THE UNIVERSITY OF SYDNEY

MATH1905 STATISTICS ADVANCED

Semester 2	**Tutorial Week 9**	2012

1. A P-value of 0.2 means:

(a) there is 20% chance H_0 true,

(b) there is 20% chance H_1 true,

(c) there is strong evidence against H_0,

(d) the data are consistent with H_0.

2. If $X \sim \mathcal{B}(64, 0.5)$, the approximating normal variable Y is $\mathcal{N}(32, 4^2)$. Using the correction for continuity, $\mathrm{P}(32 < X < 36)$ is closest to

(a) $\mathrm{P}(32 < Y < 36)$,
(b) $\mathrm{P}(32.5 < Y < 35.5)$,
(c) $\mathrm{P}(32.5 < Y < 36.5)$,

(d) $\mathrm{P}(31.5 < Y < 36.5)$,
(e) $\mathrm{P}(31.5 < Y < 35.5)$.

3. From previous studies on Male body height it is believed that the average height of an Australian Male (aged 18+ y.o.) is 175 cm (check http://en.wikipedia.org/wiki/Human_height).

(1) Recent data tries to refute this claim, i.e. that the average Australian Male is now taller than 175 cm. The data are

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> x
[1] 170 184 173 183 178 179 173 184
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(a) State the hypotheses to be tested.

(b) State the assumptions for using a t-test.

(c) Are these assumptions met? (use a range of diagnostic plots)

(d) Provide a numerical summary of the data: mean, s =standard deviation, 5 number summary.

(e) Compute the observed t-statistic for testing the hypotheses in (a).

(f) Compute the corresponding P-value. Do you agree with the claim?

(g) What would happen if you were using the normal approximation for the distribution of the test statistic rather than the exact t distribution? Comment.

(2) You are not convinced by the findings in (1) and you are concerned that the sample size (of 8) is way too small to draw your conclusions. You are looking on the Internet and you find a similar study with a larger data set ($n = 200$). The sample mean of those 200 observations are reported to be $\bar{x} = 174.955$. Repeat, as far as possible, steps (a)-(g) of (1) assuming that the true population standard deviation is $\sigma = 7$cm. Based on the results, what do you conclude?

4. Suppose the probability of success at each repetition of an experiment is p. Perform a *two-sided* test of $H_0 : p = 0.5$ vs $H_1 : p \neq 0.5$ if 60 successes are observed in 100 trials (a) using R; (b) using a pen, a paper and the normal table.

5. (a) Use R to find c if

(i) $\mathrm{P}(t_{12} > c) = 0.01$
(ii) $\mathrm{P}(t_5 \leq c) = 0.95$
(iii) $\mathrm{P}(|t_{25}| > c) = 0.05$.

(b) Use R to find

(i) $\mathrm{P}(t_{11} > 2.5)$
(ii) $\mathrm{P}(|t_{15}| > 2.2)$.

6. A biology laboratory is updating its weighing equipment and the new weights are calibrated against the old: thirteen molluscs are weighed on both scales to see how the scales compare, and the signs of the differences in weight are $-\ \ +\ \ +\ \ +\ \ +\ \ +\ \ -\ \ +\ \ +\ \ 0\ \ +\ \ -\ \ +$ On this basis would you conclude that there is strong evidence that the scales measure differently on average?

1. (From the 1994 Examination). A random sample of 60 slow learners with a deficiency in reading was used to study a new teaching method, which is expected to be superior to the old method because of results of a pilot study. The subjects were matched by age, sex, background and current reading ability, and one of each pair was chosen at random to be taught by the old method. For the 30 pairs, the *differences* in reading ability (on a standard reading test) after a period of two months were recorded. Of the 30 differences, 18 were positive, 2 were zero and 10 were negative. Use a statistical test to analyse the data, mentioning any assumptions.

2. In a biology laboratory that is updating its weighing equipment, the weights of twelve specimens using the new equipment are calibrated against the old.
The measurements are

Specimen	Old Scales (mg)	New Scales (mg)
1	6.14	6.13
2	5.90	5.88
3	7.15	7.14
4	8.86	8.87
5	4.99	4.99
6	6.74	6.72
7	7.81	7.78
8	8.15	8.12
9	6.37	6.38
10	8.80	8.78
11	6.26	6.22
12	6.97	6.93

(a) On the basis of the twelve pairs of weights and the sign test would you conclude that there is strong evidence that the scales measure differently on average?

(b) Calculate the twelve weight differences. Assuming that the differences are normally distributed from a population with standard deviation $\sigma = 0.02$ reanalyse the data using a Z test.

3. A contractor makes large purchases of cement from a local manufacturer. The bags of cement are supposed to weigh 94 pounds on average. The contractor takes a sample of 10 bags and weighs them. The weights (in pounds) are

$$94.1,\ 93.4,\ 92.8,\ 93.4,\ 95.4,\ 93.5,\ 94.0,\ 93.8,\ 92.9,\ 94.2.$$

Perform a t-test to check the claim that the average weight of all bags produced is 94 pounds against the alternative that the bags are under weight.