Dataset_Plan

February 19, 2020

1 CMPT 898

Neural Collaborative Filtering for Expert Recommendation
Dataset Plan

- Seyedeh Mina Mousavifar
- 11279515
- sem311

2 Dataset Collection

2.1 Gathering Data from Server

These are SQL queries that provide us the required datasets.

[0]:
```
# select activities of the best users
select * from Posts where OwnerUserId in (
    select Id from Users where Reputation > 320000)

# select questions that those users answered
select * from Posts where Id in (
    select ParentId from Posts where OwnerUserId in (
        select Id from Users where (
            Reputation > 575000 and Reputation < 595000)))

# select badges of the best users
select count(*) from Badges where UserId in (
    select Id from Users where Reputation > 320000)
```

2.2 Loading Data

[0]:
```
import pandas as pd
import glob

# load questions
path = "data/Questions"
all_questions = glob.glob(path + "/*.csv")
```

```
question_list = []

for question in all_questions:
    q = pd.read_csv(question, index_col=None, low_memory=False)
    question_list.append(q)

questions = pd.concat(question_list, axis=0, ignore_index=True)
```

[0]:
```
# load answers
path = "data/Posts"
all_answers = glob.glob(path + "/*.csv")

answer_list = []

for answer in all_answers:
    a = pd.read_csv(answer, index_col=None, low_memory=False)
    answer_list.append(a)

answers = pd.concat(answer_list, axis=0, ignore_index=True)
```

Answers are the activities of our selected users. This data is a mixture of answers and questions that belong to these selected users. In order to sepreate questions and answers, we have to find the items that have $PostTypeId = 1$ and concat them to the questions dataset.

[0]:
```
questions_post = answers[answers['PostTypeId'] == 1]
answers = answers[answers['PostTypeId'] != 1]

questions = pd.concat([questions, questions_post], axis=0, ignore_index=True)
```

[0]:
```
questions.to_csv("data/Questions.csv")
answers.to_csv("data/Answers.csv")
```

[0]:
```
# load badges
path = "data/Badges"
all_badges = glob.glob(path + "/*.csv")

badge_list = []

for badge in all_badges:
    a = pd.read_csv(badge, index_col=None, low_memory=False)
    badge_list.append(a)

badges = pd.concat(badge_list, axis=0, ignore_index=True)
```

[0]:
```
badges.to_csv("data/Badges.csv")
```

3 Exploration

The following document includes exploration on *Questions*, *Answers*, *Users*, and *Badges*.

[0]:
```
import pandas as pd
```

3.1 Questions Exploration

[0]:
```
questions = pd.read_csv('data/Questions.csv').drop(['Unnamed: 0'], 1)
```

Type of data

[0]:
```
questions.dtypes
```

[0]:
```
Id                        int64
PostTypeId                int64
AcceptedAnswerId        float64
ParentId                float64
CreationDate             object
DeletionDate            float64
Score                     int64
ViewCount                 int64
Body                     object
OwnerUserId             float64
OwnerDisplayName         object
LastEditorUserId        float64
LastEditorDisplayName    object
LastEditDate             object
LastActivityDate         object
Title                    object
Tags                     object
AnswerCount               int64
CommentCount              int64
FavoriteCount           float64
ClosedDate               object
CommunityOwnedDate       object
dtype: object
```

Size of each Sample

[0]:
```
questions.head(1).transpose()
```

[0]:

	0
Id	10216788
PostTypeId	1
AcceptedAnswerId	1.0217e+07
ParentId	NaN
CreationDate	2012-04-18 19:42:58
DeletionDate	NaN
Score	0
ViewCount	2112
Body	<p>My question involves the use of SQL to assi...

```
OwnerUserId                                                  1.19531e+06
OwnerDisplayName                                                     NaN
LastEditorUserId                                             1.90595e+06
LastEditorDisplayName                                                NaN
LastEditDate                                         2017-05-07 15:11:05
LastActivityDate                                     2017-05-07 15:11:05
Title                  How to group and assign group ID to duplicate ...
Tags                                     <mysql><sql><group-by><where>
AnswerCount                                                          3
CommentCount                                                         0
FavoriteCount                                                        1
ClosedDate                                                         NaN
CommunityOwnedDate                                                 NaN
```

Number of samples in dataset

[0]:
```
i = questions.shape
print('There are', i[0], 'questions with', i[1], 'features.')
```

```
There are 922199 questions with 22 features.
```

[0]:
```
questions.describe().transpose()
```

[0]:
```
                      count          mean           std   min        25%  \
Id                 916053.0  2.148818e+07  1.732701e+07   4.0  6012371.0
PostTypeId         916053.0  1.000000e+00  0.000000e+00   1.0        1.0
AcceptedAnswerId   695344.0  2.054687e+07  1.703022e+07   7.0  5600002.5
ParentId                0.0           NaN           NaN   NaN        NaN
DeletionDate            0.0           NaN           NaN   NaN        NaN
Score              916053.0  6.469840e+00  7.257310e+01 -52.0        0.0
ViewCount          916053.0  6.385482e+03  4.761797e+04   5.0      108.0
OwnerUserId        894211.0  2.308072e+06  2.731840e+06   1.0   358438.0
LastEditorUserId   540631.0  1.598296e+06  2.272910e+06  -1.0   107418.0
AnswerCount        916053.0  2.641999e+00  2.934118e+00   1.0        1.0
CommentCount       916053.0  1.985432e+00  2.742936e+00   0.0        0.0
FavoriteCount      298847.0  6.381396e+00  6.400417e+01   0.0        1.0

                         50%          75%         max
Id                17170040.0  34561719.00  60245789.0
PostTypeId              1.0         1.00         1.0
AcceptedAnswerId  15783542.5  32850214.75  60245000.0
ParentId                NaN          NaN         NaN
DeletionDate            NaN          NaN         NaN
Score                   1.0         3.00     24080.0
ViewCount             509.0      2161.00   8389977.0
OwnerUserId         1168402.0   3287714.50  12905308.0
LastEditorUserId     651174.0   2019415.00  12902824.0
AnswerCount               2.0         3.00       518.0
```

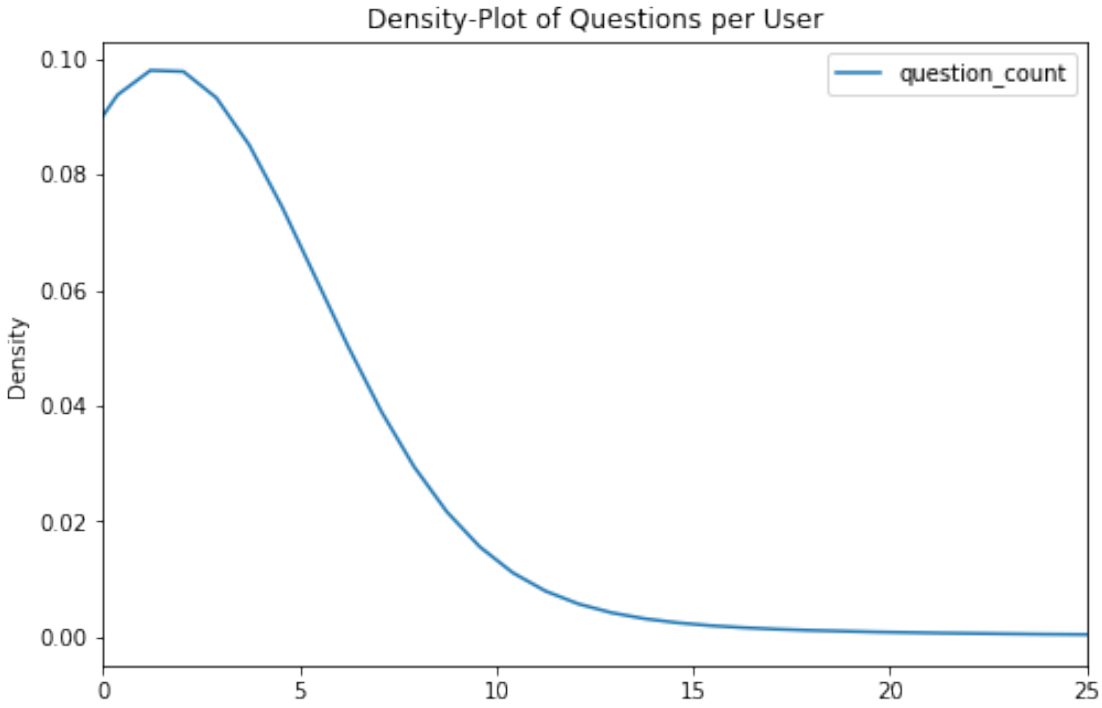
```
CommentCount            1.0          3.00         56.0
FavoriteCount           1.0          3.00      10906.0
```

3.1.1 Questions Per User

[0]:
```
user_question = questions.groupby(['OwnerUserId']).size().
↪reset_index(name='question_count')

user_question.describe()
```

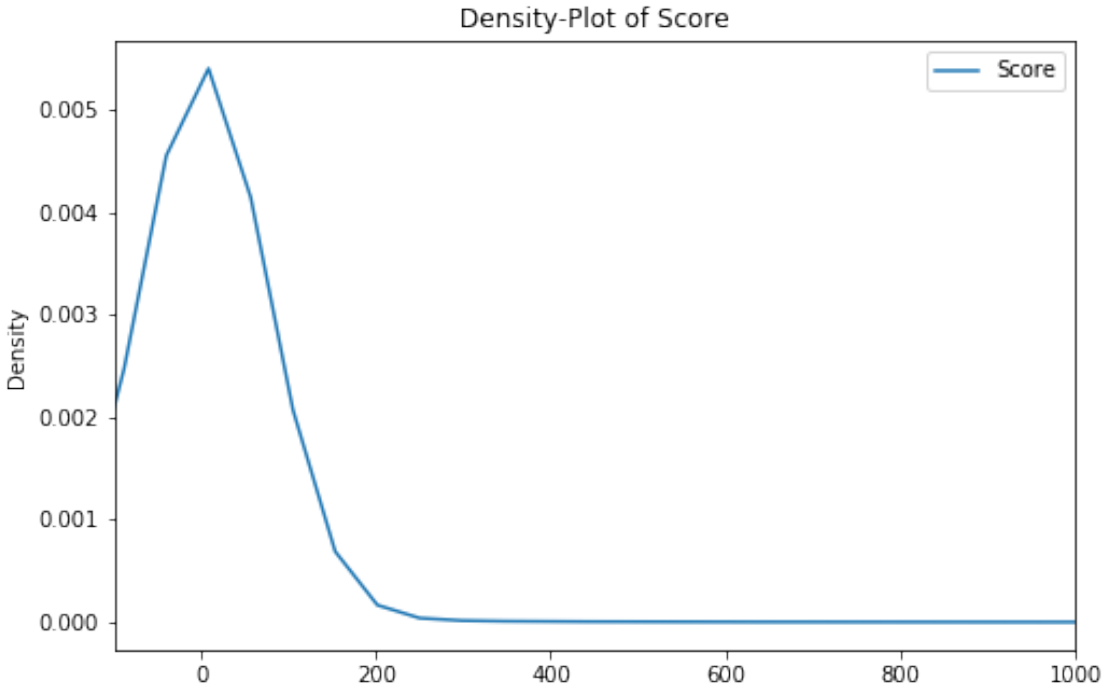
[0]:
```
         OwnerUserId  question_count
count   3.899080e+05   389908.000000
mean    3.139607e+06        2.309152
std     3.002720e+06        5.140721
min     1.000000e+00        1.000000
25%     7.722370e+05        1.000000
50%     2.105692e+06        1.000000
75%     4.682640e+06        2.000000
max     1.290531e+07      684.000000
```

[0]:
```
plot = user_question[['question_count']].plot.kde(title='Density-Plot of␣
↪Questions per User',
                                                  figsize=(8, 5.2),
                                                  xlim = (0, 25),
                                                  bw_method = 0.8)
```



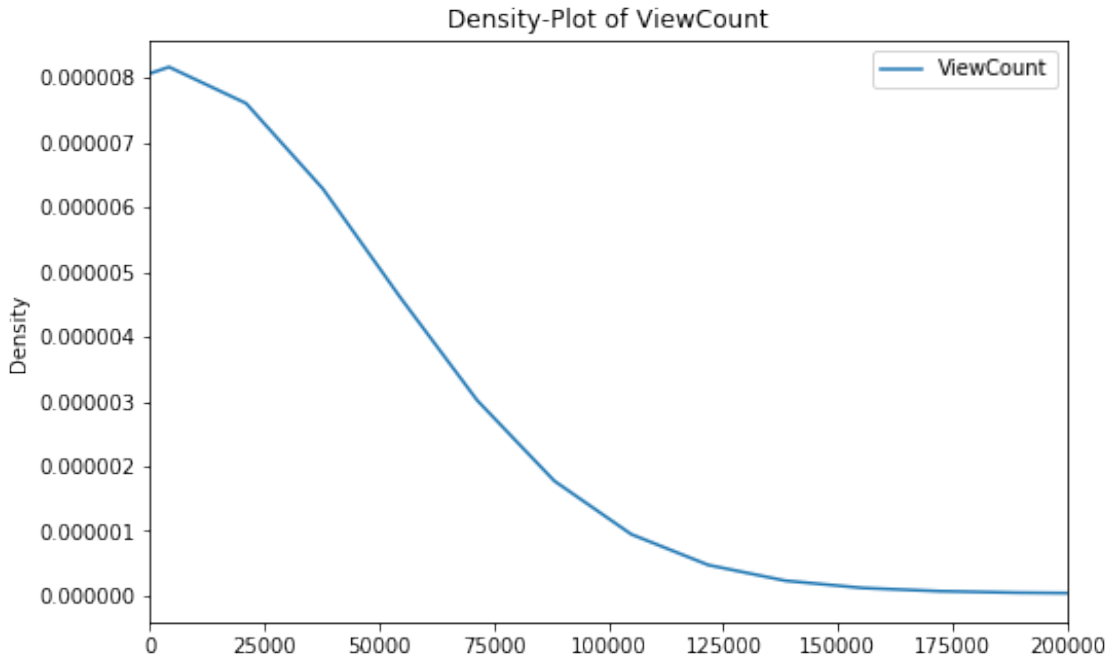
3.1.2 Questions Score Distribution

[0]:
```
# density plot for Score
dens_plot = questions[['Score']].plot.density(title='Density-Plot of Score',
                                              figsize=(8, 5.2),
                                              xlim = (-100, 1000),
                                              bw_method = 1)
```



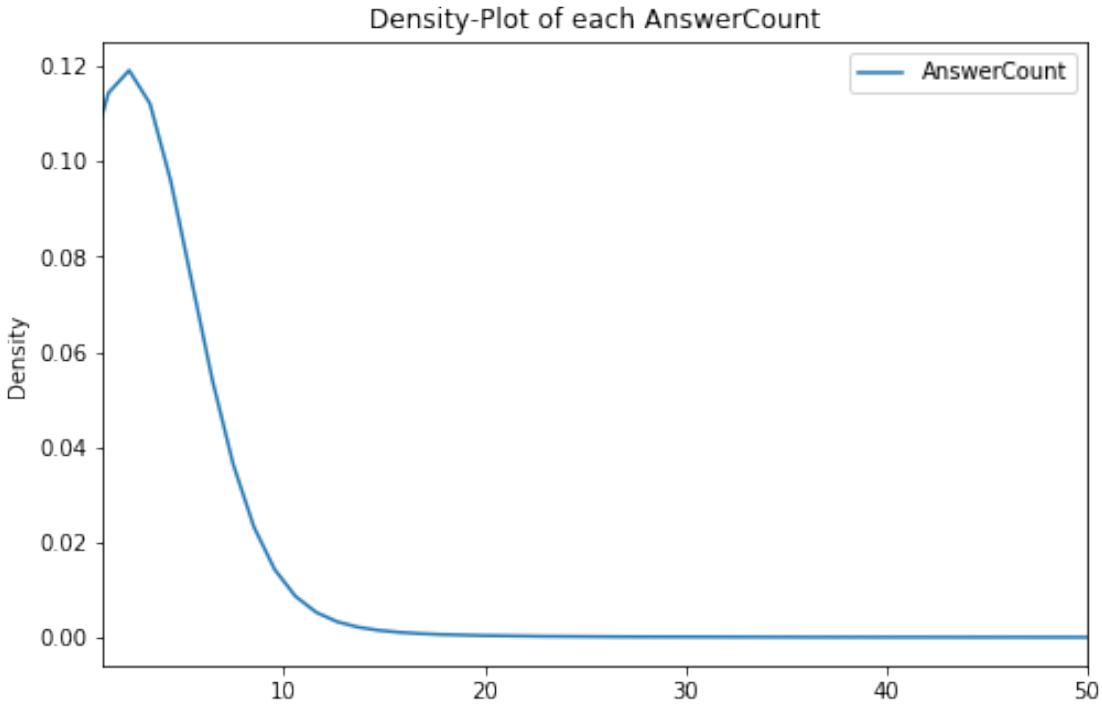
3.1.3 Questions View Count Distribution

[0]:
```
# density plot for ViewCount
dens_plot = questions[['ViewCount']].plot.density(title='Density-Plot of␣
 ↪ViewCount',
                                                  figsize=(8, 5.2),
                                                  xlim = (1, 200000),
                                                  bw_method = 1)
```



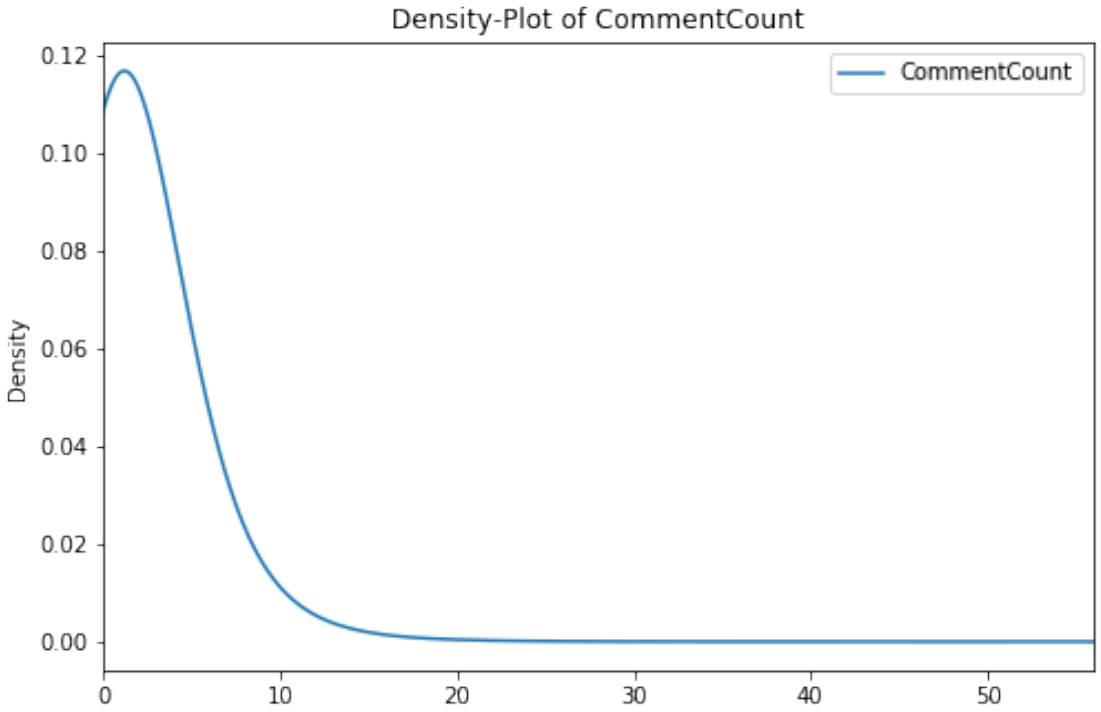
3.1.4 Questions Answer Count Distribution

[0]:
```
# density plot for AnswerCount
dens_plot = questions[['AnswerCount']].plot.density(title='Density-Plot of each␣
 ↪AnswerCount',
                                                    figsize=(8, 5.2),
                                                    xlim = (1, 50),
                                                    bw_method = 1)
```



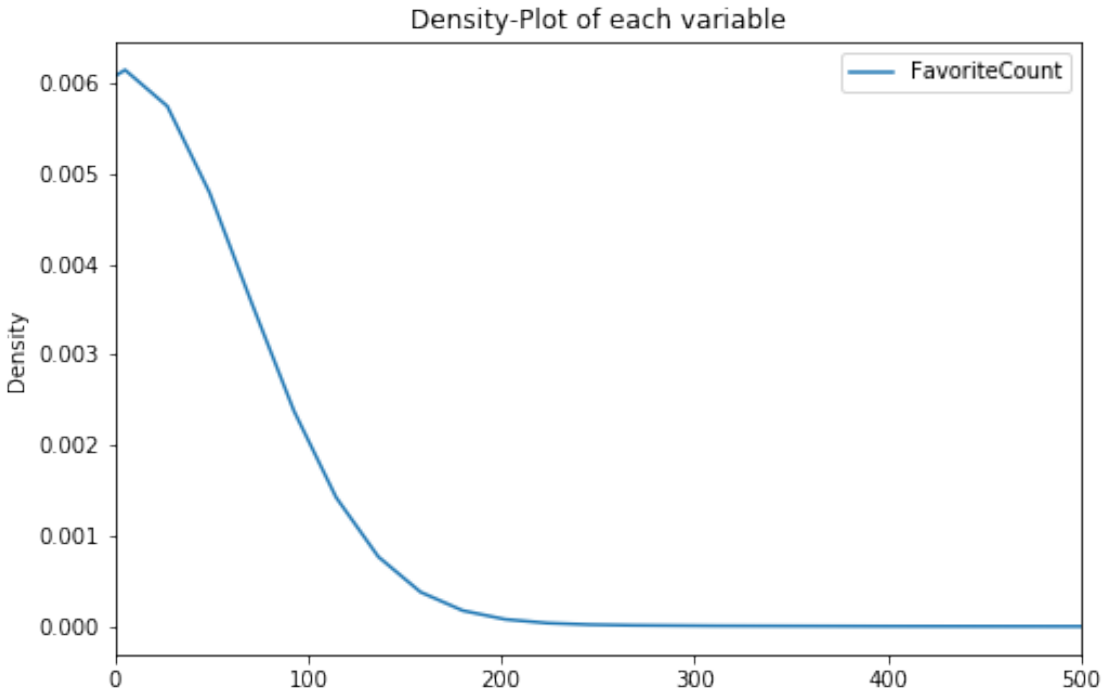
3.1.5 Questions Comment Count Distribution

[0]:
```
# density plot for CommentCount
dens_plot = questions[['CommentCount']].plot.density(title='Density-Plot of␣
 ↪CommentCount',
                                                      figsize=(8, 5.2),
                                                      xlim = (0, 56),
                                                      bw_method = 1)
```



3.1.6 Questions Favourite Count Distribution

[0]:
```
# density plot for FavoriteCount
dens_plot = questions[['FavoriteCount']].plot.density(title='Density-Plot of␣
 ↪each variable',
                                                      figsize=(8, 5.2),
                                                      xlim = (0, 500),
                                                      bw_method = 1)
```



3.2 Answers Exploration

[0]:
```
answers = pd.read_csv('data/Answers.csv',
                      low_memory=False).drop(['Unnamed: 0'], 1)
```

Type of data

[0]:
```
answers.dtypes
```

[0]:
```
Id                        int64
PostTypeId                int64
AcceptedAnswerId        float64
ParentId                float64
CreationDate             object
DeletionDate            float64
Score                     int64
ViewCount               float64
Body                     object
OwnerUserId               int64
OwnerDisplayName         object
LastEditorUserId        float64
LastEditorDisplayName    object
LastEditDate             object
LastActivityDate         object
```

```
Title                   object
Tags                    object
AnswerCount            float64
CommentCount             int64
FavoriteCount          float64
ClosedDate              object
CommunityOwnedDate      object
dtype: object
```

Size of each Sample

[0]:
```
answers.head(1).transpose()
```

[0]:
```
                                                                    0
Id                                                            8825740
PostTypeId                                                          2
AcceptedAnswerId                                                  NaN
ParentId                                                  2.38153e+06
CreationDate                                          2012-01-11 19:53:57
DeletionDate                                                      NaN
Score                                                              14
ViewCount                                                         NaN
Body                    <p>It is possible to do everything you want. A...
OwnerUserId                                                   1144035
OwnerDisplayName                                                  NaN
LastEditorUserId                                                188246
LastEditorDisplayName                                             NaN
LastEditDate                                          2015-01-12 17:05:26
LastActivityDate                                      2015-01-12 17:05:26
Title                                                             NaN
Tags                                                              NaN
AnswerCount                                                       NaN
CommentCount                                                        3
FavoriteCount                                                     NaN
ClosedDate                                                        NaN
CommunityOwnedDate                                                NaN
```

Number of samples in dataset

[0]:
```
i = answers.shape
print('There are', i[0], 'answers with', i[1], 'features.')
```

```
There are 930668 answers with 22 features.
```

[0]:
```
answers.describe().transpose()
```

[0]:
```
                    count          mean           std     min         25%  \
Id                930668.0  2.118422e+07  1.714353e+07  1141.0  5757926.25
```

```
PostTypeId        930668.0  1.997192e+00  1.288017e-01     1.0        2.00
AcceptedAnswerId    5130.0  1.307581e+07  1.550224e+07  4449.0  1936562.75
ParentId          923124.0  2.114552e+07  1.710958e+07     4.0  5758321.50
DeletionDate           0.0           NaN           NaN     NaN         NaN
Score             930668.0  6.537395e+00  7.674702e+01   -51.0        1.00
ViewCount           6146.0  1.598089e+04  1.339871e+05    10.0      396.25
OwnerUserId       930668.0  4.776141e+05  8.383701e+05   267.0    23354.00
LastEditorUserId  327056.0  6.456028e+05  1.151393e+06    -1.0    20860.00
AnswerCount         6146.0  3.207615e+00  6.428819e+00     0.0        1.00
CommentCount      930668.0  1.837640e+00  2.690593e+00     0.0        0.00
FavoriteCount       3827.0  2.423700e+01  2.607855e+02     0.0        1.00

                        50%          75%         max
Id                16930827.0  34224430.25  60245884.0
PostTypeId              2.0         2.00         6.0
AcceptedAnswerId  5283550.0  21194412.75  60244434.0
ParentId          16915848.0  34127949.25  60245789.0
DeletionDate             NaN          NaN         NaN
Score                    2.0         4.00     31409.0
ViewCount             1330.5       5137.75   7996617.0
OwnerUserId         118068.0     548225.00   3832970.0
LastEditorUserId    157247.0     641914.00  12809784.0
AnswerCount              2.0         4.00       407.0
CommentCount             1.0         3.00       116.0
FavoriteCount            3.0         7.00     10906.0
```

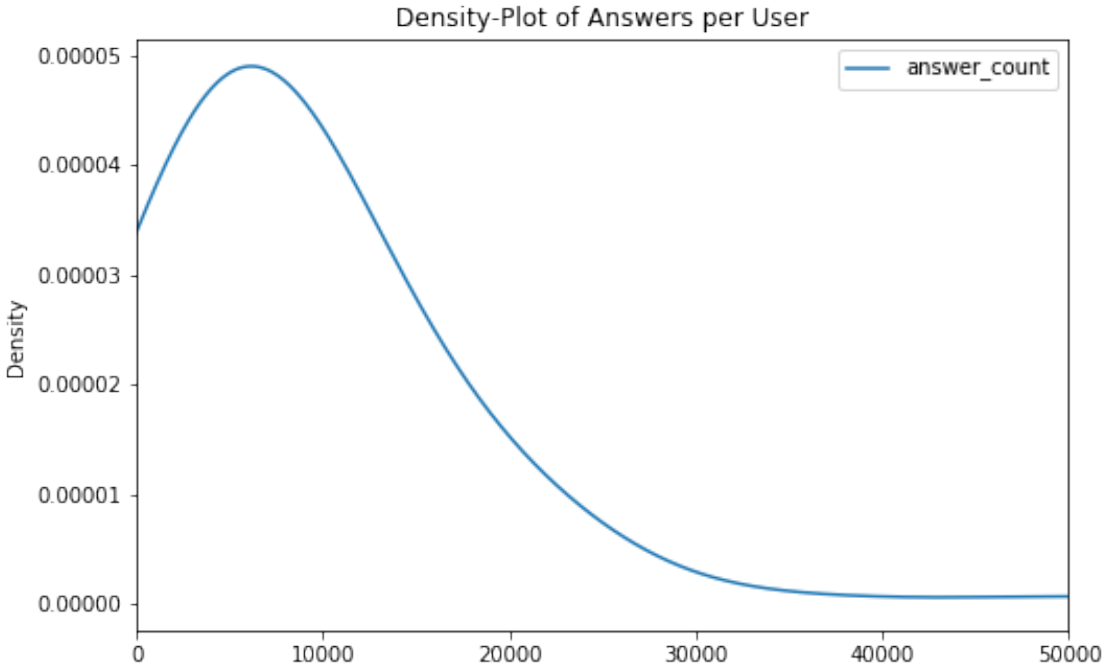
3.2.1 Answers Per User

[0]:
```
user_answer = answers.groupby(['OwnerUserId']).size().
 ↪reset_index(name='answer_count')

user_answer.describe()
```

[0]:
```
        OwnerUserId  answer_count
count  1.080000e+02    108.000000
mean   3.211547e+05   8617.296296
std    6.297311e+05   7481.176941
min    2.670000e+02    186.000000
25%    2.230050e+04   3833.000000
50%    1.052865e+05   6447.500000
75%    2.807802e+05  11221.500000
max    3.832970e+06  50000.000000
```

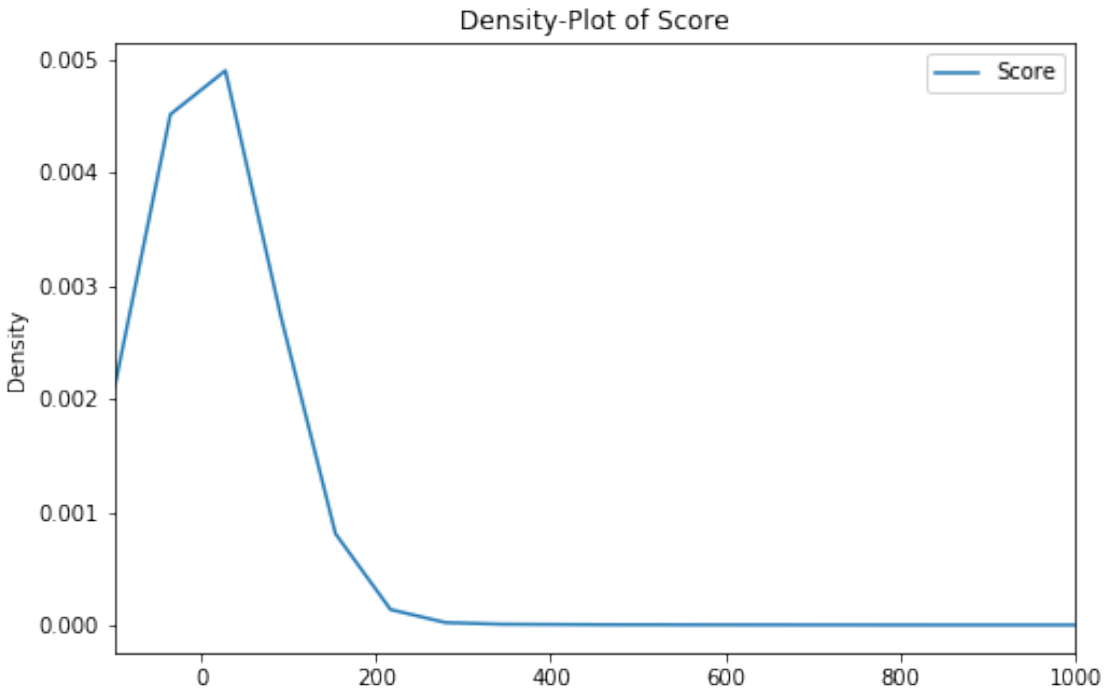
[0]:
```
plot = user_answer[['answer_count']].plot.kde(title="Density-Plot of Answers␣
 ↪per User",
                                              figsize=(8, 5.2),
                                              xlim = (0, 50000),
```

```
                                                bw_method = 0.8)
```



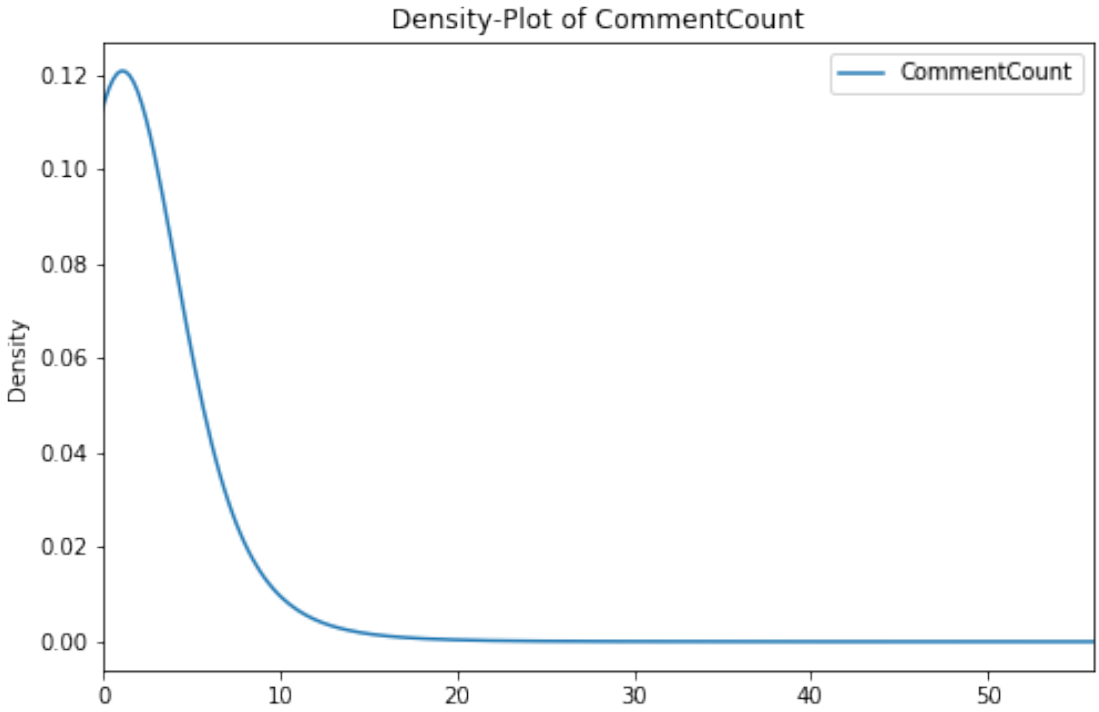
3.2.2 Answers Score Distribution

[0]:
```
# density plot for Score
dens_plot = answers[['Score']].plot.density(title='Density-Plot of Score',
                                            figsize=(8, 5.2),
                                            xlim = (-100, 1000),
                                            bw_method = 1)
```



3.2.3 Answers Comment Count Distribution

[0]:
```
# density plot for CommentCount
dens_plot = answers[['CommentCount']].plot.density(title='Density-Plot of␣
 ↪CommentCount',
                                                    figsize=(8, 5.2),
                                                    xlim = (0, 56),
                                                    bw_method = 1)
```



3.3 Users Exploration

[0]:
```
users = pd.read_csv('data/Users.csv')
```

Type of data

[0]:
```
users.dtypes
```

[0]:
```
Id                 int64
Reputation         int64
CreationDate      object
DisplayName       object
LastAccessDate    object
WebsiteUrl        object
Location          object
AboutMe           object
Views              int64
UpVotes            int64
DownVotes          int64
ProfileImageUrl   object
EmailHash        float64
AccountId          int64
dtype: object
```

Size of each Sample

[0]:
```
users.head(1).transpose()
```

[0]:
```
                                                          0
Id                                                     9021
Reputation                                           464987
CreationDate                             2008-09-15 17:31:26
DisplayName                                            nickf
LastAccessDate                           2019-12-16 22:41:23
WebsiteUrl                             http://spadgos.github.io/
Location                                 Zürich, Switzerland
AboutMe          <p>Javascript nerd. Senior Software Engineer a...
Views                                                  16993
UpVotes                                                 2593
DownVotes                                                319
ProfileImageUrl                                          NaN
EmailHash                                                NaN
AccountId                                               5559
```

Number of samples in dataset

[0]:
```
i = users.shape
print('There are', i[0], 'users with', i[1], 'features.')
```

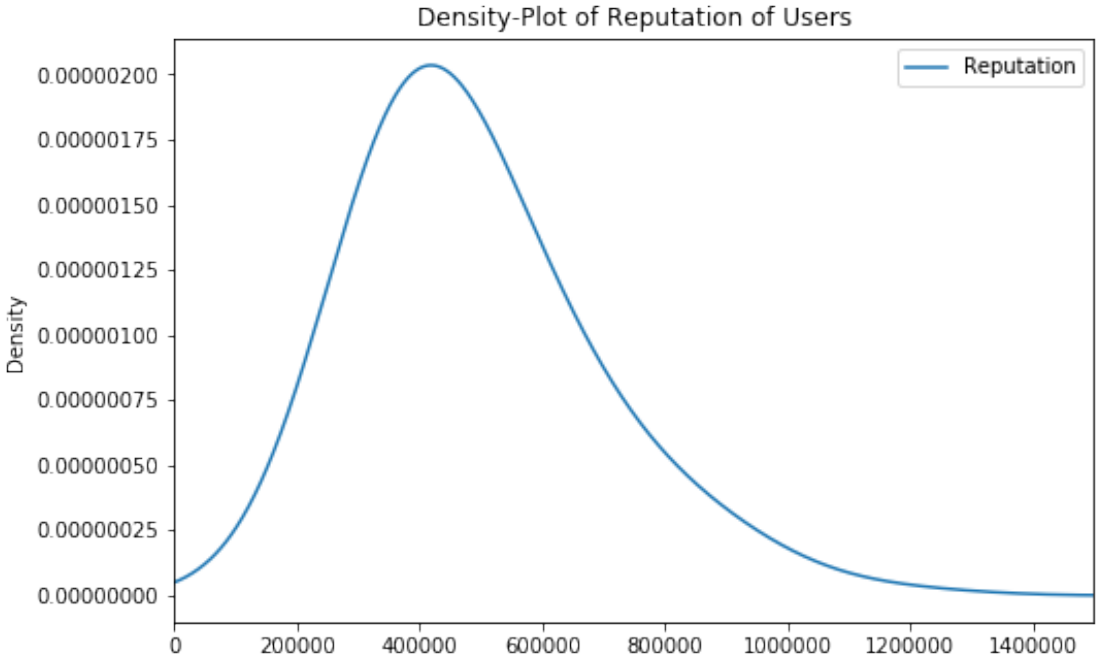
```
There are 108 users with 14 features.
```

[0]:
```
users.describe().transpose()
```

[0]:
```
             count           mean            std       min        25%  \
Id           108.0  321154.712963  629731.073190     267.0   22300.50
Reputation   108.0  491845.148148  171224.797635  323699.0  366319.50
Views        108.0   93265.824074  192077.494966    9096.0   33791.75
UpVotes      108.0    9040.462963    8430.048718       2.0    3366.75
DownVotes    108.0    5337.314815   11321.339032       0.0     278.75
EmailHash      0.0            NaN            NaN       NaN        NaN
AccountId    108.0  269277.370370  753982.206048     213.0   11534.50

                50%        75%        max
Id          105286.5  280780.25  3832970.0
Reputation  433458.5  579305.00  1163680.0
Views        50124.0   86302.75  1905220.0
UpVotes       6630.0   12451.75    52943.0
DownVotes     1057.0    4094.00    69355.0
EmailHash        NaN        NaN        NaN
AccountId    36873.5  112759.75  4739783.0
```

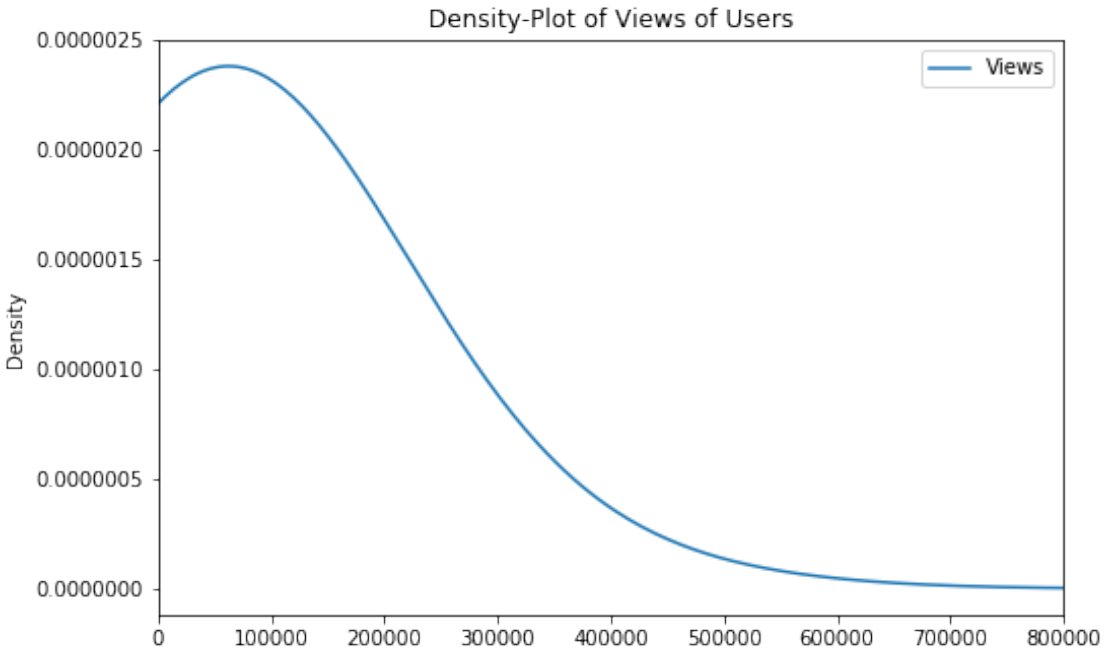
3.3.1 Users Reputation Distribution

[0]:
```
plot = users[['Reputation']].plot.kde(title="Density-Plot of Reputation of␣
↪Users",
                                                    figsize=(8, 5.2),
                                                    xlim = (0, 1500000),
                                                    bw_method = 0.8)
```



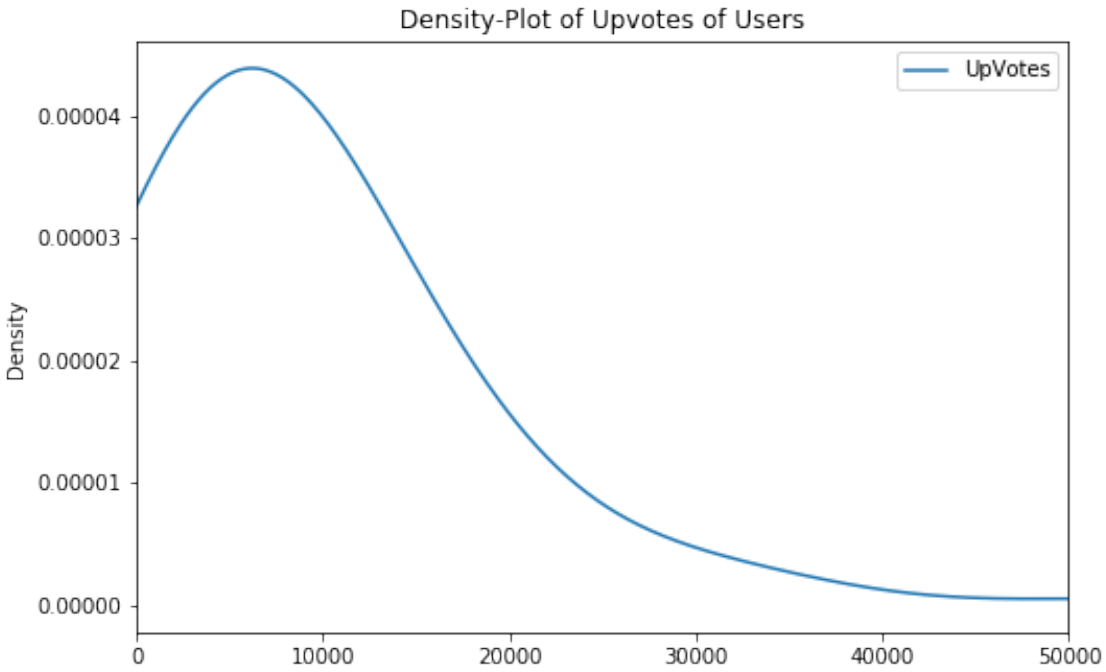
3.3.2 Users View Count Distribution

[0]:
```
plot = users[['Views']].plot.kde(title="Density-Plot of Views of Users",
                                 figsize=(8, 5.2),
                                 xlim = (0, 800000),
                                 bw_method = 0.8)
```



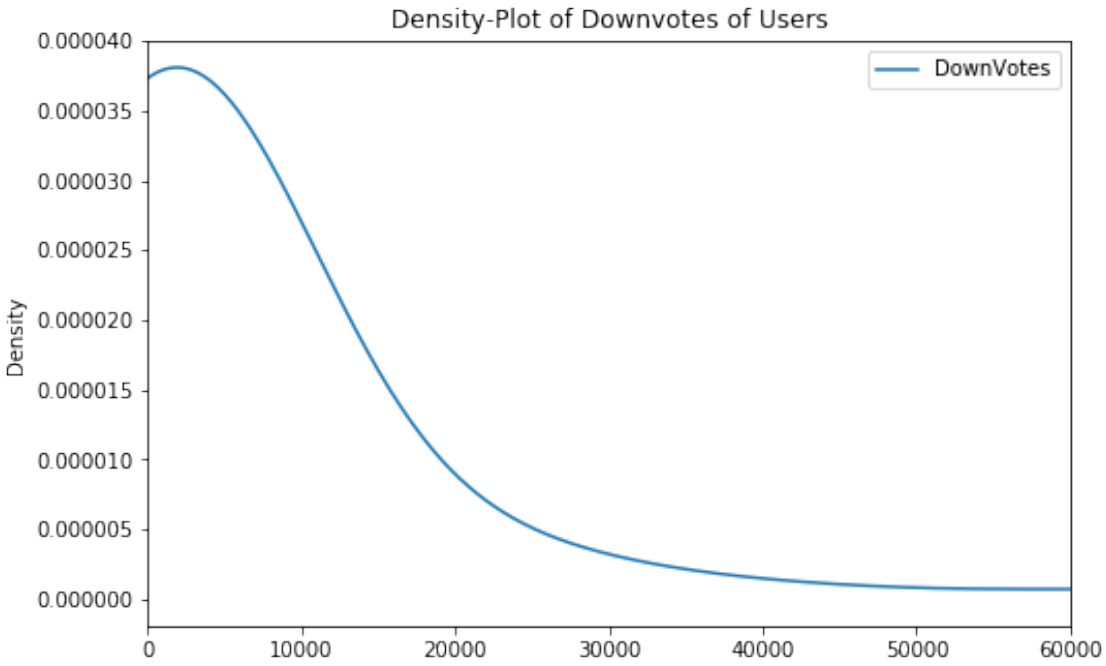
3.3.3 Users Upvotes Distribution

[0]:
```
plot = users[['UpVotes']].plot.kde(title="Density-Plot of Upvotes of Users",
                                   figsize=(8, 5.2),
                                   xlim = (0, 50000),
                                   bw_method = 0.8)
```



3.3.4 Users Downvotes Distribution

[0]:
```
plot = users[['DownVotes']].plot.kde(title="Density-Plot of Downvotes of Users",
                                     figsize=(8, 5.2),
                                     xlim = (0, 60000),
                                     bw_method = 0.8)
```



3.4 Badges Exploration

[0]:
```
badges = pd.read_csv('data/Badges.csv').drop(['Unnamed: 0'], 1)
```

[0]:
```
badges
```

[0]:

	Id	UserId	Name	Date	Class	TagBased
0	18343493	22656	Good Answer	2016-04-19 13:46:29	2	False
1	20650151	22656	Nice Answer	2016-10-18 12:25:41	3	False
2	20650211	6309	Nice Answer	2016-10-18 12:30:45	3	False
3	20650808	22656	Enlightened	2016-10-18 13:14:18	2	False
4	20652124	22656	Good Answer	2016-10-18 14:43:19	2	False
...	...	...	...	...	...	...
219720	29286882	17034	Good Answer	2018-08-22 06:50:26	2	False
219721	29288330	19068	Great Answer	2018-08-22 09:10:28	1	False
219722	29288723	157882	Nice Answer	2018-08-22 09:45:18	3	False
219723	29290738	157247	Good Answer	2018-08-22 12:25:08	2	False
219724	29291506	157882	Announcer	2018-08-22 13:25:18	3	False

[219725 rows x 6 columns]

Type of data

[0]:
```
badges.dtypes
```

[0]:
```
Id           int64
UserId       int64
Name        object
Date        object
Class        int64
TagBased      bool
dtype: object
```

Size of each Sample

[0]:
```
badges.head(1).transpose()
```

[0]:
```
                            0
Id                   18343493
UserId                  22656
Name              Good Answer
Date      2016-04-19 13:46:29
Class                       2
TagBased                False
```

Number of samples in dataset

[0]:
```
i = badges.shape
print('There are', i[0], 'badges with', i[1], 'features.')
```

```
There are 219725 badges with 6 features.
```

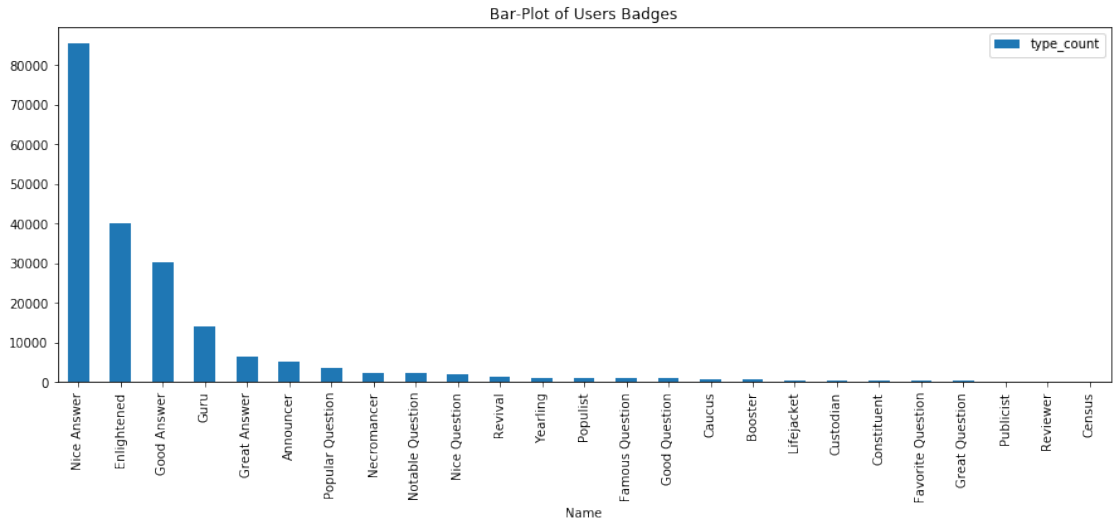
3.4.1 Users Badges Distribution

[0]:
```
user_badges = badges[badges['TagBased'] == False]
user_badges = user_badges.groupby(['Name']).size().
 ↪reset_index(name='type_count')
user_badges = user_badges.sort_values(['type_count'], ascending=False).
 ↪reset_index()

user_badges
```

[0]:
```
    index                Name  type_count
0      51         Nice Answer       85403
1      27         Enlightened       40163
2      36         Good Answer       30321
3      40                Guru       13982
4      38        Great Answer        6598
..    ...                 ...         ...
86     66  Research Assistant          10
87      6                Beta           8
88     72             Sheriff           7
89     22  Documentation Beta           4
```

```
90     53          Not a Robot            3

[91 rows x 3 columns]
```

[0]:
```
plot = user_badges.head(25).plot.bar(title='Bar-Plot of Users Badges',
                                     figsize=(15, 5.2),
                                     x='Name',
                                     y='type_count',
                                     rot=90)
```



3.5 Analysis

Perform some statistical analysis of the dataset to quantify it's distribution. > As we can see in the plots above, most of our distributions follow *Power law distribution* because they are related to human behaviour. But users' reputation, questions score, and answer score seem to follow *Beta distribution*.

3.6 Potential Problems

Note any potential problems with the dataset

> The Stack Overflow has millions of active users that create content on this platform. As a result, the datasets are enormous, and it is impossible to store them on PC RAMs. The first problem is how to deal with these datasets? The only solution is using Database to store them on HDDs, but these datasets are more massive than our HDDs. Consequently, we must use cloud base Database platforms like Google Big Query and Stack Exchange Data Explorer. We choose SEDE because it is free. This platform enables us to retrieve a small chunk of datasets using SQL queries. We prune the data first by users who have the most contribution to this platform. After pruning the users, we try to find these users' activities and information. We solved this problem for now, but

we eliminate lots of data that may lead to a decrease in the significance of our results or maybe affect the reliability of our results. If we can not manage to find a suitable model, we'll have to add more data from other types of users and retrain our model. However, these users have the best data quality among all of the users, so we hope that we can model real and unseen users and questions based on these selected users with the least possible error.

3.7 Related dataset

List any related public datasets that are similar to the one you will use.

Our dataset is publicly available here which is in XML format. Another available dataset is SOTorrent, but both are gigantic, and require to set up a database to work with this data.

Note Amirabbas Jalali and Mina Mousavifar have both contributed in this phase of the project, because we will use the same dataset for the same problem with different approaches.