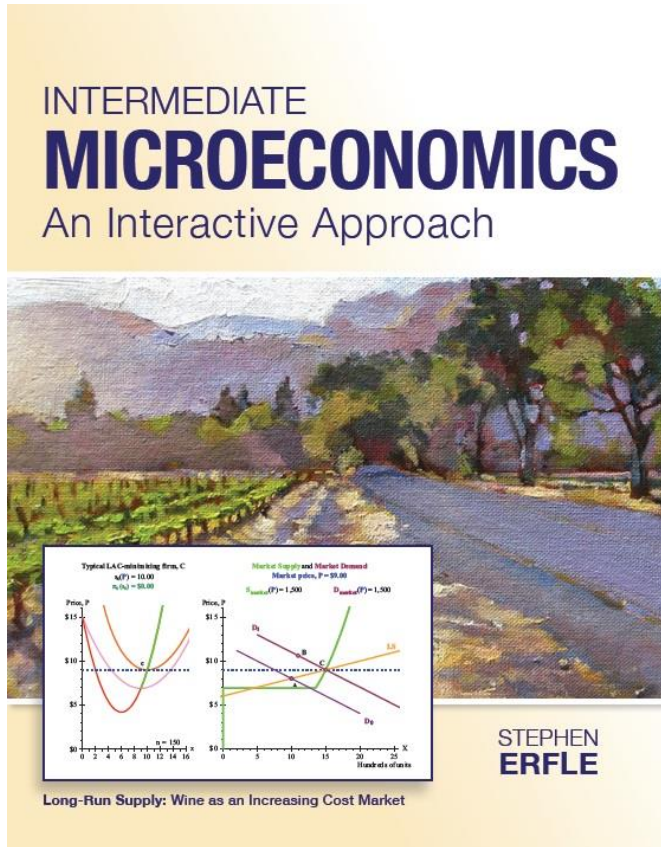


# Intermediate Microeconomics: An Interactive Approach Workbook



Textbook Media Press

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## Preface

The best way to learn microeconomics is to do problems. This is a book of problems that will aid you in that learning process. This book is coordinated with *Intermediate Microeconomics: An Interactive Approach* (IMaIA) but it can be used as a supplement to other intermediate level textbooks as well. Many texts provide end of chapter questions in the text, IMaIA included. Those questions typically test for reading comprehension, or provide basic problem-solving scenarios. Such questions only bring us part of the truly understanding the material.

By contrast, the problems in this Workbook dig more deeply into the material than do the end of chapter questions in IMaIA. These problems test your ability to synthesize what you have read and prompt you to apply that reading to new situations ... or to create and explain new situations yourself.

A number of the problems in this Workbook key off of the dynamic Excel figure files that form the centerpiece of IMaIA. All files mentioned in the Workbook (and more) are available from the IMaIA e-book.

These problems are designed to be turned in as homework. Sometimes the problems build off of earlier problems. Problems that are likely to be handed in on different days are placed on different sheets of paper. For the same reason, this Workbook is delivered to you 3-ring binder ready and is single sided.

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## Workbook Chapter 1: Preliminary Issues

The starting point for our analysis is to acknowledge what you have already learned in your introductory microeconomics class. Chapters 1 and 2 of *Intermediate Microeconomics: An Interactive Approach* (IMaIA) are provided as a quick review of that material. The centerpiece of microeconomics, the supply and demand model, is examined in Chapter 2. Prior to this, in Chapter 1, we examine more preliminary issues such as the use of models in economic analysis, the notions of opportunity cost, positive and normative economics and the distinction between real and nominal prices. Typically your professor will not spend more than a lecture or two on these chapters because this material should not be “new” although it may well not be sitting in the front of your short-term memory. These chapters are provided as a way to quickly remind you of things you have previously learned but may have forgotten since you last used microeconomics.

The other goal of an initial chapter is that it allows us to describe the basic structure of the text and to note any special characteristics or strategies that will be used to help you master the material in the text.

***This text was written to provide a more visual approach to understanding microeconomics by incorporating technology into the learning process.***

Most students have computers of their own or they have ready access to computers and computers can provide the option for open-ended experimentation with graphs if those graphs are available for manipulation.

***The static graphs in the text have interactive counterparts available from the IMaIA website.***

The only requirement to use these files is that you have Excel on your computer (you do not need to know how to use Excel because you manipulate the files with sliders and with click boxes).

Computer generated graphs are not a substitute for creating your own graphs, but they can provide a useful complement to the static graphs in the text (and the ones you create) because, by necessity, they must be “right.” In this context “right” means that the curves that you can move via sliders act in exactly the way economists expect them to act. Given this, the intersection points change as they should as well: comparative statics analysis is made easier if you know that the graph you are manipulating changes in a way that maintains the logic of the economic analysis. Comparative statics analysis examines how economic outcomes (intersection points) change when an underlying parameter changes.

Economists think graphically: “a picture tells a thousand words” is an aphorism that is especially appropriate for economic analysis. Whenever you begin to work on a problem, or even as you read, keep a piece of scratch paper available for doodling and make sure you label your axes as you begin to sketch out a graph that helps to answer a question. An even better strategy is to keep some graph paper available because it is often useful to describe locations of points and curves with precise regard to specific numerical values. It is also useful to have at least 2 different colored pens as well as a pencil available to depict curves and changes in curves.

Graphical solutions for many of the problems in this workbook can be obtained using the Excel figures from the text. Once you read the problem you should immediately begin to sketch out a solution with paper and pencil, even if you know you will eventually use an Excel figure.

This “doodling” is an invaluable part of learning microeconomics. Think back through the chapter to diagrams that seem like they describe similar behavior.

Some problems will tell you to work with explicit files, but others leave the choice up to you. Part of the learning experience is figuring out what works and what does not. As a result, some problems are posed in a more open-ended fashion than others, while some problems may require you to go beyond the graphs provided in the text and sketch out your own solution on graph paper.

**NOTE:**

The material below will help you manipulate Excel figures so you can use the figures to answer workbook problems. This information will be presented in the context of answering a problem that is a variation on a question asked in the chapter.

Since instructors often assign the introductory chapters of a text as self-study or ignore these chapters, we will provide a similar discussion of manipulating the Excel files again in Chapter 3.

In Chapter 3, repeated material will be boxed (like this notice), so you can skip it if you already know how to transfer figures into Word and do calculations in Excel.

### **An Initial Example**

Consider an extension of the model presented in Section 1.2. The starting point for the present analysis is the model described in Figure 1.7. This figure examined how to allocate time between writing an economics paper and studying for an economics exam given a total of 4 hours available for both tasks. That analysis concluded that point **G** produces the highest expected average score given an equal weight between the exam and the paper (and the production constraints described by Equations 1.2.economics and 1.2.paper in the text). Point **G** is based on 2 hours and 21 minutes devoted to the exam. This produces an average score of 78.1, the average of the 92.2 exam score and the 64.0 paper score. This result occurs because point **G** has an opportunity cost of 1 point on the exam for 1 point on the paper (put another way, the slope of the tangent at **G** is  $-1$ ).

Suppose we replace the equal weight assumption by an assumption that places twice as much weight on the paper as the exam.

**Alternative Assumption:**     **The paper is worth twice as much as the exam.**

Q) Based on this alternative assumption, how much of the four hours should be devoted to the paper and how much should be devoted to the exam?

We will return to this question once we provide some preliminary information about the Excel files available by hyperlinks on the online version of IMAIA.

### **About Excel figure files**

Some problems will require you to turn in graphs that are at least partially completed within Excel, but which you might further label prior to turning in as homework. The Excel figures were used to create each figure in the text but they are more “generic” in nature in order to provide maximum flexibility for answering problems. Excel figures maintain the numbering

system from the chapter, but do not expect to always use them in numerical order in working on problems in the workbook.

One Excel figure file may well be used to create more than one static image in the text. For example, all seven figures in Chapter 1 are based on one Excel figure file. Sometimes this is done on one worksheet but sometimes it is done on multiple worksheets. **You should have the Excel file for Chapter 1 open as you read this page.**

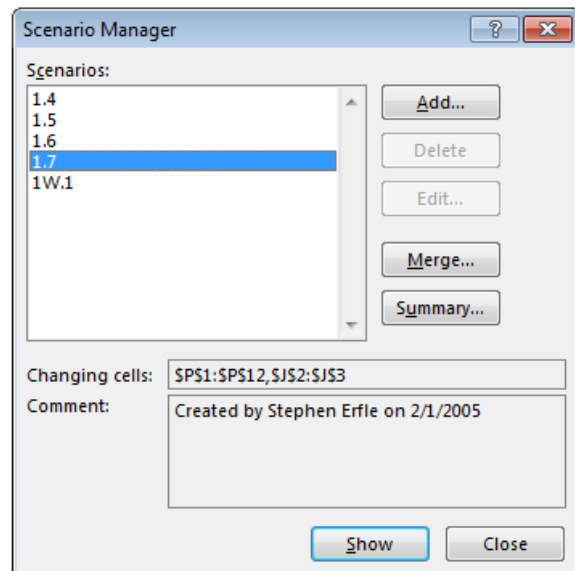
*About worksheets.* This file has two **worksheets**. (You can move between worksheets in Excel by clicking on the tabs at the bottom of the screen. Specific commands or references in Excel are printed in **Bold** in the text (and in this workbook).) If you want to see the production function that produced Figures 1.1 – 1.3, click on the tab labeled **1.1-1.3Score on One Exam**. If you want to work with the PPF depicted in Figures 1.4-1.7 click on the other tab.

These files have been modified to allow you to add your own labels and do your own calculations (in the blue cells and the green cells). Sliders and click boxes will allow you to modify the curves and lines in the figure to create your own answer.

*Using existing scenarios.* The **Scenarios** function allows the user to recall specific settings of the sliders and click boxes that are used to create textbook figures. An easy way to move from figure to figure is to use the **Scenarios** function if you do not want to manipulate the sliders and click boxes to match a figure in the text.

For example, open the file for Figures 1.1-1.7 and click on the

**1.4-1.7EconVsFrench** worksheet tab (at the bottom of the screen). Click **Data, What If Analysis, Scenario Manager** if using Excel 2007 (or **Tools, Scenarios** if using Excel 2003). The **Scenario Manager** popup menu will appear (this menu looks slightly different in Excel 2003 but has the same functionality).



From here you can choose the scenario you wish to see on the screen by clicking on that scenario, then click **Show, Close** and the figure will now look like the figure in the text (with the possible exception that the text version may have further labeling added).

*Creating your own scenarios.* Once you have a picture you wish to save, you can create your own scenario. (This is not necessary but can be done if you wish to come back to this same graph at another time.) To do so, set the sliders and click the check boxes as you wish to have them and click: **Data, What If Analysis, Scenario Manager** if using Excel 2007 (or **Tools, Scenarios** if using Excel 2003), then click **Add**. *Type in your scenario name*, then click: **OK, OK, Show, Close**. Note: the **Scenarios** function will remember the location of sliders and click boxes, but it may not remember the labels you may have typed into the light blue boxes.

**Back to the question:** Figure 1.7 is a useful starting point but it is based on equal weights for the exam and the paper. If we want the paper to have double the weight then the appropriate weighted average score is:

$$W = (1/3) \cdot E + (2/3) \cdot P \quad \text{where } E \text{ is the exam score and } P \text{ is the paper score.}$$

Paper points are twice as valuable as exam points given this weighting scheme. Point **G** in Figure 1.7 represents the point where the tradeoff between paper and exam is 1:1. This represents an inefficiently large amount of time studying for the exam (since it is only worth half as much as the paper).

In terms of opportunity cost, we will maximize the weighted average score on the exam plus paper if we choose the point on the PPF associated with trading 0.5 points on the paper for 1 point on the exam. In numbers, we want the opportunity cost to be  $\frac{1}{2}$  rather than 1.0. We can use the slider in cell D26:E26 to adjust the time devoted to the exam. As we decrease this time, the opportunity cost declines (starting at 1.0 given the starting point of **G** in Figure 1.7). If you adjust the slider down you will find that the opportunity cost is  $\frac{1}{2}$  (see cell E27) when the amount of time devoted to the exam is 1:04 (one hour and 4 minutes). This is also included as Scenario 1W.1 but you would benefit by moving the slider yourself and watching what happens on the graph as you decrease exam time from that shown at point **G**.

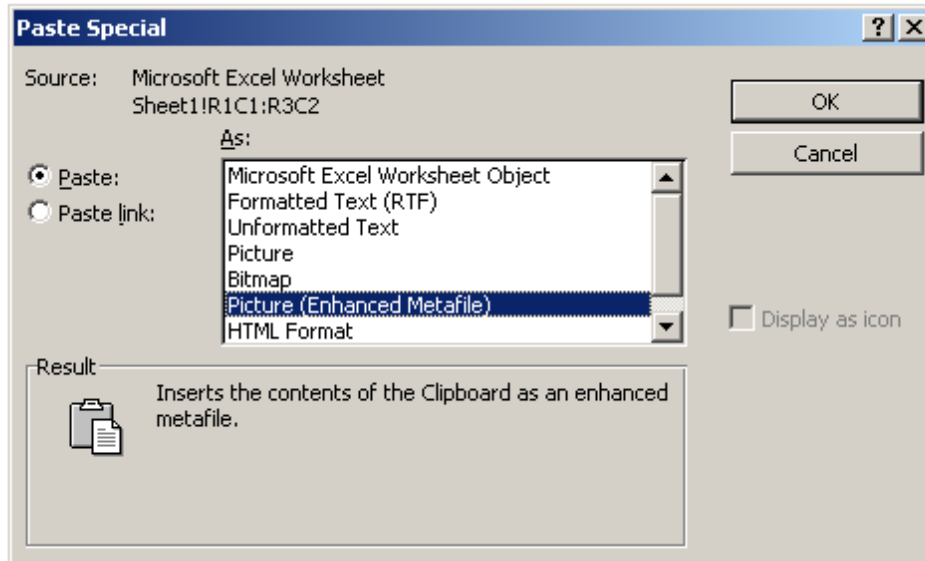
Once you get to this point, you are ready to copy the file onto your answer sheet. We now return to our Excel discussion to see how to accomplish this task.

### How to Transfer an Excel Diagram to Word

When you have a diagram you wish to use to answer a question, you can transfer it to Word using the following mechanism (a simple **Copy** in Excel and **Paste** in Word will not provide you with a usable diagram):

1. Open a Word document into which you wish to insert the figure.
2. Go back to the Excel file whose figure you wish to transfer into Word.
3. Highlight the cells you wish to transfer into Word. There are a couple of ways to do this but the easiest to learn is to do the following:
  - A. Click on a cell and use the arrow keys to move to a corner of the area you wish to transfer into Word. (*For example, move to cell G19 in the 1.4-1.7EconVsFrench worksheet.*)
  - B. Hold down the Shift key and move the arrow keys until the area you wish to transfer has been highlighted. (*In this instance, you would move the left arrow to highlight from G19 back to A19 and the up arrow so that rows 19 to row 1 become highlighted.*)

Once you release the Shift key the highlighted area should show as blue-gray. (*For example, the cells A1:G19 from the 1.4-1.7EconVsFrench worksheet have been highlighted to create Figure 1W.1.*)
4. Click **Copy** in Excel (using either the **Edit** pulldown menu or by clicking the **Copy** icon on the **Standard** toolbar in Excel 2003 or main ribbon in Excel 2007).
5. Return to the Word document and move to where you want to place the figure. Click **Edit, Paste Special, Picture (Enhanced Metafile)** (the Paste Special popup menu should look as shown below), **OK**.



The result will be a picture of the highlighted area, just as you see it on the screen. If you are doing much editing of your document, it is worthwhile to place the figure just after a hard page break so that you do not have to move it until you are finished working on the document. (Click **Insert, Break, Page Break, OK** to create a hard page break.)

*Modifying a picture in Word.* From here you can modify the picture if you wish using Word. The diagram on the next page shows some of the basic modifications discussed below.

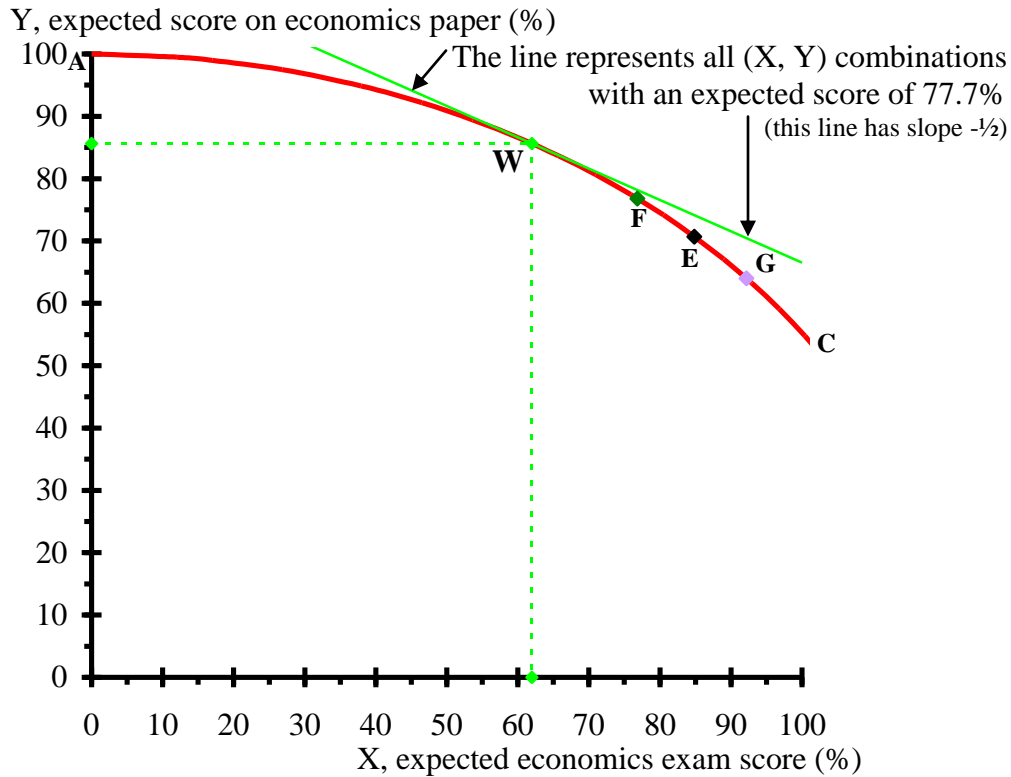
To see the range of modifications you can make to an image within Word, right click on the picture, then click **Format Picture**, and you can see a number of things you can do with the picture by looking at the various tabs. Two tabs in particular are useful, the **Size** tab and the **Layout** tab. The **Size** tab allows you to resize the picture up or down. The **Layout** tab allows you to place the picture where you wish within the Word document. If you have a picture you do not want to modify, use the **In line with text, Square** or **Tight** options. These options do not allow you to add information to the picture.

If you wish to add information to the picture, use the **In front of text** option then navigate underneath the picture using the arrow keys and the space bar. For example, I typed the statement “The line represents all (X, Y) combinations with an expected score of 77.7% (this line has slope  $-1/2$ )” on three lines by simply navigating “beneath” the picture of Figure 1W.1 in Word. I also added arrows pointing at the tangent opportunity cost line and the label **W**.

Inserting an arrow requires clicking the **Insert** ribbon then **Shapes** in Word 2007. (In Word 2003, use the **Drawing** toolbar. To add this to your standard setup within Word (typically the **Standard** and **Formatting** toolbars are shown), click **View, Toolbars, Drawing**.) When drawing arrows and lines you can move them in large increments by placing it in the rough location, then clicking on the object and then using the arrow keys. For fine movements, hold down the **Ctrl** key as you use the arrow keys. Unfortunately, letters such as **W** cannot be micro-moved in the same way, nonetheless, you can get close to where you want the letter placed by adding or taking away blank spaces (alternatively you can micro-move the figure one you have roughed in the letters).



Figure 1W.1  
 Allocating study time given the paper is twice as important as the exam.



**Doing Simple Calculations in Excel**

Excel is basically a large calculator that is able to adjust its calculations as you adjust the data on which those calculations are based. Extended discussions of using Excel are provided in the Mathematical Appendix and in Section 19.2 but the basics are described here. There are numerous pieces of data that are available in the typical Excel file and these pieces of data can be used to help answer questions. The graph above, for example, shows the result of one such calculation in the labeling of the green line as having an expected score of 77.7%. This number is based on the following calculation:  $77.7 = 1/3 \cdot \text{Exam score} + 2/3 \cdot \text{Paper score}$  given an exam score of 62.0 (based on spending 1:04 studying for the exam) and a paper score of 85.6 (based on spending the remaining 2:56 on the paper).

You can check that this is the right solution by calculating the weighted average score in the calculating area (the block of green cells on a worksheet). This is done in cell K6 in order to show how to create equations in Excel. An equation in Excel is very easy to create: simply start with an equal sign and follow the normal rules used for algebraic calculations. The slider time devoted to the economics exam is shown in A26:B26 in hours and minutes and in cell D27 in decimal form of the **1.4-1.7EconVsFrench** worksheet. The resulting scores on the exam and paper are shown in cells G26:H26 if the check box in G26 is clicked on. The equation in cell K6 is simply  $=G26/3+H26*2/3$ .

This equation can be seen by clicking on cell K6 and looking at the contents of the cell in the **Formula Bar** (the white area above the E and F column labels). This equation weights the exam score by 1/3 and the paper score by 2/3 as expected based on the *Alternative Assumption* at the start of this workbook chapter (the paper is worth twice as much as the exam). Although cell

K6 looks like the number 77.74583 occupies the cell, in actuality, that number is simply the result of the equation in the cell.

You can easily check that this is the correct amount of time to devote to studying for the exam by moving the time slider in both directions away from 1:04. As you do so, even by a minute, the weighted average in cell K6 will decline. The farther time moves away from 1:04 the lower is the weighted average score. (You should make sure to open up the file and check this for yourself. If you want to start at the maximum point you can call up the final answer using the **Scenario** function (since this scenario has been saved as 1W.1 in the file).

The above example has shown how one can use the Excel figures to help attack problems. The problems to which we now turn provide further opportunities to explore these issues.

The goal of this workbook chapter is to remind you about some basic aspects of economic modeling described in Chapter 1. The model developed in Section 1.2 involves reinterpreting the production possibilities frontier but the focus was really on model building rather than on the model itself. The problems below allow you to further develop your modeling skills and to explore the difference between various concepts discussed in Chapter 1.

- You should be able to derive information from price and inflation data.
- You should be able to use the concept of opportunity cost to make decisions.
- You should begin to become comfortable using the Excel figures in order to explore how the results of the model change as the underlying parameters of the model change.

1. Consider the first two rows of data in Table 1.1 (reproduced below). The price of each of the six goods listed in 1981 is larger than the corresponding price in 1980.

	Electricity	Utility gas	Gasoline	Eggs	Bananas	Medical
1980	\$29.83	\$38.53	\$1.25	\$0.84	\$0.34	74.9
1981	\$34.19	\$44.42	\$1.38	\$0.90	\$0.36	82.9

A) Are each of these prices real or nominal prices? \_\_\_\_\_

B) Calculate the percentage price increase for each of these goods for the year using 1980 as the base. (You can do this with a calculator or by using the Excel file for this table.)

Electricity	Utility gas	Gasoline	Eggs	Bananas	Medical

C) Without calculating the inflation rate for 1980, suppose you have been told that electricity is more expensive in real terms in 1981 than in 1980. Based on this information and your answers in part B alone, can you say whether any of the other five goods are also **more** expensive in real terms in 1981 than 1980?

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Can you tell whether any of the other five goods are **less** expensive in 1981 than 1980?

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2. (This does not require Problem 1.) Consider the first two rows of data in Table 1.1 (reproduced at the start of Problem 1 above). CPI information is also included in Table 1.1 for those years:  $CPI_{1980} = 82.4$  and  $CPI_{1981} = 90.9$ .

A) Using this CPI data, calculate the real price for each of these goods in 1981 using 1980 dollars.

Electricity	Utility gas	Gasoline	Eggs	Bananas	Medical

B) Which goods became better buys and which have become worse buys in 1981 on a real basis based on the change in real price between 1980 and 1981 derived in part A?

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3. (Requires Problems 1 and 2.) Consider inflation directly using the CPI data for those years:  $CPI_{1980} = 82.4$  and  $CPI_{1981} = 90.9$ .

A) Using this CPI data, what is the inflation rate between 1980 and 1981?

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B) Compare this inflation rate to the percentage price increases in your answer to Problem 1B. Are your answers to Problem 2B confirmed for each good? Explain.

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4. Suppose your exam score as a function of study time is given by Equation 1.1b:  $S(t) = 50 \cdot t^{0.5}$ . How much time would you have to devote to studying to get a 75 on an exam? Do this by algebraic manipulation.

*Hints:* You do not have to provide this in hours and minutes, you can simply provide a decimal answer for  $t$ . You know the answer is a bit more than two hours because points **A** and **B** on the PPF in Figure 1.4 shows that you get a 70.7 on such an exam if you devote 2 hours to the exam:  $70.7 = 50 \cdot 2^{0.5}$ .

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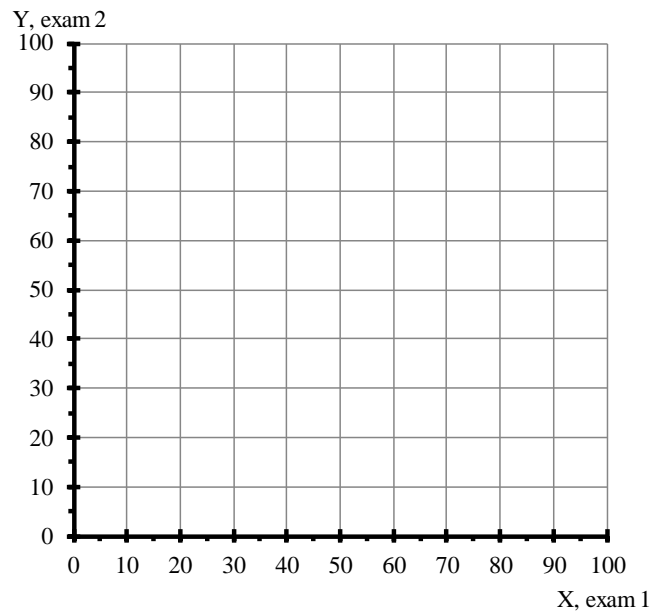
5. Suppose you have two exams and both face the same score as a function of study time as given by Equation 1.1b:  $S(t) = 50 \cdot t^{0.5}$ . Suppose you wish to get a 75 on both exams.

A) How much time do you have to devote to studying for both exams and how do you apportion study time across exams?

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B) What is the opportunity cost of exam 1 in units of exam 2 score at this allocation of study time?

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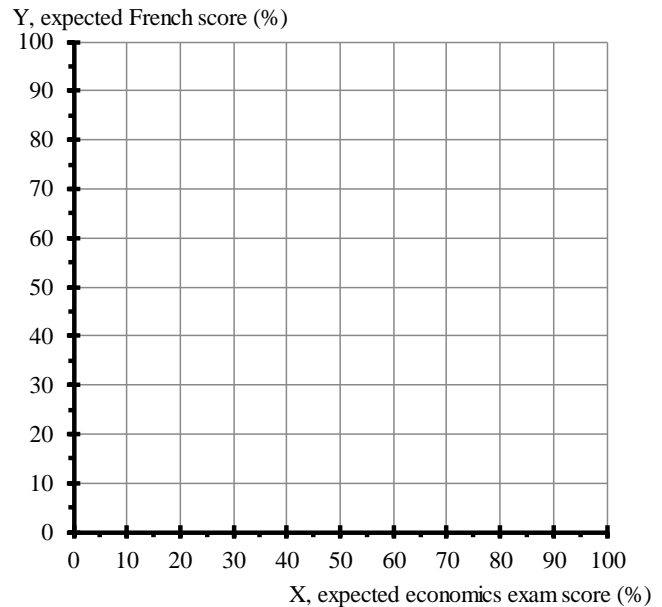
Provide a PPF graph that is consistent with your answer. If you wish to use the Excel figure instead of sketching the answer in the graph provided simply attach the figure as a separate page to your homework.

*Hint:* This is easy to do using the Excel figure and starting with Figure 1.4 then click the blue PPF off in cell I20 and click on the red adjustable PPF in cell I22. This is also easy to answer if you have done Problem 4.

6. Start from Figure 1.5 in which you find economics is 20% easier to study for than French (so the production functions are given by Equations 1.2.economics and 1.2.French in the text). You need not use the equations but you can confirm your answers with them if you wish.

A) Suppose you wish to obtain a 75 on each exam. How much study time total should you devote to studying and how should you apportion study time across subjects?

B) What is the opportunity cost of economics in units of French score at this allocation of study time?



C) Provide a PPF graph that is consistent with your answer.

*Hints:* This is easy to do using the Excel figure file and starting with Figure 1.5 then adjusting the total time slider. Part of your answer is already done if you did Problem 4. Do not worry about one minute differences in answers on the worksheet – such differences are due to rounding.

7. Start from Scenario 1W.1 described above in which the paper is worth twice as much as the exam and you have 4 hours to devote to both. We showed in Figure 1W.1 at the start of this workbook chapter that a maximum expected score of 77.7 occurs if we devote 1:04 to studying for the exam with the remaining 2:56 devoted to the paper (by looking at that answer in cell K6 in the calculating area). How sensitive is this answer to getting the allocation right? Put another way, determine the range of values of study time devoted to the exam that will be within ONE point of the maximum score by answering the questions below. There is no need to provide graphical support for your answer.

*Hint:* This is easy to answer if you simply copy the maximum number (77.74583) into another one of the green cells then place the difference between this number and K6 in a third cell. As you move the slider in D26:E26, you will be able to see when the difference becomes larger than 1.00.

- A) What is the **smallest** amount of time you can devote to the exam and be within one point of the top score? \_\_\_\_\_
- B) What is the **largest** amount of time you can devote to the exam and be within one point of the top score? \_\_\_\_\_
- C) How large is the range of exam times over which you lose less than a point in expected score as a result of your choice of allocation time? \_\_\_\_\_

8. Suppose you begin to use a language lab to study for your French exams and it increases your productivity over your previous productivity level. (As a result, the two production functions are:  $S_{\text{French}}(t) = 55 \cdot t^{0.5}$  and your economics production function remains  $S_{\text{economics}}(t) = 60 \cdot t^{0.5}$ .) Do this by modifying Figure 1.6.

- A) What percentage increase in productivity occurred in your French exam as a result of using the language lab? \_\_\_\_\_
- B) Given the new French and economics exam score production functions, would you expect to study the same amount of time in each class if you wish to have equal scores across exams? Explain.

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- C) If you wish to devote three hours to economics and French total, how should you allocate study time so as to equalize expected scores in both classes? What score do you expect on each exam?

*Hint:* You can do this algebraically but it is easier to use the Excel file.

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- 9. (Requires Problem 8.) Provide an algebraic proof that the allocation of study time you derived in Problem 8 equalizes expected score across exams.

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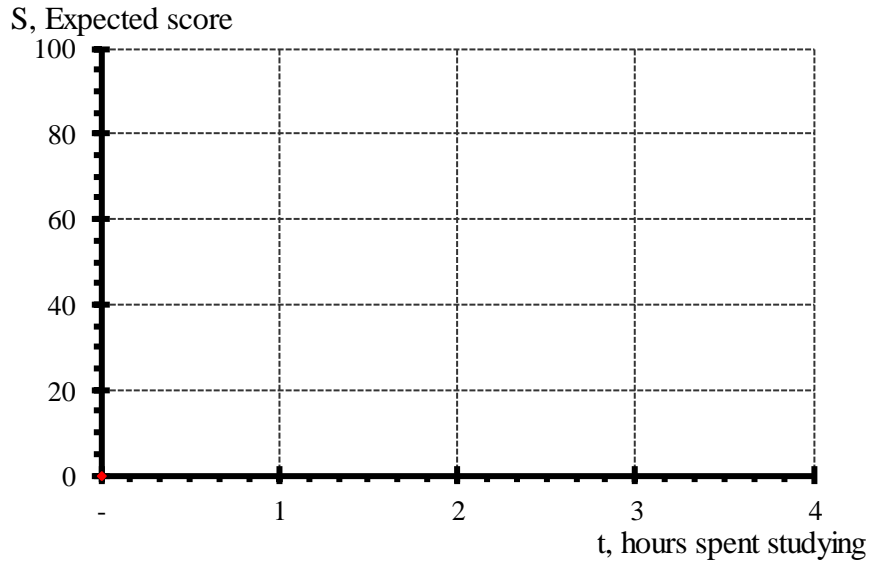
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10. We argued in the text that most exams exhibit diminishing returns to extra study time. This need not be the case. For example you might be studying for a class that is quite complex and for which you only see the “full picture” if you devote a sufficient amount of time to the class. How would you model this production function? (In order to be able to use the file that produced Figures 1.1 – 1.3, assume you see the “full picture” (by getting a perfect score) with 4 hours of studying. How would you adjust the score given 1 hour of study time slider in row 17 to model this situation? Explain and provide graphical support.



11. (This is more challenging than the rest of the problems.) Prove that the PPF in Figure 1.4 is a quarter circle (and will remain a quarter circle as long as both exams are equally hard).  
*Hints:* To prove this you must recall that the equation for a circle is  $x^2 + y^2 = c$  where  $c > 0$ . If  $x$  is written as  $x(t)$  then  $y$  is  $y \cdot (H - t)$  where  $H$  is the time devoted to studying.

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**Note:** This workbook chapter has some redundant boxed inserts that replicates material explained in earlier parts of the Workbook (since Chapters 1 and 2 may not be formally assigned). Ignore these boxes if you have already seen this material.

### Workbook Chapter 3: Preferences

Chapter 3 presents the most basic notion in consumer theory, the notion of preferences. Individuals, when offered a choice between alternatives, will always be able to say which they prefer. Preferences, most basically, involve pair-wise comparisons of bundles of goods. Since pair-wise comparisons are time consuming to analyze, economists have developed geometric and algebraic methods of representing preferences. Chapter 3 focuses on the geometric interpretation of preferences: indifference curves.

Well-behaved preferences have four properties: completeness, transitivity, monotonicity and convexity. Completeness simply means all bundles can be compared. Transitivity means that if you prefer bundle **A** to **B** and **B** to **C**, then you must prefer **A** to **C**. Completeness and transitivity are required for preferences to be well-defined, and in our examples we will always assume these two properties hold. Some of the preferences examined in this chapter violate the other two properties, monotonicity and convexity. Monotonicity means more is better and convexity means that the set of bundles at least as good as a given bundle is a convex set. Monotonicity implies that indifference curves are downward sloping. Convexity implies that the set of bundles between any two indifferent bundles are at least as good as the endpoint bundles. When preferences are both convex and monotonic, the slope of the indifference curve cannot increase as  $x$  increases along the indifference curve.

Indifference curves allow us to tell economic stories – even behavior that we will typically not see in the market. For example, people will not typically purchase goods that they dislike. Nonetheless, we can use preference over “bads” (a “bad” is a good that is disliked) to describe tradeoffs between various products. You should practice describing preferences with indifference curves because it is difficult initially to move from a description of preferences to a graphical representation of preferences using indifference curves. As you consider your preferences, do not restrict yourself to goods you typically buy in a store, but instead try to describe preferences over less traditional goods using indifference curves.

#### The following is also explained in Workbook Chapter 1

Whenever you begin to work on a problem, or even as you read, keep a piece of scratch paper available for doodling and make sure you label your axes as you begin to sketch out a graph that helps to answer a problem. An even better strategy is to keep some graph paper available because it is often useful to describe specific locations of points and curves with precise regard to specific numerical values.

A few pages of blank graph paper have been included at the end of the workbook. The file **BlankGraphPage** allows you to print graph paper as needed (**all files mentioned in the Workbook are available from the IMaIA e-book**).

It is also useful to have at least 2 different colored pens as well as a pencil available to depict curves and changes in curves.



**An Initial Example**

Consider once again the tradeoffs inherent in consuming carrots,  $c$ , and zucchini,  $z$ . Tom likes both goods, and he likes to have equal quantities of both goods. When he has more zucchini than carrots he is willing to trade 2 zucchinis per carrot and when he has more carrots than zucchini he is willing to trade 3 carrots per zucchini.

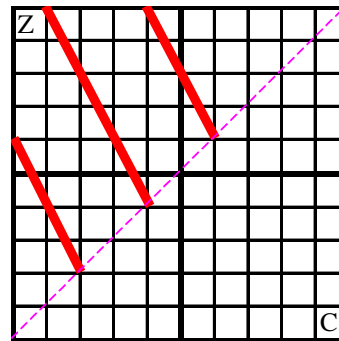
- A) Sketch indifference curves consistent with Tom’s preferences (place carrots on the horizontal axis).
- B) What type of preferences does this remind you of?
- C) Are these preferences convex? Monotonic? Strictly convex? Strictly monotonic?

**Attacking this Problem**

None of the figures in the text will work exactly here but a couple of the figures can get you close to Tom’s preferences. This has some aspect of the “L shaped” perfect complements preferences because he likes to have equal quantities of each good. This suggests that the vertices of Tom’s indifference curves are on the  $45^\circ$  line. But, unlike perfect complements, above the  $45^\circ$  line indifference curves are not vertical and below the  $45^\circ$  line indifference curves are not horizontal. In this respect it is more like perfect substitutes.

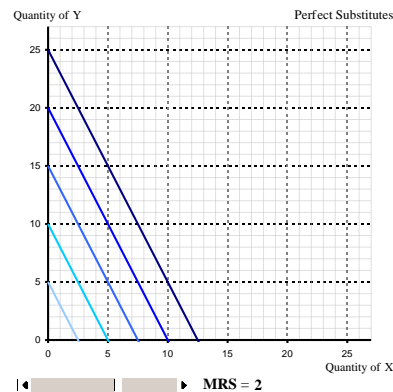
The best way to proceed with Part A is to break the problem into two parts. You know that Tom’s indifference curves look different above and below the  $c = z$  line (the  $45^\circ$  line). As a result, start by labeling axes and drawing in a dashed line where  $c = z$  as is done in Figure 3W.1. Consider first having more zucchini than carrots. In this instance, indifference curves have  $MRS = 2$  because he is willing to trade 2 zucchinis per carrot in this instance. Put another way, Tom’s indifference curves have a slope of  $-2$  when  $z > c$ .

Figure 3W.1



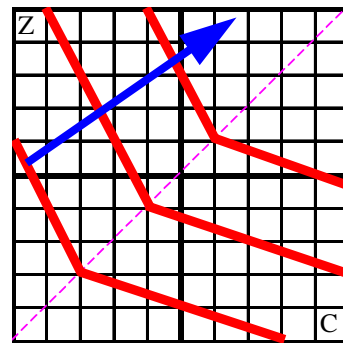
The resulting indifference curves look like perfect substitute indifference curves where carrots are liked twice as much as zucchini. Although it is unnecessary to use the Excel files to answer this question, you should note the similarity between Figure 3W.1 and Figure 3W.2 obtained from the perfect substitutes file, Figure 3.5, by adjusting the slider so that  $MRS = 2$ . The two figures are not the same, but if you visualize a  $45^\circ$  line in Figure 3W.2 and ignore everything beneath this line then the figures portray the same preferences on the “half space” where there are more zucchini than carrots.

Figure 3W.2



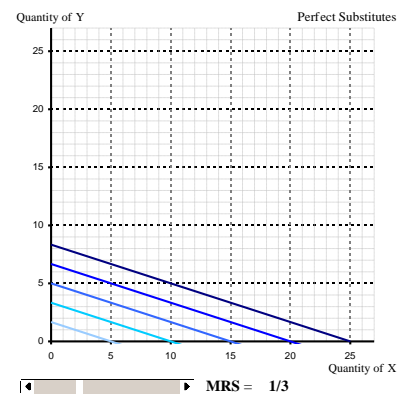
The bottom half of each indifference curve is based on the tradeoffs inherent when Tom has more carrots than zucchini. In this instance, Tom is willing to trade 3 carrots per zucchini. This implies a slope of  $-1/3$  in this instance (since slope =  $\Delta z/\Delta c = -1/3$ ) or, in terms of MRS, we have  $MRS = 1/3$ . Start at each of the  $c = z$  points on the indifference curves started in Figure 3W.1 and draw a line with slope  $-1/3$  as shown in Figure 3W.3. One final piece is shown in that figure – the blue arrow points in the direction of more preferred bundles. These arrows were not shown in the text because the text used different shades of blue to denote the direction of more preferred bundles. An alternative way to show the same thing is to simply have an arrow point in the direction of better bundles. Figure 3W.3 answers part A of this question.

Figure 3W.3



The bottom part of the indifference curves look like perfect substitute indifference curves where zucchini is liked three times as much as carrots. You should therefore be able to see the similarity between the lower part of Figure 3W.3 and 3W.4. Figure 3W.4 is obtained in the same way as 3W.2 discussed above.

Figure 3W.4

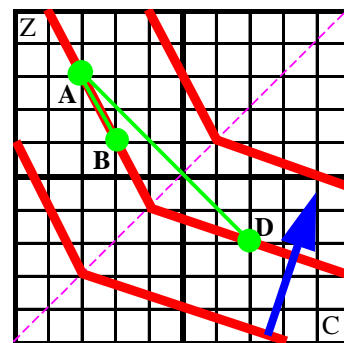


**B)** Tom’s preferences are like a blend of perfect substitutes and perfect complements. They are like perfect complements in that each indifference curve has a vertex. They are like perfect substitutes in that they have constant MRS in each “half space” above and below the  $c = z$  line.

**C)** Consider first monotonicity. Monotonicity means more is at least as good as less of each good. These preferences are monotonic because an increase in each good with the same amount of the other good is strictly preferred to the initial bundle. Therefore, these preferences are also strictly monotonic.

Consider next convexity. Convexity requires that the bundles between any two indifferent bundles be at least as good as the endpoint bundles. Put another way, the upper contour set of any bundle is a convex set. Two points on one of Tom’s indifference curves are either both on one side of the  $c = z$  dashed line or they are on opposing sides. Both situations are depicted in Figure 3W.5. The bundles between **A** and **B** (on the green line segment **AB**) are indifferent to **A** or **B** and the bundles between **A** and **D** (on the green line segment **AD**) are strictly preferred to **A** or **D**. Therefore preferences are convex.

Figure 3W.5



Strict convexity requires that the bundles between any two indifferent bundles be better than the endpoint bundles. While this is true if the two indifferent bundles are on opposite sides of the  $45^\circ$  line (for example **A** and **D** in Figure 3W.5) it is not true for indifferent bundles on the same side of the  $45^\circ$  line (for example **A** and **B**). Therefore, Tom’s preferences are convex but they are not strictly convex. This is consistent with the discussion of Figures 3.3 and 3.4 in the

text where it is noted that if indifference curves have linear segments then preferences cannot be strictly convex.

The following is also explained in Chapter 1

Graphical solutions for many of the problems in this workbook can be obtained using the Excel figure files from the text. Once you read the problem you should immediately begin to sketch out a solution with paper and pencil, even if you know you will eventually use an Excel file. This “doodling” is an invaluable part of learning microeconomics. Think back through the chapter to diagrams that seem like they describe similar behavior.

Some problems will tell you to work with explicit files, but others leave the choice up to you. Part of the learning experience is figuring out what works and what does not. As a result, some problems that are posed are posed in a more open-ended fashion than others, while some problems may require you to go beyond the graphs provided in the text and sketch out your own solution on graph paper.

Whenever you are asked to provide a graphical answer using the Excel files, you should make sure to label your graph and adjust the graph so that it is consistent with the information described. Then use the **Copy** command within Excel and the **Paste Special, Picture (Enhanced Metafile)** command within Word to transfer files into your answer sheet. (*This Copy and Paste Special command is described more explicitly later in this chapter at the point where it is explicitly requested. See, p. 47.*)

If you want to hand-sketch your answer you can insert blank graph paper into your Word document in the same way using the file **BlankGraphPage**. Just highlight as much as you want to use, then use the same **Copy** and **Paste Special, Picture (Enhanced Metafile)** commands to transfer the graph paper from Excel to Word.

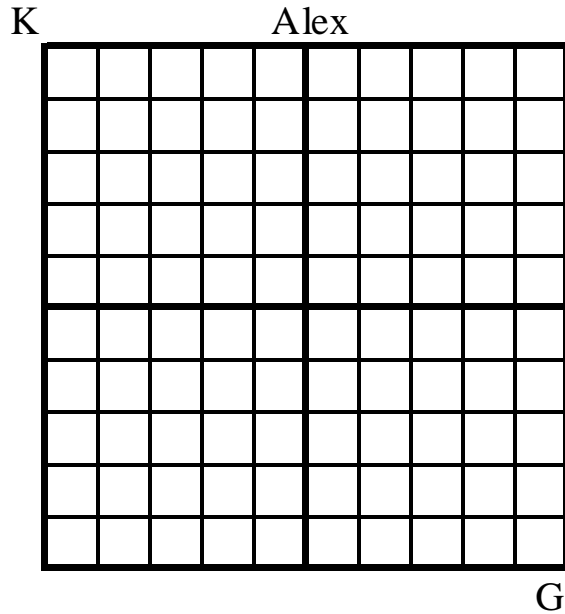
The goal of this workbook chapter is to provide you with sufficient practice at telling economic stories that you will be able to do the following

- Move from a verbal description of preferences to a hand drawn indifference map.
- Provide a verbal description of what an indifference map depicts.
- Determine from an indifference map the preference ordering of specific bundles
- Be able to identify preferences that are monotonic, strictly monotonic, convex, and strictly convex.
- Become comfortable with the concept of marginal rate of substitution.
- Identify situations when specific types of preferences such as perfect substitutes, perfect complements, satiation points and bliss points apply and use the Excel files associated with those preferences.
- Graphically model when one or both of the goods are economic goods, economic bads, and economic neutrals.

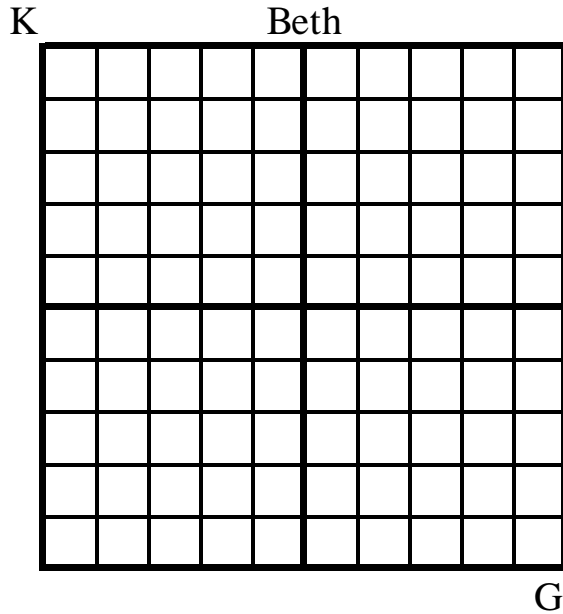
**A general note about doing problems:** Manipulate the Excel files as appropriate to answer the following problems. For some problems you will be directed to a specific file, for others a file may help you answer the problem.

1. Assume each individual has strictly convex preferences over gardenias, G, and kiwis, K. Sketch each individual's preference map placing G on the horizontal axis and K on the vertical axis. In each sketch, include an arrow pointing in the direction of more preferred bundles.

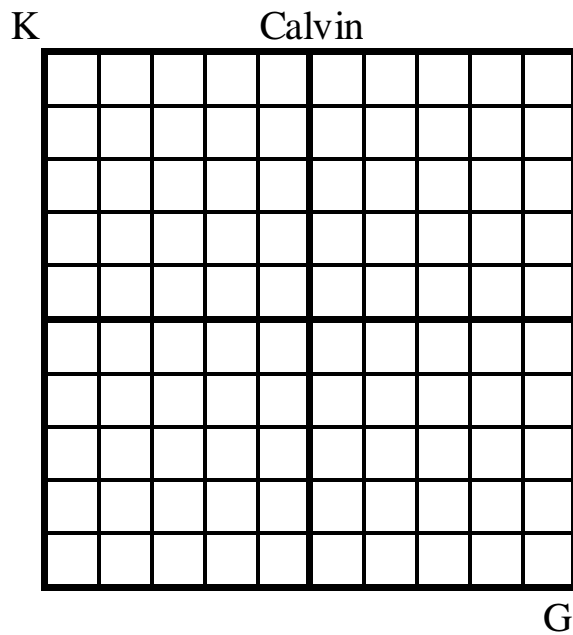
A) Alex likes gardenias but dislikes kiwis.



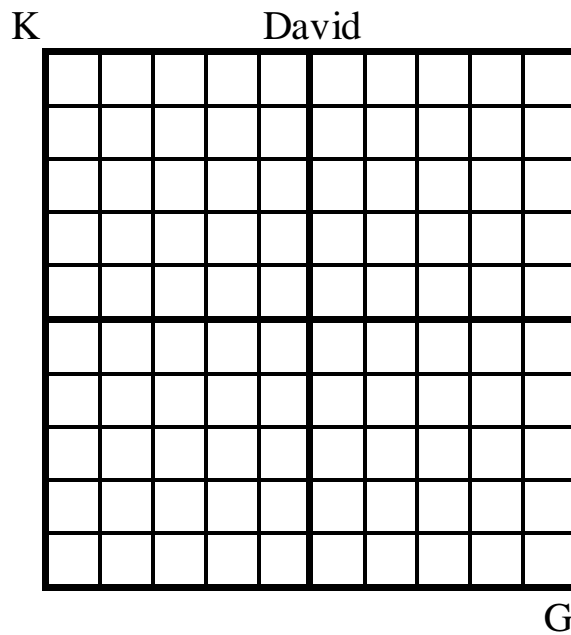
B) Beth dislikes gardenias and dislikes kiwis.



C) Calvin likes both gardenias and kiwis.

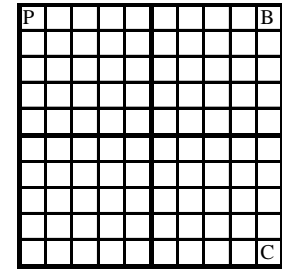
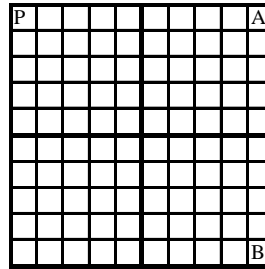


D) David likes kiwis but dislikes gardenias.



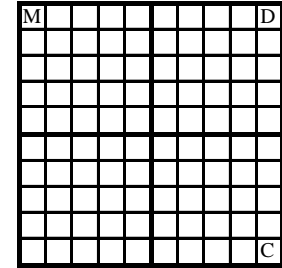
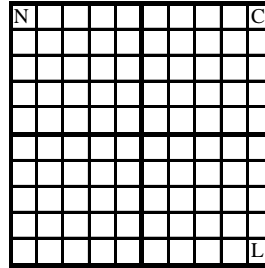
2. Graph indifference maps of the following (draw an arrow in the direction of more preferred bundles as has been done Figure 3W.3 above):

A) I tend to like two ounces of peanuts (P) for every beer (B) I drink.



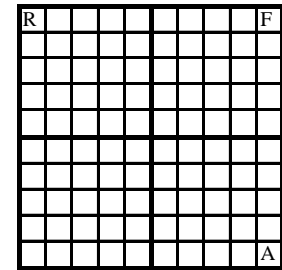
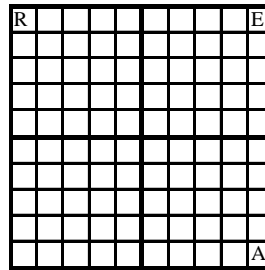
B) I like Coke (C) and Pepsi (P) equally, but I would rather have all one or the other rather than some of each on a given evening.

C) I dislike olives (L) and onions (N) on pizza. If I must have them on my pizza, I would be willing to give up two olive slices per piece of onion.



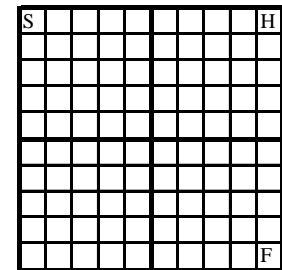
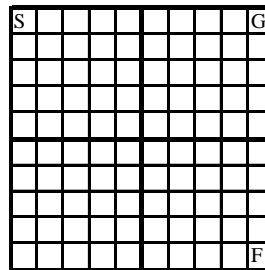
D) I do not care how much cheese (C) is on my pizza, but I like mushrooms (M) - the more the merrier.

E) I like apples (A) and oranges (R) equally, but I prefer some of each to more of one and less of the other.



F) I like apples (A) and oranges (R) equally and only care how many total pieces of fruit I have in my fruit basket.

G) I have tons of free time and don't mind spending it watching TV. If watching marathons of either, I consider one Seinfeld rerun (S) "worth" two Friends reruns (F) but on a given evening I would prefer some of each rather than a marathon of either show.



H) I have tons of free time and don't mind spending it watching TV. If watching marathons of either, I consider one Seinfeld rerun (S) "worth" two Friends reruns (F) but on a given evening I would prefer a marathon of either show.

3. Answer this problem by filling in the table below, answer yes or no and briefly explain. For each of the preferences A-H described in 1, answer:

**M)** Could these preferences be monotonic?



**SM)** Could these preferences be strictly monotonic?



**C)** Could these preferences be convex?

**SC)** Could these preferences be strictly convex?

	<b>M</b>	<b>SM</b>	<b>C</b>	<b>SC</b>	<b>Explanation</b>
<b>A</b>					
<b>B</b>					
<b>C</b>					
<b>D</b>					
<b>E</b>					
<b>F</b>					
<b>G</b>					
<b>H</b>					

4. Figure 3.14D examines why well-behaved indifference curves cannot intersect. If preferences are not convex or monotonic, can indifference curves intersect? Use a graph to explain your answer.

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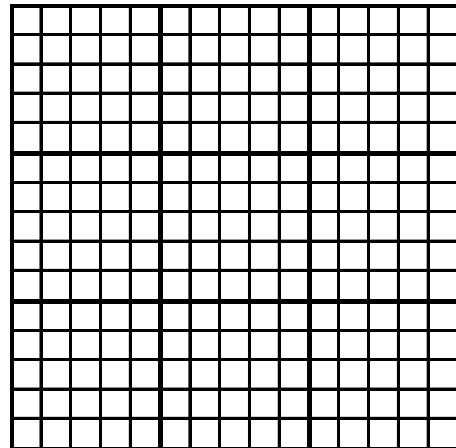
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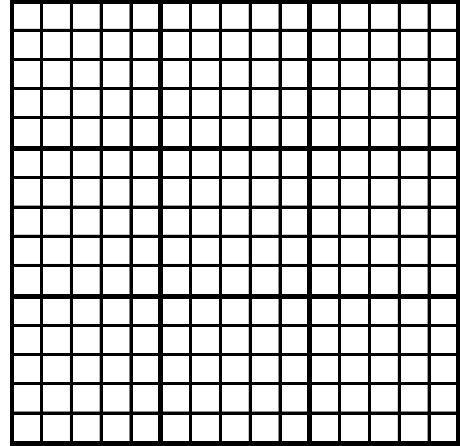



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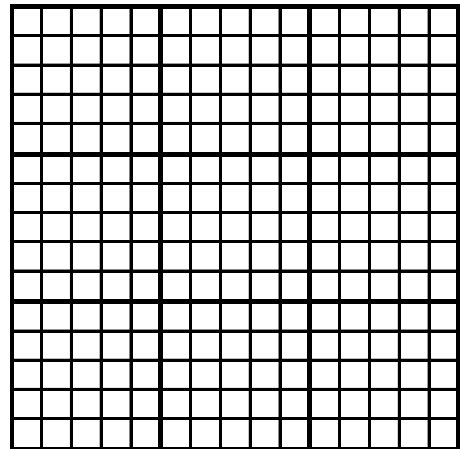


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5. Consider the following situation. Ralph, who has monotonic and strictly convex preferences over fruit, is at the supermarket where he is considering the following bundles of apples and bananas (put apples on the horizontal axis and bananas on the vertical axis). He has preferences over the six bundles **A** = (1, 6), **B** = (2, 5), **C** = (3, 4), **D** = (4, 3), **E** = (5, 2) and **F** = (6, 1). In particular, Ralph is indifferent between **A** and **E**. He is also indifferent between **B** and **D**.



i) Given this information, provide a rank ordering of his preferences over these six bundles, and explain how you arrived at your answers. (i.e. show which is/are best, next best, and so on.) Use both  $\succ$ ,  $\sim$ , and  $\succeq$  and a graph to describe the rank ordering (make sure you correctly label **A** – **F** and show indifference curves through these points).



ii) Provide numerical bounds on MRS for each of the 6 points. (Each answer should say:  $n > \text{MRS} > m$  (fill in numbers for  $n$  and  $m$ ) but each  $>$  could be  $\geq$ .)

**A**

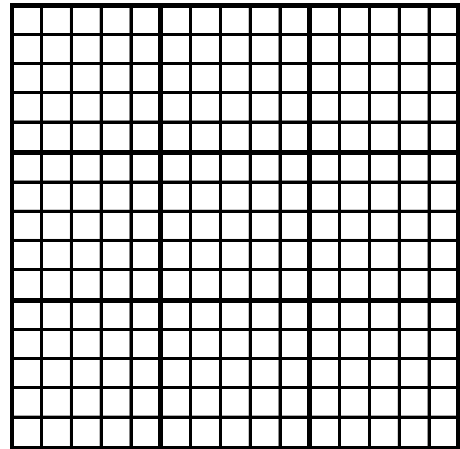
**B**

**C**

**D**

**E**

**F**



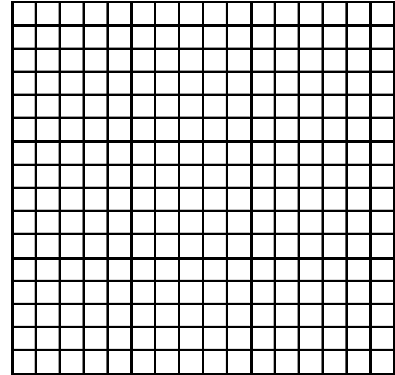
iii) How do your answers to parts i and ii change if you replace strict convexity with convexity in the start of the problem? Briefly explain by referring to what happens at each point.

iv) Suppose that we drop monotonicity from the start of the problem (but keep strict convexity). How does your answer to part i change, if at all. Explain with appropriate reference to diagram(s) as needed.

6. Jill has preferences over alfalfa sprouts (A) and bean sprouts (B) that are strictly convex and monotonic. Jill is considering her preferences over the following 5 bundles (place ounces of alfalfa sprouts on the horizontal axis and ounces of bean sprouts on the vertical axis):

**A** = (1, 11); **B** = (3, 7); **C** = (6, 6); **D** = (9, 5); **E** = (11, 1). She is indifferent between **A** and **E**. She is also indifferent between **B** and **D**.

i) Can you help Jill out? Provide a rank ordering of her preferences over these five bundles, and explain why this ordering is necessary. Provide a graph that is consistent with the information presented in part i.



ii) Jill is interested in providing numerical bounds on her MRS at points **A** – **E**. (Each answer should say:  $n > \text{MRS} > m$  (fill in numbers for  $n$  and  $m$ ) but each  $>$  could be  $\geq$ .) For each bundle, she would like to know upper and lower bounds on her MRS that are consistent with the above information. In each case, provide a rationale for your answer. If you do not think that there is an answer for one or more of these points, provide a reason why this is the case.

**A**

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**B**

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**C**

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**D**

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**E**

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iii) How do your answers to parts i and ii change if you replace strict convexity with convexity in the start of the problem? Briefly explain by referring to what happens at each point.

**A**

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**B**

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**C**

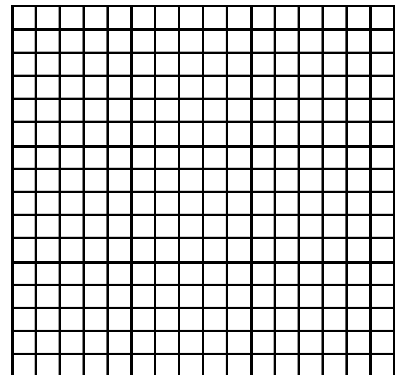
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**D**

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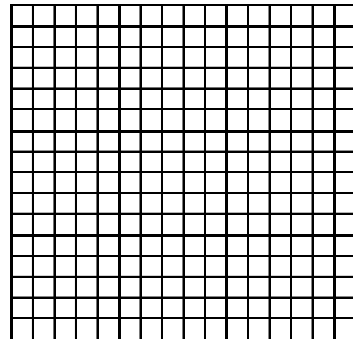
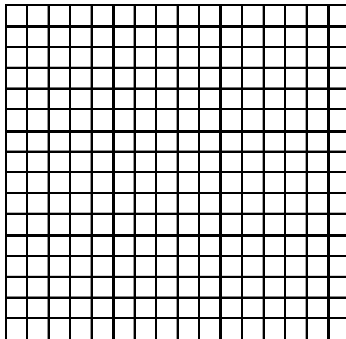
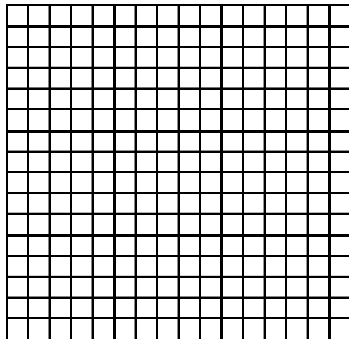
**E**

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6.iv) Suppose that we drop monotonicity from the start of the problem (but keep strict convexity). How does your answer to part i. change, if at all. Explain with appropriate reference to diagram(s) as needed. Three possibilities could potentially result.




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7. Dan likes to diet. In the past he has followed three main diet plans: low calorie, low fat, and low carb. He has had some success with each program and his current method of determining which meal he prefers is based on comparing the meal on all three aspects. Specifically he prefers meal A to meal B ( $A \succ B$ ) if it is lower on at least two of three aspects. Dan is considering three possible dinners.

- S: The steak with ultralight beer is low carb, medium calorie, and high fat.
- P: The pasta with salad and Perrier is low calorie, medium fat and high carb.
- F: The fillet of sole with chardonnay is low fat, medium carb and high calorie.

i) Does Dan prefer S or P? Explain.

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ii) Does Dan prefer P or F? Explain.

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iii) Does Dan prefer S or F? Explain.

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Are Dan's preferences well-defined? Explain.

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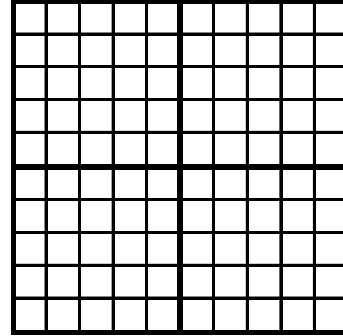
8. Explain why the assumption of convex preferences might be recast as: "averages are preferred to extremes." *Hint:* reread the definitions of convexity and strict convexity and try to create "average" points relative to two indifferent "extreme" points.

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9. Suppose you have matched up your nuts and bolts and now realize you need two washers per nut&bolt combination. Describe your preferences over (washer, nut&bolt) bundles graphically and in words (put washers on the horizontal axis and nut&bolt on the vertical axis).




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10. Suppose Jim and Fred have well-behaved preferences over CDs and DVDs. At their endowment bundles, Fred’s MRS of DVDs per CD is larger than Jim’s. Who will end up with more CDs and who will end up with more DVDs than their initial endowment bundle at the end of the day? (Suppose trading is costless.)

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11. Open the Excel file for Figure 3.14. Consider the  $(x, y)$  bundles  $\mathbf{A} = (3, 12)$ ,  $\mathbf{B} = (4, 9)$  and  $\mathbf{C} = (6, 6)$ . When the slider is all the way to the left, what is the rank ordering of these three points? How does the rank ordering change if the slider is placed in the middle? How does the rank ordering change if the slider is all the way to the right? For each of these three scenarios, provide names of goods  $x$  and  $y$  that might lead to these preferences (and explain why you think these goods are appropriate).

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**An extension of an example from the text:** Consider, once again, studying Economics versus French as discussed in Section 3.3. In the text solutions were proposed using the bliss point Excel file that allowed you to describe preferences over these two “bads.” Consider a different

scenario regarding your dislike over these two subjects. The scenario may be described by the following three assumptions:

**Assumption i)** You have a symmetric dislike for studying French and economics.

**Assumption ii)** You have strictly convex preferences over these two goods.

**Assumption iii)** You are indifferent with spending 20% more total time studying if you can split your time equally between the two subjects relative to spending all study time on one subject or the other.

Provide an indifference map of these preferences and show indifference curves that pass through the (E, F) bundles  $\mathbf{A} = (0, 5) \sim (5, 0) = \mathbf{B}$  and  $\mathbf{C} = (0, 10) \sim (10, 0) = \mathbf{D}$ .

**Attacking this problem:** You should start by reviewing the similar problem at the end of Section 3.3. As with that problem, the bliss point Excel file can be used to solve this one. The first strategy for attacking the problem is to use pencil and paper and try to create a freehand graph of an indifference curve based on this information. Consider, for instance the indifference curve through  $\mathbf{C}$  and  $\mathbf{D}$ . A quarter circle with radius 10 and center at  $(0, 0)$  is strictly convex and would satisfy Assumptions i and ii. The set of bundles at least as good as this indifference curve (the upper contour set) is the boundary of the quarter circle and everything inside the quarter circle. This set is strictly convex. This can be easily drawn with graph paper and a compass.

You can examine this with graph paper or you can use Ch03W.10-13BlissPoint.xls Excel file. A screen shot from the 10,11Stretching worksheet in this file is provided as Figure 3W.6. (Sliders have been shown beneath the figure but that is not necessary when copying a graph from Excel to Word. They are shown in this context to allow you to duplicate the figure for yourself.)

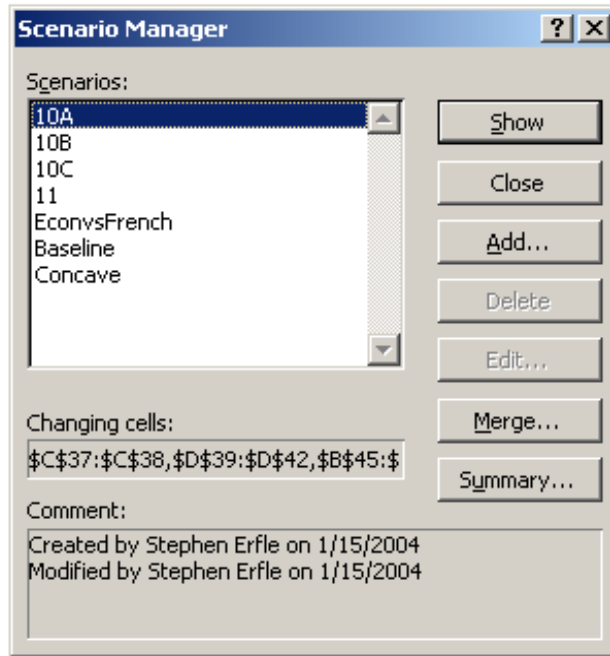
The following is also explained in Chapter 1

Some problems will require you to turn in graphs that are at least partially completed within Excel, but which you might further label prior to turning in as homework.

**About workbook files:** Workbook files are based on the figure files from the textbook but are more “generic” in nature in order to provide maximum flexibility for answering these problems. Workbook files are labeled the same as chapter files but a **W** has been added after the chapter number. Workbook files maintain the numbering system from the chapter, but do not expect to always use them in numerical order. These files have been modified to allow you to add information. For example, workbook files have spaces where you can add labels; these are colored **light blue**. Sliders and click boxes will allow you to modify the curves and lines in the figure to create your answer.

**Using existing scenarios:** Excel has a built in function that allows the user to remember specific settings of the sliders and click boxes that are used to create textbook figures. If you do not want to manipulate the sliders to match a figure in the text you can use the **Scenario** function. For example, open the file for Figures 3.10-3.13 and click on the **10,11Stretching** worksheet tab (at the bottom of the screen). Click: **Data, What If Analysis, Scenario Manager** if using Excel 2007 (or **Tools, Scenarios** if using Excel 2003); then the **Scenario Manager** popup menu shown below will appear (the 2007 version looks slightly different but has the same functionality). From here you can choose the scenario you wish to see on the screen by clicking on that

scenario, then click **Show**, **Close** and the figure will now look like the figure in the text (with the possible exception that the text version may have further labeling added).



**Creating your own scenarios:** Once you have a picture you wish to save, you can create your own scenario. (This is not necessary but can be done if you wish to come back to this same graph at another time.) To do so, set the sliders and click the check boxes as you wish to have them and click: **Data, What If Analysis, Scenario Manager** if using Excel 2007 (or **Tools, Scenarios** if using Excel 2003); **Add**. Type in your scenario name, then click: **OK, OK, Show, Close**. Note: the **Scenario** function will remember the location of sliders and click boxes, but it will not remember the labels you may have typed into the light blue boxes.

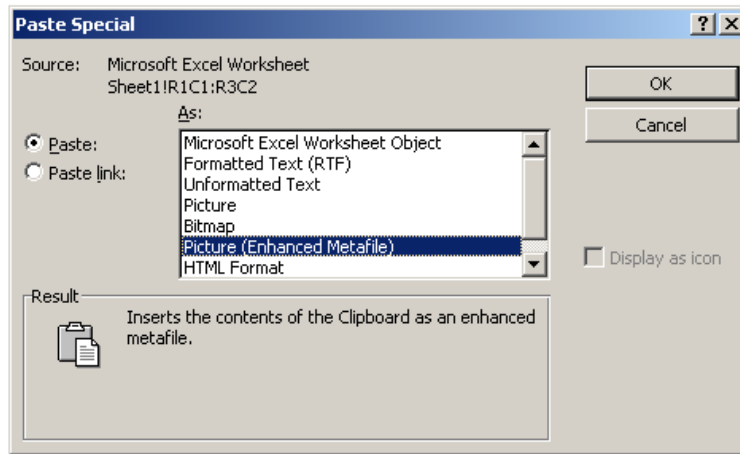
**How to Transfer an Excel Diagram to Word:** When you have a diagram you wish to use to answer a problem, you can transfer it to Word using the following mechanism (a simple **Copy** in Excel and **Paste** in Word will not provide you with a usable diagram):

1. Open a Word document into which you wish to insert the figure.
2. Go back to the Excel file whose figure you wish to transfer into Word.
3. Highlight the cells you wish to transfer into Word. This is accomplished by clicking on a corner cell and moving the mouse until you have an open white cross. Hold down the left button and drag the mouse until you have highlighted the area. Once you release the left click button on your mouse the highlighted area should show as blue-gray.

*For example, the cells A1:K29 from the 10,11Stretching worksheet have been highlighted to create Figure 3W.6.*

4. Right click and choose **Copy**.

5. Return to the Word document and move to where you want to place the figure. Click **Edit, Paste Special, Picture (Enhanced Metafile)** (the Paste Special popup menu should look as shown below), **OK**.



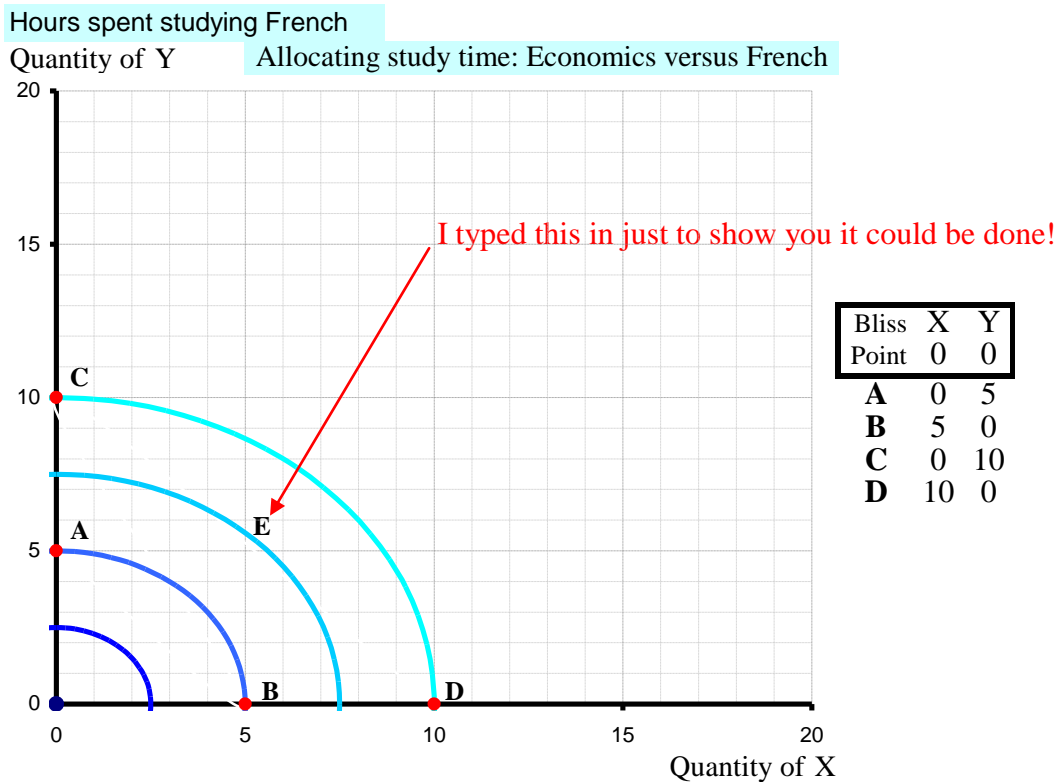
The result should be a picture of the highlighted area, just as you see it on the screen. If you are doing much editing of your document, it is worthwhile to place the figure just after a hard page break so that you do not have to move it until you are finished working on the document. (Click **Insert, Break, Page Break, OK** to create a hard page break.)

**Modifying a picture in Word:** From here you can modify the picture if you wish using Word.

To see the kinds of things you can do with an image within word, right click on the picture, then click **Format Picture**, and you can see a number of things you can do with the picture by looking at the various tabs. Two tabs in particular are useful, the **Size** tab and the **Layout** tab. The **Size** tab allows you to resize the picture up or down. The **Layout** tab allows you to place the picture where you wish within the Word document. If you have a picture you do not want to modify, use the **In line with text, Square** or **Tight** options. These options do not allow you to add information to the picture.

If you wish to add information to the picture, use the **In front of text** option then navigate underneath the picture using the arrow keys and the space bar. For example, I typed the statement “I typed this in just to show you it could be done!” and formatted it in red at point (10, 15) by simply navigating “beneath” the picture of Figure 3W.6 in Word. I also added a red arrow pointing at the bundle (6, 6) and the label **E**. The arrow requires using **Shapes** on the **Insert** ribbon in Excel 2007 (or the **Drawing** toolbar in Excel 2003. To add this to your standard setup within Word (typically the **Standard** and **Formatting** toolbars are shown), click **View, Toolbars, Drawing**.) When drawing arrows and lines you can move them in large increments by placing it in the rough location, then clicking on the object and using the arrow keys. For fine movements, hold down the **Ctrl** key as you use the arrow keys. Unfortunately, letters such as **E** cannot be micro-moved in the same way; nonetheless, you can get close to where you want the letter placed by adding or taking away blank spaces.

Figure 3W.6



Hours spent studying Economics

location of bliss point		"cost" of not being at bliss point	
X = 0	◀ [ ] ▶	X direction	◀ [ ] ▶
Y = 0	◀ [ ] ▶	Y direction	◀ [ ] ▶

Show shifted axes at bliss point.      low      high

Show points A - D (labels are based on bliss point of (0,0)).

Although the quarter circle satisfies Assumptions i and ii we must consider if the quarter circle satisfies Assumption iii. Assumption iii says that you would be willing to study 20% more if you split your time equally between the two subjects. Consider  $C \sim D$ . Assumption iii says that you would be indifferent with  $E = (6, 6) \sim C \sim D$  because 12 hours split evenly between Economics and French is 20% more than studying only Economics or French for 10 hours.

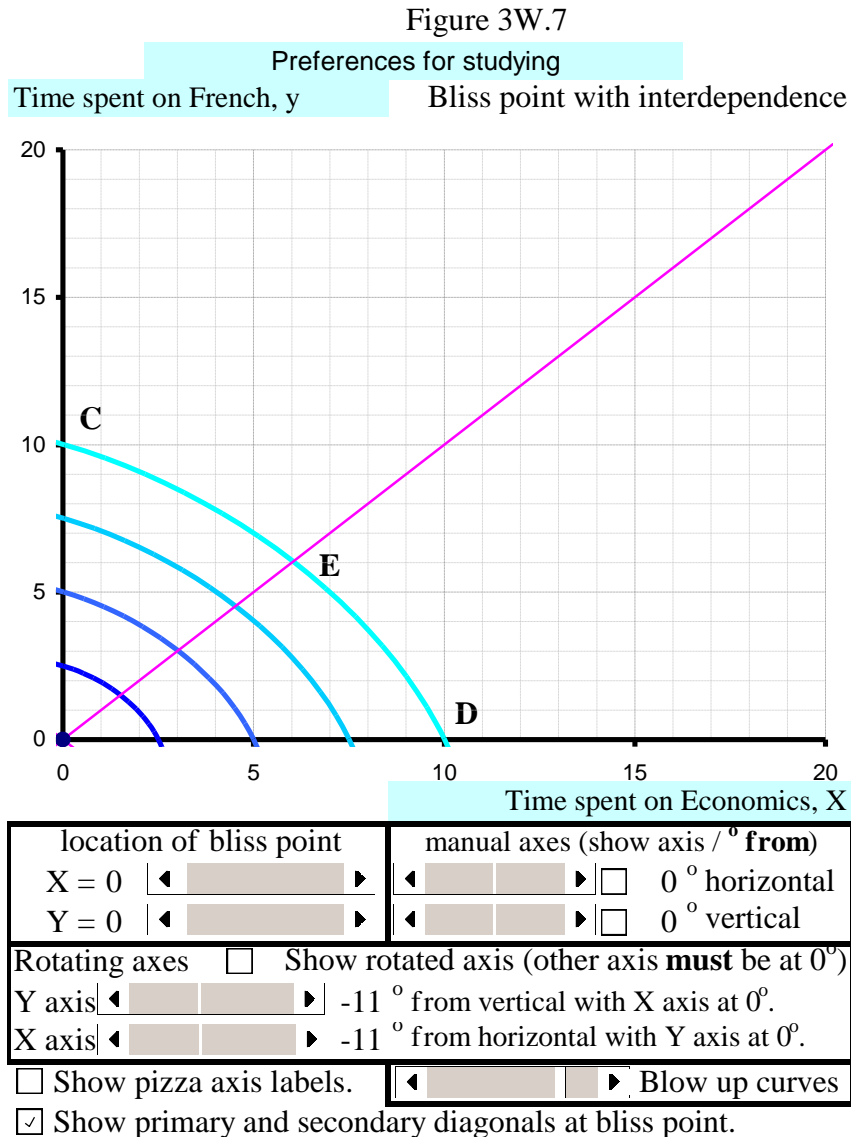
Figure 3W.6 does not depict such preferences because  $E \succ C \sim D$  according to the figure. (Recall, since both goods are economic bads, bundles closer to the origin are preferred to bundles on the indifference curve.)

Indeed, if you were asked what percent increase in time you would permit given the preferences depicted in Figure 3W.6 the answer is a bit more than 40%. The proof is simple:

$x = y$  on the circle going through  $C$  and  $D$  when  $2 \cdot x^2 = 100$  according to the Pythagorean Theorem.  $x = 50^{0.5} = 7.07$ , and  $2 \cdot 7.07 = 14.14$  is 41.4% more than 10.

We need an indifference curve that is downward sloping and becoming steeper like in Figure 3W.6 but is less “curvy” since it should go through (6, 6) rather than (7.07, 7.07). This is accomplished using a tilted oval rather than a circle.

Assumption i requires that both goods exhibit symmetry about the 45° line. The **12,13Rotating** worksheet allows you to create ovals that are symmetric about the 45° line by maintaining equal numbers for both sliders in Rows 28 and 29 of the worksheet. As you do this the size of the ovals shown in the first quadrant will change so you will want to adjust the overall size using the slider in Row 30, as well, in order to maintain an indifference curve that goes through **C** and **D**. Figure 3W.7 provides an indifference map that satisfies all three assumptions.



Note that this solution works for lower indifference curves as well. In particular, **A** = (0, 5) ~ (5, 0) = **B** ~ **F** = (3, 3) and 6 hours divided between the two subjects (3 + 3) is 20% more time spent studying than 5 hours of either subject in isolation.

12. Use the Excel file for Figure3W.05 and put nickels on the horizontal axis for each scenario. Use the slider to depict the following. A) pennies versus nickels. B) dimes versus nickels; C) quarters versus nickels. (Copy your graphs using the **Copy** command within Excel and the **Edit, Paste Special, Picture (Enhanced Metafile)** command within Word to transfer files into your answer sheet (*as described in the examples above*.)

13. The three panels in Figure 3.8 depict three of the six strict preference relations that may exist between 3 bundles.

i) Use sliders on the Excel file for Figure 3.8 to depict the other three relations:

$A \succ C \succ B$        $C \succ A \succ B$       and       $C \succ B \succ A$ .

(Copy your graphs using the **Copy** command within Excel and the **Edit, Paste Special, Picture (Enhanced Metafile)** command within Word to transfer files into your answer sheet.)

ii) What is the economic significance of being able to depict all six of the strict preference relations?

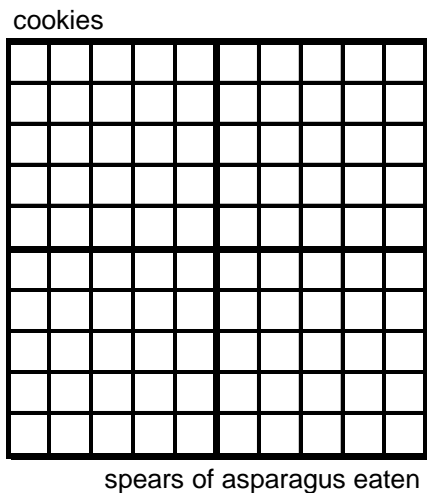
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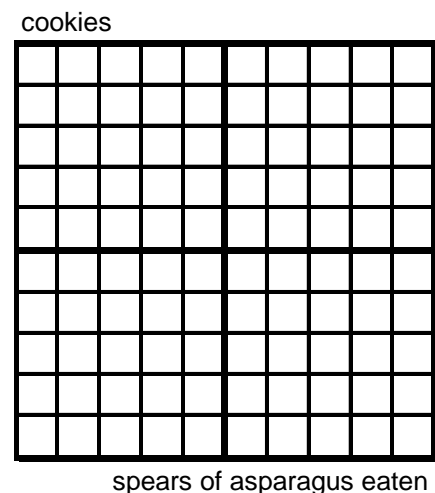


14. Mom and dad are trying to teach Kate and Vera to love their vegetables. They were both given 10 asparagus spears at the start of the meal and both have only five spears left at the end of the meal – and both are now asking for cookies for dessert. Mom says: “If you eat four more spears of asparagus you can have three cookies.” “Great!” says Kate. “I’m full” says Vera. As Vera is about to get up from the table she says, “I’d eat two spears of asparagus if I can get one cookie.” Kate says “I’d rather eat four more spears of asparagus and get three cookies than eat two spears of asparagus for only one cookie.” Graph preferences consistent with each of their answers assuming each achieved satiation at five spears. Label their initial bundle  $(5, 0) = \mathbf{E}$ , Mom’s offer point  $\mathbf{M}$  and Vera’s counter offer  $\mathbf{V}$ . Also provide a rank ordering of the bundles  $\mathbf{E}$ ,  $\mathbf{M}$ , and  $\mathbf{V}$  for both girls. (You could answer this using the Excel file for Figure 3.8.)

Kate’s preferences

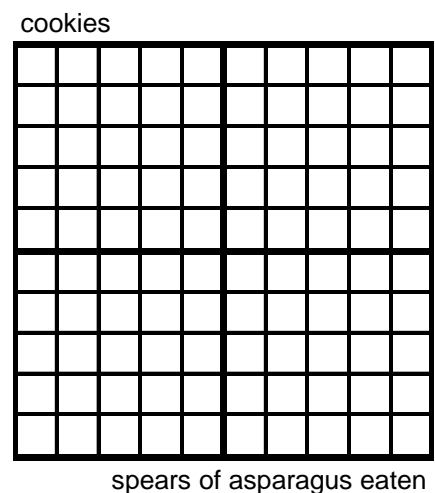


Vera’s preferences



15. (You need not answer Problem 14 to do this problem.) David is a bit more cautious about extra asparagus than Kate or Vera. Dave has eaten five of the ten asparagus spears that were placed in front of him at the start of the meal and he has heard Mom’s offer and Vera’s response. Dave, being quite analytical, says: “I certainly would not accept Mom’s offer that I eat four spears (of asparagus) for three cookies, in fact, I’m indifferent between what I’ve eaten now and eating four spears for four cookies (label this bundle  $\mathbf{D}$ ). And Vera’s response also leaves me indifferent with what I’ve eaten now. Dave has strictly convex preferences.

David’s preferences



i) Use sliders on the Excel file for Figure 3.8 to depict Dave’s preferences assuming that Dave achieved satiation at five spears. You can sketch them using the graph provided but it may help to do this with the Excel file.

15.ii) Dad considers intervening with Dave. Dad is willing to cut cookies in two and has devised three alternative options (label the options **A**, **B** and **C**):

- Option A) One spear for one half a cookie.
- Option B) Three spears for three cookies.
- Option C) Three spears for two and a half cookies.

Obviously Dave would like option B rather than C if offered both options since he has to eat the same number of asparagus spears but he gets an extra half cookie in option B. But Dave’s dad is devious – he wants to figure out if an offer will be accepted prior to offering it. Can you help Dave’s dad out? Provide a graph and a short answer to each question. (You will have to use the concept of strict convexity to answer this question.)

ii.A) Given the information in part i, if offered only Option A, will David eat one spear in exchange for one half cookie? Provide graphical support for your answer using the upper graph.

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ii.B) If offered only Option B, will David eat three spears in exchange for three cookies? Provide graphical support for your answer using the middle graph.

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ii.C) If offered only Option C, will David eat three spears in exchange for two and a half cookies? Provide graphical support for your answer using the lower graph.

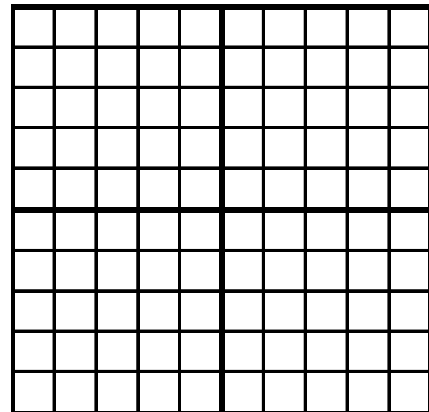
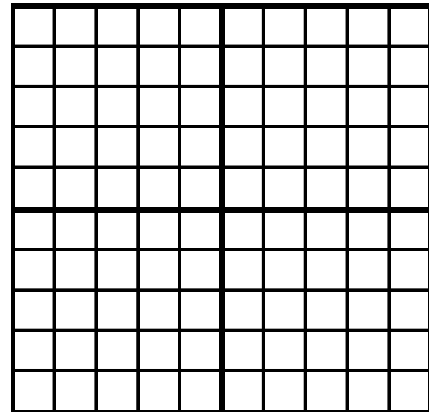
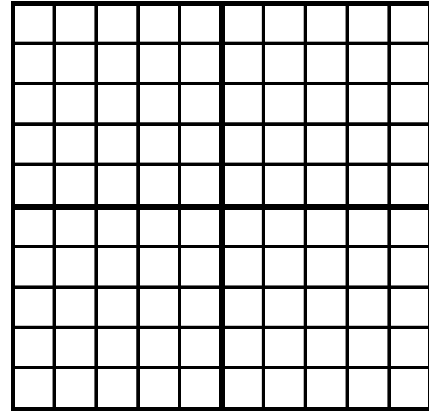
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16. Open the Excel file for Figure 3.13. Click: **Data, What If Analysis, Scenario Manager** if using Excel 2007 (or **Tools, Scenarios** if using Excel 2003); **Q16Setup, Show, Close** to set up the file to do this problem. Move the sliders in rows 28 and 29 to the right by  $5^\circ$  at a time up to  $+40^\circ$ , keeping both sliders at the same level (both at  $+5^\circ$ , both at  $+10^\circ$ , and so on).

i) Describe what happens to the economic region of consumption as the degrees increase.

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ii) Does this depict competition or synergy between x and y?

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iii) What is the economic interpretation of the main diagonal (going through the longer diagonal of the oval) in this instance?

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17. Redo Problem 16 but move the sliders to the left of center in **B28:D29**,  $5^\circ$  at a time to  $-40^\circ$ .

i) Describe what happens to the economic region of consumption as the degrees increase.

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ii) Does this depict competition or synergy between x and y?

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iii) What is the economic interpretation of the main diagonal (going through the longer diagonal of the oval) in this instance?

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18. Show that the set of Pareto optimal allocations in the barter model developed in Section 3.5 is the set of points  $y_A = (14/15) \cdot x_A$ .

Hint: If Annie has  $x_A$  units of  $x$  and  $y_A$  units of  $y$ , how much of each good does Bob have?

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19. Explain why each of the Pareto optimal outcomes in the barter model developed in Section 3.5 had  $MRS_A = MRS_B = 0.93$ . (This is easy to do if you have already done problem 18.)

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NOTE: The Edgeworth Box material from this chapter has been reworked into an article in the Online Section of the *Journal of Economic Education* (Fall 2015). For extra Edgeworth Box questions or to see an alternate take on this material, see:  
<http://users.dickinson.edu/~erfle/ExcelGraphics/BarterEdgeworthBoxHW.xlsx>