9 Comparing Two Populations from Paired Samples

In §8, our data consisted of _____ samples drawn from two populations, and we saw several tests for the difference between measures of center. Here we compare population measures of center of based on _____ samples from each.

In a *matched pairs* experiment, choose subjects _____ to minimize _____. Then randomly assign the treatment to _____. Since differences within pairs _____ treatment have been minimized, differences in pairs _____ treatment should be due mostly to _____. Ideal examples include:

- Testing a drug on pairs of _____ to get rid of variability across subjects due to age, sex, genetics, etc. Treatments are assigned randomly within each pair.
- Testing _____ subjects twice, _____, to reduce effect of variability _____. The order of tests is randomly chosen for each subject.

Notation:

- $\{(X_1, Y_1), \cdots, (X_n, Y_n)\}$: raw _____ data
- $\{D_i = X_i - Y_i\}$: a random sample from a population of _____
- $\mu_D = \mu_X - \mu_Y$: unknown mean _____ ; its point estimate is _____
- σ_D: unknown standard deviation of differences; its point estimate is _____

Studying the differences within matched pairs is the _____ of this section. Except for finding differences within pairs, everything that follows below is review. Apply one-sample test or confidence interval procedures to the differences, $\{D_i\}$, as usual:

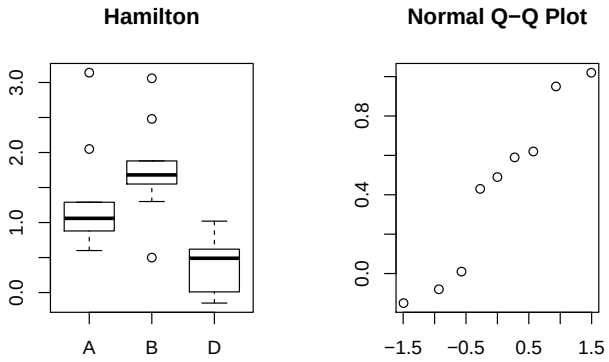
- _____ for known σ and large n or normal population of differences
- _____ for unknown σ and large n or normal population of differences
- _____ or _____ for small n and non-normal population of differences

Examples

e.g. (Hollander & Wolfe, 1973; thanks to Guilherme Ludwig) Here are measurements from the Hamilton depression scale for 9 patients before (B) and after (A) taking a tranquilizer:

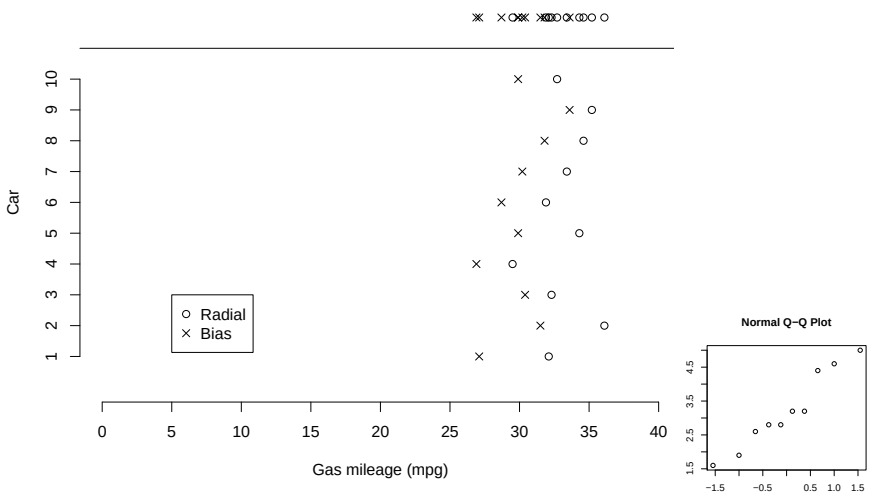
B	1.83	.50	1.62	2.48	1.68	1.88	1.55	3.06	1.30
A	.88	.65	.60	2.05	1.06	1.29	1.06	3.14	1.29

- Make boxplots of B and A. Give two reasons why the §8.1 or 8.2 small-sample test for the difference of two means is a poor choice.
- Plot the differences, $D = B - A$. Is a matched pairs t test of $H_0 : \mu_D = 0$ vs. $H_A : \mu_D > 0$ reasonable? If so, do it.



e.g. (p. 302 #17) A taxi company will decide whether to switch from bias tires to radial tires to improve fuel economy. Each of 10 taxis is equipped with one of the two tire types and driven on a test course. Without changing drivers, tires were then switched to the other type and the course was repeated. The fuel economy (in mpg) for the cars is as follows:

Car	Radial	Bias	D
1	32.1	27.1	5.0
2	36.1	31.5	4.6
3	32.3	30.4	1.9
4	29.5	26.9	2.6
5	34.3	29.9	4.4
6	31.9	28.7	3.2
7	33.4	30.2	3.2
8	34.6	31.8	2.8
9	35.2	33.6	1.6
10	32.7	29.9	2.8
		$\bar{d} =$	3.21
		$s_D =$	1.13



Switching tires is expensive, so management will not switch unless a test gives strong evidence that the mileage will be improved. Run the appropriate test.