

**Probability and Statistics for Psychology
and Quantitative Methods for Human Sciences
Problem Sheet 2 (HT 10)**

1. (a) We write $t_\alpha(d)$ for the α quantile of the T distribution with d degrees of freedom; that is, the number t such that $P(T < t) = \alpha$. Use the t-distribution table to find $t_{0.025}(5)$, $t_{0.05}(6)$, $t_{0.99}(2)$, $t_{0.995}(20)$.
(b) Suppose T has the Student t distribution with 7 degrees of freedom. Using the table, compute $P\{-2.37 \leq T \leq 3.00\}$ and $P\{3.00 \leq T \leq 3.50\}$.
(c) We have six independent samples from a normal distribution with unknown mean μ and unknown variance σ^2 : 109, 93, 99, 87, 103, 101. Compute a symmetric 99% confidence interval for μ .
(d) Suppose you find out for sure that $\sigma = 10$. What would be your new symmetric 99% confidence interval?
2. A hospital is checking whether the mean birth weight of babies delivered in the hospital (after normal pregnancy) follows the national average of 3200g. A sample of size 20 was taken and it was found that the sample mean is 3490g and the sample standard deviation 560g. Use a one-sample t test at the 0.05 level.
 - (a) State the test hypotheses.
 - (b) State any assumptions you have to make.
 - (c) Calculate the test statistic, look up the critical value and conclude.
 - (d) Construct a 95% confidence interval for the mean birth weight babies in the hospital. How is this result consistent with that in (c)?
3. A survey organisation is hired by an internet provider to find out what fraction of people in Oxford (population 150,000) might be willing to sign up for a new broadband service. They interview 400 people.
 - (a) Suppose they want a result that is twice as accurate — that is, with the confidence interval half as wide. How many people would they need to interview?
 - (b) The company is also interested in expanding to Coventry (population 300,000), and wants to know how much interest there

might be there. True or false, and explain: To obtain the same accuracy as in Oxford, they need to interview about 800 people in Coventry.

4. A researcher wants to know the family backgrounds of Oxford students. She wants to interview about 100 students. She looks in a directory, and finds that there are about that many students whose surnames start with 'Z', so she contacts all of them. She gets exactly 100 responses, including family income. Among the respondents, the average annual family income is £40,000, with an SD of £20,000. She then reports that a 95% confidence interval for the average family income of Oxford students is $£40,000 \pm £4,000$. Is that correct? Why or why not?
5. The following exchange appeared in the American advice column "Dear Abby", October 4, 1990:

Dear Abby: In a recent column, a writer stated that it was foolish to work for nothing as a hospital volunteer. Thanks for saying, "The rewards are more valuable than money."

In 1988, a study was done by the University of Michigan Survey Research Center. They followed 2700 people in Tecumseh, Michigan for 10 years to determine the impact of social relationships on health. They found that people who regularly did volunteer work had dramatically longer life expectancy.

This was especially significant for men: Men who did no volunteer work were 2.5 times more likely to die during the course of the 10-year study than those who volunteered at least once a week.

Research at Yale, the University of California, Johns Hopkins, the National Institutes of Health, and Ohio State supports these findings.

**Longime Volunteer,
Mechanicsville, VA**

Dear Longtime: People who spend their time doing for others feel useful, productive and good about themselves. Volunteers, particularly those who work in hospitals, hospices

and nursing homes, are too busy to dwell on their own troubles or feel depressed. Those who give, get!

Does the evidence stated show that volunteer work increases life expectancy? Explain why or why not.