Quiz Tues April 9 9.2–9.4

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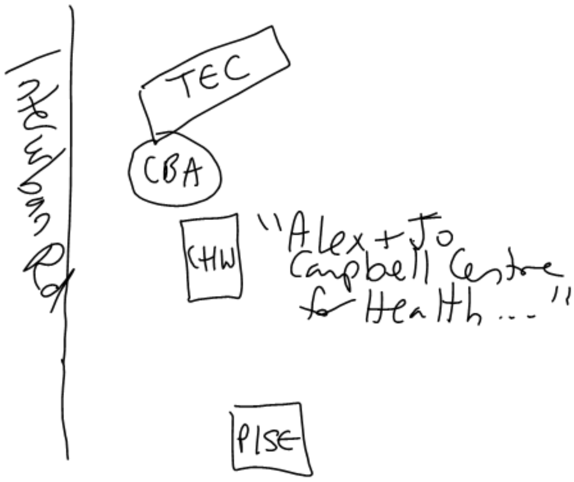
## Exam

Mon April 22
8:30 am
CHW 351

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Office Hours Fri Apr 19 12–1pm

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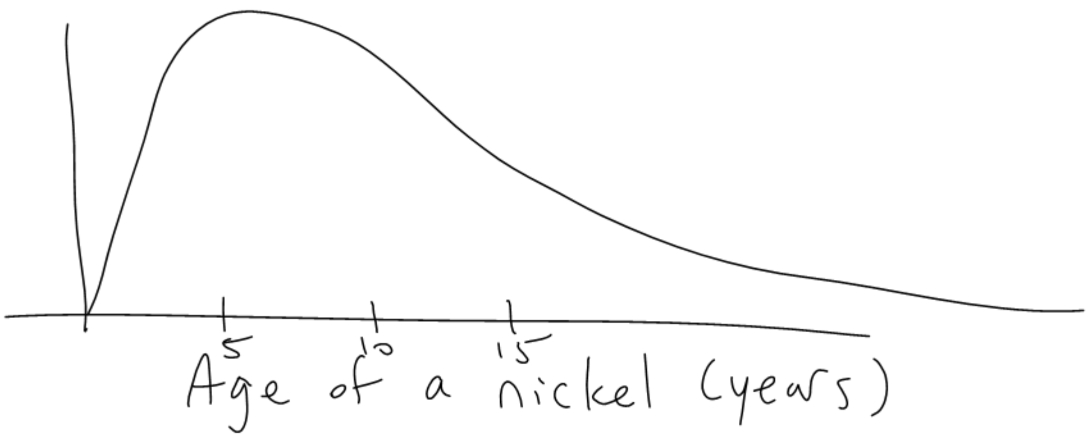
## Exam Breakdown

23 Questions
Three Hours

| Ch | % of Marks on Exam |
|---|---|
| 1 | 10 |
| 2 | 36 |
| 3 | 12.5 |
| 4 | 5 |
| 5 | 5 |
| 6 | 10 |
| 8 | 14 |
| 9 | 2.5 |
| 10 | 5 |

# 9.5 The Central Limit Theorem




Take random samples of 30 nickels, and calculate the sample mean $\bar{x}$ for each sample.

$\bar{x}$ = Average age of 30 nickels

- mound-shaped
- same centre as the population
- way less spread out than the population

# Central Limit Theorem

If the number of measurements in a sample is at least 30 then:

The set of all possible $\bar{x}$ values is normally distributed, the mean of the possible $\bar{x}$ values is $\mu$, and the standard deviation of the possible $\bar{x}$ values is $\frac{\sigma}{\sqrt{n}}$.

don't memorize

$\mu$ = population mean
$\sigma$ = " standard deviation
$n$ = # of measurements in a sample

Central Limit Theorem
Simulation (see video on website)

## 10.1 Estimating with Confidence

We want to estimate the average hours of homework done last week by all Camosun students, by sampling 50 students.

We want to say something like:

"We are 95% confident that the average hours of homework done last week by all Camosun students is between 19 and 23 hours."

This is called a <u>95% confidence interval for $\mu$</u>.

A 90% confidence interval for $\mu$ would be narrower.

$\longleftrightarrow$

90% C.I.

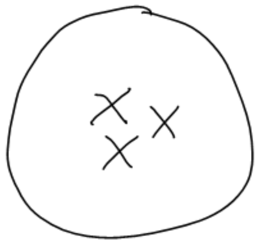
$\longleftrightarrow$

95% C.I. (default)

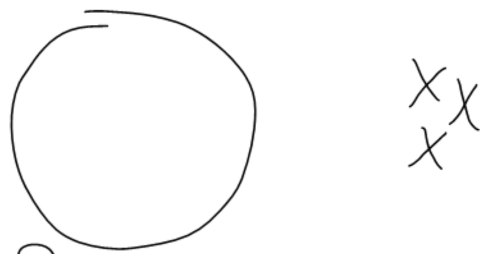
$\longleftrightarrow$

99% C.I.

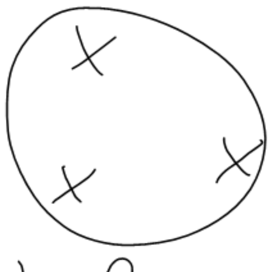
# Precision versus Accuracy



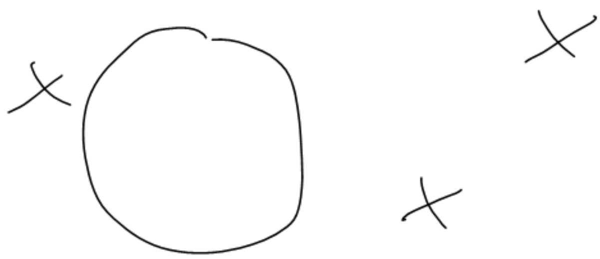
Precise
and Accurate



Precise
not Accurate



not Precise
and Accurate



not Precise
and not Accurate

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We get good accuracy by using a sample that is <u>representative</u> of the population.

We get good precision by choosing a sample with <u>lots of measurements</u>.

# 10.2 Large Sample Confidence Intervals for the Mean

$\mu$ = population mean

$\bar{x}$ = sample mean

$\sigma$ = population standard deviation

$s$ = sample standard deviation
($s \approx \sigma$)

Main Idea:

Estimate $\mu$ using $\bar{x}$ and either $s$ or $\sigma$.

Point estimate for $\mu$: $\mu \approx \bar{x}$

Confidence intervals are better because we select an appropriate confidence level.

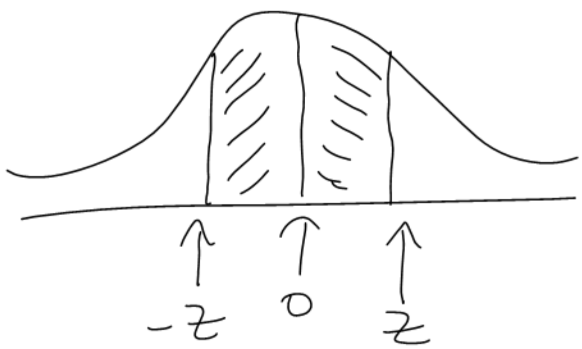
Example of a 95% confidence interval for $\mu$:

"The average temperature in downtown Victoria at noon yesterday was between 13 and 15°C"

Notation:

$z$ is a variable that is normally distributed with $\mu = 0$ and $\sigma = 1$.

Ex: Consider the shaded area below:




Find the value of $z$ so that

the shaded area is:

a) 0.90

Value from Area
Enter area = 0.90, $\mu=0$, $\sigma=1$
Select "between"
Hit "recalculate"

$z = 1.645$

b) 0.95

$z = 1.96$

c) 0.98

$z = 2.326$

d) 0.99

$z = 2.576$

The z-value is sometimes written $z_{\alpha/2}$. We'll just use z.

# Confidence Interval Formula

$$\mu = \bar{x} \pm z \frac{\sigma}{\sqrt{n}}$$

Comments:

- $n$ is the sample size (# of measurements in a sample)
- $n \geq 30$ is required
- can use $s$ instead of $\sigma$
- follows from the Central Limit Theorem

| Confidence Level | $z$ |
|---|---|
| 0.90 | 1.645 |
| 0.95 | 1.96 |
| 0.98 | 2.326 |
| 0.99 | 2.576 |

Ex: 40 students were asked how much they studied the weekend before exams. The mean was 15.1 hours with a standard deviation of 6.5 hours. Find a 90% confidence interval for $\mu$.

$$\mu = \bar{x} \pm \frac{z\sigma}{\sqrt{n}}$$

$z = 1.645$

$\bar{x} = 15.1$

$s = 6.5$ $(s \approx \sigma)$

$n = 40$

$$\mu = \bar{x} \pm \frac{z\sigma}{\sqrt{n}}$$

$$\mu = 15.1 \pm \frac{1.645(6.5)}{\sqrt{40}}$$

$$\mu = 15.1 \pm 1.7$$

$$13.4 \le \mu \le 16.8 \text{ hours}$$