

Developer Introduction to Power BI



Student Introductions

- Basic Info
 - What's your name?
 - Where do you work? (optional)
 - How long have you been a developer?
- List skills with which you already feel comfortable
 - Working with the Power BI platform
 - Creating PBIX projects with Power BI Desktop
 - Programming with JavaScript and/or TypeScript
 - Working with the R platform
 - Developing with C# and ASP.NET MVC
 - Programming against REST and ODATA web APIs
 - Developing with Microsoft Azure



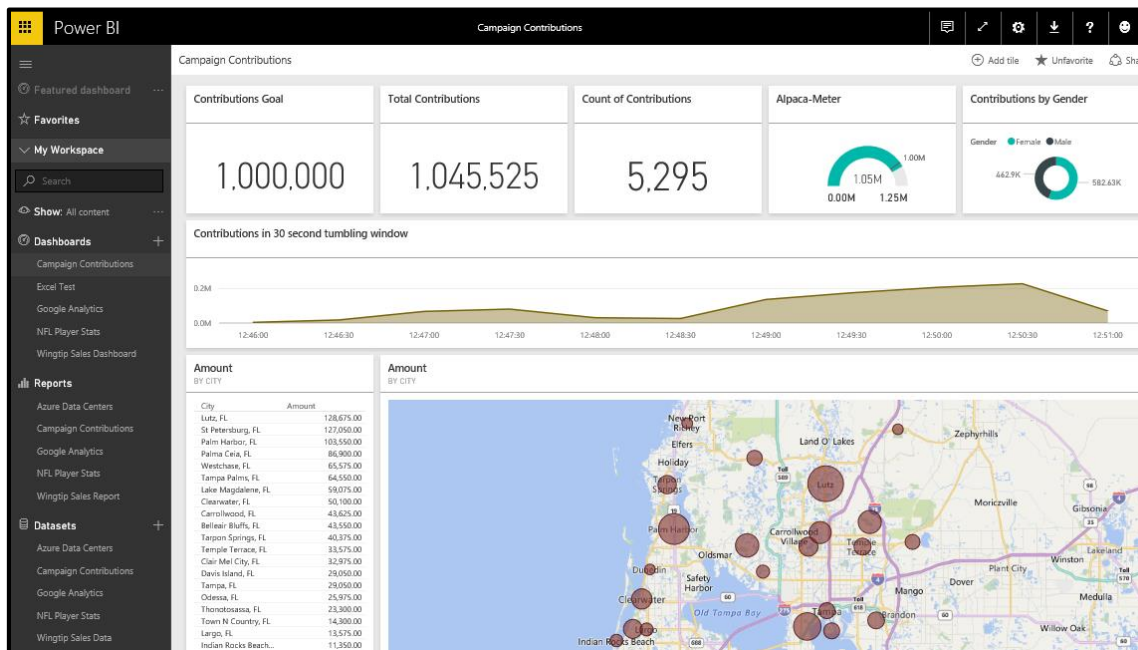
Agenda

- Power BI as a Development Platform
- Setting Up a Power BI Dev Environment
- Working with Power BI Desktop and PBIX Files
- Developer Opportunities in Power BI
- Understanding Workspaces and Capacities
- Power BI Developer Resources



The Power BI Service – Who Is It For?

- Provides SaaS service used by web and mobile users
 - Power BI portal accessible to browsers at <https://app.powerbi.com>
 - Power BI mobile accessible to users on mobile phones & devices
- Provides PaaS service used by software developers
 - Power BI Service API accessible at <https://api.powerbi.com>



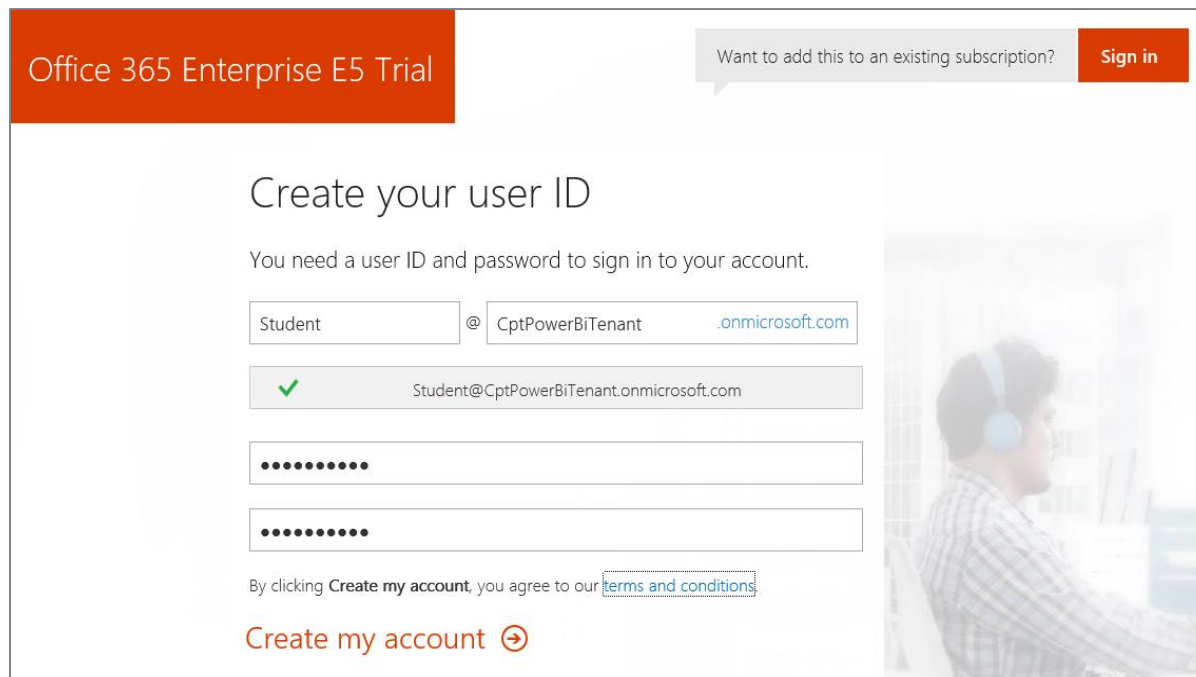
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Creating a Power BI Dev Environment

- Sign up for an Office 365 Enterprise E5 trial account
 - Creates a new Office 365 tenant
 - Creates an account which is tenant administrator
 - You can create 25 user accounts for testing purposes
 - Office 365 E5 provides Power BI Pro license



The screenshot shows the Microsoft Office 365 Enterprise E5 Trial sign-up page. At the top, there's an orange banner with the text "Office 365 Enterprise E5 Trial". To the right, there's a link "Sign in" and a speech bubble asking "Want to add this to an existing subscription?". The main heading is "Create your user ID". Below it, a message states: "You need a user ID and password to sign in to your account." The form consists of three input fields: a first name field containing "Student", a last name field containing "CptPowerBiTenant", and a domain dropdown menu showing ".onmicrosoft.com". Below these fields, the email address "Student@CptPowerBiTenant.onmicrosoft.com" is displayed with a green checkmark. There are two password fields, each with a masked password of eight dots. At the bottom, there's a link to "terms and conditions" and a "Create my account" button with a right-pointing arrow.

Office 365 Enterprise E5 Trial

Want to add this to an existing subscription? [Sign in](#)

Create your user ID

You need a user ID and password to sign in to your account.

Student @ CptPowerBiTenant .onmicrosoft.com

Student@CptPowerBiTenant.onmicrosoft.com

.....

.....

By clicking **Create my account**, you agree to our [terms and conditions](#)

Create my account ➔



Creating User Accounts for Testing

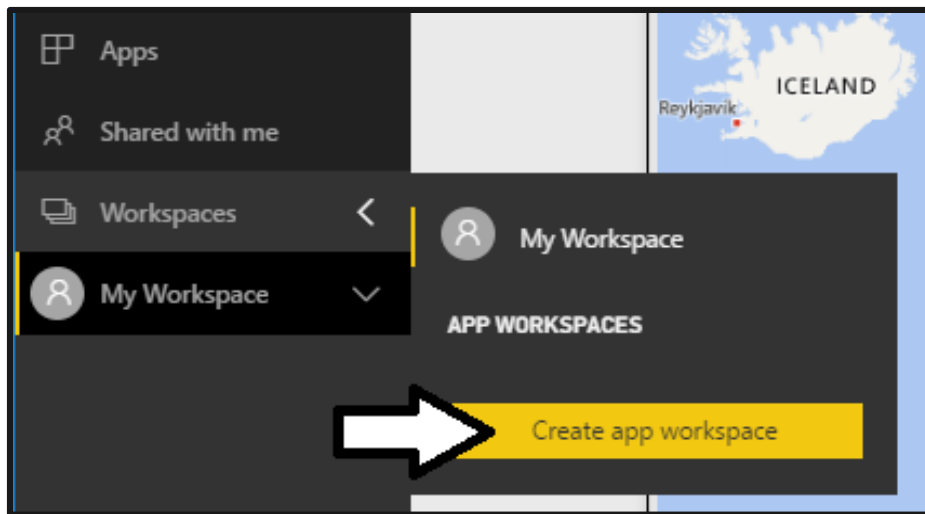
- Can be accomplished in Microsoft 365 Admin center
- Can be automated using PowerShell

```
CreateUserAccountsFromCSV.ps1 X
27
28 $mailNickname = $firstNameClean + $lastNameClean.SubString(0,1)
29 $userPrincipalName = $mailNickname + "@" + $classroomDomain
30
31 $password = "pass@word1"
32 $passwordProfile = New-Object -TypeName Microsoft.Open.AzureAD.Model.PasswordProfile
33 $passwordProfile.Password = $password
34 $passwordProfile.EnforceChangePasswordPolicy = $false
35 $passwordProfile.ForceChangePasswordNextLogin = $false
36
37 # Create new user account for student
38 $newUser = New-AzureADUser `
39     -DisplayName $displayName `
40     -GivenName $firstName `
41     -Surname $lastName `
42     -MailNickName $mailNickname `
43     -PasswordProfile $passwordProfile `
44     -PasswordPolicies "DisablePasswordExpiration, DisableStrongPassword" `
45     -UserPrincipalName $userPrincipalName `
46     -UsageLocation "US" `
47     -AccountEnabled $True
48
```



Creating App Workspaces

- Power BI content published in app workspaces
 - Power BI Pro license required to author content in app workspace
 - Datasets & reports created by publishing PBIX project files
 - Dashboards must be created by hand

A screenshot of the 'Create an app workspace' dialog box. It contains the following fields and options:

- Name your workspace:** A text input field containing 'Ted Pattison'.
- Workspace ID:** A text input field containing 'tedpattison'.
- Available:** A checkbox that is checked.
- Privacy:** A dropdown menu set to 'Private - Only approved members can see what's inside'.
- Permissions:** A dropdown menu set to 'Members can edit Power BI content'.
- Add workspace members:** A section with a text input field for 'Enter email addresses', an 'Add' button, and a list of members. One member is listed: 'criticalpathuser42@powerbimvps.onm...' with the role 'Admin'.
- Advanced:** A dropdown menu.
- Buttons:** 'Save' and 'Cancel' buttons at the bottom right.

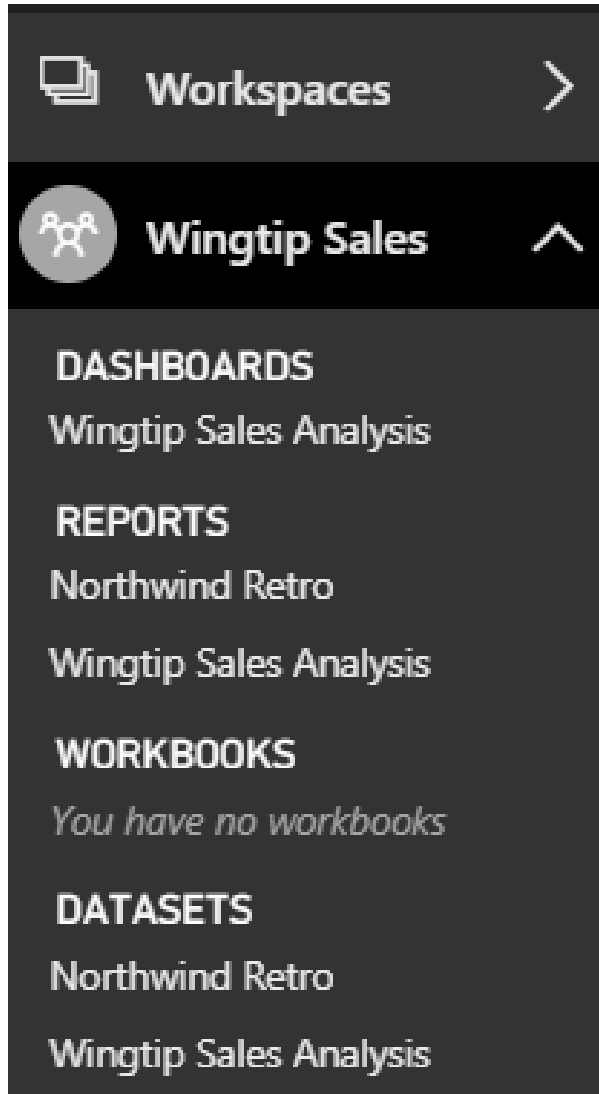


Power BI App Workspaces - V2

- Power BI transitioning between workspace models
 - V2 app workspaces just moved from preview to GA
 - Microsoft will soon force the migration from V1 to V2
- V1 workspaces built on top of Office 365 groups
 - Largely managed in Office 365 admin not Power BI
- V2 workspaces independent of Office 365 groups
 - Fully managed within Power BI admin portal
 - Provides more flexibility in assigning members



Central Power BI Concepts

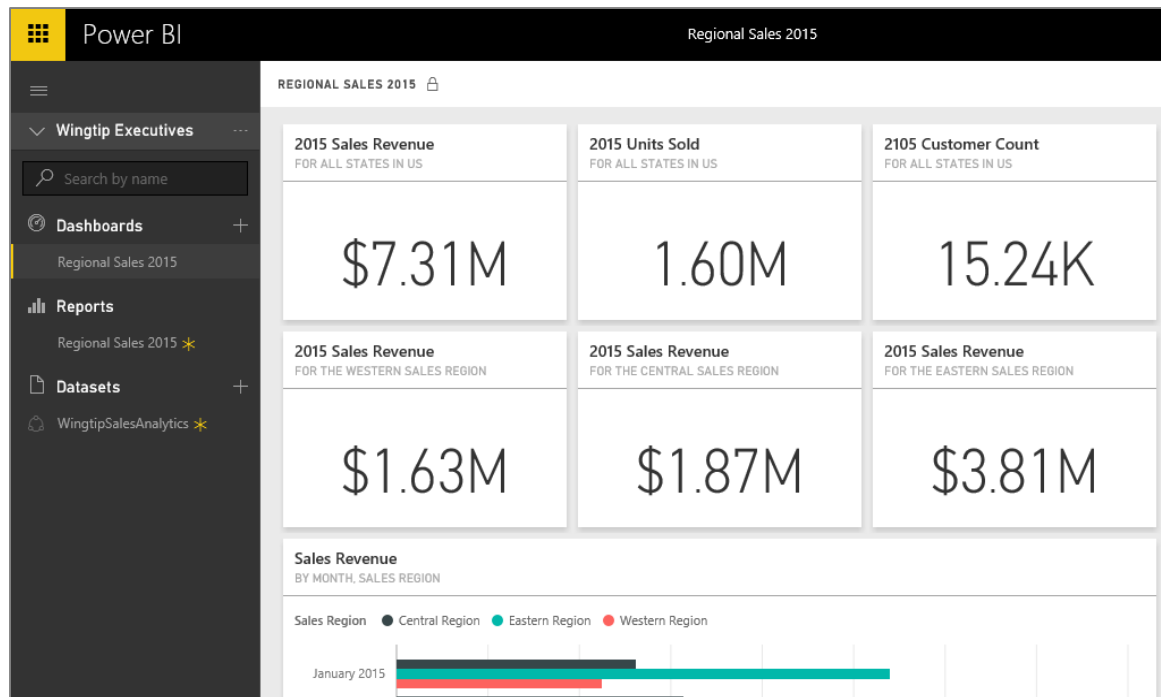


- **Workspace**
 - Secure container for publishing content
 - Every licensed user gets a personal workspace
 - App workspaces created for custom solutions
- **Dashboard**
 - Consolidated view into reports and datasets
 - Custom solution entry point for mobile users
- **Report**
 - Collection of pages with tables & visualizations
 - Provides interactive control of filtering
- **Dataset**
 - Data model containing one or more tables
 - Can be very simple or very complex



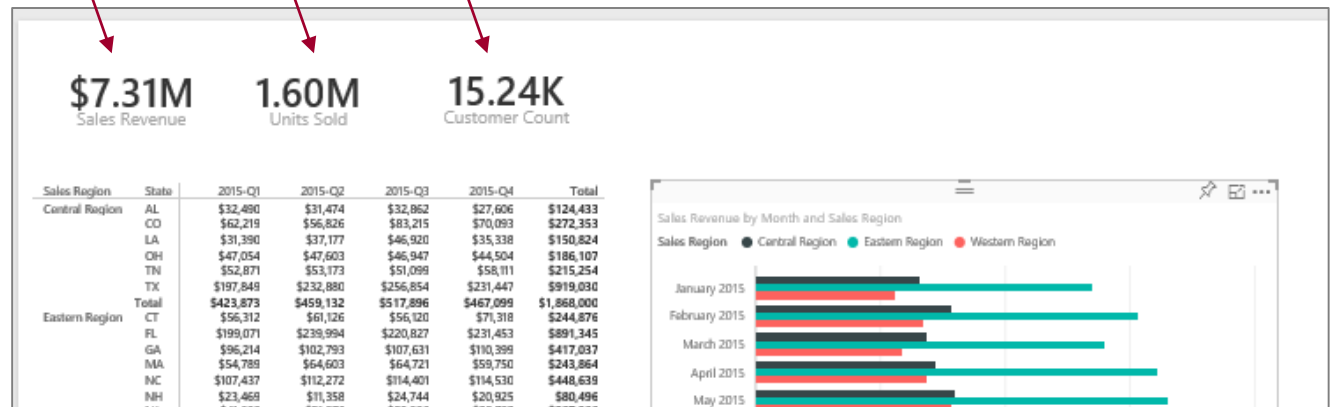
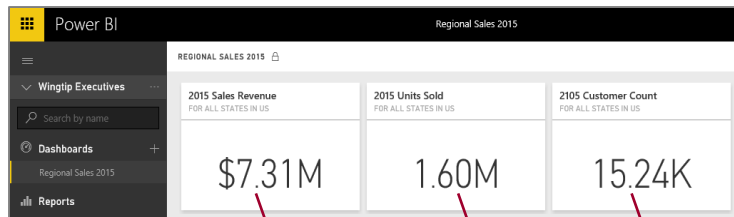
Dashboards and Tiles

- Dashboard is a collection of tiles
 - Tile can be created by pinning visual from a report
 - Tile can be created by pinning query result from dataset



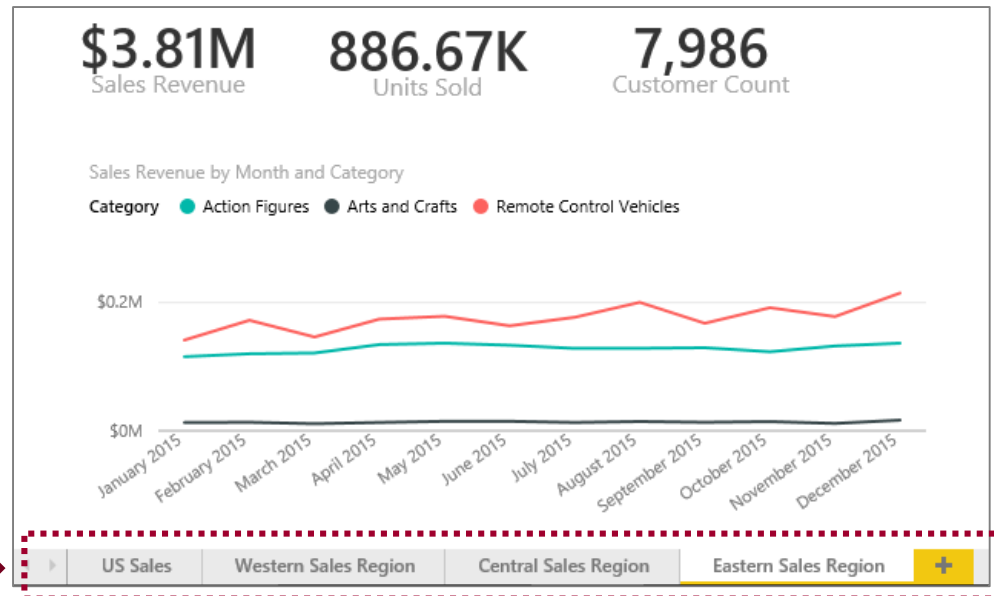
Dashboards and Reports

- Dashboards link users to reports
 - Dashboard tiles designed to provide high-level view
 - Clicking tiles drills down into report to see more detail



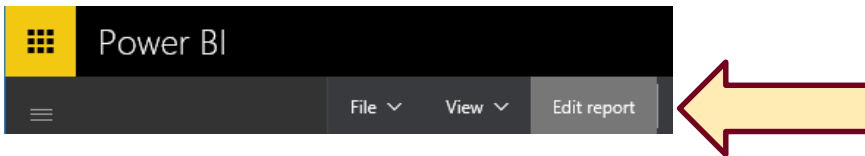
Reports and Pages

- Reports contain one or more pages
 - A report can be designed with a single page
 - A report can be designed with many pages
 - Tabbed navigation located at bottom of report view
 - Each report is associated with exactly one dataset



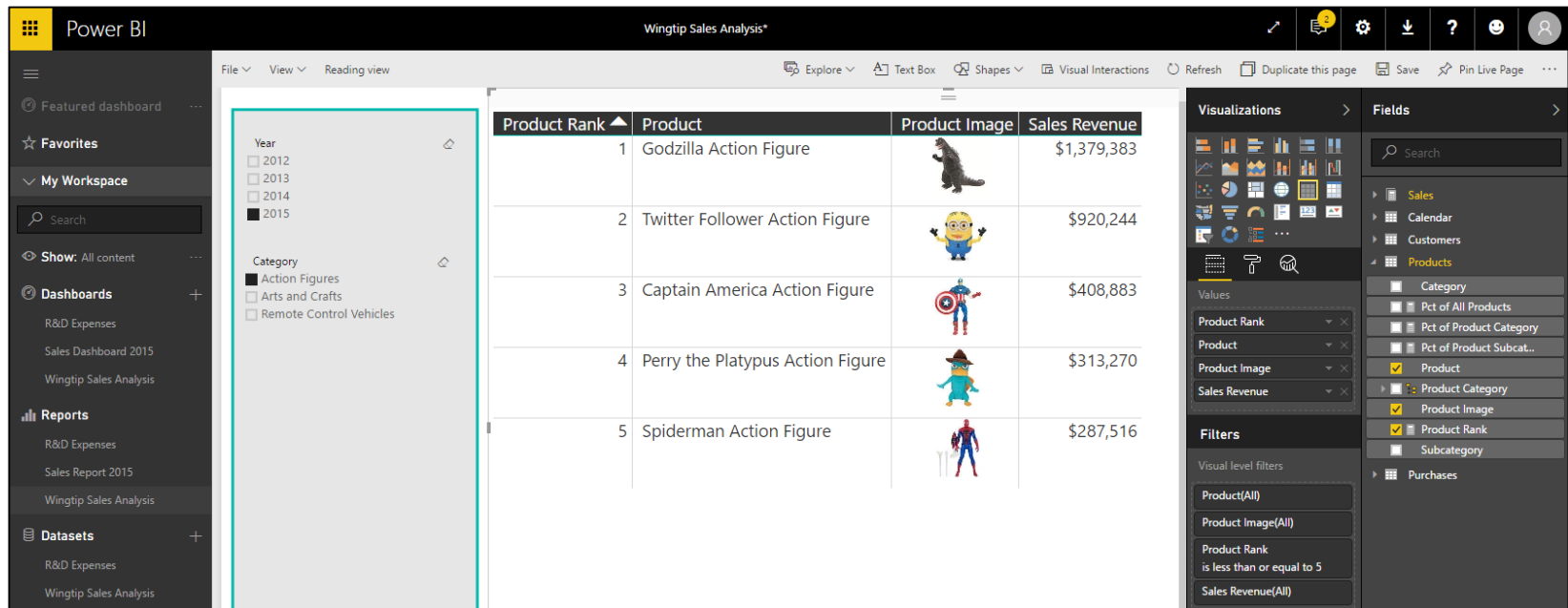




Report Authoring

- Report initially opens in reading view
 - Click Edit report to switch to edit mode



- Report design tools appear on right side of page

The image shows the Power BI report in edit mode. The report is titled 'Wingtip Sales Analysis' and is displayed in 'Reading view'. The report content is a table with the following data:

Product Rank	Product	Product Image	Sales Revenue
1	Godzilla Action Figure		\$1,379,383
2	Twitter Follower Action Figure		\$920,244
3	Captain America Action Figure		\$408,883
4	Perry the Platypus Action Figure		\$313,270
5	Spiderman Action Figure		\$287,516

The right side of the page shows the 'Visualizations' and 'Fields' panes. The 'Visualizations' pane contains a list of visual types, and the 'Fields' pane contains a list of fields. The 'Fields' pane is currently expanded, showing a search bar and a list of fields including 'Sales', 'Calendar', 'Customers', 'Products', 'Category', 'Pct of All Products', 'Pct of Product Category', 'Pct of Product Subcat...', 'Product', 'Product Category', 'Product Image', 'Product Rank', 'Subcategory', and 'Purchases'.

Visuals (aka Visualizations)

- Reports are designed using visual (aka visualizations)
 - Each visual is based on an underlying visualization type
 - Visualization type can be changed using **Visualizations** pane

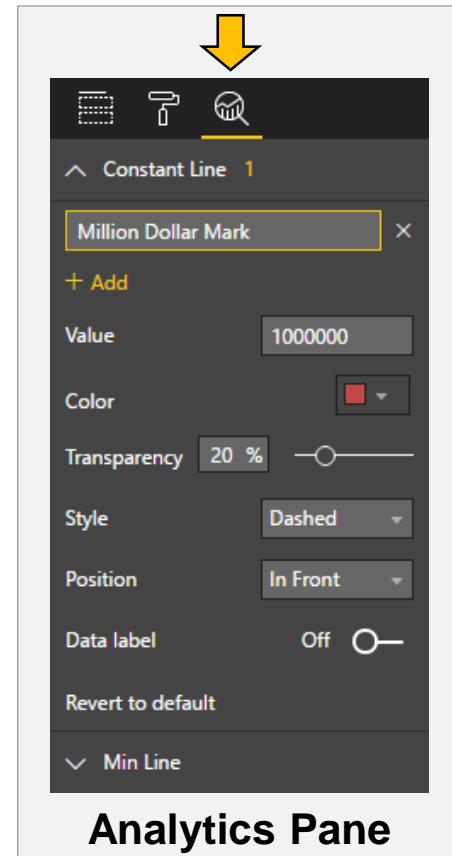
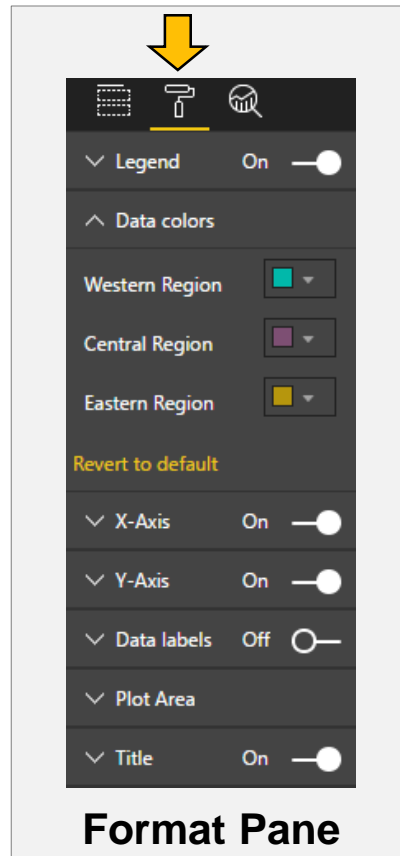
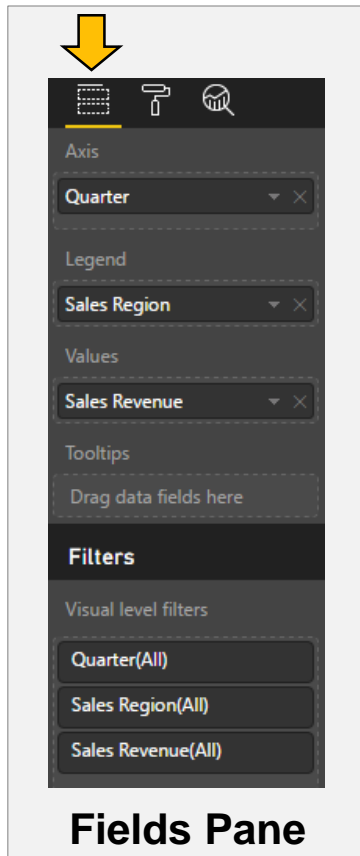


- Visuals creating by using fields from tables inside **Fields** list



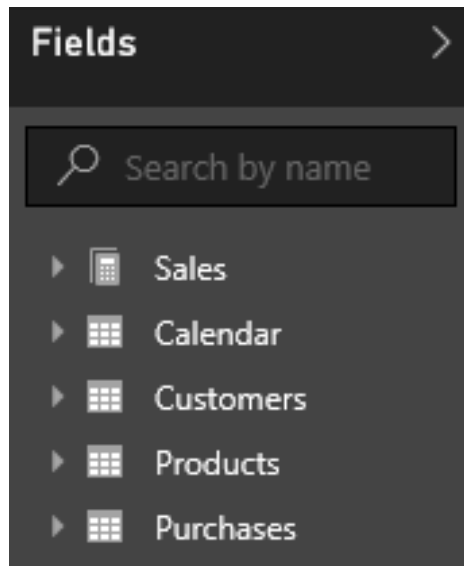
Editing Visual Properties

- Visual properties modified using three property panes
 - Visual properties vary greatly depending on type of visualization



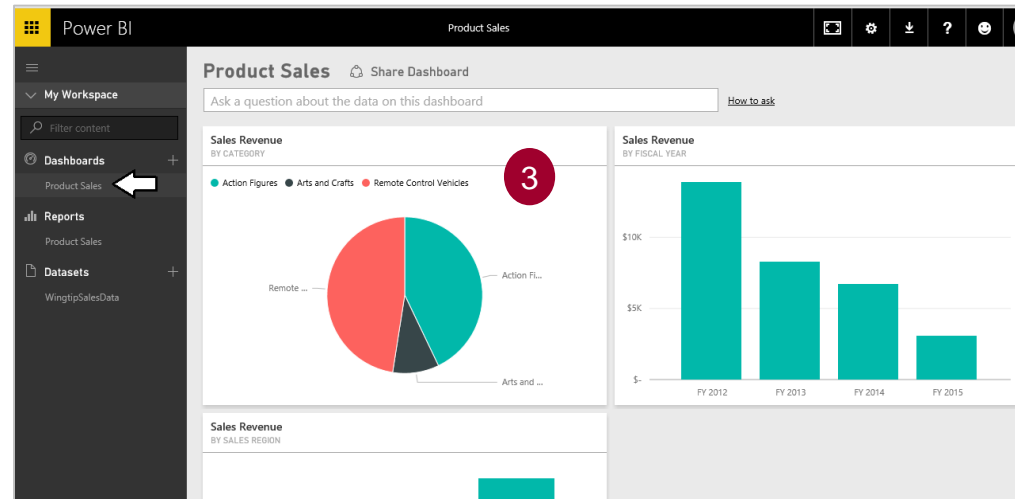
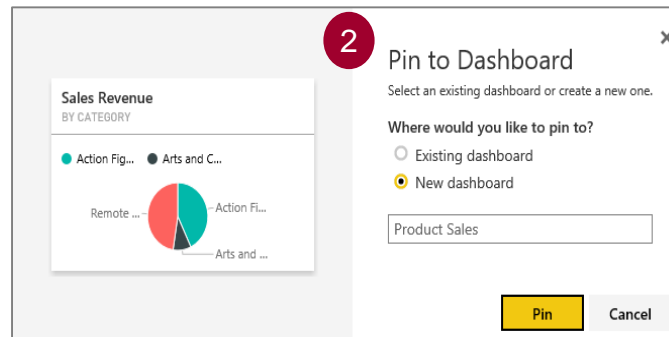
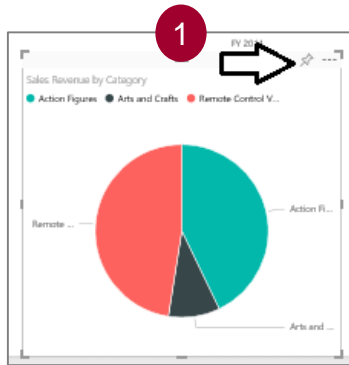
Report and Datasets

- Each report is based on an underlying dataset
 - **Fields** list in report designer shows tables and fields
 - Report author sees tables & fields as dataset consumer



Creating Dashboards

- Dashboards contain tiles
- Tiles created from visuals on report pages





DEMO

Getting started with Datasets, Reports and Dashboards

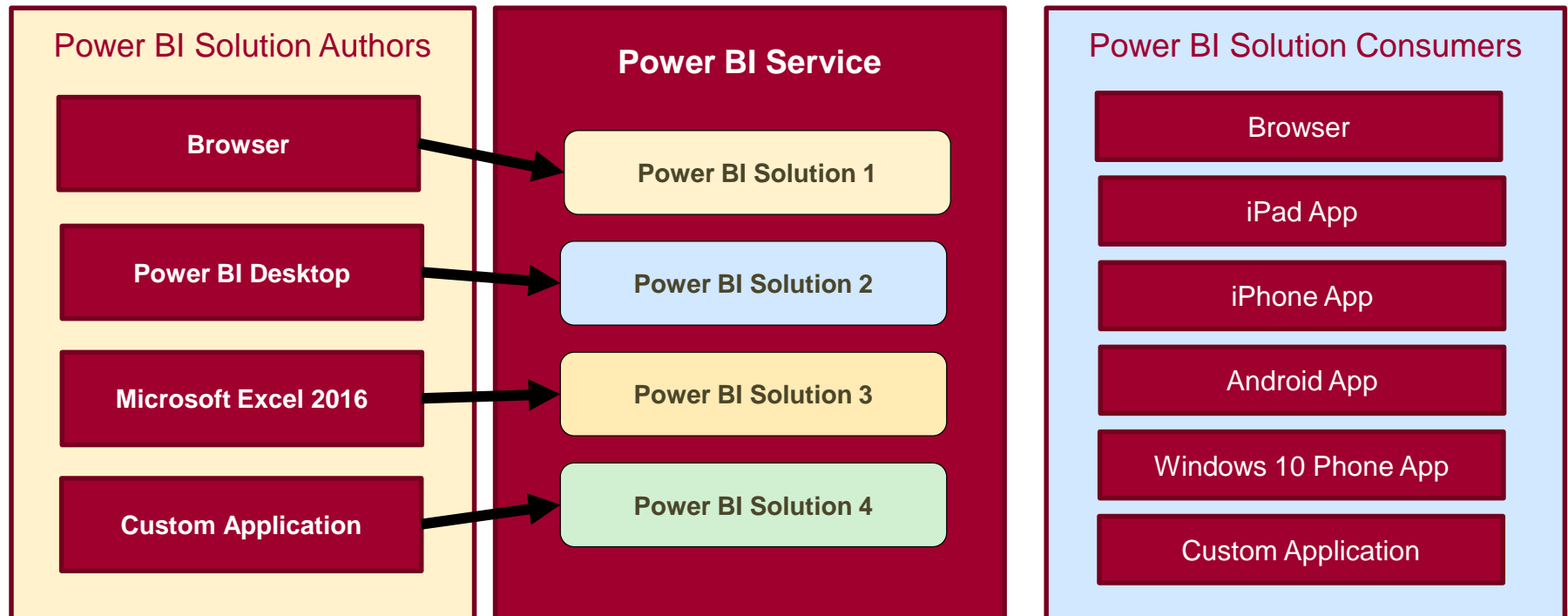
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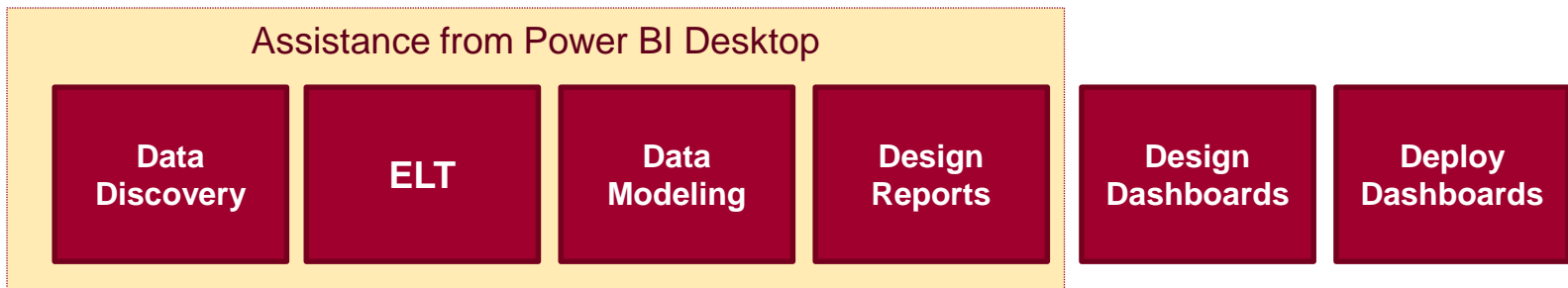
Power BI Builder Tools

- Power BI support for authors and consumers
 - BI solution authors have a choice in authoring tools
 - BI solutions consumers can use wide range of devices



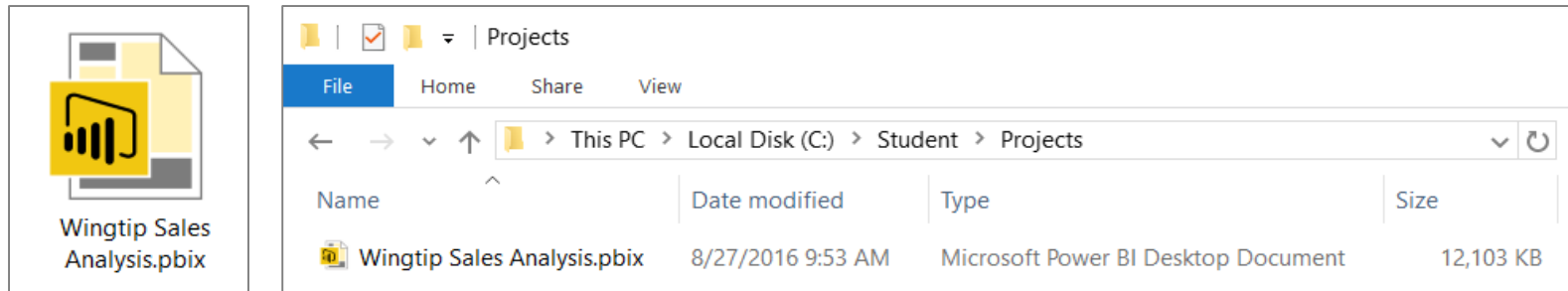
Working with Power BI Desktop

- Power BI Desktop focuses on first four phases
 - Query features for Data Discovery
 - Query features for ETL
 - Design features and DAX language for data modeling
 - Report design using a visual report designer
 - No support for designing dashboards
 - No support for packaging an entire solution



Power BI Desktop Projects and PBIX Files

- Power BI Desktop projects saved using PBIX files
 - PBIX file contains data source definitions
 - PBIX file contains query definitions
 - PBIX file contains data imported from queries
 - PBIX file contains exactly one data model definition
 - PBIX file contains exactly one report
 - PBIX file never contains data source credentials



- PBIX files can be tracked in source control (e.g. github.com)
 - PBIX files is a versioned unit of work with 1 dataset and 1 report
 - Some Power BI resources (e.g. Dashboard) have no backing file support



Division of Labor with Power BI Embedding

- Content Management Team

- Build Power BI Desktop projects
- Publish reports & datasets via PBIX files
- Create dashboards in PBI Service
- Publish App Workspaces as Apps
- Monitor Power BI environment



- Application Development Team

- Develop web apps with PBI embedding
- Authenticate with Azure Active Directory
- Retrieve data using Power BI Service API
- Embed resources using Power BI JavaScript API
- This team sees PBIX files as black boxes



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Developer Opportunities in Power BI

1. Programming the Power BI Service API
2. Embedding Reports in Custom Applications
3. Developing Solutions with Real-time dashboards
4. Developing Custom Visuals
5. Developing Custom Connectors using M
6. Developing Custom Solutions using R
7. Developing Custom Solutions using Python
8. Leveraging the Power BI features for AI



Developing with the Power BI Service API

- Used to develop web and desktop applications
 - Requires registering app with Azure Active Directory
- What can you do with the Power BI Service API?
 - Upload PBIX files and configure data sources
 - Create and manage app workspaces
 - Embed PBI reports and dashboard tiles into web apps
 - Create streaming dataset for real-time dashboards



Developing Custom Visuals

- What is involved?
 - Learning to program in TypeScript instead of JavaScript
 - Learning to use graphics libraries such as D3.js
 - Getting up to speed on the cross-platform toolchain
 - Creating and debugging custom visuals using Node.js
 - Packaging custom visuals for distribution



Developing Custom Data Connectors

- Custom Connectors let you write reusable query logic
 - Custom connector is written using M programming language
 - Custom connector can be used across PBIX project files
- Common motivation for developing a custom connector
 - Creating a friendly view of a REST API for business analyst
 - Providing branding on top of existing connector
 - Exposing a limited/filtered view over your data source
 - Control how mashup engine authenticates against datasource
 - Implementing OAuth v2 authentication flow for a SaaS offering



Integrating R with Power BI

- What is R?
 - Platform for statistics, data analysis and visualization
 - Programming language + Runtime layer + Libraries
 - Strong ability to generate statistics and visualizations
- Where can you use R code in Power BI?
 - Inside a query to perform data extraction and cleanup
 - Inside an R visual to generate rich visualizations



Integrating Python with Power BI

- What is Python?
 - Platform for statistics, data analysis and visualization
 - Programming language + Runtime layer + Libraries
 - Strong ability to generate statistics and visualizations
- Where can you use Python code in Power BI?
 - Inside a query to perform data extraction and cleanup
 - Inside an Python visual to generate rich visualizations







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Power BI Licensing Though Office 365

User-based licensing

<p>Power BI (free)</p> <p>\$0.00 user/month</p> <p>A cloud-based business analytics service that enables anyone to visualize and analyze data with greater speed, efficiency, and understanding. It ...</p> <p>Office 2016 desktop & mobile apps Not included</p> <p>Office 365 services </p> <p>...</p>	<p>Power BI Pro</p> <p>\$9.99 user/month</p> <p>A cloud-based business analytics service that enables anyone to visualize and analyze data with greater speed, efficiency, and understanding. Power BI ...</p> <p>Office 2016 desktop & mobile apps Not included</p> <p>Office 365 services </p> <p>...</p>	<p>Office 365 Enterprise E5</p> <p>\$35.00 user/month</p> <p>The Office suite, plus email, instant messaging, HD video conferencing, 1 TB personal file storage and sharing, and advanced security, analytics and PSTN ...</p> <p>Office 2016 desktop & mobile apps </p> <p>Office 365 services </p> <p>...</p>
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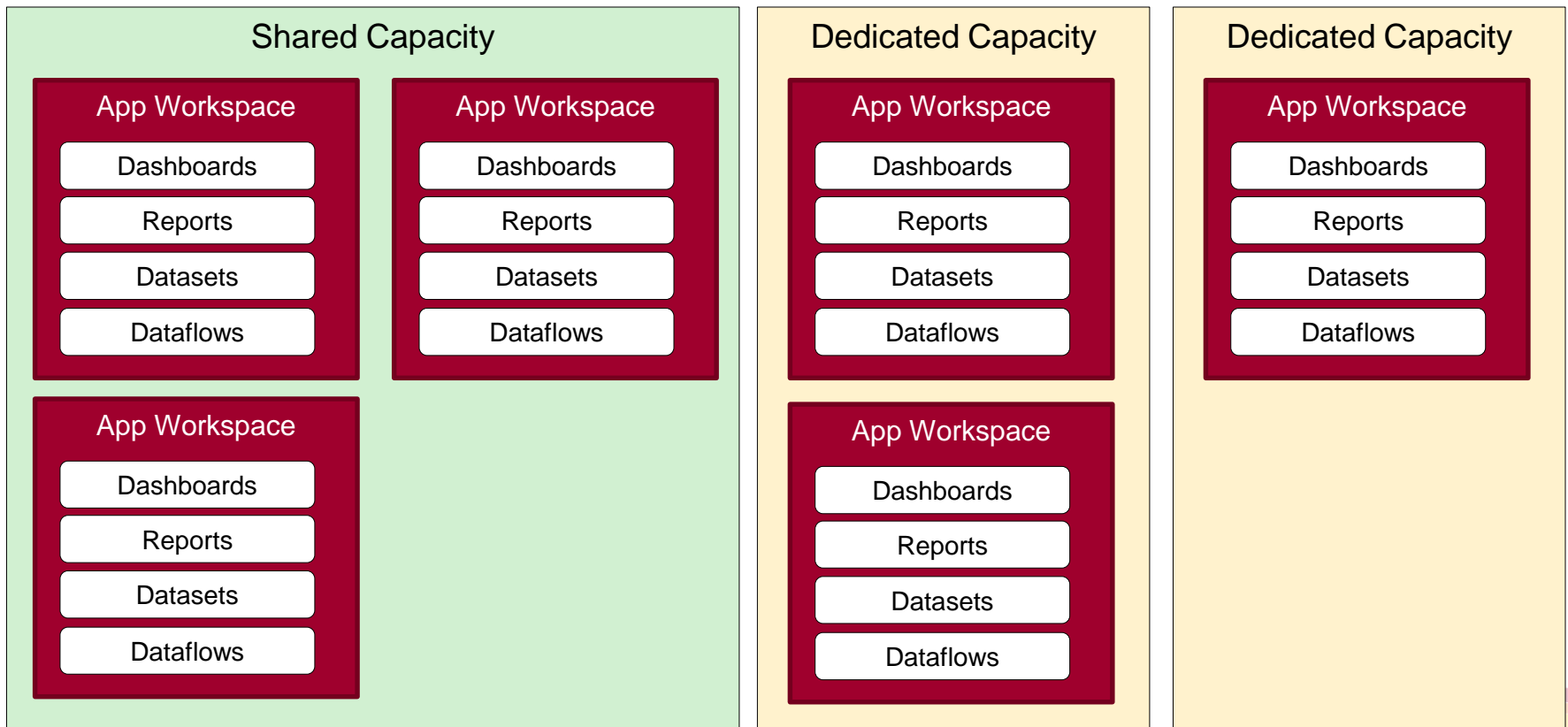
Capacity-based Licensing

<p>Power BI Premium P1</p> <p>\$4,995.00 instance/month</p> <p>Power BI capacity dedicated to your organization, unlocking unlimited content distribution and dependable performance. P1 offers 8 virtual cores ...</p> <p>Office 2016 desktop & mobile apps Not included</p> <p>Office 365 services </p> <p>...</p>	<p>Power BI Premium P2</p> <p>\$9,995.00 instance/month</p> <p>Power BI capacity dedicated to your organization, unlocking unlimited content distribution and dependable performance. P2 offers 16 virtual cores ...</p> <p>Office 2016 desktop & mobile apps Not included</p> <p>Office 365 services </p> <p>...</p>	<p>Power BI Premium P3</p> <p>\$19,995.00 instance/month</p> <p>Power BI capacity dedicated to your organization, unlocking unlimited content distribution and dependable performance. P3 offers 32 virtual cores ...</p> <p>Office 2016 desktop & mobile apps Not included</p> <p>Office 365 services </p> <p>...</p>	<p>Power BI Premium P4</p> <p>\$39,995.00 instance/month</p> <p>Power BI capacity dedicated to your organization, unlocking unlimited content distribution and dependable performance. P4 offers 64 virtual cores ...</p> <p>Office 2016 desktop & mobile apps Not included</p> <p>Office 365 services </p> <p>...</p>	<p>Power BI Premium P5</p> <p>\$79,995.00 instance/month</p> <p>Power BI capacity dedicated to your organization, unlocking unlimited content distribution and dependable performance. P5 offers 128 virtual cores ...</p> <p>Office 2016 desktop & mobile apps Not included</p> <p>Office 365 services </p> <p>...</p>	<p>Power BI Premium EM3 (Month to Month)</p> <p>\$2,495.00 instance/month</p> <p>Embed Power BI content in your custom application, powered by 4 virtual cores of dedicated capacity. Some Premium features are disabled ...</p> <p>Office 2016 desktop & mobile apps Not included</p> <p>Office 365 services </p> <p>...</p>
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Capacities and Workspace Associations

- Every Power BI workspace runs in the context of a capacity
 - By default, app workspaces and personal workspace run in **shared capacity**
 - Organizations have the option of purchasing **dedicated capacities**



Dedicated Capacities

- Power BI workspaces run in one of two possible environments
 - Shared capacity
 - Dedicated capacity
- Dedicated capacity required for third party embedding
 - You pay Microsoft capacity-based fee for processors cores and RAM
 - No need to pay Microsoft for user licensing
- Dedicated capacity can be used for first party embedding
 - Allows users to have free license instead of Power BI Pro license
- Dedicated capacities come in two flavors
 - Power BI Premium capacities purchased through Office 365
 - Power BI Embedded capacities purchased through Azure SKU



Managing Premium Capacities

- Dedicated capacities managed in Power BI Admin portal

The screenshot shows the Power BI Admin portal interface. On the left is a navigation sidebar with options: Favorites, Recent, Apps, Shared with me, Workspaces, and My Workspace. The main content area is titled 'Admin portal' and contains a list of settings: Usage metrics, Users, Audit logs, Tenant settings, Capacity settings (selected), Embed Codes, and Organization visuals. The 'Capacity settings' section is active, showing tabs for 'Power BI Premium' and 'Power BI Embedded'. Under 'Power BI Premium', it displays 'V-CORES' as '8 of 8 used' with a yellow progress bar and '0 available'. A 'Set up new capacity' button is present. Below this is a table of 'PREMIUM CAPACITIES'.

CAPACITY NAME	CAPACITY ADMINS	ACTIONS	SKU	V-CORES	REGION	STATUS
P1	Charles Sterling, duryan		P1	8	East US 2	Active

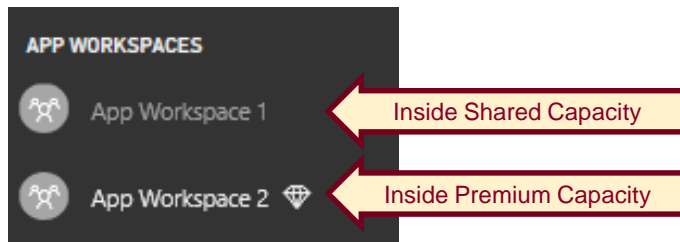
This screenshot shows the detailed configuration page for a 'Power BI Premium > P1' capacity. At the top right is a 'Settings' link. Below the header, 'USAGE IN THE LAST 7 DAYS' is shown with four metrics: CPU (Exceeded 80% utilization 0 times), Memory Thrashing (Exceeded 80% utilization 0 times), Memory Usage (Average: 2GB), and Direct Query (Exceeded 80% utilization 0 times). The 'CAPACITY SIZE' section states 'This capacity is a P1, which is 8 v-cores.' and includes a 'Change capacity size' button. The 'REGION' is 'East US 2'. Under 'USER PERMISSIONS', 'Capacity admins' are listed. The 'WORKSPACES (53)' section contains a table of assigned workspaces.

WORKSPACE NAME	WORKSPACE ADMINS	ACTIONS	STATUS
Adventure Works	View admins		Assigned
ChucksAADGroup	View admins		Assigned

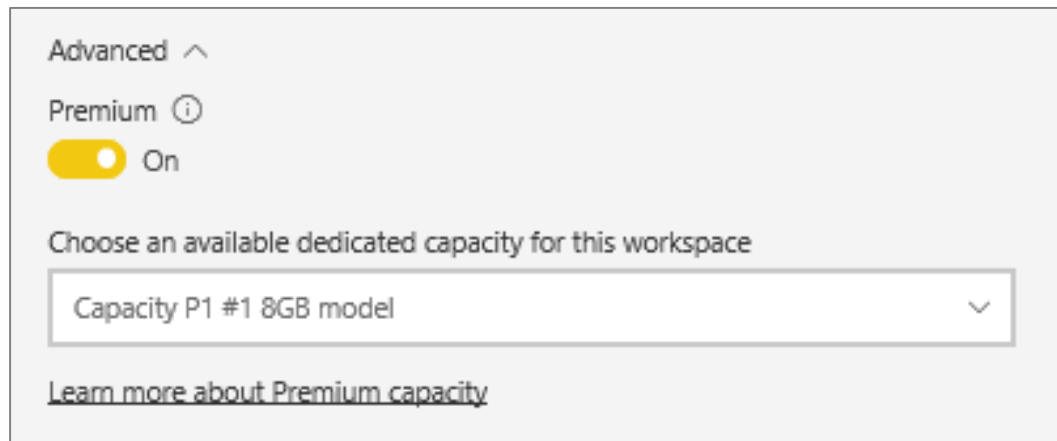
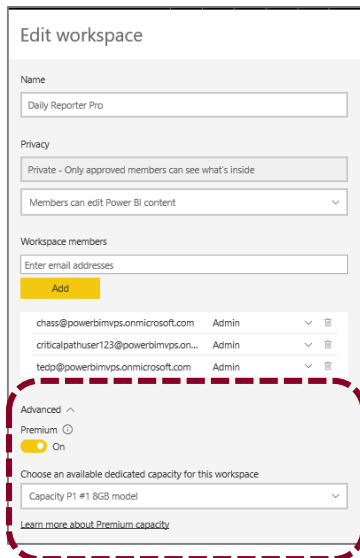
At the bottom right of the workspace table are links: 'Remove all' and '+ Assign workspaces'.

Associating App Workspaces with a Capacity

- App Workspace in Premium Capacity has diamond icon

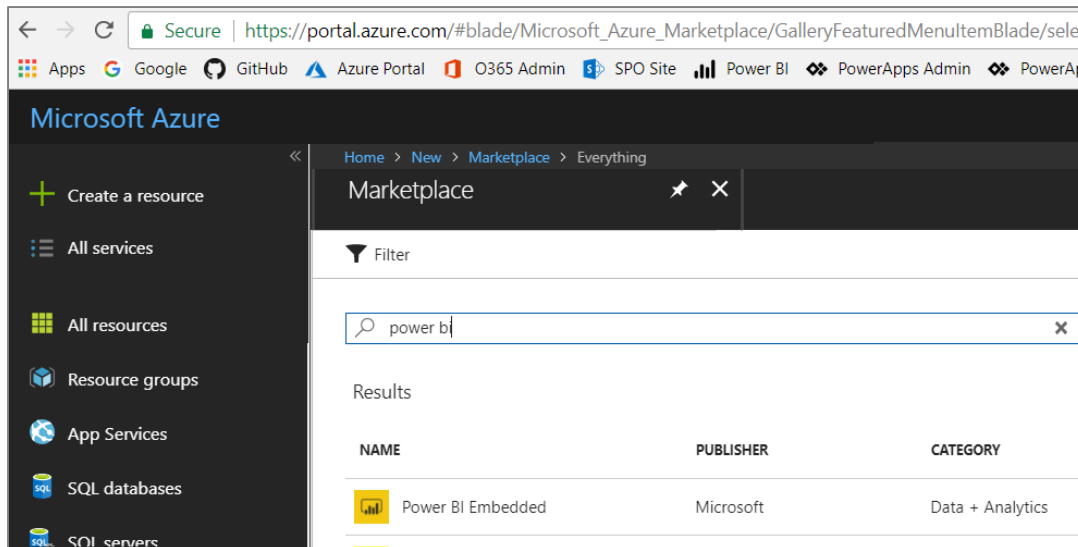


- App workspace moved into Premium capacity in Advanced settings



Creating the Power BI Embedded Service

- Power BI Embedded in an Azure on-demand service
 - Must be created in same location as Power BI Service for tenant
 - Can be created manually through the Azure portal
 - Can be created in automated fashion using PowerShell
 - Requires an Azure subscription *in same tenant*



The screenshot shows the 'Power BI Embedded' creation form. The fields are filled with the following values:

- Resource name: myfirstcapacity
- Subscription: Pay-As-You-Go
- Resource group: Create new (selected), biz-app-summit-demos
- Power BI capacity administrator (Select): TedP@BizAppSummit.onmicrosoft.com
- Location: West US 2
- Pricing tier (View full pricing details): A1 (1 V-Cores)

Buttons at the bottom: Create, Automation options

Embedded Capacity Pricing Tiers

Home > myfirstcapacity

myfirstcapacity
Power BI Embedded

Search (Ctrl+)

Overview
Activity log
Access control (IAM)
Tags
Diagnose and solve problems

SCALE

Pricing tier

SETTINGS

Quick Start
Power BI capacity administrators
Properties
Locks
Automation script

MONITORING

Diagnostics logs
Metrics
Alerts

Pause Move Delete

Essentials

Resource group (change)
biz-app-summit-demos
Status
Active
Location
West US 2
Subscription name (change)
Pay-As-You-Go
Subscription ID
63bf3c07-a58b-4940-ab25-a6a66dda26dc

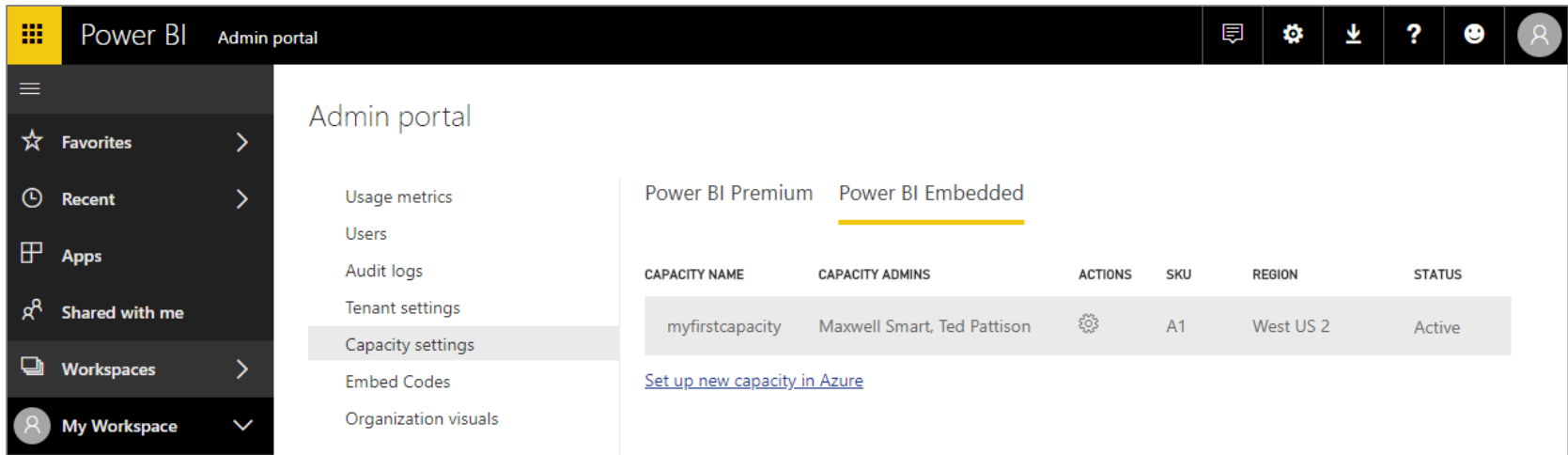
Resource name
myfirstcapacity
Pricing tier
A1

A1	A2	A3
1 V-Cores	2 V-Cores	4 V-Cores
Up to 3 GB Cache	Up to 5 GB Cache	Up to 10 GB Cache
Shared infrastructure	Shared infrastructure	Dedicated service
750.03 USD/MONTH (ESTIMATED)	1,494.03 USD/MONTH (ESTIMATED)	2,994.00 USD/MONTH (ESTIMATED)

A4	A5	A6
8 V-Cores	16 V-Cores	32 V-Cores
Up to 25 GB Cache	Up to 50 GB Cache	Up to 100 GB Cache
Dedicated service	Dedicated service	Dedicated service
5,994.04 USD/MONTH (ESTIMATED)	11,994.02 USD/MONTH (ESTIMATED)	23,994.45 USD/MONTH (ESTIMATED)

Managing Power BI Embedded Capacities

- Managing Power BI Embedded capacity done Azure portal
 - Use Azure portal to assign administrators & change pricing tier to scale
- Managing Power BI Embedded capacity in Power BI Admin portal
 - Power BI Admin portal to assign workspaces to capacities



The screenshot displays the Power BI Admin portal interface. The top navigation bar includes the Power BI logo, 'Admin portal', and several utility icons. A left-hand sidebar contains navigation links: Favorites, Recent, Apps, Shared with me, Workspaces, and My Workspace. The main content area is titled 'Admin portal' and features a sub-menu on the left with options like Usage metrics, Users, Audit logs, Tenant settings, Capacity settings (highlighted), Embed Codes, and Organization visuals. The main panel shows two tabs: 'Power BI Premium' and 'Power BI Embedded' (selected). Below the tabs is a table listing capacities.

CAPACITY NAME	CAPACITY ADMINS	ACTIONS	SKU	REGION	STATUS
myfirstcapacity	Maxwell Smart, Ted Pattison		A1	West US 2	Active

Below the table, there is a link: [Set up new capacity in Azure](#).



PBI Capacity SKU Decoder Ring

	P SKU	EM SKU	A SKU
Purchased through...	Office 365	Office 365	Azure
Supports Power BI embedding in custom applications	Yes	Yes	Yes
Supports 3 rd Party Embedding in custom applications	Yes	Yes	Yes
Supports 1 st Party Embedding in custom applications	Yes	Yes	Yes
Supports free users accessing content in Power BI portal	Yes	No	No
Supports free users accessing content in Power BI Mobile	Yes	No	No
Billing cycle	Monthly	Monthly	Hourly
Commitment	Monthly	Monthly/Yearly	None
Turn it off when your not using it	No	No	Yes



Agenda

- ✓ Power BI as a Development Platform
- ✓ Setting Up a Power BI Dev Environment
- ✓ Working with Power BI Desktop and PBIX Files
- ✓ Developer Opportunities in Power BI
- ✓ Understanding Workspaces and Capacities
- Power BI Developer Resources



Power BI Team Blog

- Power BI Team Blog is an Essential Resource

<https://powerbi.microsoft.com/en-us/blog/>

- Be on the lookout for monthly updates

Power BI Service and Mobile June Feature Summary

Announcements

Features

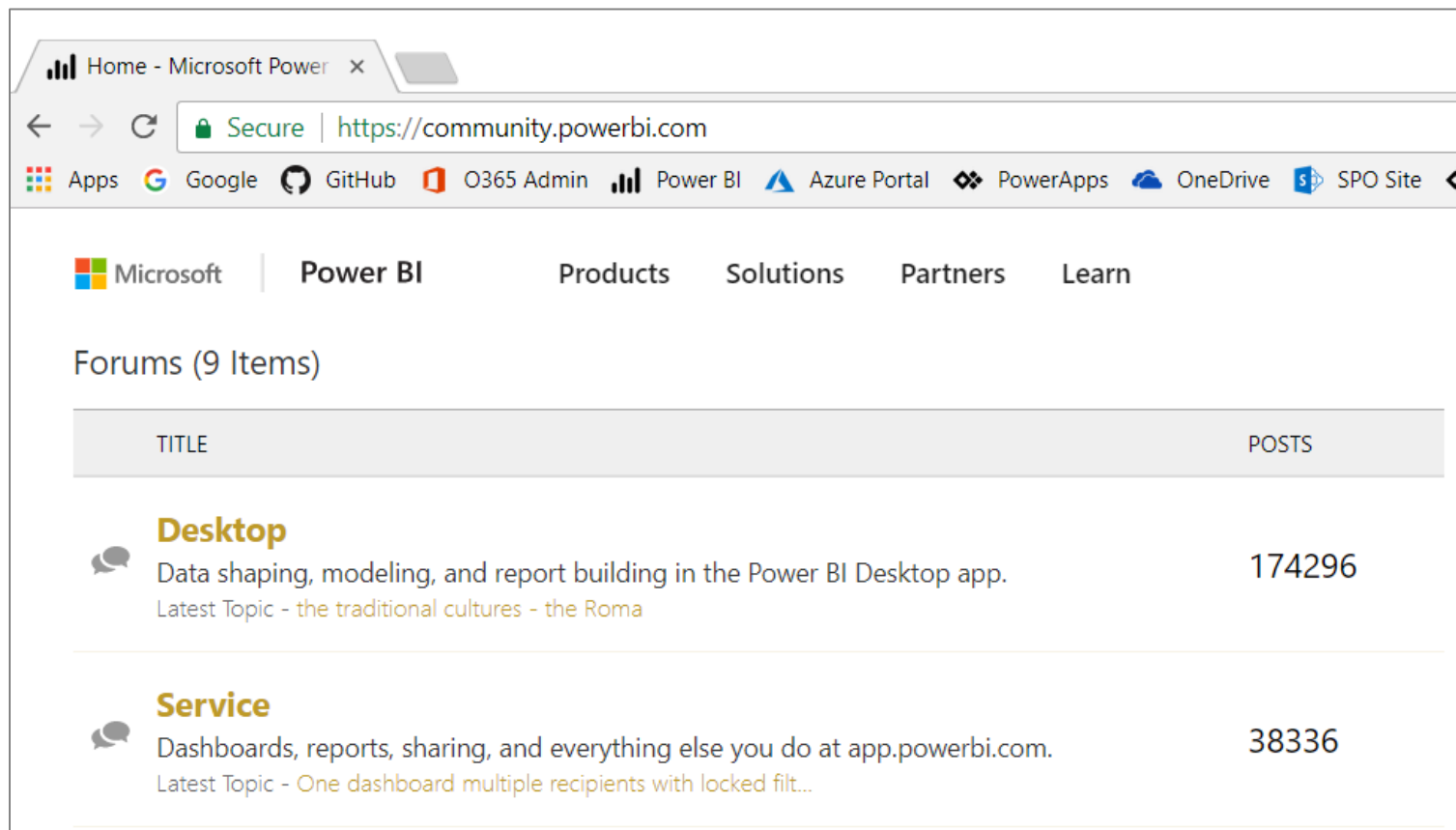
📅 July 11, 2018 by Nikhil Gaekwad

The month of June flew by quickly for Power BI. With summer in the air and MBAS just around the corner, we are laser focused on planning another unforgettable conference for you in Seattle! There...



Power BI Community Forums

- Located at <https://community.powerbi.com/>
 - Great place to get answers to tough questions



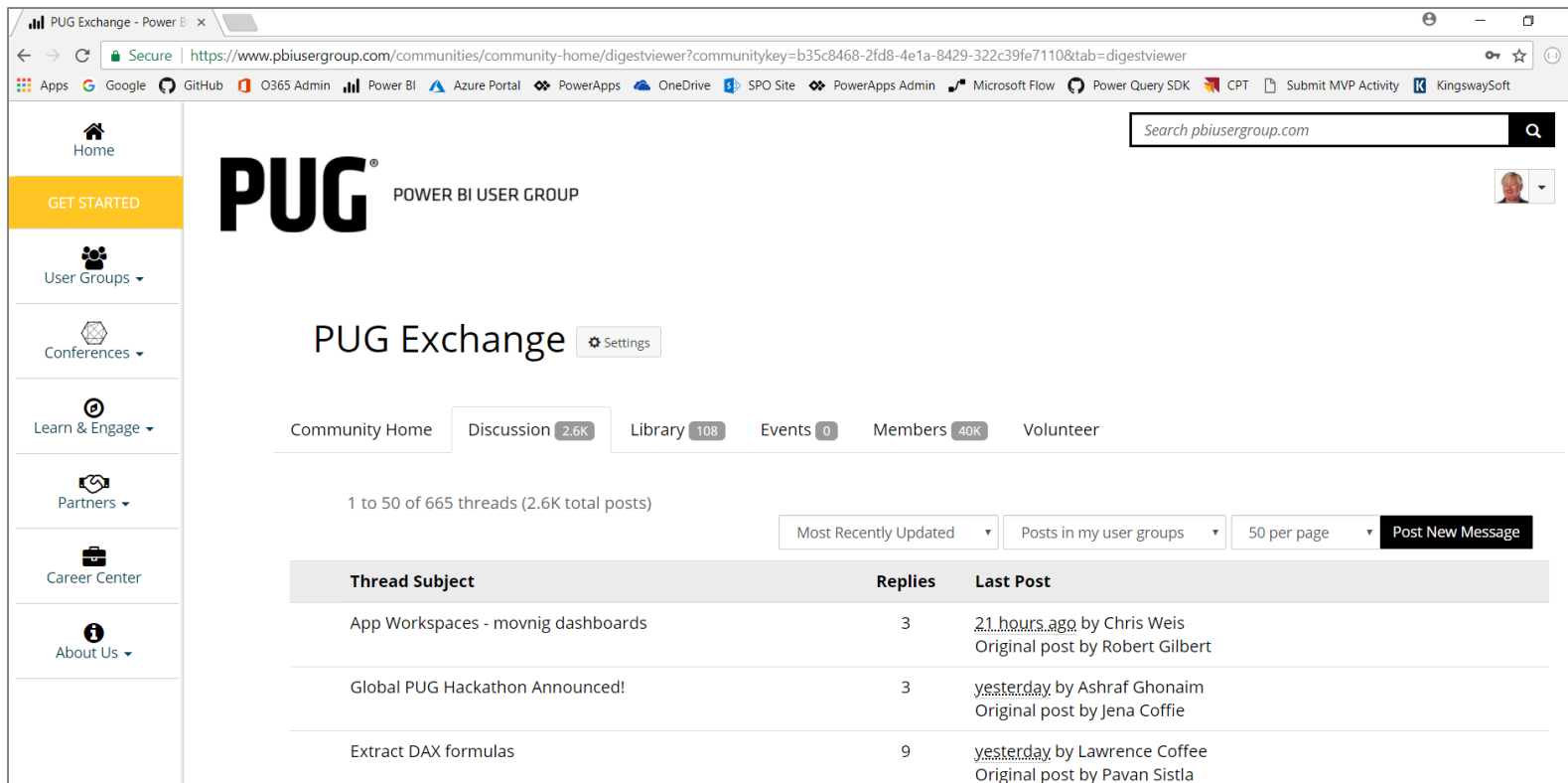
The screenshot shows a web browser window with the URL <https://community.powerbi.com/>. The page features a navigation bar with links to Microsoft, Power BI, Products, Solutions, Partners, and Learn. Below the navigation bar, the section is titled "Forums (9 Items)". A table lists the forum categories:

TITLE	POSTS
Desktop Data shaping, modeling, and report building in the Power BI Desktop app. Latest Topic - the traditional cultures - the Roma	174296
Service Dashboards, reports, sharing, and everything else you do at app.powerbi.com. Latest Topic - One dashboard multiple recipients with locked filt...	38336



Power BI User Group (PUG)

- Located at <http://pbiusergroup.com/>
 - PUG Exchange is another place to get questions answered
 - Also let's you find and connect with local Power BI User Groups



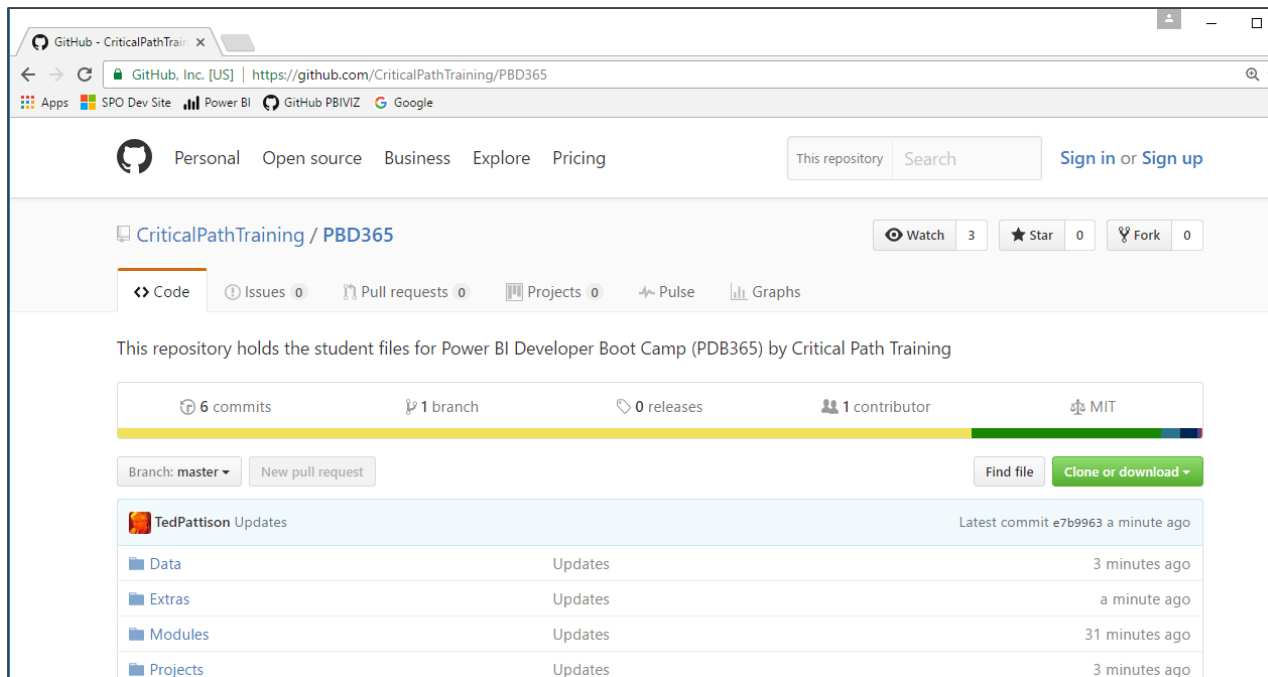
The screenshot shows the PUG Exchange website interface. The left sidebar contains navigation links: Home, GET STARTED, User Groups, Conferences, Learn & Engage, Partners, Career Center, and About Us. The main header features the PUG logo and the text "POWER BI USER GROUP". Below the header, the "PUG Exchange" section includes a "Settings" button and a navigation bar with links to Community Home, Discussion (2.6K), Library (108), Events (0), Members (40K), and Volunteer. A search bar is located in the top right corner. The main content area displays a list of discussion threads, showing 1 to 50 of 665 threads (2.6K total posts). The threads are sorted by "Most Recently Updated" and show 50 posts per page. A "Post New Message" button is visible in the top right of the thread list.

Thread Subject	Replies	Last Post
App Workspaces - movnig dashboards	3	21 hours ago by Chris Weis Original post by Robert Gilbert
Global PUG Hackathon Announced!	3	yesterday by Ashraf Ghonaim Original post by Jena Coffie
Extract DAX formulas	9	yesterday by Lawrence Coffee Original post by Pavan Sistla



Live Labs for PBD365

- Student files for this course maintained in GitHub
 - Students files updated on a monthly basis
 - Lab write-ups available in PDF and XPS formats
 - Go to <https://github.com/CriticalPathTraining/PBD365>



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