

Homework Assignment 3 due Thursday, 3/14**Testing Hypotheses**

- Several thousand measurements on a checkweight average out to 512 micrograms above a kilogram and their SD is 50 micrograms. Then the weight is cleaned. The next 100 measurements average out to 508 micrograms above one kilogram and their SD is 52 micrograms. Apparently, the weight got 4 micrograms lighter. Or is this chance variation?
 - Formulate the problem as a statement about a box model.
 - Would you estimate the SD of the box as 50 or 52 micrograms?
 - Would you make a z -test (based on normal table) or a t -test?
 - Did the weight get lighter? If so, by how much?
- National data shows that on average, college freshmen spend 7.5 hours a week going to parties. One administrator does not believe that these figures apply at his college, which has nearly 3,000 freshmen. He takes a simple random sample of 100 freshmen and interviews them. On average, they report 6.6 hours per week going to parties and the SD is 9 hours. Is the difference between 6.6 and 7.5 real? Begin your answer by formulating a box model.
- One kind of plant has only blue flowers and white flowers. According to Mendel's genetic model, the offsprings of a certain cross have a 75% chance to be blue-flowering, and a 25% chance to be white-flowering, independently of each other. Two hundred seeds of such a cross are raised, and 142 turn out to be blue-flowering. Are the data consistent with Mendel's law? Answer yes or no, and explain why.

(Hints: Think in terms of a 0-1 box model. The population variance of a 0-1 box model is $p(1-p)$ if p is the proportion of 1's in the model. Equivalently, the sample variance of a 0-1 list is $q(1-q)$ if q is the proportion of 1's in the list. For a 0-1 list or population box, the mean is the proportion of 1's.)
- Two medical research labs compare the weight of their mice. The average weight of all the mice in the first lab is 34.7 grams. In the second lab, they find an average of 35.2 grams. Is the difference statistically significant? If possible, answer this question using a statistical test (with significance level 5%). Explain the probabilistic model underlying the test, and state the null and the alternative hypotheses.
- Hermaphrodites are animals that possess the reproductive organs of both sexes. *Genetical Research* (June 1995) published a study of the mating systems of hermaphroditic snail species. The mating habits of the snails were classified into two groups: (1) self-fertilizing (*selfing*) snails that mate with snails of the same sex, and (2) cross-fertilizing (*outcrossing*) snails that mate with snails of the opposite sex. One variable of interest in the study was the effective population size of the snail species.

Independent simple random samples of 17 outcrossing snail species and 5 selfing snail species are taken. The sample mean of the effective population size for the outcrossing snails was 4,894 with an SD of 1,932. For the selfing snails, the sample mean was 4,133 with an SD of 1,890.

Someone claims that the effective population size in outcrossing snails is larger than in selfing snails. Do the data supply sufficient evidence to support the claim? If possible, answer this question using a statistical test (with significance level 5%). Explain the probabilistic model underlying the test, and state the null and the alternative hypotheses.

6. Breast-feeding infants for the first few months after their birth is considered to be better for their health than bottle feeding. According to several observational studies, withholding the bottle in hospital nurseries increases the likelihood that mothers will continue to breast-feed after leaving the hospital. As a result, withholding supplementatin has been recommended.

A controlled experiment was done by K.Gray-Donald, M.S. Kramer, and associates at the Royal Victoria Hospital in Montreal. There were two nurseries. In the "traditional" one, supplemental feedings of newborn infants were figen as usual: a bottle at 2 a.m., and whenever the infant seemed hungry after breastfeeding. In the experimental one, mothers were awakened at 2 a.m. and asked to breast-feed their babies; supplemental feeding was discouraged.

Over the four-month period of the experiment, 393 mothers and their infants were assigned at random to the traditional nursery, and 388 to the experimental one. the typical stay in the hospital was 4 days, and there was followup for 9 weeks after release from the hospital.

- (a) At the end of 9 weeks, 54.7% of the mothers who had been assigned to the traditional nursery were still breast-feeding their infants, compared to 54.1% in the experimental nursery. Is this difference statistically significant? Formulate the Null and the alternative hypothesis, and perform a test on a significance level of 5%.
- (b) It was really up to the mothers whether to breast-feed or bottle-feed. Were their decisions chaged by the treatments? To answer that question, the investigators looked at the amounts of bottle-feeding in the two nurseries, expressed a milliliters per day (ml/day). In the traditional nursery, this averaged 36.6% ml/day per infant, and the SD was 44.3; in the experimental nurserey, the figures were 15.7 and 43.6. What do you conclude?
- (c) did the different treatments in the two nurseries affect the infants in any way? To answer that question, the investigators looked at the weight lost by each infant during the stay, expressed as a percentage of birth weight. In the tradional nursery, this averaged 5.1% and the SD was 2.0%; in the experimental nursery, the average was 6.0% and the SD was 2.0%. What do you conclude? (It may be surprising, but most newborns lose a bit of weight during the first few days of life.)
- (d) Was the randomiztaion successful? To find out, the investigators looked at the birth weights themselves (among other variables). In the traditional nursery, these averaged 3,486 grams and the SD was 438 grams. In the experimental nursery, the average was 3,459 grams and the SD was 434 grams. What do you conclude?