
- Yield (Analyzed)**
- Optimization
- Numerical
- Graphical
- Point Prediction

Transform Fit Summary f(x) Model ANOVA Diagnostics **Model Graphs**

Response 1 Yield Transform: None

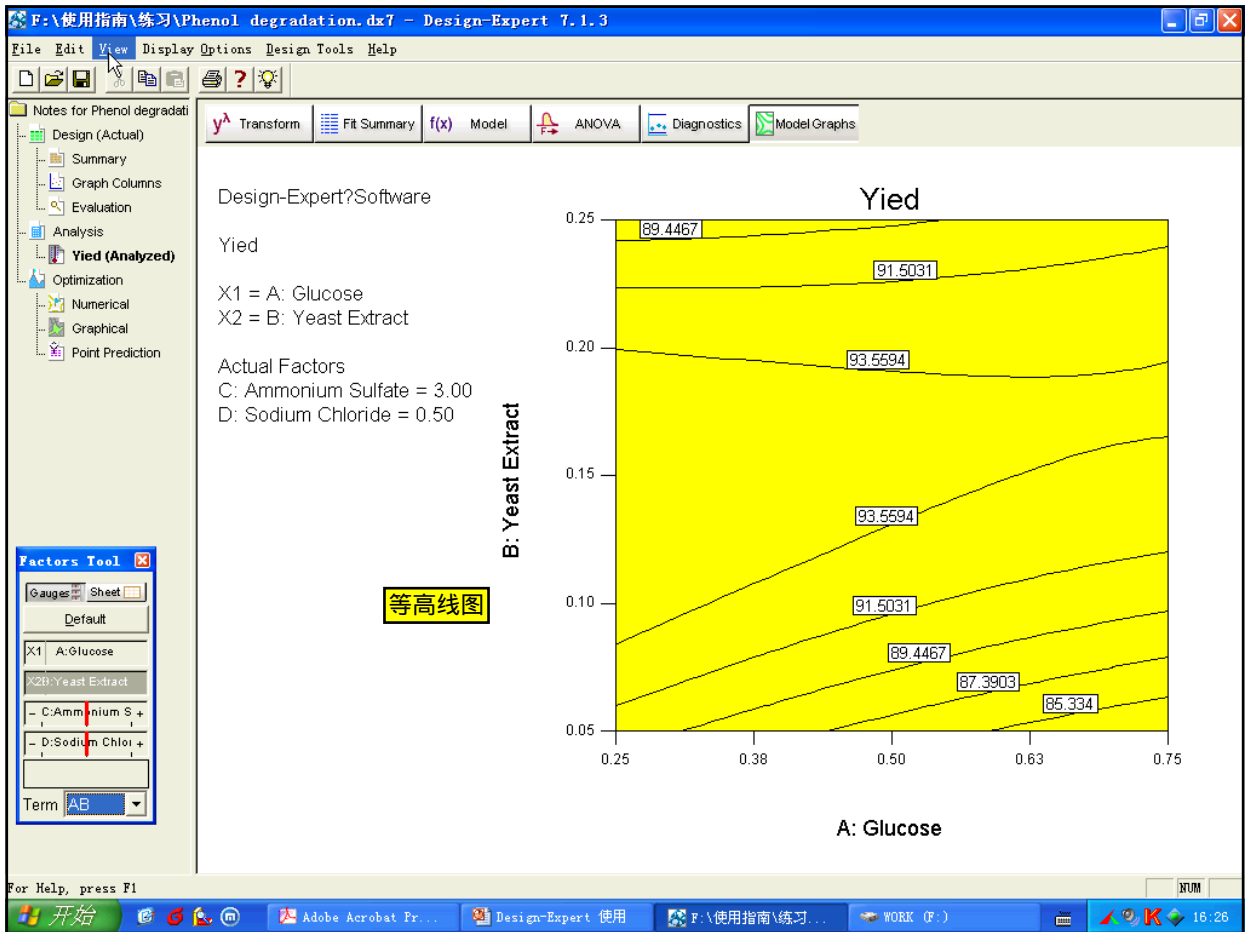
**实际实验值** **方程预测值**

Diagnostics Case Statistics

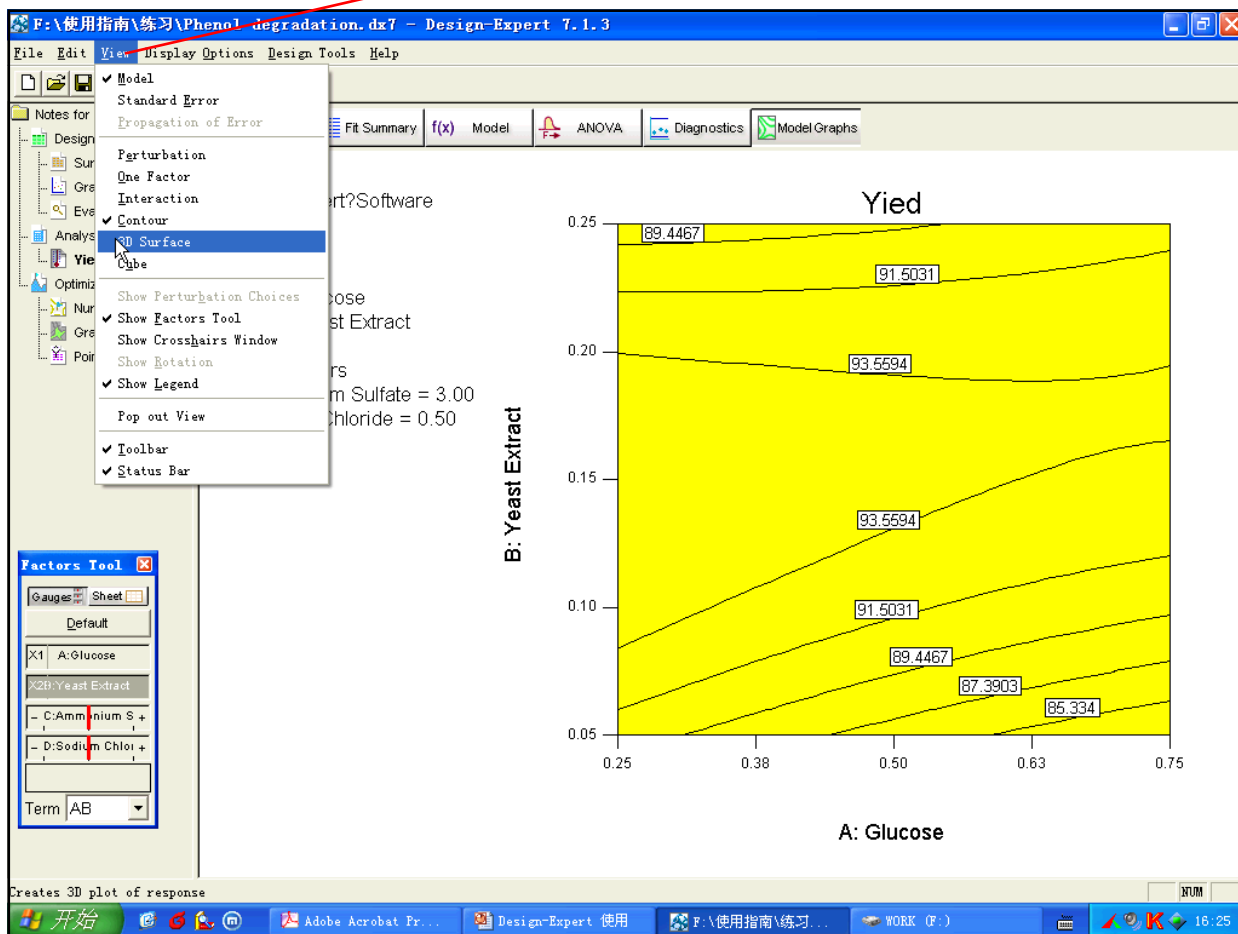
Standard Order	Actual Value	Predicted Value	Residual	Leverage	Internally Studentized Residual	Externally Studentized Residual	Influence on Fitted Value DFFITS	Cook's Distance	Run Order
1	87.66	90.42	-2.76	0.882	-1.639	-1.757	* -4.80	* 1.34	25
2	76.91	83.28	-6.37	0.641	-2.169	-2.566	* -3.43	0.560	14
3	92.00	88.39	3.61	0.663	1.267	1.298	1.821	0.211	15
4	92.80	89.21	3.59	0.238	0.838	0.829	0.464	0.015	21
5	93.38	96.50	-3.12	0.401	-0.823	-0.813	-0.665	0.030	4
6	95.62	94.77	0.85	0.573	0.266	0.257	0.297	0.006	9
7	97.95	96.50	1.45	0.401	0.381	0.369	0.302	0.006	22
8	84.21	85.04	-0.83	0.819	-0.396	-0.384	-0.817	0.047	11
9	95.96	99.33	-3.37	0.651	-1.164	-1.180	-1.611	0.168	26
10	91.46	93.91	-2.45	0.731	-0.965	-0.962	-1.587	0.169	7
11	92.46	92.36	0.096	0.648	0.033	0.032	0.043	0.000	6
12	88.13	82.91	5.22	0.397	1.371	1.420	1.151	0.082	23
13	89.84	92.56	-2.72	0.791	-1.213	-1.236	* -2.40	0.371	27
14	92.90	88.61	4.29	0.657	1.496	1.573	* 2.18	0.286	18
15	78.01	85.02	-7.01	0.606	-2.279	-2.768	* -3.43	0.531	29
16	95.66	90.81	4.85	0.478	1.371	1.420	1.359	0.115	19
17	96.23	94.63	1.60	0.641	0.545	0.530	0.709	0.035	12
18	98.00	99.50	-1.50	0.654	-0.520	-0.506	-0.696	0.034	24
19	97.92	90.80	7.12	0.642	2.429	3.077	* 4.12	0.705	28
20	85.50	90.49	-4.99	0.293	-1.211	-1.233	-0.795	0.041	2

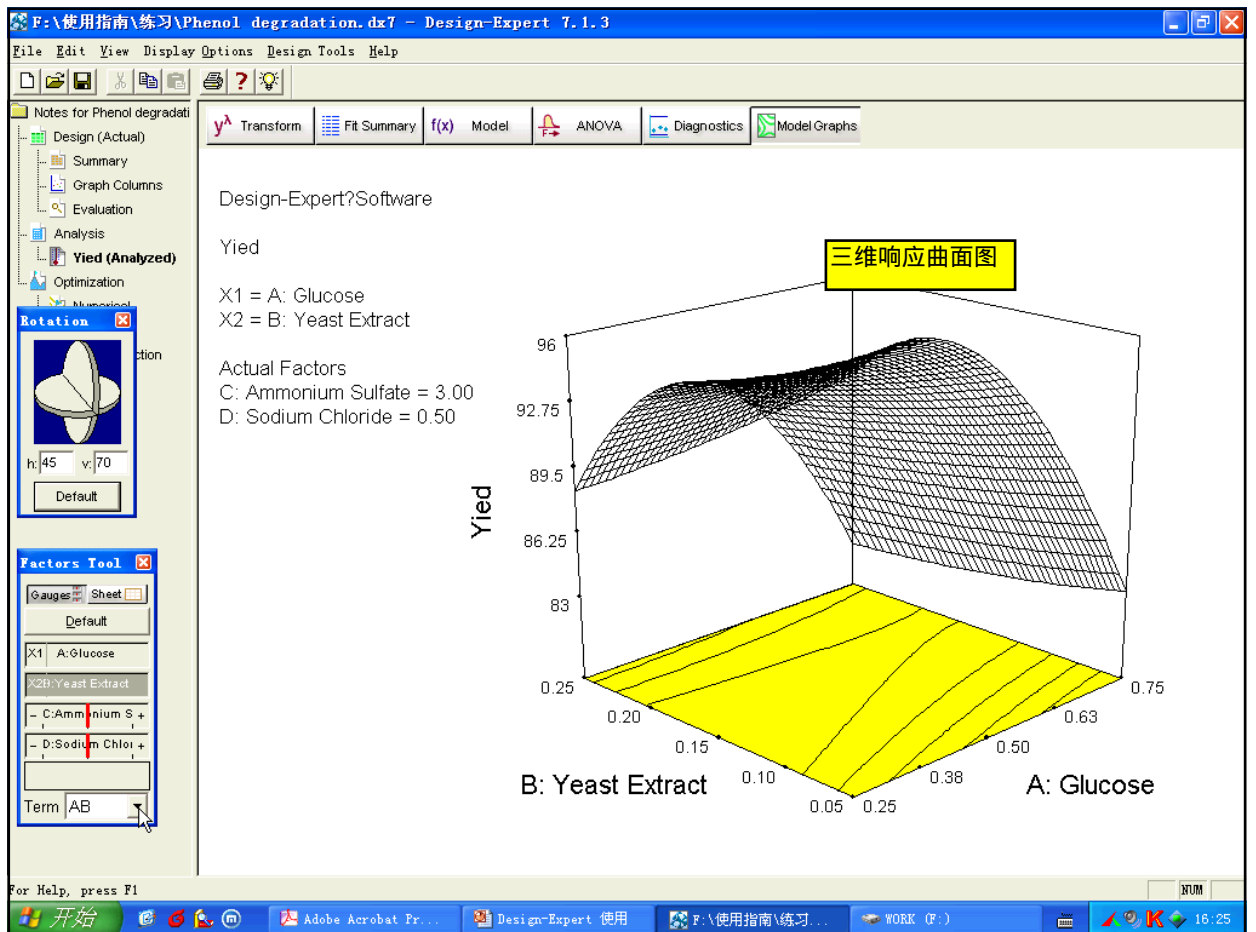
For Help, press F1

开始 Adobe Acrobat Pr... Design-Expert 使用 F:\使用指南\练习... WORK (F:)

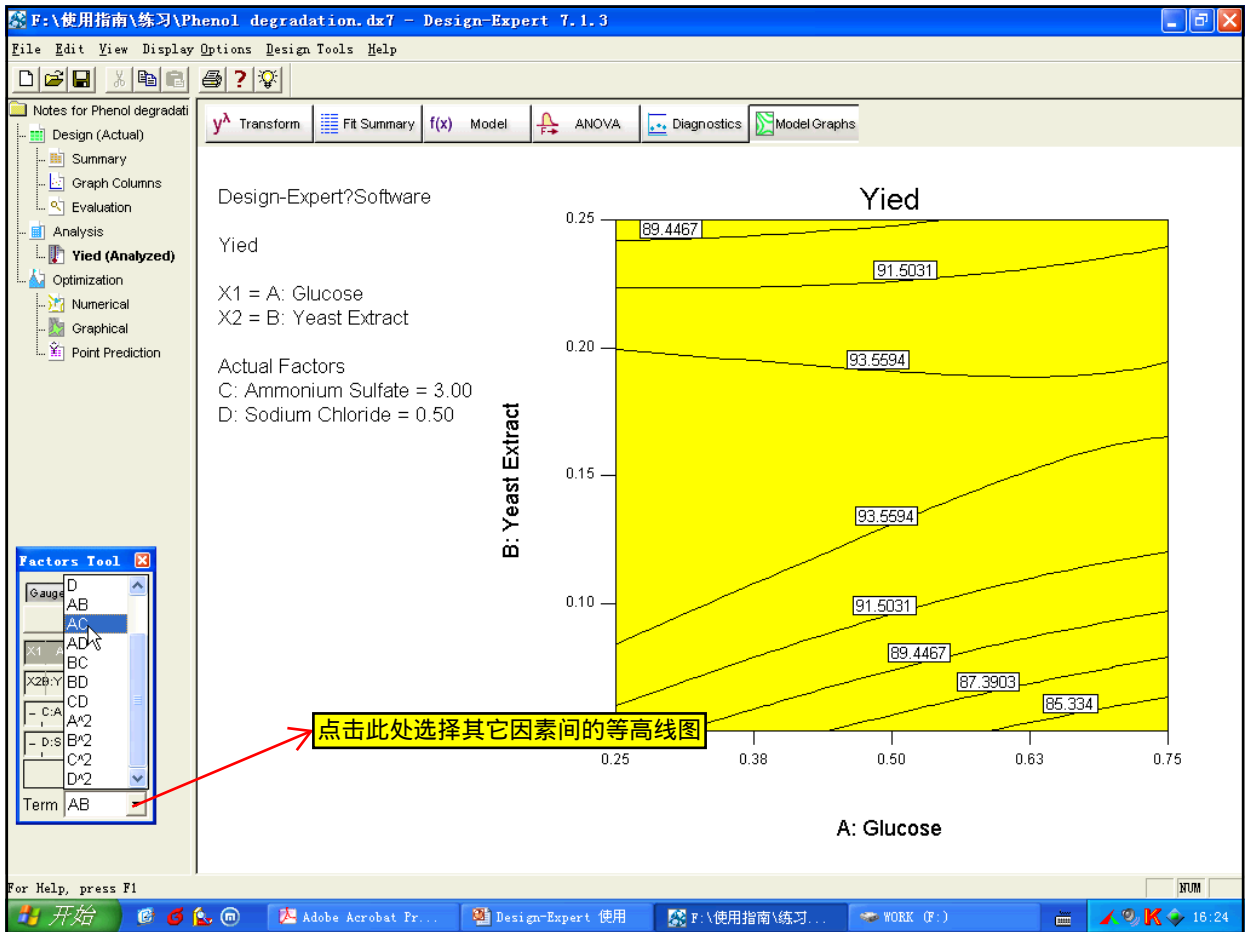


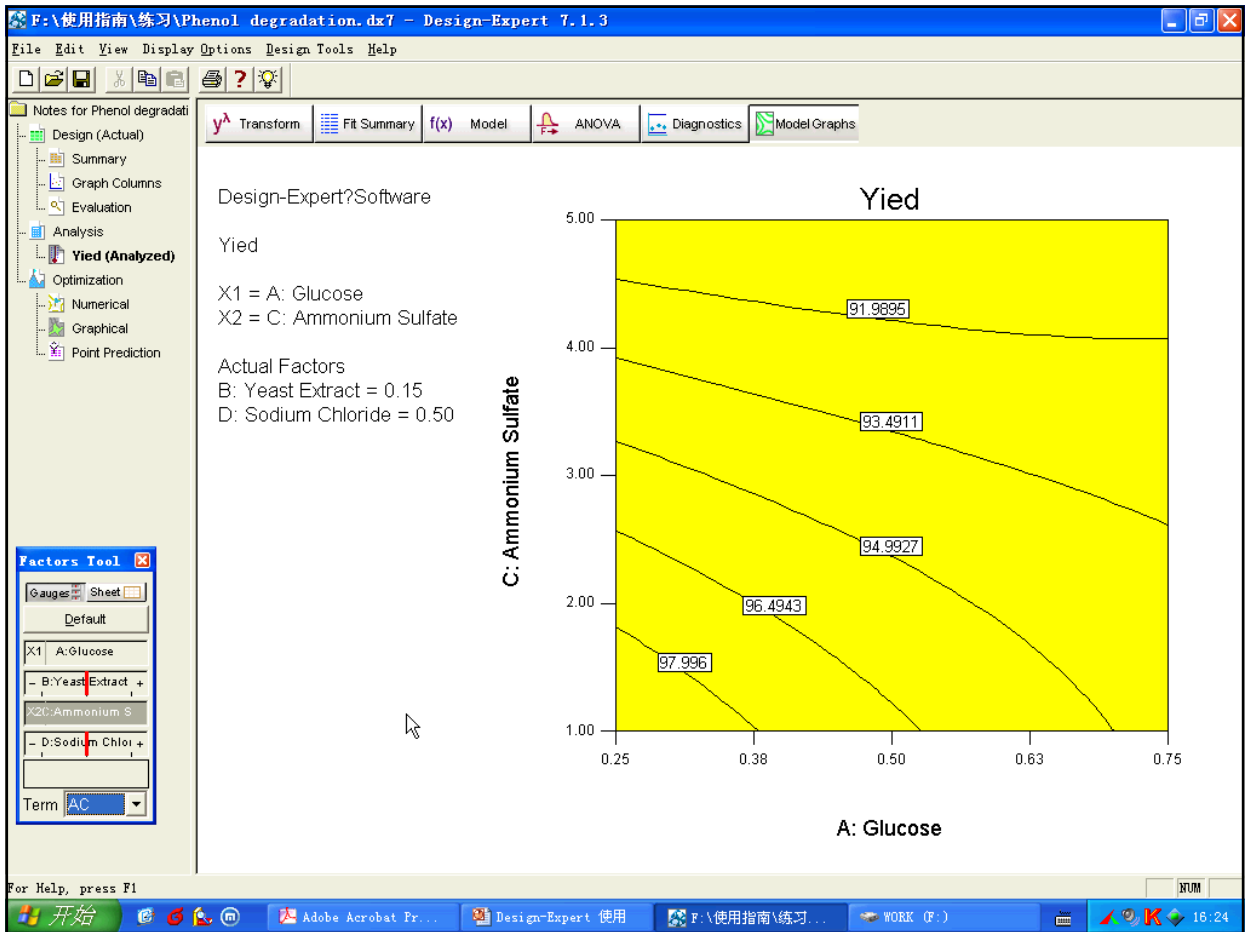
点击View下的3D surface  
看三维响应曲面图











F:\使用指南\练习\Phenol degradation.dz7 - Design-Expert 7.1.3

File Edit View Display Options Design Tools Help

Notes for Phenol degradati

- Design (Actual)
  - Summary
  - Graph Columns
  - Evaluation
- Analysis
  - Yield (Analyzed)**
  - Optimization
    - Numerical
    - Graphical
    - Point Prediction

Design-Expert?Software

Yield

X1 = A: Glucose  
X2 = C: Ammonium Sulfate

Actual Factors  
B: Yeast Extract = 0.15  
D: Sodium Chloride = 0.50

Yield

C: Ammonium Sulfate

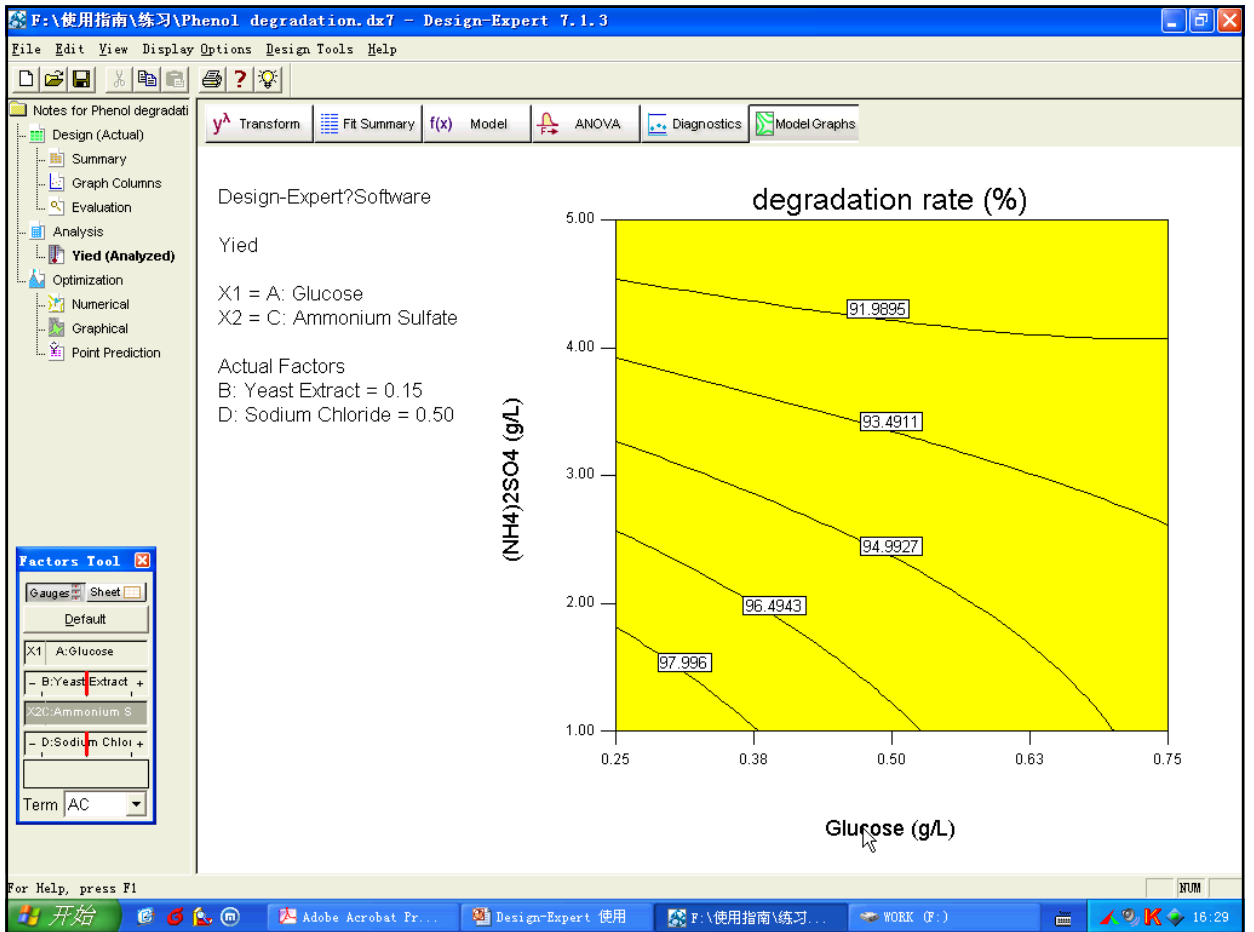
A: Glucose

Factors Tool

选中文字点击右键，修改坐标名称

For Help, press F1

开始 Adobe Acrobat Pr... Design-Expert 使用 F:\使用指南\练习... WORK (F...) 16:27



把响应曲面图及等高线图 导入WORD中的步骤

The screenshot shows the Design-Expert 7.1.3 software interface. The 'File' menu is open, and the 'Export Graph to file...' option is highlighted. A red arrow points from this option to a yellow box with the text 'File下的Export Graph to file'. The main window displays a contour plot titled 'degradation rate (%)'. The x-axis is labeled 'Glucose (g/L)' and ranges from 0.25 to 0.75. The y-axis is labeled 'Sulfate (g/L)' and ranges from 1.00 to 5.00. The plot shows several contour lines with numerical values: 97.996, 96.4943, 94.9927, 93.4911, and 91.9895. A 'Factors Tool' window is visible on the left side of the software interface.

Contour Value
97.996
96.4943
94.9927
93.4911
91.9895

F:\使用指南\练习\Phenol degradation.dx7 - Design-Expert 7.1.3

File Edit View Display Options Design Tools Help

Notes for Phenol degradati

Design (Actual)

- Summary
- Graph Columns
- Evaluation

Analysis

- Yield (Analyzed)

Optimization

- Numerical
- Graphical
- Point Prediction

Transform Fit Summary f(x) Model ANOVA Diagnostics Model Graphs

Design-Expert?Software

Yield

X1 = A: Glucose  
X2 = C: Ammonium

Actual Factors

B: Yeast Extract  
D: Sodium Chloride

degradation rate (%)

5.00

311

327

1.00

0.38 0.50 0.63 0.75

Glucose (g/L)

另存为

保存在 (W): 练习

文件名 (N): Phenol degradation\_Model Graph of Yield

保存类型 (T):

- Enhanced Metafile (\*.emf)
- Enhanced Metafile (\*.emf)
- PNG image (\*.png)
- TIFF image (\*.tif)
- GIF image (\*.gif)
- Windows BMP image (\*.bmp)
- JPEG image (\*.jpg)
- Encapsulated PostScript (\*.eps)

保存 (S) 取消

选择投稿最常用的TIFF文件格式

Factors Tool

Gauges Sheet

Default

X1 A: Glucose

X2 B: Yeast Extract

X3 C: Ammonium S

X4 D: Sodium Chloride

Term AC

For Help, press F1

开始 Adobe Acrobat Pr... Design-Expert 使用 F:\使用指南\练习... WORK (F) 16:30

软件(Ⓜ) 编辑(E) 视图(V) 插入(I) 格式(O) 工具(T) 表格(A) 窗口(W) 帮助(H) Adobe PDF(B) Acrobat 注释(C) 键入需要帮助的问题

正文 Times New Roman 五号 B I U A A A 100% 阅读(R)

把上面保存的TIF格式图片复制到word中，用图片工具栏中的裁剪功能对图片进行裁剪

8 6 4 2 2 4 6 8

图片

裁剪

Design-Expert?Software

Yield

X1 = A: Glucose  
X2 = C: Ammonium Sulfate

Actual Factors  
B: Yeast Extract = 0.15  
D: Sodium Chloride = 0.50

degradation rate (%)

(NH4)2SO4 (g/L)

5.00

4.00

3.00

2.00

91.9895

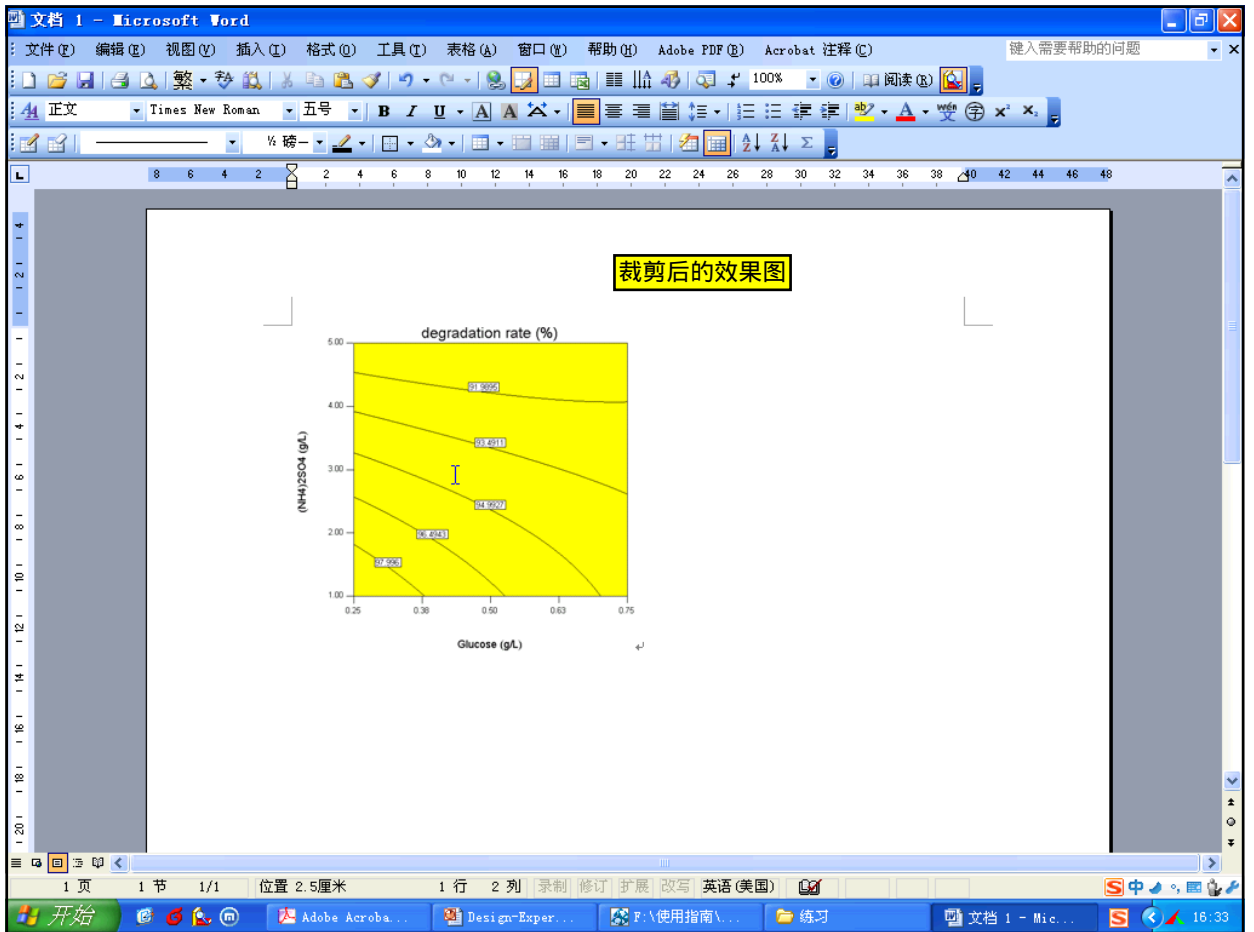
93.4911

94.9927

96.4943

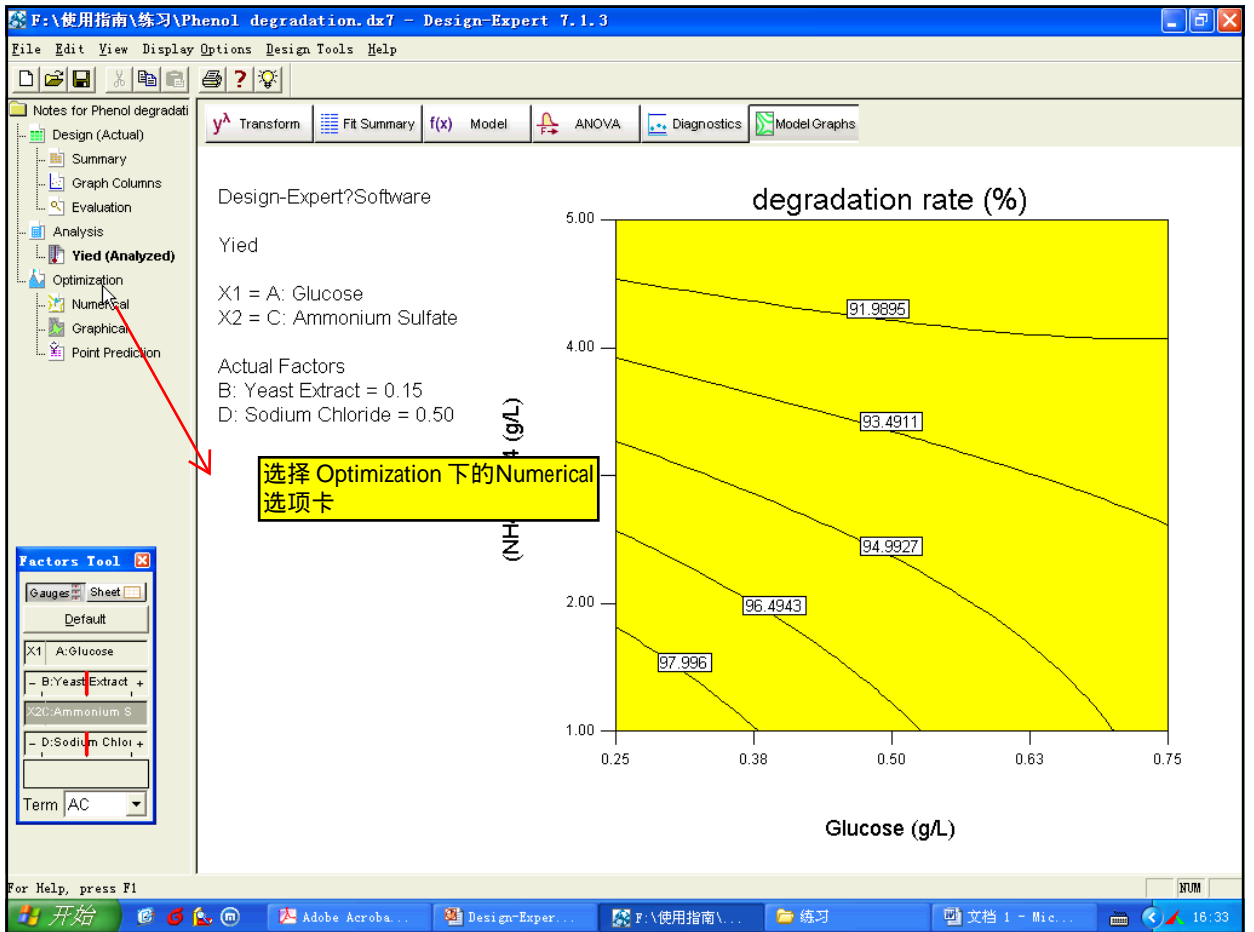
97.996

1 页 1 节 1/1 位置 2.5厘米 1 行 1 列 录制 修订 扩展 改写 英语(美国)





由RSM预测最优值



F:\使用指南\练习\Phenol degradation.dz7 - Design-Expert 7.1.3

File Edit View Display Options Design Tools Help

Notes for Phenol degradati

- Design (Actual)
  - Summary
  - Graph Columns
  - Evaluation
- Analysis
  - Yield (Analyzed)
  - Optimization
    - Numerical**
    - Graphical
    - Point Prediction

Criteria Solutions Graph

**Glucose**

Yeast Extract  
Ammonium Sulfate  
Sodium Chloride  
Yield

Goal: In range

Lower	Upper
0.25	0.75

Weights: | |

Importance: +++

Options...

0.25 0.75

Glucose

For Help, press F1

开始 Adobe Acroba... Design-Exper... F:\使用指南\... 练习 文档 1 - Mic... 16:35

NUM

确定各因素的取值范围

F:\使用指南\练习\Phenol degradation.dx7 - Design-Expert 7.1.3

File Edit View Display Options Design Tools Help

Notes for Phenol degradati

- Design (Actual)
  - Summary
  - Graph Columns
  - Evaluation
- Analysis
  - Yield (Analyzed)
  - Optimization
  - Numerical**
  - Graphical
  - Point Prediction

Criteria Solutions Graphs

Glucose  
Yeast Extract  
Ammonium Sulfate  
Sodium Chloride  
Yield

Goal: none  
none  
maximize  
minimize  
target ->  
in range

Upper: 98

Importance: +++

Options...

76.91                      98

Yield

For Help, press F1

开始 Adobe Acroba... Design-Exper... F:\使用指南\... 练习 文档 1 - Mic... 16:35

NUM

确定响应值（因变量）的目标（最大值、最小值、范围值、目标值）  
此实例中，是优化四个因素使响应值最大，选择Maximize

F:\使用指南\练习\Phenol degradation.dx7 - Design-Expert 7.1.3

File Edit View Display Options Design Tools Help

Notes for Phenol degradati

- Design (Actual)
  - Summary
  - Graph Columns
  - Evaluation
- Analysis
  - Yield (Analyzed)
- Optimization
  - Numerical**
  - Graphical
  - Point Prediction

Criteria Solutions Graphs

Glucose  
Yeast Extract  
Ammonium Sulfate  
Sodium Chloride  
Yield

Goal: maximize **低值取默认值**

Lower Upper

Limits: 76.91 200 **高值项中输入一个尽可能大的无法达到的值**

Weights: 1 1

Importance: +++

Options...

76.91 98 200

Yield

For help, press F1

开始 Adobe Acroba... Design-Exper... F:\使用指南\... 练习 文档 1 - Mic... 16:36

F:\使用指南\练习\Phenol degradation.dx7 - Design Expert 7.1.3  
 File Edit View Display Options Design Tools Help

点击Solutions选项卡

Notes for Phenol degradati  
 Design (Actual)  
 Summary  
 Graph Columns  
 Evaluation  
 Analysis  
 Yield (Analyzed)  
 Optimization  
 Numerical  
 Graphical  
 Point Prediction

Criteria Solutions Graphs

Solutions 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

**Constraints**

Name	Goal	Lower Limit	Upper Limit	Lower Weight	Upper Weight	Importance
Glucose	is in range	0.25	0.75	1	1	3
Yeast Extract	is in range	0.05	0.25	1	1	3
Ammonium Sulf	is in range	1	5	1	1	3
Sodium Chloride	is in range	0.25	0.75	1	1	3
Yield	maximize	76.91	200	1		

**Solutions**

Number	Glucose	Yeast Extract	Ammonium Su	Sodium Chloride	Yield	Desirability	Selected
1	0.25	0.14	1.00	0.25	101.355	0.199	Selected
2	0.25	0.13	1.00	0.25	101.355	0.199	
3	0.25	0.14	1.00	0.25	101.345	0.199	
4	0.25	0.14	1.02	0.25	101.342	0.198	
5	0.25	0.13	1.06	0.25	101.314	0.198	
6	0.25	0.13	1.06	0.25	101.311	0.198	
7	0.25	0.14	1.00	0.25	101.31	0.198	
8	0.25	0.13	1.08	0.25	101.302	0.198	
9	0.25	0.13	1.00	0.25	101.278	0.198	
10	0.25	0.12	1.00	0.25	101.275	0.198	
11	0.25	0.13	1.00	0.26	101.256	0.198	
12	0.25	0.14	1.16	0.25	101.241	0.198	
13	0.26	0.14	1.00	0.25	101.232	0.198	

Solutions...  
 Report  
 Ramps  
 Bar Graph

For Help, press F1

第一个方案即为各因素取最优值后的响应所能取到的最大值。

开始 Adobe Acroba... Design-Exper... F:\使用指南\... 练习 文档 1 - Mic... 16:38



谢 谢