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HLST 2300 6.0
Quantitative Research Methods in Health Studies

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Lecture 1: Course motivation and Mathematical review

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Course Motivation

Binge drinking by young women raises future health risks

Episodes of heavy alcohol use could increase susceptibility to stroke, cancer

By Janet Davison, CBC News Posted: Aug 10, 2015 5:00 AM ET | Last Updated: Aug 10, 2015 5:05 AM ET

More fruits and veggies may be gobbled up by kids if they're offered money

Rewards can be used to encourage children to repeatedly try fruits and vegetables

Thomson Reuters Posted: Sep 10, 2015 3:40 PM ET | Last Updated: Sep 10, 2015 3:47 PM ET

Hydration not connected to performance for athletes: study

The study is published in the Scandinavian Journal of Medicine and Science in Sports

The Canadian Press Posted: May 12, 2015 8:39 AM ET | Last Updated: Jul 20, 2015 11:34 AM ET

Ebola vaccine from Canada seems to work in trial in Guinea: WHO

Experimental vaccine from National Microbiology Laboratory '1st ray of hope': Doctors Without Borders

CBC News Posted: Jul 31, 2015 8:41 AM ET | Last Updated: Jul 31, 2015 8:11 PM ET

Course Motivation

Inside Rate My Hospital: How we measured performance

A look at the project's methodology, grading system

CIHI's data divides hospitals into four groups:

- Small community hospitals.
- Medium community hospitals.
- Large community hospitals.
- Teaching hospitals.

Hospitals of the same size and that treat similar types of patients are grouped together. Placing hospitals in four groups levels the playing field and makes it easier to compare them.

CIHI has also adjusted the data to account for factors that may contribute to worse outcomes, such as age, gender and whether a patient has multiple medical problems. These risk adjustments are intended to make comparisons between hospitals of the same size more valid.

http://www.cbc.ca/news2/health/features/ratemyhospital/methodology.html

Course Motivation

How do we know whether to believe all of the reports relating to health that the media present to us?

How do we evaluate research evidence to make appropriate decisions and recommendations?

How do we go about answering interesting questions about the world?

Math review topics

1. Rounding
2. Converting percents to fractions to decimals
3. Square and square root
4. Exponents
5. Summation notation
6. Factorial notation
7. Substituting into equations
8. Solving equations

Rounding

Decide which is the last digit to keep.
Leave it the same if the next digit is less than 5 (< 5).
But increase it by 1 if the next digit is 5 or more (≥ 5).

Round to the nearest whole number:

a) 65.4 — 65
b) 65.5 — 66
c) 0.6 — 1
d) 38.499 — 38
e) 148.475 — 148
f) 10.05 — 10
g) 15.555 — 16

Round correct to two decimal places:

a) 65.699 — 65.70
b) 68.636 — 68.64
c) 0.005 — 0.01
d) 100.005 — 100.01
e) 1.1548 — 1.15
f) 17.999 — 18.00
g) 0.003 — 0

For zero only, if the final answer is exactly 0.00, we state 0 instead.

Rounding rules for HLST 2300

For the purposes of HLST 2300, if calculations require rounding, we will round our final answers to 2 decimal places; intermediary steps will be rounded to 5 decimal places.

$$\sqrt{\frac{9.75}{100(2-1)}}$$

$= \pm 0.31$

$\sqrt{144}$

$= \pm 12$ is the correct answer

If you wrote ± 12.00 this would be incorrect since $\sqrt{144}$ is exactly equal to ± 12 (ie it did not require rounding to 2 decimal places since 12 is a whole number)

87.1 + 2(39)

= 165.1 is the correct answer

If you wrote 165.10 this would be incorrect since none of the terms went up to 2 decimal places (ie it did not require rounding to 2 decimal places since the highest is 1 decimal place. Therefore, we will round to 1 decimal place.

Fractions, decimals and percentages

a) Fraction to Percentage

To convert a fraction to a percentage:

① divide the numerator by the denominator

② multiply by 100

③ add a percent sign

Examples:

$\frac{2}{3}$ ← numerator
← denominator

Intermediary step: round to 5 decimals

① $2 \div 3 = 0.66667$

② $0.66667 \times 100 = 66.667$

③ 66.67 %

Final answer round to 2 decimals

$\frac{138}{12}$

① $138 \div 12 = 11.5$

② $11.5 \times 100 = 1150$

③ 1150 %

$4\frac{5}{9} = \frac{41}{9}$

Intermediary step: round to 5 decimals

① $41 \div 9 = 4.55556$

② $4.55556 \times 100 = 455.556$

③ 455.56 %

Final answer round to 2 decimals

b) Decimal to Percentage

To convert a decimal to a percentage:

① multiply by 100 (which moves the decimal point two places to the right)

② add a percent sign

Examples:

0.074

① 0.074 x 100 = 7.4

② 7.4 %

2.25

① 2.25 x 100 = 225

② 225 %

c) Percentage to Decimal

To convert a percentage to a decimal:

① eliminate the percent sign

② divide by 100

Examples:

73%

① 73

② 73 ÷ 100 = 0.73

0.09%

① 0.09

② 0.09 ÷ 100 = 0.0009

= 0 (rounded to 2 decimal places)

d) Decimal to Fraction

To convert a decimal to a fraction:

① place the decimal number in the numerator and 1 in the denominator

② multiply both numerator and denominator by 10 for every digit after the decimal point

③ reduce to the lowest fraction

Examples:

1.9

① $\frac{1.9}{1}$

② $\frac{1.9}{1} \begin{matrix} \times 10 \\ \times 10 \end{matrix} = \frac{19}{10}$

③ $\frac{19}{10}$

0.058

① $\frac{0.058}{1}$

② $\frac{0.058}{1} \begin{matrix} \times 1000 \\ \times 1000 \end{matrix} = \frac{58}{1000}$

③ $\frac{29}{500}$

e) Percentage to Fraction

To convert a percentage to a fraction:

① eliminate the percent sign

② place the percentage number in the numerator and 100 in the denominator

③ reduce to the lowest fraction

Examples:

46%

① 46

② $\frac{46}{100}$

③ $\frac{23}{50}$

0.02%

① 0.02

② $\frac{0.02}{100}$

③ $\frac{1}{5000}$

Since we don't like our fraction to contain a decimal, we can multiply both numerator and denominator by 100 to get rid of the decimal.

$$\frac{0.02}{100} \times 100 \times 100 = \frac{2}{10000}$$

Square and square root

In mathematics, a **square** is the result of multiplying a number by itself.

$3^2 = 3 \times 3 = 9$ $\quad (4x)^2 = (4x)(4x) = 16x^2$ $\quad 4x^2 = 4(x)(x) = 4x^2$

A **square root** of a number *a*, denoted by $\sqrt{a}$, is a number *y* such that $y^2 = a$.

For example, 4 and −4 are square roots of 16 because $4^2 = (-4)^2 = 16$.

$\sqrt{64} = \pm 8$

Exponents

In mathematics, an **exponent** is the result of multiplying a number by itself repeatedly. The number of times of repeat multiplication is called the exponent.

$7^3 = 7 \times 7 \times 7 = 343$ "7 to the exponent 3"

$0.5^4 = (0.5)(0.5)(0.5)(0.5) = 0.06$

Final answer round to 2 decimals

$0.2^{0.5} = 0.45$

Final answer round to 2 decimals

Important to note that any number to the exponent zero is equal to exactly 1. For example, $7^0 = 1$, $0.5^0 = 1$

Summation notation

A **variable** is a characteristic that changes or varies over time and/or for different individuals or objects under consideration. For example, body temperature is a variable that changes over time within a single individual; it also varies from person to person. Ethnic origin, income, height, age are all variables – characteristics that vary depending on the individual chosen.

Quantitative variables, often represented by the letter x, produce numerical data, such as those listed here:

x = daily caloric intake of 5 year olds living in Toronto

x = midnight occupancy at Hospital ABC

x = average weight of premature born infants

Summation notation

Since statistical formulas often involve adding or "summing" numbers, we use a shorthand symbol to indicate the process of summing. Suppose there are n measurements on the variable x – call them $x_1, x_2, \ldots, x_n$. To add the n measurements together, we use this shorthand notation:

$$\sum_{i=1}^{n} x_i$$ which means $x_1 + x_2 + x_3 + \cdots + x_n$

The Greek capital sigma ($\sum$) tells you to add the items that appear to its right, beginning with the number below the sigma ($i = 1$) and ending with the number above ($i = n$). However, since the typical sums in statistical calculations are almost always made on the total set of n measurements, you can use a simpler notation: $\sum x_i$ which means "the sum of all the x measurements"

Summation notation

You are given n = 5 measurements: 0, 5, 1, 1, 3. Find $\sum x_i$

$\sum x_i = 0 + 5 + 1 + 1 + 3 = 10$

Given the below table, find $\sum (x_i - 3) + 7(y_i)$

i	x_i	y_i
1	7	2
2	0	-2
3	3	5
4	8	1
5	-1	9
6	4	3

= (7-3) + 7(2)
+ (0-3) + 7(-2)
+ (3-3) + 7(5)
+ (8-3) + 7(1)
+ (-1-3) + 7(9)
+ (4-3) + 7(3)
= 4+14-3-14+0+35+5+7-4+63+1+21
= 129

Factorial notation

The factorial of a non-negative integer n, denoted by $n!$, is the product of all positive integers less than or equal to n.

$$n! = n(n-1)(n-2)\cdot\ \cdot\ \cdot(3)(2)(1)$$

8! = 8(7)(6)(5)(4)(3)(2)(1) = 40320

$\frac{24!}{22!}$ = 24(23) = 552

Important to note that 0! = 1

Substituting into equations

Given $f(x) = 3x^2 - 5x + 2$, evaluate each expression,

$f(2) = 3(2)^2 - 5(2) + 2$
$= 3(4) - 10 + 2$
$= 12 - 8$
$= 4$

$f(-1) = 3(-1)^2 - 5(-1) + 2$
$= 3(1) - (-5) + 2$
$= 3 + 5 + 2$
$= 10$

Solving equations

Solve for b:

$2b - 3 = 7$

$2b - 3 + 3 = 7 + 3$

$2b = 10$

$\frac{2b}{2} = \frac{10}{2}$

$b = 5$

$\frac{b}{2} - 5 = 5$

$\frac{b}{2} = 5 + 5$

$\frac{b}{2} = 10$

$b = 2(10)$

$b = 20$

$\frac{2b - 5}{2} = \frac{3b - 1}{4}$

$4(2b - 5) = 2(3b - 1)$

$8b - 20 = 6b - 2$

$8b - 6b = -2 + 20$

$2b = 18$

$b = 9$