In [14]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import pickle
from sklearn.metrics import accuracy_score, roc_curve, auc
import warnings
warnings.filterwarnings("ignore")
```

**Loading categorical features calculated from eda & feature engineering**

In [15]:

```
lead_time_mean = float(np.load('C:/Users/ganesh.chandra/Proj 87- Determinig items for sho
rtage prior occurence- Inventory Mgmt/lead_time_mean.npy'))
potential_issue_probability_matrix = pd.read_csv('C:/Users/ganesh.chandra/Proj 87- Determ
inig items for shortage prior occurence- Inventory Mgmt/potential_issue_probability_matri
x.csv')
deck_risk_probability_matrix = pd.read_csv('C:/Users/ganesh.chandra/Proj 87- Determinig i
tems for shortage prior occurence- Inventory Mgmt/deck_risk_probability_matrix.csv')
oe_constraint_probability_matrix = pd.read_csv('C:/Users/ganesh.chandra/Proj 87- Determin
ig items for shortage prior occurence- Inventory Mgmt/oe_constraint_probability_matrix.cs
v')
ppap_risk_probability_matrix = pd.read_csv('C:/Users/ganesh.chandra/Proj 87- Determinig i
tems for shortage prior occurence- Inventory Mgmt/ppap_risk_probability_matrix.csv')
stop_auto_buy_probability_matrix = pd.read_csv('C:/Users/ganesh.chandra/Proj 87- Determin
ig items for shortage prior occurence- Inventory Mgmt/stop_auto_buy_probability_matrix.cs
v')
rev_stop_probability_matrix = pd.read_csv('C:/Users/ganesh.chandra/Proj 87- Determinig it
ems for shortage prior occurence- Inventory Mgmt/rev_stop_probability_matrix.csv')

data = pd.read_csv("C:/Users/ganesh.chandra/Proj 87- Determinig items for shortage prior
occurence- Inventory Mgmt/Kaggle_Test_Dataset_v2.csv")

y = data['went_on_backorder']
x = data.drop('went_on_backorder', axis=1)
```

# Model interpretability: Instance level

In [16]:

```
def final_fun_1(x):
    """
    Takes the dataframe as input and predicts if the products have gone into backorder or
not. 0 indicates the product has not gone into backorder
    and 1 indicates, the product has gone into backorder.
    """
    if type(x) == dict:
        dataframe = pd.DataFrame(x, index=[0], columns=['sku', 'national_inv', 'lead_tim
e', 'in_transit_qty',
                                                     'forecast_3_month', 'forecast_6_mon
th', 'forecast_9_month',
                                                     'sales_1_month', 'sales_3_month', '
sales_6_month', 'sales_9_month',
                                                     'min_bank', 'potential_issue', 'pie
ces_past_due', 'perf_6_month_avg',
                                                     'perf_12_month_avg', 'local_bo_qty'
, 'deck_risk', 'oe_constraint',
                                                     'ppap_risk', 'stop_auto_buy', 'rev_
stop'])
    else:
        dataframe = x

    dataframe = dataframe.drop('sku', axis=1) #dropping sku column
    if dataframe.iloc[-1].isna().all() == True:
        dataframe = dataframe[:-1] #removing last row as there are NaN values

    dataframe = dataframe.fillna(lead_time_mean) #mean imputation
    dataframe.replace({'Yes': 1, 'No': 0}, inplace=True) #converting categorical feature
s into binary features

    #adding binary_pieces_past_due
    conditions = [dataframe['pieces_past_due'] == 0, dataframe['pieces_past_due'] > 0]
    values = [0, 1]
    dataframe['binary_pieces_past_due'] = np.select(conditions, values)

    #adding binary_local_bo_qty
    conditions = [dataframe['local_bo_qty'] == 0, dataframe['local_bo_qty'] > 0]
    values = [0, 1]
    dataframe['binary_local_bo_qty'] = np.select(conditions, values)

    #imputing all categorical features
    conditions_pt = [dataframe['potential_issue'] == 0, dataframe['potential_issue'] ==
1]
    values_pt = [potential_issue_probability_matrix['No'][0], potential_issue_probabilit
y_matrix['No'][1]]
    dataframe['potential_issue'] = np.select(conditions_pt, values_pt)

    conditions_dr = [dataframe['deck_risk'] == 0, dataframe['deck_risk'] == 1]
    values_dr = [deck_risk_probability_matrix['No'][0], deck_risk_probability_matrix['No'
][1]]
    dataframe['deck_risk'] = np.select(conditions_dr, values_dr)

    conditions_oe = [dataframe['oe_constraint'] == 0, dataframe['oe_constraint'] == 1]
    values_oe = [oe_constraint_probability_matrix['No'][0], oe_constraint_probability_ma
trix['No'][1]]
    dataframe['oe_constraint'] = np.select(conditions_oe, values_oe)

    conditions_pp = [dataframe['ppap_risk'] == 0, dataframe['ppap_risk'] == 1]
    values_pp = [ppap_risk_probability_matrix['No'][0], ppap_risk_probability_matrix['No'
][1]]
    dataframe['ppap_risk'] = np.select(conditions_pp, values_pp)

    conditions_stp = [dataframe['stop_auto_buy'] == 0, dataframe['stop_auto_buy'] == 1]
    values_stp = [stop_auto_buy_probability_matrix['No'][0], stop_auto_buy_probability_m
atrix['No'][1]]
    dataframe['stop_auto_buy'] = np.select(conditions_stp, values_stp)

    conditions_rev = [dataframe['rev_stop'] == 0, dataframe['rev_stop'] == 1]
    values_rev = [rev_stop_probability_matrix['No'][0], rev_stop_probability_matrix['No'
][1]]
    dataframe['rev_stop'] = np.select(conditions_rev, values_rev)

    filename = 'best_model_forest.h5'
    best_model = pickle.load(open(filename, 'rb'))
    predictions = best_model.predict(dataframe)
    if len(predictions) == 1:
        predictions = int(predictions)
    return predictions
a = final_fun_1(x) #taking entire dataframe as input
one_datapoint = dict(x.loc[0])
print(one_datapoint)
```

```
{'sku': 3285085, 'national_inv': 62.0, 'lead_time': nan, 'in_transit_qty': 0.0, 'forecast
_3_month': 0.0, 'forecast_6_month': 0.0, 'forecast_9_month': 0.0, 'sales_1_month': 0.0, '
sales_3_month': 0.0, 'sales_6_month': 0.0, 'sales_9_month': 0.0, 'min_bank': 1.0, 'potent
ial_issue': 'No', 'pieces_past_due': 0.0, 'perf_6_month_avg': -99.0, 'perf_12_month_avg':
-99.0, 'local_bo_qty': 0.0, 'deck_risk': 'Yes', 'oe_constraint': 'No', 'ppap_risk': 'No',
'stop_auto_buy': 'Yes', 'rev_stop': 'No'}
```

In [17]:

```
final_fun_1(one_datapoint) #taking one datapoint(dict) as input
```

Out[17]:

```
0
```

## Model interpretability: Overall Model level

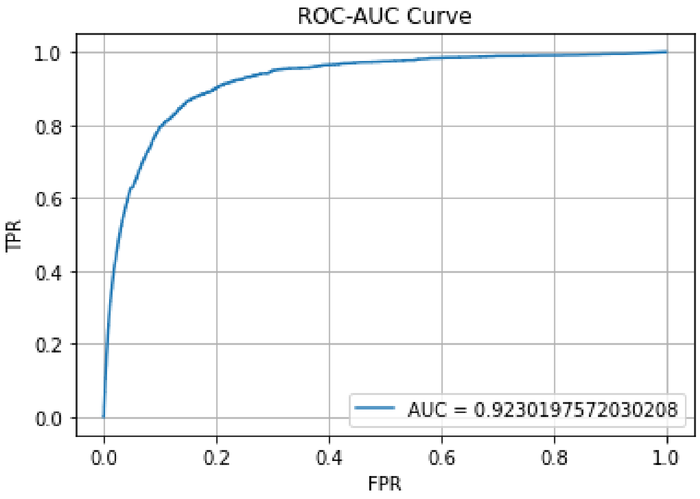
In [18]:

```
def final_fun_2(x, y):
    """
    Takes the input dataframe and the target label as input and makes prediction. These predictions and then used to compute the performance
    of the model. Metrics shown are accuracy, precision, recall, AUC and confusion matrix.
    """
    if np.isnan(y.iloc[-1]) == True:
        y = y[:-1]
        y.replace({'Yes': 1, 'No': 0}, inplace=True)
    else:
        y.replace({'Yes': 1, 'No': 0}, inplace=True)

    x = x.drop('sku', axis=1)
    #removing last row if they are all NaN
    if x.iloc[-1].isna().all() == True:
        x = x[:-1]

    x = x.fillna(lead_time_mean) #mean imputation
    x.replace({'Yes': 1, 'No': 0}, inplace=True) #converting categorical features into binary features

    #adding binary_pieces_past_due
    conditions = [x['pieces_past_due'] == 0, x['pieces_past_due'] > 0]
    values = [0, 1]
    x['binary_pieces_past_due'] = np.select(conditions, values)

    #adding binary_local_bo_qty
    conditions = [x['local_bo_qty'] == 0, x['local_bo_qty'] > 0]
    values = [0, 1]
    x['binary_local_bo_qty'] = np.select(conditions, values)

    #imputing all categorical features
    conditions_pt = [x['potential_issue'] == 0, x['potential_issue'] == 1]
    values_pt = [potential_issue_probability_matrix['No'][0], potential_issue_probability_matrix['No'][1]]
    x['potential_issue'] = np.select(conditions_pt, values_pt)

    conditions_dr = [x['deck_risk'] == 0, x['deck_risk'] == 1]
    values_dr = [deck_risk_probability_matrix['No'][0], deck_risk_probability_matrix['No'][1]]
    x['deck_risk'] = np.select(conditions_dr, values_dr)

    conditions_oe = [x['oe_constraint'] == 0, x['oe_constraint'] == 1]
    values_oe = [oe_constraint_probability_matrix['No'][0], oe_constraint_probability_matrix['No'][1]]
    x['oe_constraint'] = np.select(conditions_oe, values_oe)

    conditions_pp = [x['ppap_risk'] == 0, x['ppap_risk'] == 1]
    values_pp = [ppap_risk_probability_matrix['No'][0], ppap_risk_probability_matrix['No'][1]]
    x['ppap_risk'] = np.select(conditions_pp, values_pp)

    conditions_stp = [x['stop_auto_buy'] == 0, x['stop_auto_buy'] == 1]
    values_stp = [stop_auto_buy_probability_matrix['No'][0], stop_auto_buy_probability_matrix['No'][1]]
    x['stop_auto_buy'] = np.select(conditions_stp, values_stp)

    conditions_rev = [x['rev_stop'] == 0, x['rev_stop'] == 1]
    values_rev = [rev_stop_probability_matrix['No'][0], rev_stop_probability_matrix['No'][1]]
    x['rev_stop'] = np.select(conditions_rev, values_rev)

    filename = 'best_model_forest.h5'
    best_model = pickle.load(open(filename, 'rb'))
    predictions = best_model.predict(x)

    #printing metrics
    print('Accuracy:', accuracy_score(y, predictions))
    #plotting confurion matrix
    y_pred = best_model.predict_proba(x)[:,1]
    fpr, tpr, thresholds = roc_curve(y, y_pred)
    print('AUC:', auc(fpr, tpr))
    plt.plot(fpr, tpr, label="AUC ="+' '+str(auc(fpr, tpr)))
    plt.legend()
    plt.xlabel("FPR")
    plt.ylabel("TPR")
    plt.title("ROC-AUC Curve")
    plt.grid()
    plt.show()
```

In [19]:

```
final_fun_2(x, y)
```

```
Accuracy: 0.9620902612826603
AUC: 0.9230197572030208
```


ROC-AUC Curve
TPR
AUC = 0.9230197572030208
FPR