Metric Code Examples

Viewing the Python code for metrics available in the system is accessible from the application interface:

1. On the metrics catalog page (*Control Panel > Metrics*), select the desired metric, hover over the menu symbol (three dots) on the right side of the corresponding row and click "View".
2. A screen form with information about the metric will open. Scroll down the page and click the "Open code" button in the bottom right corner of the screen form.

Example of a Scalar Metric with a Traffic Light without a Chart

The flags `is_scalar = True` and `is_signal = True` are specified. The methods `scalar` and `signal` are declared and implemented. The methods `__call__` and `save` are declared, but the implementation is omitted.

```
from typing import Literal

import pandas as pd
from sklearn.metrics import mean_absolute_percentage_error


class rvc_3_MAPE:
    """
    Mean Absolute Percentage Error (MAPE). Average absolute error in
percentage

    Attributes:
        __desc__ (str): Description of the class.
        __tags__ (list[str]): List of tags associated with the class.
        is_scalar (bool): Whether the metric is scalar or not.
        is_signal (bool): Whether the metric has signal or not.

    """

    __desc__ = "Mean Absolute Percentage Error (MAPE). Average absolute error
in percentage"
    __tags__ = ["core", "regression", "scalar"]
    is_scalar = True
    is_signal = True

    def __init__(
        self,
        df: pd.DataFrame,
        predict_column: str,
```

```
        target_column: str,
        threshold_yellow: float = 0.3,
        threshold_red: float = 0.4,
    ):
        if df.empty:
            raise Exception("Dataframe is empty")
        if target_column not in df:
            raise ValueError(f"Field {target_column} does not exist in the
dataframe")
        if predict_column not in df:
            raise ValueError(f"Field {predict_column} does not exist in the
dataframe")

        self.predict_column = predict_column
        self.target_column = target_column
        self.df = df.astype({self.predict_column: "float", self.target_column:
"float"})
        self.threshold_yellow = threshold_yellow
        self.threshold_red = threshold_red

    def __call__(self) -> None:
        pass

    def scalar(self) -> int | float:
        df = self.df.loc[:, [self.target_column,
self.predict_column]].dropna()[
            abs(self.df[self.target_column]) > 0
        ]

        self.scalar_value = mean_absolute_percentage_error(
            y_pred=df[self.predict_column],
            y_true=df[self.target_column],
        )

        return self.scalar_value

    def signal(self) -> Literal["red", "yellow", "green"]:
        signal_light = "green"

        if self.scalar_value > self.threshold_red:
            signal_light = "red"
        elif self.scalar_value > self.threshold_yellow:
            signal_light = "yellow"

        return signal_light

    def save(self, output_dir: str) -> dict[str, str] | None:
        pass
```

Result:

MAPE_metric GREEN

0.16

Example of a Scalar Metric with a Traffic Light and a Chart

The flags `is_scalar = True` and `is_signal = True` are specified. The methods `scalar` and `signal` are declared and implemented. The methods `__call__` and `save` are declared and implemented.

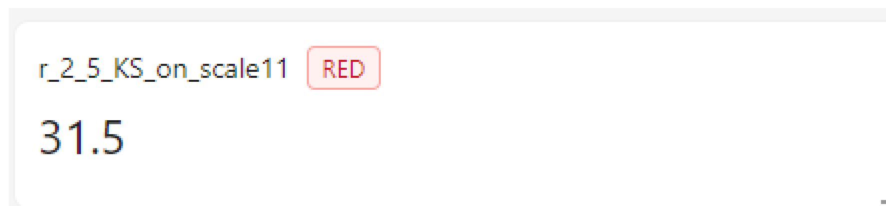
```
from typing import Any, Dict, Literal, Optional

import numpy as np
import pandas as pd
import plotly.graph_objects as go


class r_2_5_KS_on_scale:
    """
    Kolmogorov-Smirnov Test

    Shows how well the model's score separates "good" clients from "bad" ones
in terms of the rating scale.

    Attributes:
        __desc__ (str): Description of the class.
        __tags__ (list[str]): List of tags associated with the class.
        is_scalar (bool): Whether the metric is scalar or not.
        is_signal (bool): Whether the metric has signal or not.

    """

    __desc__ = "KS-test on scale. Kolmogorov-Smirnov Test"
    __tags__ = ["risk", "scalar"]

    is_scalar = True
    is_signal = True

    def __init__(
        self,
        df: pd.DataFrame,
        scale_column: str,
        target_column: str,
        threshold_yellow: float = 10,
        threshold_red: float = 30,
    ):
        self.scale_column = scale_column
        self.target_column = target_column
        self.df = df.astype({self.target_column: "float"})
        self.threshold_yellow = threshold_yellow
```

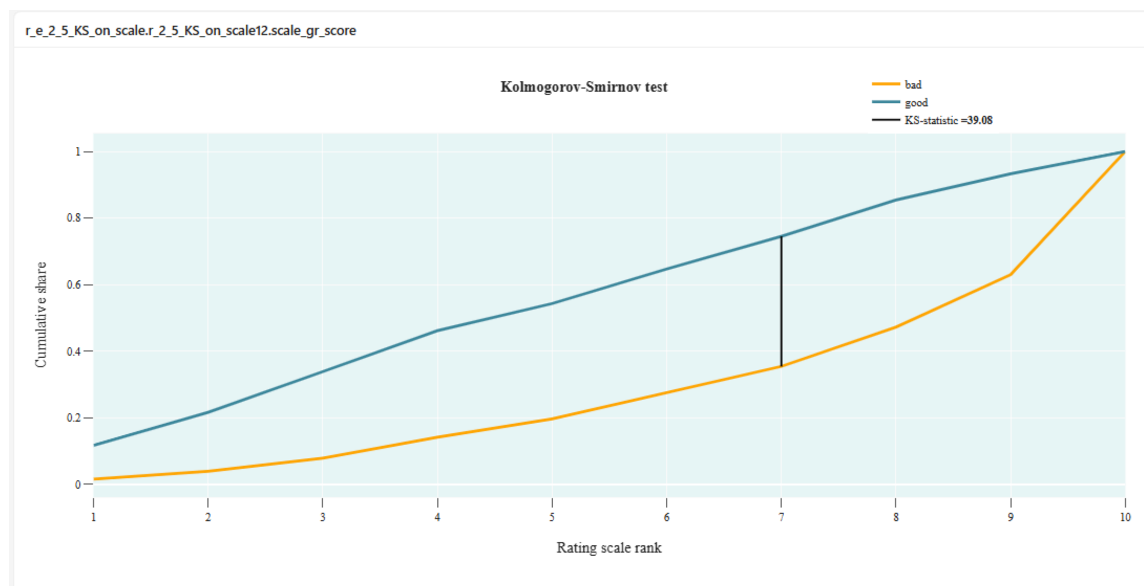
```
        self.threshold_red = threshold_red

        if self.df.empty:
            raise Exception("Dataframe is empty")
        if self.target_column not in self.df:
            raise ValueError(f"Field {self.target_column} does not exist in
the dataframe")
        if self.scale_column not in self.df:
            raise ValueError(f"Field {self.scale_column} does not exist in the
dataframe")
        if self.df[self.scale_column].nunique() > 100:
            raise Exception("Error: the scale variable is not categorical")

    def __call__(self) -> None:
        dataset = self.df.loc[:, [self.target_column,
self.scale_column]].dropna()

        # rating scale digit number
        # (the method of obtaining depends on the data format in the
self.scale column)
        dataset["bin_number"] = dataset[self.scale_column].map(
            lambda x: int(x.split("_")[-1])
        )  # dataset[self.scale].astype('category').cat.codes#

        dataset = dataset.sort_values(by=["bin_number"], ascending=False)

        good_cnt = dataset[dataset[self.target_column] == 0].shape[0]
        bad_cnt = dataset[dataset[self.target_column] == 1].shape[0]

        gr_bad = (
            pd.DataFrame(
                dataset.groupby("bin_number", observed=False)
[self.target_column].sum()
            ).cumsum()
            / bad_cnt
        )
        dataset["target_inverse"] = np.where(dataset[self.target_column] == 1,
0, 1)
        gr_good = (
            pd.DataFrame(
                dataset.groupby("bin_number", observed=False)
["target_inverse"].sum()
            ).cumsum()
            / good_cnt
        )

        ks_calc_temp = pd.merge(gr_good, gr_bad, how="left", left_index=True,
right_index=True)
        ks_calc_temp["diff"] = 0
        ks_calc_temp["diff"] = abs(
            ks_calc_temp.iloc[:, 0:1].values - ks_calc_temp.iloc[:,
1:2].values
        )

        self.scalar_value = 100 * ks_calc_temp["diff"].max()
        ks_result = round(self.scalar_value, 2)
        result_idx = ks_calc_temp["diff"].argmax()
```

```
        x_value1 = gr_bad.index.values.tolist()
        y_value1 = gr_bad[self.target_column].values.astype("float").tolist()
        x_value2 = gr_good.index.values.tolist()
        y_value2 = gr_good["target_inverse"].values.astype("float").tolist()
        x_value3 = [
            float(gr_bad.index.values[result_idx]),
            float(gr_bad.index.values[result_idx]),
        ]
        y_value3 = [
            float(gr_bad[self.target_column].values[result_idx]),
            float(gr_good["target_inverse"].values[result_idx]),
        ]

        line1 = go.Scatter(
            mode="lines",
            x=x_value1,
            y=y_value1,
            name="bad",
            line={"width": 3},
            marker={"color": "#63666A"},
        )
        line2 = go.Scatter(
            mode="lines",
            x=x_value2,
            y=y_value2,
            name="good",
            line={"width": 3},
            marker={"color": "#3eb489"},
        )
        line3 = go.Scatter(
            mode="lines",
            x=x_value3,
            y=y_value3,
            name=f"KS-statistic = {ks_result.astype('float')}",
            marker={"color": "black"},
        )
        self.fig = go.Figure(data=[line1, line2, line3])
        self.fig.layout = self.custom_layout()

    def scalar(self) -> int | float:
        return self.scalar_value

    def signal(self) -> Literal["red", "yellow", "green"]:
        signal_light = "green"

        if self.scalar_value > self.threshold_red:
            signal_light = "red"
        elif self.scalar_value > self.threshold_yellow:
            signal_light = "yellow"

        return signal_light

    def custom_layout(self) -> Optional[Dict[str, Any]]:
        return {
            "title": {"text": "<b>Kolmogorov-Smirnov Test</b>", "x": 0.1, "y":
0.97},
```

```
            "legend": {"yanchor": "bottom", "y": 0.05, "xanchor": "right",
"x": 1},
            "yaxis": {"title": "Cumulative Share", "side": "left"},
            "xaxis": {
                "title": "Rating Scale Digit",
                "side": "left",
                "type": "category",
                "domain": [0, 0.8],
            },
            "margin": {"t": 35, "b": 5, "l": 5, "r": 5},
        }

    def save(self, output_dir: str) -> dict[str, str] | None:
        self.fig.write_html(
            f"{output_dir}/data.html",
            config={"displaylogo": False},  # remove the plotly logo
        )
        return {f"scale_{self.scale_column}": f"{output_dir}/data.html"}
```

Result:





Example of Metric Code with Chart, but without Scalar and Signal

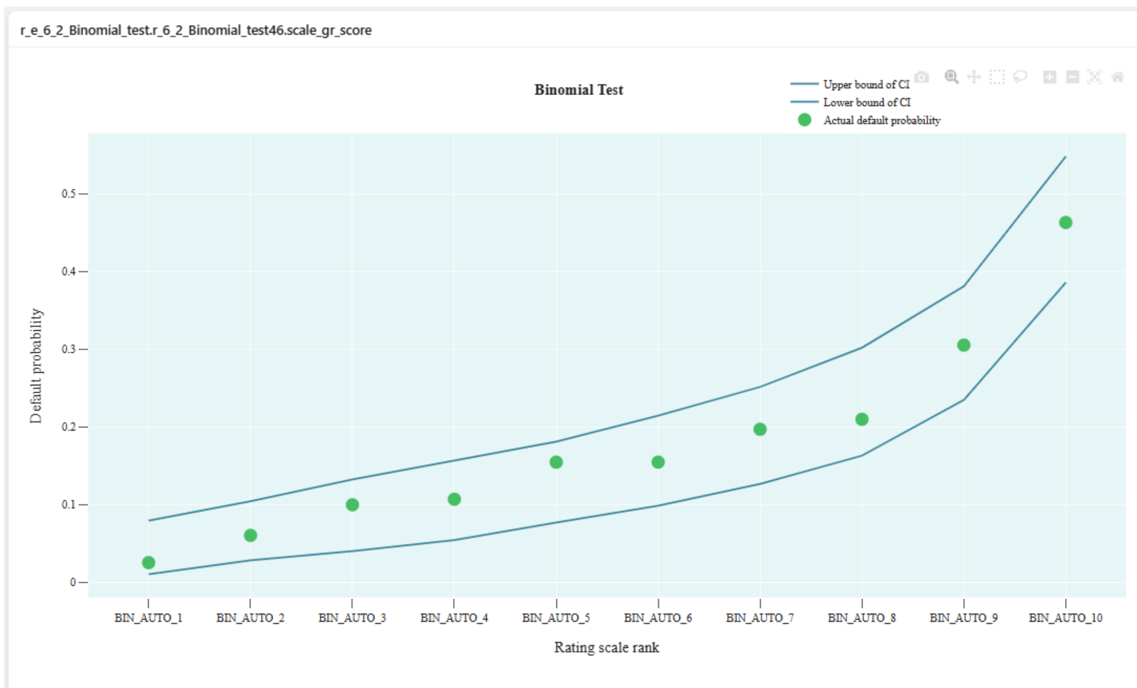
The flags `is_scalar = False` and `is_signal = False` are specified. The methods `scalar` and `signal` are not declared. The methods `__call__` and `save` are declared and implemented.

```python
from typing import Any, Dict, Optional

import numpy as np
import pandas as pd
import plotly.graph_objects as go
from scipy.stats import norm


class r_6_2_Binomial_test:
    """
    Checks the average default level in the rating scale bucket against
    the confidence interval built on the model scores.

    Attributes:
        __desc__ (str): Description of the class.
        __tags__ (list[str]): List of tags associated with the class.
        is_scalar (bool): Whether the metric is scalar or not.
        is_signal (bool): Whether the metric has signal or not.

    """

    __desc__ = "Binomial Test. Биномиальный тест"
    __tags__ = ["risk"]

    is_scalar = False
    is_signal = False

    def __init__(
        self,
        df: pd.DataFrame,
        predict_column: str,
        target_column: str,
        scale_column: str,
        confidence_level: float = 0.99,
    ):
        if predict_column not in df.columns:
            raise ValueError(
                f"Invalid column name for 'predict_column'. "
                f"There is not colomn '{predict_column}' in the dataframe"
            )
        if target_column not in df.columns:
            raise ValueError(
                f"Invalid column name for 'target_column'. "
                f"There is not colomn '{target_column}' in the dataframe"
            )
        if scale_column not in df.columns:
            raise ValueError(
                f"Invalid column name for 'scale_column'. "
                f"There is not colomn '{scale_column}' in the dataframe"
            )

        self.predict_column = predict_column
        self.target_column = target_column
        self.scale_column = scale_column
        self.df = df.astype({self.predict_column: "float", self.target_column:
"float"})
        self.confidence_level = confidence_level
```

```
        if self.df.empty:
            raise ValueError("Dataframe is empty")
        if self.df[self.scale_column].nunique() > 100:
            raise Exception("Error: scale variable is not categorical")

    def __call__(self) -> None:
        data_gr = (
            self.df[[self.scale_column, self.target_column,
self.predict_column]]
            .groupby([self.scale_column], observed=False)
            .agg({self.target_column: ["sum", "count"], self.predict_column:
["mean"]})
            .reset_index()
        )

        data_gr.columns = [self.scale_column, self.target_column, "cnt_all",
self.predict_column]
        data_gr["target_prc"] = data_gr[self.target_column] /
data_gr["cnt_all"]

        data_gr["CI_LEFT"] = data_gr[self.predict_column] - norm.ppf(
            self.confidence_level
        ) * np.sqrt(
            (data_gr[self.predict_column] * (1 -
data_gr[self.predict_column])) / data_gr["cnt_all"]
        )
        data_gr["CI_RIGHT"] = data_gr[self.predict_column] + norm.ppf(
            self.confidence_level
        ) * np.sqrt(
            (data_gr[self.predict_column] * (1 -
data_gr[self.predict_column])) / data_gr["cnt_all"]
        )

        data_gr["color"] = data_gr.apply(
            lambda x: "green"
            if (x["target_prc"] >= x["CI_LEFT"]) & (x["target_prc"] <=
x["CI_RIGHT"])
            else "red",
            axis=1,
        )

        data_gr = data_gr.sort_values(self.scale_column, key=lambda x:
x.str[-3:])
        # sorting above is specific to the particular df,
        # pay attention to the format of entries in the scale column
        # when running on new data

        line1 = go.Scatter(
            mode="lines",
            x=data_gr[self.scale_column].tolist(),
            y=data_gr["CI_RIGHT"].tolist(),
            name="Upper CI Bound",
            marker={"color": "#23654D"},
            xaxis="x1",
            yaxis="y1",
        )
```

```
        line2 = go.Scatter(
            mode="lines",
            x=data_gr[self.scale_column].tolist(),
            y=data_gr["CI_LEFT"].tolist(),
            name="Lower CI Bound",
            marker={"color": "#23654D"},
            xaxis="x1",
            yaxis="y1",
        )
        line3 = go.Scatter(
            mode="markers",
            x=data_gr[self.scale_column].tolist(),
            y=data_gr["target_prc"].tolist(),
            name="Actual Default Probability",
            marker={"color": data_gr["color"].tolist(), "size": 24},
            xaxis="x1",
            yaxis="y1",
        )

        self.fig = go.Figure(data=[line1, line2, line3])
        self.fig.layout = self.custom_layout()

    def custom_layout(self) -> Optional[Dict[str, Any]]:
        return {
            "title": {"text": "<b>Binomial Test</b>", "x": 0.1, "y": 0.97},
            "legend": {"yanchor": "bottom", "y": 0.01, "xanchor": "left", "x":
1},
            "yaxis": {"title": "Default Probability", "side": "left"},
            "xaxis": {
                "title": "Rating Scale Tier",
                "side": "right",
                "type": "category",
                "domain": [0, 1],
            },
            "margin": {"t": 35, "b": 5, "l": 5, "r": 5},
        }

    def save(self, output_dir: str) -> dict[str, str] | None:
        self.fig.write_html(
            f"{output_dir}/data.html",
            config={"displaylogo": False},  # remove the plotly logo
        )
        return {f"scale_{self.scale_column}": f"{output_dir}/data.html"}
```

Result:



Example of Metric Code with Multiple Charts

The methods `__call__` and `save` are declared and implemented.

In the `save` method, charts are created in a loop.

```
from typing import Any, Dict, Optional

import pandas as pd
import plotly.graph_objects as go


class cd_2_4_Density_Distr_features:
    """
    Density Distribution for Selected Columns
    Attributes:
        __desc__ (str): Description of the class.
        __tags__ (list[str]): List of tags associated with the class.
        is_scalar (bool): Whether the metric is scalar or not.
        is_signal (bool): Whether the metric has signal or not.

    """

    __desc__ = (
        "Density Distribution for Selected Columns. Density distribution for
selected fields"
    )
    __tags__ = ["core", "data"]

    is_scalar = False
    is_signal = False
```

```
    def __init__(
        self,
        df: pd.DataFrame,
        field_columns: str,
        categorial_threshold: int = 10,
        split_charts: bool = False,
    ):
        self.df = df
        self.categorial_threshold = categorial_threshold
        self.split_charts = split_charts
        self.field_columns = [x.strip() for x in field_columns.split(",")]
        if self.df.empty:
            raise Exception("Dataframe is empty")
        for field in self.field_columns:
            if field not in self.df:
                raise ValueError(f"Field {field} does not exist in the
dataframe")

    def __call__(self) -> None:
        self.df = self.df[self.field_columns]
        charts_dict = self.create_fields_charts()

        if self.split_charts:
            self.figs = {
                column_name: go.Figure(
                    data=[chart],
layout=self.custom_layout(column_name=column_name)
                )
                for column_name, chart in charts_dict.items()
            }
        else:
            self.fig = go.Figure(data=list(charts_dict.values()),
layout=self.custom_layout())

    def create_fields_charts(self):
        signal = {}
        self.min_x = 0
        self.max_x = 0
        counted_labels = []

        # loop through all columns in df
        for columnName, columnData in self.df.items():
            # if the data in the column is not numeric, skip it
            if not pd.api.types.is_numeric_dtype(columnData):
                print(f'Column "{columnName}" type is not numeric')
                continue

            counted_labels.append(columnName)
            visible_mode = (
                "legendonly" if columnName != counted_labels[0] and not
self.split_charts else True
            )

            # if the data in the column is categorical, build a histogram
            if columnData.nunique() <= self.categorial_threshold:
                freq_df = (
                    columnData.value_counts(normalize=True, sort=False,
```

```
dropna=True)
                    .reset_index()
                    .sort_values(columnName)
                )

                freq_df["percent"] = freq_df["proportion"] * 100
                if self.split_charts:
                    freq_df[columnName] = freq_df[columnName].astype("string")

                elem = go.Bar(
                    x=freq_df[columnName].tolist(),
                    y=freq_df["percent"].tolist(),
                    name=columnName,
                    opacity=0.7,
                    marker=dict(line=dict(color="black", width=1.0)),
                    visible=visible_mode,
                )
                signal[columnName] = elem
                continue

            # otherwise - linear density distribution graph
            vals = columnData.dropna().values
            nbucket = int(len(vals) / 10) + 1
            den_x = []
            den_y = []
            wgth = (max(vals) - min(vals)) / nbucket  # width of one interval
            minval = min(vals)
            self.max_x = max(max(vals), self.max_x)
            self.min_x = min(min(vals), self.min_x)
            self.max_pos = 0

            for i in range(0, nbucket):
                count = 0
                for j in vals:
                    if (minval + i * wgth) <= j < (minval + (i * wgth) +
wgth):
                        count = count + 1
                den_x.append(round((minval + i * wgth + wgth / 2), 6))
                den_y.append(round(count * 100 / (len(vals)), 6))

            elem = go.Scatter(
                x=den_x,
                y=den_y,
                name=columnName,
                mode="lines",
                line_width=4,
                line_dash="solid",
                visible=visible_mode,
            )

            self.max_pos = max(max(den_y), self.max_pos)

            signal[columnName] = elem

        return signal

    def custom_layout(self, column_name: str | None = None) ->
```

```
Optional[Dict[str, Any]]:
        column_info = (
            " of selected columns" if column_name is None else f" for column
<b>{column_name}</b>"
        )
        return {
            "title": {"text": f"<b>Density Distribution</b>{column_info}",
"x": 0.1, "y": 0.98},
            "legend": {"yanchor": "bottom", "y": 0.05, "xanchor": "right",
"x": 1},
            "xaxis": {
                "title": "Value",
                "side": "left",
                "showgrid": True,
                "zeroline": True,
                "gridcolor": "#bdbdbd",
                "gridwidth": 1.5,
                "zerolinecolor": "#969696",
                "zerolinewidth": 3,
            },
            "yaxis": {
                "title": "Probability, %",
                "side": "left",
                "showgrid": True,
                "zeroline": True,
                "gridcolor": "#bdbdbd",
                "gridwidth": 1.5,
                "zerolinecolor": "#969696",
                "zerolinewidth": 3,
            },
            "margin": {"t": 45, "b": 5, "l": 5, "r": 5},
        }

    def save(self, output_dir: str) -> dict[str, str] | None:
        if self.split_charts:
            result = {}
            for column_name, fig in self.figs.items():
                file_path = f"{output_dir}/data_{column_name}.html"
                fig.write_html(
                    file_path,
                    config={"displaylogo": False},  # remove the plotly logo
                )

                result[column_name] = file_path
            return result
        else:
            self.fig.write_html(
                f"{output_dir}/data.html",
                config={"displaylogo": False},  # remove the plotly logo
            )

            return {"fig_name": f"{output_dir}/data.html"}
```

Result:

Example of Metric Code that Saves the Result as an Image

The methods `__call__` and `save` are declared and implemented.

In the `save` method, the graphs are saved as images, not HTML files.

```
from typing import Any, Dict, Literal, Optional

import numpy as np
import pandas as pd
from sklearn.metrics import roc_auc_score, roc_curve
import matplotlib.pyplot as plt


class ROC_AUC_img:
    """
    ROC-AUC Value and ROC Curve Plot

    Attributes:
        __desc__ (str): Description of the class.
        __tags__ (list[str]): List of tags associated with the class.
        is_scalar (bool): Whether the metric is scalar or not.
        is_signal (bool): Whether the metric has signal or not.

    """

    __desc__ = "ROC Curve Plot, ROC-AUC Value"
    __tags__ = ["core", "classification", "scalar"]
```

```
    is_scalar = True
    is_signal = True

    def __init__(
        self,
        df: pd.DataFrame,
        predict_column: str,
        target_column: str,
        threshold_yellow: float = 0.75,
        threshold_red: float = 0.65,
    ):
        self.predict_column = predict_column
        self.target_column = target_column
        self.df = df.astype({self.predict_column: "float", self.target_column:
"float"})
        self.threshold_yellow = threshold_yellow
        self.threshold_red = threshold_red

        if self.df.empty:
            raise Exception("Dataframe is empty")
        if self.target_column not in self.df:
            raise ValueError(f"Field {self.target_column} does not exist in
the dataframe")
        if self.predict_column not in self.df:
            raise ValueError(f"Field {self.predict_column} does not exist in
the dataframe")
        if self.predict_column == self.target_column:
            raise Exception("Error. Check the selection of columns for
calculation")

    def __call__(self) -> None:
        temp = self.df.loc[:, [self.target_column,
self.predict_column]].dropna()
        preds = temp[self.predict_column]
        y_test = temp[self.target_column]

        fpr, tpr, threshold = roc_curve(y_test, preds)
        fpr = np.around(fpr, decimals=4).tolist()
        tpr = np.around(tpr, decimals=4).tolist()
        base_roc = np.around(np.linspace(0, 1, 10), decimals=2).tolist()

        self.scalar_value = float(
            roc_auc_score(temp[self.target_column], temp[self.predict_column])
        )
        self.fig, ax = plt.subplots()
        ax.plot(fpr, tpr)
        ax.set(xlabel='False Positive Rate', ylabel='True Positive Rate',
title='ROC Curve')
        ax.grid()

    def scalar(self) -> int | float:
        return self.scalar_value

    def signal(self) -> Literal["red", "yellow", "green"]:
        signal_light = "green"
```

```
        if self.scalar_value < self.threshold_red:
            signal_light = "red"
        elif self.scalar_value < self.threshold_yellow:
            signal_light = "yellow"

        return signal_light

    def save(self, output_dir: str) -> dict[str, str] | None:
        self.fig.savefig(f"{output_dir}/data.svg")
        return {"svg": f"{output_dir}/data.svg"}
```

Result: