TurbineMap7 Instructions

TurbineModel7 Class Description (just for background)

- Data
  - Object.TurbineMapData – input map data
  - Object.TurbineModel – output model results
- Functions
  - Object.TurbineMapDataPrep(“PathToTurbineDataFile”,”DataType”) – reads turbine mapping data and creates obj.TurbineMapData
    - “DataType” = ‘Training’ or ‘Validation’
  - Object.BuildTurbineModel – fits model to training data and creates Object.TurbineModel
  - Object.SolveTurbineModel – returns estimated turbine map data to Object.TubineModel for each map in TurbineMapData
  - Object.CreateScaledTurbine(GeometryScaleFactors) – returns estimated turbine map data for scaling model
    - GeometryScaleFactors = 1x3 or 3x1 array, [RotorInletRadiusScaleRatio, RotorOutletRadiusScaleRatio, HousingA/RScaleRatio]
  - Object.PlotModel – creates 3 plots for each map in Turbine Model (training, validation, or scale)

A Warning About Older Matlab Versions (known for R2019b and earlier, maybe R2020a/b)

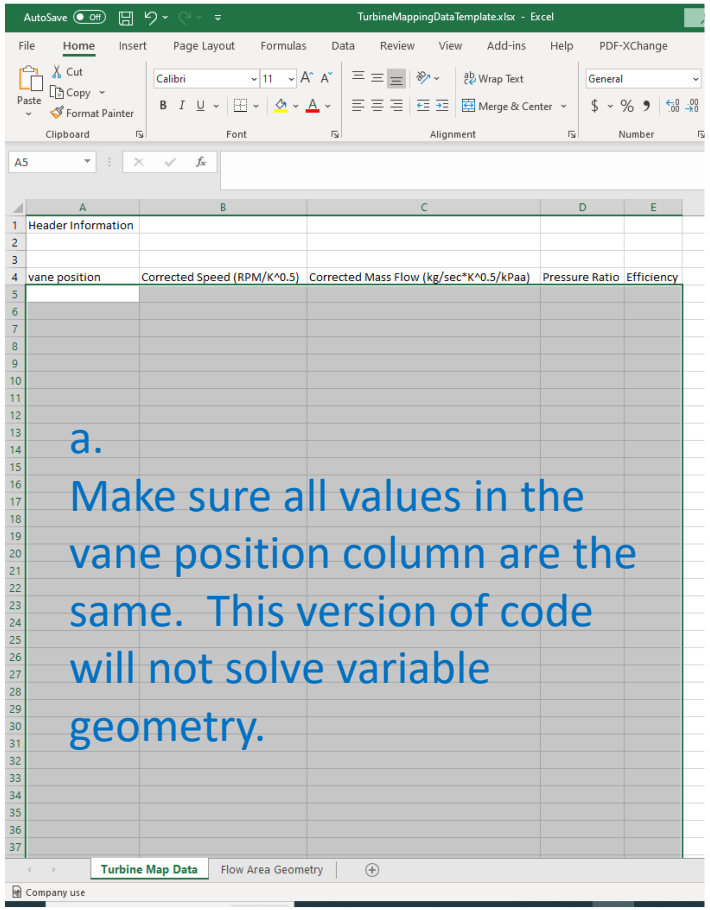
```
1   classdef TurbineModel7
2       %build model from turbine mapping data
3       %estimate turbine map for scaled geometry
4       %this version only works for fixed geometry
5       %created by Bob McMullen
6
7       properties
8           TurbineMapData
9           TurbineModel
10      end
11
12      properties(Constant)
13          ConvergenceEfficiencyError = 0.0001;
14      end
15
16      methods
17          function obj = TurbineModel7
18              obj.TurbineMapData = [];
19              obj.TurbineModel = [];
20          end
21
22          function obj = TurbineMapDataPrep(obj,PathTurbineData,DataType)
23              %% read turbine map data
24              %older Matlab versions
25              %TurbineGeometryInputTable = readtable(PathTurbineData,'Sheet','Flow Area Geometry');
26              %newer Matlab versions
27              TurbineGeometryInputTable = readtable(PathTurbineData,'Sheet','Flow Area Geometry','NumHeaderLines',1);
28              TurbineMapPrep = readmatrix(PathTurbineData,'Sheet','Turbine Map Data');
29              TurbineGeometryInput = TurbineGeometryInputTable{:,3};
30              TurbineDataSort = sortrows(TurbineMapPrep,1); %sort data by vane position
```

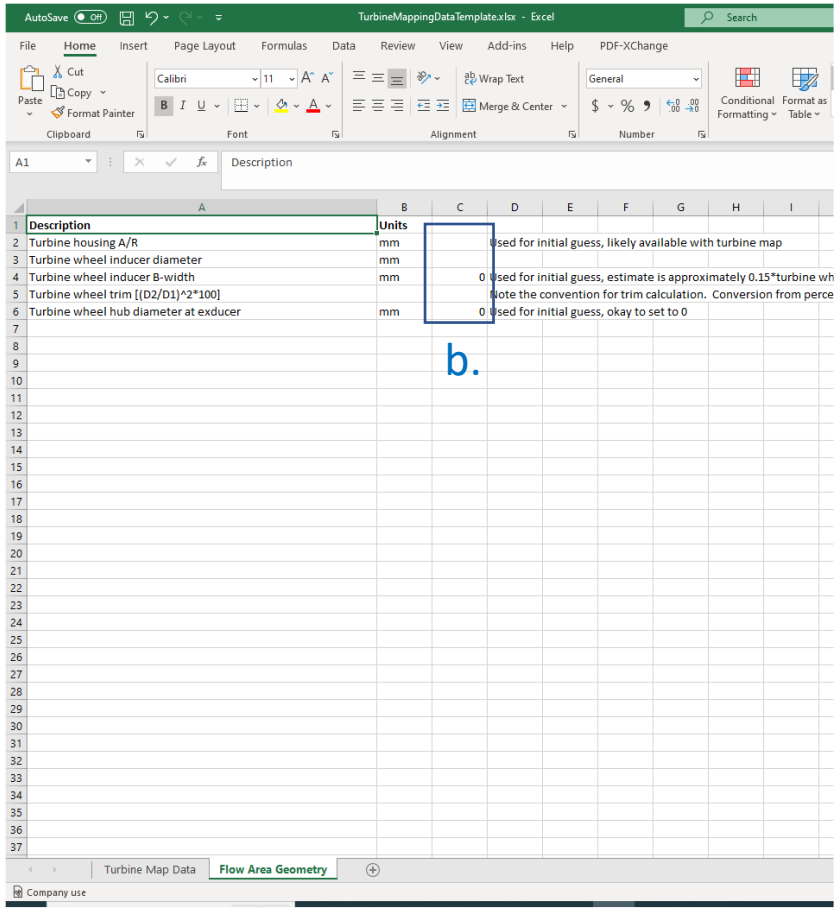
Older Matlab versions do not recognize ‘NumHeaderLines’ parameter for loading excel file, requiring line 25 to be uncommented, and line 27 to be commented in the TurbineModel7 object file.

Turbine Mapping Data

1. Create turbine mapping data files (one for each turbine map) using TurbineMappingDataTemplate.xlsx as a guide.
   a. Paste turbine mapping data into “Turbine Map Data” worksheet.
   b. Fill in geometry information on “Flow Area Geometry” worksheet.

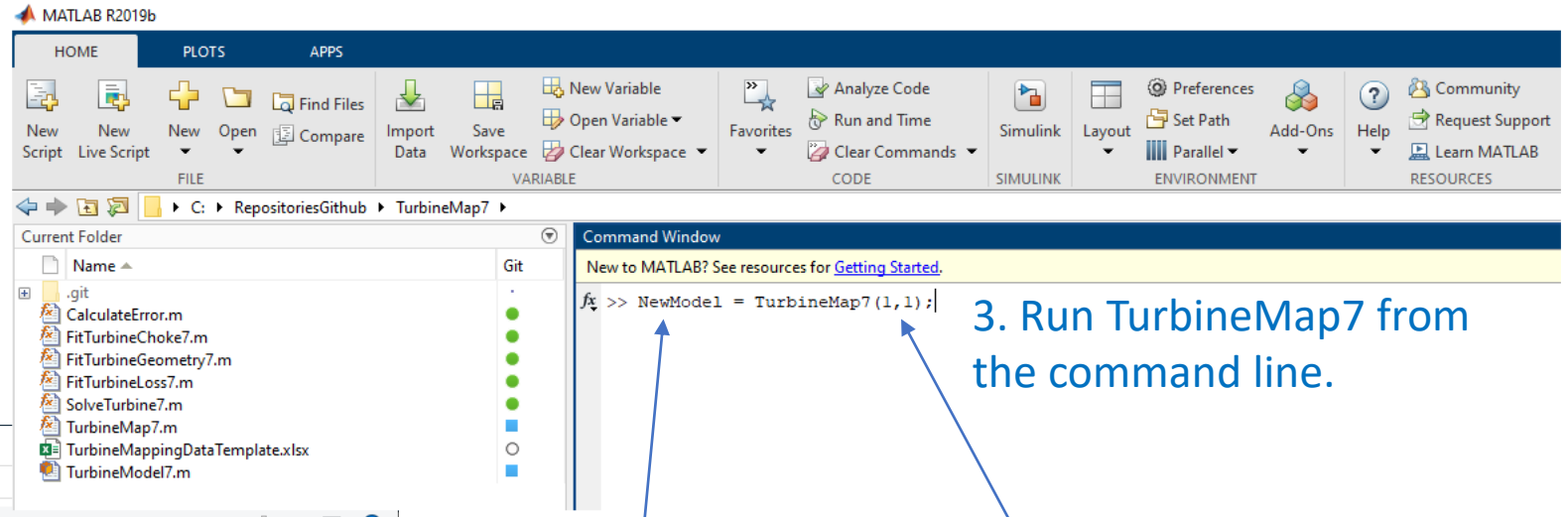
Three turbine mapping data files populated with made-up data are also included in the repository.





TurbineMap7.m

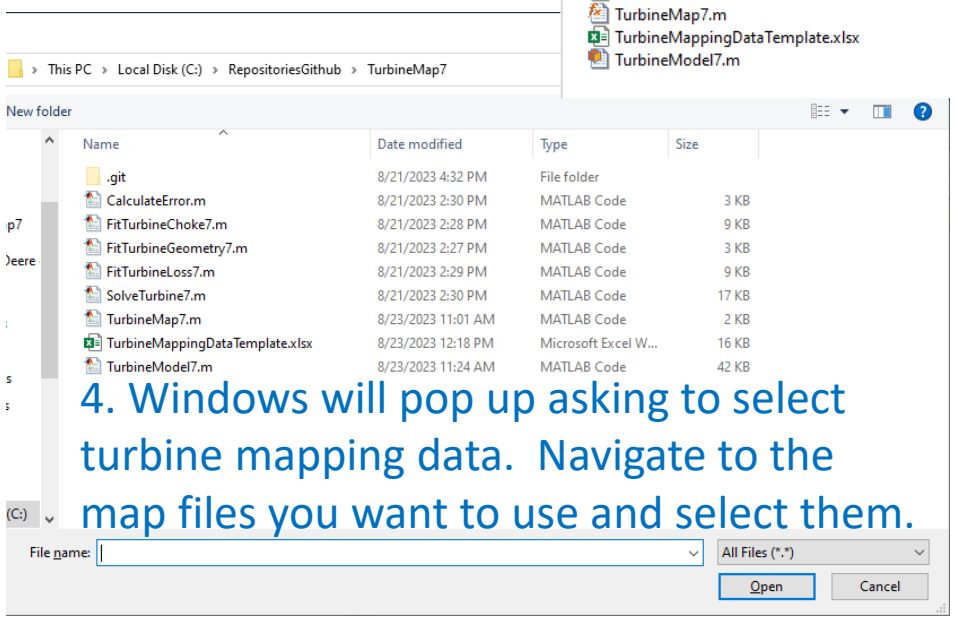
2. Set the working directory to the local copy of the files in TurbineMap7 repository, or make sure this location is on Matlab's path.



3. Run TurbineMap7 from the command line.

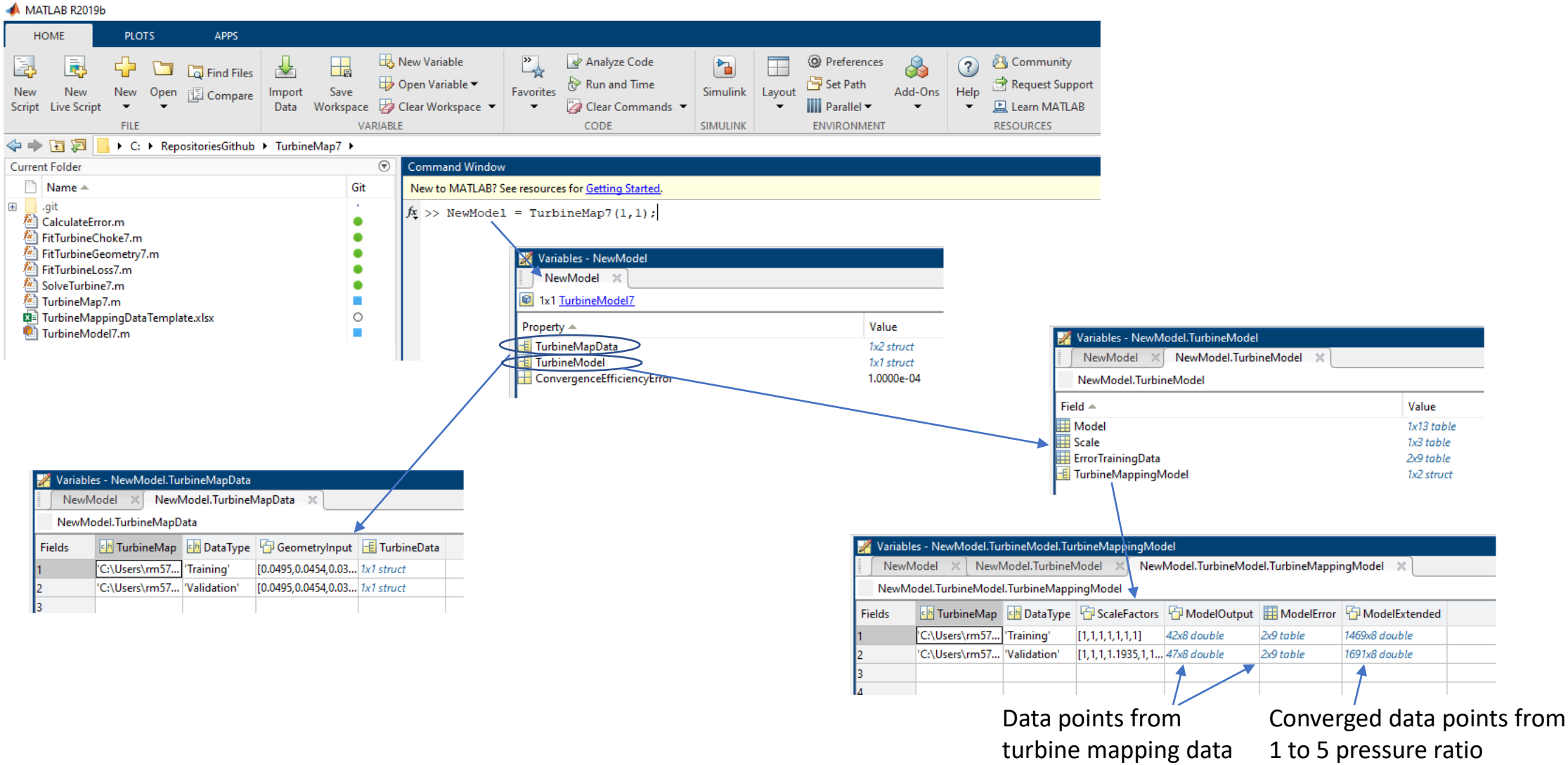
Replace "NewModel" with what you want to call the turbine model.

Arguments are (number of training maps, number of validation maps). Number of training maps must be >= 1. Number of validation maps must be >= 0.

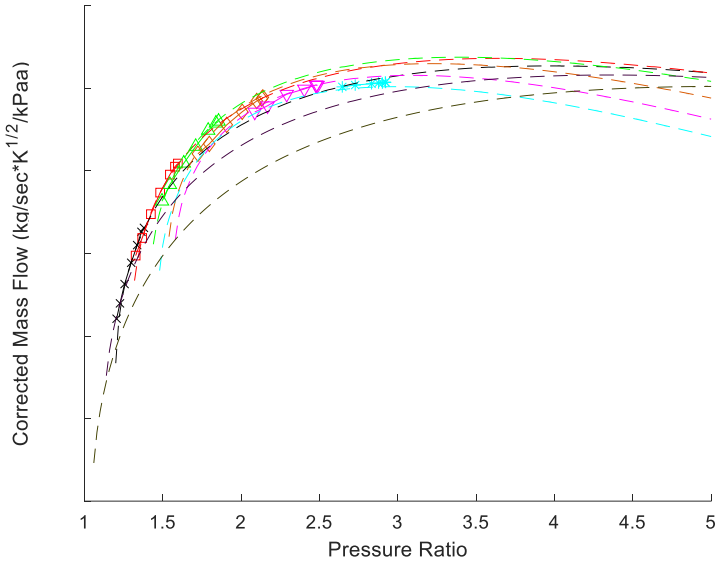


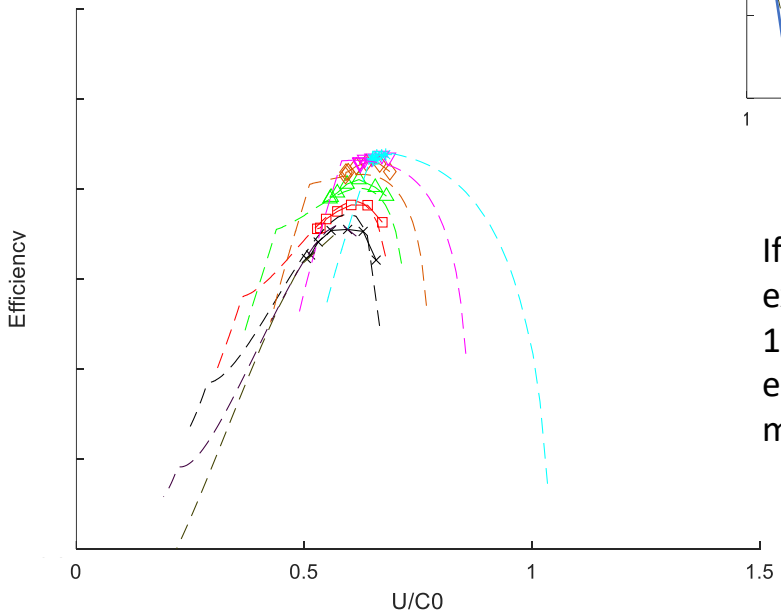
4. Windows will pop up asking to select turbine mapping data. Navigate to the map files you want to use and select them.

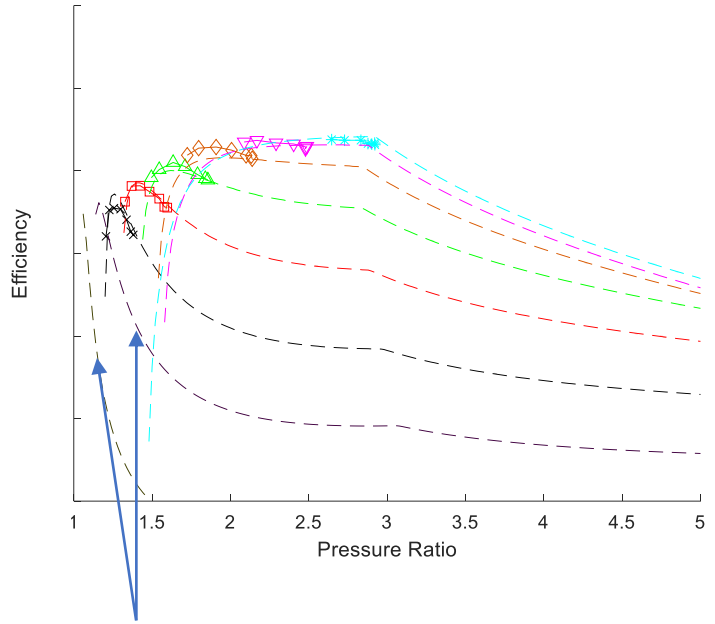
TurbineMap7.m Output



TurbineMap7.m Plots



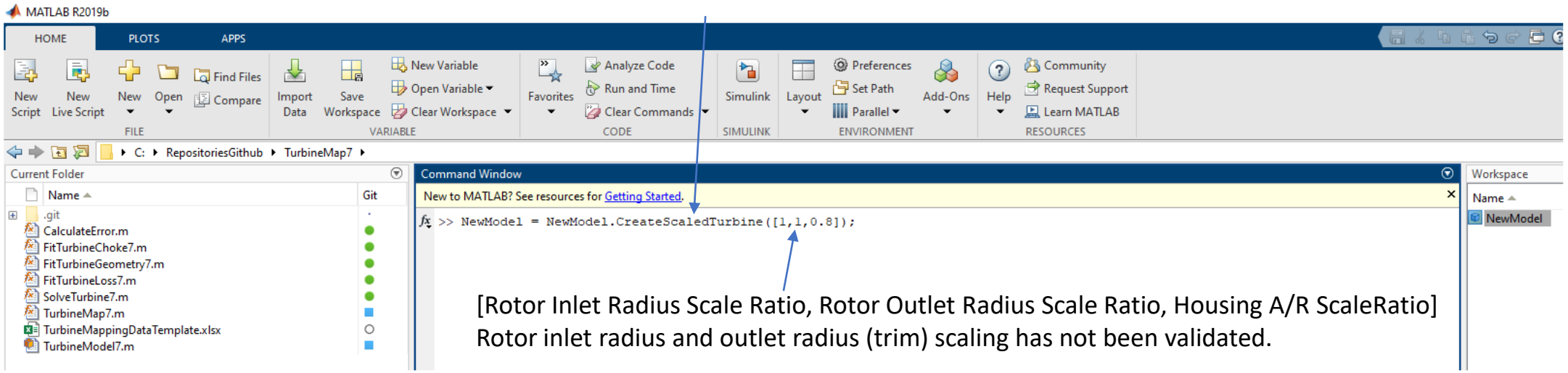




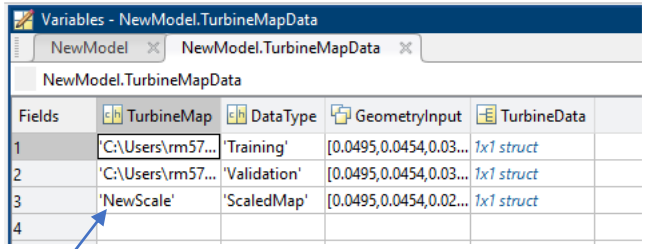
If data starts higher than 150 m/sec, extended model adds lower speedlines to 100 m/sec rotor inlet tip speed. If data ends lower than 450 m/sec, extended model adds higher speedlines to 500 m/sec

Scaling a Turbine Map

5. Call CreateScaledTurbine from the command line.

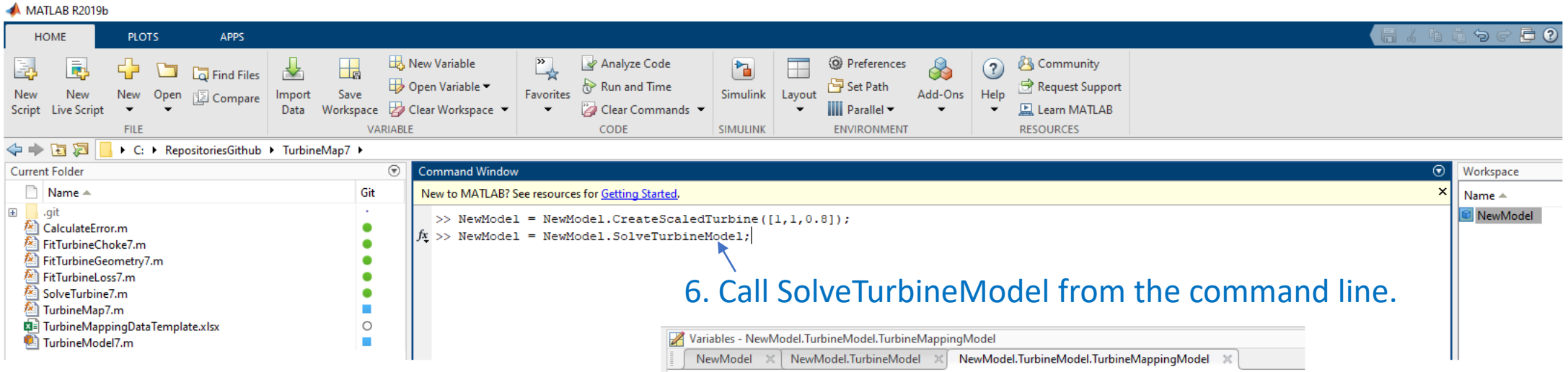


[Rotor Inlet Radius Scale Ratio, Rotor Outlet Radius Scale Ratio, Housing A/R ScaleRatio]
Rotor inlet radius and outlet radius (trim) scaling has not been validated.

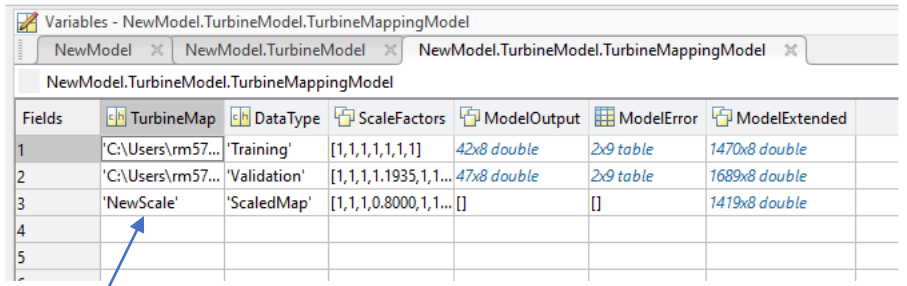


A new row will be added to “TurbineMapData”

Scaling a Turbine Map

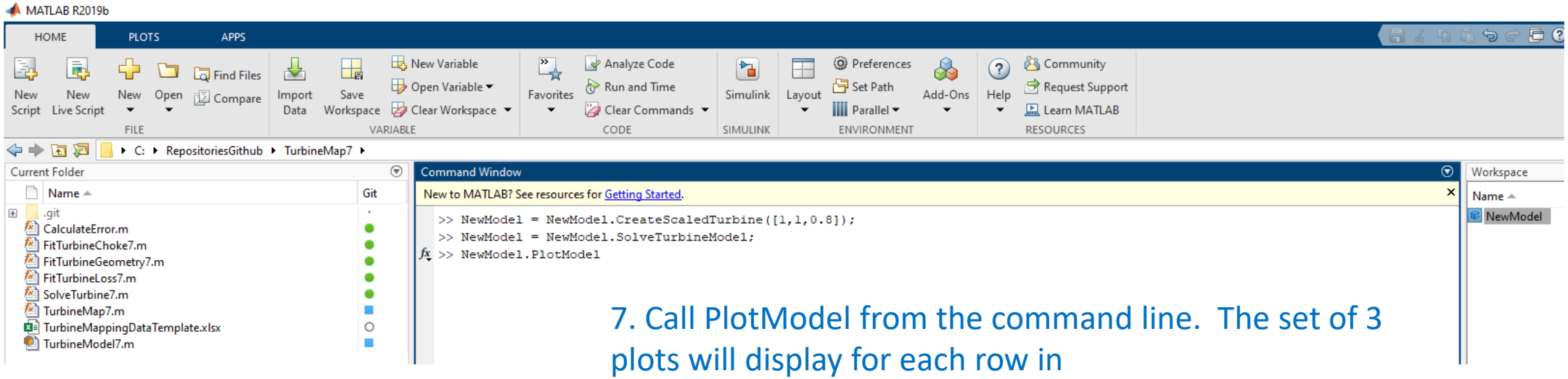


6. Call SolveTurbineModel from the command line.



A new row will be added to “TurbineModel.TurbineMappingModel”

Plot the Scaled Turbine Map



7. Call PlotModel from the command line. The set of 3 plots will display for each row in TurbineModel.TurbineMappingModel – 9 plots total for the example shown (3 for training data, 3 for validation data, 3 for scaled map)