In [28]:
```
# API lib

import requests
import base64
import json
import math
import numpy as np
from numpy import concatenate
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.preprocessing import MinMaxScaler, StandardScaler
from keras.models import load_model
import seaborn as sns
sns.set()
```

In [2]:
```
# Test GPU
from tensorflow.python.client import device_lib
import tensorflow as tf
print(device_lib.list_local_devices())
print(tf.test.is_built_with_cuda())
```

```
[name: "/device:CPU:0"
device_type: "CPU"
memory_limit: 268435456
locality {
}
incarnation: 5095193973292421776
, name: "/device:GPU:0"
device_type: "GPU"
memory_limit: 3231462195
locality {
  bus_id: 1
}
incarnation: 13081051308803819527
physical_device_desc: "device: 0, name: GeForce GTX 950M, pci bus id: 0000:0
1:00.0, compute capability: 5.0"
]
True
```

Init

In [3]:
```
# APIs
api_key = ''
api_header = {}
with open('api_header.json') as f:
    api_header = json.load(f)
f = open("api_key.txt", "r")
api_key = f.read()
api_header["X-IG-API-KEY"] = api_key


pd.options.display.max_columns = None


# start_session_init()
date0 = '2019-05-01T00%3A00%3A00'
date1 = '2019-08-01T00%3A00%3A00'
date2 = '2020-04-22T23%3A59%3A59'
# resolution = 'HOUR_2'
resolution = 'MINUTE_30'
xau_epic = 'CS.D.CFDGOLD.CFDGC.IP'
usd_epic = 'CO.D.DX.FWS2.IP'
us500_epic = 'IX.D.SPTRD.IFD.IP'
us100_epic = 'IX.D.NASDAQ.IFD.IP'
eur_epic = 'CS.D.EURUSD.CFD.IP'
ftse_epic = 'IX.D.FTSE.CFD.IP'
eurchn_epic = 'CS.D.EURCNH.CFD.IP'
usdchn_epic = 'CS.D.USDCNH.CFD.IP'
usoil_epic = 'CC.D.CL.UNC.IP'
```

Functions

In [4]:
```
def start_session():
    url = "https://demo-api.ig.com/gateway/deal"
    session = "/session/encryptionKey"
    m_url = url + session
    return  requests.get(m_url, headers=headers)

def price_history(epic,resolution,date1,date2):
    m_url = "https://api.ig.com/gateway/deal/prices/{}?resolution={}&from={}&t
o={}&pageSize=0".format(epic,resolution,date1,date2)
     # "Version": "2"
    return  requests.get(m_url, headers=headers)

def price_extractor(dfx,obj):
    # always have problem with str or not str. please convert to csv first
    suffix = '' # obj + '_'
    dfx[suffix +'openPrice'] = dfx['openPrice'].apply(lambda x: (eval(x)).get(
'ask'))
    dfx[suffix +'closePrice'] = dfx['closePrice'].apply(lambda x: (eval(x)).ge
t('ask'))
    dfx[suffix +'highPrice'] = dfx['highPrice'].apply(lambda x: (eval(x)).get(
'ask'))
    dfx[suffix +'lowPrice'] = dfx['lowPrice'].apply(lambda x: (eval(x)).get('a
sk'))

def ts(new_data, look_back = 100, pred_col = 1):
    t = new_data.copy()
    t['id'] = range(1, len(t)+1)
    t = t.iloc[:-look_back,:]
    t.set_index('id', inplace= True)
    pred_value = new_data.copy()
    pred_value = pred_value.iloc[look_back:, pred_col]
    pred_value.columns = ['Pred']
    pred_value = pd.DataFrame(pred_value)
    pred_value['id'] = range(1,len(pred_value)+1)
    pred_value.set_index('id', inplace= True)
    final_df= pd.concat([t,pred_value],axis=1)
    return final_df



# create a differenced series
def difference(dataset, interval=1):
        diff = list()
        for i in range(interval, len(dataset)):
                value = dataset[i] - dataset[i - interval]
                diff.append(value)
        return Series(diff)

# invert differenced value
def inverse_difference(history, yhat, interval=1):
        return yhat + history[-interval]

# scale train and test data to [-1, 1]
def scale(train, test):
        # fit scaler
        scaler = StandardScaler()
```

```
        scaler = scaler.fit(train)
        # transform train
        train = train.reshape(train.shape[0], train.shape[1])
        train_scaled = scaler.transform(train)
        # transform test
        test = test.reshape(test.shape[0], test.shape[1])
        test_scaled = scaler.transform(test)
        return scaler, train_scaled, test_scaled

# inverse scaling for a forecasted value
def invert_scale(scaler, X, yhat):
        new_row = [x for x in X] + [yhat]
        array = np.array(new_row)
        array = array.reshape(1, len(array))
        inverted = scaler.inverse_transform(array)
        return inverted[0, -1]

# convert series to supervised learning
def series_to_supervised(data, n_in=1, n_out=1, dropnan=True):
        n_vars = 1 if type(data) is list else data.shape[1]
        df = pd.DataFrame(data)
        cols, names = list(), list()
        # input sequence (t-n, ... t-1)
        for i in range(n_in, 0, -1):
                cols.append(df.shift(i))
                names += [('var%d(t-%d)' % (j+1, i)) for j in range(n_vars)]
        # forecast sequence (t, t+1, ... t+n)
        for i in range(0, n_out):
                cols.append(df.shift(-i))
                if i == 0:
                        names += [('var%d(t)' % (j+1)) for j in range(n_vars)]
                else:
                        names += [('var%d(t+%d)' % (j+1, i)) for j in range(n_
vars)]
        # put it all together
        agg = pd.concat(cols, axis=1)
        agg.columns = names
        # drop rows with NaN values
        if dropnan:
                agg.dropna(inplace=True)
        return agg

def adj_r2(x,r2):
    n = x.shape[0]
    p = x.shape[1]
    adjusted_r2 = 1-(1-r2)*(n-1)/(n-p-1)
    return adjusted_r2
```

Data Import from API. *[Do only when needed!]*

In [ ]:
```
# Data Import
xau = price_history(xau_epic,resolution,date1,date2)
xau_list = json.loads(xau.text)['prices']
usd = price_history(usd_epic,resolution,date1,date2)
usd_list = json.loads(usd.text)['prices']
us500 = price_history(us500_epic,resolution,date1,date2)
us500_list = json.loads(us500.text)['prices']
us100 = price_history(us100_epic,resolution,date1,date2)
us100_list = json.loads(us100.text)['prices']
eur = price_history(eur_epic,resolution,date1,date2)
eur_list = json.loads(eur.text)['prices']
ftse = price_history(ftse_epic,resolution,date1,date2)
ftse_list = json.loads(ftse.text)['prices']
usoil = price_history(usoil_epic,resolution,date1,date2)
usoil_list = json.loads(usoil.text)['prices']
# eurchn = price_history(eurchn_epic,resolution,date1,date2)
# eurchn_list = json.loads(eurchn.text)['prices']
# usdchn = price_history(usdchn_epic,resolution,date1,date2)
# usdchn_list = json.loads(usdchn.text)['prices']
# DataFrame convert
df_xau = pd.DataFrame(xau_list)
df_usd = pd.DataFrame(usd_list)
df_us500 = pd.DataFrame(us500_list)
df_us100 = pd.DataFrame(us100_list)
df_eur = pd.DataFrame(eur_list)
df_ftse = pd.DataFrame(ftse_list)
df_usoil = pd.DataFrame(usoil_list)
# df_eurchn = pd.DataFrame(eurchn_list)
# df_usdchn = pd.DataFrame(usdchn_list)


# Give it a name
# df_xau.name = 'xau'
# df_eur.name = 'usd'
# df_us500.name = 'us500'
# df_us100.name = 'us100'
# df_eur.name = 'eur'
tables = ['xau','usd','us500','us100','usoil','eur','ftse','eurchn','usdchn']

#       Dict extract openPrice  {'bid': 1275.64, 'ask': 1275.94, 'lastTraded': None}
price_extractor(df_xau,'xau')
price_extractor(df_usd, 'usd')
price_extractor(df_us500, 'us500')
price_extractor(df_us100, 'us100')
price_extractor(df_usoil, 'usoil')
price_extractor(df_eur, 'eur')
price_extractor(df_ftse, 'ftse')
# price_extractor(df_eurchn, 'eurchn')
# price_extractor(df_usdchn, 'usdchn')


df_xau['price_change'] = df_xau['openPrice'] - df_xau['closePrice']
df_xau['price_maxmin'] = df_xau['highPrice'] - df_xau['lowPrice']
df_usd['price_change'] = df_usd['openPrice'] - df_usd['closePrice']
df_usd['price_maxmin'] = df_usd['highPrice'] - df_usd['lowPrice']
```

```
df_us500['price_change'] = df_us500['openPrice'] - df_us500['closePrice']
df_us500['price_maxmin'] = df_us500['highPrice'] - df_us500['lowPrice']
df_us100['price_change'] = df_us100['openPrice'] - df_us100['closePrice']
df_us100['price_maxmin'] = df_us100['highPrice'] - df_us100['lowPrice']
df_usoil['price_change'] = df_usoil['openPrice'] - df_usoil['closePrice']
df_usoil['price_maxmin'] = df_usoil['highPrice'] - df_usoil['lowPrice']
df_eur['price_change'] = df_eur['openPrice'] - df_eur['closePrice']
df_eur['price_maxmin'] = df_eur['highPrice'] - df_eur['lowPrice']
df_ftse['price_change'] = df_ftse['openPrice'] - df_ftse['closePrice']
df_ftse['price_maxmin'] = df_ftse['highPrice'] - df_ftse['lowPrice']
# df_eurchn['price_change'] = df_eurchn['openPrice'] - df_eurchn['closePrice']
# df_eurchn['price_maxmin'] = df_eurchn['highPrice'] - df_eurchn['lowPrice']
# df_usdchn['price_change'] = df_usdchn['openPrice'] - df_usdchn['closePrice']
# df_usdchn['price_maxmin'] = df_usdchn['highPrice'] - df_usdchn['lowPrice']


# zscore_fun_improved = lambda x: (x - x.rolling(window=200, min_periods=20).m
ean())\
# / x.rolling(window=200, min_periods=20).std()
# features['f10'] =prices.groupby(level='symbol').close.apply(zscore_fun_impro
ved)
# features.f10.unstack().plot.kde(title='Z-Scores (accurate)')
```

Backup / Restore DataFrames

In [5]:
```
# Backup/Restore Data -----------------------------------

# df_xau.to_csv('df_xau'+ '_' + resolution +'.csv',index=False,header = True)
# df_usd.to_csv('df_usd'+ '_' + resolution +'.csv',index=False,header = True)
# df_us500.to_csv('df_us500'+ '_' + resolution +'.csv',index=False,header = Tr
ue)
# df_us100.to_csv('df_us100'+ '_' + resolution +'.csv',index=False,header = Tr
ue)
# df_usoil.to_csv('df_usoil'+ '_' + resolution +'.csv',index=False,header = Tr
ue)
# df_eur.to_csv('df_eur'+ '_' + resolution +'.csv',index=False,header = True)
# df_ftse.to_csv('df_ftse'+ '_' + resolution +'.csv',index=False,header = Tru
e)
# df_eurchn.to_csv('df_eurchn.csv',index=False,header = True)
# df_usdchn.to_csv('df_usdchn.csv',index=False,header = True)

df_xau = pd.read_csv('df_xau'+ '_' + resolution +'.csv', parse_dates=['snapsho
tTime']) # Data Restore
df_usd = pd.read_csv('df_usd'+ '_' + resolution +'.csv', parse_dates=['snapsho
tTime']) # Data Restore
df_us500 = pd.read_csv('df_us500'+ '_' + resolution +'.csv', parse_dates=['sna
pshotTime']) # Data Restore
df_us100 = pd.read_csv('df_us100'+ '_' + resolution +'.csv', parse_dates=['sna
pshotTime']) # Data Restore
df_usoil = pd.read_csv('df_usoil'+ '_' + resolution +'.csv', parse_dates=['sna
pshotTime']) # Data Restore
df_eur = pd.read_csv('df_eur'+ '_' + resolution +'.csv', parse_dates=['snapsho
tTime']) # Data Restore
df_ftse = pd.read_csv('df_ftse'+ '_' + resolution +'.csv', parse_dates=['snaps
hotTime']) # Data Restore
# df_eurchn = pd.read_csv('df_eurchn'+ '_' + resolution +'.csv', parse_dates=
['snapshotTime']) # Data Restore
# df_usdchn = pd.read_csv('df_usdchn'+ '_' + resolution +'.csv', parse_dates=
['snapshotTime']) # Data Restore
```

Feature Matrix Prep

In [6]:

```
df_prices = pd.merge(df_xau, df_usd, on='snapshotTime', how = 'left', suffixes
=('','_usd'))
df_prices = pd.merge(df_prices, df_us500, on='snapshotTime', how = 'left', suf
fixes=('','_us500'))
df_prices = pd.merge(df_prices, df_us100, on='snapshotTime', how = 'left', suf
fixes=('','_us100'))
df_prices = pd.merge(df_prices, df_usoil, on='snapshotTime', how = 'left', suf
fixes=('','_usoil'))
df_prices = pd.merge(df_prices, df_eur, on='snapshotTime', how = 'left', suffi
xes=('','_eur'))
df_prices = pd.merge(df_prices, df_ftse, on='snapshotTime', how = 'left', suff
ixes=('','_ftse'))
# df_prices = pd.merge(df_prices, df_eurchn, on='snapshotTime', how = 'left',
 suffixes=('','_eurchn'))
# df_prices = pd.merge(df_prices, df_usdchn, on='snapshotTime', how = 'left',
 suffixes=('','_usdchn'))

df_prices = df_prices[[
                    'snapshotTime','openPrice','closePrice','price_change','pr
ice_maxmin','lastTradedVolume',
                    'openPrice_usd','closePrice_usd','price_change_usd','price
_maxmin_usd','lastTradedVolume_usd',
                    'openPrice_us500','closePrice_us500','price_change_us500',
'price_maxmin_us500','lastTradedVolume_us500',
                    'openPrice_us100','closePrice_us100','price_change_us100',
'price_maxmin_us100','lastTradedVolume_us100',
                    'openPrice_usoil','closePrice_usoil','price_change_usoil',
'price_maxmin_usoil','lastTradedVolume_usoil',
                    'openPrice_eur','closePrice_eur','price_change_eur','price
_maxmin_eur','lastTradedVolume_eur',
                    'openPrice_ftse','closePrice_ftse','price_change_ftse','pr
ice_maxmin_usd','lastTradedVolume_ftse',
                    # 'openPrice_eurchn','closePrice_eurchn','price_change_eur
chn','price_maxmin_eurchn','lastTradedVolume_eurchn',
                    # 'openPrice_usdchn','closePrice_usdchn','price_change_usd
chn','price_maxmin_usdchn','lastTradedVolume_usdchn',
                    ]]

# df_prices.reset_index(inplace = True)
df_prices.to_csv('gold_feature_price'+ '_' + resolution +'.csv',index=False,he
ader = True)
# df_prices = pd.read_csv('gold_feature_price'+ '_' + resolution +'.csv', pars
e_dates=['snapshotTime']) # Data Restore
```

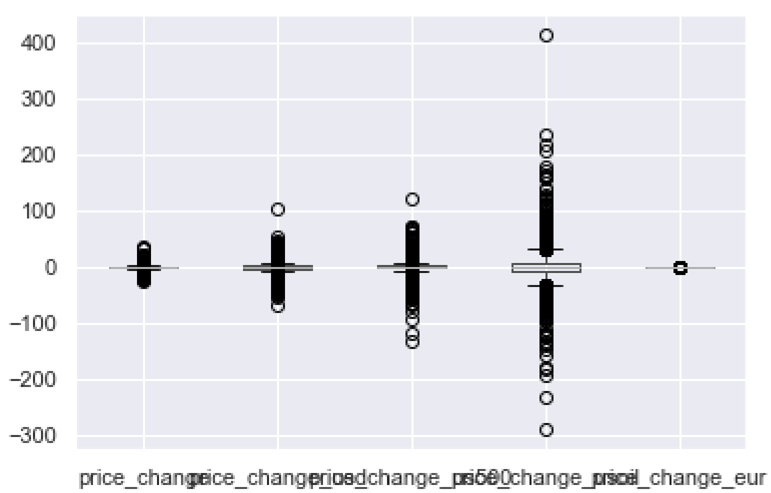
In [35]:
```
# feature prep
features_price = df_prices.copy()

# NaNs
# features_price = features_price.iloc[100:, :]
features_price.dropna(axis = 0, inplace = True)
features_price = features_price.sort_values('snapshotTime')
features_price.reset_index(inplace = True)

#

# features_price = features_price[['closePrice','closePrice_usd','closePrice_eur','closePrice_usoil']] #,'closePrice_us500','closePrice_ftse','closePrice_ftse','closePrice_eurchn']
features_price = features_price[['price_change','price_change_usd','price_change_us500','price_change_usoil', 'price_change_eur']]

# features_price.plot(subplots=True)
# plt.show()
features_price.shape
```

Out[35]:
```
(7613, 5)
```

Some Visualization

In [37]:
```
# sns.set_context("talk")
# plt.figure(figsize=(12, 6))
# g = sns.boxplot(x="timezone", y="delay_d", , data=df_prices, ) #  hue="origin", kind="swarm",  jitter=False, #
# g.set(xlabel='Timezone', ylabel='Departure Delay')
features_price.boxplot(list(features_price.columns))
```

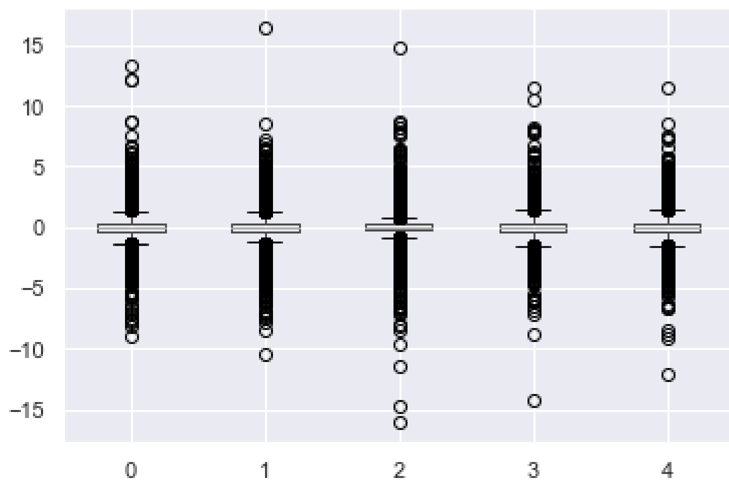
Out[37]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1fd919406d8>
```



In [39]:
```
# Split test/training
counter = 7613
split_point1 = 7400
split_point2 = 7600
features_matrix = features_price.values.astype('float32')
train_price = features_matrix[:split_point1,:]
test_price = features_matrix[split_point1:,:]
# test_price = features_matrix[split_point2:,]
scaler, train_scaled, test_scaled = scale(train_price,test_price)

print(train_price.shape, test_price.shape)
df_train = pd.DataFrame(train_scaled)
df_train.boxplot(list(df_train.columns))
```

```
(7400, 5) (213, 5)
```

Out[39]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1fd91a34550>
```



Linear Regression Coefficients. 1 is bad

In [10]:
```
from sklearn.linear_model import LinearRegression
regressor = LinearRegression()
X_train, y_train = train_scaled[:,1:], train_scaled[:,0:1]
regressor.fit(X_train, y_train)
r2 = regressor.score(X_train,y_train)
print('accuracy:',r2,'Adj-R2:',adj_r2(X_train,r2))
```

```
accuracy: 0.08705933753300299 Adj-R2: 0.08656552243498161
```

In [11]:
```
# Create a regression summary where we can compare them with one-another
reg_summary = pd.DataFrame(features_price.columns.values[1:], columns=['Featur
es'])
reg_summary['Coefs'] = regressor.coef_[0]
reg_summary['Weights^2'] = np.exp(np.abs(regressor.coef_[0]))
reg_summary.sort_values('Weights^2',ascending=False)
```

Out[11]:

	Features	Coefs	Weights^2
0	price_change_usd	-0.258392	1.294847
1	price_change_us500	-0.042301	1.043208
2	price_change_usoil	-0.041932	1.042823
3	price_change_eur	0.035957	1.036611

RNN Matrix prep

In [21]:
```
# The Scale
rnn_time_steps = 48
n_features = train_price.shape[1]
print(n_features)
scaler, train_scaled, test_scaled = scale(train_price,test_price)
print(train_scaled.shape)
```

```
5
(7400, 5)
```

Matrix Reformation methods

In [22]:
```
# One feature method
# gold_price_scaled = scaled_price #[:,0:1]
# rnn_size = 300
# X_train = list()
# y_train = list()
# for i in range(rnn_size, spliting_point):
#     X_train.append(gold_price_scaled[i-rnn_size:i, 0])
#     y_train.append(gold_price_scaled[i, 0])
# X_train, y_train = np.array(X_train), np.array(y_train)

# Blog method
# train_scaled = pd.DataFrame(train_scaled)
# train_scaled = ts(train_scaled,rnn_depth,pred_col=-1)
# train_scaled = train_scaled.values

# series_to_supervised
# series_to_supervised(scaled, n_hours, 1)
train_scaled = series_to_supervised(train_scaled,n_in=rnn_time_steps,n_out=1)
train_scaled = train_scaled.values

test_scaled = series_to_supervised(test_scaled,n_in=rnn_time_steps,n_out=1)
test_scaled = test_scaled.values

# Keras
# from keras.preprocessing import TimeseriesGenerator
# seq = TimeseriesGenerator(data, targets, length, sampling_rate=1, stride=1,
 start_index=0, end_index=None, shuffle=False, reverse=False, batch_size=128)
train_scaled.shape
```

Out[22]:
```
(7352, 245)
```

In [23]:
```
# Split into Input and output, X & Y
# One feature method
# x_train, y_train = train_scaled[:,1:], train_scaled[:,0:1]
# x_test, y_test = test_scaled[:,1:], test_scaled[:,0:1]

# split into input and outputs
n_obs = rnn_time_steps * n_features
x_train, y_train = train_scaled[:, :n_obs], train_scaled[:, -n_features]
x_test, y_test = test_scaled[:, :n_obs], test_scaled[:, -n_features]
print(x_train.shape, len(x_train), y_train.shape)

print(x_train.shape,y_train.shape,x_test.shape,y_test.shape)
```

```
(7352, 240) 7352 (7352,)
(7352, 240) (7352,) (165, 240) (165,)
```

In [24]:
```
# # Reshaping (batch_size, timesteps, input_dim) # reshape input to be 3D [samples, timesteps, features]
# train_X = train_X.reshape((train_X.shape[0], 1, train_X.shape[1]))

X_train = x_train.reshape(x_train.shape[0], rnn_time_steps, n_features)
X_test = x_test.reshape(x_test.shape[0], rnn_time_steps, n_features)
print(X_train.shape,X_test.shape)
```

```
(7352, 48, 5) (165, 48, 5)
```

LSTM Model

In [25]:
```
#  RNN Model libs
from keras.models import Sequential
from keras.layers import Dense, LSTM, Dropout

# Init RNN
regressor = Sequential()

# 1st LSTM Layer + dropout regularisation
regressor.add(LSTM(units = 50, return_sequences = True, input_shape = (X_train
.shape[1], X_train.shape[2])))
regressor.add(Dropout(0.2))

# # 2nd LSTM Layer + dropout regularisation
# regressor.add(LSTM(units = 50, return_sequences = True))
# regressor.add(Dropout(0.2))

# # 3rd LSTM Layer + dropout regularisation
# regressor.add(LSTM(units = 20, return_sequences = True))
# regressor.add(Dropout(0.2))

# 4th LSTM Layer+ dropout regularisation
regressor.add(LSTM(units = 20))
regressor.add(Dropout(0.2))

# Output layer
regressor.add(Dense(units = 1, activation = 'tanh'))

# Compile the model
regressor.compile(  optimizer = 'adam', loss = 'mean_squared_error') #, metric
s = ['accuracy'])

# Fitting the RNN to the training set
regressor.fit(X_train,y_train, epochs = 30, batch_size=48, validation_data=(X_
test, y_test), verbose=2, shuffle=False)
regressor.save('reg_lstm_v2_1.h5')
```

```
Train on 7352 samples, validate on 165 samples
Epoch 1/30
 - 35s - loss: 0.9976 - val_loss: 1.8212
Epoch 2/30
 - 35s - loss: 0.9936 - val_loss: 1.8492
Epoch 3/30
 - 37s - loss: 0.9940 - val_loss: 1.8496
Epoch 4/30
 - 38s - loss: 0.9932 - val_loss: 1.8585
Epoch 5/30
 - 37s - loss: 0.9924 - val_loss: 1.8351
Epoch 6/30
 - 38s - loss: 0.9860 - val_loss: 1.8863
Epoch 7/30
 - 37s - loss: 0.9818 - val_loss: 1.9046
Epoch 8/30
 - 37s - loss: 0.9789 - val_loss: 1.8697
Epoch 9/30
 - 37s - loss: 0.9736 - val_loss: 1.9425
Epoch 10/30
 - 37s - loss: 0.9696 - val_loss: 1.9921
Epoch 11/30
 - 37s - loss: 0.9648 - val_loss: 1.9577
Epoch 12/30
 - 38s - loss: 0.9574 - val_loss: 1.9854
Epoch 13/30
 - 38s - loss: 0.9500 - val_loss: 1.9197
Epoch 14/30
 - 40s - loss: 0.9478 - val_loss: 2.2680
Epoch 15/30
 - 41s - loss: 0.9438 - val_loss: 1.8557
Epoch 16/30
 - 42s - loss: 0.9485 - val_loss: 1.9356
Epoch 17/30
 - 40s - loss: 0.9372 - val_loss: 1.9105
Epoch 18/30
 - 40s - loss: 0.9279 - val_loss: 1.8785
Epoch 19/30
 - 40s - loss: 0.9315 - val_loss: 1.8868
Epoch 20/30
 - 37s - loss: 0.9231 - val_loss: 1.8488
Epoch 21/30
 - 38s - loss: 0.9313 - val_loss: 1.8425
Epoch 22/30
 - 38s - loss: 0.9273 - val_loss: 1.9046
Epoch 23/30
 - 39s - loss: 0.9229 - val_loss: 1.8709
Epoch 24/30
 - 39s - loss: 0.9039 - val_loss: 1.8971
Epoch 25/30
 - 41s - loss: 0.8925 - val_loss: 1.8471
Epoch 26/30
 - 37s - loss: 0.8980 - val_loss: 1.9563
Epoch 27/30
 - 38s - loss: 0.8979 - val_loss: 1.8871
Epoch 28/30
 - 38s - loss: 0.8862 - val_loss: 1.9246
```

```
Epoch 29/30
 - 40s - loss: 0.8899 - val_loss: 1.8823
Epoch 30/30
 - 38s - loss: 0.8857 - val_loss: 1.8833
```

In [ ]:

```
# Restore a Model to aviod test set conflicts
# regressor.save('reg_lstm4.h5')
# regressor = load_model('reg_lstm2.h5')
```

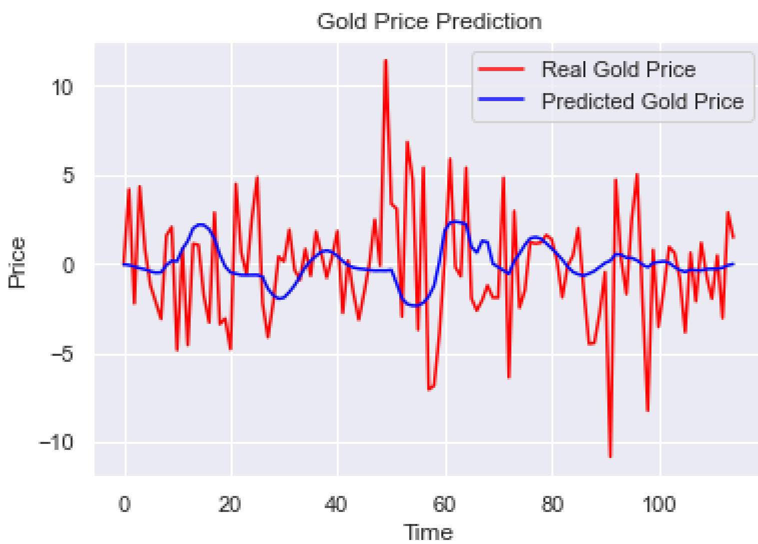
Test the Model

In [26]:
```
# Test the RNN
# dataset_test = test_price #['closePrice']
# real_gold_price = dataset_test.iloc[:,0:1].values

# # dataset_total = pd.concat((dataset_train['Open'], dataset_test['Open']), a
xis = 0)
# dataset_total = features_price #['closePrice']
# inputs = dataset_total[len(dataset_total) - len(dataset_test) - 200:].values
# inputs = inputs.reshape(-1,1)
# gold_test_scaled = sc.transform(inputs[:,0:1])
# # gold_test_scaled =

# # RNN Data Structure
# X_test = list()
# for i in range(200, 277):
#     X_test.append(gold_test_scaled[i-200:i, 0])
# X_test = np.array(X_test)

# # Reshaping
# X_test = np.reshape(X_test, (X_test.shape[0], X_test.shape[1], 1))

# Prediction
y_pred = regressor.predict(X_test)
# Hint: test_X = test_X.reshape((test_X.shape[0], n_hours*n_features))
X_test = X_test.reshape((X_test.shape[0], rnn_time_steps*n_features))
# invert scaling for forecast
inv_yhat = concatenate((y_pred, X_test[:, -(n_features-1):]), axis=1)
inv_yhat = scaler.inverse_transform(inv_yhat)
inv_yhat = inv_yhat[:,0]
# invert scaling for actual
y_test = y_test.reshape((len(y_test), 1))
inv_y = concatenate((y_test, X_test[:, -(n_features-1):]), axis=1)
inv_y = scaler.inverse_transform(inv_y)
inv_y = inv_y[:,0]

# inv_yhat = concatenate((yhat, test_X[:, -7:]), axis=1)
# inv_yhat = scaler.inverse_transform(inv_yhat)
# inv_yhat = inv_yhat[:,0]
# # invert scaling for actual
# test_y = test_y.reshape((len(test_y), 1))
# inv_y = concatenate((test_y, test_X[:, -7:]), axis=1)
# inv_y = scaler.inverse_transform(inv_y)
# inv_y = inv_y[:,0]


# predicted_gold_price = invert_scale(scaler, X_test, y_pred)
# predicted_gold_price = scaler.inverse_transform(predicted_gold_price)
# predicted_gold_price = predicted_gold_price[:,0]
# predicted_gold_price = predicted_gold_price.reshape(-1,1)
```

In [29]:
```
# calculate RMSE
from sklearn.metrics import mean_squared_error
rmse = math.sqrt(mean_squared_error(inv_y, inv_yhat))

print(inv_y.shape, inv_yhat.shape)
print('Test RMSE: %.3f' % rmse)
```

```
(165,) (165,)
Test RMSE: 3.592
```

In [32]:
```
# Visualization the results
plot_size = 50 # Max 165
plt.plot(inv_y[plot_size:], color= 'red', label = 'Real Gold Price')
plt.plot(inv_yhat[plot_size:], color= 'blue', label = 'Predicted Gold Price')
plt.title('Gold Price Prediction')
plt.xlabel('Time')
plt.ylabel('Price')
plt.legend()
# plt.savefig('gold_multi_feature_test.png' , dpi=150)
plt.show()
```



In [72]:
```
X_test.shape, y_pred.shape
```

Out[72]:
```
((211, 2, 4), (211, 1))
```