In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline

sns.set_style("whitegrid")
plt.style.use("fivethirtyeight")
```

In [2]:
```
# Reading the csv
data = pd.read_csv('rawdata.csv')
```

In [3]:
```
# EDA
print("############ Shape #############")
print(data.shape)

print("############ Types #############")
print(data.dtypes)
```

```
############ Shape #############
(1202783, 11)
############ Types #############
patient_token     object
supply_date       object
supply_time       object
pharmacy_id       object
birth_year         int64
gender             int64
cnk                int64
product_name      object
atc               object
units              int64
price            float64
dtype: object
```

In [4]:
```
data.head()
```

Out[4]:

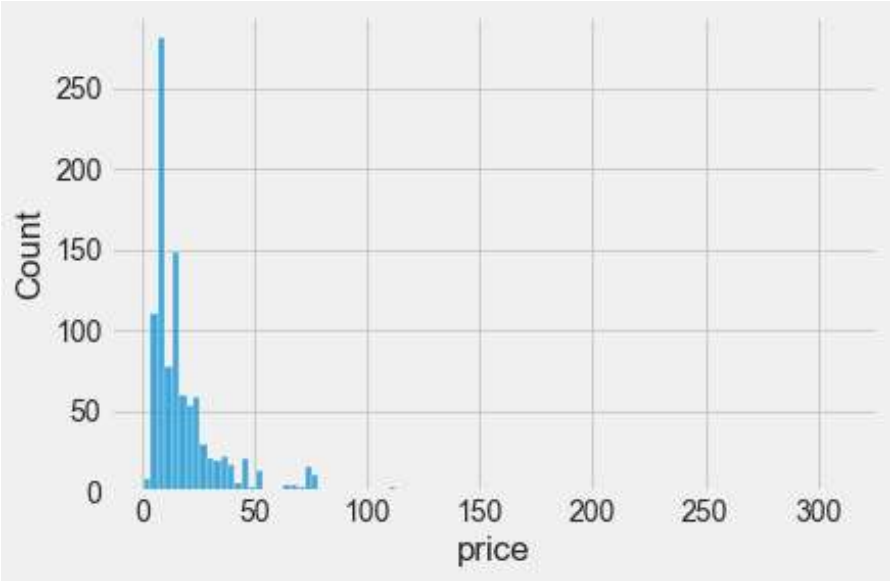
	patient_token	supply_date	supply_time	pharmacy_id	birth_year	gender	cnk	product_na
0	a	02/01/2017	17:14	A2	2016	2	62521	NYSTAT SUSP 1X2 100000U
1	a	02/01/2017	17:14	A2	2016	2	62521	NYSTAT SUSP 1X2 100000U
2	a	08/01/2020	15:13	A3	2019	1	62521	NYSTAT SUSP 1X2 100000U
3	a	09/01/2017	NaN	A1	2016	2	1543305	ATROV MONOD 0,25MG/ VIAL
4	a	23/01/2020	11:21	A2	2019	1	2322436	ROTATE TUBE 1 D = 2

In [5]:
```
data = data.head(1000)
sns.pairplot(data)
```

Out[5]:
```
<seaborn.axisgrid.PairGrid at 0x7ff7d800acd0>
```

In [33]:
```
sns.histplot(data['price'])
```

Out[33]:
```
<AxesSubplot:xlabel='price', ylabel='Count'>
```



In [10]:
```
sns.heatmap(data.corr(), annot=True)
```

Out[10]: <AxesSubplot:>

In [12]:
```
# Training a Linear Regression Model
X = data[['birth_year','cnk', 'gender','units']]
y = data['price']
```

In [13]:
```
# Train Test Split
from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_st
```

In [14]:
```
from sklearn import metrics
from sklearn.model_selection import cross_val_score

def cross_val(model):
    pred = cross_val_score(model, X, y, cv=10)
    return pred.mean()

def print_evaluate(true, predicted):
    mae = metrics.mean_absolute_error(true, predicted)
    mse = metrics.mean_squared_error(true, predicted)
    rmse = np.sqrt(metrics.mean_squared_error(true, predicted))
    r2_square = metrics.r2_score(true, predicted)
    print('MAE:', mae)
```

```
    print('MSE:', mse)
    print('RMSE:', rmse)
    print('R2 Square', r2_square)

def evaluate(true, predicted):
    mae = metrics.mean_absolute_error(true, predicted)
    mse = metrics.mean_squared_error(true, predicted)
    rmse = np.sqrt(metrics.mean_squared_error(true, predicted))
    r2_square = metrics.r2_score(true, predicted)
    return mae, mse, rmse, r2_square
```

In [17]:
```
# Preparing Data for linear regression
from sklearn.preprocessing import StandardScaler
from sklearn.pipeline import Pipeline

pipeline = Pipeline([('std_scalar', StandardScaler())])

X_train = pipeline.fit_transform(X_train)
X_test = pipeline.transform(X_test)
```

In [18]:
```
# Linear regression

from sklearn.linear_model import LinearRegression

lreg = LinearRegression(normalize=True)
lreg.fit(X_train, y_train)
```

Out[18]:
```
LinearRegression(normalize=True)
```

In [19]:
```
# Model Evaluation
print(lreg.intercept_)
```

```
20.106
```

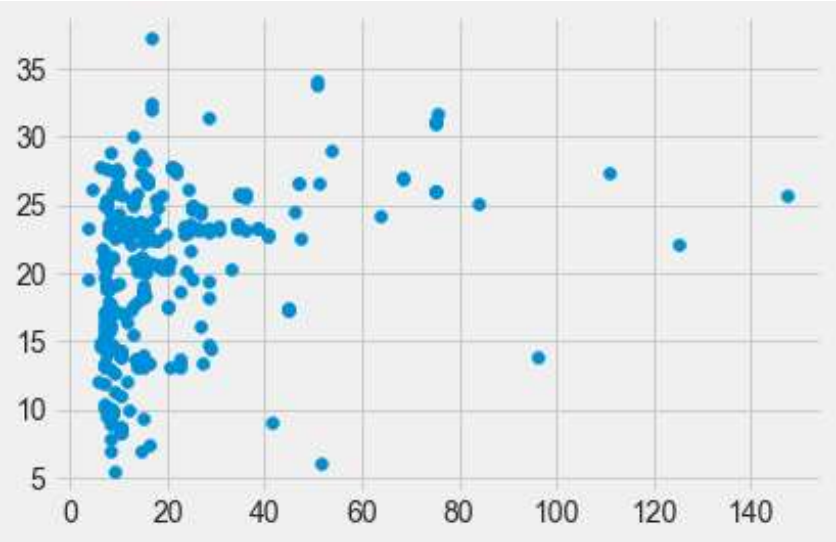
In [20]:
```
coeff_df = pd.DataFrame(lreg.coef_, X.columns, columns=['Coefficient'])
coeff_df
```

Out[20]:

	Coefficient
birth_year	1.200177
cnk	5.654222
gender	-2.570862
units	-0.739471

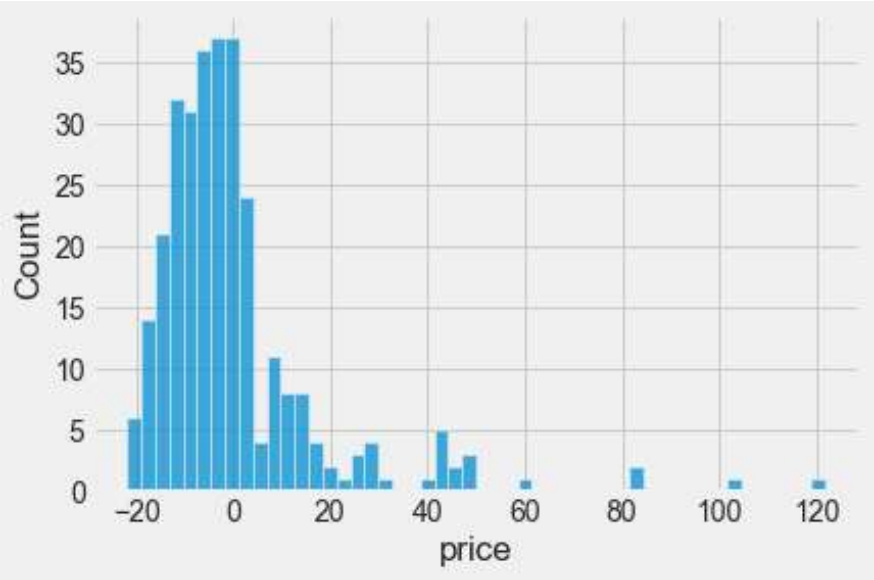
In [23]:
```
pred = lreg.predict(X_test)
plt.scatter(y_test, pred)
```

Out[23]:
```
<matplotlib.collections.PathCollection at 0x7ff81e0f1730>
```



In [34]:
```
sns.histplot((y_test - pred), bins=50)
```

Out[34]:
```
<AxesSubplot:xlabel='price', ylabel='Count'>
```



In [37]:
```
test_pred = lreg.predict(X_test)
train_pred = lreg.predict(X_train)

print('Test set evaluation:\n_____________________________________')
print_evaluate(y_test, test_pred)
print('====================================')
print('Train set evaluation:\n_____________________________________')
print_evaluate(y_train, train_pred)
```

```
Test set evaluation:

_____________________________________
MAE: 11.183837694513857
MSE: 323.47624776768066
RMSE: 17.98544544257052
R2 Square 0.1082905247253324
====================================
Train set evaluation:

_____________________________________
MAE: 11.852840092064808
MSE: 415.0237898989758
RMSE: 20.372132679201158
R2 Square 0.07811602251535754
```

In [39]:
```
# MAE is the easiest to understand, because it's the average error.
```

```
# MSE is more popular than MAE, because MSE "punishes" larger errors, which tends
# RMSE is even more popular than MSE, because RMSE is interpretable in the "y" uni

results_df = pd.DataFrame(data=[["Linear Regression", *evaluate(y_test, test_pred)
                           columns=['Model', 'MAE', 'MSE', 'RMSE', 'R2 Square', "Cr
results_df
```

Out[39]:

	Model	MAE	MSE	RMSE	R2 Square	Cross Validation
0	Linear Regression	11.183838	323.476248	17.985445	0.108291	-0.399531