Paired t Tests

1. Researchers designed an experiment to study the effects of caffeine withdrawal. They recruited 11 volunteers who were diagnosed as being caffeine dependent to serve as subjects. Each subject was barred from coffee, colas, and other substances with caffeine for the duration of the experiment. During one 2-day period, subjects took capsules containing their normal caffeine intake. During another 2-day period, they took placebo capsules. The order in which subjects took caffeine and the placebo was randomized. At the end of each 2-day period, a test for depression was given to all 11 subjects. Researchers wanted to know whether being deprived of caffeine would lead to an increase in depression.

The table below contains data on the subjects' scores on the depression test. Higher scores show more symptoms of depression. For each subject, we calculated the difference in test scores following each of the two treatments (placebo – caffeine). We chose this order of subtraction to get mostly positive values.

Results of a caffeine-deprivation study

Subject	Depression (caffeine)	Depression (placebo)	Difference (placebo – caffeine)
1	5	16	11
2	5	23	18
3	4	5	1
4	3	7	4
5	8	14	6
6	5	24	19
7	0	6	6
8	0	3	3
9	2	15	13
10	11	12	1
11	1	0	–1

Carry out a significance test at the 1% level to determine if being deprived of caffeine leads to an increase in depression.

2. The following table gives the ages of the husband and wife of a simple random sample of couples that have obtained a marriage licenses in Cumberland County, Pennsylvania in 1993.

Couple #	Husband	Wife		Couple #	Husband	Wife	
1	25	22		13	25	24	
2	25	32		14	23	22	
3	51	50		15	19	16	
4	25	25		16	71	73	
5	38	33		17	26	27	
6	30	27		18	31	36	
7	60	55		19	26	24	
8	54	57		20	62	60	
9	31	30		21	29	26	
10	54	47		22	31	23	
11	23	23		23	29	28	
12	34	39		24	35	36	

Conduct an appropriate test of significance at the 5% level to determine if there is evidence to support the claim that husbands tend to be older than their wives.