Practice Excercises: t-tests

Question 1:

As a check of their laboratory protocol for growing mouse embryos *in vitro*, a group of scientists want to compare the mean mass of 15 embryos grown for two weeks in their lab (see data below) to an average mass value of 75 μg that was obtained in several other published studies that used the same protocol. Is the mass of the mouse embryos grown in this study significantly less than that expected from previously published studies? Assume that all assumptions are met.

Embryo Mass	52	57	62	96	88	89	49	50	83	52	99	65	62	75	63

Answer to Question 1:

Test required:	1-sample t-test (1-tailed)
Independent variable:	laboratory protocol
Dependent variable:	mass of embryos (ug)
Number & description of replicates:	15 different embryos
Statistical hypotheses:	Ho: mean of embryo mass $\geq$ 75ug Ha: mean of embryo mass < 75ug
Assumption check:	assumed all met
Results:	t = 1.230, df = 14, P = 0.239 Accept Ho.
Conclusion:	The results of this analysis indicate that the mean mass of the embryos was not significantly less than the expected value of 75ug (t = 1.230, df = 14, P = 0.239).

Question 2

A laboratory study was conducted to investigate whether wind speed affects the diameter of the web that orb spiders produce. Therefore, the scientists exposed 20 spiders to low wind speeds (5 km/hr) and another 20 spiders to high wind speeds (15 km/hr) in individual containers. Several days later, the scientists determined the diameter (in mm) of the webs spun by each spider; one spider did not spin a web. Is there a significant difference in the mean diameter of webs spun at high versus low wind speeds? Assume all assumptions met.

Low Wind	68	98	99	88	78	91	69	91	83	83	74	57	91	91	97	87	90	84	73	53
High Wind	80	60	82	58	49	52	47	92	76	79	88	89	51	72	95	62	75	63	59	

Answer to Question 2:

Test required:	2-sample t-test
Independent variable:	wind speed; 2 levels: low (5 km/h) & high (15 km/h)
Dependent variable:	diameter of web (mm)
Number & description of replicates:	20 spider webs in low wind trt & 19 webs in high wind trt
Statistical hypotheses:	Ho: $\overline{X}_{lowwind} = \overline{X}_{highwind}$ Ha: $\overline{X}_{lowwind} \neq \overline{X}_{highwind}$
Assumption check:	assume all met
Results:	t = 2.691, df = 37, P = 0.011 Reject Ho.
Conclusion:	The results of this analysis indicate that the mean diameter of webs spun by spiders at wind speeds of 5 km/h are significantly different than those spun at 15 km/h (t = 2.691, df = 37, P = 0.011). Webs spun at low wind speeds are larger.

Question 3:

An experiment was conducted to determine if growth of a reef-dwelling sponge differed significantly between sponges growing on the top versus the side of the reef. Two tissue samples of equal volume (each 30 cm^3) were removed from each of 17 randomly chosen sponges. One tissue sample from each individual sponge was fixed to the top of 17 reefs and the second sample from the same individual sponge was fixed to the side of another 17 reefs (34 reef sites in all). After three months, the volume of each sponge tissue was remeasured and those data are given below. Does orientation on the reef (top vs. side) significantly effect the growth of sponges? Assume that assumptions are met.

Individual	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Reef Top	41	33	43	42	57	45	43	48	37	44	47	32	65	61	55	44	44
Reef Side	41	40	43	44	42	47	48	42	40	41	39	41	37	47	45	46	38

Answer to Question 3:

Test required: paired t-test

Independent variable: reef location; two levels: side vs. top of reef

Dependent variable: sponge volume (~ growth)

Number & description of replicates: 17 sponges; paired tissue samples from each sponge

Statistical hypotheses: Ho: $\overline{X}_{reefside} = \overline{X}_{reeftop}$

Ha: $\overline{X}_{reefside} \neq \overline{X}_{reeftop}$

Assumption check: assume all met

Results: $t = 1.548$, $df = 16$, $P = 0.141$

Conclusion: The results of this analysis indicate that the mean sponge volume on the top of the reef does not differ significantly from that on the side of the reef ($t = 1.548$, $df = 16$, $P = 0.141$).