英文版

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Mathematics for Economics and Business

Fifth Edition

Ian Jacques

商务与经济数学

（英）伊恩·雅克 著

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图书在版编目（CIP）数据

商务与经济数学 /（英）雅克（Jacques，I.）著．—影印本．—大连：东北财经大学出版社，2008.9
（高等院校双语教学适用教材）
书名原文：Mathematics for Economics and Business
ISBN 978-7-81122-477-1

Ⅰ．商… Ⅱ．雅… Ⅲ．经济数学—双语教学—高等学校—教材—英文 Ⅳ．F224.0

中国版本图书馆 CIP 数据核字（2008）第 142907 号

辽宁省版权局著作权合同登记号：图字 06-2008-22 号

东北财经大学出版社出版
（大连市黑石礁尖山街 217 号 邮政编码 116025）
总 编 室：（0411）84710523
营 销 部：（0411）84710711
网 址：http://www.dufep.cn
读者信箱：dufep@dufe.edu.cn
大连图腾彩色印刷有限公司印刷 东北财经大学出版社发行

幅面尺寸：210mm×270mm 印张：37 3/4 插页：1
2008 年 9 月第 1 版 2008 年 9 月第 1 次印刷

责任编辑：孙冰洁 封面设计：冀贵收

ISBN 978-7-81122-477-1
定价：68.00 元

出版者的话

当前，在教育部的大力倡导下，财经和管理类专业的双语教学在我国各大高校已经逐步开展起来。一些双语教学开展较早的院校积累了丰富的经验，同时也发现了教学过程中存在的一些问题，尤其对教材提出了更高的要求；一些尚未进入这一领域的院校，也在不断探索适于自身的教学方式和方法以及适用的教材，以期时机成熟时加入双语教学的行列。总之，对各类院校而言，能否找到“适用”的教材都成为双语教学成功与否的关键因素之一。

然而，国外原版教材为国外教学量身定做的一些特点，如普遍篇幅较大、侧重于描述性讲解、辅助材料（如习题、案例、延伸阅读材料等）繁杂，尤其是许多内容针对性太强，与所在国的法律结构和经济、文化背景结合过于紧密等，显然不适于国内教学采用，并成为制约国内双语教学开展的重要原因。因此，对国外原版教材进行本土化的精简改编，使之变成更加“适用”的双语教材，已然迫在眉睫。

东北财经大学出版社作为国内较早涉足引进版教材的一家专业出版社，秉承自己一贯服务于财经教学的宗旨，总结自身多年的出版经验，同培生教育出版集团和汤姆森学习出版集团等国外著名出版公司通力合作，在国内再次领先推出了会计、工商管理、经济学等专业的“高等院校双语教学适用教材”。这套丛书的出版经过了长时间的酝酿和筛选，编选人员本着“品质优先、首推名作”的选题原则，既考虑了目前我国财经教育的现状，也考虑了我国财经高等教育所具有的学科特点和需求指向，在教材的遴选、改编和出版上突出了以下一些特点：

- 优选权威的最新版本。入选改编的教材是在国际上多次再版的经典之作的最新版本，其中有些教材的以前版本已在国内部分高校中进行了试用，获得了一致的好评。
- 改编后的教材在保持英文原版教材特色的基础上，力求内容精要，逻辑严密，适合中国的双语教学。选择的改编人员既熟悉原版教材内容，又具有本书或本门课程双语教学的经验。
- 改编后的教材配有丰富的辅助教学支持资源，教师可在网上免费获取。
- 改编后的教材篇幅合理，符合国内教学的课时要求，价格相对较低。

本套教材是在双语教学教材出版方面的一次新的尝试。我们在选书、改编及出版的过程中得到了国内许多高校的专家、教师的支持和指导，在此深表谢意，也期待广大读者提出宝贵的意见和建议。

尽管我们在改编的过程中已加以注意，但由于各教材的作者所处的政治、经济和文化背景不同，书中的内容仍可能有不妥之处，望读者在阅读中注意比较和甄别。

东北财经大学出版社

导　读

本书是一本商务与经济数学的基础教材。它主要面向经济学、工商管理专业的低年级本科生。本书的语言浅显易懂，内容深入浅出，书中含有大量的例题。使用本书的读者即使此前没有参加过任何大学数学的课程，也可轻松读懂本书。此外，为了使读者能够进行自我测试，本书的每一部分都设有大量的课后练习题。因此，本书也可以作为一本自学教材。本书涉猎广泛，从最基础的数学知识，如百分比和线性方程，到较为复杂的数学问题，如多变量函数的有约束优化问题，均有所涉及。因此，本书既可以用于低层次的数量方法课程，也可用于高层次的数量方法课程。

本书自1991年第一版问世以来，至今已更新至第五版，不仅栏目设置越来越灵活多样，而且内容也更加符合当今的教学需要以及读者的自学要求，这也使得本书不像传统的数学教科书那样枯燥，对读者更具吸引力，从而部分减轻了读者对学习数学的恐惧心理。

本书的主要特点如下：

· 书中含有大量的应用性问题和实际问题，这些问题使得读者能够从商务与经济学的角度来认识数学，将数学作为一种工具来分析现实生活中的商务与经济学问题。

· 教师可根据教学需要自由地设定授课的节奏。

· 书后特附一张光盘，光盘中有课后练习题的答案以及详细的解答。

· 本书简单介绍了Excel软件和Maple软件的应用。

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Introduction

Getting Started

Notes for students: how to use this book

I am always amazed by the mix of students on first-year economics courses. Some have not acquired any mathematical knowledge beyond elementary algebra (and even that can be of a rather dubious nature), some have never studied economics before in their lives, while others have passed preliminary courses in both. Whatever category you are in, I hope that you will find this book of value. The chapters covering algebraic manipulation, simple calculus, finance and matrices should also benefit students on business studies and accountancy courses.

The first few chapters are aimed at complete beginners and students who have not taken mathematics courses for some time. I would like to think that these students once enjoyed mathematics and had every intention of continuing their studies in this area, but somehow never found the time to fit it into an already overcrowded academic timetable. However, I suspect that the reality is rather different. Possibly they hated the subject, could not understand it and dropped it at the earliest opportunity. If you find yourself in this position, you are probably horrified to discover that you must embark on a quantitative methods course with an examination looming on the horizon. However, there is no need to worry. My experience is that every student, no matter how innumerate, is capable of passing a mathematics examination. All that is required is a commitment to study and a willingness to suspend any prejudices about the subject gained at school. The fact that you have bothered to buy this book at all suggests that you are prepared to do both.

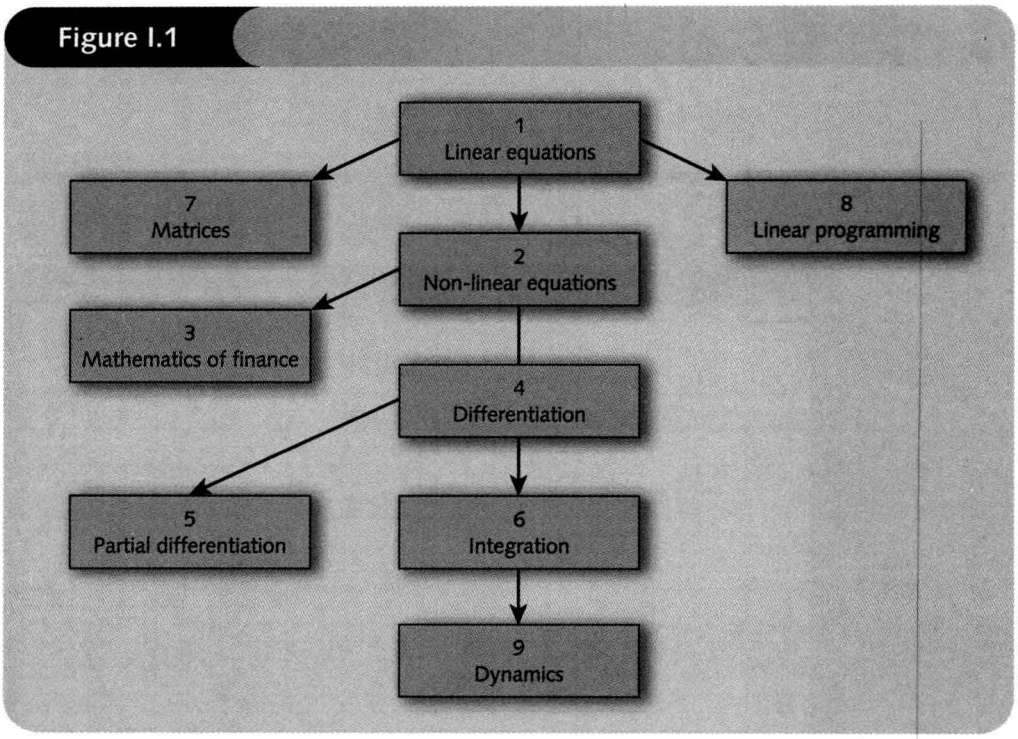
To help you get the most out of this book, let me compare the working practices of economics and engineering students. The former rarely read individual books in any great depth. They tend to visit college libraries (usually several days after an essay was due to be handed in) and to skim through a large number of books picking out the relevant information. Indeed, the ability to read selectively and

to compare various sources of information is an important skill that all arts and social science students must acquire. Engineering students, on the other hand, are more likely to read just a few books in any one year. They read each of these from cover to cover and attempt virtually every problem *en route*. Even though you are most definitely not an engineer, it is the engineering approach that you need to adopt while studying mathematics. There are several reasons for this. Firstly, a mathematics book can never be described, even by its most ardent admirers, as a good bedtime read. It can take an hour or two of concentrated effort to understand just a few pages of a mathematics text. You are therefore recommended to work through this book systematically in short bursts rather than to attempt to read whole chapters. Each section is designed to take between one and two hours to complete and this is quite sufficient for a single session. Secondly, mathematics is a hierarchical subject in which one topic follows on from the next. A construction firm building an office block is hardly likely to erect the fiftieth storey without making sure that the intermediate floors and foundations are securely in place. Likewise, you cannot 'dip' into the middle of a mathematics book and expect to follow it unless you have satisfied the prerequisites for that topic. Finally, you actually need to do mathematics yourself before you can understand it. No matter how wonderful your lecturer is, and no matter how many problems are discussed in class, it is only by solving problems yourself that you are ever going to become confident in using and applying mathematical techniques. For this reason, several problems are interspersed within the text and you are encouraged to tackle these as you go along. You will require writing paper, graph paper, pens and a calculator for this. There is no need to buy an expensive calculator unless you are feeling particularly wealthy at the moment. A bottom-of-the-range **scientific** calculator should be good enough. Detailed solutions are provided at the end of this book so that you can check your answers. However, please avoid the temptation to look at them until you have made an honest attempt at each one. Remember that in the future you may well have to sit down in an uncomfortable chair, in front of a blank sheet of paper, and be expected to produce solutions to examination questions of a similar type.

At the end of each section there are some further practice problems to try. You may prefer not to bother with these and to work through them later as part of your revision. Ironically, it is those students who really ought to try more problems who are most likely to miss them out. Human psychology is such that, if students do not at first succeed in solving problems, they are then deterred from trying additional problems. However, it is precisely these people who need more practice.

The chapter dependence is shown in Figure I.1. If you have studied some advanced mathematics before then you will discover that parts of Chapters 1, 2 and 4 are familiar. However, you may find that the sections on economics applications contain new material. You are best advised to test yourself by attempting a selection of problems in each section to see if you need to read through it as part of a refresher course. Economics students in a desperate hurry to experience the delights of calculus can miss out Chapter 3 without any loss of continuity and move straight on to Chapter 4. The mathematics of finance is probably more relevant to business and accountancy students, although you can always read it later if it is part of your economics syllabus.

Figure I.1



I hope that this book helps you to succeed in your mathematics course. You never know, you might even enjoy it. Remember to wear your engineer's hat while reading the book. I have done my best to make the material as accessible as possible. The rest is up to you!

Getting started with Excel

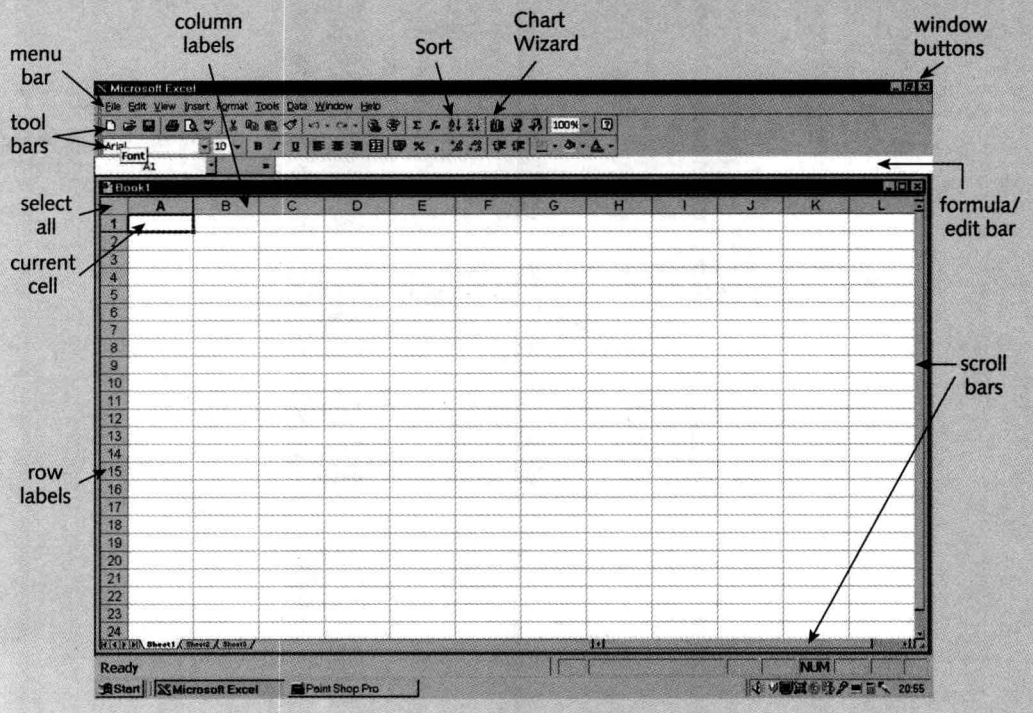
Excel is the Microsoft® spreadsheet package that we shall be using in some of our worked examples. If you are already familiar with this product, you may be able to skip some, or all, of this introductory section.

A spreadsheet is simply an array of boxes, or cells, into which tables of data can be inserted. This can consist of normal text, numerical data or a formula, which instructs the spreadsheet package to perform a calculation. The joy about getting the spreadsheet to perform the calculation is that it not only saves us some effort, but also detects any subsequent changes we make to the table, and recalculates its values automatically without waiting to be asked.

To get the most out of this section, it is advisable to work through it on your own computer, as there is no substitute for having a go. When you enter the Excel package, either by double-clicking the icon on your desktop, or by selecting it from the list of programs, a blank worksheet will be displayed, as shown in Figure I.2 (overleaf).

Each cell is identified uniquely by its column and row label. The current cell is where the cursor is positioned. In Figure I.2, the cursor is in the top left-hand corner: the cell is highlighted, and it can be identified as cell A1.

Figure I.2



Example

EXCEL

A shop audits its toy department to see how much profit it makes from sales of its five best-selling lines. Table I.1 shows the wholesale price (which is the cost to the shop of buying the toy from the manufacturer), the retail price (which is the price that customers pay for each toy), and sales (which is the total number of toys of each type that are sold during the year).

(a) Enter the information in this table into a blank spreadsheet, with the title, Annual Profit, in the first row.

(b) In a fifth column, calculate the annual profit generated by each toy and hence find the total profit made from all five toys.

(c) Format and print the completed spreadsheet.

Table I.1

Item	Wholesale price ($)	Retail price ($)	Sales
Badminton racket	28	58	236
Doll	36	85	785
Silly Putty	1	2	472
Paddling pool	56	220	208
Building bricks	8	26	582

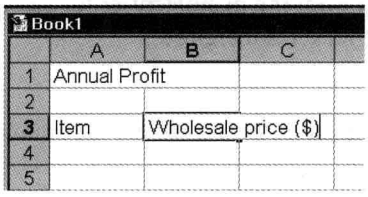
Solution

(a) Entering the data

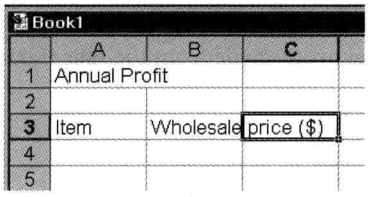
You can move between the different cells on the spreadsheet using the tab keys or arrow keys, or by positioning the cursor in the required cell and clicking the left mouse button. Have a go at this on your blank sheet to get the feel of it before we begin to enter the data.

To give the spreadsheet a title, we position the cursor in cell A1, and type Annual Profit. Don't worry that the text has run into the next cell. This does not matter, as we are not going to put anything more in this row.

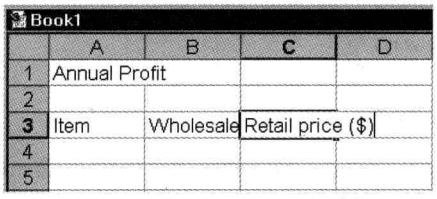
Leaving the next row blank, we type in the column headings for the spreadsheet in row 3. To do this, we position the cursor in cell A3 and type Item; we then move the cursor to cell B3, and type Wholesale price ($). At this stage, the spreadsheet looks like:



This text has also run into the next cell. Although it looks as if we are positioned in C3 now, we are actually still in B3, as shown by the highlighting. The cursor can be positioned in cell C3 by using the tab, or right arrow key to give:

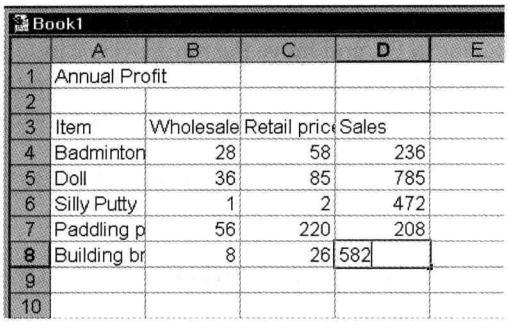


Notice that the next cell is highlighted, even though it still contains our previous typing. We can ignore this, and enter Retail price ($). As soon as you start entering this, the previous typing disappears. It is actually still there, but hidden from view as its own cell is not large enough to show all of its contents:



There is no need to worry about the hidden typing. We will sort this out when we format our spreadsheet in part (c). Finally, we position the cursor in cell D3 and type in the heading Sales.

We can now enter the names of the five items in cells A4 to A8, together with the prices and sales in columns B, C and D to create the spreadsheet:



➔

If you subsequently return to modify the contents of any particular cell, you will find that when you start typing, the original contents of the cell are deleted, and replaced. If you simply want to amend, rather than replace the text, highlight the relevant cell, and then position the cursor at the required position in the original text, *which is displayed on the edit bar.* You can then edit the text as normal.

(b) Calculating profit

In order to create a fifth column containing the profits, we first type the heading Profit in cell E3. Excel is capable of performing calculations and entering the results in particular cells. This is achieved by typing mathematical formulae into these cells. In this case, we need to enter an appropriate formula for profit in cells E4 to E8.

The profit made on each item is the difference between the wholesale price and retail price. For example, the shop buys a badminton racket from the manufacturer for \$28 and sells it to the customers at \$58. The profit made on the sale of a single racket is therefore

$$58 - 28 = 30$$

During the year the shop sells 236 badminton rackets, so the annual profit is

$$30 \times 236 = 7080$$

In other words, the profit on the sale of badminton rackets is worked out from

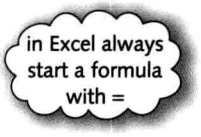
$$(58 - 28) \times 236$$

Looking carefully at the spreadsheet, notice that the numbers 58, 28 and 236 are contained in cells C4, B4 and D4, respectively. Hence annual profit made from the sale of badminton rackets is given by the formula

```
(C4-B4)*D4
```

We would like the result of this calculation to appear underneath the heading Profit, in column 5, so in cell E4 we type

```
=(C4-B4)*D4
```



If you move the cursor down to cell E5, you will notice that the formula has disappeared, and the answer, 7080, has appeared in its place. To get back to the formula, click on cell E4, and the formula is displayed in the formula bar, where it can be edited if necessary.

We would like a similar formula to be entered into every cell in column E, to work out the profit generated by each type of toy. To avoid having to re-enter a similar formula for every cell, it is possible to replicate the one we just put into E4 down the whole column. The spreadsheet will automatically change the cell identities as we go.

To do this, position the cursor in E4, and move the mouse very carefully towards the bottom right-hand corner of the *cell* until the cursor changes from a ✞ to a ✚. Hold down the left mouse button and drag the cell down the column to E8. When the mouse button is released, the values of the profit will appear in the relevant cells.

To put the total profit into cell E9, we need to sum up cells E4 to E8. This can be done by typing

```
=SUM(E4:E8)
```

into E9. Pressing the Enter key will then display the answer, 90 605, in this position.

The spreadsheet is displayed in Figure I.3.

Figure I.3

Book1

	A	B	C	D	E	F
1	Annual Profit					
2						
3	Item	Wholesale	Retail pric	Sales	Profit	
4	Badminton	28	58	236	7080	
5	Doll	36	85	785	38465	
6	Silly Putty	1	2	472	472	
7	Paddling p	56	220	208	34112	
8	Building br	8	26	582	10476	
9					90605	
10						
11						
12						

(c) Formatting and printing the spreadsheet

Before we can print the spreadsheet we need to format it, to make it look more attractive to read. In particular, we must alter the column widths to reveal the partially hidden headings. If necessary, we can also insert or delete rows and columns. Perhaps the most useful function is the Undo, which reverses the previous action. If you do something wrong and want to go back a stage, simply click on the ↶ button, which is located towards the middle of the toolbar.

Here is a list of four useful activities that we can easily perform to tidy up the spreadsheet.

Adjusting the column widths to fit the data

Excel can automatically adjust the width of each column to reveal the hidden typing. You can either select an individual column by clicking on its label, or select all the columns at once by clicking the Select All button in the top left-hand corner (see Figure I.2 earlier). From the menu bar we then select **Format: Column: Autofit Selection.** The text that was obscured, because it was too long to fit into the cells, will now be displayed.

Shading and borders

Although the spreadsheet appears to have gridlines around each of the cells, these will not appear on the final printout unless we explicitly instruct Excel to do so. This can be done by highlighting the cells A3 to E8 by first clicking on cell A3, and then with the left mouse button held down, dragging the cursor across the table until all the cells are highlighted. We then release the mouse button, and select **Format: Cells** via the menu bar. Click on the **Border** tab, choose a style, and click on the boxes so that each cell is surrounded on all four sides by gridlines.

Sorting data into alphabetical order

It is sometimes desirable to list items in alphabetical order. To do this, highlight cells A4 to E8, by clicking and dragging, and then click the A → Z button on the toolbar.

Printing the spreadsheet

Before printing a spreadsheet, it is a good idea to select **File: Print Preview** from the menu bar to give you some idea of what it will look like. To change the orientation of the paper, select **File: Page Setup.** Additional

➔

Figure I.4

Annual Profit

Item	Wholesale price ($)	Retail price ($)	Sales	Profit
Badminton racket	28	58	236	7080
Building bricks	8	26	582	10476
Doll	36	85	785	38465
Paddling pool	56	220	208	34112
Silly Putty	1	2	472	472
			Total:	90605

features can be introduced such as headers, footers, column headings repeated at the top of every page, and so on. You might like to experiment with some of these to discover their effect. When you are happy, either click on the Print button, or select **File: Print** from the menu bar.

The final printout is shown in Figure I.4. As you can see, we have chosen to type in the text Total: in cell D9 and have also put gridlines around cells D9 and E9, for clarity.

Practice Problem — EXCEL

1 An economics examination paper is in two sections. Section A is multiple choice and marked out of 40, whereas Section B consists of essay questions and is marked out of 60. Table I.2 shows the marks awarded in each section to six candidates.

Table I.2

Candidate	Section A mark	Section B mark
Fofaria	20	17
Bull	38	12
Eoin	34	38
Arefin	40	52
Cantor	29	34
Devaux	30	49

(a) Enter the information in this table into a blank spreadsheet, with the title, Economics Examination Marks, in the first row.

(b) In a fourth column, calculate the total mark awarded to each candidate.

(c) Use Excel to calculate the average examination mark of these six candidates and give it an appropriate heading.

(d) Format and print the spreadsheet, putting the names of the candidates in alphabetical order.

(e) The second candidate, Bull, asks for a re-mark. Although the Section A mark is correct, the Section B mark is raised to 42. Produce a new spreadsheet based on the correct results.