Course

Sets and Statistics

MTH-P103-2

Presecondary

“Facts are stubborn things, but statistics are more pliable.”

Mark Twain

Presentation of the Course *Sets and Statistics*

The course *Sets and Statistics* is designed to help adult learners deal competently with real-life situations that involve problems related to data classification.

Adults will therefore learn to use basic concepts pertaining to sets and statistics in real-life situations involving large amounts of data that are already classified or that must be classified.

This course introduces learners to the use of statistics and sets through real-life situations. Data classification is carried out using sets and subsets, in concrete contexts. Thus, rather than examine formal set theory, the course will focus on the development of set logic, which is one of the cornerstones of logical reasoning. Among other things, adults will be able to use this logic to classify data in tables and graphs. Although adults will rarely be required to produce statistical graphs in real-life situations, learning how to produce this type of representation will help them better understand those presented in the media or in different types of documents. They will therefore learn about a few simple statistical representations: tables of variables, data tables, frequency tables, pictographs and bar graphs. The classifications will involve data that are easy to understand. The goal is not to emphasize data collection, which will be examined in Secondary Cycle One, but rather the classification, interpretation and representation of data.

After completing this course, learners will be able to interpret and produce set and statistical classifications of all types (e.g. objects, files, concepts, survey results, school results). They will accurately use the various modes of representation to convey these classifications. They will use deductive and inductive reasoning based mainly on set logic. By developing healthy skepticism with respect to persons or organizations involved in producing statistics, adults will be able to interpret these statistics rationally and critically.

Dealing With the Real-Life Situations

Dealing effectively with real-life situations is based on actions. These actions are grouped into categories and make use of a set of resources that include operational competencies and essential knowledge. During the learning process, adults are expected to construct knowledge related to these resources in order to be able to deal appropriately with their real-life situations.

The class of situations, categories of actions, operational competencies and essential knowledge constitute the compulsory elements of the course. These elements are explained in detail under their respective headings.

Class of Situations Addressed by the Course

This course addresses a single class of situations: *Classifying data*.

All the real-life situations in this class involve problems related to data classification. Some situations involve classifying data in set or statistical representations, while others involve interpreting data that are already classified in these types of representations. Adults must be relatively familiar with the real-life situations dealt with in this class and be able to readily transform facts into data.

In order to make informed decisions, adults are often required to process data regarding nutrition or personal, occupational and consumer choices. They may be required to provide information on their lifestyles, classify products according to food groups or group public services in various categories. The real-life situations in this class also require adults to interpret data related to natural resources, social issues or the advertising of goods and services. They may also be required to make connections between their occupational identities (e.g. fields of interest, aptitudes) and training possibilities or to assess job placement possibilities in a given occupation by interpreting classifications of data such as job banks.

Class of Situations	Examples of Real-Life Situations
Classifying data	▪ Planning a balanced meal ▪ Planning a purchase ▪ Choosing a sports activity ▪ Arranging clothes ▪ Managing electronic files ▪ Selecting goods and public services ▪ Establishing a personal budget ▪ Studying various natural resources ▪ Reading polls on voting intentions ▪ Participating in a debate on a societal issue ▪ Analyzing his/her academic performance ▪ Participating in a hockey pool

Categories of Actions

The *categories of actions* are groups of actions that are appropriate for dealing with the real-life situations addressed in the course. *Examples of actions* are provided to illustrate the scope of the category in a variety of contexts.

Categories of Actions	Examples of Actions
▪ Interpreting set and statistical classifications	▪ Determines to which food group a food item belongs ▪ Uses an organizational chart to determine the department to which a person belongs ▪ Compares voting intentions at various times during an election campaign ▪ Determines the nutritional value of a food item ▪ Determines which natural resources are threatened ▪ Determines which hockey players continue to perform well ▪ Calculates the average mark of a class on an exam
▪ Producing set and statistical classifications	▪ Classifies foods according to their nutritional value ▪ Classifies household products according to their use ▪ Classifies mammals according to species ▪ Classifies clothes according to the seasons ▪ Organizes his/her favourite Internet sites ▪ Records total expenses in a data table ▪ Records his/her monthly absences in a frequency table ▪ Using a pictograph, represents the participation rate in various extracurricular activities

Compulsory Elements and End-of-Course Outcomes

The compulsory elements are those that the teacher must absolutely take into account when designing learning situations.

Class of Situations

Classifying data

Categories of Actions

- Interpreting set and statistical classifications
- Producing set and statistical classifications

Operational Competencies

Thinks logically

- Infers the characteristics shared by several data values
- Selects the appropriate arithmetic operations
- Makes deductions based on set logic
- Checks that his/her conclusions are realistic and coherent

Communicates

- Accurately decodes the symbols, notations and terms associated with set and statistical representations
- Recognizes information that enables them to have an understanding of the data represented
- Checks his/her interpretation with other people
- Accurately organizes the message using appropriate modes of representation
- Accurately uses the symbols, notations and terms associated with set and statistical representations
- Makes sure his/her message is clear

Exercises critical and ethical judgment

- Compares various sources of information
- Forms an opinion based on facts or data
- Shows an openness to changing his/her opinion

Essential Knowledge

- Sets
- Statistical distributions
- Decimals
- Mixed numbers

The end-of-course outcomes describe how adults make use of the compulsory elements to deal with the real-life situations addressed in the course.

End-of-Course Outcomes
In order to deal with the situations in the class *Classifying data*, adults interpret and produce various types of set and statistical classifications of data. Adults must interpret the set or statistical classifications used in a food guide, a newspaper article or electronic media. To be able to do this, they must accurately decode the symbols, notations and terms related to Venn diagrams, sets described by listing their elements, tables, pictographs or bar graphs. They recognize information that enables them to understand data represented, such as an object quantified in a diagram or the name given to a set. They determine whether an element belongs to a given set or subset. Their deductions are largely based on set logic. They verify the plausibility and coherence of their conclusions. Interpreting statistical representations requires that they compare various sources of information and check their credibility. Adults form an opinion and make choices based on facts or objective data; they are critical of the personal opinions of those who have an interest in influencing them. They are nonetheless open to changing their initial opinion when the various sources of information are consistent. Adults produce set and statistical classifications when they group objects, organize electronic files, analyze their academic performance, etc. They carefully examine the data to be classified and infer a characteristic that is shared by many of the data values. In this way, they create classes, categories, subclasses or subcategories while ensuring that their conjecture with respect to the common characteristic is plausible and coherent. In order to illustrate their data classifications to be able to convey them to others or to use them for their personal needs, they organize these classifications properly by using the appropriate modes of representation. Adults use the symbols, notations and terms (e.g. title, subheading, legend, labelling of axes) appropriately. They make sure that the set and statistical representations are clear. When they must perform calculations in order to deal with a real-life situation (e.g. means, sums of quantitative data, portions of pictographs), adults select and correctly apply the appropriate arithmetic operations and check the plausibility of their results.

Evaluation Criteria

- Interprets set and statistical classifications correctly
- Produces coherent set and statistical classifications

Operational Competencies

The contribution of each operational competency is described in terms of the actions that are appropriate for dealing with the real-life situations in this course. These operational competencies are addressed in other courses and therefore all of the courses taken together contribute to their development.

In this course, only the following operational competencies are addressed: *Thinks logically*, *Communicates* and *Exercises critical and ethical judgment.*

Contribution of the Operational Competency *Thinks logically*	
The operational competency *Thinks logically* enables adults to make connections and draw conclusions when dealing with the real-life situations that belong to the class *Classifying data*. This competency consists in using deductive and inductive reasoning, which, in this course, is based mainly on set logic. By determining the characteristics shared by a set of data, adult learners infer categories, classes or groups. They then look for examples in order to verify the given hypothesis with respect to the shared characteristic or find counterexamples to specify, readjust or refute their initial classification. This general rule regarding shared characteristics also applies to a set of quantitative data when adult learners want to produce a statistical representation. This approach enables adults to determine the elements that are quantified in a table or a graph and to establish disjoint subsets in order to avoid having the same elements considered twice.	Adults make connections among the various data values, which makes it possible to classify them in order to study a phenomenon, make a realistic choice, plan, etc. To determine a mean, they first determine the number of data values and select the arithmetic operations that will allow them to calculate it. Many deductions are based on set logic. For example, by knowing to which group a food item belongs, the adult deduces that its nutritional content is similar to other food items in the same group. Similarly, by knowing that a certain cleaning product is acidic, they can deduce the risks associated with using this product. Adults check the plausibility and coherence of their conclusions (e.g. classifications, interpretations, calculations, conjectures).

Contribution of the Operational Competency *Communicates*

The operational competency *Communicates* enables adults to interpret and produce messages containing set and statistical representations when dealing with real-life situations belonging to the class *Classifying data.* It consists in decoding and correctly using mathematical language associated with these modes of representation.

When interpreting a message, adults accurately decode the symbols, notations and terms related to Venn diagrams, sets whose elements are listed, tables, pictographs or bar graphs, thereby enabling them to find the information conveyed by these modes of representation. For example, by reading the titles and subheadings of different statistical representations, they will be able to determine which one provides the desired information. They will also be able to find a precise value in these representations by decoding the legend and the axes. Adults recognize information that enables them to understand the data represented as an object quantified in a graph or the name given to a set of data. They can then interpret surveys, information conveyed in the media or any other representation of a data classification. When in doubt, they validate their interpretation with others.

When they produce a message, adults accurately use the appropriate symbols, notations and terms. They organize their messages appropriately by using the most suitable mode of representation for the given situation. They correctly identify a set or a table, graduate the axes in a bar graph, etc. In the event of a fire, they are able to transmit a list of damaged items to the insurance company, by category, or draw up a table of their financial situation. Adults make sure their messages are clear and understandable to their audience.

Contribution of the Operational Competency *Exercises critical and ethical judgment*	
The operational competency *Exercises critical and ethical judgment* enables adults to make judgments and informed decisions when dealing with real-life situations examined in the class *Classifying data*. It allows them to develop a healthy skepticism with respect to statistics and to make objective decisions.	Adults use their critical and ethical judgment when they analyze statistical distributions conveyed by the media or appearing in various documents. It is important that they be careful when considering this type of information. Adults assess the validity of the information that is presented by comparing different sources when possible. They learn that the choice of data in a given representation can be dictated by the interests of those who produced it. The same is true of the comments that accompany statistical representations: adult learners must realize that these comments are coloured by the personal opinions of those who formulated them. They must exercise discernment when forming an opinion or making choices based on facts or data that leave no room for interpretation. They nonetheless retain an element of doubt and are open to changing their position when the various sources of information are opposed to their initial opinion. Thus, when producing a statistical representation, learners try to remain objective. They avoid giving a personal opinion that is gratuitous and unfounded.

Essential Knowledge

All of the knowledge shown in the table below is compulsory since it is essential for dealing with many of the situations in the class *Classifying data.*

The left-hand column shows the essential knowledge that was not covered in previous courses. Where necessary, its scope is shown in parentheses. The right-hand column shows the essential knowledge that was covered in previous courses. Since it is also required to deal with the situations in this course, adult learners must deepen their understanding of this knowledge by adapting it to situations that involve classifying data. In some cases, the knowledge outlined in this column is included with more general knowledge in the left-hand column. It is nonetheless listed to make it easier to identify adult learners' previously acquired knowledge.

Since essential knowledge in arithmetic is dealt with only in a context involving orientation in space and time, this material is covered only partially. In order that every facet of this essential knowledge may be addressed in a greater range of contexts, it has been made compulsory in other mathematics courses in this program that examine other types of situations.

New compulsory knowledge	Compulsory knowledge acquired in previous courses
Sets • Sets and subsets (only disjoint sets will be examined as well as their subsets, which are also disjoint) • Membership, inclusion and exclusion relationships • Sets of numbers (natural, whole and rational) • Classifying elements using sets and subsets • Reading representations involving sets and subsets • Describing sets and subsets using words • Representing sets and subsets by listing their elements and using a Venn diagram	**Decimals** • Decimals (up to three places) • Comparing decimals (including negative numbers) • Rounding off positive decimals • Making a mental estimate of the result of an operation or sequences of operations on positive decimals • Positioning decimals on the number line (including negative numbers) • Solving sequences of arithmetic operations on positive decimals (with no more than one set of parentheses and four operations)

New compulsory knowledge	Compulsory knowledge acquired in previous courses
Statistical distributions • Discrete quantitative data or qualitative data • Axes • Legend • Mean • Reading statistical representations (tables of variables, frequency tables, bar graphs and pictographs) • Constructing tables of variables and frequency tables • Graphing statistical distributions (bar graphs and pictographs) • Calculating the mean using the data from statistical distributions (the calculations must be simple i.e. adding the data and dividing it by the number of data)	**Mixed numbers (for pictographs)** • Representing mixed numbers (e.g. using the base 10 number system and visual aids: set of blocks, illustrations) • Calculating the fraction of a natural number • Determining the fraction corresponding to a part of a whole

Attitudes

The following attitudes are provided as suggestions only. The development of these attitudes can help adults to become more competent in dealing with the real-life situations in this course.

Rigour	Vigilance
This attitude enables adults to adhere to the logic of set operations at all times, as well as to be precise and methodical when producing representations.	This attitude enables adults to be critical when they interpret statistics and read the accompanying comments and analyses. Adults must be aware that statistics are subject to different interpretations.

Complementary Resources

The following resources are provided as suggestions only and consist of references that may be consulted in learning situations.

Social Resources	Material Resources
▪ Statistics Canada ▪ Institut de la statistique du Québec ▪ Emploi-Québec ▪ Environment Canada	▪ Calculator ▪ Ruler ▪ Newspapers ▪ Magazines ▪ Government publications ▪ Electronic media ▪ Spreadsheets

Contribution of the Subject Areas

The contribution of certain subject areas, in particular the Social Sciences, Personal Development, Languages and Mathematics, Science and Technology is also useful for dealing with the real-life situations in this course. The elements identified for each subject area are not compulsory and do not constitute prerequisites.

Subject Area: Social Sciences

Programs of Study: *Social and Political Life*, *Community and Culture* and *Consumer Habits*

- When adults produce or interpret statistical or set representations, adults may use their knowledge of social structures (government departments, school boards, centres), politics, the economy, advertising, etc.

Subject Area: Working Life

Programs of Study: *Introduction to the World of Work* and *Career Choice*

- Since some of the real-life situations examined in this course involve working life and career choices, adults may be required to use what they know about trades and occupations, the structure of a company, etc.

Subject Area: Personal Development

Program of Study: *Health*

- As certain life situations examined in this course deal with health, adult learners may be required to use the food groups, compare the number of calories in different foods, list life habits, etc.

Subject Area: Languages

Program of Study: *English, Language of Instruction*

- All of the situations in this course require adult learners to communicate orally and in writing. Consequently, the language of instruction will be used throughout the course.

Subject Area: Mathematics, Science and Technology

Program of Study: *Computer Science*

- Some of the real-life situations in this course may involve computer resources. For example, this is the case when adults use a spreadsheet to product statistical representations. System software may also be useful for organizing computer files.

Program of Study: *Relationship With the Environment*

- A knowledge of animal and plant species, pollution, natural resources, may also be useful in this course.

Program of Study: *Mathematics*

- In addition to the knowledge that is compulsory for this course, working with some of the real-life situations may require a knowledge of mathematical content covered in other common core education courses. This is the case, for instance, for the mode in qualitative statistical distributions, percentages and other types of tables and graphs that are not compulsory content for this course.

Andragogical Context

Everyday situations that involve large amounts of data are common in the lives of adults, whether these situations involve choosing an occupation or an educational program, registering for an activity, using a service, etc. The teacher draws on the real-life experiences of learners in order to present them with plausible learning situations. The closer the learning situations are to actual everyday situations, the more meaningful they are and the more knowledge the students will retain.

Learning achieved through this course will give adults the opportunity to understand that classifying data allows them to dispense with memorization, make better informed decisions and better organize their own knowledge. Likewise, filing documents and storing objects of all kinds, when based on set logic, makes it easier to find them again. Adults will also realize that the interpretation of data classified in statistical and set representations is useful if they must make an informed opinion or look for specific information.

The learning situations should place more emphasis on interpreting representations rather than on producing them. In fact, it is quite rare that adults are required to produce statistical or set representations in their everyday lives. In a learning situation, the purpose of this type of exercise is mainly to get adults to develop a sense of set logic and to better understand how to represent data in order to be able to better interpret them.

Since set classification is a prerequisite to producing statistical representations, certain learning situations in this course may combine these two aspects so that adults may make connections between them. Among other things, they will understand that the subsets chosen for quantified objects must be disjoint if they want to avoid having the same data considered twice.

Although this course focuses on data classification, it continues to build on arithmetic knowledge. If learners do not have certain types of knowledge related to the compulsory content of the prerequisite courses (right-hand column in the table of essential knowledge), the teacher will have to set aside time and assign simpler learning situations to allow adults to acquire this knowledge.

Learning Situation

The learning situation that follows is provided as an example to show teachers how the principles of the education reform can be applied in the classroom.

It is authentic in the sense that it addresses a real-life situation (taken from the class of situations in the course) that adults may find themselves in. It is sufficiently open and comprehensive to allow adult learners to explore several important aspects related to dealing with this real-life situation.

The examples of actions presented in the course help the teacher to identify those actions that an adult would take to deal with the real-life situation. The teacher can then refer to these examples in order to develop pertinent learning activities.

The learning situation is organized in terms of the three steps of the teaching-learning process, which are as follows:

- planning learning
- actual learning
- integrating and reinvesting learning

These steps highlight the principles of the education reform insofar as they encourage adults to be active, to reflect on their learning and to interact with their peers when the learning context is suitable. They include learning activities and may also include evaluation activities intended to support adults in the learning process.

These activities help learners to construct knowledge related to the compulsory elements of the course that are targeted by the learning situation concerned: one or more categories of actions, essential knowledge and the actions of the operational competencies associated with the categories of actions.

The example provided also refers to certain teaching strategies—pedagogical methods and techniques—that can be selected according to the learners, the context and the learning environment. Certain learning strategies may also be suggested, as well as a variety of material and social resources.

Example of a Learning Situation

Planning a Purchase

The real-life situation chosen for the class *Classifying data* involves making a purchase.

The teacher begins by presenting the class with a catalogue page or an ad illustrating the wide range of choices offered for a given product. In a class or small-group discussion, the teacher has the adult learners explain how they go about choosing an item. The teacher attempts to point out the advantages of classifying the items in order to make an informed choice. In order to make the learning situation more interesting, the teacher has the adults select an item they would like to purchase in the near future.

Through questions, the teacher leads the adults to determine all the characteristics they consider important in making their purchase, such as identifying the item selected, the brand name, constituent materials, price, durability, guarantee, etc. These characteristics are classified by category by distinguishing the quantitative data from the qualitative data. This step allows the adults to consolidate what they have learned about data and sets in previous learning situations. The adults then learn to make a table of variables by using set-related concepts and techniques. Through a series of questions, the adults discover that a table constitutes a set and that each column represents a subset of characteristics. With the participation of the class, the teacher then demonstrates how to make a table and suggests other examples of tables. Individual exercises are then assigned so that individual learners can assess their understanding of the subject matter.

The adult learners can now prepare a table for recording the characteristics considered for the purchase. The title and subheadings are correctly written and the table is subdivided according to the selected characteristics. The adults can then compare their respective tables and make any necessary corrections. Working alone, they classify the relevant data taken from catalogues or Internet sites. They perform the necessary calculations and deductions in order to determine the costs that are not explicitly indicated (e.g. sum of prices, taxes, discounts). The teacher makes sure that the comparative table contains a choice of five items. The titles, subheadings and all the data must be clearly indicated and consistent with current conventions. Lastly, the adults compare the various characteristics identified, establish their priorities and make a choice that is consistent with their needs and ability to pay. They are asked to present their choice individually to the teacher as well as the reasons for these choices by basing their argument on financial considerations, the quality of the item and their personal needs. If necessary, the teacher intervenes during the presentation to correct inappropriate terms and to get the learners to explain their choices.

After handing back the tables, the teacher leads a class discussion on what has been learned and on the difficulties encountered. The teacher summarizes the discussion by interacting with the learners. Lastly, each person is asked to identify another real-life situation in which it would be useful to use a data table. The other people in the class express their opinions on the subject.

Elements of the Course Addressed by the Learning Situation

Class of Situations
Classifying data
Learning Situation
Planning a Purchase
Categories of Actions
▪ Interpreting set and statistical classifications ▪ Producing set and statistical classifications

Operational Competencies	Essential Knowledge
▪ Thinks logically ▪ Communicates ▪ Exercises critical and ethical judgment	▪ Relationships of belonging, inclusion and exclusion ▪ Classifying elements using sets and subsets ▪ Quantitative discrete data or qualitative data ▪ Constructing tables of variables ▪ Comparing decimals ▪ Solving sequences of arithmetic operations involving decimals

Complementary Resources
▪ Calculator ▪ Ruler ▪ Page from a catalogue or an advertisement