

# Telecommunication Discovery – Visual Statistics

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## Script Format:

This script contains instructions for navigating the demo image, background information, and notes on the information being displayed. The symbols below are used throughout the script.

- Navigation Instructions (note that mouse clicks are left clicks unless otherwise specified)



*Background Information*



*Notes*

## Telecommunications Cross-sell and Up-sell Report:



The purpose of this demonstration is to give you a brief hands-on introduction and exposure to SAS Viya environment. This is a Viya demo for Telecommunication cross-sell and up-sell to improve revenue. This script is based on data collected from telecommunication systems for an imaginary firm. The script will walk you through the Discovery phase of the analytics life cycle.



## Log onto SAS Viya:

Using the logon provided in your welcome e-mail. Log into SAS Viya:



For this scenario, you are a data scientist working for a telecommunications firm. You have been asked to target customers for up-sell and/or cross-sell. You have been provided with usage data from a subset of customers who have contacted our customer care centers.

The analytics base table has been enhanced by adding cleansed demographics data, and is ready for use in analytics or reporting.



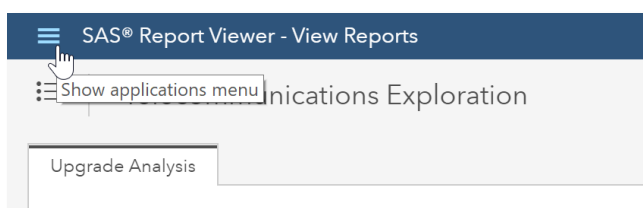
## Discovery:



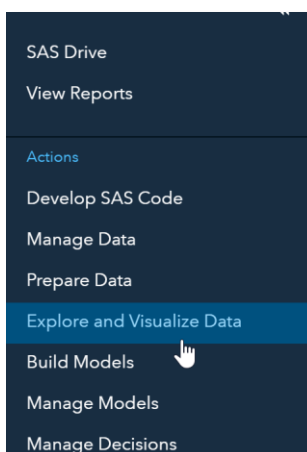
Our Telecommunications Company would like to improve revenue by cross-selling and up-selling to our current customers. Our Data scientist have been hard at work producing an analytical based table for further statistical analysis. We'll start exploring and visualize this data using SAS Viya to see if any issues materialize.

## Create a New Report:

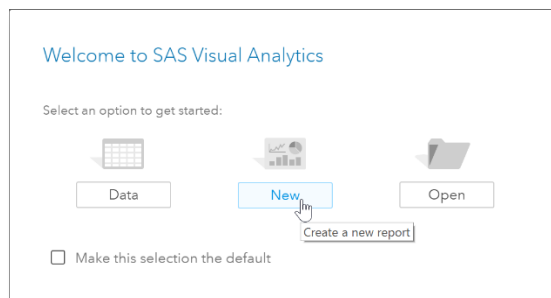
- Click on the **Show Applications Menu** icon on the top left of the screen.



- Click on the **Explore and Visualize Data** button.



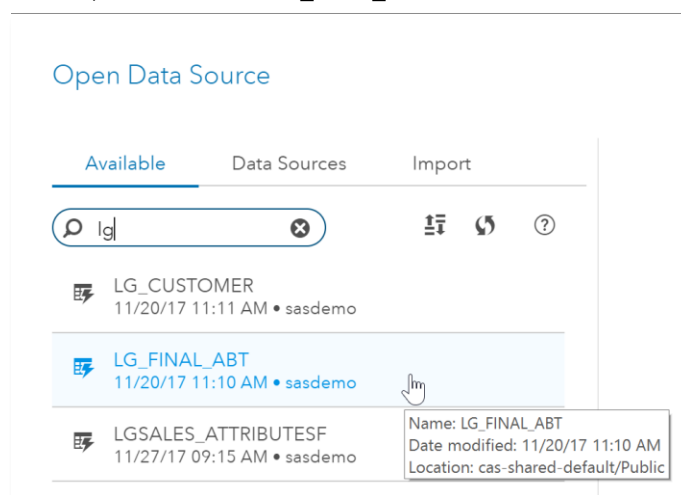
- Click on the **New** button.



- Click **Data** on the left-hand pane.

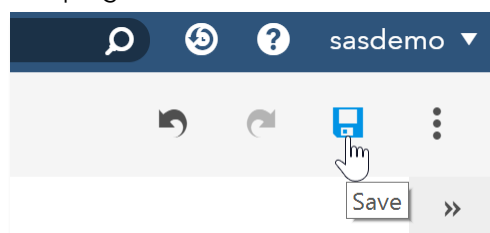


- Type **lg** in the search field, then click on **LG\_Final\_ABT**.



**Note:** If you do not see LG\_FINAL\_ABT in Available then it is not yet loaded. To load, click on **Data Sources**, double-click **cas-shared-default**, then double-click on **Public path**. Next, right-click on **LG\_FINAL\_ABT.sashdat** and select **Load**.

- Click **Ok**.
- Click on the save icon on the top right.



- Save the report as **VS Decision Tree Model** in the **My Folder** location. Click **Save**.

## Decision Tree:

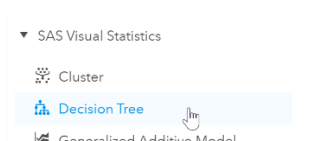


Let's first identify important attributes that are related to whether a customer of our company upgrades their service. To do this we'll create a decision tree visualization.

- Double click on **Page 1** tab and rename it to **Decision Tree Analysis**.

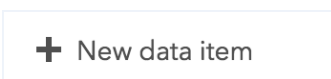


- From the left-hand pane, click **Objects**.
- Drag and drop a **Decision Tree** (found under SAS Visual Statistics) onto the page.

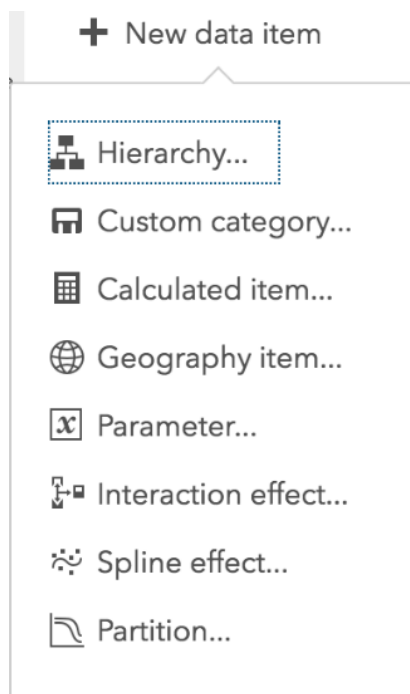


Before we start building our model let's partition our data so that we have data to train our model and data to validate it.

- From the left pane select **Data**.
- Click on **New data item** next to the dataset name.

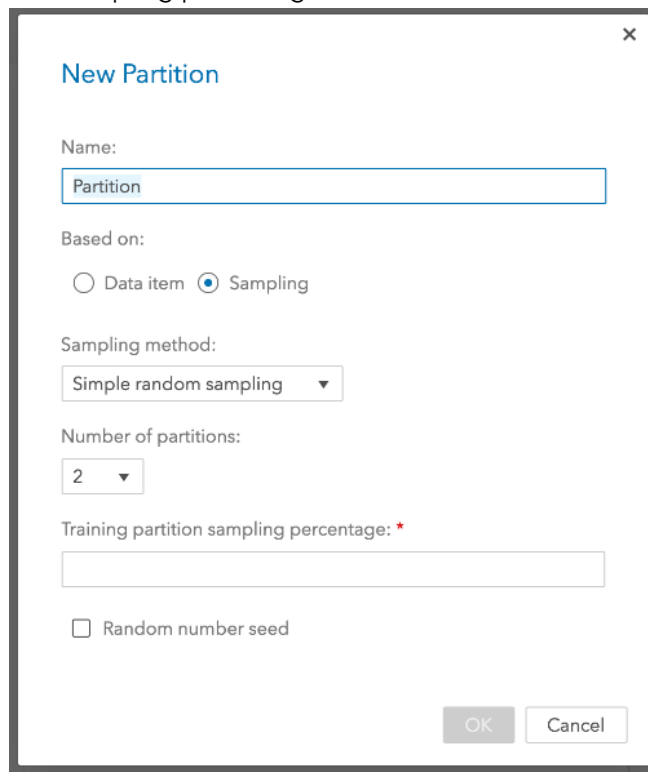


- Click **Partition...**



- Type **Partition** for the **Partition name**.

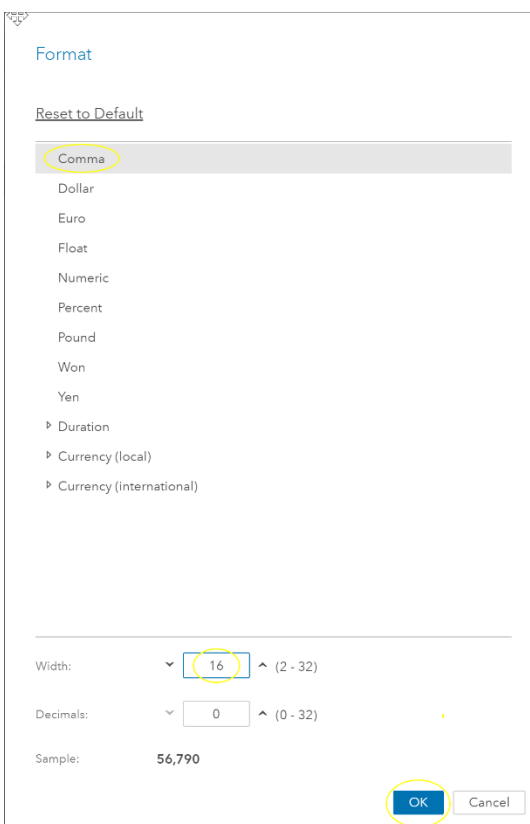
- For the training partition sampling percentage enter **70**.



The image shows a 'New Partition' dialog box with the following fields and options:

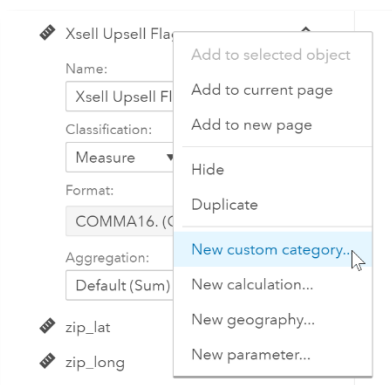
- Name:** A text box containing 'Partition'.
- Based on:** Two radio buttons: 'Data item' (unselected) and 'Sampling' (selected).
- Sampling method:** A dropdown menu showing 'Simple random sampling'.
- Number of partitions:** A dropdown menu showing '2'.
- Training partition sampling percentage: \*** An empty text box.
- ☐ Random number seed
- Buttons:** 'OK' and 'Cancel' at the bottom right.

- Click **Ok**.



Before we begin let's create a **Xsell Upsell Flag** Category to use in our analysis.

- From the left-hand pane, select **Data**.
- Right Click on **Xsell Upsell Flag**.
- Select **New Custom Category**.



- Type **Xsell Upsell Flag Category** for the name.
- Drag and Drop **0** under **Value Group 1**
- Double click **Value Group 1** and rename it to **Not Yet Upgraded**.
- Click the **+** to add a new value group.
- Drag and Drop **1** under **Value Group 1**.
- Double click **Value Group 1** and rename it to **Upgraded**.

- Click **OK**.

**New Custom Category**

Name:  Based on:  Group by:

Values of Xsell Upsell Flag

0 to 1

No items

Value Groups

- Not Yet Upgraded
- Upgraded

+ Click or drag values here to add a value group

Remaining Values:

☐ Show as missing ☒ Group as:

**OK** Cancel

Next, we'll add our Roles. Because we don't know which variables are important in predicting upgrade yet, we'll add many variables and use machine learning to tell us which ones are important.

- From the right pane, select **Roles**.
- Under **Response**, click **Add** then **Xsell Upsell Flag Category**.
- Under **Predictors**, click **Add** then select the following:



## ▼ Predictors

Acquisition Channel

Credit Class

Handset Mfg

Plan Life Stage

Plan Name

3M Avg Billed Data Usage

3M Avg Data Charges

3M Avg Overage Charges

3M Avg Premium Data Charges

3M Avg Revenue per User

6M Avg Billed Data Usage

6M Avg Billed Data Usage No...

6M Avg Minutes On Network ...

6M Avg Minutes Roaming No...

9M Avg Billed Data Usage

Account Tenure

Data Usage Amount

Data Usage Amt Tweedie Dist...

Last Call Satisfaction Rating G...

MB Data Usage 1 Mth Prior

MB Data Usage 2 Mths Prior

MB Data Usage 3 Mths Prior

MB Data Usage Roam 1 Mth P...

MB Data Usage Roam 2 Mths ...

MB Data Usage Roam 3 Mths ...

Minutes On Network Pct Cha...

Minutes Roaming Pct Change...

Minutes Total Pct Change Mo...

Plan Data MB

Premium Data Charges

Times Suspended Last 6M

Total Billed Data Usage

Total Calls Curr

Total Days Over Plan

Total MB of Data Usage

Total MB of Roam Data Usage

Total Number Contracts Lifeti...

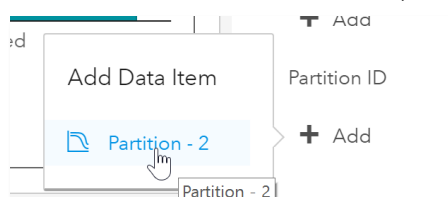
Total Overage Charges

Total Times Over Plan

Total Voice Billed Minutes of ...

Total Voice Charges

- Last, we'll add our **Partition** to **Partition ID**. Under **Partition ID**, click **Add** then **Partition**.

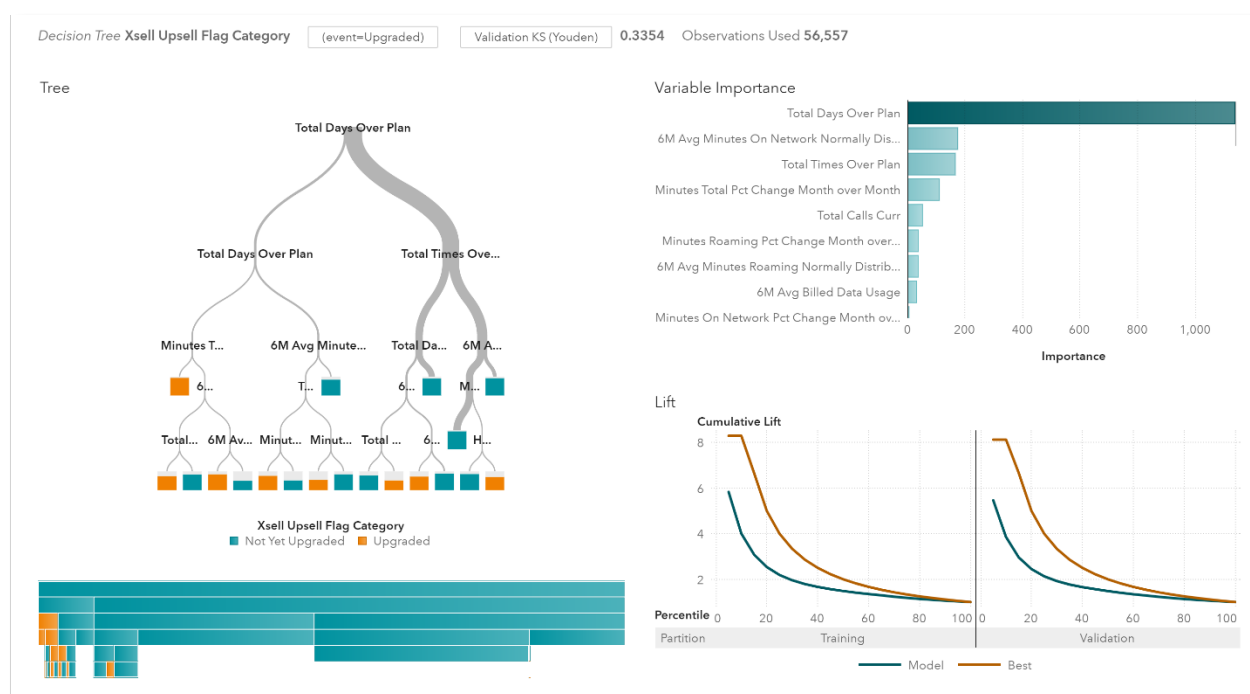




SAS Visual Statistics uses the C4.5 algorithm and the information gain criterion to select the attribute that's used to split the data recursively and then build a decision tree. Notice that SAS Visual Statistics quickly grows and prunes a decision tree. It also identifies which attributes are important in general and which attributes are not important to customer upgrades.

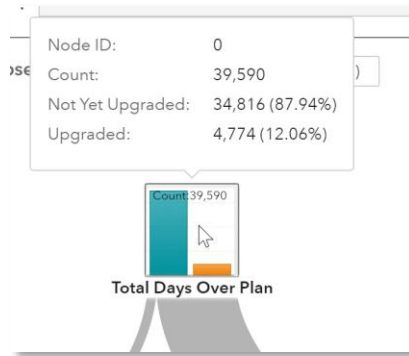
**Note:** Because our data was randomly partitioned, the following results may not be the same.

The **Variable Importance** plot ranks the attributes based on their contribution to the splits in the entire tree. If an attribute is used in an earlier split, it contributes more to the target variable. In this example, **Total Days Over Plan**, **6M Avg Minutes On Network Normally Distributed**, **Total Times Over Plan**, **Minutes Total Pct Change Month over Month**, **Total Calls Curr**, **Minutes roaming Pct Change Month over Month**, **6M Avg Minutes Roaming Normally Distributed** and **6M Avg Billed Data Usage** seem to be important variables in predicting whether a customer will upgrade or not.



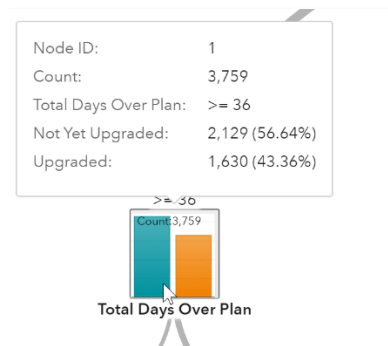
Let's zoom into this tree.

- Zoom into the tree by placing your mouse over the Tree chart and using the mouse wheel.
- Move the cursor over the first node.



Here we can see that 12% of our accounts have upgraded altogether. Let's look at the next node in the tree.

- Mouse over the second Node to the left.



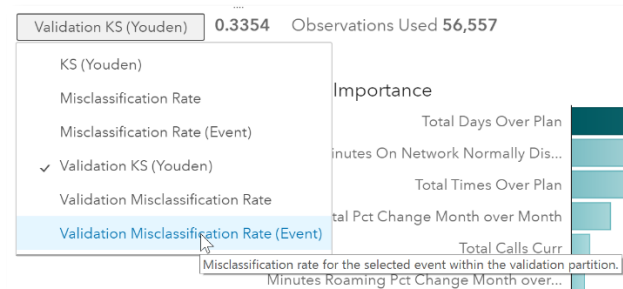
Here we see that 43% (1,630) of customers who were 36 days or more over their plan upgraded.

At the top of the chart you can see values that help you analyze your model. If you look at our KS value, 0.3354, it is not very high which indicates that this model may not be the best fit.

Decision Tree Xsell Upsell Flag Category (event=Upgraded) Validation KS (Youden) 0.3354 Observations Used 56,557

We can also change the statistic that we show.

- Click on **Validation KS (Youden)** and change it to **Validation Misclassification Rate (Event)**.

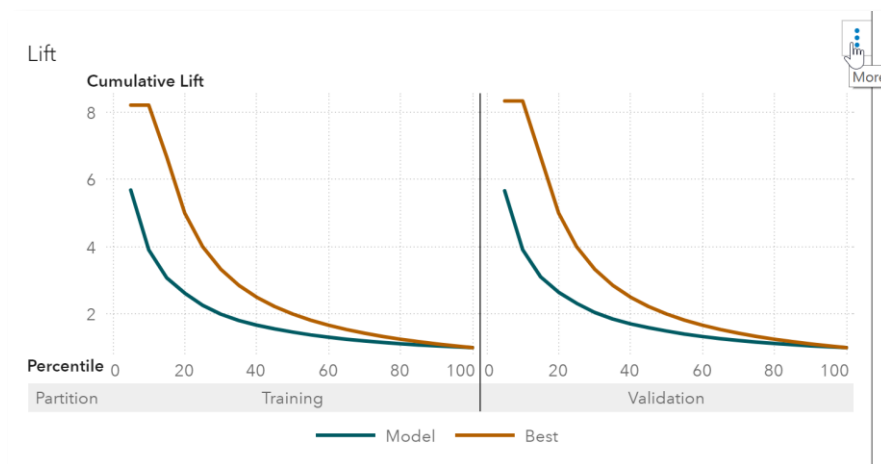


Our misclassification rate is 0.1051. This means that 10% of the time this model will misclassify our variable.

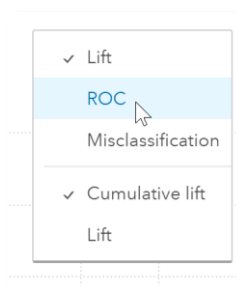


If you'd like to analyze your model further, SAS Visual Statistics provides several model assessment visualizations, such as the Lift chart, the ROC curve, and the Misclassification chart.

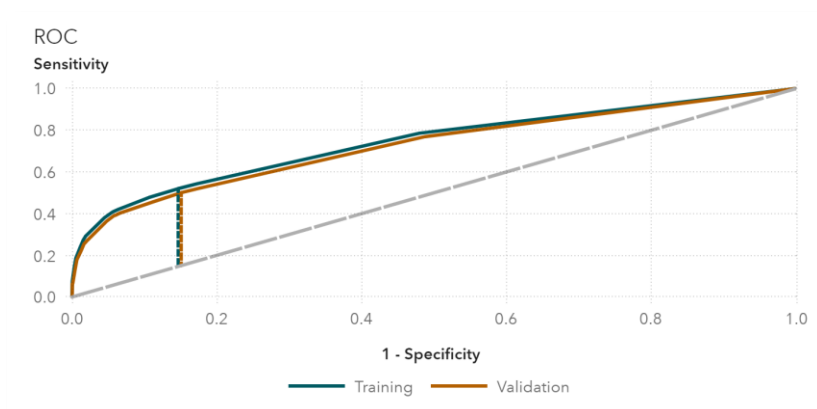
- Click on the three dots located on the upper right corner of the **Lift Chart**.



- Click on **ROC**.

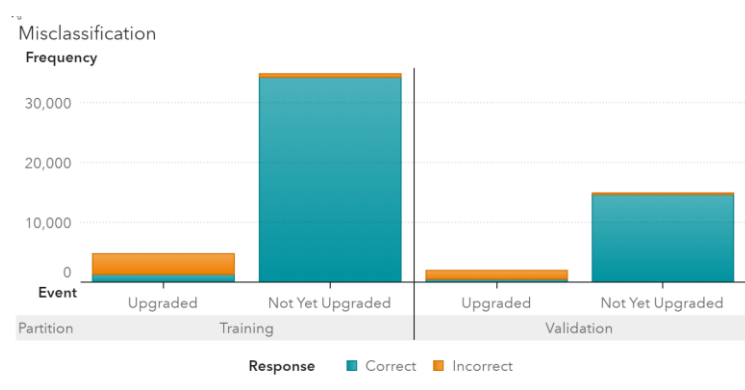


Here you can see our ROC Sensitivity chart.



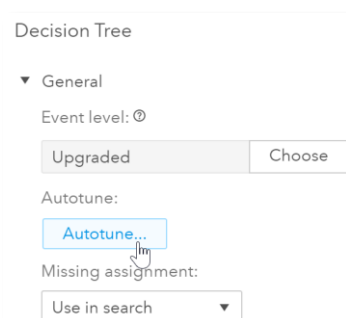
We can also see the misclassifications.

- Change the chart to **Misclassification**.



On the **Options** tab, you can see all the options you could modify for the decision tree. Let's click on the Autotune button and have the machine choose the best model.

- Click **Autotune**.





Notice the options for Autotune. You can enter the maximum number of seconds the computer spends computing our Maximum Iterations or Maximum evaluations. Due to time constraints, we will select 10 for the Maximum Seconds.

- Change the **Maximum Seconds** to **10**. Then click **Autotune**.

**Autotune Hyperparameters**

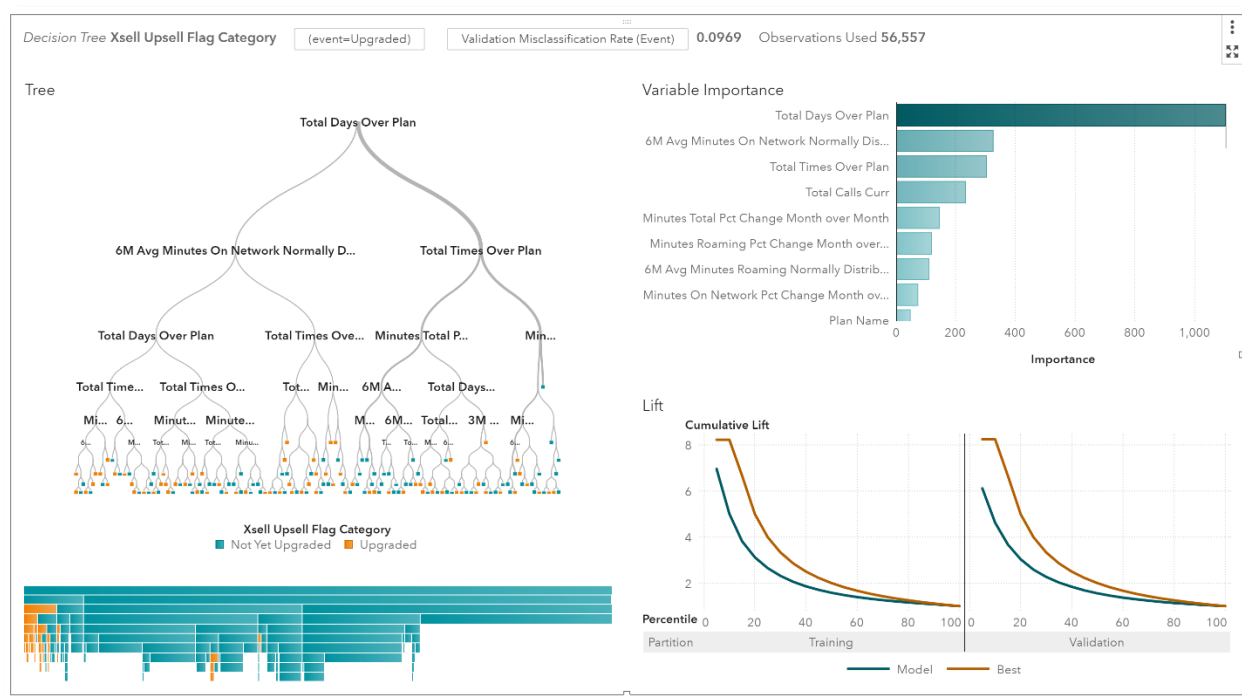
Maximum seconds:  
10

Maximum iterations:  
5

Maximum evaluations:  
50

Autotuning will select the optimal values for:  
Maximum levels  
Predictor bins

Autotune Cancel



Leaf size.

While this model has improved some, we could spend more time fine tuning it to see if we can make it more accurate. However, due to time constraints, we'll leave it as is. From the options tab on the right-hand pane, notice the maximum branches, Maximum Levels and

Growth strategy:  
Custom ▼

Maximum branches: ②  
2

Maximum levels: ②  
10

Leaf size: ②  
5

☒ Bin response variable

Predictor bins: ②  
20

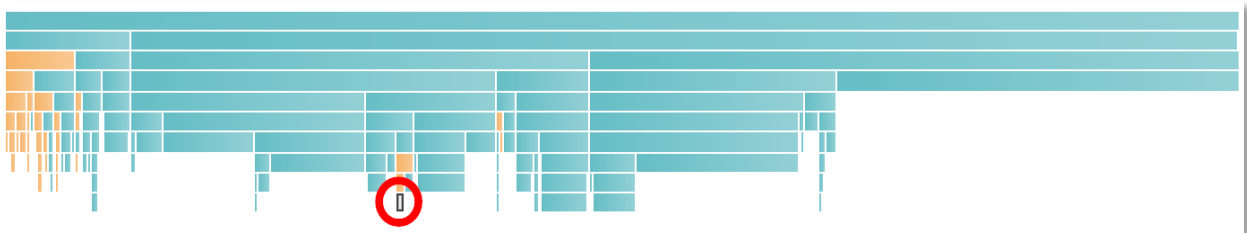
☐ Rapid growth ②

Pruning: ②  
75%

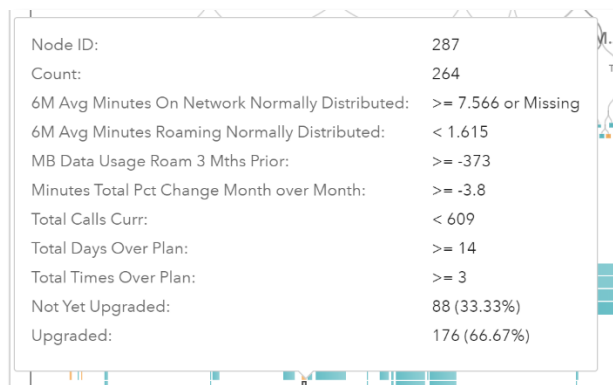
☒ Reuse predictors ②

The computer determined what values would work best for our model. Let's now scroll into our tree and see if we can find a segment that has a high percent of upgraded customers but still has some customers that haven't upgraded. We'll then target these customers for an upgrade.

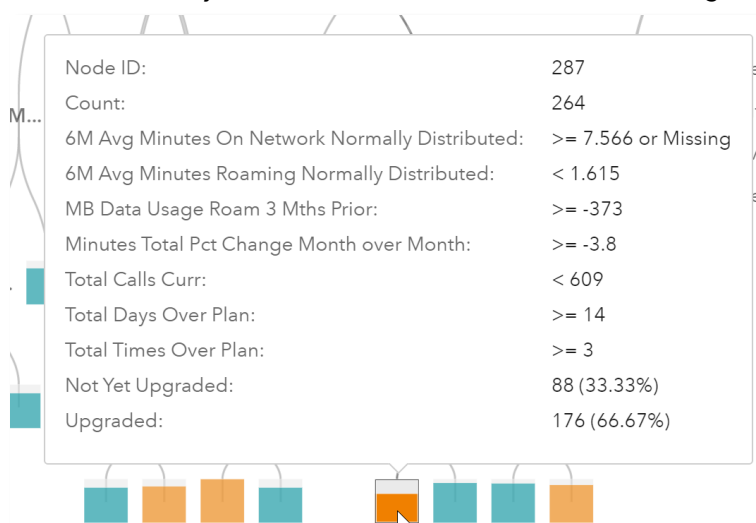
The color of the node in the icicle plot indicates the predicted level for that node. The size of the square indicates the number of records represented by that square. When you select a node in either the decision tree or the icicle plot, the corresponding node is selected in the other location. Let's find an ending orange node (i.e. no branches leading off it) that still has many customers who have not yet upgraded. If I use the icicle plot at the bottom I can see one segment that would be good to isolate for further analysis.



If I mouse over that box I can see all the business rules for that customer segment in our model.



Alternatively, you could zoom in on your decision tree and find a customer segment.



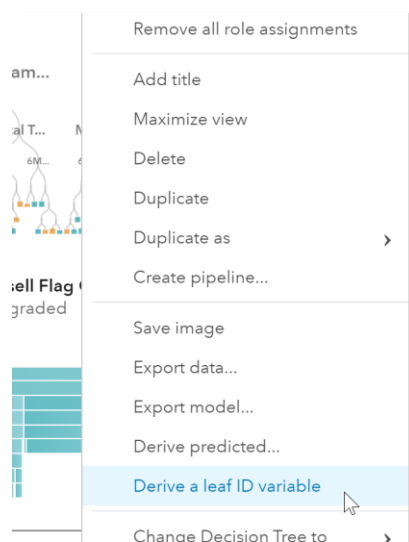
- Because of our random partition and the auto-tuning you may not have the same results. Use either method to isolate a node in your tree that is orange and has a high number of not yet upgraded customers. Note that node id.



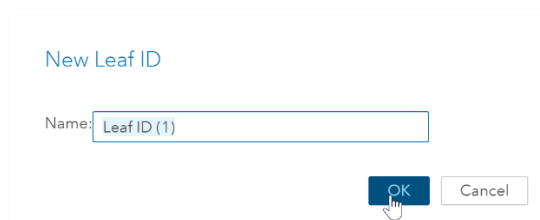
This node is node id: 287. We have a total of 264 accounts in this segment. Of those, 67% have upgraded. We can see that customers in this segment have 6 month Average Minutes on Network  $\geq 7.566$ . Notice all the other business rules. Seeing as the percent upgraded is high in this segment, there's a good chance that the other Not Yet Upgraded customers might up-sell or cross-sell if we target them. Let's create a detailed customer list for those customers in this segment who have not upgraded. We can then send this list to our customer care centers for follow-up.

- Right click on the decision tree chart.
- Select **Derive a leaf ID Variable**.

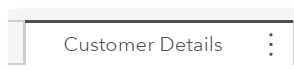




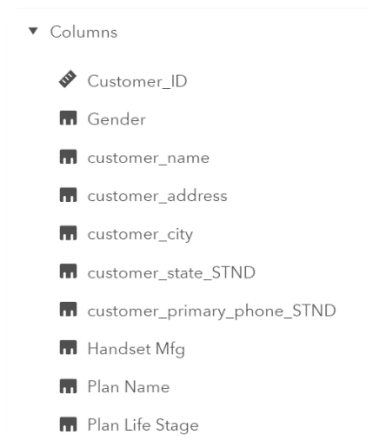
- Click **OK**. As we'll just accept the name **Leaf ID (1)** as our New Leaf ID.



- Click the **+** sign next to the **Decision Tree Analysis** tab to add a new page.
- Double Click **Page 2** and rename it **Customer Details**.

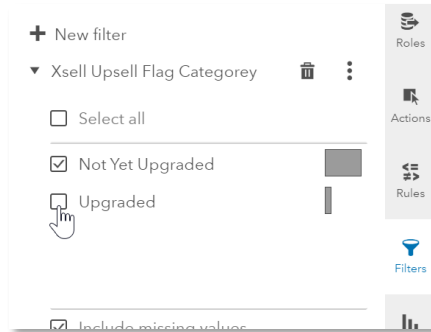


- From the left-hand pane, select **Objects**.
- Drag and Drop **List Table** onto the page.
- From the right-hand pane, select **Roles**.
- Under **Columns**, click **Add**, then select the following columns:



Let's filter the table so that it shows only those customers who have not yet upgraded.

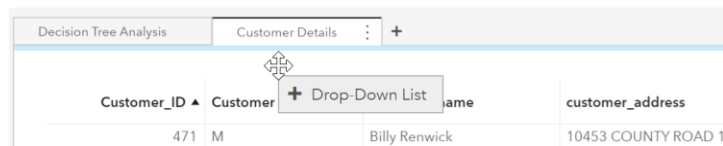
- From the right-hand pane, select **Filters**.
- Click **New Filter**, then select **Xsell Upsell Flag Category**.
- Deselect the box next to **Upgraded** by clicking on it.



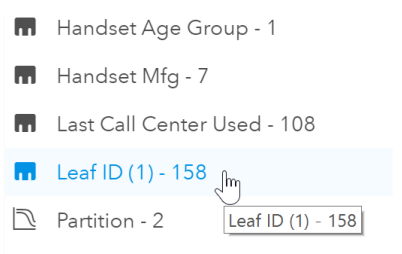
Customer_ID	Gender	customer_name	customer_address	customer_city	customer_state	customer_primary_phone	Handset Mfg	Plan Name	Plan Life Stage
4816	M	Harold Goodson	10102 N I CLOP DR	Detroit	MI	(631) 955 0994	LG	Lotto Minutes Classic SL	FABY 11-NUB13
107202	M	Herbert Willis	108 GIBSON LN	Fairhaven	MA	(304) 418 2255	Samsung	Lotto Minutes Classic FT	ON-CONTRACT
118150	F	Pauline Wilson	1 HUNTER DR	Portage	MI	(318) 939 6597	Apple	Legacy SL	OFF-CONTRACT
159210	F	Linda Wolf	1018 W A ST	Holersville	WI	(605) 586 1319	Apple	Lotto Minutes Classic SL	ON-CONTRACT
174780	F	Janet Thall	10133 COUNTY ROAD 15	Winnem	OH	(315) 749 4102	Apple	Lotto Minutes Classic FT	ON-CONTRACT
184748	F	Kristie Staggs	107 INTERNATIONAL LN	Eastpointe	MI	(229) 896 8761	Apple	Lotto Minutes Classic FT	ON-CONTRACT
222381	M	Dennis Sell	100 KNOX RD RD 511 P 2	Mid south	KS	(973) 982 3533	Samsung	Lotto Minutes F-I	ON-CONTRACT
232133	F	Rosalee L even	1 SHWINGDALE CT	Bethel	CT	(605) 694 4006	Apple	Unlimited SL	ON-CONTRACT
234036	M	Marshall Stuck	10996 N STATE ST	Durham	NC	(830) 540 9117	Apple	Lotto Minutes Classic FT	ON-CONTRACT
245880	M	Charles Frasher	102 SHIPWAY # 38183	Hilldale	NJ	(914) 955 2288	Samsung	Lotto Value SL	ON-CONTRACT
241020	M	Ray Wisniewski	1 MCKINAW RD CT	Midvale	WI	(225) 625 5196	Apple	Lotto Minutes Classic FT	ON-CONTRACT
253972	F	Beth Goulbourn	100 MURPHY LN	Spartanburg	SC	(201) 792 9169	HTC	Lotto Minutes Classic SL	ON-CONTRACT
262628	F	Virginia Goldstein	100 KINGS CT	Hollywood	FL	(618) 754 0008	Apple	Unlimited SL	ON-CONTRACT
318390	M	Sheren Alexander	101 EDWARDS ST	Everett	WA	(918) 656 5017	Apple	Lotto Minutes Classic FT	EARLY TENURE
329438	F	Ivelyn Jordan	104 VOICE CANYON RD	Sueyemish	WA	(248) 322 1040	Apple	Lotto Minutes Classic FT	ON-CONTRACT
338020	F	Ruth Roberts	1088 OFF CAM RD	Racine	WI	(645) 333 3199	Apple	Lotto Minutes Classic FT	ON-CONTRACT
342523	F	Dennis Lamore	1001 GOLF COURSE DR APT D3	Lawrenceville	GA	(312) 641 2865	Apple	Lotto Value FT	OFF-CONTRACT
374703	F	Gloria Young	1 GR-FN POND RD RD	Oriskany	PA	(781) 254 4941	Apple	Lotto Minutes Classic FT	ON-CONTRACT
386236	U	Louis Keller	10101 BRUNION PI 511 100	Heber City	UT	(830) 281 1811	Samsung	Lotto Minutes Classic SL	ON-CONTRACT
406400	M	Todd Romero	100 LAKE HICKORY CT	Mesquite	TX	(617) 431 6456	HTC	Lotto Minutes Classic SL	ON-CONTRACT
434780	F	Susan Wells	105 WOLF RD STE 3	San Francisco	CA	(309) 489 8229	Samsung	Lotto Minutes SL	ON-CONTRACT
477242	F	Laura Bondi	1 681 NITE ID CT	Foley	SC	(970) 490 8980	Apple	Lotto Minutes Classic SL	ON-CONTRACT
517938	M	Richard Edwards	10737 S FREEDOM WAY APT A8-101	Greenville	SC	(718) 721 4199	Apple	Legacy SL	OFF-CONTRACT
536679	F	Tiffani Wheeler	101 LILLIAN WAY	Eugene	OR	(678) 892 5670	Apple	Unlimited SL	ON-CONTRACT
537149	F	Melissa Richardson	1001 ROCKVIEW 1100 APT 809	Santa Ana	CA	(708) 446 8801	Apple	Legacy F-I	ON-CONTRACT
539926	M	Robert Fischer	10101 KIMWOOD DR APT 155	Clive	IA	(744) 872 0766	Apple	Lotto Value SL	FABY 11-NUB13
555895	M	Kevin Casaley	0 SILHOUETTE BOOKS	Salem	MA	(270) 339 8843	Samsung	Lotto Minutes FT	ON-CONTRACT
602290	F	Mandy Mann	11 PINEHURST DR # 5095 # 3348	Las Vegas	NV	(669) 326 8311	Apple	Lotto Minutes Classic FT	ON-CONTRACT
688791	F	Rosalee Alden	1080 CLARK ST	Bradford	CT	(843) 296 9811	Apple	Lotto Value F-I	ON-CONTRACT
440576	F	Bashy-Wing	100 CALLE BOGOTA	Jackson	MS	(909) 438 5616	Samsung	Lotto Minutes FT	ON-CONTRACT
660622	M	Jose Beaman	10900 COUNTY ROAD 508	Las Cruces	NM	(410) 895 1773	Apple	Lotto Minutes Classic FT	ON-CONTRACT
661317	M	Kath Hornumder	1056 4111 AVE W	Dublin	CA	(605) 881 7118	Samsung	Lotto Minutes F-I	ON-CONTRACT
667269	M	Jose James	1 CARR BOULEVARD	Fargo	ND	(916) 566 1135	LG	Lotto Minutes Classic FT	ON-CONTRACT
668091	M	Willie Wright	10916 APRICOT ST APT 1	Owatonna	MN	(312) 728 9604	Apple	Lotto Minutes Classic FT	ON-CONTRACT
676198	U	Dana Cooper	101 RANES SPRINGS CLOP RD	Rockaway	NJ	(909) 378 6667	Nokia	Lotto Minutes Classic SL	ON-CONTRACT
681229	F	Lisa Thompson	1 HUBBARDSON DR RD	Kenne	NH	(201) 545 9801	Apple	Lotto Minutes Classic F-I	ON-CONTRACT

Next, we'll add a drop-down filter so we can select our node id and filter on it.

- From the left-hand pane, select **Objects**.
- Drag and Drop the **Drop-Down List** to the very top of the page.

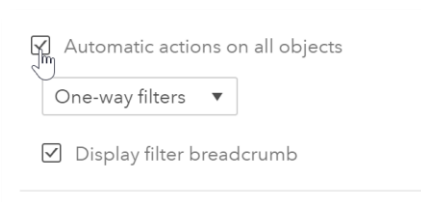


- From the right-hand pane, select **Roles**.
- Under **Category**, click **Add** and select **Leaf ID (1)**.



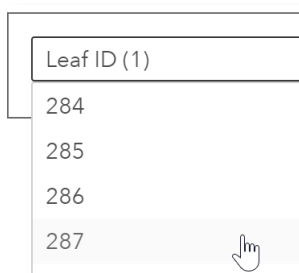
Let's create an action to filter the list table based on our drop-down selection.

- Click on your new drop-down filter to make it active.
- From the right-hand pane, select **Actions**.
- Click on the box next to **Automatic actions on all object**.

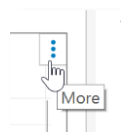


Now we can filter our customer details and send the list to customer care centers.

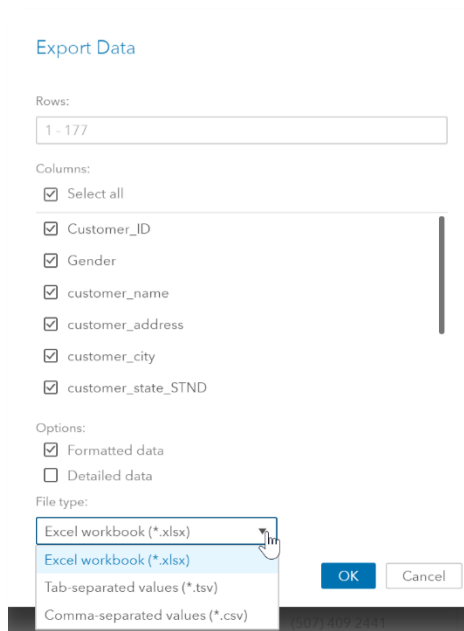
- From the drop-down filter select **287** (this is the node ID we identified from our tree, yours might have been different).



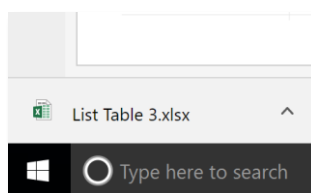
- Click on the list table to make it active.
- Click the three dots located on the top right corner of the list table.



- Select **Export Data**.
- Notice the exported file types: Excel, tsv and csv.



- Click **OK**.
- The file will show up at the bottom of your screen.



So, in general, we can see that the decision tree model helps us segment the customers into subgroups with different likelihood of upgrading. We can also see that for each customer subgroup, the decision tree provides a business rule to help us characterize the group. We can take the intelligence of this tree and use it to score a new customer, identify the possibility of upgrading for that customer, and deliver that information to our marketing peers.

## SAS Drive:

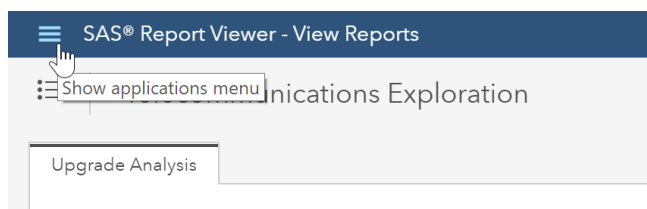


SAS Drive is the landing page that allows users to customize access to information and create shortcuts to SAS components. From there, depending on their roles, users can go to different components for different tasks, which varies from managing the system and tables to analyzing data and creating reports and dashboards, viewing reports and accessing SAS Studio code.

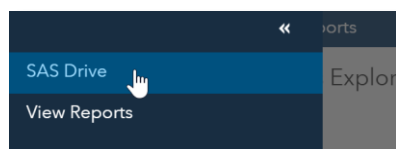
With SAS Drive users see, organize and collaborate on their work. Users can favorite, share, preview and tag their content from one place. They can create projects that share data, content and other

resources with project members. A search engine makes it easier to find assets that other users created and shared.

- Click the three stacked lines (**Show applications menu**) at the top left of the screen to go to SAS Drive.



- Click on **SAS Drive**.



You will notice that any report you've created now shows up in the top pane for quick access.

Thank you for taking the time to walk through this demo. We hope you found it helpful. Check out the other options available for the report and SAS Drive! Have fun exploring SAS Visual Statistics!