

## Prognostic query examples

Here we demonstrate prognostic queries requiring increasingly complex models and describe what's behind the answers. Note: query answers are slightly edited for readability.

1. The simplest case consists of a query that asks for the value of a single variable, provides all the necessary inputs, and to answer it the system uses a model that requires a single equation:

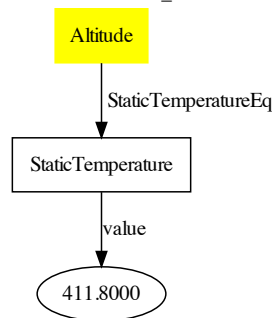
what is the ^value of StaticTemperature when the ^value of Altitude is 30000?

The system returns the results:

```
CM: "'Model' = 'CG_1554164425555',  
    'Variable' = 'StaticTemperature',  
    'Mean' = '411.8000000000001',  
    'StdDev' = '1.1368683772161603e-13'".
```

The system also displays a visualization of the model on a web browser tab:

Assembled Model CG\_1554164425555



The DBN execution framework returns mean and standard deviation values. All the variables in our example domain are deterministic, so there is only one value and the standard deviation is essentially zero.

We can check what equations were used through the query:

Ask ShowModelEquations: [CG\_1554140666320].

```
CM: "'Equation' = 'http://aske.ge.com/hypersonics#StaticTemperatureEq',  
    'Assumptions' = 'altitude < 36152'".
```

Recall that although the equations include assumption information the system currently does not evaluate the assumptions to rule out models. That is part of future work.

2. If the user provides inputs that are not needed to compute an answer, the DBN execution framework ignores them and computes the answer:

what is the ^value of StaticTemperature when the ^value of Altitude is 30000 and the ^value of AirSpeed is 1000?

```
CM: "'Model' = 'CG_1554165068661',  
    'Variable' = 'StaticTemperature',  
    'Mean' = '411.8000000000001',  
    'StdDev' = '1.1368683772161603e-13'".
```

3. With an additional equation for computing StaticTemperature in the KG, the system has two models available and returns two answers. The equation can be added to the SADL model file (Hypersonics.sadl) which will store it permanently, or it can be added on the interactive dialog page (see the dialog\_interaction demo), where it will persist while the dialog continues but will be lost when quitting the system. If we add it on the dialog page and then rerun the above query, we obtain these results:

```
StaticTemperatureEq2 is a StaticTemperatureEquation  
  sciknow:input (a Argument argType Altitude argName "altitude")  
  sciknow:output (a StaticTemperature)  
  expression (a Script with script "389.98", with language Text).
```

what is the ^value of StaticTemperature when the ^value of Altitude is 30000?

```
CM: "'Model' = 'CG_1554165231558',  
    'Variable' = 'StaticTemperature',  
    'Mean' = '411.8000000000001',  
    'StdDev' = '1.1368683772161603e-13'
```

```
    'Model' = 'CG_1554165231847',  
    'Variable' = 'StaticTemperature',  
    'Mean' = '389.97999999999996',  
    'StdDev' = '5.684341886080802e-14'".
```

4. The slightly more complex query for SpeedOfSound uses two equations. The DBN framework returns not only values for the output variable (SpeedOfSound) but also for the intermediate variables (in this case, StaticTemperature):

what is the ^value of SpeedOfSound when the ^value of Altitude is 30000?

```
CM: "'Model', 'Variable', 'Mean', 'StdDev'  
'CG_1554165342610', 'StaticTemperature', '411.8000001', '1.1368683772161603e-13'  
'CG_1554165342610', 'SpeedOfSound', '995.2192522253573', '3.410605131648481e-13'  
  
'Model', 'Variable', 'Mean', 'StdDev'  
'CG_1554165342934', 'StaticTemperature', '389.97999996', '5.684341886080802e-14'  
'CG_1554165342934', 'SpeedOfSound', '968.4936220750243', '0.0'".
```

5. Next try a more complex query for Total Temperature, which takes two values as input: altitude and air speed:

what is the ^value of TotalTemperature when the ^value of Altitude is 30000 and the ^value of AirSpeed is 5000?

```
CM: "'Model','Variable','Mean','StdDev'
'CG_1554165510474','StaticTemperature','411.8000001','1.1368683772161603e-13'
'CG_1554165510474','SpeedOfSound','995.2192522253573','3.410605131648481e-13'
'CG_1554165510474','MachSpeed','3.4254672038025977','1.3322676295501878e-15'
'CG_1554165510474','TotalTemperature','1378.1978734779877','0.0'

'Model','Variable','Mean','StdDev'
'CG_1554165510814','StaticTemperature','389.97999996','5.684341886080802e-14'
'CG_1554165510814','SpeedOfSound','968.4936220750243','0.0'
'CG_1554165510814','MachSpeed','3.5199931433588976','4.440892098500626e-16'
'CG_1554165510814','TotalTemperature','1356.37787347798','2.2737367544323206e-13'".
```

6. Next, the same query for total temperature, but providing only the altitude. In this case, the range and distribution information associated with AirSpeed is provided to the DBN execution framework which uses it to do sampling of air speed values in lieu of a user given value:

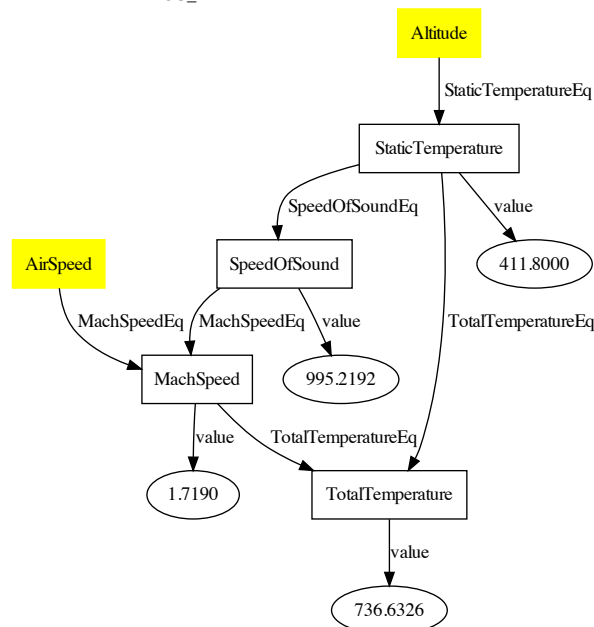
what is the ^value of TotalTemperature when the ^value of Altitude is 30000?

```
CM: "'Model','Variable','Mean','StdDev'
'CG_1554165865108','StaticTemperature','411.8000001','1.1368683772161603e-13'
'CG_1554165865108','SpeedOfSound','995.2192522253573','3.410605131648481e-13'
'CG_1554165865108','MachSpeed','1.719079396597638','0.9943967965607714'
'CG_1554165865108','TotalTemperature','736.6326960128736','288.6722629550413'
```

```
'Model','Variable','Mean','StdDev'
'CG_1554165865623','StaticTemperature','389.97999999','5.684341886080802e-14'
'CG_1554165865623','SpeedOfSound','968.4936220750243','0.0'
'CG_1554165865623','MachSpeed','1.7610360667883622','1.0336869644287892'
'CG_1554165865623','TotalTemperature','715.2043489517596','289.61381049128914'".
```

In the previous query, a value of 5000 is given for air speed. The knowledge graph defines a range of 0 to 5000 for air speed. In this query, air speed is sampled uniformly from that range, hence the lower values of Mach speed and Total temperature. The visualization of the first model is:

Assembled Model CG\_1554165865108



7. Finally, let's run a query with multiple output variables:

what is the ^value of TotalTemperature and the ^value of TotalPressure when the ^value of Altitude is 30000?

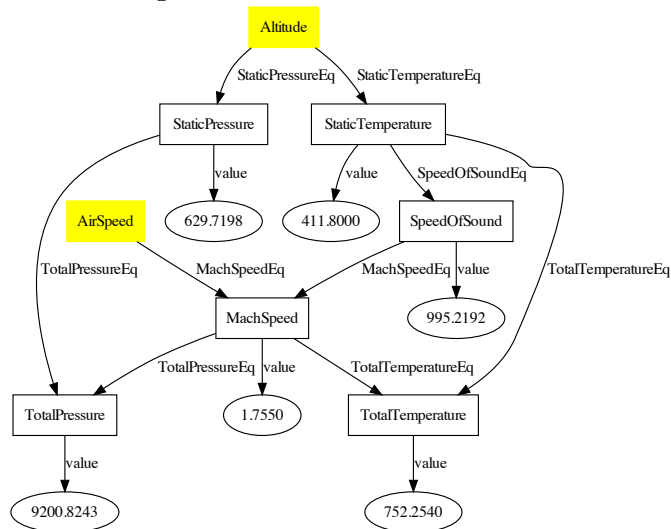
CM: "'Model','Variable','Mean','StdDev'

'CG\_1554219219939','StaticTemperature','411.8000000','1.1368683772161603e-13'  
'CG\_1554219219939','StaticPressure','629.7198640929647','1.1368683772161e-13'  
'CG\_1554219219939','SpeedOfSound','995.2192522253573','3.410605131648481e-13'  
'CG\_1554219219939','MachSpeed','1.7550956633917458','1.0263380322039113'  
'CG\_1554219219939','TotalPressure','9200.824365008511','11232.041679512435'  
'CG\_1554219219939','TotalTemperature','752.2540476042278','298.0658505080898'

'Model','Variable','Mean','StdDev'

'CG\_1554219220266','StaticTemperature','389.9799999999','5.6843418860808e-14'  
'CG\_1554219220266','StaticPressure','629.7198640929647','1.1368683772161e-13'  
'CG\_1554219220266','SpeedOfSound','968.4936220750243','0.0'  
'CG\_1554219220266','MachSpeed','1.707504468389609','1.0122007960610238'  
'CG\_1554219220266','TotalPressure','8651.708969115825','10982.997754817814'  
'CG\_1554219220266','TotalTemperature','697.2937524792854','278.2840539416843''.

Assembled Model CG\_1554219219939



Assembled Model CG\_1554219220266

