Inna Williams

```
#################################################################
#
  Problem 6.1
#################################################################
#

data PROBLEM_6_1;
input DRUG $ TIME;

cards;
A 40
T 35
A 42
T 37
A 48
T 42
A 35
T 22
A 62
T 38
A 35
T 29
;
proc ttest data=PROBLEM_6_1;
title "Problem 6.1 ";
class DRUG;
var TIME;
Run;
```

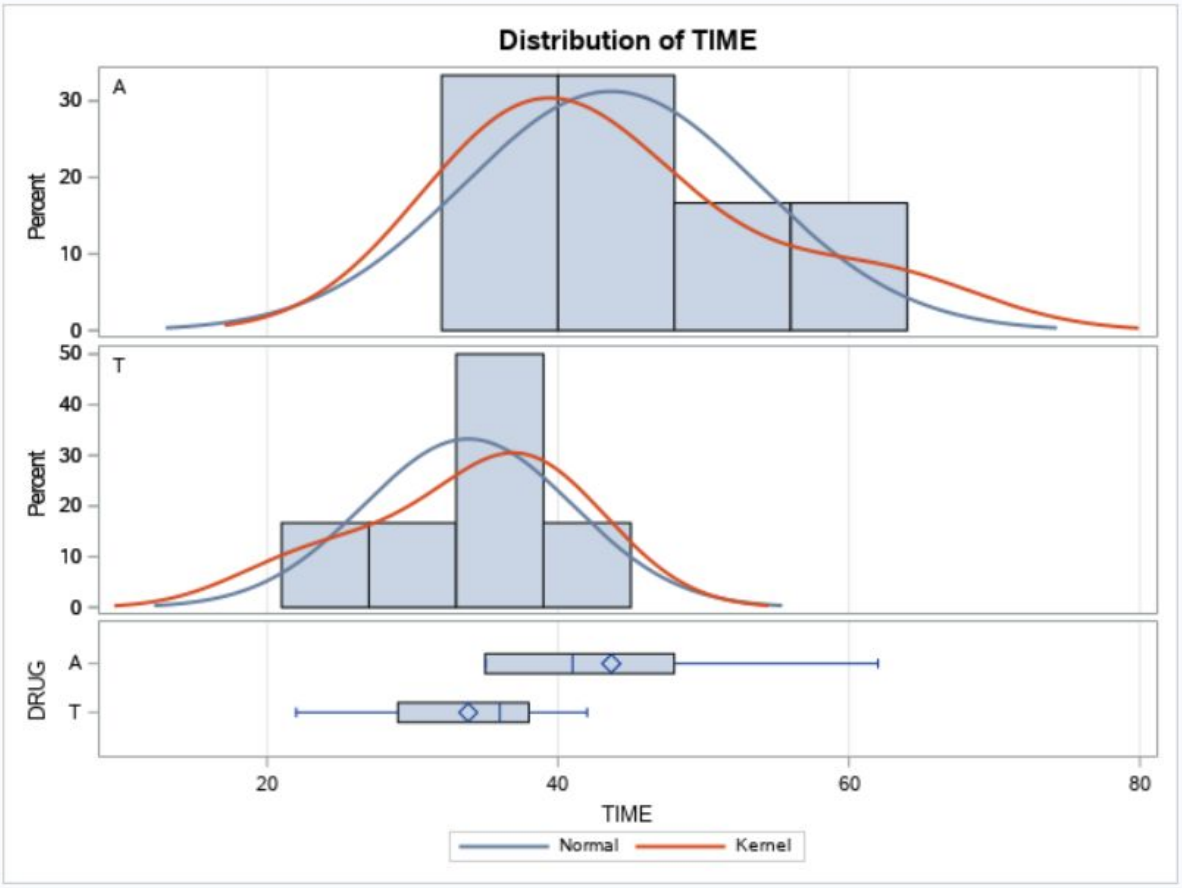
Variable: TIME

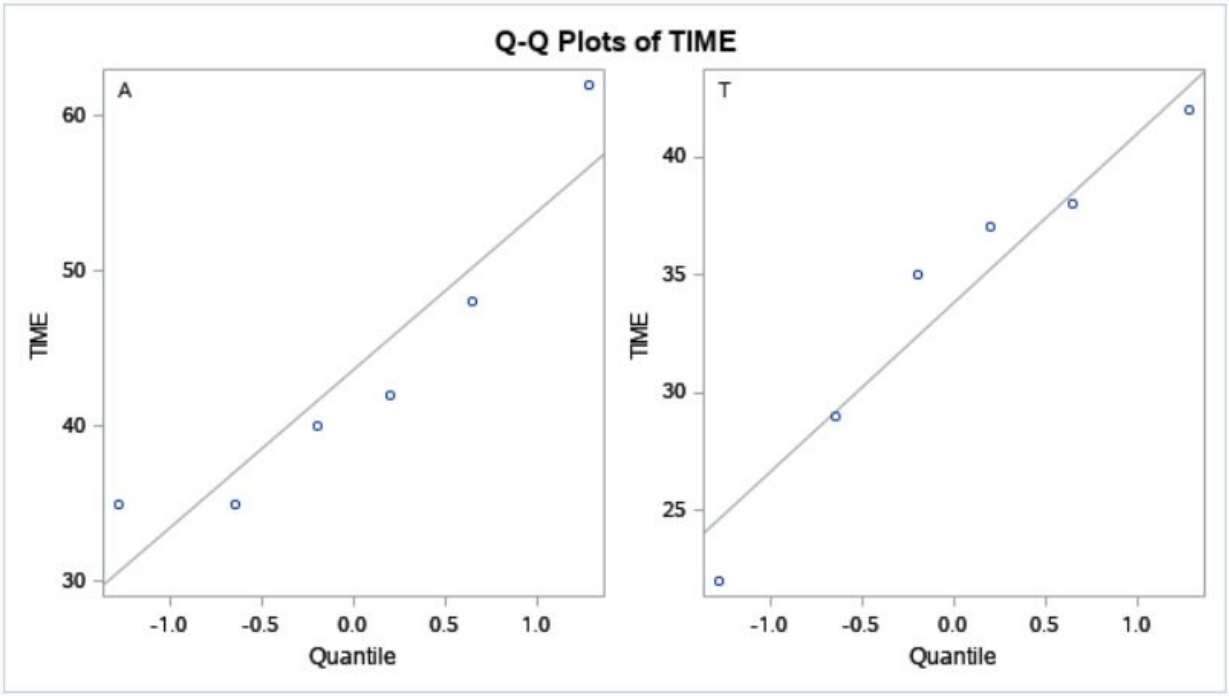
DRUG	Method	N	Mean	Std Dev	Std Err	Minimum	Maximum
A		6	43.6667	10.2111	4.1687	35.0000	62.0000
T		6	33.8333	7.1949	2.9373	22.0000	42.0000
Diff (1-2)	Pooled		9.8333	8.8327	5.0996		
Diff (1-2)	Satterthwaite		9.8333		5.0996		

DRUG	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
A		43.6667	32.9508	54.3826	10.2111	6.3739	25.0439
T		33.8333	26.2827	41.3839	7.1949	4.4911	17.6463
Diff (1-2)	Pooled	9.8333	-1.5292	21.1959	8.8327	6.1716	15.5008
Diff (1-2)	Satterthwaite	9.8333	-1.7060	21.3727			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	10	1.93	0.0827
Satterthwaite	Unequal	8.983	1.93	0.0860

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	5	5	2.01	0.4606


Distribution of TIME
A
T
Percent
DRUG
TIME
Normal
Kernel


Q-Q Plots of TIME
A
T
TIME
Quantile

```
Ho -> The Aspirin and Tylenol  variances are equal.
Ha -> The Aspirin and Tylenol  variances are not equal.
F value = 2.01 p-value = 0.4606 > alpha = 0.05
Therefore we use the line for equal
for variances that is equal:
     T value = 1.93  Pr > |t|  -> 0.0827
Conclusion:
 Fail to reject H0
 At 0.05 Significance level the difference in
 The mean value of Aspirin time compared to the mean Value
 of the Tylenol time are not significant.
 T value = 1.93      Pr > |t|  -> 0.0827
 With 95% confidence the mean values of the times of the
 subject to feel relief from Aspirin and from Tylenol
 are in  the interval [-1.5292,    21.1959]


#################################################################
#   Problem 6.3
#################################################################
#

proc npar1way data=PROBLEM_6_1 wilcoxon;
title "Problem 6.3 ";
class DRUG;
var TIME;
exact wilcoxon;
Run;
```

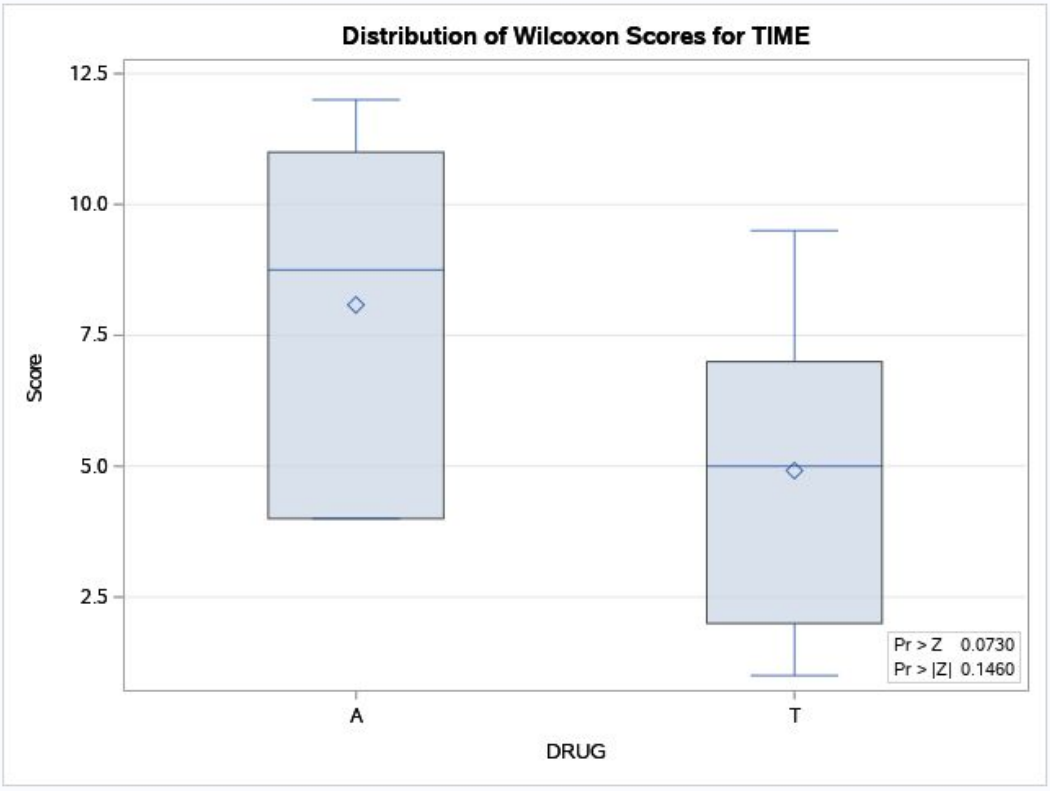
Problem 6.3

The NPAR1WAY Procedure

Wilcoxon Scores (Rank Sums) for Variable TIME Classified by Variable DRUG					
DRUG	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
A	6	48.50	39.0	6.190168	8.083333
T	6	29.50	39.0	6.190168	4.916667
Average scores were used for ties.					

Wilcoxon Two-Sample Test	
Statistic (S)	48.5000
Normal Approximation	
Z	1.4539
One-Sided Pr > Z	0.0730
Two-Sided Pr > |Z|	0.1460
t Approximation	
One-Sided Pr > Z	0.0869
Two-Sided Pr > |Z|	0.1739
Exact Test	
One-Sided Pr >= S	0.0693
Two-Sided Pr >= |S - Mean|	0.1385
Z includes a continuity correction of 0.5.	

Kruskal-Wallis Test	
Chi-Square	2.3553
DF	1
Pr > Chi-Square	0.1249




```
Ho -> The distribution of Aspirin time and Tylenol time are the same
Ha -> The distribution of Aspirin time and Tylenol time are not the same
Sum of Scores:
   Aspirin = 48.50
   Tylenol = 29.50
Exact Two-Sided Z test : Pr >= |S - Mean| =  0.1385  > alpha=0.05
Conclusion:
    Fail to reject Ho. Approximation using normal approximation with
    z-correction = 1.4539 , p = 0.1460


#################################################################
#
Problem 6.2
#################################################################
#

data PROBLEM_6_2;
```

```
input PROGRAM $ SCORE @@;
cards;
C 500 C 450 C 505 C 404 C 555 C 567 C 588 C 577 C 566 C 644 C
511 C 522 C 543 C 578
S 355 S 388 S 440 S 600 S 510 S 501 S 502 S 489 S 499 S 489 S
515 S 520 S 520 S 480
;
proc npar1way data=PROBLEM_6_2 wilcoxon;
title "Problem 6.2 ";
class PROGRAM;
var SCORE;
exact wilcoxon;
run;
```

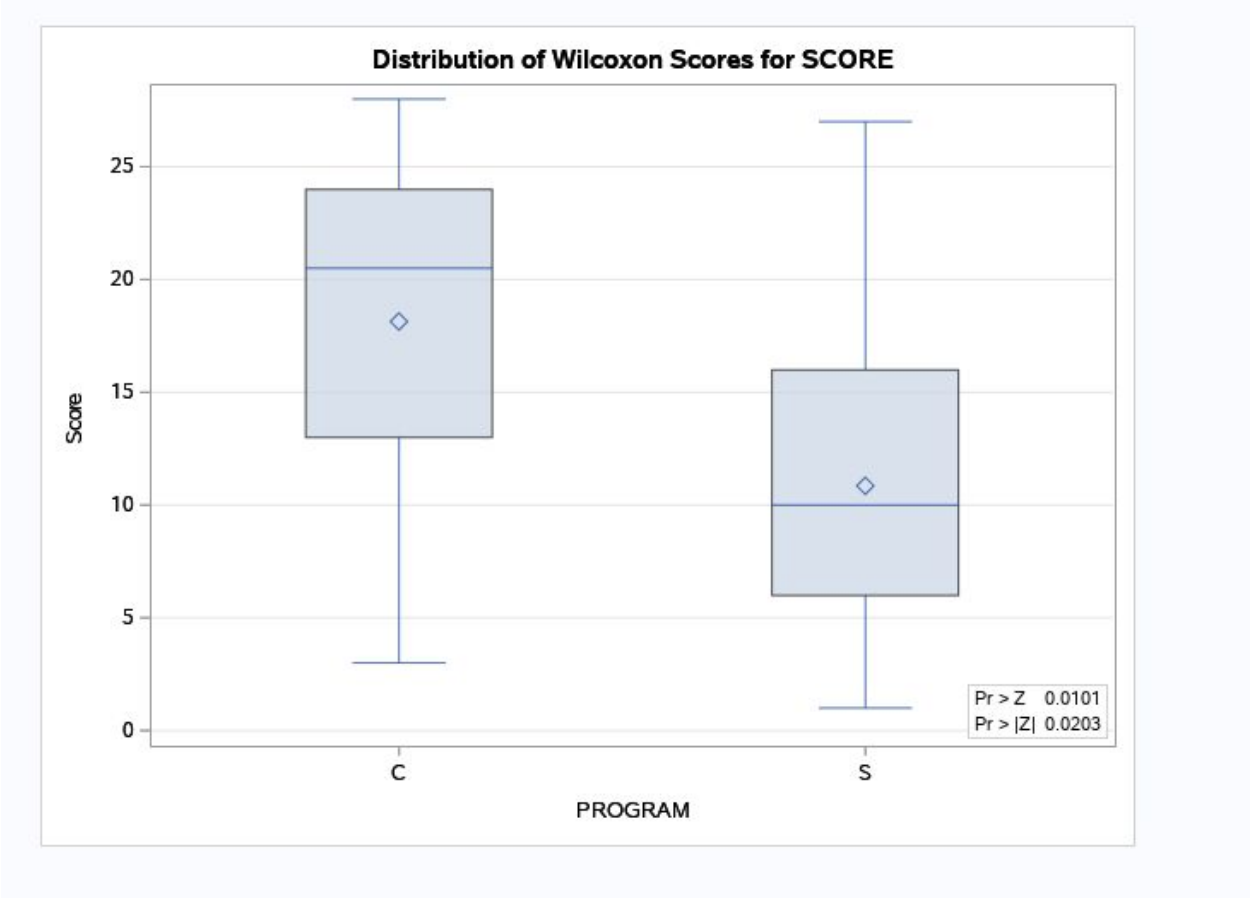
Problem 6.2

The NPAR1WAY Procedure

Wilcoxon Scores (Rank Sums) for Variable SCORE Classified by Variable PROGRAM					
PROGRAM	N	Sum of Scores	Expected Under H0	Std Dev Under H0	Mean Score
C	14	254.0	203.0	21.757927	18.142857
S	14	152.0	203.0	21.757927	10.857143
Average scores were used for ties.					

Wilcoxon Two-Sample Test	
Statistic (S)	254.0000
Normal Approximation	
Z	2.3210
One-Sided Pr > Z	0.0101
Two-Sided Pr > |Z|	0.0203
t Approximation	
One-Sided Pr > Z	0.0140
Two-Sided Pr > |Z|	0.0281
Exact Test	
One-Sided Pr >= S	0.0090
Two-Sided Pr >= |S - Mean|	0.0179
Z includes a continuity correction of 0.5.	

Kruskal-Wallis Test	
Chi-Square	5.4942
DF	1
Pr > Chi-Square	0.0191




```
Ho -> The distribution of Scores Cody Program and Smith program are the same
Ha -> The distribution of Scores Cody Program and Smith program are not the
same
Sum of Scores:
   Cody Program = 254.0
   Smith Program = 152.0
Exact Two-Sided Z test : Pr >= |S - Mean| =  0.0179  > alpha=0.05
Conclusion:
    Reject Ho.
    The distribution of Scores Cody Program and Smith program
    are not the same.
```

```
#####################################################################
#
Problem 6.4
#####################################################################
#
DATA QUES6_4;
 DO GROUP = 'A','B','C';
  DO I = 1 to 10;
```

```
   X = ROUND(RANNOR(135)*10+300 *5*(GROUP EQ 'A') - 7 *(GROUP EQ 'C'));
   Y = ROUND(RANUNI(135)*100 + X);
        OUTPUT;
     END;
  END;
  DROP I;
run;

proc print data=QUES6_4;
title 'Problem_6_4';
run;

proc ttest data=QUES6_4;
title 'Problem_6_4 Tests for X and Y using only group A and C';
where GROUP in('A','C');
class GROUP;
var X Y;
Run;
```

Problem_6_4

Obs	GROUP	X	Y
1	A	1502	1600
2	A	1476	1561
3	A	1503	1575
4	A	1499	1571
5	A	1516	1536
6	A	1507	1521
7	A	1495	1586
8	A	1493	1571
9	A	1515	1581
10	A	1495	1585
11	B	-12	59
12	B	-10	3
13	B	1	75
14	B	-9	51
15	B	7	63
16	B	-3	27
17	B	-27	50
18	B	-4	77
19	B	16	76
20	B	-6	60
21	C	-14	-7
22	C	-24	-3
23	C	-7	87
24	C	-10	-9
25	C	-10	30
26	C	-24	74
27	C	-13	77
28	C	-7	22
29	C	-1	79
30	C	-6	31

Problem_6_4 Tests for X and Y using only group A and C

The TTEST Procedure

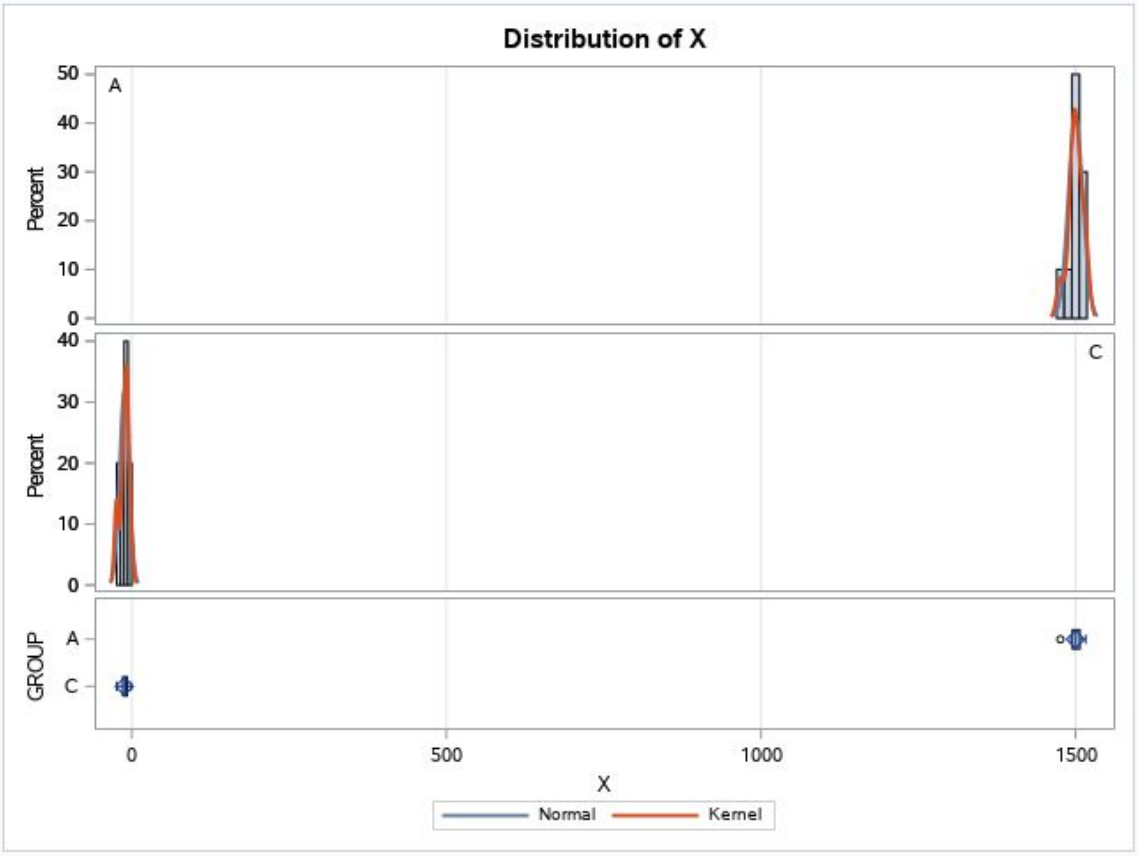
Variable: X

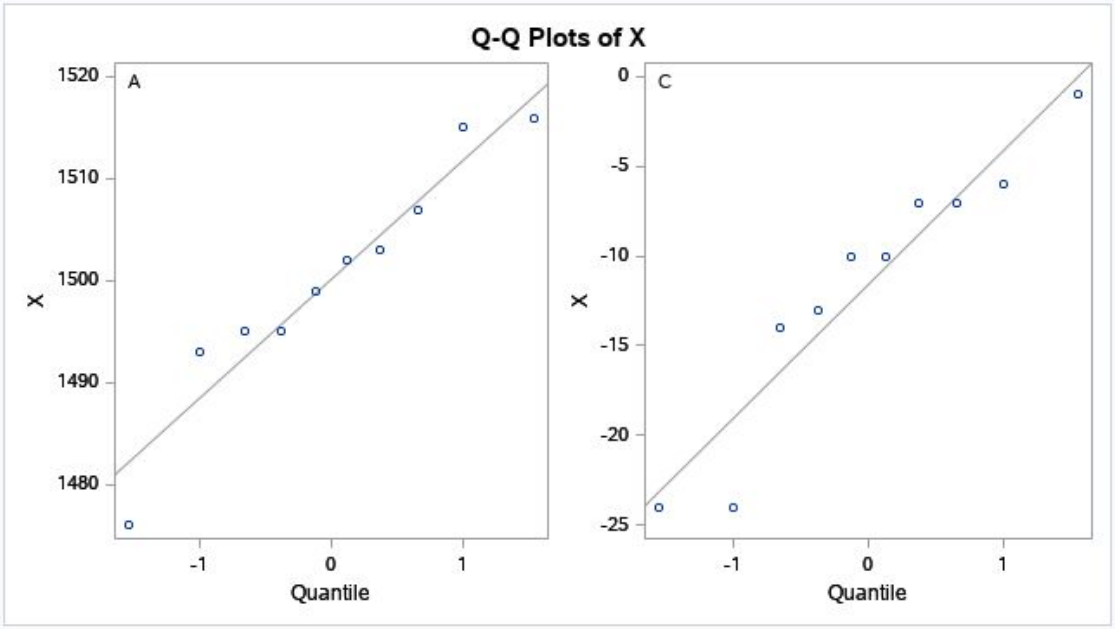
GROUP	Method	N	Mean	Std Dev	Std Err	Minimum	Maximum
A		10	1500.1	11.6376	3.6801	1476.0	1516.0
C		10	-11.6000	7.5011	2.3721	-24.0000	-1.0000
Diff (1-2)	Pooled		1511.7	9.7903	4.3784		
Diff (1-2)	Satterthwaite		1511.7		4.3784		

GROUP	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
A		1500.1	1491.8	1508.4	11.6376	8.0047	21.2457
C		-11.6000	-16.9660	-6.2340	7.5011	5.1595	13.6941
Diff (1-2)	Pooled	1511.7	1502.5	1520.9	9.7903	7.3977	14.4781
Diff (1-2)	Satterthwaite	1511.7	1502.4	1521.0			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	18	345.27	<.0001
Satterthwaite	Unequal	15.377	345.27	<.0001

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	9	9	2.41	0.2068


Distribution of X
A
C
Percent
GROUP
X
Normal
Kernel


Q-Q Plots of X
A
C
X
Quantile

Variable: Y

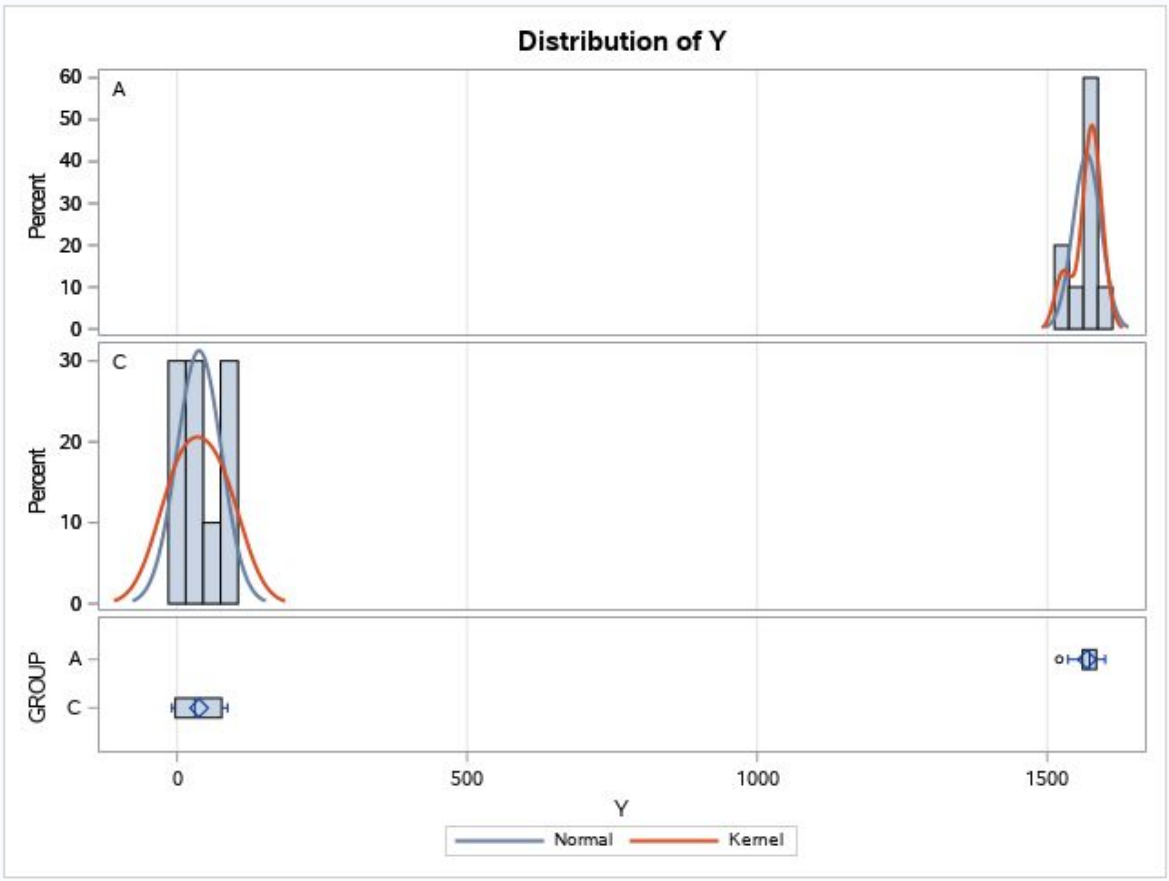
Variable: Y

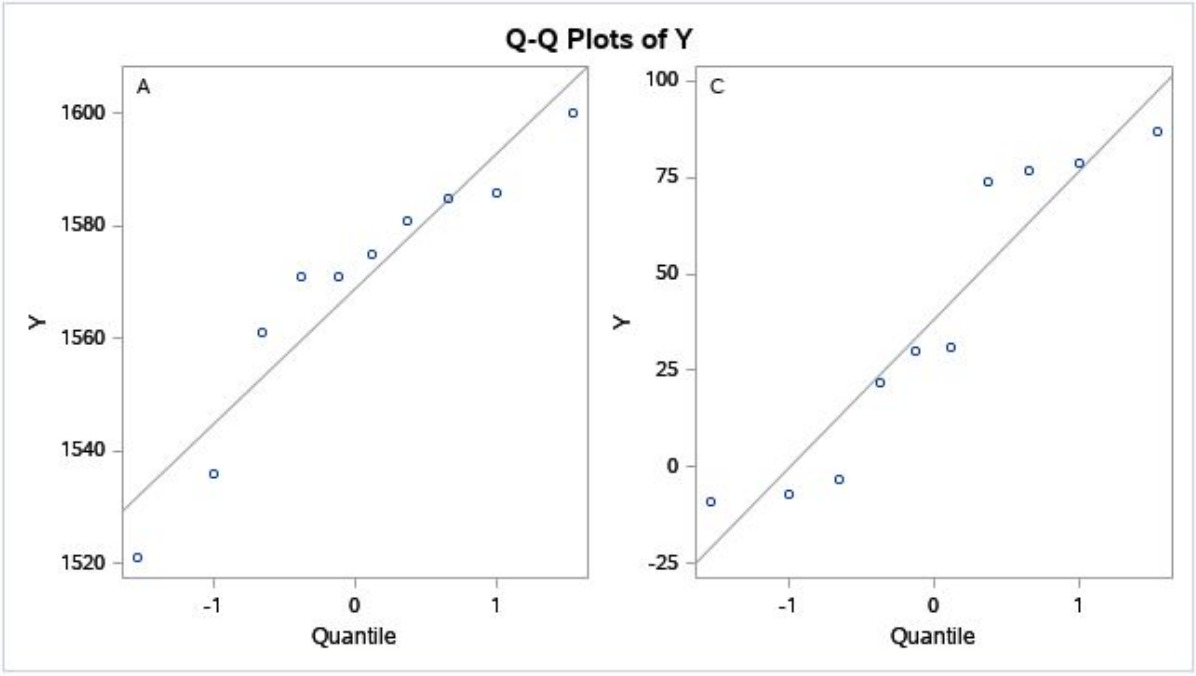
GROUP	Method	N	Mean	Std Dev	Std Err	Minimum	Maximum
A		10	1568.7	23.9214	7.5646	1521.0	1600.0
C		10	38.1000	38.2723	12.1028	-9.0000	87.0000
Diff (1-2)	Pooled		1530.6	31.9139	14.2724		
Diff (1-2)	Satterthwaite		1530.6		14.2724		

GROUP	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
A		1568.7	1551.6	1585.8	23.9214	16.4540	43.6711
C		38.1000	10.7217	65.4783	38.2723	26.3250	69.8702
Diff (1-2)	Pooled	1530.6	1500.6	1560.6	31.9139	24.1146	47.1951
Diff (1-2)	Satterthwaite	1530.6	1500.2	1561.0			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	18	107.24	<.0001
Satterthwaite	Unequal	15.101	107.24	<.0001

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	9	9	2.56	0.1777





Ho -> The A and C variances are equal for var X

```
Ha -> The A and C  variances are not equal for var X.
For var X : F value = 2.41          p-value = 0.2068 > alpha = 0.05
Therefore we use the line for equal.
Conclusion:
 Fail to reject H0
 At 0.05 Significance level the difference in
 The mean value of A compared to the mean Value
 of the C are not significant. Use Equal T stat
 T value = 345.27  Pr > |t|  -> 0001
 With 95% confidence the mean values of the Group A
 and Group C are in the interval [1502.5  1520.9]
```

Ho -> The A and C variances are equal for var Y

```
Ha -> The A and C  variances are not equal for var Y.
FOr var Y : F value = 2.56          p-value = 0.1777 > alpha =0.05
Therefore we use the line for equal.
Conclusion:
 Fail to reject H0
 At 0.05 Significance level the difference in
 The mean value of A compared to the mean Value
 of the C are not significant. Use Equal T stat
 T value = 107.24  Pr > |t|  -> 0001
 With 95% confidence the mean values of the Group A
 and Group C are in the interval [1500.6  1560.6]
```

```
#####################################################################
#
Problem 6.5
#####################################################################
#
data Problem_6_5;
input SUBJECT $ A_TIME B_TIME;
cards;
1 20 18
2 40 36
3 30 30
4 45 46
5 19 15
6 27 22
7 32 29
8 26 25
;
```

```
proc ttest data=Problem_6_5;
title "Problem 6.5";
paired A_TIME*B_TIME;
run;
```

Problem 6.5

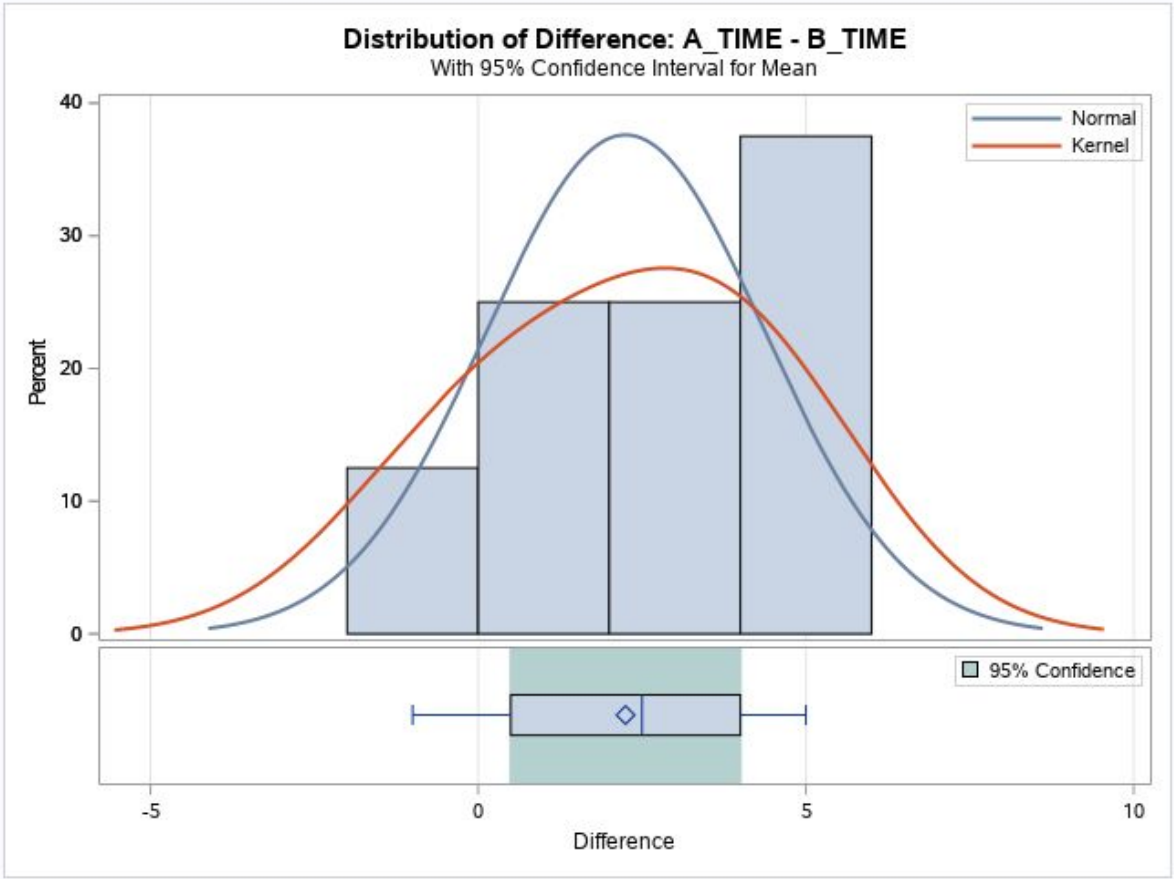
The TTEST Procedure

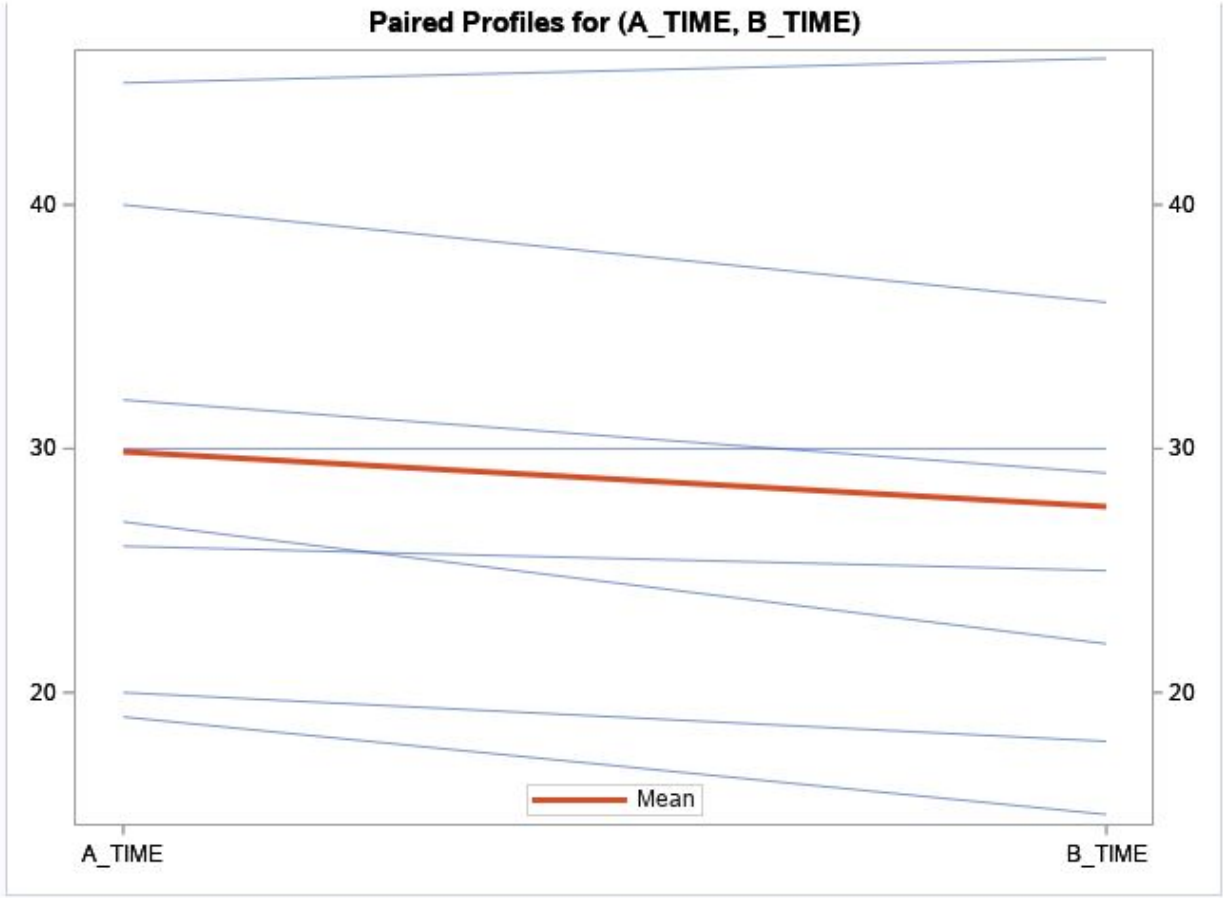
Difference: A_TIME - B_TIME

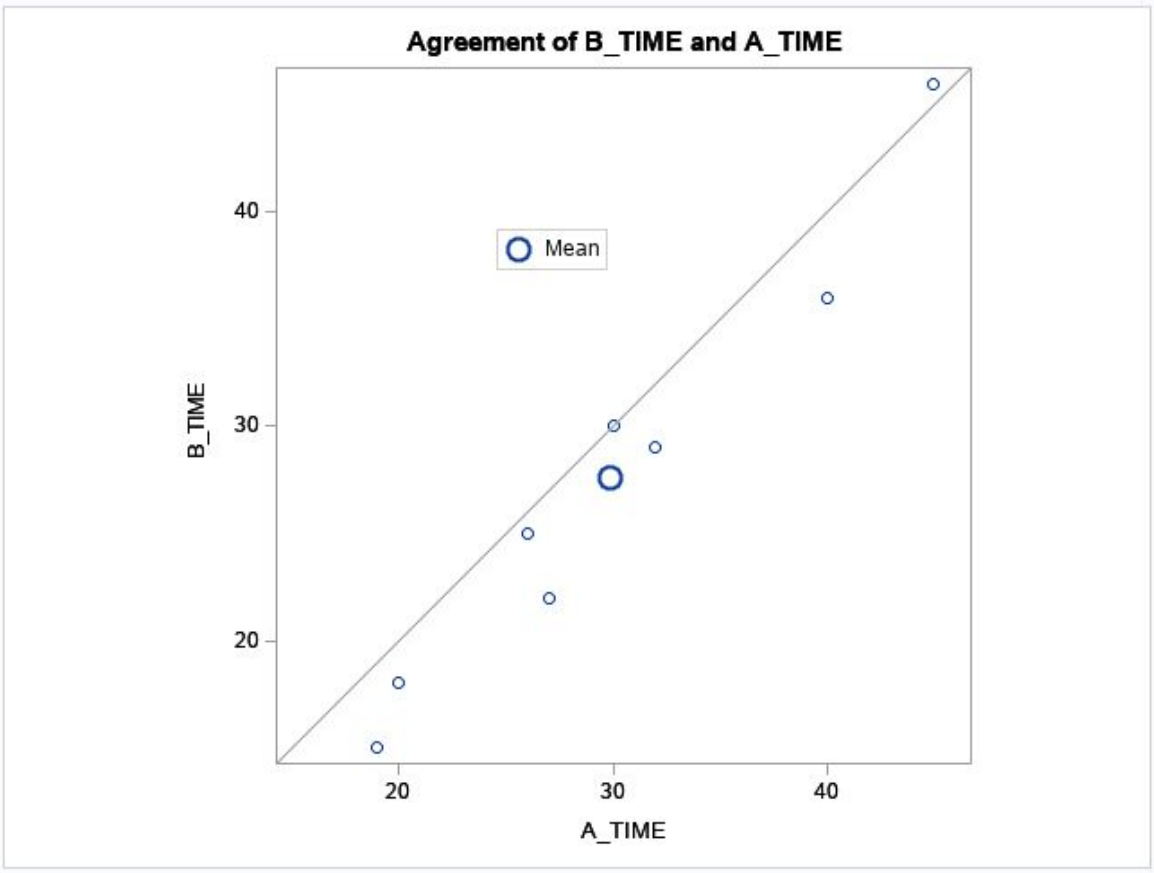
N	Mean	Std Dev	Std Err	Minimum	Maximum
8	2.2500	2.1213	0.7500	-1.0000	5.0000

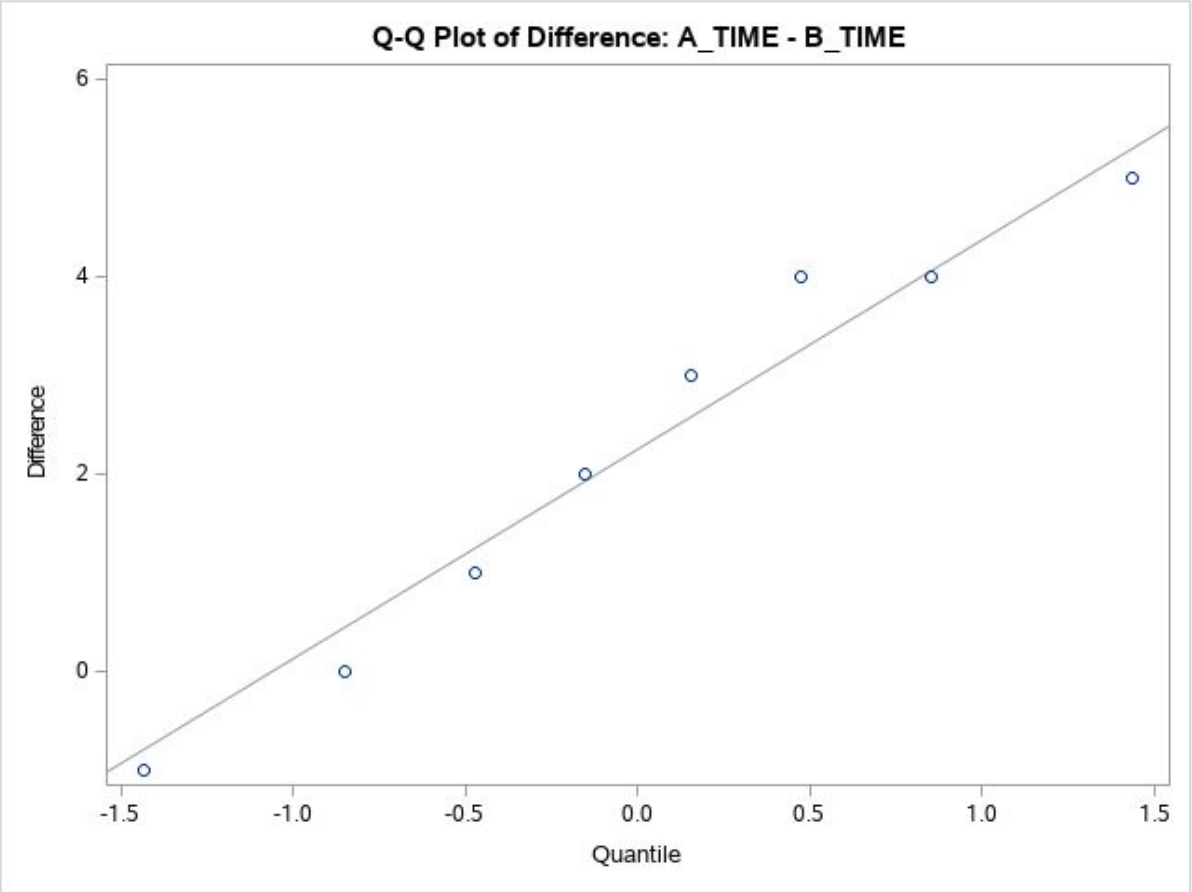
Mean	95% CL Mean		Std Dev	95% CL Std Dev	
2.2500	0.4765	4.0235	2.1213	1.4026	4.3175

DF	t Value	Pr > |t|
7	3.00	0.0199




Paired Profiles for (A_TIME, B_TIME)
40
30
20
Mean
A_TIME
B_TIME


Agreement of B_TIME and A_TIME
Mean
B_TIME
A_TIME
20
30
40
20
30
40




```
Ho->difference between A_TIME-B_TIME=0
Ha->difference between A_TIME-B_TIME != 0
t value = 3.00    p-value = 0.0199 < alpha=0.05
Conclusion:
we reject Ho
At significance level alpha=0.05 the difference
between Drug A time and drug B time are significantly
different from zero.
It means that A_TIME - B_TIME = 3
therefore A_TIME > B_TIME
Or drug B works faster.
With 95% confidence difference A_TIME-B_TIME
are in the interval [0.4765   4.0235]

############################################################
Problem 6_6
############################################################

data Problem_6_6;
input SUBJECT $ A_WEIGHT   B_WEIGHT  @@;
```

```
cards;

1  290  300
2  331  350
3  200  190
4  395  400
5  240  244
6  300  321
7  332  330
8  242  250
9  185  190
10 158  160
11 256  260
12 220  240
;
proc ttest data=Problem_6_6;
title "Problem 6.6";
paired A_WEIGHT*B_WEIGHT;
Run;
```

Problem 6.6

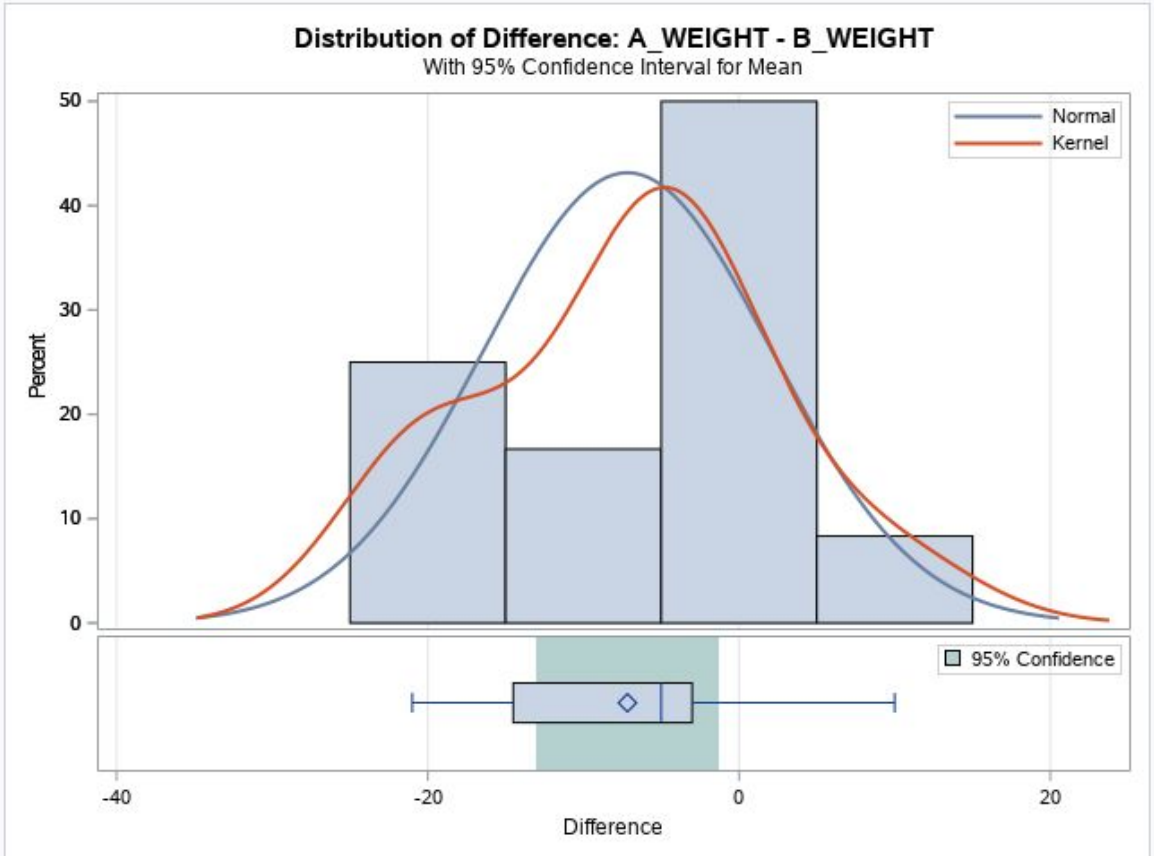
The TTEST Procedure

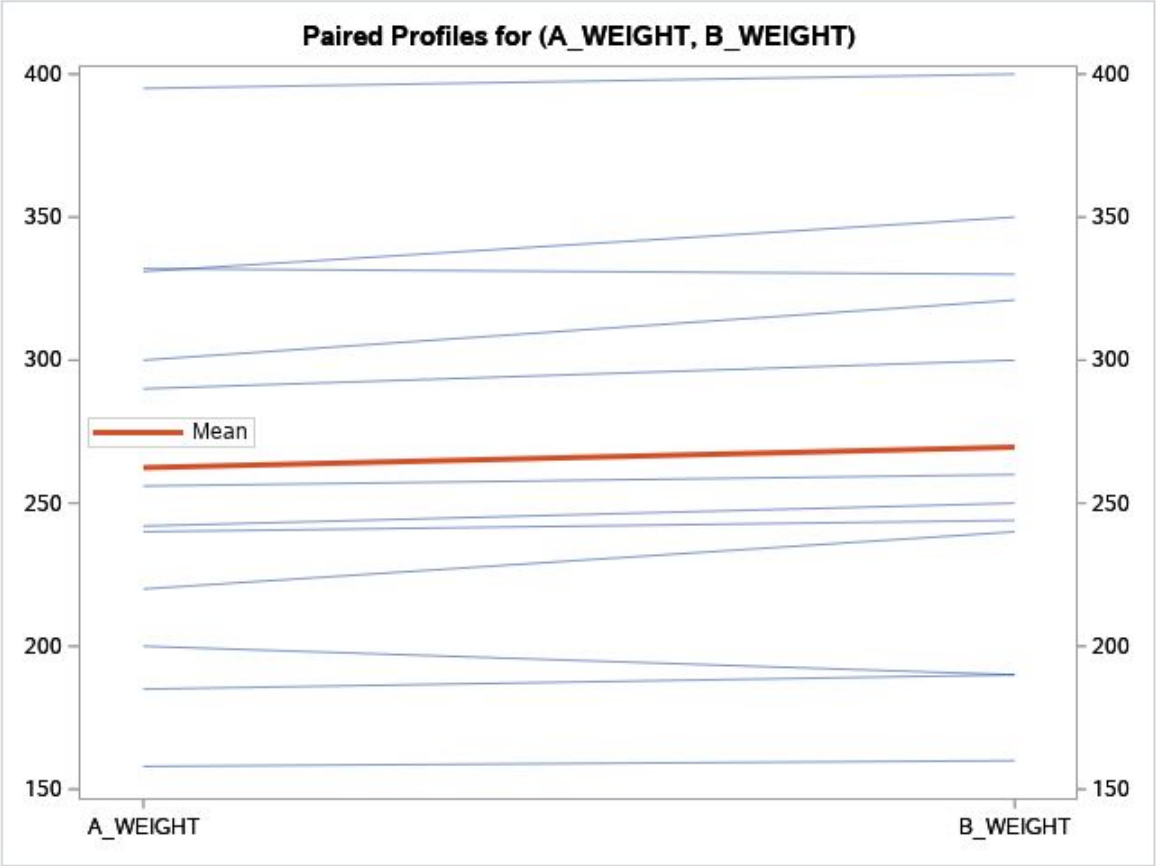
Difference: A_WEIGHT - B_WEIGHT

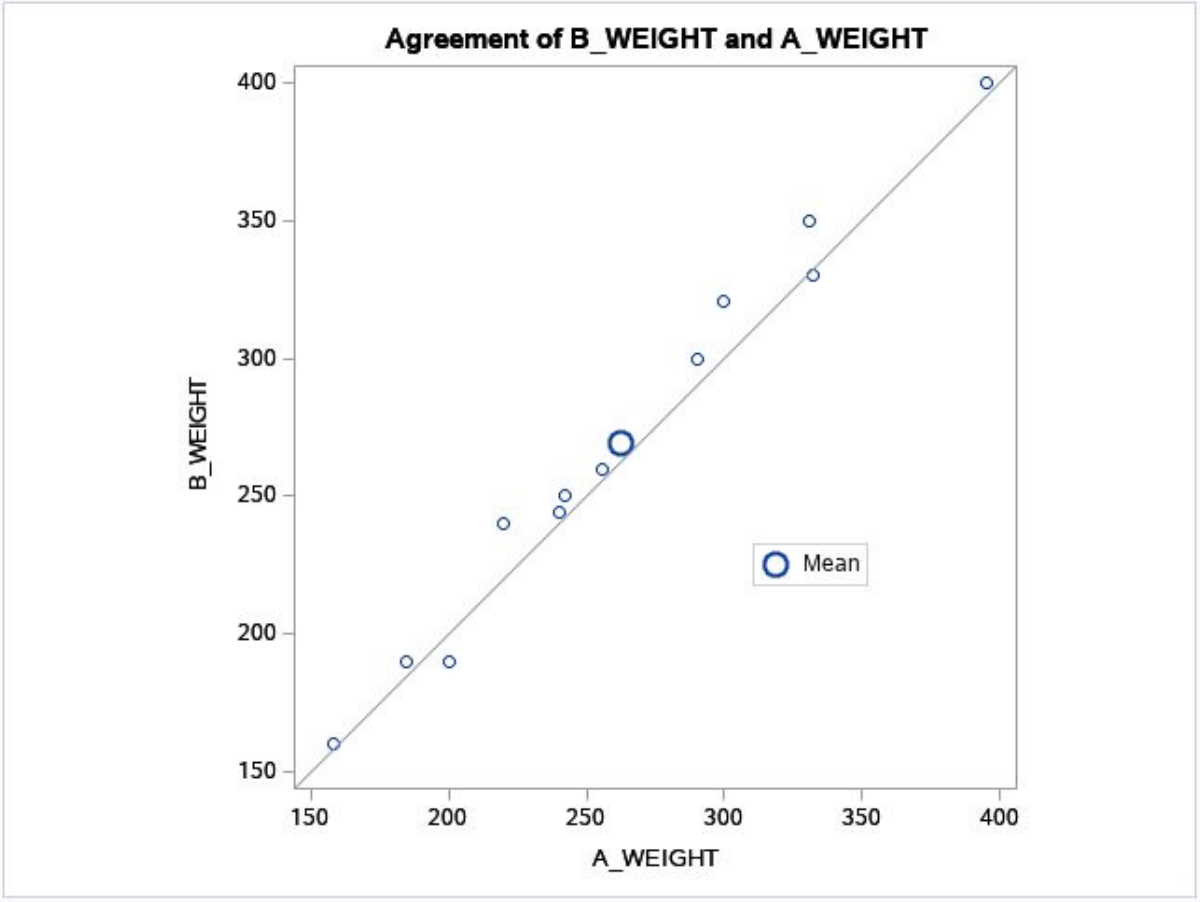
N	Mean	Std Dev	Std Err	Minimum	Maximum
12	-7.1667	9.2425	2.6681	-21.0000	10.0000

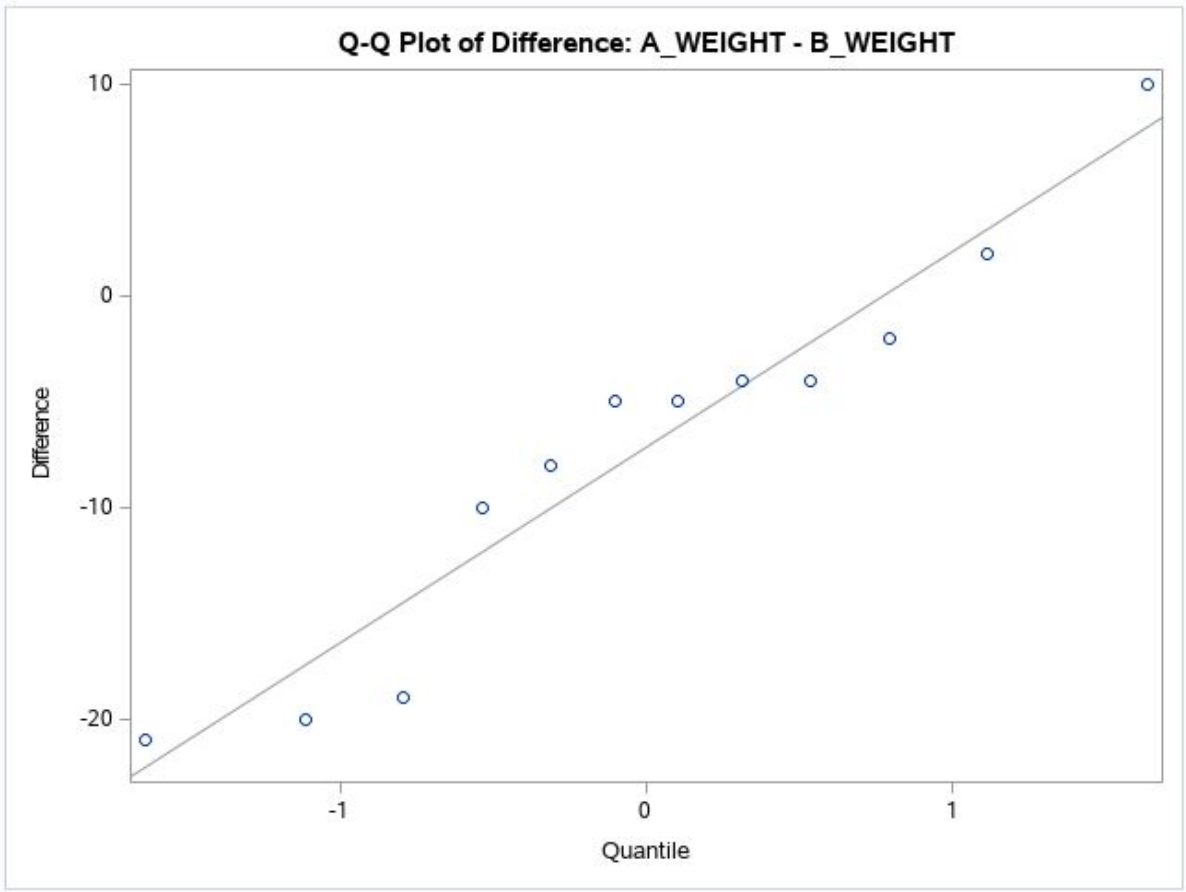
Mean	95% CL Mean		Std Dev	95% CL Std Dev	
-7.1667	-13.0391	-1.2942	9.2425	6.5474	15.6927

DF	t Value	Pr > |t|
11	-2.69	0.0212




Paired Profiles for (A_WEIGHT, B_WEIGHT)
400
350
300
250
200
150
Mean
A_WEIGHT
B_WEIGHT


Agreement of B_WEIGHT and A_WEIGHT
B_WEIGHT
A_WEIGHT
400
350
300
250
200
150
150
200
250
300
350
400
Mean




```
Ho->difference between A_WEIGHT-B_WEIGHT=0
Ha->difference between A_WEIGHT-B_WEIGHT != 0
t value = -2.69   p-value = 0.0212 < alpha=0.05
we reject Ho
Conclusion:
At significance level alpha=0.05 the difference
between WEIGHT after diet A  and WEIGHT after
diet B  are significantly different from zero.
It means that A_WEIGHT - B_WEIGHT = -2.69
therefore A_WEIGHT < B_WEIGHT
Or after diet B the weight is higher.
With 95% confidence difference A_WEIGHT - B_WEIGHT
are in the interval [-1.2942   ,  -13.0391]
```

```
data Problem_6_6_NOT_PAIRED;
input GROUP $ WEIGHT  @@;
cards;
```

```
A 290 B 300 A 331 B 350 A 200 B 190 A 395 B 400 A 240 B 244 A
300 B 321
A 332 B 330 A 242 B 250 A 185 B 190 A 158 B 160 A 256 B 260 A
220 B 240
;
proc ttest data=Problem_6_6_NOT_PAIRED;
title "Problem 6.6 IF NOT PAIRED";
class GROUP;
VAR WEIGHT;
Run;
```

Problem 6.6 IF NOT PAIRED

The TTEST Procedure

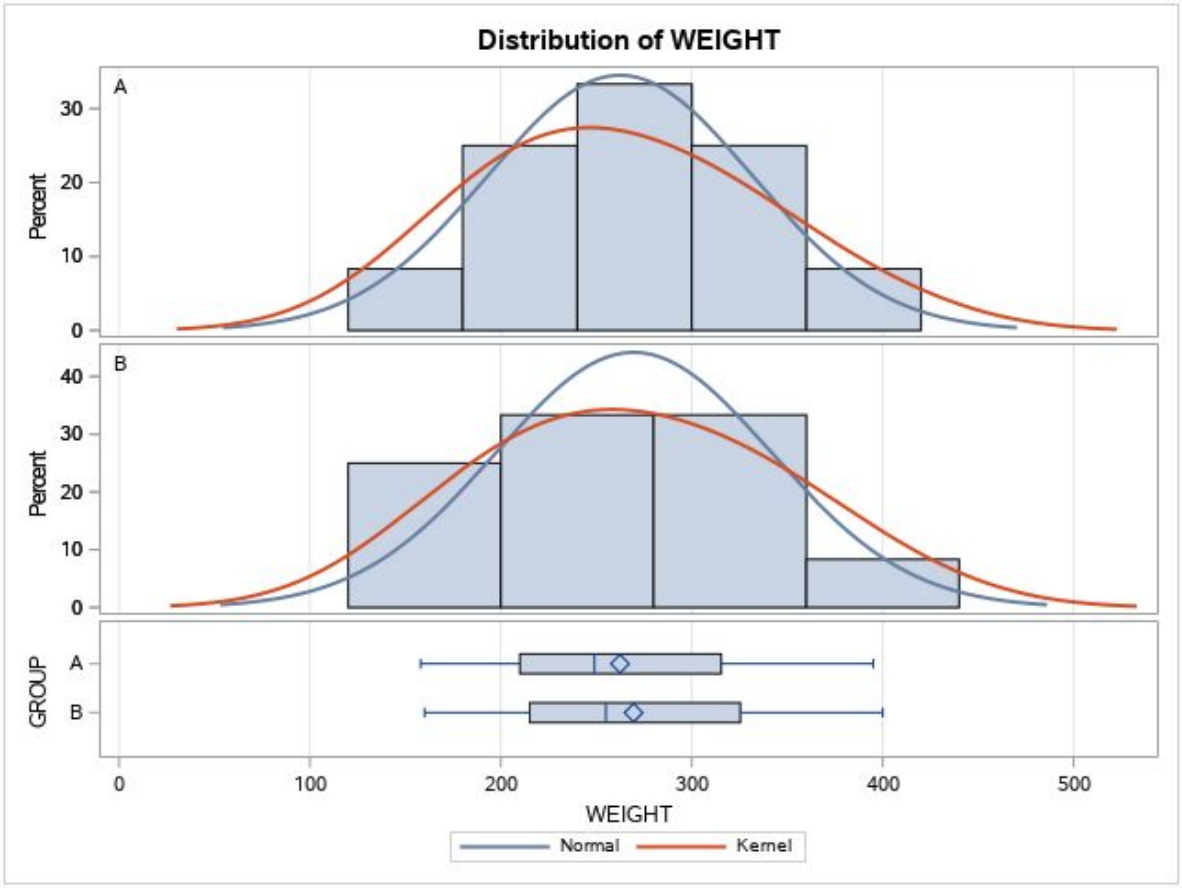
Variable: WEIGHT

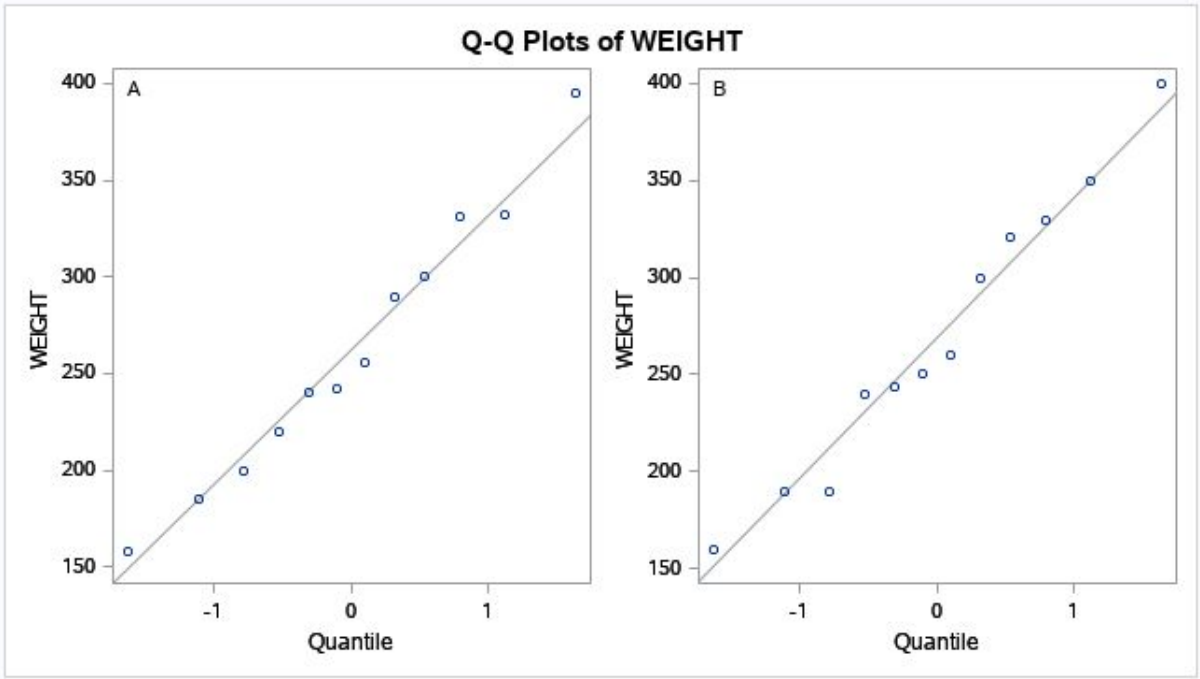
GROUP	Method	N	Mean	Std Dev	Std Err	Minimum	Maximum
A		12	262.4	69.3141	20.0093	158.0	395.0
B		12	269.6	72.2212	20.8485	160.0	400.0
Diff (1-2)	Pooled		-7.1667	70.7826	28.8969		
Diff (1-2)	Satterthwaite		-7.1667		28.8969		

GROUP	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
A		262.4	218.4	306.5	69.3141	49.1018	117.7
B		269.6	223.7	315.5	72.2212	51.1611	122.6
Diff (1-2)	Pooled	-7.1667	-67.0951	52.7618	70.7826	54.7429	100.2
Diff (1-2)	Satterthwaite	-7.1667	-67.1010	52.7676			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	22	-0.25	0.8064
Satterthwaite	Unequal	21.963	-0.25	0.8064

Equality of Variances				
Method	Num DF	Den DF	F Value	Pr > F
Folded F	11	11	1.09	0.8940


Distribution of WEIGHT
A
B
Percent
GROUP
A
B
0
100
200
300
400
500
WEIGHT
Normal
Kernel


Q-Q Plots of WEIGHT
A
B
WEIGHT
Quantile
150
200
250
300
350
400
-1
0
1

Procedure

```
Ho -> Before and After WEIGHT variances are equal.
Ha -> Before and After WEIGHT variances are not equal.
F value = 1.09    p-value = 0.8940 > alpha = 0.05
Therefore we fail to reject Ho use the line for equal
for variances that is equal:
     T value = -0.25    0.8064 Pr > |t|  -> 0.8064
Conclusion:
 Fail to reject H0
 At 0.05 Significance level the difference in
 The mean value of WEIGHT Before  compared to the mean Value
 of the WEIGHT After are not significant.
 t value = -0.25   Pr > |t|  -> 0.8064
 With 95% confidence the mean values of the WEIGHT Before
 compare to mean values of the WEIGHT After the diet
 are in  the interval [-67.0951     52.7618]
```

for paired t value = -2.69 p-value = 0.0212
fo non paired t value = -0.25 Pr > |t| -> 0.8064

p-value for paired is much smaller 0.0212 << 0.8064
for paired : A_WEIGHT-B_WEIGHT = 3
for non-paired A_WEIGHT and B_WEIGHT variances are equal.
Or difference in mean value are not significant.