Math 193 Practice for Final

~~**Math 189 – Assignment #4**~~ **Name:** Solution Set

Total : 25

1. What survey design is used in each of the following situations?

   a) A random sample of classes at Camosun is chosen, and every student in that class is asked a question.

   cluster

   b) The Camosun student body is divided up into program areas (Civil Engineering, Nursing, etc.) and a random selection of students from each area is asked a question.

   stratified random

   4

   c) A certain number of student records are selected randomly from the entire student record database, and those students are asked a question.

   simple random

   d) The student records are listed in order by student number. The 11^{th} student and every 25^{th} student thereafter (11^{th}, 36^{th}, 61^{st}, etc.) is asked a question.

   1-in-25 systematic

   not 1-in-k! Plug in for k!

2. ~~On your way to class, you stop at Tim Horton's and pick up a box of six doughnuts. Will the weight of the box be normally distributed if~~

   ~~a) the weight of each doughnut is normally distributed? Yes/No/Maybe~~

   ~~b) the weight of each doughnut is skewed? Yes/No/Maybe~~

   2

   ~~What if, instead, you picked up a box containing forty Timbits? Will the weight of the box be normally distributed if~~

   ~~a) the weight of each Timbit is normally distributed? Yes/No/Maybe~~

   ~~b) the weight of each Timbit is skewed? Yes/No/Maybe~~

   2

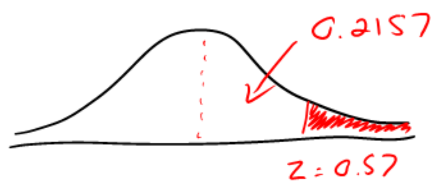
2 4. A study of people's weights indicates that the weight of an adult is normally distributed, with mean of 150 lbs and standard deviation of 35 lbs. As a civil engineer, you are asked to study the maximum number of people who can occupy a particular elevator.

a) What is the probability that any one person's weight exceeds 170 lbs?

$$z = \frac{x - \mu}{\sigma} = \frac{170 - 150}{35} = 0.57$$

3

$$P(x > 170) = P(z > 0.57)$$
$$= 0.5 - 0.2157$$
$$= 0.2843$$
$$= 28\%$$



b) If ten people occupy an elevator, what is the probability that the average weight per person exceeds 170 lbs?

$$z = \frac{\bar{x} - \mu}{SE} = \frac{x - \mu}{35/\sqrt{10}} = 1.81$$

3

$$P(\bar{x} > 170) = P(z > 1.81)$$
$$= 0.5 - 0.4649$$
$$= 0.0351$$
$$= 3.5\%$$

c) If the elevator's design gives a maximum load of 1700 lbs (10 × 170 lbs), would you recommend that ten be the maximum number of passengers? Explain your answer.

1

No! If P(exceeding design load) = 3.5%, that means that the design limits will be exceeded one out of every 30 (ish) trips. For some busy elevators, that could be more than one time per day!

Way too many. Unacceptable.

3 ~~5.~~ A regional computer centre wants to determine the average time between failures for its disk drives. To estimate this, the centre recorded the time between failures for a random sample of disk-drive failures, and found that the mean was 1762 hours with a standard deviation of 215 hours.

Based on this sample data, estimate the true mean time between failures with a 90% confidence interval, if

a) the size of the sample was 45 disk-drive failures

b) the size of the sample was 12 disk-drive failures

a)
$$\mu = \bar{x} \pm \frac{z_{\alpha/2}\, s}{\sqrt{n}}$$
$$= 1762 \pm \frac{1.645(215)}{\sqrt{45}}$$
$$= 1762 \pm 52.72$$
$$\left.\begin{aligned} &= 1762 \pm 53 \text{ hours} \\ &= 1760 \pm 50 \text{ hours} \end{aligned}\right\} \text{ either is acceptable}$$

3

The mean time between failures, with 90% confidence, is 1710 to 1810 hours.

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b)
$$\mu = \bar{x} \pm \frac{t_{\alpha/2}\, s}{\sqrt{n}} \quad \text{with } df = n-1 = 11$$

(use t instead of z because $n < 30$)

so this is 0.05

and $\alpha/2 = 0.05$

$$= 1762 \pm \frac{1.796(215)}{\sqrt{12}}$$
$$= 1762 \pm 111.5$$
$$\left.\begin{aligned} &= 1762 \pm 111 \text{ hours} \\ &= 1760 \pm 110 \text{ hours} \end{aligned}\right\} \text{ either is acceptable}$$

3

The mean time between failures, with 90% confidence, is 1650 to 1870 hours.

4 ~~6.~~ An entomologist wishes to estimate the average development time of the citrus red mite correct to within 0.5 days. From previous experiments it is known that σ is in the neighbourhood of 4 days. How large a sample should the entomologist take to be 95% confident of her estimate?

$$MOE \le B$$
$$Z_{\alpha/2}\, SE \le B$$
$$Z_{\alpha/2} \frac{\sigma}{\sqrt{n}} \le B$$
$$Z_{\alpha/2} \frac{\sigma}{B} \le \sqrt{n}$$
$$n \ge \left(\frac{Z_{\alpha/2}\,\sigma}{B}\right)^2$$

$$n \ge \left(\frac{(1.96)(4)}{0.5}\right)^2$$
$$\ge 245.862$$
$$\ge 246$$

The entomologist should take at least 250 samples.

4

5. (a) positive
   (b) $r^2 = (0.946)^2 = 0.895$
   (c) 89.5%
   (d) $\hat{y} = 0.815x + 31.1 = 0.815(157.5) + 31.1 = 159.5$ cm
   (e) $\hat{y} = 0.815x + 31.1$ so $x = \dfrac{\hat{y} - 31.1}{0.815} = \dfrac{157.5 - 31.1}{0.815} = 155.1$ cm
   (f) Because $x = 0$ is outside of the range of x-values in our data set.

6. First, let's calculate the usual quantities:

	x	y	x^2	xy	y^2
	2	3	4	6	9
	3	5	9	15	25
	4	5.5	16	22	30.25
	6	8	36	48	64
	7	9.5	49	66.5	90.25
sum	22	31	114	157.5	218.5

$$S_{xx} = \Sigma x^2 - \frac{(\Sigma x)^2}{n} = 114 - \frac{22^2}{5} = 17.2$$
$$S_{xy} = \Sigma xy - \frac{(\Sigma x)(\Sigma y)}{n} = 157.5 - \frac{22 \times 31}{5} = 21.1$$
$$S_{yy} = \Sigma y^2 - \frac{(\Sigma y)^2}{n} = 218.5 - \frac{31^2}{5} = 26.3$$
$$b_1 = \frac{S_{xy}}{S_{xx}} = \frac{21.1}{17.2} = 1.226744$$
$$b_0 = \overline{y} - b_1\overline{x} = 6.2 - 1.226744(4.4) = 0.802326$$

Then,

   (a) $\hat{y} = b_0 + b_1 x = 0.802 + 1.23x$
   (b) $r^2 = \dfrac{(S_{xy})^2}{S_{xx}S_{yy}} = \dfrac{21.1^2}{17.2 \times 26.3} = 0.984$