

# ZEMENTIS for Datameer User Guide

10.3.0.1

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### **Chapter 1. Introduction**

As advanced analytics becomes pervasive across the enterprise to drive better business decisions, the need for efficient execution of predictive models is paramount. An ever growing array of data mining tools and, all too often, custom specialized software is used to mine data and derive statistical models from a wealth of collected data. The ultimate goal is to turn these models into business value by incorporating them into day to day business operations. This necessitates the ability to integrate them into the IT infrastructure where the outcomes can easily flow into the finger-tips of the decision makers. At the same time, the accelerating growth rate of data collected implies that only the most scalable database architectures will be able to meet storage, and more importantly, processing requirements.

In the era of big data, more and more organizations are turning to the scalable architecture of Hadoop to meeting this growing challenge. To bring the power of predictive models into this architecture, Software AG and Datameer<sup>®</sup> have joined forces to deliver the ZEMENTIS Predictive Analytics (ZEMENTIS) for Datameer<sup>®</sup>. ZEMENTIS offers Datameer<sup>®</sup> users the best combination of open standards and scalability for the application of predictive analytics. With the Predictive Modeling Mark-up Language (PMML) as the bridge between the model development environment and the IT data warehousing infrastructure, ZEMENTIS for Datameer<sup>®</sup> offers standards-based deployment of predictive models and execution on a highly scalable analytics platform. This joint solution combines the power of ZEMENTIS Predictive Analytics server, the flagship product of Software AG, with that of Datameer<sup>®</sup>, the only analytics application natively built on Hadoop. As a result, a wide range of predictive models, possibly developed with different tools in different environments, can fully leverage the scalability and flexibility of Hadoop to bring game changing data integration and analytics to end users. Practically, PMML becomes yet another analytical function available in Datameer<sup>®</sup> offering execution performance that can meet the volume and performance requirements of the most demanding environments.

This document serves as a guide for installing and using ZEMENTIS for Datameer<sup>®</sup>. It first gives a brief overview of the plug-in. It then presents the simple installation process. Finally, it illustrates the use of ZEMENTIS with two PMML models showing how to upload, deploy and score them using ZEMENTIS for Datameer<sup>®</sup>.

#### Note

With respect to the EU General Data Protection Regulation (GDPR), our product does not collect or store any personally identifiable information. However, as the input data might contain sensitive personal information, please anonymize any such data to ensure that the processing of personal data is in accordance with the GDPR.

### **Chapter 2. Overview**

### 2.1. Predictive Model Markup Language (PMML)

As the de-facto standard for data mining models, PMML provides tremendous benefits for business, IT, and the data mining industry in general. Developed by the Data Mining Group (DMG), an independent, vendor-led consortium, PMML increases business agility by eliminating the need for proprietary solutions or custom code development.

Today, it is supported by all major data mining tools, commercial and open source. As an open standard, it enables project stakeholders to standardize on one common representation for data mining models. It practically eliminates the barriers and gaps between development and production deployment of predictive analytics. In effect, it minimizes the complexity, cost, and time to turn predictive models into operational IT and business assets.

As the lingua franca for predictive analytics, data mining models can be easily exchanged between PMML-compliant applications. In this way, a model may be built in one statistical tool and easily moved to another for production deployment or visualization. PMML also serves as a bridge between all the teams involved in the data mining process inside a company since it can be used to disseminate knowledge and best practices, thereby stimulating cross-team and inter-organizational collaboration. In a world in which data-driven decisions are becoming more and more pervasive, predictive analytics and standards such as PMML make it possible for organizations to benefit from smart solutions that will truly revolutionize their business.

Besides offering a rich set of structures for describing all the intricate details of a predictive algorithm, PMML also provides information about the inputs and outputs of a model. This includes names and types of all input and output data fields, often along with the set of permissible values. In addition, a model expressed in PMML typically includes information about how to handle invalid or missing input values.

#### Note

A variety of sample PMML models are included with the ZEMENTIS distribution package. In addition, a wealth of resources on PMML can be found from the PMML in Action.

### 2.2. ZEMENTIS Predictive Analytics (ZEMENTIS)

ZEMENTIS enables execution of standards-based predictive analytics directly within Datameer<sup>®</sup>. It shares the PMML execution core with the ZEMENTIS server offered by Software AG.

In addition, the plug-in takes on the responsibility of bridging the PMML and the Datameer<sup>®</sup>/Hadoop world. This means that it presents each loaded PMML model as a Datameer<sup>®</sup> function. The name, input arguments and outputs

of each function match the name, input fields, and output fields of the corresponding model as defined in the PMML file. This way, scoring a data set requires nothing more than invoking the analytics function correspondent to the appropriate predictive analytics model. Predictions (scores, probabilities, categories, clusters, etc.) can be just as easily become part of further analytics inspection, or plotted with the use of dashboards.

Like the ZEMENTIS server, ZEMENTIS plugin accepts PMML models of all versions (2.0, 2.1, 3.0, 3.1, 3.2, 4.0, 4.1, 4.2 and 4.3) generated by any of the major commercial and open source data mining tools.





At a high level, the process of using PMML models in Datameer<sup>®</sup> is presented in Figure 2.1. It starts after the predictive models have been created and have been exported in PMML format from the data mining and model development tool. With the PMML files at hand, all it takes is to upload and deploy them into ZEMENTIS for Datameer<sup>®</sup> where they are translated into functions.

The plug-in supports a wide range of PMML elements that implement the following predictive analytic techniques:

- Decision Trees for classification and regression
- K-Nearest Neighbors for regression, classification and clustering
- Neural Network Models: Back-Propagation, Radial-Basis Function, and Neural-Gas

- Support Vector Machines for regression, binary and multi-class classification
- Linear and Logistic Regression (binary and multinomial)
- Naïve Bayes Classifiers
- General and Generalized Linear Models
- Cox Regression Models
- Rule Set Models (flat decision trees)
- Clustering Models: Distribution-Based, Center-Based, and 2-Step Clustering
- Scorecards (including reason codes and point allocation for complex attributes)
- Association Rules (mining schema attribute usageType = "group" is not supported)
- Model Segmentation
- Model Ensemble (including Random Forest Models)
- Model Composition and Chaining

In addition, it implements all the PMML built-in functions and transformations for data pre- and post-processing.

#### Note

Note that in addition to association rules which use usageType = "group", ZEMENTIS for Datameer<sup>®</sup> does not currently support time series, text models, and sequence models.

### **Chapter 3. Installation**

This section describes how to install the ZEMENTIS for Datameer<sup>®</sup>.

### 3.1. Requirements

In order to install ZEMENTIS for Datameer<sup>®</sup> on your system, you will need an existing Datameer<sup>®</sup> installation. Uploading new PMML models with ZEMENTIS for Datameer<sup>®</sup> requires a valid Product License Key which can be obtained by contacting Software AG.

### 3.2. Packaging

ZEMENTIS for Datameer<sup>®</sup> is distributed as a compressed archive file: uppi-datameer6-10.3.0.1.zip. The distributed package consists of several files, including this documentation and several sample files. When uncompressed, the package reveals a number of directories as described in Table 3.1.

Directory	Contents
docs	Documentation in HTML and PDF format.
pmml	A number of sample PMML files along with data files in CSV format. These include the examples described in this document.
classes, lib	Runtime code and library used by ZEMENTIS for Datameer <sup>®</sup> .
license	License information for ZEMENTIS and 3rd party libraries.

#### Table 3.1. Directory Structure of the ZEMENTIS for Datameer<sup>®</sup> package.

### 3.3. New Installation

To install ZEMENTIS for Datameer<sup>®</sup> navigate your browser to "Administration" tab and select "Plugins" option from left-side menu. On the bottom of the page you will find "Upload Plug-in" panel. Click on "Choose File" button, select uppi-datameer6-10.3.0.1.zip file, and click on "Upload" button. If installation was successful, a green message box will be displayed, and if it failed, a red message box will be displayed. Also, on the same page in the "Plug-ins" panel which displays table of all installed plugins you will find new row entry with "ZEMENTIS Plug-In" in "Name" column. Lastly, place the Product License Key file, zementis.license, in the Datameer<sup>®</sup> root directory. Please note that execution of existing models will not be interrupted when the license expires.

#### Note

Note that if you have installed Datameer<sup>®</sup> in a computer running Mac OS X, you will need to right-click on top of the Datameer<sup>®</sup> application package and choose "Show Package Contents" in order to have access to its directory structure.

Once the ZEMENTIS for Datameer<sup>®</sup> is installed, you can go ahead and upload and deploy your predictive models. This is described in Chapter 4.

### 3.4. Upgrade Installation

Upgrading existing ZEMENTIS for Datameer<sup>®</sup> installation involves few steps to ensure that Datameer<sup>®</sup> worksheets with currently deployed PMML functions will remain operational with newer version of ZEMENTIS for Datameer<sup>®</sup>. First, you have to make sure that copies of all PMML files corresponding to PMML functions are backed up and available for re-upload. If this is the case, remove all PMML functions using ZEMENTIS configuration interface. Details on PMML function removal and deployment operations can be found in Chapter 4. Next, remove ZEMENTIS for Datameer<sup>®</sup> by navigating to "Administration" tab, selecting "Plugins" option from left-side menu, and then clicking on thrash icon in "ZEMENTIS Plug-In" entry of "Plug-Ins" panel. Install new ZEMENTIS for Datameer<sup>®</sup> by uploading uppi-datameer6-10.3.0.1.zip file through "Upload Plug-in" panel at the bottom of the same page. Finally, restore all PMML functions by uploading each PMML file using ZEMENTIS configuration interface.

### Chapter 4. From PMML to Datameer<sup>®</sup>

This section will describe in detail how PMML models are made available to be used directly in Datameer<sup>®</sup>. As explained earlier, ZEMENTIS turns predictive models into functions which can be readily used from inside Datameer<sup>®</sup> as any other function available through the "Formula Builder".

### 4.1. Configure ZEMENTIS for Datameer<sup>®</sup>

To make your PMML models available in Datameer<sup>®</sup>, go to the "Administration" tab and select the "Plug-ins" option from the left-side menu. In the table of available plug-ins, locate the ZEMENTIS Plug-In and click on the "Configure" hyperlink. Once you do that, you will be faced with a screen as shown in Figure 4.1. It is here that you will upload and deploy your PMML models.

#### Figure 4.1. Configure ZEMENTIS for Datameer<sup>®</sup>

III File Browser	+ 💽 Admin
Datameer View Help	
System Dashboard	Configure ZEMENTIS Plug
Job History	New PMML Function
Authentication	Browse No file se
Groups	
Roles	Upload
Users	
Mail Server	
Hadoop Cluster	
Cluster Health	
Database Drivers	
Plug-ins	
License	

In this section, we describe the process of uploading and deploying PMML files in ZEMENTIS for Datameer<sup>®</sup>. These files represent two distinct predictive models.

The first model is a Support Vector Machine (SVM) trained with the Audit dataset. This model will produce a single output field which will contain "0" in case the taxpayer's claim does not need to be adjusted or "1" in case it does. The audit dataset is supplied as part of the R Rattle package - http://rattle.togaware.com (it is also available for download as a CSV file from http://rattle.togaware.com/audit.csv). It consists of fictional clients who have been audited, perhaps for tax refund compliance. For each case an outcome is recorded (whether the taxpayer's claims had to be adjusted or not).

The second model is a Neural Network (NN) model trained with the Iris dataset. This model will produce four output fields, the class or type of Iris plant (setosa, virginica, or versicolor) with the computed probabilities for the three

different flower types. The Iris dataset is perhaps the best known dataset to be found in the pattern recognition literature. It contains three classes representing different types of the Iris plant. Each class is represented by 50 records. For more information on the Iris dataset, please check the Iris page at the UCI Repository of Machine Learning Databases - http://archive.ics.uci.edu/ml/datasets/Iris (Asuncion, A. and Newman, D.J. (2007). UCI Machine Learning Repository. Irvine, CA: University of California, School of Information and Computer Science).

To make the Tax Audit SVM model available in Datameer<sup>®</sup>, simply click on the "Choose File" button and locate the corresponding PMML file, and click on the "Upload" button. Once the file is uploaded and model is successfully deployed, you should see the screen as shown in Figure 4.2. You can inspect PMML file for warnings highlighted in green by scrolling down text in the window under "Annotated PMML source" heading. Clicking "Clear" button causes this message panel to revert back to PMML file upload panel.



#### Figure 4.2. Uploading the Tax Audit SVM Model to Datameer<sup>®</sup>

You can view a list of all deployed PMML functions under "PMML Functions" section. It contains expandable bars, each with function name on the left and delete button on the right. You can view parameters used by each model, such as list of inputs and outputs, by clicking on expandable bar or by clicking "Expand All" checkbox. The function name corresponding to a PMML file is derived from the PMML attribute "modelName". The input parameters reflect all the input fields necessary for the model to be executed. In case of the Tax Audit SVM model, these are:

"Age", "Employment", "Education", "Marital", "Occupation", "Income", "Sex", "Deductions", and "Hours". The output parameters represent fields that the model returns as output. For the Tax Audit SVM model, the output parameter is field "predictedValue\_Adjusted". The details of Tax Audit SVM model are shown in Figure 4.3,

	•		
Datameer View Help			
lystem Dashboard	Configure ZEMENTIS Plug-in		
ob History	New PMML Function		
Authentication			
Groups	Browse No file selecte	d.	
Roles	Lipland		
1	Opload		
Isers			Expand All
Aail Server			
ladoop Cluster	TAXAUDIT_SVM		
Juster Health			Delete
Database Drivers	Function Name:		
Rug inc	TAXAUDIT_SVM		
nughns	Input Parameters:		
lcense	1. Age	Integer, Float	
	2. Employment	String	
	3. Education	String	
	4. Marital	String	
	6 Income	Integer Float	
	7. Sex	String	
	8. Deductions	Integer, Eloat	
	9. Hours	Integer, Float	
	Output Parameters:		
	1 predictedValue Adjusted	String	
	T. predicted value_Aujusted	oung	

#### Figure 4.3. Viewing Tax Audit SVM Model Details

If you try to upload and deploy a model in ZEMENTIS for Datameer<sup>®</sup> that has already been uploaded, you will get an error notifying you that a Datameer<sup>®</sup> function with the same name already exists as shown in Figure 4.4. To avoid such an error, we recommend you delete the existing model before attempting to upload the new one.

#### Note

ZEMENTIS will also notify you of any errors if the PMML file you are trying to upload has any errors. In that case, we recommend you correct the issue(s) pointed out and upload the model again.

#### Figure 4.4. Configuration error in Datameer<sup>®</sup>

Datameer View Help			
Jystem Dashboard	Configure ZEMENTIS Plug-in		
lob History	New PMML Function		
Authentication			
Groups	Browse No file selecte	d.	
Roles	Function TAXAUDIT_SVM alread	y exists	
1	Upload		
Jsers			
Aail Server			Expand All
Hadoop Cluster	▼ TAXAUDIT_SVM		
Cluster Health			
Database Drivers	Function Name:		Delete
Plug-ins	TAXAUDIT_SVM		
icense	Input Parameters:		
	1. Age	Integer, Float	
	2. Employment	String	
	3. Education	String	
	4. Marital	String	
	6. Income	Integer. Float	
	7. Sex	String	
	8. Deductions	Integer, Float	
	9. Hours	Integer, Float	
	Output Parameters:		
	1. predictedValue_Adjusted	String	
			Save

To make the Iris NN model available in Datameer<sup>®</sup>, select the corresponding PMML file and click on the "Upload" button. Once the file is uploaded and model is successfully deployed, you should see a successful upload panel with the annotated source. After clicking on "Clear" button on the upload panel, you should see the screen as shown in Figure 4.5.

Figure 4.5. Uploading the Iris NN Model to Datameer<sup>®</sup>

n File Browser	+ (2) Admin		
Datameer View Help			
System Dashboard	Configure ZEMENTIS Plug-in		
Job History	New PMML Function		
Authentication			
Groups	Browse No file selec	:d.	
Roles	Upload		
Users			
Mail Server			Expand All
Hadoop Cluster	▼ IRIS_NN		
Cluster Health			Delete
Database Drivers	Function Name:		
Plua-ins	IRIS_NN		
License	Input Parameters:		
Liconac	1. sepal_length	Integer, Float	
	3. petal length	Integer, Float	
	4. petal_width	Integer, Float	
	Output Parameters:		
	1 0000	String	
	2. Probability setosa	Float	
	3. Probability versicolor	Float	
	4. Probability_virginica	Float	
	► TAXAUDIT_SVM		
			Save

To continue uploading and deploying models in ZEMENTIS for Datameer<sup>®</sup> simply repeat the process described above. There is no limit to the number of models that can be uploaded. However, we recommend you delete models whenever they are no longer required. You can do that by clicking on "X" button located on the right side of each PMML function bar as shown in the screenshots above.

#### Note

Note that models are listed in alphabetical order in Datameer<sup>®</sup>, not the order in which they were uploaded. In this case, even if the Iris NN model had been uploaded first, it would still be shown after the Tax Audit SVM model.

Let's now consider a case where the PMML file for the Iris NN model had an error which could not be corrected automatically by ZEMENTIS when uploading the model. In this case, the model would not be deployed and instead you would get an error stating that the PMML file was not valid, as shown in Figure 4.6.

#### Figure 4.6. Error during model deployment

New PMML Function       ntication       s       Annotated PMML source:       Annotated PMML source:       Annotated PMML source:       Prver       ip Cluster       op Cluster       erver       p Cluster       op Cluster
Annotated PMML       erver       >p Cluster       <
Ps     No valid models were found in the provided file       Annotated PMML source:       s       s       s       server       vop Cluster       vop Cluster       vom Cluster       v
Annotated PMML source: Annotated PMML source: Annotated PMML some source: Server Server Server Sop Cluster Sop Cluster Server Sop Cluster Server S
Annotated PMML <pre>c?xml version="1.0" encoding="UTF-8"&gt; </pre> <pre>c?xml version="4.0" encoding="UTF-8"&gt; </pre> <pre>c?xml version="4.4"; "version="4.4"; "version="4.4"</pre>
Annotated PMML        Server        op Cluster        Op Cluster <t< td=""></t<>
Server     <(Comment generated by ÅDAPA) There is at least 1 error in this PMML document.
Op Cluster         Detailed information can be found as comments embedded in the appropriate locations within this document>           op Cluster <pmiml ;="" version="4.4" visitschemal.coation="http://www.dmg.org/PMIML-4_4 http://www.dmg.org/V4-4/pmml-4.4.xsd" xmins:xsl="http://www.dmg.org/PMIL-4_4">           op Cluster         <pmiml ;="" version="4.4" visitschemal.coation="http://www.dmg.org/PMIL-4_4">           version="4.4" version="4.4"; visitschemal.coation="http://www.dmg.org/PMIL-4_4"&gt;           <pmiml ;="" version="4.4" visitschemal.coation="http://www.dmg.org/PMIL-4_4"> <pmiml ;="" <="" td="" version="4.4" visitschemal.coation="4.4"> <patient ;="" td="" version="4.4" visitschemal.coati<="" visitschemal.coation="4.4"></patient></pmiml></pmiml></pmiml></pmiml></pmiml></pmiml></pmiml>
Op Cluster     op Cluster       op Cluster
ter Health <pre></pre> <pre><!--</td--></pre>
See     S
<datafield datatype="double" name="output2" optype="continuous"></datafield>
Se
ISE <pre></pre>
<apply function="zeme1:func1"> &lt;(comment consected by ADAPA) From: Function "zeme1:func1(double" is not defined&gt;</apply>
<fieldref field="input"></fieldref>
<kejressionmodel functionivame="regression" modelivame="simple_kegression_U"></kejressionmodel>
Allining Field name="output2" usagitype="predicted"/>
<output></output>
OutputField feature="predictedValue" name="predictedValue_output2" dataType="double" optype="continuous">
(Comment generated by ADAPA) Modification: Renamed [field] attribute from [output2] to [predictedValue_output2]
Clear

Before a PMML file is deployed in ZEMENTIS for Datameer<sup>®</sup>, it is checked for syntactic and semantic problems. During this process, it may encounter errors, which prevent a model from being deployed, and/or minor issues which are reported as warnings. Errors and warnings are embedded into the uploaded PMML file and can be viewed in the configuration panel after model upload is complete. PMML models with errors are also available for inspection in Datameer<sup>®</sup> as part of the application log file and can be accessed through the "System Dashboard" as shown in Figure 4.7.

#### Figure 4.7. Inspecting errors and warnings

Datameer View Help													
System Dashboard	Job Sch	heduler											
Job History	JC 📎	ob scheduler is currentl	ly running. Press 'Pause' if you	I want to stop it from submitting ne	ew jobs to the cluster.		Pause						
Authentication		Auto compaction is turned on. Datameer will auto compact small files in the background. Press 'Pause' if you want to stop it from Pause     Pause											
Groups													
Roles													
Users	Running	g Jobs											
Mail Server	ID	Job Name	Triggered by	Started on	Estimated Finish	Progress	Abort						
Hadoop Cluster													
Cluster Health													
Database Drivers													
Database Drivers Plug-ins													
Database Drivers Plug-ins License													
Database Drivers Plug-ins License													
Database Drivers Plug-ins License													
Database Drivers Plug-ins License	Applied	ting I on											
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Database Drivers Plug-Ins License	Applica	tion Log Show 1000 1005 J WARN [2018-06-27	recent lines 15:53:25.180] [F1r 15:53:09.982] [qtp1496	Halizer∫ (U†S⊦ileStore.jaVa 724653-22) (UPPIPreferencef	:168) - Closing u Page.java:194) - (	nclosed file sto Got uploaded fil	re tile:/op e Simple Re						
Database Drivers Plug-Ins License	Applica [anonym [admin] [admin] [admin]	tion Log Show 1000 INFO [2018-06-27 ERROR [2018-06-27 ERROR [2018-06-27	▼ recent lines 16-27 15:51:25.180] [F1r 15:53:09.982] [qtp1496 15:53:10.134] [qtp1496 ing="UTF-8"?>	alizerj (UfsFileStore.java 724653-22] (UPPIPreferencef 724653-22] (PmmlPlugin.java	:168) - Closing u Page.java:194) - a:291) - Annotate	nclosed file sto Got uploaded fil d PMML	re tile:/op e Simple_Re						
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#### Note

Note that even though a model may be deployed with no errors, ZEMENTIS may still find minor issues with the PMML code that are reported as warnings. Though these warnings typically do not impact the scoring process, they should be reviewed by the data science team.

### Chapter 5. Scoring Models in Datameer<sup>®</sup>

This chapter describes the process of executing predictive models in Datameer<sup>®</sup>. Models can only be executed if they have already been uploaded and deployed in ZEMENTIS for Datameer<sup>®</sup>. This process is described in Chapter 4.

Once a predictive model is uploaded and deployed in ZEMENTIS for Datameer<sup>®</sup>, it becomes yet another function available through the "Formula Builder". To access the formula builder wizard, you will need to create a "Workbook" and import your data into it. The formula builder will be shown whenever you click on an empty cell. Given that we have already uploaded the PMML files for models Tax Audit SVM and Iris NN, these are shown as two distinct functions under the PMML function class as shown in Figure 5.1.

#### Figure 5.1. Datameer<sup>®</sup> Formula Builder

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### 5.1. Scoring Models with a single output

To create formula for Tax Audit SVM, simply select the TaxAudit\_SVM function in the wizard. Once you do that, it will expand to show all the input arguments required for scoring the Tax Audit SVM model as depicted in Figure 5.2.

Figure 5.2. Scoring the Tax Audit SVM Model in ZEMENTIS for Datameer<sup>®</sup>

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To select the appropriate data columns for the input arguments in the wizard, simply click on any data cell for the column you would like to select. Datameer<sup>®</sup> automatically assumes the next selection you make is for the next argument in the formula wizard. After all entries have been mapped accordingly, as shown in Figure 5.3, simply click the "OK" button.

#### Figure 5.3. Tax Audit SVM Model inputs

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25	25	23	Private	Yr11	Unmarried	Profession	260,405.44	Male	0.0	35	0				
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The preview of predicted values will be shown in the column for which the formula wizard was invoked in the first place. In this case, column "A" in worksheet "Result" that was manually renamed to "Adjusted", contains predicted values. For the Tax Audit SVM model, they will contain "0" in case the taxpayer's claim does not need to be adjusted or "1" in case it does. Scoring results are shown in Figure 5.4. After saving our workbook, scoring can be fully processed simply by executing workbook job.



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### **5.2. Scoring Models with Multiple Outputs**

You can use the same process for scoring the Iris NN model. Besides the predicted value "class", this model also outputs probabilities for each of the three possible classes: setosa, virginica, and versicolor, as described in Chapter 4. For ZEMENTIS for Datameer<sup>®</sup> to be able to return all four outputs, and not only the predicted value, make sure to add a "JSON\_OUTPUT" field at the bottom of the list of arguments in the formula wizard. You can do that by clicking the "+" icon next to the last entry. Then set the "JSON\_OUTPUT" to "true" as shown in Figure 5.5.

Figure 5.5. Scoring the Iris NN Model in ZEMENTIS for Datameer<sup>®</sup>

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15	15	5.8	4.0	1.2	0.2	ext Mining - Part of Speech Tanging	Top Values Count
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17	17	5.4	3.9	1.3	0.4	RIS_NN: The PMML model IRIS_NN [Function: Classification, Technique: BackPropagationNetwork]	with FLOAT type data.
18	18	5.1	3.5	1.4	0.3	RIS_NN Online Documentation and Samples	
19	19	5.7	3.8	1.7	0.3	raumentes	
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Once you click on the "OK" button, ZEMENTIS for Datameer<sup>®</sup> will show the preview of the output from the Iris NN model. In our example, the outputs will be written to column "A" of "Result" worksheet as shown in Figure 5.6. In order to separate out a particular output, invoke the "Formula Builder" once again and select function "JSON\_VALUE" under "text". Once you do that, the formula wizard will expand to show two arguments: "JSON Array" and "JSON Key". The first, "JSON Array" needs to be mapped to the "JSON\_OUTPUT" which is available in column "A". The second argument, "JSON Key" needs to be populated with the output of interest which, in our example, is "Probability\_setosa".

Figure 5.6. Multiple outputs with JSON\_OUTPUT

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8	{"class":"Iris-setosa"	,"Probability_s	etosa																
9	{"class":"Iris-setosa"	,"Probability_s	etosa	Arguments:															
0	{"class":"Iris-setosa"	,"Probability_s	etosa	JSON Object *		Abe	#IRIS_NN	output		+	- n								
1	{"class":"Iris-setosa"	,"Probability_s	etosa	JSON Key *		Abs	Probability	setosa		-									
2	{"class":"Iris-setosa"	,"Probability_s	etosa	* required							L	/							
3	{"class":"Iris-setosa"	,"Probability_s	etosa																
4	{"class":"Iris-setosa"	,"Probability_s	etosa						Cano	el	ок								
5	{"class":"Iris-setosa"	,"Probability_s	etosa																
6	{"class":"Iris-setosa"	,"Probability_s	etosa"	:0.9980857500904449,*	Probability_v	vers 0.	99808575	00904449											
7	C																		
wo	ing 150 sample rows. Run wo	rkbook for full resul	ts.																

By clicking on the "OK" button, the probability for class "Iris\_setosa" is then extracted from column "A" and copied to column "B", later manually renamed to "Probability\_setosa", as shown in Figure 5.7. Note that the same process could be used to extract the predicted class as well as any of the other class probabilities. After saving our workbook, scoring can be fully processed simply by executing workbook job.

#### Figure 5.7. Selecting a specific output with JSON\_VALUE

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fx	JSON_VAL	UE(#IRIS_N	N_outp	out;"Probability_	setosa")																					
	IRIS_NN_ou	tput									P	robability	setosa		c		0		Е		F	# Probab	ility_set	tosa		
1	{"class":	'Iris-set	osa",'	"Probability_	setosa'	:0.99	95535104	1664939,	"Probabili	ty_ver	rs 0.	. 9995535	10466493	9								1				_
2	{"class":	Iris-set	osa",	"Probability_	setosa'	:0.99	85890830	740689,	"Probabili	ty_ver	rs 0.	. 9985898	83074068	9								Rows with	values:	150	100%	
3	{"class":"Iris-setosa","Probability_setosa":0.9993451737365701,"Probability_vers 0.9993451737365701																	Empty rows: 0 0%								
- 4	{"class":	Iris-set	osa",'	"Probability_	setosa'	:0.99	90465573	3403722,	"Probabili	ty_ver	rs 0.	.9990465	57340372	2												
5	{"class":	Iris-set	osa",'	"Probability_	setosa'	:0.99	96235869	5906407,	"Probabili	ty_ver	rs 0	.9996235	86590640	7												
6	{"class":	Iris-set	osa",'	"Probability_	setosa'	:0.99	96197194	1537706,	"Probabili	ty_ver	rs 0.	.9996197	19453770	5												
7	{"class":	Iris-set	osa",'	"Probability_	setosa'	:0.99	9480340	2036508,	"Probabili	ty_ver	rs 0.	. 9994803	40203650	3								Most		a this cal		
8	{"class":	'Iris-set	osa",'	"Probability_	setosa'	:0.99	94531082	2205926,	"Probabili	ty_ver	rs 0.	. 9994531	08220592	5								MOSI				
9	{"class":	Iris-set	osa",'	"Probability_	setosa'	:0.99	85298814	1250959,	"Probabili	ty_ver	rs 0.	.9985298	81425095	9												
10	{"class":	Iris-set	osa",'	"Probability_	setosa'	:0.99	91086909	9148333,	"Probabili	ty_ver	rs., Ø.	. 9991086	90914833	3												
11	{"class":	Iris-set	osa",'	"Probability_	setosa'	:0.99	96231408	398418,"	Probability	_vers	si 0	.9996231	40898418									U				
12	{"class":	Iris-set	osa",	"Probability_	setosa'	:0.99	94576262	2357688,	"Probabili	ty_ver	rs 0.	. 9994576	26235768	3								۲	٩		0	•
13	{"class":	Iris-set	osa",'	"Probability_	setosa'	:0.99	89665623	3918703,	"Probabili	ty_ver	rs 0.	. 9989665	62391870	3								148	-		-	-
14	{"class":	Iris-set	osa",	"Probability_	setosa'	:0.99	9357922	7376493,	"Probabili	ty_ver	rs 0.	. 9993579	22737649	3								Unique	Min		Mean	Max
15	{"class":	Iris-set	osa",'	"Probability_	setosa'	:0.99	97247270	711801,	"Probabili	ty_ver	rs 0.	. 9997247	27071180	1								Top Value				Count
16	{"class":	Iris-set	osa",'	"Probability_	setosa'	:0.99	97569042	2129826,	"Probabili	ty_ver	rs 0.	. 9997569	04212982	5								Most				aunie
17	{"class":	Iris-set	osa",	"Probability_	setosa'	:0.99	96723735	5414267,	"Probabili	ty_ver	rs 0.	.9996723	73541426	7												
18	{"class":	Iris-set	osa",'	"Probability_	setosa'	:0.99	94920093	841163,"	Probability	vers	si 0.	. 9994928	09341163													
19	{"class":	Iris-set	osa",'	"Probability_	setosa'	:0.99	9572775	648317,	"Probabili	ty_ver	rs 0.	.9995727	75164831	7												
20	{"class":	Iris-set	osa",	"Probability_	setosa'	:0.99	9658591	5957626,	"Probabili	ty_ver	rs 0.	. 9996585	91595762	5												
21	{"class":	Iris-set	osa",'	"Probability	setosa'	:0.99	92636400	9136303,	"Probabili	ty_ver	rs 0.	. 9992636	40013630	3												
22	{"class":	Iris-set	osa",	"Probability_	setosa'	:0.99	95683113	3573995,	"Probabili	ty_ver	rs 0.	. 9995683	11357399	5												
23	{"class":	Iris-set	osa",'	"Probability_	setosa'	:0.99	9693888	648723,	"Probabili	ty_ver	rs 0.	. 9996938	88564872	3												
24	{"class":	Iris-set	osa",	"Probability_	setosa'	:0.99	82035289	470531,	"Probabili	ty_ver	rs 0	. 9982035	28947053	1												
25	{"class":	Iris-set	osa",	"Probability_	setosa'	:0.99	93372633	3200199,	"Probabili	ty_ver	rs 0.	. 9993372	63320019	9												
26	{"class":	Iris-set	osa",	"Probability_	setosa'	:0.99	80857500	904449,	"Probabili	ty_ver	rs 0.	. 9980857	50090444	)												
27			_			_	_			_	-															
Show	ng 150 samp	le rows. Ru	n work	book for full res	ults.																					
	>>I 🖬 Iri	s_NN_csv		fx Sheet1		+																				

Multiple outputs and output types will vary depending on the model type (e.g. SVM, NN, Regression, Decision Tree, Clustering, ...) and function the model implements (e.g. classification, regression, ...). Nonetheless, multiple outputs in PMML are represented in the element "Output". This element determines the types of outputs a model should provide after scoring. The code shown below depicts the "Output" element for the Iris NN model. Note that, as expected, it specifies four outputs, the predicted value "class" together with the three class probabilities.

```
<Output>
<OutputField name="class" dataType="string" optype="categorical"
feature="predictedValue"/>
        <OutputField name="Probability_setosa" value="Iris-setosa"
        dataType="double" optype="continuous" feature="probability"/>
        <OutputField name="Probability_versicolor" value="Iris-versicolor"
        dataType="double" optype="continuous" feature="probability"/>
        <OutputField name="Probability_virginica" value="Iris-virginica"
        dataType="double" optype="continuous" feature="probability"/>
        <OutputField name="Probability_virginica" value="Iris-virginica"
        dataType="double" optype="continuous" feature="probability"/>
        </Output>
```

For a list of forums covering PMML and ZEMENTIS products, please make sure to visit Zementis support site. If you need technical support, please visit Software AG support site.