p_regression_QNJL

In [132]:

```
# imports
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.metrics import mean_squared_error
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import PolynomialFeatures
from sklearn.linear_model import Ridge
from sklearn.linear_model import LinearRegression
from sklearn.metrics import r2_score, mean_absolute_error
from sklearn.model_selection import cross_val_score
```

In [133]:

```
# dataset phat

DATA_PHAT = '../dataset/'
DATA_PATH_TRUE = 'DS-5-1-GAP-0-1-N-0_v2.csv'
DATA_PATH_NOISE1 = 'DS-5-1-GAP-1-1-N-1_v2.csv'
DATA_PATH_NOISE2 = 'DS-5-1-GAP-5-1-N-3_v2.csv'
```

In [134]:

```
df_true = pd.read_csv(DATA_PHAT + DATA_PATH_TRUE, header=None)
df_noise1 = pd.read_csv(DATA_PHAT + DATA_PATH_NOISE1,header=None)
df_noise2 = pd.read_csv(DATA_PHAT + DATA_PATH_NOISE2,header=None)
```

In [135]:

```
df_true.head(5)
```

Out[135]:

	0	1	2
0	0.00	17.49	17.04
1	2.12	17.65	17.17
2	3.06	17.70	17.24

	0	1	2
3	4.16	17.73	17.33
4	4.93	17.75	17.39

In [136]:

```
df_noise1.head(5)
```

Out[136]:

	0	1	2	3	4	5	6	7	8	9	...	191	192	193
0	0.00	17.49	17.50	17.49	17.49	17.50	17.49	17.50	17.49	17.49	...	17.04	17.04	17.05
1	2.12	17.65	17.65	17.64	17.64	17.65	17.65	17.65	17.64	17.65	...	17.16	17.17	17.18
2	3.06	17.69	17.70	17.70	17.69	17.69	17.70	17.69	17.69	17.70	...	17.25	17.24	17.24
3	4.16	17.74	17.73	17.74	17.73	17.74	17.74	17.74	17.74	17.73	...	17.33	17.32	17.33
4	4.93	17.75	17.74	17.73	17.74	17.74	17.75	17.75	17.75	17.74	...	17.38	17.39	17.39

5 rows × 201 columns

In [137]:

```
df_noise2.head(5)
```

Out[137]:

	0	1	2	3	4	5	6	7	8	9	...	191	192	193
0	0.00	17.61	17.55	17.48	17.46	17.43	17.53	17.35	17.66	17.60	...	17.16	17.03	17.12
1	2.12	17.71	17.55	17.70	17.52	17.67	17.62	17.76	17.73	17.63	...	17.24	17.17	17.24
2	3.06	17.68	17.77	17.61	17.72	17.73	17.78	17.80	17.81	17.68	...	17.42	17.27	17.22
3	4.16	17.62	17.72	17.66	17.69	17.75	17.65	17.82	17.78	17.86	...	17.32	17.28	17.25
4	4.93	17.80	17.54	17.66	17.71	17.82	17.69	17.70	17.81	17.82	...	17.33	17.46	17.39

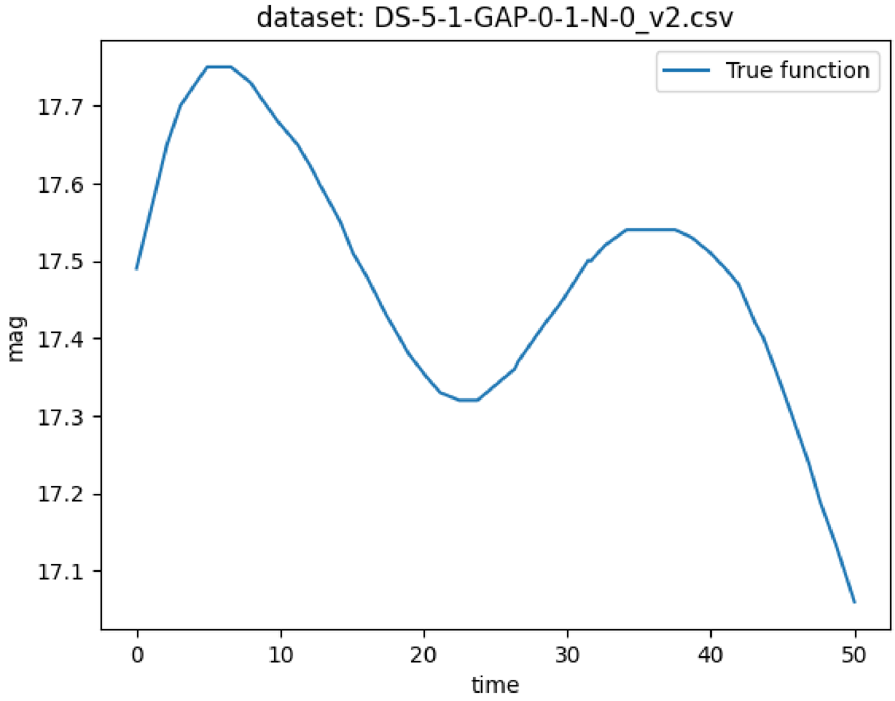
5 rows × 201 columns

In [138]:

```
#true
plt.plot(df_true[0], df_true[1], label="True function")
plt.xlabel("time")
plt.ylabel("mag")
plt.legend(loc="best")
plt.title("dataset: "+ DATA_PATH_TRUE)
```

Out[138]:

```
Text(0.5, 1.0, 'dataset: DS-5-1-GAP-0-1-N-0_v2.csv')
```



Polynomial regression on nonlinear data¶

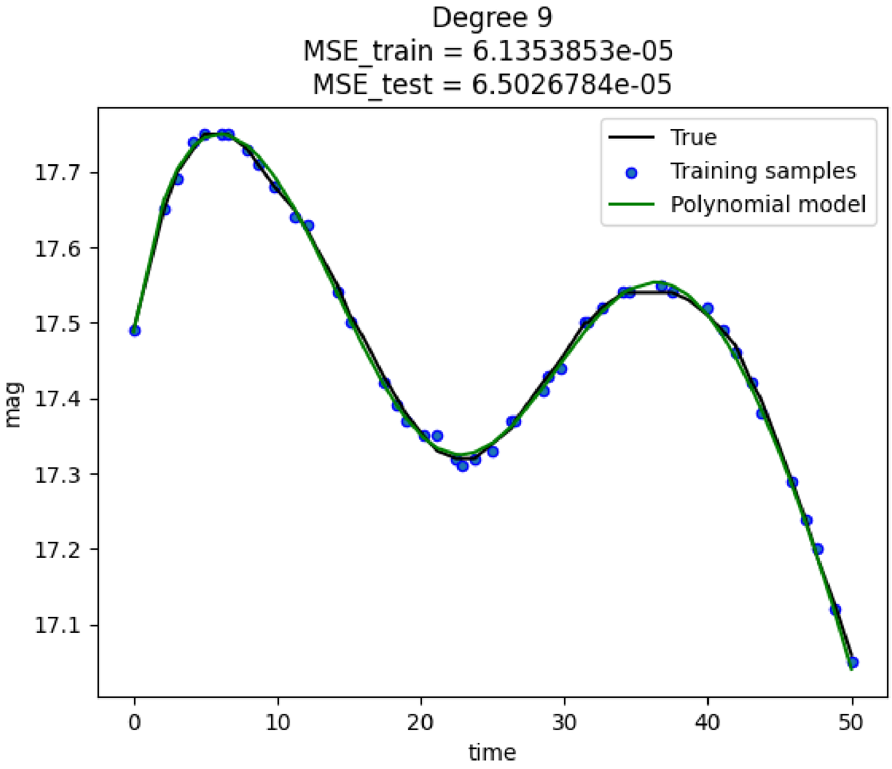
In [139]:

```
def get_best_degree_to_polynomial_model(x, y, degrees):
    best_model = None
    best_degree = None
    best_y_pred_test = None
    best_MSE_test = float('inf')
    best_MSE_train = float('inf')
    MSE_list = []

    #true is test
    X_test = df_true[0]
    Y_test = df_true[1]

    x_test = X_test.to_numpy()[:, np.newaxis]
    y_test = Y_test.to_numpy()[:, np.newaxis]

    for degree in degrees:
        # create model
        model = make_pipeline(PolynomialFeatures(degree), LinearRegression())
        #Training
        model.fit(x, y)  #get polynomial model for training data

        #Testing
        y_pred_train = model.predict(x)
        y_pred_test = model.predict(x_test)

        MSE_train = mean_squared_error(y,y_pred_train)
        MSE_test = mean_squared_error(y_test,y_pred_test)
        MSE_list.append(MSE_test)
        # Update the best model if a lower MSE is found.
        if MSE_test < best_MSE_test:
                best_y_pred_test = y_pred_test
                best_MSE_train = MSE_train
                best_MSE_test = MSE_test
                best_degree = degree
                best_model = model


    return best_model, best_degree, best_MSE_test, best_MSE_train, best_y_pred_test, x_test,
```

In [144]:

```
#DATA_PATH_NOISE1 = 'DS-5-1-GAP-1-1-N-1_v2.csv'
X = df_noise1[0]  #time
x = X.to_numpy()[:, np.newaxis]
Y = df_noise1[1]  #mag_A
y = Y.to_numpy()[:, np.newaxis]

degrees = list(range(1, 16))

best_model, best_degree, best_MSE_test, best_MSE_train, best_y_pred_test, x_test, y_test,MSE

print(best_y_pred_test.shape)

plt.plot(x_test,y_test, color='k', label="True")
plt.scatter(X, y, edgecolor='b', s=20, label="Training samples")
plt.plot(x_test, best_y_pred_test, color='g', label="Polynomial model")
plt.xlabel("time")
plt.ylabel("mag")
plt.legend(loc="best")
plt.title("Degree {}\nMSE_train = {:.8} \nMSE_test = {:.8}".format(
        best_degree, best_MSE_train, best_MSE_test))
plt.show()
```

```
(50, 1)
```

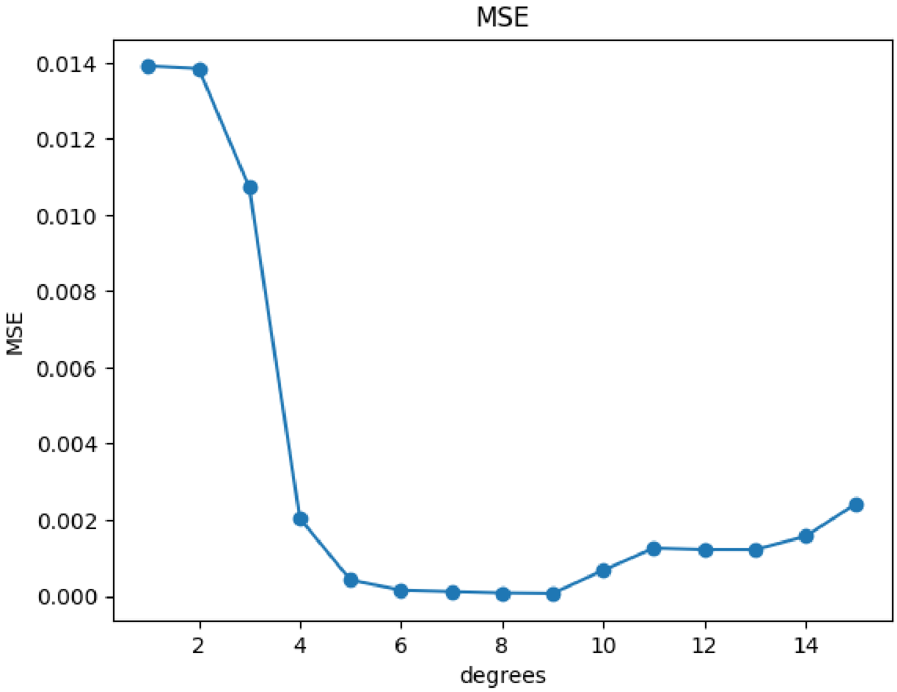


In [141]:

```
#plot all MSE
plt.plot(degrees, MSE_list, marker = 'o', linestyle= '-')
plt.xlabel('degrees')
plt.ylabel('MSE')
plt.title('MSE')
plt.show
```

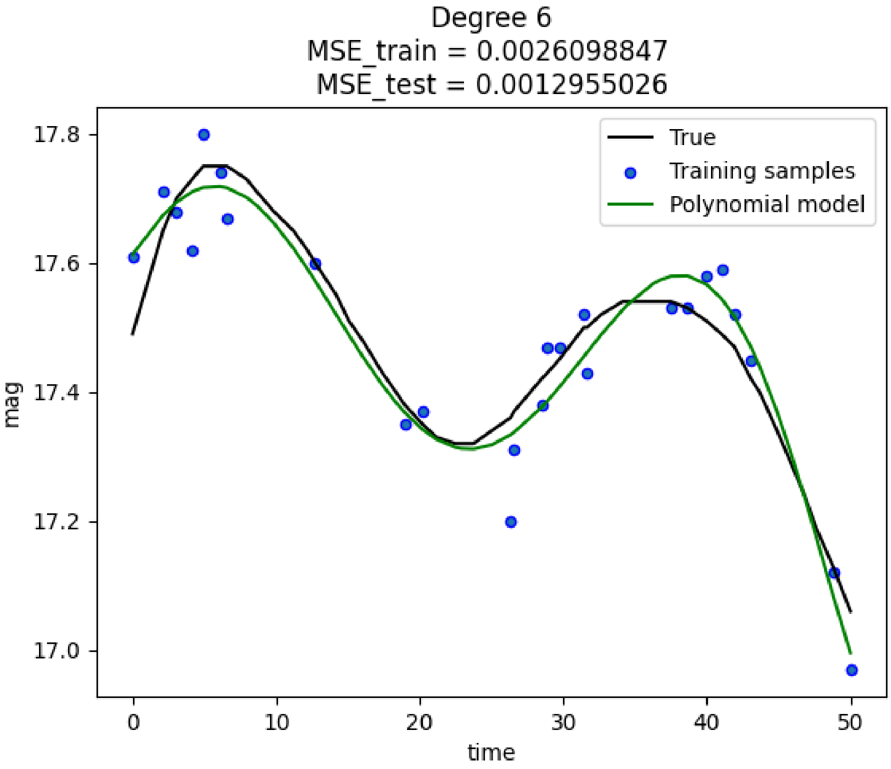
Out[141]:

```
<function matplotlib.pyplot.show(close=None, block=None)>
```



In [142]:

```
# DATA_PATH_NOISE2 = 'DS-5-1-GAP-5-1-N-3_v2.csv'
X = df_noise2[0]  #time
x = X.to_numpy()[:, np.newaxis]
Y = df_noise2[1]  #mag_A
y = Y.to_numpy()[:, np.newaxis]

degrees = list(range(1, 16))

best_model, best_degree, best_MSE_test, best_MSE_train, best_y_pred_test, x_test, y_test, MS

plt.plot(x_test,y_test, color='k', label="True")
plt.scatter(X, y, edgecolor='b', s=20, label="Training samples")
plt.plot(x_test, best_y_pred_test, color='g', label="Polynomial model")
plt.xlabel("time")
plt.ylabel("mag")
plt.legend(loc="best")
plt.title("Degree {}\nMSE_train = {:.8} \nMSE_test = {:.8}".format(
        best_degree, best_MSE_train, best_MSE_test))
plt.show()
```

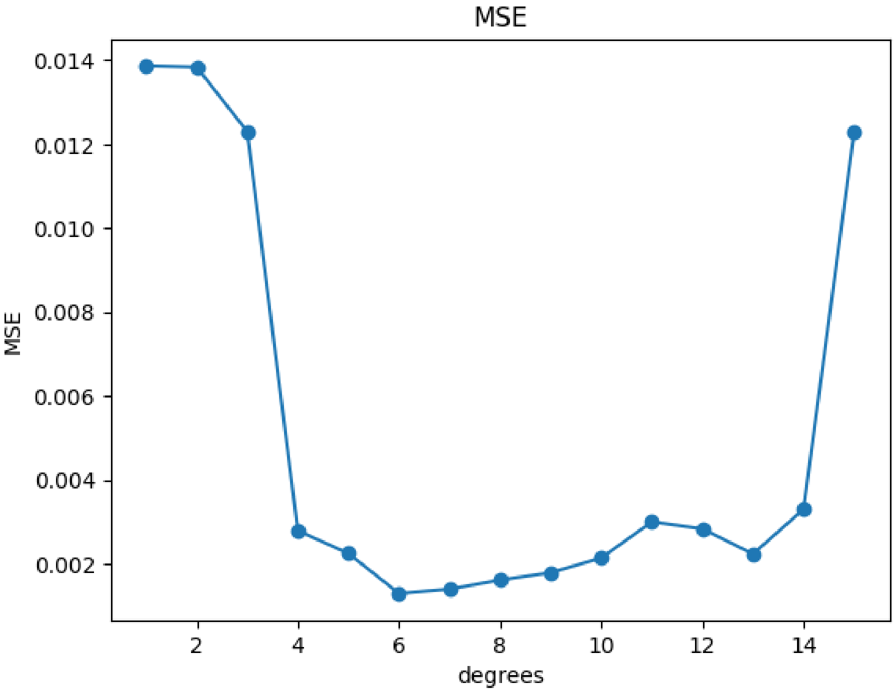


In [143]:

```
#plot all MSE
plt.plot(degrees, MSE_list, marker = 'o', linestyle= '-')
plt.xlabel('degrees')
plt.ylabel('MSE')
plt.title('MSE')
plt.show
```

Out[143]:

```
<function matplotlib.pyplot.show(close=None, block=None)>
```


MSE
MSE
0.014
0.012
0.010
0.008
0.006
0.004
0.002
2
4
6
8
10
12
14
degrees