

# FOR DAX FORMULAS PowerPivot

A Simple Guide to the Excel Revolution

The screenshot shows the Microsoft Excel interface with the PowerPivot tab active. The 'Measures Settings' dialog box is open, showing the following details:

- Table name: Sales
- Measure name (all PivotTables): Sales per Day Total Add Up
- Custom name (this PivotTable): Sales per Day Total Add Up
- Description:
- Formula: `=IF(IISONEVALUET(Products(ModelName)), [Sales per Day], SUMX(VALUES(Products(ModelName)), [Sales per Day]))`
- Formatting Options:
  - Category: Number
  - Symbol: \$
  - Decimal places: 0
  - Use 1000 Separator: [X]

The background shows a PivotTable with columns for Brand (BRAND 1 to BRAND 9) and rows for various categories. A bar chart titled 'Types of Plans' is visible on the left, and a 'PowerPivot Field List' pane is on the right.



= powerpivot(**pro**)

Rob Collie

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# DAX Formulas for PowerPivot

by

**Rob Collie**

Holy Macro! Books  
PO Box 82  
Uniontown, OH 44685

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# DAX Formulas for PowerPivot

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# Supporting Workbooks and Data Sets

When I first committed to write the book, I decided that I would not attempt a companion CD or similar electronic companion of samples, data sets, etc.

I made that decision for two reasons:

1. I've found that when I am able to say something like "take a look at the supporting files if this isn't clear," that provides me too easy of an escape hatch. Treating the book as a purely standalone deliverable keeps me disciplined (or more disciplined at least) about providing clear and complete explanations.
2. Companion materials like that would have delayed release of the book and made it more expensive.

But as I neared completion of the book I realized that I could still provide a few such materials on an informal basis, downloadable from the blog.

So I will upload the original Access database that I used as a data source, as well as the workbook itself from various points in time as I progressed through the book:

<http://ppvt.pro/BookFiles>

**Note that this will be a "living" page** – a place where you can ask for clarification on the files, suggest improvements to them, etc. As time allows I will modify and improve the contents of the page.

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## A Note on Hyperlinks

You will notice that all of the hyperlinks in this book look like this:

<http://ppvt.pro/<foo>>

Where <foo> is something that is short and easy to type. Example:

<http://ppvt.pro/1stBlog>

**This is a "short link" and is intended to make life much easier for readers of the print edition.** That link above will take you to the first blog post I ever published, which went live in October of 2009.

Its "real" URL is this:

<http://www.powerpivotpro.com/2009/10/hello-everybody/>

Which would *you* rather type?

So just a few notes:

1. **These short links will *always* start with <http://ppvt.pro/>** – which is short for "PowerPivotPro," the name of my blog.
2. **These links are case-sensitive!** If the link in the book ends in "1stBlog" like above, typing "1stblog" or "1stBLOG" will *not* take you to the intended page!
3. **Not all of these links will lead to my blog** – some will take you to Microsoft sites for instance.
4. **The book does not rely on you following the links** – the topics covered in this book are intended to be complete in and of themselves. The links provided are strictly optional "more info" type of content.

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# Introduction

## My Two Goals for This Book

**Fundamentally of course, this book is intended to train you on PowerPivot.** It captures the techniques I've learned from three years of teaching PowerPivot (in person and on my blog), as well as applying it extensively in my everyday work.

Unsurprisingly, then, the contents herein are very much instructional – a “how to” book if ever there was one.

**But I also want you to understand how to maximize PowerPivot's impact on your career.** It isn't just a better way to do PivotTables. It isn't just a way to reduce manual effort. It's not just a better formula engine.

Even though I worked on the first version of PowerPivot while at Microsoft, I had no idea how impactful it would be until about two years after I left the company. I had to experience it in the real world to see its full potential, and even then it took some time to overwhelm my skeptical nature (my Twitter profile now describes me as “skeptic turned High Priest.”)

**This is the rare technology that can (and will) fundamentally change the lives of millions of people** – it has more in common with the invention of the PC than with the invention of, say, the VCR.

The PC might be a particularly relevant example actually. At a prestigious Seattle high school in the early 1970's, Bill Gates and Paul Allen discovered a mutual love for programming, but there was no widespread demand for programmers at that point. Only when the first PC (the Altair) was introduced was there an opportunity to properly monetize their skills. Short version: they founded Microsoft and became billionaires.

But zoom out and you'll see much more. *Thousands* of people became millionaires at Microsoft alone (sadly, yours truly missed that boat by a few years). Further, without the Altair, there would have been no IBM PC, no Apple, no Mac, no Steve Jobs. No iPod, no iPhone, no Appstore. No Electronic Arts, no Myst. No World of Warcraft. **The number of people who became wealthy as a result of the PC absolutely dwarfs the number of people who had anything to do with inventing the PC itself!**

**I think PowerPivot offers the same potential wealth-generation effect to Excel users as the PC offered budding programmers like Gates and Allen:** your innate skills remain the same but their value becomes many times greater. Before diving into the instructional stuff in Chapters 2 and beyond, Chapter 1 will summarize your exciting new role in the changing world.

And like many things in my life, the story starts with a movie reference 😊





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# 1- A Revolution Built on YOU

## Does This Sound Familiar?

In the movie *Fight Club*, Edward Norton's character refers to the people he meets on airplanes as "single serving friends" – people he befriends for three hours and never sees again. I have a unique perspective on this phenomenon, thanks to a real-world example that is relevant to this book.

A woman takes her seat for a cross-country business flight and is pleased to see that her seatmate appears to be a reasonably normal fellow. They strike up a friendly conversation, and when he asks her what she does for a living, she gives the usual reply: "I'm a marketing analyst."

That answer satisfies 99% of her single-serving friends, at which point the conversation typically turns to something else. However, this guy is the exception, and asks the dreaded follow-up question: "Oh, neat! What does that *mean*, actually?"

She sighs, ever so slightly, because the honest answer to that question always bores people to death. Worse than that actually: it often makes the single-serving friend recoil a bit, and express a sentiment bordering on pity.

But she's a factual sort of person, so she gives a factual answer: "well, basically I work with Excel all day, making PivotTables." She fully expects this to be a setback in the conversation, a point on which she and her seatmate share no common ground.

Does this woman's story sound familiar? Do you occasionally find yourself in the same position?

Well imagine her surprise when this particular single-serving friend actually becomes **excited** after hearing her answer! He lights up – it's the highlight of his day to meet her.

Because, you see, on this flight, she sat down next to me. And I have some exciting news for people like her, which probably includes you :-)

## Excel Pros: The World is Changing in Your Favor

If you are reading this, I can say confidently that the world is on the verge of an incredible discovery: it is about to realize how immensely valuable you are. In large part, this book is aimed at helping you reap the full rewards available to you during this revolution.

That probably sounds pretty appealing, but why am I so comfortable making bold pronouncements about someone I have never met? Well, this is where the single-serving friend thing comes in: I have met **many** people like you over the years, and to me, you are very much 'my people.'

In fact, for many years while I worked at Microsoft, it was my **job** to meet people like you. I was an engineer on the Excel team, and I led a lot of the efforts to design new functionality for relatively advanced users.

Meeting those people, and watching them work, was crucial, so I traveled to find them. When I was looking for people to meet, the only criteria I applied was this: you had to use Excel for ten or more hours per week.

I found people like that (like you!) all over the world, in places ranging from massive banks in Europe to the back rooms of automobile dealerships in Portland, Oregon. There are also many of you working at Microsoft itself, working in various finance, accounting, and marketing roles, and I spent a lot of time with them as well (more on this later).

Over those years, I formed a 'profile' of these 'ten hour' spreadsheet people I met. Again, see if this sounds familiar.

### Attributes of an Excel Pro:

- They grab data from one or more sources.
- They prep the data, often using VLOOKUP.
- They then create pivots over the prepared data.
- Sometimes they subsequently index into the resulting pivots, using formulas, to produce polished reports. Other times, the pivots themselves serve as the reports.
- They then share the reports with their colleagues, typically via email or by saving to a network drive.

- They spend at least half of their time re-creating the same reports, updated with the latest data, on a recurring basis.

At first, it seemed to be a coincidence that there was so much similarity in the people I was meeting. But over time, it became clear that this was no accident. It started to seem more like a law of physics – an inevitable state of affairs. Much like the heat and pressure in the earth’s crust seize the occasional pocket of carbon and transform it into a diamond, the demands of the modern world ‘recruit’ a certain kind of person and forge them into an Excel Pro.

**i** **Aside:** Most Excel Pros do not think of themselves as Pros: I find that most are quite modest about their skills. However, take it from someone who has studied Excel usage in depth: if you fit the bulleted criteria above, you are an Excel Pro. Wear the badge proudly.

I can even put an estimate on how many of you are out there. At Microsoft we used to estimate that there were 300 million users of Excel worldwide. This number was disputed, and might be too low, especially today. It’s a good baseline, nothing more. But that was **all** users of Excel – from the most casual to the most expert. Our instrumentation data further showed us that only 10% of all Excel users created Pivot tables.

‘Create’ is an important word here – much more than 10% consume pivots made by others, but only 10% are able to create them from scratch. Creating pivots, then, turns out to be an overwhelmingly accurate indicator of whether someone is an Excel Pro. We might as well call them Pivot Pros.

You may feel quite alone at your particular workplace, because statistically speaking you are quite rare – less than 0.5% of the world’s population has your skillset! But in absolute numbers you are far from alone in the world – in fact, you are one of approximately thirty million people. If Excel Pros had conferences or conventions, it would be quite a sight.

**i** I, too, fit the definition of an Excel Pro. It is no accident that I found myself drawn to the Excel team after a few years at Microsoft, and it is no accident that I ultimately left to start an Excel / PowerPivot-focused business (and blog). While I have been using the word ‘you’ to describe Excel Pros, I am just as comfortable with the word ‘we.’

As I said up front, I am convinced that our importance is about to explode into the general consciousness. After all, we are a **ready crucial**.

## Our Importance Today

As proof of how vital we are, here’s another story from Microsoft, one that borders on legend. The actual event transpired about ten years ago and the details are hazy, but ultimately it’s about you; about us.

Someone from the SQL Server database team was meeting with Microsoft’s CLO Steve Ballmer. They were trying to get his support for a ‘business intelligence’ (BI) initiative within Microsoft – to make the company itself a testbed for some new BI products in development at that time. If Steve supported the project, the BI team would have a much easier time gaining traction within the accounting and finance divisions at Microsoft.

In those days, Microsoft had a bit of a ‘prove it to me’ culture. It was a common approach to ‘play dumb’ and say something like, “okay, tell me why this is valuable.” Which is precisely the sort of thing Steve said to the BI folks that day.

To which they gave an example, by asking a question like this: “If we asked you how much sales of Microsoft Office grew in South America last year versus how much they grew the year before, but only during the holiday season, you probably wouldn’t know.”

Steve wasn’t impressed. He said, “sure I would,” triggering an uncomfortable silence. The BI team **knew** he lacked the tools to answer that question – they’d done their homework. Yet here was one of the richest and most powerful men in the world telling them they were wrong.

One of the senior BI folks eventually just asked straight out, “Okay, **show** us how you’d do that.”

Steve snapped to his feet in the center of his office and started shouting. Three people hurried in, and he started waving his arms frantically and bellowing orders, conveying the challenge at hand and the informa-

tion he needed. This all happened with an aura of familiarity – this was a common occurrence, a typical workflow for Steve and his team.

Those three people then vanished to produce the requested results. In Excel, of course.

## Excel at the Core

Let that sink in: the CEO of the richest company in the world (and one of the most technologically advanced!) relies heavily on Excel Pros to be his eyes and ears for all things financial. Yes, I am sure that now, many years later, he has a broad array of sophisticated BI tools at his disposal. However, I am equally sure that his reliance on Excel Pros has not diminished by any significant amount.

Is there anything special about Microsoft in this regard? Absolutely not! This is true everywhere. No exceptions. Even at companies where they claimed to have 'moved beyond spreadsheets,' I was always told, off the record, that Excel still powered 90% of decisions. (Indeed, an executive at a large Microsoft competitor told me recently that his division, which produces a BI product marketed as a 'better' way to report numbers than Excel, uses Excel for all internal reporting!)

Today, if a decision – no matter how critical the decision, or how large the organization – is informed by data, it is overwhelmingly likely that the data is coming out of Excel. The data may be communicated in printed form, or PDF, or even via slide deck. But it was produced in Excel, and therefore by an Excel Pro.

The message is clear: today we are an indispensable component of the information age, and if we disappeared, the modern world would grind to a halt overnight. Yet our role in the world's development is just getting started.

## Three Ingredients of Revolution

There are three distinct reasons why Excel Pros are poised to have a very good decade.

### Ingredient One: Explosion of Data

The ever-expanding capacity of hardware, combined with the ever-expanding importance of the internet, has led to a truly astounding explosion in the amount of data collected, stored, and transmitted.

Estimates vary widely, but in a single day, the internet may transmit more than a thousand *exabytes* of data. That's 180 CD-ROMs' worth of data for each person on the planet, in just 24 hours!

However, it's not just the volume of data that is expanding; the number of sources is also expanding. Nearly every click you make on the internet is recorded (scary but true). Social media is now 'mined' for how frequently a certain product is mentioned, and whether it was mentioned positively or negatively. The thermostat in your home may be 'calling home' to the power company once a minute. GPS units in delivery vehicles are similarly checking in with 'home base.'

This explosion of volume and variety is often lumped together under the term 'Big Data.' A few savvy folks are front-running this wave of hype by labeling themselves as 'Big Data Professionals.' By the time you are done with this book, you might rightfully be tempted to do the same.

There's a very simple reason why 'Big Data' equals 'Big Opportunity' for Excel Pros: Human beings can only understand a single page (at most) of information at a time. Think about it: even a few hundred rows of data is too big for a human being to look at and make a decision. We need to summarize that data – to 'crunch' it into a smaller number of rows (i.e. a report) – before we can digest it.

So 'big' just means 'too big for me to see all at once.' The world is producing Big Data, but humans still need Small Data. Whether it's a few hundred rows or a few billion, people need an Excel Pro to shrink it for human consumption. The need for you is only growing.

 For more on Big Data, see <http://ppvt.pro/SaavyBigData>.

### Ingredient Two: Economic Pressure

The world has been in an economic downturn since 2008 and there is little sign of that letting up. In general this is a bad thing. If played properly, however, it can be a benefit to the Excel Pro.

Consider, for a moment, the BI industry. BI essentially plays the same role as Excel: it delivers digestible information to decision makers. It's more formal, more centralized, and more expensive – an IT function rather than an Excel Pro function – but fills the same core need for actionable information.

A surprising fact: paradoxically, BI spending increases during recessions, when spending on virtually every thing else is falling. This was true during the dot-com bust of 2000 and is true again today.

Why does this happen? Simply put: when the pressure is on, the value of smart decisions is increased, as is the cost of bad ones. I like to explain it this way: when money is falling from the sky, being 'smart' isn't all that valuable. At those times, the most valuable person is the one who can put the biggest bucket out the window. However when the easy money stops flowing, and everyone's margins get pressured, 'smart' becomes valuable once again.



### Insights are the key

Up to this point, I have used terms like 'crunched data,' 'reports,' 'Small Data,' and 'digestible information' to refer to the output produced by Excel Pros (and the BI industry). Ultimately though, the decision makers need *insights* – they need to learn things from the data that help them improve the business.

I like to use the word 'insights' to remind myself that we can't just crunch data blindly (and blindly) and hand it off. We need to keep in mind that our job is to deliver insights, and to create an environment in which others can quickly find their own. I encourage you to think of your job in this manner. It makes a real difference.

Unlike BI spending, spending on spreadsheets is not measured – people buy Microsoft Office every few years no matter what, so we wouldn't notice a change in 'Excel spending' during recessions. I suspect, however, that if we could somehow monitor the number of hours spent in Excel worldwide, we would see a spike during recessions, for the same reason we see spikes in BI spending.

So the amount and variety of data that needs to be 'crunched' is exploding, and at the same time, the business value of *insights* is increasing. This is a potent mixture.

All it needs is a spark to ignite it. And boy, do we have a bright spark.

## Ingredient Three: PowerPivot

The world's need for insights is reaching a peak. Simultaneously, the amount of data is exploding, providing massive new insight opportunities (raw material for producing insights). Where is the world going to turn?

It is going to take an army of highly skilled data professionals to navigate these waters. Not everyone is cut out for this job either – only people who *like* data are going to be good at it. They must also be trained already – there's no time to learn, because the insights are needed now!

I think you see where I am going. **That army exists today, and it is all of you.** You already enjoy data, you are already skilled analytical thinkers, and you are already trained on the most flexible data analysis tool in the world.

However, until now there have been a few things holding you back:

1. **You are already very busy.** Many of you are swamped today, and for good reason. Even a modestly complex Excel report can require hundreds of individual actions on the part of the author, and most of those actions need to be repeated when you receive new data or a slightly different request from your consumers. Our labor in Excel is truly "1% inspiration and 99% perspiration," to use Edison's famous words.
2. **Integrating data from multiple sources is tedious.** Excel may be quite flexible, but that does not mean it makes every task effortless. Making multiple sources 'play nicely' together in Excel can absorb huge chunks of your time.
3. **Truly 'Big' Data does not fit in Excel.** Even the expansion of sheet capacity to one million rows (in Excel 2007 and newer) does not address all of today's needs. In my work at Pivotstream I sometimes need to crunch data sets exceeding 100 million rows, and even data sets of 100,000 rows can become prohibitively slow in Excel, particularly when you are integrating them with other data sets.

4. **Excel has an image problem.** It simply does not receive an appropriate amount of respect. To the uninitiated, it looks a lot like Word and PowerPoint – an Office application that produces documents. Even though those same people could not *begin* to produce an effective report in Excel, and they rely critically on the insights it provides, they still only assign Excel Pros the same respect as someone who can write a nice letter in Word. That may be depressing, but it's sadly true.

### The Answer is Here

PowerPivot addresses all of those problems. I actually think it's fair to say that it completely wipes them away.

You are the army that the world needs. You just needed an upgrade to your toolset. PowerPivot provides that upgrade and then some. I would say that we probably needed a 50% upgrade to Excel, but what we got is more like a 500% upgrade; and that is not a number to throw around lightly.



Imagine the year is 1910, and you are one of the world's first biplane pilots. One day at the airfield, someone magically appears and gives you a brand-new 2012 jet plane. You climb inside and discover that the cockpit has been designed to mimic the cockpit of your 1910 biplane! You receive a *dramatic* upgrade to your aircraft without having to re-learn how to fly from scratch. That is the kind of 'gift' that PowerPivot provides to Excel Pros.

I bet you are eager to see that new jet airplane. Let's take a tour:



## 2- What Version of PowerPivot Should You Use?

### Three Primary Versions

By the time you are reading this, there will have been three different major releases of PowerPivot:

1. **PowerPivot 2008 R2** – I simply call this “PowerPivot v1.” The “2008 R2” relates back to a version of SQL Server itself and has little meaning to us.
2. **PowerPivot 2012** – unsurprisingly I call this “PowerPivot v2.” Again the 2012 relates to SQL Server, and again, we don’t care that much.
3. **PowerPivot 2013** – to be released with Excel 2013. I will probably end up calling this “PowerPivot 2013”

The first two are available from PowerPivot.com, whereas the third is shipped with Excel 2013.

Of the three, I will be using v2 (PowerPivot 2012) in this book. v2 offers many improvements over v1, but there are a number of reasons why 2013 is not widely adopted yet.

### Quirky Differences in User Interface: v2 vs. 2013

The concepts covered in this book are 100% applicable to 2013 even though the screenshots and figures all have the v2 appearance.

The differences between v2 and 2013 are “cosmetic” – formulas and functions behave the same for instance. But sometimes “cosmetic” can mean “awkward.”

And there is definitely something awkward about 2013 that they need to fix. Put simply, it’s more awkward to find and edit your formulas in 2013 than it is in v1 and v2. I’ve been in discussions with my former colleagues at Microsoft about this, and they understand it, but are not yet ready to announce a fix.

OK, get that off my chest. Let us continue : )

### 2013 PowerPivot only available in “Pro Plus” Version


Microsoft really surprised me at the last minute, just as 2013 was officially released. It was quietly announced that PowerPivot would only be included in the “Pro Plus” version of Office 2013. This is NOT the same thing as “Professional” – Pro Plus is only available through volume licensing or subscription and is not available in any store.

And unlike with 2010, there is no version of PowerPivot that you can download for 2013. If you don’t have Pro Plus, you simply can’t get PowerPivot.

For more on this issue, see <http://ppvt.org/2013ProPlus>

### 32-bit or 64-bit?

Each of the three versions of PowerPivot is available in two “flavors” – 32-bit and 64-bit. Which one should you use?

 On PowerPivot.com, 32-bit is labeled “x86” and 64-bit is labeled “AMD64.”

If you have a choice, I *highly* recommend 64-bit. 64-bit lets you work with larger volumes of data but is also more stable during intensive use, even with smaller data volumes. I run 64-bit on all of my computers.

For example, I have a 300 million row data set that works fine on my laptop with 4 GB of RAM, but with 32-bit PowerPivot, no amount of RAM would make that possible. (In fact, it would not work even if I cut it down to 20 million rows).

So if you have a choice, go with 64 bit – Offers more capacity and more stability. That said, you may not have that luxury. You have to match your choice to your copy of Excel.

 You cannot run 64-bit PowerPivot with 32-bit Excel, or vice versa!



So the first question you need to answer is whether you are running 32 bit or 64 bit, Excel.

In Excel 2010, you can find that answer here, on the Help page

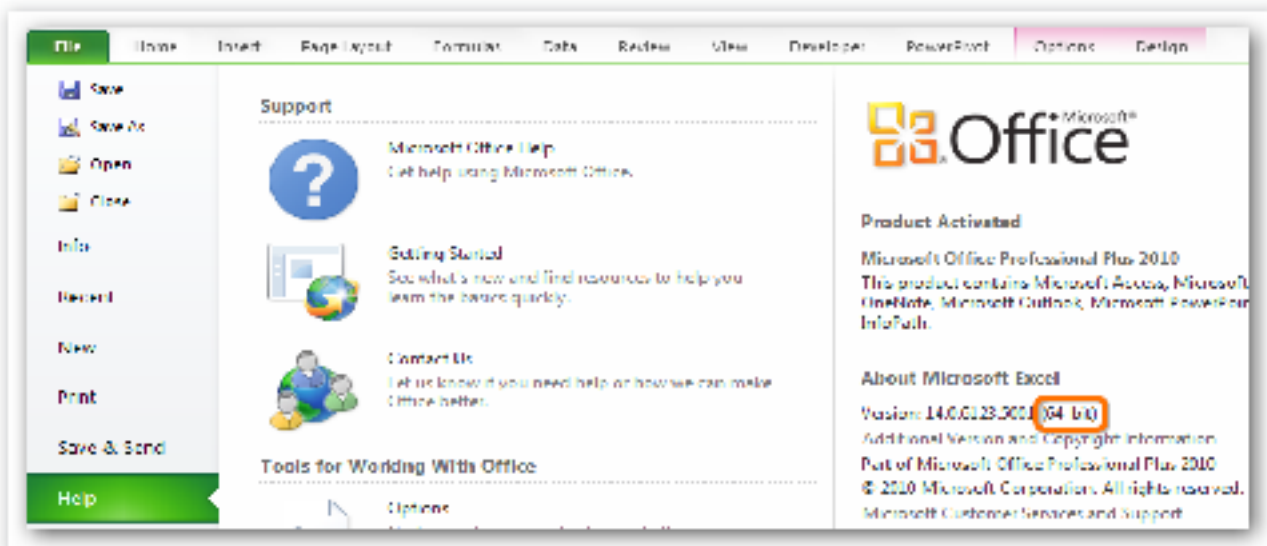


Figure 1 Finding whether your version of Excel is 32-bit or 64-bit

**If you are running 32-bit Excel, fear not: most people are.** I actually can think of no reason to run 64-bit Office except PowerPivot itself, so the 64-bit trend is really just getting started. (Who needs 64-bit Outlook, Word, and PowerPoint? No one does).



Certain Office addins only run in 32-bit, so double check that before you decide to uninstall 32-bit Office and switch to 64-bit.

## Office 2010 or Newer is Required

No, sadly you cannot run PowerPivot with Excel 2007 or earlier versions.

There were very good technical reasons for this, and it was not an attempt by Microsoft to force people into Office 2010. Remember, the PowerPivot addin is free, and it would have been better for Microsoft, too, if PowerPivot worked with 2007.

If you are curious as to the reasons behind the "2010 or newer" requirement, see this post:

<http://ppvt.pro/PP2007/>

## A Note About Windows XP

On the more recent versions of Windows (Vista, Win7, and soon Win8), the PowerPivot window has a ribbon much like Excel does:



Figure 2 The PowerPivot window has a ribbon on most versions of Windows.

But on Windows XP, the PowerPivot window has an old-style menu and toolbar:



Figure 3 On Windows XP, the PowerPivot window has a traditional menu and toolbar

All of the screenshots in this book are taken on Windows 7, and therefore show the ribbon in the PowerPivot window.

If you are using Windows XP and would like a "translation" guide, Microsoft has one here:


<http://ppvt.pro/XP2Ribbon>

## 3- Learning PowerPivot “The Excel Way”

### PowerPivot is Like Getting Fifteen Years of Excel Improvements All at Once

PowerPivot was first released in 2009, but development began *fifteen years* prior to that, in 1994. Back then, it was called Microsoft SQL Server Analysis Services (SSAS). Actually, SSAS is very much alive and well as a product today – it remains the #1-selling analytical database engine in the world. SSAS was/is an industrial-strength calculation engine for business, but targeted at highly specialized IT professionals.

In late 2008, Microsoft architect Amir Netz launched a secret incubation project (codename: Gemini) with an ambitious goal: make the full power of SSAS available and understandable to Excel Pros. A few months later he recruited me to join the effort (he and I had collaborated before when I was on the Excel team). Gemini was eventually released under the name PowerPivot in 2009.

 Continuing with the “biplane and jet” metaphor, think of SSAS as the jet plane, and Project Gemini (PowerPivot) as the effort to install an Excel-style cockpit and instrument panel so that Excel Pros can make the transition.

The key takeaway for you is this: **PowerPivot is a much, *much* deeper product than you would expect from something that appeared so recently on the scene.**

This actually has two very important implications:

1. **It is very hard to exhaust PowerPivot’s capabilities.** Its long heritage means that a staggering number of needs have been addressed, and this is very good news.
2. **It is very helpful to learn it in the right sequence.** When touring the cockpit of your new jet, much will be familiar to you – the SUM() function is there, so is ROUND(), and even our old friend RAND(). But there are new functions as well, with names like FILTER() and EARLIER() and CALCULATE(). Naturally you want to start with the simplest and most useful functions, but it is hard to know which ones those are.

That second point is very important, and worth emphasizing.

## Learn PowerPivot Like You Learned Excel: Start Simple and Grow

When you were first introduced to Excel (or spreadsheets in general), you likely started simple: learning simple arithmetic formulas and the “A1” style reference syntax. You didn’t dive right into things like pivots until later. (In fact pivots didn’t even exist in the first few versions of Excel).

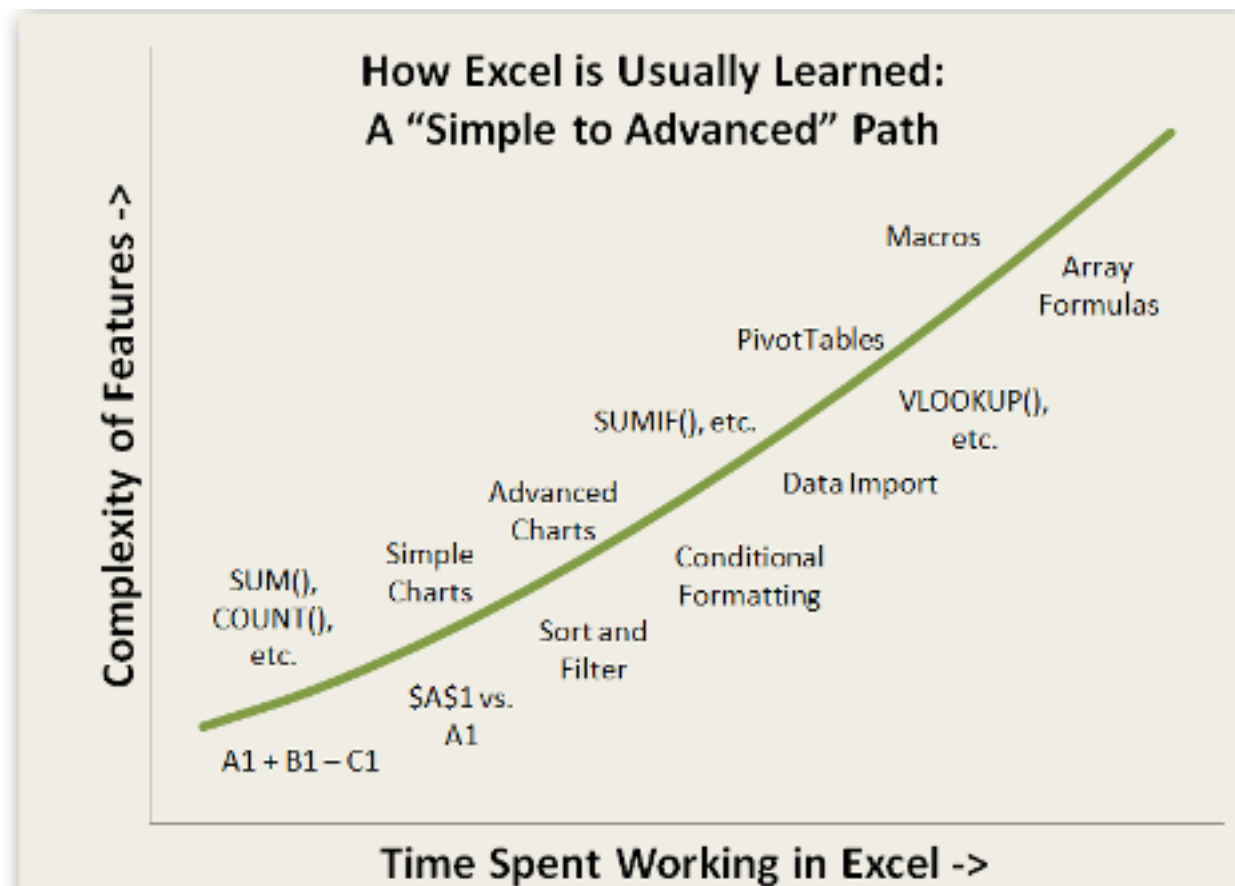


Figure 4 An Approximate Representation of the Typical Excel Learning Curve

You started with the simple stuff, got good at it, and only *then* branched out to new features. Incrementally, you added to your bag of tricks, over and over.

**PowerPivot is no different.** There are simple features (easy to learn and broadly useful) and advanced features (harder to learn and useful in more specific cases).

**I have carefully sequenced the topics in this book** to follow the same “simple to advanced” curve I developed and refined while training Excel pros over the past few years. The result is an approach that has proven to be very successful.

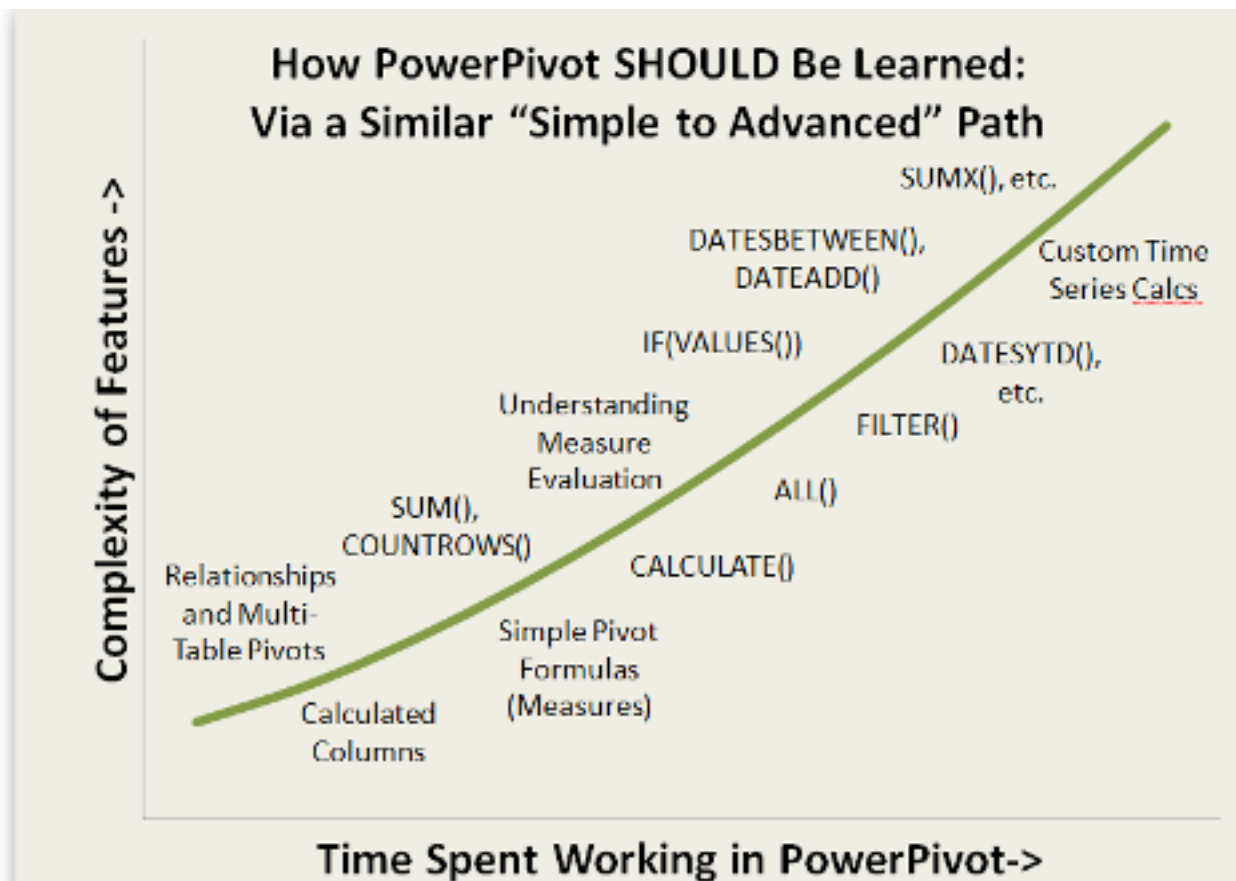


Figure 5 The learning curve I advocate to Excel Pros as they adopt PowerPivot

I highly recommend that you proceed through the book “in order.” You will see that the chapters in this book are organized in roughly the order pictured above.

## When to Use PowerPivot, and How it Relates to Normal Pivot Usage

I hear this question a lot. Simply put, PowerPivot is useful in any situation where you would normally want to use a pivot. Whether you have 100 rows of data or 100 million, if you need to analyze or report on trends, patterns, and/or aggregates from that data, rather than the original rows of data themselves, chances are very good that PowerPivot has something to offer.

When you use a traditional (non Power-) pivot, your workflow in Excel generally looks something like this:

1. **Grab data** from one or more sources, typically landing in Excel worksheets (but sometimes directly in the “pivotcache” in advanced cases).
2. **If multiple tables of data are involved**, use VLOOKUP() or similar to create integrated single tables
3. **Add calculated columns** as needed
4. **Build pivots** against that data
5. **Either use those pivots directly** as the final report/analysis, or build separate report sheets which reference into the pivots using formulas

Our guiding philosophy on PowerPivot was “make it just like Excel wherever possible, and where it’s not possible, make it ‘rhyme’ very closely with Excel.” Accordingly, the 5-step workflow from above looks like this in PowerPivot:

1. **Grab data** from one or more sources, landing in worksheet-tables in the PowerPivot window.
2. **Use relationships to quickly link multiple tables together**, entirely *bypassing* VLOOKUP() or similar tedious formulas.

3. **Optionally supplement that data with calculated columns and measures**, using Excel functions you have always known, *plus some powerful new ones*.
4. **Build pivots** against that data.
5. **Either use those pivots directly** as the final report/analysis, *or convert pivots into formulas* with a single click for flexible layout, or you can still build separate report sheets which reference into the pivots using formulas.



On net you should think of PowerPivot as “Excel+” – the only new things you have to learn should bring you tremendous benefit.

## What This Book Will Cover in Depth

**Simple Guideline:** the more “common knowledge” something is, the less pages I am going to spend on it. I figure, for instance, that the button you use to create pivots is not worth a lot of ink. That topic, and many others, has been covered in depth by Bill Jelen’s first PowerPivot book, <http://ppvt.pro/MRXLPP>. By contrast, the **formula language of PowerPivot needs a lot of attention**, so it receives many chapters and consumes most of the book.

**But even in topics that are relatively straightforward, I will still point out some of the subtleties**, the little things that you might not expect. So for instance, in my brief chapter on Data Import, I will still provide some quick tips on things I have discovered over time.

**And what is this “DAX” thing anyway?** “DAX” is the name given to the formula language in PowerPivot, and it stands for Data Analysis eXpressions. I’m not actually all that fond of the name – wish it were called “Formula+” or something that sounds more like an extension to Excel rather than something brand new. But the name isn’t the important thing – the fact is that DAX is just an extension to Excel formulas.

OK, let’s load some data.

## 4- Loading Data Into PowerPivot

### No Wizards Were Harmed in the Creation of this Chapter

I don't intend to instruct you on how to use the import wizards in this chapter. They are mostly self-explanatory and there is plenty of existing literature on them. Instead I want to share with you the things I have learned about data import over time.

Think of this chapter as primarily "all the things I learned the hard way about data import."

That said, all chapters need to start somewhere, so let's cover a few fundamentals...

### Everything Must "Land" in the PowerPivot Window

As I hinted in previous chapters, all of your relevant data MUST be loaded into the PowerPivot window rather than into normal Excel worksheets. But this is no more difficult than importing data into Excel has ever been. It's probably easier in fact.

### Launching the PowerPivot Window

The PowerPivot window is accessible via this button on the PowerPivot ribbon tab in Excel:



Figure 6 This button launches the PowerPivot window



If the PowerPivot ribbon tab does not appear for you, the PowerPivot add-in is either not installed or not enabled.

### One Sheet Tab = One Table

Every table of data you load into PowerPivot gets its own sheet tab. So if you import three different tables of data, you will end up with something like this:

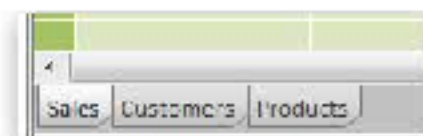


Figure 7 Three tables loaded into PowerPivot. Each gets its own sheet tab.

### You Cannot Edit Cells in the PowerPivot Window

That's right, the PowerPivot sheets are read-only. You can't just select a cell and start typing.

You can delete or rename entire sheet tabs and columns, and you can add calculated columns, but you cannot modify cells of data, ever.

Does that sound bad? Actually, it's a good thing. It makes the data more trustworthy, but even more importantly, it forces you to do things in a way that saves you a lot of time later.

## Everything in the PowerPivot Window Gets Saved into the Same XLSX File

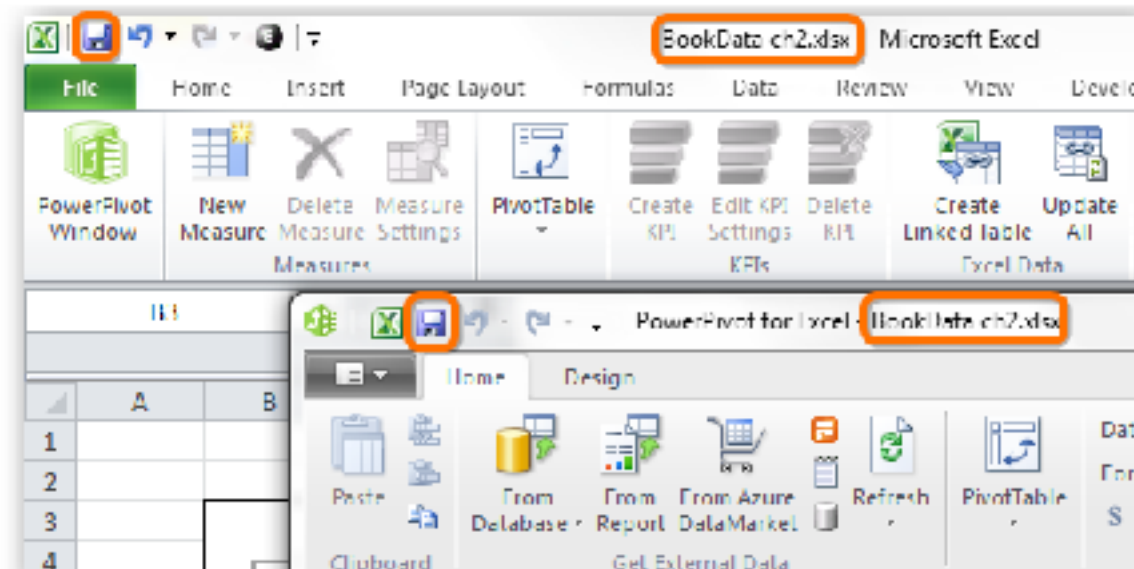


Figure 8 Both windows' contents are saved into the same file, regardless of which window you save from

Each instance of the PowerPivot window is tightly “bound” to the XLSX (or XLSM/XLSB) you had open when you clicked the PowerPivot Window button in Excel. You can have three XLSX workbooks open at one time, for instance, and three different PowerPivot windows open, but the contents of each PowerPivot window are only available to (and saved into) its original XLSX.

## Many Different Sources

PowerPivot can “eat” data from a very wide variety of sources, including the following:

- From normal Excel sheets in the current workbook
- From the clipboard – any copy/pasted data that is in the shape of a table, even tables from Word for instance
- From text files – CSV, tab delimited, etc.
- From databases – like Access and SQL Server, but also Oracle, DB2, MySQL, etc.
- From SharePoint lists
- From MS SQL Server Reporting Services (SSRS) reports
- From cloud sources like Azure DataMarket and SQL Azure
- From so-called “data feeds”

So there is literally something for everyone. I have been impressed by PowerPivot’s flexibility in terms of “eating” data from different sources, and have always found a way to load the data I need.

For each of the methods above, I will offer a brief description and my advice.

## Linked Tables (Data Source Type)

If you have a table of data in Excel like this:

CalendarYear	MonthNumberOfYear	SalesTerritoryRegion	EnglishProductSubcategoryName	Budgeted Sales
2001	7	Australia	Mountain Bikes	71510
2001	7	Australia	Road Bikes	190248
2001	7	Canada	Mountain Bikes	4183
2001	7	Canada	Road Bikes	15429
2001	7	France	Mountain Bikes	7916
2001	7	France	Road Bikes	31825
2001	7	Germany	Mountain Bikes	4384
2001	7	Germany	Road Bikes	36068
2001	7	Northeast	Mountain Bikes	73859

Figure 9 Just a normal table of data in a normal Excel sheet

You can quickly grab it into PowerPivot by using the “Create Linked Table” button on the PowerPivot ribbon tab:

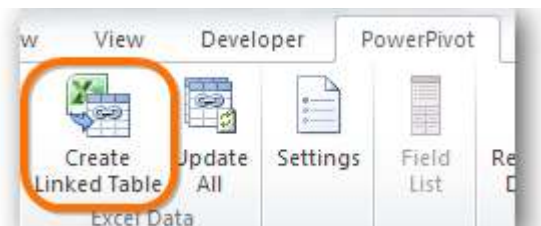


Figure 10 This will duplicate the selected Excel table into the PowerPivot window

### Advantages

- This is the quickest way to get a table from Excel into PowerPivot
- If you edit the data in Excel – change cells, add rows, etc. – PowerPivot will pick those changes up. So this is a sneaky way to work around the “cannot edit in PowerPivot window” limitation.
- If you add columns, those will *also* be picked up. I call this out specifically because Copy/Paste (below) does *not* do this, and I frequently find myself wishing I had used Link rather than Copy/Paste for that reason.

### Limitations

- **You cannot link a table in Workbook A to the PowerPivot window from Workbook B.** This only creates a linked table in the PowerPivot window “tied” to the XLSX where the table currently resides.
- **This is *not* a good way to load *large* amounts of data** into PowerPivot. A couple thousand rows is fine. But ten thousand rows or more may cause you trouble and grind your computer to a halt.
- **By default, PowerPivot will update its copy of this table every time** you leave the PowerPivot window and come back to it. That happens whether you changed anything in Excel or not, and leads to a delay while PowerPivot re-loads the same data.
- **Linked Tables cannot be scheduled for auto-refresh** on a PowerPivot server. They can only be updated on the desktop. (This is true for PowerPivot v1 and v2. I believe this is no longer true in 2013 but have not yet tried it myself).
- **You cannot subsequently change over to a different source type** – this really isn’t a limitation specifically of linked tables. This is true of every source type in this list: whatever type of data source is used to create a table, that table cannot later be changed over to use another type of data source. So if you create a PowerPivot table via Linked Table, you cannot change it in the future to be sourced from a text file, database, or any other source. You will need to delete the table and re-create it from the new source.



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