

1. Ward and Quinn (1988) collected 37 egg capsules of the intertidal predatory gastropod *Lepsiella vinosa* from the littorinid zone on a rocky intertidal shore and 42 capsules from the mussel zone. Other data indicated that rates of energy consumption by *L. vinosa* were much greater in the mussel zone so there was interest in differences in fecundity between the zones. The response variable is **number of eggs per capsule**. The sample summaries are given below:

Zone	Mean	s.d.
Littorinid	8.70	2.03
Mussel	11.36	2.33

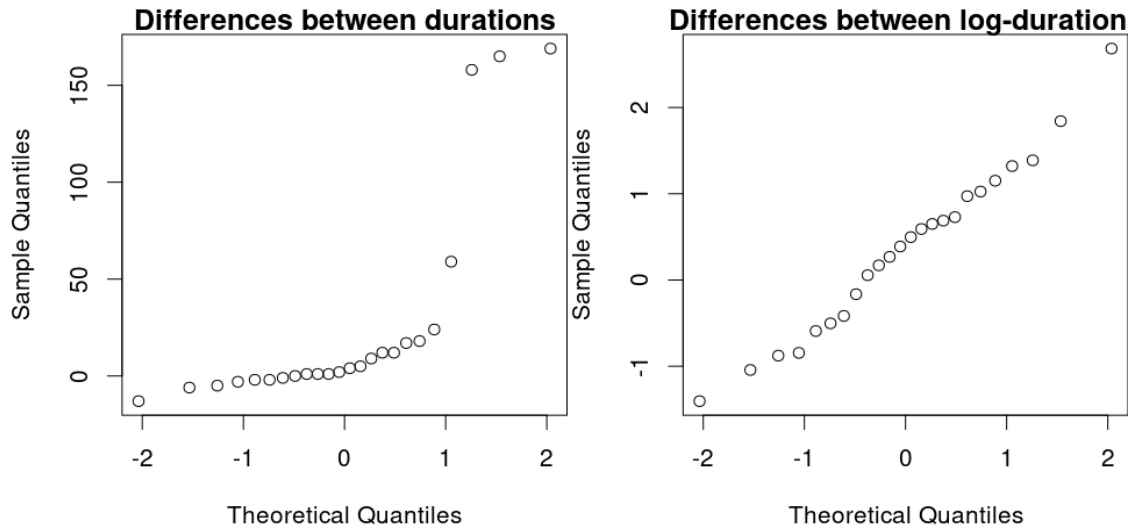
Graphical diagnostics suggest that the two groups are normally distributed and the variances are roughly equal.

- a) [6 pt] Compare the mean number of eggs per capsule using a pooled t-test. To that end, write down the null and alternative hypotheses, clearly defining any notation you use; compute the pooled s.d., t-ratio and a (reasonable) bound on the p-value. Provide a conclusion in the context of the problem.
  - b) [2 pts] Compute a 95% confidence interval for the difference between means. Interpret the interval in the given context.
  - c) [2 pts] Based only on this design, data and analysis, do you think that mussel zone *increases* fecundity in *L. vinosa*? Explain. What could be a confounding factor here? [Answer in 2–3 sentences]
2. Twenty 10-month-old Japanese Black steers were used to evaluate the effects of clay on fatty acid composition of perirenal fat. Ten steers (Clay group), chosen at random, were fed the clay (50 g/day) during 10–30 months of age. The other 10 steers (Control group) were not fed it. In this problem we consider the polyunsaturated fatty acid concentration (in mmol/L).

Group	Mean	s.d.
Control	1.92	0.21
Clay	2.49	0.71

- a) [6 pts] Use an appropriate test to compare the mean concentrations. Write down the null and the alternative hypotheses, compute a relevant test statistic and a bound on the p-value. Provide a conclusion in the context of the problem.
  - b) [2 pts] Compute a 90% confidence interval for the difference between means and interpret it in the given context.
3. A common symptom of otitis-media (inflammation of the middle ear) in young children is the prolonged presence of fluid in the middle ear, called middle-ear effusion. It is hypothesized that breast-fed babies tend to have less prolonged effusions than do bottle-fed babies. Rosner (2006) presents the results of a study of 24 pairs of infants who were matched according to sex, socioeconomic status, and type of medication taken. One member of each pair was randomly chosen to be bottle-fed and the other was breast-fed. The response variable was the duration in days of middle-ear effusions after the first episode of otitis-media.
    - a) [2 pts] What are the treatments and what are the experimental units in this study?

- b) [1 pt] Find below the QQ-plot of the differences (left panel) and of the difference between the log-days (right panel). Summary statistics are also given in the following table.



	Mean	s.d.
Differences between duration (bottle-fed minus breast-fed)	26.042 days	55.092 days
Differences between log-duration (bottle-fed minus breast-fed)	0.472	0.739

**Based** on this plot and the summaries should we compare the mean durations or the median durations? Explain.

- c) [5 pts] Based on your answer in part (b), test for treatment difference: Write down the null and the alternative hypotheses, provide a t-statistic, a reasonable bound on the p-value and a conclusion.
- d) [3 pts] Compute a 95% confidence interval for the effect size. Provide a conclusion in the context of the data.
- e) [1 pt] Do you think the inference you obtained is causal ? Explain.