

## Unpaired and Paired t-Test

1. Test the stated hypotheses at 5% significance. The difference,  $d$ , is defined as 'after – before'. You may assume that the data are normally distributed.

(a)  $H_0 : \mu_d = 0; H_1 : \mu_d > 0$

Subject	A	B	C	D	E
Before	16	20	20	16	12
After	18	24	18	16	16

(b):  $H_0 : \mu_d = 0; H_1 : \mu_d \neq 0$

Subject	A	B	C	D	E	F
Before	4.2	6.5	9.2	8.1	6.6	7.1
After	5.3	5.5	8.3	9.0	6.1	7.0

2. A tennis coach wants to determine whether a new racquet improves the speed of his pupils' serves (faster serves are considered better). He tests a group of 9 children to discover their service speed with their current racquet and with the new racquet. The results are shown in the table below.

Child	A	B	C	D	E	F	G	H	I
Speed with current racquet	58	68	49	71	80	57	46	57	66
Speed with new racquet	72	81	52	59	75	72	48	62	70

- (a) State appropriate null and alternative hypotheses.  
(b) Test at the 5% significance level whether or not the new racquets increase the service speed, justifying your choice of test.

*[8 marks]*

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1. (a)  $p = 0.121$ , do not reject  $H_0$   
 (b)  $p = 0.830$ , do not reject  $H_0$
  2. (a)  $H_0: \mu_d = 0, H_1: \mu_d > 0$   
 (b) Do not reject  $H_0$  ( $p > 0.0927$ )
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- 1 Petra noticed that one of her apple trees grew in the shade and the other did not. She wanted to find out if apples from the tree in the shade weighed less than those in the sun. She picked nine apples from each tree and weighed them in grams.

Tree in shade	75	82	93	77	85	78	91	83	92
Tree not in shade	74	81	95	79	95	82	93	88	90

Perform a  $t$ -test at the 10% significance level to test whether the apples from the tree in the shade weigh less than those in the sun.

- 2 A pharmaceutical company claims to have invented a new pill to aid weight loss. They claim that people taking these pills will lose more weight than people not taking them. A total of twenty people are weighed and tested. Ten people are given the new pills and the other ten are given a placebo. After two months the people are weighed again and any weight loss, in kg, is noted in the table below.

New remedy	1.2	2.4	1.6	3.5	3.2	4.6	2.5	0.8	1.2	3.9
Placebo	0.6	0	1.0	1.3	2.1	0.7	1.9	2.4	0.3	1.0

Perform a  $t$ -test at the 1% significance level to see if those taking the pills are losing more weight on average.

- 1  $p$ -value = 0.251;  $0.251 > 0.10$ , not significant, do not reject the null hypothesis. There is no difference in the weights of the apples.
  - 2  $p$ -value = 0.00539;  $0.00539 < 0.01$ , significant, so reject the null hypothesis. Those using the new remedy do lose more weight.
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