rs-version2

July 31, 2018

0.1 Evaluation of recommender system algorithms in tourism

0.2 ### Prediction Algorithms

In [1]:
```
# For better precision on tests
import random
import numpy as np

# For plots some results
import matplotlib.pyplot as plt
plt.style.use('tableau-colorblind10') #seaborn-talk, fivethirtyeight
%matplotlib inline

from surprise import Reader, Dataset
from surprise import KNNBasic, KNNWithMeans, KNNWithZScore, KNNBaseline
from surprise import SVD, SVDpp, NMF
from surprise import NormalPredictor, BaselineOnly
from surprise import CoClustering, SlopeOne
from surprise.model_selection import cross_validate, GridSearchCV
```

In [2]:
```
random.seed(0)
np.random.seed(0)

reader = Reader(line_format='user item rating', sep=',', rating_scale=(0,5))
data = Dataset.load_from_file('tourism.csv', reader=reader)
```

Some Functions

In [3]:
```
def crossvalidate(algorithm):
    return cross_validate(algorithm, data, measures=['RMSE', 'MAE', 'FCP'], cv=5)
```

In [4]:
```
def calculateRMSEFinalMean(algorithm):
    score = 0
    for mean in algorithm['test_rmse']:
        score = score + mean

    score = score / len(algorithm['test_rmse'])
    return score
```

```
In [5]: def calculateMAEFinalMean(algorithm):
            score = 0
            for mean in algorithm['test_mae']:
                score = score + mean

            score = score / len(algorithm['test_mae'])
            return score
```

```
In [6]: def calculateFCPFinalMean(algorithm):
            score = 0
            for mean in algorithm['test_fcp']:
                score = score + mean

            score = score / len(algorithm['test_fcp'])
            return score
```

0.3 ### Calculate Cross-Validated

Calculate all kNN cross-validated means

```
In [7]: sim_options_cosine = {'name': 'cosine','user_based': True}
        sim_options_msd = {'name': 'msd','user_based': True}
        sim_options_pearson = {'name': 'pearson','user_based': True}
        sim_options_baseline = {'name': 'pearson_baseline','user_based': True, 'shrinkage': 0}
```

kNN Basic Variations

```
In [ ]: kNNBasicCos = crossvalidate(KNNBasic(sim_options=sim_options_cosine))
        kNNBasicMSD = crossvalidate(KNNBasic(sim_options=sim_options_msd))
        kNNBasicPearson = crossvalidate(KNNBasic(sim_options=sim_options_pearson))
        kNNBasicPearsonB = crossvalidate(KNNBasic(sim_options=sim_options_baseline))
```

kNN With Means Variations

```
In [ ]: kNNMeansCos = crossvalidate(KNNWithMeans(sim_options=sim_options_cosine))
        kNNMeansMSD = crossvalidate(KNNWithMeans(sim_options=sim_options_msd))
        kNNMeansPearson = crossvalidate(KNNWithMeans(sim_options=sim_options_pearson))
        kNNMeansPearsonB = crossvalidate(KNNWithMeans(sim_options=sim_options_baseline))
```

kNN With ZScore Variations

```
In [ ]: kNNZCos = crossvalidate(KNNWithZScore(sim_options=sim_options_cosine))
        kNNZMSD = crossvalidate(KNNWithZScore(sim_options=sim_options_msd))
        kNNZPearson = crossvalidate(KNNWithZScore(sim_options=sim_options_pearson))
        kNNZPearsonB = crossvalidate(KNNWithZScore(sim_options=sim_options_baseline))
```

kNN Baseline Variations

```
In [ ]: kNNBaseCos = crossvalidate(KNNBaseline(sim_options=sim_options_cosine))
        kNNBaseMSD = crossvalidate(KNNBaseline(sim_options=sim_options_msd))
        kNNBasePearson = crossvalidate(KNNBaseline(sim_options=sim_options_pearson))
        kNNBasePearsonB = crossvalidate(KNNBaseline(sim_options=sim_options_baseline))
```

Calculate all Matrix Factorization-based algorithms cross-validated means

```
In [12]: svd = crossvalidate(SVD())
         svdpp = crossvalidate(SVDpp())
```

Calculate all Basic Algorithms cross-validated means

```
In [ ]: baselineOnly = crossvalidate(BaselineOnly())
```

Calculate other Algorithms cross-validated means

```
In [14]: coClustering = crossvalidate(CoClustering())
         slopeOne = crossvalidate(SlopeOne())
```

Calculate Final RMSE (Root Mean Squared Error) Mean of all algorithms

```
In [16]: scoreRMSE_kNNBasicCos = calculateRMSEFinalMean(kNNBasicCos)
         scoreRMSE_kNNBasicMSD = calculateRMSEFinalMean(kNNBasicMSD)
         scoreRMSE_kNNBasicPearson = calculateRMSEFinalMean(kNNBasicPearson)
         scoreRMSE_kNNBasicPearsonB = calculateRMSEFinalMean(kNNBasicPearsonB)

         scoreRMSE_kNNMeansCos = calculateRMSEFinalMean(kNNMeansCos)
         scoreRMSE_kNNMeansMSD = calculateRMSEFinalMean(kNNMeansMSD)
         scoreRMSE_kNNMeansPearson = calculateRMSEFinalMean(kNNMeansPearson)
         scoreRMSE_kNNMeansPearsonB = calculateRMSEFinalMean(kNNMeansPearsonB)

         scoreRMSE_kNNZCos = calculateRMSEFinalMean(kNNZCos)
         scoreRMSE_kNNZMSD = calculateRMSEFinalMean(kNNZMSD)
         scoreRMSE_kNNZPearson = calculateRMSEFinalMean(kNNZPearson)
         scoreRMSE_kNNZPearsonB = calculateRMSEFinalMean(kNNZPearsonB)

         scoreRMSE_kNNBaseCos = calculateRMSEFinalMean(kNNBaseCos)
         scoreRMSE_kNNBaseMSD = calculateRMSEFinalMean(kNNBaseMSD)
         scoreRMSE_kNNBasePearson = calculateRMSEFinalMean(kNNBasePearson)
         scoreRMSE_kNNBasePearsonB = calculateRMSEFinalMean(kNNBasePearsonB)

         scoreRMSE_svd = calculateRMSEFinalMean(svd)
         scoreRMSE_svdpp = calculateRMSEFinalMean(svdpp)

         scoreRMSE_baselineOnly = calculateRMSEFinalMean(baselineOnly)

         scoreRMSE_coClustering = calculateRMSEFinalMean(coClustering)
         scoreRMSE_slopeOne = calculateRMSEFinalMean(slopeOne)
```

Calculate Final MAE (Mean Absolute Error) Means off all Algorithms

```
In [18]: scoreMAE_kNNBasicCos = calculateMAEFinalMean(kNNBasicCos)
         scoreMAE_kNNBasicMSD = calculateMAEFinalMean(kNNBasicMSD)
         scoreMAE_kNNBasicPearson = calculateMAEFinalMean(kNNBasicPearson)
```

```
scoreMAE_kNNBasicPearsonB = calculateMAEFinalMean(kNNBasicPearsonB)

scoreMAE_kNNMeansCos = calculateMAEFinalMean(kNNMeansCos)
scoreMAE_kNNMeansMSD = calculateMAEFinalMean(kNNMeansMSD)
scoreMAE_kNNMeansPearson = calculateMAEFinalMean(kNNMeansPearson)
scoreMAE_kNNMeansPearsonB = calculateMAEFinalMean(kNNMeansPearsonB)

scoreMAE_kNNZCos = calculateMAEFinalMean(kNNZCos)
scoreMAE_kNNZMSD = calculateMAEFinalMean(kNNZMSD)
scoreMAE_kNNZPearson = calculateMAEFinalMean(kNNZPearson)
scoreMAE_kNNZPearsonB = calculateMAEFinalMean(kNNZPearsonB)

scoreMAE_kNNBaseCos = calculateMAEFinalMean(kNNBaseCos)
scoreMAE_kNNBaseMSD = calculateMAEFinalMean(kNNBaseMSD)
scoreMAE_kNNBasePearson = calculateMAEFinalMean(kNNBasePearson)
scoreMAE_kNNBasePearsonB = calculateMAEFinalMean(kNNBasePearsonB)

scoreMAE_svd = calculateMAEFinalMean(svd)
scoreMAE_svdpp = calculateMAEFinalMean(svdpp)

scoreMAE_baselineOnly = calculateMAEFinalMean(baselineOnly)

scoreMAE_coClustering = calculateMAEFinalMean(coClustering)
scoreMAE_slopeOne = calculateMAEFinalMean(slopeOne)
```

Calculate Final FCP (Fraction of Concordant Pairs) off all Algorithms

In [19]:
```
scoreFCP_kNNBasicCos = calculateFCPFinalMean(kNNBasicCos)
scoreFCP_kNNBasicMSD = calculateFCPFinalMean(kNNBasicMSD)
scoreFCP_kNNBasicPearson = calculateFCPFinalMean(kNNBasicPearson)
scoreFCP_kNNBasicPearsonB = calculateFCPFinalMean(kNNBasicPearsonB)

scoreFCP_kNNMeansCos = calculateFCPFinalMean(kNNMeansCos)
scoreFCP_kNNMeansMSD = calculateFCPFinalMean(kNNMeansMSD)
scoreFCP_kNNMeansPearson = calculateFCPFinalMean(kNNMeansPearson)
scoreFCP_kNNMeansPearsonB = calculateFCPFinalMean(kNNMeansPearsonB)

scoreFCP_kNNZCos = calculateFCPFinalMean(kNNZCos)
scoreFCP_kNNZMSD = calculateFCPFinalMean(kNNZMSD)
scoreFCP_kNNZPearson = calculateFCPFinalMean(kNNZPearson)
scoreFCP_kNNZPearsonB = calculateFCPFinalMean(kNNZPearsonB)

scoreFCP_kNNBaseCos = calculateFCPFinalMean(kNNBaseCos)
scoreFCP_kNNBaseMSD = calculateFCPFinalMean(kNNBaseMSD)
scoreFCP_kNNBasePearson = calculateFCPFinalMean(kNNBasePearson)
scoreFCP_kNNBasePearsonB = calculateFCPFinalMean(kNNBasePearsonB)

scoreFCP_svd = calculateFCPFinalMean(svd)
```

```
scoreFCP_svdpp = calculateFCPFinalMean(svdpp)

scoreFCP_baselineOnly = calculateFCPFinalMean(baselineOnly)

scoreFCP_coClustering = calculateFCPFinalMean(coClustering)
scoreFCP_slopeOne = calculateFCPFinalMean(slopeOne)
```

0.4 ### Plot the results

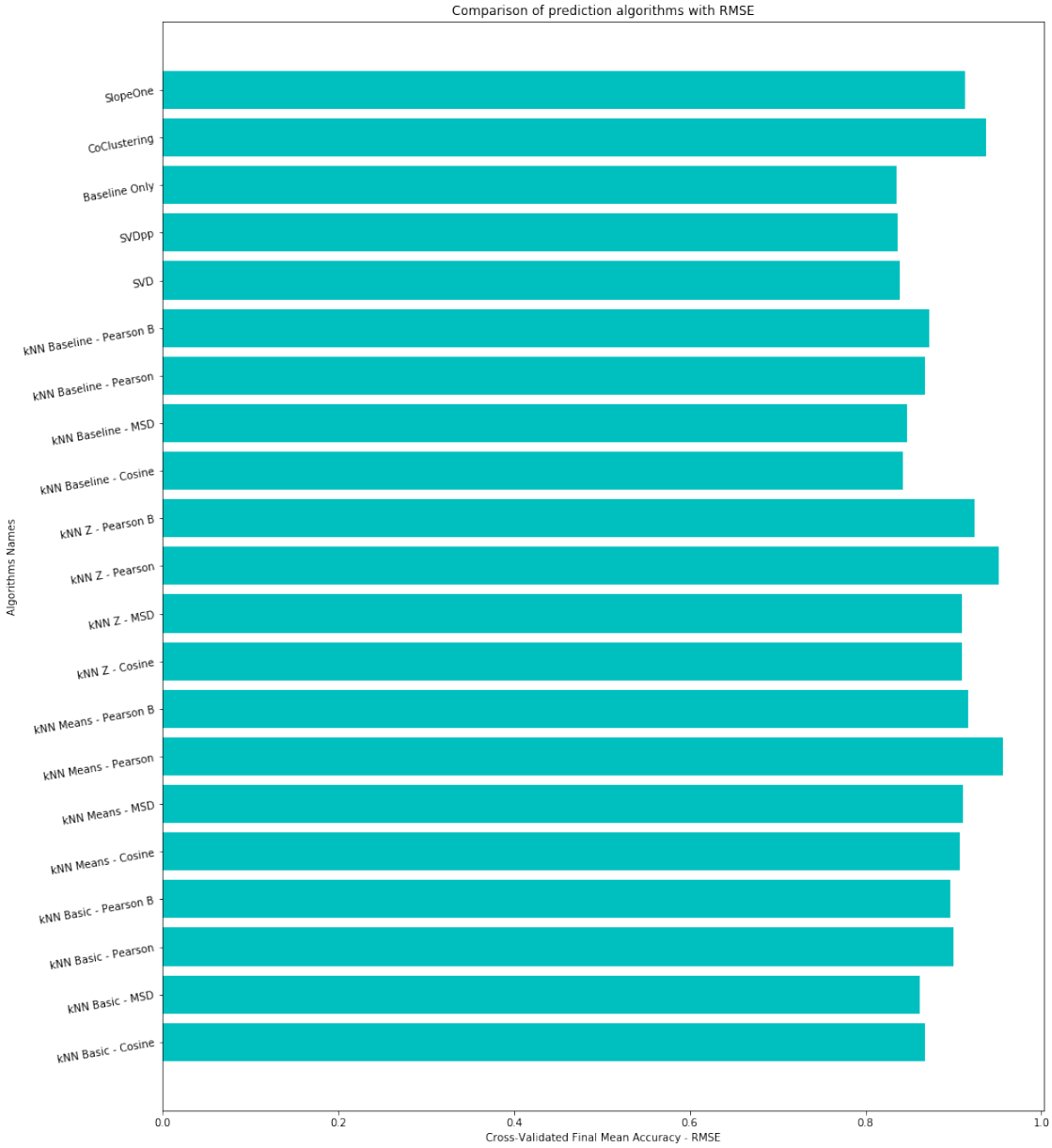
In [20]:
```
names = [
        'kNN Basic - Cosine', 'kNN Basic - MSD',
        'kNN Basic - Pearson',
        'kNN Basic - Pearson B',
        'kNN Means - Cosine',
        'kNN Means - MSD',
        'kNN Means - Pearson',
        'kNN Means - Pearson B',
        'kNN Z - Cosine',
        'kNN Z - MSD', 'kNN Z - Pearson',
        'kNN Z - Pearson B',
        'kNN Baseline - Cosine',
        'kNN Baseline - MSD',
        'kNN Baseline - Pearson',
        'kNN Baseline - Pearson B',
        'SVD',
        'SVDpp',
        'Baseline Only',
        'CoClustering',
        'SlopeOne'
        ]

namesForGraph = np.arange(len(names))

## Whitout NMF and similiar

scoresRMSE = [
            scoreRMSE_kNNBasicCos,
            scoreRMSE_kNNBasicMSD,
            scoreRMSE_kNNBasicPearson,
            scoreRMSE_kNNBasicPearsonB,
            scoreRMSE_kNNMeansCos,
            scoreRMSE_kNNMeansMSD,
            scoreRMSE_kNNMeansPearson,
            scoreRMSE_kNNMeansPearsonB,
            scoreRMSE_kNNZCos,
            scoreRMSE_kNNZMSD,
            scoreRMSE_kNNZPearson,
            scoreRMSE_kNNZPearsonB,
```

```
            scoreRMSE_kNNBaseCos,
            scoreRMSE_kNNBaseMSD,
            scoreRMSE_kNNBasePearson,
            scoreRMSE_kNNBasePearsonB,
            scoreRMSE_svd,
            scoreRMSE_svdpp,
            scoreRMSE_baselineOnly,
            scoreRMSE_coClustering,
            scoreRMSE_slopeOne
            ]

scoresMAE = [
            scoreMAE_kNNBasicCos,
            scoreMAE_kNNBasicMSD,
            scoreMAE_kNNBasicPearson,
            scoreMAE_kNNBasicPearsonB,
            scoreMAE_kNNMeansCos,
            scoreMAE_kNNMeansMSD,
            scoreMAE_kNNMeansPearson,
            scoreMAE_kNNMeansPearsonB,
            scoreMAE_kNNZCos,
            scoreMAE_kNNZMSD,
            scoreMAE_kNNZPearson,
            scoreMAE_kNNZPearsonB,
            scoreMAE_kNNBaseCos,
            scoreMAE_kNNBaseMSD,
            scoreMAE_kNNBasePearson,
            scoreMAE_kNNBasePearsonB,
            scoreMAE_svd,
            scoreMAE_svdpp,
            scoreMAE_baselineOnly,
            scoreMAE_coClustering,
            scoreMAE_slopeOne
            ]

scoresFCP = [
            scoreFCP_kNNBasicCos,
            scoreFCP_kNNBasicMSD,
            scoreFCP_kNNBasicPearson,
            scoreFCP_kNNBasicPearsonB,
            scoreFCP_kNNMeansCos,
            scoreFCP_kNNMeansMSD,
            scoreFCP_kNNMeansPearson,
            scoreFCP_kNNMeansPearsonB,
            scoreFCP_kNNZCos,
            scoreFCP_kNNZMSD,
            scoreFCP_kNNZPearson,
            scoreFCP_kNNZPearsonB,
```

```
                    scoreFCP_kNNBaseCos,
                    scoreFCP_kNNBaseMSD,
                    scoreFCP_kNNBasePearson,
                    scoreFCP_kNNBasePearsonB,
                    scoreFCP_svd,
                    scoreFCP_svdpp,
                    scoreFCP_baselineOnly,
                    scoreFCP_coClustering,
                    scoreFCP_slopeOne
                    ]
```

In [25]:
```
fig_size = plt.rcParams["figure.figsize"]
fig_size[0] = 15
fig_size[1] = 19
plt.rcParams["figure.figsize"] = fig_size

plt.barh(namesForGraph, scoresRMSE, color='c')
plt.ylabel('Algorithms Names')
plt.xlabel('Cross-Validated Final Mean Accuracy - RMSE')
plt.yticks(namesForGraph, names, rotation=10)
plt.title('Comparison of prediction algorithms with RMSE')
```

Out[25]:
```
Text(0.5,1,'Comparison of prediction algorithms with RMSE')
```




```
In [26]: plt.barh(namesForGraph, scoresMAE, color='m')
         plt.ylabel('Algorithms Names')
         plt.xlabel('Cross-Validated Final Mean Accuracy - MAE')
         plt.yticks(namesForGraph, names, rotation=10)
         plt.title('Comparison of prediction algorithms with MAE')

Out[26]: Text(0.5,1,'Comparison of prediction algorithms with MAE')
```


```
In [27]: plt.barh(namesForGraph, scoresFCP, color='g')
         plt.ylabel('Algorithms Names')
         plt.xlabel('Cross-Validated Final Mean Accuracy - FCP')
         plt.yticks(namesForGraph, names, rotation=10)
         plt.title('Comparison of prediction algorithms with FCP')

Out[27]: Text(0.5,1,'Comparison of prediction algorithms with FCP')
```

In [28]:
```
N = len(names)

rmse_means = scoresRMSE

ind = np.arange(N)
width = 0.25

fig, ax = plt.subplots()
rects1 = ax.barh(ind, rmse_means, width, color='c')
```

```
mae_means = scoresMAE
rects2 = ax.barh(ind + width, mae_means, width, color='m')

fcp_means = scoresFCP
rects3 = ax.barh(ind + width * 2, fcp_means, width, color='g')

ax.set_ylabel('Algorithms')
ax.set_title('Scores')
ax.set_yticks(ind + width)
ax.set_yticklabels(names)

ax.legend((rects1[0], rects2[0], rects3[0]), ('RMSE', 'MAE', 'FCP'))
```

Out[28]: <matplotlib.legend.Legend at 0x7efcab513d30>