PART A

How to Succeed in Business Mathematics

Are you a “people person” or a “numbers person”? Can you “do math but not word problems”? Do you experience “math anxiety”? Have you “always hated math”? We frequently hear such comments in private discussions about mathematics. The expressions in quotation marks are familiar. The questions do not seem unusual.

Now consider these questions. Are you a “people person” or a “music person”? Can you “do English but not write paragraphs”? Do you experience “biology anxiety”? Have you “always hated history”? These questions seem odd—even ridiculous. So why is it that mathematics is viewed so differently than other subjects? Why will people openly and jokingly admit to being “so bad at math I can’t balance my chequebook”, but be reluctant and embarrassed to admit to spelling poorly or not knowing the meaning of a word? As stereotypes for people talented at mathematics, why do we have stereotypes of the “math nerd” and the “boring accountant” instead of the creative design engineer and the incisive bond trader?

The point of this introduction is to demonstrate that popular attitudes toward mathematics are distorted, biased, and unjustified. Particularly damaging has been the myth that you must be either a “numbers person” or a “people person”, implying that you either have or do not have the “math gene”. Every year this groundless but widely accepted classification causes thousands of high-school students, at the first sign of difficulty with mathematics, to conclude they haven’t got the “right stuff” to do math. Believing their math ability is seriously limited or flawed at the core of their being and genome, many of these students put little effort into their math courses. Consequently, their beliefs are self-fulfilling, and the myth perpetuates as accepted wisdom.

Attitude is crucial to success in any endeavour. In light of the preceding comments, you should be open to the idea that *prevailing biases and myths may have led you to underestimate your abilities and to underachieve in mathematics*. In the following sections, you are also likely to discover many work habits and study skills that you have neglected or violated in the past. If you follow them more faithfully, greater success is assured.

To further brighten your outlook, business mathematics has some particularly appealing characteristics. You will never be left wondering what any topic “is useful for”. Usually, applications will be immediately obvious to you. In any event, you will encounter additional applications to business and finance in the solved example problems, exercises, cases, etc. An

additional bonus is that several of the applications are relevant to your personal financial planning and investing.

TIP ***HOW TO USE "HOW TO SUCCEED"***

You should read the entire contents of this Appendix during the first two weeks of classes. Note points in Sections A.1 and A.2 that have not been part of your work and study habits in the past.

Re-read A.1 and A.2 each week during the subsequent four or five weeks. Old habits, especially bad ones, are hard to break. We need frequent reminders to keep us on a new routine. Also, specific work and study suggestions have greater relevance to some topics than to others. As you progress through more topics in your course, you can bring more good habits into play.

Whenever you begin to prepare for a test or exam, re-read Sections A.3 and A.4.

A.1 Making the Most of Classes

Research has shown a strong correlation between grades and attendance for classroom-centred math courses. In plain language, the fewer classes students miss, the higher their grades tend to be.

There is an old Chinese proverb[1]:

I hear and I forget.
I see and I remember.
I do and I understand.

This proverb recognizes that there are levels of knowing (remembering vs. understanding), and that learning is a multi-sensory process. While the proverb's one-to-one connections over-simplify learning, research shows that we learn more efficiently and more effectively when all of our senses are involved in the learning process. The traditional classroom provides a combination of hearing, speaking, seeing, and doing that advanced educational technologies are now just beginning to emulate. Our multi-sensory participation in multi-faceted classroom instruction raises the correlation between attendance and grades.

The text chosen for your course includes more topics than are covered in any particular course. Your instructor's presentations, comments, and assignments indicate the relative importance of topics chosen for the curriculum in your program. Invariably, there is too little time to thoroughly cover all course topics in class. Your instructor will tend to use class time for the more difficult and the more important material, and for program-specific applications and activities.

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[1] Why aren't there any *new* Chinese proverbs?

The following points will help you get the most from your classes.

∉# **Be an *active* learner.** Your goal should be to employ as many learning inputs (hearing, seeing, doing) as possible. The least learning occurs when you passively copy whatever the instructor puts on the blackboard or projection screen. Have you noticed it is possible to do this while your mind is completely occupied by other thoughts? When this happens, your sensory inputs are disconnected from your brain and no learning takes place.

There are steps you can take to keep all sensory inputs active and engaged with your brain. In your lecture notes, add your own explanatory comments to whatever your instructor may write on the board. This forces you to concentrate on the instructor's presentation—you must understand each step of the presentation in order to write supplemental notes. If you do not have enough time to write a full comment, jot down a couple words that will later remind you of the full thought. (Develop abbreviations for frequently used terms.) If you realize you do not understand a step, ask a question on the spot, or write a question mark in the margin to remind you to clarify the point later.

When your instructor poses a question, try to answer it in your mind before another student or the instructor reveals the answer. Privately evaluate other students' answers. As your instructor develops a line of reasoning or a solution to a problem, try to anticipate the next step.

Catch yourself whenever your mind wanders from the instructor's presentation. Whenever it happens, make a tick mark on the corner of your page as a symbolic penalty. You will find that the frequency of your infractions will decrease over time.

∉# **Math is more than computations.** When an instructor develops the solution to a word problem, students tend to misdirect their focus and energy. *The heart of the solution is actually the idea, concept, relationship, or principal* that connects the unknown quantity to the given data. Once the "solution idea" is identified, the remaining steps usually involve only basic algebraic manipulations and computations. These are mechanical procedures that you have learned in the past. Yet students' tendency is to wait passively for the solution to reach the point where they can begin crunching numbers with their calculators.

You should *focus your greatest effort upon identifying the solution idea.* Even if you do not come up with the idea, your brief mental struggle makes the revelation of the solution idea more meaningful and memorable. Then, before you become occupied with verifying the instructor's calculations, give some thought to why you did not think of the solution idea. Was there some gap in your understanding? Are you now clear about the basis for the solution idea? Could you explain the solution idea to a classmate who is absent today? If not,

what question do you need to be answered? Should you ask it right now before the instructor finishes the solution? (Chances are that many of your classmates either have the same question, or would have the same question if they also used your active thought process.)

- **Watch for and note "signals" from your instructor.** An instructor will usually give some sort of verbal indication when a topic or a concept or a type of problem is particularly important. Note such signals in your lecture notes.
- **During class, don't ask the person seated next to you.** When a question arises in your mind, there is a strong temptation to ask your neighbour. (You may be hesitant to interrupt the class with what you fear might be a "dumb question".) If you do ask your neighbour, it is unlikely you will get a satisfactory answer. More often than not, your neighbour either doesn't know the answer, or he will not be able to quietly convey the information to you amidst the background noise of the classroom. But three negative consequences are certain. You will miss the ongoing instruction while asking the question and trying to hear the answer. The person next to you also misses the ongoing instruction. And finally, both of you contribute to a distracting background "buzz" in the classroom. If you think about it, it is an inconsiderate act to distract a classmate from the ongoing instruction in order to deal with your question in an awkward setting. It is only because the act is so commonplace that we tend to judge it less harshly.

A.2 Between Classes

To a greater degree than other subjects, mathematics is cumulative. The concepts in today's class are likely to be built upon in the next class. Therefore, you must gain an understanding of today's new material before you can expect to fully understand the content of the next class. Success in mathematics requires a systematic approach and timely action. Perhaps this is why some people give mathematics a "bad rap". Mathematics is less forgiving (than several other areas of study) of a casual haphazard approach to learning.

Using Your Textbook

Your textbook enables you to fill in details of the conceptual framework presented in class. It provides additional worked examples and other features that connect theory to the real world.

- **Review your class notes.** As soon as possible after your math class, go over your lecture notes. Complete unfinished thoughts and add comments that will make the notes clear when you read them several weeks later. These brief comments also serve as cues that will trigger recollections of the classroom discussion about the topic.

- **Read relevant sections in your textbook.** Your instructor or your course outline will usually indicate the sections in the text that augment each lecture or topic. After each class, you should study these sections.
- **Be an *active* reader. N**ote headings and sub-headings in the text. Based upon the heading, think of questions the subsequent discussion should answer.

  Be quick to catch your mind if it wanders. Psychologists have found that taking an overt action when your mind strays helps restore focus, and delays the next loss of concentration. Give yourself a symbolic penalty stroke on a scorecard. Your penalty count will diminish over time.
- **Commit definitions to memory.** When a new term is first introduced, it usually appears in bold type in the sentence that defines it. Definitions become part of the language of a subject. You must know exactly what each term means in order to fully comprehend subsequent discussions, problem solutions, etc. For example, if you are not clear on the precise meaning in golf of driver, birdie, slice, green, etc., commentary or instruction on golfing will be confusing. Once a term is defined in business math, subsequent discussions assume you know the precise meaning of the term. You will not fully understand these discussions if do not know the definitions of the terms employed. Therefore, when you first encounter a definition, you must commit it to memory. You can phrase the definition in your own words as long as you capture the full meaning.
- **Highlighting helps.** Highlighting selected content can provide two benefits. Core content and key ideas can be highlighted, enabling you to focus subsequent review on these areas only. In addition, the process of distinguishing core content from secondary or peripheral material makes you think actively about the content.
- **Challenge yourself on example problems.** When the text presents an example problem, pause after reading the statement of the problem. Hide the solution while you try to think of an idea, concept, or relationship that can form the basis for a solution. Usually the possibilities are quite limited since the example problem will invariably illustrate some aspect of the section's content.
- **Write down lingering questions.** If you do not understand a step in the text, in the margin write the question you would ask your instructor if she were present. It frequently happens that the answer occurs to you when you clearly articulate the question. If this does not happen, you have recorded the question as a reminder to ask a classmate or your instructor.

Assignments and Homework

Would you expect to learn how to hit a golf ball properly by watching a Tiger Woods' instruction video? Of course not. No matter how good the instruction, there always seems to be some unexpected glitches and surprises when we try something on our own.

Mathematics is no different. It is one thing for you to *follow* the steps in someone else's solution—it is quite another matter to *create* the solution yourself. There is no substitute for "doing*"* math. (Recall the "I do and I understand" part of the Chinese proverb.) By doing problems, you discover gaps in your understanding. The most valuable and enduring form of learning comes when you run "head-on" into a difficulty, and then clear up the misunderstanding or deficiency that caused it. Always remember, you learn more from a problem you have some difficulty with than from a problem you solve with ease.

Solving Word Problems

A general five-step approach for solving word problems is described in Section 2.4 of the text. We will not repeat it here, but will offer the following additional suggestions.

- **Be fearless!** Try ideas for a solving a problem as fearlessly as you experiment with new computer software. (After all, you cannot delete anything inadvertently, nothing will crash, you can't catch a virus, and there are no fatal errors!) Draw diagrams (in Step 2 of the text's problem-solving procedure) as fearlessly as when you play Pictionary. Be fearless about asking questions to your instructor and classmates in order to clear up difficulties you encounter in assigned problems.
- **Explain the steps and reasoning in your solutions.** *Detail* is what distinguishes a solution from an answer. A solution presents the problem-solving *process*. You should include brief verbal statements indicating your solution idea and the reasoning behind subsequent steps. The process of composing these statements helps you clarify and organize your thinking. Later, when preparing for a test or an exam, the brief explanations help you quickly review the solution.
- **Keep unsuccessful solution attempts.** It may help release frustration if you crush a failed solution attempt into a tiny ball and fire it across the room in the general direction of the wastebasket. But you have then thrown away valuable information that would help your instructor or a fellow student quickly "home in" on your sticking point, and diagnose your flawed reasoning.

- **Flag points of difficulty for special attention later when you prepare for an exam.** As you solve problems, flag points in the solutions where you have difficulty. Review these points when you prepare for a test or an exam.

Working in Groups

Participation in a workgroup can be beneficial, but the functioning of the group can easily become sub-optimal. Here are lists of some potential weaknesses and strengths.

Potential Weaknesses:

- The group's "math whiz" may reveal a problem's solution idea before others have had enough time to think about the solution.
- Knowing that the "math whiz" will likely "figure out" a difficult part, others in the group may have a sub-conscious tendency not to challenge themselves to the degree they would if working alone.
- One or two mathematically talented students can end up driving the agenda and the pace. Other students may develop a false sense of "understanding everything" because they can "follow" the solutions to the assigned problems.
- Everyone's cooperation is required to keep the group focussed, but it takes just one person to distract the group.

Potential Strengths:

- A workgroup can be an effective arrangement for *promptly* resolving difficulties and clearing up misunderstandings.
- The learning process is strengthened when students verbalize their questions and thinking.
- Team effort and mutual support can boost individual morale, and make learning more enjoyable.

So how can you and your workgroup realize the strengths while avoiding potential weaknesses?

- **Establish ground rules.** If the group just gathers and evolves haphazardly, the weaknesses are likely to dominate the strengths. The rules should include the following items.
- **Meet to deal with difficulties encountered while working alone.** Working alone, you should read assigned sections of the text and then attempt assigned problems. This allows you to work at your own pace without distractions. You can determine exactly where you do not understand the exposition in the text, or where you get "bogged down" in solving a problem. In each instance, write down the question you need to have answered. Take your questions and partial solutions to the group meeting.

- **Deal with difficulties in a logical sequence.** The group should first deal with questions arising from the preceding lecture(s), then with questions from the assigned reading in the text, and finally with assigned problems.
- **Share problem-solving ideas, not problem solutions.** You should be seeking the hint or "push" you need to get going again on an unfinished solution. Your learning is better served if a classmate assists you by working with *your* partial solution. (If you simply look at her completed solution, you may end up duplicating her ideas rather than understanding them.) In order for you to carry out verbally communicated ideas and instructions, you must come to a deeper understanding than is required simply to follow the steps laid out in a completed solution. Use another student's full solution only to find a mechanical or arithmetic error.

Using a Solutions Manual

When you are working on a problem whose full solution is presented in the Student Solutions Manual, there is a strong temptation to peek at the solution the moment you stall in your effort. But you should resist the temptation, and continue to struggle for another 5 to 10 minutes. If you come up with the "break-through", you gain confidence and reinforce your learning. If you don't succeed, but end up looking at the published solution for a vital clue, your effort still produces a benefit. The benefit derives from how effective learning occurs. *Learning is more effective and enduring when information is received in a rich or significant context*—for example, when the information enables you to resolve or eliminate a difficult predicament. The same information received in an unimportant or unfamiliar context make less impression upon you, and will be forgotten sooner.

Getting Help From Your Instructor

The end-of-class scrum is not a good environment for receiving assistance. Use the instructor's scheduled office hours, or arrange an appointment if your schedule conflicts with the office hours.

- **Prepare a list of your questions.** This should be a simple matter of collecting together various questions you wrote down while reviewing your notes, reading your text, or attempting problems. Without the list, you are likely to forget details of the scenario surrounding some questions. The list also helps if you are a bit nervous (and your organized approach will impress your instructor "big time"!)
- **Take partial solutions with you.** It is difficult for the instructor to know where to begin if a student says: "I can't do Problem 23." (Some instructors may be inclined not to deal with such undefined questions.) At the very least, you can complete Steps 1 and 2 of the problem-

solving procedure presented in Section 2.4. Your partial solution enables the instructor to quickly spot the point at which you "bogged down", and to diagnose the probable cause of your difficulty.

A.3 Preparing for Tests and Exams

The best way to avoid exam anxiety is to be well prepared. If you have followed the suggestions in Sections A.1 and A.2, you are well positioned for efficient and effective exam preparation. Keeping current in your study, highlighting core content in your text, doing all assigned problems, flagging points at which you had difficulty understanding concepts or solving problems, and seeking timely assistance with these difficulties—these practices will now deliver further benefits. You begin your preparation with no major gaps in your understanding. Exam preparation becomes a process of refreshing and fine-tuning your comprehension. We suggest the following sequence.

- **Review your lecture notes.** Pay particular attention to the difficult points you flagged when you first encountered the material. When you review example problems that were presented in class, first hide the solution and spend a minute trying to come up with the solution idea. Note any instructor "signals" you have recorded—they provide indications of topics or types of problems that are more likely than others to appear on the test or exam.
- **Review relevant sections of the text.** Depending on the time available, you may choose either to review all the content, or only the content you highlighted in the past. As in your review of lecture notes, give particular attention to flagged points. Make an effort to write down the solution idea for each example problem before you read the text's solution. After you review a chapter, go over the problems that were assigned from the chapter. Again, challenge yourself to think of the solution idea (or even sketch out a more complete solution) before your read your original solution.
- **Practise new problems.** The ideal final step in your preparation is to work through an old test or exam (covering the same range of topics.) Otherwise, select problems from the Review Problems and Self-Test Exercise at the end of each chapter.
- **Participating in a study group.** If you belong to a workgroup, the members may also decide to get together for exam preparation. It requires more forethought to make a study group effective than it does to make a workgroup function well. Try to avoid a scenario where any individual can raise a question at any time. A preferable arrangement is for members to study a chapter on their own for 45 minutes or an hour, and then gather for 15

minutes to deal with any questions concerning that chapter. Then repeat the process for the next chapter.

- **Psychological preparation.** Good work habits on a day-to-day basis plus solid preparation for an exam are the best measures to put you in a positive frame of mind. In contrast, if you enter an examination after a night of cramming, knowing that there are still big gaps in your comprehension—that's a recipe for anxiety, mind-block, and panic.

  While waiting to enter the exam room, don't discuss course content or speculate with your classmates about exam questions. Someone may mention an obscure point you have overlooked, causing you to fret about it when it's too late to do anything about it. Instead, discuss non-academic matters to help you relax before the exam.

  Surprises during an exam have the potential to "rattle" you. You should approach the exam expecting the unexpected. Expect to find one or two unanticipated problems on the exam. Expect to be under time pressure. Expect that someone sitting near you will have some sort of annoying behaviour—sniffling, punching calculator keys noisily, sighing, pencil tapping, etc. Expect that one or two classmates will play "head games" (such as asking for another exam book 30 minutes into the exam, or conspicuously finishing the exam mid-way through the exam period.)

A.4 Writing Tests and Exams

- **Budget your time.** Divide the length of the exam period (in minutes) by the maximum total marks for the exam. This gives the average number of minutes you have available per mark. For example, if a two-hour exam has a total of 100 marks, you should budget 1.2 minutes per mark. Therefore, 12 minutes should be budgeted for a 10-mark question. When you start a question, write the start time and the time allotment next to it.
- **Start with an easy question.** There is wide consensus on this principle because it helps you "get rolling", settle jittery nerves, and gain confidence before you struggle with a difficult question. However, there is disagreement on how you should go about identifying the easy question(s). The majority view appears to be that you should first read the entire exam to assess the degree of difficulty of each question. It seems to us this approach has two disadvantages. The time required for you to read the exam is likely to be about 5% of the exam period—this is a significant sacrifice if time pressure is going to be a factor. Of greater concern to us is the possibility that the following may happen. During the quick overview, you become concerned that you have no idea how to solve two or three of the problems.

Some students have difficulty getting such concerns out of their mind while they work on easier questions.

Our suggestion is to use other clues to select the easier or more straightforward questions. If a question asks you to define or explain terms, start with it. Generally speaking, an easier question is stated in fewer words and is worth fewer marks than a difficult question. Instructors will usually structure an exam by organizing questions approximately in order of increasing difficulty. (It strikes us as a fair question to ask your instructor, well before your first test, if her tests and exams follow this pattern.)

∉# **Give brief descriptions of the steps in solutions.** A simple slip in your calculations—the proverbial "stupid mistake"—will cause your answer to be incorrect. Nevertheless, if you clearly present a correct procedure, you will likely earn the majority of the marks for the problem. On the other hand, if you provide only sketchy calculations yielding numbers that do not fit the solution, you are unlikely to receive any marks (even though your overall approach may be sound.)

∉# **Know when to hold 'em, know when to fold 'em.** If you do not finish a problem in its budgeted time, one of the following situations applies to you.

1. You cannot get "untracked"—you are still searching for a solution idea.
2. You are on the wrong track and don't know it.
3. You are on the right track—you have the correct solution idea but you are still working on the computations.

In the first case, there is no point consuming more scarce time on the problem. If the solution idea has eluded you during the budgeted time, you are unlikely to come up with it in the next five or ten minutes.

You may not be able to distinguish case (2) from case (3). But even in case (3), it is usually best to move on to another problem, unless you are within a minute of finishing your computations. Here is the reasoning. The first half of the full solution is usually worth two-thirds or three-quarters of the problem's marks. The rationale for this allocation is that the first half of a solution usually demonstrates whether you know *what* concept or principle applies to the problem, and whether you know *how* to adapt the concept or principle to the particular problem. In terms of both the time required and the written solution, most of the second half of a solution consists of algebraic manipulations and computations at a grade 11 or lower level. Correct performance of these basic skills does not warrant half of the marks allocated to the problem.

In conclusion, your scarce time on an exam is more productively employed in setting up a solution than in finishing its mechanical computations. Therefore, even in case (3) you should move on to another question when the budgeted time expires.

If you complete some problems in less than the budgeted time, use the “saved” time near the end of the exam first to finish calculations in case (3) solutions, and then to work on case (1) solutions. Finally, use any remaining time to check your solutions for mechanical errors (commonly known as “stupid mistakes”.)