

LEARNING GUIDE

MATHEMATICS

DBE

# SOLUTIONS

MTH-5152-1

CST

VOTE DISTRIBUTION  
MODELS AND RANDOM  
EXPERIMENTS  
IN A GENERAL CONTEXT

IN COMPLIANCE  
WITH THE NEW  
PROGRAM  
OF STUDY

SOFAD

LEARNING GUIDE

MATHEMATICS

DBE

# SOLUTIONS

MTH-5152-1

CST

**VOTE DISTRIBUTION  
MODELS AND RANDOM  
EXPERIMENTS**  
IN A GENERAL CONTEXT

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Legend: r = right      c = centre      l = left  
t = top                  b = bottom

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# HOW THE LEARNING GUIDE IS STRUCTURED

Welcome to the learning guide of the **Vote Distribution Models and Random Experiments in a General Context** course. The aim of this course, which is the third in the **Secondary V Cultural, Social and Technical** sequence, is to develop your ability to handle situations that require processing of data from a random experiment. To achieve this, you will study different models of vote distribution:

- majority rule
- plurality voting
- Borda count
- Condorcet method
- approval voting
- runoff (or elimination) method
- proportional representation

You will complete your learning by expanding your knowledge about probability by addressing, for example:

- counting
- mutually exclusive events
- conditional probability
- the concept of chance
- mathematical expectation

You will be required to use various solution strategies to understand and model situational problems. You will need to use your mathematical reasoning skills. You will also have to describe how you solved these problems clearly and thoroughly using mathematical language.

You are now invited to complete the learning activities found in the three chapters of the guide for this course and enrich your knowledge of data processing.

## Portailsofad.com

Go to [portailsofad.com](http://portailsofad.com) for videos, ICT activities and printable versions of resources that are complementary to the SOLUTIONS series, which you can use throughout your learning journey.



# CHAPTER COMPONENTS

The learning process followed in each chapter enables students to progress by building on what they have learned from one section to the next. The following diagrams illustrate this approach and specify the pedagogical intent of each section.

## CHAPTER INTRODUCTION

The first page describes the context and theme that will serve as a backdrop for the acquisition of the new knowledge discussed in the chapter.

**CHAPTER 1**

### Types of Probability and the Concept of Equity

#### Making Decisions in a Context of Uncertainty

In everyday life, just as in the business world, making decisions is essential. But making a decision is not always easy. In the business world, for example, a simple decision can often make the difference between the success and failure of a project. Also, since it is impossible to predict the future with certainty, you might think that some of the decisions that propelled companies to the top were essentially random. Yet, this is very rarely the case! In fact, success is more a matter of a thoughtful business decision: a good manager analyzes the information to determine the various possible outcomes and thus make the best decision. To do this, managers usually use mathematics - more specifically, probability. While not guaranteeing success, this approach allows an informed decision to be made.

In this chapter, you will learn how to use probability, applying a theoretical, experimental or subjective approach, to analyze random situations. You will also see how the concept of mathematical expectation can serve as a guide for planning optimal production.

**TABLE OF CONTENTS**

- SITUATION 1.1 THEORETICAL PROBABILITY, EXPERIMENTAL PROBABILITY, SUBJECTIVE PROBABILITY, COUNTING AND ENUMERATION OF POSSIBILITIES, SP 1.1 - Designing a Board Game p. 4
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**CHAPTER 1**

A table of contents accompanies this first page. The knowledge to be acquired is described for each of the *Situations*, as well as the theme of the situational problems.

## SITUATIONS

In general, there are two learning *Situations* per chapter. The approach taken in these situations makes it possible to acquire new knowledge and develop mathematical skills in real, realistic or purely mathematical contexts.

**SITUATION 1.1**

### Designing a Board Game

Chance plays an important role in board games. To design a game with a good dose of fun, you must look at the probabilities of different events that may occur so that the game is balanced. This increases the chances of the game's commercial success.

Olivia and Astrid complete the design of a board game. To play, you use a regular die for the moves, an irregular colour die in the shape of a right prism with a rectangular base and a game board. The game board contains 16 boxes, each of which is red, green or blue.

The goal of the game is simple: move with the regular die, then throw the colour die. If the colour rolled is the same as that of the box on which you land, you win a point. To finish the design of the game, the colour of each of the 16 boxes of the board must be determined. The objective is to assign a colour to the 16 boxes of the board so that an outcome is more likely on the colour die, it must be less likely on the game board, and if an outcome is less likely on the colour die, it must be more likely on the game board. To achieve this, Olivia and Astrid were interested in the behaviour of the colour die on several rolls. To the right are the outcomes obtained by each player.

**Appearance of the colour die**

NOTE: The result of the roll of the die is the face on the top.

**TASK**

From the probability associated with the different outcomes, propose a way to colour the boxes of the game board.

**SITUATION 1.2**

### Expecting a Profitable Yield

Every year in Québec, farmers plan their next crop based on a multitude of factors: local and international demand, climate, nutrients in the soil, and so on. Each of these factors is associated with a certain amount of uncertainty. Wise planning is necessary to give the best chances for a profitable yield.

Eager to generate maximum profits, a young farmer is planning his next crop of vegetables. He has 30 hectares. Here are the options he considers:

- Cultivate only one variety.
- Divide the land evenly into three plots and cultivate the three varieties of vegetables.
- Divide the land equally into two plots and cultivate only two of the three varieties.

NOTE: In a monoculture, the probability of losing his crop due to disease is 20%. In such a case, the crop is lost. In other cases, the probability of losing his crop is only 2%.

**Help the farmer plan the cultivation for which he can expect the greatest gain and provide an estimate of how much he could earn.**

Crop	Problems	Benefits
Carrots	Cost related to seed purchase and crop: \$1300/ha	Cost related to seed purchase and crop: \$1300/ha
Peas	Maximum theoretical production: 12 t/ha	Maximum theoretical production: 12 t/ha
Broccoli	Yield: About 5 plants out of 100 do not produce ears	Yield: About 80% of the produce is good for retail, the others are sold
Spinach	Selling price: \$250/t	Selling price: \$250/t
Peas	Cost related to seed purchase and crop: \$1300/ha	Maximum theoretical production: 12 t/ha
Carrots	Cost related to seed purchase and crop: \$1300/ha	Maximum theoretical production: 12 t/ha
Peas	Yield: About 5 plants out of 100 do not produce ears	Yield: About 80% of the produce is good for retail, the others are sold
Spinach	Selling price: \$250/t	Selling price: \$250/t

**TIP**

A hectare that is a surface area equivalent to one square hectometre. Thus, one hectare corresponds to an area of 10 000 m<sup>2</sup>. To visualize what this represents in terms of area, tell yourself that the playing surface of a regular football field has an area of about 1 hectare.

**NOTE**

NOTE: In a monoculture, the probability of losing his crop due to disease is 20%. In such a case, the crop is lost. In other cases, the probability of losing his crop is only 2%.

**CHAPTER 1**

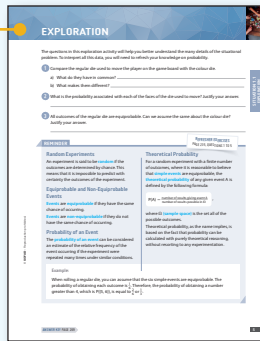
# PHASES OF EACH SITUATION



## SITUATIONAL PROBLEM

Linked to the main theme of the chapter, this page briefly describes the context of the situational problem, as well as the information required to solve it.

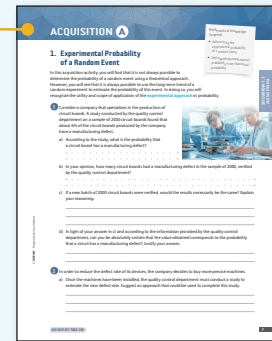
A box describes the task you will have to perform later in the *Solution* section. This task is the starting point for acquiring new knowledge to solve the situational problem.



## EXPLORATION

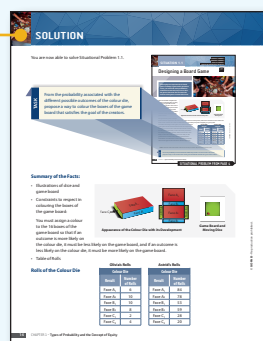
This section invites you to analyze the data of a situational problem, and then to identify the knowledge that you possess and the knowledge you need to acquire in order to perform the task.

The questions posed will guide you toward a problem-solving strategy.



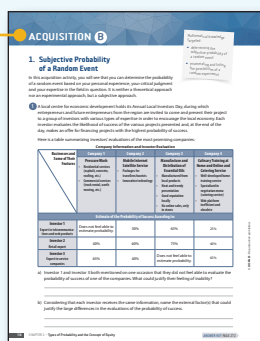
## ACQUISITION A

This is where the knowledge needed to solve the situational problem is assimilated. Each *Acquisition* encourages reflection before presenting new mathematical knowledge.



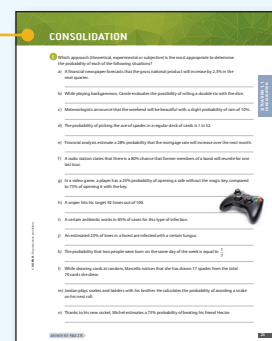
## SOLUTION

By the time you reach this section, you should have acquired all the knowledge and strategies that are essential to solving the situational problem described at the beginning of the situation.



## ACQUISITION B

In this second acquisition, you will acquire new knowledge prescribed by the program linked to the knowledge encountered in *Acquisition A*.



## CONSOLIDATION

This section will allow you to consolidate the mathematical knowledge acquired in *Acquisitions A* and *B*. As in the *Integration* section, this *Consolidation* also contributes to the development of mathematical skills.

## AT THE END OF A CHAPTER...

### KNOWLEDGE SUMMARY

This section summarizes all the knowledge to *Remember* in the form of fill-in-the-blank questions. We invite you to fill in the missing information.

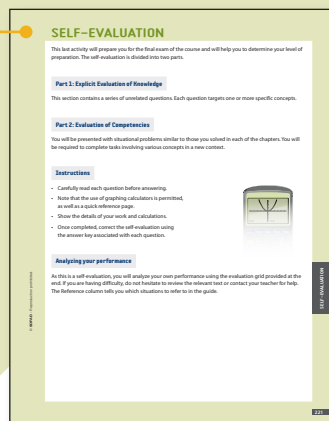
### INTEGRATION

In this section, which includes exercises and complex situations, you will have to apply the knowledge seen in this chapter.

### LES

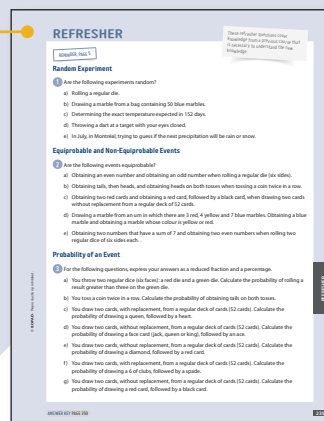
The *LES* is a complex task developed according to the certification evaluation model. It is accompanied by a competency evaluation grid.

# COMPLEMENTS



## SELF-EVALUATION

A *Self-Evaluation* section can be found in the first part of the *Complements* section. It allows you to evaluate your acquired knowledge and the mathematical skills you have developed throughout the course. In this way, you will be able to identify the knowledge that you have mastered and that for which a revision is necessary before moving on to the *Summary Scored Activity*.



## REFRESHER

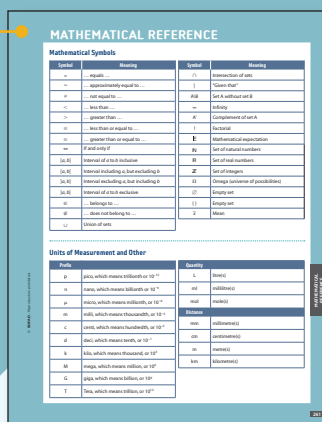
Throughout the *Situations*, you will come across headings entitled *Reminders*. These sections present concepts seen in a previous course that are necessary to understand the new knowledge or to solve the current situation.

The *Refresher* section allows you to use exercises to review the mathematical rules and concepts that are the subject of a *Reminder*.



## KNOWLEDGE SUMMARY

The full version of the *Knowledge Summary* is found in this section. A printable version is also available online.



## MATHEMATICAL REFERENCE

In this section, we present mathematical symbols used in the guide and some abbreviations of units of measurement. Reminders of mathematical formulas are also provided.



## GLOSSARY

Words and expressions **written in blue** in the current text are defined in the *Glossary*.

## ANSWER KEY

Toward the end of the guide, you will find the *Answer Key*. It is designed not only for checking your answers, but also to complement your learning process. It contains the answers to questions and detailed explanations of the approach to be taken or the reasoning to be used.

## EVALUATION GRID

A competency *Evaluation Grid* is available at the end of the guide. After solving an *LES*, you are asked to evaluate yourself using this grid. You can then complete the abbreviated version at the bottom of each *LES*.

## QUICK REFERENCE

You can create your own quick reference guide. A detachable sheet is provided for this purpose at the end of the guide. You may use this quick reference during the final test.

# HEADINGS AND PICTOGRAMS



Invites the student to watch a video clip on the situational problem.

## TASK

From the probability associated with different possible outcomes...

Presents the task to be performed as part of your Situational Problem.

## REMINDER

REFRESHER EXERCISES  
PAGE 235, QUESTIONS 1 TO 5

### Random Experiments

An experiment is said to be **random** if the outcomes are determined by chance.  
This means that...

Refers to knowledge you have acquired in previous courses and refresher exercises related to this *Reminder*.

## REMEMBER

### Probability...

**Experimental probability** is an estimate of the theoretical probability of a random event...

Presents the mathematical knowledge you will be required to master. This is the knowledge prescribed by the study program.

## STRATEGY Extract from...

You can generally extract several pieces of data that do not always appear...

Presents problem-solving strategies that can be applied to a variety of situations.

### DID YOU KNOW?

In basketball, a free throw is awarded by the referee to a player...

Allows you to discover historical and cultural information related to the mathematical concepts being studied.

### TIP

It may be advantageous to represent a fraction by a percentage (or a decimal number) for the purpose of interpreting...

Provides a tip that simplifies the task, or offers a different way of dealing with the problem or of applying the concept being studied.

### CAUTION!

Since the experimental approach is an estimate of the probability of a random event, it is generally said that...

Warns of traps to avoid or exceptions that may apply to the concept being studied.

### ICT

ICT Activity 1.2.1 compares the theoretical calculations of probability and mathematical expectation using an experiment simulator. This activity is...

Prompts you to complete an online activity (GeoGebra or graphing calculator) that will encourage you to explore the concept studied using technological tools.

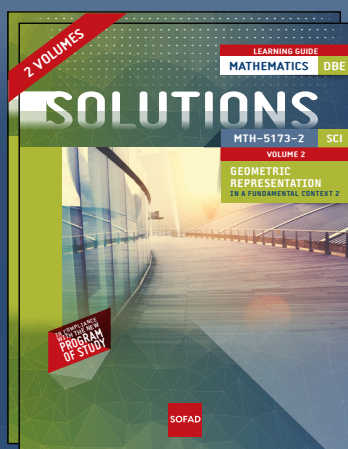
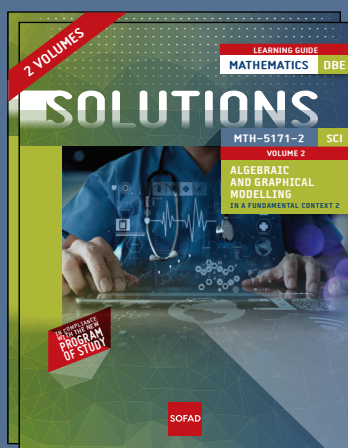
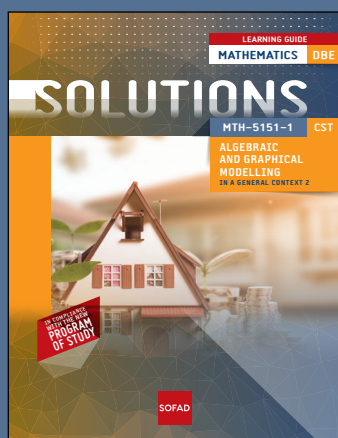
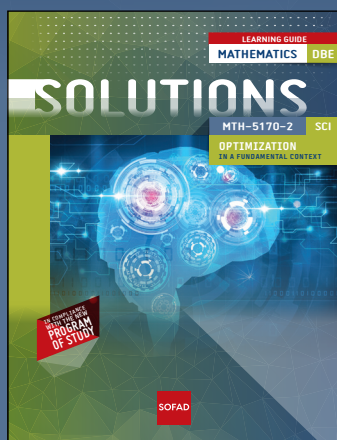
### SCORED ACTIVITY

You must now complete Scored Activity 1 on Chapter 1. Find it at...

Indicates that you are ready to complete the *Scored Activity* designed to assess your comprehension as you learn. The *Summary Scored Activity* is completed at the very end of the course. These activities are presented in separate booklets of the guide. You will have to submit each completed activity to your teacher or tutor who will provide you with feedback following correction.

# SOLUTIONS

The **SOLUTIONS** series covers all the courses in the Diversified Basic Education Program, including the Secondary V *Cultural, Social and Technical (CST)* and *Science (Sci)* options.



**SOFAD**

The **SOLUTIONS** learning approach is based on the acquisition of all the prescribed mathematical knowledge in a problem-solving context. The learning sequence that supports this approach is as follows:

PRESENTATION OF A  
SITUATIONAL PROBLEM

EXPLORATION  
OF PROBLEM

KNOWLEDGE  
ACQUISITION

PROBLEM-SOLVING

CONSOLIDATION  
OF LEARNING

Inductive and deductive questions give meaning to the knowledge and strategies to be acquired. The learning guides offer a multitude of simple exercises and more complex tasks to meet the needs expressed by learners and teachers. Additional resources are also available on [portailsofad.com](http://portailsofad.com).

## Components of the **SOLUTIONS** series:

- Learning guide: print and PDF versions;
- Teaching guide (PDF);
- Videos on situational problems;
- ICT activities: GeoGebra, graphing calculator;
- Scored activities;
- Answer keys.

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