In [23]:
```
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
import numpy as np # linear algebra
import matplotlib
import matplotlib.pyplot as plt
import sklearn
import re
from sklearn.pipeline import Pipeline
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.naive_bayes import MultinomialNB
from nltk.stem import PorterStemmer
from sklearn.decomposition import TruncatedSVD
from sklearn.preprocessing import StandardScaler
from sklearn.feature_extraction import text
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import GridSearchCV
from sklearn.svm import SVC
from bs4 import BeautifulSoup
```

In [24]:
```
d_train=pd.read_csv("train.csv")
d_test = pd.read_csv("test.csv")
```

In [40]:
```
d_train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10158 entries, 0 to 10157
Data columns (total 6 columns):
 #   Column               Non-Null Count  Dtype  
---  ------               --------------  -----  
 0   id                   10158 non-null  int64  
 1   query                10158 non-null  object 
 2   product_title        10158 non-null  object 
 3   product_description  7714 non-null   object 
 4   median_relevance     10158 non-null  int64  
 5   relevance_variance   10158 non-null  float64
dtypes: float64(1), int64(2), object(3)
memory usage: 476.3+ KB
```

In [42]:
```
d_train.product_description.fillna('',inplace=True)
d_train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10158 entries, 0 to 10157
Data columns (total 6 columns):
 #   Column               Non-Null Count  Dtype  
---  ------               --------------  -----  
 0   id                   10158 non-null  int64  
 1   query                10158 non-null  object 
 2   product_title        10158 non-null  object 
 3   product_description  10158 non-null  object 
 4   median_relevance     10158 non-null  int64  
 5   relevance_variance   10158 non-null  float64
dtypes: float64(1), int64(2), object(3)
memory usage: 476.3+ KB
```

In [43]:
```
d_test.info()
```

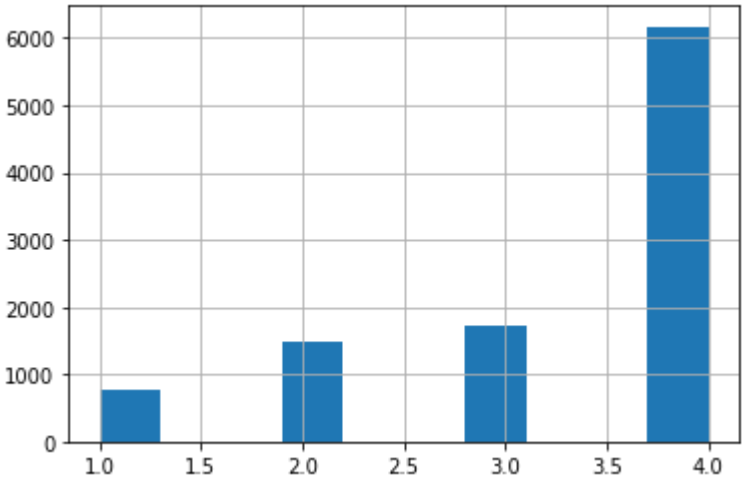
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 22513 entries, 0 to 22512
Data columns (total 4 columns):
 #   Column               Non-Null Count  Dtype 
---  ------               --------------  ----- 
 0   id                   22513 non-null  int64 
 1   query                22513 non-null  object
 2   product_title        22513 non-null  object
 3   product_description  17086 non-null  object
dtypes: int64(1), object(3)
memory usage: 703.7+ KB
```

In [44]:
```
d_train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10158 entries, 0 to 10157
Data columns (total 6 columns):
 #   Column               Non-Null Count  Dtype  
---  ------               --------------  -----  
 0   id                   10158 non-null  int64  
 1   query                10158 non-null  object 
 2   product_title        10158 non-null  object 
 3   product_description  10158 non-null  object 
 4   median_relevance     10158 non-null  int64  
 5   relevance_variance   10158 non-null  float64
dtypes: float64(1), int64(2), object(3)
memory usage: 476.3+ KB
```

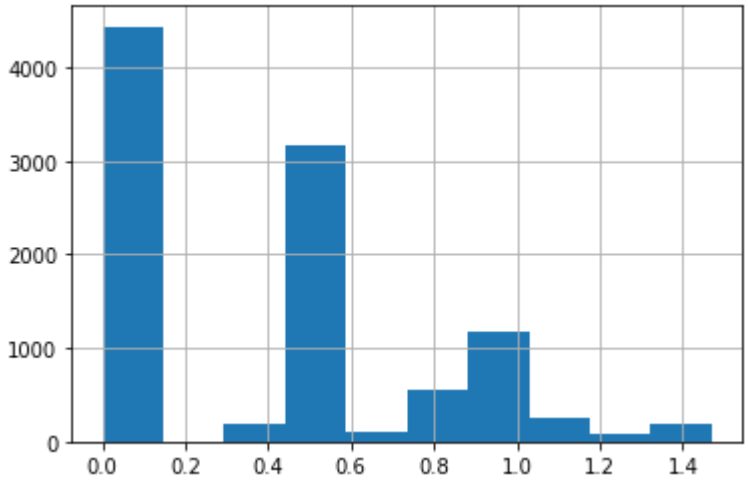
In [20]:
```
d_train.median_relevance.hist()
```

Out[20]:
```
<AxesSubplot:>
```



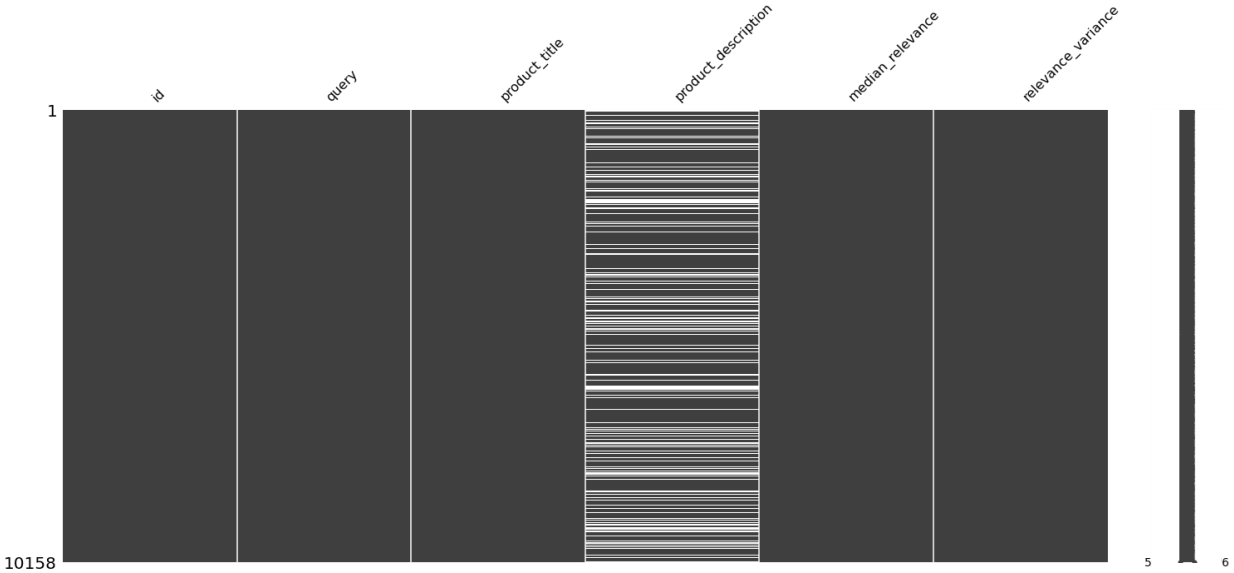
In [21]:
```
d_train.relevance_variance.hist()
```

Out[21]:
```
<AxesSubplot:>
```



In [38]:
```
#checking for missing values in dataset
import missingno

ax=missingno.matrix(d_train)
```



In [52]:
```
d_train.head(15)
```

Out[52]:

	id	query	product_title	product_description	median_relevance	relevance_variance
0	1	bridal shower decorations	Accent Pillow with Heart Design - Red/Black	Red satin accent pillow embroidered with a hea...	1	0.000
1	2	led christmas lights	Set of 10 Battery Operated Multi LED Train Chr...	Set of 10 Battery Operated Train Christmas Lig...	4	0.000
2	4	projector	ViewSonic Pro8200 DLP Multimedia Projector		4	0.471
3	5	wine rack	Concept Housewares WR-44526 Solid-Wood Ceiling...	Like a silent and sturdy tree, the Southern En...	4	0.000
4	7	light bulb	Wintergreen Lighting Christmas LED Light Bulb ...	WTGR1011\nFeatures\nNickel base, 60,000 averag...	2	0.471
5	8	oakley polarized radar	Oakley Sunglasses - Radar Path Polished Black/...	Durability and all-day comfort of lightweight,...	3	1.166
6	10	boyfriend jeans	How To Make An American Quilt (DVD)	ITEM#: 2518897\nDirector Jocelyn Moorhouse's f...	1	0.000
7	13	screen protector samsung	ZAGG InvisibleShield Cell Phone Screen Protect...	Protect your most precious technology with the...	4	0.000
8	17	pots and pans set	Cook N Home Stainless Steel 4-Piece Pasta Cook...	This ultimate pasta and vegetable steamer cook...	2	0.632
9	20	waffle maker	Presto FlipSide Electric Waffle Maker- 03510	Please the waffle lover in your family with th...	4	0.471
10	28	oakley radar	Oakley Radar Pitch Replacement Lens Gray, One ...	If you own the most technologically advanced p...	3	0.471

	id	query	product_title	product_description	median_relevance	relevance_variance
11	31	workout clothes for women	Plus Size Peyton Tank - Tulah		3	0.000
12	32	decorative pillows	Surya Ruffle Circle Decorative Pillows Gray 18...	Stylish yet simple, this Surya toss pillow wil...	4	0.943
13	35	wall clocks	Lorell Round ProFile Radio Controlled Wall Clock	Lorell Round Profile Radio Controlled Wall Clo...	4	0.000
14	46	cuisinart coffee maker	Cuisinart DCC-3200 PerfecTemp 14-Cup Programma...	The Cuisinart 14-Cup Programmable Coffeemaker ...	4	0.000

In [64]:

```
stemmer = PorterStemmer()
sw=[]
ML_STOP_WORDS = ['http','www','img','border','color','style','padding','table','font',
ML_STOP_WORDS += list(text.ENGLISH_STOP_WORDS)
for stw in ML_STOP_WORDS:
    sw.append("z"+str(stw))
ML_STOP_WORDS += sw
for i in range(len(ML_STOP_WORDS)):
    ML_STOP_WORDS[i]=stemmer.stem(ML_STOP_WORDS[i])

def clean(f3):
    f2=""
    if len(f2)<3:
        f2="feature2null"
    if len(f3)<3:
        f3="feature3null"
    tx = BeautifulSoup(f3)
    tx1 = [x.extract() for x in tx.findAll('script')]
    tx = tx.get_text(" ").strip()
    s = (" ").join(["z"+ str(z) for z in f2.split(" ")]) + " " + tx
    s = re.sub("[^a-zA-Z0-9]"," ", s)
    s = re.sub("[0-9]{1,3}px"," ", s)
    s = re.sub(" [0-9]{1,6} |000"," ", s)
    s = (" ").join([stemmer.stem(z) for z in s.split(" ") if len(z)>2])
    s = s.lower()
    return s



idx = d_test.id.values.astype(int)

d_train.drop('id',axis=1)
d_test.drop('id',axis=1)

y = d_train.median_relevance.values
```

```
d_train2 = d_train.copy()
d_train.drop(['median_relevance','relevance_variance'],axis=1)

traindata = np.array(d_train.apply(lambda x:'%s %s %s' % (x['query'],x['product_title'
testdata = np.array(d_test.apply(lambda x:'%s %s %s' % (x['query'],x['product_title'],

for i in range(len(traindata)):
    traindata[i]=clean(traindata[i])
for i in range(len(testdata)):
    testdata[i]=clean(testdata[i])


tsvd = TruncatedSVD(n_components=200, algorithm='randomized', n_iter=5, random_state=N
scaler = StandardScaler()
tfidf = TfidfVectorizer(max_features=2500,min_df=0.0,max_df=0.4,stop_words=ML_STOP_WOR
classifier = SVC(C=10.0, kernel='rbf', degree=3, gamma=0.001, coef0=0.0, shrinking=Tru
parameters = { 'class__n_estimators': (10,50,100) }
pipe = Pipeline([('tfidf',tfidf),
                 ('tsvd',tsvd),
                 ('scl',scaler),
                 ('class',classifier)])
#grid_search = GridSearchCV(pipe,parameters)
pipe.fit(traindata,y)
predicted = pipe.predict(testdata) #pipe.predict(testdata)

df_res = pd.DataFrame()
df_res['id']=idx
df_res['prediction']=predicted
```

In [60]:
```
df_res['prediction'].value_counts()
```

Out[60]:
```
4    19944
2     1157
1      840
3      572
Name: prediction, dtype: int64
```

In [61]:
```
accuracy = int(df_res.prediction[df_res.prediction==4].value_counts()) * 100 / len(df_
accuracy

print('the accuracy of the model trained is:' , accuracy , '%')
```

```
the accuracy of the model trained is: 88.58881535113046 %
```

In [62]:
```
len(d_test)
```

Out[62]:
```
22513
```

In [63]:
```
len(df_res)
```

Out[63]:
```
22513
```

In [65]:
```
d_test_new = d_test.copy()
```

In [66]:
```
d_test_new.head()
```

Out[66]:

	id	query	product_title	product_description
0	3	electric griddle	Star-Max 48 in Electric Griddle	NaN
1	6	phillips coffee maker	Philips SENSEO HD7810 WHITE Single Serve Pod C...	NaN
2	9	san francisco 49ers	2013 San Francisco 49ers Clock	A 2013 San Francisco 49ers clock is the ultima...
3	11	aveeno shampoo	AVEENO 10.5FLOZ NRSH SHINE SH	Water, Ammonium Lauryl Sulfate, Dimethicone, S...
4	12	flea and tick control for dogs	Merial Frontline Plus Flea and Tick Control fo...	NaN

In [67]:
```
d_test.head()
```

Out[67]:

	id	query	product_title	product_description
0	3	electric griddle	Star-Max 48 in Electric Griddle	NaN
1	6	phillips coffee maker	Philips SENSEO HD7810 WHITE Single Serve Pod C...	NaN
2	9	san francisco 49ers	2013 San Francisco 49ers Clock	A 2013 San Francisco 49ers clock is the ultima...
3	11	aveeno shampoo	AVEENO 10.5FLOZ NRSH SHINE SH	Water, Ammonium Lauryl Sulfate, Dimethicone, S...
4	12	flea and tick control for dogs	Merial Frontline Plus Flea and Tick Control fo...	NaN

In [68]:
```
df_res.head()
```

Out[68]:

	id	prediction
0	3	4
1	6	4
2	9	3
3	11	4
4	12	4

In [69]:
```
d_test_new['median_relevance'] = df_res['prediction']
```

In [70]:
```
d_test_new.head()
```

Out[70]:

	id	query	product_title	product_description	median_relevance
0	3	electric griddle	Star-Max 48 in Electric Griddle	NaN	4
1	6	phillips coffee maker	Philips SENSEO HD7810 WHITE Single Serve Pod C...	NaN	4
2	9	san francisco 49ers	2013 San Francisco 49ers Clock	A 2013 San Francisco 49ers clock is the ultima...	3
3	11	aveeno shampoo	AVEENO 10.5FLOZ NRSH SHINE SH	Water, Ammonium Lauryl Sulfate, Dimethicone, S...	4
4	12	flea and tick control for dogs	Merial Frontline Plus Flea and Tick Control fo...	NaN	4

In [81]:
```
d_train2=d_train2.drop(['relevance_variance' ], axis=1)
```

In [82]:
```
combined_df = pd.concat([d_train2, d_test_new], axis=0)
combined_df = combined_df.drop_duplicates('id')
print(combined_df.shape)
```

```
(32671, 5)
```

In [83]:
```
combined_df.head()
```

Out[83]:

	id	query	product_title	product_description	median_relevance
0	1	bridal shower decorations	Accent Pillow with Heart Design - Red/Black	Red satin accent pillow embroidered with a hea...	1
1	2	led christmas lights	Set of 10 Battery Operated Multi LED Train Chr...	Set of 10 Battery Operated Train Christmas Lig...	4
2	4	projector	ViewSonic Pro8200 DLP Multimedia Projector		4
3	5	wine rack	Concept Housewares WR-44526 Solid-Wood Ceiling...	Like a silent and sturdy tree, the Southern En...	4
4	7	light bulb	Wintergreen Lighting Christmas LED Light Bulb ...	WTGR1011\nFeatures\nNickel base, 60,000 averag...	2

In [84]:
```
combined_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 32671 entries, 0 to 22512
Data columns (total 5 columns):
 #   Column               Non-Null Count  Dtype 
---  ------               --------------  ----- 
 0   id                   32671 non-null  int64 
 1   query                32671 non-null  object
 2   product_title        32671 non-null  object
 3   product_description  27244 non-null  object
 4   median_relevance     32671 non-null  int64 
dtypes: int64(2), object(3)
memory usage: 1.5+ MB
```

In [85]:
```
combined_df['product_description'] = combined_df['product_description'].fillna("")
```

In [86]:
```
combined_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 32671 entries, 0 to 22512
Data columns (total 5 columns):
 #   Column               Non-Null Count  Dtype 
---  ------               --------------  ----- 
 0   id                   32671 non-null  int64 
 1   query                32671 non-null  object
 2   product_title        32671 non-null  object
 3   product_description  32671 non-null  object
 4   median_relevance     32671 non-null  int64 
dtypes: int64(2), object(3)
memory usage: 1.5+ MB
```