py_datamining_1206

2020 年 12 月 6 日

数据预处理 & 可视化

```
In [7]: import os
        import pandas as pd
        import numpy as np
        import matplotlib.pyplot as plt # 导入 matplotlib.pyplot 画图模块
        import seaborn as sns
        import matplotlib.font_manager as mfm  # 字体
        font_path = r"/Users/mac/Library/Fonts/字体管家方萌简（非商业使用）v1.1.ttf"
        prop = mfm.FontProperties(fname = font_path)
```

1 1. 读入数据

```
In [77]: os.chdir("/Users/mac/Desktop/快乐研一/数据挖掘/留学推荐 code&data/留学数据 code&data/")
         descriptive = pd.read_csv('./data/Data_Cleaning.csv') # 读取原始数据
         print(descriptive.shape)
         descriptive.head()
```

```
(16215, 32)
```

```
Out[77]:    index_origin        author  time toefl gre_total gre_v gre_q gre_aw  \
         0         10001     leucocyte    17    92       319   149   170      3
         1         10003       yycenty    17    96       327   NaN   NaN    3.5
         2         10004       JOJOJie    17   101       322   NaN   NaN    3.5
         3         10008     smallyeye    17   103       325   NaN   NaN    3.5
         4         10013  wannagotousa    17   108       328   NaN   NaN    3.5

           district season   ...   major_before cross gpa_measure rl  intern research  \
         0       美国   Fall   ...             CS     1         4.0  0        0        0
         1       美国   Fall   ...             环工     0         4.0  0        0        0
         2       美国   Fall   ...             EE     0       100.0  0        0        0
```

```
3        美国    Fall    ...          能源与动力工程      0        100.0  0        0         0
4        美国    Fall    ...            电信工程      0        100.0  0        1         0

  paper first sci exchange
0     0     0   0        0
1     0     0   0        0
2     1     1   1        0
3     0     0   0        0
4     0     0   0        0

[5 rows x 32 columns]
```

2 2. 因变量

```
In [78]: # 2. 因变量调整
         # 调整命名
         descriptive['offertype'] = descriptive['offertype'].replace('Rej','Rejected')
         descriptive['offertype'] = descriptive['offertype'].replace(['AD 小奖','Offer','AD 无奖']
         descriptive = descriptive.dropna(subset=['offertype'])  # 删去缺失录取结果的样本
         print(descriptive['offertype'].unique())
         # 为简化后续分信息，删掉录取结果为 WaitingList 的样本
         descriptive = descriptive[descriptive['offertype'] != 'WaitingList']
         descriptive['offertype'].value_counts()
```

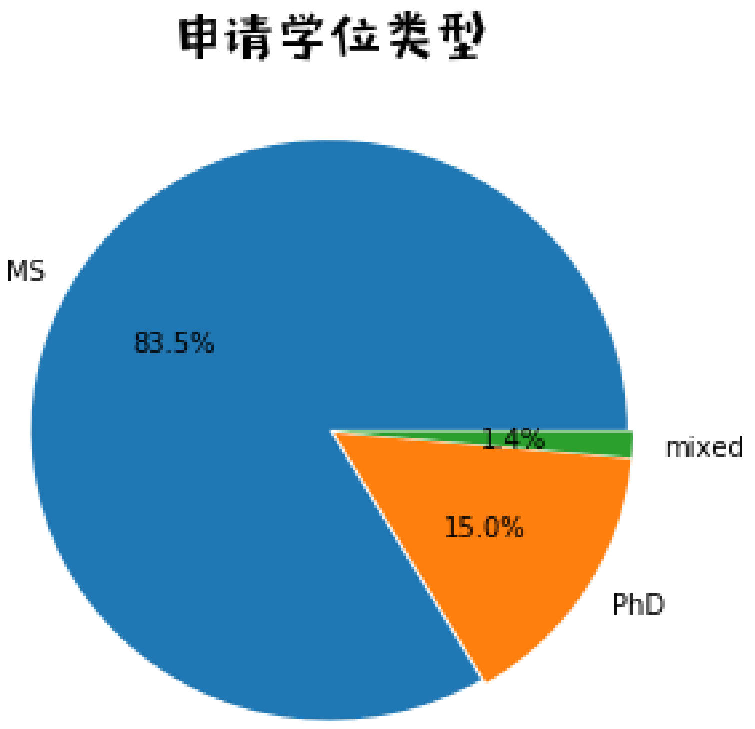
```
['Rejected' 'Admitted' 'WaitingList']
```

```
Out[78]: Admitted    11370
         Rejected     4538
         Name: offertype, dtype: int64
```

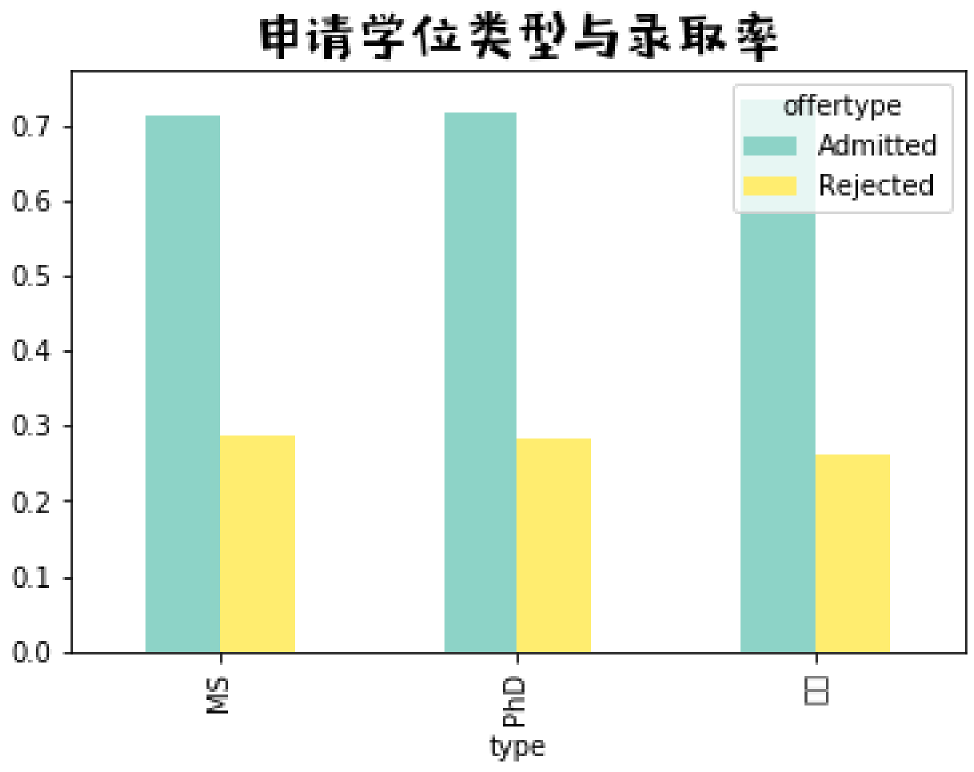
3 3. 申请学位

```
In [14]: # 饼图
         descriptive['type'].unique()
         plt.figure(figsize=(5,5))
         plt.pie(list(descriptive['type'].value_counts()),
                 explode = [0.01,0.01,0.01],
                 labels = ['MS', 'PhD', 'mixed'],
                 autopct='%1.1f%%')
```

```
plt.title('申请学位类型',fontproperties=prop, fontsize=20)
plt.show()
plt.close()
# 不同学位录取率
admit_counts=pd.crosstab(descriptive['type'],descriptive['offertype'])
admit_pcts=admit_counts.div(admit_counts.sum(1),axis=0)
print(admit_pcts)
admit_pcts.plot.bar(cmap = "Set3")
plt.title('申请学位类型与录取率',fontproperties=prop, fontsize=20)
plt.show()
plt.close()
```



```
offertype  Admitted  Rejected
type
MS         0.713759  0.286241
PhD        0.718045  0.281955
混合         0.736842  0.263158
```



4 4. 申请学校

```
In [17]: descriptive['college_apply']=descriptive['college_apply'].replace(['Texas A','M Universit
         descriptive['college_apply']=descriptive['college_apply'].replace(['Washington University
```

4.1 4.1 统一学校名称

```
In [19]: suoxie=pd.read_table('./data/所有大学 & 地区/美国大学缩写汇总.txt',sep=' ')
         college_low=descriptive['college_apply'].str.lower()
         suoxie_low=suoxie['ysuoxie'].str.lower()
         college_apply_new=[]
         for i in college_low:
             count2 = 0
             for j in suoxie_low :
                 if str(j) in str(i):
                     count2 += 1
                     college_apply_new.append(suoxie[suoxie['ysuoxie'].str.lower()==str(j)]['yquan
                     break
```

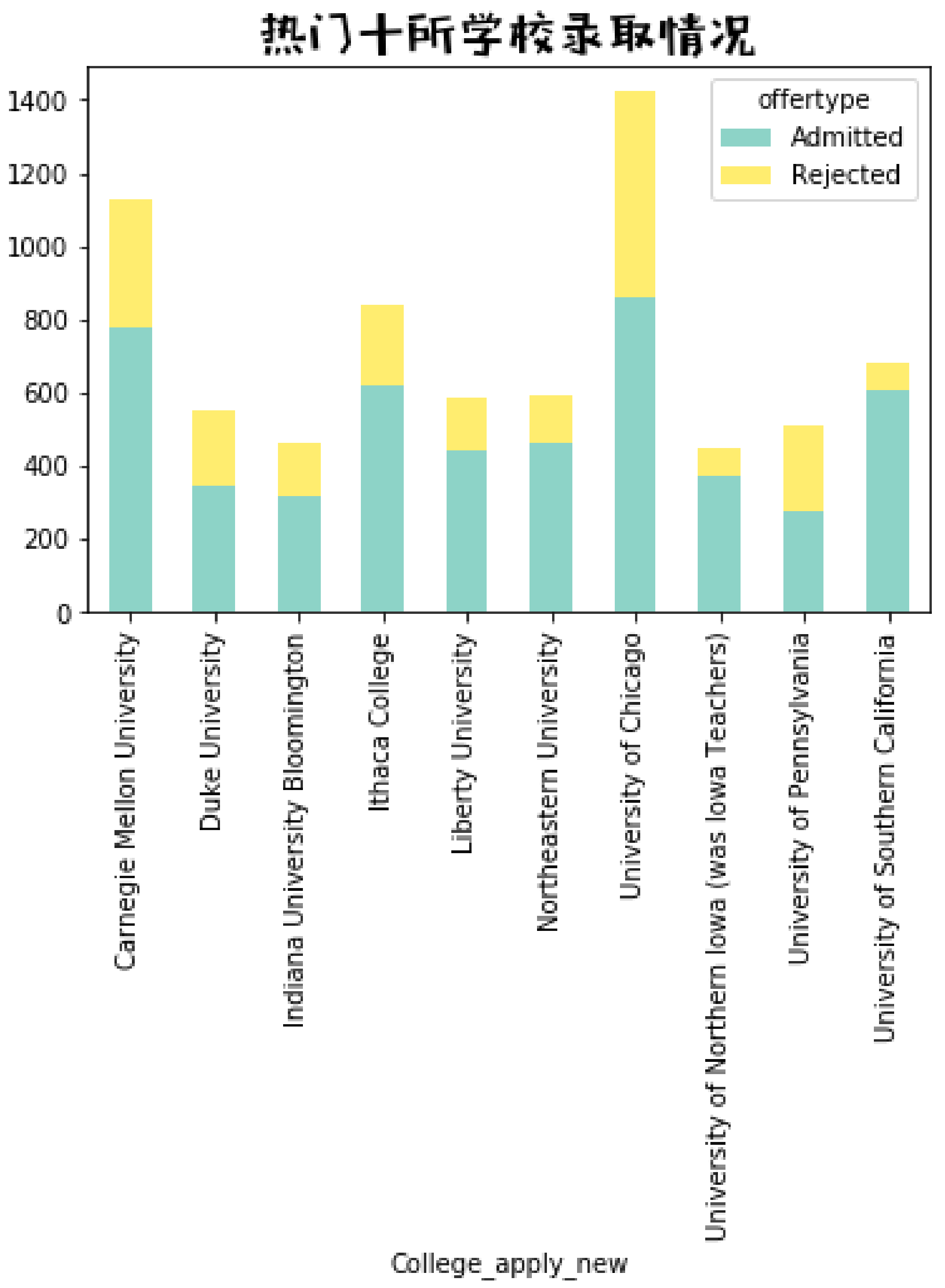
```
            if not count2:
                college_apply_new.append(i)
        print(len(college_apply_new))
        descriptive['College_apply_new'] = college_apply_new    ## 统一名称后的新变量
```

```
15344
```

4.2 4.2 热门申请学校

```
In [20]: # 找出十大热门学校
         top10_college_apply=descriptive['College_apply_new'].value_counts()[:10].index.tolist()
         descriptive_top10=descriptive.loc[descriptive['College_apply_new'].isin(top10_college_app
         print(top10_college_apply)
         # 图表展示
         top10_counts = pd.crosstab(descriptive_top10['College_apply_new'],descriptive_top10['offe
         top10_counts.plot.bar(stacked = True,cmap = "Set3")
         plt.title('热门十所学校录取情况',fontproperties=prop, fontsize=20)
         plt.show()
         plt.close()
```

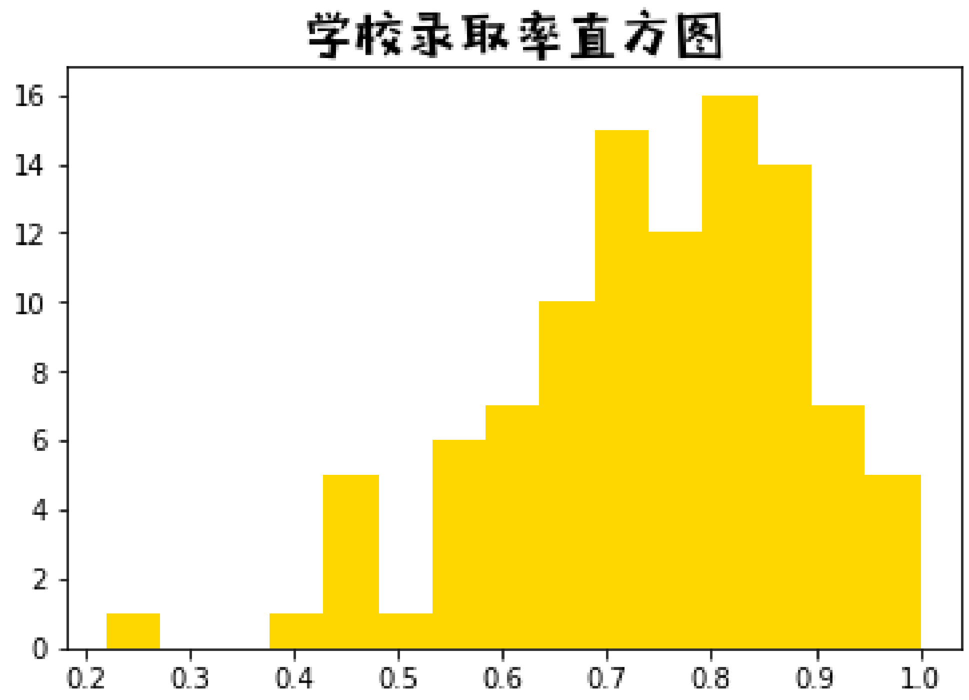
```
['University of Chicago', 'Carnegie Mellon University', 'Ithaca College', 'University of Southern
```



4.3 4.3 各学校录取率

```
In [21]: # 4.3 各学校录取率
         # 排序并提取申请人数较多的百所学校
         top100_college_apply=descriptive['College_apply_new'].value_counts()[:100].index.tolist()
```

```
descriptive=descriptive.loc[descriptive['College_apply_new'].isin(top100_college_apply)]
counts_100=pd.crosstab(descriptive['College_apply_new'],descriptive['offertype'])
counts_pcts=counts_100.div(counts_100.sum(1),axis=0)
plt.hist(counts_pcts['Admitted'],color = "gold",bins=15)
plt.title('学校录取率直方图',fontproperties=prop, fontsize=20)
plt.show()
plt.close()

# 录取率最低和最高的
print(counts_pcts[counts_pcts['Admitted']==max(counts_pcts['Admitted'])])
print(counts_pcts[counts_pcts['Admitted']==min(counts_pcts['Admitted'])])
```



```
offertype                              Admitted  Rejected
College_apply_new
New Jersey Institute of Technology          1.0       0.0
Rochester Institute of Technology           1.0       0.0
University of Alabama                       1.0       0.0
University of Utah                          1.0       0.0
ethz                                        1.0       0.0
offertype              Admitted  Rejected
```

```
College_apply_new
Princeton University      0.22      0.78
```

4.4 4.4. 申请学校排名

```
In [24]: ## 按学校名称匹配大学排名
         universities = pd.read_table('./data/QS 大学排名前百（美国）.txt',header = None)  ## 读入
         universities = [x[0] for x in universities.values]
         top10university = descriptive['College_apply_new'].isin(universities[:6])
         top10_50university = descriptive['College_apply_new'].isin(universities[6:])
         ranktmp = top10university * 2+ top10_50university
         collegeRank,collegeranktop50 = [],[]
         for rk in ranktmp:
             if rk > 0:
                 collegeranktop50.append('Top50')
                 if rk == 2:
                     collegeRank.append('Top10')
                 elif rk == 1:
                     collegeRank.append('Top10_50')
             else:
                 collegeranktop50.append('Others')
                 collegeRank.append('Others')
         descriptive['CollegeRank']=collegeRank  ## 并入原数据
         descriptive['CollegeRankTop50']=collegeranktop50  ## 并入原数据
         print(descriptive['CollegeRank'].value_counts())
```

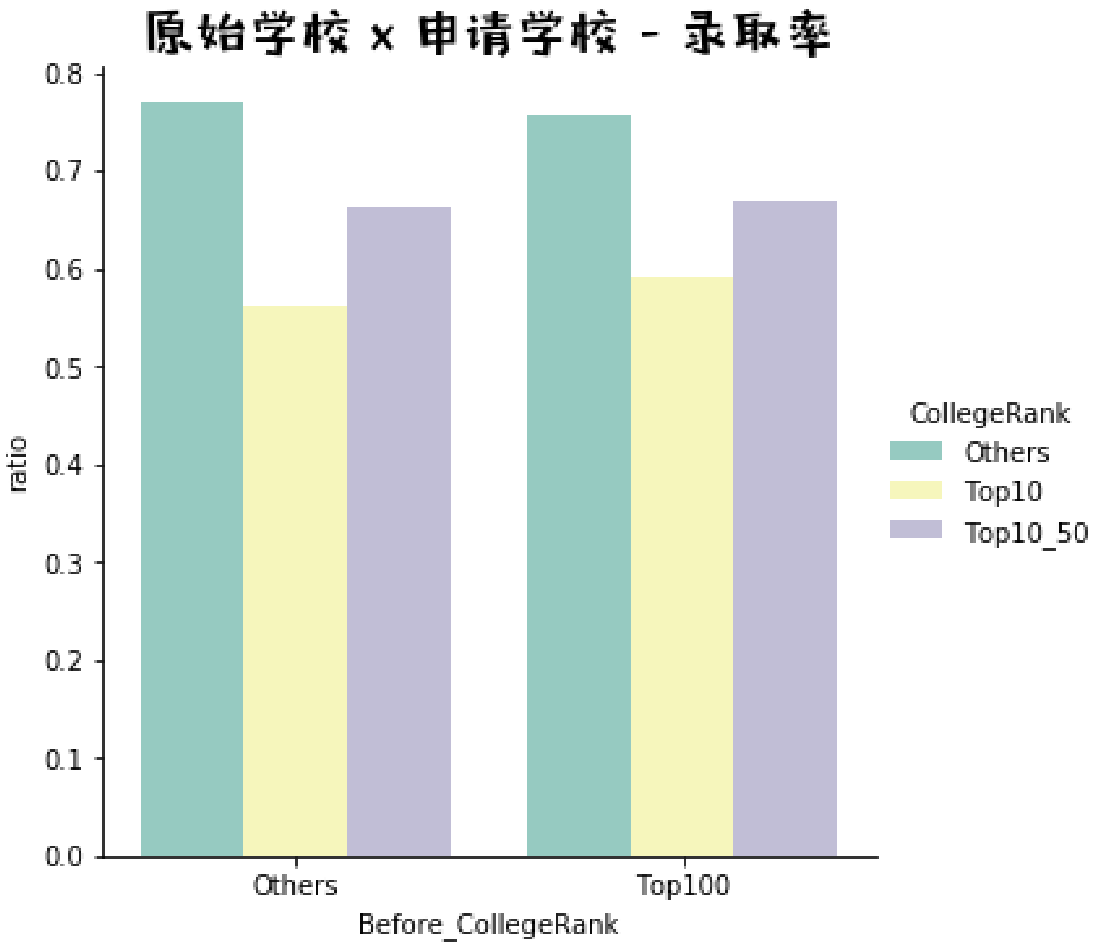
```
Others      9026
Top10_50    4586
Top10       1732
Name: CollegeRank, dtype: int64
```

5 5. 原始学校

```
In [28]: ## 读入学校排名数据
         universities2=pd.read_table('./data/QS 大学排名前 500（中国）.txt', header = None, sep='\t
         a100=universities2.values.tolist()[:10]
         b100=[i for item in a100 for i in item]
         ## 匹配学校
```

```
top100university=[]
for i in descriptive['college_before']:
    count3 = 0
    for j in b100:
        if str(i) in str(j):
            count3 += 1
            top100university.append('Top100')
        break
    if not count3:
        top100university.append('Others')
print(len(top100university))
descriptive['Before_CollegeRank']=top100university
### 图表展示
top100_counts = pd.crosstab([descriptive['CollegeRank'],descriptive['Before_CollegeRank']
top100_pcts=top100_counts.div(top100_counts.sum(1),axis=0)
top100_pcts1 = pd.DataFrame(top100_pcts)
rownames = top100_pcts1._stat_axis.values.tolist()
top100_pcts1['CollegeRank'] = [x[0] for x in rownames]
top100_pcts1['Before_CollegeRank'] = [x[1] for x in rownames]
top100_pcts1 = top100_pcts1.drop('Rejected', axis = 1)
# 宽-长
top100_pcts2 = top100_pcts1.melt(
        id_vars=["CollegeRank","Before_CollegeRank"],   # 要保留的主字段
        value_name="ratio"                  # 拉长的度量值名称
        )
print(top100_pcts2)
sns.catplot(x='Before_CollegeRank', y='ratio', hue = 'CollegeRank',
              kind='bar', data=top100_pcts2, palette = "Set3")
plt.title('原始学校 x 申请学校 - 录取率',fontproperties=prop, fontsize=20)
plt.show()
plt.close()
```

```
15344
  CollegeRank Before_CollegeRank offertype     ratio
0      Others             Others  Admitted  0.768595
1      Others             Top100  Admitted  0.754938
2       Top10             Others  Admitted  0.562833
3       Top10             Top100  Admitted  0.591885
4    Top10_50             Others  Admitted  0.663664
5    Top10_50             Top100  Admitted  0.669586
```



6 6. 专业

```
In [30]: def matchmajor(x):
             if x in ["统计","统计学","Statistics","STAT","Stat","stat","Biostat","应用数学","数学"
                 return "Stat/Biostat"
             if x in ["软件工程","se","Software Engineering"]:
                 return "SE"
             if x in ["cs", "计算机科学","计算机","信息与计算科学","计算机科学与技术","Computer Scie
                 return "CS"
             if x in ["材料","material","MSE","材料科学与工程","Material Physics"]:
                 return "Material"
             if x in ["通信工程","信息工程","电子信息工程","ee","电子科学与技术","微电子","ECE","光电
```

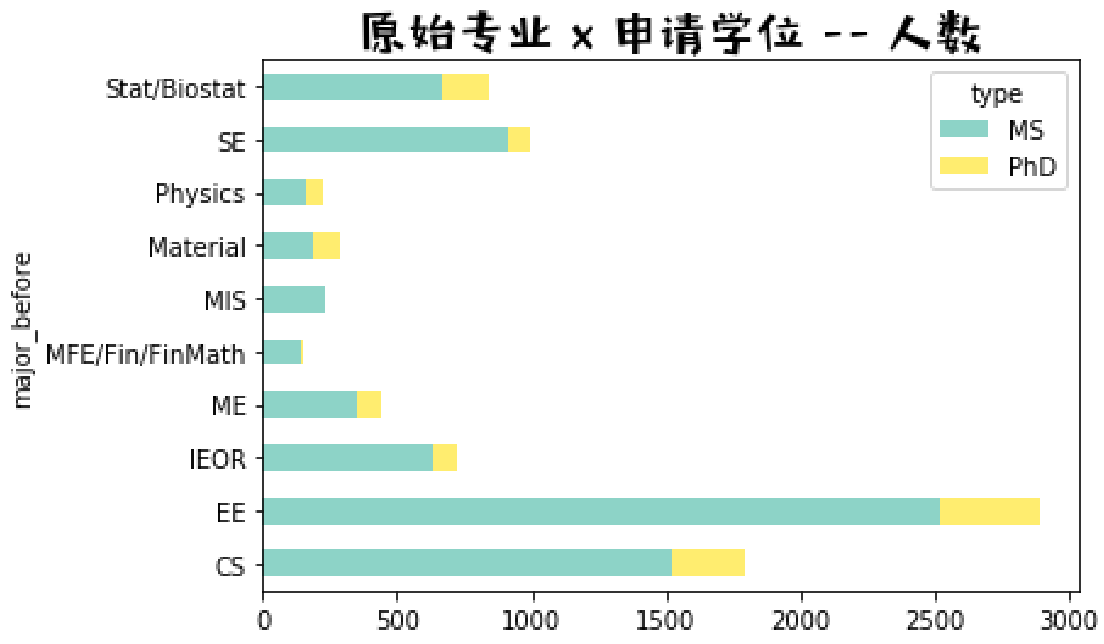
```
            return "EE"
        if x in ["Automation","自动化","工业工程","IE",'自动化控制',"电气工程及其自动化"]:
            return "IEOR"
        if x in ["金融数学","金融","金融工程","MFE","Fin","FinMath","fiannce","精算","数理金融'
            return "MFE/Fin/FinMath"
        if x in ["机械","机械工程",'热能与动力工程',"测控"]:
            return "ME"
        if x in ["物理","力学","physics","应用物理"]:
            return "Physics"
        if x in ["信息管理与信息系统"]:
            return "MIS"
        return x
```

6.1 6.1 十大热门原始专业

```
In [32]: # 6.1 十大热门原始专业
         major_before = list(descriptive['major_before'].values)
         major_before = [matchmajor(x) for x in major_before]
         descriptive['major_before'] = major_before
         top10majorbefore = descriptive['major_before'].value_counts()[:10]
         print(top10majorbefore)
         top10mj_bf = top10majorbefore._stat_axis.values.tolist()
         top10mj_bf_des = descriptive[(descriptive['major_before'].isin(top10mj_bf))]
         # 原始专业 x 申请学位 -- 人数
         mj_bf_top = pd.crosstab(top10mj_bf_des['major_before'],top10mj_bf_des['type'])
         mj_bf_top = mj_bf_top.drop('混合', axis = 1)  # 删掉混合
         mj_bf_top.plot.barh(stacked = True, cmap = "Set3")  # 画图
         plt.title('原始专业 x 申请学位 -- 人数',fontproperties=prop, fontsize=20)
         plt.show()
         plt.close()
```

```
EE                 2935
CS                 1820
SE                 1002
Stat/Biostat        853
IEOR                727
ME                  456
Material            286
MIS                 236
Physics             231
MFE/Fin/FinMath     146
```

```
Name: major_before, dtype: int64
```

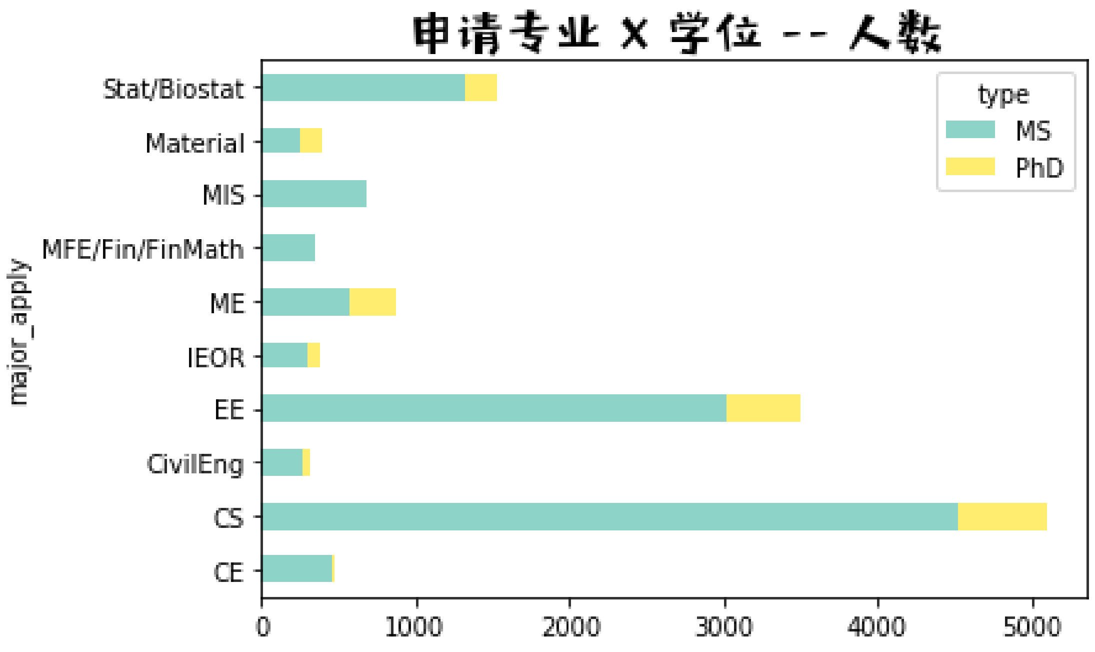


6.2 6.2 热门申请专业

```
In [33]: ## 6.2 热门申请专业
         top10mj_ap = descriptive['major_apply'].value_counts()[:11]
         print(top10mj_ap)
         top10mj_ap = top10mj_ap._stat_axis.values.tolist()
         top10mj_ap.pop(-4)  # 删掉 others
         top10mj_ap_des = descriptive[(descriptive['major_apply'].isin(top10mj_ap))]
         # 申请专业 X 学位 -- 人数
         mj_ap_top =  pd.crosstab(top10mj_ap_des['major_apply'],top10mj_ap_des['type'])
         mj_ap_top = mj_ap_top.drop('混合', axis = 1)  # 删掉混合
         mj_ap_top.plot.barh(stacked = True, cmap = "Set3")  # 画图
         plt.title('申请专业 X 学位 -- 人数',fontproperties=prop, fontsize=20)
         plt.show()
         plt.close()
```

```
CS                  5160
EE                  3548
Stat/Biostat        1549
```

```
ME                907
MIS               692
CE                477
Material          405
Other             391
IEOR              375
MFE/Fin/FinMath   338
CivilEng          323
Name: major_apply, dtype: int64
```

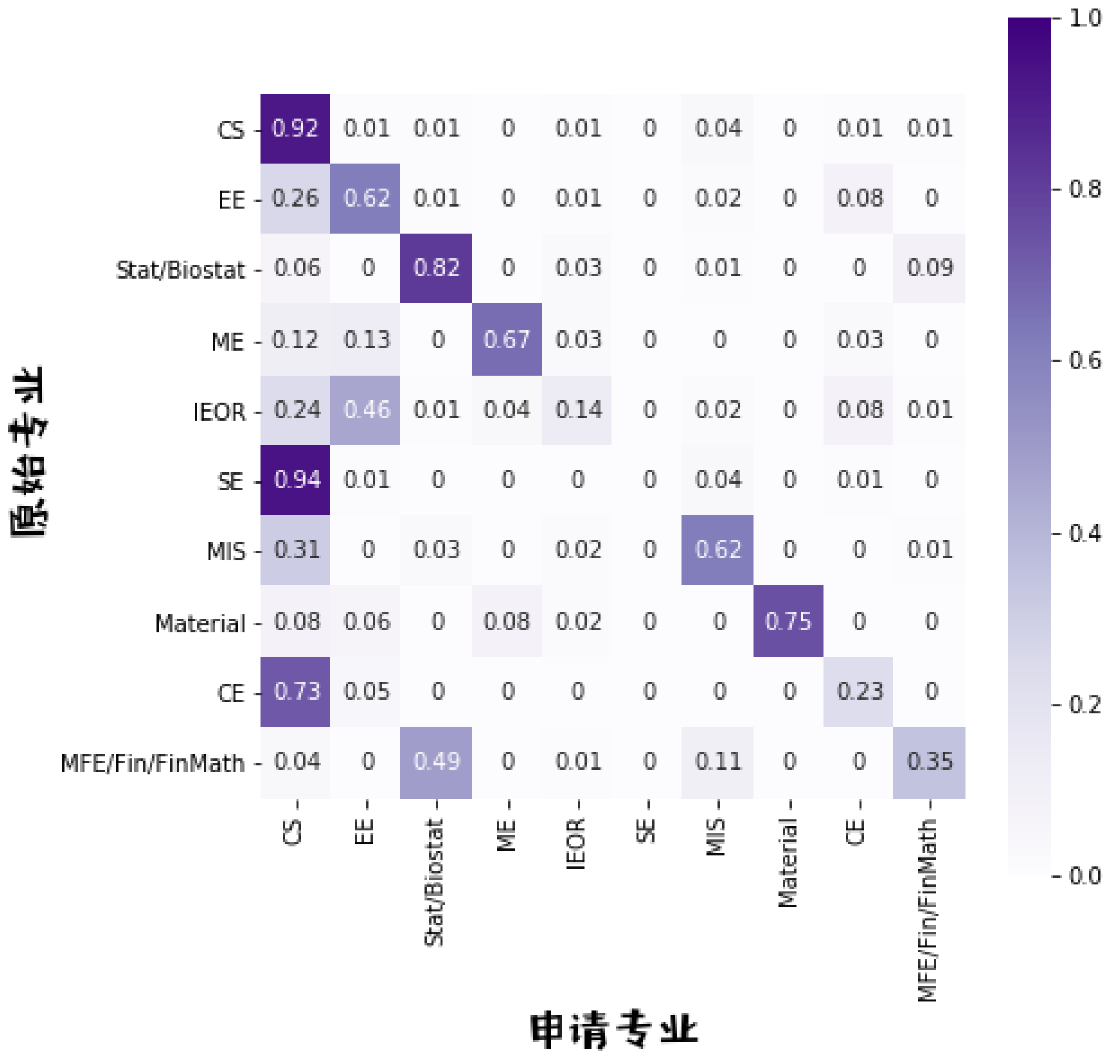


6.3 6.3 转专业矩阵

```
In [39]: # 原始 + 申请的总的 10 大专业
         major_before = list(descriptive['major_before'].values)
         major_apply = list(descriptive['major_apply'].values)
         majors = major_before + major_apply
         TOP10major = pd.value_counts(majors)[:10]
         TOP10major = TOP10major._stat_axis.values.tolist()
         print(TOP10major)
         # 取出申请或者原始为热门专业的数据
         major_bf_ap = [(major_before[i] in TOP10major) and (major_apply[i] in TOP10major) for i i
```

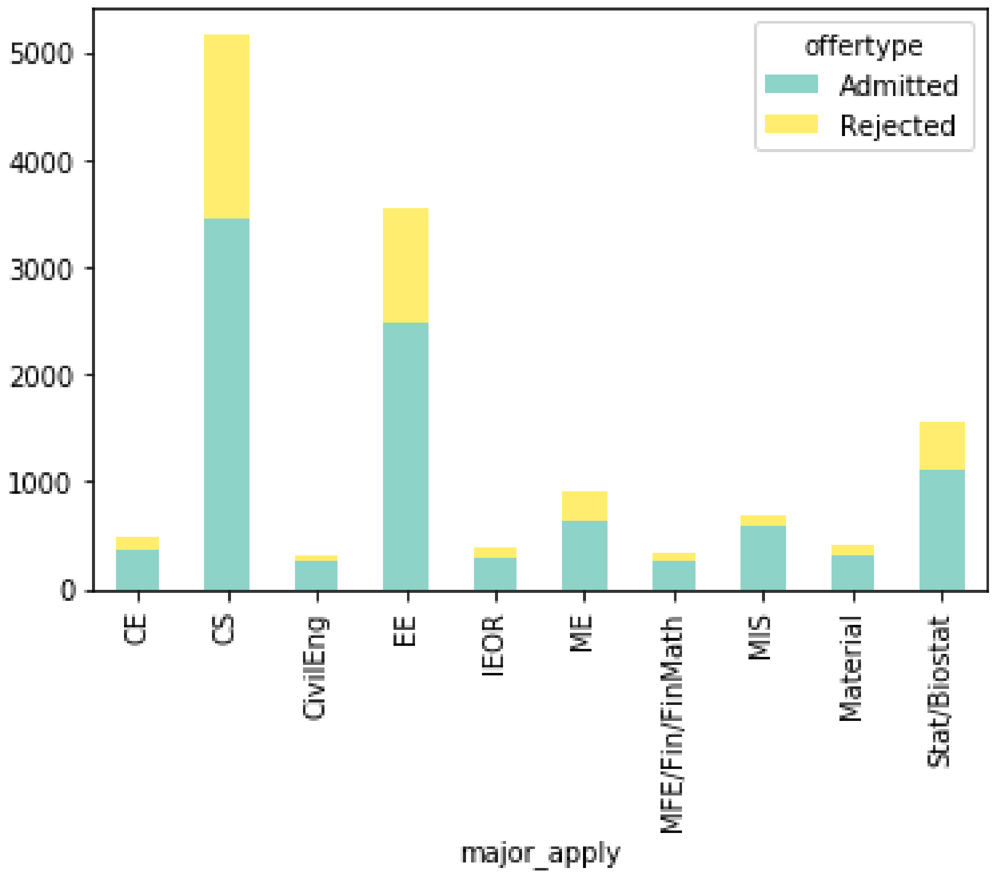
```
major_des = descriptive[(major_bf_ap)]
# apply 矩阵:
major_ap_matrix = pd.get_dummies(major_des.major_apply, prefix="apply")   # 全部生成虚拟变
major_ap_matrix.insert(0, "apply_SE", 0, allow_duplicates=False)
major_ap_matrix2 = major_ap_matrix.reindex(["apply_"+x for x in TOP10major],axis = 1)
major_ap_matrix2.columns
# bf 矩阵
major_bf_matrix = pd.get_dummies(major_des.major_before, prefix="before")   # 全部生成虚拟
major_bf_matrix2 = major_bf_matrix.reindex(["before_"+x for x in TOP10major],axis = 1)
major_bf_matrix2.columns
# 转移矩阵
major_ap_matrix = np.array(major_ap_matrix2)
major_bf_matrix = np.array(major_bf_matrix2)
TOP10major_matrix = np.dot(major_bf_matrix.T,major_ap_matrix)
TOP10major_matrixPct = TOP10major_matrix / np.sum(TOP10major_matrix, axis = 1, keepdims =
print(np.round(TOP10major_matrixPct,2))
# 矩阵图
plt.figure(figsize=(7,7))
sns.heatmap(pd.DataFrame(np.round(TOP10major_matrixPct,2),
                         columns = TOP10major,
                         index = TOP10major),
                annot=True, vmax=1,vmin = 0,
                xticklabels= True, yticklabels= True,
                square=True, cmap = 'Purples')
plt.xlabel('申请专业',fontproperties=prop, fontsize=20)
plt.ylabel('原始专业',fontproperties=prop, fontsize=20)
plt.show()
plt.close()
```

```
['CS', 'EE', 'Stat/Biostat', 'ME', 'IEOR', 'SE', 'MIS', 'Material', 'CE', 'MFE/Fin/FinMath']
[[0.92 0.01 0.01 0.   0.01 0.   0.04 0.   0.01 0.01]
 [0.26 0.62 0.01 0.   0.01 0.   0.02 0.   0.08 0.  ]
 [0.06 0.   0.82 0.   0.03 0.   0.01 0.   0.   0.09]
 [0.12 0.13 0.   0.67 0.03 0.   0.   0.   0.03 0.  ]
 [0.24 0.46 0.01 0.04 0.14 0.   0.02 0.   0.08 0.01]
 [0.94 0.01 0.   0.   0.   0.   0.04 0.   0.01 0.  ]
 [0.31 0.   0.03 0.   0.02 0.   0.62 0.   0.   0.01]
 [0.08 0.06 0.   0.08 0.02 0.   0.   0.75 0.   0.  ]
 [0.73 0.05 0.   0.   0.   0.   0.   0.   0.23 0.  ]
 [0.04 0.   0.49 0.   0.01 0.   0.11 0.   0.   0.35]]
```



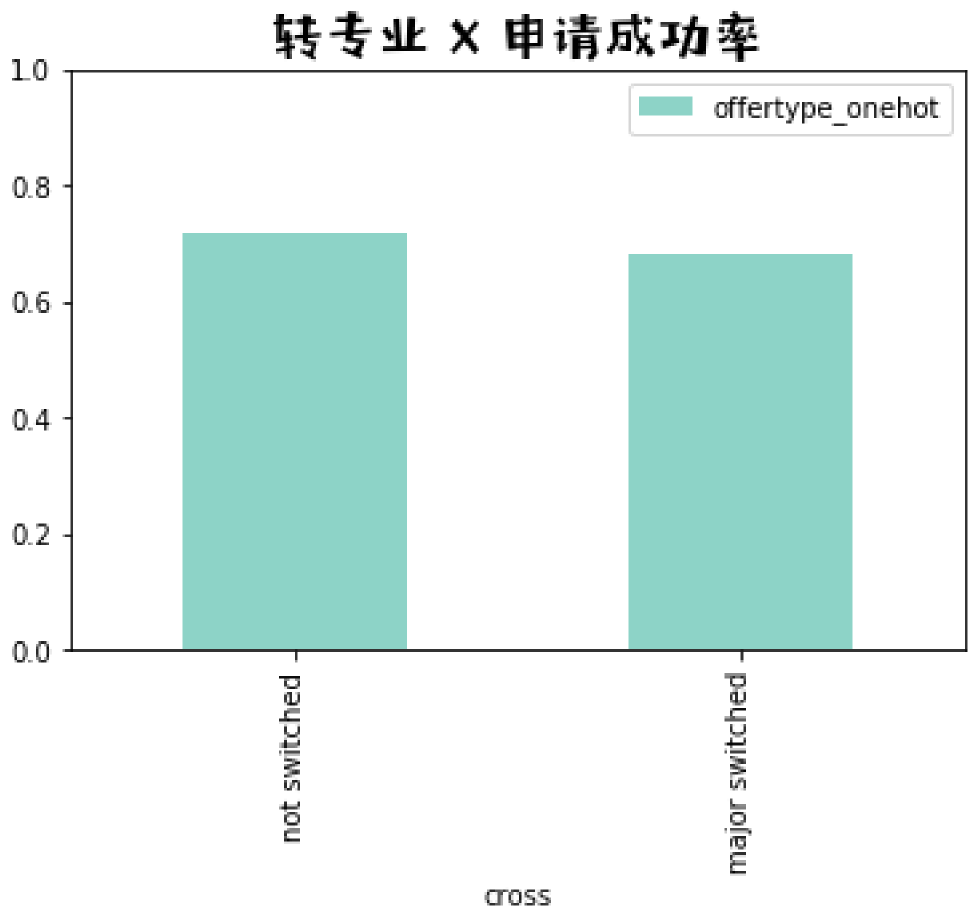
6.4 6.4 热门专业申请结果

```
In [41]: top10major_apply = descriptive.loc[descriptive['major_apply'].isin(top10mj_ap)]
         top10major_offer = pd.crosstab(top10major_apply['major_apply'],top10major_apply['offertyp
         top10major_offer.plot.bar(stacked = True, cmap = "Set3")

Out[41]: <matplotlib.axes._subplots.AxesSubplot at 0x1a295d05f8>
```



6.5 6.5 转专业申请成功率

```
In [42]: offertype2 = [1 if x == "Admitted" else 0 for x in descriptive['offertype'].values]
         descriptive['offertype_onehot'] = offertype2
         cross_offer_rate = descriptive.groupby(by = 'cross').agg({'offertype_onehot': "mean"})
         cross_offer_rate.plot.bar(stacked = True, cmap = "Set3")
         plt.xticks([0, 1],
           ['not switched', 'major switched'])
         plt.ylim(0, 1)
         plt.title('转专业 X 申请成功率',fontproperties=prop, fontsize=20)
         plt.show()
         plt.close()
```



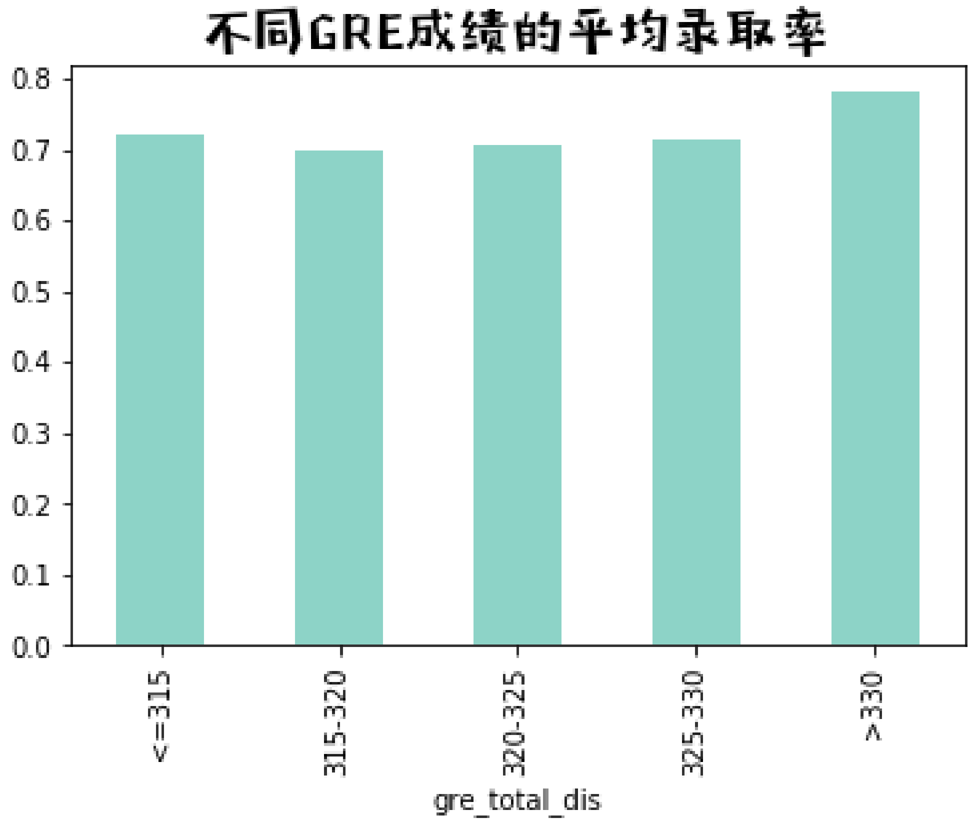
7 7. GRE

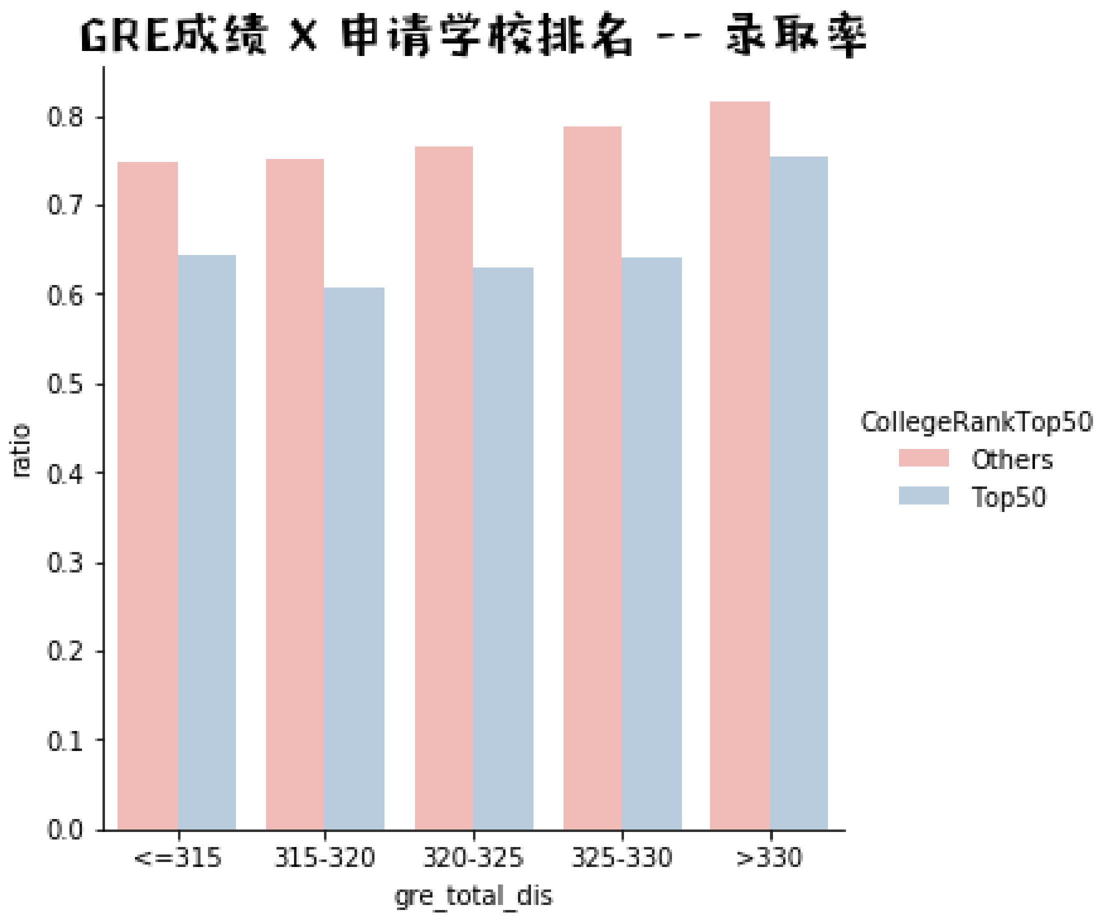
7.1 7.1 GRE 成绩预处理

```
In [44]: ### 7.1 GRE 成绩预处理
         ## 转化为 numeric 型
         gre_plot_dt=descriptive[['gre_total','gre_v','gre_q']]
         descriptive['gre_v']=pd.to_numeric(gre_plot_dt['gre_v'],errors='coerce')
         descriptive['gre_total']=pd.to_numeric(gre_plot_dt['gre_total'],errors='coerce')
         descriptive['gre_q']=pd.to_numeric(gre_plot_dt['gre_q'],errors='coerce')
         ### 删去旧版 gre verbal
         descriptive=descriptive[descriptive['gre_total']<=340]

         ## 成绩分段
         gre_total_dis=pd.cut(descriptive['gre_total'],
                        bins = [0, 315, 320, 325, 330, 350],    # 划分为 5 段
                         labels = ["<=315", "315-320", "320-325", "325-330", ">330"])
descriptive['gre_total_dis']=gre_total_dis
```

7.2 7.2 gre 成绩与录取率

```
In [48]: ## 计算录取率
         gre_counts=pd.crosstab(descriptive['gre_total_dis'],descriptive['offertype'])
         gre_pcts=gre_counts.div(gre_counts.sum(1),axis=0)
         gre_pcts['Admitted'].plot.bar( cmap = "Set3")
         plt.title("不同 GRE 成绩的平均录取率",fontproperties=prop, fontsize=20)
         plt.show()
         plt.close()
         ## gre 成绩 x 申请学校排名 x 录取率
         gre_college_counts=pd.crosstab([descriptive['gre_total_dis'],descriptive['CollegeRankTop5
         gre_college_pcts=gre_college_counts.div(gre_college_counts.sum(1),axis=0)
         gre_college_pcts1=pd.DataFrame(gre_college_pcts)
         rownames2=gre_college_pcts1._stat_axis.values.tolist()
         gre_college_pcts1=gre_college_pcts1.drop('Rejected',axis=1)
         gre_college_pcts1['gre_total_dis']= [x[0] for x in rownames2]
         gre_college_pcts1['CollegeRankTop50'] = [x[1] for x in rownames2]
         gre_college_pcts2 = gre_college_pcts1.melt(
                 id_vars=["gre_total_dis","CollegeRankTop50"],    # 要保留的主字段
                 value_name="ratio"                   # 拉长的度量值名称
                 )
         sns.catplot(x='gre_total_dis', y='ratio',  palette = "Pastel1", hue = 'CollegeRankTop50',
         plt.title("GRE 成绩 X 申请学校排名 -- 录取率",fontproperties=prop, fontsize=20)
         plt.show()
         plt.close()
```

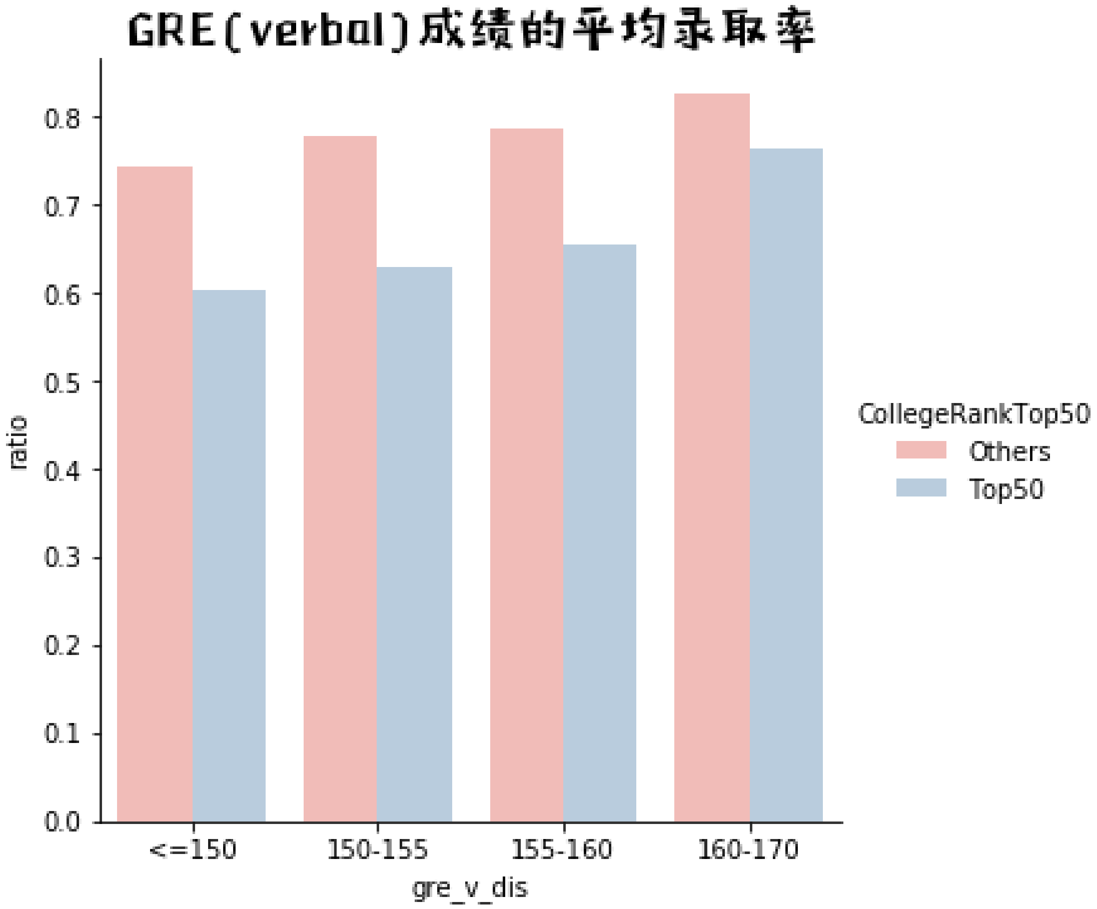

不同GRE成绩的平均录取率
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
<=315
315-320
320-325
325-330
>330
gre_total_dis



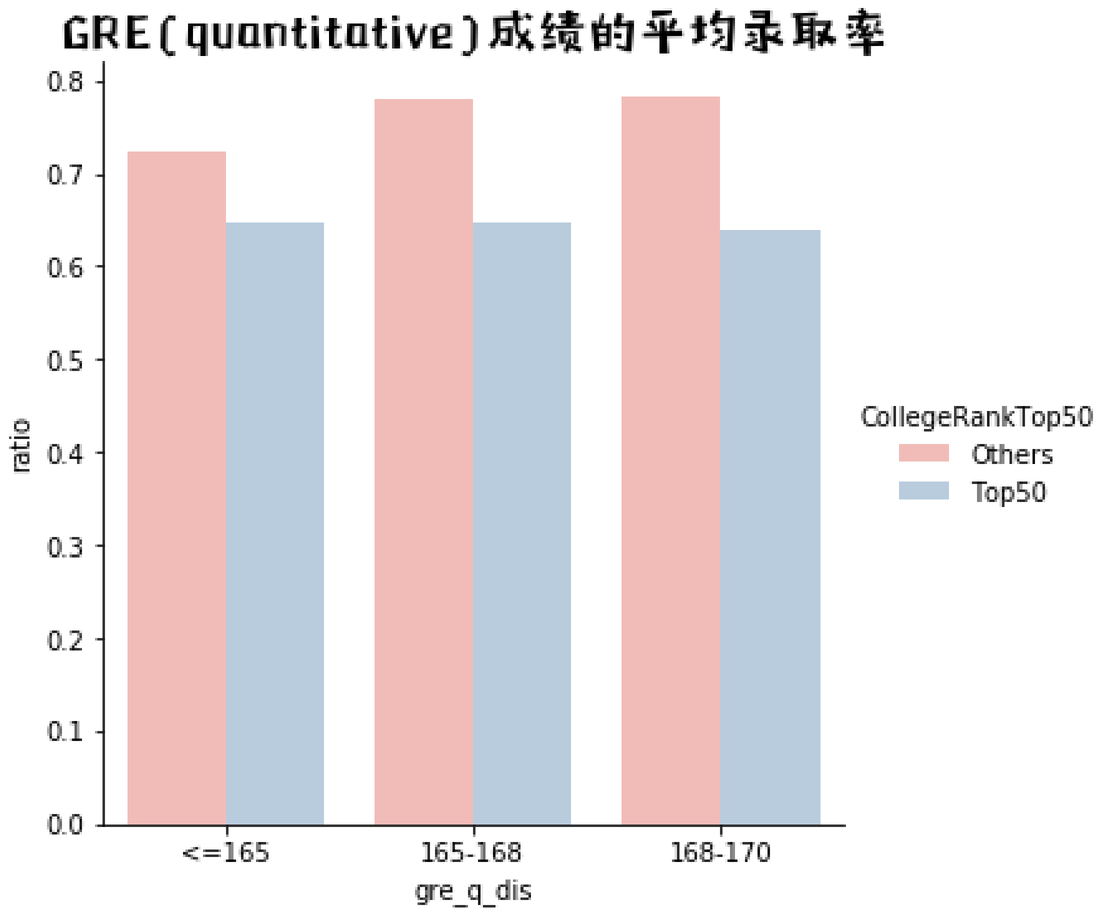
7.3 7.3 gre(verbal)、gre(quantitative) 分数、学校排名与录取率

```
In [50]: ## gre verbal 录取率
         gre_v_dis=pd.cut(descriptive['gre_v'],    # 成绩分段（下同）
                          bins = [0,150,155,160,170],
                          labels =["<=150","150-155","155-160","160-170"])
         gre_v_counts=pd.crosstab([gre_v_dis,descriptive['CollegeRankTop50']],descriptive['offerty
         gre_v_pcts=gre_v_counts.div(gre_v_counts.sum(1),axis=0)
         gre_v_pcts1=pd.DataFrame(gre_v_pcts)
         rownames3=gre_v_pcts1._stat_axis.values.tolist()
         gre_v_pcts1=gre_v_pcts1.drop('Rejected',axis=1)
         gre_v_pcts1['gre_v_dis']= [x[0] for x in rownames3]
         gre_v_pcts1['CollegeRankTop50'] = [x[1] for x in rownames3]
         gre_v_pcts2 = gre_v_pcts1.melt(
                 id_vars=["gre_v_dis","CollegeRankTop50"],    # 要保留的主字段
```

```
        value_name="ratio"                  # 拉长的度量值名称
        )
sns.catplot(x='gre_v_dis', y='ratio', hue = 'CollegeRankTop50', kind='bar',
               palette = "Pastel1", data=gre_v_pcts2)
plt.title("GRE(verbal) 成绩的平均录取率",fontproperties=prop, fontsize=20)
plt.show()
plt.close()
## gre quantitative 录取率
gre_q_dis=pd.cut(descriptive['gre_q'],   # 成绩分段（下同）
                bins = [0,165,168,170],
                labels =["<=165","165-168","168-170"])
gre_q_counts=pd.crosstab([gre_q_dis,descriptive['CollegeRankTop50']],descriptive['offerty
gre_q_pcts=gre_q_counts.div(gre_q_counts.sum(1),axis=0)
gre_q_pcts1=pd.DataFrame(gre_q_pcts)
rownames4=gre_q_pcts1._stat_axis.values.tolist()
gre_q_pcts1=gre_q_pcts1.drop('Rejected',axis=1)
gre_q_pcts1['gre_q_dis']= [x[0] for x in rownames4]
gre_q_pcts1['CollegeRankTop50'] = [x[1] for x in rownames4]
gre_q_pcts2 = gre_q_pcts1.melt(
        id_vars=["gre_q_dis","CollegeRankTop50"],   # 要保留的主字段
        value_name="ratio"                  # 拉长的度量值名称
        )
sns.catplot(x='gre_q_dis', y='ratio', hue = 'CollegeRankTop50', kind='bar',
               palette = "Pastel1", data=gre_q_pcts2)
plt.title("GRE(quantitative) 成绩的平均录取率",fontproperties=prop, fontsize=20)
plt.show()
plt.close()
```

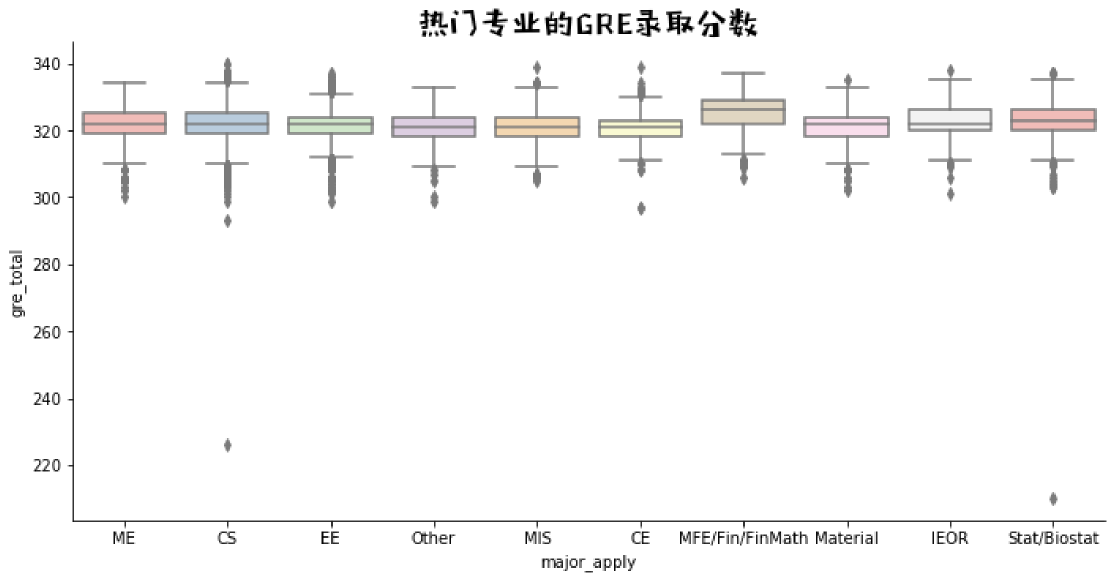


GRE(verbal)成绩的平均录取率
ratio
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
<=150
150-155
155-160
160-170
gre_v_dis
CollegeRankTop50
Others
Top50



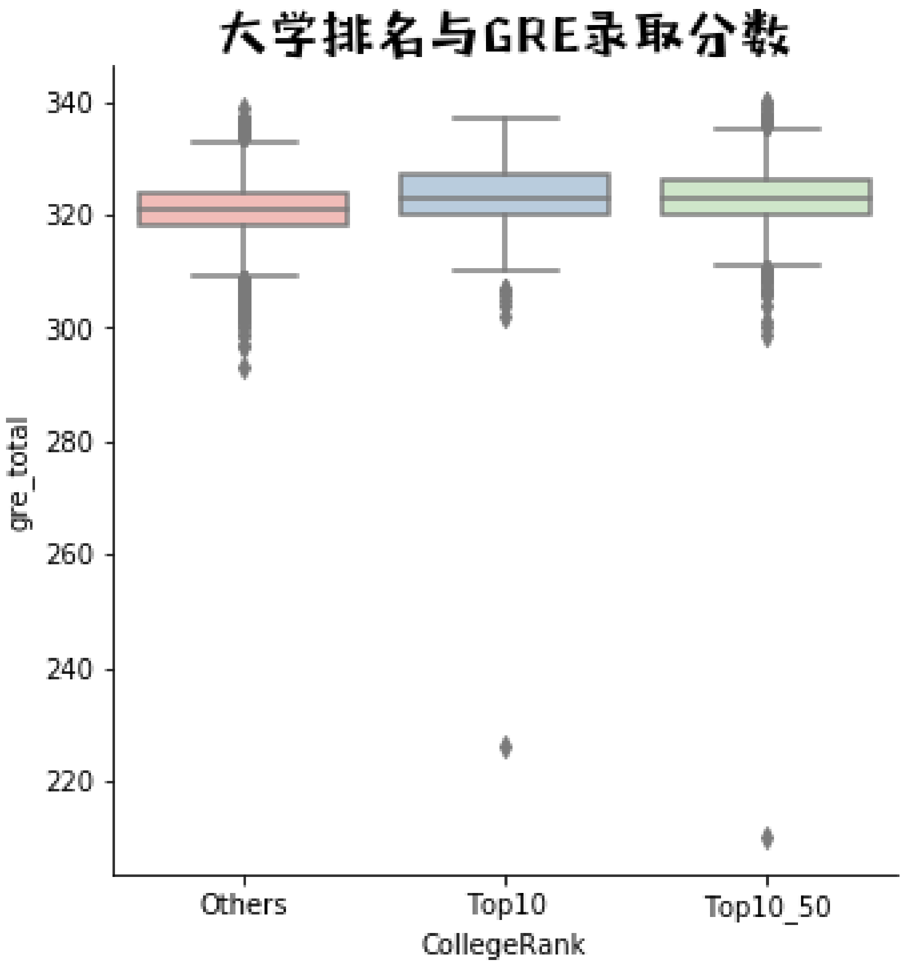
7.4 7.4 热门专业的 GRE 录取分数

```
In [51]: gre_admitted=descriptive[descriptive['offertype']=='Admitted']    ## 选出结果为录取的数据
         top10mj_ap=['CS', 'EE', 'Stat/Biostat', 'ME', 'MIS', 'CE', 'Material', 'Other', 'IEOR', '
         gre_top10mu_ap=gre_admitted[gre_admitted['major_apply'].isin(top10mj_ap)]
         sns.catplot(x='major_apply',y='gre_total',kind='box', data=gre_top10mu_ap,
                     height=5, aspect=2, palette="Pastel1")
         plt.title("热门专业的 GRE 录取分数",fontproperties=prop, fontsize=20)
         plt.show()
         plt.close()
```



7.5 7.5 大学排名与 GRE 录取分数

In [52]:
```
sns.catplot(x='CollegeRank',y='gre_total',kind='box',data=gre_top10mu_ap, palette="Pastel
plt.title("大学排名与 GRE 录取分数",fontproperties=prop, fontsize=20)
plt.show()
plt.close()
```



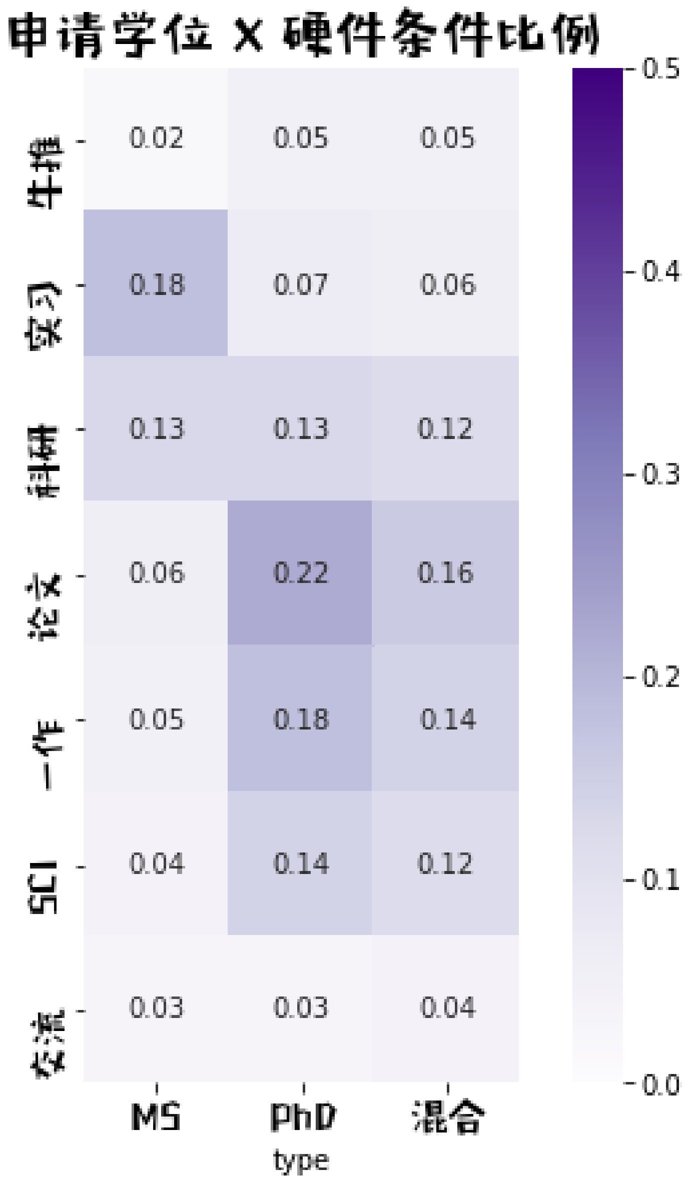
8 8. 硬件条件

```
In [53]: descriptive['first'] = abs(descriptive['first'])
         descriptive['sci'] = abs(descriptive['sci'])
```

8.1 8.1 学位 X 硬件条件比例

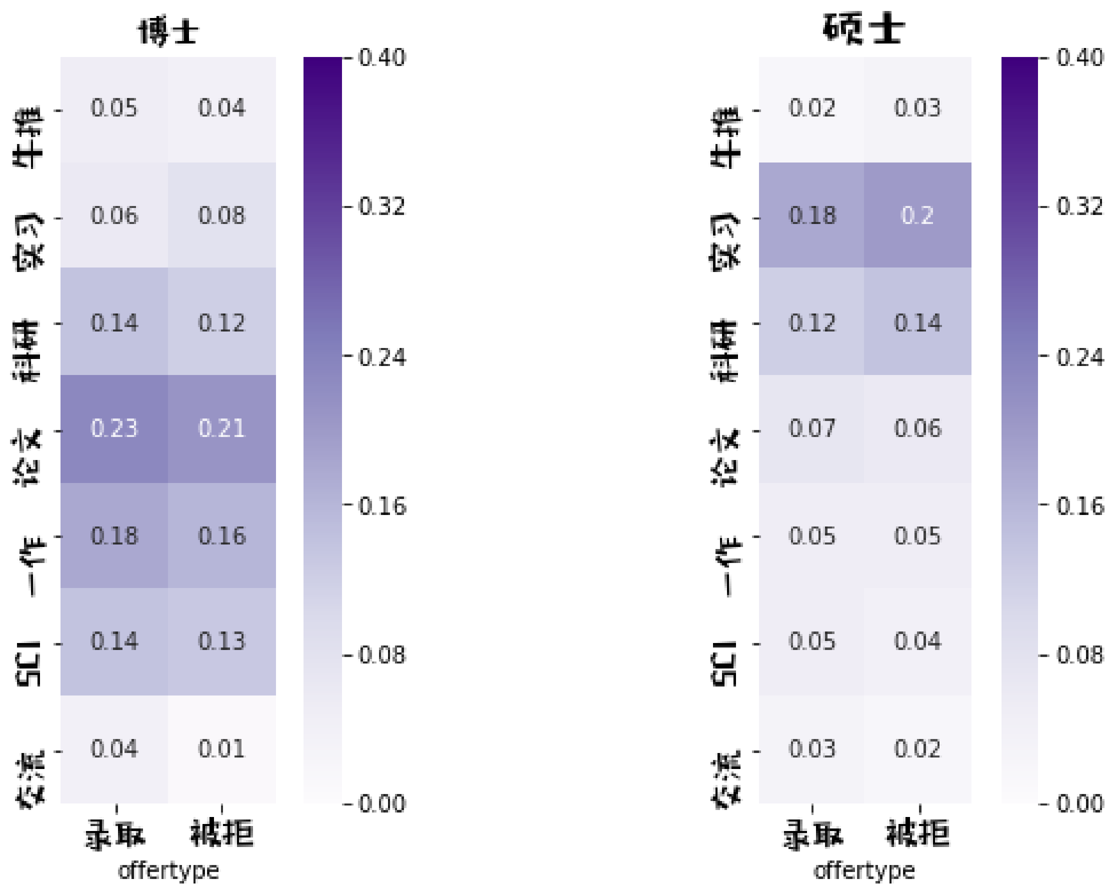
```
In [54]: # 8.1 学位 X 硬件条件比例
         yingjian_type = descriptive.groupby(by = 'type').agg({'rl': "mean", 'intern': "mean",
                                   'research': "mean",'paper': "mean",'first': "mean",
                                   'sci': "mean",'exchange': "mean"})
         fig = plt.figure(figsize=(7, 7))    # 画布
         ax1 = fig.add_subplot(111)         # 创建子图
```

```
sns.heatmap(np.round(yingjian_type, 2).T, annot=True, vmax=0.5,vmin = 0,
                square= True, cmap = "Purples")
ax1.set_yticklabels(labels = ["牛推","实习","科研","论文","一作","SCI","交流"], fontproper
ax1.set_xticklabels(labels = yingjian_type.index, fontproperties=prop, fontsize=15)
ax1.set_title('申请学位 X 硬件条件比例', fontproperties = prop, fontsize=20)
plt.show()
plt.close()
```



8.2 8.2 硬件条件 X 录取（博士 or 硕士）

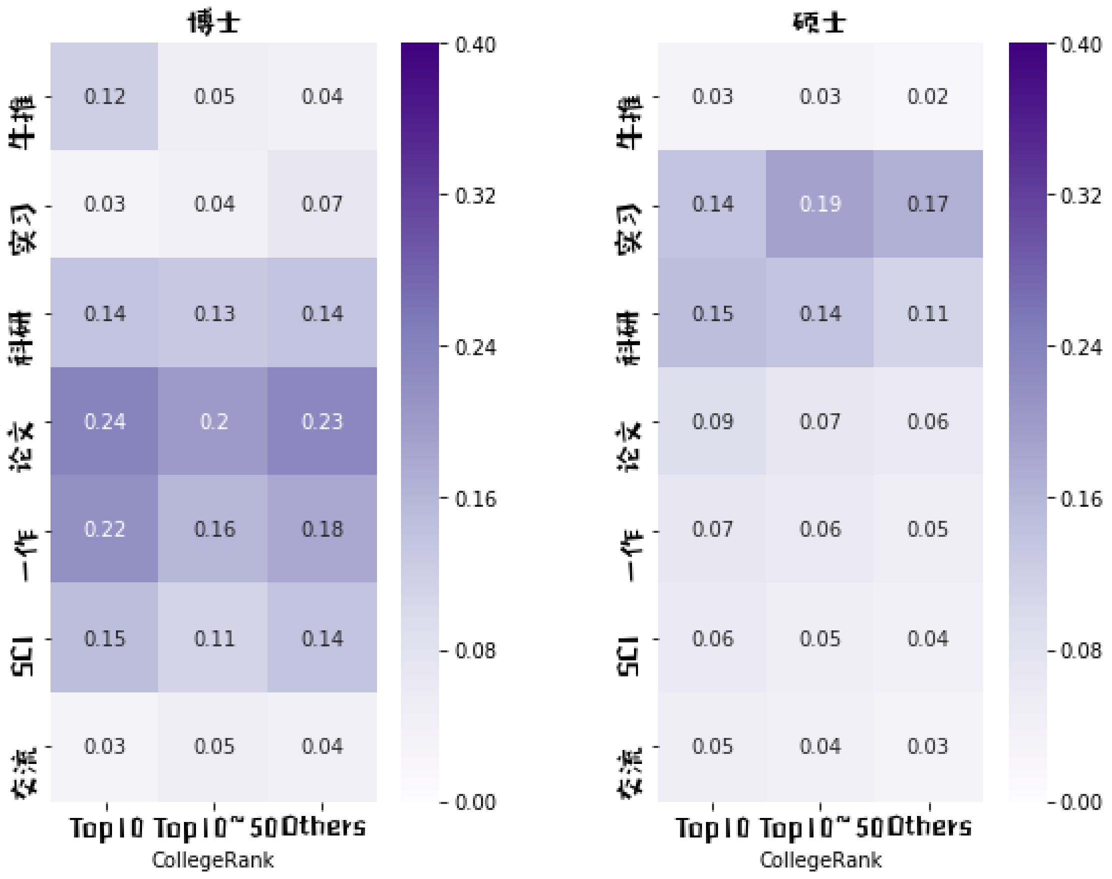
```
In [72]: # 博士
         des_phd = descriptive[descriptive['type']=='PhD']   # 选出 phd
         yingjian_offer_phd = des_phd.groupby(by = 'offertype').agg({'rl': "mean", 'intern': "mean
                            'research': "mean",'paper': "mean",'first': "mean",
                            'sci': "mean",'exchange': "mean"})
         fig = plt.figure(figsize=(10, 6))   # 画布
         ax1 = fig.add_subplot(121)        # 创建子图
         sns.heatmap(np.round(yingjian_offer_phd, 2).T, annot=True, vmax=0.4,vmin = 0,
                         square= True, cmap = "Purples")
         ax1.set_yticklabels(labels = ["牛推","实习","科研","论文","一作","SCI","交流"], fontproper
         ax1.set_xticklabels(labels = ["录取","被拒"], fontproperties=prop, fontsize=15)
         ax1.set_title('博士', fontproperties = prop, fontsize=15)

         # 硕士
         des_ms = descriptive[descriptive['type']=='MS']   # 选出 phd
         yingjian_offer_ms = des_ms.groupby(by = 'offertype').agg({'rl': "mean", 'intern': "mean",
                            'research': "mean",'paper': "mean",'first': "mean",
                            'sci': "mean",'exchange': "mean"})
         ax2 = fig.add_subplot(122)        # 创建子图
         sns.heatmap(np.round(yingjian_offer_ms, 2).T, annot=True, vmax=0.4,vmin = 0,
                         square= True, cmap = "Purples")
         ax2.set_yticklabels(labels = ["牛推","实习","科研","论文","一作","SCI","交流"], fontproper
         ax2.set_xticklabels(labels = ["录取","被拒"], fontproperties=prop, fontsize=15)
         ax2.set_title('硕士', fontproperties = prop, fontsize=20)
         plt.show()
         plt.close()
```



8.3 8.3 硬件条件 X 申请学校排名

```
In [73]: # 博士
         des_admitted = descriptive[descriptive['offertype']=='Admitted']   # 选出被录取的
         des_admitted_phd = des_admitted[des_admitted['type']=='PhD']   # 选出 phd 被录取的
         yingjian_college_rank1 = des_admitted_phd.groupby(by = 'CollegeRank').agg({'rl': "mean",
                             'research': "mean",'paper': "mean",'first': "mean",
                             'sci': "mean",'exchange': "mean"})
         yingjian_college_rank1 = yingjian_college_rank1.reindex(["Top10","Top10_50","Others"],axi
         fig = plt.figure(figsize=(10, 7))    # 画布
         ax1 = fig.add_subplot(121)         # 创建子图
         sns.heatmap(np.round(yingjian_college_rank1, 2).T, annot=True, vmax=0.4,vmin = 0,
                         square= True, cmap = "Purples")
         ax1.set_yticklabels(labels = ["牛推","实习","科研","论文","一作","SCI","交流"], fontproper
         ax1.set_xticklabels(labels = ["Top10","Top10~50","Others"], fontproperties=prop, fontsize
         ax1.set_title('博士', fontproperties = prop, fontsize=15)
```

```
# 硕士
des_admitted = descriptive[descriptive['offertype']=='Admitted']   # 选出被录取的
des_admitted_MS = des_admitted[des_admitted['type']=='MS']   # 选出 ms 录取的
yingjian_college_rank2 = des_admitted_MS.groupby(by = 'CollegeRank').agg({'rl': "mean", '
                   'research': "mean",'paper': "mean",'first': "mean",
                   'sci': "mean",'exchange': "mean"})
yingjian_college_rank2 = yingjian_college_rank2.reindex(["Top10","Top10_50","Others"],axi
ax2 = fig.add_subplot(122)        # 创建子图
sns.heatmap(np.round(yingjian_college_rank2, 2).T, annot=True, vmax=0.4,vmin = 0,
                square= True, cmap = "Purples")
ax2.set_yticklabels(labels = ["牛推","实习","科研","论文","一作","SCI","交流"], fontproper
ax2.set_xticklabels(labels = ["Top10","Top10~50","Others"], fontproperties=prop, fontsize
ax2.set_title('硕士', fontproperties = prop, fontsize=15)
plt.show()
plt.close()
```


博士
牛推
实习
科研
论文
一作
SCI
交流
Top10 Top10~50 Others
CollegeRank
硕士
牛推
实习
科研
论文
一作
SCI
交流
Top10 Top10~50 Others
CollegeRank