

Paired or Independent?

For each of these problems discuss whether the matched-pair approach is appropriate

1. A pharmaceutical company is conducting an experiment to test the effects of a new antibiotic on bacterial counts in tissue cultures. Twenty randomly selected cultures were laced in vials and infected with a low quantity of bacterial cells. Of these twenty, 10 were randomly selected and given a dose of antibiotic. The other 10 were given a similar quantity of distilled water. On completion of the experiment, full bacterial counts were made in each vial.
2. Scientists studying the effect of slash burning examined the diversity of spiders in clear-cut areas of coastal forests. The number of species of spiders was measured at 22 sites of equal size (1.4 ha). The sites were then burned. Four years later the number of spider species at each site was measured again. Was there a significant change in number of species of spiders between the two sampling periods?
3. Maguire et al. (2000, Proc. Natl. Acad. Sci. USA 97: 4398.4403) used MRI to scan the brains of London taxi cab drivers, who are renowned for feats of spatial memory and navigation (individuals must undergo two years of extensive training and pass a stringent set of examinations known as “The Knowledge” before they can be licensed). MRI scans focused on the hippocampus, a region of the brain associated with spatial memory (especially the posterior hippocampus). The data record the volume of gray matter (mm^3) in the right posterior hippocampus and the right anterior hippocampus of 15 drivers with different numbers of years of experience. Volume of the posterior hippocampus was measured using the VBM method, which provides a relative measure, whereas the anterior hippocampus was measured using a pixel-counting method that estimates absolute volume. All subjects were right-handed males between 32 and 62 years of age. Sample data is given in the following table:

years as taxi driver	months as taxi driver	posterior hippocampus volume (adjusted)	anterior hippocampus volume (mm^3)
less than 15 years	54	-2.40	109.68
⋮	⋮	⋮	⋮
less than 15 years	139	-3.77	98.4
more than 15 years	223	-3.89	81.94
⋮	⋮	⋮	⋮
more than 15 years	349	4.54	96.93

4. As you very well know, nuclear plants can have a major impact on the environment. In southern California an assessment study was conducted. Data were collected from a location near the outfall pipe, which released heated seawater into the ocean. The species that was of most concern when the plant was built, was the Giant Kelp, a large brown seaweed growing to a height of 20m, and providing a major habitat for a range of fish. The monitoring program collected data on the density of these algae, by counting the number of plants in large (10 m x 10 m) quadrats on the sea floor of two rocky reefs, near the discharge point. Monitoring started in 1981, before the outfall had been constructed, providing 5 quarterly samples before the thermal discharge began, and continued for a further 7 quarters after the discharge.

The data for the monitoring program are shown below, as the number of plants per 100 m²:

Before the discharge	9.4	13.1	8.9	14.5	8.9		
After the discharge	36.9	43	16.5	13.1	41.4	13.1	36.9

Based on this study, is there an indication that the release of the heated seawater into the ocean increased the density of the Giant Kelp?

5. Shortly after metric units of length were officially introduced in Australia, each of a group of 44 students were asked to guess, to the nearest metre, the width of the lecture hall in which they were sitting. Another group of 69 students in the same room was asked to guess the width in feet, to the nearest foot. The true width of the hall was 13.1 meters (43.0 feet). The data were collected by Professor T. Lewis. Based on this data, which group of students guesses the length of the room better?

Guesses in meters:

8 9 10 10 10 10 10 10 11 11 11 11 11 12 12 13 13 13 14 14 14 15 15 15 15 15 15 15 15 15 16 16 16 17 17 17 17 18 18 18 20 22 25 27 35 38 40

Guesses in feet:

24 25 27 30 30 30 30 30 30 32 32 33 34 34 34 35 35 36 36 36 37 37 40 40 40 40 40 40 40 40 40 41 41 42 42 42 43 43 44 44 44 45 45 45 45 45 45 46 46 47 48 48 50 50 50 51 54 54 54 55 55 60 60 63 70 75 80 94

6. Does increasing calcium intake reduce blood pressure? Observational studies suggest that there is a link, and that it is strongest in African-American men. Twenty-one African-American men participated in an experiment to test this hypothesis. Ten of the men took a calcium supplement for 12 weeks while the remaining 11 men recieved a placebo. Researchers measured the blood pressure of each subject before and after the 12-week period.

Treatment	Begin	End	Treatment	Begin	End
Calcium	107	100	Placebo	123	124
Calcium	110	114	Placebo	109	97
Calcium	123	105	Placebo	112	113
Calcium	129	112	Placebo	102	105
Calcium	112	115	Placebo	98	95
Calcium	111	116	Placebo	114	119
Calcium	107	106	Placebo	119	114
Calcium	112	102	Placebo	112	114
Calcium	136	125	Placebo	110	121
Calcium	102	104	Placebo	117	118
			Placebo	130	133

7. Based on the data below, can you conclude whether prices in cents per pound received by fishermen and vessel owners for various species of fish and shellfish increased from 1970 to 1980?

Type of Fish; Price in 1970; Price in 1980;

COD 13.1 27.3

FLOUNDER 15.3 42.4

HADDOCK 25.8 38.7

MENHADEN 1.8 4.5

OCEAN PERCH 4.9 23

SALMON, CHINOOK 55.4 166.3

SALMON, COHO 39.3 109.7

TUNA, ALBACORE 26.7 80.1

CLAMS, SOFT-SHELLED 47.5 150.7

CLAMS, BLUE HARD-SHELLED 6.6 20.3

LOBSTERS, AMERICAN 94.7 189.7

OYSTERS, EASTERN 61.1 131.3

SEA SCALLOPS 135.6 404.2

SHRIMP 47.6 149