

AZURE SYNAPSE STUDIO DEVELOPMENT TOOLS

RUSS LOSKI

INTRODUCTION

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- Data Engineer
- Husband, dad and grandad
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- <https://www.linkedin.com/in/russloski>
- Slides and Code: <https://github.com/rloski-public/Presentations/tree/main/Atlanta%202023>



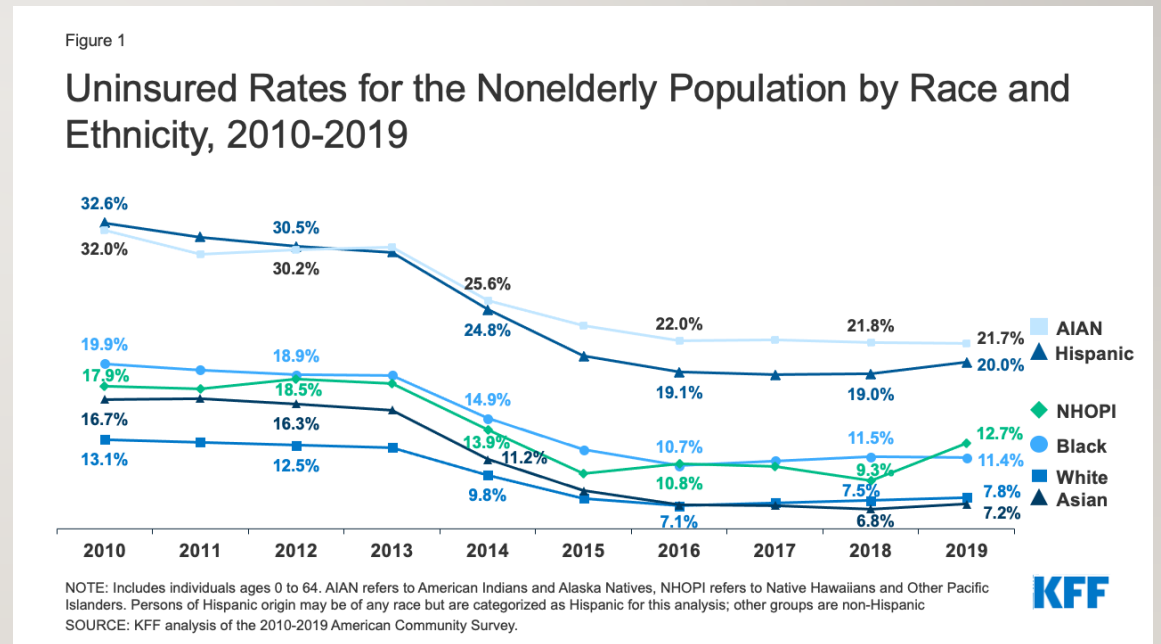
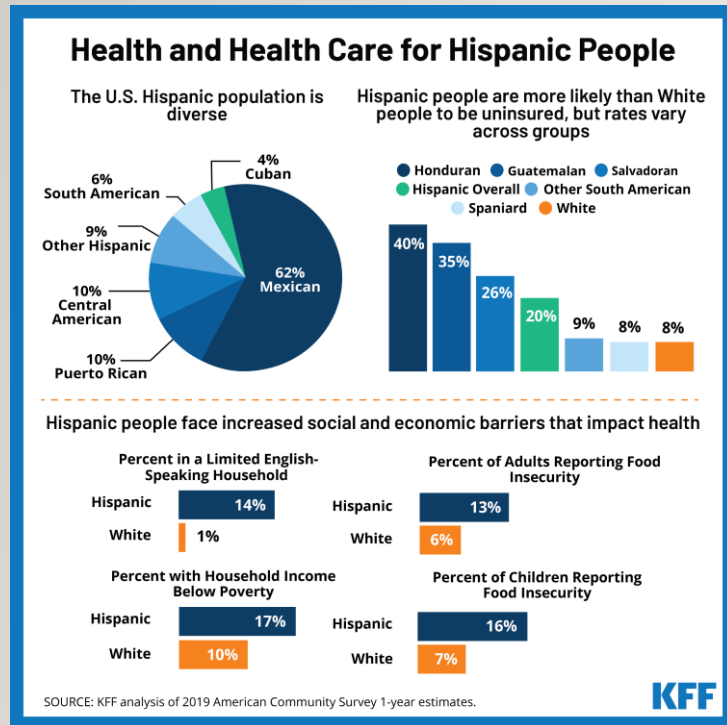
AGENDA

- Data problem
- Overview of the interface
- Developing SQL
- Developing Spark



DATA IS THE NEW TREASURE

HEALTH INSURANCE RATES FOR HISPANICS



[COW-Hispanic-Hertiage-Month_v5.png \(4500×4500\) \(kff.org\)](#)

[Health Coverage by Race and Ethnicity, 2010-2019 | KFF](#)

PUBLIC DATA SOURCE

- American Community Surveys (ACS)
 - [American Community Survey \(ACS\) \(census.gov\)](https://www.census.gov/programs-surveys/acs/data.html)
- Public Use Microdata Sample (PUMS)
 - [American Community Survey Microdata \(census.gov\)](https://www.census.gov/programs-surveys/acs/data/pums.html)
- PUMS 2017
 - <https://www2.census.gov/programs-surveys/acs/data/pums/2017/1-Year/>
 - csv_hus.zip (Housing file)
 - csv_pus.zip (Population or Person file)

WHAT DO I NEED FROM THIS FILE?

- Is Hispanic?
- Is insured?
- Population
- Age

DATA WAREHOUSE

- Requires IT involvement
- Requires setting up server and database
- Requires ETL pipeline
- Maybe data not suitable
- Maybe question is only relevant a short time

OTHER OPTIONS

- Power BI (Power Query)
- Excel
- Python
- Databricks
- Azure Synapse Analytics

Microsoft Azure | Synapse Analytics | loskisyapse

Synapse live | Validate all | Publish all

Home | Data | Develop | Integrate | Monitor | Manage

Develop

Filter resources by name

SQL scripts 10

- BuildCensusScriptHealthInsurance
- BuildCensusScriptRooms
- CensusPumsHousing2012
- Create Lookup tables
- SQL script 1
- SQL script 2
- SQL script 3
- SQL script 4
- SQL script 5
- Test Script

Notebooks 1

BuildCensusScriptH...

Run | Undo | Publish | Query plan | Connect to Built-in | Use database test1

```
1 USE test1;
2 SELECT
3     TOP 100 *
4 FROM
5     OPENROWSET(
6         BULK 'https://loskisyapsedatalake.dfs.core.windows.net/loskisyapsefilesystem/census/PUMS/1-year/2017/Population/psam_pusa.csv',
7         FORMAT = 'CSV',
8         PARSER_VERSION = '2.0'
9     ) AS [result];
10
11
12
13
14 SELECT
15     TOP 100 *
16 FROM
17     OPENROWSET(
18         BULK 'https://loskisyapsedatalake.dfs.core.windows.net/loskisyapsefilesystem/census/PUMS/1-year/2017/Population/psam_pusa.csv',
19         FORMAT = 'CSV',
20         PARSER_VERSION = '2.0',
21         HEADER_ROW = TRUE
22     ) AS [result];
23
24 -- Change the data types and focus on the columns of interest
```

OVERVIEW OF THE INTERFACE

LAUNCHING AZURE SYNAPSE STUDIO

- <https://web.azuresynapse.net/>
- Alternatively you can log in to your Azure portal, find your Azure Synapse Analytics Workspace and click the Open Synapse Studio link

Getting started



Open Synapse Studio

Start building your fully-integrated analytics solution and unlock new insights.

[Open](#) ↗

MAIN TABS



- Home



- Data



- Develop



- Integrate (Azure Data Factory)

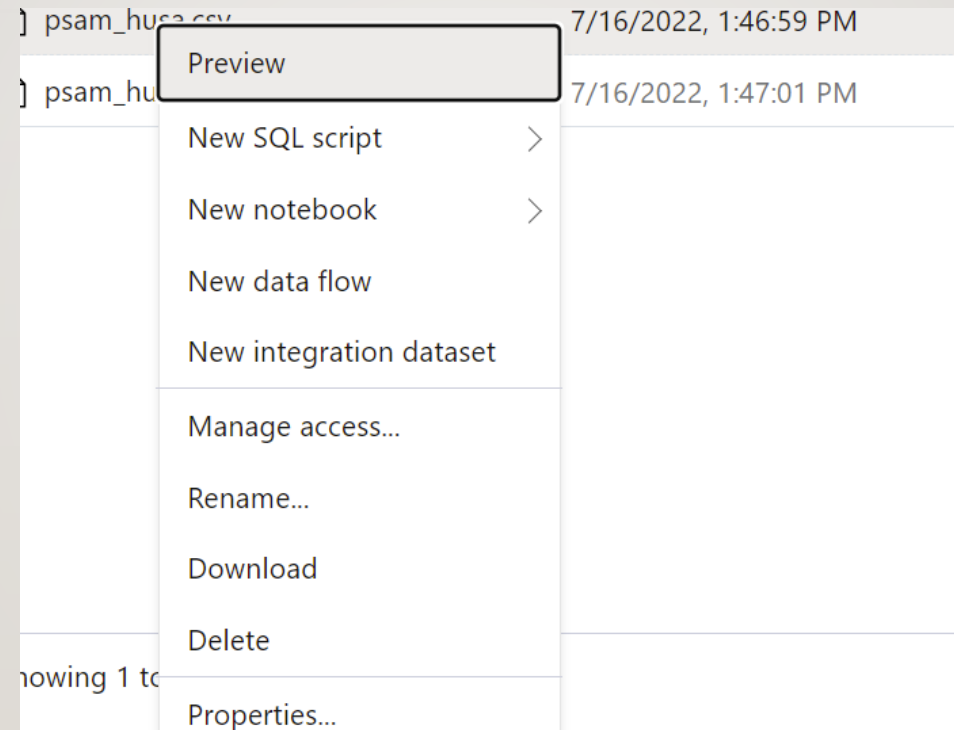


- Monitor



- Manage

DATA – CSV FILE CONTEXT MENU



Develop

Filter resources by name

SQL scripts10

BuildCensusScriptHealthInsurance

BuildCensusScriptRooms

CensusPumsHousing2012

Create Lookup tables

SQL script 1

SQL script 2

SQL script 3

SQL script 4

SQL script 5

Test Script

Notebooks2

Demonstration Notebook

Demonstration Notebook Population

BuildCensusScriptH... x

Demonstration Note...

Run

Undo

Publish

Query plan

Connect toBuilt-in

Use database

test1

12-- Make the first row the header

13

14SELECT

15...TOP 100.*

16FROM

17...OPENROWSET(

18...BULK'https://[redacted].dfs.core.windows.net/[redacted]/census/PUMS/1-year/2017/Population/psa'

19...FORMAT='CSV',

20...PARSER_VERSION='2.0',

21...HEADER_ROW=TRUE

22...)-AS[result];

23

24-- Change the data types and focus on the columns of interest

25-- **

Results

Messages

View

Table

Chart

Export results

Search

RT	SERIALNO	DIVISION	SPORDER	PUMA	REGION	ST	ADJINC	P
P	2017000000016	6	1	2500	3	1	1011189	2
P	2017000000031	6	1	1800	3	1	1011189	4
P	2017000000061	6	1	2400	3	1	1011189	1

00:00:11 Query executed successfully.

DEVELOPING SQL

PROBLEM

What is in the PUMS population file? Can it answer my question about Hispanic health insurance rates?

SERVERLESS SQL POOLS

- Can connect to data in data lake
- Can write T-SQL queries
- Pay for the compute when you run query
- Still pay for storing data in the data lake

SQL SELECT FROM FILE

- `SELECT`
- `TOP 100 *`
- `FROM`
- `OPENROWSET(`
- `BULK 'https://<account>.dfs.core.windows.net/<container>/census/PUMS/1-year/2017/Housing/psam_husa.csv',`
- `FORMAT = 'CSV',`
- `PARSER_VERSION = '2.0',`
- `HEADER_ROW = TRUE`
- `) AS [result];`

SQL DATA TYPES

```
SELECT
```

```
    *
```

```
FROM
```

```
    OPENROWSET(
```

```
        BULK 'https://<account>.dfs.core.windows  
.net/<container>/census/PUMS/1-  
year/2017/Housing/psam_husa.csv',
```

```
        FORMAT = 'CSV',
```

```
    PARSER_VERSION = '2.0'
```

```
    , FIRSTROW = 2
```

```
)
```

```
WITH (
```

```
    SerialNumber NVARCHAR(13) 2,
```

```
    DivisionCode NVARCHAR(1) 3,
```

```
    RegionCode NVARCHAR(1) 5,
```

```
    StateCode NVARCHAR(2) 6,
```

```
    NumberOfPersons int 10,
```

```
    NumberOfBedrooms int 16,
```

```
    NumberOfRooms int 38,
```

```
    FamilyIncome int 57
```

```
) AS [result];
```

SERVERLESS SQL OBJECTS

- CREATE VIEW ...
- CREATE EXTERNAL FILE FORMAT
- CREATE EXTERNAL DATA SOURCE
- CREATE EXTERNAL TABLE

ADDITIONAL BENEFITS

- Can connect to open datasets
 - [Tutorial: Analyze Azure Open Datasets in Synapse Studio - Azure Synapse Analytics | Microsoft Learn](#)
- Can be used as data source in Power BI
 - [Tutorial: Connect serverless SQL pool to Power BI Desktop & create report - Azure Synapse Analytics | Microsoft Learn](#)

Synapse live

Validate all

Publish all

Develop

Filter resources by name

SQL scripts 10

Notebooks 2

Demonstration Notebook

Demonstration Notebook Population

BuildCensusScriptHe...

Demonstration Note...

Demonstration Not...

Cancel all

Undo

Publish

Outline

Attach to Spark1

Language PySpark (Python)

Variables

Please wait a few minutes while your session starts.

Demonstration

This is code to demonstrate how to work with the **Azure Synapse Studio** notebooks. You can get more help at [Create, develop, and maintain Synapse notebooks in Azure Synapse Analytics](#).

We will examine the following:

1. Markdown cells [Markdown for Jupyter notebooks cheatsheet](#)
2. Working with the file magic commands
3. Using the mssparkutil class
4. Access file as dataset
5. Display options
 1. Show column information
 2. Show sample data
 3. Display in charts
6. Using multiple languages
7. Using SQL

We won't go deep into how to actually develop. My goal is to get you up and started with some of the mechanics of working with the notebooks.

1 print("Hello world!")

* 1 min 21 sec - Starting Apache Spark session

+ Code

+ Markdown

File magic commands

The first thing I like to do is to get my bearings in the file system. There are enough places that I am going to mess up. I need to make sure that the file is where I think that it is.

These are some of the commands that **might** be available in Azure Synapse Studio. <https://ipython.readthedocs.io/en/stable/interactive/magics.html>.

Try %lsmagic to get a full list of the commands.

lsmagic

This provides a list of the magic commands with a link to the ipython document mentioned above.

Properties

General Related (0)

Name *

Demonstration Notebook Population

Description

This is a notebook for demonstrating how to work with Azure Synapse Analytics notebooks.

Type

.ipynb notebook

Size

703,404 bytes

Notebook settings

☒ Include cell output when saving

☐ Enable unpublished notebook reference

Session

Configure session

DEVELOPING SPARK



PROBLEM

I am more comfortable using Python to work with data.

SPARK

- Distributed system
- [What is Apache Spark - Azure HDInsight | Microsoft Docs](#)

CONFIGURE SPARK CLUSTER

New Apache Spark pool

Basics • Additional settings * Tags Review + create

Create an Synapse Analytics Apache Spark pool with your preferred configurations. Complete the Basics tab then go to Review + Create to provision with smart defaults, or visit each tab to customize.

i Create a managed private endpoint from this workspace to its primary Data Lake Storage Gen2 account for Spark pools to access data. [Learn more](#)

Apache Spark pool details

Name your Apache Spark pool and choose its initial settings.

Apache Spark pool name *

Pool

Isolated compute * ⓘ

☐ Enabled ☒ Disabled

Node size family *

Memory Optimized

Node size *

Medium (8 vCores / 64 GB)

Autoscale * ⓘ


☒ Enabled ☐ Disabled

Number of nodes *

3 ∞ 10

Estimated price ⓘ

Est. cost per hour
3.54 to 11.81 USD
[View pricing details](#)



Dynamically allocate executors * ⓘ

☐ Enabled ☒ Disabled

DEVELOP - MARKDOWN

Demonstration

This is code to demonstrate how to work with the **Azure Synapse Studio** notebooks. You can get more help at [Create, develop, and maintain Synapse notebooks in Azure Synapse Analytics](https://docs.microsoft.com/en-us/azure/synapse-analytics/spark/apache-spark-development-using-notebooks).

We will examine the following:

1. Markdown cells [Markdown for Jupyter notebooks cheatsheet](#)
2. Working with the file magic commands

- # Demonstration
- This is code to demonstrate how to work with the **Azure Synapse Studio** notebooks.
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- We will examine the following:
 1. Markdown cells [\[Markdown for Jupyter notebooks cheat sheet\]\(https://www.ibm.com/docs/en/watson-studio-local/1.2.3?topic=notebooks-markdown-jupyter-cheatsheet\)](https://www.ibm.com/docs/en/watson-studio-local/1.2.3?topic=notebooks-markdown-jupyter-cheatsheet)
- 1. Working with the file magic commands

DEVELOP – MAGIC

- %lsmagic
- %fs ls
- %fs head
- %%sql

DEVELOP - MSSPARKUTIL

```
from notebookutils import mssparkutils

folder = "abfss://<container>@<
accountname>.dfs.core.windows.net/census/PUMS/1-year/2017/Housing/"

files = mssparkutils.fs.ls(folder)

for file in files:
    print(file.name, file.isDir, file.isFile, file.path, file.size)
```

DEVELOP – CONNECT TO FILE

```
df = spark.read.load('abfss://<containername>@<accountname>.dfs.core.windows.net/census/PUMS/1-year/2017/Housing/psam_husa.csv', format='csv'
## If header exists uncomment line below
, header=True
)
df.printSchema()
```


SNIPPETS

- ☐ [Snippet: 3D Bar Plots in matplotlib](#)
- ☐ [Snippet: 3D Scatter Plots in matplotlib](#)
- ☐ [Snippet: Bar chart in matplotlib](#)
- ☐ [Snippet: Conditional update delta lake data witho](#)
- ☐ [Snippet: Configure access to Azure Blob Storage](#)
- ☐ [Snippet: Configure delta lake path](#)
- ☐ [Snippet: Configure delta lake path](#)
- ☐ [Snippet: Configure Spark session](#)
- ☐ [Snippet: fill_between and alpha in matplotlib](#)
- ☐ [Snippet: Heatmap in seaborn](#)
- ☐ [Snippet: Histogram charts in matplotlib](#)
- ☐ [Snippet: Interactive scatter plot in bokeh](#)
- ☐ [Snippet: Line charts in matplotlib](#)
- ☐ [Snippet: Looking into the history of a delta lake...](#)
- ☐ [Snippet: Pie charts in matplotlib](#)
- ☐ [Snippet: Plotting glyphs over a map in bokeh.](#)

- ☐ [Snippet: Python Logging Sample Code](#)
- ☐ [Snippet: Read data from Azure Blob Storage \(WASB\)](#)
- ☐ [Snippet: Read data from Azure Data Lake \(ADLS Gen...](#)
- ☐ [Snippet: Read data from delta lake table](#)
- ☐ [Snippet: Read data from delta lake table](#)
- ☐ [Snippet: Read data from SQL pool Table](#)
- ☐ [Snippet: Read older versions of delta lake data](#)
- ☐ [Snippet: Scatter chart in matplotlib](#)
- ☐ [Snippet: Scatterplot in seaborn](#)
- ☐ [Snippet: Stack plots in matplotlib](#)
- ☐ [Snippet: Subplotting using Subplot2grid in matplo...](#)
- ☐ [Snippet: Wireframe Plots in matplotlib](#)
- ☐ [Snippet: Write data to Azure Blob Storage \(WASB\)](#)
- ☐ [Snippet: Write data to Azure Data Lake \(ADLS Gen2\)](#)
- ☐ [Snippet: Write data to delta lake table](#)
- ☐ [Snippet: Write data to SQL pool Table](#)

RESOURCES

- [How to use Synapse notebooks - Azure Synapse Analytics | Microsoft Docs](#)
- [SQL scripts in Synapse Studio - Azure Synapse Analytics | Microsoft Docs](#)
- [Markdown for Jupyter notebooks cheatsheet - IBM Documentation](#)
- [Index of /programs-surveys/acs/data/pums/2017/1-Year \(census.gov\)](#)

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- <https://www.linkedin.com/in/russloski>
- Slides and Code: <https://github.com/rloski-public/Presentations/tree/main/Atlanta%202023>