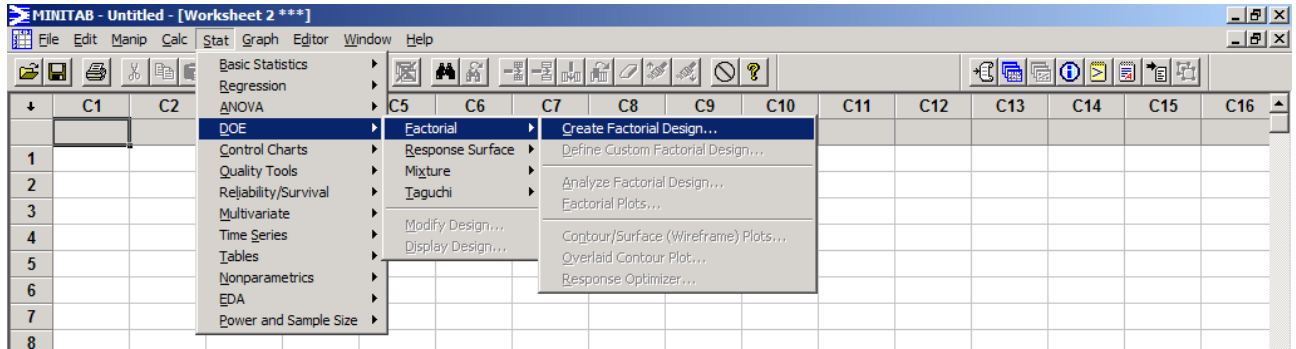


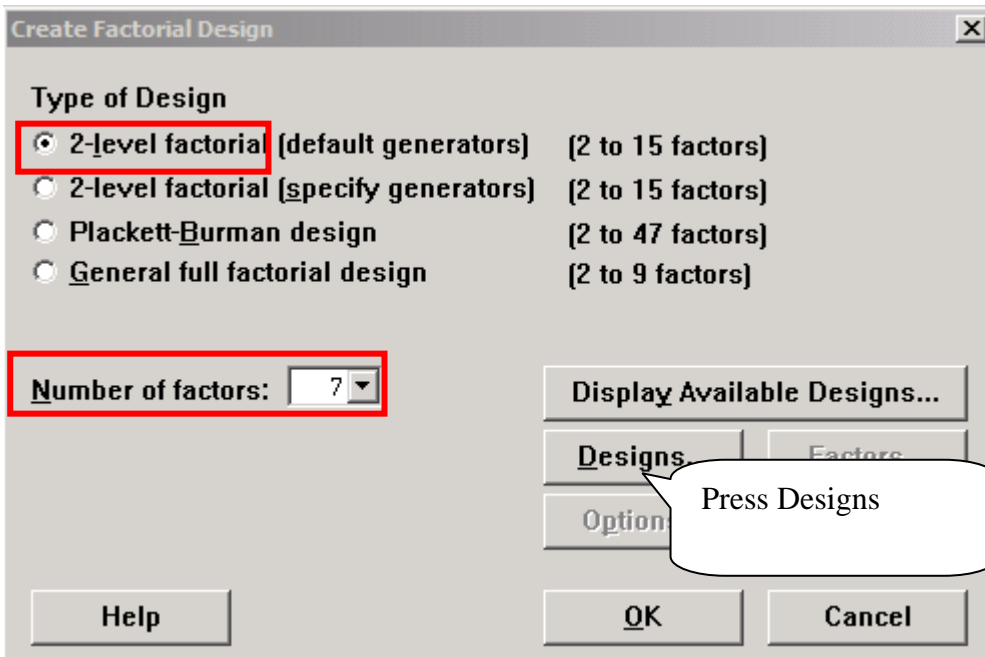
Example 13.11

A. Create Factorial Design

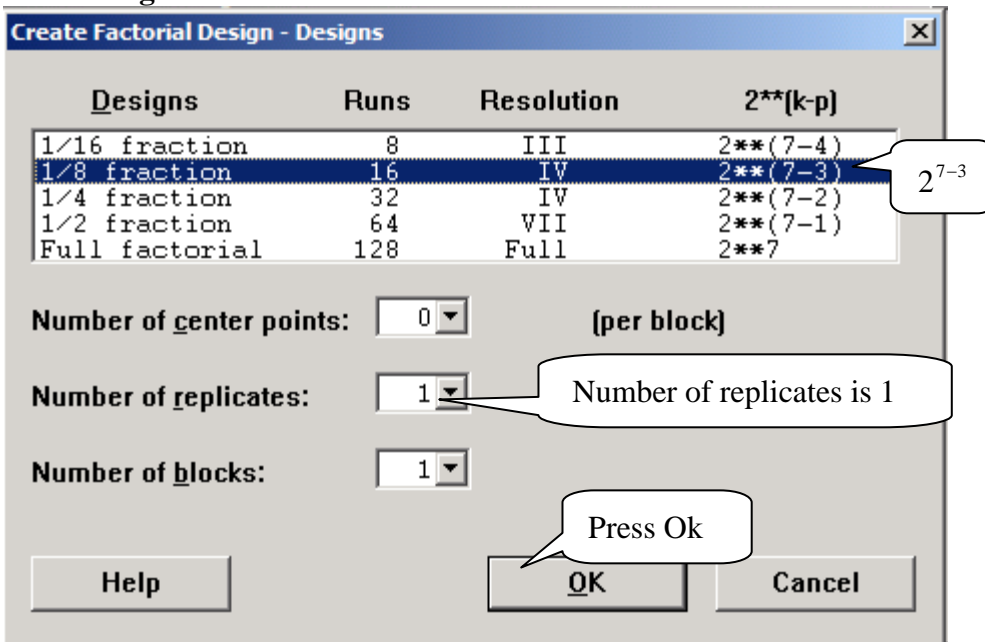
1. Stat>DOE>Factorial>Create Factorial Design



2. 2 levels and 7 factors



3. Select Designs



4. You could key the data in column 12.

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
	StdOrder	RunOrder	CenterPt	Blocks	A	B	C	D	E	F	G	
1	10	1	1	1	1	-1	-1	1	1	1	-1	
2	9	2	1	1	-1	-1	-1	1	-1	1	1	
3	5	3	1	1	-1	-1	1	-1	1	1	1	
4	3	4	1	1	-1	1	-1	-1	1	1	-1	
5	4	5	1	1	1	1	-1	-1	-1	1	1	
6	11	6	1	1	-1	1	-1	1	1	-1	1	
7	8	7	1	1	1	1	1	-1	1	-1	-1	
8	1	8	1	1	-1	-1	-1	-1	-1	-1	-1	
9	2	9	1	1	1	-1	-1	-1	1	-1	1	
10	12	10	1	1	1	1	-1	1	-1	-1	-1	
11	16	11	1	1	1	1	1	1	1	1	1	
12	14	12	1	1	1	-1	1	1	-1	-1	1	
13	13	13	1	1	-1	-1	1	1	1	-1	-1	
14	6	14	1	1	1	-1	1	-1	-1	1	-1	
15	15	15	1	1	-1	1	1	1	-1	1	-1	
16	7	16	1	1	-1	1	1	-1	-1	-1	1	
17												

B. Factorial Plots

Stat>DOE>Factorial> Factorial Plots

	C5	C8	C9	C10	C11	C12	C13
	temperature(A)				holding pressure(G)	Observed Shrinkage	
1	-1				-1	6	
2	1				1	10	
3	-1				-1	32	
4	1				1	60	
5	-1				-1	4	
6	1				-1	15	
7	-1	1			1	26	
8	1	1	-1		-1	60	
9	-1	-1	-1	1	-1	1	8
10	1	-1	-1	1	1	12	
11	-1	1	-1	1	-1	34	
12	1	1	-1	1	-1	60	
13	-1	-1	1	1	-1	16	
14	1	-1	1	1	-1	5	
15	-1	1	1	1	-1	37	
16	1	1	1	1	1	52	
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							

Factorial Plots

- M**ain Effects Plot
- I**nteraction Plot
- C**ube Plot

Type of Means to Use in Plots

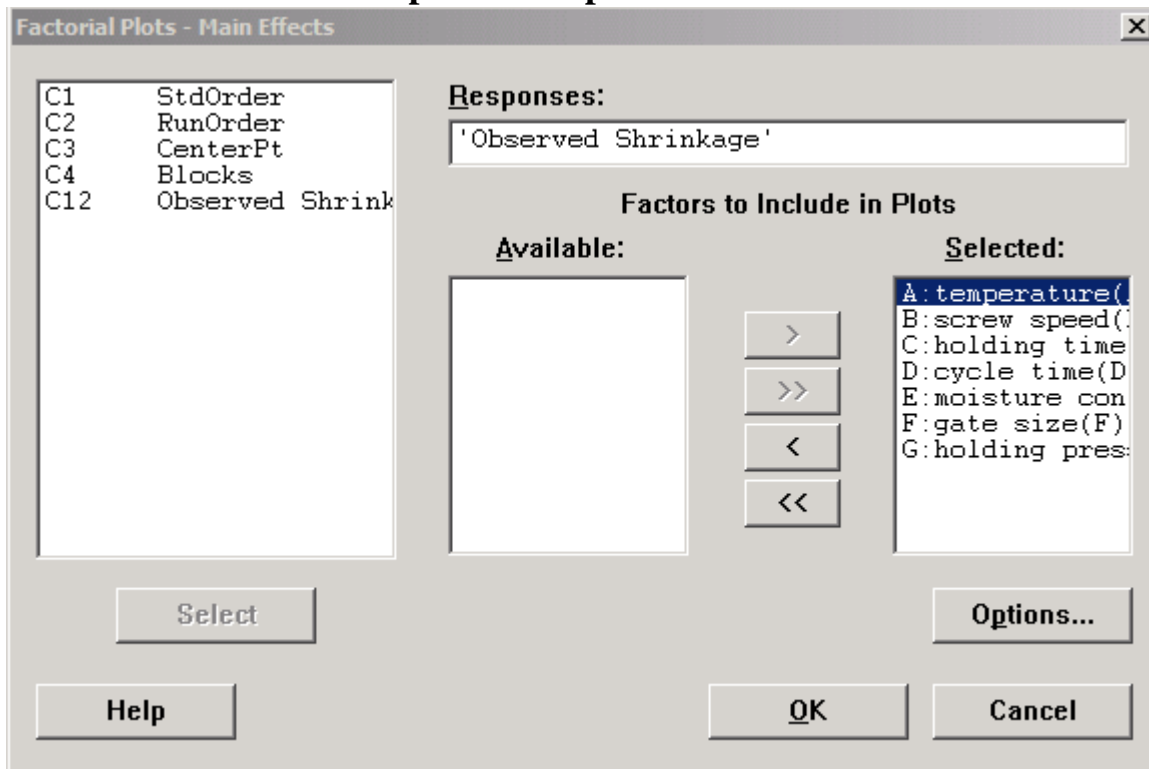
- D**ata Means
- F**itted Means

Buttons: Help, OK, Cancel

Setup... Setup... Setup...

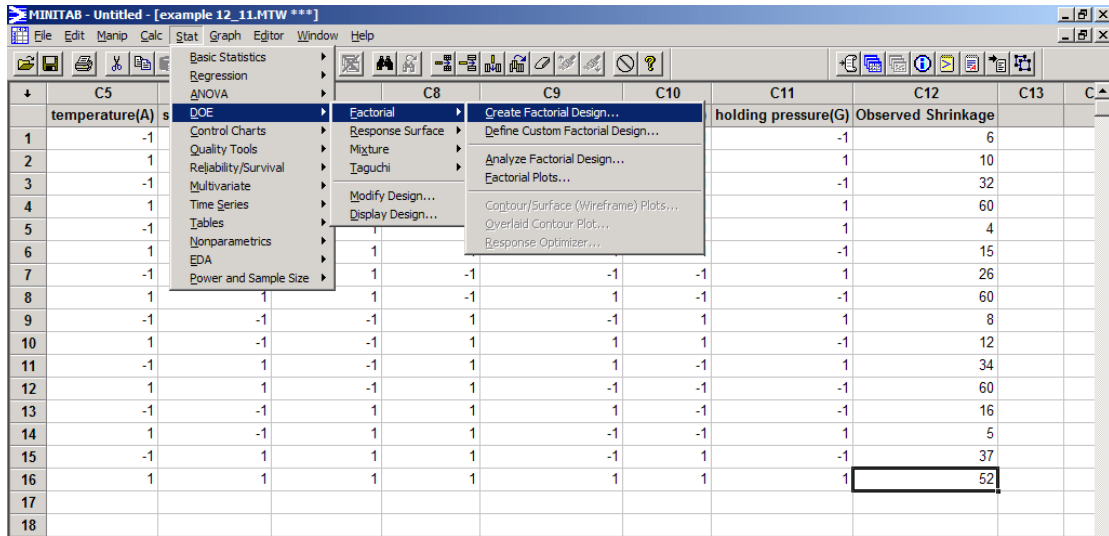
To select which factors you want to plot.

Take “Main Effects –setup” as example

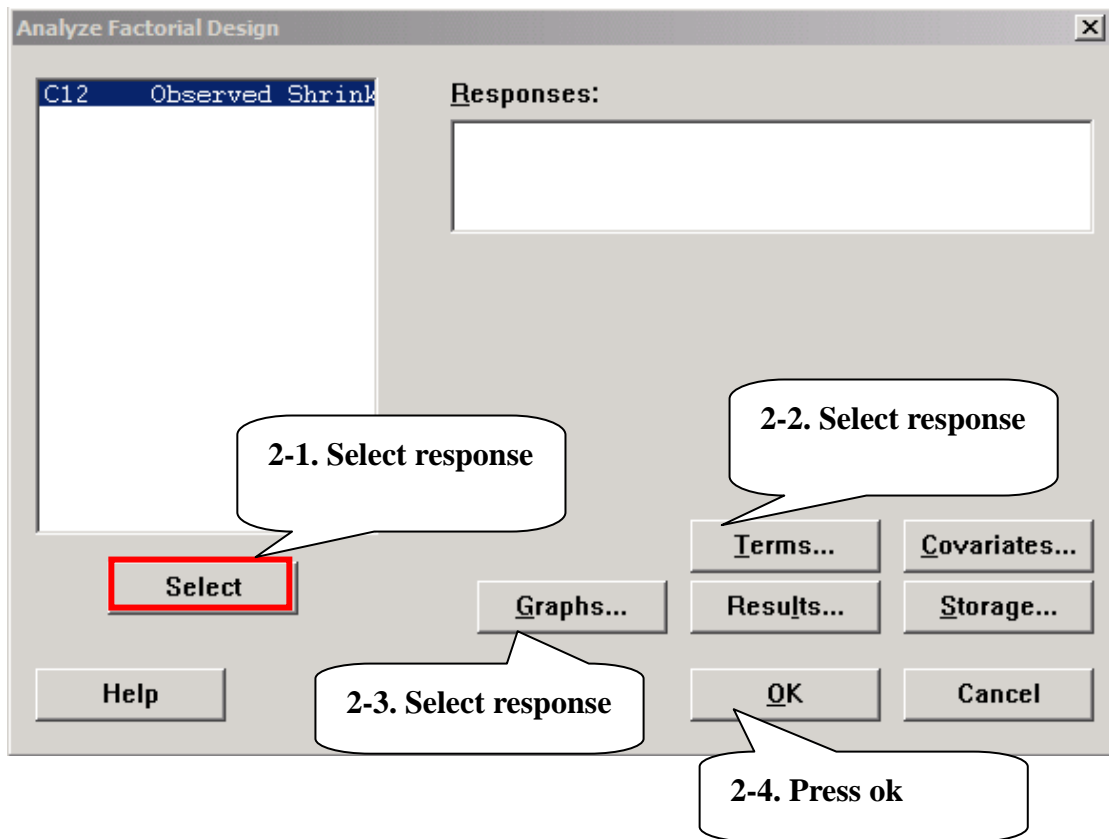


B. Analysis data

1. Stat>DOE>Factorial>Analyze Factorial Design



2. Analyze Factorial Design



2-2. Term

Analyze Factorial Design - Terms

Include terms in the model up through order: 7

Available Terms:

- A:temperature
- B:screw speed
- C:holding time
- D:cycle time
- E:moisture con
- F:gate size
- G:holding pres

Selected Terms:

- A:temperature
- B:screw speed
- C:holding ti
- D:cycle time
- E:moisture c
- F:gate size
- G:holding pr
- AB
- AC
- AD
- AE
- AF
- AG
- BC

Include blocks in the model

Include center points in the model

Help OK Cancel

Press ok

2-3. Graph

Analyze Factorial Design - Graphs

C1 StdOrder
C2 RunOrder
C3 CenterPt
C4 Blocks
C5 temperature(A)
C6 screw speed(B)
C7 holding time(C)
C8 cycle time(D)
C9 moisture center
C10 gate size(F)
C11 holding pressur
C12 Observed Shrink

Effects Plots

Normal Pareto Alpha: 0.01

Residuals for Plots:

Regular Standardized Deleted

Residual Plots

Histogram
 Normal plot
 Residuals versus fits
 Residuals versus order
 Residuals versus variables:

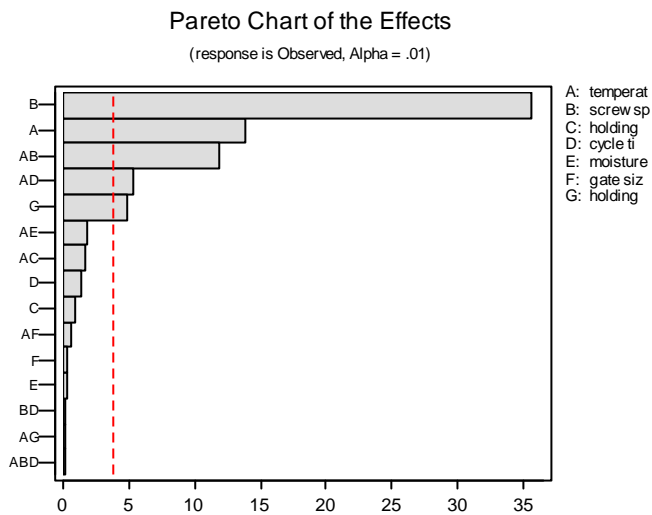
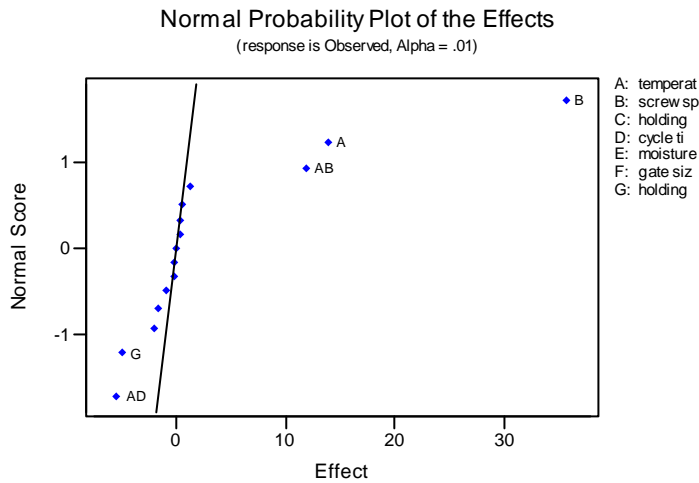
Select

Help OK Cancel

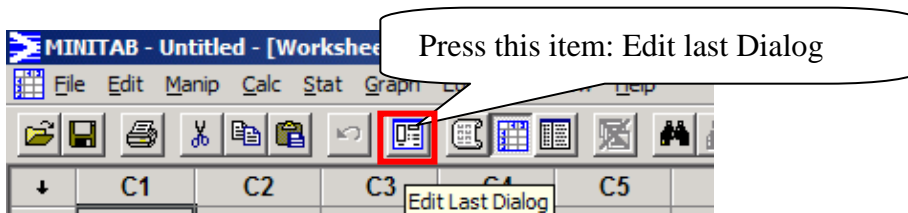
Press ok

2-4. Press ok

Output 1

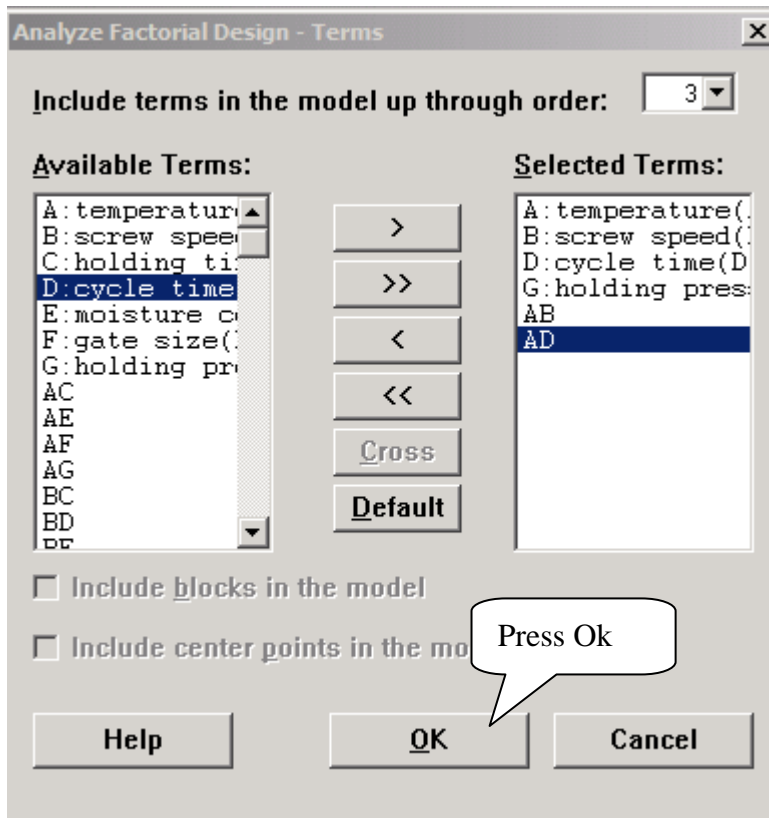


Select **A, B, AB, AD, G, D** (To include the interaction “AD”, term D must be selected.)



You will see step “2. Analyze Factorial Design”

2-2 Terms (Select A, B, AB, AD, G, D)



2-4. Press ok

Output 2

Fractional Factorial Fit: Observed Shr versus temperature(, screw speed(, ...

Estimated Effects and Coefficients for Observed (coded units)

Term	Effect	Coef	SE Coef	T	P
Constant		27.313	0.4607	59.29	0.000
temperat	13.875	6.937	0.4607	15.06	0.000
screw sp	35.625	17.812	0.4607	38.66	0.000
cycle ti	1.375	0.688	0.4607	1.49	0.170
holding	-4.875	-2.437	0.4607	-5.29	0.000
temperat*screw sp	11.875	5.938	0.4607	12.89	0.000
temperat*cycle ti	-5.375	-2.688	0.4607	-5.83	0.000

Analysis of Variance for Observed (coded units)

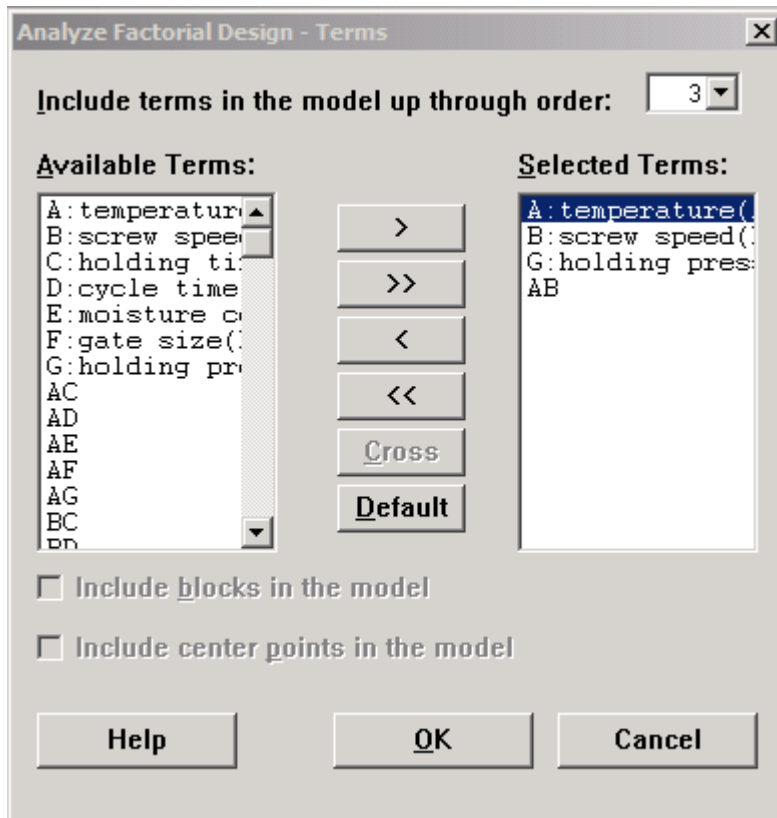
Source	DF	Seq SS	Adj SS	Adj MS	F	P
Main Effects	4	5949.25	5949.25	1487.31	437.98	0.000
2-Way Interactions	2	679.63	679.63	339.81	100.07	0.000
Residual Error	9	30.56	30.56	3.40		
Total	15	6659.44				

Alias Structure

I
 temperat
 screw
 cycle
 holding
 temperat*screw
 temperat*cycle

Delete D and AD (Only A, B, G, AB), since p_value of factor D is larger than significant level 0.01.

Go to 2-2 Terms (Select A, B, G, AB)



Output 3

Fractional Factorial Fit: Observed Shr versus temperature(, screw speed(, ...

Estimated Effects and Coefficients for Observed (coded units)

Term	Effect	Coef	SE Coef	T	P
Constant		27.313	0.9345	29.23	0.000
temperat	13.875	6.937	0.9345	7.42	0.000
screw sp	35.625	17.812	0.9345	19.06	0.000
holding	-4.875	-2.438	0.9345	-2.61	0.024
temperat*screw sp	11.875	5.938	0.9345	6.35	0.000

Analysis of Variance for Observed (coded units)

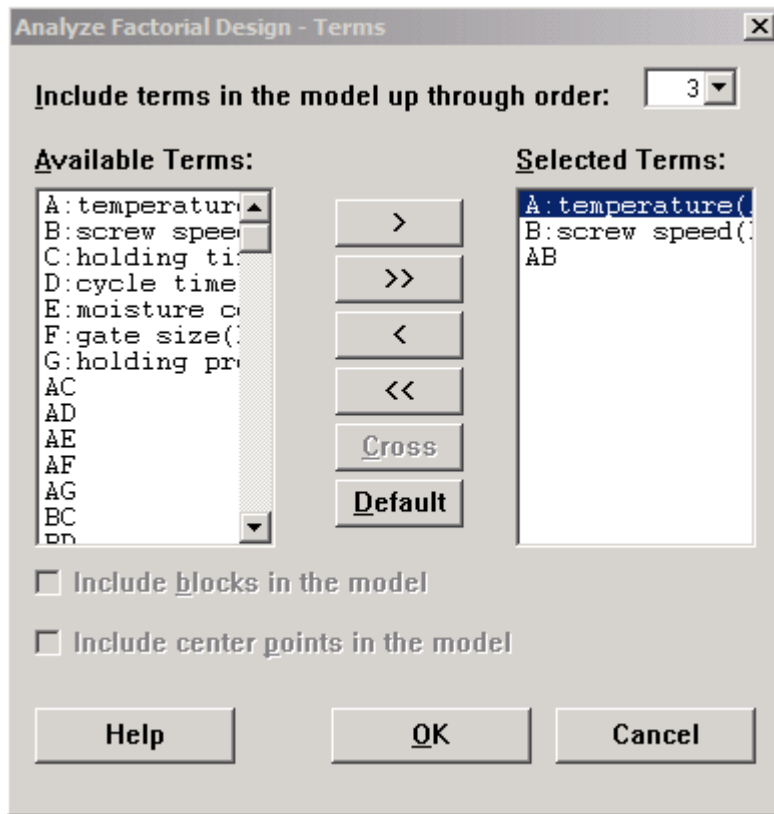
Source	DF	Seq SS	Adj SS	Adj MS	F	P
Main Effects	3	5941.69	5941.69	1980.56	141.76	0.000
2-Way Interactions	1	564.06	564.06	564.06	40.37	0.000
Residual Error	11	153.69	153.69	13.97		
Lack of Fit	3	2.19	2.19	0.73	0.04	0.989
Pure Error	8	151.50	151.50	18.94		
Total	15	6659.44				

Alias Structure

I
 temperat
 screw
 holding
 temperat*screw

Delete G (Only A, B, AB), because p_value of D is larger than 0.01

Go to 2-2 Terms (Select A, B, AB)



Output 4

Fractional Factorial Fit: Observed Shr versus temperature(, screw speed(

Estimated Effects and Coefficients for Observed (coded units)

Term	Effect	Coef	SE Coef	T	P
Constant		27.313	1.138	24.00	0.000
temperat	13.875	6.937	1.138	6.09	0.000
screw sp	35.625	17.812	1.138	15.65	0.000
temperat*screw sp	11.875	5.938	1.138	5.22	0.000

Analysis of Variance for Observed (coded units)

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Main Effects	2	5846.6	5846.6	2923.31	141.02	0.000
2-Way Interactions	1	564.1	564.1	564.06	27.21	0.000
Residual Error	12	248.7	248.7	20.73		
Pure Error	12	248.8	248.8	20.73		
Total	15	6659.4				

Alias Structure

I
 temperat
 screw
 temperat*screw

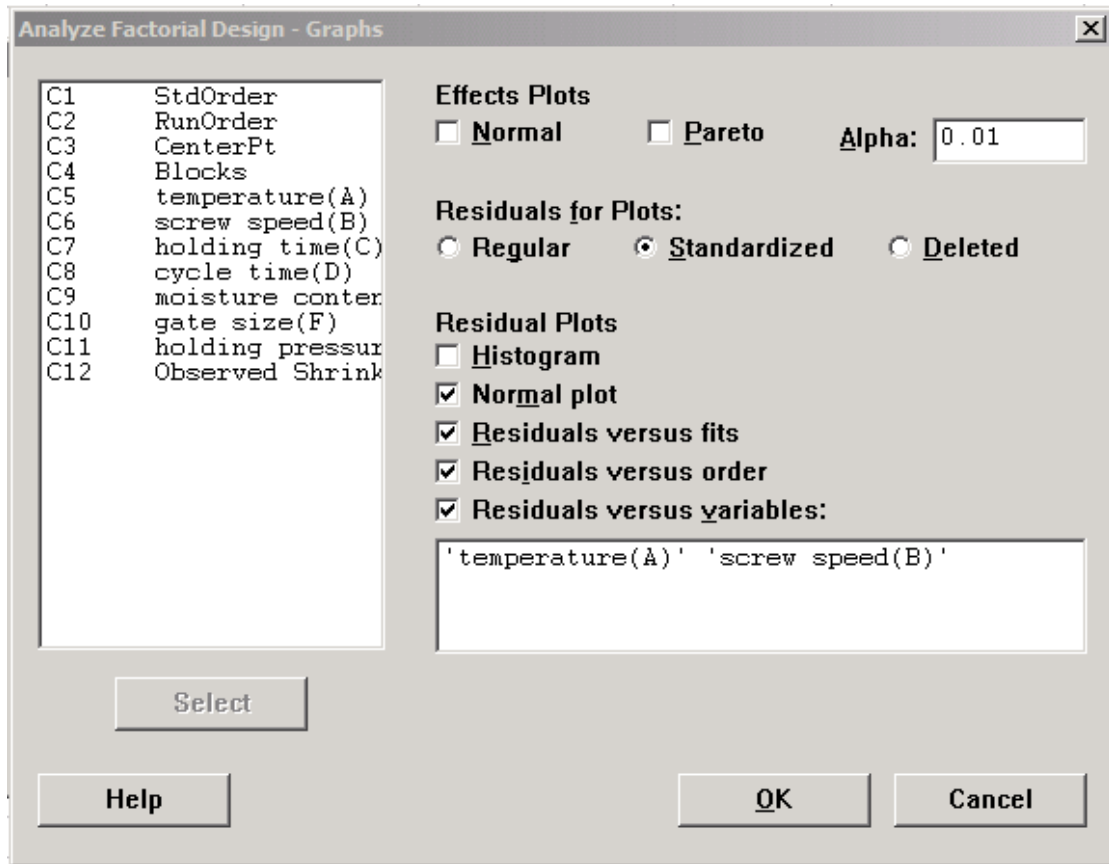
The fitting model for predicted shrinkage (See textbook to get more details)

$$\hat{y} = 27.313 + 6.937x_1 + 17.812x_2 + 5.938x_1x_2$$

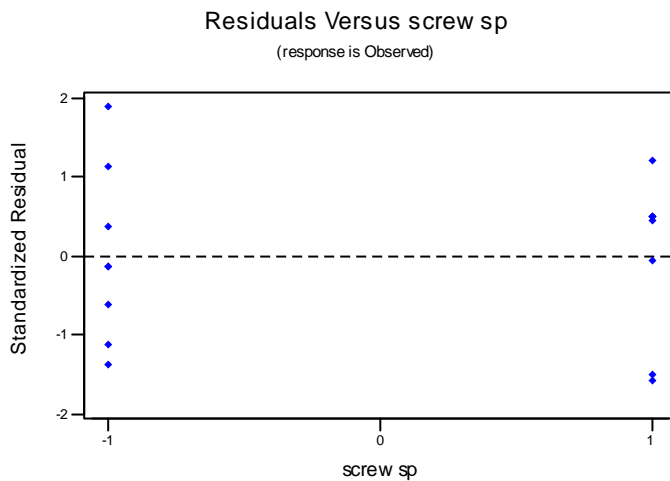
Residual analysis

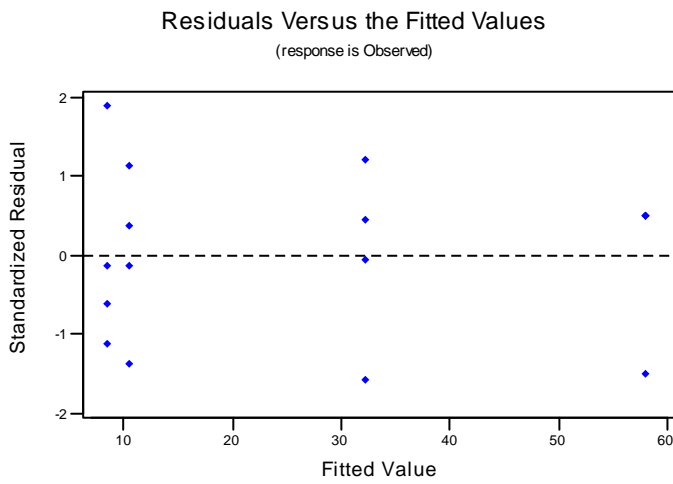
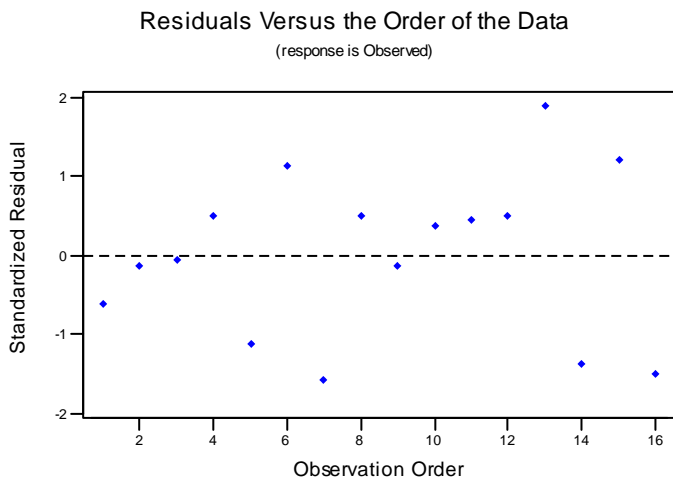
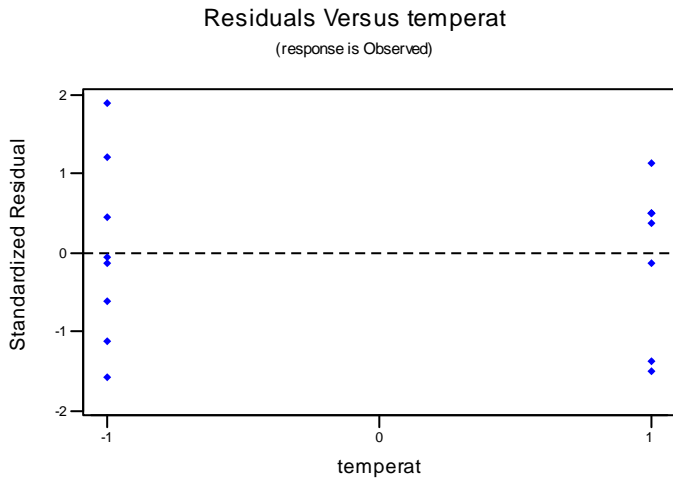
(After you select the final model, you must analyze residuals.)

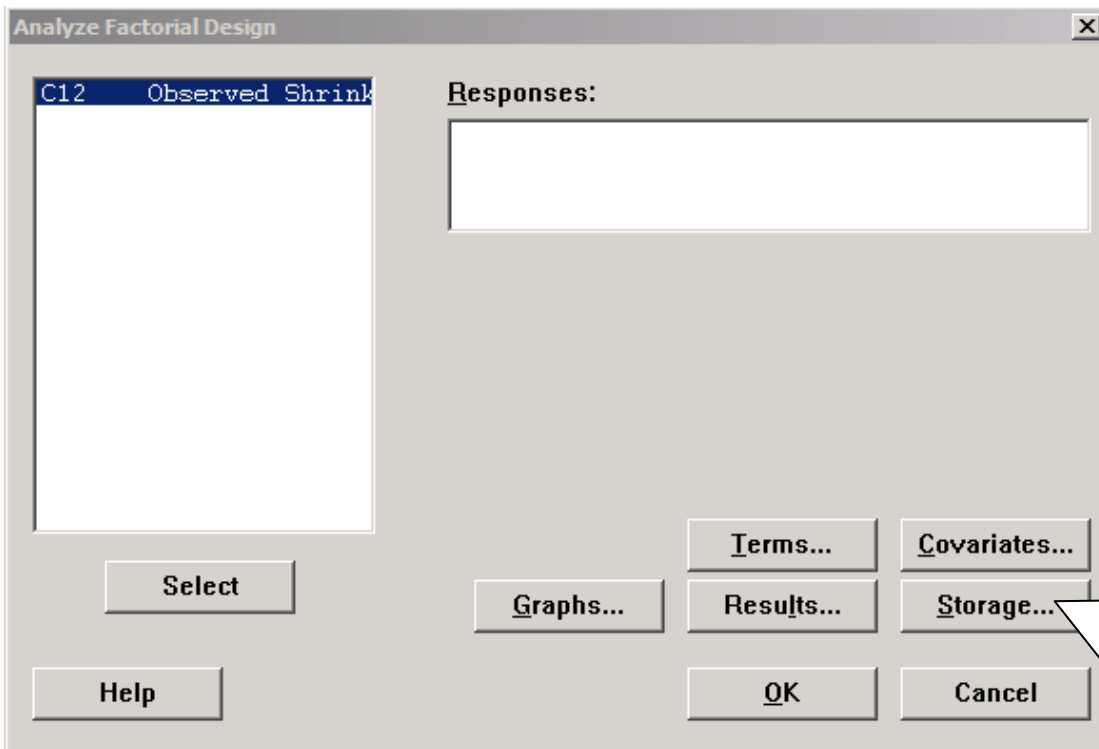
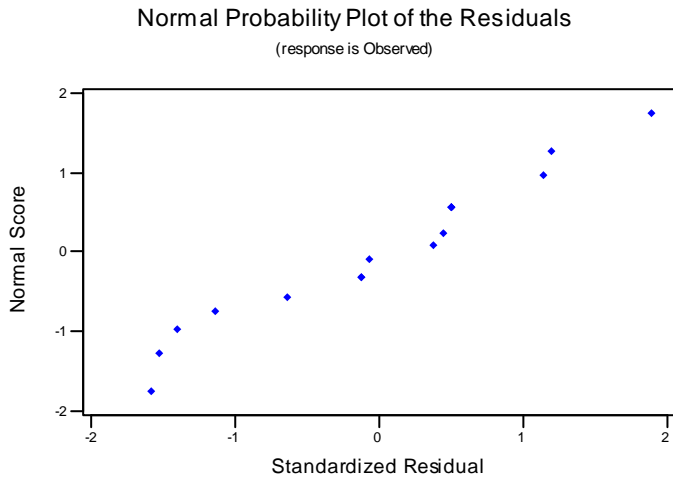
Go to 2-3. Graph



Output 5







You also can press Storage to store fits, residuals,

