Quantitative Methods

Introduction

Dan Brandon, Ph.D., PMP

Instructor Contact Information

- Email
  - dbrandon@cbu.edu
- Phone
  - 321-3615 (email is better)
- Office
  - BU 302
    - **Check office door for current physical office hours**
    - **Online courses may have all office hours online**

Canvas

- Canvas is now used for this course
- Whether this class is in-person, online, or hybrid:
  - All submissions of assignments are to be submitted via Canvas
  - Gradebook is in Canvas
- Canvas contains the syllabus page and the course policies page

Canvas (con't)

Navigation Tip

The left-side navigation menu includes a "Modules" button, which acts as a gateway to learning content and other helpful resources (including Canvas support).

If you are accessing this course from a mobile device, please review the following: Mobile Guides - Canvas Student

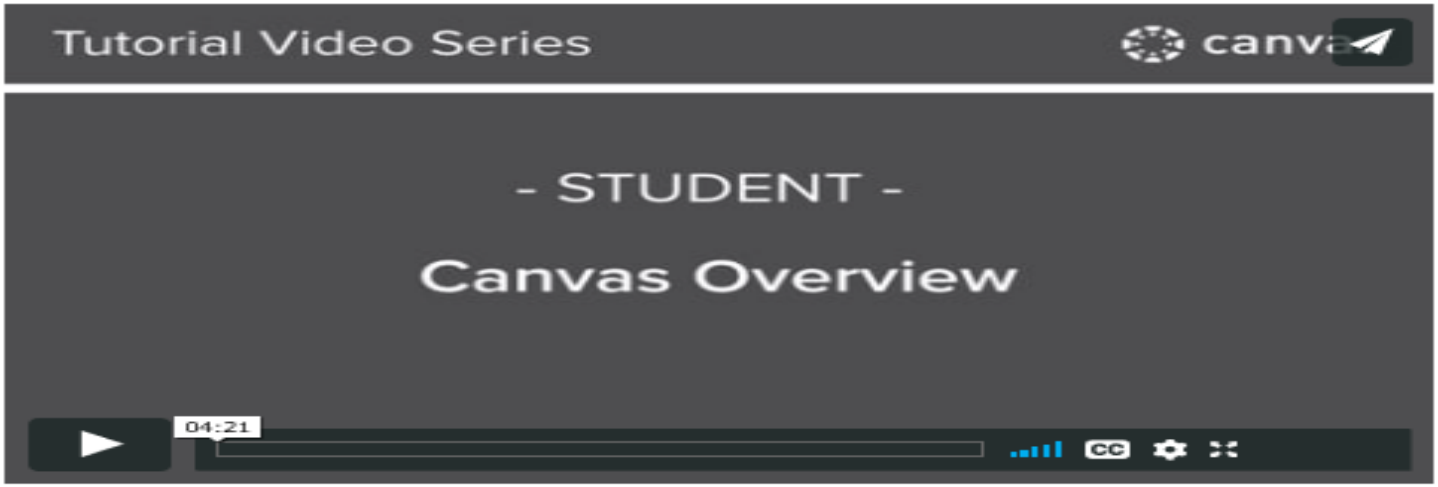
Canvas (con’t)

Canvas: Getting Started

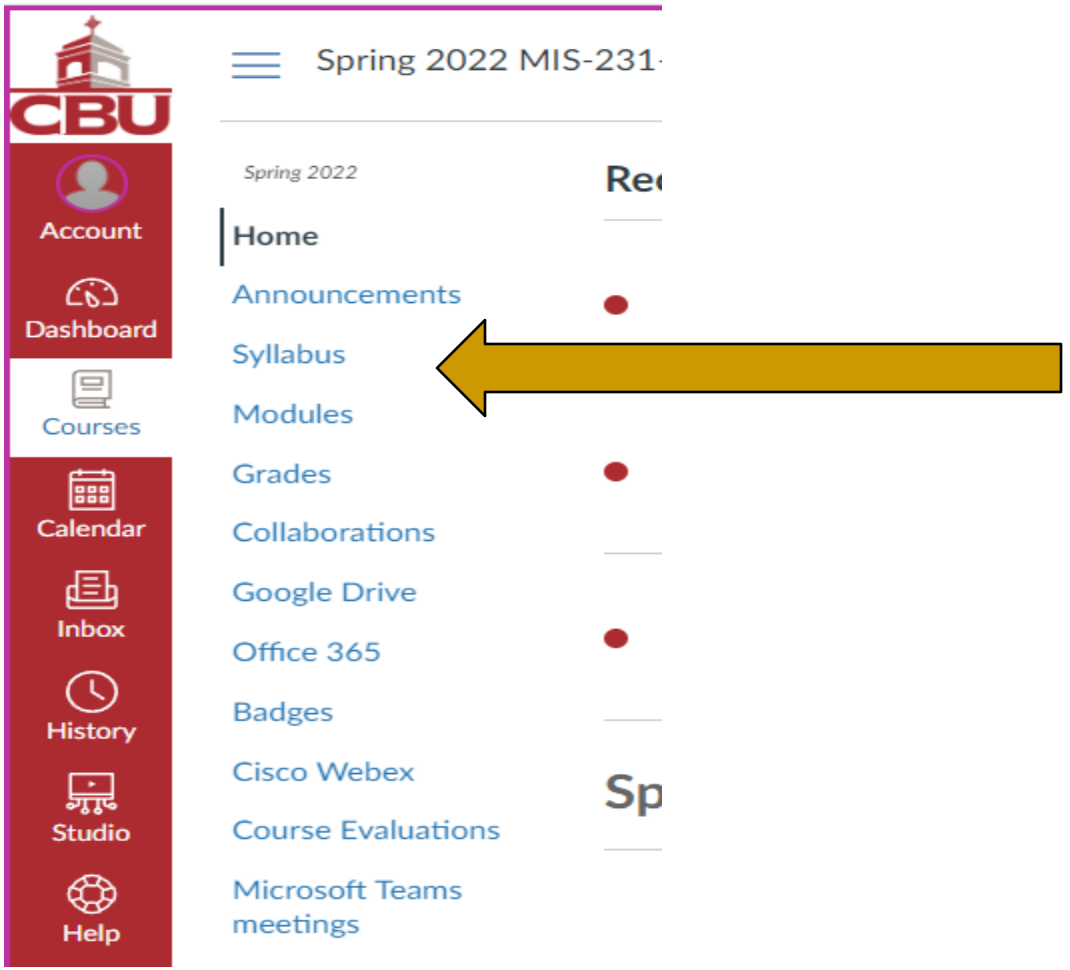
The Basics

- What are the basic computer specifications for Canvas?
- Which browsers does Canvas support?
- How can I use Canvas on my mobile device?
- How do I get Help?

Canvas Overview



Syllabus in Canvas

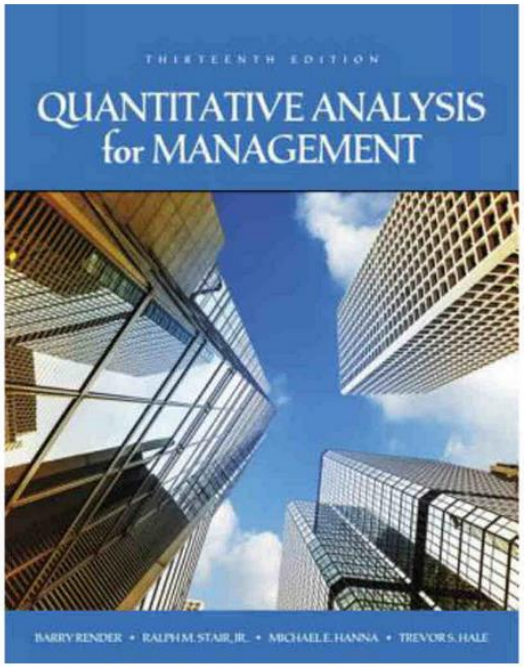


Lesson Files & Multimedia

- Some slides contain video links/lessons (see image below) - make sure your sound is fully enabled
- Videos contain additional information or information presented in another manner, and the videos are generally prepared by industry experts in the field
- For some videos, you may have to hit the browser back or exit button to return to this lesson
- Some videos may require you to enter your session content username/password (supplied to students in class)
- Some videos may have expired or been removed
  - Let instructor know if your encounter this

Textbook

- Render, B., Stair, R., & Hanna M.
- Quantitative Analysis for Management
- Latest Edition
- Pearson Prentice-Hall



Student Resources

[www.pearsonhighered.com/render]

Quantitative Analysis for Management, 13/e

Render • Stair, Jr. • Hanna • Hale

- Instructor Resources
- Student Resources
- Buy this book

Optional Software – QM's

[https://media.pearsoncmg.com/ph/bp/bridgepages/bp_render_bridgepage/qam_13e/index.html]

Click the links below to download the files that accompany your textbook.

Additional Book Resources

Data files for Examples	.zip	[425 KB]
Online Modules	.zip	[11.2 MB]
Internet Homework Problems	.zip	[94 KB]
Internet Case Studies	.zip	[3.3 MB]

Software Downloads

NOTE: If your virus protection program will not allow you to download or to install the software please see the following document.

Excel OM/QM for PCs, Version 5.3	.msi	[6.3 MB]
Excel OM/QM for Macs, Version 5.3	.zip	[6 MB]
POM/QM for Windows®, Version 4	.zip	[27.1 MB]

CBU Follet Access Program

[https://www.cbu.edu/bookstore/follett-access-book-program/]

- Now all CBU class textbook rental and required supplies costs will now be included in a flat-rate "book fee" on your CBU bill so that you know in advance what your costs will be
- The **Follett ACCESS Program** delivers required materials for the courses for which you're registered, making sure you're prepared for the first day of class
- Students will be charged $23 per credit hour (Spring 2022 rate) to cover all required course materials
- To make paying for the fee convenient, it can be included in any payment plan you choose
- Typically, students save money with the flat fee based on total credit hours!

CBU Follet Access Program

Is Follett ACCESS required for all students?

No, students may choose to opt out of the Follett ACCESS program by clicking here. Please note that you will be prompted to create an account to allow you to opt out. Students wishing to opt out must do so by the last day to add/drop a course to avoid having the "book fee" assessed on their account. When students opt out of Follett ACCESS, they do so for all courses in a given term. Students may not opt out of individual courses.

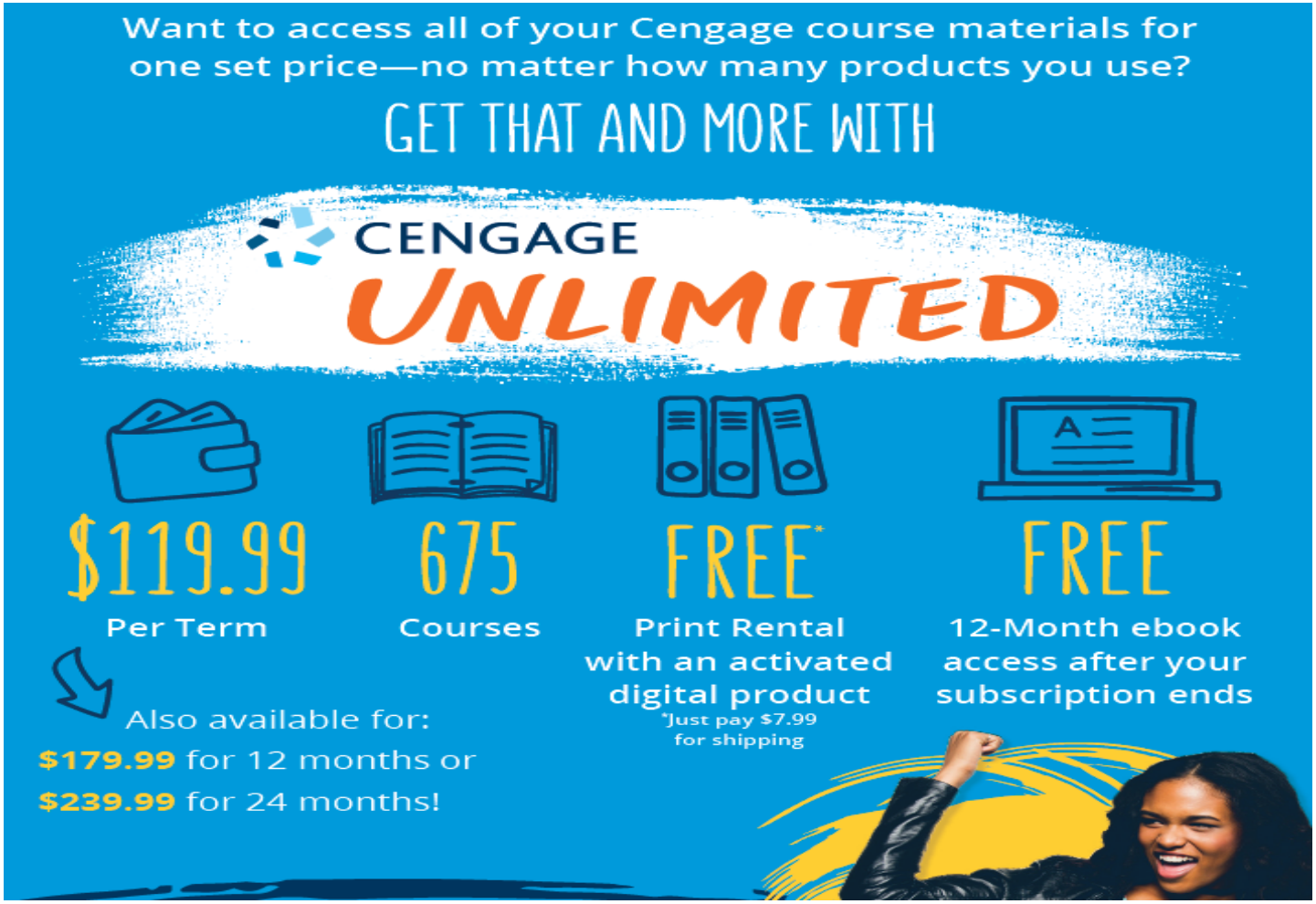
Follett ACCESS Opt Out

All students are by default enrolled in the Follett ACCESS program and must take action to opt out of the program.

Students who opt out of Follett ACCESS will be responsible for finding their required course materials on their own. You are not under an obligation to purchase your required course materials from the CBU Campus Bookstore or through the Follett ACCESS program, but all materials will be available at the CBU Campus Bookstore.

Cengage Unlimited

Cengage Unlimited (con't)



Cengage Unlimited (con't)

- All that is required of the student for a Cengage Unlimited subscription is to come by the CBU bookstore and choose whether they would like a 4 month (119.99), a 12 month (179.99), or 24 month access (239.99)
- With this access, they will have every book Cengage has ever digitized, which is around 22,000 total titles and about 7800 that Follett currently uses across all US stores
- Even if they are not taking the course the book is being used for, they can still access that title
- All instructors need to do is adopt the book through the bookstore and on the Shelf Tag, it will print the prices for the New and Used Retail, New and Used Rental (If Applicable) the three tiers of Cengage Unlimited, and the eBook only price

Cengage Unlimited eTextbooks

STUDENT PRICING OPTIONS

Cengage Unlimited options are available direct to students in campus bookstores and online.

	CENGAGE UNLIMITED eTEXTBOOKS	CENGAGE UNLIMITED MINDTAP | WEBASSIGN | OPENNOW | SAM | CNOW^{V2} | OWL^{V2} | eTEXTBOOKS		
	$69.99 for 4 months	$119.99 for 4 months	$179.99 for 1 year	$239.99 for 2 years
Instant Access Code (IACs)	978-0-357-69333-9	978-0-357-70000-6	978-0-357-70001-3	978-0-357-70002-0
Printed Access Code (PACs)	978-0-357-69393-3	978-0-357-70003-7	978-0-357-70004-4	978-0-357-70005-1

Backups

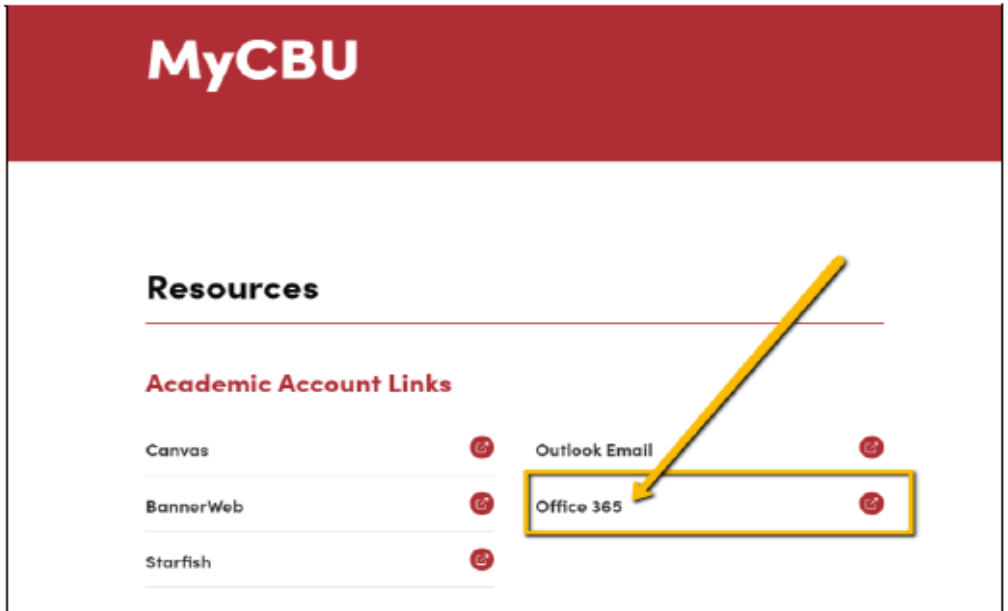
- Students are responsible for backing up their files
- Losing a file (or an USB) is no excuse
- Office 365 OneDrive
- Cloud Providers

1. What OneDrive Is

OneDrive is a cloud-based storage drive for your CBU files. Your OneDrive is linked to your CBU Microsoft 365 account and password protected behind CBU's single sign-on (SSO). It's an ideal place to upload files you want to use in your course and to share.

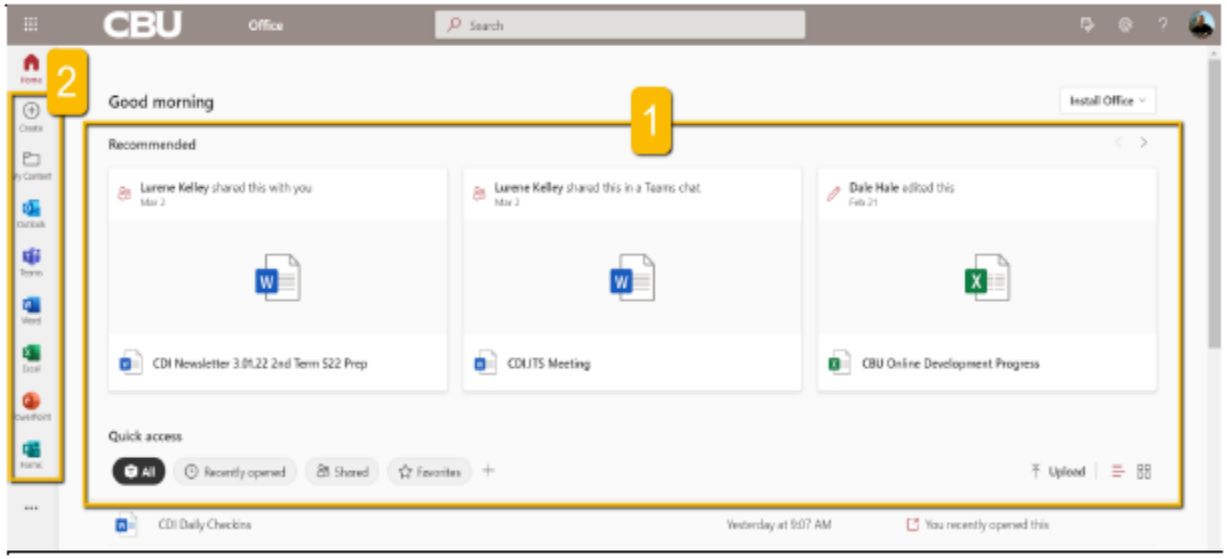
2. Finding Your OneDrive

1. From the CBU website, access and log in to MyCBU.
2. From the Resources section, select Office 365.



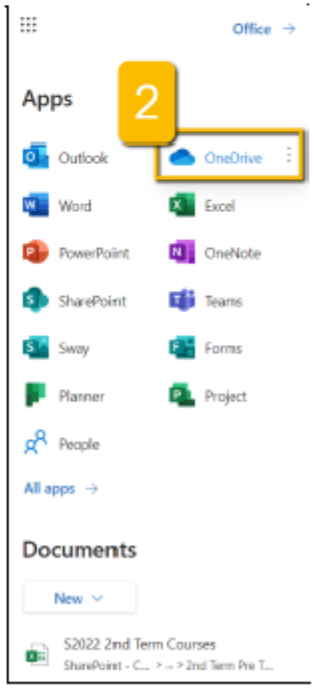
3. Your Office 365 Dashboard

1. You land in your Office 365 Dashboard, a place where you can quickly see and access the files you've recently been working on
2. From the left-hand toolbar, you can quickly create new files or access a number of commonly-used Office 365 tools.



4. The App Launcher & OneDrive

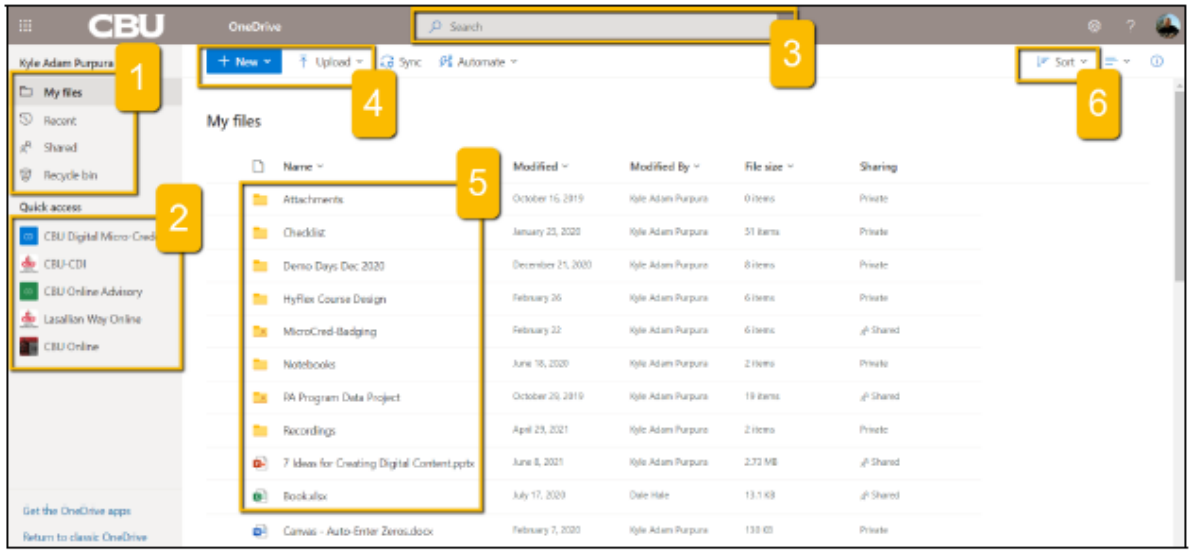
1. To access the Office 365 App Launcher and OneDrive, click the domino icon in the upper right-hand corner of your Dashboard.
2. From the menu drawer that appears at the left of the screen, select OneDrive. Your OneDrive will open in a new tab.



5. Your OneDrive Dashboard

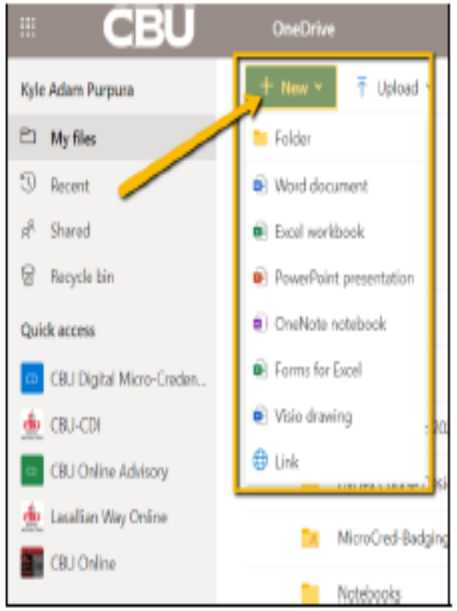
From your OneDrive Dashboard, you can:

1. Quickly access all your files, your recent files, files that have been shared with you, or files that have been trashed;
2. Quickly access any groups to which you have been attached and any files or shared resources that are housed with these groups;
3. Search for a specific file or folder;
4. Quickly create new files/folders or upload existing files/folders from your desktop;
5. View your files and folders;
6. Sort your files and folders in a way that makes sense to you.



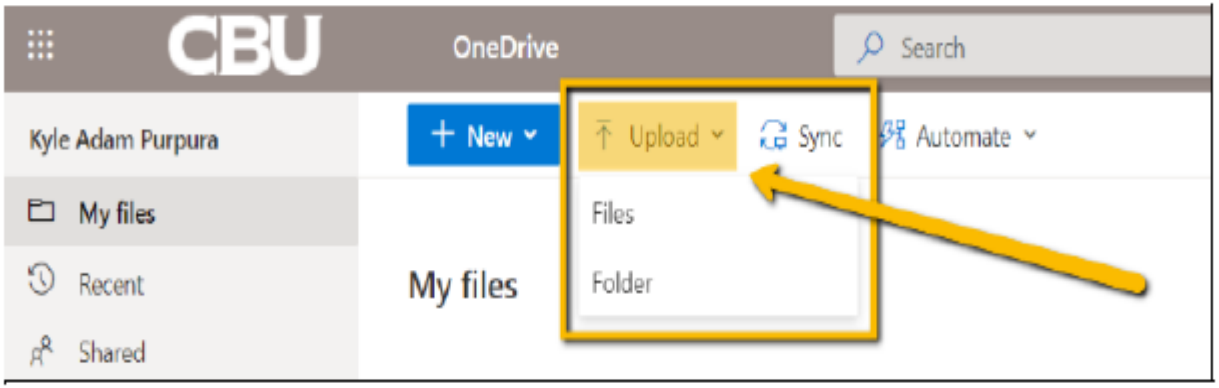
6. Create New Files & Folders

- Click the +New button to create new files (Word, Excel, PPT, OneNote, Forms, etc.) or folders in which to organize your files



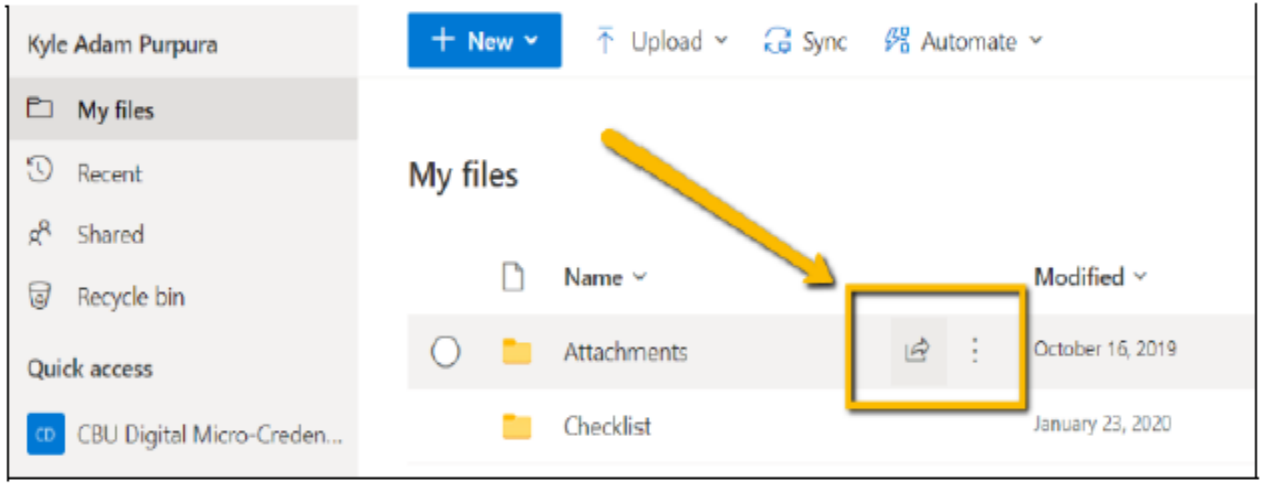
7. Upload Existing Content

- With just a couple of clicks, upload files and folders saved locally



8. Manage Files & Folders

- Hover to the right of file/folder titles to reveal a sharing button and an options (ellipsis) menu

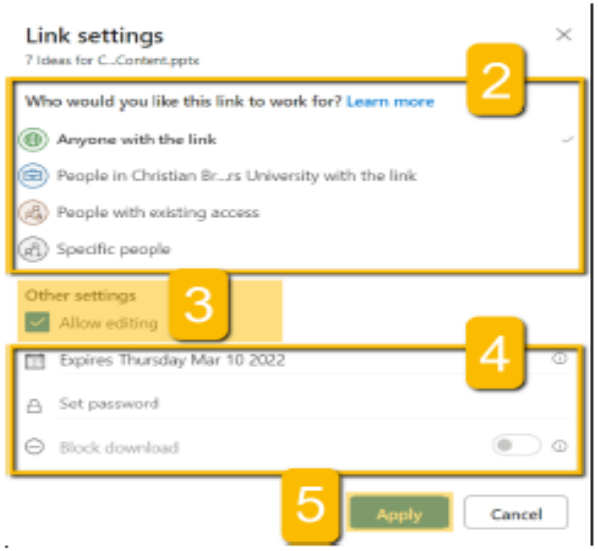


9. Sharing Settings

- You can manage the sharing permissions for any file or folder by clicking the sharing icon located to the right of the file/folder title.

1. Send links via email or copy a link to embed in a file;

2. Decide who has access;
3. Manage editing rights;
4. Set added security measures;
5. Click Apply to save settings.

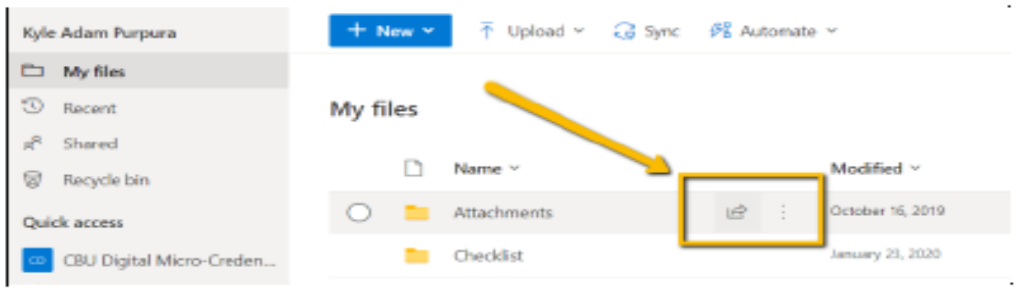


***Notes**

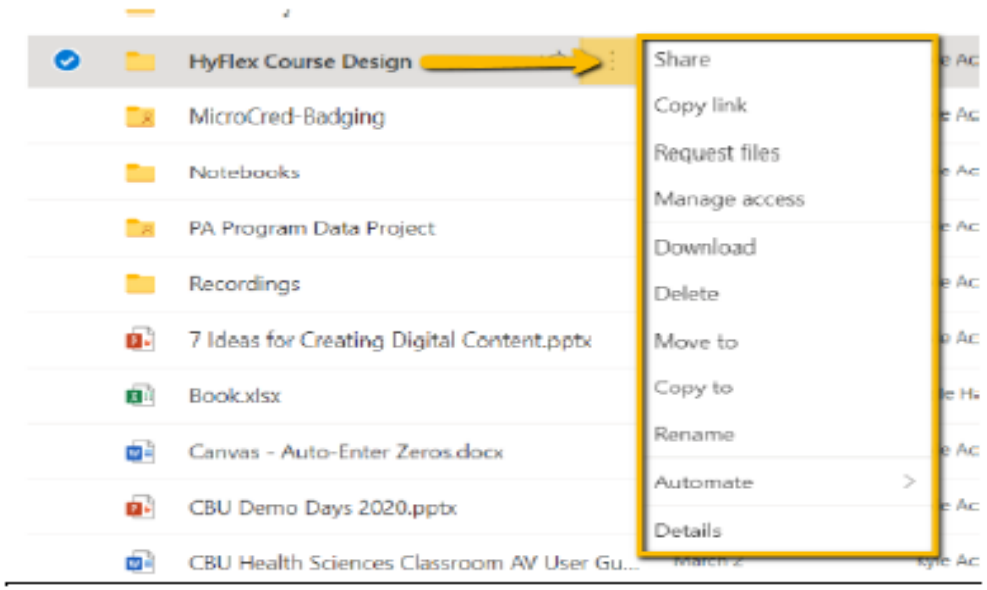
- "Anyone with the link" expires automatically in 24 hours
- If you are sharing for a professor in a course, it's best to select "Specific people" and then enter the professor's CBU email where indicated
- Sharing settings applied to a folder are automatically applied to any file within the folder, unless individually changed

10. Ellipsis (Options) Menu

- The Ellipsis (Options) menu gives you more action options for your files/folders



- Sharing, copying, requesting files via email from another person, managing access of existing people shared already, downloading, deleting, moving or copying to another location, renaming, automating (disabled at CBU), and accessing file information



Cloud Backup & Sharing Sites

THE SITE	FREE SPACE	BEST FOR...
Google Drive drive.google.com	5GB	Documents, because the interface makes it easy to edit them
Amazon Cloud Drive amazon.com/clouddrive	5GB	Music, since you can play your stored tunes on any device with Amazon Cloud Player
Dropbox dropbox.com	2GB	Photos, because the site offers a viewer and makes it easy to share albums
Microsoft SkyDrive skydrive.live.com	7GB	Microsoft Office projects that you use from multiple computers, because the site syncs automatically
SugarSync sugarsync.com	5GB	Documents you're collaborating with others on, since you can password-protect public files

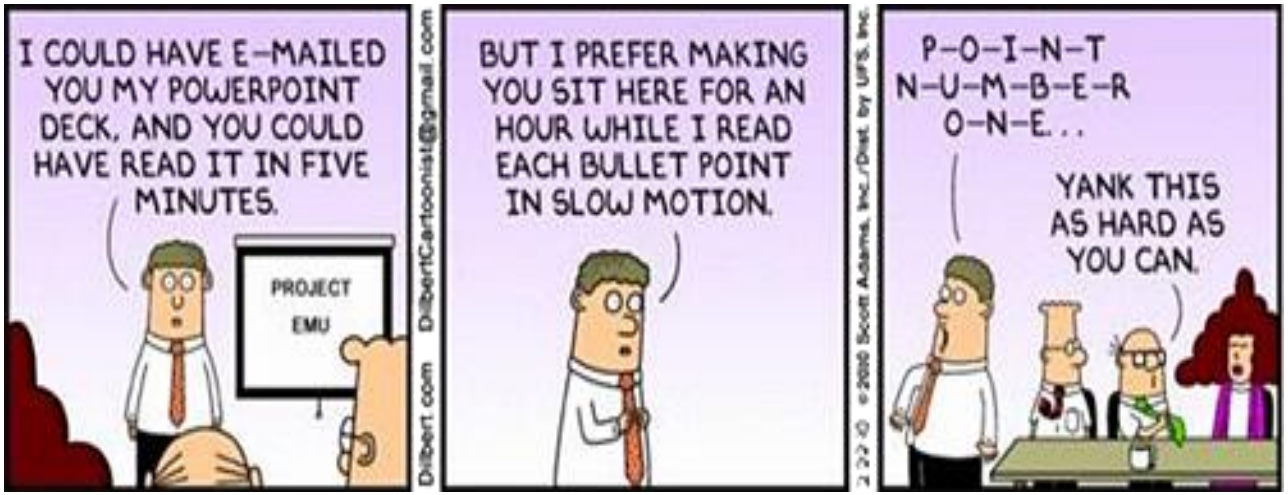
Quantitative Methods Course

- Application of math and science to business and management decisions
- Pre-reqs: MIS 153, STAT course
- Theory and mathematics is covered, but emphasis is on:
  - Understanding basic principles of these techniques
  - Applying techniques to management situations
  - Setting up the problems in modern solution tools
  - Interpreting results

Lessons

- Hopefully not “Death by PowerPoint”
- Lessons contain:
  - Content & videos
  - Discussion Questions
  - Exercises/Answers
  - Assignments/Projects

Class room interactivity depends upon student participation !



Quantitative Methods Course

[Operations Research]

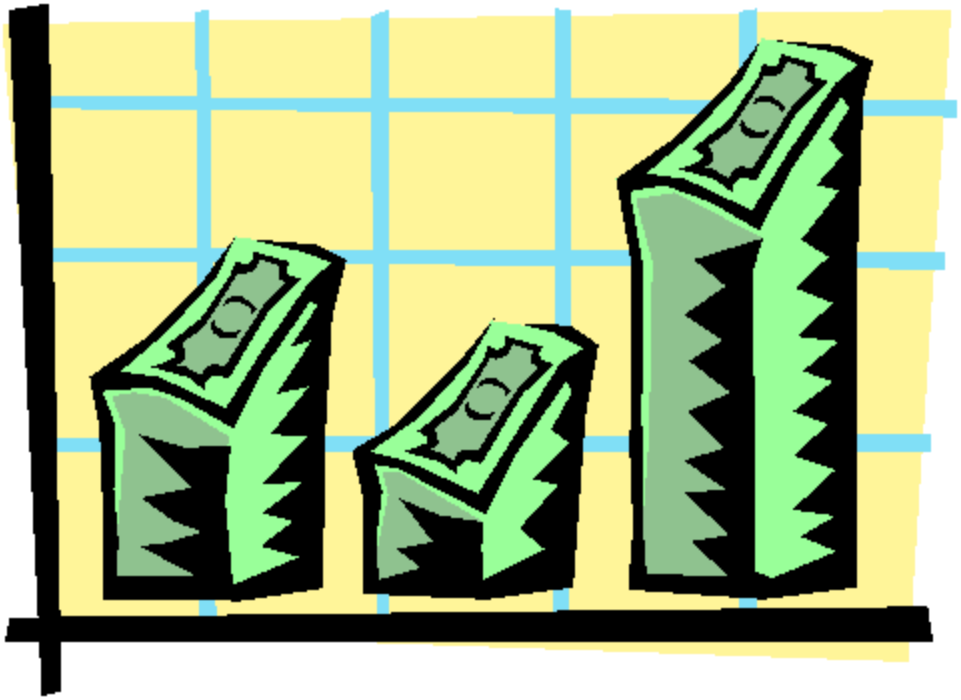
- Methods and tools to make <u>quantitative management decisions</u>
- Not

Tools/Software

- The primary learning tool is Microsoft Excel (or other comparable spreadsheet)
  - During live classes have an Excel window open
  - PC, laptop, tablet, or Mac platform can be used
- The Excel QM add-in and Win POM QM is available from the textbook publisher website
- There are specific software programs available for most of the methods/algorithms, but none are needed for this class

Thought ???

- What is one of the best ways to succeed in business ?



Thought ???

- Do not look ahead !

Thought ???

- To be able to predict the future !

Business $uccess

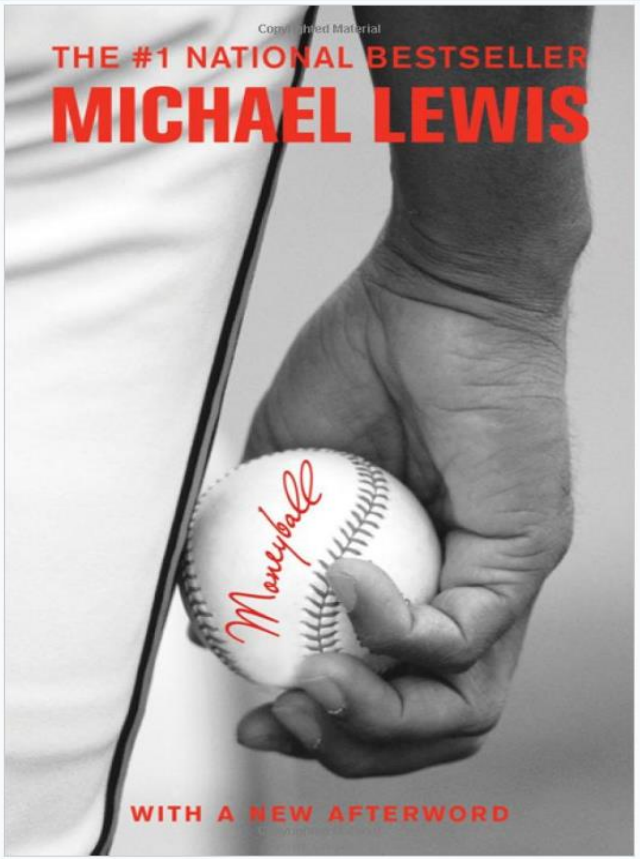
- Knowledge
- Ethics
- Hard Work & Planning
- Team Play
- Leadership
- Confidence
- Contacts (networking)
- Luck ?
- Being able to predict the future …

Predicting the Future

- How does one predict the weather ?
- Prediction:
  - Past history
  - Forces at play
  - Relationships between influencing factors
  - Common patterns
  - Algorithms & math models
- Business Intelligence & Analytics
  - Applying algorithms to modern data (“big data”)

Moneyball

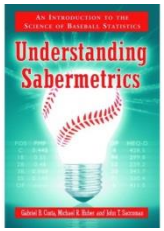
- Using IT and statistics for competitive advantage
- “Information is baseball’s currency” – Epstein, Boston
- On-base % is a far better tool to evaluate a hitter than batting average
- Typical Apps:
  - Red Sox – “Carmine”
  - Indians – “DiamondView”



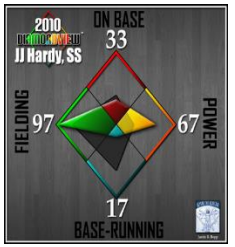
2003

Moneyball (con't)

- *Moneyball*, which opened 9/2011, is based on a 2003 book of the same name by Michael Lewis
- It describes how the Oakland A's general manager Billy Beane eschewed traditional metrics such as RBIs and home runs when evaluating and selecting players
- Instead, he focused on lesser-known and rarely used metrics such as walks plus hits per inning pitched (WHIP), on-base average, and value over replacement player (VORP) when deciding how valuable a player would be to the team
- His approach resulted in the creation of an Oakland baseball team that made it to several playoff rounds in the early to mid-2000s even though it had the lowest payroll in Major League Baseball
- Like professional sports teams, traditional companies must rethink how [such] measures can also drive changes in business processes
- Enterprises must find ways to modify and optimize their processes by using lessons learned from early adopters of such approaches like the Athletics
- The techniques described in Moneyball can be applied to key business processes such as vendor selection, portfolio optimization, etc. in any organization -- player selection for instance, is similar to vendor selection - you need to look at quantitative and qualitative measures



Analytics & Baseball "Sabermetrics"



Sabermetrics is the specialized analysis of baseball through objective, empirical evidence, specifically baseball statistics that measure in-game activity

The term is derived from the acronym SABR, which stands for the Society for American Baseball Research; **Examples of sabermetric measurements:**

- Base runs (BsR)
- Batting average on balls in play (BABIP)
- Defense independent pitching statistics (DIPS)
  - Defense-Independent ERA
  - Defense-Independent Component ERA
  - Fielding independent pitching (FIP)
  - Expected FIP (xFIP)
- Equivalent average (EQA)
- Fantasy batter value (FBV)
- Late-inning pressure situations (LIPS)
- On-base plus slugging (OPS)
- PECOTA (Player empirical comparison and optimization test algorithm)
- Peripheral ERA (PERA)
- Pythagorean expectation
- NERD
- Range factor
- Runs created
- Secondary average
- Similarity score
- Speed Score
- Super linear weights
- Total player rating, or Batter-Fielder Wins (TPR, BFW); Total Pitcher Index, or Pitcher Wins (TPI, PW)
- Ultimate zone rating (UZR)
- Value over replacement player (VORP)
- Win shares
- wOBA
- Wins above replacement (WAR)

Analytics & Football

- Football teams are also using big data technology to guide their decision-making on and off the field
- For instance, by tracking personnel formations, run-pass distributions by field segment and repeated and successful play tendencies, teams can determine which areas of the field are leading to greater success
- They can then call plays that target those areas of the field

Analytics & Basketball

- Real shifts in strategic philosophy have been rare in basketball—the metrics employed a half-century ago by John Wooden and Red Auerbach to evaluate talent remain prevalent today
- But for nearly a decade now, many N.B.A. teams have taken clear steps to integrate advanced statistical analysis into their scouting processes and in-game strategy, a cultural shift that happened in other sports, like baseball and football, years ago
- Twenty-two of the thirty N.B.A. teams have some kind of analytics department in their front offices, and that number is trending significantly upward

Analytics & Golf

- A number of current PGA Tour pros have added a data analytics expert to their team (swing coach, short game guru, trainer, massage therapist, sport psychologist, and caddie)
- The PGA's Shotlink System (introduced in 2001) collects and circulates scoring and statistical data and scoring on every shot by every player

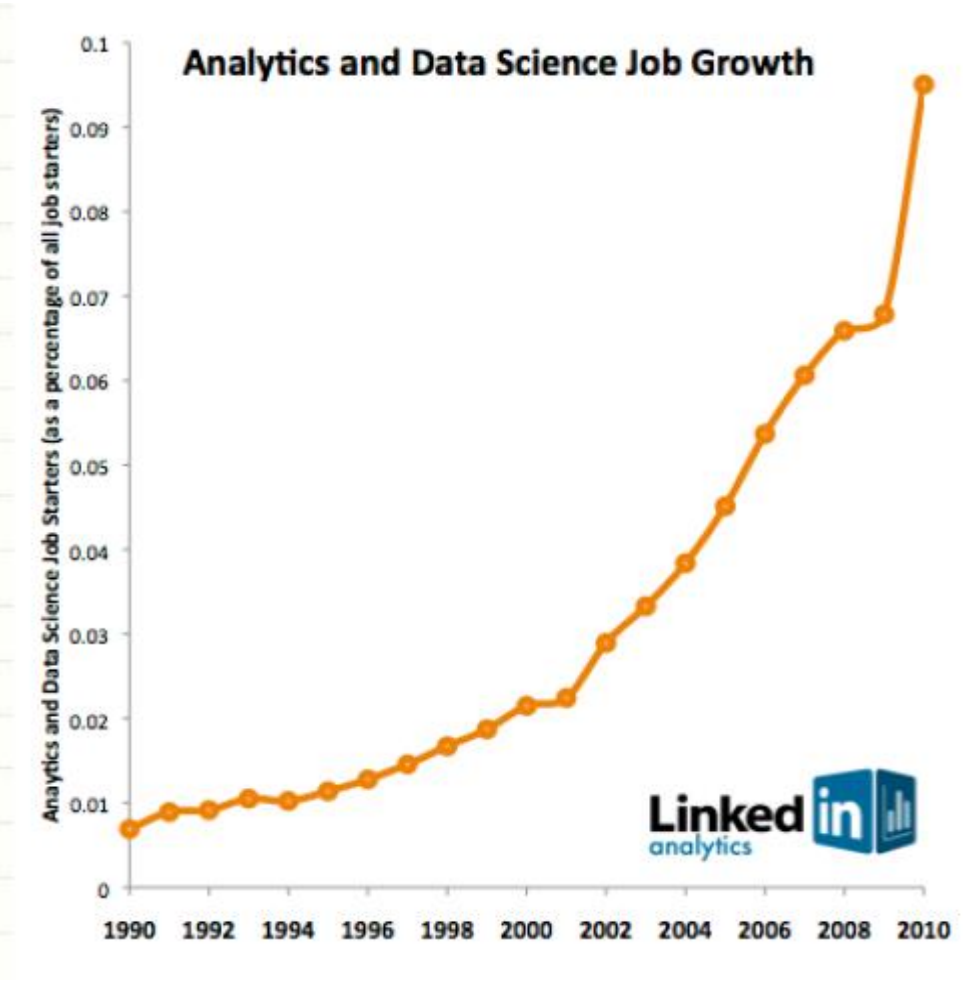
Top Tech Initiatives
[CIO Magazine Survey]

- Business Intelligence (analytics)
- Mobile Technologies
- Cloud Services
- Application Modernization
- Customer Experience Technologies
- Security and Risk Management

Data Analytics Jobs

A report released by Glassdoor says that data scientists have the best jobs in the U.S., according to that company's analysis.

With a median base salary of $116,840, more than 1,700 job openings on Glassdoor's site, and a user-provided career opportunities rating of 4.1, "data scientist" took the prize for most highly rated job title in America.



The 10 best jobs in America

Not all amazing jobs pay well. But getting a fat paycheck goes a long way toward making an otherwise middling job feel pretty awesome. This week, recruiting website Glassdoor **published its annual ranking of the 50 best jobs in America** . For the ranking, Glassdoor weighed average annual salary, an overall job-satisfaction rating based on a five-point scale and the number of openings available. Here are the best jobs in America that also pay a handsome, six-figure salary.

1. Data Scientist
Job score: 4.8
Job satisfaction rating: 4.4
Median base salary: $110,000
2. DevOps Engineer
Job score: 4.7
Job satisfaction rating: 4.2
Median base salary: $110,000
3. Data Engineer
Job score: 4.7
Job satisfaction rating: 4.3
Median base salary: $106,000

4. Tax Manager
Job score: 4.7
Job satisfaction rating: 4.0
Median base salary: $110,000
5. Analytics Manager
Job score: 4.6
Job satisfaction rating: 4.1
Median base salary: $112,000
6. Strategy Manager
Job score: 4.5
Job satisfaction rating: 4.3
Median base salary: $130,000
7. Solutions Architect
Job score: 4.4
Job satisfaction rating: 3.7
Median base salary: $125,000
8. Nurse Practitioner
Job score: 4.3
Job satisfaction rating: 3.5
Median base salary: $100,000
9. Software Engineer
Job score: 4.3
Job satisfaction rating: 3.5
Median base salary: $101,000
10. Supply Chain Manager
Job score: 4.3
Job satisfaction rating: 3.9
Median base salary: $100,000

Student Evaluation

- Homework
  - From the textbook, and detailed in lessons
  - 30% of grade
- Quizzes
  - 30% of grade
  - Note Self-Test at end of each textbook chapter
- Projects
  - 40% of grade
  - Thirteen projects to choose from - 8 projects must be completed by end of term for full credit

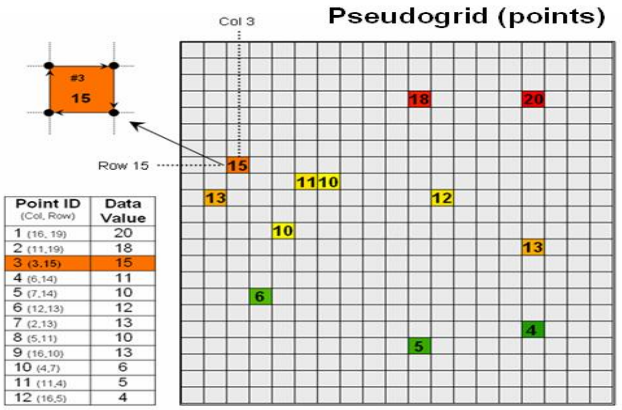
Lesson Files

- Lesson files (PDF) are linked in Canvas modules
- Lesson files are also containers for:
  - Discussion questions
  - Exercises and solutions
  - Videos
  - References
  - Assignments
    - Homework
    - Projects
  - Appendices (additional optional material)

Assignments

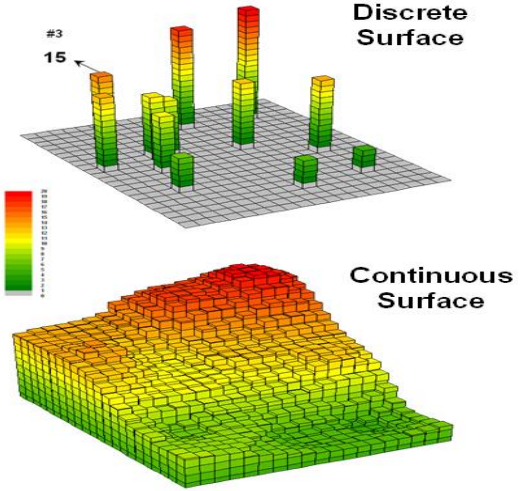
- Homework & Projects
- All assignments (homework & projects) must be completed by end of term
- Instructor will reply back:
  - “OK” or
  - Message indicating what is wrong (or incomplete) with assignment, so that student can re-submit

INTRODUCTION TO QUANTITATIVE ANALYSIS



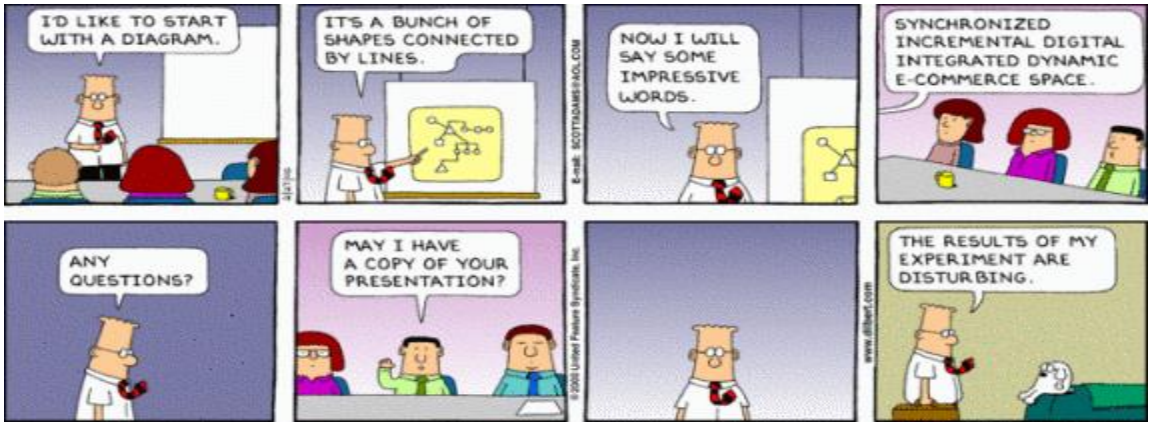
Point ID (Col, Row)	Data Value
1 (16, 19)	20
2 (11,19)	18
3 (3,15)	15
4 (6,14)	11
5 (7,14)	10
6 (12,13)	12
7 (2,13)	13
8 (5,11)	10
9 (16,10)	13
10 (4,7)	6
11 (11,4)	5
12 (16,5)	4

…a pseudogrid represents grid data as a continuous set of square polygons covering a project area.



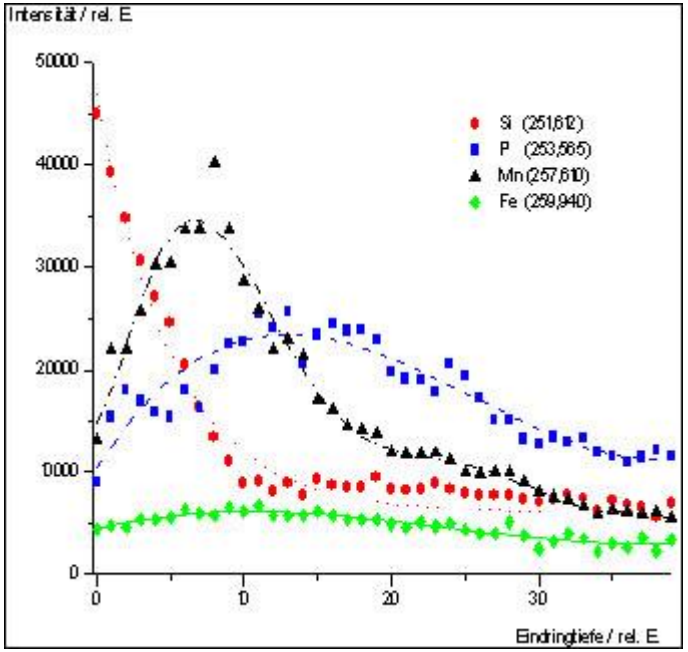
Lesson Objectives

- Describe the quantitative analysis approach
- Understand the application of quantitative analysis in a real situation
- Describe the use of modeling in quantitative analysis
- Use computers and spreadsheet models to perform quantitative analysis
- Discuss possible problems in using quantitative analysis
- Perform a break-even analysis
- Review basic statistics



Introduction

- Mathematical tools have been used for thousands of years
- Quantitative analysis can be applied to a wide variety of business problems
- The formal approach to using quantitative analysis in business and management started in the 20th century



Tools and Application

- It's not enough to just know the mathematics of a technique or solution methods:
  - Spreadsheet (i.e. Excel)
  - Quant Tools (QM, Excel-QM)
  - SPSS, SAS, etc.
  - Custom Software
- One must understand the:
  - Applicability of the technique
  - Its limitations
  - Its assumptions

The Right Tool for the Job

If all you have is a hammer,
then all problems look like a nail.

Mathematical Tools

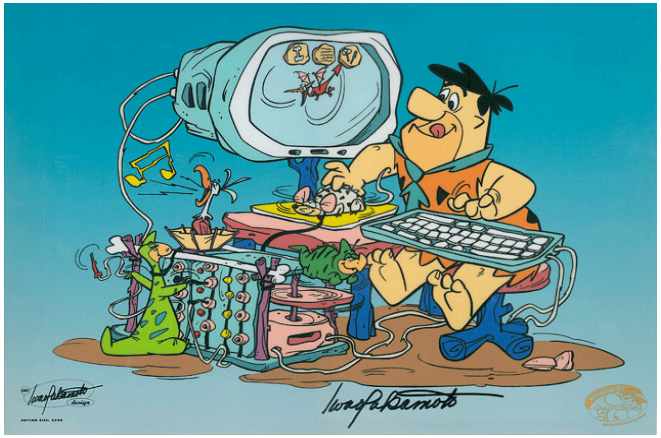
- It's important to use the right tool for the job, and to know how to use the tool
- But, in choosing a builder for your house, are you going to pick the contractor with the:
  - Latest power tools?, or
  - A set of blueprints?

Thought ???

- Do not look ahead !

Mathematical Tools

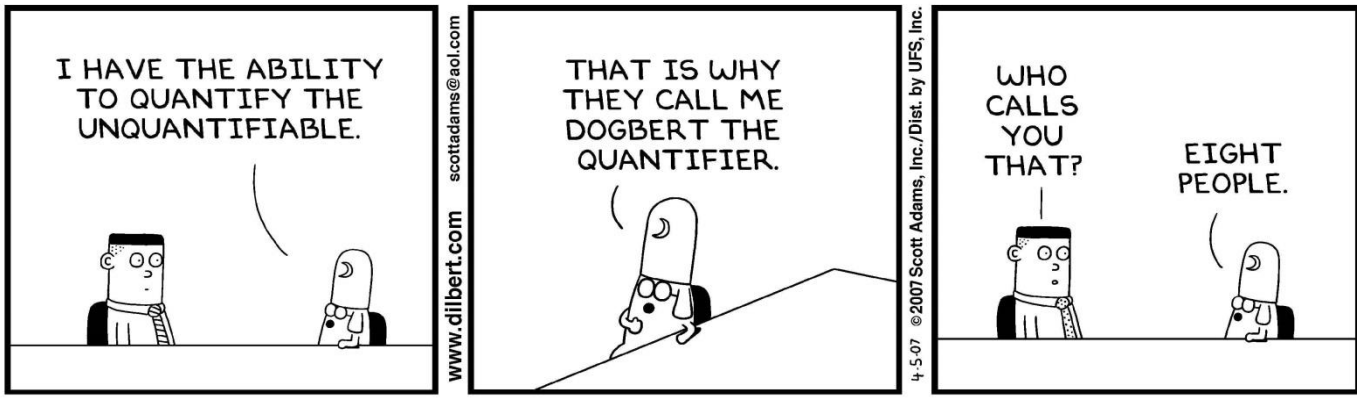
- "A fool with a tool is still a fool"



- Need a plan -- a model
- Need to know when, where, how to apply the tools

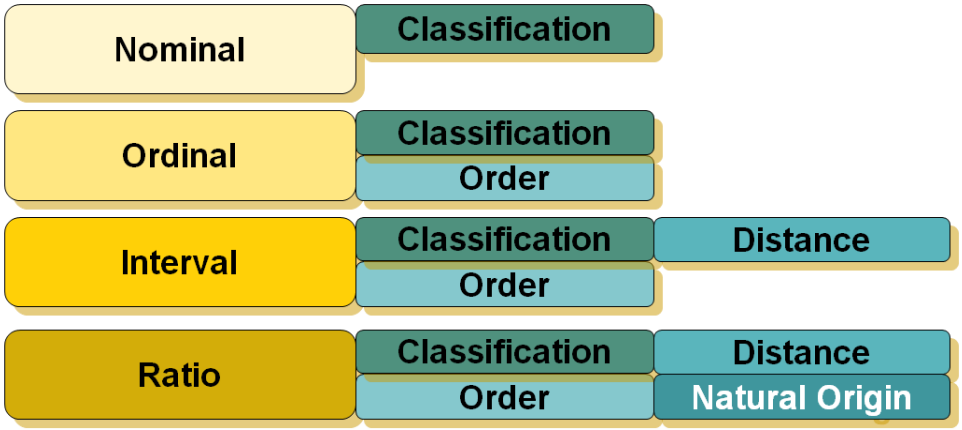
"Quants"

- A **quantitative analyst** is a person who works in business using numerical techniques
- Similar work is done in most other modern industries
- In business, people who perform quantitative analysis are frequently called "**quants**"



Quantitative Thinking

- Quantifying concepts into numbers
  - Measurement Scales
  - Analytics
  - Algorithms
  - Models

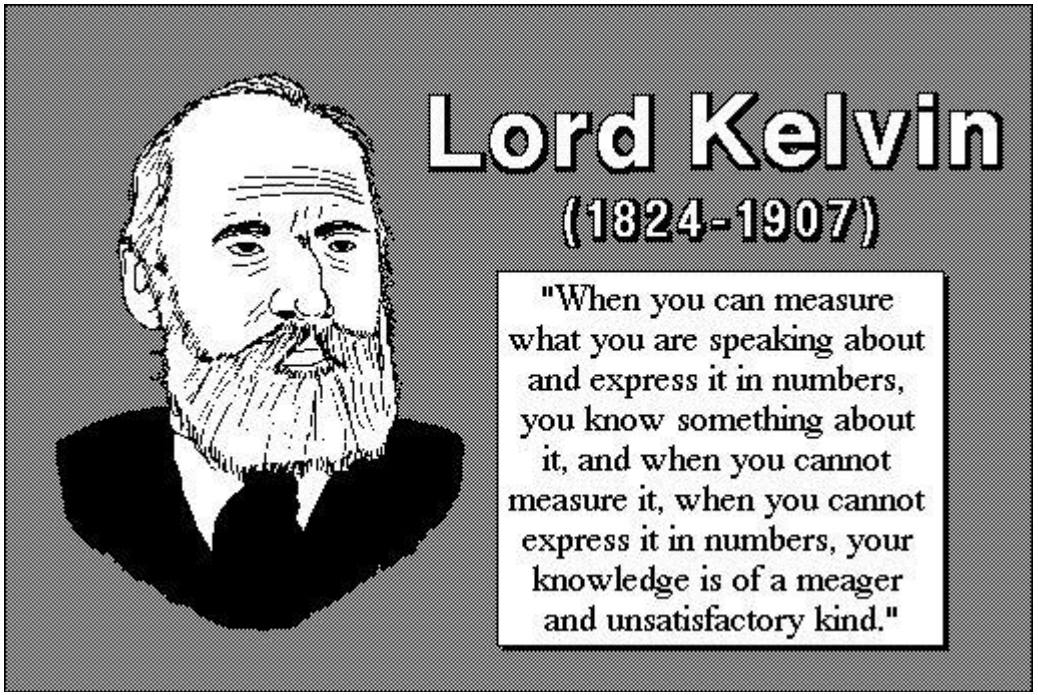


Qualitative vs Quantitative

Oil Painting 	*Oil Painting* 
Qualitative data: • blue/green color, gold frame • smells old and musty • texture shows brush strokes of oil paint • peaceful scene of the country • masterful brush strokes	**Quantitative data:** • picture is 10" by 14" • with frame 14" by 18" • weighs 8.5 pounds • surface area of painting is 140 sq. in. • cost $300

Lord Kelvin

- **You cannot improve what you cannot measure !**
  - Lord Kelvin



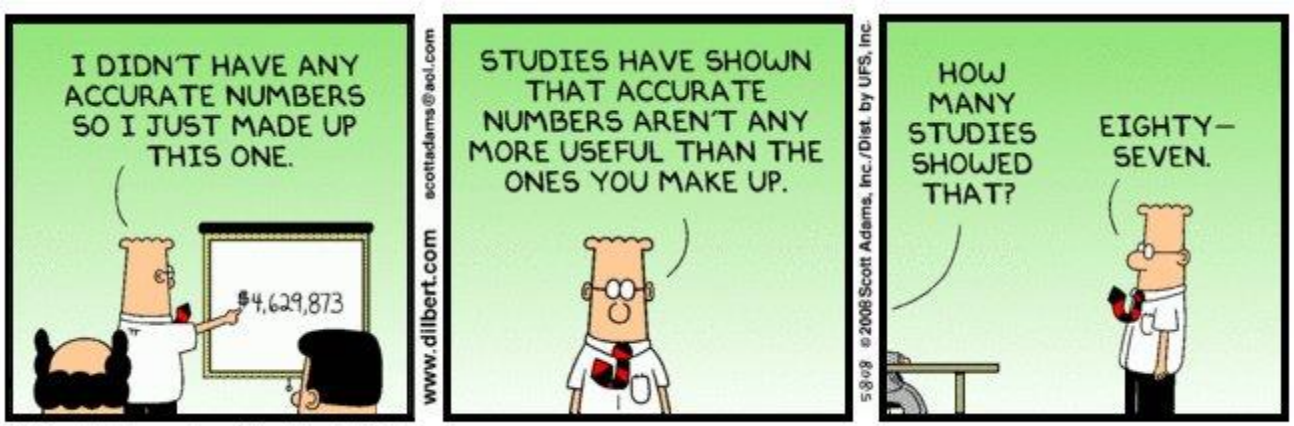
The Google Way

[Infoworld, 2/23/04]

- The Google corporate philosophy is expressed in five principles:
  - "Work on things that matter
  - Affect everyone in the world
  - Solve problems with algorithms if possible
  - Hire bright people and give them lots of freedom
  - Don't be afraid to try new things.“

Quantitative thinking…

- You have a 10x10x10 rubix cube
- You paint the entire outside
- How many cubes have paint on them?
  - Hint follows →



- Hint:
- For a 3x3x3 rubix cube
- How many cubes have paint on them ?
- How many total cubes ?
- How many do not ?

Wait….

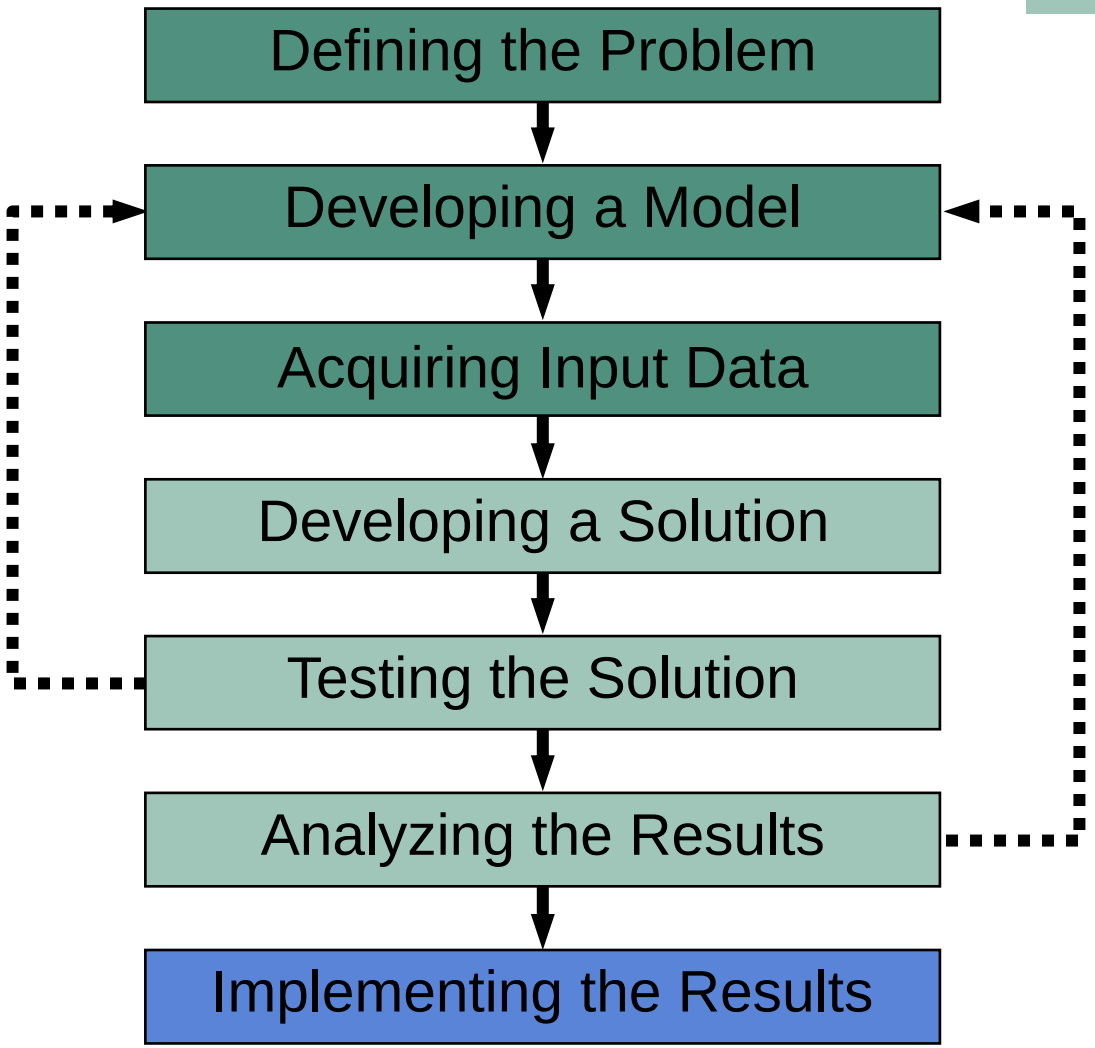
?

Don’t look ahead, until you have your answer !

- Inside each 10x10x10 cube is an 8x8x8 cube that cannot be painted
- Subtract two from each side's length and then just calculate the volume
- Subtract the result from 1000 (10x10x10)
- So, Answer is 1000 - 8*8*8 = 488

So, 488 cubes have paint on them

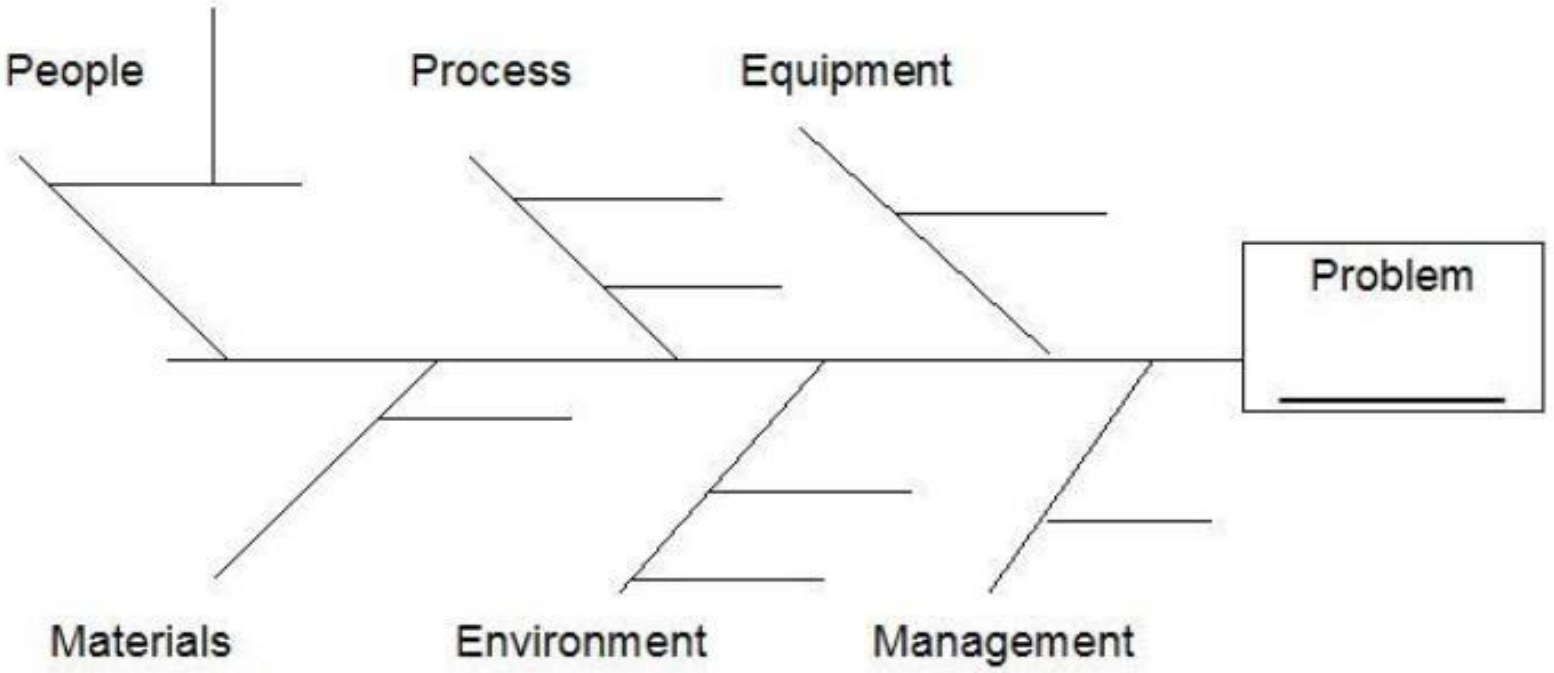
The Quantitative Analysis Approach



Defining the Problem

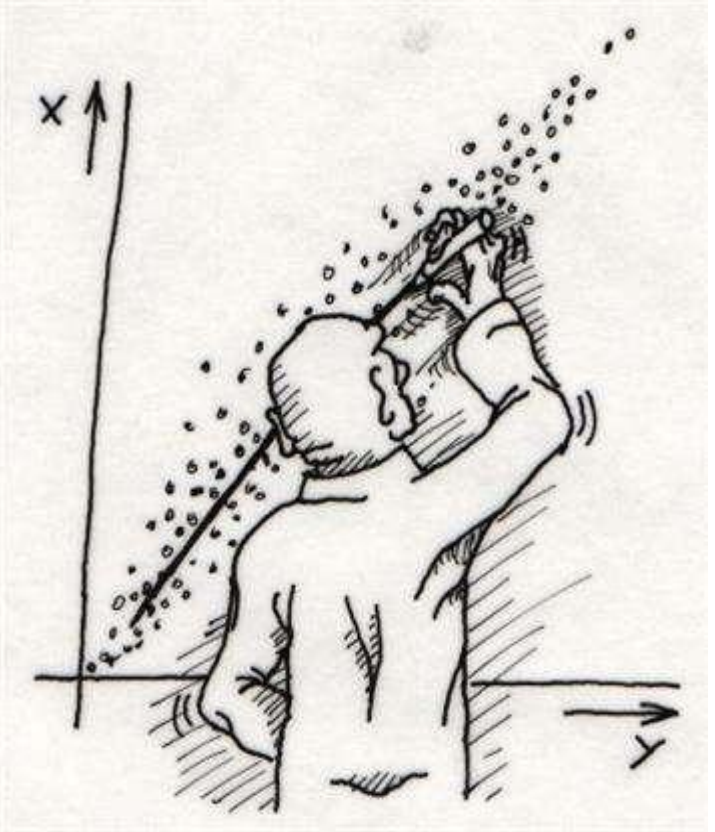
- Cause-and-Effect Diagrams or Ishikawa Diagrams (see next slide for example)
- These diagrams show how various causes or potential causes (and their sub causes) relate to create problems
- Helps stimulate thinking and organizes thoughts
- Can also be used to study a desired outcome and the factors that may lead to that outcome

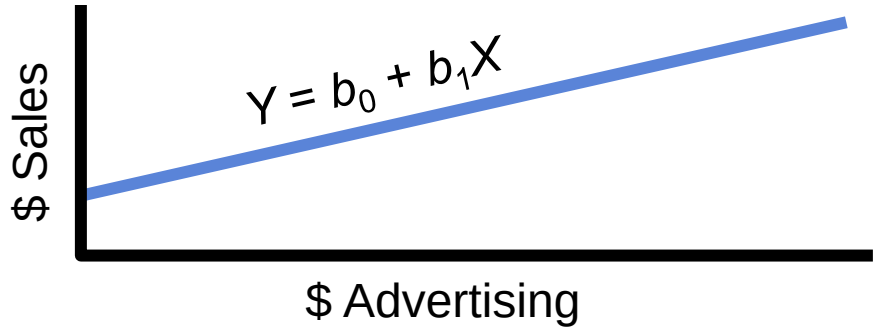
Common Fishbone Template



Developing a Model

Quantitative analysis models are realistic, solvable, and understandable mathematical representations of a situation





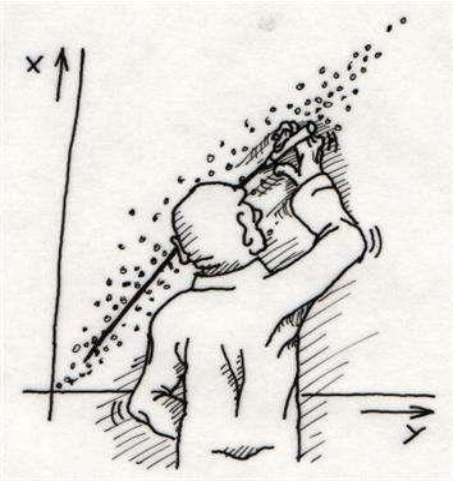
Types of Models

- Physical (i.e. scale models, prototypes, …)
- Schematic (drawings, blue prints, …)
- Mathematical
  - $Y = b_0 * X + b_1$

Developing a Model

- Models generally contain variables and parameters
- Controllable variables (independent variables) are generally the decision variables and the best values are generally unknown (i.e. the best routes and sizes of airplanes)
- Parameters are known quantities that are a part of the problem (i.e. the current price of fuel)
- The values of dependent variables depend upon the independent variables and parameters

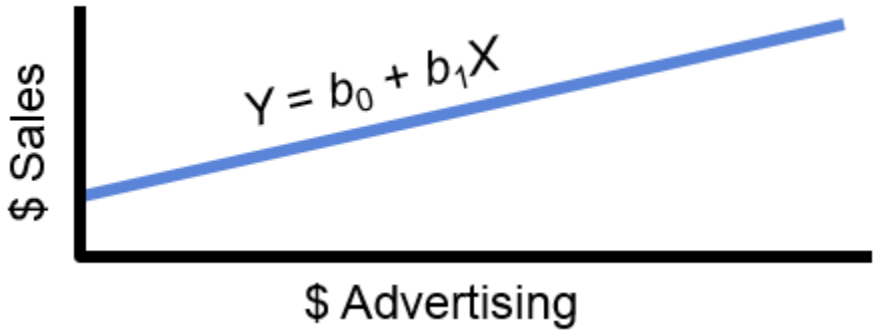
- $Y = b_0 * X + b_1$
- What is is dependent variable(s) ?
- What is the independent variable(s) ?
- What is the parameter(s)



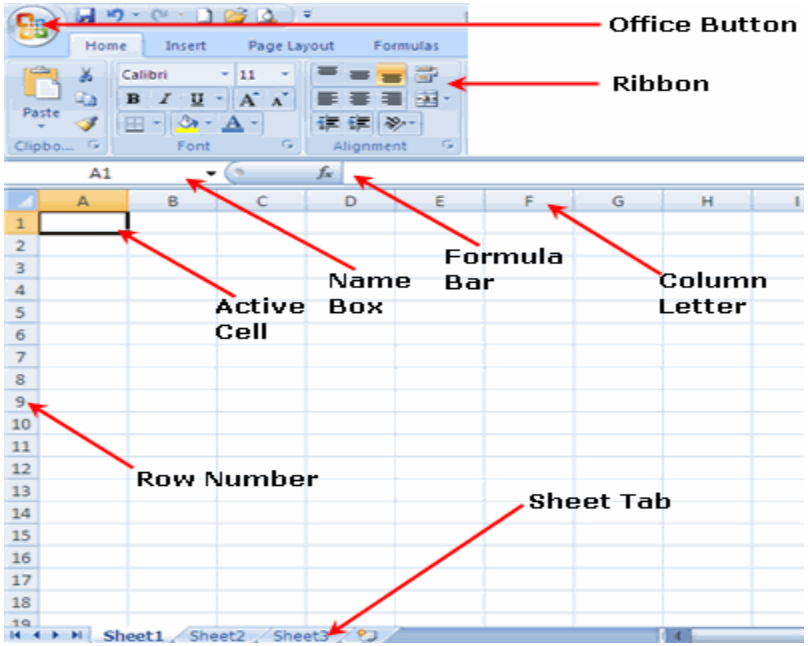
Fishbone Diagrams

- Do not look ahead !

- $Y = b_0 * X + b_1$
  - Y is dependent variable
  - Y depends upon x (the independent variable)
  - and parameters b_0 and b_1



- How are parameters generally set up in Microsoft Excel ?

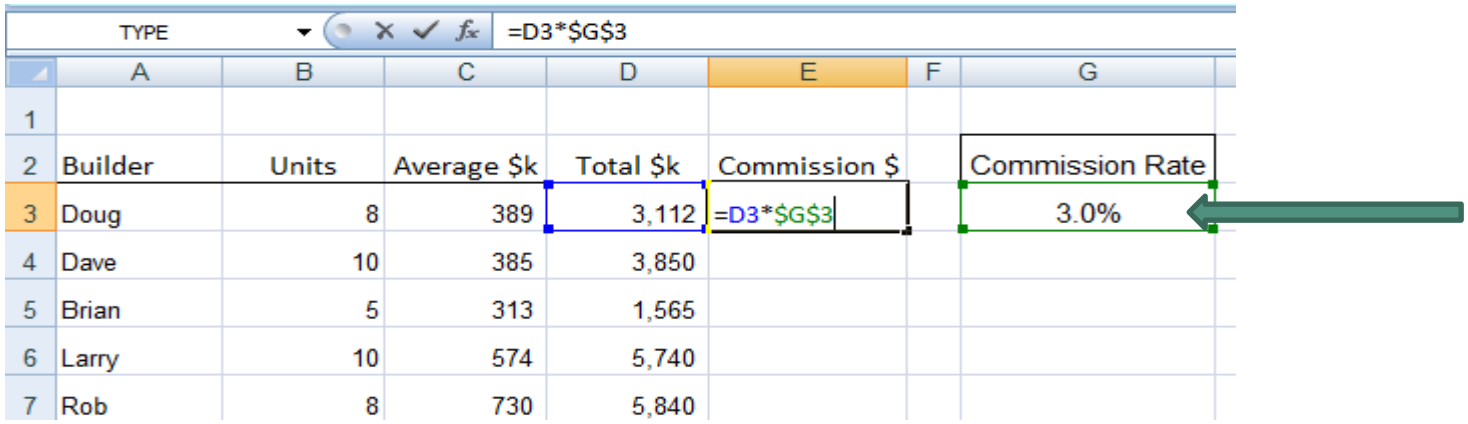


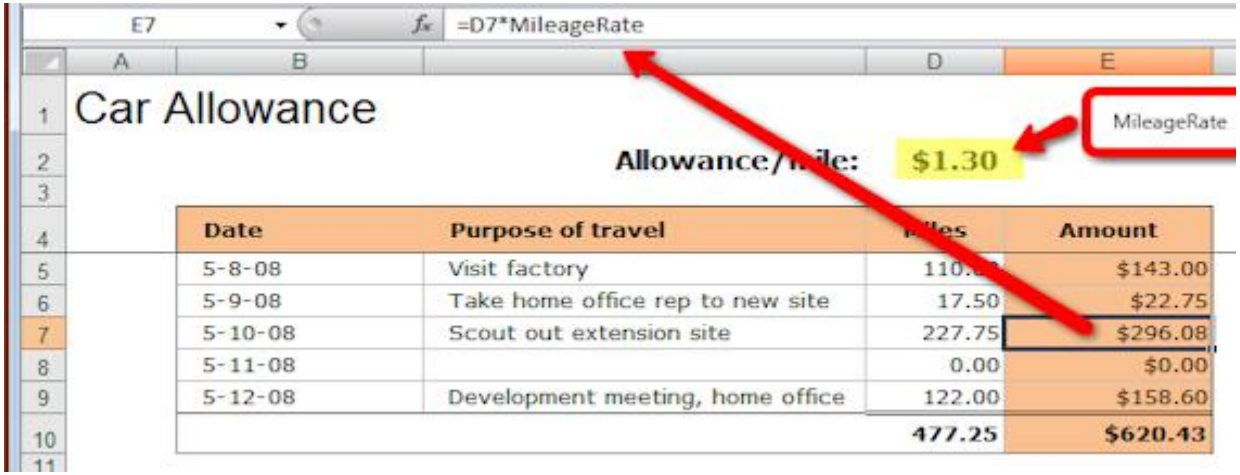
Wait….

?

Don’t look ahead, until you have your answer !

Absolute references (or cell names) rather than relative references





Exercise

Calculate the Y values, and draw the graph.

	A	B	C
1	**Intercept**	3	
2	**Slope**	5	
3			
4	**X**	**Y**	
5	1		
6	2		
7	3		
8	4		
9	5		
10	6		
11	7		
12	8		
13	9		
14	10		
15	11		
16	12		
17			

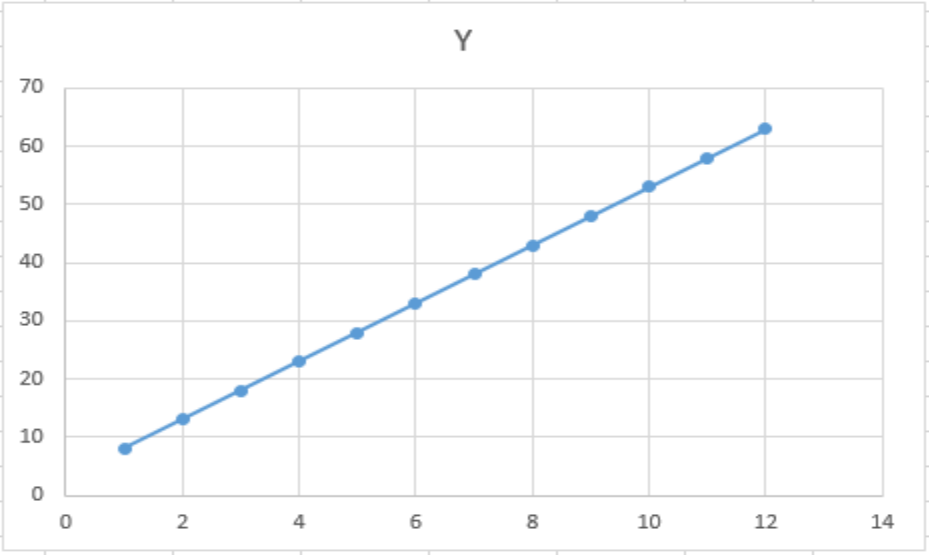
Wait….

?

Don’t look ahead, until you have your answer !

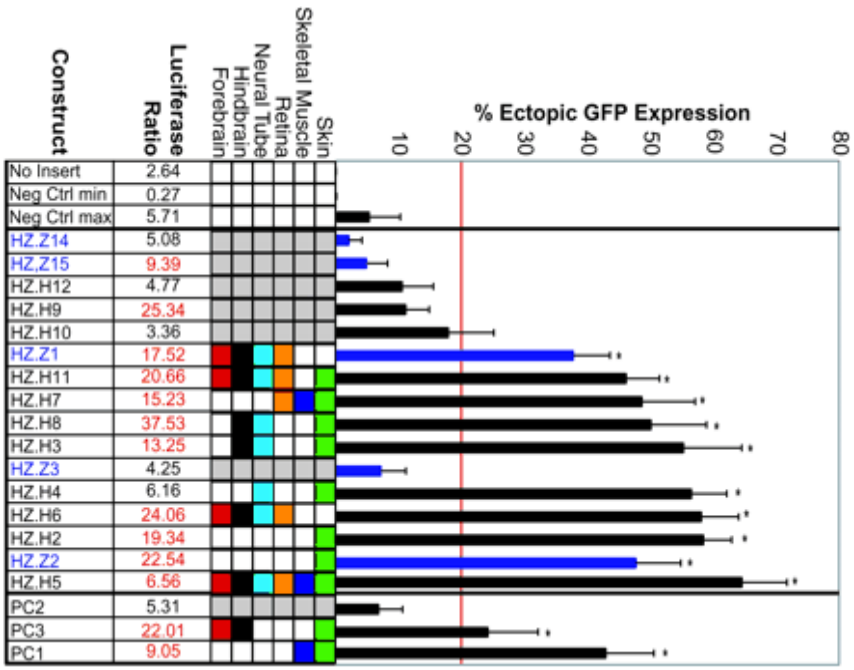
B5 =$B$1+A5*$B$2

	A	B
1	**Intercept**	3
2	**Slope**	5
3		
4	**X**	**Y**
5	1	8
6	2	13
7	3	18
8	4	23
9	5	28
10	6	33
11	7	38
12	8	43
13	9	48
14	10	53
15	11	58
16	12	63
17		
18		
19		



Acquiring Input Data

- Data sources:
  - Secondary data:
    - Published data
      - Internal
      - External
  - Primary data:
    - Experimental data
    - Interviews
    - Surveys
    - Measurements & Observations
    - Focus groups



Developing a Solution

- Desired solution characteristics: accurate, timely, flexible, economical, reliable
- Common solution techniques are
  - *Solving* equations
  - *Trial and error* – trying various approaches and picking the best result
  - *Complete enumeration* – trying all possible values
  - Using an *algorithm* – a series of repeating steps to reach a solution
  - Using a *simulation*

- What are the advantages of using a model ?

Do not look ahead !

Advantages of Mathematical Modeling

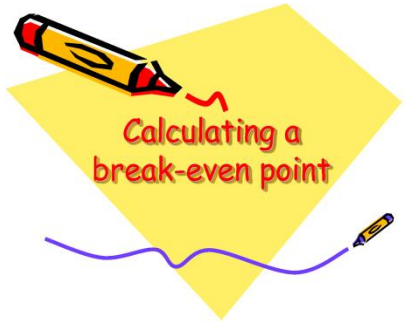
- Models can closely represent reality
- Models can help a decision maker formulate problems
- Models can give us insight and information
- Models can save time and money in decision making and problem solving
- Models may provide safety in usage
- A model may be the only way to solve large or complex problems in a timely fashion
- A model can be used to communicate problems and solutions to others

Models Categorized by Uncertainty (Risk)

- Mathematical models that do not involve uncertainty are called *deterministic* models
  - We know all the values used in the model with complete certainty
- Mathematical models that involve risk, chance, or uncertainty are called *probabilistic* models
  - Values used in the model are estimates based on probabilities

Example: Breakeven Analysis

- Profit = Revenue – Cost
- Cost = Fixed Cost + Variable Cost



- Fixed costs – do not vary with production/sales
  - rent, management salaries
- Variable cost – vary with the number of units produced:
  - raw materials, labor costs

Breakeven Analysis (con't)

Profit = Revenue – (Fixed cost + Variable cost)

Profit = (Selling price per unit)(number of units sold) – [Fixed cost + (Variable costs per unit)(Number of units sold)]

Profit = $sX - [f + vX]$

Profit = $sX - f - vX$

where

s = selling price per unit

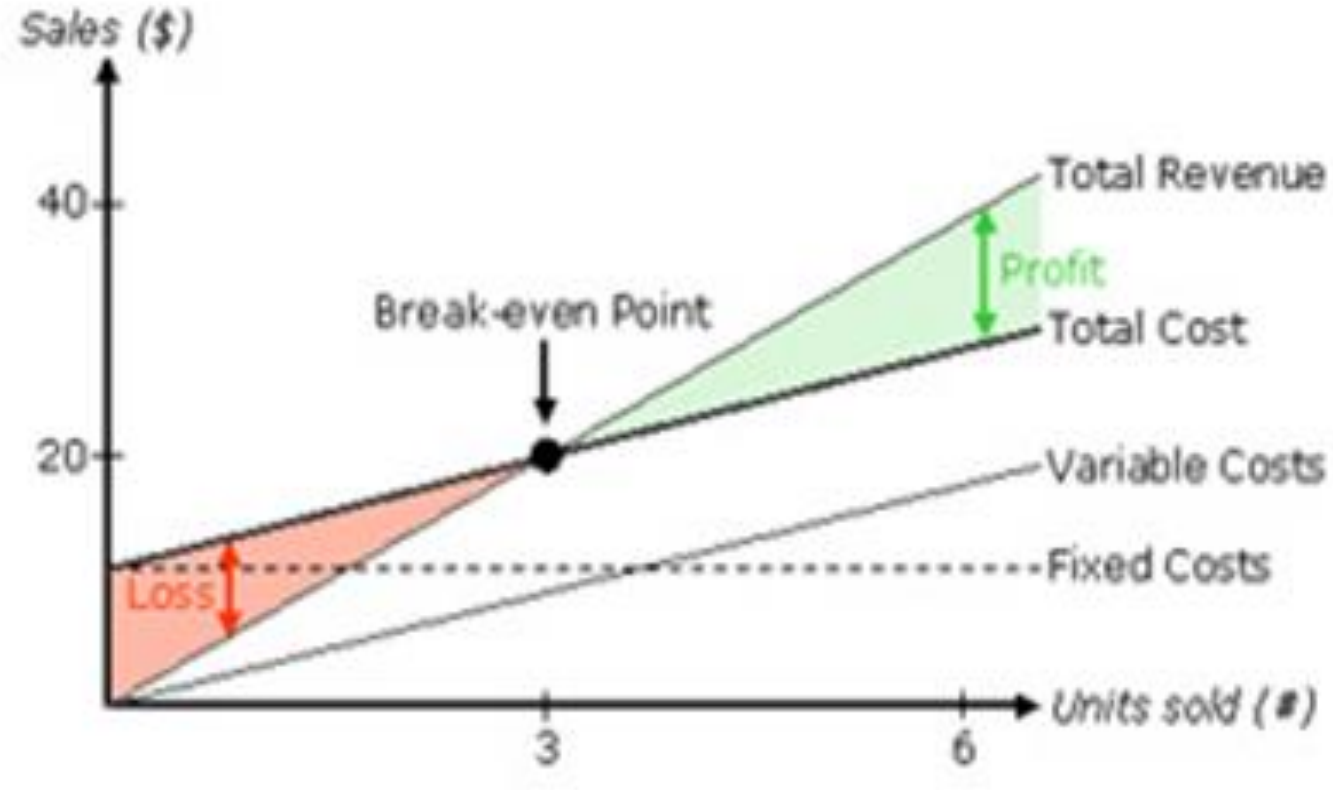
v = variable cost per unit

f = fixed cost

X = number of units sold

The *parameters* of this model are f, v, and s as these are the inputs inherent in the model; the *decision (independent)variable* of interest is X; the dependent variable is profit

Breakeven Analysis (con't)



Breakeven Example

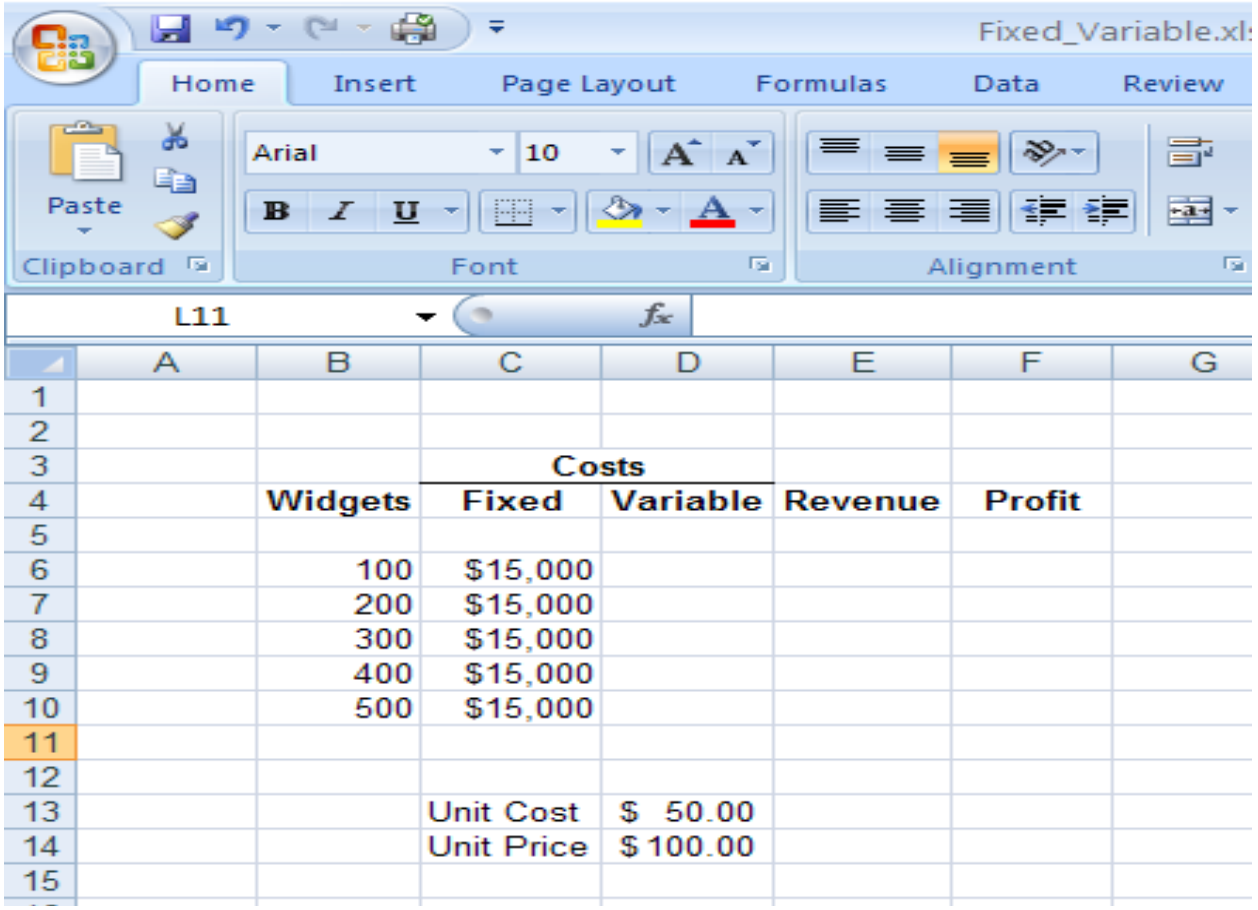
- A company buys, sells, and repairs old watch springs
- Rebuilt springs sell for $10 per unit – unit sale price (s)
- Fixed cost of equipment to build springs is $1,000 (f)
- Variable cost for spring material is $5 per unit (v)
- Profit = 10X – 1000 – 5X

Breakeven Point

- Breakeven point is point at which profit is zero
- Profit = sX – f – vX
- 0 = sX – f – vX
  - Solving for X
  - X = f/(s-v)
  - X = 1000/(10 - 5) = 200

Excel Lab

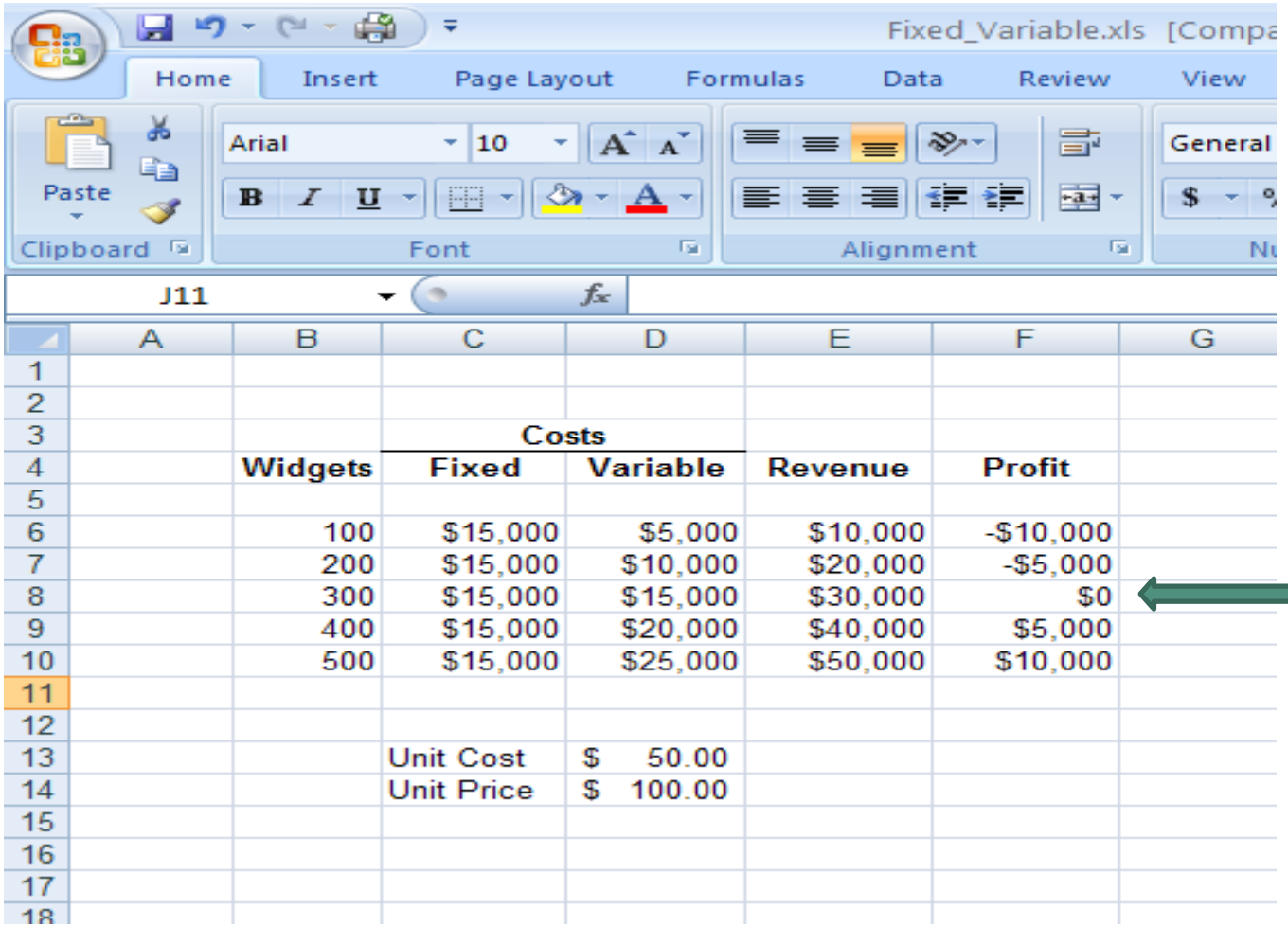
[complete the spreadsheet below to determine the breakeven point, with a graph also of profit vs widgets sold]



	A	B	C	D	E	F	G
1							
2							
3			Costs				
4		Widgets	Fixed	Variable	Revenue	Profit	
5							
6		100	$15,000				
7		200	$15,000				
8		300	$15,000				
9		400	$15,000				
10		500	$15,000				
11							
12							
13			Unit Cost	$ 50.00			
14			Unit Price	$ 100.00			
15							

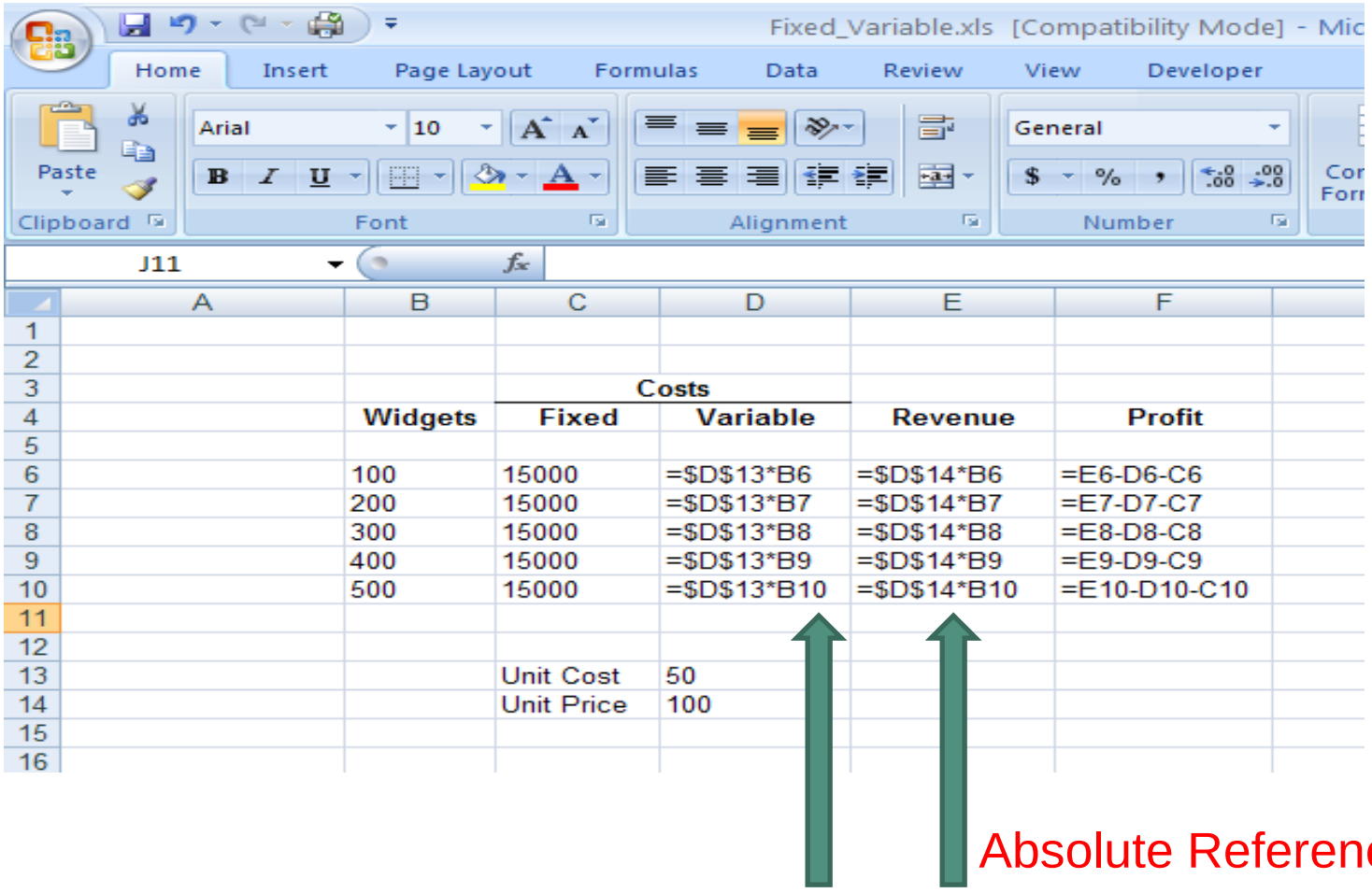
Do not look ahead !

Breakeven with Excel



	A	B	C	D	E	F	G
1							
2							
3			Costs				
4		Widgets	Fixed	Variable	Revenue	Profit	
5							
6		100	$15,000	$5,000	$10,000	-$10,000	
7		200	$15,000	$10,000	$20,000	-$5,000	
8		300	$15,000	$15,000	$30,000	$0	
9		400	$15,000	$20,000	$40,000	$5,000	
10		500	$15,000	$25,000	$50,000	$10,000	
11							
12							
13			Unit Cost	$ 50.00			
14			Unit Price	$ 100.00			
15							
16							
17							
18							

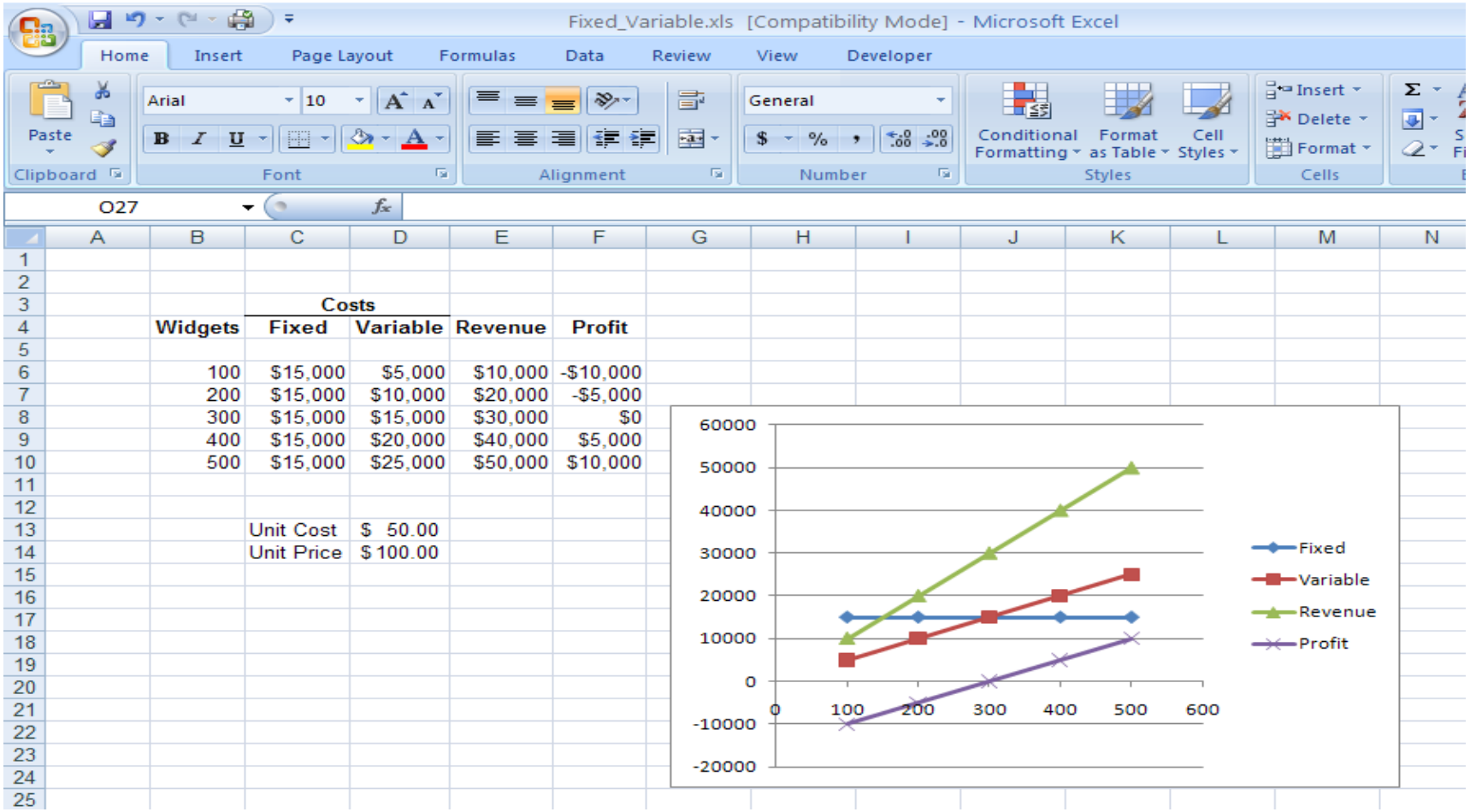
Breakeven with Excel (con't)



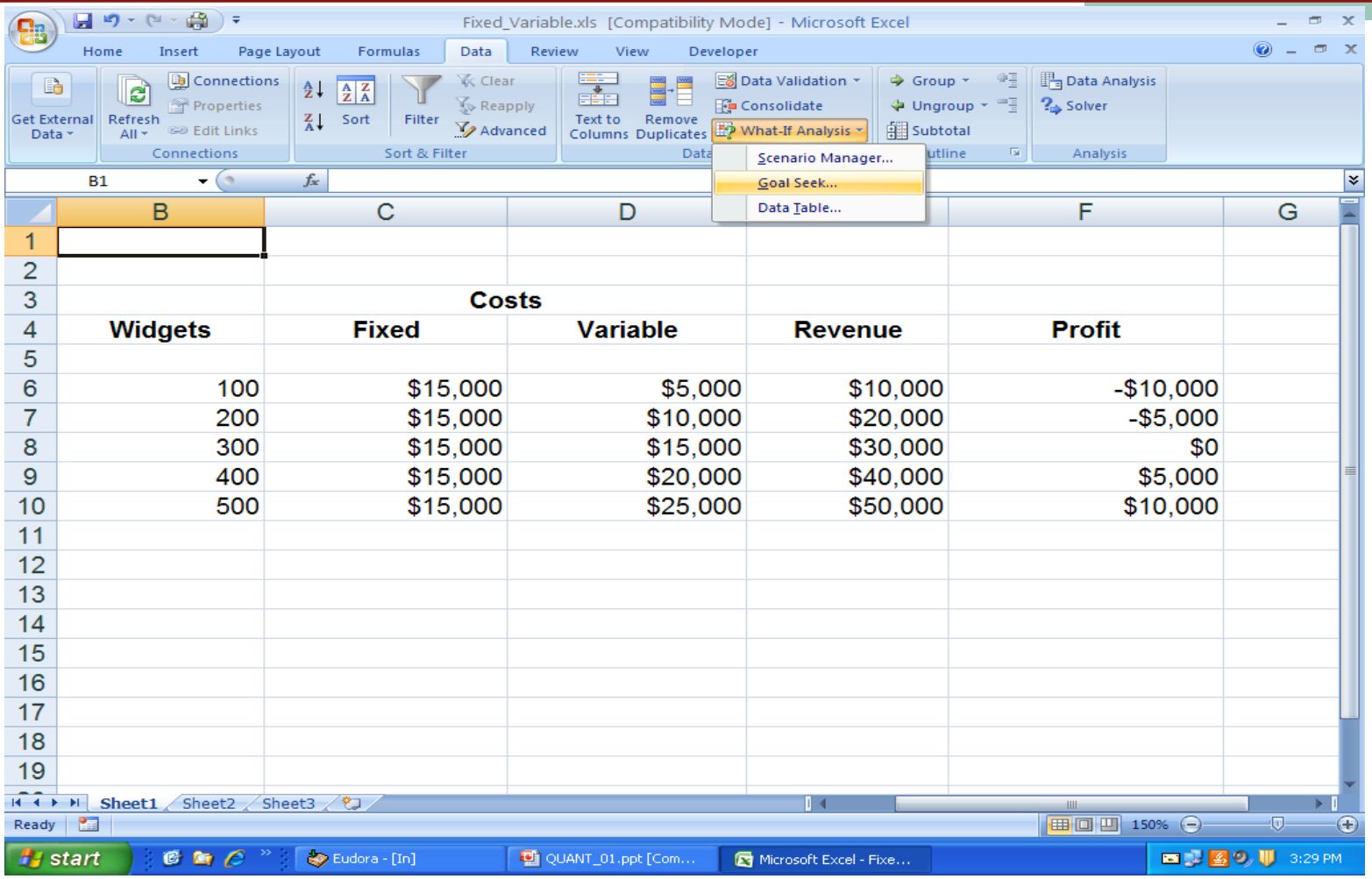
	A	B	C	D	E	F
1						
2						
3			Costs			
4		Widgets	Fixed	Variable	Revenue	Profit
5						
6		100	15000	=$D$13*B6	=$D$14*B6	=E6-D6-C6
7		200	15000	=$D$13*B7	=$D$14*B7	=E7-D7-C7
8		300	15000	=$D$13*B8	=$D$14*B8	=E8-D8-C8
9		400	15000	=$D$13*B9	=$D$14*B9	=E9-D9-C9
10		500	15000	=$D$13*B10	=$D$14*B10	=E10-D10-C10
11						
12						
13			Unit Cost	50		
14			Unit Price	100		
15						
16						

Graphical Breakeven with Excel

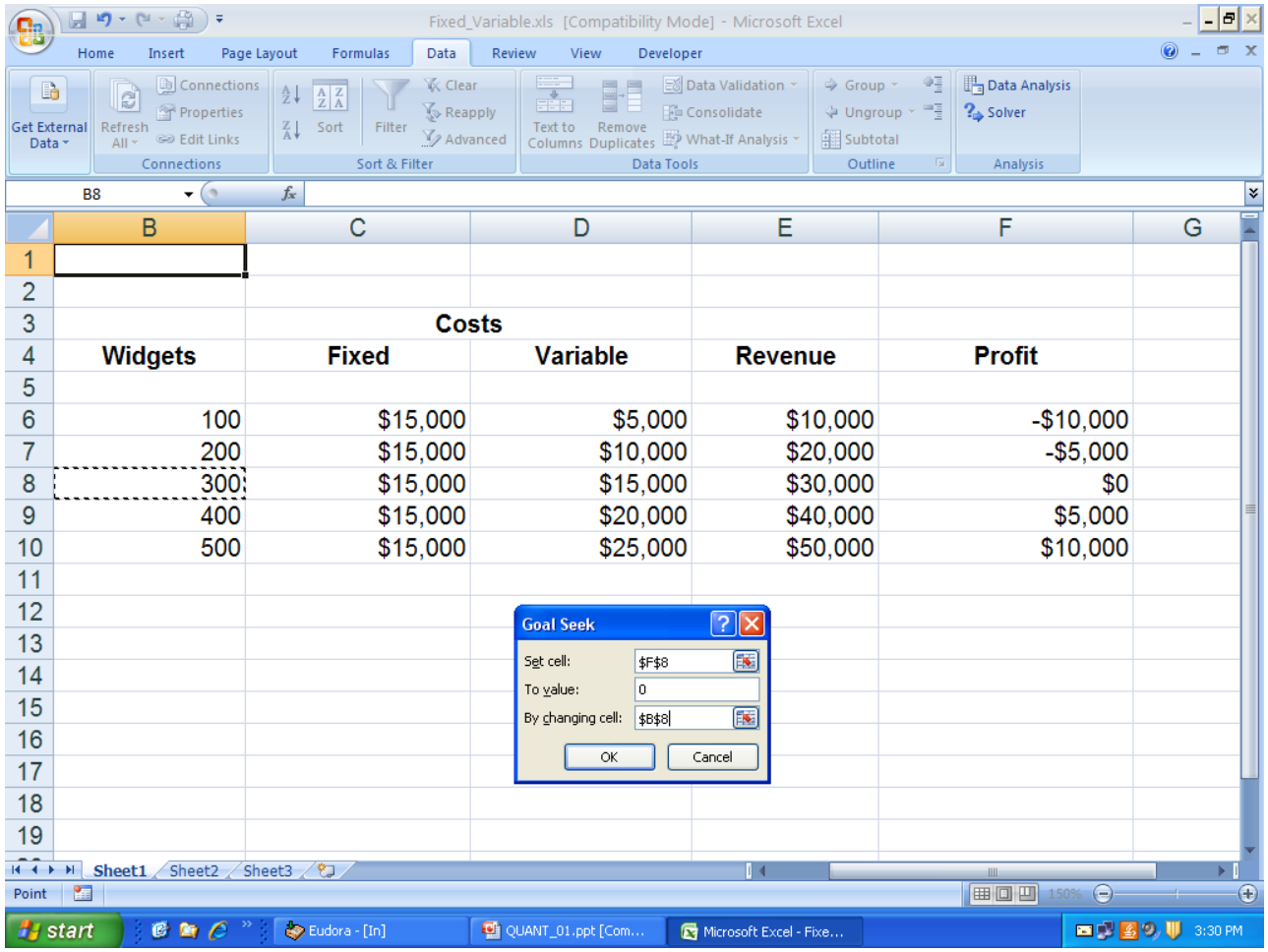
["what if analysis" – manually change # of widgets to see effect upon profit]



Excel Goal Seek

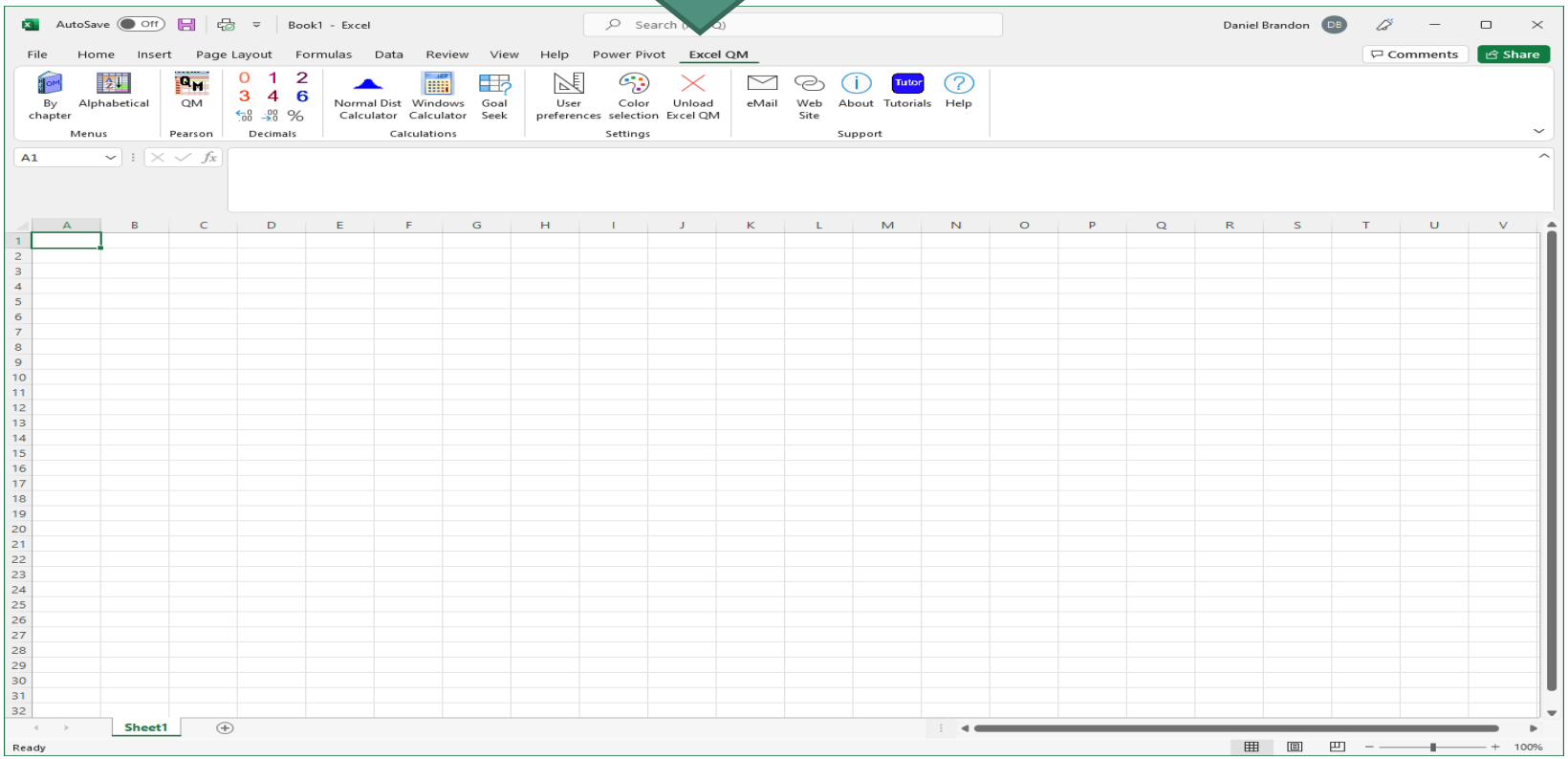


Excel Goal Seek (con't)



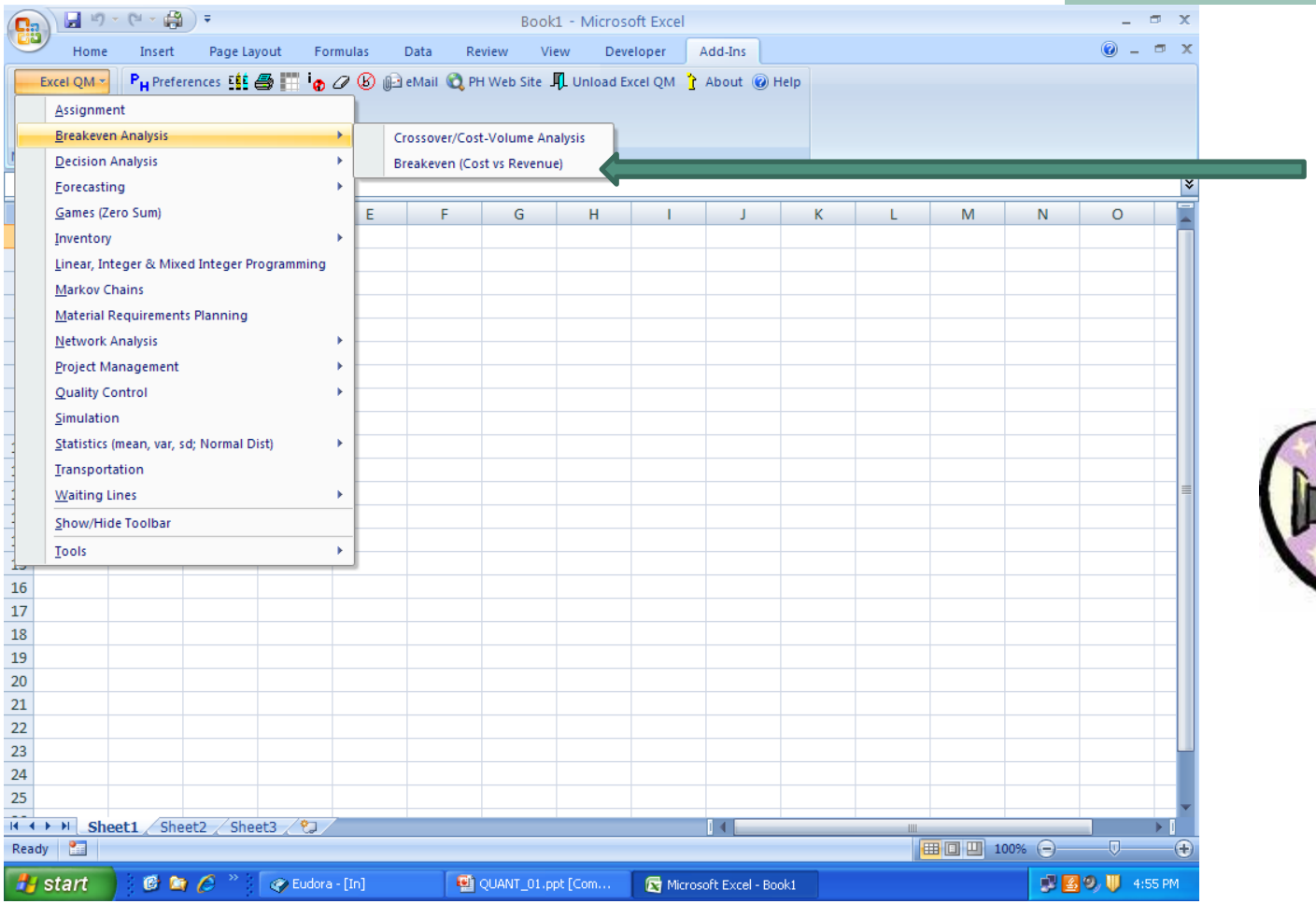
Excel QM

[Separate program – desktop icon]

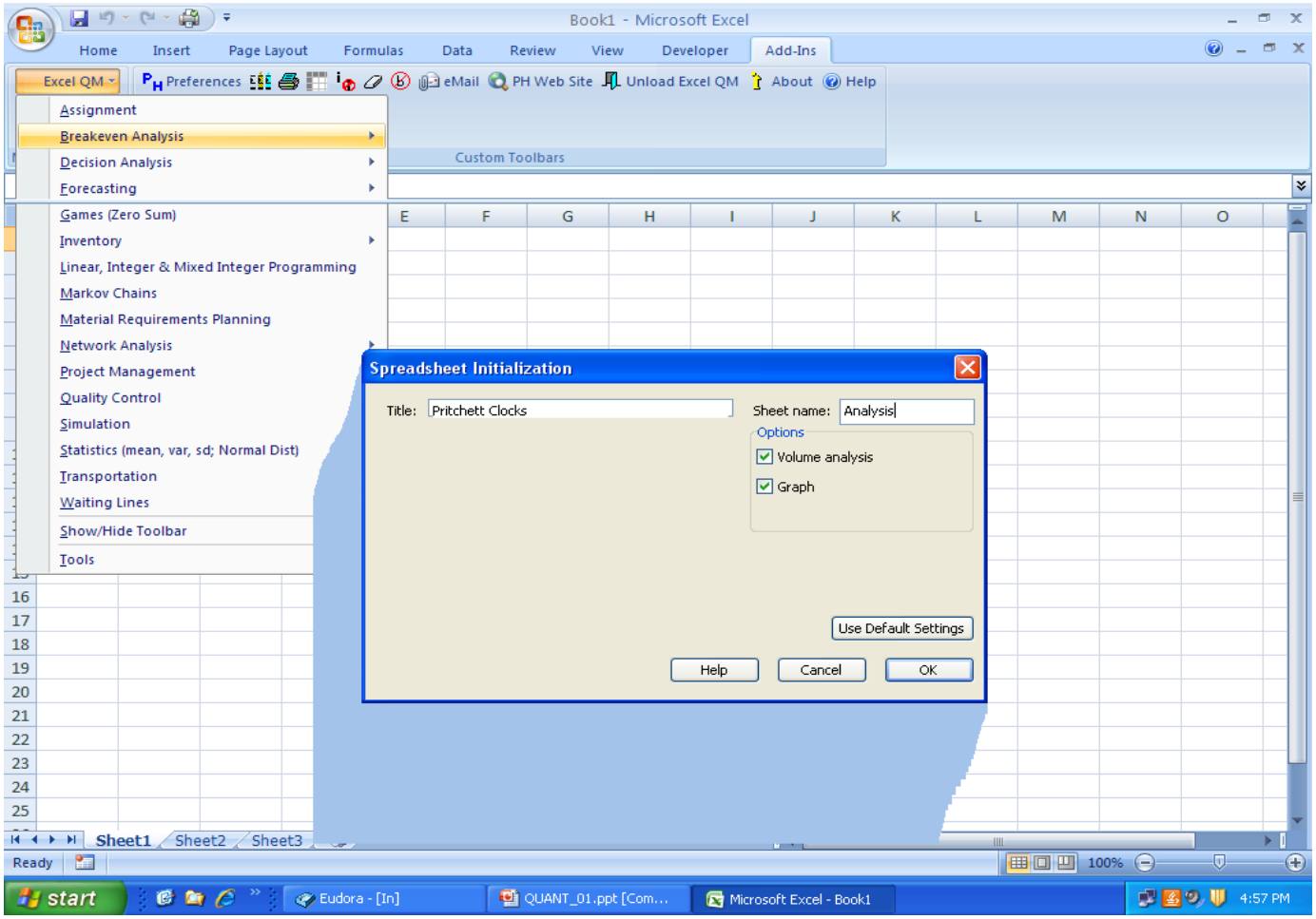


May have to pick "enable macros" button upon startup

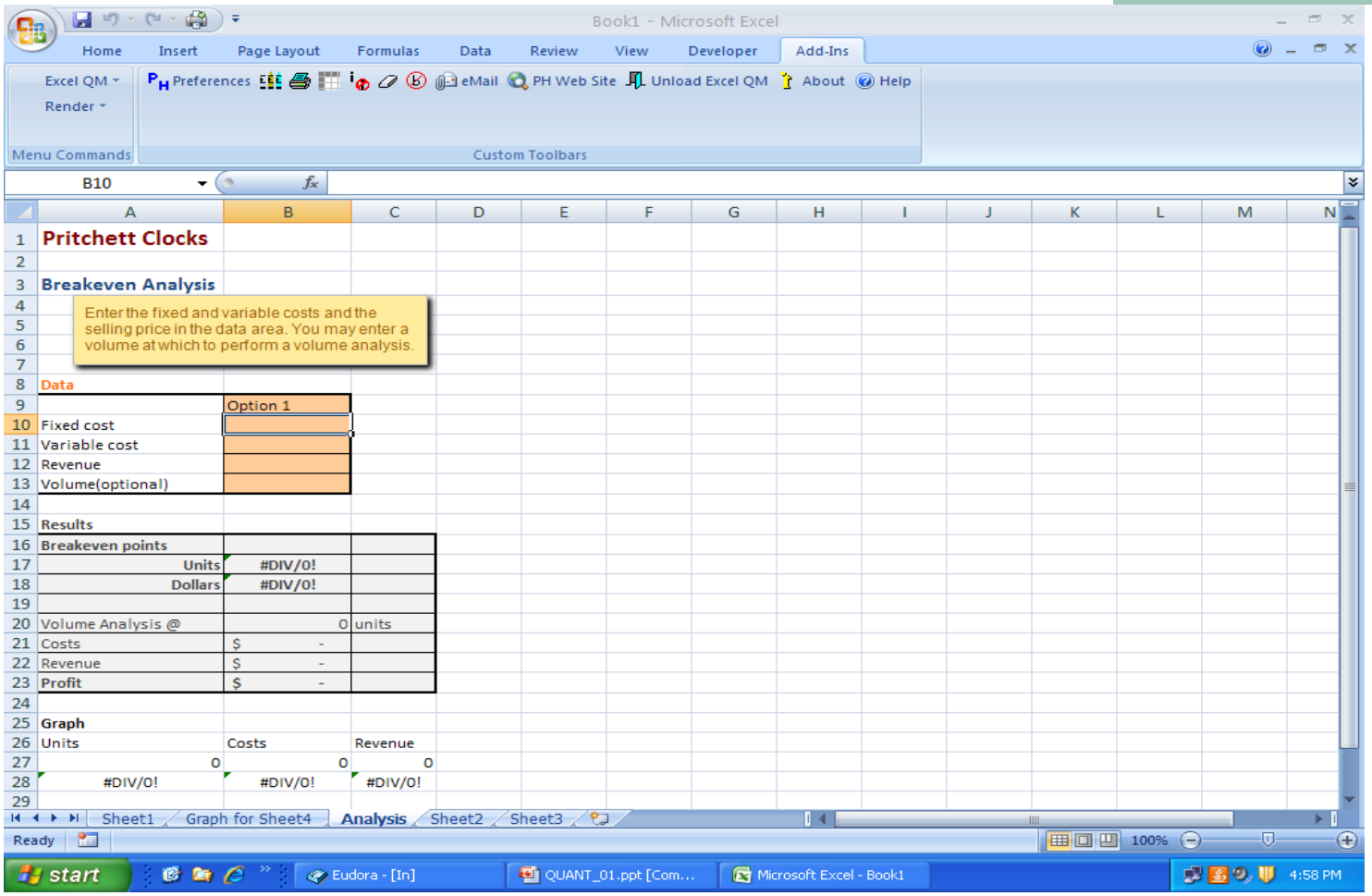
Excel QM Breakeven Analysis [cost vs revenue]



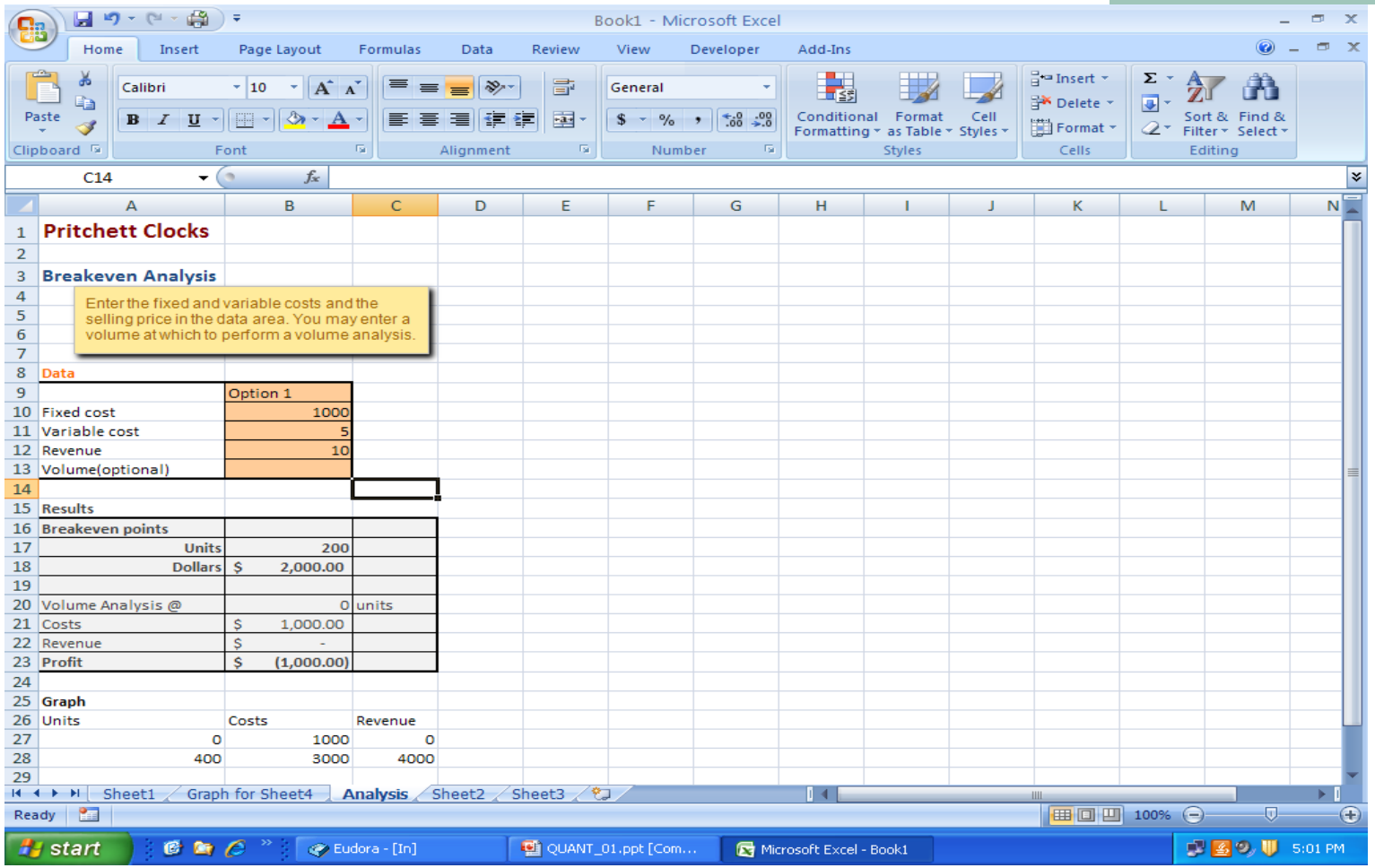
Excel QM Breakeven Analysis (con't)



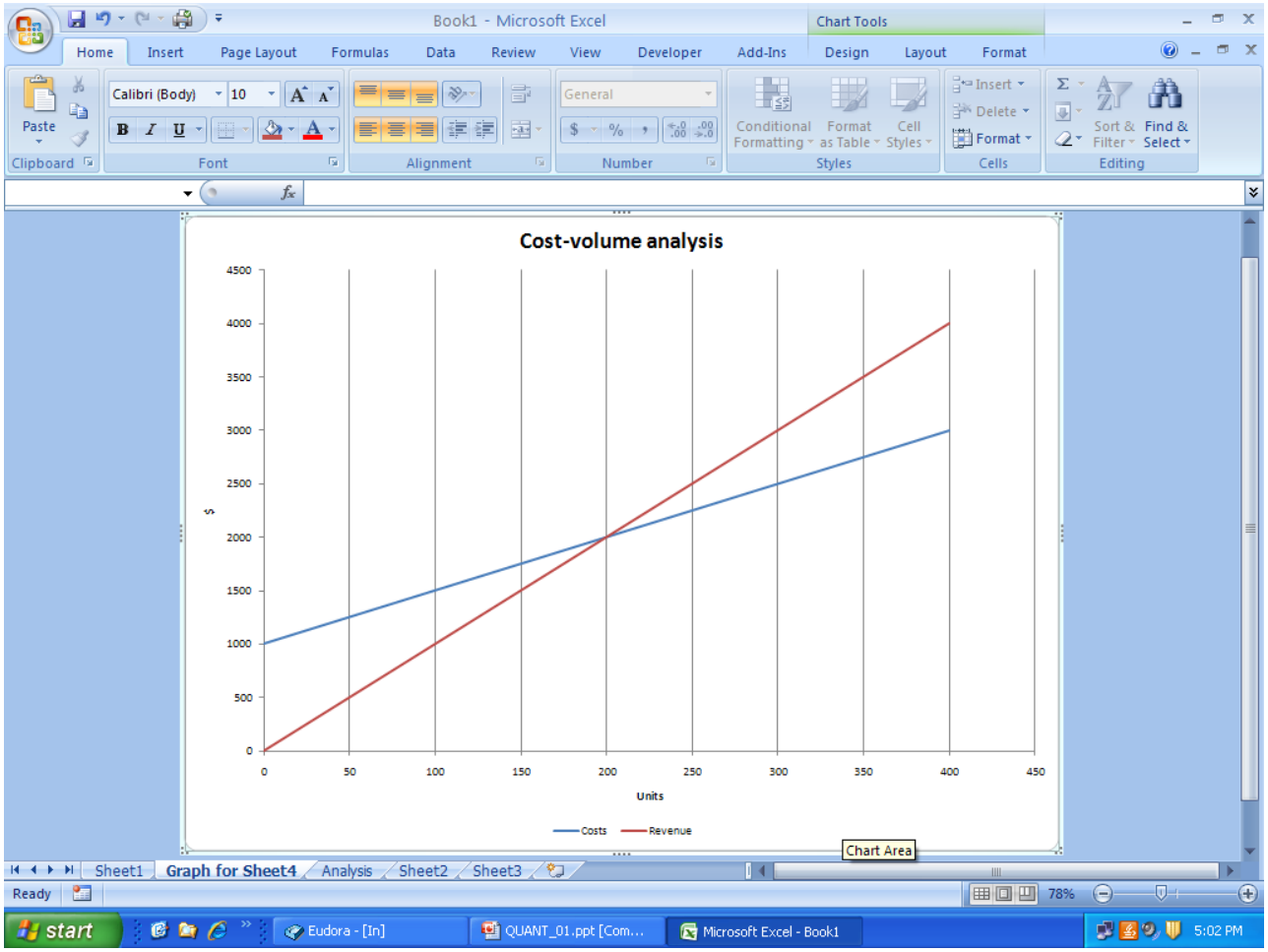
Excel QM Breakeven Analysis (con't) [blank form to fill out]



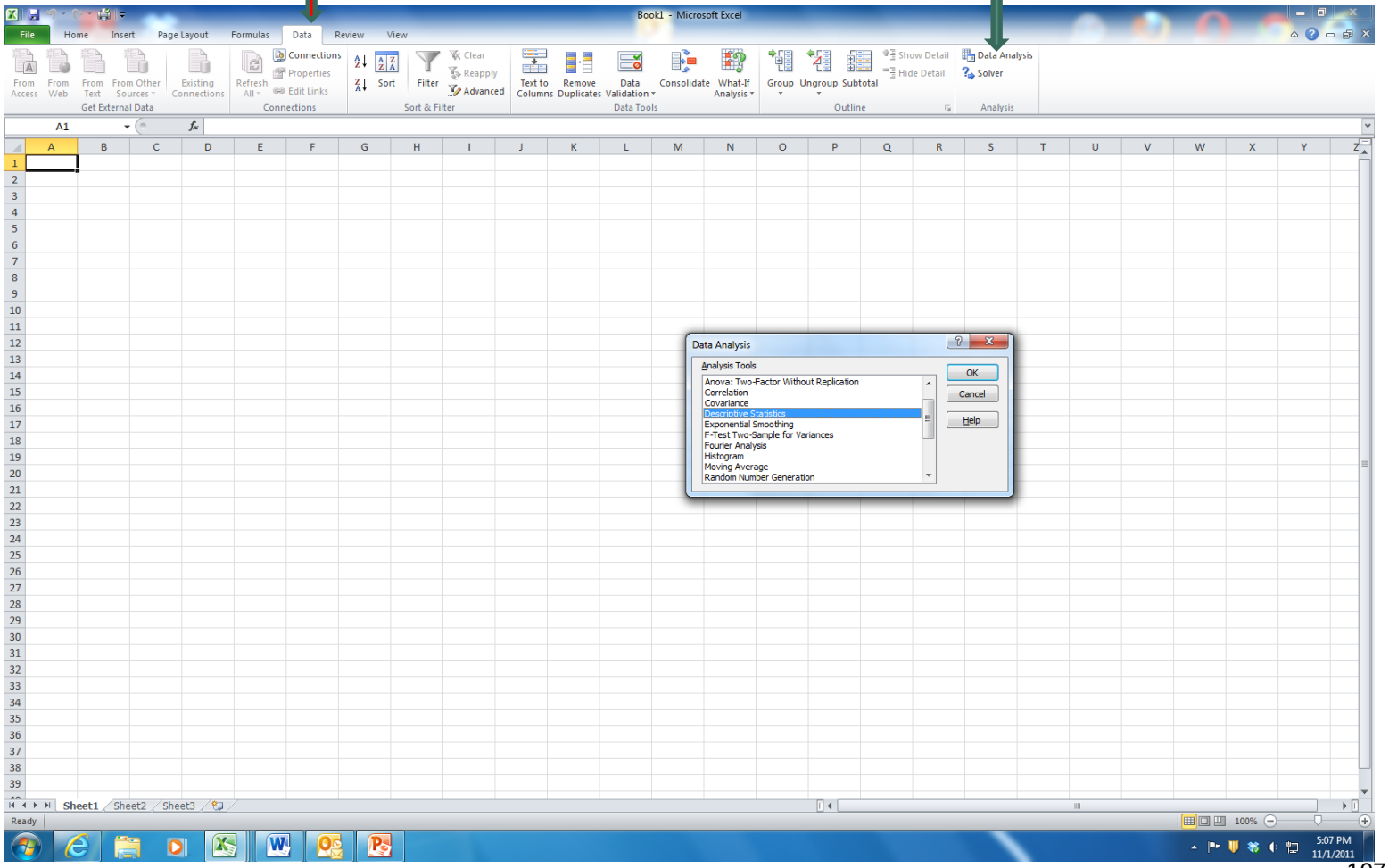
Excel QM Breakeven Analysis (con't) [after filing in data from spring problem]



Excel QM Breakeven Analysis (con't [graph in another worksheet]

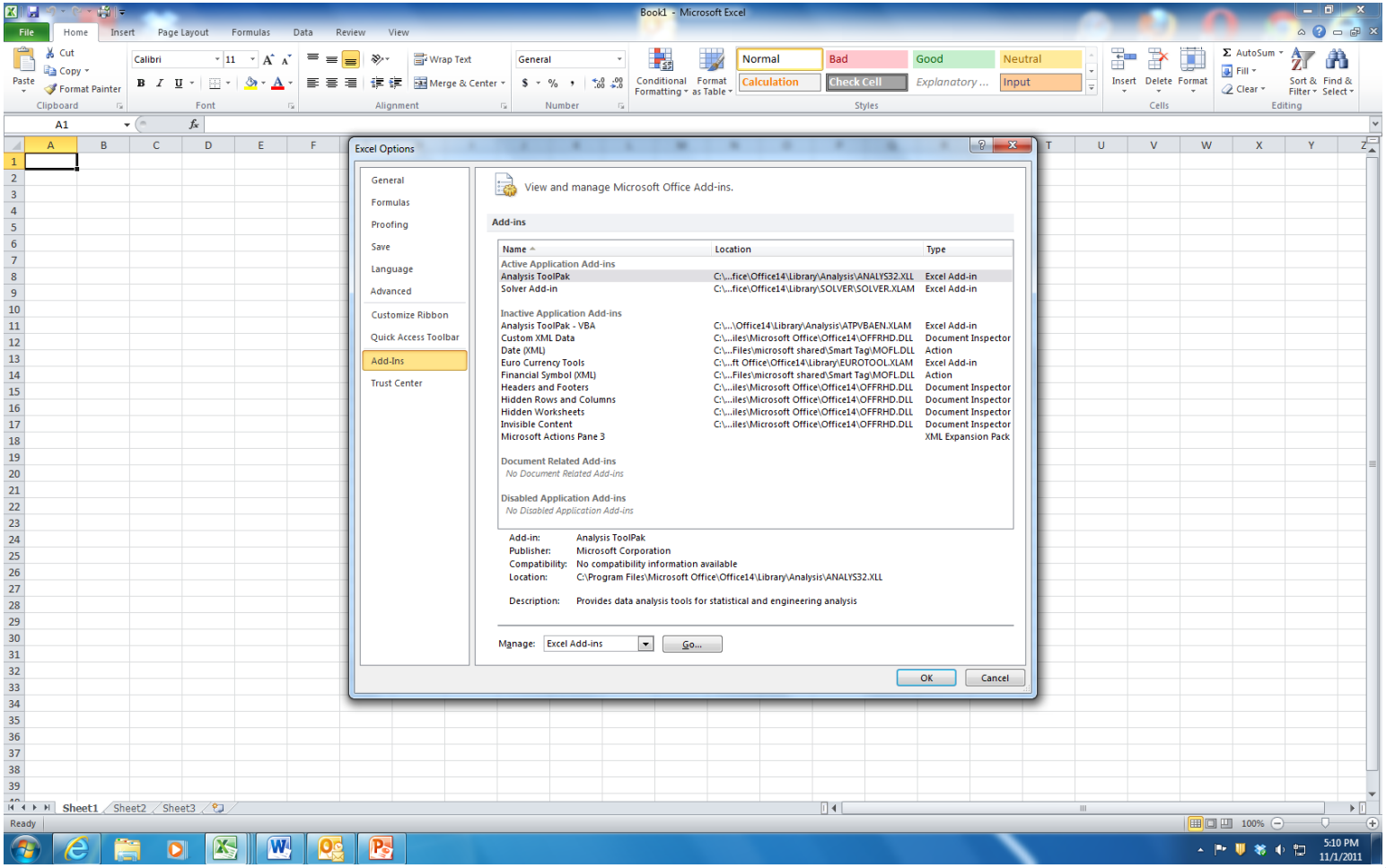


Data Analysis Tools in Excel 2007/10+



Adding ToolPak to Tools Group

File → Options → Add Ins → Analysis ToolPak



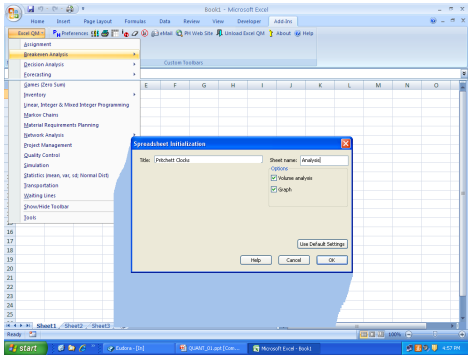
Statistics & Probability Reviews

- There is a lesson for review of basic statistics and another lesson for review of basic probability available on the syllabus website

"Data don't make any sense,
we will have to resort to statistics."

Homework

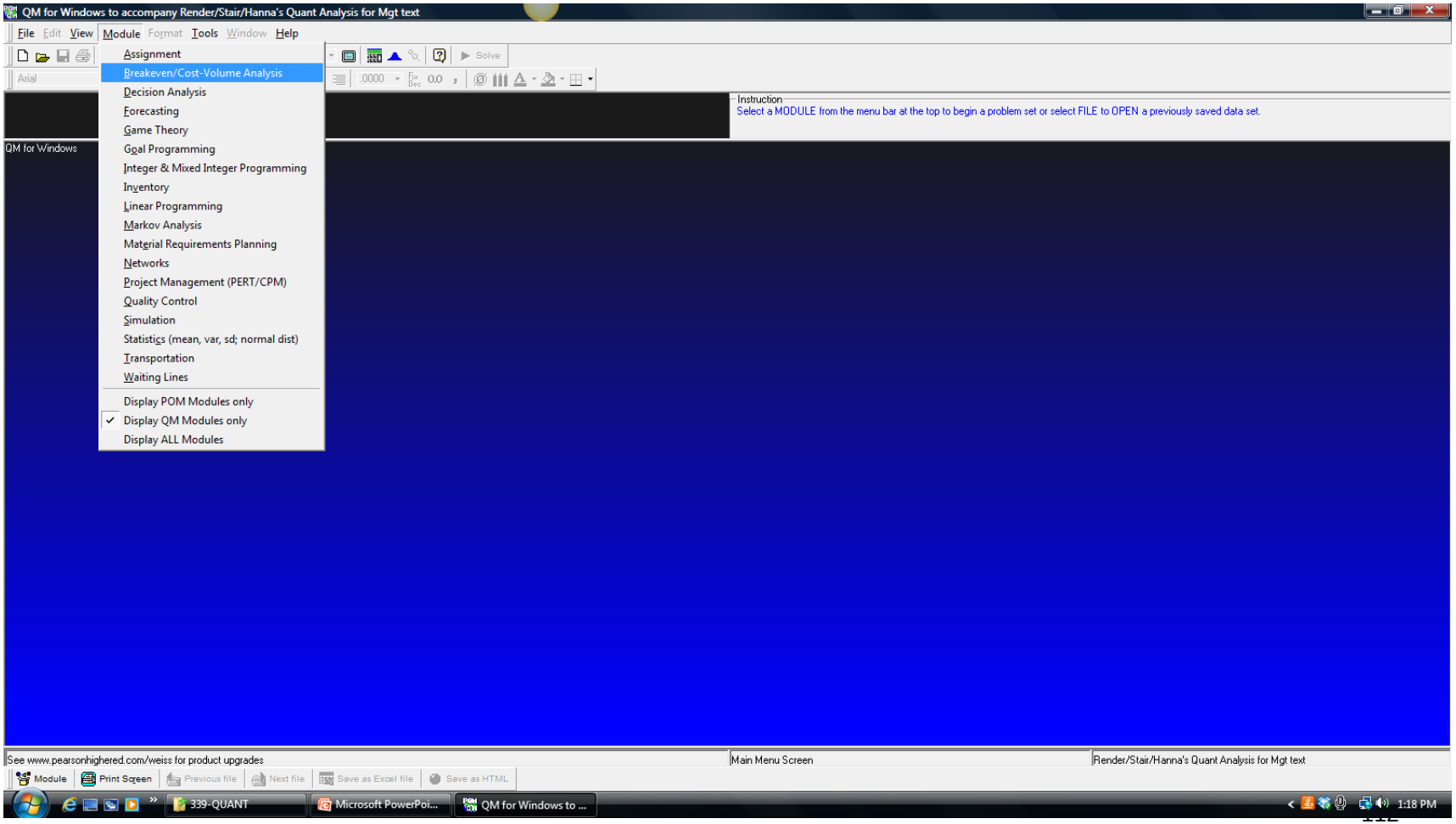
- Textbook Chapter 1 and Textbook Appendices E & F on QM
  - Quiz 1
- If necessary:
  - Excel review
  - Statistics/Excel review
  - Probability review
- Appendix on POM QM for breakeven
- Complete Excel QM breakeven analysis (clocks problem) – submit xlsx file or QM file or screen copy



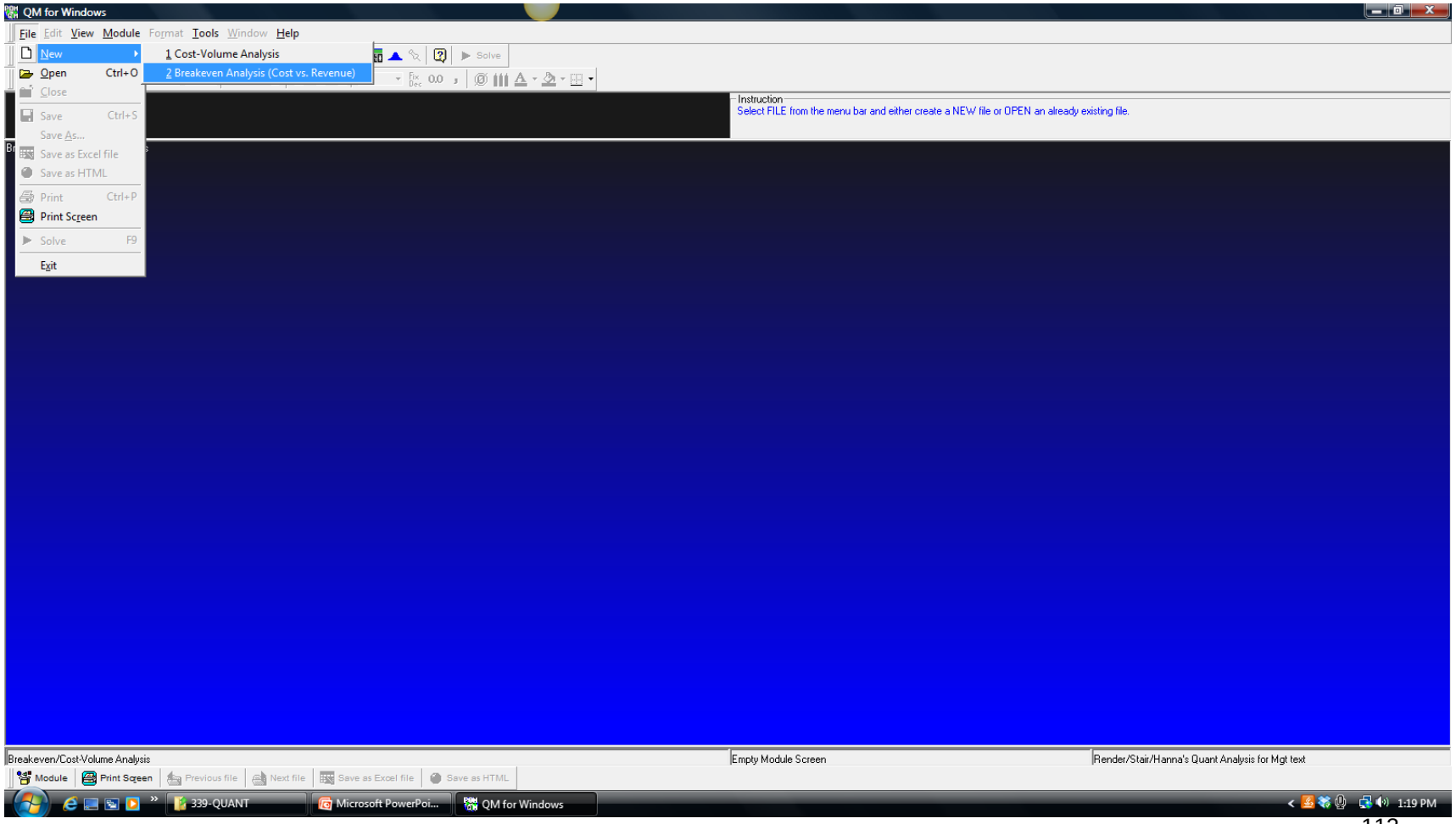
APPENDIX

POM QM

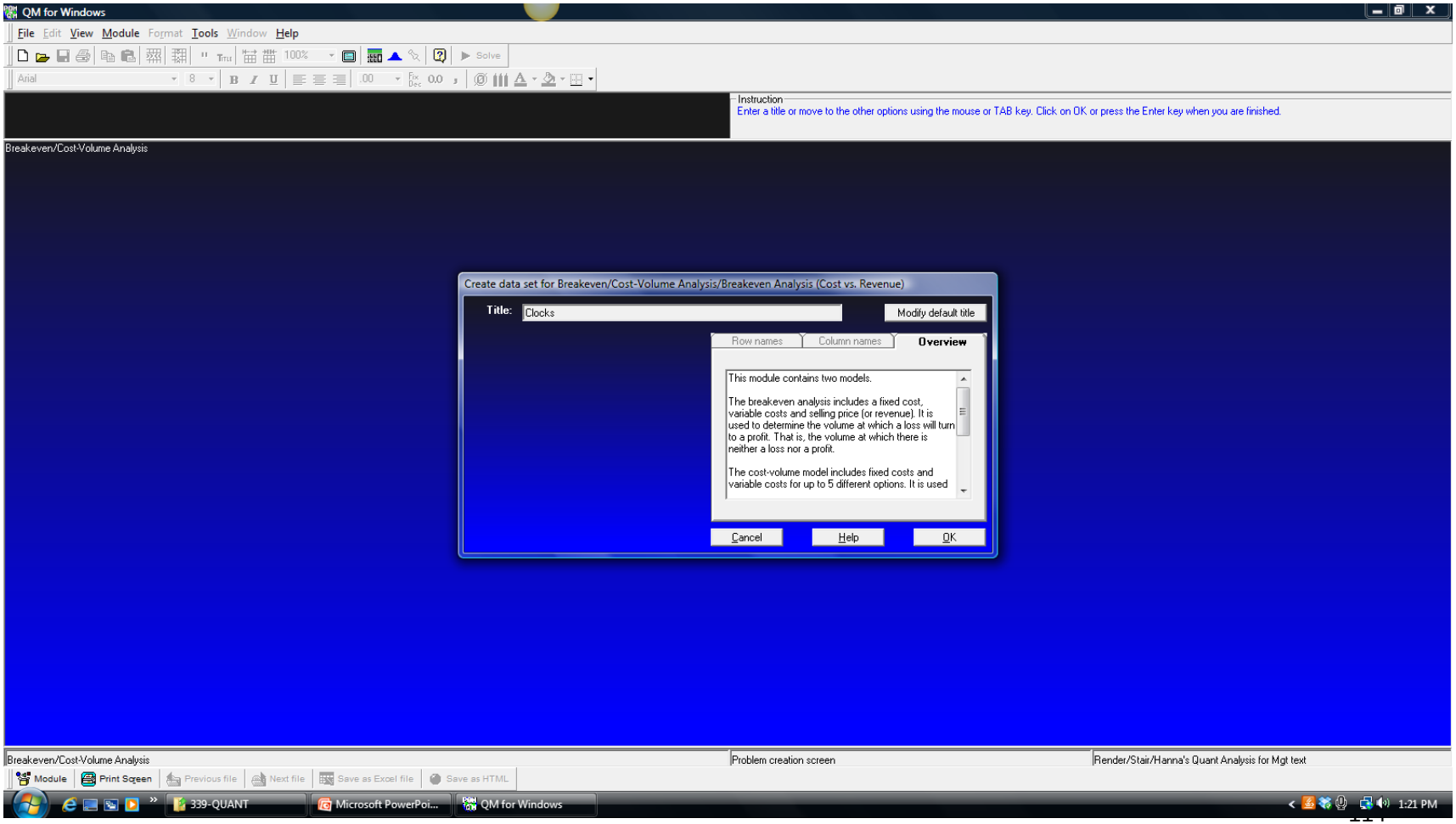
[chose breakeven analysis]



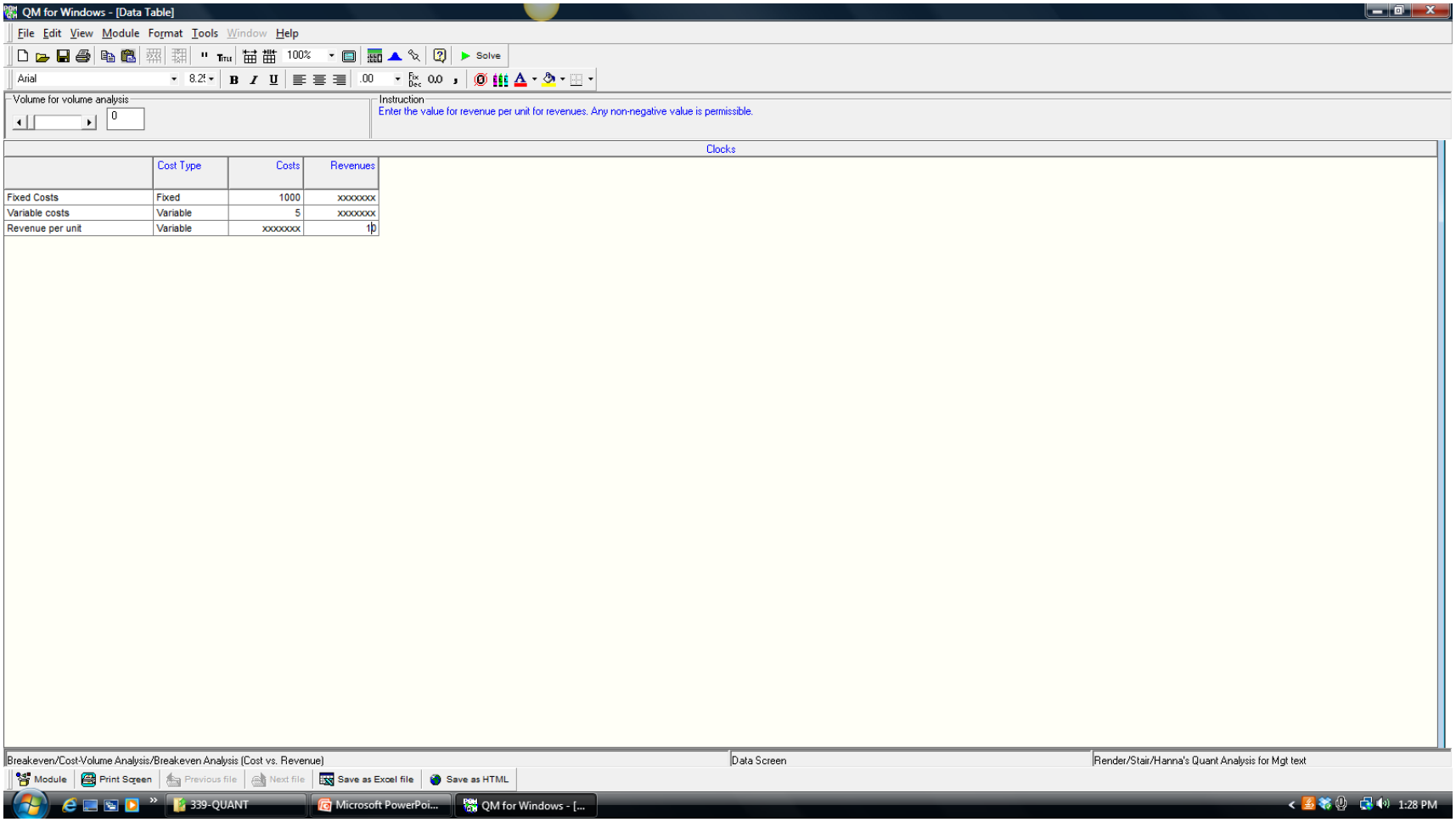
New file for breakeven analysis…



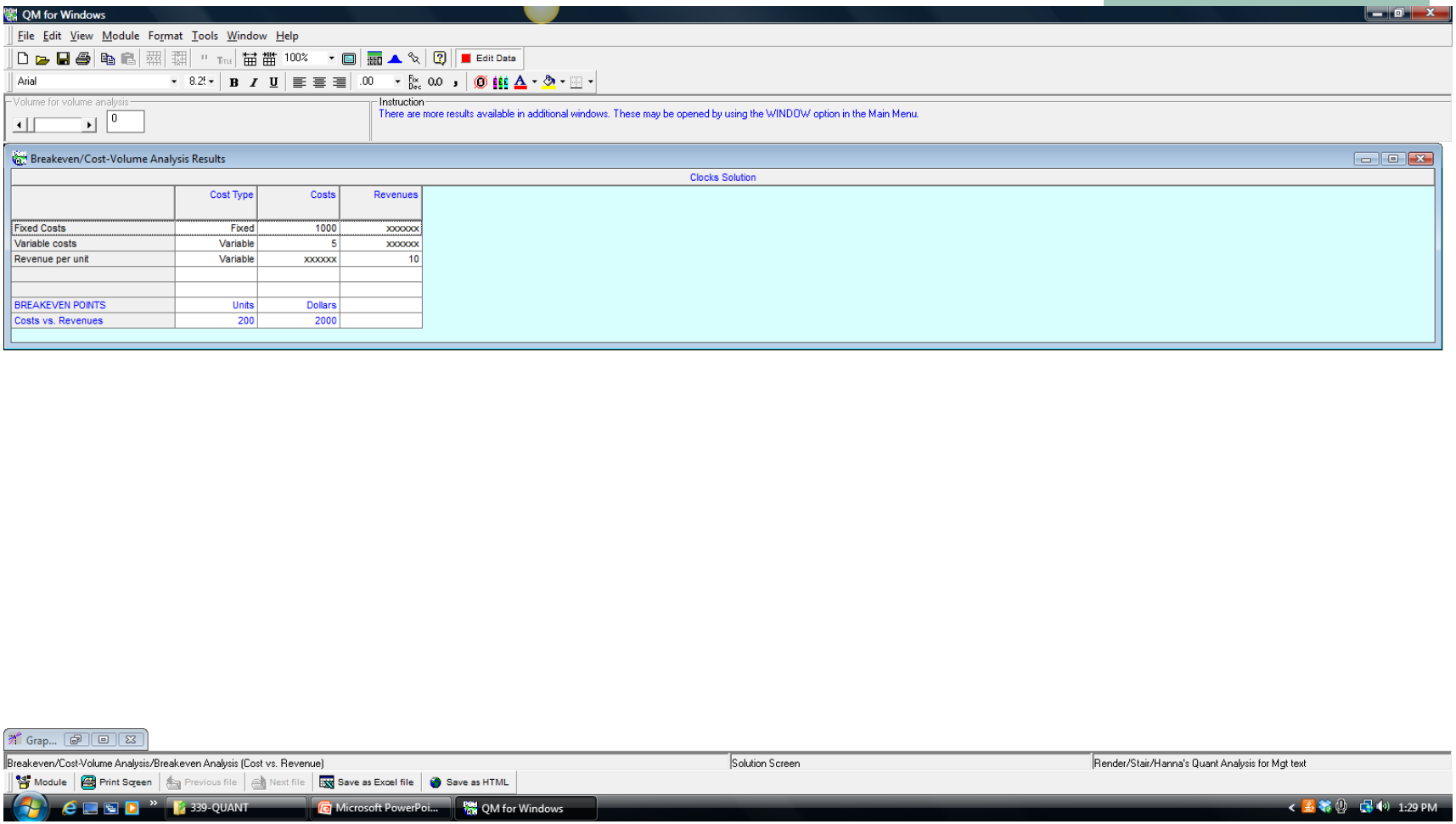
Enter title, read overview…



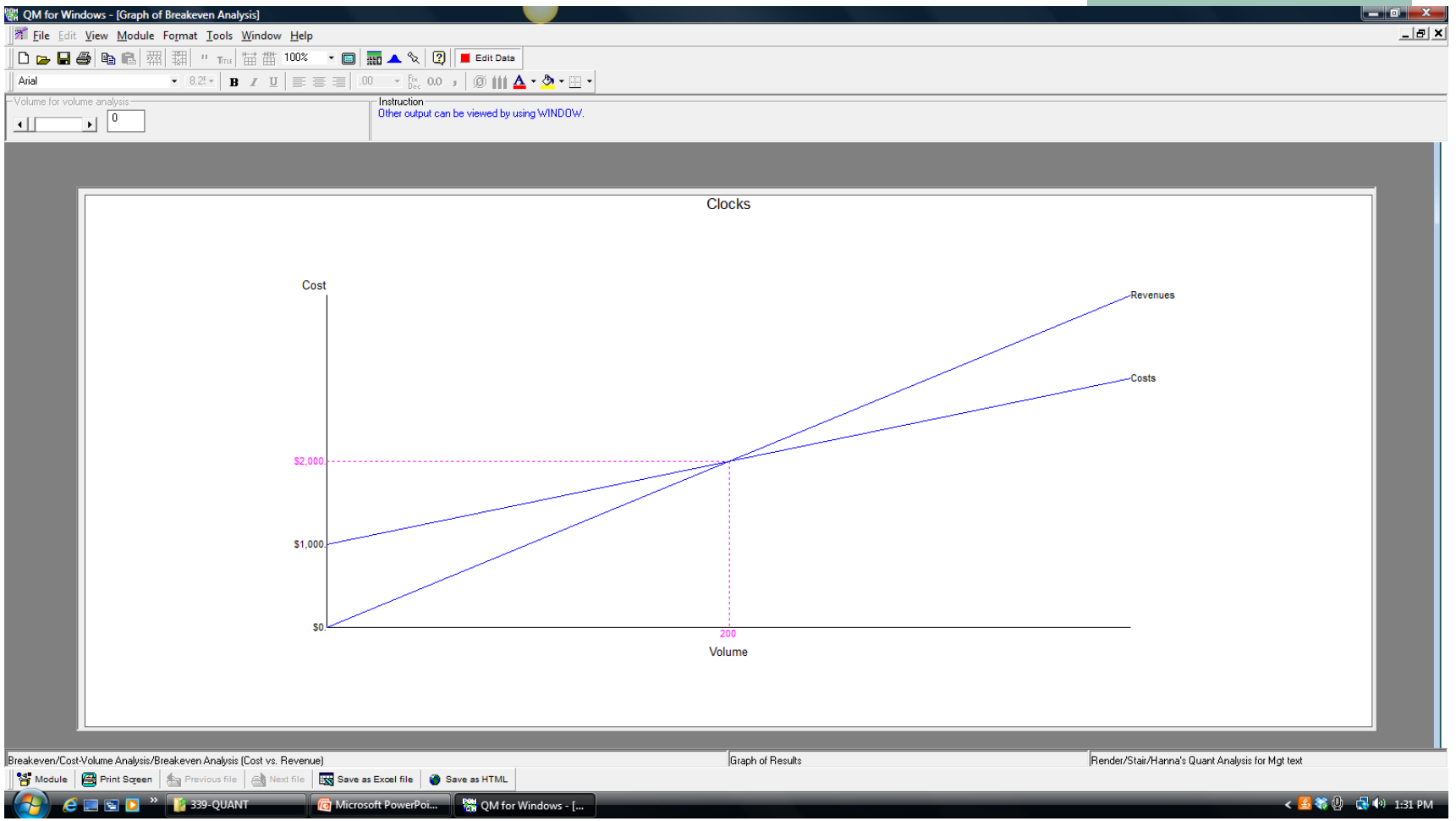
Enter cost and price (revenue) data…



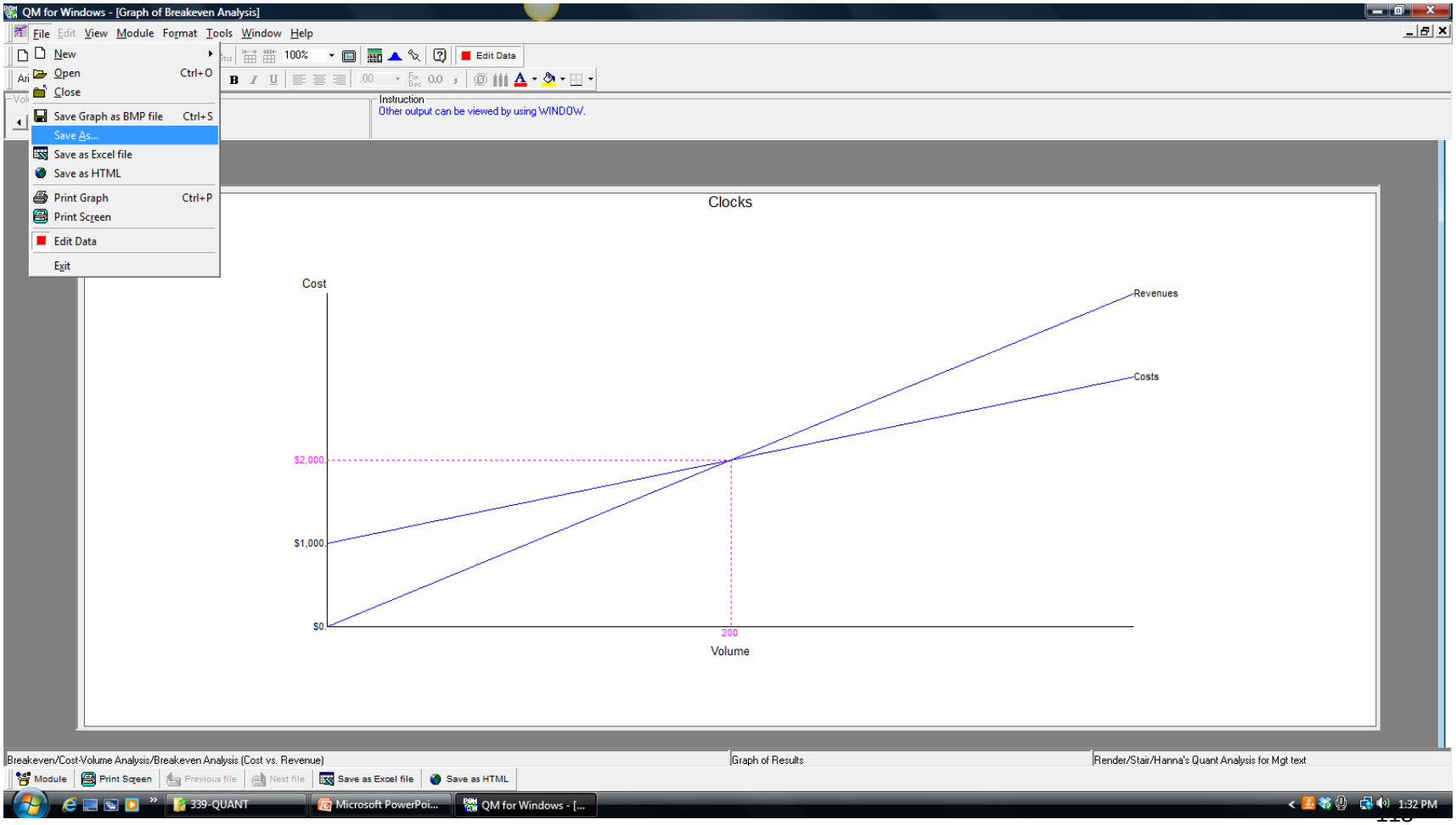
After hitting “solve” button…



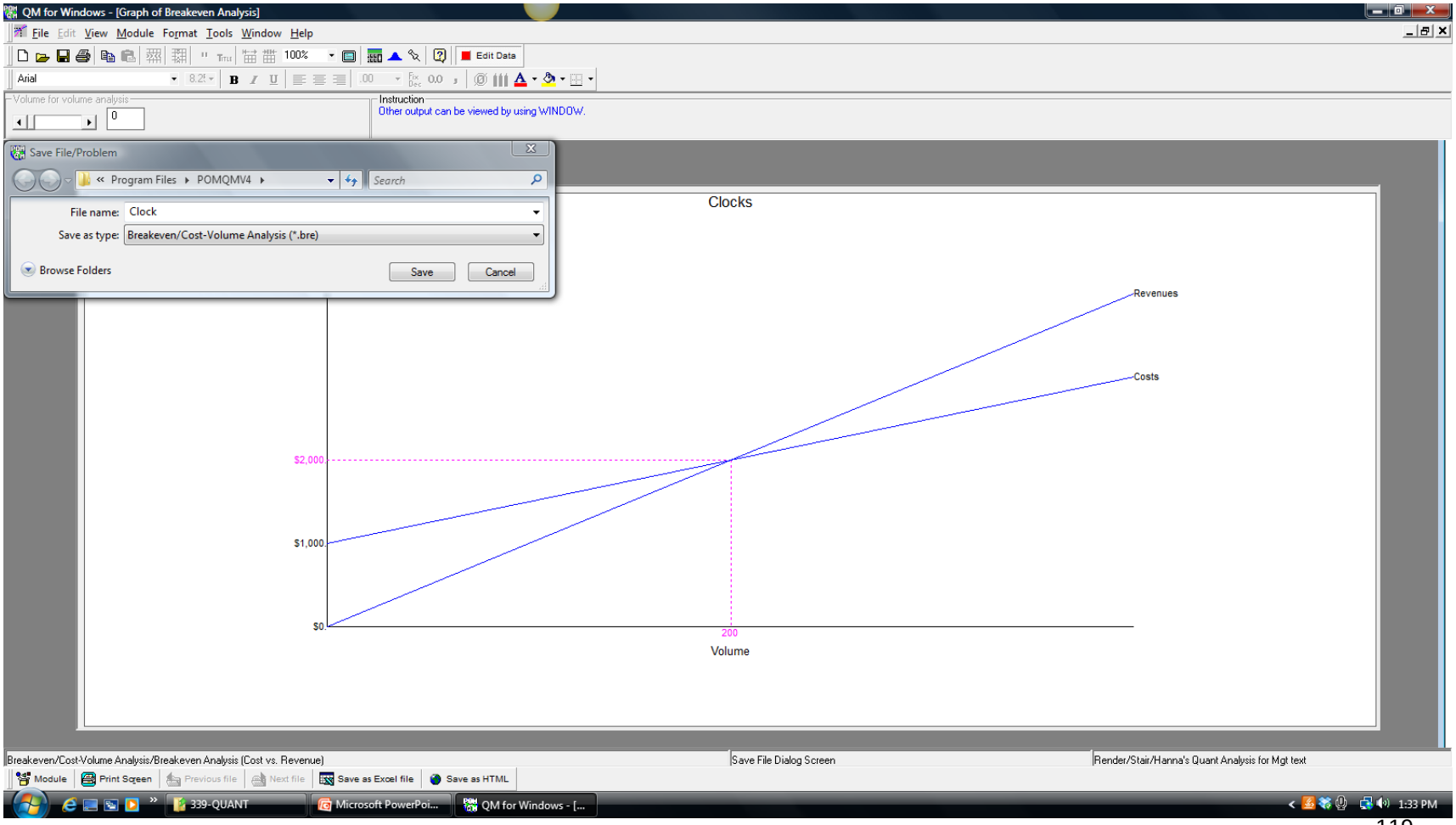
Expanding graph



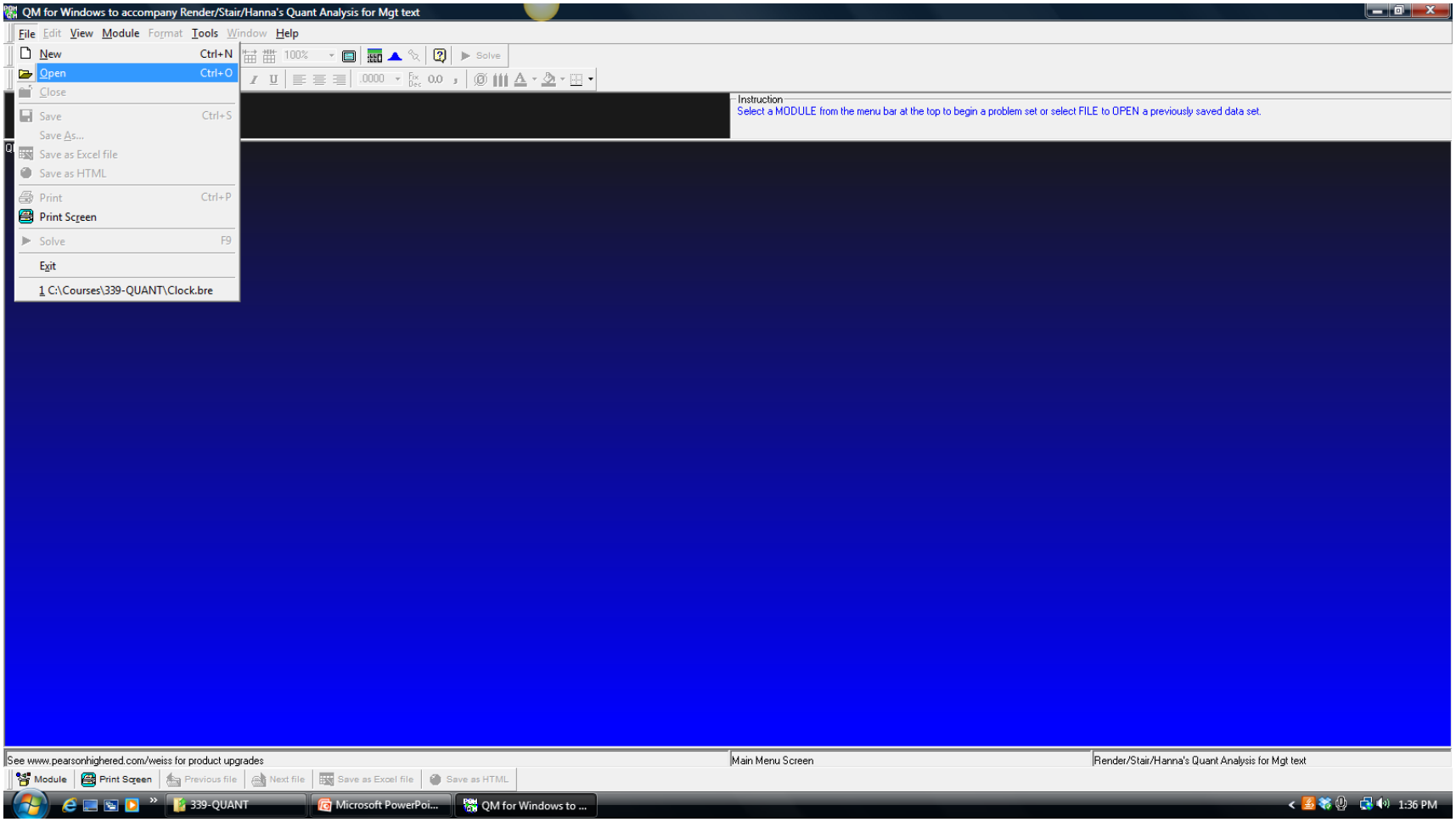
Save file…



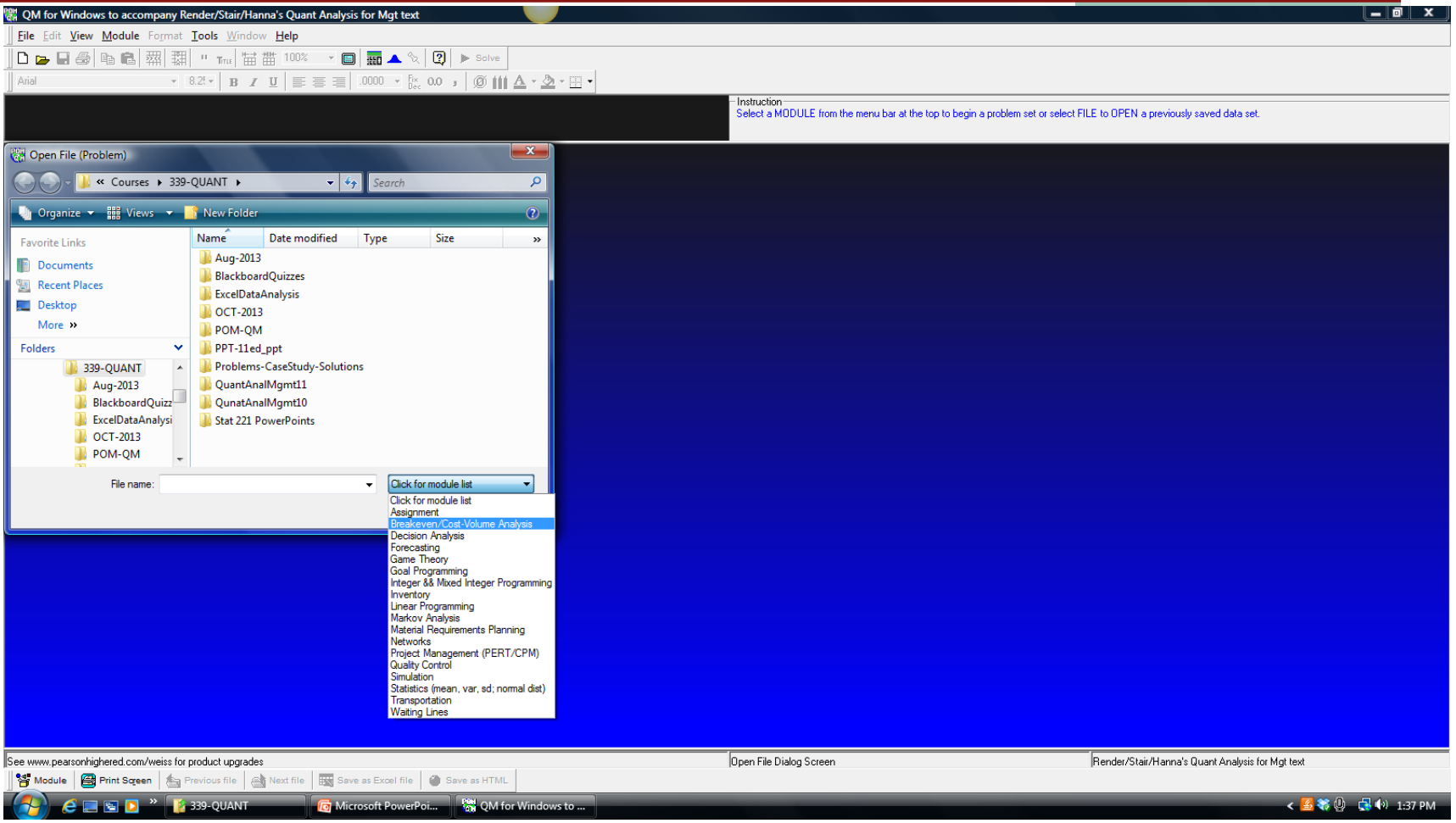
Save as “Clock.bre”…



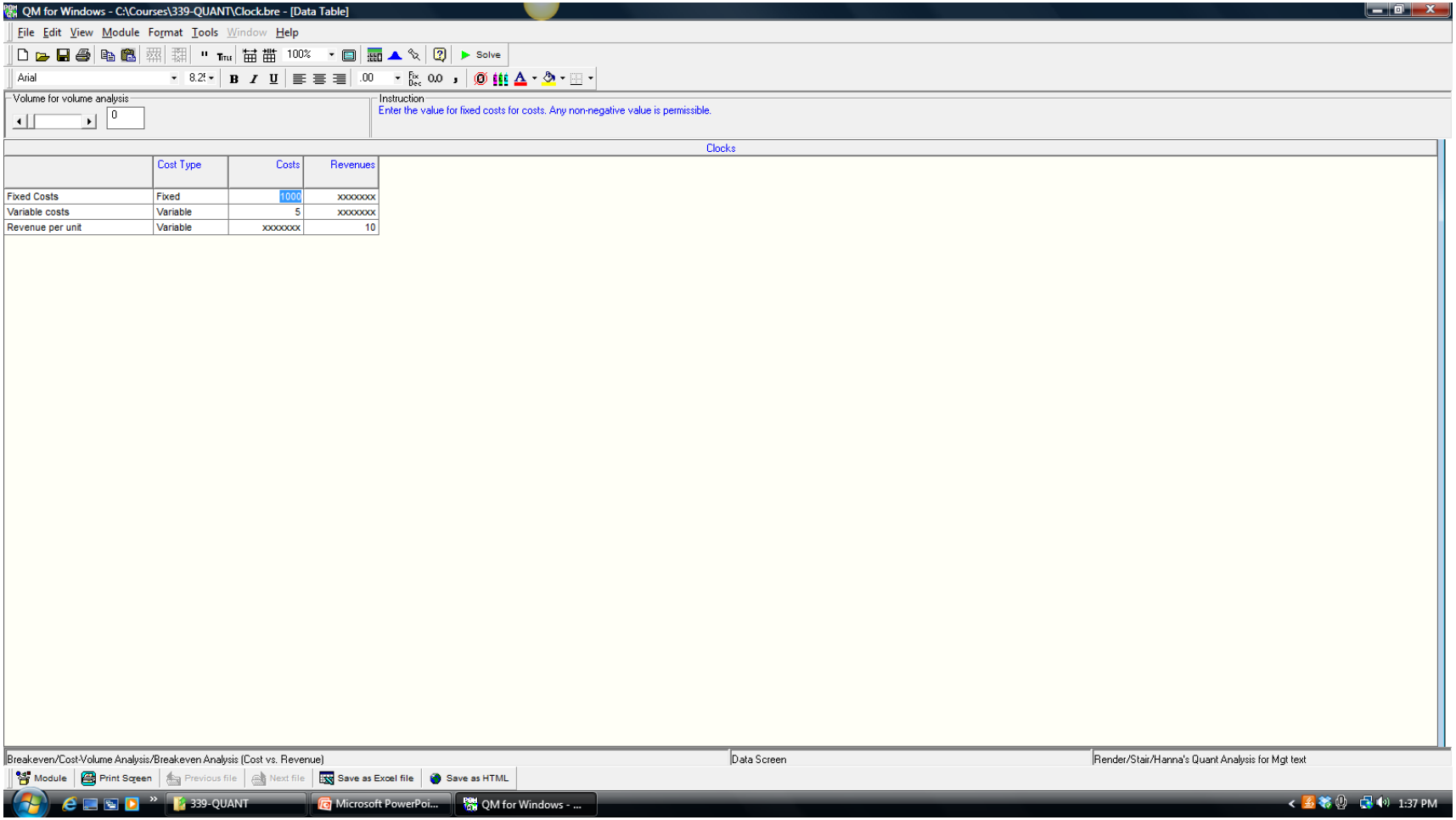
Open file…



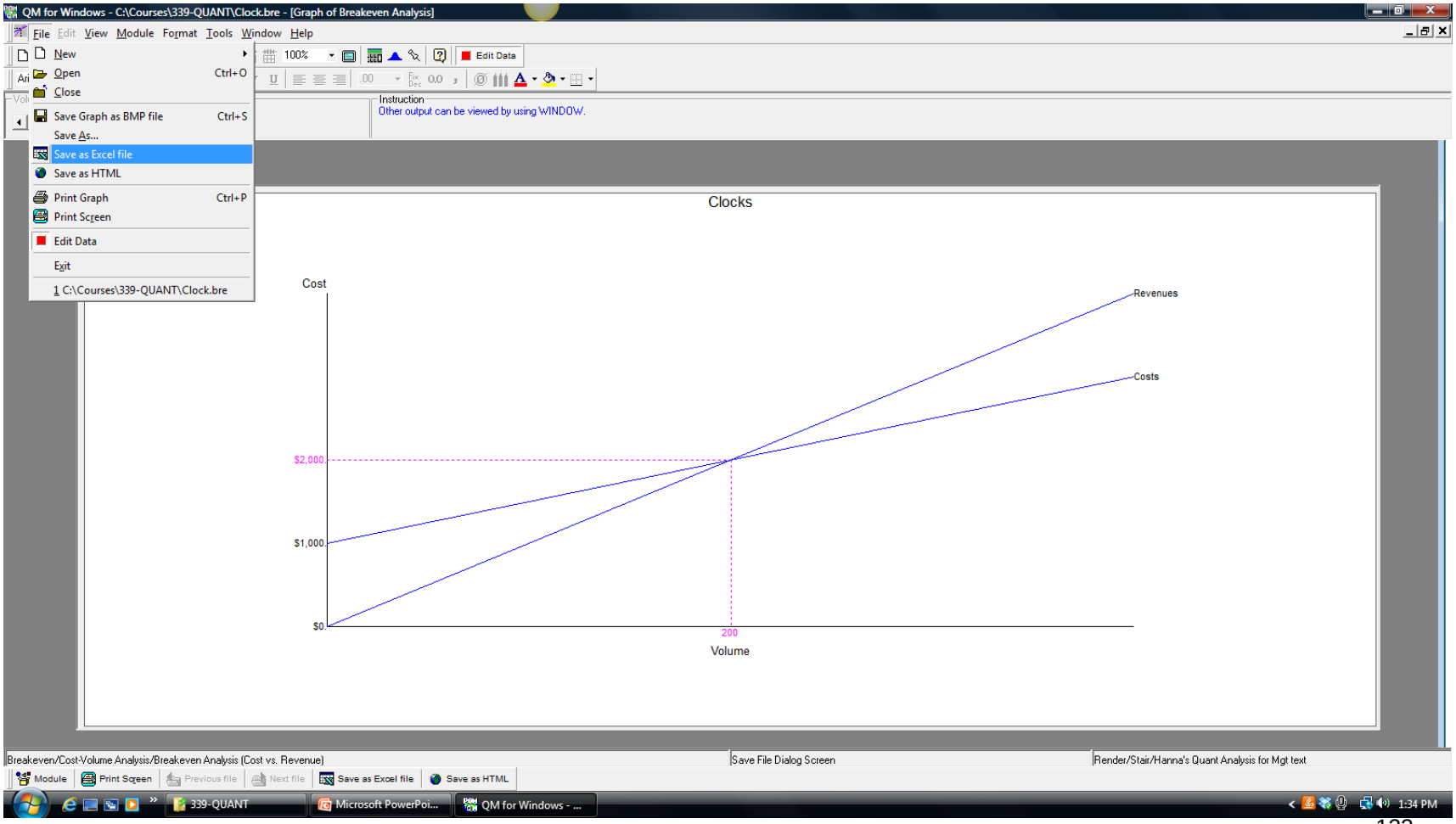
Chose module type…



Clock file, re-opened…



Save as Excel file …



Clock file opened in Excel…