

*Definition of the Domain
for Summative Evaluation*

MTH-4104-2

Mathematics Statistics II

Measures and Data Gathering

Québec 

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for Summative Evaluation*

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Mathematics Statistics II

Measures and Data Gathering

Formation professionnelle et technique
et formation continue

Direction de la formation générale
des adultes

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1. INTRODUCTION

This Definition of the Domain for Summative Evaluation describes and classifies the essential and representative elements of the secondary-level adult education Mathematics program and, more specifically, of the course entitled Statistics II (Measures and Data Gathering). As such, it gives an overview of the program, but should by no means replace the program itself. The purpose of defining the domain is to ensure that all summative evaluation instruments are consistent with the overall program.

The Definition of the Domain for Summative Evaluation for each course in this program is organized in a similar manner; however, the content of this definition of the domain is specific to the course entitled Statistics II (Measures and Data Gathering).

The goal of the Definition of the Domain for Summative Evaluation is to prepare examinations that are valid from one version to another or from one school board to another, taking into account the responsibilities shared by the Ministère de l'Éducation and the school boards.

2. PROGRAM ORIENTATIONS AND CONSEQUENCES FOR SUMMATIVE EVALUATION

ORIENTATIONS

The main objective of the secondary-level adult education Mathematics program is to help students fully understand mathematical concepts.

The program is designed to help students master the use of certain mathematical tools used in the field of science and technology or in different trades.

The program aims to provide students with the skills they need to process information by applying mathematical models and appropriate strategies for solving problems.

The program also aims to improve the students' ability to clearly relate information using mathematical language.

The program is intended to help students develop a systematic work method.

The program will help students master the use of technological tools.

CONSEQUENCES

Evaluation should involve verifying whether the student has fully understood the different concepts.

Evaluation items should pertain to situations in the field of science and technology or to situations related to trades.

Evaluation items should involve performing tasks that require the students to classify information, use mathematical models and solve problems.

Evaluation items should involve performing tasks that require the use of mathematical language. The appropriateness and clarity of the language used should be taken into account in the marking process.

Evaluation items should require the students to present their work in a clear and structured manner. This should be taken into account in the marking process.

The use of a scientific calculator is permitted for the examinations related to this course.

3. CONTENT OF THE PROGRAM FOR PURPOSES OF SUMMATIVE EVALUATION

Concepts

Data gathering

- census, sample survey, study
- representativeness of a sample
- sources of bias in a statistical survey
 - choice of sample
 - data gathering method
 - data processing and analysis
- effect of undecided responses on the interval of a result
- margin of error in relation to the size of the sample, or the size of the sample in relation to the margin of error

Measures

- measures of central tendency
 - mean
 - median
 - mode
 - modal-class interval
- measures of dispersion
 - range
- measures of position
 - quintile rank
 - percentile rank

Graphing a distribution

- distribution divided into classes
- distribution presented in a table
- distribution presented in a stem-and-leaf table
- distribution presented in a box-and-whisker plot

Skills

Each skill is defined within the context of a mathematics program.

- Structuring** Being familiar with the fundamentals of mathematics, understanding some mathematical concepts and establishing simple cognitive relations among them.
- Possible actions: to associate, classify, compare, complete, describe, define, contrast, distinguish, state, enumerate, group, name, rank, organize, recognize, arrange, and so on.
- Operating** Performing a given operation or transformation.
- Possible actions: to calculate, construct, break down, perform, estimate, evaluate, isolate, measure, reconstruct, solve, draw, transform, verify, and so on.
- Mathematizing** Interpreting a given situation using a mathematical model (arithmetic, algebraic or graphical).
- Possible actions: to formalize, illustrate, represent, schematize, symbolize, translate, transpose, and so on.
- Analyzing** Demonstrating, in an organized fashion, the complex connections between concepts or definitions and their related actions and illustrations.
- Possible actions: to conclude, correct, deduce, derive, demonstrate, explain, extrapolate, infer, justify, and so on.

4. TABLE OF DIMENSIONS

CONCEPTS	DATA GATHERING	MEASURES OF CENTRAL TENDENCY, MEASURES OF DISPERSION AND MEASURES OF POSITION	DISTRIBUTIONS
SKILLS	25%	40%	35%
STRUCTURING 15%	Justify choice of method used (census, sample survey, study) 1 5%		
	Determine whether a sample is representative. 2 5%		
	Identify sources of bias in a statistical survey. 3 5%		
OPERATING 35%	Determine which interval contains the results if the undecided responses are taken into account and which interval contains the results if the undecided responses are not taken into account. 4 5%	Calculate the mean and the median and determine the modal-class interval of a distribution divided into classes. 6 5%	
	Determine the margin of error or the size of a sample. 5 5%	Calculate the mean, median, mode and range of a distribution represented by a stem-and-leaf table. 7 10%	
		Calculate the quintile rank or percentile rank of a data value. 8 5%	
		Determine the data value or data values corresponding to a percentile rank. 9 5%	
MATHEMATIZING 10%			Construct a box-and-whisker plot. 12 10%
ANALYZING 40%		Evaluate statements pertaining to measures of central tendency and to the range. 10 5%	Evaluate statements pertaining to a distribution represented by a box-and-whisker plot. 13 5%
		Evaluate statements that require a comparative analysis of data and measures of position. 11 10%	Evaluate statements pertaining to the comparison of two distributions, each represented by a stem-and-leaf table. 14 10%
			Associate a statement or statements describing a characteristic with three distributions represented by a diagram or table. 15 10%

5. OBSERVABLE BEHAVIOURS

Examination items should be formulated on the basis of the observable behaviours listed below. The requirements and restrictions specified in the dimensions and the objectives of the program must be observed.

Dimension 1

Given the description of a specific context, state whether it is preferable to conduct a census, a sample survey or a study in order to obtain the desired information. The students must justify their choice.

(structuring) /5

Dimension 2

Given the description of a population and the objective of the sample survey to be carried out within this population, identify which characteristics of the population should be taken into account when choosing a sample that will be representative of the population described.

(structuring) /5

Dimension 3

Given the description of a statistical survey that is biased, identify the elements likely to have biased the results (the choice of sample, the method of gathering data or the processing and analysis of the data).

(structuring) /5

Dimension 4

Given the results of a survey for which the margin of error is known, determine which interval contains the results if the undecided responses are taken into account and which interval contains the results if the undecided responses are not taken into account.

(operating) /5

Dimension 5

In the context of a sample survey, determine the margin of error, given the size of the sample, or determine the size of the sample, given the margin of error.

(operating) /5

Dimension 6

Calculate the mean and the median and determine the modal-class interval of a distribution divided into classes (up to 10 classes).

(operating)

/5

Dimension 7

Calculate the mean, median, mode and range of a distribution consisting of no more than 30 data values presented in a stem-and-leaf table.

(operating)

/10

Dimension 8

Calculate the quintile rank or the percentile rank of a data value in a distribution representing a concrete situation (there may be several data values with the same value). For the quintile rank, the number of data values should not exceed 30. For the percentile rank, the number of data values should not exceed 200. In both cases, the values must be presented in order.

(operating)

/5

Dimension 9

Determine the data value or data values corresponding to a percentile rank. There should be no more than 200 data values.

(operating)

/5

Dimension 10

Given a distribution represented by a table or diagram other than a box-and-whisker plot or a stem-and-leaf table, evaluate statements pertaining to measures of central tendency and to the range. One of the statements must relate to the measure of central tendency that best represents this distribution. The students must justify their answers.

(analyzing)

/5

Dimension 11

Evaluate two statements that require a comparative analysis of data and measures of position from the same distribution. The students must justify their answers.

(analyzing)

/10

Dimension 12

Construct a box-and-whisker plot representing a distribution. There should be no more than 30 data values. The data is presented in a stem-and-leaf table. The students must clearly show all their work.

(mathematizing)

/10

Dimension 13

Evaluate five statements describing a distribution represented by a box-and-whisker plot.

(analyzing)

/5

Dimension 14

Given a stem-and-leaf table representing two similar distributions, evaluate two statements pertaining to the comparison of these two distributions. Each distribution may contain up to 30 data values. The students must justify their answers.

(analyzing)

/10

Dimension 15

Given three distributions represented by a diagram or table, associate a statement or statements describing a characteristic with each distribution.

(analyzing)

/10

Notes: The formulas are provided.

The different situations should not involve ambiguous calculations or borderline cases.

6. JUSTIFICATION OF CHOICES

In the examination, 15% of the items test the students' **STRUCTURING** skills by verifying their understanding of the following concepts:

- choice of method for gathering data
- representativeness of a sample
- sources of bias in a statistical survey

In the examination, 35% of the items test the students' **OPERATING** skills by verifying whether they have mastered the calculations pertaining to certain measures:

- the interval that contains the results if the undecided responses are taken into account and the interval that contains the results if the undecided responses are not taken into account
- margin of error in relation to the size of the sample, or the size of the sample in relation to the margin of error
- measures of central tendency
- range of a distribution
- quintile rank or percentile rank of a data value
- determining the data value or data values corresponding to a percentile rank

In the examination, 10% of the items test the students' **MATHEMATIZING** skills by verifying whether they are able to translate a given situation into a mathematical model:

- constructing a box-and-whisker plot

In the examination, 40% of the items test the students' skill in **ANALYZING** information; they involve verifying whether the students have the ability to make connections:

- by evaluating statements pertaining to measures of central tendency and to the range
- by evaluating statements pertaining to a distribution represented by a box-and-whisker plot
- by evaluating statements pertaining to the comparison of two distributions, each represented by a stem-and-leaf table
- by associating statements with a distribution
- by evaluating statements pertaining to the comparative analysis of data and measures of position

7. DESCRIPTION OF THE EXAMINATION

A. TYPE OF EXAMINATION

The summative examination will be a written examination consisting of short- or extended-response items.

The items should take into account the restrictions and the requirements specified in the dimensions and the objectives of the program. The weighting of marks should be consistent with the percentages set out in the table of dimensions.

B. CHARACTERISTICS OF THE EXAMINATION

The examination will be administered in a single session lasting no more than two and a half hours.

Students are permitted to use a scientific calculator; however, they are not permitted to use a graphing calculator.

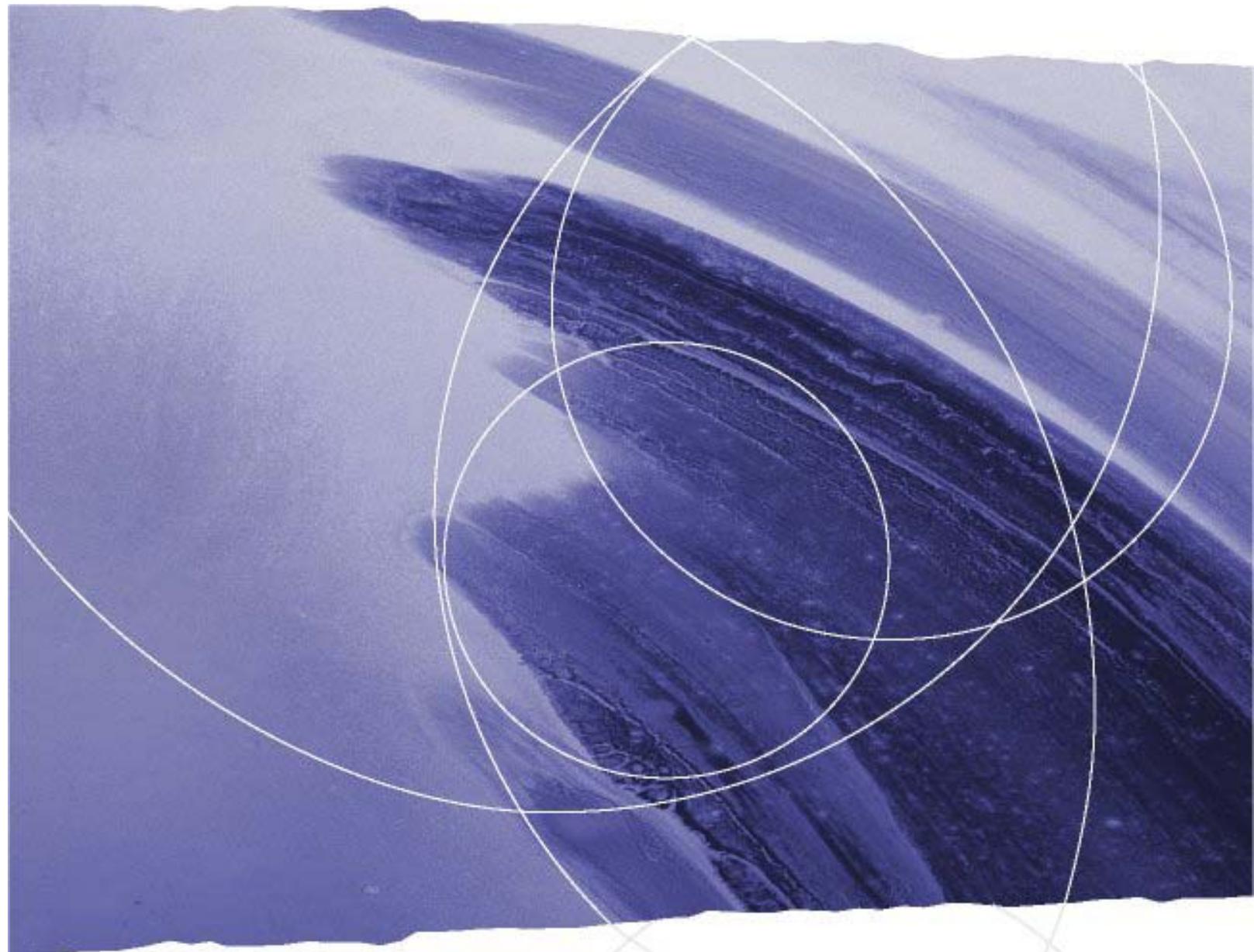
A list of formulas is provided (see appendix).

C. PASS MARK

The pass mark is set at 60 out of 100.

LIST OF FORMULAS

Formulas	List of Symbols
<p style="text-align: center;">Sample size and margin of error</p> $n = \frac{0.9604}{E^2}$	<p>n: number of data values E: margin of error in percentage</p>
<p style="text-align: center;">Median of a distribution divided into classes</p> $M_d = l_i + \frac{r}{f} \times e$	<p>M_d: median l_i: lower median class limit r: rank of the median in the median class f: frequency of the median class e: range of the median class</p>
<p style="text-align: center;">Mean of a distribution divided into classes</p> $\bar{x} = \frac{\sum f_i \times m_i}{n}$	<p>\bar{x}: mean Σ: sum f_i: frequency of each class m_i: middle of each class n: total number of data values</p>
<p style="text-align: center;">Quintile rank</p> $R_5(x) = 5 \times \frac{N_{>} + \frac{N_{\dot{e}}}{2}}{N_t}$	<p>R_5: quintile rank of data value x $N_{>}$: number of data values greater than x $N_{\dot{e}}$: number of data values equal to x N_t: total number of data values</p>
<p style="text-align: center;">Percentile rank</p> $R_{100}(x) = 100 \times \frac{N_{<} + \frac{N_{\dot{e}}}{2}}{N_t}$	<p>R_{100}: percentile rank of data value x $N_{<}$: number of data values less than x $N_{\dot{e}}$: number of data values equal to x N_t: total number of data values</p>



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