Chapter 5 - Minitab Details

Case 5.1.1. Diet Restriction and Longevity – A Randomized Experiment.
R&S p. 114-116

Step 1: Copy the data into a Minitab Worksheet: use these steps:
File → Open Worksheet →Browse your local directory and upload the csv file case0501.csv. The data will appear as two columns C1 and C2 titled LIFETIME and DIET

Step 2: Unstack LIFETIME by DIET: the unstacked data displays thus:

Row	lopro	N/N85	N/R40	N/R50	NP	R/R50
1	49.7	42.3	54.6	51.9	35.5	50.7
2	49.3	40.1	54.0	51.7	35.4	50.6
3	48.6	39.5	53.8	51.4	34.9	50.5
4	48.3	38.6	53.3	51.3	34.8	50.3
5	48.0	38.4	52.9	50.9	33.8	50.1
6	47.7	38.3	52.7	50.5	33.5	50.1
7	47.5	37.8	52.5	50.5	32.6	50.0
8	47.2	37.6	52.4	50.2	32.4	50.0
9	47.1	37.4	52.0	50.0	31.8	49.8
10	47.0	37.3	51.8	49.4	31.6	49.7
11	47.0	36.8	51.3	49.2	31.5	49.6
12	47.0	36.5	51.3	49.2	31.4	49.0
13	46.9	36.5	51.0	49.1	31.4	48.9
14	46.9	36.5	50.8	49.1	31.3	48.5
15	46.3	36.4	50.3	49.1	30.8	48.3
16	45.9	35.9	50.1	49.1	30.7	48.3
17	45.9	35.5	49.8	48.7	30.5	48.1
18	44.5	35.5	48.7	48.3	30.4	47.7
19	44.1	35.3	48.3	48.1	30.2	47.0
20	44.0	35.3	48.1	48.0	30.2	46.8
21	43.6	34.9	47.6	47.8	30.1	46.8
22	43.3	34.6	47.6	47.7	30.0	46.8
23	42.1	34.5	47.6	47.6	29.6	46.2
24	42.0	34.4	47.5	47.5	29.3	46.2
25	42.0	33.8	47.5	47.3	28.9	45.1
26	41.9	33.5	47.5	47.2	28.3	45.0
27	41.9	33.3	50.5	46.9	28.0	45.0
28	41.6	33.3	47.5	46.7	27.5	44.3
29	40.5	33.1	46.4	46.5	27.3	43.6
30	40.1	33.0	45.3	46.3	27.1	43.1
31	39.2	32.9	45.7	45.6	26.8	42.3
32	38.9	32.5	44.2	45.2	26.6	42.9
33	37.4	32.4	43.8	45.1	26.5	42.7
34	37.3	32.3	43.8	44.4	26.3	42.4
35	36.7	31.7	43.7	43.9	25.9	42.0
36	36.4	31.7	43.6	43.6	25.1	41.8
37	36.2	31.6	43.6	42.9	24.8	41.6
38	35.8	31.6	43.3	42.7	24.7	40.6
39	35.7	31.5	43.2	42.6	24.3	40.4
40	35.4	33.1	43.1	42.5	24.1	39.9
41	35.3	31.5	42.7	42.4	24.0	39.5
42	35.0	31.4	42.7	42.0	22.1	39.2
43	35.0	31.4	42.5	41.5	21.5	39.0
44	34.8	31.0	42.3	41.3	21.8	38.5
45	34.7	30.3	42.2	40.9	20.0	38.2

46	33.5	30.1	42.2	40.7	18.0	38.0
47	32.8	29.6	41.6	40.4	13.8	36.2
48	31.5	29.3	40.8	39.9	9.2	36.3
49	30.8	29.2	40.3	39.4	6.4	35.8
50	30.6	28.8	40.0	38.9		34.0
51	29.9	27.9	38.9	38.2		33.4
52	29.2	24.5	37.2	37.7		32.2
53	28.0	22.3	36.7	37.6		30.6
54	26.3	21.9	36.6	37.2		27.5
55	24.7	19.8	36.1	35.4		26.3
56	23.4	19.3	33.9	35.4		24.2
57		17.9	31.0	35.2		
58			29.4	34.3		
59			19.6	32.7		
60			47.6	32.5		
61				31.8		
62				31.1		
63				30.9		
64				29.8		
65				26.8		
66				25.7		
67				25.1		
68				23.5		
69				18.6		
70				42.4		
71				48.1		

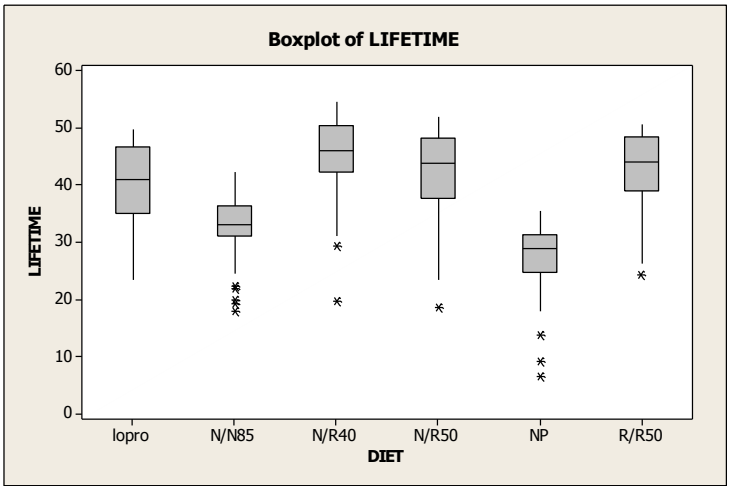
Step 3: Summary Statistics

Summary Statistics

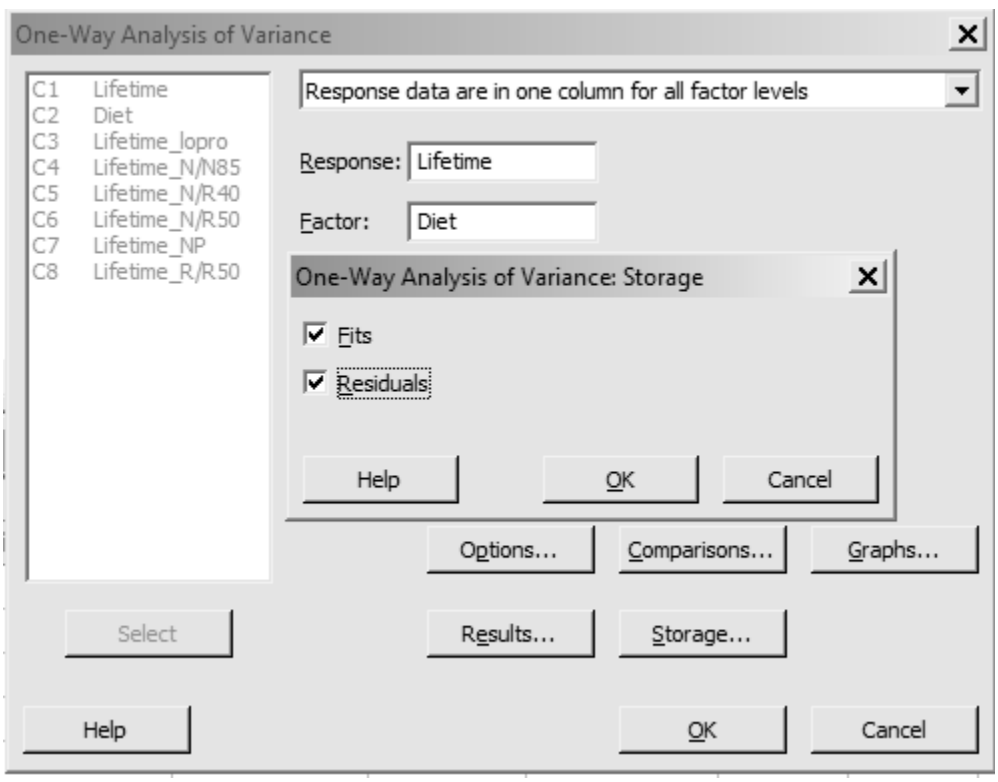
	Variable	DIET	N	N*	Mean	SE Mean	StDev	Minimum	Q1	Median
LIFETIME	lopro	56	0	39.686	0.934	6.992	23.400	35.000	41.050	
	N/N85	57	0	32.691	0.679	5.125	17.900	31.200	33.100	
	N/R40	60	0	45.117	0.865	6.703	19.600	42.225	46.050	
	N/R50	71	0	42.297	0.922	7.768	18.600	37.700	43.900	
	NP	49	0	27.402	0.876	6.134	6.400	24.750	28.900	
	R/R50	56	0	42.886	0.893	6.683	24.200	39.050	43.950	

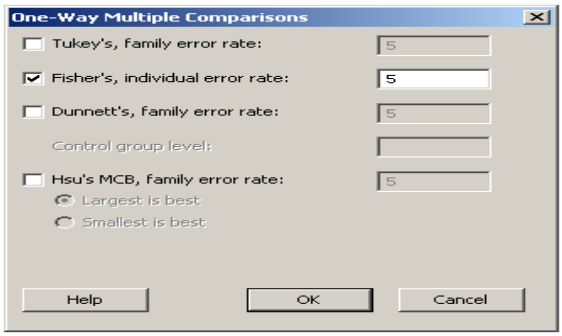
Variable	DIET	Q3	Maximum
LIFETIME	lopro	46.750	49.700
	N/N85	36.450	42.300
	N/R40	50.450	54.600
	N/R50	48.300	51.900
	NP	31.400	35.500
	R/R50	48.450	50.700

Step 4: Side-by-side Boxplots of LIFETIME



Step 5: One-way ANOVA test: Go to STAT → ANOVA → One-way





One-way ANOVA: Lifetime versus Diet

```
Method

Null hypothesis         All means are equal
Alternative hypothesis  At least one mean is different
Significance level      α = 0.05

Equal variances were assumed for the analysis.


Factor Information

Factor  Levels  Values
Diet         6  lopro, N/N85, N/R40, N/R50, NP, R/R50


Analysis of Variance

Source   DF  Adj SS   Adj MS  F-Value  P-Value
Diet      5   12734  2546.79    57.10    0.000
Error   343   15297    44.60
Total   348   28031


Model Summary

      S    R-sq  R-sq(adj)  R-sq(pred)
6.67824  45.43%     44.63%      43.54%


Means

Diet    N    Mean  StDev       95% CI
lopro  56  39.686  6.992  (37.930, 41.441)
N/N85  57  32.691  5.125  (30.951, 34.431)
N/R40  60  45.117  6.703  (43.421, 46.812)
N/R50  71  42.297  7.768  (40.738, 43.856)
NP     49  27.402  6.134  (25.526, 29.279)
R/R50  56  42.886  6.683  (41.130, 44.641)

Pooled StDev = 6.67824
```

Fisher Pairwise Comparisons

Grouping Information Using the Fisher LSD Method and 95% Confidence

Diet	N	Mean	Grouping				
N/R40	60	45.117	A				
R/R50	56	42.886	A	B			
N/R50	71	42.297		B			
lopro	56	39.686			C		
N/N85	57	32.691				D	
NP	49	27.402					E

Means that do not share a letter are significantly different.

Case 5.1.2. The Spock Conspiracy trial – An Observational Study
R&S p. 117-118

Step 1: Copy the data into a Minitab Worksheet: use these steps:
File → Open Worksheet →Browse your local directory and upload the csv file case0502.csv. The data will appear as two columns C1 and C2 titled PERCENT and JUDGE.

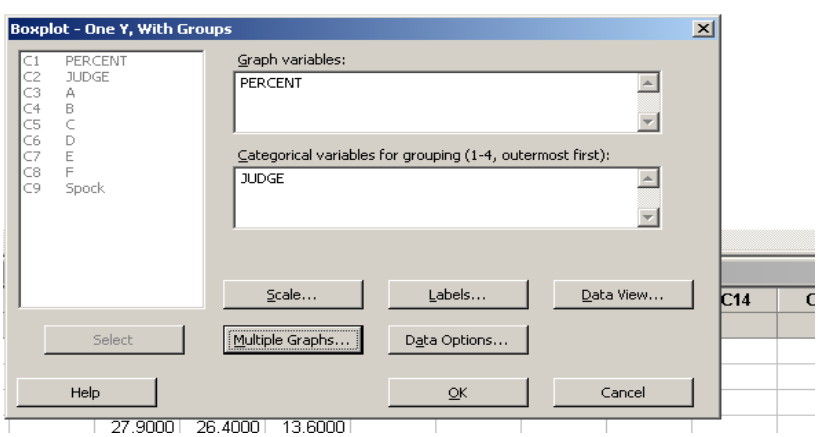
Step 2: Unstack PERCENT by JUDGE: the unstacked data displays thus:

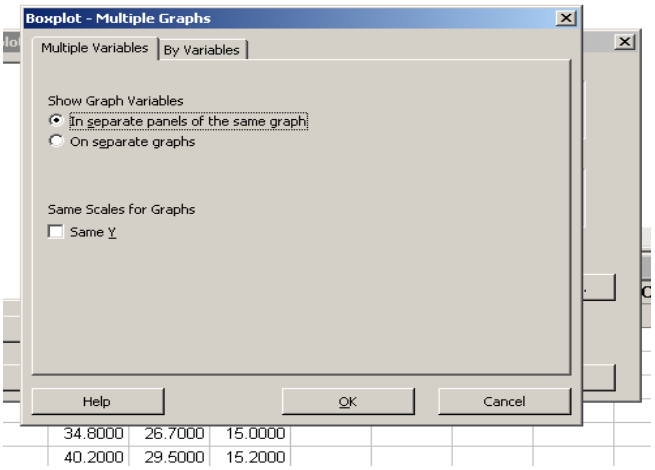
Row	A	B	C	D	E	F	Spock
1	16.8000	27.0000	21.0000	24.3000	17.7000	16.5000	6.4000
2	30.8000	28.9000	23.4000	29.7000	19.7000	20.7000	8.7000
3	33.6000	32.0000	27.5000		21.5000	23.5000	13.3000
4	40.5000	32.7000	27.5000		27.9000	26.4000	13.6000
5	48.9000	35.5000	30.5000		34.8000	26.7000	15.0000
6		45.6000	31.9000		40.2000	29.5000	15.2000
7			32.5000			29.8000	17.7000
8			33.8000			31.9000	18.6000
9			33.8000			36.2000	23.1000

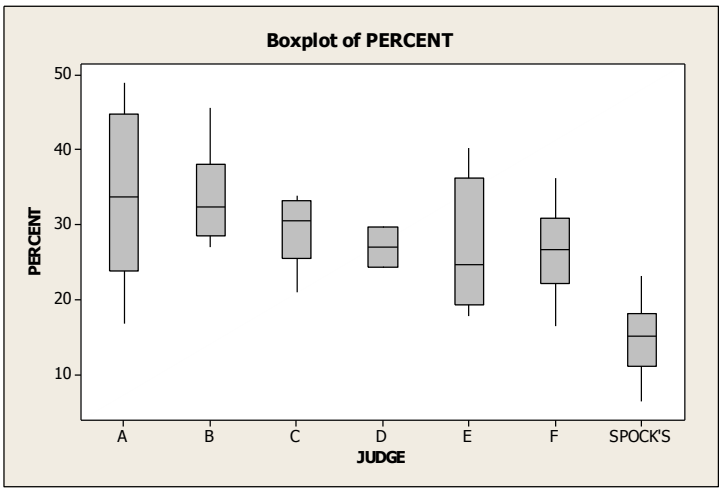
Step 3: Summary Statistics.

Descriptive Statistics: A, B, C, D, E, F, Spock

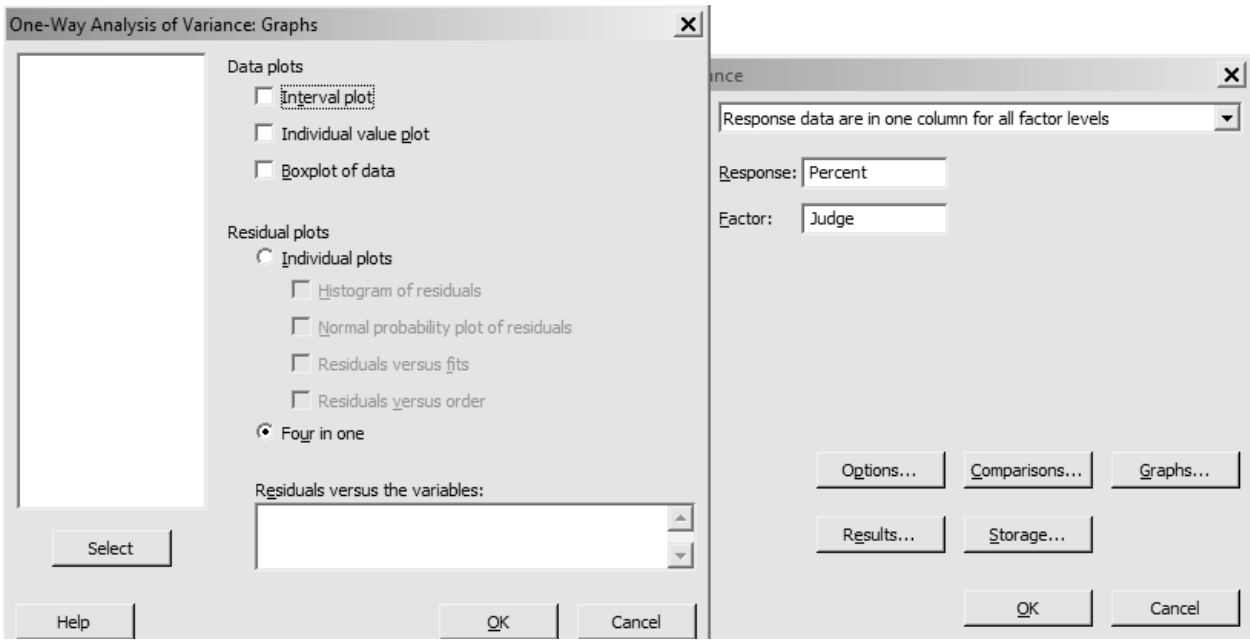
Variable	N	N*	Mean	SE Mean	StDev	Minimum	Q1	Median	Q3	Maximum
A	5	0	34.12	5.34	11.94	16.80	23.80	33.60	44.70	48.90
B	6	0	33.62	2.69	6.58	27.00	28.42	32.35	38.02	45.60
C	9	0	29.10	1.53	4.59	21.00	25.45	30.50	33.15	33.80
D	2	0	27.00	2.70	3.82	24.30	*	27.00	*	29.70
E	6	0	26.97	3.68	9.01	17.70	19.20	24.70	36.15	40.20
F	9	0	26.80	1.99	5.97	16.50	22.10	26.70	30.85	36.20
Spock	9	0	14.62	1.68	5.04	6.40	11.00	15.00	18.15	23.10







Step 4: One-way ANOVA. Go to Stat, click on ANOVA, One-Way (unstacked).



One-way ANOVA: Percent versus Judge

```
Method

Null hypothesis         All means are equal
Alternative hypothesis  At least one mean is different
Significance level      α = 0.05

Equal variances were assumed for the analysis.


Factor Information

Factor  Levels  Values
Judge        7  A, B, C, D, E, F, Spock's


Analysis of Variance

Source  DF  Adj SS  Adj MS  F-Value  P-Value
Judge    6    1927  321.18     6.72    0.000
Error   39    1864   47.81
Total   45    3792


Model Summary

      S    R-sq  R-sq(adj)  R-sq(pred)
6.91421  50.83%     43.26%      29.38%


Means

Judge    N   Mean  StDev      95% CI
A        5  34.12  11.94  (27.87, 40.37)
B        6  33.62   6.58  (27.91, 39.33)
C        9  29.10   4.59  (24.44, 33.76)
```

D	2	27.00	3.82	(17.11, 36.89)
E	6	26.97	9.01	(21.26, 32.68)
F	9	26.80	5.97	(22.14, 31.46)
Spock's	9	14.62	5.04	(9.96, 19.28)

Pooled StDev = 6.91421

Fisher Pairwise Comparisons

Grouping Information Using the Fisher LSD Method and 95% Confidence

Judge	N	Mean	Grouping
A	5	34.12	A
B	6	33.62	A
C	9	29.10	A
D	2	27.00	A
E	6	26.97	A
F	9	26.80	A
Spock's	9	14.62	B

Means that do not share a letter are significantly different.

Fisher Individual Tests for Differences of Means

Difference of Levels	Difference of Means	SE of Difference	95% CI	T-Value	Adjusted P-Value
B - A	-0.50	4.19	(-8.97, 7.97)	-0.12	0.905
C - A	-5.02	3.86	(-12.82, 2.78)	-1.30	0.201
D - A	-7.12	5.78	(-18.82, 4.58)	-1.23	0.226
E - A	-7.15	4.19	(-15.62, 1.32)	-1.71	0.095
F - A	-7.32	3.86	(-15.12, 0.48)	-1.90	0.065
Spock's - A	-19.50	3.86	(-27.30, -11.70)	-5.06	0.000
C - B	-4.52	3.64	(-11.89, 2.85)	-1.24	0.223
D - B	-6.62	5.65	(-18.04, 4.80)	-1.17	0.248
E - B	-6.65	3.99	(-14.72, 1.42)	-1.67	0.104
F - B	-6.82	3.64	(-14.19, 0.55)	-1.87	0.069
Spock's - B	-18.99	3.64	(-26.37, -11.62)	-5.21	0.000
D - C	-2.10	5.41	(-13.03, 8.83)	-0.39	0.700
E - C	-2.13	3.64	(-9.50, 5.24)	-0.59	0.562
F - C	-2.30	3.26	(-8.89, 4.29)	-0.71	0.485
Spock's - C	-14.48	3.26	(-21.07, -7.89)	-4.44	0.000
E - D	-0.03	5.65	(-11.45, 11.39)	-0.01	0.995
F - D	-0.20	5.41	(-11.13, 10.73)	-0.04	0.971
Spock's - D	-12.38	5.41	(-23.31, -1.44)	-2.29	0.028
F - E	-0.17	3.64	(-7.54, 7.20)	-0.05	0.964
Spock's - E	-12.34	3.64	(-19.72, -4.97)	-3.39	0.002
Spock's - F	-12.18	3.26	(-18.77, -5.59)	-3.74	0.001

Simultaneous confidence level = 58.26%

Fisher Individual 95% CIs

Dunnett Multiple Comparisons with a Control

Grouping Information Using the Dunnett Method and 95% Confidence

Judge	N	Mean	Grouping
A (control)	5	34.12	A
B	6	33.62	A
C	9	29.10	A
D	2	27.00	A
E	6	26.97	A
F	9	26.80	A
Spock's	9	14.62	

Means not labeled with the letter A are significantly different from the control level mean.

Dunnett Simultaneous Tests for Level Mean - Control Mean

Difference of Levels	Difference of Means	SE of Difference	95% CI	T-Value	Adjusted P-Value
B - A	-0.50	4.19	(-11.65, 10.65)	-0.12	1.000
C - A	-5.02	3.86	(-15.29, 5.25)	-1.30	0.592
D - A	-7.12	5.78	(-22.53, 8.29)	-1.23	0.643
E - A	-7.15	4.19	(-18.30, 4.00)	-1.71	0.334
F - A	-7.32	3.86	(-17.59, 2.95)	-1.90	0.242
Spock's - A	-19.50	3.86	(-29.77, -9.23)	-5.06	0.000

Individual confidence level = 98.88%

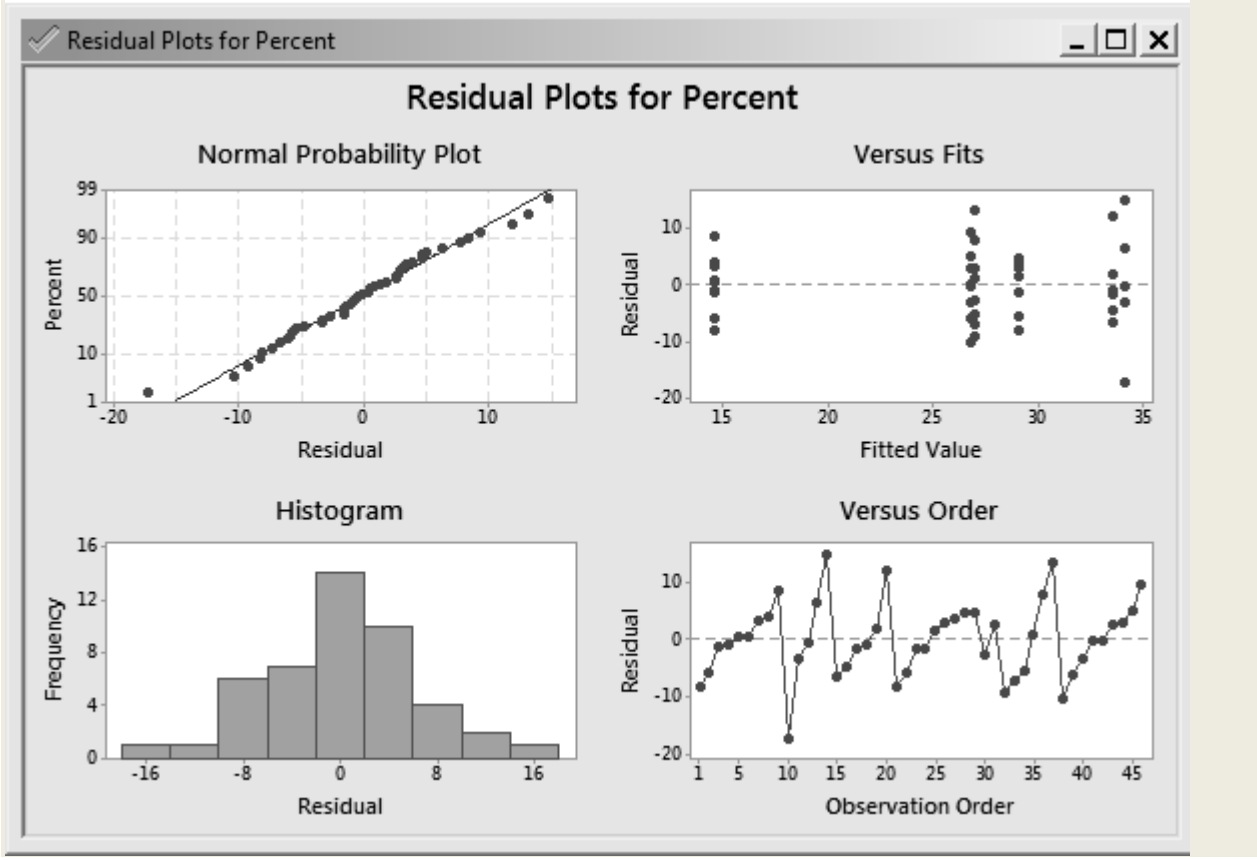
Dunnett Simultaneous 95% CIs

Hsu Multiple Comparisons with the Best (MCB)

Hsu Simultaneous Tests for Level Mean - Largest of Other Level Means

Difference of Levels	Difference of Means	SE of Difference	95% CI	T-Value	Adjusted P-Value
A - B	0.50	4.19	(-9.61, 10.61)	0.12	0.867
B - A	-0.50	4.19	(-10.61, 9.61)	-0.12	0.867
C - A	-5.02	3.86	(-14.33, 4.28)	-1.30	0.353
D - A	-7.12	5.78	(-21.09, 6.85)	-1.23	0.385
E - A	-7.15	4.19	(-17.26, 2.96)	-1.71	0.195
F - A	-7.32	3.86	(-16.63, 1.98)	-1.90	0.141
Spock's - A	-19.50	3.86	(-28.81, 0.00)	-5.06	0.000

Individual confidence level = 97.95%


Residual Plots for Percent
Residual Plots for Percent
Normal Probability Plot
Percent
Residual
Versus Fits
Residual
Fitted Value
Histogram
Frequency
Residual
Versus Order
Residual
Observation Order