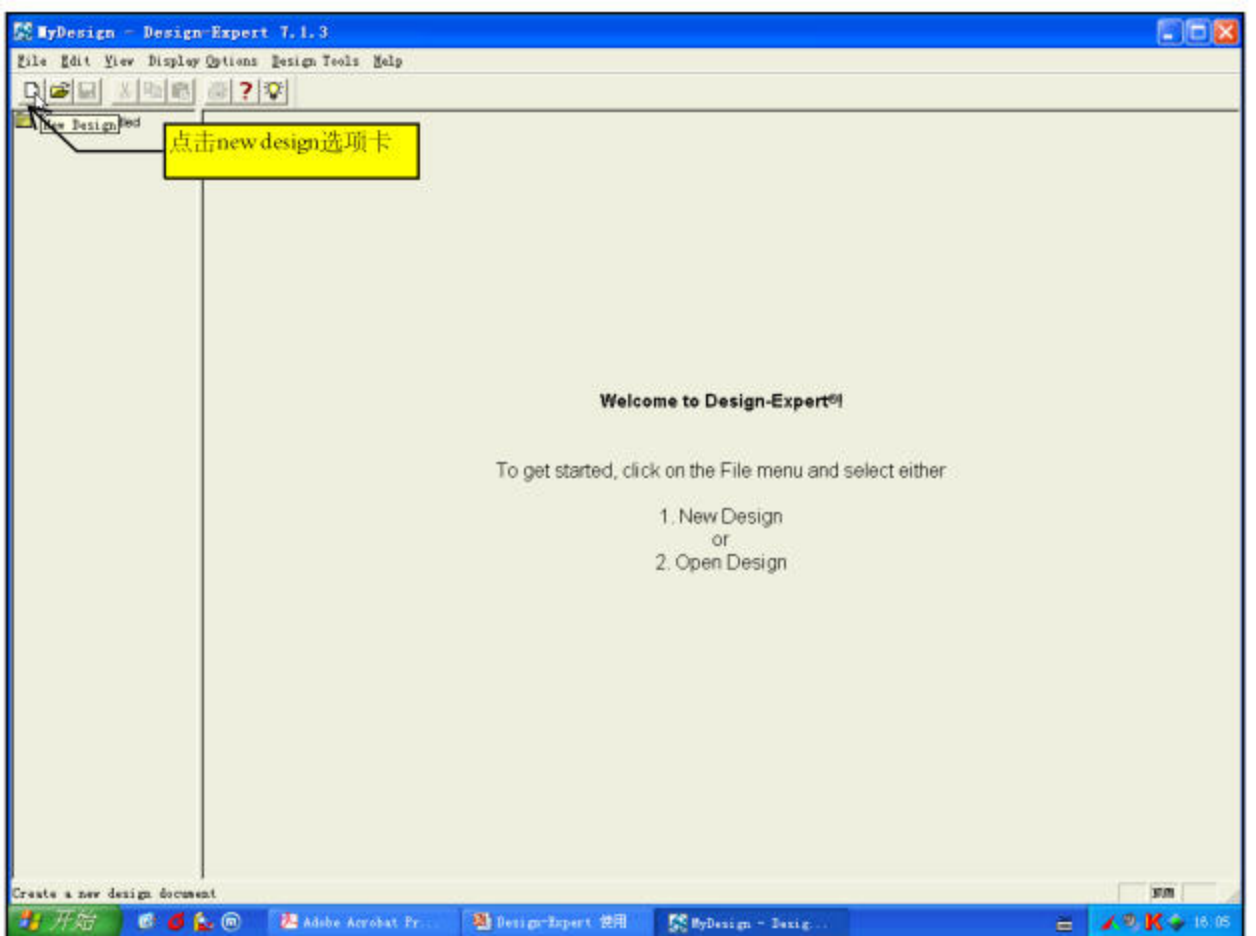
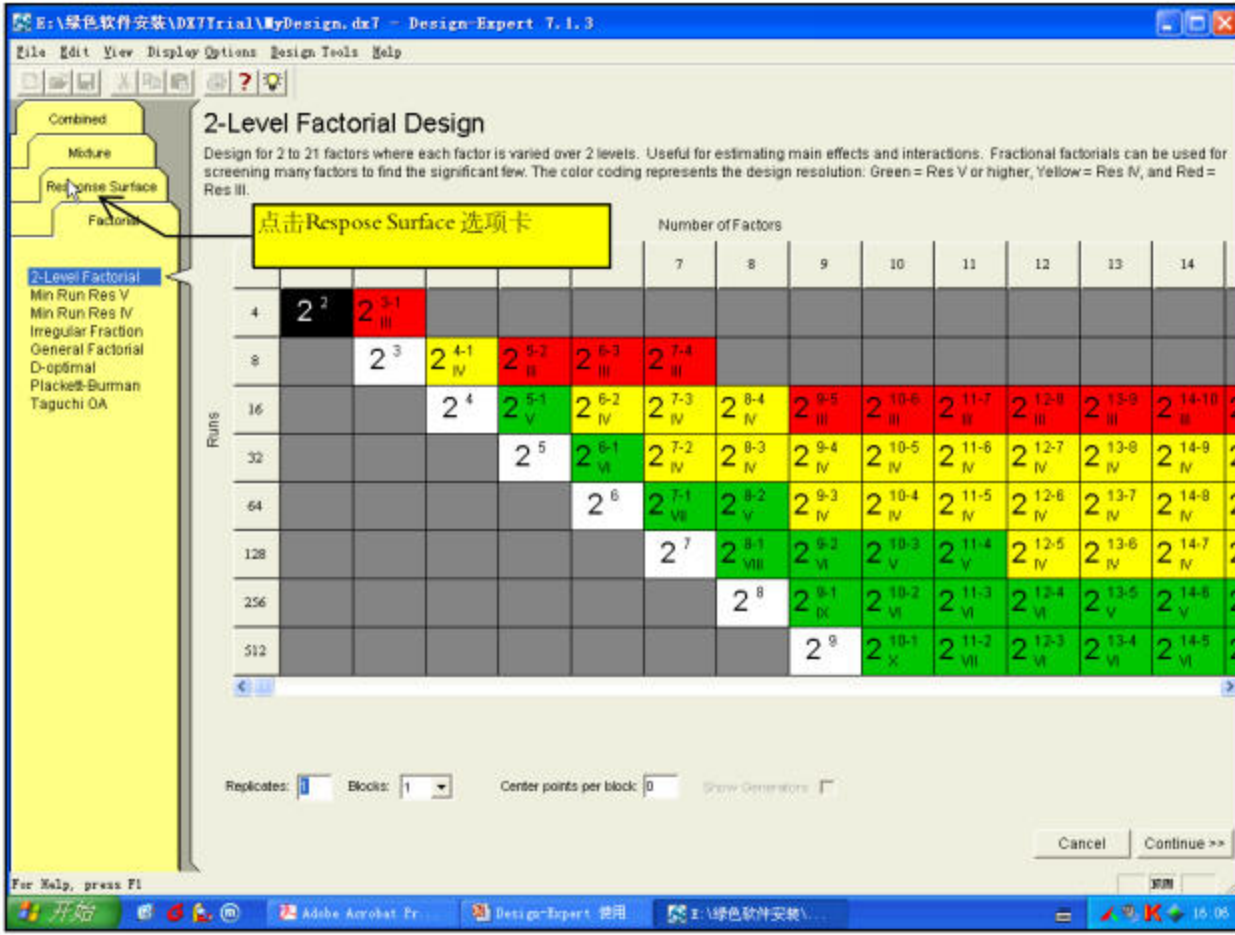
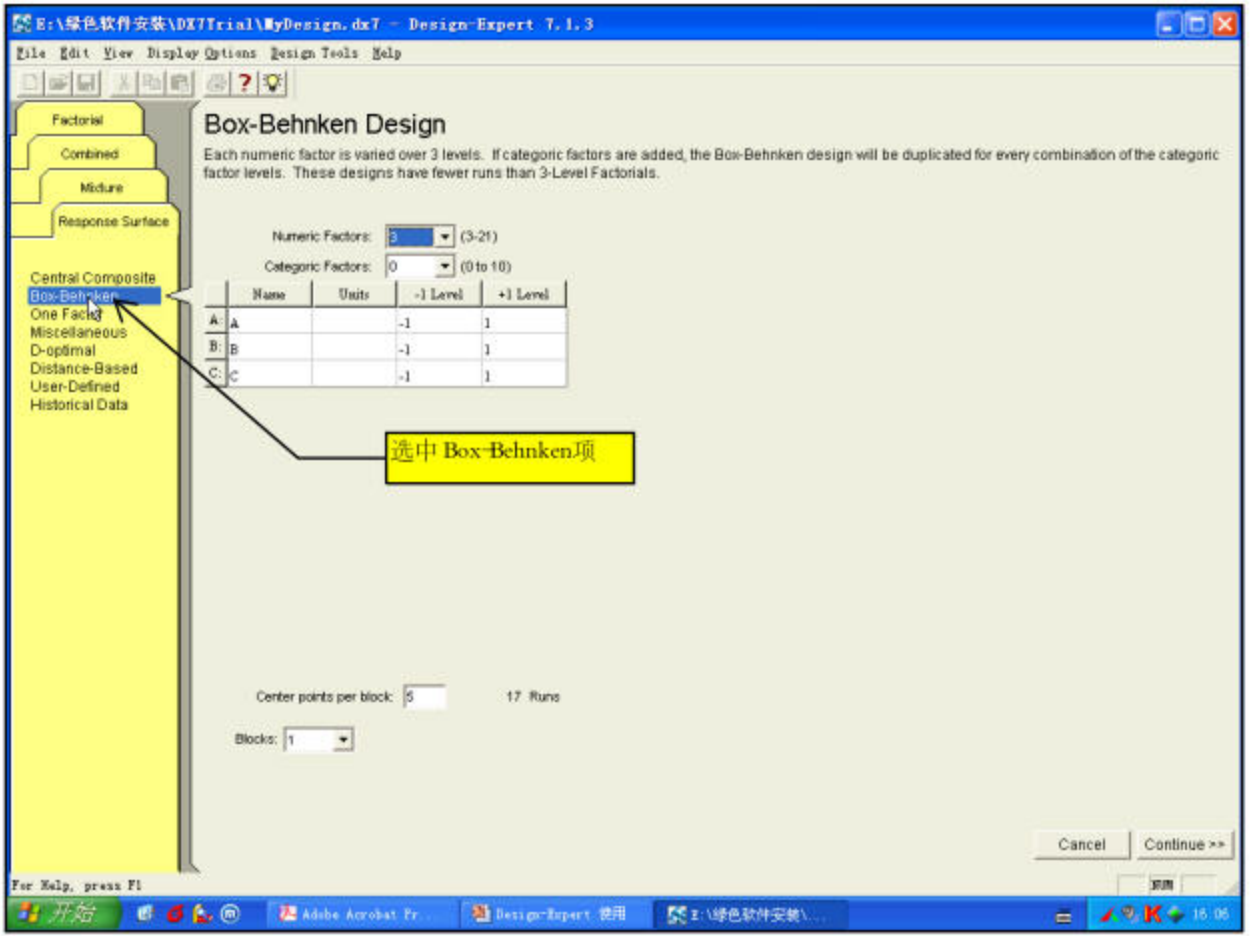
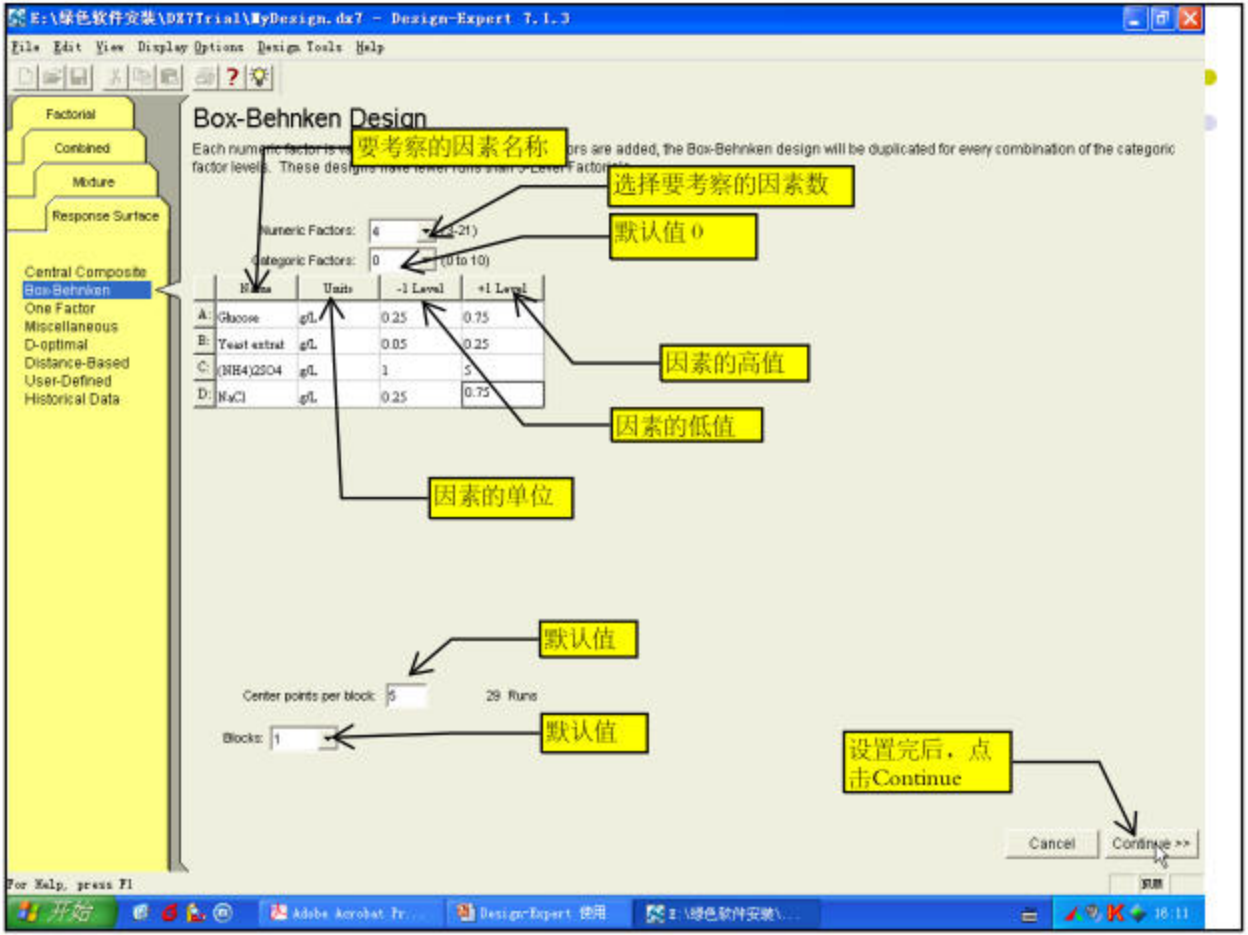
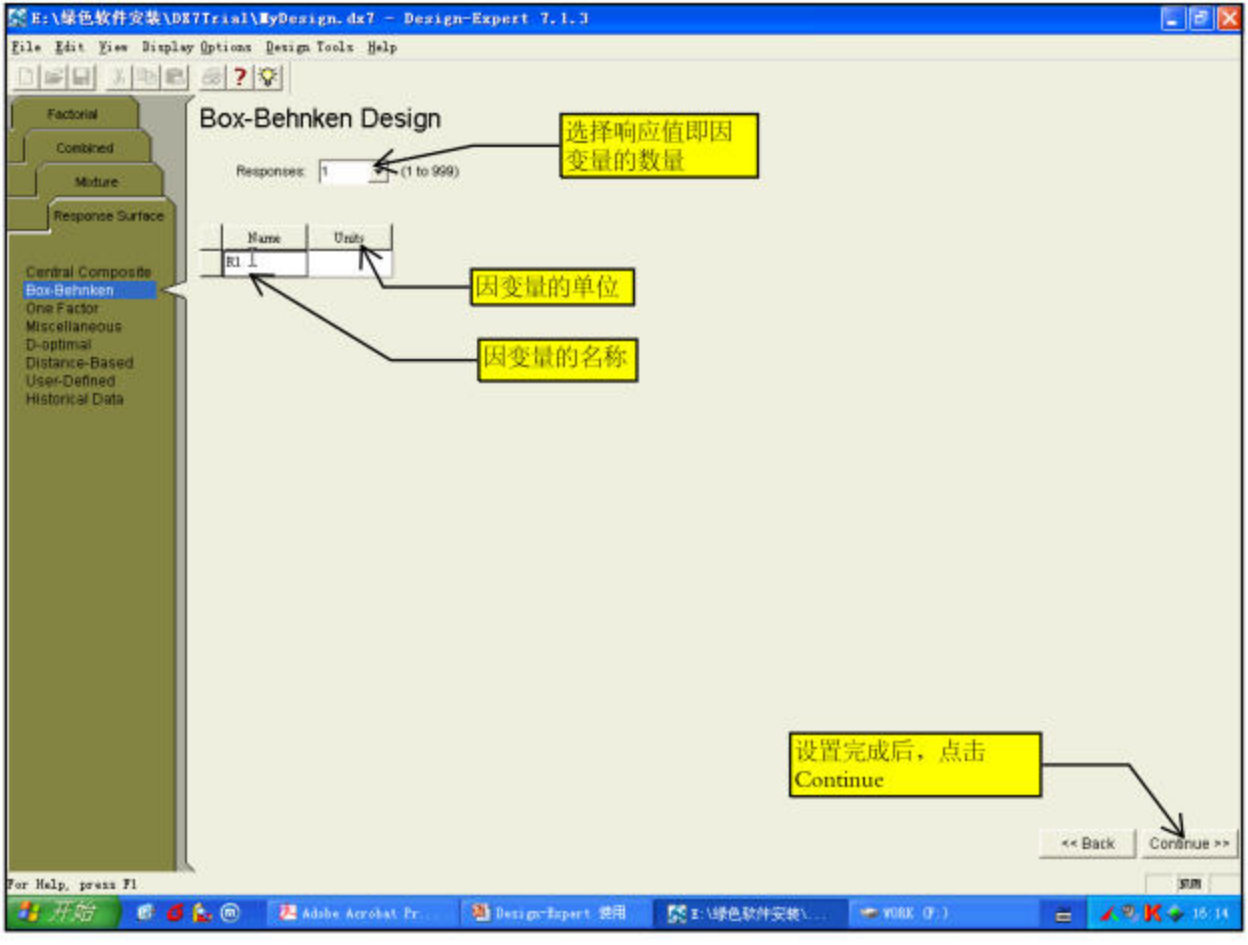
- Design-Expert是全球顶尖级的实验设计软件。
- Design-Expert 是最容易使用、功能最完整、界面最具亲和力的软件。在已经发表的有关响应曲面（RSM）优化试验的论文中， Design-Expert是最广泛使用的软件。
- Plackett–Burman(PB)、Central Composite Design (CCD)、Box-Behnken Design(BBD)是最常用的实验设计方法。
- 本教程以BBD为例说明Design-Expert的使用，CCD，PB与此类似。

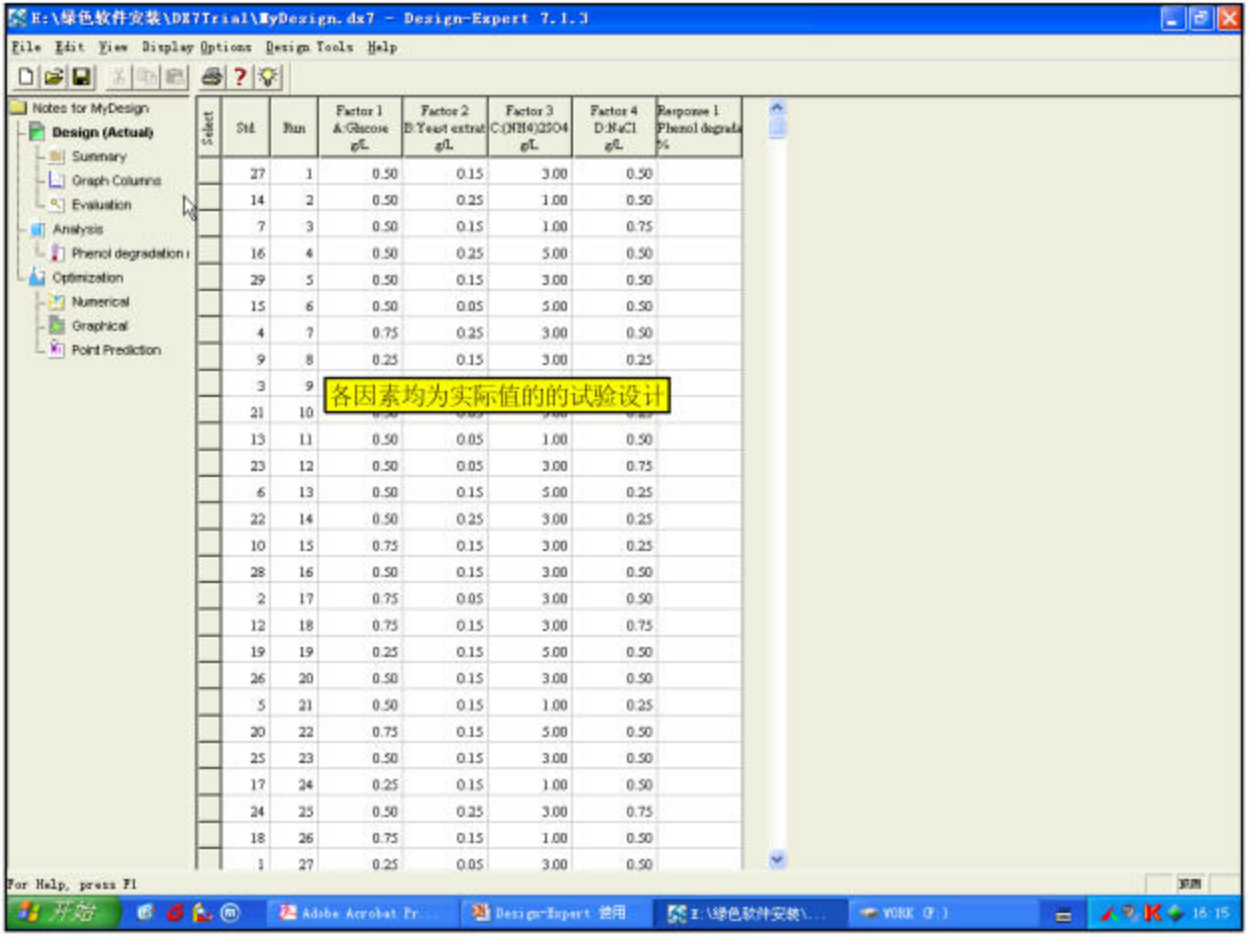

MyDesign - Design-Expert 7.1.3
File Edit View Display Options Design Tools Help
New Design
点击new design选项卡
Welcome to Design-Expert®!
To get started, click on the File menu and select either
1. New Design
or
2. Open Design
Create a new design document


E:\绿色软件安装\DX7Trial\MyDesign.dx7 - Design-Expert 7.1.3
File Edit View Display Options Design Tools Help
Combined
Mixture
Response Surface
Factorial
点击Respose Surface 选项卡
2-Level Factorial
Min Run Res V
Min Run Res IV
Irregular Fraction
General Factorial
D-optimal
Plackett-Burman
Taguchi OA
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.
Number of Factors
Runs
4
8
16
32
64
128
256
512
Replicates:
Blocks:
Center points per block:
Show Generators
Cancel
Continue >>
For Help, press F1


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 over 3 levels. If categoric factors are added, the Box-Behnken design will be duplicated for every combination of the categoric factor levels. These designs have fewer runs than 3-Level Factorials.
Numeric Factors: 3 (3-21)
Categoric Factors: 0 (0 to 10)
Name
Units
-1 Level
+1 Level
A: A -1 1
B: B -1 1
C: C -1 1
选中 Box-Behnken项
Center points per block: 5
17 Runs
Blocks: 1
Cancel
Continue >>
For Help, press F1
开始
Adobe Acrobat Pr...
Design-Expert 使用
E:\绿色软件安装\...
16:06

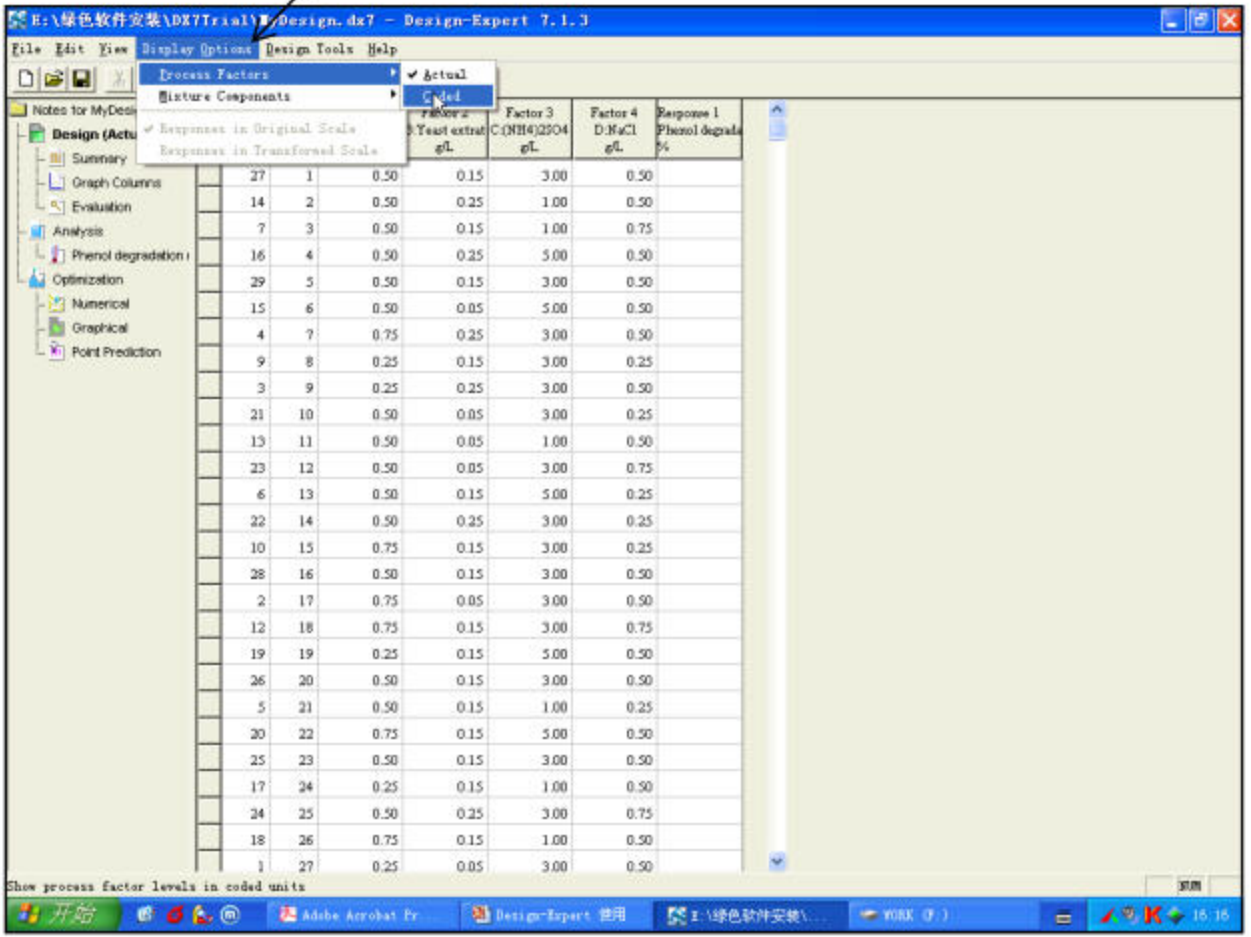

E:\绿色软件安装\DX7Trial\MyDesign.dx7 - Design-Expert 7.1.3
File Edit View Display Options Design Tools Help
Factorial
Combined
Mixture
Response Surface
Central Composite
Box-Behnken
One Factor
Miscellaneous
D-optimal
Distance-Based
User-Defined
Historical Data
Box-Behnken Design
Numeric Factors:
Categoric Factors:
(0 to 10)
Name
Units
-1 Level
+1 Level
A: Glucose g/L 0.25 0.75
B: Yeast extrat g/L 0.05 0.25
C: (NH4)2SO4 g/L 1 5
D: NaCl g/L 0.25 0.75
Center points per block:
29 Runs
Blocks:
Cancel
Continue >>
For Help, press F1
要考察的因素名称
选择要考察的因素数
默认值 0
因素的高值
因素的低值
因素的单位
默认值
默认值
设置完后，点击Continue


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
Responses: 1 (1 to 999)
选择响应值即因变量的数量
Name
Units
A1
因变量的单位
因变量的名称
设置完成后，点击Continue
<< Back
Continue >>
For Help, press F1

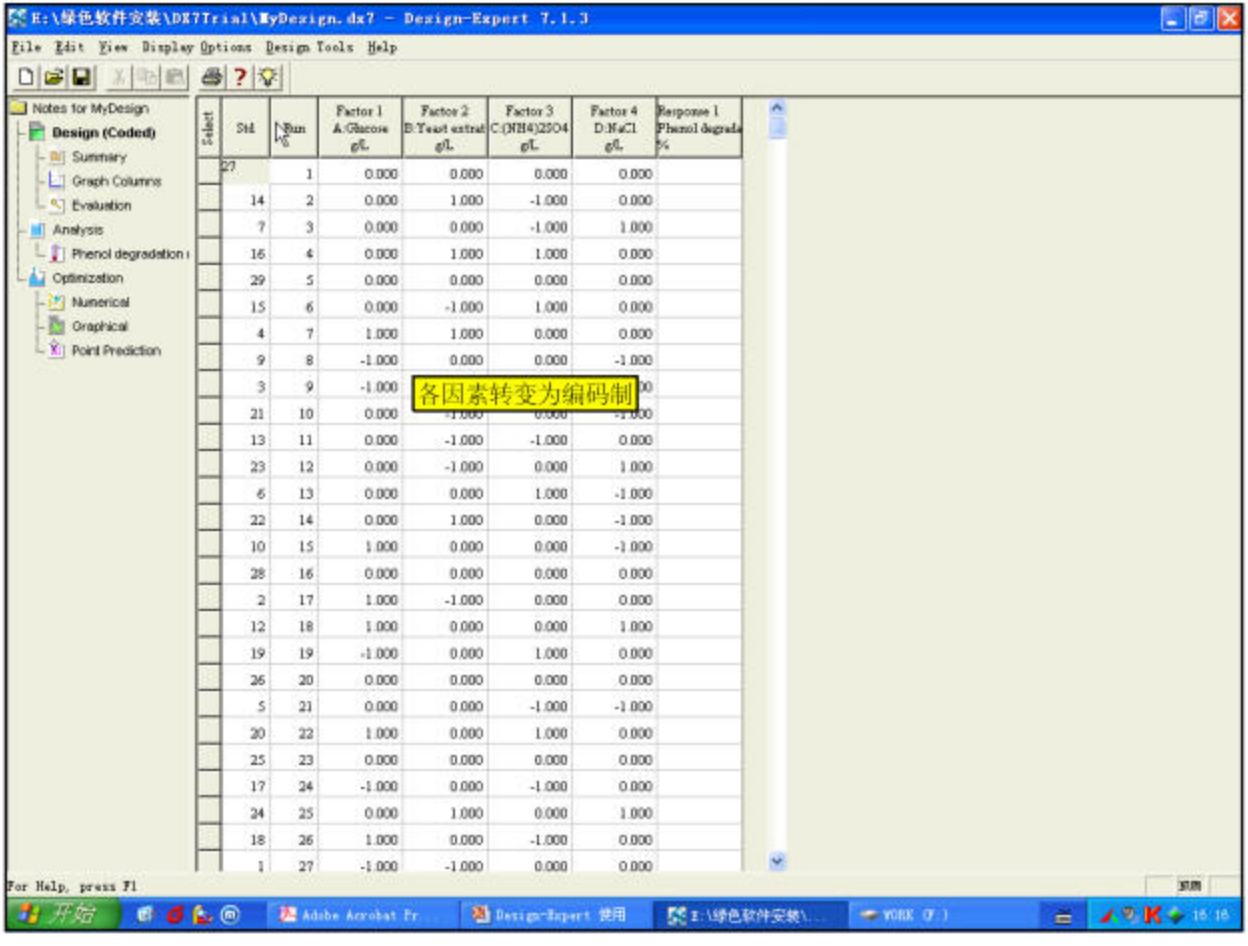


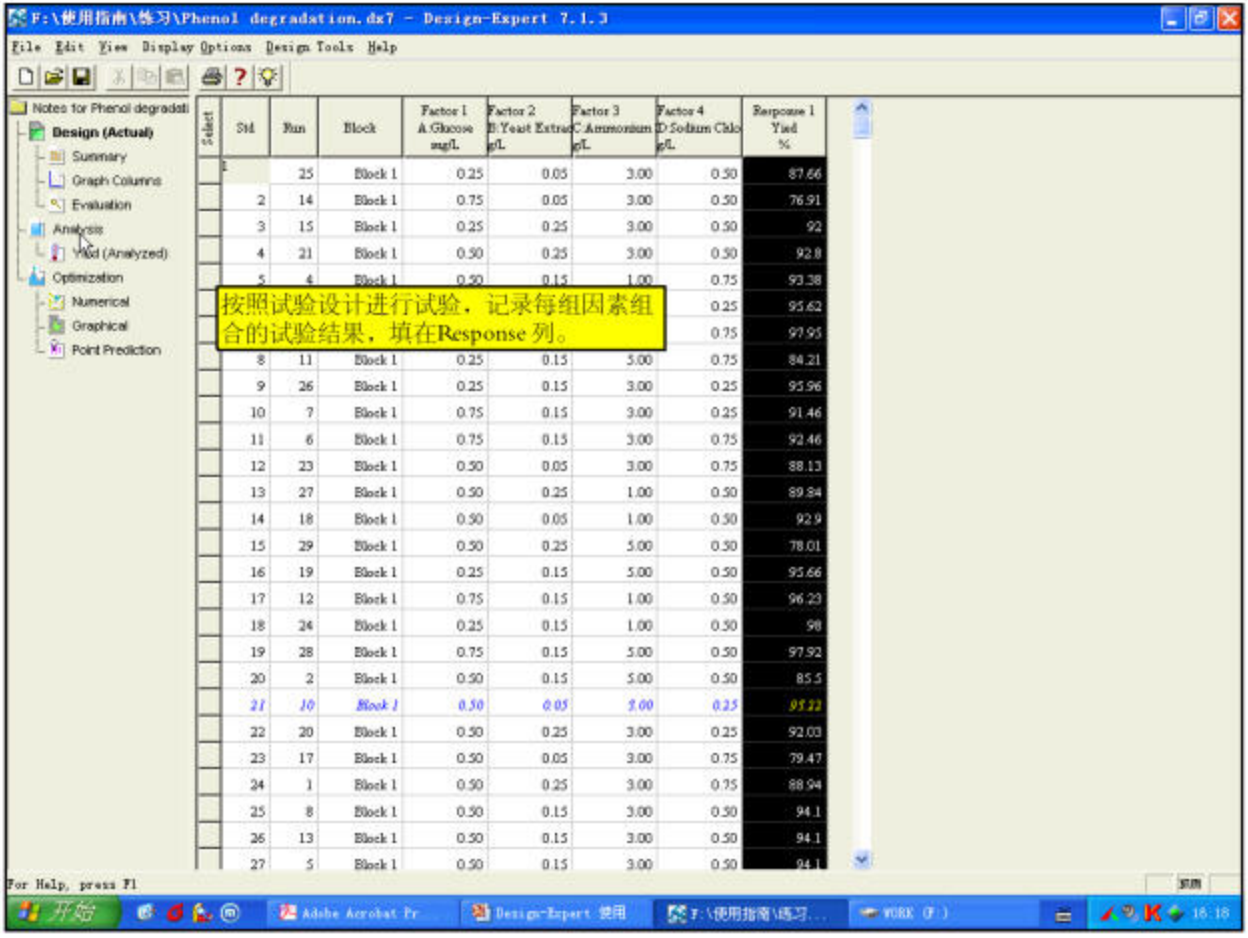
Select	Std	Run	Factor 1 A:Glucose g/L	Factor 2 B:Yeast extrac g/L	Factor 3 C:(NH4)2SO4 g/L	Factor 4 D:NaCl g/L	Response 1 Phenol degrada %
	27	1	0.50	0.15	3.00	0.50	
	14	2	0.50	0.25	1.00	0.50	
	7	3	0.50	0.15	1.00	0.75	
	16	4	0.50	0.25	5.00	0.50	
	29	5	0.50	0.15	3.00	0.50	
	15	6	0.50	0.05	5.00	0.50	
	4	7	0.75	0.25	3.00	0.50	
	9	8	0.25	0.15	3.00	0.25	
	3	9					
	21	10					
	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	

各因素的实际值转变为编码制的操作过程

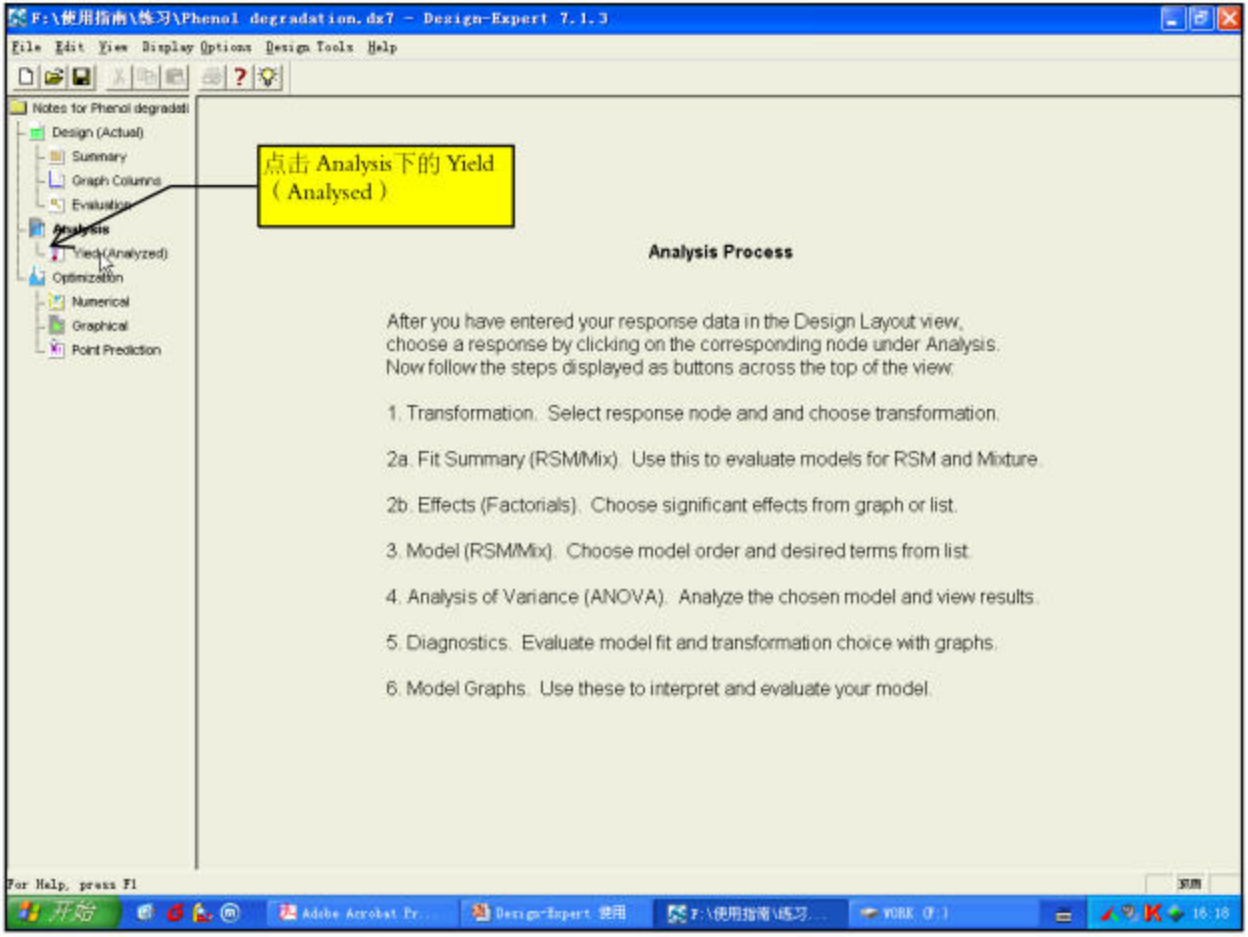


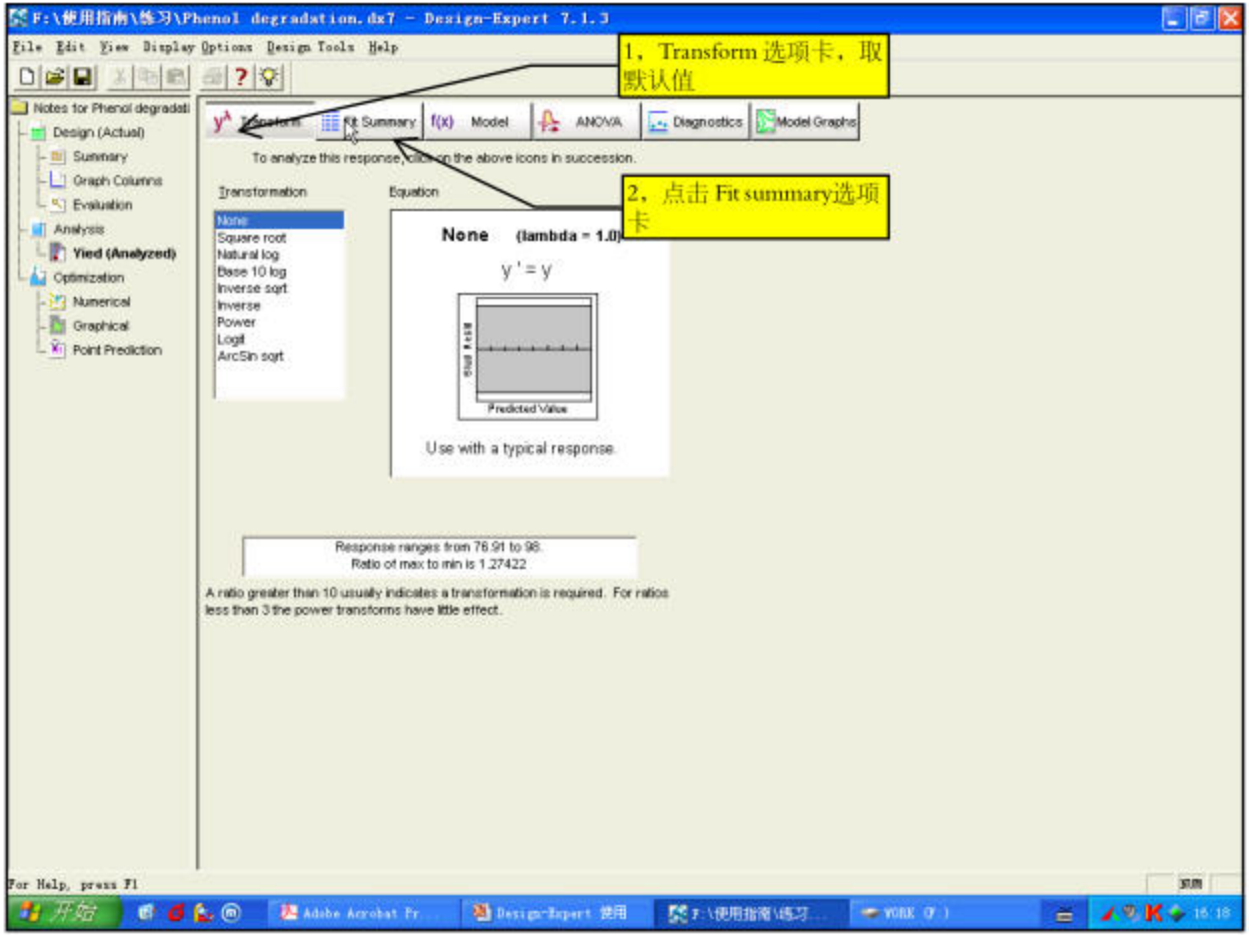
	27	1	0.50	0.15	3.00	0.50	
	14	2	0.50	0.25	1.00	0.50	
	7	3	0.50	0.15	1.00	0.75	
	16	4	0.50	0.25	5.00	0.50	
	29	5	0.50	0.15	3.00	0.50	
	15	6	0.50	0.05	5.00	0.50	
	4	7	0.75	0.25	3.00	0.50	
	9	8	0.25	0.15	3.00	0.25	
	3	9	0.25	0.25	3.00	0.50	
	21	10	0.50	0.05	3.00	0.25	
	13	11	0.50	0.05	1.00	0.50	
	23	12	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	


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
21 10 0.000
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
开始
Adobe Acrobat Pr...
Design-Expert 使用
E:\绿色软件安装\...
WORK (F:)
15:16



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	22	Block 1	0.75	0.25	1.00	0.25	95.62
	7	16	Block 1	0.25	0.25	1.00	0.75	97.93
	8	11	Block 1	0.25	0.15	5.00	0.75	84.21
	9	26	Block 1	0.25	0.15	3.00	0.25	95.96
	10	7	Block 1	0.75	0.15	3.00	0.25	91.46
	11	6	Block 1	0.75	0.15	3.00	0.75	92.46
	12	23	Block 1	0.50	0.05	3.00	0.75	88.13
	13	27	Block 1	0.50	0.25	1.00	0.50	89.84
	14	18	Block 1	0.50	0.05	1.00	0.50	92.9
	15	29	Block 1	0.50	0.25	5.00	0.50	78.01
	16	19	Block 1	0.25	0.15	5.00	0.50	95.66
	17	12	Block 1	0.75	0.15	1.00	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	95.22
	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


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
点击 Analysis 下的 Yield
（Analysed）
Analysis Process
After you have entered your response data in the Design Layout view,
choose a response by clicking on the corresponding node under Analysis.
Now follow the steps displayed as buttons across the top of the view.
1. Transformation. Select response node and and choose transformation.
2a. Fit Summary (RSM/Mix). Use this to evaluate models for RSM and Mixture.
2b. Effects (Factorials). Choose significant effects from graph or list.
3. Model (RSM/Mix). Choose model order and desired terms from list.
4. Analysis of Variance (ANOVA). Analyze the chosen model and view results.
5. Diagnostics. Evaluate model fit and transformation choice with graphs.
6. Model Graphs. Use these to interpret and evaluate your model.
For Help, press F1
开始
Adobe Acrobat Pr...
Design-Expert 使用
F:\使用指南\练习...
WORK (F:)
16:16


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
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Graph Columns
Evaluation
Analysis
Yied (Analyzed)
Optimization
Numerical
Graphical
Point Prediction
Transform
Fit Summary
Model
ANOVA
Diagnostics
Model Graphs
To analyze this response, click on the above icons in succession.
2，点击 Fit summary选项卡
Transformation
Equation
None
Square root
Natural log
Base 10 log
Inverse sqrt
Inverse
Power
Logit
ArcSin sqrt
None (lambda = 1.0)
y ' = y
Std Resid
Predicted Value
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
开始
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Design-Expert 使用
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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
  - Yied (Analyzed)
- Optimization
  - Numerical
  - Graphical
  - Point Prediction

Transform | Fit Summary | Model | ANOVA | Diagnostics | Model Graphs

Response 1 **Yied** **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 Quadrati	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.

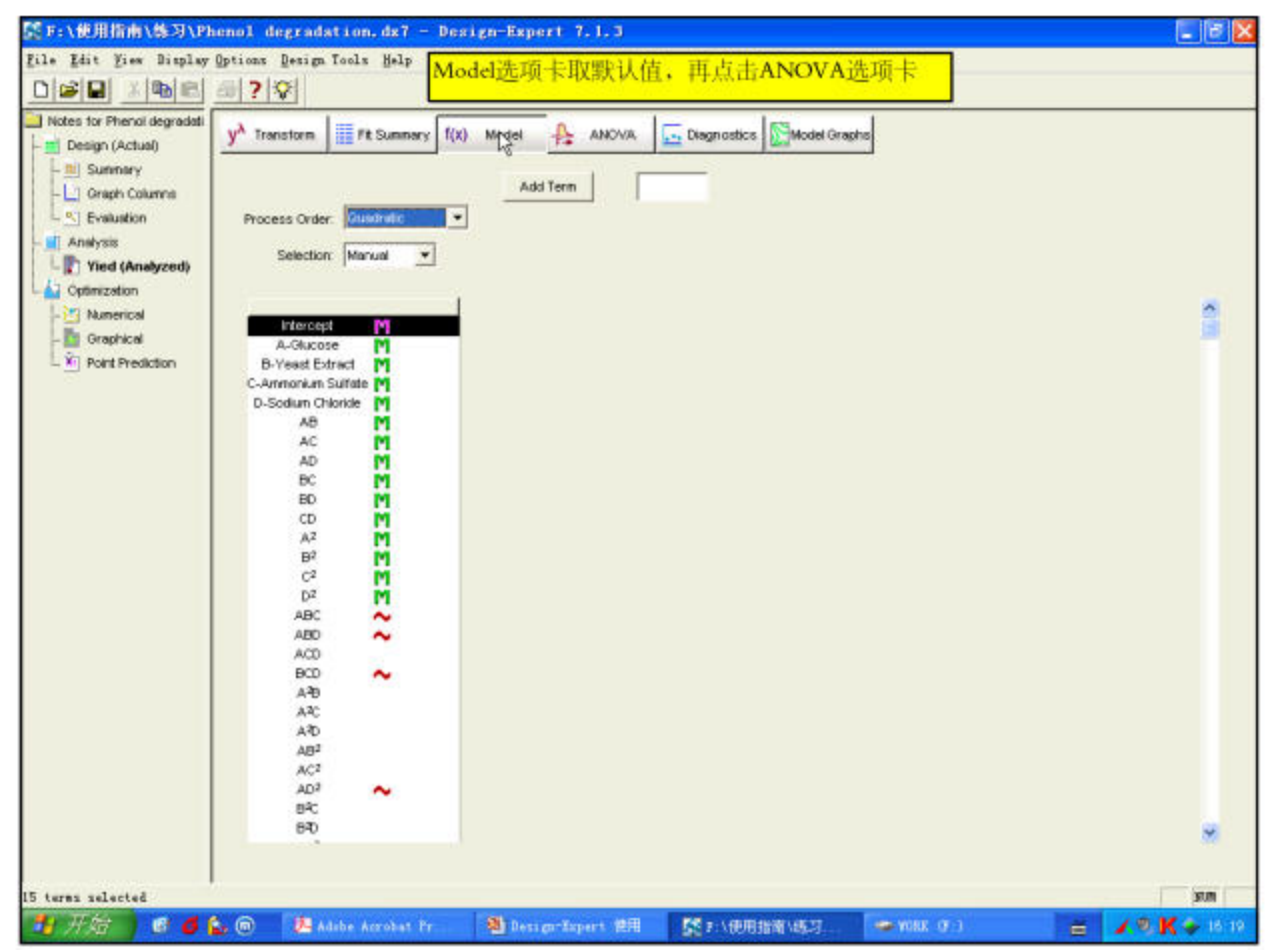
Lack of Fit Tests

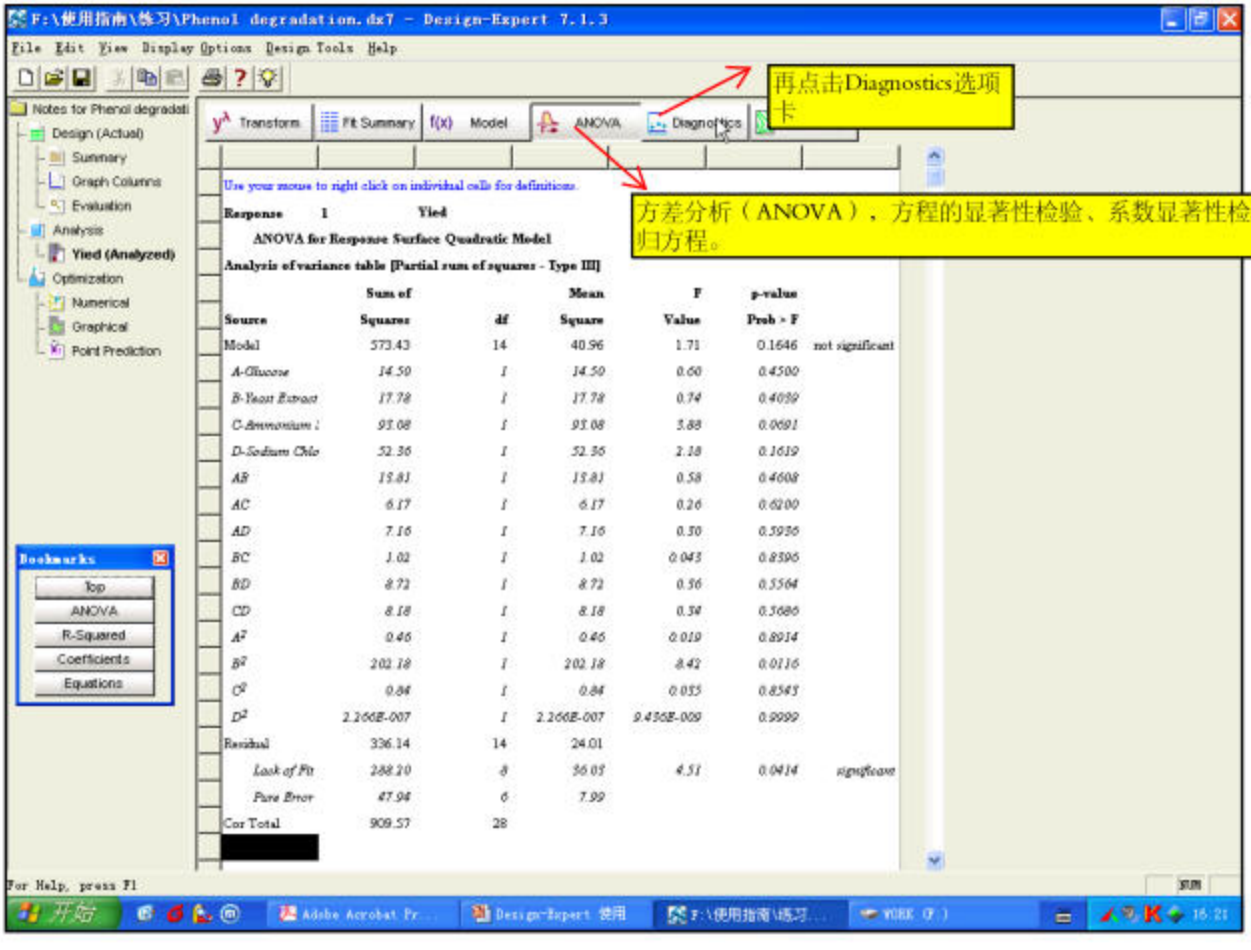
Source	Sum of Squares	df	Mean Square	F Value	p-value Prob > F	
Linear	665.38	18	36.97	4.63	0.0333	
2FI	524.16	12	43.68	5.47	0.0239	
Quadratic	288.20	8	36.03	4.51	0.0414	Suggested
Cubic	0.000	0				Aliased
Pure Error	47.94	6	7.99			

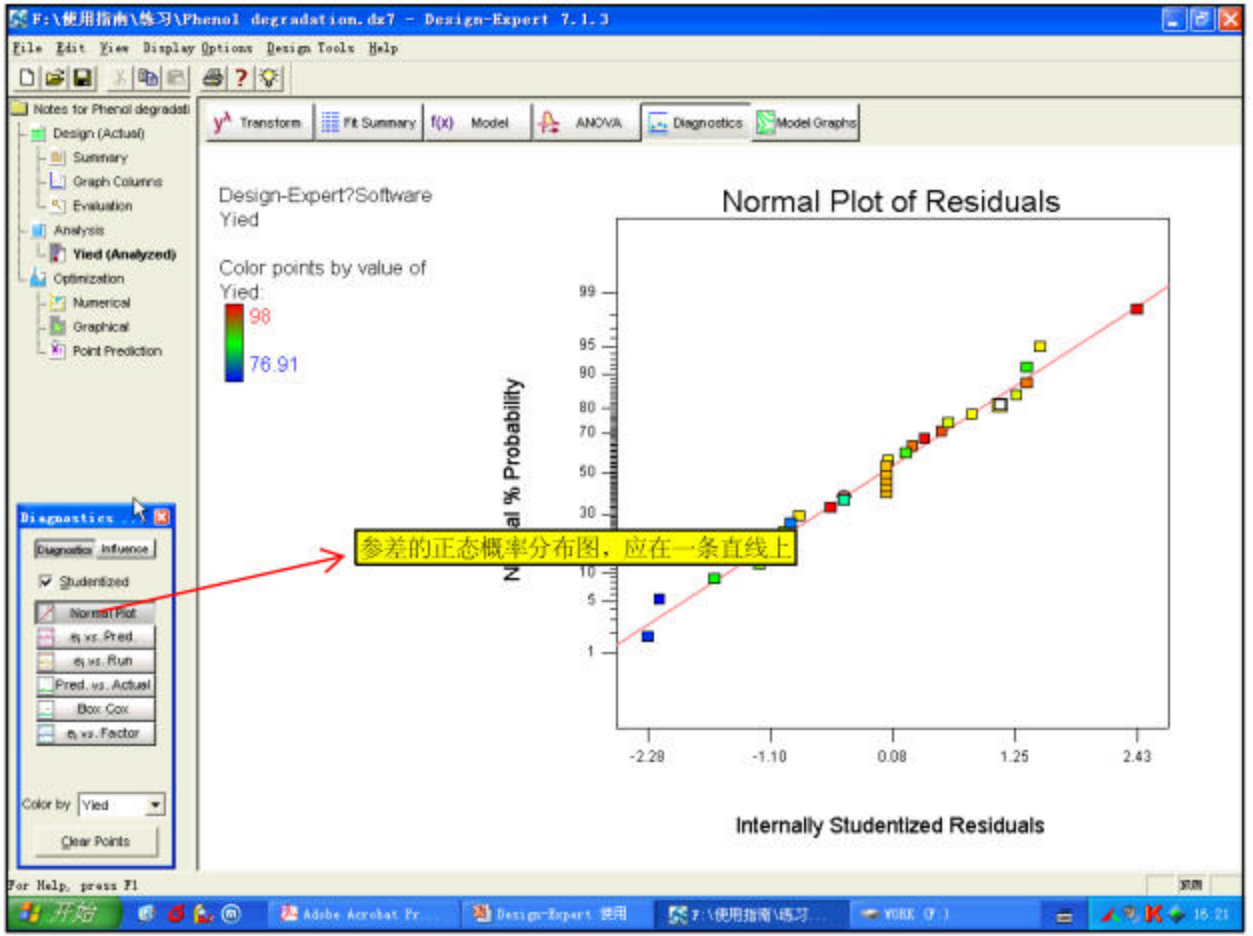
Bookmarks
- Top
- Sum of Squares
- Lack of Fit
- R-Squared

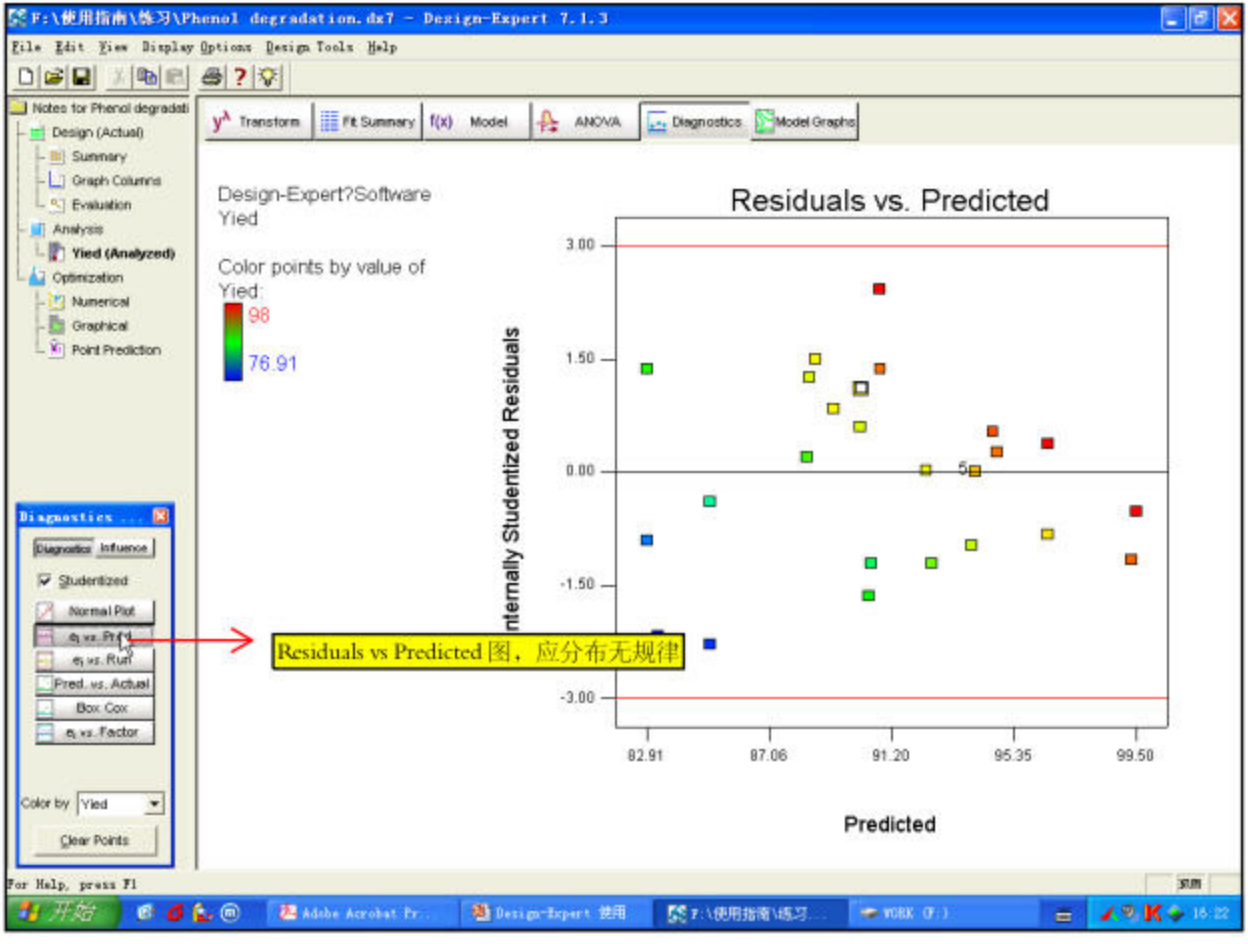
For Help, press F1

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
Model选项卡取默认值，再点击ANOVA选项卡
Notes for Phenol degradati
Design (Actual)
Summary
Graph Columns
Evaluation
Analysis
Yied (Analyzed)
Optimization
Numerical
Graphical
Point Prediction
Transform
Fit Summary
Model
ANOVA
Diagnostics
Model Graphs
Add Term
Process Order: Quadratic
Selection: Manual
Intercept M
A-Glucose M
B-Yeast Extract M
C-Ammonium Sulfate M
D-Sodium Chloride M
AB M
AC M
AD M
BC M
BD M
CD M
A² M
B² M
C² M
D² M
ABC ~
ABD ~
ACD
BCD ~
AB²
AC²
AD² ~
B²C
B²D
15 terms selected
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
Notes for Phenol degradati
Design (Actual)
Summary
Graph Columns
Evaluation
Analysis
Yied (Analyzed)
Optimization
Numerical
Graphical
Point Prediction
Transform
Fit Summary
Model
ANOVA
Diagnostics
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，归方程。
Use your mouse to right click on individual cells for definitions.
Response 1 Yied
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 | 0.4059
C-Ammonium : | 93.08 | 1 | 93.08 | 3.88 | 0.0691
D-Sodium Chlo | 52.36 | 1 | 52.36 | 2.18 | 0.1619
AB | 15.81 | 1 | 15.81 | 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 | 0.8395
BD | 8.72 | 1 | 8.72 | 0.36 | 0.5564
CD | 8.18 | 1 | 8.18 | 0.34 | 0.5686
A² | 0.46 | 1 | 0.46 | 0.019 | 0.8914
B² | 202.18 | 1 | 202.18 | 8.42 | 0.0116
C² | 0.84 | 1 | 0.84 | 0.035 | 0.8545
D² | 2.266E-007 | 1 | 2.266E-007 | 9.435E-009 | 0.9999
Residual | 336.14 | 14 | 24.01
Lack of Fit | 288.20 | 8 | 36.05 | 4.51 | 0.0414 significant
Pure Error | 47.94 | 6 | 7.99
Cor Total | 909.57 | 28
Bookmarks
Top
ANOVA
R-Squared
Coefficients
Equations
For Help, press F1


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
Yied (Analyzed)
Optimization
Numerical
Graphical
Point Prediction
Transform
Fit Summary
Model
ANOVA
Diagnostics
Model Graphs
Design-Expert?Software
Yied
Color points by value of
Yied:
98
76.91
Normal Plot of Residuals
Normal % Probability
99
95
90
80
70
50
30
10
5
1
-2.28
-1.10
0.08
1.25
2.43
Internally Studentized Residuals
参差的正态概率分布图，应在一条直线上
Diagnostics
Diagnostics
Influence
Studentized
Normal Plot
ei vs. Pred
ei vs. Run
Pred. vs. Actual
Box-Cox
ei vs. Factor
Color by
Yied
Clear Points
For Help, press F1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File Edit View Display Options Design Tools Help
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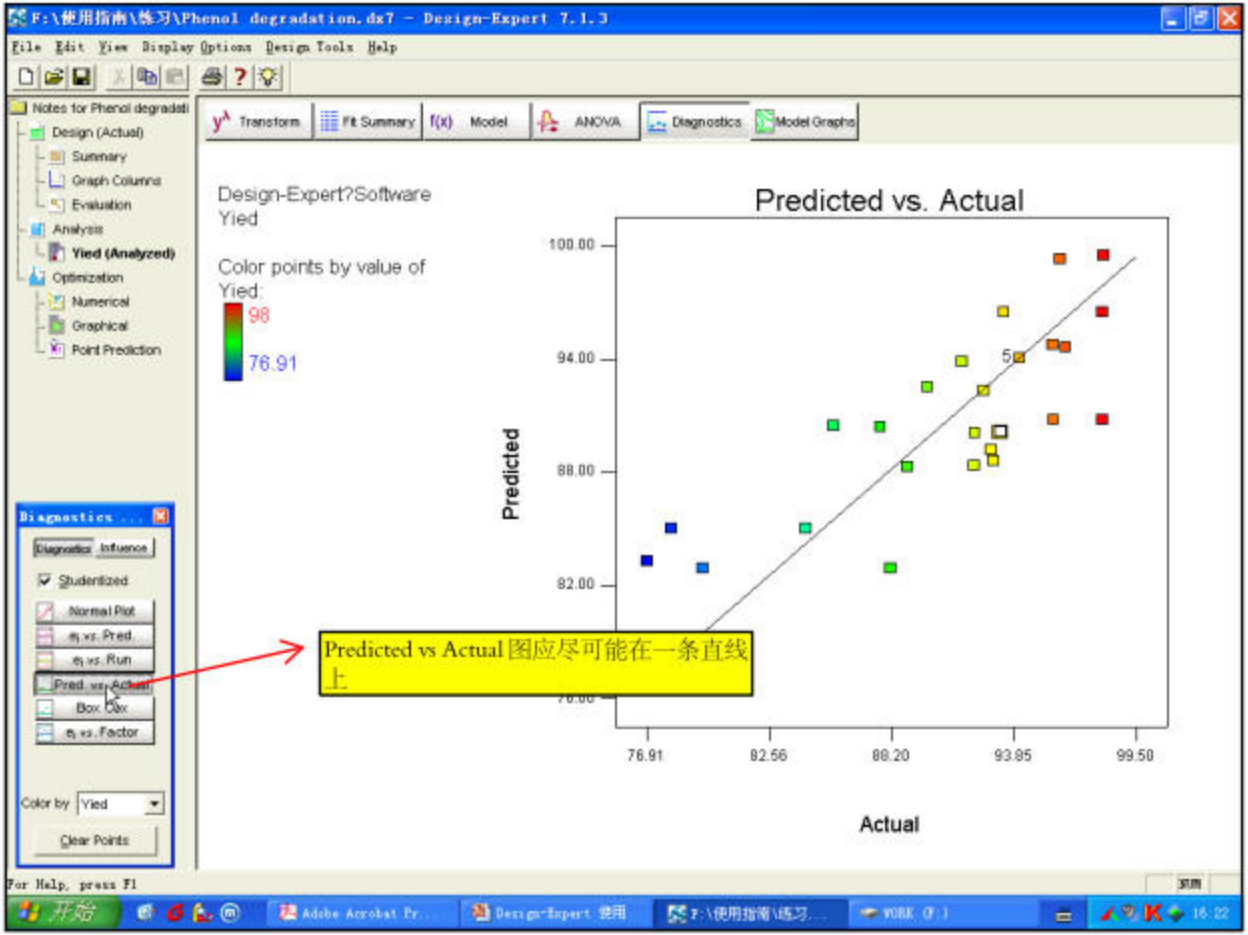
Point Prediction
Transform
Fit Summary
Model
ANOVA
Diagnostics
Model Graphs
Design-Expert?Software
Yied
Color points by value of
Yied:
98
76.91
Residuals vs. Predicted
Internally Studentized Residuals
3.00
1.50
0.00
-1.50
-3.00
82.91
87.06
91.20
95.35
99.50
Predicted
Diagnostics
Diagnostics
Influence
Studentized
Normal Plot
Residuals vs. Predicted
Residuals vs. Run
Pred. vs. Actual
Box-Cox
Residuals vs. Factor
Color by
Yied
Clear Points
Residuals vs Predicted 图，应分布无规律
For Help, press F1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Fit Summary
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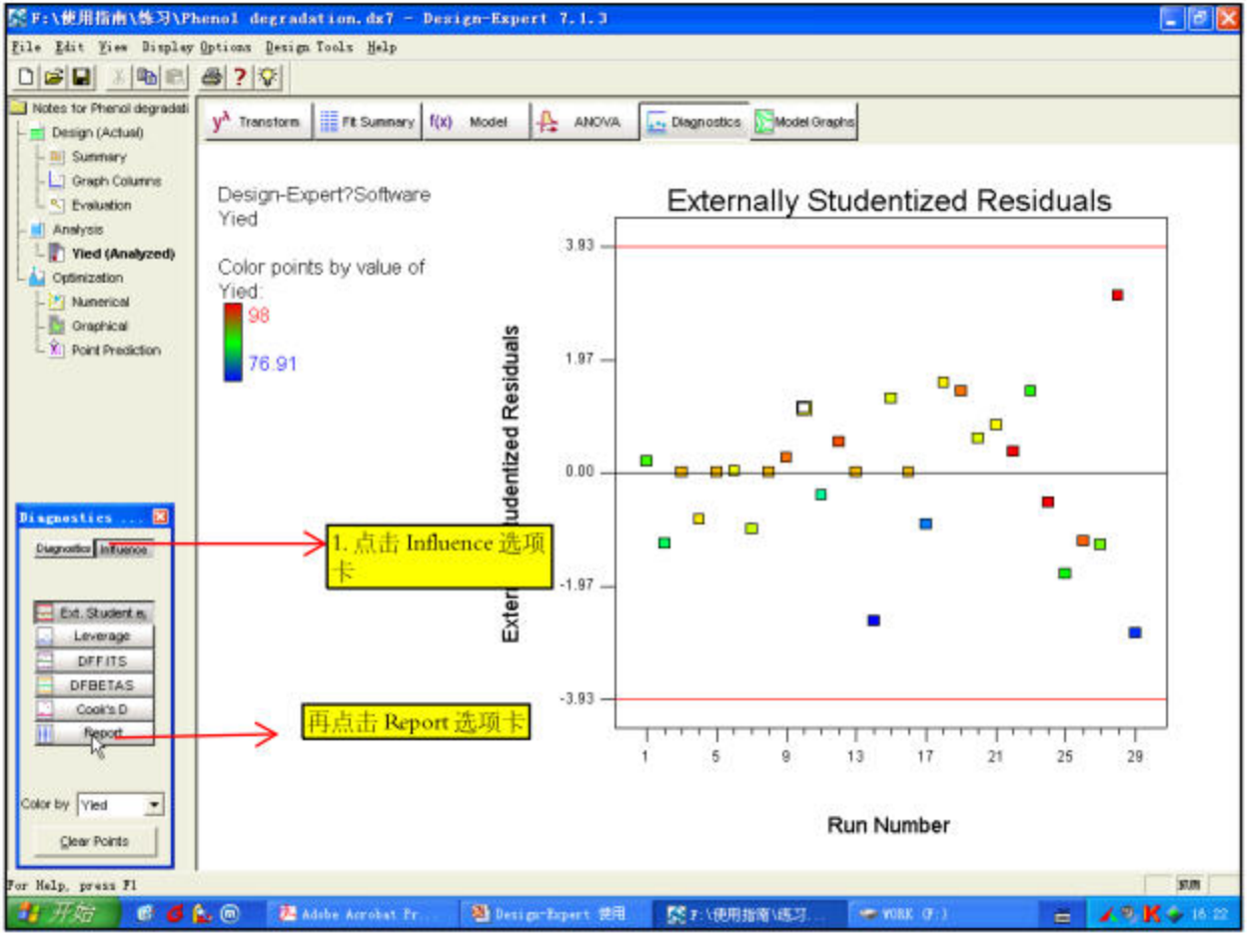
Diagnostics
Model Graphs
Design-Expert?Software
Yied
Color points by value of
Yied:
98
76.91
Predicted vs. Actual
Predicted
Actual
100.00
94.00
88.00
82.00
76.91
82.56
88.20
93.85
99.50
Diagnostics
Diagnostics
Influence
Studentized
Normal Plot
ei vs. Pred.
ei vs. Run
Pred. vs. Actual
Box-Cox
ei vs. Factor
Color by
Yied
Clear Points
Predicted vs Actual图应尽可能在一条直线上
For Help, press F1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Fit Summary
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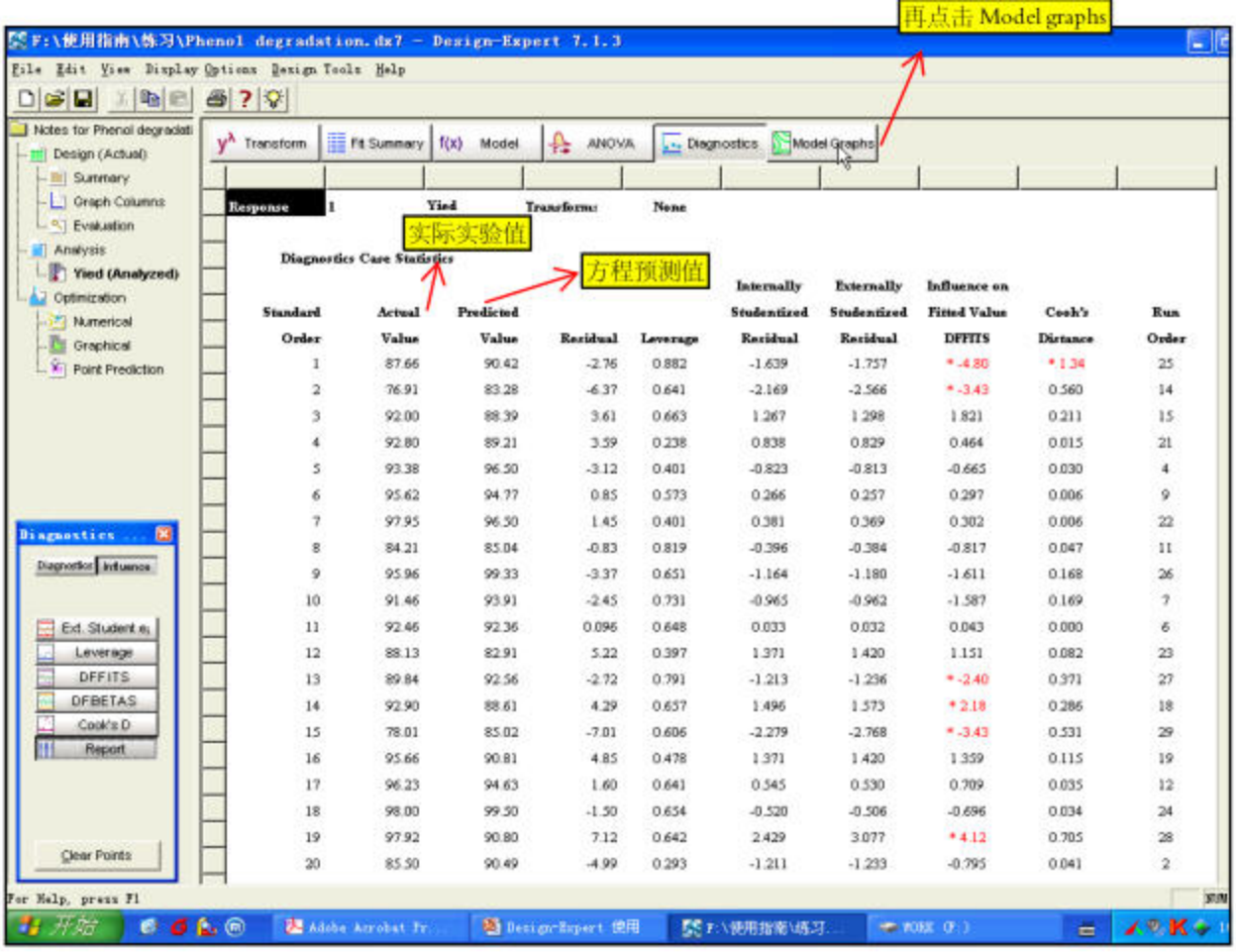
ANOVA
Diagnostics
Model Graphs
Design-Expert?Software
Yied
Color points by value of
Yied:
98
76.91
Externally Studentized Residuals
3.93
1.97
0.00
-1.97
-3.93
1
5
9
13
17
21
25
29
Run Number
Diagnostics
Diagnostics
Influence
Ext. Student e
Leverage
DFFITS
DFBETAS
Cook's D
Report
Color by
Yied
Clear Points
1. 点击 Influence 选项卡
再点击 Report 选项卡
For Help, press F1


再点击 Model graphs
F:\使用指南\练习\Phenol degradation.dx7 - Design-Expert 7.1.3
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Point Prediction
Transform
Fit Summary
Model
ANOVA
Diagnostics
Model Graphs
Response 1 Yied 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
Diagnostics ...
Diagnostics Influence
Ext. Student e_i
Leverage
DFFITS
DFBETAS
Cook's D
Report
Clear Points
For Help, press F1
开始
Adobe Acrobat Pr...
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File Edit View Display Options Design Tools Help

Notes for Phenol degradati
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Optimization
Numerical
Graphical
Point Prediction

Transform | Fit Summary | Model | ANOVA | Diagnostics | Model Graphs

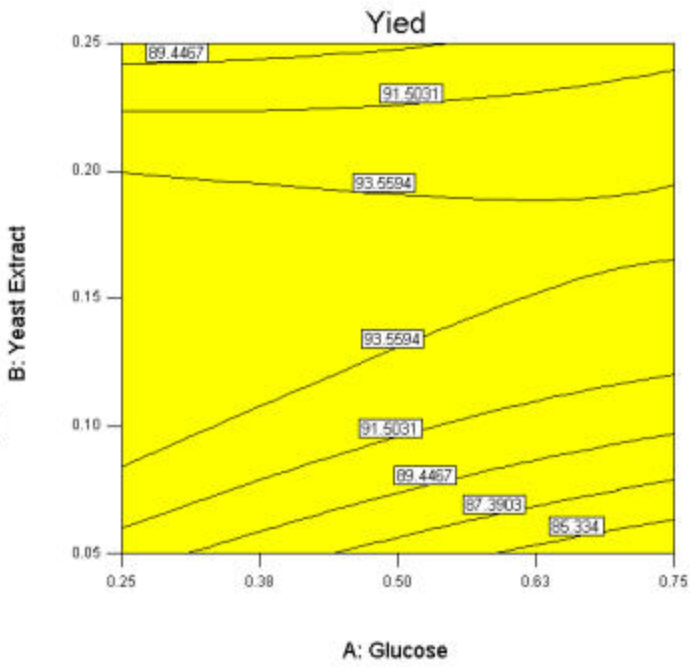
Design-Expert?Software

Yied

X1 = A: Glucose
X2 = B: Yeast Extract

Actual Factors
C: Ammonium Sulfate = 3.00
D: Sodium Chloride = 0.50

等高线图

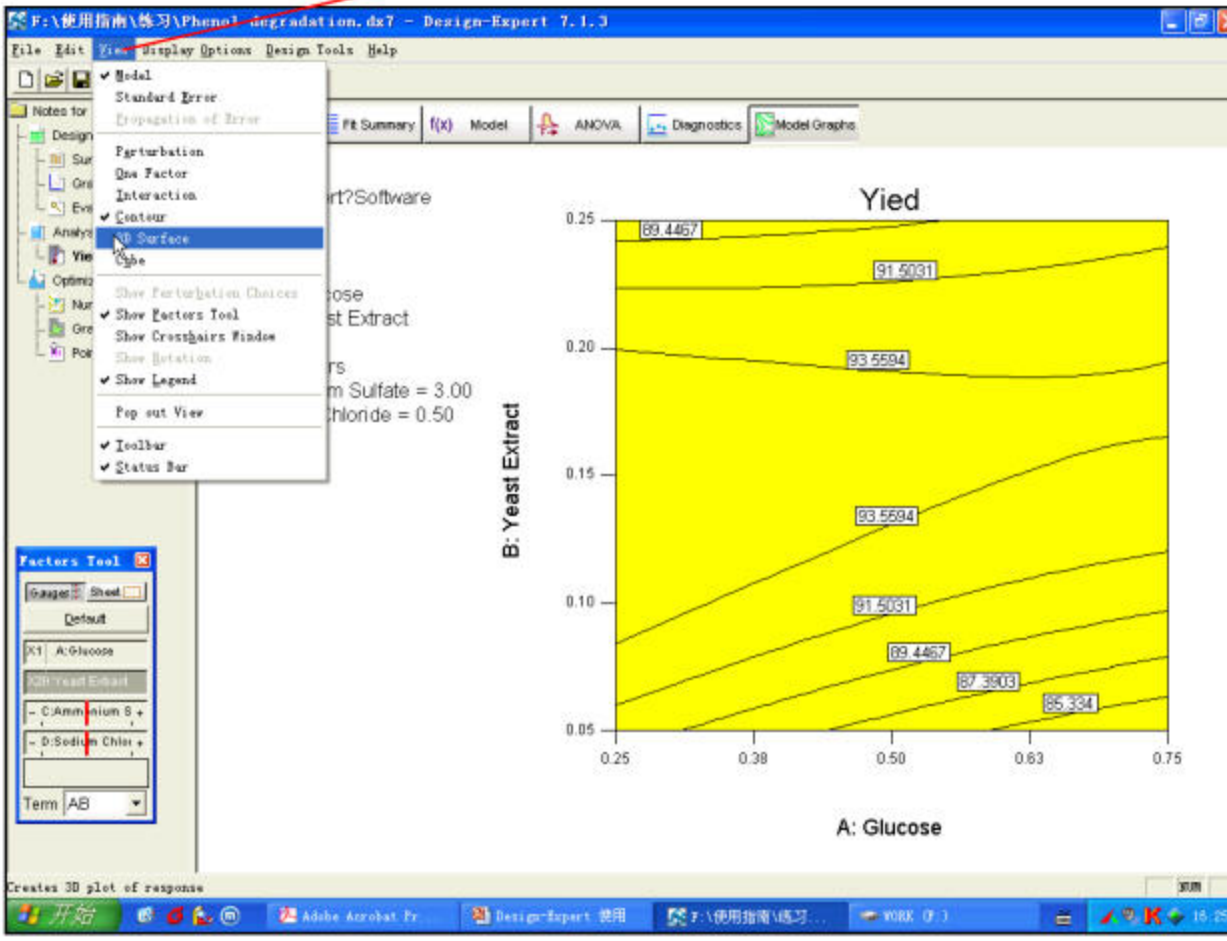


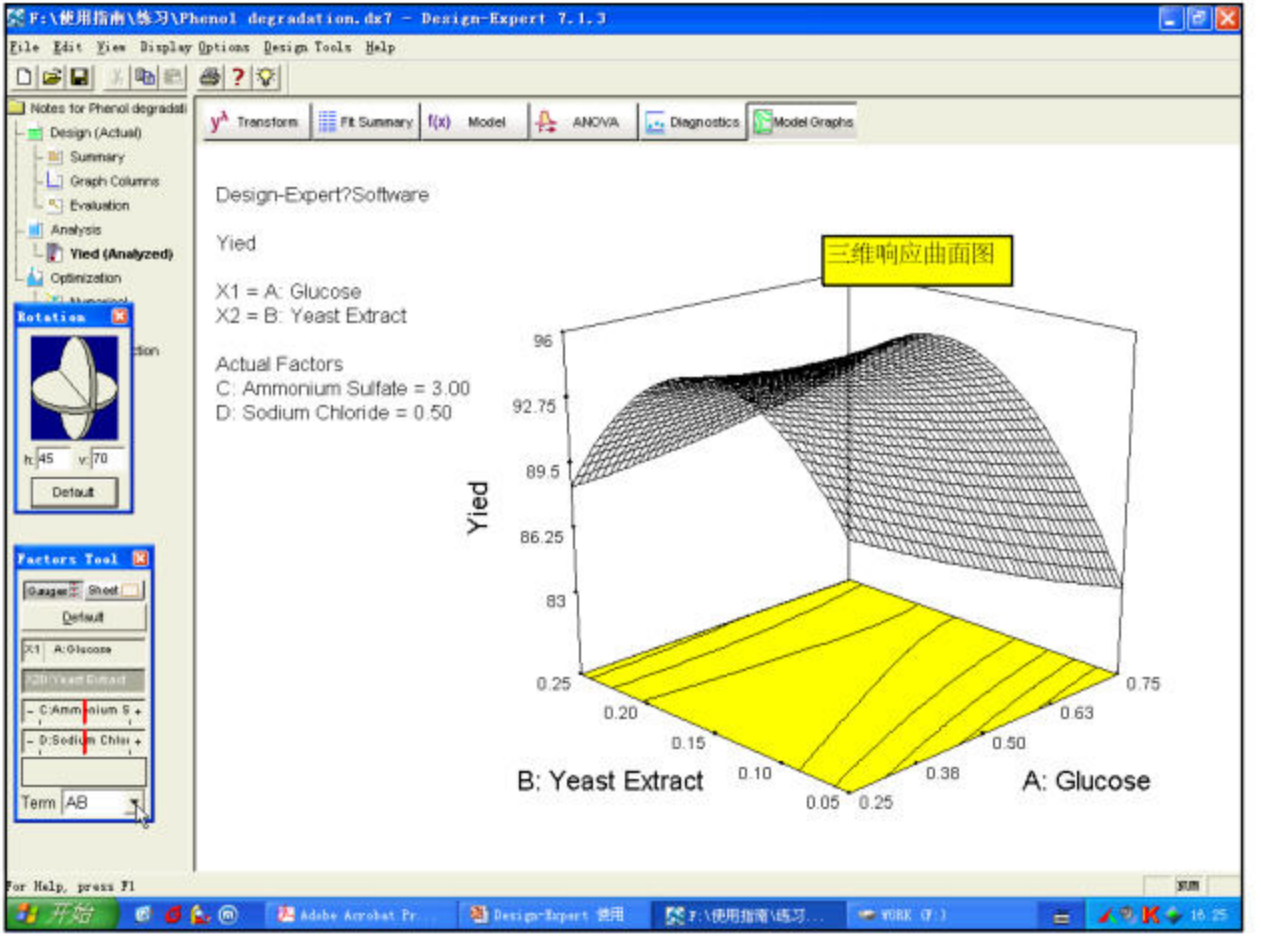
Factors Tool
Graphs | Sheet
Default
X1 A:Glucose
X2 B:Yeast Extract
C:Ammonium S
D:Sodium Chlor
Term AB

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

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ANOVA
Diagnostics
Model Graphs
Rotation
h: 45 v: 70
Default
Factors Tool
Gauges Sheet
Default
X1 A:Glucose
X2 B:Yeast Extract
C:Ammonium S
D:Sodium Chlo
Term AB
Design-Expert?Software
Yied
X1 = A: Glucose
X2 = B: Yeast Extract
Actual Factors
C: Ammonium Sulfate = 3.00
D: Sodium Chloride = 0.50
三维响应曲面图
Yied
96
92.75
89.5
86.25
83
0.25
0.20
0.15
0.10
0.05
B: Yeast Extract
0.25
0.38
0.50
0.63
0.75
A: Glucose
For Help, press F1
开始
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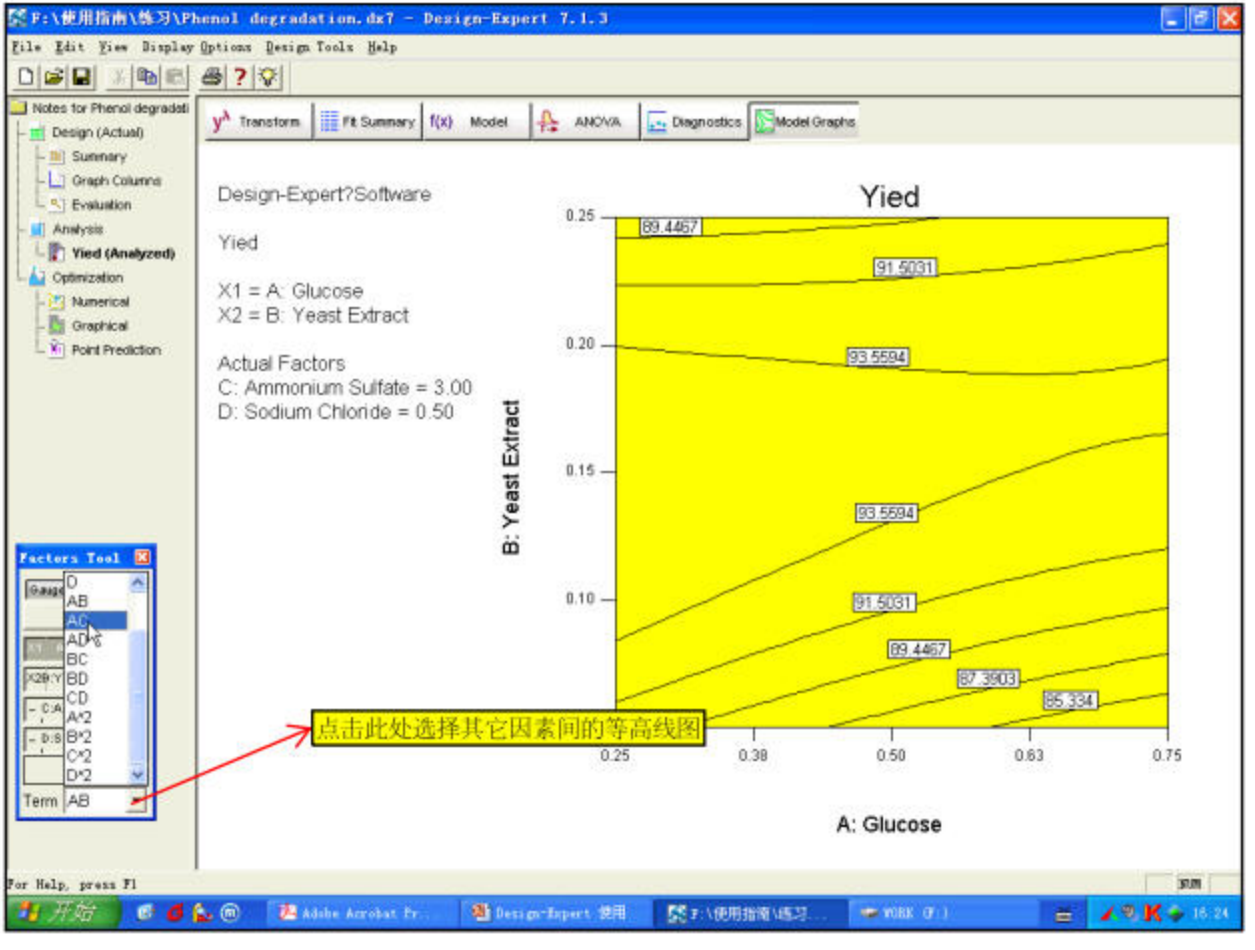
WORK (F:)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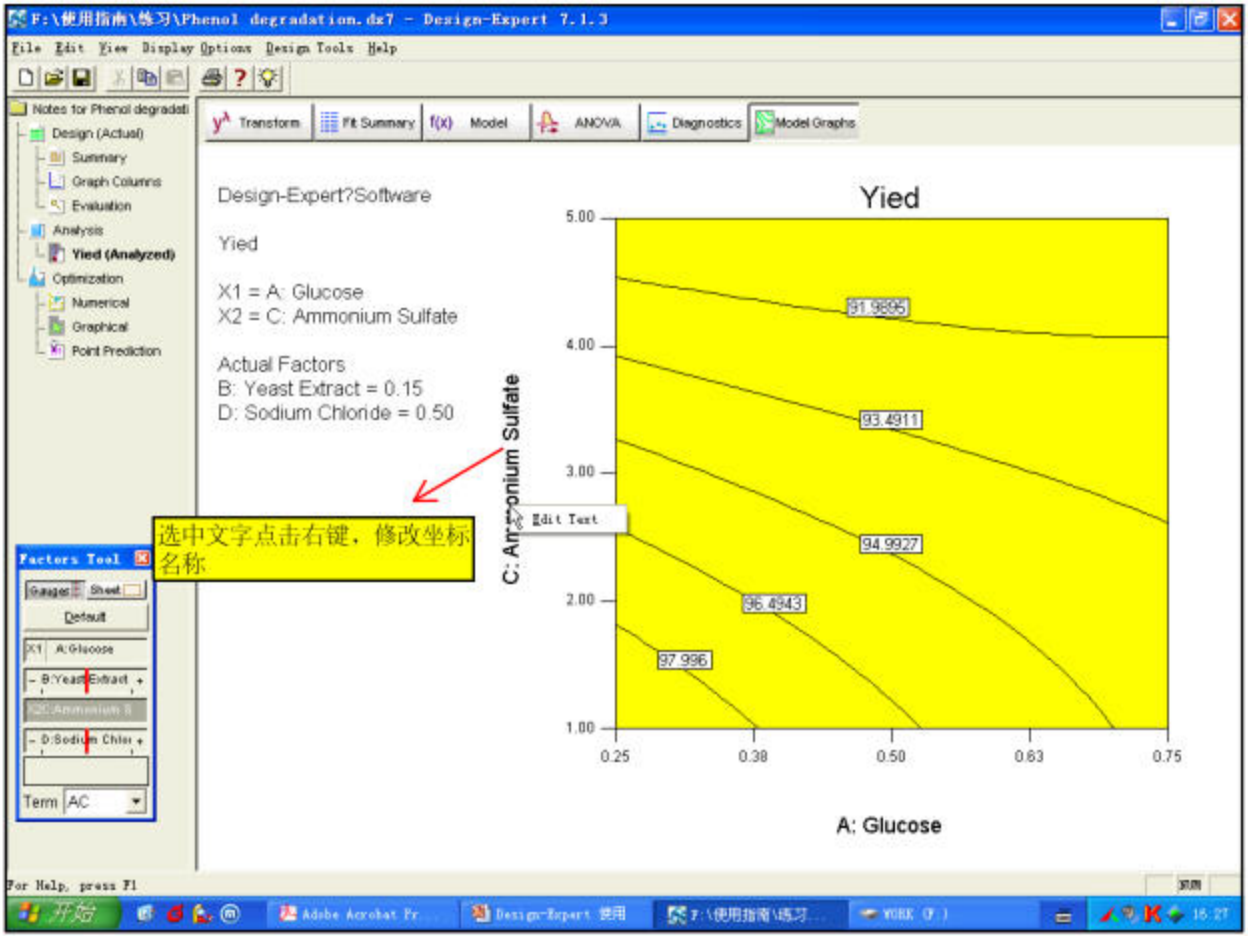
Yied
X1 = A: Glucose
X2 = B: Yeast Extract
Actual Factors
C: Ammonium Sulfate = 3.00
D: Sodium Chloride = 0.50
Yied
89.4467
91.5031
93.5594
93.5594
91.5031
89.4467
87.3903
85.334
B: Yeast Extract
0.25
0.20
0.15
0.10
0.25
0.38
0.50
0.63
0.75
A: Glucose
Factors Tool
D
AB
AC
AD
BC
BD
CD
A^2
B^2
C^2
D^2
Term
AB
点击此处选择其它因素间的等高线图
For Help, press F1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File Edit View Display Options Design Tools Help
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Optimization
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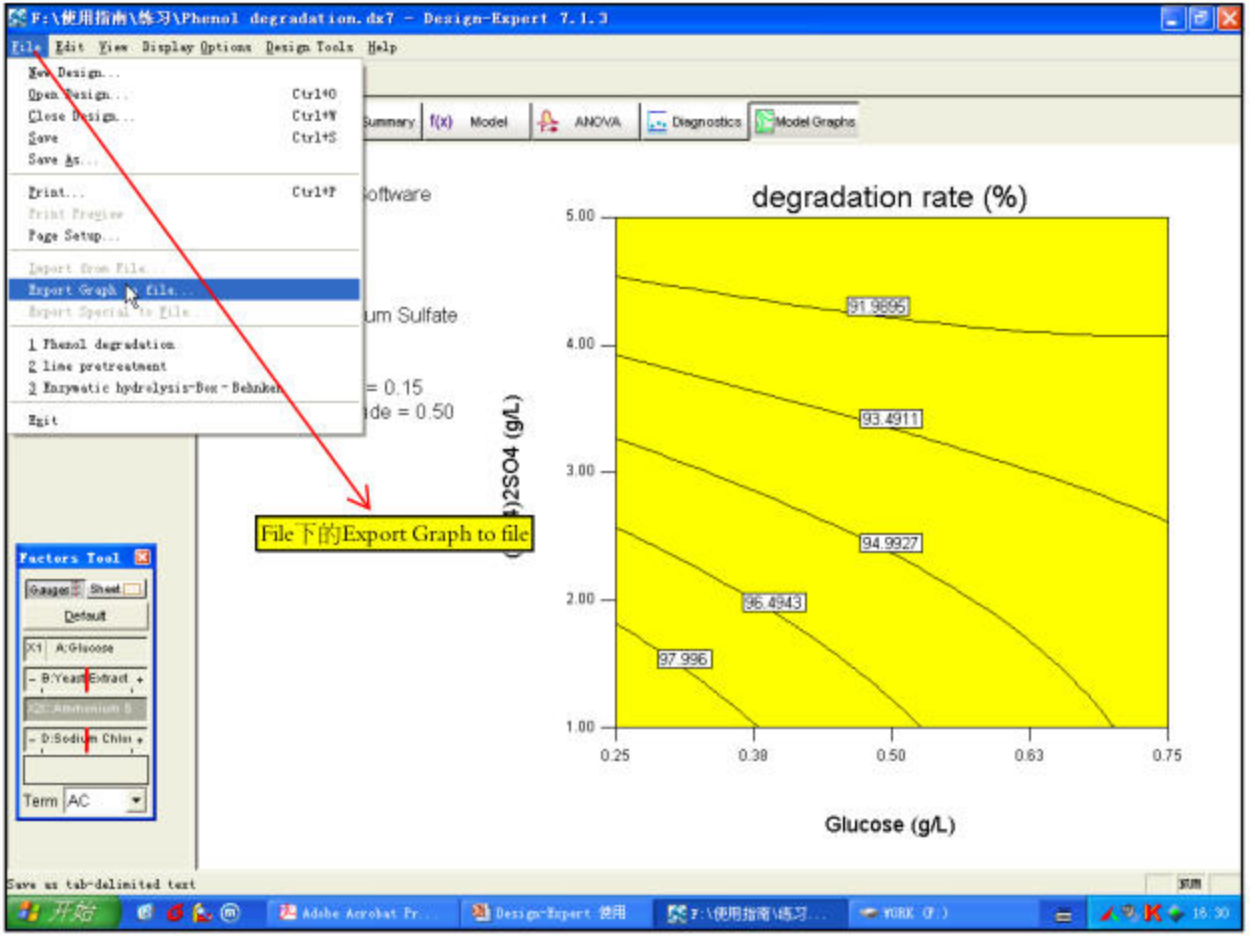
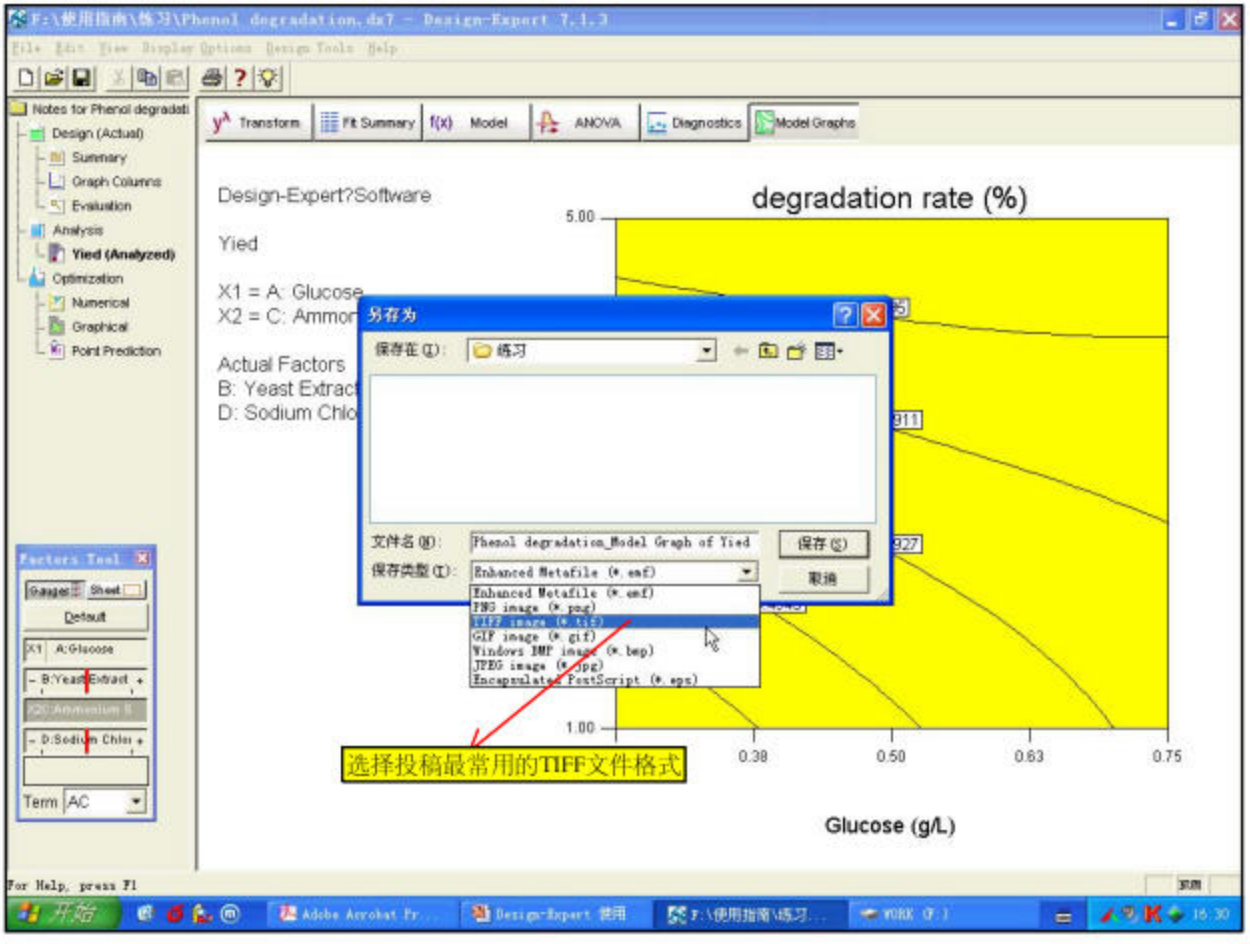
Graphical
Point Prediction
Transform
Fit Summary
Model
ANOVA
Diagnostics
Model Graphs
Design-Expert?Software
Yied
X1 = A: Glucose
X2 = C: Ammonium Sulfate
Actual Factors
B: Yeast Extract = 0.15
D: Sodium Chloride = 0.50
选中文字点击右键，修改坐标名称
Edit Text
Factors Tool
Gauges
Sheet
Default
X1 A:Glucose
B:Yeast Extract
X2 C:Ammonium S
D:Sodium Chlor
Term AC
Yied
81.9895
93.4911
94.9927
96.4943
97.996
5.00
4.00
3.00
2.00
1.00
C: Ammonium Sulfate
0.25
0.38
0.50
0.63
0.75
A: Glucose
For Help, press F1
开始
Adobe Acrobat Pr...
Design-Expert 使用...
F:\使用指南\练习...
WORK (F:)

把响应曲面图及等高线图导入WORD中的步骤

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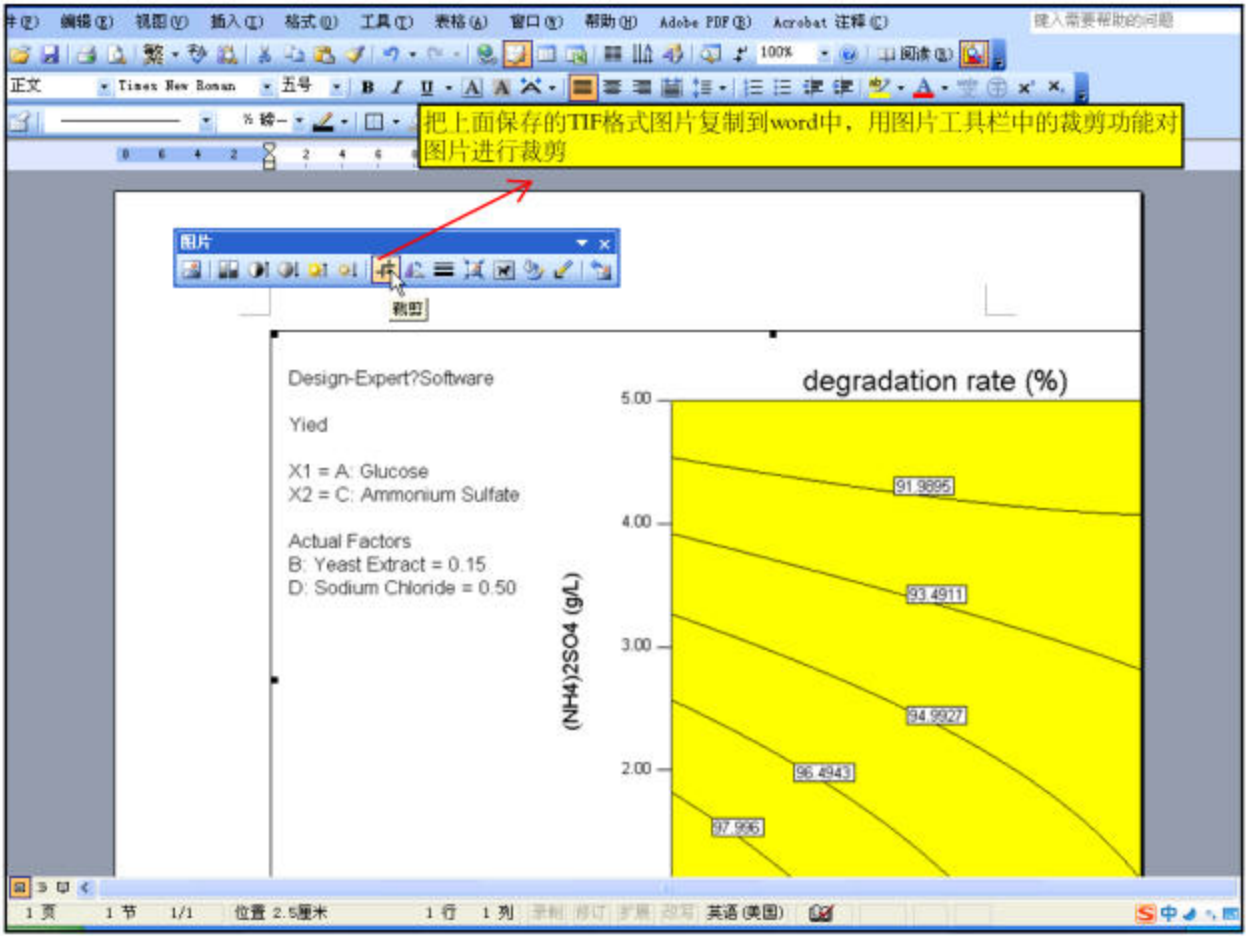
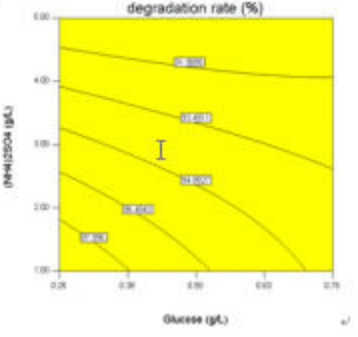
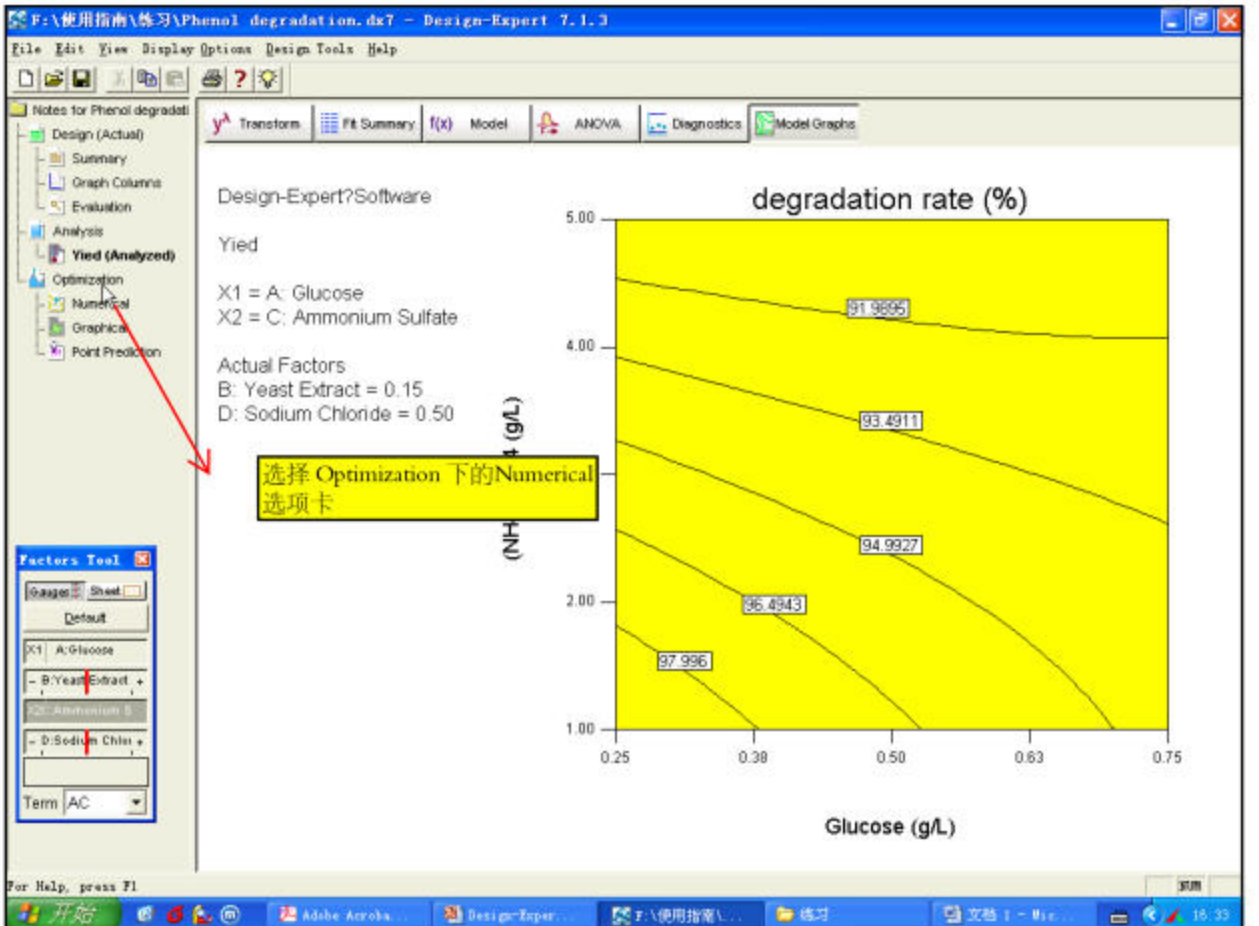
Yied (Analyzed)
Optimization
Numerical
Graphical
Point Prediction
Transform
Fit Summary
Model
ANOVA
Diagnostics
Model Graphs
Design-Expert?Software
Yied
X1 = A: Glucose
X2 = C: Ammor
Actual Factors
B: Yeast Extract
D: Sodium Chlo
degradation rate (%)
5.00
1.00
0.38
0.50
0.63
0.75
Glucose (g/L)
另存为
保存在(I):
练习
文件名(N):
Phenol degradation_Model Graph of Yied
保存(S)
保存类型(T):
Enhanced Metafile (*.emf)
取消
Enhanced Metafile (*.emf)
PNG image (*.png)
TIFF image (*.tif)
GIF image (*.gif)
Windows BMP image (*.bmp)
JPEG image (*.jpg)
Encapsulated PostScript (*.eps)
选择投稿最常用的TIFF文件格式
Factors Tool
Default
A:Glucose
B:Yeast Extract
D:Sodium Chlo
Term
AC
For Help, press F1


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
图片
裁剪
Design-Expert?Software
Yied
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
97.995

裁剪后的效果图



由RSM预测最优值


F:\使用指南\练习\Phenol degradation.dx7 - Design-Expert 7.1.3
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Yied (Analyzed)
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Numerical
Graphical
Point Prediction
Transform
Fit Summary
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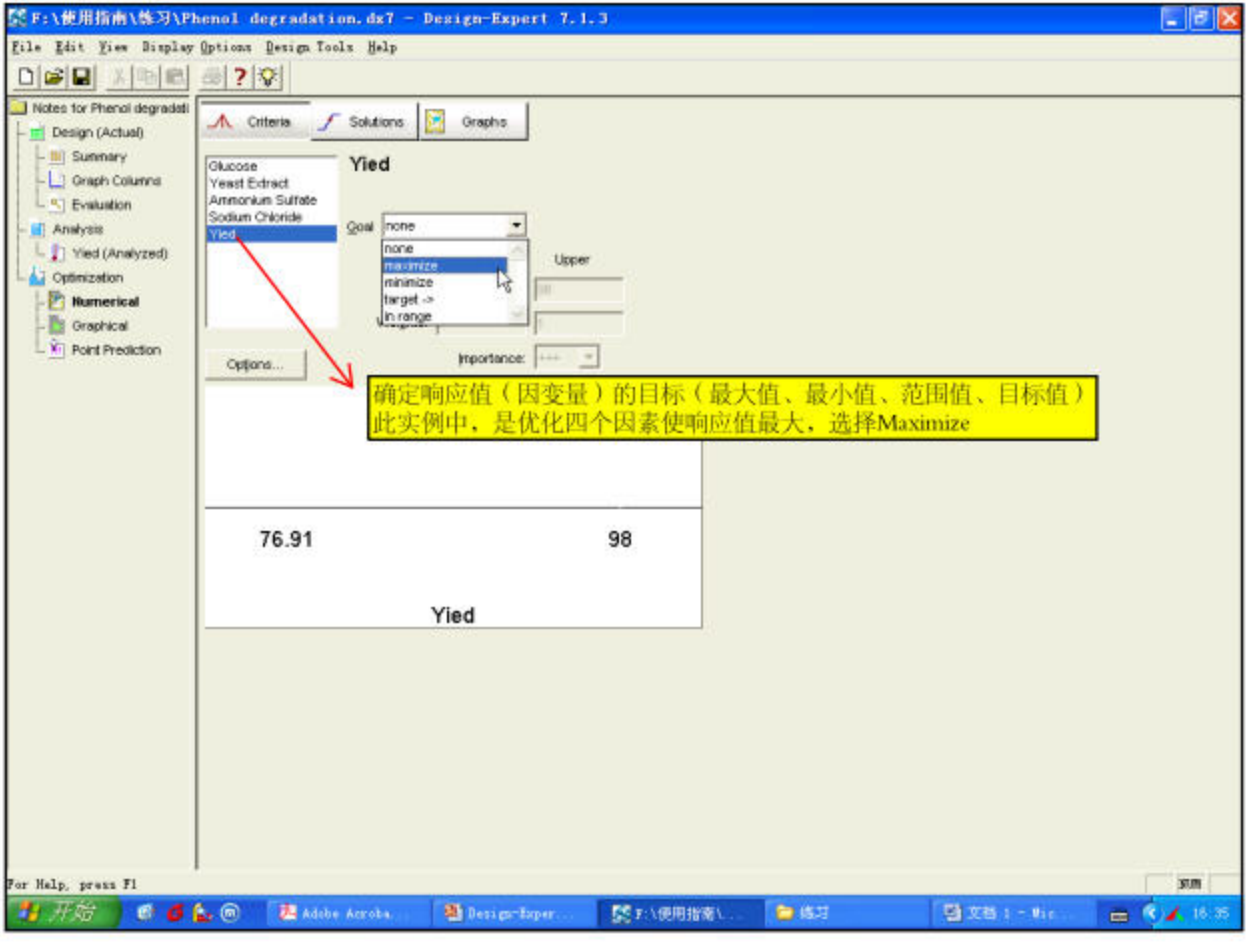
ANOVA
Diagnostics
Model Graphs
Design-Expert?Software
Yied
X1 = A: Glucose
X2 = C: Ammonium Sulfate
Actual Factors
B: Yeast Extract = 0.15
D: Sodium Chloride = 0.50
选择 Optimization 下的Numerical 选项卡
degradation rate (%)
91.9895
93.4911
94.9927
96.4943
97.996
5.00
4.00
2.00
1.00
0.25
0.38
0.50
0.63
0.75
Glucose (g/L)
(NH4)2SO4 (g/L)
Factors Tool
Gauges
Sheet
Default
X1 A:Glucose
B:Yeast Extract
X2 Ammonium S
D:Sodium Chlo
Term AC
For Help, press F1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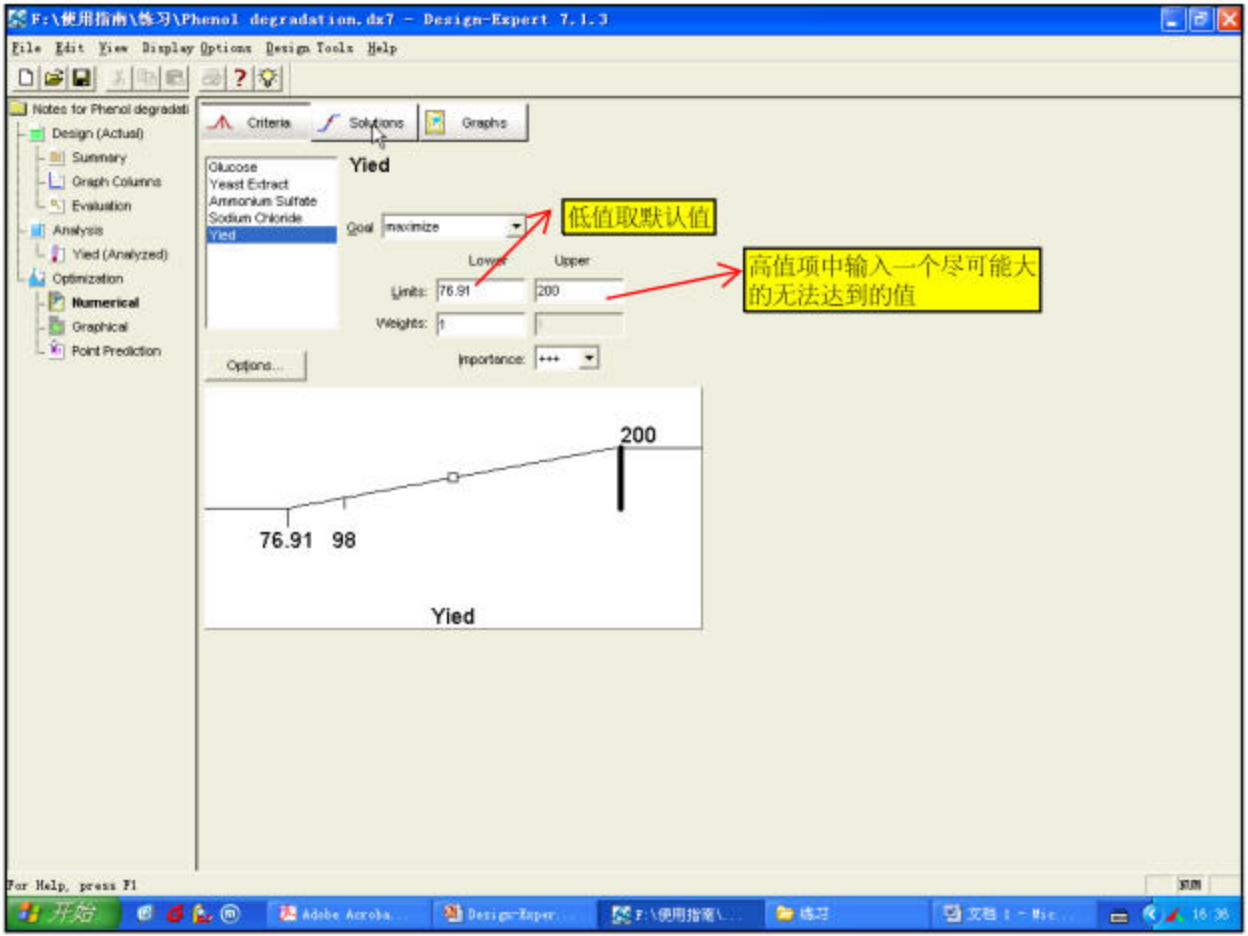
Graphical
Point Prediction
Criteria
Solutions
Graphs
Glucose
Yeast Extract
Ammonium Sulfate
Sodium Chloride
Yied
Yied
Goal
none
none
maximize
minimize
target =
in range
Upper
Importance:
Options...
确定响应值（因变量）的目标（最大值、最小值、范围值、目标值）
此实例中，是优化四个因素使响应值最大，选择Maximize
76.91
98
Yied
For Help, press F1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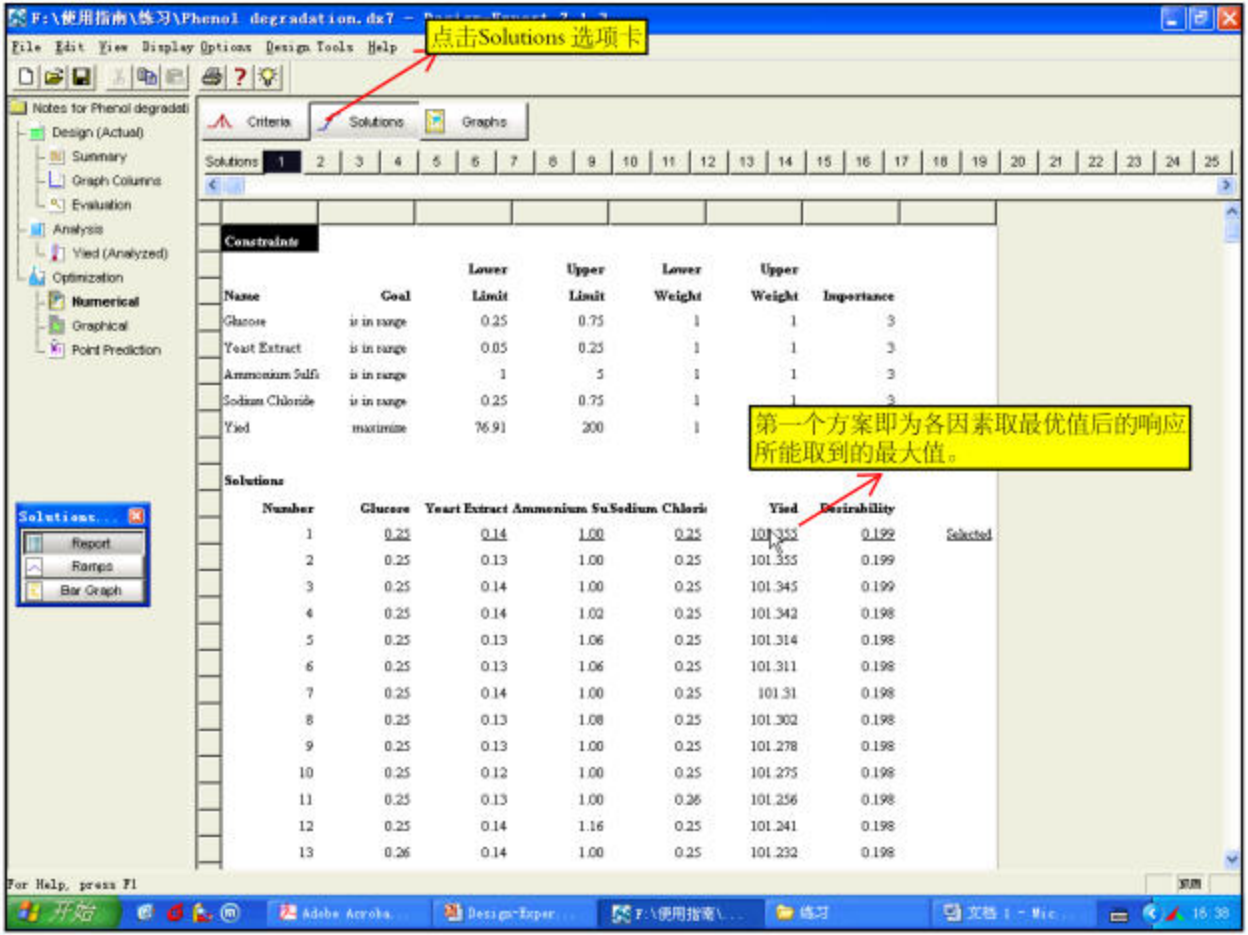
Point Prediction
Criteria
Solutions
Graphs
Glucose
Yeast Extract
Ammonium Sulfate
Sodium Chloride
Yied
Yied
Goal maximize
Lower
Upper
Limits: 76.91 200
Weights: 1 1
Importance: +++
Options...
低值取默认值
高值项中输入一个尽可能大的无法达到的值
200
76.91 98
Yied
For Help, press F1


点击Solutions 选项卡
File Edit View Display Options Design Tools Help
Notes for Phenol degradati
Design (Actual)
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Yied (Analyzed)
Optimization
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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 Sulfi is in range 1 5 1 1 3
Sodium Chloride is in range 0.25 0.75 1 1 3
Yied maximize 76.91 200 1 1 3
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。
Solutions
Number Glucose Yeast Extract Ammonium Su Sodium Chlorid Yied Desirability
1 0.25 0.14 1.00 0.25 101.353 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