

THE UNIVERSITY OF SYDNEY
MATH1905 STATISTICS ADVANCED

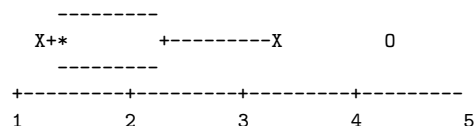
Semester 2	Tutorial Week 7	2012
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1. A Quiz takes place in lieu of the tutorial.

Semester 2	Problem Sheet Week 7	2012
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Assignment 1 for MATH1905 STATISTICS (due on Tuesday, 2nd October, in week 9) will consist of selected questions from the Problem Sheets for weeks 1, 2, 3, 4, 5, 6, 7, 8.

1. *From the 1997 examination* A sample of 36 observations was selected from a large population with true mean $\mu = 1.92$ and standard deviation $\sigma = 0.85$ and a computer-produced boxplot of the sample appears below (it's from the 1997 exam, you can't expect a more modern version of the boxplot).



- (a) Would you be prepared to believe that the sample came from a normal distribution?
- (b) A further 19 samples were obtained independently and all gave similar boxplots. The following is a computer summary of the *complete* set of 20 samples.

Col	Size	Mean	StDev	Min	LQ	Median	UQ	Max
1	36	1.94	0.84	1.26	1.30	1.37	2.31	4.32
2	36	2.00	0.82	1.26	1.30	1.87	2.31	4.30
3	36	1.91	0.84	1.26	1.29	1.32	2.31	4.31
4	36	2.00	0.86	1.28	1.30	1.81	2.32	4.32
5	36	2.18	0.84	1.27	1.30	2.08	2.80	3.35
6	36	1.77	0.61	1.25	1.30	1.32	2.28	3.33
7	36	1.83	0.69	1.27	1.31	1.33	2.30	3.31
8	36	1.91	0.77	1.27	1.29	1.32	2.30	4.28
9	36	1.75	0.66	1.26	1.30	1.32	2.30	3.32
10	36	1.66	0.54	1.25	1.29	1.32	2.29	3.32
11	36	1.95	1.07	1.27	1.29	1.92	2.32	4.32
12	36	1.88	0.97	1.27	1.29	1.31	2.30	5.27
13	36	2.08	0.90	1.27	1.30	2.07	2.31	4.32
14	36	1.77	0.62	1.27	1.29	1.32	2.31	3.32
15	36	1.82	0.70	1.26	1.29	1.31	2.30	4.29
16	36	1.82	0.77	1.26	1.30	1.32	2.29	4.29
17	36	2.02	0.91	1.27	1.30	1.80	2.31	5.30
18	36	1.83	0.74	1.24	1.29	1.32	2.31	3.31
19	36	1.88	0.81	1.26	1.29	1.32	2.29	4.32
20	36	2.27	0.97	1.28	1.31	2.18	3.27	4.30

- (i) Produce a stem-and-leaf display for the 20 sample means and give a five number summary, presented as a rough boxplot. Comment.
- (ii) The Central Limit Theorem (CLT) states that means of samples of size n are approximately normal $\mathcal{N}\left(\mu, \frac{\sigma^2}{n}\right)$. Use the CLT to describe the approximate distribution of the means of samples of size 36 from the population sampled.
- (iii) Calculate the average of the 20 means in (b).
- (iv) Calculate the standard deviation of the 20 means.
- (v) Explain how the repeated samples above help to illustrate the CLT.

2. Steel cylinders have lengths that are normally distributed with mean 3.25m and standard deviation 0.05m. If two cylinders are selected at random and placed end to end what is the probability that their combined length is less than 6.40m?
3. An electrical firm manufactures light bulbs which have an average length of life of 800 hours with a standard deviation of 40 hours. Using the CLT, find the probability that the average life of a random sample of n bulbs is less than 790 hours,
 - (a) for $n = 25$,
 - (b) for $n = 100$.
4. Use the normal distribution to approximate the probability of getting 7 heads and 7 tails in 14 tosses of a fair coin. Also find the error of this approximation.
5. Don tosses a fair coin 11 times while Giulia tosses a fair coin 10 times. What is the probability that Don obtained more heads than Giulia?
6. A plant nursery has discovered an old batch of seeds for a species that it has not grown in many years. If the germination probability for each seed is 0.25, what is the smallest number of seeds that should be planted in order that the probability of getting at least one plant will be at least 0.9? (Assume the seeds germinate independently of each other.)
7. It is known from clinical trials that 75% of patients with vascular migraine obtain relief within one hour with a new (expensive!) migraine tablet. The tablet is prescribed by a medical centre for 120 unrelated patients who suffer from this form of migraine.
 - (a) What is the probability that at least 80 of these patients will obtain the relief promised?
 - (b) What is the probability that more than 96 obtain the relief promised?
 (Use the normal approximation with correction for continuity.)
8. For a certain brand of lawn mower the probability is 0.07 that it will need an in-store service before being placed on the sales floor. We want to find the probability that exactly 3 of 120 randomly selected mowers will need in-store servicing. Assume that we can model the number of mowers needing service by $X \sim \mathcal{B}(120, 0.07)$.
 - (a) Find $P(X = 3)$ exactly.
 - (b) Use the normal approximation to obtain a value for this probability.
 - (c) Use the Poisson approximation to obtain a value for this probability.

<p>Extra questions to try: <i>A Primer of Statistics</i>: Ch II page 75: Q 17-19.</p>
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