Automated Data Collection

PRICE Systems, LLC

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Agenda

- Introduction and Motivation
- Data Collection Challenges
- Introduction to RapidMiner Capabilities
- RapidMiner - Crawling the Web
- Implementation
- Future Directions

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Introduction and Motivation

- Data Collection is a necessary evil for cost estimators
  - To support the creation of Cost Estimating Relationships (CERs)
  - To support estimating by analogy
  - To support selection of input values for cost estimating models
- Data collection is hard
  - Data is often hard to find
  - Even when data is found it is often hard to mine as the process is tedious and time consuming
  - Data is often very noisy making it hard to understand and work with

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Introduction and Motivation

- Original motivation for this work arose from efforts around an overhaul of the TruePlanning ® Information Technology Services Cost Model
- Many of the models we developed for IT Services required commodity pricing information
- Commodity pricing is hard to estimate because
  - Prices are constantly changing
  - Many companies have negotiated agreements with specific vendors
  - There are many things that drive commodity pricing outside of the scope of a typical cost estimating relationship

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Data Collection Challenges For Commodity Prices

- Finding the right data
  - Accurate pricing data
  - Significant technical and specification information
  - Normalization across multiple vendors
- Keeping the data up to date
  - Commodity prices change frequently – based on market factors, supply and demand, etc.
  - Good pricing data from last quarter is unlikely to relevant in this quarter
- Need a solution that is
  - Repeatable
  - Consistent
  - Can be accomplished quickly with the push of a button
  - Can be updated regularly (monthly, quarterly, bi-annually) without extensive time investment

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RapidMiner

- Open Source application
- RapidMiner 5.3 and 7.2 currently available for download from
  http://rapidminer.software.informer.com/5.3/
  https://my.rapidminer.com/nexus/index/html#downloads
- Licensed under GMU Affero General Public License version 3
- User friendly, graphical user interface that allows for data collection and analysis

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Summary of RapidMiner Capability

- Data Transformation
  - Filtering
  - Sorting
  - Replacing Missing values in a data set
  - Aggregation, etc.
- Modeling
  - Classification
  - Clustering
  - Correlation, etc.
- Evaluation
  - Validation
  - Regression
  - Significance, etc.
- Text Processing
  - Extraction
  - Transformation
  - Extraction
  - Tokenization, etc.
- Web Mining
  - Server Log Processing
  - HTML Processing
  - Web Crawling
  - Read RSS Feed, etc.

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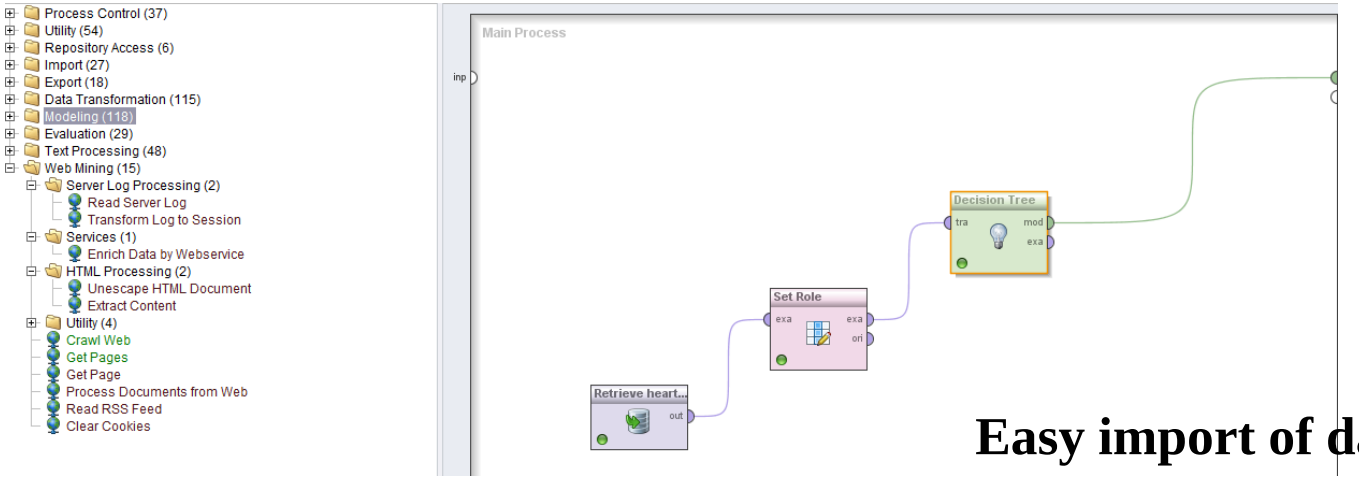
Introduction to RapidMiner Capabilities

Drag and Drop Interface to Build Processes



Easy import of data from Excel

Data View | Meta Data View | Plot View | Advanced Charts | Annotations

ExampleSet (138 examples, 0 special attributes, 8 regular attributes)

Row No.	Age	Marital_Stat...	Gender	Weight_Cat...	Cholesterol	Stress_Man...	Trait_Anxiety	2nd_Heart_...
1	60	2	0	1	150	1	50	Yes
2	69	2	1	1	170	0	60	Yes
3	52	1	0	0	174	1	35	No
4	66	2	1	1	169	0	60	Yes
5	70	3	0	1	237	0	65	Yes
6	52	1	0	0	174	1	35	No
7	58	2	1	0	140	0	45	No
8	59	2	1	0	143	0	45	Yes
9	60	2	0	0	139	0	45	No
10	51	1	1	0	174	1	40	No
11	52	1	0	0	189	1	65	No
12	70	2	1	1	147	1	50	Yes
13	52	2	1	2	160	0	40	Yes
14	74	3	1	2	178	0	75	Yes
15	64	2	1	2	236	1	80	Yes
16	69	2	0	1	146	1	50	Yes
17	58	2	0	0	141	0	45	No
18	68	1	0	0	172	0	60	No

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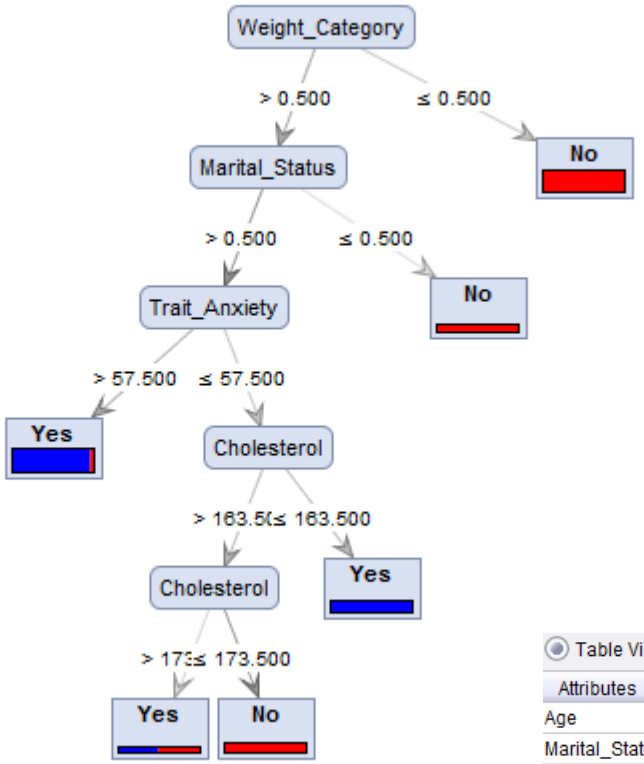
Introduction to RapidMiner Capabilities

Countless ways to visualize your data



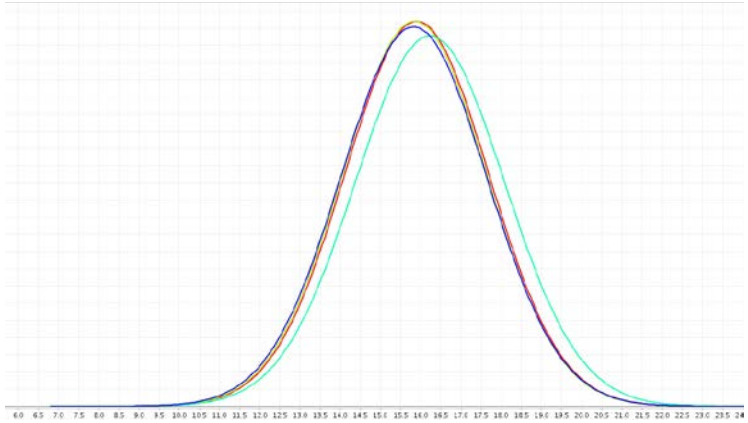


Table View | Pairwise Table | Plot View | Annotations

Attributes	Age	Marital_Stat...	Gender	Weight_Cat...	Cholesterol	Stress_Man...	Trait_Anxiety	2nd_Heart_...
Age	1	0.427	0.076	0.402	0.395	-0.359	0.667	-0.499
Marital_Statu	0.427	1	-0.033	0.065	0.274	-0.292	0.238	-0.365
Gender	0.076	-0.033	1	0.449	0.191	-0.241	0.082	-0.318
Weight_Cate	0.402	0.065	0.449	1	0.398	-0.347	0.501	-0.731
Cholesterol	0.395	0.274	0.191	0.398	1	-0.406	0.579	-0.507
Stress_Man	-0.359	-0.292	-0.241	-0.347	-0.406	1	-0.321	0.439
Trait_Anxiety	0.667	0.238	0.082	0.501	0.579	-0.321	1	-0.483
2nd_Heart_A	-0.499	-0.365	-0.318	-0.731	-0.507	0.439	-0.483	1

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Introduction to RapidMiner Capabilities

Multiple Regression Models, Weighting and Analysis

Attribute	Coefficient	Std. Error	Std. Coeffici...	Tolerance	t-Stat	p-Value	Code
attribute_1	2.053	1.677	1.618	0.904	1.224	0.307	
attribute_2	2.007	1.531	1.721	0.930	1.310	0.257	
attribute_3	-5.631	1.425	-4.936	0.886	-3.951	0.000	****
attribute_4	3.253	0.874	2.808	0.953	3.720	0.000	****
attribute_8	-1.191	0.532	-0.753	0.910	-2.241	0.030	**
attribute_9	0.943	0.637	0.627	0.850	1.479	0.181	
attribute_10	-0.381	0.586	-0.246	0.802	-0.649	0.523	
attribute_11	0.247	0.665	0.139	0.701	0.371	0.714	
attribute_12	1.027	0.538	0.575	0.777	1.908	0.069	*
attribute_13	0.422	0.536	0.218	0.851	0.788	0.439	
attribute_14	-0.361	0.485	-0.200	0.955	-0.745	0.464	
attribute_15	0.257	0.494	0.165	0.996	0.521	0.608	
attribute_16	-0.256	0.480	-0.157	1.000	-0.532	0.600	
attribute_17	-0.696	0.502	-0.441	1.000	-1.387	0.219	
attribute_18	1.007	0.469	0.582	1.000	2.149	0.038	**
attribute_19	-0.732	0.404	-0.374	0.961	-1.811	0.087	*
attribute_20	0.615	0.473	0.287	0.925	1.300	0.263	
attribute_21	-0.623	0.464	-0.264	0.896	-1.341	0.242	
attribute_22	0.647	0.468	0.265	0.941	1.384	0.221	
attribute_23	-0.506	0.479	-0.196	0.970	-1.057	0.428	
attribute_24	1.156	0.490	0.411	0.995	2.358	0.022	**

attribute	
duration	0
pension	0.062
education-allowance	0.064
shift-differential	0.185
bereavement-assistance	0.185
working-hours	0.227
col-adj	0.258
vacation	0.271
wage-inc-3rd	0.298
standby-pay	0.412
contrib-to-dental-plan	0.424
longterm-disability-assistance	0.535
wage-inc-2nd	0.547
contrib-to-health-plan	0.676
statutory-holidays	0.685
wage-inc-1st	1

PolynomialRegression

```
  25.320 * a1 ^ 1.000
+ 3.697 * a2 ^ 2.000
+ 1.814 * a3 ^ 2.000
- 2.192 * a4 ^ 1.000
- 0.673 * a5 ^ 2.000
- 83.828
```

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RapidMiner for Web Crawling

Starting with a webpage that is setup where you can view list of products:

- Get Page
  - Sends RapidMiner out to product page URL
  - Example: http://www.tigerdirect.com/applications/category/category_slc.asp?page=1&Nav=|c:4935|&Sort=3&Recs=10
- Process Documents
  - Uses Xpaths to grab product links
- Get Pages
  - Sends RapidMiner out to each product link that it grabbed in Process Documents
- Process Documents from Data
  - Uses Xpaths to grab product specifications on each product page

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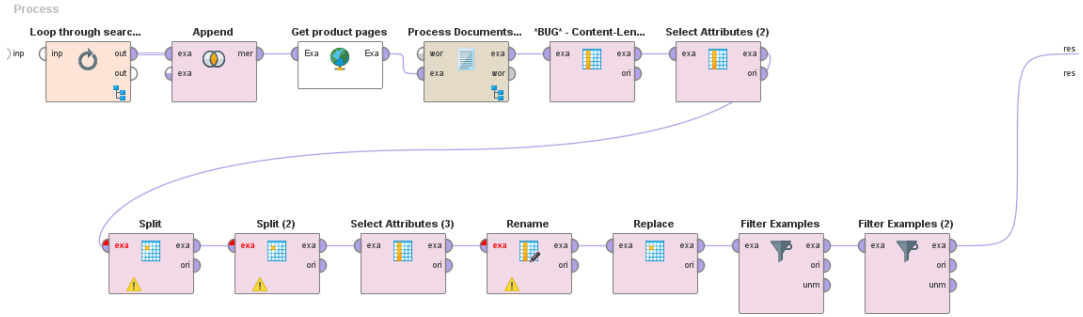
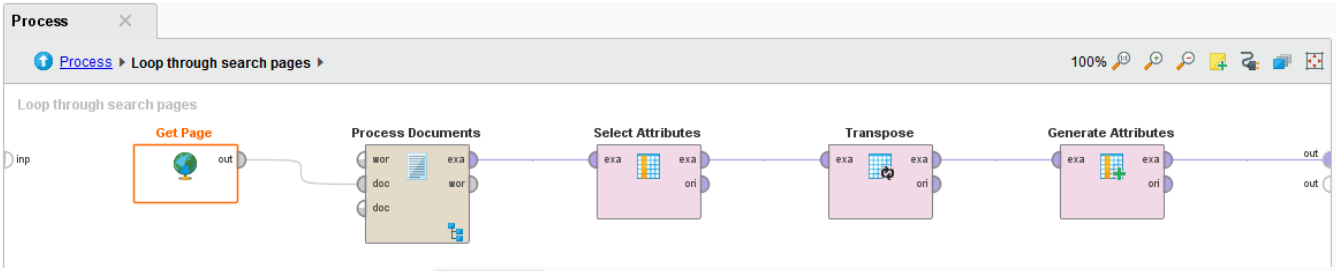
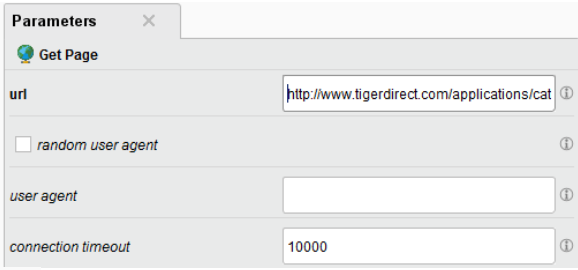
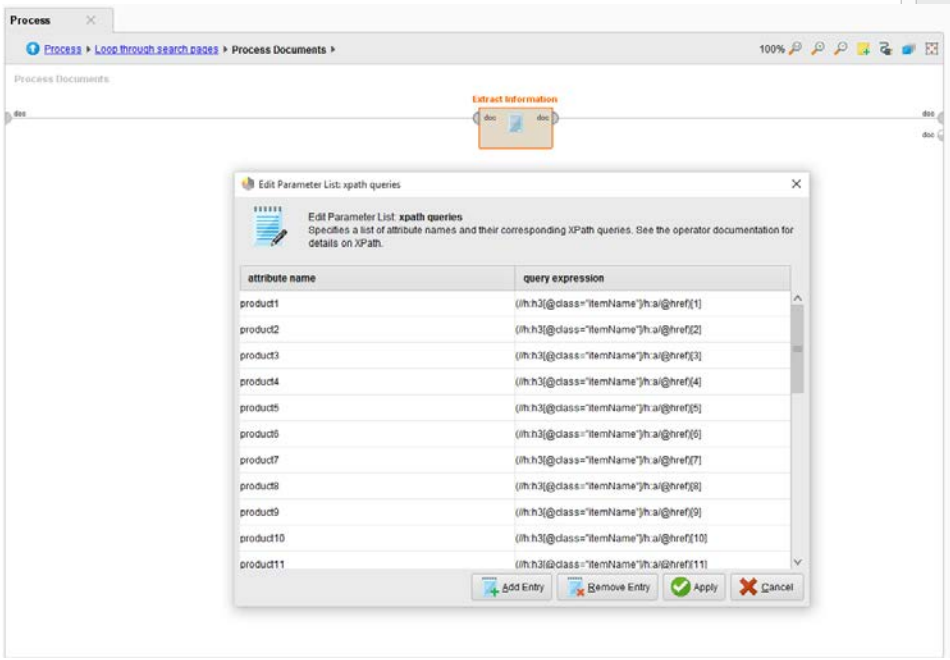
Implementation to Support Commodity Pricing Data Collection









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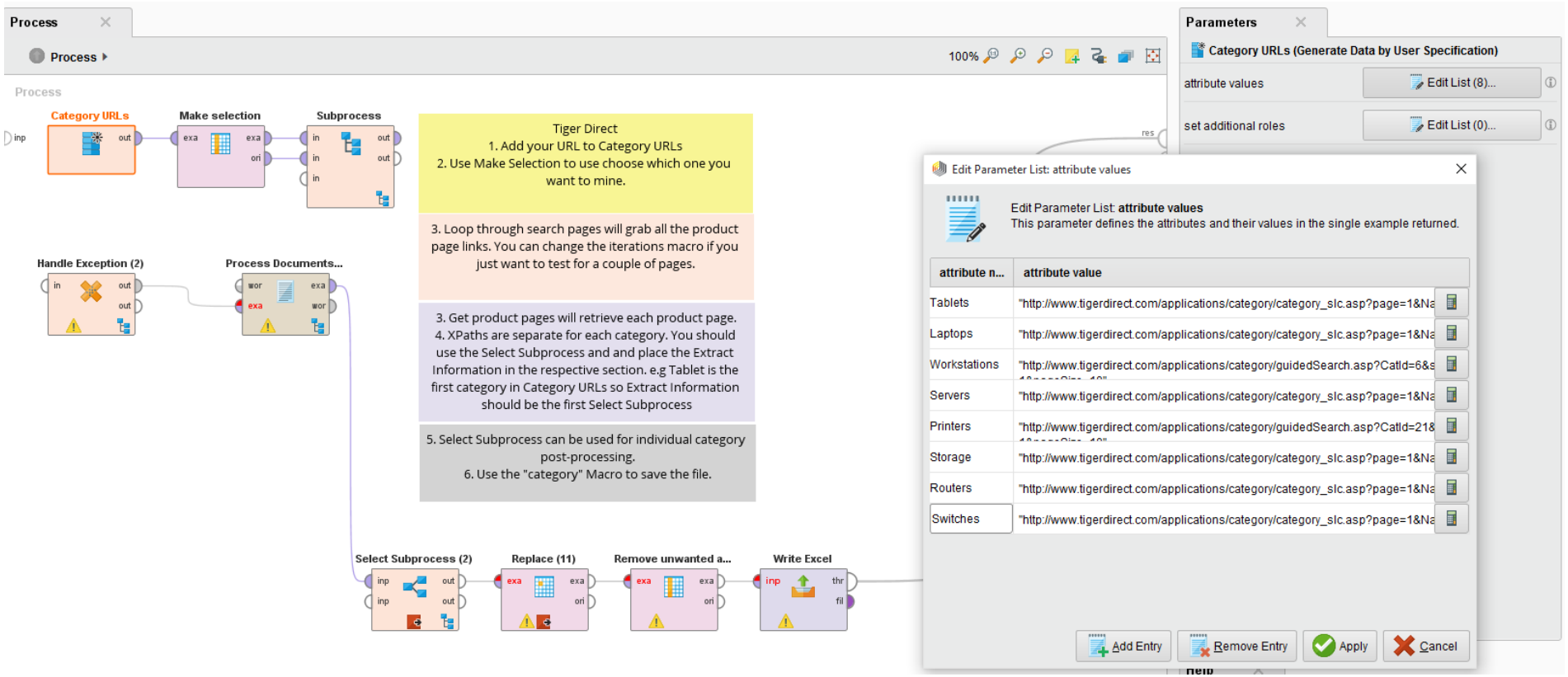
Combining into one process



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RapidMiner for Web Crawling

Process to find relevant pages when webpage has various product links to follow:

- Crawl Web
  - Start at the highest level URL for each product
    - *Example: http://www.dell.com/us/business/p/laptops*
  - Crawling rules will send RapidMiner out to any URL matching your search
- Process Documents from Data
  - Uses Xpaths to grab product specifications on each product page

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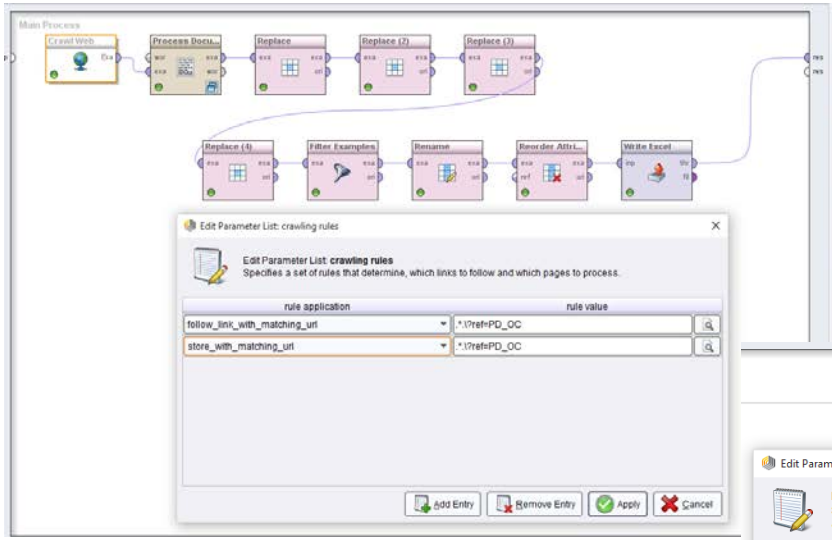
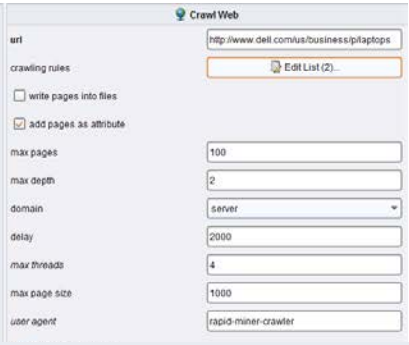
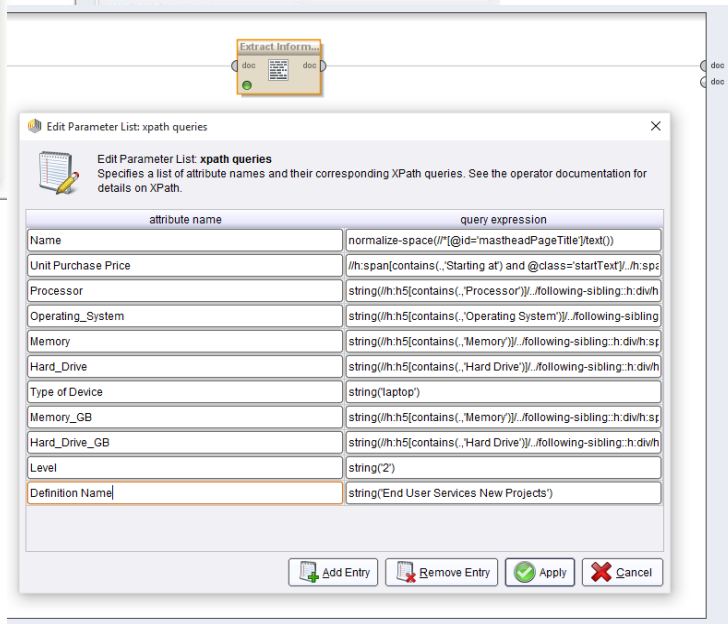
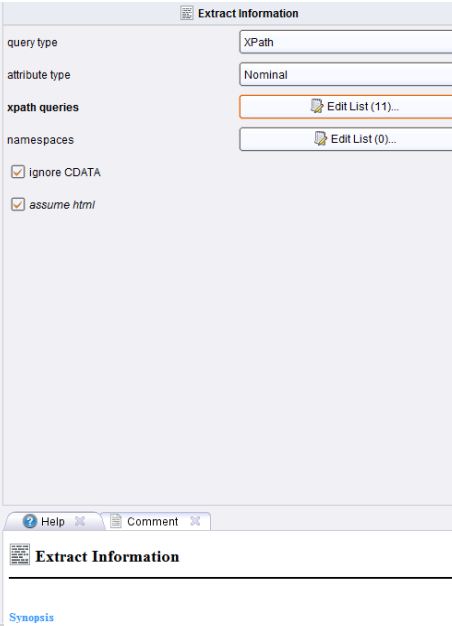
Implementation to Support Commodity Pricing Data Collection









Row No.	URL	Name	Definition Name	Hard_Drive	Hard_Drive...	Level	Memory	Memory_GB	Operating_System	Processor	Type of Device	Unit Purchase Price
1	http://www.d	Latitude 13 3(	End User Services	M.2 128GB S	128	2	4GB (1x4G) :	4	Windows 10 Pro 64t	Pentium DC	laptop	699
2	http://www.d	Latitude 12 7(	End User Services	M.2 128GB S	128	2	4GB (1x4GB	4	Windows 10 Pro, 64-	6th Generat	laptop	1049
3	http://www.d	Latitude 13 7(	End User Services	M.2 128GB S	128	2	4GB LPDDR	4	Windows 7 Professi	Intel® Core™	laptop	1299
4	http://www.d	New Inspiron	End User Services	500GB 5400	500	2	4GB Single (	4	Windows 10 Home,	Intel® Pentii	laptop	499
5	http://www.d	New Inspiron	End User Services	500GB 5400	500	2	4GB Single (	4	Windows 10 Home,	Intel® Pentii	laptop	449
6	http://www.d	New Inspiron	End User Services	256GB Solid	256	2	8GB Dual Ch	8	Windows 10 Home 6	6th Generat	laptop	749
7	http://www.d	New Inspiron	End User Services	256GB Solid	256	2	8GB Dual Ch	8	Windows 10 Home 6	6th Generat	laptop	749
8	http://www.d	Precision 15 :	End User Services	500GB 2.5 ir	500	2	8GB (2x4GB	8	Windows 7 Professi	Intel® Core™	laptop	999
9	http://www.d	Precision 15 !	End User Services	500GB 2.5 ir	500	2	8GB (2x4GB	8	Windows 7 Professi	Intel® Core™	laptop	1399
10	http://www.d	XPS 15 Lapto	End User Services	500GB 7200	200	2	8GB (1x8G) :	8	Windows 10 Home,	6th Generat	laptop	999

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Implementation to Support Commodity Pricing Data Collection

- Processes have been created to crawl Dell, HP and TigerDirect for pricing and performance data for:
  - Laptops
  - Workstations
  - Tablets
  - Printers
  - Storage Devices
  - Servers
  - Other Supporting Hardware
- These processes create Excel files that are directly importable into the IT Hardware TrueFindings® database
- This database can be updated in several hours to support monthly or quarterly updates of the database

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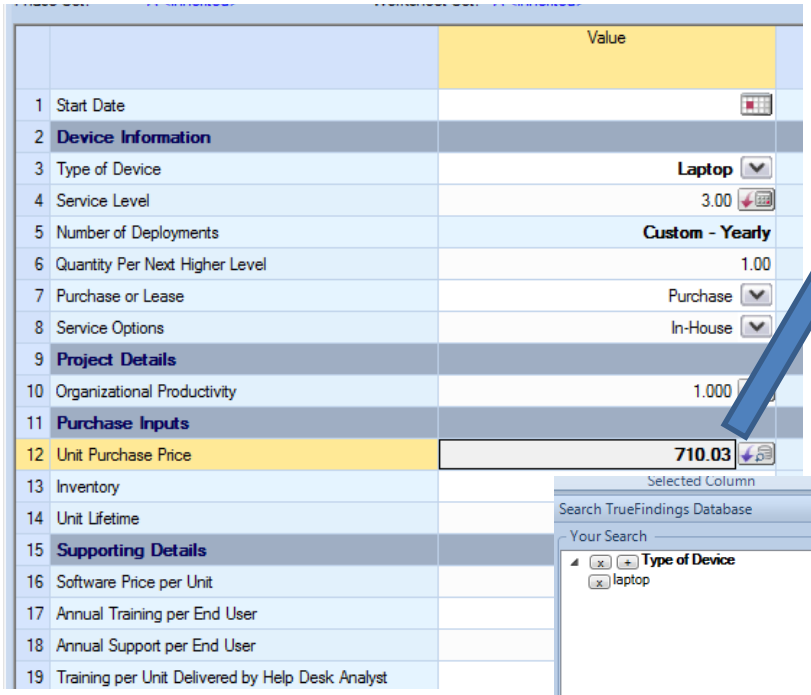
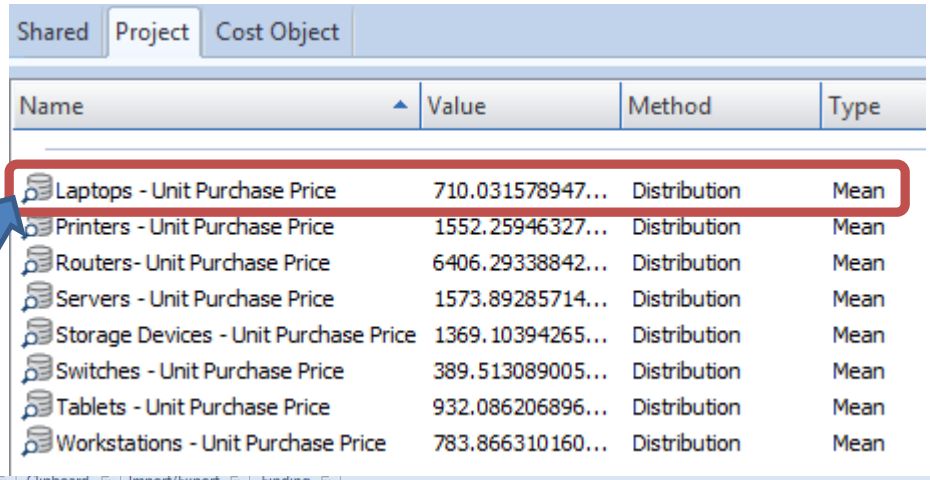
IT Hardware for TrueFindings® and TruePlanning®

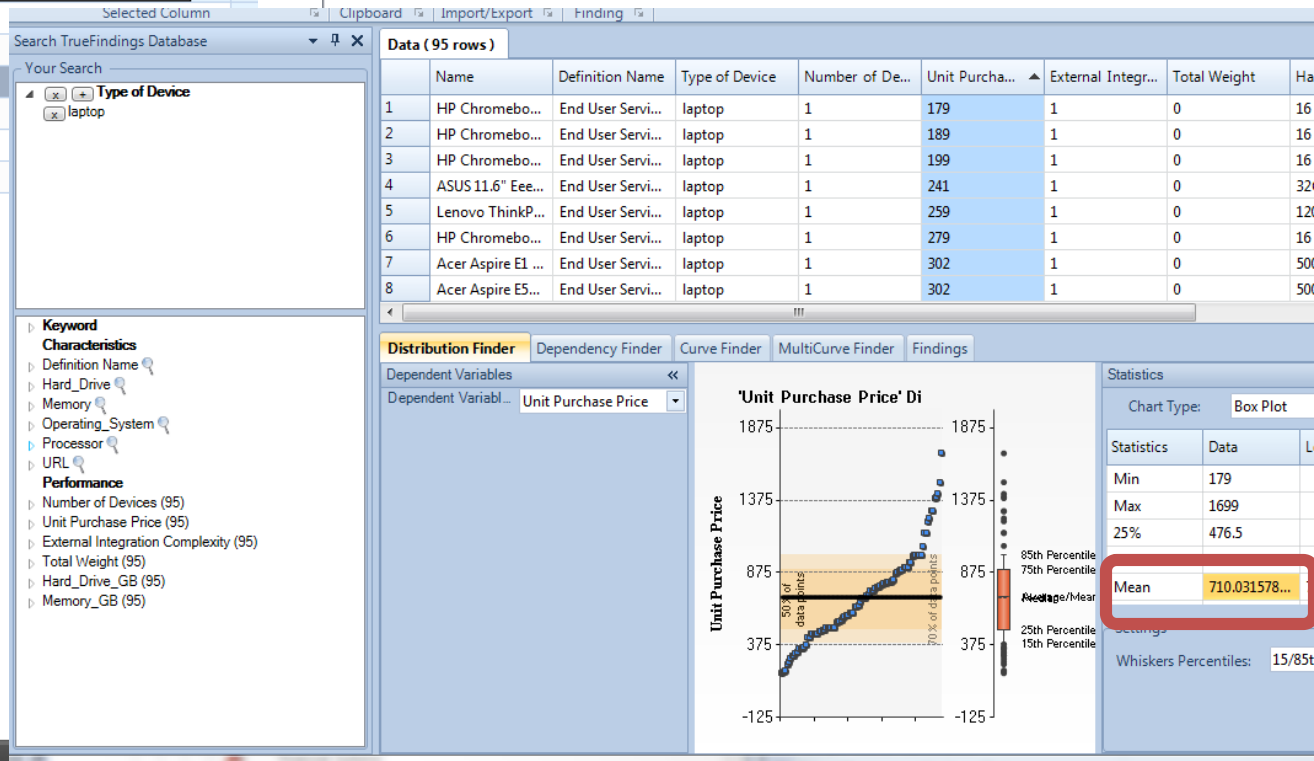


		Value
1	Start Date	
2	**Device Information**	
3	Type of Device	Laptop
4	Service Level	3.00
5	Number of Deployments	Custom - Yearly
6	Quantity Per Next Higher Level	1.00
7	Purchase or Lease	Purchase
8	Service Options	In-House
9	**Project Details**	
10	Organizational Productivity	1.000
11	**Purchase Inputs**	
12	Unit Purchase Price	710.03
13	Inventory	
14	Unit Lifetime	
15	**Supporting Details**	
16	Software Price per Unit	
17	Annual Training per End User	
18	Annual Support per End User	
19	Training per Unit Delivered by Help Desk Analyst	



Shared | Project | Cost Object

Name	Value	Method	Type
Laptops - Unit Purchase Price	710.031578947...	Distribution	Mean
Printers - Unit Purchase Price	1552.25946327...	Distribution	Mean
Routers- Unit Purchase Price	6406.29338842...	Distribution	Mean
Servers - Unit Purchase Price	1573.89285714...	Distribution	Mean
Storage Devices - Unit Purchase Price	1369.10394265...	Distribution	Mean
Switches - Unit Purchase Price	389.513089005...	Distribution	Mean
Tablets - Unit Purchase Price	932.086206896...	Distribution	Mean
Workstations - Unit Purchase Price	783.866310160...	Distribution	Mean



Selected Column | Clipboard | Import/Export | Finding

Search TrueFindings Database

Your Search

Type of Device
laptop

Keyword
Characteristics
Definition Name
Hard_Drive
Memory
Operating_System
Processor
URL
Performance
Number of Devices (95)
Unit Purchase Price (95)
External Integration Complexity (95)
Total Weight (95)
Hard_Drive_GB (95)
Memory_GB (95)

Data (95 rows)

	Name	Definition Name	Type of Device	Number of De...	Unit Purcha...	External Integr...	Total Weight	Ha
1	HP Chromebo...	End User Servi...	laptop	1	179	1	0	16
2	HP Chromebo...	End User Servi...	laptop	1	189	1	0	16
3	HP Chromebo...	End User Servi...	laptop	1	199	1	0	16
4	ASUS 11.6" Eee...	End User Servi...	laptop	1	241	1	0	32
5	Lenovo ThinkP...	End User Servi...	laptop	1	259	1	0	12
6	HP Chromebo...	End User Servi...	laptop	1	279	1	0	16
7	Acer Aspire E1 ...	End User Servi...	laptop	1	302	1	0	50
8	Acer Aspire E5...	End User Servi...	laptop	1	302	1	0	50

Distribution Finder | Dependency Finder | Curve Finder | MultiCurve Finder | Findings

Dependent Variables

Dependent Variabl... Unit Purchase Price

'Unit Purchase Price' Di

Unit Purchase Price

1875
1375
875
375
-125

50% of data points

70% of data points

85th Percentile
75th Percentile
Mean/Mean
25th Percentile
15th Percentile

Statistics

Chart Type: Box Plot

Statistics	Data
Min	179
Max	1699
25%	476.5
Mean	710.031578...

Whiskers Percentiles: 15/85t

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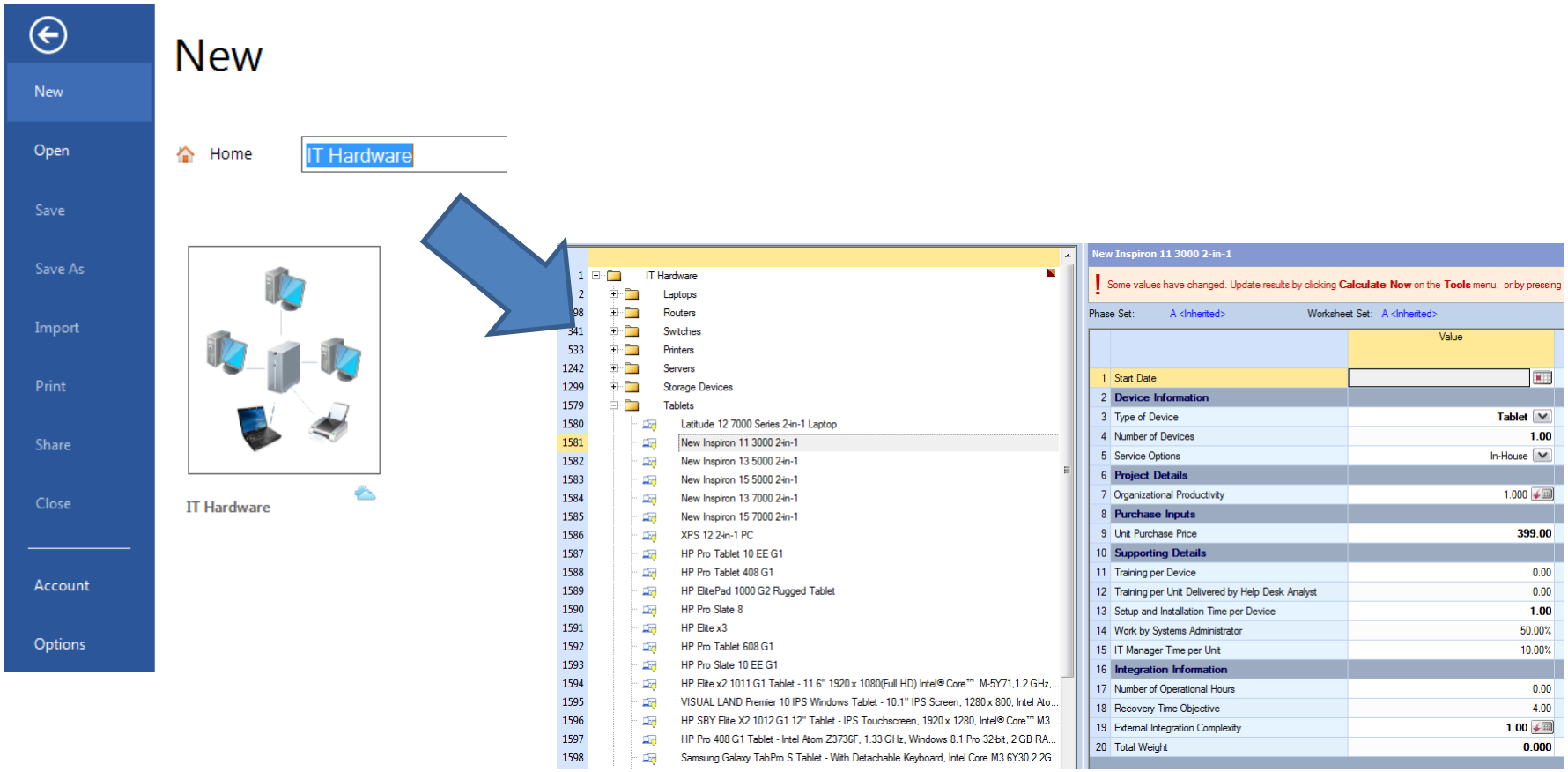
Implementation to Support Commodity Pricing Data Collection

- These data points can also be accessed via the File New Template Search in TruePlanning 16.0 for immediate drag and drop into a project file.



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Future Directions

- PRICE intends to update and extend the IT Hardware Commodity database
  - Regular updates with the existing processes that have been developed
  - Developing new processes based on user requirements & suggestions
- We are currently investigating the feasibility of creating similar processes to support the IT Software pricing requirements
  - This may be problematic because many software applications require calls to the vendor for quotes – we're hopeful we may be able to find sources
- We are considering extending this project to include commodity prices for electronic components to support Microcircuit cost estimation
- We would like to apply this expertise to develop custom solutions for clients based on their specific purchasing processes

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