1_Reference_EDA

August 22, 2019

1 DonorsChoose

DonorsChoose.org receives hundreds of thousands of project proposals each year for classroom projects in need of funding. Right now, a large number of volunteers is needed to manually screen each submission before it's approved to be posted on the DonorsChoose.org website.

```
Next year, DonorsChoose.org expects to receive close to 500,000 project proposals. As a result

How to scale current manual processes and resources to screen 500,000 projects so that they ca
<li>How to increase the consistency of project vetting across different volunteers to improve
<li>How to focus volunteer time on the applications that need the most assistance</li>
</ul>
```

The goal of the competition is to predict whether or not a DonorsChoose.org project proposal submitted by a teacher will be approved, using the text of project descriptions as well as additional metadata about the project, teacher, and school. DonorsChoose.org can then use this information to identify projects most likely to need further review before approval.

1.1 About the DonorsChoose Data Set

The `train.csv` data set provided by DonorsChoose contains the following features:

Feature	Description
`project_id`	A unique identifier for the proposed project. **Example:** `p036502`

`project_title` | Title of the project. **Examples:**
Art Will Make You Happy!
First Grade Fun
`project_grade_category` | Grade level of students for which the project is targeted. One of the following enumerated values:
Grades PreK-2
Grades 3-5
Grades 6-8
Grades 9-12
`project_subject_categories` | One or more (comma-separated) subject categories for the project from the following enumerated list of values:
Applied Learning

Care & Hunger
Health & Sports
History & Civics
Literacy & Language
Math & Science
Music & The Arts
Special Needs
Warmth
Examples:
Music & The Arts
Literacy & Language, Math & Science

`school_state` | State where school is located (Two-letter U.S. postal code). **Example:** `WY`

`project_subject_subcategories` | One or more (comma-separated) subject subcategories for the project. **Examples:**

Literacy
Literature & Writing, Social Sciences

`project_resource_summary` | An explanation of the resources needed for the project. **Example:**

My students need hands on literacy materials to manage sensory needs!

`project_essay_1` | First application essay
`project_essay_2` | *Second application essay* `project_essay_3` | Third application essay
`project_essay_4` | *Fourth application essay* `project_submitted_datetime` | Datetime when project application was submitted. **Example:** `2016-04-28 12:43:56.245`
`teacher_id` | A unique identifier for the teacher of the proposed project. **Example:** `bdf8baa8fedef6bfeec7ae4ff1c15c56`
`teacher_prefix` | Teacher's title. One of the following enumerated values:

nan
Dr.
Mr.
Mrs.
Ms.
Teacher.

`teacher_number_of_previously_posted_projects` | Number of project applications previously submitted by the same teacher. **Example:** `2`

* See the section Notes on the Essay Data for more details about these features.

Additionally, the `resources.csv` data set provides more data about the resources required for each project. Each line in this file represents a resource required by a project:

Feature	Description
`id`	A `project_id` value from the `train.csv` file. **Example:** `p036502`
`description`	Desciption of the resource. **Example:** `Tenor Saxophone Reeds, Box of 25`

Feature	Description
`quantity`	Quantity of the resource required. **Example:** `3`
`price`	Price of the resource required. **Example:** `9.95`

Note: Many projects require multiple resources. The `id` value corresponds to a `project_id` in train.csv, so you use it as a key to retrieve all resources needed for a project:

The data set contains the following label (the value you will attempt to predict):

Label	Description
`project_is_approved`	A binary flag indicating whether DonorsChoose approved the project. A value of `0` indicates the project was not approved, and a value of `1` indicates the project was approved.

1.1.1 Notes on the Essay Data

Prior to May 17, 2016, the prompts for the essays were as follows:

project_essay_1: "Introduce us to your classroom"

project_essay_2: "Tell us more about your students"

project_essay_3: "Describe how your students will use the materials you're requesting"

project_essay_3: "Close by sharing why your project will make a difference"

Starting on May 17, 2016, the number of essays was reduced from 4 to 2, and the prompts for the first 2 essays were changed to the following:

project_essay_1: "Describe your students: What makes your students special? Specific details about their background, your neighborhood, and your school are all helpful."

project_essay_2: "About your project: How will these materials make a difference in your students' learning and improve their school lives?"

For all projects with project_submitted_datetime of 2016-05-17 and later, the values of project_essay_3 and project_essay_4 will be NaN.

```
In [1]: %matplotlib inline
        import warnings
        warnings.filterwarnings("ignore")

        import sqlite3
        import pandas as pd
```

```
import numpy as np
import nltk
import string
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.feature_extraction.text import TfidfTransformer
from sklearn.feature_extraction.text import TfidfVectorizer

from sklearn.feature_extraction.text import CountVectorizer
from sklearn.metrics import confusion_matrix
from sklearn import metrics
from sklearn.metrics import roc_curve, auc
from nltk.stem.porter import PorterStemmer

import re
# Tutorial about Python regular expressions: https://pymotw.com/2/re/
import string
from nltk.corpus import stopwords
from nltk.stem import PorterStemmer
from nltk.stem.wordnet import WordNetLemmatizer

from gensim.models import Word2Vec
from gensim.models import KeyedVectors
import pickle

from tqdm import tqdm
import os

from plotly import plotly
import plotly.offline as offline
import plotly.graph_objs as go
offline.init_notebook_mode()
from collections import Counter
```

1.2 1.1 Reading Data

```
In [2]: project_data = pd.read_csv('train_data.csv')
        resource_data = pd.read_csv('resources.csv')

In [3]: print("Number of data points in train data", project_data.shape)
        print('-'*50)
        print("The attributes of data :", project_data.columns.values)
```

```
Number of data points in train data (109248, 17)
--------------------------------------------------
The attributes of data : ['Unnamed: 0' 'id' 'teacher_id' 'teacher_prefix' 'school_state'
 'project_submitted_datetime' 'project_grade_category'
 'project_subject_categories' 'project_subject_subcategories'
```

```
 'project_title' 'project_essay_1' 'project_essay_2' 'project_essay_3'
 'project_essay_4' 'project_resource_summary'
 'teacher_number_of_previously_posted_projects' 'project_is_approved']
```

In [4]:
```
print("Number of data points in resource data", resource_data.shape)
print(resource_data.columns.values)
resource_data.head(2)
```

```
Number of data points in resource data (1541272, 4)
['id' 'description' 'quantity' 'price']
```

Out[4]:

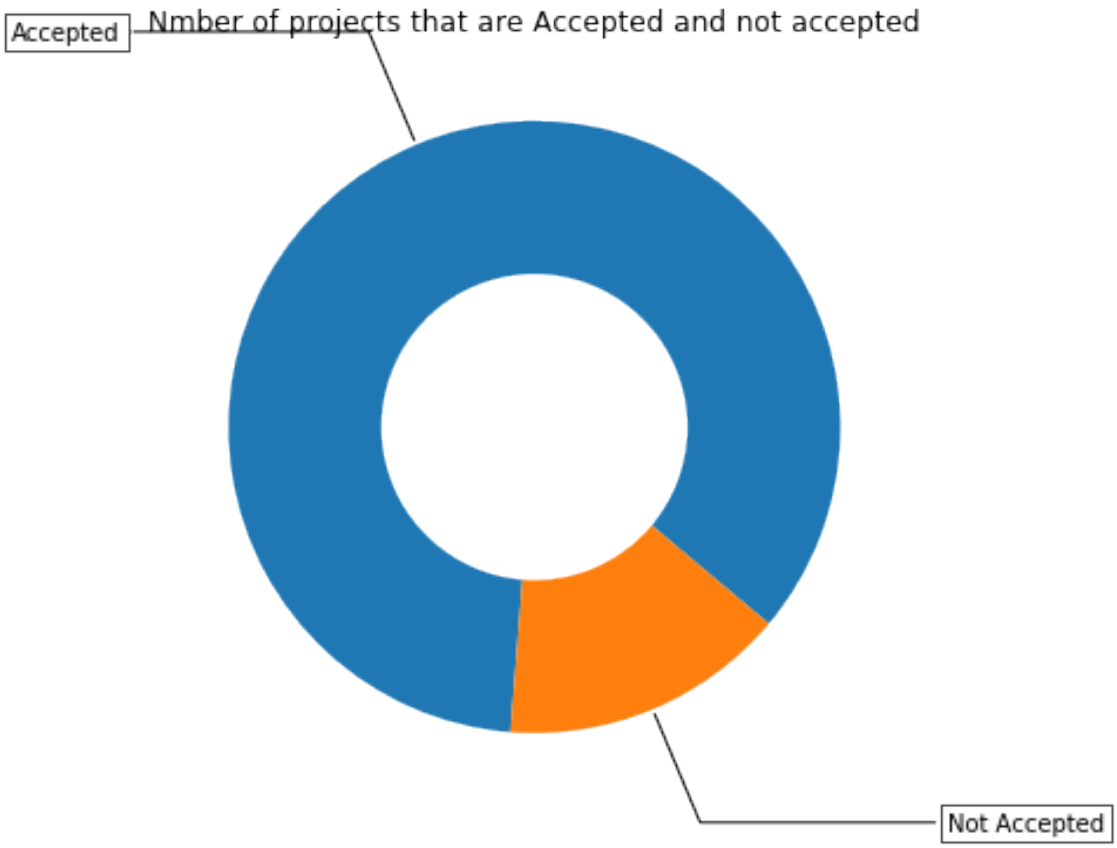
	id	description	quantity	price
0	p233245	LC652 - Lakeshore Double-Space Mobile Drying Rack	1	149.00
1	p069063	Bouncy Bands for Desks (Blue support pipes)	3	14.95

2 1.2 Data Analysis

In [5]:
```
# this code is taken from
# https://matplotlib.org/gallery/pie_and_polar_charts/pie_and_donut_labels.html#sphx-g


y_value_counts = project_data['project_is_approved'].value_counts()
print("Number of projects thar are approved for funding ", y_value_counts[1], ", (", (y
print("Number of projects thar are not approved for funding ", y_value_counts[0], ", (

fig, ax = plt.subplots(figsize=(6, 6), subplot_kw=dict(aspect="equal"))
recipe = ["Accepted", "Not Accepted"]

data = [y_value_counts[1], y_value_counts[0]]

wedges, texts = ax.pie(data, wedgeprops=dict(width=0.5), startangle=-40)

bbox_props = dict(boxstyle="square,pad=0.3", fc="w", ec="k", lw=0.72)
kw = dict(xycoords='data', textcoords='data', arrowprops=dict(arrowstyle="-"),
          bbox=bbox_props, zorder=0, va="center")

for i, p in enumerate(wedges):
    ang = (p.theta2 - p.theta1)/2. + p.theta1
    y = np.sin(np.deg2rad(ang))
    x = np.cos(np.deg2rad(ang))
    horizontalalignment = {-1: "right", 1: "left"}[int(np.sign(x))]
    connectionstyle = "angle,angleA=0,angleB={}".format(ang)
```

```
        kw["arrowprops"].update({"connectionstyle": connectionstyle})
        ax.annotate(recipe[i], xy=(x, y), xytext=(1.35*np.sign(x), 1.4*y),
                    horizontalalignment=horizontalalignment, **kw)

    ax.set_title("Nmber of projects that are Accepted and not accepted")

    plt.show()
```

```
Number of projects thar are approved for funding  92706 , ( 84.85830404217927 %)
Number of projects thar are not approved for funding  16542 , ( 15.141695957820739 %)
```



2.0.1 1.2.1 Univariate Analysis: School State

In [6]:
```
# Pandas dataframe grouby count, mean: https://stackoverflow.com/a/19385591/4084039

temp = pd.DataFrame(project_data.groupby("school_state")["project_is_approved"].apply(
# if you have data which contain only 0 and 1, then the mean = percentage (think about
temp.columns = ['state_code', 'num_proposals']

# How to plot US state heatmap: https://datascience.stackexchange.com/a/9620
```

```
        scl = [[0.0, 'rgb(242,240,247)'],[0.2, 'rgb(218,218,235)'],[0.4, 'rgb(188,189,220)'],\
                    [0.6, 'rgb(158,154,200)'],[0.8, 'rgb(117,107,177)'],[1.0, 'rgb(84,39,143)']

        data = [ dict(
                type='choropleth',
                colorscale = scl,
                autocolorscale = False,
                locations = temp['state_code'],
                z = temp['num_proposals'].astype(float),
                locationmode = 'USA-states',
                text = temp['state_code'],
                marker = dict(line = dict (color = 'rgb(255,255,255)',width = 2)),
                colorbar = dict(title = "% of pro")
            ) ]

        layout = dict(
                title = 'Project Proposals % of Acceptance Rate by US States',
                geo = dict(
                    scope='usa',
                    projection=dict( type='albers usa' ),
                    showlakes = True,
                    lakecolor = 'rgb(255, 255, 255)',
                ),
            )

        fig = go.Figure(data=data, layout=layout)
        offline.iplot(fig, filename='us-map-heat-map')
```

In [7]:
```
        # https://www.csi.cuny.edu/sites/default/files/pdf/administration/ops/2letterstabbrev.
        temp.sort_values(by=['num_proposals'], inplace=True)
        print("States with lowest % approvals")
        print(temp.head(5))
        print('='*50)
        print("States with highest % approvals")
        print(temp.tail(5))
```

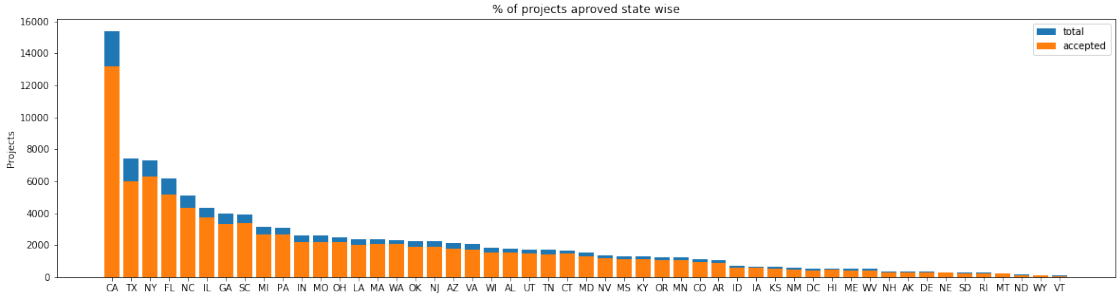
```
States with lowest % approvals
   state_code  num_proposals
46         VT       0.800000
7          DC       0.802326
43         TX       0.813142
26         MT       0.816327
18         LA       0.831245
==================================================
States with highest % approvals
   state_code  num_proposals
30         NH       0.873563
```

```
35          OH       0.875152
47          WA       0.876178
28          ND       0.888112
8           DE       0.897959
```

In [8]:
```
#stacked bar plots matplotlib: https://matplotlib.org/gallery/lines_bars_and_markers/b
def stack_plot(data, xtick, col2='project_is_approved', col3='total'):
    ind = np.arange(data.shape[0])

    plt.figure(figsize=(20,5))
    p1 = plt.bar(ind, data[col3].values)
    p2 = plt.bar(ind, data[col2].values)

    plt.ylabel('Projects')
    plt.title('% of projects aproved state wise')
    plt.xticks(ind, list(data[xtick].values))
    plt.legend((p1[0], p2[0]), ('total', 'accepted'))
    plt.show()
```

In [9]:
```
def univariate_barplots(data, col1, col2='project_is_approved', top=False):
    # Count number of zeros in dataframe python: https://stackoverflow.com/a/51540521/
    temp = pd.DataFrame(project_data.groupby(col1)[col2].agg(lambda x: x.eq(1).sum()))

    # Pandas dataframe grouby count: https://stackoverflow.com/a/19385591/4084039
    temp['total'] = pd.DataFrame(project_data.groupby(col1)[col2].agg({'total':'count'}
    temp['Avg']   = pd.DataFrame(project_data.groupby(col1)[col2].agg({'Avg':'mean'}))

    temp.sort_values(by=['total'],inplace=True, ascending=False)

    if top:
        temp = temp[0:top]

    stack_plot(temp, xtick=col1, col2=col2, col3='total')
    print(temp.head(5))
    print("="*50)
    print(temp.tail(5))
```

In [10]:
```
univariate_barplots(project_data, 'school_state', 'project_is_approved', False)
```



	school_state	project_is_approved	total	Avg
4	CA	13205	15388	0.858136
43	TX	6014	7396	0.813142
34	NY	6291	7318	0.859661
9	FL	5144	6185	0.831690
27	NC	4353	5091	0.855038

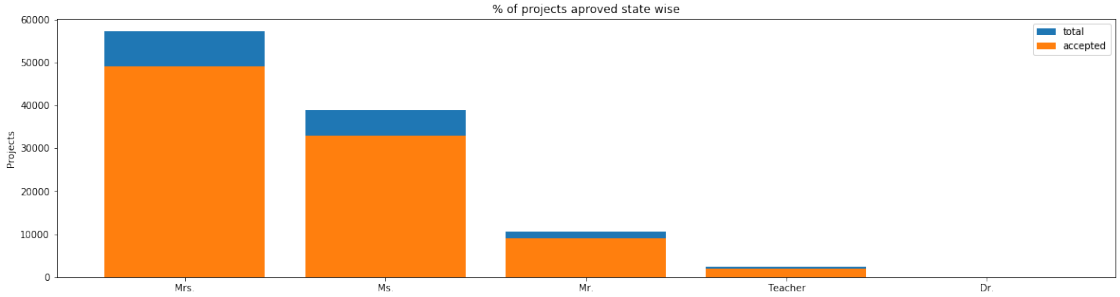
==========

	school_state	project_is_approved	total	Avg
39	RI	243	285	0.852632
26	MT	200	245	0.816327
28	ND	127	143	0.888112
50	WY	82	98	0.836735
46	VT	64	80	0.800000

Every state is having more than 80% success rate in approval

2.0.2 1.2.2 Univariate Analysis: teacher_prefix

```
In [11]: univariate_barplots(project_data, 'teacher_prefix', 'project_is_approved' , top=False
```



	teacher_prefix	project_is_approved	total	Avg
2	Mrs.	48997	57269	0.855559
3	Ms.	32860	38955	0.843537
1	Mr.	8960	10648	0.841473
4	Teacher	1877	2360	0.795339
0	Dr.	9	13	0.692308

==========

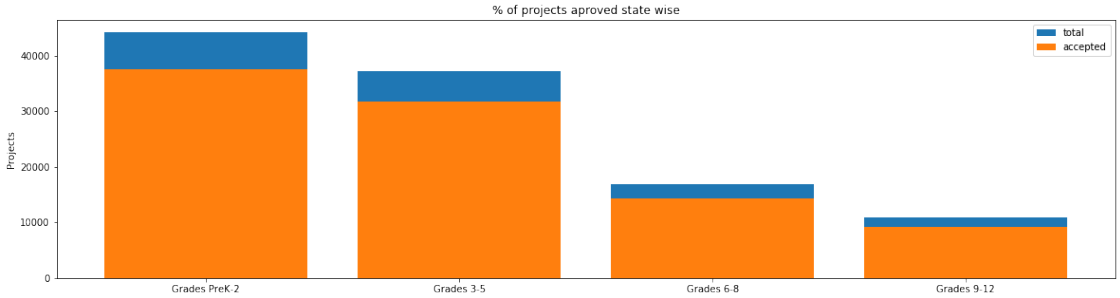
	teacher_prefix	project_is_approved	total	Avg
2	Mrs.	48997	57269	0.855559
3	Ms.	32860	38955	0.843537
1	Mr.	8960	10648	0.841473
4	Teacher	1877	2360	0.795339
0	Dr.	9	13	0.692308

Teachers with prefix Mrs. are more likely to get their projects approved with average rate of 86% which is most among all

there are very few people that work as school teachers after completing their phd

2.0.3 1.2.3 Univariate Analysis: project_grade_category

```
In [12]: univariate_barplots(project_data, 'project_grade_category', 'project_is_approved', to
```




```
  project_grade_category  project_is_approved  total       Avg
3          Grades PreK-2                37536  44225  0.848751
0             Grades 3-5                31729  37137  0.854377
1             Grades 6-8                14258  16923  0.842522
2            Grades 9-12                 9183  10963  0.837636
==================================================
  project_grade_category  project_is_approved  total       Avg
3          Grades PreK-2                37536  44225  0.848751
0             Grades 3-5                31729  37137  0.854377
1             Grades 6-8                14258  16923  0.842522
2            Grades 9-12                 9183  10963  0.837636
```

Students of grade from prek to 5 are having most fun here with various projects proposed for them

Where as students of grade 6 to 12 are surprisingly getting low number of projects

approval rate is almost similar but the projects proposed for grade 6-12 are less

2.0.4 1.2.4 Univariate Analysis: project_subject_categories

```
In [13]: catogories = list(project_data['project_subject_categories'].values)
         # remove special characters from list of strings python: https://stackoverflow.com/a/

         # https://www.geeksforgeeks.org/removing-stop-words-nltk-python/
         # https://stackoverflow.com/questions/23669024/how-to-strip-a-specific-word-from-a-st
         # https://stackoverflow.com/questions/8270092/remove-all-whitespace-in-a-string-in-py
         cat_list = []
         for i in catogories:
```

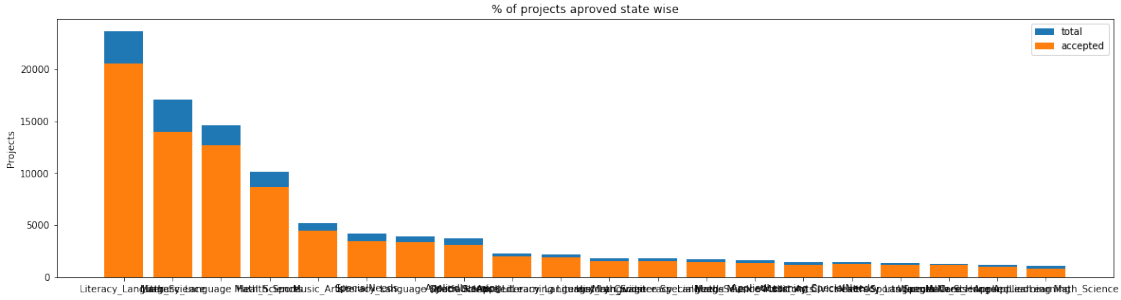
```
    temp = ""
    # consider we have text like this "Math & Science, Warmth, Care & Hunger"
    for j in i.split(','): # it will split it in three parts ["Math & Science", "Warm
        if 'The' in j.split(): # this will split each of the catogory based on space
            j=j.replace('The','') # if we have the words "The" we are going to replac
        j = j.replace(' ','') # we are placeing all the ' '(space) with ''(empty) ex:
        temp+=j.strip()+" " #" abc ".strip() will return "abc", remove the trailing s
        temp = temp.replace('&','_') # we are replacing the & value into
    cat_list.append(temp.strip())
```

In [14]:
```
project_data['clean_categories'] = cat_list
project_data.drop(['project_subject_categories'], axis=1, inplace=True)
project_data.head(2)
```

Out[14]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime	project_grade_category	project_subject_subcategories	project_title	project_essay_1	project_essay_2	project_essay_3	project_essay_4	project_resource_summary	teacher_number_of_previously_posted_projects	project_is_approved	clean_categories
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	Mrs.	IN	2016-12-05 13:43:57	Grades PreK-2	ESL, Literacy	Educational Support for English Learners at Home	My students are English learners that are work...	\"The limits of your language are the limits o...	NaN	NaN	My students need opportunities to practice beg...	0	0	Literacy_Language
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	Mr.	FL	2016-10-25 09:22:10	Grades 6-8	Civics & Government, Team Sports	Wanted: Projector for Hungry Learners	Our students arrive to our school eager to lea...	The projector we need for our school is very c...	NaN	NaN	My students need a projector to help with view...	7	1	History_Civics Health_Sports

In [15]: univariate_barplots(project_data, 'clean_categories', 'project_is_approved', top=20)



	clean_categories	project_is_approved	total	Avg
24	Literacy_Language	20520	23655	0.867470
32	Math_Science	13991	17072	0.819529
28	Literacy_Language Math_Science	12725	14636	0.869432
8	Health_Sports	8640	10177	0.848973
40	Music_Arts	4429	5180	0.855019

==========

	clean_categories	project_is_approved	total	Avg
19	History_Civics Literacy_Language	1271	1421	0.894441
14	Health_Sports SpecialNeeds	1215	1391	0.873472
50	Warmth Care_Hunger	1212	1309	0.925898
33	Math_Science AppliedLearning	1019	1220	0.835246
4	AppliedLearning Math_Science	855	1052	0.812738

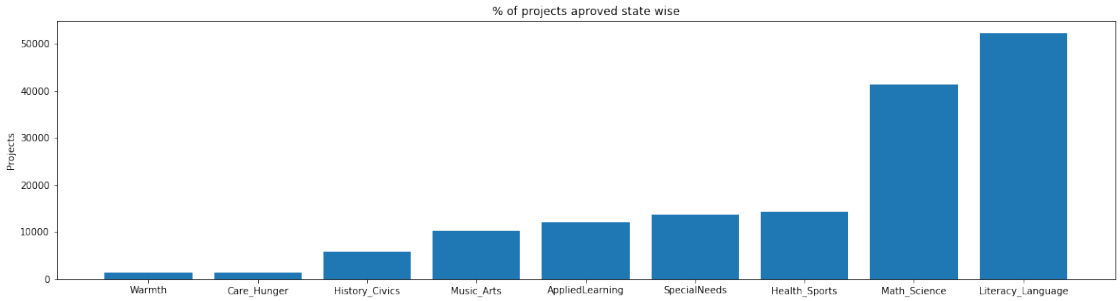
Count of projects proposed for languge, math-science is high but only language project proposals are getting approved

average approval rate of projects related to hunger is pretty high

In [16]:
```
# count of all the words in corpus python: https://stackoverflow.com/a/22898595/40840
from collections import Counter
my_counter = Counter()
for word in project_data['clean_categories'].values:
    my_counter.update(word.split())
```

In [17]:
```
# dict sort by value python: https://stackoverflow.com/a/613218/4084039
cat_dict = dict(my_counter)
sorted_cat_dict = dict(sorted(cat_dict.items(), key=lambda kv: kv[1]))


ind = np.arange(len(sorted_cat_dict))
plt.figure(figsize=(20,5))
p1 = plt.bar(ind, list(sorted_cat_dict.values()))
```

```
plt.ylabel('Projects')
plt.title('% of projects aproved state wise')
plt.xticks(ind, list(sorted_cat_dict.keys()))
plt.show()
```




```
In [18]: for i, j in sorted_cat_dict.items():
             print("{:20} :{:10}".format(i,j))
```

```
Warmth               :      1388
Care_Hunger          :      1388
History_Civics       :      5914
Music_Arts           :     10293
AppliedLearning      :     12135
SpecialNeeds         :     13642
Health_Sports        :     14223
Math_Science         :     41421
Literacy_Language    :     52239
```

2.0.5 1.2.5 Univariate Analysis: project_subject_subcategories

```
In [19]: sub_catogories = list(project_data['project_subject_subcategories'].values)
         # remove special characters from list of strings python: https://stackoverflow.com/a/

         # https://www.geeksforgeeks.org/removing-stop-words-nltk-python/
         # https://stackoverflow.com/questions/23669024/how-to-strip-a-specific-word-from-a-st
         # https://stackoverflow.com/questions/8270092/remove-all-whitespace-in-a-string-in-py

         sub_cat_list = []
         for i in sub_catogories:
             temp = ""
             # consider we have text like this "Math & Science, Warmth, Care & Hunger"
             for j in i.split(','): # it will split it in three parts ["Math & Science", "Warm
                 if 'The' in j.split(): # this will split each of the catogory based on space
                     j=j.replace('The','') # if we have the words "The" we are going to replac
                 j = j.replace(' ','') # we are placeing all the ' '(space) with ''(empty) ex:
```

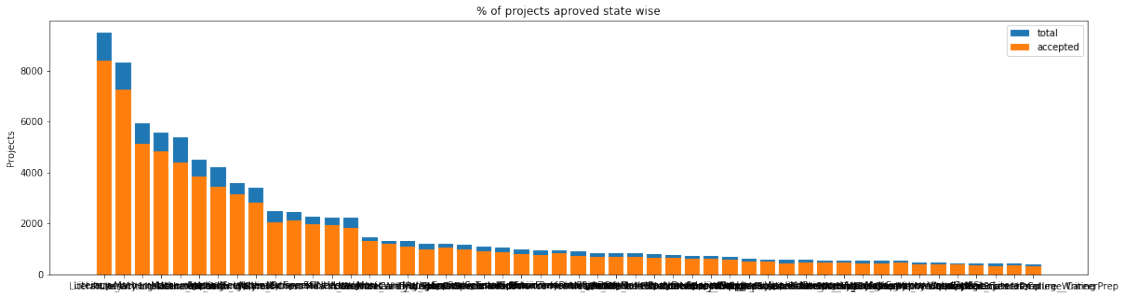
```
            temp +=j.strip()+" "#" abc ".strip() will return "abc", remove the trailing sp
            temp = temp.replace('&','_')
        sub_cat_list.append(temp.strip())
```

In [20]:
```
project_data['clean_subcategories'] = sub_cat_list
project_data.drop(['project_subject_subcategories'], axis=1, inplace=True)
project_data.head(2)
```

Out[20]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime	project_grade_category	project_title	project_essay_1	project_essay_2	project_essay_3	project_essay_4	project_resource_summary	teacher_number_of_previously_posted_projects	project_is_approved	clean_categories	clean_subcategories
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	Mrs.	IN	2016-12-05 13:43:57	Grades PreK-2	Educational Support for English Learners at Home	My students are English learners that are work...	\"The limits of your language are the limits o...	NaN	NaN	My students need opportunities to practice beg...	0	0	Literacy_Language	ESL Literacy
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	Mr.	FL	2016-10-25 09:22:10	Grades 6-8	Wanted: Projector for Hungry Learners	Our students arrive to our school eager to lea...	The projector we need for our school is very c...	NaN	NaN	My students need a projector to help with view...	7	1	History_Civics Health_Sports	Civics_Government TeamSports

In [21]:
```
univariate_barplots(project_data, 'clean_subcategories', 'project_is_approved', top=5
```



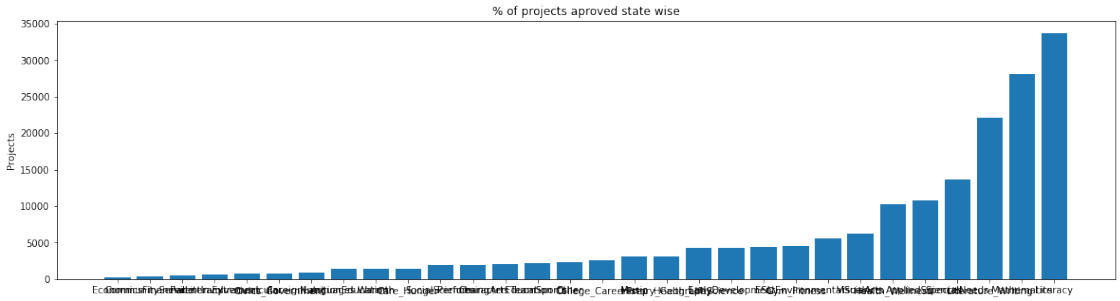
	clean_subcategories	project_is_approved	total	Avg
317	Literacy	8371	9486	0.882458
319	Literacy Mathematics	7260	8325	0.872072
331	Literature_Writing Mathematics	5140	5923	0.867803
318	Literacy Literature_Writing	4823	5571	0.865733
342	Mathematics	4385	5379	0.815207

==========

	clean_subcategories	project_is_approved	total	Avg
196	EnvironmentalScience Literacy	389	444	0.876126
127	ESL	349	421	0.828979
79	College_CareerPrep	343	421	0.814727
17	AppliedSciences Literature_Writing	361	420	0.859524
3	AppliedSciences College_CareerPrep	330	405	0.814815

In [22]:
```
# count of all the words in corpus python: https://stackoverflow.com/a/22898595/4084039
from collections import Counter
my_counter = Counter()
for word in project_data['clean_subcategories'].values:
    my_counter.update(word.split())
```

In [23]:
```
# dict sort by value python: https://stackoverflow.com/a/613218/4084039
sub_cat_dict = dict(my_counter)
sorted_sub_cat_dict = dict(sorted(sub_cat_dict.items(), key=lambda kv: kv[1]))


ind = np.arange(len(sorted_sub_cat_dict))
plt.figure(figsize=(20,5))
p1 = plt.bar(ind, list(sorted_sub_cat_dict.values()))

plt.ylabel('Projects')
plt.title('% of projects aproved state wise')
plt.xticks(ind, list(sorted_sub_cat_dict.keys()))
plt.show()
```

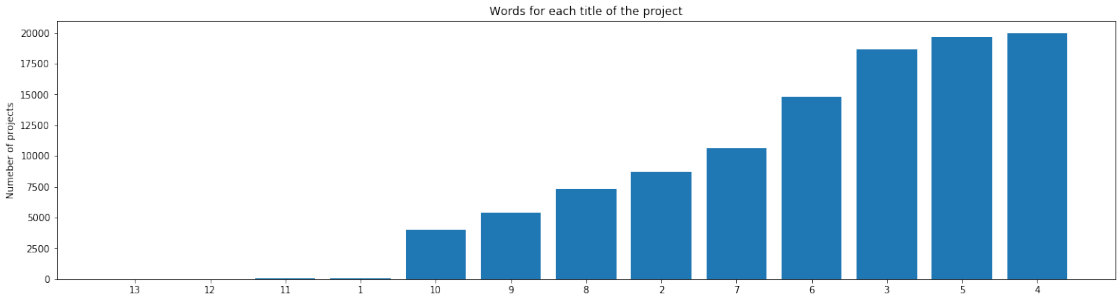



```
In [24]: for i, j in sorted_sub_cat_dict.items():
             print("{:20} :{:10}".format(i,j))
```

```
Economics            :       269
CommunityService     :       441
FinancialLiteracy    :       568
ParentInvolvement    :       677
Extracurricular      :       810
Civics_Government    :       815
ForeignLanguages     :       890
NutritionEducation   :      1355
Warmth               :      1388
Care_Hunger          :      1388
SocialSciences       :      1920
PerformingArts       :      1961
CharacterEducation   :      2065
TeamSports           :      2192
Other                :      2372
College_CareerPrep   :      2568
Music                :      3145
History_Geography    :      3171
Health_LifeScience   :      4235
EarlyDevelopment     :      4254
ESL                  :      4367
Gym_Fitness          :      4509
EnvironmentalScience :      5591
VisualArts           :      6278
Health_Wellness      :     10234
AppliedSciences      :     10816
SpecialNeeds         :     13642
Literature_Writing   :     22179
Mathematics          :     28074
Literacy             :     33700
```

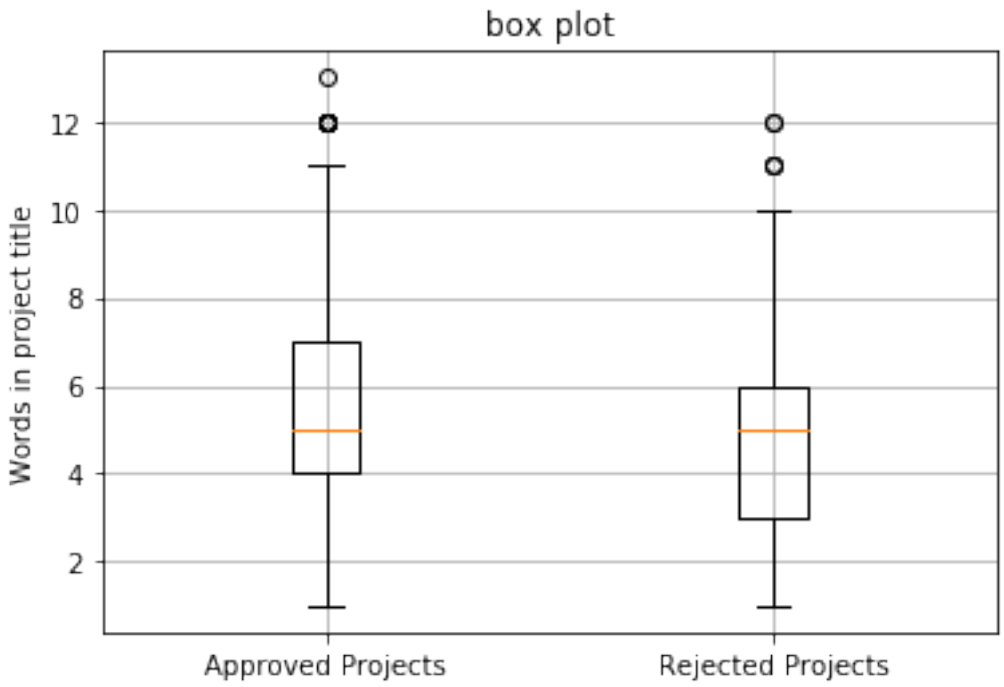
2.0.6 1.2.6 Univariate Analysis: Text features (Title)

In [25]:
```
#How to calculate number of words in a string in DataFrame: https://stackoverflow.com
word_count = project_data['project_title'].str.split().apply(len).value_counts()
word_dict = dict(word_count)
word_dict = dict(sorted(word_dict.items(), key=lambda kv: kv[1]))


ind = np.arange(len(word_dict))
plt.figure(figsize=(20,5))
p1 = plt.bar(ind, list(word_dict.values()))

plt.ylabel('Numeber of projects')
plt.title('Words for each title of the project')
plt.xticks(ind, list(word_dict.keys()))
plt.show()
```

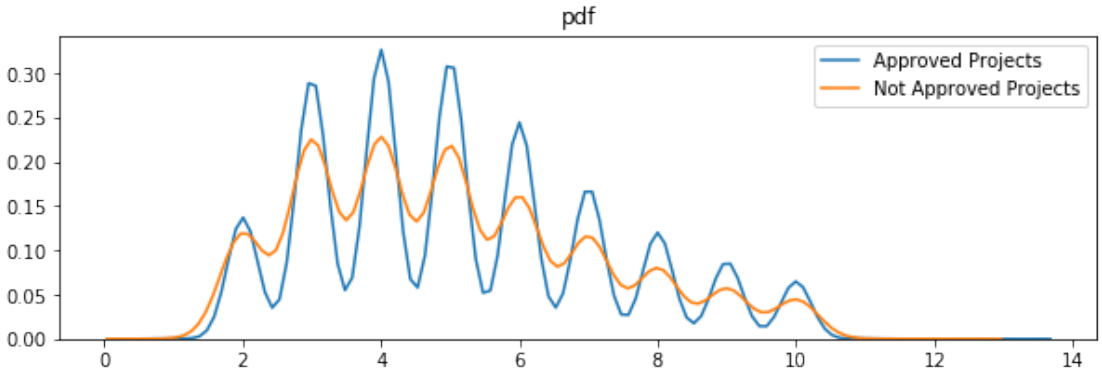


In [26]:
```
approved_word_count = project_data[project_data['project_is_approved']==1]['project_ti
approved_word_count = approved_word_count.values

rejected_word_count = project_data[project_data['project_is_approved']==0]['project_ti
rejected_word_count = rejected_word_count.values
```

In [27]:
```
# https://glowingpython.blogspot.com/2012/09/boxplot-with-matplotlib.html
plt.boxplot([approved_word_count, rejected_word_count])
plt.xticks([1,2],('Approved Projects','Rejected Projects'))
plt.ylabel('Words in project title')
plt.grid()
plt.title('box plot')
plt.show()
```



In [28]:
```
plt.figure(figsize=(10,3))
sns.distplot(approved_word_count, hist=False, label="Approved Projects")
sns.distplot(rejected_word_count, hist=False, label="Not Approved Projects")
plt.legend()
plt.title('pdf')
plt.show()
```

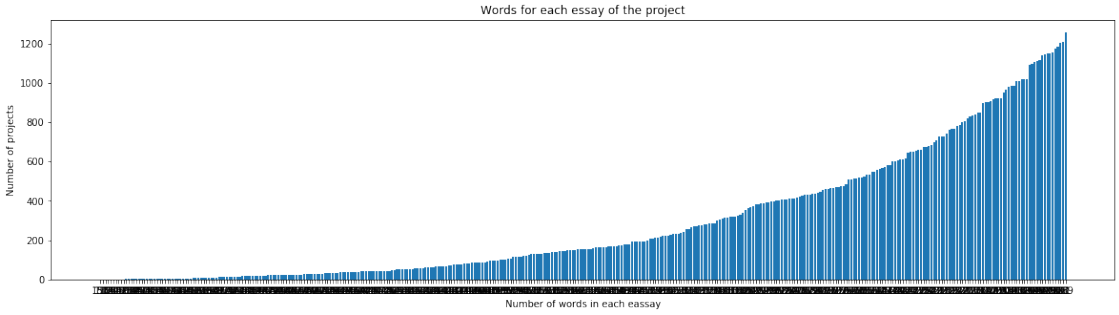


2.0.7 1.2.7 Univariate Analysis: Text features (Project Essay's)

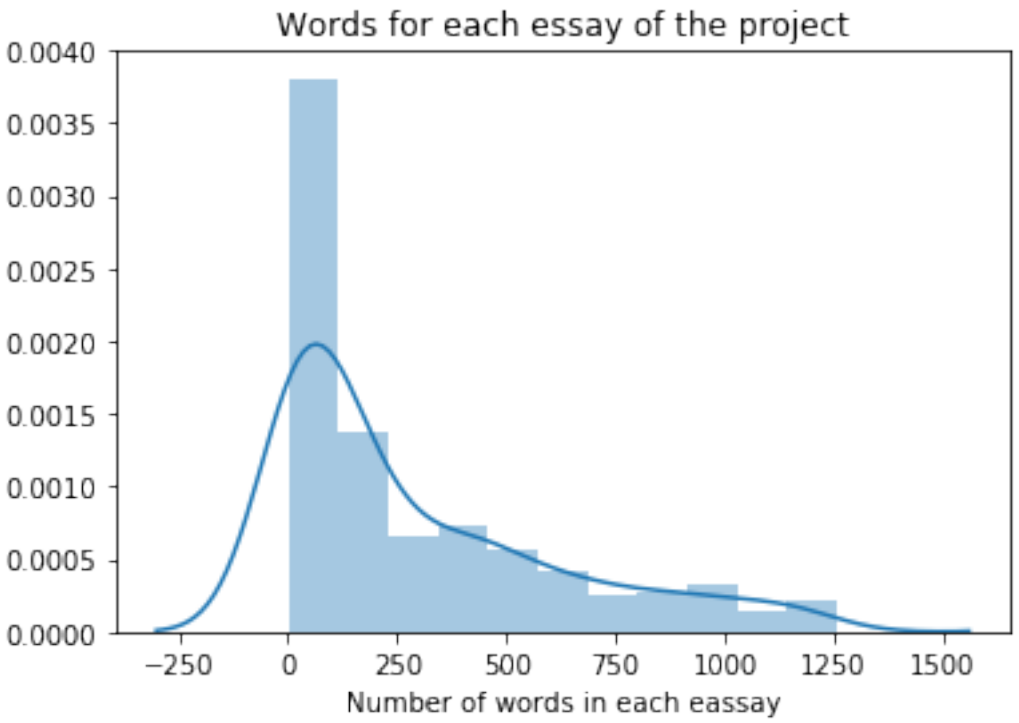
In [29]:
```
# merge two column text dataframe:
project_data["essay"] = project_data["project_essay_1"].map(str) +\
```

```
                                    project_data["project_essay_2"].map(str) + \
                                    project_data["project_essay_3"].map(str) + \
                                    project_data["project_essay_4"].map(str)
```

In [30]:
```
#How to calculate number of words in a string in DataFrame: https://stackoverflow.com
word_count = project_data['essay'].str.split().apply(len).value_counts()
word_dict = dict(word_count)
word_dict = dict(sorted(word_dict.items(), key=lambda kv: kv[1]))


ind = np.arange(len(word_dict))
plt.figure(figsize=(20,5))
p1 = plt.bar(ind, list(word_dict.values()))

plt.ylabel('Number of projects')
plt.xlabel('Number of words in each eassay')
plt.title('Words for each essay of the project')
plt.xticks(ind, list(word_dict.keys()))
plt.show()
```

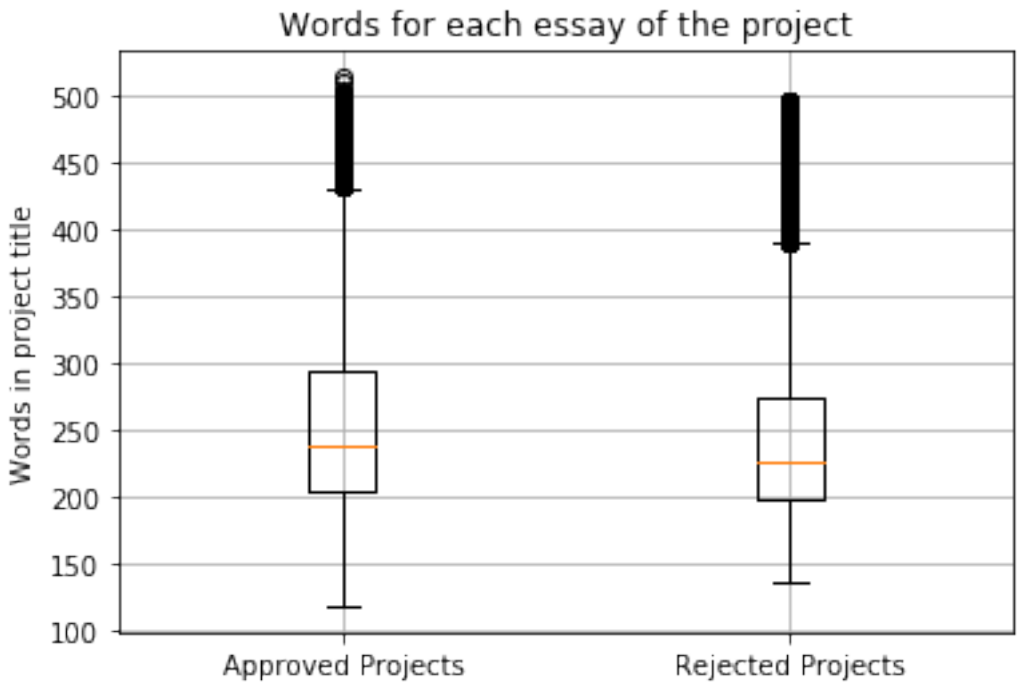


In [32]:
```
sns.distplot(word_count.values)
plt.title('Words for each essay of the project')
plt.xlabel('Number of words in each eassay')
plt.show()
```

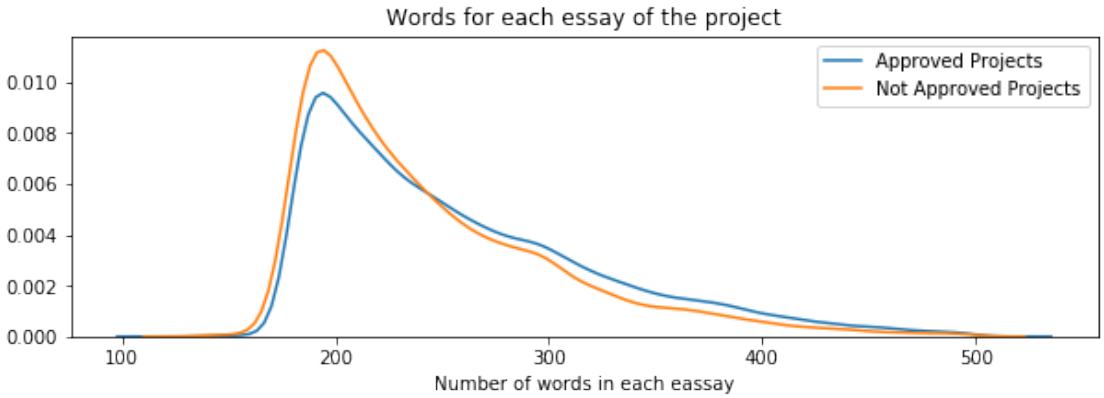


In [33]:
```
approved_word_count = project_data[project_data['project_is_approved']==1]['essay'].st
approved_word_count = approved_word_count.values

rejected_word_count = project_data[project_data['project_is_approved']==0]['essay'].st
rejected_word_count = rejected_word_count.values
```

In [34]:
```
# https://glowingpython.blogspot.com/2012/09/boxplot-with-matplotlib.html
plt.boxplot([approved_word_count, rejected_word_count])
plt.title('Words for each essay of the project')
plt.xticks([1,2],('Approved Projects','Rejected Projects'))
plt.ylabel('Words in project title')
plt.grid()
plt.show()
```




```
In [35]: plt.figure(figsize=(10,3))
         sns.distplot(approved_word_count, hist=False, label="Approved Projects")
         sns.distplot(rejected_word_count, hist=False, label="Not Approved Projects")
         plt.title('Words for each essay of the project')
         plt.xlabel('Number of words in each eassay')
         plt.legend()
         plt.show()
```



2.0.8 1.2.8 Univariate Analysis: Cost per project

In [36]:
```
# we get the cost of the project using resource.csv file
resource_data.head(2)
```

Out[36]:

	id	description	quantity	price
0	p233245	LC652 - Lakeshore Double-Space Mobile Drying Rack	1	149.00
1	p069063	Bouncy Bands for Desks (Blue support pipes)	3	14.95

In [37]:
```
# https://stackoverflow.com/questions/22407798/how-to-reset-a-dataframes-indexes-for-
price_data = resource_data.groupby('id').agg({'price':'sum', 'quantity':'sum'}).reset_
price_data.head(2)
```

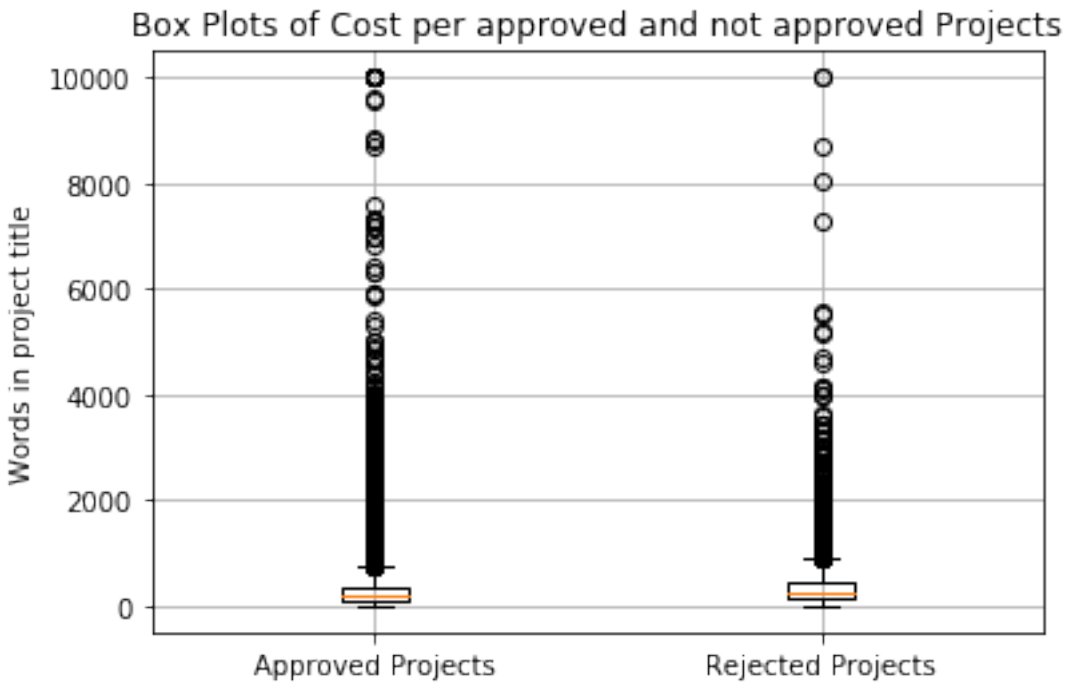
Out[37]:

	id	price	quantity
0	p000001	459.56	7
1	p000002	515.89	21

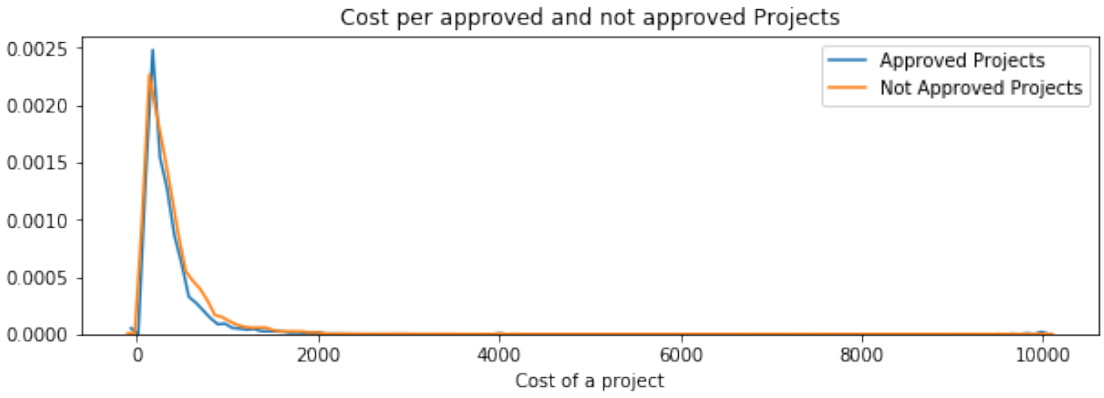
In [38]:
```
# join two dataframes in python:
project_data = pd.merge(project_data, price_data, on='id', how='left')
```

In [39]:
```
approved_price = project_data[project_data['project_is_approved']==1]['price'].values

rejected_price = project_data[project_data['project_is_approved']==0]['price'].values
```

In [40]:
```
# https://glowingpython.blogspot.com/2012/09/boxplot-with-matplotlib.html
plt.boxplot([approved_price, rejected_price])
plt.title('Box Plots of Cost per approved and not approved Projects')
plt.xticks([1,2],('Approved Projects','Rejected Projects'))
plt.ylabel('Words in project title')
plt.grid()
plt.show()
```




```
In [41]: plt.figure(figsize=(10,3))
         sns.distplot(approved_price, hist=False, label="Approved Projects")
         sns.distplot(rejected_price, hist=False, label="Not Approved Projects")
         plt.title('Cost per approved and not approved Projects')
         plt.xlabel('Cost of a project')
         plt.legend()
         plt.show()
```




```
In [42]: # http://zetcode.com/python/prettytable/
         from prettytable import PrettyTable
```

```
x = PrettyTable()
x.field_names = ["Percentile", "Approved Projects", "Not Approved Projects"]

for i in range(0,101,5):
    x.add_row([i,np.round(np.percentile(approved_price,i), 3), np.round(np.percentile
print(x)
```

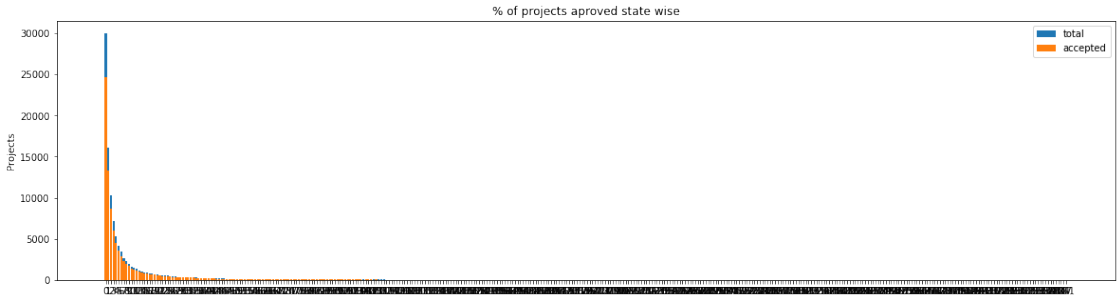
```
+------------+-------------------+-----------------------+
| Percentile | Approved Projects | Not Approved Projects |
+------------+-------------------+-----------------------+
|     0      |        0.66       |          1.97         |
|     5      |       13.59       |          41.9         |
|     10     |       33.88       |         73.67         |
|     15     |        58.0       |         99.109        |
|     20     |       77.38       |         118.56        |
|     25     |       99.95       |        140.892        |
|     30     |       116.68      |         162.23        |
|     35     |      137.232      |        184.014        |
|     40     |       157.0       |        208.632        |
|     45     |      178.265      |        235.106        |
|     50     |       198.99      |        263.145        |
|     55     |       223.99      |         292.61        |
|     60     |       255.63      |        325.144        |
|     65     |      285.412      |         362.39        |
|     70     |      321.225      |         399.99        |
|     75     |      366.075      |        449.945        |
|     80     |       411.67      |        519.282        |
|     85     |       479.0       |        618.276        |
|     90     |       593.11      |        739.356        |
|     95     |      801.598      |        992.486        |
|    100     |       9999.0      |         9999.0        |
+------------+-------------------+-----------------------+
```

1.2.9 Univariate Analysis: teacher_number_of_previously_posted_projects

```
In [43]: project_data['teacher_number_of_previously_posted_projects'].isnull().any()
```

```
Out[43]: False
```

```
In [44]: univariate_barplots(project_data,'teacher_number_of_previously_posted_projects', 'pro
```




```
   teacher_number_of_previously_posted_projects  project_is_approved  total  \
0                                             0                24652  30014
1                                             1                13329  16058
2                                             2                 8705  10350
3                                             3                 5997   7110
4                                             4                 4452   5266

        Avg
0  0.821350
1  0.830054
2  0.841063
3  0.843460
4  0.845423
==================================================
     teacher_number_of_previously_posted_projects  project_is_approved  total  \
242                                           242                   1      1
268                                           270                   1      1
234                                           234                   1      1
335                                           347                   1      1
373                                           451                   1      1

     Avg
242  1.0
268  1.0
234  1.0
335  1.0
373  1.0
```

- One thing we can observe from these results is that the teachers who never posted any project earlier are the most to send the projects with average of 82% approval rate.
- maximum number of projects submitted by a teacher earlier is 451.

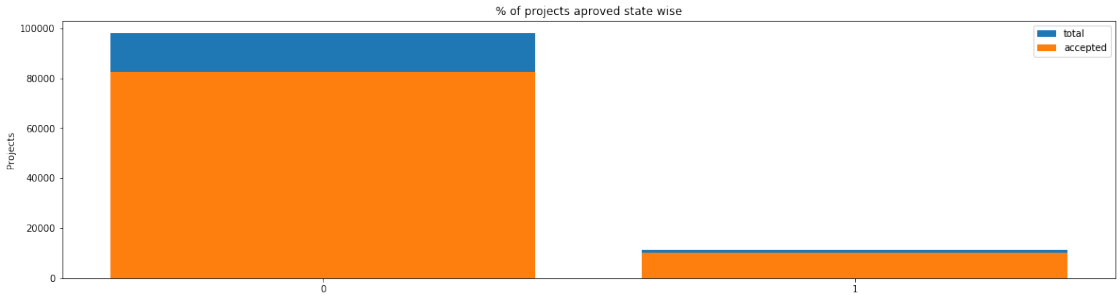
1.2.10 Univariate Analysis: project_resource_summary

```
In [45]: project_summary_lst = list(project_data['project_resource_summary'])
```

```
In [46]: len(project_summary_lst)

Out[46]: 109248

In [47]: print(project_summary_lst[1002])

My students need a new low table, pillows, and bean bags to have a variety of seating in the cl


In [48]: def is_number_present(lst) :
             """
             this function tells if a number is present in text
             if number is present then 1
             if number is not present then 0
             """
             for txt in lst :
                 count = 0
                 for word in txt.split() :
                     if not word.isdigit():
                         continue
                     elif word.split() :
                         count += 1
                 if(count > 0) :
                     is_digit_present.append(1)
                 else :
                     is_digit_present.append(0)

In [49]: is_digit_present = []
         is_number_present(project_summary_lst)

In [50]: len(is_digit_present)

Out[50]: 109248

In [51]: project_data['is_digit_present'] = is_digit_present

In [52]: project_data.head(2)

Out[52]:    Unnamed: 0       id                         teacher_id teacher_prefix  \
         0      160221  p253737  c90749f5d961ff158d4b4d1e7dc665fc           Mrs.
         1      140945  p258326  897464ce9ddc600bced1151f324dd63a            Mr.

           school_state project_submitted_datetime project_grade_category  \
         0           IN        2016-12-05 13:43:57          Grades PreK-2
         1           FL        2016-10-25 09:22:10             Grades 6-8

                                              project_title  \
         0  Educational Support for English Learners at Home
         1             Wanted: Projector for Hungry Learners
```

```
                                    project_essay_1  \
0  My students are English learners that are work...
1  Our students arrive to our school eager to lea...

                                    project_essay_2        ...         \
0  \"The limits of your language are the limits o...        ...
1  The projector we need for our school is very c...        ...

  project_essay_4                         project_resource_summary  \
0             NaN  My students need opportunities to practice beg...
1             NaN  My students need a projector to help with view...

  teacher_number_of_previously_posted_projects  project_is_approved  \
0                                            0                    0
1                                            7                    1

              clean_categories           clean_subcategories  \
0            Literacy_Language                   ESL Literacy
1  History_Civics Health_Sports  Civics_Government TeamSports

                                               essay  price  quantity  \
0  My students are English learners that are work...  154.6        23
1  Our students arrive to our school eager to lea...  299.0         1

   is_digit_present
0                 0
1                 0

[2 rows x 21 columns]
```

In [53]:
```
univariate_barplots(project_data, 'is_digit_present', 'project_is_approved', False)
```




```
   is_digit_present  project_is_approved  total       Avg
0                 0                82562  98011  0.842375
1                 1                10144  11237  0.902732
```

```
================================================
   is_digit_present  project_is_approved  total       Avg
0                 0                82562  98011  0.842375
1                 1                10144  11237  0.902732
```

From this data we can observe two things

First of all we have huge number of projects which do not contain any number in the project summary(i.e class 0)

and the chances of approval for class 0 projects is 84%

But one interesting thing is that if you put number inside the project summary then chancs of your project to be approved is 90%

2.0.9 Putting this dataframe to new csv file as we have adden few new columns in it.

```
In [59]: new_train_csv = project_data.to_csv ('new_train.csv', index = None, header=True) #Don
```