▼ Variable "parroquia_urbana" PRUEBA 1

Cargamos las librerias necesarias para la elaboración y desarrollo de la minería de datos

```
!pip install plotly
import numpy as np #Operaciones matemáticas rápidas sobre matrices
import pandas as pd #biblioteca de análisis y manipulación de datos para Python
import plotly.express as px
import matplotlib.pyplot as plt #Proporciona una forma de trazado similar a MATLAB. pyplot está diseñado principalmente para gráficos in
import seaborn as sns #permite generar fácilmente elegantes gráficos, proporciona una interfaz de alto nivel que es realmente sencilla d
import statsmodels.api as sm
# Preprocesado y modelado
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier
from sklearn.tree import plot_tree
from sklearn.tree import export graphviz
from sklearn.tree import export_text
from sklearn.model_selection import GridSearchCV
from sklearn.compose import ColumnTransformer
from sklearn.preprocessing import OneHotEncoder
from sklearn.metrics import accuracy score
from sklearn.metrics import confusion_matrix
# Configuración warnings
# -----
import warnings
warnings.filterwarnings('once')
df= pd.read_csv('AT2021_NBD.csv')
         Requirement already satisfied: plotly in /usr/local/lib/python3.10/dist-packa
         Requirement already satisfied: tenacity>=6.2.0 in /usr/local/lib/python3.10/c
         <frozen importlib._bootstrap>:914: ImportWarning: APICoreClientInfoImportHook
         <frozen importlib._bootstrap>:914: ImportWarning: _PyDriveImportHook.find_spe
         <frozen importlib._bootstrap>:914: ImportWarning: _OpenCVImportHook.find_spec
         <frozen importlib._bootstrap>:914: ImportWarning: _BokehImportHook.find_spec(
         <frozen importlib._bootstrap>:914: ImportWarning: _AltairImportHook.find_spec
         <frozen importlib._bootstrap>:914: ImportWarning: APICoreClientInfoImportHook
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         <frozen importlib._bootstrap>:914: ImportWarning: _OpenCVImportHook.find_spec
         <frozen importlib._bootstrap>:914: ImportWarning: _BokehImportHook.find_spec(
         <frozen importlib._bootstrap>:914: ImportWarning:
                                                                                              AltairImportHook.find spec
         <frozen importlib._bootstrap>:914: ImportWarning: APICoreClientInfoImportHook
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         <frozen importlib._bootstrap>:914: ImportWarning: _OpenCVImportHook.find_spec
         <frozen importlib._bootstrap>:914: ImportWarning:
                                                                                              BokehImportHook.find spec(
         <frozen importlib._bootstrap>:914: ImportWarning: _AltairImportHook.find_spec
                                                   latitud
               fecha
                                dia hora
                                                                     longitud
                                                                                          tipologia direccion
                                                                                                               orillas del
                                                                                                               zamora y
                                         h11 -3.991993 -79.201155 estrellamiento
              01-01 viernes
                                                                                                                iose felix
                                                                                                                               urbana
                                                                                                                        de
                                                                                                              valdivieso
                                                                                                                benjamin
                                                                                               choque
                                                                                                                carrion v
               01-05
                           martes
                                         h17
                                                 -4.020370 -79.217962
                                                                                                 lateral
                                                                                                                               urbana
                                                                                                                 gustavo
                                                                                       perpendicular
                                                                                                                 serrano
                                                                                                              nueva loja
                                                                                          choque por
              01-05
                           martes
                                                -3.987230 -79.202984
                                                                                                                               urbana
                                                                                               alcance
                                                                                                               guaranda
                                                                                                                    angel
                                                                                                                               urbana
          3 01-08
                                         h10
                                                -3.989410 -79.236506
                                                                                              atropello
                         viernes
                                                                                                               felicisimo
                                                                                                                     rojas
                                                                                                                    isidro
                                                                                               choque
              01-09 sabado
                                         h06 -3 979784 -79 218689
                                                                                                 lateral
                                                                                                                  ayora y
                                                                                                                               urbana
                                                                                               angular
                                                                                                                 habana
```

```
fig = px.density_mapbox(df,lat='latitud', lon='longitud',radius=3,center=dict(lat=-3.99313,lon=-79.20422),zoom=10.5,mapbox_style="open-s
fig.show()
          /usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: Deprecation
              and should_run_async(code)
           <frozen importlib._bootstrap>:914: ImportWarning: APICoreClientInfoImportHook
          <frozen importlib._bootstrap>:914: ImportWarning: _PyDriveImportHook.find_spe
<frozen importlib._bootstrap>:914: ImportWarning: _OpenCVImportHook.find_spec
          \verb|\dots| importlib.\_bootstrap>: 914: ImportWarning: \_BokehImportHook.find\_spec(|\dots|) | ImportWarning: \_BokehImportHook.find\_spec(|\do
          <frozen importlib._bootstrap>:914: ImportWarning: _AltairImportHook.find_spec
           <frozen importlib._bootstrap>:914: ImportWarning: APICoreClientInfoImportHook
           <frozen importlib._bootstrap>:914: ImportWarning: _PyDriveImportHook.find_spe
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          <frozen importlib. bootstrap>:914: ImportWarning:
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          <frozen importlib._bootstrap>:914: ImportWarning:
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          <frozen importlib._bootstrap>:914: ImportWarning:
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          <frozen importlib._bootstrap>:914: ImportWarning:
          _AltairImportHook.find_spec() not found; falling back to find_module()
```

```
#verifico datos nulos
df.isnull().sum()
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: DeprecationWarning:
```

`should_run_async` will not call `transform_cell` automatically in the future. Please pass the result to `transformed_cell` argumer

```
fecha
dia
                           0
hora
                           0
latitud
                           1
longitud
                           1
tipologia
                           0
                           0
direccion
zona
parroquia_urbana
                           0
causas
                           0
gravedad
                           0
nro_heridos
                           a
nro_fallecidos
                           0
vehiculos_retenidos
                           0
senalizacion_existente
                           0
condicion_calzada
                           0
condicion_atmosferica
                           0
dtype: int64
```

4

```
df=df.loc[:,df.columns!="fecha"]
df=df.loc[:,df.columns!="zona"]
df=df.loc[:,df.columns!="latitud"]
df=df.loc[:,df.columns!="longitud"]
df=df.loc[:,df.columns!="direccion"]
df=df.loc[:,df.columns!="gravedad"]
df=df.loc[:,df.columns!="vehiculos_retenidos"]
df=df.loc[:,df.columns!="senalizacion_existente"]
df=df.loc[:,df.columns!="condicion_calzada"]
df=df.loc[:,df.columns!="condicion_atmosferica"]
```

/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: DeprecationWarning:

`should_run_async` will not call `transform_cell` automatically in the future. Please pass the result to `transformed_cell` argumer

df.isnull().sum()

dia 0
hora 0
tipologia 0
parroquia_urbana 0
causas 0
nro_heridos 0
nro_fallecidos 0
dtype: int64

df.sample(10)

4

/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: Deprecation

`should_run_async` will not call `transform_cell` automatically in the future $\parbox{\cite{thm}}$

	dia	hora	tipologia	parroquia_urbana	causas	nro_heridos	r
112	sabado	h16	roce negativo	san sebastian	imprudencia del conductor	0	
314	domingo	h11	choque por alcance	el sagrario	conducir en estado de embriaguez	1	
356	martes	h19	choque lateral perpendicular	sucre	imprudencia del conductor	3	
14	lunes	h16	roce negativo	sucre	conducir en exceso de velocidad	5	
11		1.04	choque		imprudencia 	^	>

```
df.head()
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: Deprecation
     `should_run_async` will not call `transform_cell` automatically in the future
            dia hora
                         tipologia parroquia_urbana
                                                            causas nro_heridos nro
                                                        conducir en
      0 viernes
                  h11 estrellamiento
                                               el valle
                                                          estado de
                                                                              1
                                                        embriaguez
                            choque
                                                        conducir en
         martes
                 h17
                             lateral
                                              punzara
                                                          estado de
                                                                              1
                       perpendicular
                                                        embriaguez
                                                        no montonor
ds=pd.DataFrame(df)
#Presenta el numero de filas
print("El numero de filas(observaciones) es: ",ds.shape[0])
#Presenta el numero de columnas
print("El numero de columnas(variables) es: ",len(ds.columns))
     El numero de filas(observaciones) es: 370
     El numero de columnas(variables) es: 7
     /usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: DeprecationWarning:
     `should_run_async` will not call `transform_cell` automatically in the future. Please pass the result to `transformed_cell` argumer
# tipos de la variables
ds.dtypes
     dia
                         object
     hora
                         object
     tipologia
                         object
     parroquia_urbana
                         object
     causas
                         object
     nro_heridos
                          int64
     nro_fallecidos
                          int64
     dtype: object
df.shape[0]
     370
df['causas'].value_counts()
     imprudencia del conductor
                                                161
     conducir en estado de embriaguez
     conducir en exceso de velocidad
                                                 75
     imprudencia del peaton
                                                 15
     no respetar las senales de transito
                                                 15
     fallas mecanicas no previsibles
                                                  6
     no mantener la distancia reglamentaria
                                                  2
     condiciones climaticas desfavorables
                                                  2
     no ceder el derecho de via
                                                  2
     impericia del conductor
                                                  2
     cruce de animales en la via
     Name: causas, dtype: int64
print(df['causas'].unique())# datos en texto
     ['conducir en estado de embriaguez'
       'no mantener la distancia reglamentaria' 'imprudencia del peaton'
      'conducir en exceso de velocidad' 'no respetar las senales de transito'
      'condiciones climaticas desfavorables' 'no ceder el derecho de via'
      'impericia del conductor' 'imprudencia del conductor'
      'fallas mecanicas no previsibles' 'cruce de animales en la via']
     /usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: DeprecationWarning:
     `should_run_async` will not call `transform_cell` automatically in the future. Please pass the result to `transformed_cell` argumer
print(df['causas'].unique())# datos en texto
     ['conducir en estado de embriaguez'
       'no mantener la distancia reglamentaria' 'imprudencia del peaton'
```

```
'impericia del conductor' 'imprudencia del conductor'
      'fallas mecanicas no previsibles' 'cruce de animales en la via']
Transformamos los datos a numéricos
df['causas']= df['causas'].apply(lambda x:
                                   1 if x == 'conducir en estado de embriaguez' else
                                    2 if x == 'imprudencia del conductor' else
                                    3 if x == 'no ceder el derecho de via' else
                                    4 if x == 'conducir en exceso de velocidad' else
                                    5 if x == 'cambio brusco e indebido de carril' else
                                    6 if x == 'fallas mecanicas no previsibles' else
                                    7 if x == 'no respetar las senales de transito' else
                                    8 if x == 'invadir carril de circulacion' else
                                    9 if x == 'imprudencia del peaton' else
                                    10 if x == 'no mantener la distancia reglamentaria' else
                                    11 if x == 'razones desconocidas' else
                                    12 if x == 'condiciones climaticas desfavorables' else
                                    13 if x == 'negligencia del conductor' else
                                    14 if x == 'no respetar las ordenes del agente de transito' else
                                    15 if x == 'impericia del conductor' else
                                    16)
print(df['parroquia_urbana'].unique()) # datos convertidos a numeros enteros
     ['el valle' 'punzara' 'sucre' 'san sebastian' 'carigan' 'el sagrario']
df['parroquia_urbana']= df['parroquia_urbana'].apply(lambda x:
                                   1 if x == 'el sagrario' else
                                    2 if x == 'san sebastian' else
                                    3 if x == 'el valle' else
                                    4 if x == 'sucre' else
                                    5 if x == 'punzara' else
                                    6)
print(df['parroquia urbana'].unique()) # datos convertidos a numeros enteros
     [3 5 4 2 6 1]
print(df['tipologia'].unique()) # datos convertidos a numeros enteros
     ['estrellamiento' 'choque lateral perpendicular' 'choque por alcance'
       'atropello' 'choque lateral angular' 'roce negativo' 'perdida de carril'
       'perdida de pista' 'choque frontal excentrico' 'colision' 'atipico'
      'arrollamiento' 'volcamiento' 'roce positivo' 'rozamiento'
      'caida de pasajero']
df['tipologia']= df['tipologia'].apply(lambda x:
                                    1 if x == 'arrollamiento' else
                                    2 if x == 'atipico' else
                                    3 if x == 'atropello' else
                                    4 if x == 'caida de pasajero' else
                                    5 if x == 'choque frontal' else
                                    6 if x == 'choque frontal excentrico' else
                                    7 if x == 'choque frontal longitudinal' else
                                    8 if x == 'choque lateral angular' else
                                    9 if x == 'choque lateral perpendicular' else
                                    10 if x == 'choque por alcance' else
                                    11 if x == 'colision' else
                                   12 if x == 'encunetamiento' else
                                    13 if x == 'estrellamiento' else
                                    14 if x == 'perdida de carril' else
                                    15 if x == 'perdida de pista' else
                                    16 if x == 'roce negativo' else
                                    17 if x == 'roce positivo' else
                                    18 if x == 'rozamiento' else
                                    19 if x == 'volcamiento' else
                                    20 if x == 'volcamiento lateral' else
                                    21)
print(df['tipologia'].unique()) # datos convertidos a numeros enteros
     [13 9 10 3 8 16 14 15 6 11 2 1 19 17 18 4]
```

'conducir en exceso de velocidad' 'no respetar las senales de transito' 'condiciones climaticas desfavorables' 'no ceder el derecho de via'

```
df['dia']= df['dia'].apply(lambda x:
                                    1 if x == 'lunes' else
                                    2 if x == 'martes' else
                                    3 if x == 'miercoles' else
                                    4 if x == 'jueves' else
                                    5 if x == 'viernes' else
                                    6 if x == 'sabado' else
                                    7)
print(df['dia'].unique()) # datos convertidos a numeros enteros
     [5 2 6 7 1 4 3]
df= df[df['parroquia_urbana'] <= 6]</pre>
df['hora']= df['hora'].apply(lambda x:
                                    0 if x == 'h00' else
                                    1 if x == 'h01' else
                                    2 if x == 'h02' else
                                    3 if x == 'h03' else
                                    4 if x == 'h04' else
                                    5 if x == 'h05' else
                                    6 if x == 'h06' else
                                    7 if x == 'h07' else
                                    8 if x == 'h08' else
                                    9 if x == 'h09' else
                                    10 if x == 'h10' else
                                    11 if x == 'h11' else
                                    12 if x == 'h12' else
                                    13 if x == 'h13' else
                                    14 if x == 'h14' else
                                    15 if x == 'h15' else
                                    16 if x == 'h16' else
                                    17 if x == 'h17' else
                                    18 if x == 'h18' else
                                    19 if x == 'h19' else
                                    20 if x == 'h20' else
                                    21 if x == 'h21' else
                                    22 if x == 'h22' else
                                    23)
```

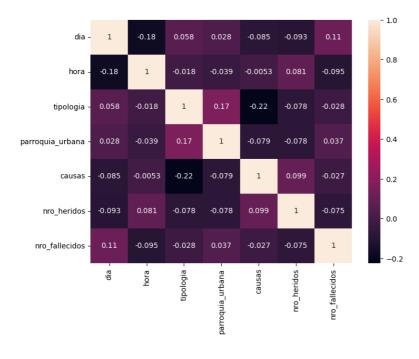
df.head()

	dia	hora	tipologia	parroquia_urbana	causas	nro_heridos	nro_fallecido
0	5	11	13	3	1	1	
1	2	17	9	5	1	1	
2	2	12	10	4	10	0	
3	5	10	3	4	9	1	
4							+

datos aleatorios (muestra de 10 elementos)

df.sample(10)

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: Deprecation
     `should_run_async` will not call `transform_cell` automatically in the future
Verificamos la correlaxion de los datos
#corelacion
corr_df = df.corr(method='pearson')
plt.figure(figsize=(8, 6))
sns.heatmap(corr_df, annot=True)
plt.show()
     /usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: Deprecatic
     `should_run_async` will not call `transform_cell` automatically in the future
     <frozen importlib._bootstrap>:914: ImportWarning:
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     <frozen importlib._bootstrap>:914: ImportWarning:
     _OpenCVImportHook.find_spec() not found; falling back to find_module()
     <frozen importlib._bootstrap>:914: ImportWarning:
     _BokehImportHook.find_spec() not found; falling back to find_module()
     <frozen importlib._bootstrap>:914: ImportWarning:
     _AltairImportHook.find_spec() not found; falling back to find_module()
```



```
X = df.iloc[:, [0,1,2,4,5,6]] # atributos de entrada seran las primeras columnas
Y = df.iloc[:,[3]] # atributos de destino

#presentacion de los atributos de entrada
X.head()
```

```
dia hora tipologia causas nro heridos nro fallecidos
           5
                11
                           13
      1
          2
                17
                           9
                                   1
                                                 1
                                                                0
feature_names = X.columns.tolist()
# Imprimir los nombres de las características
print(feature_names)
     ['dia', 'hora', 'tipologia', 'causas', 'nro heridos', 'nro fallecidos']
     /usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: DeprecationWarning:
     `should run async` will not call `transform cell` automatically in the future. Please pass the result to `transformed cell` argumer
#presentacion de los atributos de destino
Y.head()
        parroquia_urbana
```

Cargamos el modelo

0

1

2

3

4

```
from joblib import load
arbol_modelo = load('modelo_parroquia_urbana_python.joblib')
y pred = arbol modelo.predict(X)
```

3

5

4

4

4

/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: DeprecationWarning:

`should_run_async` will not call `transform_cell` automatically in the future. Please pass the result to `transformed_cell` argumer /usr/local/lib/python3.10/dist-packages/sklearn/base.py:318: UserWarning:

Trying to unpickle estimator DecisionTreeClassifier from version 1.0.2 when using version 1.2.2. This might lead to breaking code (https://scikit-learn.org/stable/model_persistence.html#security-maintainability-limitations

print(y_pred)

```
4 1 4 4 4 1 4 4 4 4 4 4 4 1 4 4 4 1 4 4 4 1 4 4 4 4 4 4 4 4 4 4 4 1 1 4 4 4 1 4
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: DeprecationWarning:
```

`should_run_async` will not call `transform_cell` automatically in the future. Please pass the result to `transformed_cell` argumer

```
# Resumen de las predicciones hechas por el clasificador
from sklearn import metrics
reporte = metrics.classification_report(Y, y_pred,output_dict=True)
pre = pd.DataFrame(reporte).transpose()
print(pre)
pre.to_excel("resumen_precision_parroquia_urbana_2021.xlsx")
```

/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning:

Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted samples. Use `zero division` parameter to co /usr/local/lib/python3.10/dist-packages/sklearn/metrics/ classification.py:1344: UndefinedMetricWarning:

Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to cc

```
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning:
Precision and F-score are ill-defined and being set to 0.0 in labels with no predicted samples. Use `zero_division` parameter to co
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<frozen importlib._bootstrap>:914: ImportWarning:
OpenCVImportHook.find spec() not found; falling back to find module()
<frozen importlib._bootstrap>:914: ImportWarning:
_BokehImportHook.find_spec() not found; falling back to find_module()
<frozen importlib._bootstrap>:914: ImportWarning:
_AltairImportHook.find_spec() not found; falling back to find_module()
             precision
                          recall f1-score
                                               support
              0.333333 0.444444 0.380952
                                             63.000000
1
                                             55.000000
2
              0.000000 0.000000 0.000000
3
              0.000000 0.000000 0.000000
                                            33.000000
              0.352313 0.860870 0.500000 115.000000
4
5
              0.200000 0.016129 0.029851
                                             62.000000
6
              0.000000
                       0.000000 0.000000
                                             42.000000
              0.345946 0.345946 0.345946
accuracy
                                              0.345946
              0.147608 0.220241 0.151801
macro avg
                                            370.000000
weighted avg 0.199773 0.345946 0.225272 370.000000
```

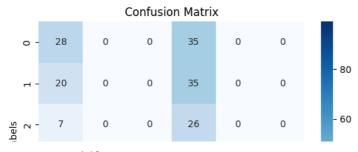
Pedicciones

Generamos la matriz de confusión

```
#Matriz de confusion
matriz=confusion_matrix(Y, y_pred)
ax= plt.subplot()
sns.heatmap(matriz, annot=True, cmap="Blues",fmt='g');
ax.set_xlabel('Predicted labels');ax.set_ylabel('True labels');
ax.set_title('Confusion Matrix');
```

/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: Deprecation

`should_run_async` will not call `transform_cell` automatically in the future



#Para concatenar variables

import pandas as pd

```
prediccion = pd.DataFrame(y_pred,columns=['parroquia_urbana_prediccion'])
original = Y
original.reset_index(drop=True, inplace=True)
df_combined = pd.concat([prediccion,original], axis=1)
df_combined.head(10)
```

/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: Deprecatic

`should_run_async` will not call `transform_cell` automatically in the future

	parroquia_urbana_pred:	iccion	parroquia_urbana	1	11.	
0		4	3			
1		1	5			
2		4	4			
3		4	4			
4		4	4			
5		4	4			
6		4	2			
7		4	4			
8		4	2			
4			^			

Visualizamos la exactitud del modelo

```
from \ sklearn.metrics \ import \ accuracy\_score, \ recall\_score, \ precision\_score
print('Exactitud árboles de decisión: ',accuracy_score(pred,Y)*100)
print('Exhaustividad árboles de decisión: ', recall_score(pred,Y,average='micro')*100)
print('Precision árboles de decisión: ',accuracy_score(pred,Y)*100)
```

Exactitud árboles de decisión: 34.5945945946 Exhaustividad árboles de decisión: 34.5945945945 Precision árboles de decisión: 34.5945945945

/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: DeprecationWarning:

`should_run_async` will not call `transform_cell` automatically in the future. Please pass the result to `transformed_cell` argumer

Transformamos las variables

```
#transformar datos para visualización de variables predictoras y originales
\label{lem:df_combined} $$ df_combined['parroquia_urbana_prediccion'] = df_combined['parroquia_urbana_prediccion']. apply(lambda x: df_combined['parroquia_urbana_prediccion']. Apply(la
                                                                                                                                                                                                                                                                   'el sagrario' if x == 1 else
                                                                                                                                                                                                                                                                     'san sebastian' if x == 2 else
                                                                                                                                                                                                                                                                   'el valle' if x == 3 else
                                                                                                                                                                                                                                                                     'sucre' if x == 4 else
                                                                                                                                                                                                                                                                     'punzara' if x == 5 else
                                                                                                                                                                                                                                                                   'carigan')
```

```
df_combined['parroquia_urbana'] = df_combined['parroquia_urbana'].apply(lambda x:
                                     'el sagrario' if x == 1 else
```

```
'san sebastian' it x == 2 else
'el valle' if x == 3 else
'sucre' if x == 4 else
'punzara' if x == 5 else
'carigan')
```

 $/usr/local/lib/python 3.10/dist-packages/ipykernel/ipkernel.py: 283: \ Deprecation Warning: \\$

`should_run_async` will not call `transform_cell` automatically in the future. Please pass the result to `transformed_cell` argumer

Graficamos las estadisticas originales de los datos

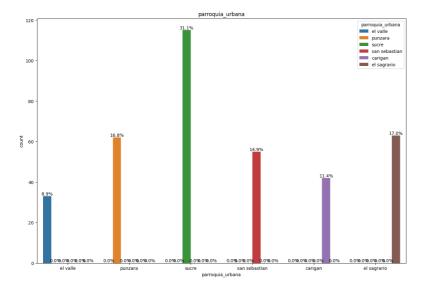
import seaborn as sns #permite generar fácilmente elegantes gráficos, proporciona una interfaz de alto nivel que es realmente sencilla d ax = plt.subplots(figsize = (15,10))

ncount=len(df_combined)

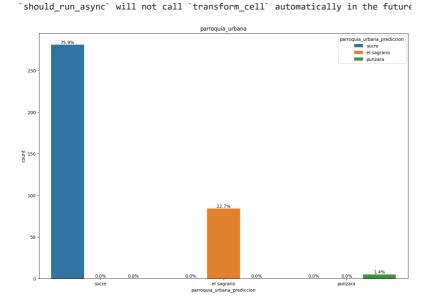
sns.countplot(x='parroquia_urbana', hue = 'parroquia_urbana', data = df_combined, ax = ax[1]) #Muestre el conteo de observaciones en cada ax[1].set_title('parroquia_urbana')

```
for p in ax[1].patches:
   x=p.get_bbox().get_points()[:,0]
   y=p.get_bbox().get_points()[1,1]
   ax[1].annotate('{:.1f}%'.format(100.*y/ncount), (x.mean(), y),
           ha='center', va='bottom') # set the alignment of the text
```

#Guardamos la figura de barras original ax[0].savefig("barras_original_parroquia_urbana_2021.png")



Graficamos las estadisticas predecidas de los datos



```
< □
```

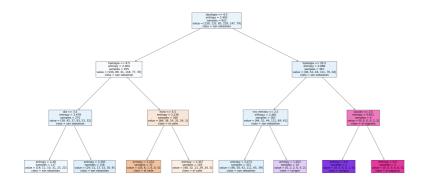
Crear el arbol de desición actual con el modelo con datos predichos del 2021

/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: DeprecationWarning:

`should_run_async` will not call `transform_cell` automatically in the future. Please pass the result to `transformed_cell` argumer

Creamos la figura del arbol

figura_arbol = plt.figure(figsize=(40,20)) # Le indicamos las dimensiones que queremos que tenga
plot_tree(arbol_modelo,feature_names=feature_names,filled=True, class_names=target_names_str, fontsize=15)
plt.show()



figura_arbol.savefig("arbol_colab_parroquia_urbana_2021.png")

X.head()

	dia	hora	tipologia	causas	nro_heridos	nro_fallecidos	7	th
0	5	11	13	1	1	0		
1	2	17	9	1	1	0		
2	2	12	10	10	0	0		
3	5	10	3	9	1	0		
4	6	6	8	1	0	0		

Verificamos la probabilidad de los accidentes de tránsito a través de la predicción del modelo

```
#Verificamos la probabilidad de todas las variables
y_proba = arbol_modelo.predict_proba(X)
probabilidad_acierto = np.round(y_proba[0][y_pred] * 100, 2)
print("Probabilidad de Acierto: " + str(probabilidad_acierto) + "%")
```

```
Probabilidad de Acierto: [18.41 14.16 18.41 18.41 18.41 18.41 18.41 18.41 18.41 14.16 18.41 18.41
     18.41 18.41 11.05 18.41 18.41 14.16 18.41 14.16 14.16 18.41 11.05 18.41
     18.41 14.16 14.16 14.16 14.16 18.41 14.16 14.16 14.16 18.41 18.41 18.41
      18.41 18.41 18.41 18.41 18.41 18.41 18.41 18.41 18.41 18.41 18.41 18.41 14.16
     18.41 18.41 18.41 14.16 18.41 18.41 11.05 18.41 18.41 14.16 14.16 14.16
     14.16 18.41 14.16 14.16 18.41 18.41 18.41 14.16 18.41 18.41 18.41 14.16
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     18.41 18.41 18.41 14.16 14.16 18.41 18.41 18.41 14.16 18.41]%
     /usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: DeprecationWarning:
     `should_run_async` will not call `transform_cell` automatically in the future. Please pass the result to `transformed_cell` argumer
print(type(probabilidad acierto))
columna_probabilidades = pd.DataFrame()
columna_probabilidades['probabilidad'] = pd.DataFrame(probabilidad_acierto)
print(columna probabilidades)
     <class 'numpy.ndarray'>
          probabilidad
     0
                 18.41
                 14.16
                 18.41
     3
                 18.41
     4
                 18.41
                 18.41
     365
     366
                 18.41
     367
                 18.41
     368
                 14.16
                 18.41
     369
     /usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: DeprecationWarning:
     `should_run_async` will not call `transform_cell` automatically in the future. Please pass the result to `transformed_cell` argumer
Presentamos la probabilidad de los datos
```

```
y_prediccion = pd.DataFrame()
y_prediccion['predicciones'] = pd.DataFrame(y_pred)
probabilidades_2021_df = pd.concat([df,columna_probabilidades, y_prediccion], axis=1)
probabilidades_2021_df.sample(10)
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: Deprecation
```

`should_run_async` will not call `transform_cell` automatically in the future

```
dia hora tipologia parroquia_urbana causas nro_heridos nro_falleci
           234
                                                        8
                                                                                                           7
                        6
                                  11
                                                                                           4
                                                                                                                                    1
            73
                                  21
                                                       13
                                                                                            6
                                                                                                           2
                                                                                                                                    1
           301
                        6
                                    5
                                                       13
                                                                                                                                    0
probabilidades_2021_df['predicciones']= probabilidades_2021_df['predicciones'].apply(lambda x:
                                                                       'el sagrario' if x == 1 else
                                                                      'san sebastian' if x == 2 else
                                                                      'el valle' if x == 3 else
                                                                       'sucre' if x == 4 else
                                                                      'punzara' if x == 5 else
                                                                       'carigan')
probabilidades_2021_df['dia'] = probabilidades_2021_df['dia'].apply(lambda x:
                                                                      'lunes' if x == 1 else
                                                                      'martes' if x == 2 else
                                                                      'miercoles' if x == 3 else
                                                                       'jueves' if x == 4 else
                                                                      'viernes' if x == 5 else
                                                                      'sabado' if x == 6 else
                                                                      'domingo' )
probabilidades_2021_df['hora'] = probabilidades_2021_df['hora'].apply(lambda x:
                                                                      'h00' if x == 0 else
                                                                      'h01' if x == 1 else
                                                                      'h02' if x == 2 else
                                                                      'h03' if x == 3 else
                                                                      'h04' if x == 4 else
                                                                      'h05' if x == 5 else
                                                                      'h06' if x == 6 else
                                                                      'h07' if x == 7 else
                                                                      'h08' if x == 8 else
                                                                      'h09' if x == 9 else
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                                                                      'h11' if x == 11 else
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                                                                      'h20' if x == 20 else
                                                                      'h21' if x == 21 else
                                                                      'h22' if x == 22 else
                                                                      'h23')
probabilidades\_2021\_df['parroquia\_urbana'] = probabilidades\_2021\_df['parroquia\_urbana']. apply(lambda \ x: lambda \ x: lambd
                                                                      'el sagrario' if x == 1 else
                                                                       'san sebastian' if x == 2 else
                                                                      'el valle' if x == 3 else
                                                                      'sucre' if x == 4 else
                                                                      'punzara' if x == 5 else
                                                                      'carigan')
probabilidades_2021_df['tipologia'] = probabilidades_2021_df['tipologia'].apply(lambda x:
                                                                       'arrollamiento' if x == 1 else
                                                                      'atipico' if x == 2 else
                                                                      'atropello' if x == 3 else
                                                                       'caida pasajero' if x == 4 else
                                                                      'choque frontal' if x == 5 else
                                                                      'choque frontal excentrico' if x == 6 else
                                                                      'choque frontal longitudinal' if x == 7 else
                                                                      'choque lateral angular' if x == 8 else
                                                                      'choque lateral perpendicular' if x == 9 else
                                                                      'choque alcance' if x == 10 else
                                                                      'colision' if x == 11 else
                                                                      'encunetamiento' if x == 12 else
                                                                      'estrellamiento' if x == 13 else
                                                                      'perdida carril' if x == 14 else
                                                                       'perdida pista' if x == 15 else
                                                                      'roce negativo' if x == 16 else
                                                                       'roce posositivo' if x == 17 else
                                                                       'rozamiento' if x == 18 else
                                                                       'volcamiento' if x == 19 else
```

С→

```
'volcamiento lateral' if x == 20 else
'volcamiento longitudinal')
```

```
probabilidades_2021_df['causas'] = probabilidades_2021_df['causas'].apply(lambda x:
                                    'conducir en estado de embriaguez' if x == 1 else
                                    'imprudencia del conductor' if x == 2 else
                                    'no ceder el derecho de via' if x == 3 else
                                    'conducir en exceso de velocidad' if x == 4 else
                                    'cambio brusco e indebido de carril' if x == 5 else
                                    'fallas mecanicas no previsibles' if x == 6 else
                                    'no respetar las senales de transito' if x == 7 else
                                    'invadir carril de circulacion' if x == 8 else
                                    'imprudencia del peaton' if x == 9 else
                                    'no mantener la distancia reglamentaria' if x == 10 else
                                    'razones desconocidas' if x == 11 else
                                    'condiciones climaticas desfavorables' if x == 12 else
                                    'negligencia del conductor' if x == 13 else
                                    'no respetar las ordenes del agente de transito' if x == 14 else
                                    'impericia del conductor' if x == 15 else
                                    'cruce de animales en la via')
```

probabilidades_2021_df.sample(10)

/dist-packages/ipykernel/ipkernel.py:283: DeprecationWarning:

ot call `transform_cell` automatically in the future. Please pass the result to `tran

pologia	parroquia_urbana	causas	nro_heridos	nro_fallecidos	probabilidad	prec
llamiento	sucre	conducir en estado de embriaguez	0	0	18.41	
llamiento	sucre	conducir en exceso de velocidad	0	0	18.41	
llamiento	punzara	conducir en exceso de velocidad	1	0	18.41	
llamiento	punzara	conducir en exceso de velocidad	0	0	18.41	
choque lateral angular	el sagrario	imprudencia del conductor	2	0	18.41	
•						•

```
import pandas as pd
import matplotlib.pyplot as plt
from matplotlib.backends.backend_pdf import PdfPages

# Crear una figura y un eje
fig, ax = plt.subplots(figsize=(8, 6))

# Eliminar marcas del eje
ax.axis('off')

# Crear la tabla a partir del DataFrame
tabla = pd.plotting.table(ax, probabilidades_2021_df, loc='center', cellLoc='center', fontsize=14)

# Guardar la tabla en un archivo PDF
with PdfPages('tabla_probabilidades_parroquia_urbana_2021.pdf') as pdf:
    pdf.savefig(fig, bbox_inches='tight')
```

```
/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: Deprecatic `should_run_async` will not call `transform_cell` automatically in the future <frozen importlib._bootstrap>:914: ImportWarning:

APICoreClientInfoImportHook.find_spec() not found; falling back to find_modul <frozen importlib._bootstrap>:914: ImportWarning:

_PyDriveImportHook.find_spec() not found; falling back to find_module() <frozen importlib._bootstrap>:914: ImportWarning:

_OpenCVImportHook.find_spec() not found; falling back to find_module() <frozen importlib._bootstrap>:914: ImportWarning:

_BokehImportHook.find_spec() not found; falling back to find_module() <frozen importlib._bootstrap>:914: ImportWarning:

_AltairImportHook.find_spec() not found; falling back to find_module()
```

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Guardamos el modelo del año 2021

```
from joblib import dump
dump(arbol_modelo, 'modelo_parroquia_urbana2021_python.joblib')

/usr/local/lib/python3.10/dist-packages/ipykernel/ipkernel.py:283: DeprecationWarning:
    `should_run_async` will not call `transform_cell` automatically in the future. Please pass the result to `transformed_cell` argumer
    ['modelo_parroquia_urbana2021_python.joblib']
```

Creamos un nuevo dato para verificar la eficiencia del modelo y la probabilidad del dato

```
#Nuevos datos
import pandas as pd
import numpy as np
x test1 = pd.DataFrame(columns=('dia', 'hora', 'tipologia', 'parroquia urbana', 'causas', 'nro heridos', 'nro fallecidos'))
print(x_test1)
x_{test1.loc[0]} = (1, 9, 9, 2, 10, 10, 10)
print(x_test1)
y_pred1 = arbol_modelo.predict(x_test1.drop(['parroquia_urbana'], axis=1))
print("Predicción: " + str(y_pred1))
y_proba1 = arbol_modelo.predict_proba(x_test1.drop(['parroquia_urbana'], axis=1))
probabilidad_acierto1 = np.round(y_proba1[0][y_pred1] * 100, 2)
print("Probabilidad de Acierto: " + str(probabilidad_acierto1) + "%")
     Empty DataFrame
     Columns: [dia, hora, tipologia, parroquia_urbana, causas, nro_heridos, nro_fallecidos]
     Index: []
       dia hora tipologia parroquia_urbana causas nro_heridos nro_fallecidos
               9
                                                    10
     Predicción: [1]
     Probabilidad de Acierto: [21.48]%
```