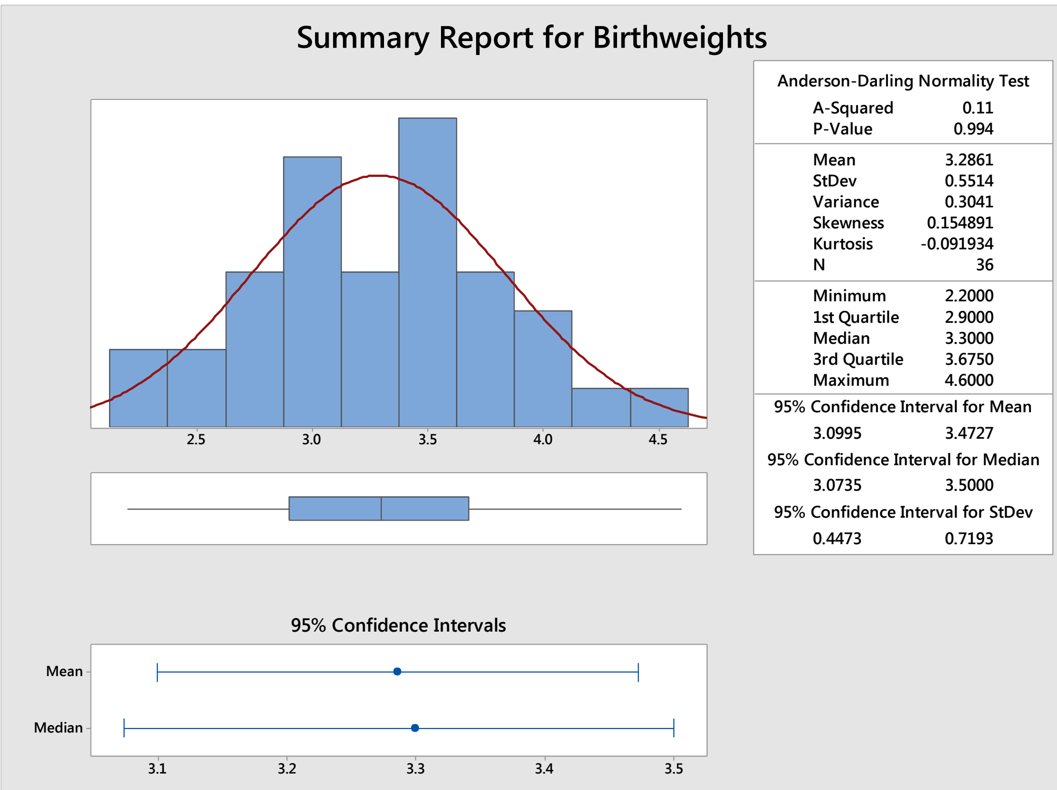
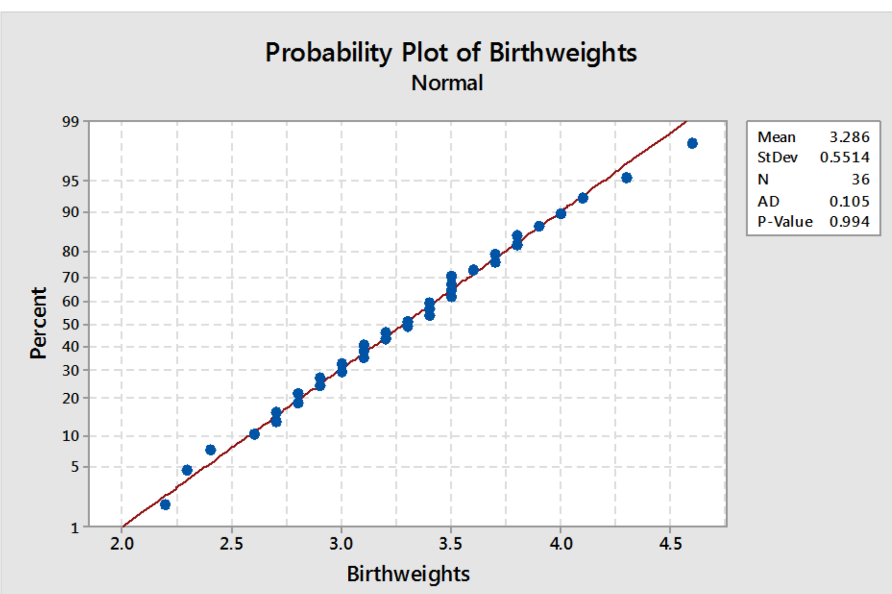
MAT9UD2 : Practical Statistics Spring 2017

Solutions to Practical 6

Question 1

The data is quantitative, one sample, small sample (n<30) and the question asks about the mean. Formal technique to answers the question would be a One Sample t-test. This assumes that the data is Normally distributed.





Normal Probability Plot looks linear so we can assume that the data follows a Normal distribution.

One-Sample T: Birthweights

Test of μ = 3.6 vs ≠ 3.6

Variable	N	Mean	StDev	SE Mean	95% CI	T	P
Birthweights	36	3.2861	0.5514	0.0919	(3.0995, 3.4727)	-3.42	0.002

H_o: $\mu = 3.6$ H_1 $\mu \neq 3.6$

$p<0.05$ so we can reject H_o in favour of H_1 at 5% level (also at 1% level) so evidence that the mean birthweight is significantly different to 3.6kgs. Further 95% certain that mean birthweight lies between 3.1 and 3.5kgs (does not include 3.6 so can draw same conclusion).

Question 2

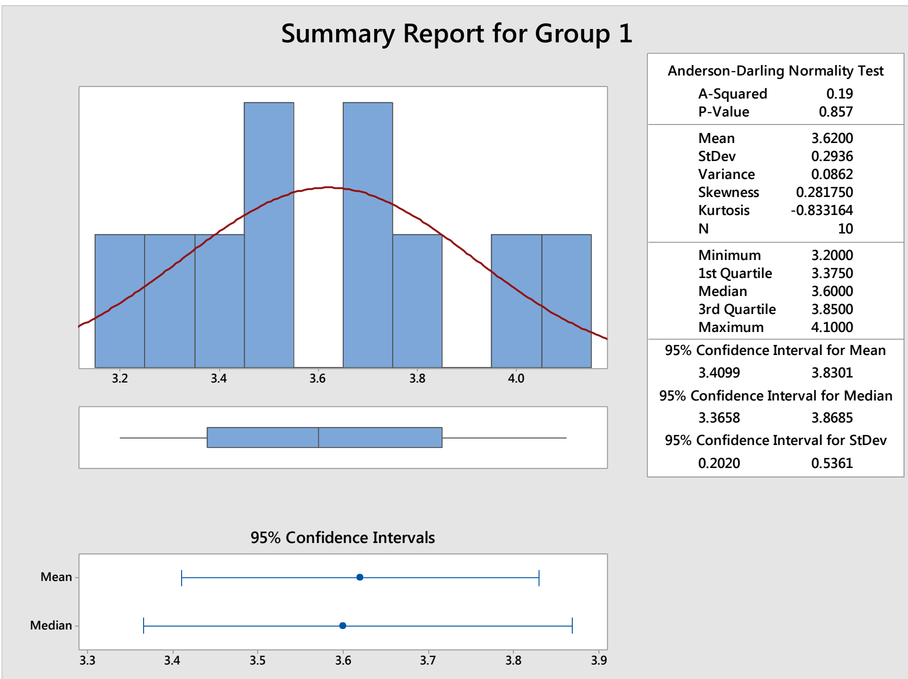
The data is quantitative, two independent samples and the question asks about comparing the means.

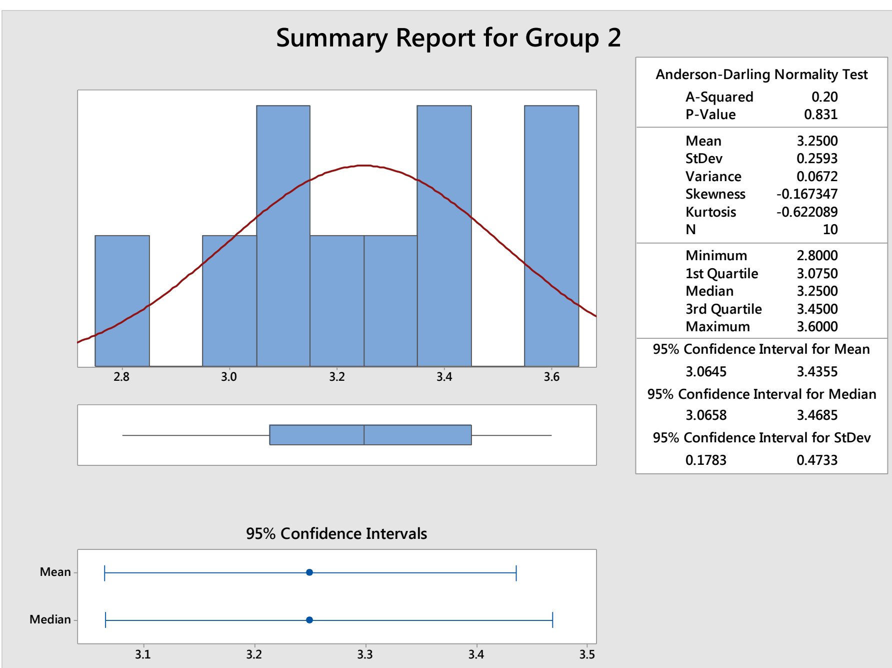
Formal technique to answer the question would be an Unpaired t-test; the most commonly used Unpaired t-test assumes equal variance (we will test this last – should be done first!!).

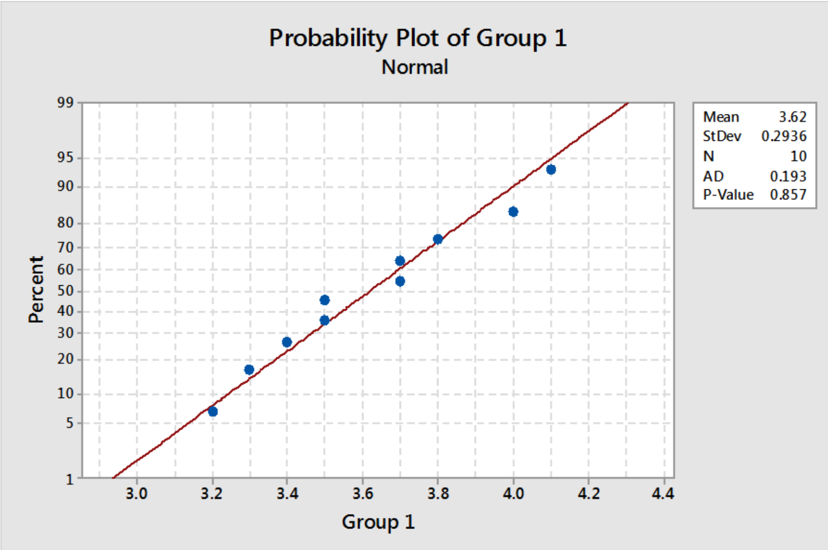
This assumes that the data in both samples is Normally distributed.

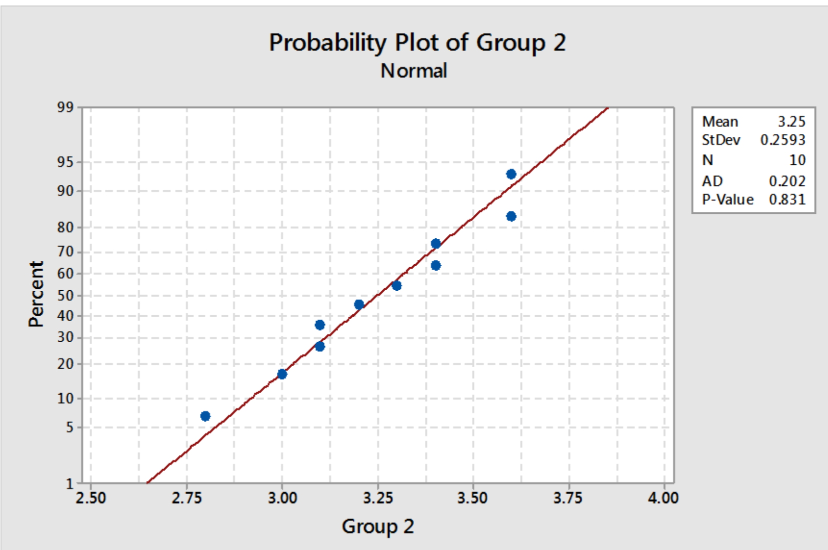
The assumption of Normality is valid if the data follows a Normal distribution.

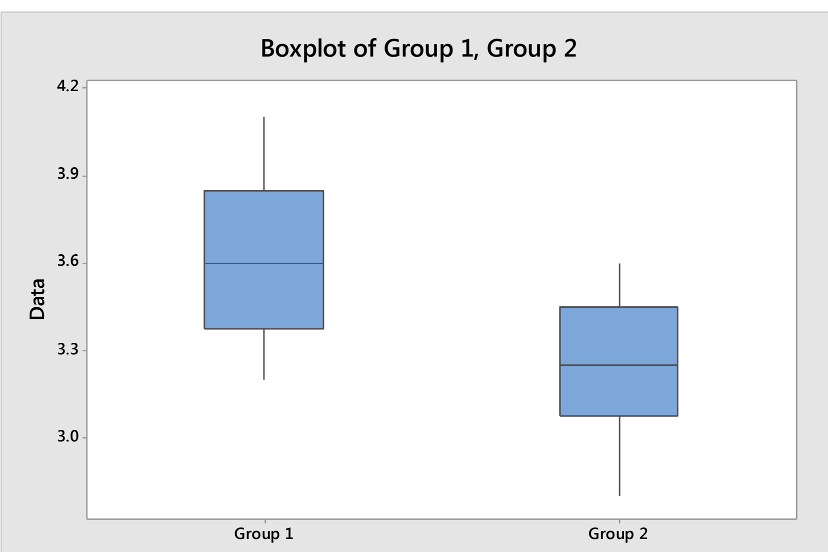
Examining the Normal probability plots below, we can assume that the data from both groups follow Normal distribution since the plots are approximately linear.











Informal/ Subjective Impression

Group 1 mean 3.62 and Group 2 mean 3.25

The sample means look fairly different numerically and looking at the boxplot plots the groups look to have a similar spread.

Two-Sample T-Test and CI: Group 1, Group 2

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Two-sample T for Group 1 vs Group 2

          N   Mean  StDev  SE Mean
Group 1  10  3.620  0.294    0.093
Group 2  10  3.250  0.259    0.082


Difference = μ (Group 1) - μ (Group 2)
Estimate for difference:  0.370
95% CI for difference:  (0.110, 0.630)
T-Test of difference = 0 (vs ≠): T-Value = 2.99  P-Value = 0.008  DF = 18
Both use Pooled StDev = 0.2770
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H_o: $\mu_1 = \mu_2$ H_1 $\mu_1 \neq \mu_2$

$p<0.05$ so we can reject H_o in favour of H_1 at 5% level (also at 1% level) so evidence that the mean drug levels are significantly different. Further 95% certain that difference in means lies between 0.110 and 0.63 ng/ml i.e. this does not include zero so can reject H_o in favour of H_1 at 5% level so evidence that the mean drug levels are significantly different and is of this magnitude.

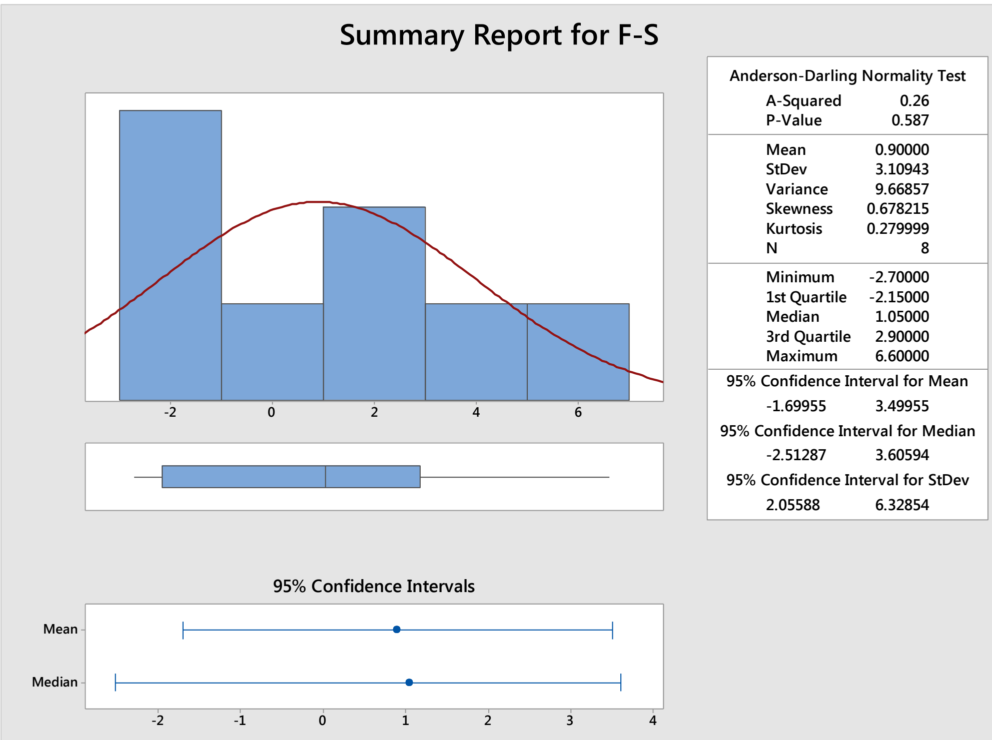
This test assumes equal variance - we should have checked this first!!!

Question 3

The data is quantitative, two sample - paired, small sample (n<30) and the question asks about the mean. Two tailed because question asks whether there is a difference.

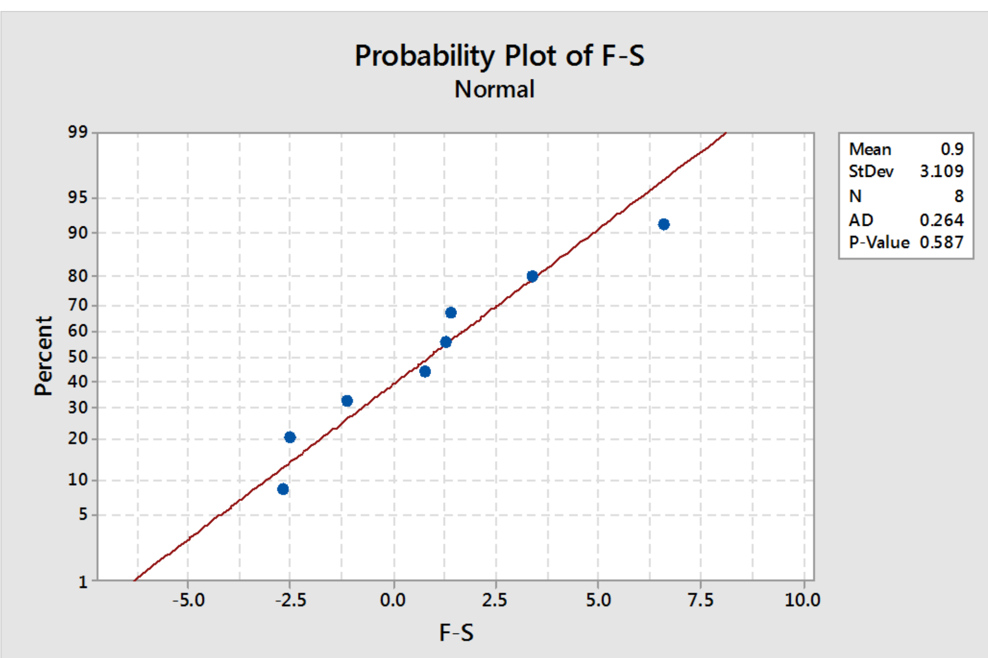
Formal technique to answers the question would be a Paired t-test. This assumes that the differences are Normally distributed.

Note : All graphs should be for the differences since the data is paired.



Informal/ Subjective Impression

Mean difference = 0.9 with sd of 3.1 so in there is a difference it is very small.



Normal Probability Plot looks linear so we can assume that the data follows a Normal distribution.

Paired T-Test and CI: Father's height, Son's height

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Paired T for Father's height - Son's height

                  N   Mean  StDev  SE Mean
Father's height   8  68.59   3.65     1.29
Son's height      8  67.69   2.95     1.04
Difference        8   0.90   3.11     1.10


95% CI for mean difference: (-1.70, 3.50)
T-Test of mean difference = 0 (vs ≠ 0): T-Value = 0.82  P-Value = 0.440
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H_o : $\mu_d = 0$ H_1 $\mu_d \neq 0$

P = 0.44 >0.05 so we cannot reject H_o in favour of H_1 at 5% level so insufficient evidence that the mean difference is significantly different to zero.

Further 95% certain that mean difference in height lies between

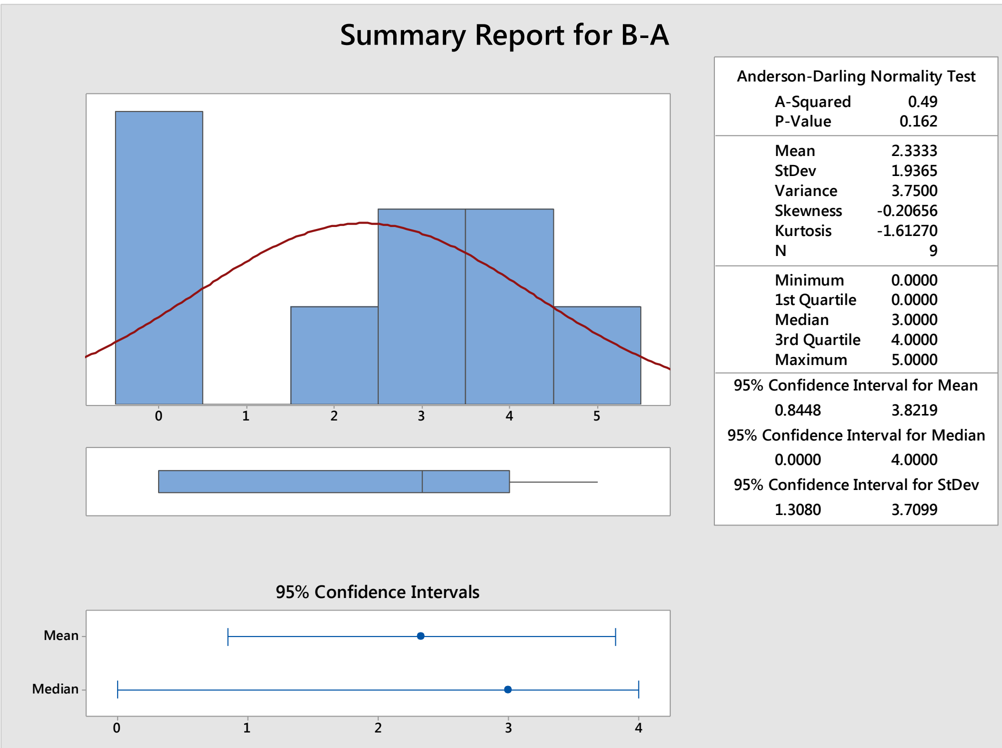
-1.7inches and 3.50inches (includes 0 so can draw same conclusion).

Question 4

The data is quantitative, two sample - paired, small sample (n<30) and the question asks about the mean. One tailed because question asks whether B results in higher scores than A.

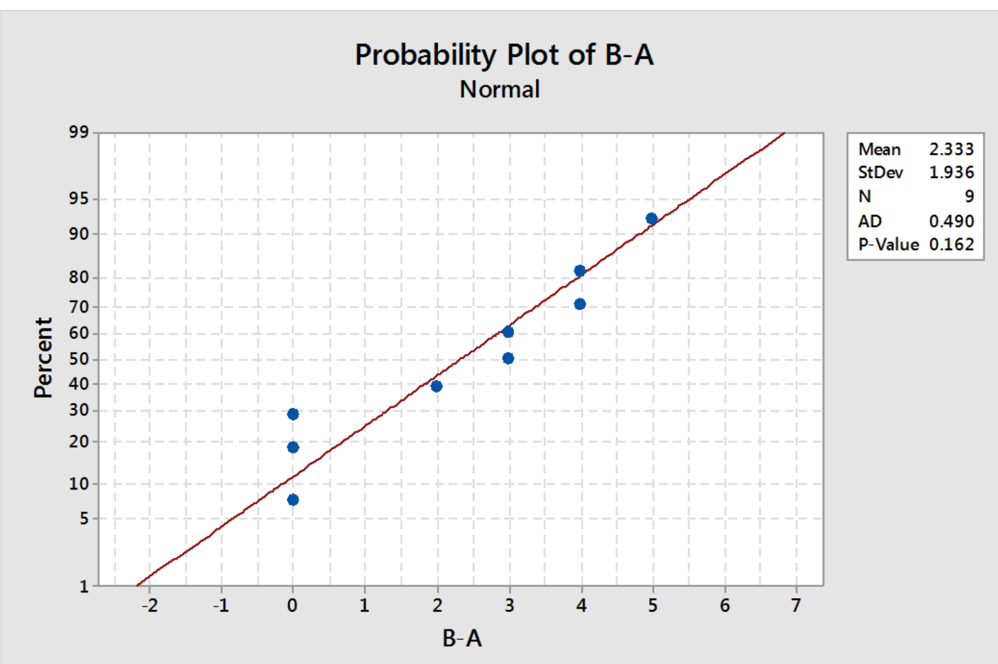
Formal technique to answers the question would be a Paired t-test. This assumes that the differences are Normally distributed.

Note : All graphs should be for the differences since the data is paired.



Informal/ Subjective Impression

Mean difference = 2.33 with sd of 1.94 and all difference (B-A) are positive so there is a difference.



Normal Probability Plot looks linear so we can assume that the data follows a Normal distribution.

Paired T-Test and CI: B, A

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Paired T for B - A

             N   Mean  StDev  SE Mean
B            9  6.444  2.068    0.689
A            9  4.111  2.667    0.889
Difference   9  2.333  1.936    0.645


95% lower bound for mean difference: 1.133
T-Test of mean difference = 0 (vs > 0): T-Value = 3.61  P-Value = 0.003
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H_o: $\mu_d = 0$ H_1 $\mu_d > 0$

P = 0.003 < 0.05 so we can reject H_o in favour of H_1 at 5% level (and at 1% level) so sufficient evidence that the mean difference is significantly greater than zero.

Further 95% certain that mean difference in score lies between 1.133 and infinity (does not include 0 so can draw same conclusion).