

Problem 1

In his Paper, Shannon talks about the increase in interest in general theory of communication. He describes the main problem of communication as reproducing a message at a particular point. To solve this problem, he suggests using a logarithmic measure since it is more useful, near our intuitive feelings as a proper measurement, and mathematically more suitable. In part 1, Shannon talks about discrete channels for transmitting information, specifically teletype and telegraphy. Under general conditions, the log of the number of signals in a discrete channel increases linearly with time. He goes on to describe discrete Markoff processes, giving an example of ordered approximation to English. He found that a complex enough stochastic process will produce a reasonable representation of a discrete source. Shannon also talks about entropy and redundancy, and how in English, redundancy is about 50%. Consequently, half of English writing is determined by the structure of English and the other half is chosen by the writer. He also mentions how encoding requires long delays in the transmitter and receivers and the relationship with entropy.

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In [32]: #Problem 2
#pdf scraping
#many libraries work, but some leave out the spacing
#TA suggested to use "slate" PDF miner for python https://github.com/timClick
s/slate
#urllib to open up the webpage, BeautifulSoup to parse webpage and download pdfs

#Code to Download all pdfs(no need to run)
import requests
import urllib.request
from bs4 import BeautifulSoup as bs
import os

_URL = 'http://proceedings.mlr.press/v70/'

r = requests.get(_URL)
soup = bs(r.text)
urls = []
names = []
for i, link in enumerate(soup.findAll('a')):
    _FULLURL = link.get('href')
    if _FULLURL.endswith('.pdf'):
        url,name = os.path.split(_FULLURL)
        urls.append(url + "/" + name)
        names.append(name)

names_urls = zip(names, urls)

for name, url in names_urls:
    url.encode('ascii', 'ignore')
    print(url)
    #urlretrieve(url, "pdfs/" + name)
    opener = urllib.request.FancyURLopener({})
    try:
        f = opener.open(url)
    except UnicodeError:
        continue
    pdf = open("pdfs/" + name, 'wb')
    pdf.write(f.read())
    pdf.close()

```

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<http://proceedings.mlr.press/v70/achab17a/achab17a-suppl.pdf>
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In [43]: *#Problem 2*
#pdfs already imported from code above

```

In [123]: #Problem 2
#pdfs already imported from code above
import warnings
warnings.filterwarnings('ignore')

#Reading all the pdfs
import slate
import os
import logging
import numpy as np
logging.getLogger('pdfminer').setLevel(logging.ERROR);

allText = ''
for filename in os.listdir("pdfs/"):
    with open("pdfs/" + filename, 'rb') as fp:
#pdfs10 is a directory with first 10 downloaded pdfs alphabetically, more viable runtime than all pdfs
#for filename in os.listdir("pdfs10/"):
    # with open("pdfs10/" + filename, 'rb') as fp:
        doc = slate.PDF(fp)
        for i in range(len(doc)):
            allText +=doc[i]
words = allText.split(" ")
words = [word.rstrip() for word in words]

wordSet = set(words)
wordCounts = {}
for word in wordSet:
    wordCounts[word] = 0
    for w in words:
        if w == word:
            wordCounts[word] += 1
allCount = len(words)

wordProbs = {}
for word in wordCounts:
    wordProbs[word] = wordCounts[word] / float(allCount)

#Part 1
print("Part 1")

top10Words = []
temp = [word for word in wordSet]
for i in range(10):
    topCount = 0
    topWord = ""

    for word in temp:
        if wordCounts[word] > topCount:
            topWord = word
            topCount = wordCounts[word]
    temp.remove(topWord)
    top10Words.append(topWord)
print("The 10 most popular words found: ", top10Words)

```



```

print("\n")

#Part 2
print("Part 2")

entropy = sum([-wordProbs[word] * np.math.log(wordProbs[word],2) for word in list(wordSet)])
print("Entropy: ",entropy)

print("\n")

#Part 3
print("Part 3")

weights = [wordProbs[word] for word in wordSet]
paragraphLength = np.random.randint(60,120)
paragraph = ""
for i in range(paragraphLength):
    if i != 0:
        paragraph += " "
    paragraph += np.random.choice(list(wordSet),p=weights)
print("Probabilistically generated paragraph: \n", paragraph)

print("\n")

#Part 4
print("Part 4")
print("Extra credit, not done")

```

Part 1

The 10 most popular words found: ['the', 'of', 'and', 'to', 'a', 'is', 'in', '=', 'that', 'on']

Part 2

Entropy: 9.948765445656361

Part 3

Probabilistically generated paragraph:

(cid:48))

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Part 4

Extra credit, not done

```

In [99]: #Problem 3
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib

import matplotlib.pyplot as plt
from scipy.stats import skew
from scipy.stats.stats import pearsonr
%matplotlib inline

train = pd.read_csv("train.csv")
test = pd.read_csv("test.csv")

display(train.head())

#Data Preprocessing(from Kaggle)
#Take all features, excluding the label
all_data = pd.concat((train.loc[:, 'MSSubClass': 'SaleCondition'],
                      test.loc[:, 'MSSubClass': 'SaleCondition']))

#Visual before/after Log transform
matplotlib.rcParams['figure.figsize'] = (12.0, 6.0)
prices = pd.DataFrame({"price":train["SalePrice"], "log(price + 1)":np.log1p(t
rain["SalePrice"])}))
prices.hist()
plt.show()

#Log transform the target:
train["SalePrice"] = np.log1p(train["SalePrice"])

#Log transform skewed numeric features:
numeric_feats = all_data.dtypes[all_data.dtypes != "object"].index

skewed_feats = train[numeric_feats].apply(lambda x: skew(x.dropna())) #compute
skewness
skewed_feats = skewed_feats[skewed_feats > 0.75]
skewed_feats = skewed_feats.index

all_data[skewed_feats] = np.log1p(all_data[skewed_feats])

all_data = pd.get_dummies(all_data)

#filling NA's with the mean of the column:
all_data = all_data.fillna(all_data.mean())

#creating matrices for sklearn:
X_train = all_data[:train.shape[0]]
X_test = all_data[train.shape[0]:]
y = train.SalePrice

from sklearn.linear_model import Ridge
from sklearn.metrics import mean_squared_error
from sklearn.model_selection import cross_val_score

model_ridge = Ridge(alpha=0.1) #Alpha is the hyperparameter for the amount of

```

regularization

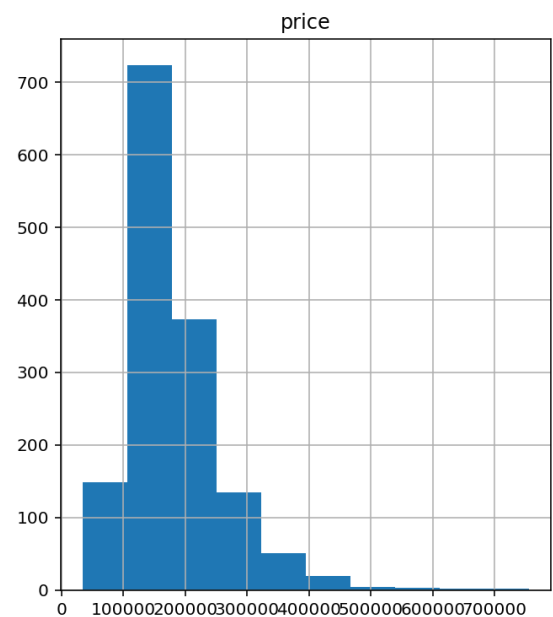
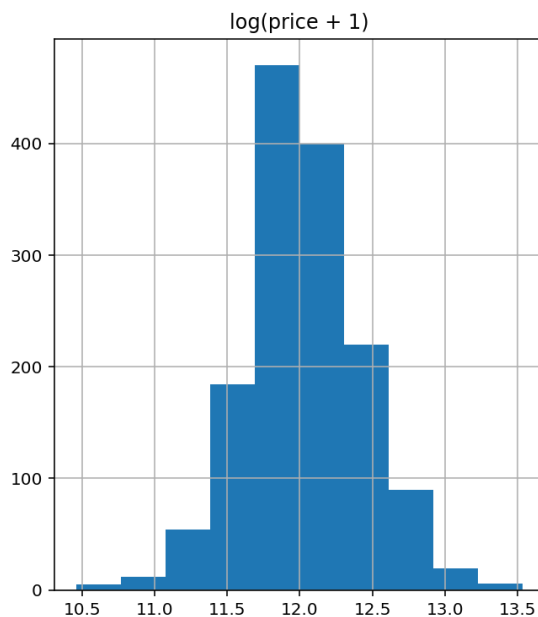
```
model_ridge.fit(X_train, y) #Train
yhat= model_ridge.predict(X_test) #Run model on test set

#Make submission
#yhat_pred = np.expm1(yhat)
#submission = pd.DataFrame({"Id": test["Id"], "SalePrice": yhat_pred})
#submission.loc[submission['SalePrice'] <= 0, 'SalePrice'] = 0
#fileName = "submission.csv"
#submission.to_csv(fileName, index=False)

print("Score on Kaggle Submission was a RMSE of 0.13029")
```

	Id	MSSubClass	MSZoning	LotFrontage	LotArea	Street	Alley	LotShape	LandCont
0	1	60	RL	65.0	8450	Pave	NaN	Reg	Lvl
1	2	20	RL	80.0	9600	Pave	NaN	Reg	Lvl
2	3	60	RL	68.0	11250	Pave	NaN	IR1	Lvl
3	4	70	RL	60.0	9550	Pave	NaN	IR1	Lvl
4	5	60	RL	84.0	14260	Pave	NaN	IR1	Lvl

5 rows × 81 columns



Score on Kaggle Submission was a RMSE of 0.13029

```

In [100]: def rmse_cv(model):
            rmse= np.sqrt(-cross_val_score(model, X_train, y, scoring="neg_mean_square
            d_error", cv = 5))
            return(rmse)

model_ridge = Ridge()
alphas = [0.05, 0.1, 0.3, 1, 3, 5, 10, 15, 30, 50, 75]
cv_ridge = [rmse_cv(Ridge(alpha = alpha)).mean()
            for alpha in alphas]
cv_ridge = pd.Series(cv_ridge, index = alphas)

print("Ridge best RMSE after CV:", cv_ridge.min())

from sklearn.linear_model import Lasso

model_lasso = LassoCV(alphas = [1, 0.1, 0.001, 0.0005]).fit(X_train, y)
alphas = [0.05, 0.1, 0.3, 1, 3, 5, 10, 15, 30, 50, 75]
print("Lasso best RMSE after CV:", rmse_cv(model_lasso).mean())
print("Lasso performs better than Ridge")

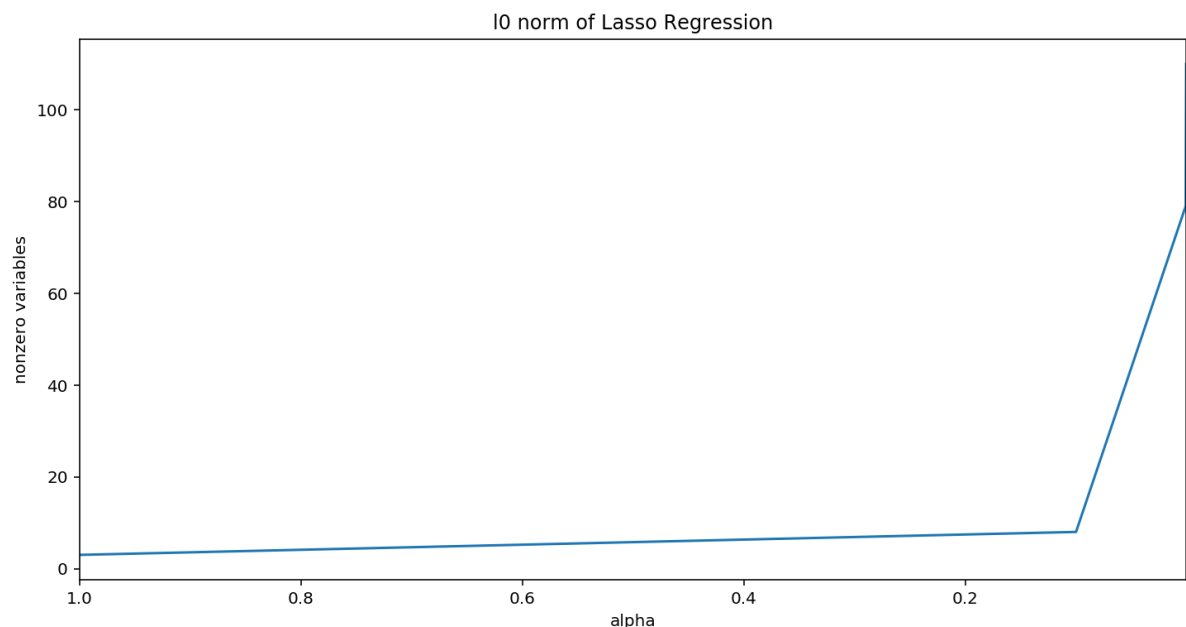
alphas = [1, 0.1, 0.001, 0.0005]
cv_lasso = [sum(Lasso(alpha = alpha).fit(X_train, y).coef_ != 0)
            for alpha in alphas]
cv_lasso = pd.Series(cv_lasso, index = alphas)
cv_lasso.plot(title = "l0 norm of Lasso Regression")
plt.xlabel("alpha")
plt.ylabel("nonzero variables")
plt.show()

```

Ridge best RMSE after CV: 0.127337346687

Lasso best RMSE after CV: 0.12314421091

Lasso performs better than Ridge



```
In [101]: model_ridge = Ridge(10)
model_ridge.fit(X_train,y)
model_lasso = Lasso(.0005)
model_lasso.fit(X_train,y)

ridge = model_ridge.predict(X_train).reshape(-1, 1)
lasso = model_lasso.predict(X_train).reshape(-1, 1)

X_train2 = np.append(X_train,ridge,axis=1)
X_train2 = np.append(X_train2,lasso,axis=1)

model_ridge.fit(X_train2,y)
print("RMSE Score with Ensembling and Stacking Ridge Regression:", rmse_cv(model_ridge).mean())
```

RMSE Score with Ensembling and Stacking Ridge Regression: 0.127337346687

```
In [121]: import xgboost as xgb

dtrain = xgb.DMatrix(X_train, label = y)
dtest = xgb.DMatrix(X_test)

#Params gotten from Kaggle tutorial
params = {"max_depth":2, "eta":0.1, "silent":1}
model = xgb.cv(params, dtrain, num_boost_round=500, early_stopping_rounds=100)
model_xgb = xgb.XGBRegressor(n_estimators=360, max_depth=2, learning_rate=0.1)

model_xgb.fit(X_train, y)

xgb_preds = np.expml(model_xgb.predict(X_test))

#print(rmse_cv(model_xgb).mean())

#Make submission
xgb_predse = np.expml(xgb_preds)
submission = pd.DataFrame({"Id": test["Id"], "SalePrice": xgb_preds})
submission.loc[submission['SalePrice'] <= 0, 'SalePrice'] = 0
fileName = "submission.csv"
submission.to_csv(fileName, index=False)

print("XGBoost with the parameters given by the tutorial gave a score of 0.13426, actually worse than Ridge or Lasso. This",
      "\n can be improved by optimizing the parameters further.")
```

XGBoost with the parameters given by the tutorial gave a score of 0.13426, actually worse than Ridge or Lasso. This can be improved by optimizing the parameters further.