Finra_wine_reviewers_JintingHang

May 2, 2019

1 Finra Project: Wine reviews

- by Jinting Hang

Questions: 1. find the pair which has the moest similar distribution of in items of points 2. compute the word frequency and identify words that differentiate classes the most 3. Build a text classifier using Naive Bayes 4. derive TFIDF matrix of wine reviewers given any taster and further compute similarity matrix 5. identify the taster that has the most similar style of wine reviews

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```
In [396]: import numpy as np
          import pandas as pd
          import re
          from itertools import permutations
          from sklearn.model_selection import train_test_split
          from sklearn.metrics import classification_report
          from sklearn.preprocessing import normalize
          from scipy.stats import f
          from collections import Counter
          import matplotlib.pyplot as plt
          plt.style.use('ggplot')
          %matplotlib inline
```

```
In [397]: df_reviews = pd.read_csv('winemag-data-130k-v2.csv')
          df_reviews.head()
```

```
Out[397]:    Unnamed: 0   country                                        description  \
          0           0     Italy  Aromas include tropical fruit, broom, brimston...
          1           1  Portugal  This is ripe and fruity, a wine that is smooth...
          2           2        US  Tart and snappy, the flavors of lime flesh and...
```

```
3           3        US  Pineapple rind, lemon pith and orange blossom ...
4           4        US  Much like the regular bottling from 2012, this...

                          designation  points  price           province  \
0                        Vulkà Bianco      87    NaN  Sicily & Sardinia
1                            Avidagos      87   15.0              Douro
2                                 NaN      87   14.0             Oregon
3                Reserve Late Harvest      87   13.0           Michigan
4  Vintner's Reserve Wild Child Block      87   65.0             Oregon

              region_1           region_2         taster_name  \
0                 Etna                NaN        Kerin OKeefe
1                  NaN                NaN          Roger Voss
2    Willamette Valley  Willamette Valley        Paul Gregutt
3  Lake Michigan Shore                NaN  Alexander Peartree
4    Willamette Valley  Willamette Valley        Paul Gregutt

  taster_twitter_handle                                              title  \
0          @kerinokeefe                  Nicosia 2013 Vulkà Bianco  (Etna)
1            @vossroger      Quinta dos Avidagos 2011 Avidagos Red (Douro)
2           @paulgwineă      Rainstorm 2013 Pinot Gris (Willamette Valley)
3                   NaN  St. Julian 2013 Reserve Late Harvest Riesling ...
4           @paulgwineă  Sweet Cheeks 2012 Vintner's Reserve Wild Child...

          variety               winery
0     White Blend              Nicosia
1  Portuguese Red  Quinta dos Avidagos
2      Pinot Gris            Rainstorm
3        Riesling           St. Julian
4      Pinot Noir         Sweet Cheeks
```

2.1 Answer question 1

- find the pair which has the moest similar distribution of in items of points

```
In [3]: df_reviews = df_reviews.dropna()
```

```
In [5]: len(df_reviews['variety'].unique())
```

```
Out[5]: 183
```

```
In [69]: df_reviews.groupby(['variety'])['points'].value_counts()
```

```
Out[69]: variety            points
         Abouriou           85          1
         Aglianico          92          2
                            86          1
         Albariño           87         13
                            88          6
```

```
                   90          6
                   89          5
                   91          4
                   86          3
                   92          3
                   84          2
                   82          1
                   85          1
                   93          1
Alicante Bouschet  87          1
                   88          1
                   90          1
                   91          1
Aligoté            87          2
Alvarelhão         85          1
Arneis             88          1
                   90          1
Auxerrois          90          4
                   89          1
Baco Noir          87          1
Barbera            89         23
                   90         23
                   88         16
                   91         14
                   86         10
                                ...
White Blend        83         11
                   84         10
                   93          5
                   94          4
                   95          2
                   80          1
                   82          1
White Riesling     88          1
                   96          1
Zinfandel          90        195
                   88        138
                   91        129
                   87        127
                   92        107
                   89         87
                   86         82
                   85         65
                   93         63
                   84         35
                   94         25
                   83         23
                   82         18
```

```
                 95          8
                 80          6
                 81          3
                 96          2
                 97          1
Zweigelt         90          2
                 87          1
                 88          1
Name: points, Length: 981, dtype: int64
```

```
In [108]: def similar_distribution_adv(df):
              X= df['points'].value_counts()
              return pd.Series({'Variance': X.var(), 'length':len(X)})
```

```
In [109]: df_variety_distribution = df_reviews.groupby(['variety']).apply(similar_distribution_
```

```
In [120]: df_variety_distribution.dropna(inplace = True)
          df_variety_distribution = df_variety_distribution.loc[df_variety_distribution['Varian
```

```
In [121]: df_variety_distribution.head()
```

```
Out[121]:                 Variance  length
          variety
          Aglianico       0.500000     2.0
          Albariño       12.290909    11.0
          Auxerrois       4.500000     2.0
          Barbera        69.072727    11.0
          Blaufränkisch   0.200000     5.0
```

```
In [393]: alpha = 0.05 # threshold value to test whether two have equal variance.
```

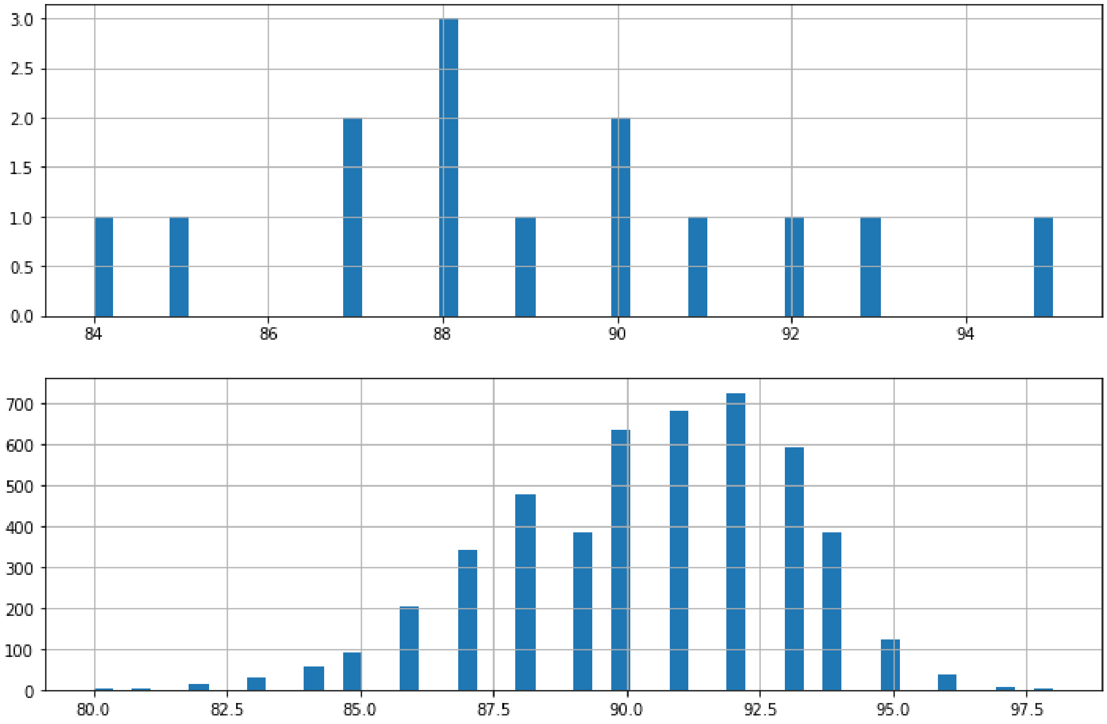
```
In [212]: # Get all permutations of length 2
          # calculate p_value based on ftest to see which pair has the smallest pvalue, normal
          #0.5, we can accept the hypothesis that two groups have the same variance, otherwise

          def most_similar_pair(DF):
              ind = DF.index
              perm = permutations(ind, 2)
              similar_pair = []
              minp = 1 << 30
              for a, b in perm:
                  #print('a:',a,'b:', b, DF.loc[a, 'Variance'])
                  F = DF.loc[a, 'Variance'] / DF.loc[b, 'Variance']
                  df1, df2 = DF.loc[a, 'length'], DF.loc[b, 'length']
                  p_value = f.cdf(F, df1, df2)
                  if p_value < minp:
                      similar_pair = [a, b]
                      minp = p_value
              return similar_pair, p_value
```

```
In [215]: similar_pair, pvalue = most_similar_pair(df_variety_distribution)
          similar_pair, pvalue

Out[215]: (['Fumé Blanc', 'Pinot Noir'], 1.4019283822650899e-06)
```

```
In [216]: # plot out the most similar distribution in in terms of points
          def plot_similar_pair(df, similar_pair):
              plt.figure(figsize = (12, 8))
              plt.subplot(211)
              df_test = df.loc[df['variety'] ==  similar_pair[0], 'points']
              df_test.hist(bins = 50)
              plt.subplot(212)
              df_test = df.loc[df['variety'] ==  similar_pair[1], 'points']
              df_test.hist(bins = 50)
          plot_similar_pair(df_reviews, similar_pair)
```



2.1.1 We have chosen the pair group which has the smallest pvalue as having the most similar distribution.

3 Answer question 2

- compute the word frequency and identify words that differentiate classes the most

```
In [407]: df_reviews['class']  = 0
          df_reviews.loc[df_reviews['points'] > 90, 'class'] = 1
```

```
In [408]: df_reviews['class'].value_counts()

Out[408]: 0    96336
          1    33635
          Name: class, dtype: int64

In [409]: df_reviews['description'] = df_reviews['description'] + ' '

In [ ]: # analyze the frequency of words for each description
        def extract_frequency(df):
            #extract = Counter([re.sub(r'[^\w]', ' ', c) for c in df['description'].sum().spli
            extract = Counter([c.strip("',.() ").replace(" " " ", "") for c in df['description
            return pd.Series(extract)

In [ ]: frequency_word = df_reviews.groupby(['class']).apply(extract_frequency).unstack(level =

In [ ]: df_reviews_test = df_reviews.iloc[0: 2000]
        frequency_word_test = df_reviews_test.groupby(['class']).apply(extract_frequency).unsta

In [ ]: frequency_word_test.iloc[:50]

In [229]: frequency_word.fillna(0, inplace = True)

In [398]: # choose the most frequent 50 words for each class
          def distint_words(df):
              class_0_freq_words = df.sort_values(by = 0, ascending = False).iloc[0:50].index
              class_1_freq_words = df.sort_values(by = 1, ascending = False).iloc[0:50].index
              # use a set intersection to find out the distint words for each class
              return set(class_0_freq_words) - set(class_1_freq_words), set(class_1_freq_words)

In [400]: distint_words(frequency_word)

Out[400]: ({'Sauvignon', 'apple', 'has', 'light', 'offers', 'ripe', 'tart', 'vanilla'},
           {'blackberry',
            'bottling',
            'dark',
            'dried',
            'pepper',
            'shows',
            'through',
            'vineyard'})
```

3.1 Answer question 3

- Build a text classifier using Naive Bayes

```
In [ ]: import nltk
        from nltk.corpus import stopwords
        from nltk.stem import WordNetLemmatizer
        import string
        import pandas as pd
        from nltk import pos_tag
        from nltk.stem import PorterStemmer
```

```
In [ ]: def preprocessing(text):
            text2 = " ".join("".join([" " if ch in string.punctuation else ch
        for ch in text]).split())
            tokens = [word for sent in nltk.sent_tokenize(text2) for word in
        nltk.word_tokenize(sent)]
            tokens = [word.lower() for word in tokens]
            stopwds = stopwords.words('english')
            tokens = [token for token in tokens if token not in stopwds]
            tokens = [word for word in tokens if len(word)>=3]
            stemmer = PorterStemmer()
            tokens = [stemmer.stem(word) for word in tokens]
            tagged_corpus = pos_tag(tokens)
            Noun_tags = ['NN','NNP','NNPS','NNS']
            Verb_tags = ['VB','VBD','VBG','VBN','VBP','VBZ']
            lemmatizer = WordNetLemmatizer()
            def prat_lemmatize(token,tag):
                if tag in Noun_tags:
                    return lemmatizer.lemmatize(token,'n')
                elif tag in Verb_tags:
                    return lemmatizer.lemmatize(token,'v')
                else:
                    return lemmatizer.lemmatize(token,'n')
                pre_proc_text = " ".join([prat_lemmatize(token,tag) for token,tag in tagged_co
            return pre_proc_text
```

```
In [238]: ## choose the first 2000 rows data
          df_reviews_mini = df_reviews.iloc[:2000]
          df_reviews_mini['class'].value_counts()
```

```
Out[238]: 0    1171
          1     829
          Name: class, dtype: int64
```

```
In [239]: # setting the prior, since 0s and 1s have different probability
          p_0 = 1171/2000
          p_1 = 829/2000
```

```
In [244]: frequency_word_mini = df_reviews_test.groupby(['class']).apply(extract_frequency).uns
          frequency_word_mini.fillna(0, inplace = True)
```

```
In [250]: frequency_word_mini = frequency_word_mini.sort_values(by = 0, ascending = False)
          frequency_word_mini.head()
```

```
Out[250]: class       0       1
          and    3084.0  2723.0
          of     1641.0  1503.0
          the    1550.0  1385.0
          a      1449.0  1169.0
          with    957.0   824.0
```

```
In [276]: frequency_word_mini.shape[0]
```

```
Out[276]: 7491
```

```
In [277]: vocabulary = frequency_word_mini.index
          vocabulary_class0 = frequency_word_mini.loc[frequency_word_mini[0] != 0].index
          vocabulary_class1 = frequency_word_mini.loc[frequency_word_mini[1] != 0].index
```

```
In [279]: len(vocabulary_class0)
```

```
Out[279]: 5131
```

```
In [251]: df_reviews_mini.head()
```

```
Out[251]:     Unnamed: 0 country                                        description  \
          4            4      US  Much like the regular bottling from 2012, this...
          10          10      US  Soft, supple plum envelopes an oaky structure ...
          23          23      US  This wine from the Geneseo district offers aro...
          25          25      US  Oak and earth intermingle around robust aromas...
          35          35      US  As with many of the Erath 2010 vineyard design...

                                     designation  points  price    province  \
          4   Vintner's Reserve Wild Child Block      87   65.0      Oregon
          10                      Mountain Cuvée      87   19.0  California
          23                 Signature Selection      87   22.0  California
          25                 King Ridge Vineyard      87   69.0  California
          35                              Hyland      86   50.0      Oregon

                         region_1           region_2     taster_name  \
          4   Willamette Valley  Willamette Valley    Paul Gregutt
          10        Napa Valley               Napa  Virginie Boone
          23        Paso Robles      Central Coast    Matt Kettmann
          25       Sonoma Coast             Sonoma  Virginie Boone
          35        McMinnville  Willamette Valley    Paul Gregutt

             taster_twitter_handle                                              title  \
          4            @paulgwineă  Sweet Cheeks 2012 Vintner's Reserve Wild Child...
          10               @vboone  Kirkland Signature 2011 Mountain Cuvée Caberne...
          23         @mattkettmann  Bianchi 2011 Signature Selection Merlot (Paso ...
          25               @vboone  Castello di Amorosa 2011 King Ridge Vineyard P...
          35           @paulgwineă         Erath 2010 Hyland Pinot Noir (McMinnville)

                         variety               winery  class
          4           Pinot Noir         Sweet Cheeks      0
          10  Cabernet Sauvignon   Kirkland Signature      0
          23              Merlot              Bianchi      0
          25          Pinot Noir  Castello di Amorosa      0
          35          Pinot Noir                Erath      0
```

```
In [349]: X = df_reviews_mini['description']
          y = df_reviews_mini['class']
          Xtrain, Xtest, ytrain, ytest = train_test_split(X, y)
          Xtrain = pd.DataFrame(Xtrain, columns = ['description'])
          Xtrain.index.name = 'ID'
          ytrain = pd.DataFrame(ytrain, columns = ['class'])
          Xtest = pd.DataFrame(Xtest, columns = ['description'])
          Xtest.index.name = 'ID'
          ytest = pd.DataFrame(ytest, columns = ['class'])
```

```
In [350]: # since it is a binary classification, we first calculate the likelihood function fo
          def assign_class(df):
              df_freq = frequency_word_mini
              val = df.values[0][0]
              _dic = Counter([word.strip(',.') for word in val.split()])
              # get conditional prob for class 1 and 0
              P_class0, P_class1 = 1, 1
              for key in _dic:
                  try:
                      P_class1 *= ((df_freq.loc[key, 1] + 1) / (len(vocabulary_class1) + len(vo
                      P_class0 *= ((df_freq.loc[key, 0] + 1) / (len(vocabulary_class0) + len(vo
                  except:
                      continue

              P_class0 *= p_0

              P_class1 *= p_1
              return pd.Series(0, index = ['Class']) if P_class0 > P_class1 else pd.Series(1, i
```

```
In [351]: y_train_pred = Xtrain.groupby('ID').apply(assign_class)
          y_train_pred['Class'].value_counts()

Out[351]: 0    1101
          1     399
          Name: Class, dtype: int64
```

```
In [354]: print('classification_report_train: \n',classification_report(ytrain, y_train_pred))

classification_report_train:
              precision    recall  f1-score   support

          0       0.59      0.74      0.65       879
          1       0.42      0.27      0.33       621

avg / total       0.52      0.54      0.52      1500
```

```
In [355]: y_test_pred = Xtest.groupby('ID').apply(assign_class)
          y_test_pred['Class'].value_counts()
```

```
Out[355]: 0    372
          1    128
          Name: Class, dtype: int64
```

```
In [356]: print('classification_report_test: \n',classification_report(ytest, y_test_pred))
```

```
classification_report_test:
              precision    recall  f1-score   support

          0       0.60      0.76      0.67       292
          1       0.46      0.28      0.35       208

avg / total       0.54      0.56      0.54       500
```

The low precision and recall might due to the fact that I haven't removed any stop words and stemmings, if I have more time, I will implement them on both the train and test data.

4 Answer question 4

- derive TFIDF matrix of wine reviewers given any taster and further compute similarity matrix

```
In [357]: df_reviews_mini.head()
```

```
Out[357]:     Unnamed: 0 country                                        description  \
          4            4      US  Much like the regular bottling from 2012, this...
          10          10      US  Soft, supple plum envelopes an oaky structure ...
          23          23      US  This wine from the Geneseo district offers aro...
          25          25      US  Oak and earth intermingle around robust aromas...
          35          35      US  As with many of the Erath 2010 vineyard design...

                                designation  points  price    province  \
          4   Vintner's Reserve Wild Child Block      87   65.0      Oregon
          10                      Mountain Cuvée      87   19.0  California
          23                 Signature Selection      87   22.0  California
          25                 King Ridge Vineyard      87   69.0  California
          35                              Hyland      86   50.0      Oregon

                      region_1           region_2     taster_name  \
          4   Willamette Valley  Willamette Valley    Paul Gregutt
          10        Napa Valley               Napa  Virginie Boone
          23        Paso Robles      Central Coast   Matt Kettmann
          25       Sonoma Coast             Sonoma  Virginie Boone
          35        McMinnville  Willamette Valley    Paul Gregutt

             taster_twitter_handle                                              title  \
          4             @paulgwineă  Sweet Cheeks 2012 Vintner's Reserve Wild Child...
          10                @vboone  Kirkland Signature 2011 Mountain Cuvée Caberne...
          23          @mattkettmann  Bianchi 2011 Signature Selection Merlot (Paso ...
          25                @vboone  Castello di Amorosa 2011 King Ridge Vineyard P...
          35            @paulgwineă         Erath 2010 Hyland Pinot Noir (McMinnville)

                         variety              winery  class
          4           Pinot Noir        Sweet Cheeks      0
          10  Cabernet Sauvignon  Kirkland Signature      0
          23              Merlot             Bianchi      0
          25          Pinot Noir  Castello di Amorosa      0
          35          Pinot Noir               Erath      0
```

```
In [379]: # analyze the TFIDF of words for each description
          def extract_TFIDF(df):
              #extract = Counter([re.sub(r'[^\w]', ' ', c) for c in df['description'].sum().sp
              extract = Counter([c.strip("',. ").replace(" " " ", "") for c in df['description
              n = sum(extract.values())
              # calculate the inverse frequency
              dic = {}
              for key in extract:
                  dic[key] = np.log(n/ extract[key])

              return pd.Series(dic)
```

```
In [380]: # IFIDF: inverse frequency of terms
          grp_by_taster = df_reviews_mini.groupby('taster_name').apply(extract_TFIDF).unstack(
          grp_by_taster.head()
```

```
Out[380]: taster_name  Jim Gordon  Joe Czerwinski  Matt Kettmann  Michael Schachner  \
                              0.0        0.000000       0.000000                0.0
          "dry,"              0.0        5.758902       0.000000                0.0
          $12                 0.0        0.000000       0.000000                0.0
          $20                 0.0        0.000000       0.000000                0.0
          $25                 0.0        0.000000       9.903188                0.0

          taster_name  Paul Gregutt  Roger Voss  Sean P. Sullivan  Susan Kostrzewa  \
                             0.0000         0.0          9.299907              0.0
          "dry,"             0.0000         0.0          0.000000              0.0
          $12                0.0000         0.0          0.000000              0.0
          $20                9.3299         0.0          0.000000              0.0
          $25                0.0000         0.0          0.000000              0.0

          taster_name  Virginie Boone
                             0.000000
          "dry,"             0.000000
          $12               10.088846
          $20                0.000000
          $25                0.000000
```

```
In [385]: # build similarity matrix
          A = normalize(grp_by_taster)
          similarity_matrix = A.T.dot(A)
          np.fill_diagonal(similarity_matrix, 0)
```

```
In [388]: similarity_matrix = pd.DataFrame(similarity_matrix, columns = grp_by_taster.columns,
          similarity_matrix
```

```
Out[388]: taster_name        Jim Gordon  Joe Czerwinski  Matt Kettmann  \
          taster_name
          Jim Gordon           0.000000       17.200131     180.847054
          Joe Czerwinski      17.200131        0.000000      22.453870
          Matt Kettmann      180.847054       22.453870       0.000000
          Michael Schachner   15.393099        6.379032      21.730015
          Paul Gregutt       215.180184       27.393243     375.441039
          Roger Voss           2.001555        1.396979       2.937266
          Sean P. Sullivan   122.863583       16.667886     204.398779
          Susan Kostrzewa      9.964144        3.840653      11.617836
          Virginie Boone     207.674775       21.176357     404.497218

          taster_name        Michael Schachner  Paul Gregutt  Roger Voss  \
          taster_name
          Jim Gordon                 15.393099    215.180184    2.001555
          Joe Czerwinski              6.379032     27.393243    1.396979
          Matt Kettmann              21.730015    375.441039    2.937266
          Michael Schachner           0.000000     25.536940    1.124541
          Paul Gregutt               25.536940      0.000000    2.745645
          Roger Voss                  1.124541      2.745645    0.000000
          Sean P. Sullivan           16.742858    248.903781    2.504328
          Susan Kostrzewa             3.146881     13.895070    0.915540
          Virginie Boone             24.789757    465.042123    2.921999

          taster_name        Sean P. Sullivan  Susan Kostrzewa  Virginie Boone
          taster_name
          Jim Gordon               122.863583         9.964144      207.674775
          Joe Czerwinski            16.667886         3.840653       21.176357
          Matt Kettmann            204.398779        11.617836      404.497218
          Michael Schachner         16.742858         3.146881       24.789757
          Paul Gregutt             248.903781        13.895070      465.042123
          Roger Voss                 2.504328         0.915540        2.921999
          Sean P. Sullivan           0.000000        10.069487      239.092529
          Susan Kostrzewa           10.069487         0.000000       13.887551
          Virginie Boone           239.092529        13.887551        0.000000
```

5 Answer question 5

- identify the taster that has the most similar style of wine reviews

```
In [394]: def find_max(df):
              return df.idxmax()
```

```
In [395]: similarity_matrix.apply(find_max, axis = 0)
```

```
Out[395]: taster_name
          Jim Gordon              Paul Gregutt
          Joe Czerwinski          Paul Gregutt
          Matt Kettmann         Virginie Boone
          Michael Schachner       Paul Gregutt
          Paul Gregutt          Virginie Boone
          Roger Voss             Matt Kettmann
          Sean P. Sullivan        Paul Gregutt
          Susan Kostrzewa         Paul Gregutt
          Virginie Boone          Paul Gregutt
          dtype: object
```

```
In [ ]:
```