Water Quality Analysis using Python.ipynb

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```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
```

```
[5] data = pd.read_csv("water_potability.csv")
    data.head()
```

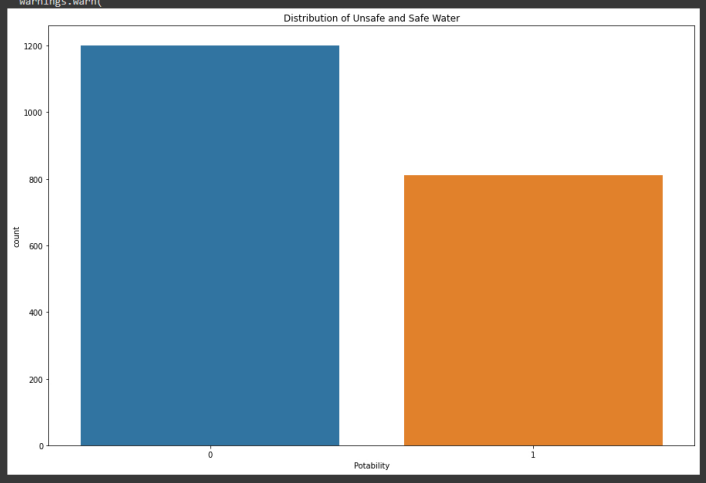
	ph	Hardness	Solids	Chloramines	Sulfate	Conductivity	Organic_carbon	Trihalomethanes	Turbidity	Potability
0	NaN	204.890455	20791.318981	7.300212	368.516441	564.308654	10.379783	86.990970	2.963135	0
1	3.716080	129.422921	18630.057858	6.635246	NaN	592.885359	15.180013	56.329076	4.500656	0
2	8.099124	224.236259	19909.541732	9.275884	NaN	418.606213	16.868637	66.420093	3.055934	0
3	8.316766	214.373394	22018.417441	8.059332	356.886136	363.266516	18.436524	100.341674	4.628771	0
4	9.092223	181.101509	17978.986339	6.546600	310.135738	398.410813	11.558279	31.997993	4.075075	0

```
[6] data = data.dropna()
    data.isnull().sum()
```

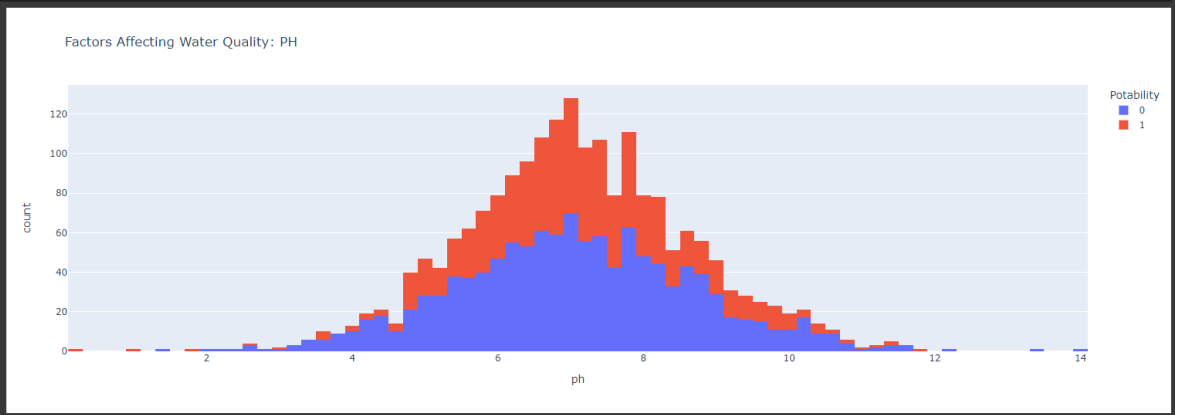
```
ph               0
Hardness         0
Solids           0
Chloramines      0
Sulfate          0
Conductivity     0
Organic_carbon   0
Trihalomethanes  0
Turbidity        0
Potability       0
dtype: int64
```

```
[7] plt.figure(figsize=(15, 10))
    sns.countplot(data.Potability)
    plt.title("Distribution of Unsafe and Safe Water")
    plt.show()
```

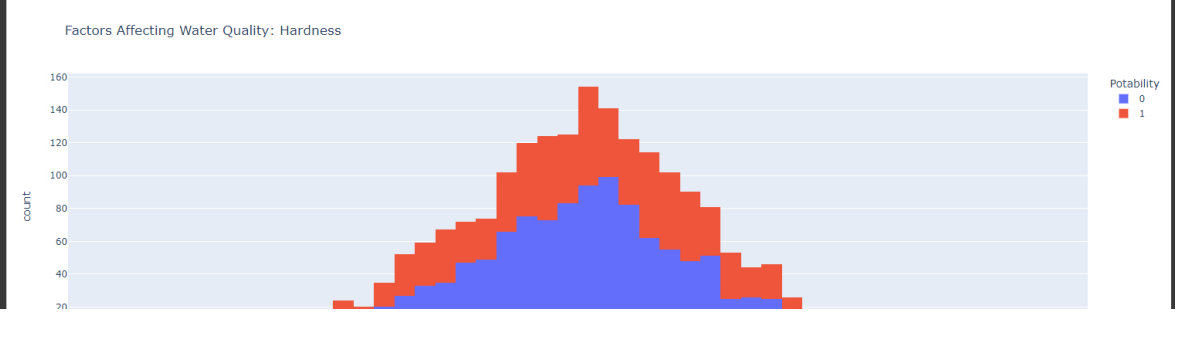
```
/usr/local/lib/python3.8/dist-packages/seaborn/_decorators.py:36: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `dat
  warnings.warn(
```

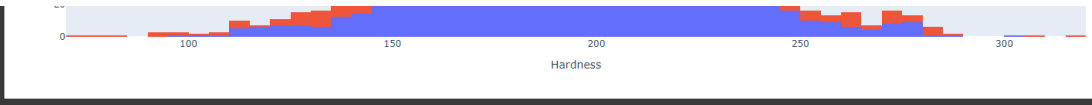



```
[8] import plotly.express as px
    data = data
    figure = px.histogram(data, x = "ph",
                          color = "Potability",
                          title= "Factors Affecting Water Quality: PH")
    figure.show()
```

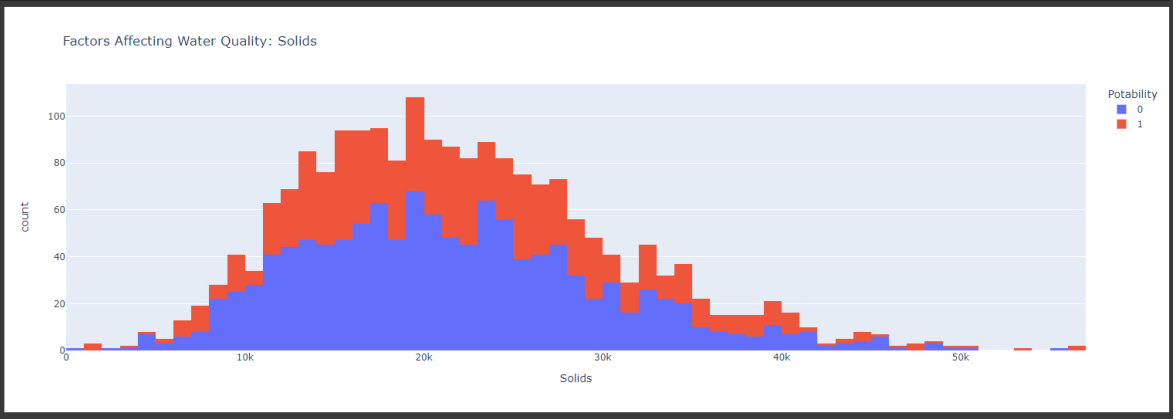



```
[9] figure = px.histogram(data, x = "Hardness",
                          color = "Potability",
                          title= "Factors Affecting Water Quality: Hardness")
    figure.show()
```

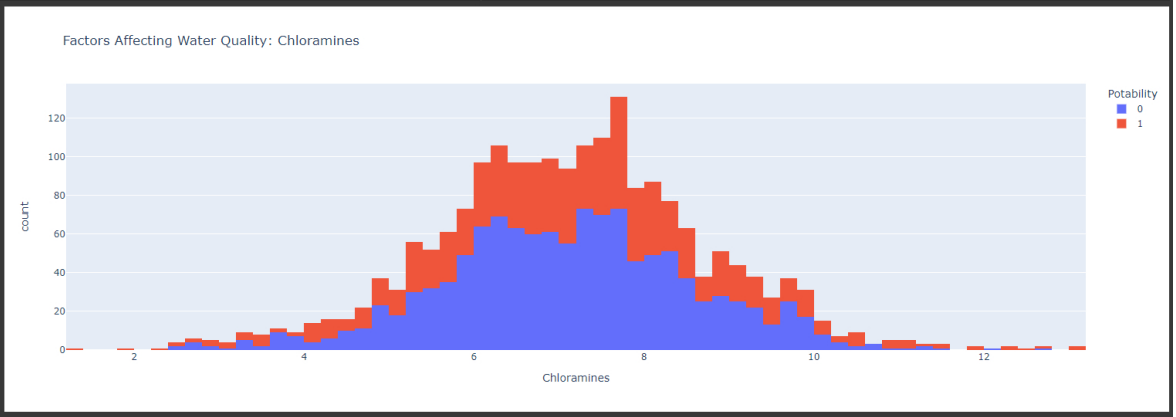




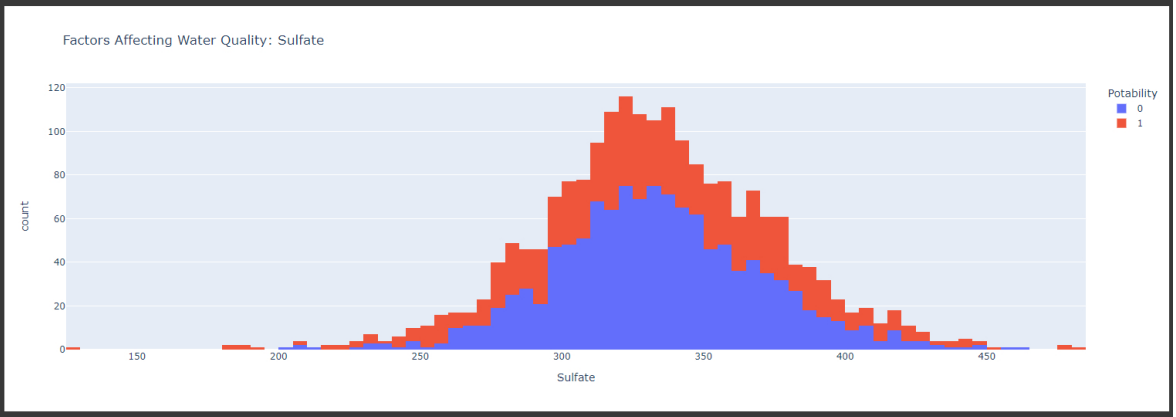

```
[10] figure = px.histogram(data, x = "Solids",
                           color = "Potability",
                           title= "Factors Affecting Water Quality: Solids")
     figure.show()
```



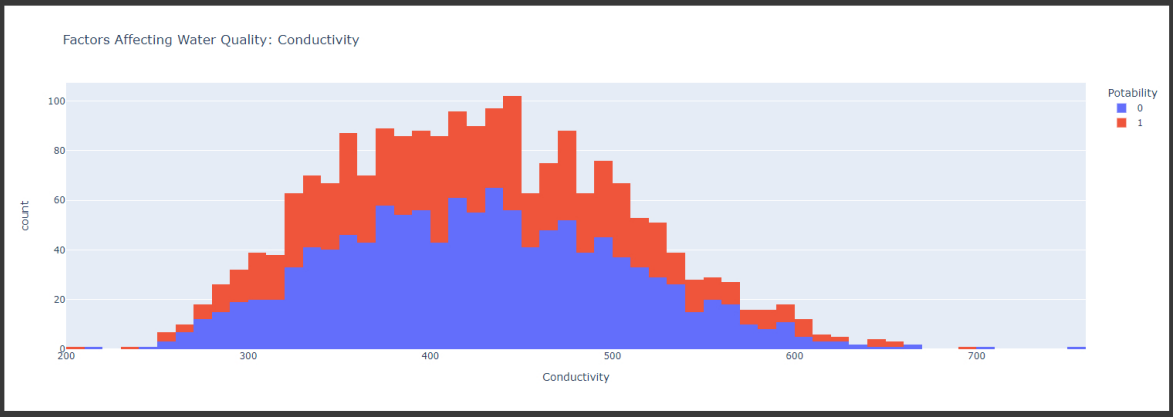

```
[11] figure = px.histogram(data, x = "Chloramines",
                           color = "Potability",
                           title= "Factors Affecting Water Quality: Chloramines")
     figure.show()
```




```
[12] figure = px.histogram(data, x = "Sulfate",
                           color = "Potability",
                           title= "Factors Affecting Water Quality: Sulfate")
     figure.show()
```

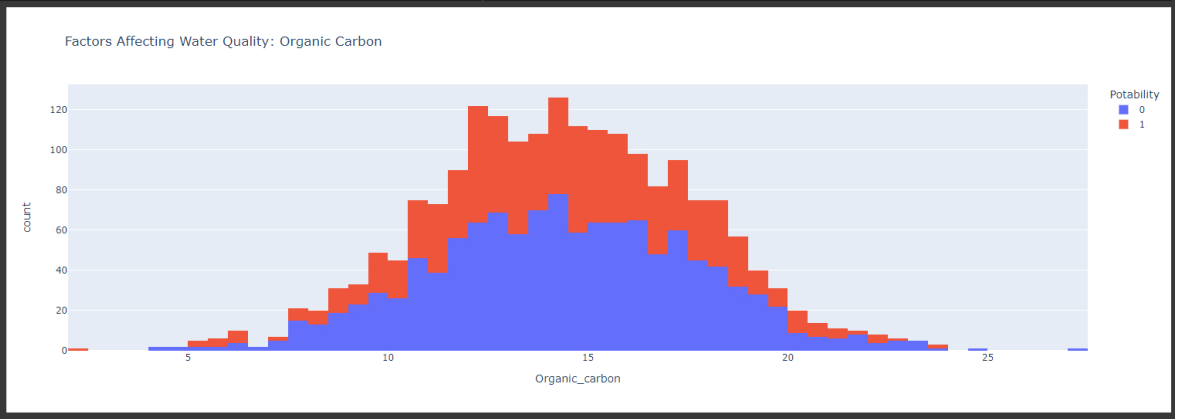



```
[13] figure = px.histogram(data, x = "Conductivity",
                           color = "Potability",
                           title= "Factors Affecting Water Quality: Conductivity")
     figure.show()
```

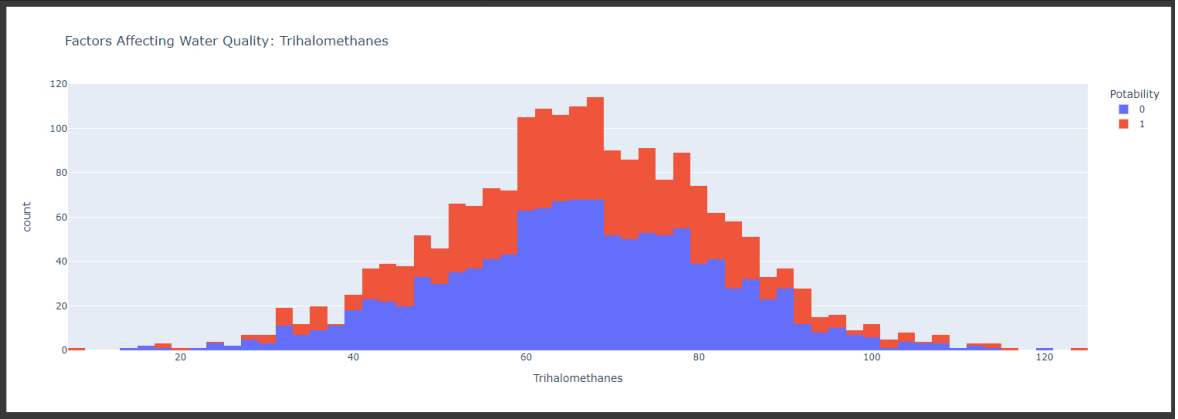



```
[14] figure = px.histogram(data, x = "Organic carbon",
```

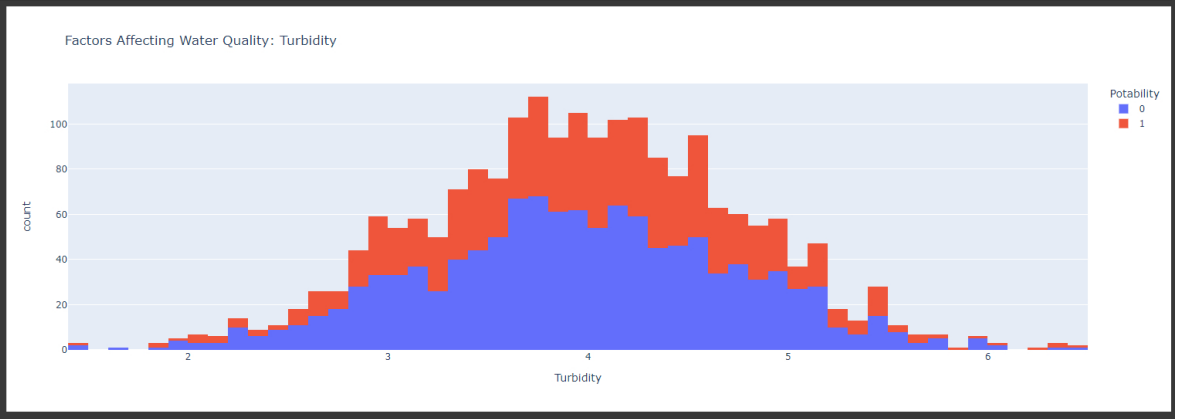
```
                        color = "Potability",
                        title= "Factors Affecting Water Quality: Organic Carbon")
figure.show()
```




```
[15] figure = px.histogram(data, x = "Trihalomethanes",
                        color = "Potability",
                        title= "Factors Affecting Water Quality: Trihalomethanes")
figure.show()
```




```
[16] figure = px.histogram(data, x = "Turbidity",
                        color = "Potability",
                        title= "Factors Affecting Water Quality: Turbidity")
figure.show()
```




```
[17] pip install pycaret
```

```
    Uninstalling scipy-1.7.3:
      Successfully uninstalled scipy-1.7.3
  Attempting uninstall: requests
    Found existing installation: requests 2.25.1
    Uninstalling requests-2.25.1:
      Successfully uninstalled requests-2.25.1
  Attempting uninstall: numba
    Found existing installation: numba 0.56.4
    Uninstalling numba-0.56.4:
      Successfully uninstalled numba-0.56.4
  Attempting uninstall: thinc
    Found existing installation: thinc 8.1.7
    Uninstalling thinc-8.1.7:
      Successfully uninstalled thinc-8.1.7
  Attempting uninstall: statsmodels
    Found existing installation: statsmodels 0.12.2
    Uninstalling statsmodels-0.12.2:
      Successfully uninstalled statsmodels-0.12.2
  Attempting uninstall: scikit-learn
    Found existing installation: scikit-learn 1.0.2
    Uninstalling scikit-learn-1.0.2:
      Successfully uninstalled scikit-learn-1.0.2
  Attempting uninstall: yellowbrick
    Found existing installation: yellowbrick 1.5
    Uninstalling yellowbrick-1.5:
      Successfully uninstalled yellowbrick-1.5
  Attempting uninstall: spacy
    Found existing installation: spacy 3.4.4
    Uninstalling spacy-3.4.4:
      Successfully uninstalled spacy-3.4.4
  Attempting uninstall: mlxtend
    Found existing installation: mlxtend 0.14.0
    Uninstalling mlxtend-0.14.0:
      Successfully uninstalled mlxtend-0.14.0
  Attempting uninstall: lightgbm
    Found existing installation: lightgbm 2.2.3
    Uninstalling lightgbm-2.2.3:
      Successfully uninstalled lightgbm-2.2.3
  Attempting uninstall: imbalanced-learn
    Found existing installation: imbalanced-learn 0.8.1
    Uninstalling imbalanced-learn-0.8.1:
      Successfully uninstalled imbalanced-learn-0.8.1
  Attempting uninstall: pandas-profiling
    Found existing installation: pandas-profiling 1.4.1
    Uninstalling pandas-profiling-1.4.1:
      Successfully uninstalled pandas-profiling-1.4.1
```

```
xarray 2022.12.0 requires numpy>=1.20, but you have numpy 1.19.5 which is incompatible.
xarray-einstats 0.5.1 requires numpy>=1.20, but you have numpy 1.19.5 which is incompatible.
xarray-einstats 0.5.1 requires scipy>=1.6, but you have scipy 1.5.4 which is incompatible.
tensorflow 2.11.0 requires numpy>=1.20, but you have numpy 1.19.5 which is incompatible.
jaxlib 0.3.25+cuda11.cudnn805 requires numpy>=1.20, but you have numpy 1.19.5 which is incompatible.
jax 0.3.25 requires numpy>=1.20, but you have numpy 1.19.5 which is incompatible.
en-core-web-sm 3.4.1 requires spacy<3.5.0,>=3.4.0, but you have spacy 2.3.9 which is incompatible.
confection 0.0.4 requires srsly<3.0.0,>=2.4.0, but you have srsly 1.0.6 which is incompatible.
cmdstanpy 1.1.0 requires numpy>=1.21, but you have numpy 1.19.5 which is incompatible.
Successfully installed Boruta-0.3 Mako-1.2.4 alembic-1.9.3 catalogue-1.0.2 databricks-cli-0.17.4 docker-6.0.1 funcy-1.18 gitdb-4.0.10 gitpython-3.1.30 gunicorn-20.1.0 htmlmin-0.1.12 imagehash-4.
```

[18]
```
correlation = data.corr()
correlation["ph"].sort_values(ascending=False)
```

```
ph                 1.000000
Hardness           0.108948
Organic_carbon     0.028375
Trihalomethanes    0.018278
Potability         0.014530
Conductivity       0.014128
Sulfate            0.010524
Chloramines       -0.024768
Turbidity         -0.035849
Solids            -0.087615
Name: ph, dtype: float64
```

[20]
```
from pycaret.classification import *
clf = setup(data, target = "Potability", silent = True, session_id = 786)
compare_models()
```

	Model	Accuracy	AUC	Recall	Prec.	F1	Kappa	MCC	TT (Sec)
rf	Random Forest Classifier	0.6830	0.7005	0.4197	0.6744	0.5133	0.2976	0.3182	0.514
qda	Quadratic Discriminant Analysis	0.6823	0.7192	0.3985	0.6883	0.5013	0.2917	0.3174	0.023
et	Extra Trees Classifier	0.6816	0.6941	0.3861	0.6858	0.4916	0.2863	0.3123	0.267
lightgbm	Light Gradient Boosting Machine	0.6652	0.6916	0.4762	0.6078	0.5324	0.2781	0.2840	0.178
gbc	Gradient Boosting Classifier	0.6602	0.6735	0.3718	0.6306	0.4667	0.2419	0.2603	0.522
nb	Naive Bayes	0.6184	0.6078	0.2478	0.5545	0.3412	0.1261	0.1462	0.013
dt	Decision Tree Classifier	0.6034	0.5895	0.5186	0.5049	0.5097	0.1775	0.1784	0.024
lr	Logistic Regression	0.5984	0.5199	0.0071	0.1900	0.0134	0.0028	0.0127	0.402
ridge	Ridge Classifier	0.5984	0.0000	0.0089	0.1583	0.0168	0.0035	0.0056	0.018
dummy	Dummy Classifier	0.5984	0.5000	0.0000	0.0000	0.0000	0.0000	0.0000	0.014
lda	Linear Discriminant Analysis	0.5977	0.4903	0.0089	0.1500	0.0167	0.0021	0.0024	0.016
ada	Ada Boost Classifier	0.5956	0.5671	0.2919	0.4896	0.3644	0.0972	0.1034	0.280
knn	K Neighbors Classifier	0.5743	0.5423	0.3644	0.4642	0.4070	0.0826	0.0846	0.023
svm	SVM - Linear Kernel	0.5194	0.0000	0.3982	0.1604	0.2287	-0.0014	-0.0104	0.020

```
INFO:logs:create_model_container: 14
INFO:logs:master_model_container: 14
INFO:logs:display_container: 2
INFO:logs:RandomForestClassifier(bootstrap=True, ccp_alpha=0.0, class_weight=None,
                       criterion='gini', max_depth=None, max_features='auto',
                       max_leaf_nodes=None, max_samples=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, n_estimators=100,
                       n_jobs=-1, oob_score=False, random_state=786, verbose=0,
                       warm_start=False)
INFO:logs:compare_models() succesfully completed.....................................
RandomForestClassifier(bootstrap=True, ccp_alpha=0.0, class_weight=None,
                       criterion='gini', max_depth=None, max_features='auto',
                       max_leaf_nodes=None, max_samples=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, n_estimators=100,
                       n_jobs=-1, oob_score=False, random_state=786, verbose=0,
                       warm_start=False)
```

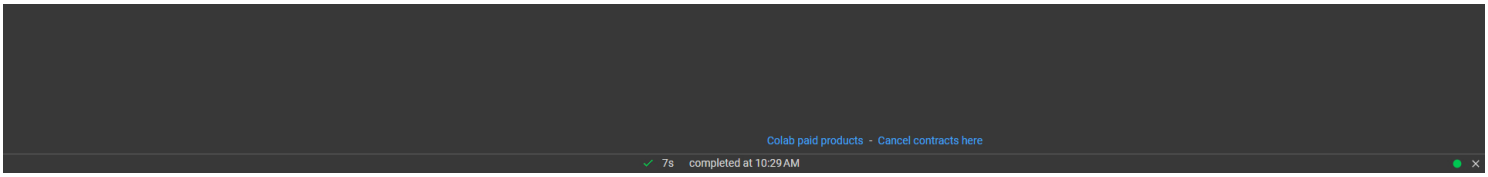
```
model = create_model("rf")
predict = predict_model(model, data=data)
predict.head()
```

2	0.6879	0.7056	0.4386	0.6757	0.5319	0.3134	0.3299
3	0.6738	0.7172	0.3684	0.6774	0.4773	0.2691	0.2955
4	0.6667	0.6885	0.3158	0.6923	0.4337	0.2417	0.2791
5	0.6312	0.6404	0.3929	0.5500	0.4583	0.1904	0.1966
6	0.7092	0.7192	0.5357	0.6667	0.5941	0.3717	0.3771
7	0.6786	0.6988	0.5000	0.6222	0.5545	0.3077	0.3122
8	0.7071	0.7090	0.3750	0.7778	0.5060	0.3322	0.3769
9	0.6857	0.7033	0.4107	0.6765	0.5111	0.2994	0.3196
Mean	0.6830	0.7005	0.4197	0.6744	0.5133	0.2976	0.3182
Std	0.0288	0.0290	0.0637	0.0690	0.0523	0.0640	0.0677

```
INFO:logs:create_model_container: 15
INFO:logs:master_model_container: 15
INFO:logs:display_container: 3
INFO:logs:RandomForestClassifier(bootstrap=True, ccp_alpha=0.0, class_weight=None,
                       criterion='gini', max_depth=None, max_features='auto',
                       max_leaf_nodes=None, max_samples=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, n_estimators=100,
                       n_jobs=-1, oob_score=False, random_state=786, verbose=0,
                       warm_start=False)
INFO:logs:create_model() succesfully completed.....................................
INFO:logs:Initializing predict_model()
INFO:logs:predict_model(estimator=RandomForestClassifier(bootstrap=True, ccp_alpha=0.0, class_weight=None,
                       criterion='gini', max_depth=None, max_features='auto',
                       max_leaf_nodes=None, max_samples=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, n_estimators=100,
                       n_jobs=-1, oob_score=False, random_state=786, verbose=0,
                       warm_start=False), probability_threshold=None, encoded_labels=False, drift_report=False, raw_score=False, round=4, verbose=True, ml_usecase=MLUsecase.CLASSIFICATION, displ
INFO:logs:Checking exceptions
INFO:logs:Preloading libraries
INFO:logs:Preparing display monitor
```

	Model	Accuracy	AUC	Recall	Prec.	F1	Kappa	MCC
0	Random Forest Classifier	0.904	0.9691	0.8237	0.9304	0.8738	0.7968	0.8007

	ph	Hardness	Solids	Chloramines	Sulfate	Conductivity	Organic_carbon	Trihalomethanes	Turbidity	Potability	Label	Score
3	8.316766	214.373394	22018.417441	8.059332	356.886136	363.266516	18.436524	100.341674	4.628771	0	0	0.87
4	9.092223	181.101509	17978.986339	6.546600	310.135738	398.410813	11.558279	31.997993	4.075075	0	0	0.91
5	5.584087	188.313324	28748.687739	7.544869	326.678363	280.467916	8.399735	54.917862	2.559708	0	0	0.83
6	10.223862	248.071735	28749.716544	7.513408	393.663396	283.651634	13.789695	84.603556	2.672989	0	0	0.89
7	8.635849	203.361523	13672.091764	4.563009	303.309771	474.607645	12.363817	62.798309	4.401425	0	0	0.94


Colab paid products - Cancel contracts here
7s completed at 10:29 AM