Tyche Example - Biorefinery Toy Model

Set up.

One only needs to execute the following line once, in order to make sure recent enough packages are installed.

In [ ]:
```
#!pip install 'numpy>=1.17.2' 'pandas>=0.25.1'
```

Import packages.

In [1]:
```
import os
import sys
sys.path.insert(0, os.path.abspath("../src"))
```

In [2]:
```
import numpy             as np
import matplotlib.pyplot as pl
import pandas            as pd
import re                as re

# The `tyche` package is located at <https://github.com/NREL/portfoli
o/tree/master/production-function/framework/src/tyche/>.
import tyche             as ty
```

Load data.

The data are stored in a set of tab-separated value files in a folder.

In [3]:
```
scenarios = ty.Designs("../data/biorefinery")
```

Compile the production and metric functions for each technology in the dataset.

In [4]:
```
scenarios.compile()
```

Examine the data.

The `functions` table specifies where the Python code for each technology resides.

In [5]:
```
scenarios.functions
```

Out[5]:

Technology	Style	Module	Capital	Fixed	Production	Metrics	Notes
Biorefinery	numpy	biorefinery	capital_cost	fixed_cost	production	metrics	

The `indices` table defines the subscripts for variables.

In [6]:
```
scenarios.indices
```

Out[6]:

Technology	Type	Index	Offset	Description	Notes
Biorefinery	Capital	Conversion	2		
		Fermentation	1		
		Preprocessing	0		
		Separation	3		
	Fixed	Insurance	1		
		Rent	0		
	Input	Energy	1		
		Feedstock	0		
	Metric	Jobs	0		
	Output	Product	0		
	Technical Parameter	Conversion	1		
		Fermentation	0		

The `designs` table contains the cost, input, efficiency, and price data for a scenario.

In [7]:
```
scenarios.designs
```

Out[7]:

Technology	Scenario	Variable	Index	Value	Units	Notes
Biorefinery	Actual	Input	Energy	5000	MJ/biorefinery	
			Feedstock	3000	tons feedstock/biorefinery	
		Input efficiency	Energy	0.71	1	
			Feedstock	0.82	1	
		Input price	Energy	0.5	USD/MJ	
			Feedstock	45	USD/ton feedstock	
		Lifetime	Conversion	25	year	
			Fermentation	25	year	
			Preprocessing	25	year	
			Separation	25	year	
		Output efficiency	Product	0.8	1	
		Output price	Product	600	USD/ton product	
		Scale	NaN	1	biorefinery/year	
	Ideal	Input	Energy	5000	MJ/biorefinery	
			Feedstock	3000	tons feedstock/biorefinery	
		Input efficiency	Energy	0.85	1	
			Feedstock	0.9	1	
		Input price	Energy	0.5	USD/MJ	
			Feedstock	45	USD/ton feedstock	
		Lifetime	Conversion	25	year	
			Fermentation	25	year	
			Preprocessing	25	year	
			Separation	25	year	
		Output efficiency	Product	0.89	1	
		Output price	Product	600	USD/ton product	
		Scale	NaN	1	biorefinery/year	

The `parameters` table contains additional techno-economic parameters for each technology.

In [8]:
```
scenarios.parameters
```

Out[8]:

Technology	Scenario	Parameter	Offset	Value	Units	Notes
Biorefinery	Actual	Capital cost for Conversion	5	750	USD	
		Capital cost for Fermentation	4	1500	USD	
		Capital cost for Preprocessing	3	1000	USD	
		Capital cost for Separation	6	1250	USD	
		Conversion yield	1	0.81		
		Fermentation yield	0	0.7		
		Fixed cost for Insurance	8	2000	USD/year	
		Fixed cost for Rent	7	5000	USD/year	
		Jobs	2	2.0		
	Ideal	Capital cost for Conversion	5	750	USD	
		Capital cost for Fermentation	4	1500	USD	
		Capital cost for Preprocessing	3	1000	USD	
		Capital cost for Separation	6	1250	USD	
		Conversion yield	1	0.95		
		Fermentation yield	0	0.82		
		Fixed cost for Insurance	8	2000	USD/year	
		Fixed cost for Rent	7	5000	USD/year	
		Jobs	2	4.0		

The `results` table specifies the units of measure for results of computations.

In [9]:
```
scenarios.results
```

Out[9]:

Technology	Variable	Index	Units	Notes
Biorefinery	Cost	Cost	USD/biorefinery	
	Metric	Jobs	jobs/biorefinery	
	Output	Product	tons product/biorefinery	

Evaluate the designs in the dataset.

In [10]:
```
results = scenarios.evaluate_scenarios()
```

In [11]:
```
results
```

Out[11]:

					Value	Units
Technology	**Scenario**	**Sample**	**Variable**	**Index**		
Biorefinery	Actual	1	Cost	Cost	-549858.600	USD/biorefinery
			Metric	Jobs	2.000	jobs/biorefinery
			Output	Product	1115.856	tons product/biorefinery
	Ideal	1	Cost	Cost	-992357.200	USD/biorefinery
			Metric	Jobs	4.000	jobs/biorefinery
			Output	Product	1871.937	tons product/biorefinery