Appendix A1 - R CODES

Anova

```
one.way <- aov(PM2.5 ~ PM10, data = data)
```

Bernoulli Distribution

```
library(Rlab)
x_dbern <- seq(0, 10, by = 1)
```

Binomial Distribution

```
y <- dbinom(x,50,0.5)
```

Boxplot

```
boxplot(pm2_5)
```

Chi Square

```
chisq <- chisq.test(pm2_52)
```

Cohen's d

```
library(effsize)
cohen.d(pm2_52,f = NA)
```

Correlation

```
data = read.csv(file="C:/Users/GL62M/Desktop/b3.csv")
cormat <- round(cor(data),2)
cormat
```

Count

```
length(pm2_5)
```

Cumulative Frequency

```
breaks = seq(1.5, 5.5, by=0.5)
duration.cut = cut(pm2_5, breaks, right=FALSE)
duration.freq = table(duration.cut)
```

Geometric Mean

```
gm_mean = function(x, na.rm=TRUE, zero.propagate = FALSE){
  if(any(x < 0, na.rm = TRUE)){
    return(NaN)
  }
  if(zero.propagate){
    if(any(x == 0, na.rm = TRUE)){
      return(0)
    }
    exp(mean(log(x), navar(duration) .rm = na.rm))
  } else {
    exp(sum(log(x[x > 0]), na.rm=na.rm) / length(x))
  }
}

gm_mean(pm2_5, na.rm = TRUE, zero.propagate = FALSE)
```

Histogram

```
hist(pm2_5,xlab = "Weight",col = "yellow",border = "blue")
```

Harmonic Mean

```
1/result.mean
```

InterQuartile Range

```
IQR(pm2_5, na.rm = TRUE, type = 7)
```

Linear Regression

```
fit <- lm(PM2.5 ~ PM10 + NO2 + SO2, data=data)
```

Loading Data

```
dat = read.csv(file="C:/Users/GL62M/Desktop/deep learning course/Week 3 ICTE Footprinting Tools/b3.csv")
pm2_5 = mat[, 6]
pm2_5 <- as.numeric(pm2_5)
```

Mean

```
result.mean <-  mean(pm2_5,na.rm = TRUE)
```

Median

```
median(pm2_5, na.rm = TRUE)
```

Mode

```
Mode <- function(x) {
  ux <- na.omit(unique(x) )
  tab <- tabulate(match(x, ux)); ux[tab == max(tab) ]
}


Mode(pm2_5)
```

Normal Distribution

```
norm <- rnorm(100)
```

Percentile

```
p = quantile(pm2_5, na.rm = TRUE, probs = c(0.125,0.375,0.625,0.875))
```

Poisson Distribution

```
pois <- rpois(100, lambda = 3)
```

Quantile

```
quantile(pm2_5, na.rm = TRUE, probs = c(0.25,0.50,0.75))
```

Range

```
range(pm2_5, na.rm = TRUE)
```

2D Scatter Plot

```
pm10 = mat[, 7]
pm10 <- as.numeric(pm10)
plot(pm2_5, pm10, main="Scatterplot Example",
   xlab="PM2_5", ylab="PM10 ", pch=19)
```

3D Scatter Plot

```
library("scatterplot3d")
scatterplot3d(pm2_5, y=pm10, z=NO2)
```

Skew

```
skewness(pm2_5, na.rm=TRUE)
```

Standard Deviation

```
sd(pm2_5, na.rm=TRUE)
```

Summary

```
summary(pm2_5)
```

T Test

```
t.test(pm2_5,pm10)
```

Variance

```
var(pm2_5, na.rm=TRUE)
```

Wilcox Rank

```
res <- wilcox.test(pm2_52, pm2_5)
```

Wilcox Sum

```
wilcox.test(pm2_52, pm2_52, alternative = "two.sided")
```

Weighted Mean

```
year = mat[, 2]
year <- as.numeric(year)
weighted.mean(pm2_5,year, na.rm = TRUE)
```

Appendix A2 - Python CODES

Anova

```
stats.f_oneway(df['PM2.5'],df['PM10'],df['NO2’])
```

Bernoulli Distribution

```
# import bernoulli
from scipy.stats import bernoulli
# generate bernoulli
data_bern = bernoulli.rvs(size=10,p=0.1)
```

Binomial Distribution

```
from scipy.stats import binom
data_binom = binom.rvs(n=10,p=0.5,size=50)
```

Boxplot

```
plt.boxplot(df['PM2.5'])
```

Chi Square

```
from scipy.stats import chisquare
chisquare(df['PM2.5'])
```

Cohen’s d

```
# calculate the Cohen's d between two samples
from numpy.random import randn
from numpy.random import seed
from numpy import mean
from numpy import var
from math import sqrt
import pandas as pd
```

```
# function to calculate Cohen's d for independent samples
def cohend(d1, d2):
	# calculate the size of samples
	n1, n2 = len(d1), len(d2)
	# calculate the variance of the samples
	s1, s2 = var(d1, ddof=1), var(d2, ddof=1)
	# calculate the pooled standard deviation
	s = sqrt(((n1 - 1) * s1 + (n2 - 1) * s2) / (n1 + n2 - 2))
	# calculate the means of the samples
	u1, u2 = mean(d1), mean(d2)
	# calculate the effect size
	return (u1 - u2) / s

df = pd.read_csv('b3.csv')
d = cohend(df['PM2.5'], df['PM10'])
print('Cohens d: %.3f' % d)
```

Correlation

```
cov_xy = df['PM2.5'].cov(df['PM10'])
```

Count

```
df.count
```

Cumulative Frequency

```
res = stats.cumfreq(df['PM2.5'], numbins=4)
```

Geometric Mean

```
import scipy.stats
scipy.stats.gmean(df['PM2.5'])
```

Histogram

```
import matplotlib.pyplot as plt
```

```
plt.hist(df['PM2.5'])
```

Harmonic Mean

```
 import statistics
statistics.harmonic_mean(df['PM2.5'])
```

InterQuartile Range

```
stats.iqr(df['PM2.5'])
```

Linear Regression

```
scipy.stats.linregress(df['PM2.5'],df['PM10'])
```

Loading Data

```
df = pd.read_csv('b3 (2).csv')
```

Mean

```
df.mean()
```

Median

```
statistics.median(df['PM2.5'])
```

Mode

```
statistics.mode(df['PM2.5'])
```

Normal Distribution

```
from scipy.stats import norm
# generate random numbersfrom N(0,1)
data_normal = norm.rvs(size=100,loc=0,scale=1)
```

Percentile

```
np.percentile(df['PM2.5'], 5)
```

Poisson Distribution

```
from scipy.stats import poisson
data_poisson = poisson.rvs(mu=3, size=100)
```

Quantile

```
q =df['PM2.5'].quantile([.1, .25, .5, .75])
```

Range

```
df['PM2.5'].max() - df['PM2.5'].min()
```

2D Scatter Plot

```
plt.scatter(df['PM2.5'], df['PM10'])
```

3D Scatter Plot

```
from mpl_toolkits.mplot3d import Axes3D
ax = fig.add_subplot(111, projection='3d')
ax.scatter(df['PM2.5'], df['PM10'], df['NO2'], c='r', marker='o')
plt.show()
```

Skew

```
import scipy.stats
scipy.stats.skew(df['PM2.5'], bias=False)
```

Standard Deviation

```
statistics.stdev(df['PM2.5'])
```

Summary

```
df.describe()
```

T Test

```
stats.ttest_ind(df['PM2.5'],df['PM10'])
```

Variance

```
statistics.variance(df['PM2.5'])
```

Wilcox Rank

```
from scipy.stats import wilcoxon
w, p = wilcoxon(df['PM2.5'])
```

Wilcox Sum

```
from scipy.stats import ranksums
ranksums(df['PM2.5'],df['PM10'])
```

Weighted Mean

```
w = np.average(df['PM2.5'], weights=df['year'])
```

Appendix A3 - MATLAB CODES

Anova

```
ano = Z{:,2:12}
[p,tbl,stats] = anova1(ano)
```

Bernoulli Distribution

```
p = 0.75;
x = 0:1;
y = binopdf(0:1,1,p);
```

Binomial Distribution

```
x = 0:50;
y = binopdf(x,10,0.5);
```

Boxplot

```
[p,tbl,stats] = anova1(ano)
```

Chi Square

```
h = chi2gof(PM2_5)
```

Cohen's d

```
function d = computeCohen_d(x1, x2, varargin)
%
% call: d = computeCohen_d(x1, x2, varargin)
%
% EFFECT SIZE of the difference between the two
% means of two samples, x1 and x2 (that are vectors),
% computed as "Cohen's d".
%
```

```
% If x1 and x2 can be either two independent or paired
% samples, and should be treated accordingly:
%
%   d = computeCohen_d(x1, x2, 'independent');  [default]
%   d = computeCohen_d(x1, x2, 'paired');
%
% Note: according to Cohen and Sawilowsky:
%
%      d = 0.01  --> very small effect size
%      d = 0.20  --> small effect size
%      d = 0.50  --> medium effect size
%      d = 0.80  --> large effect size
%      d = 1.20  --> very large effect size
%      d = 2.00  --> huge effect size
%
%
% Ruggero G. Bettinardi (RGB)
% Cellular & System Neurobiology, CRG
% -------------------------------------------------------------------------------------
%
% Code History:
%
% 25 Jan 2017, RGB: Function is created

if nargin < 3, testType = 'independent';
else           testType = varargin{1};
end

% basic quantities:
n1       = numel(x1);
n2       = numel(x2);
mean_x1  = nanmean(x1);
mean_x2  = nanmean(x2);
var_x1   = nanvar(x1);
var_x2   = nanvar(x2);
```

```
meanDiff = (mean_x1 - mean_x2);

% select type of test:
isIndependent = strcmp(testType, 'independent');
isPaired      = strcmp(testType, 'paired');

% compute 'd' accordingly:
if isIndependent

   sv1      = ((n1-1)*var_x1);
   sv2      = ((n2-1)*var_x2);
   numer    =  sv1 + sv2;
   denom    = (n1 + n2 - 2);
   pooledSD =  sqrt(numer / denom); % pooled Standard Deviation
   s        = pooledSD;             % re-name
   d        =  meanDiff / s;        % Cohen's d (for independent samples)

elseif isPaired

   haveNotSameLength = ~isequal( numel(x1), numel(x2) );
   if haveNotSameLength, error('In a paired test, x1 and x2 have to be of
same length!'), end

   deltas   = x1 - x2;         % differences
   sdDeltas = nanstd(deltas);  % standard deviation of the diffferences
   s        = sdDeltas;        % re-name
   d        =  meanDiff / s;   % Cohen's d (paired version)

end


computeCohen_d(PM2_5, PM2_5)
```

Correlation

```
corrcoef(ano)
```

Count

```
length(PM2_5)
```

Cumulative Frequency

```
A = cumsum(PM2_5)
```

Geometric Mean

```
G =geomean(PM2_5)
```

Histogram

```
h = histogram(PM2_5,25)
```

Harmonic Mean

```
H = harmmean(PM2_5)
```

InterQuartile Range

```
iqr(PM2_5)
```

Linear Regression

```
y1 = Z{:,4}
PM10 = Z{:,3}
y2 = Z{:,5}
mdl = fitlm(PM10+y1+y2,PM2_5)
```

Loading Data

```
 Z = readtable('b3 (2).csv')
 PM2_5 = Z{:,2}
```

Mean

```
M =mean(PM2_5)
```

Median

```
Med = median(PM2_5)
```

Mode

```
Mod = mode(PM2_5)
```

Normal Distribution

```
r = normrnd(3,10,[1,5])
```

Percentile

```
prctile(PM2_5,42)
```

Poisson Distribution

```
lambda = 10:2:20
r = poissrnd(lambda)
```

Quantile

```
y = quantile(PM2_5,[0.025 0.25 0.50 0.75 0.975])
```

Range

```
range(PM2_5)
```

2D Scatter Plot

```
 scatter(PM2_5,PM10)
```

3D Scatter Plot

```
scatter3(PM2_5,PM10,y1)
```

Skew

```
skewness(PM2_5)
```

Standard Deviation

```
stddev =std(PM2_5)
```

Summary

```
su1= summary(Z)
```

T Test

```
ttest(PM2_5,PM10)
```

Variance

```
vari = var(PM2_5)
```

Wilcox Rank

```
si = signrank(PM2_5,PM10)
```

Wilcox Sum

```
 su= ranksum(PM2_5,PM10)
```

Weighted Mean

```
function y = wmean(x,w,dim)
%WMEAN   Weighted Average or mean value.
%   For vectors, WMEAN(X,W) is the weighted mean value of the elements in X
%   using non-negative weights W. For matrices, WMEAN(X,W) is a row vector
%   containing the weighted mean value of each column.  For N-D arrays,
%   WMEAN(X,W) is the weighted mean value of the elements along the first
%   non-singleton dimension of X.
%
%   Each element of X requires a corresponding weight, and hence the size
%   of W must match that of X.
%
```

```
%   WMEAN(X,W,DIM) takes the weighted mean along the dimension DIM
of X.
%
%   Class support for inputs X and W:
%      float: double, single
%
%   Example:
%       x = rand(5,2);
%       w = rand(5,2);
%       wmean(x,w)

if nargin<2
   error('Not enough input arguments.');
end

% Check that dimensions of X match those of W.
if(~isequal(size(x), size(w)))
   error('Inputs x and w must be the same size.');
end

% Check that all of W are non-negative.
if (any(w(:)<0))
   error('All weights, W, must be non-negative.');
end

% Check that there is at least one non-zero weight.
if (all(w(:)==0))
   error('At least one weight must be non-zero.');
end

if nargin==2,
  % Determine which dimension SUM will use
  dim = min(find(size(x)~=1));
  if isempty(dim), dim = 1; end
end
```

```
y = sum(w.*x,dim)./sum(w,dim);
```

```
wmean(PM2_5,10)
```

Appendix B - Overall Joulemeter

To find the .csv files for overall joulemeter browse to the folder attached named overall Joulemeter. Listed alphabetically are the files for the overall joulemeter analysis in the sheet named **Overall Analysis** for each of the 33 experiments.
For the individual results of each of the languages for each of the experiments, check folder R Joule Data, Python Joule Data and Matlab Joule Data - where the results of the 33 experiments are recorded. Each file has 10 sheets which represents the results of the number of times the experiments were performed.

Appendix C - Overall Carbon Footprint

To find the .csv files for overall carbon footprint browse to the folder attached named overall Joulemeter. Listed alphabetically are the files for the overall carbon footprint analysis in the sheet named **Sheet 1** for each of the 33 experiments.

Appendix D - Overall Power Gadget

To find the .csv files for the overall power gadget browse to the folder attached named overall power gadget. Listed alphabetically are the files for the overall power gadget analysis in the sheet named **Sheet 1** for each of the 33 experiments.
For the individual results of each of the languages for each of the experiments, check folder R Power Gadget, Python Power Gadget and Matlab Power Gadget - where the results of the 33 experiments are recorded.

Appendix E - Overall Time & Memory

To find the .csv files for the overall time & memory browse to the folder attached named overall time & memory. Listed alphabetically are the files for the overall time & memory analysis in the sheet named **Sheet 1** for each of the 33 experiments.

For the individual results of each of the languages for each of the experiments, check folder R Time & Mem, Python Time & Mem and Matlab Time & Mem - where the results of the 33 experiments are recorded and also the conversion to a consistent unit is calculated.

APPENDIX F - ANOVA CODES FOR OVERALL JOULEMETER ANALYSIS

```
#testing
import scipy.stats as stats
import numpy as np
x = np.array([50.09747 , 49.85563 , 49.51923 , 50.92323 , 52.44267 , 51.77866 , 52.3622 , 50.
y = np.array([37.07,2])
z = np.array([38.83,3])
stats.f_oneway(x,y,z)
```

```
F_onewayResult(statistic=11.530945218719557, pvalue=0.001996097065476839)
```

```
#testing
stats.f_oneway(x,y,z)
```

```
F_onewayResult(statistic=1.9743213931436647, pvalue=0.1583977847751512)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_anova.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]
x.fillna(0)
print(x)
y = df.iloc[14:24, 16]
y.fillna(0)
print(y)
z = df.iloc[26:36, 16]
print(z)
stats.f_oneway(x,y,z)
```

```
2     50.0975
3     49.8556
4     49.5192
5     50.9232
6     52.4427
7     51.7787
8     52.3622
9     50.0978
10     50.098
11    49.9509
Name: Unnamed: 16, dtype: object
14    28.7484
15    25.1125
16    48.7548
17    49.2352
18    49.8054
19    49.3808
20    49.5669
```

```
21    51.7703
22          0
23    48.0569
Name: Unnamed: 16, dtype: object
26    28.7484
27    25.1125
28    48.7548
29    49.2352
30    49.8054
31    49.3808
32    49.5669
33    51.7703
34          0
35    48.0569
Name: Unnamed: 16, dtype: object
F_onewayResult(statistic=1.9743213931436647, pvalue=0.1583977847751512)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_bern.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]
x.fillna(0)
y = df.iloc[14:24, 16]
y.fillna(0)
z = df.iloc[26:36, 16]
stats.f_oneway(x,y,z)
```

```
F_onewayResult(statistic=6.233013884585272, pvalue=0.005948324941887414)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_bino.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]
x.fillna(0)
y = df.iloc[14:24, 16]
y.fillna(0)
z = df.iloc[26:36, 16]
stats.f_oneway(x,y,z)
```

```
F_onewayResult(statistic=13.526153073698842, pvalue=8.519590869301595e-05)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_boxplot.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]
print(x)
```

```
print(x)
y = df.iloc[14:24, 16]
print(y)
z = df.iloc[26:36, 16]
print(z)
stats.f_oneway(x,y,z)
```

```
     2     51.3918
     3     52.0161
     4     51.1264
     5     24.4824
     6     22.5923
     7     24.9325
     8     24.0324
     9     24.7525
     10    23.8524
     11    53.5965
     Name: Unnamed: 16, dtype: object
     14    36.4306
     15    36.0107
     16    36.4095
     17    35.2377
     18    36.7202
     19    37.4133
     20    37.8072
     21    54.0319
     22    49.1902
     23    37.9609
     Name: Unnamed: 16, dtype: object
     26    32.8406
     27    49.6599
     28      38.73
     29    49.3756
     30    49.8548
     31    29.0729
     32    23.0423
     33    25.8326
     34    23.4023
     35    48.0189
     Name: Unnamed: 16, dtype: object
     F_onewayResult(statistic=0.39470304498475417, pvalue=0.6777050716722535)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_chisq.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
2     54.5094
3     51.4677
4     53.4604
5     53.9293
6     51.2869
7     52.9237
8        53.8
9      53.202
10    39.2118
11    54.2857
Name: Unnamed: 16, dtype: object
14    24.9325
15    23.5824
16    24.4824
17    23.0423
18    23.0402
19    22.8623
20    23.0423
21    22.7723
22    23.0423
23    29.4805
Name: Unnamed: 16, dtype: object
26    33.9831
27     33.884
28    8.26873
29    32.6248
30    32.9134
31          0
32    49.5669
33    32.1065
34    33.9223
35    33.4194
Name: Unnamed: 16, dtype: object
F_onewayResult(statistic=28.862727326573264, pvalue=1.9734360516203313e-07)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_cohen.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
F_onewayResult(statistic=12.232538968962976, pvalue=0.0001651924697802406)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
```

```
df = pd.read_excel('Overall_corr.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=2.351632134203569, pvalue=0.11442135187963036)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_count.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=1.503512144183362, pvalue=0.2403816233658418)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_cumfreq.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=9.171586473629175, pvalue=0.0009130615810195906)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_gmean.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]
```

```
z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)

     F_onewayResult(statistic=3.851822079179866, pvalue=0.033755707511877446)


import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_hist.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)

     F_onewayResult(statistic=48.551096133201725, pvalue=1.1412694590499427e-09)


import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_hmean.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)

     F_onewayResult(statistic=2.0025757832874347, pvalue=0.15454456042169334)


import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_iqr.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)

     F_onewayResult(statistic=3.9166766536333975, pvalue=0.032097741262396555)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_linreg.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=5.320461746520029, pvalue=0.01127190114374448)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_loaddata.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=9.216573702685277, pvalue=0.0008889507370249087)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_mean.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=1.6018809780447965, pvalue=0.22008314934591744)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
```

```
import xlrd
df = pd.read_excel('Overall_median.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=1.1492947715377242, pvalue=0.3318793132771058)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_mode.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=76.21822819476544, pvalue=7.863512518839603e-12)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_norm.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=6.778787042415076, pvalue=0.004115657431658563)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_percentile.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]
```

```
z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=15.412497239929372, pvalue=3.4264958989878186e-05)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_poisson.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=25.787943330996857, pvalue=5.457646423840843e-07)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_quantile.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=5.495186087027267, pvalue=0.009949881673218674)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_range.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=0.7360682864750515, pvalue=0.48835993871993205)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_scatter2d.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=0.8457967786979216, pvalue=0.4402737277203582)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_scatter3d.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=7.589412132097583, pvalue=0.002424574183304962)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_skew.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=4.7025172840661495, pvalue=0.017690140054180386)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
```

```
import xlrd
df = pd.read_excel('Overall_stddev.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=15.08446912392156, pvalue=3.997137688063425e-05)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_summary.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=19.18970544326382, pvalue=6.530663037470971e-06)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_ttest.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=46.19912824317396, pvalue=1.922817286832807e-09)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_var.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]
```

```
z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=5.093103565390951, pvalue=0.013281752459980974)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_wil1.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=6.372269388030124, pvalue=0.005409599161177788)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_wil2.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=13.188999682824763, pvalue=0.00010092990668226323)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('Overall_wmean.xlsx', sheet_name='Overall Analysis')
x = df.iloc[2:12, 16]

y = df.iloc[14:24, 16]

z = df.iloc[26:36, 16]

stats.f_oneway(x,y,z)
```

```
F_onewayResult(statistic=12.995477728713707, pvalue=0.00011134922250595993)
```

APPENDIX G - ANOVA CODES FOR OVERALL TIME ANALYSIS

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabAnovaTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonAnovaTime&Mem - Copy.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RANovTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
F_onewayResult(statistic=754.603787172878, pvalue=2.0245902354669195e-24)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabBernDistTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonBernDistTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RBernTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
F_onewayResult(statistic=1817.9221240734773, pvalue=1.6287773260081523e-29)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabBinoDistTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonBinoDistTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RBinomTime&Mem.xlsx')
z = df.iloc[0:10,2]
```

```
stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=1512.647124518498, pvalue=1.9096529039881465e-28)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabChiSqTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonChiSqTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RCHiSqTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=78.0408707691056, pvalue=5.9938082406729114e-12)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabCohenTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonCohenTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RCohenTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=68.89086014073034, pvalue=2.483927283101927e-11)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabCorrTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonCorrTime&Mem - Copy.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RCorrTime&Mem.xlsx')
```

```
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=621.007651443922, pvalue=2.6705961378128995e-23)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabCountTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
x = np.zeros(10)
df = pd.read_excel('/content/PythonCountTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RCountTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=32131.257540328937, pvalue=2.591306539986155e-46)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabCumFreqMemory&Time.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
x = np.zeros(10)
df = pd.read_excel('/content/PythonCumFreqTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RCumFreqTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=66.28047170336997, pvalue=3.836204743364569e-11)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabGMeanTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonGMeanTime&Mem.xlsx')
```

```
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RGMeanTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=82.04385593855051, pvalue=3.363322823377444e-12)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabHistTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonHistTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RHistTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=6.792908608568004, pvalue=0.004077160722051536)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabHMeanTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonHMeanTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RHMeanTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=104.70581877445628, pvalue=1.9005588620025722e-13)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabIQRMem&Time.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
```

```
df = pd.read_excel('/content/PythonIQRTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RIQRTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=786.0528689627308, pvalue=1.1777927164450402e-24)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabLinRegMem&Time.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonLinRegTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RLInRegTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=95.2842157587486, pvalue=5.832656823312091e-13)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabLoadDataTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonLoadDataTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RLoadDataTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=1134.9573209145856, pvalue=8.870646187931821e-27)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabMeanTime&Mem.xlsx')
x = df.iloc[0:10, 2]
```

```
x.fillna(0)
df = pd.read_excel('/content/PythonMeanTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RMeanTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=311.9972370281424, pvalue=2.1883522905798747e-19)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabMedianTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonMedianTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RMedianTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=197.84883405176353, pvalue=7.447453746494136e-17)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabModeTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonModeTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RModeTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=126.71491060170347, pvalue=1.8957636098521313e-14)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabNormalDistMem&Time.xlsx')
```

```
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonNormDistTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RNormDistTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=489.4697396696739, pvalue=6.14739050371486e-22)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabPercentileMem&Time.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonPercentileTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RPercentileTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=50.07943694342568, pvalue=8.217330004020992e-10)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabPoissonDistMem&Time.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonPoissonDistTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RPoissonTime&mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=252.88338671335134, pvalue=3.274609650105954e-18)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
```

```
df = pd.read_excel('/content/MatlabQuantileMem&Time.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonQuantileTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RQuantileTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=52.91036457690877, pvalue=4.5637485192419555e-10)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabRangeMem&Time.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonRangeTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RRangeTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=27291440.67495386, pvalue=7.466992875372117e-86)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabScatter2dTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonScatter2dTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RScatter2dTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=429.8491297807739, pvalue=3.3762668130408144e-21)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
```

```
import xlrd
df = pd.read_excel('/content/MatlabScatter3dTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonScatter3dTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RScatter3dTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=639.464922532139, pvalue=1.8133969451414182e-23)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabSkewMem&Time.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonSkewTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RSkewTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=27.032946049000476, pvalue=3.581752486570328e-07)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabStdTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonStddevTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RStdDevTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=21.34966957890172, pvalue=2.7531121328455954e-06)
```

```
import scipy.stats as stats
import numpy as np
```

```
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabSummaryTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonSummaryTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RSummaryTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=62.48761726638959, pvalue=7.404192740383474e-11)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabTtestMem&Time.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonTtestTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RTtestTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=117.85155075736049, pvalue=4.577523830431365e-14)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabVariTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonVarTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RVarTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=21.693543260767083, pvalue=2.4113234103051742e-06)
```

```
import scipy.stats as stats
```

```
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabWilcoxRankTime&Memory.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonWilcoxRankTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RWilcoxRankTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=296.9471764175425, pvalue=4.1464051283974783e-19)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabWilcoxSumTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonWilcoxSumTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RWilcoxSumTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=602.8177642583383, pvalue=3.954964759467457e-23)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabWmeanTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonWMeanTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RWMeanTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=89.50013609006908, pvalue=1.2195387229320638e-12)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabBoxplotTime&Mem.xlsx')
x = df.iloc[0:10, 2]
x.fillna(0)
df = pd.read_excel('/content/PythonBoxplotTime&Mem.xlsx')
y = df.iloc[0:10, 1]
y.fillna(0)
df = pd.read_excel('/content/RBoxPlotTime&Mem.xlsx')
z = df.iloc[0:10,2]

stats.f_oneway(x,y,z)
```

```
F_onewayResult(statistic=478.52223970668655, pvalue=8.273932456472281e-22)
```

Double-click (or enter) to edit

APPENDIX H - ANOVA CODES FOR OVERALL MEMORY ANALYSIS

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabAnovaTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonAnovaTime&Mem - Copy.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RANovTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
F_onewayResult(statistic=27341.788782001837, pvalue=2.2879591837706708e-45)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabBernDistTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonBernDistTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RBernTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
F_onewayResult(statistic=8602785.351370534, pvalue=4.3839844056419844e-79)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabBinoDistTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonBinoDistTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RBinomTime&Mem.xlsx')
z = df.iloc[0:10,3]
```

```
stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=7641860848.8089905, pvalue=6.859898224572043e-119)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabChiSqTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonChiSqTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RCHiSqTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=2917005.570304818, pvalue=9.612265360458405e-73)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabCohenTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonCohenTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RCohenTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=20145813.091455378, pvalue=4.497872507828226e-84)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabCorrTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonCorrTime&Mem - Copy.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RCorrTime&Mem.xlsx')
```

```
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=10782.440479630295, pvalue=6.463821786187949e-40)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabCountTime&Mem.xlsx')
#x = df.iloc[0:10, 4]
#x.fillna(0)
x = np.zeros(10)
df = pd.read_excel('/content/PythonCountTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RCountTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=8.904582580685016e+16, pvalue=2.7524708933892707e-214)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabCumFreqMemory&Time.xlsx')
#x = df.iloc[0:10, 4]
#x.fillna(0)
x = np.zeros(10)
df = pd.read_excel('/content/PythonCumFreqTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RCumFreqTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=17973850.88468085, pvalue=2.098196494931119e-83)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabGMeanTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonGMeanTime&Mem.xlsx')
```

```
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RGMeanTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=2070215455.0985532, pvalue=3.1138376046099152e-111)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabHistTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonHistTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RHistTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=35738.8246567685, pvalue=6.16450234477578e-47)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabHMeanTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonHMeanTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RHMeanTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=-8.058823209291141e+16, pvalue=nan)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabIQRMem&Time.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
```

```
df = pd.read_excel('/content/PythonIQRTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RIQRTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=101225163596.12738, pvalue=4.876534431194885e-134)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabLinRegMem&Time.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonLinRegTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RLInRegTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=702132526.9883513, pvalue=6.8053115396643244e-105)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabLoadDataTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonLoadDataTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RLoadDataTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=5754.865026773012, pvalue=3.056989528187469e-36)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabMeanTime&Mem.xlsx')
x = df.iloc[0:10, 4]
```

```
x.fillna(0)
df = pd.read_excel('/content/PythonMeanTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RMeanTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=1512567224.4994018, pvalue=2.1545549147236824e-109)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabMedianTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonMedianTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RMedianTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=2169996171.9487596, pvalue=1.6493384138528909e-111)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabModeTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonModeTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RModeTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=2123276028.8639052, pvalue=2.212680311841547e-111)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabNormalDistMem&Time.xlsx')
```

```
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonNormDistTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RNormDistTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=5189222233.45304, pvalue=1.2753377414529836e-116)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabPercentileMem&Time.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonPercentileTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RPercentileTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=8.967682618885845e+16, pvalue=2.502204362794044e-214)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabPoissonDistMem&Time.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonPoissonDistTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RPoissonTime&mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=67742535152.41395, pvalue=1.1037643454384836e-131)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
```

```
df = pd.read_excel('/content/MatlabQuantileMem&Time.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonQuantileTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RQuantileTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=61375051024.402626, pvalue=4.184231261831458e-131)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabRangeMem&Time.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonRangeTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RRangeTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=8.905683100700115e+16, pvalue=2.747882593276822e-214)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabScatter2dTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonScatter2dTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RScatter2dTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=202094.4660871321, pvalue=4.306550541500102e-57)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
```

```
import xlrd
df = pd.read_excel('/content/MatlabScatter3dTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonScatter3dTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RScatter3dTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=35957.435887365566, pvalue=5.67750362230199e-47)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabSkewMem&Time.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonSkewTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RSkewTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=2097543.6410526866, pvalue=8.248397211305177e-71)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabStdTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonStddevTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RStdDevTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=2027656007.0431118, pvalue=4.121763550495816e-111)
```

```
import scipy.stats as stats
import numpy as np
```

```
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabSummaryTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonSummaryTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RSummaryTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=11802390.61606048, pvalue=6.136268903537214e-81)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabTtestMem&Time.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonTtestTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RTtestTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=1125873.807221042, pvalue=3.667114013502201e-67)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabVariTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonVarTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RVarTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=2170263941.132682, pvalue=1.646593323070225e-111)
```

```
import scipy.stats as stats
```

```
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabWilcoxRankTime&Memory.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonWilcoxRankTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RWilcoxRankTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=15107.665967047174, pvalue=6.840763758344959e-42)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabWilcoxSumTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonWilcoxSumTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RWilcoxSumTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=15172.659445544234, pvalue=6.455925005703814e-42)
```

```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabWmeanTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonWMeanTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RWMeanTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

```
     F_onewayResult(statistic=3531586774.0446744, pvalue=2.3009779100489752e-114)
```

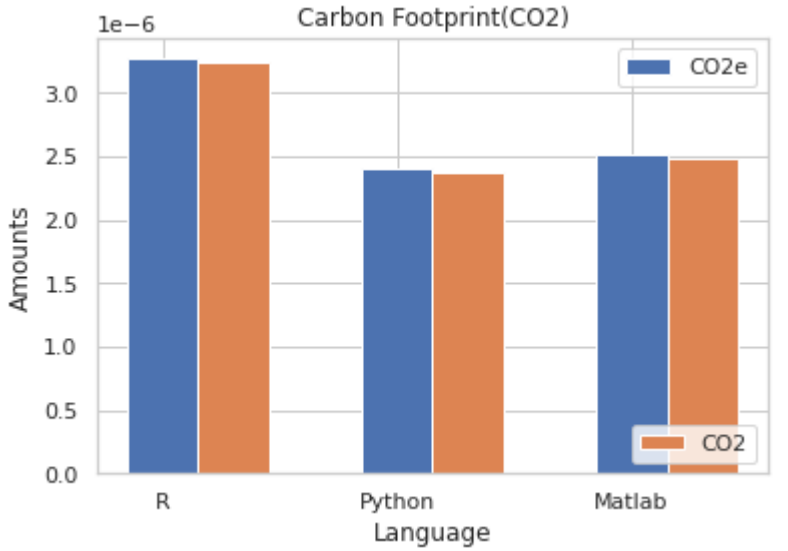
```
import scipy.stats as stats
import numpy as np
import pandas as pd
import xlrd
df = pd.read_excel('/content/MatlabBoxplotTime&Mem.xlsx')
x = df.iloc[0:10, 4]
x.fillna(0)
df = pd.read_excel('/content/PythonBoxplotTime&Mem.xlsx')
y = df.iloc[0:10, 3]
y.fillna(0)
df = pd.read_excel('/content/RBoxPlotTime&Mem.xlsx')
z = df.iloc[0:10,3]

stats.f_oneway(x,y,z)
```

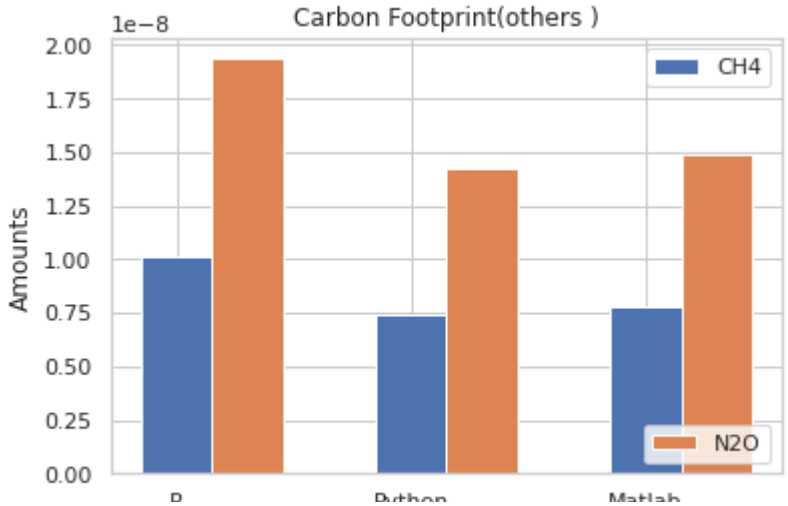
```
     F_onewayResult(statistic=24522.68452928076, pvalue=9.933698641733768e-45)
```

APPENDIX I - GRAPH CODES FOR OVERALL CARBON FOOTPRINT

```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt
from matplotlib.pyplot import *

df = pd.read_excel('Overall_anova.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_anova.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```

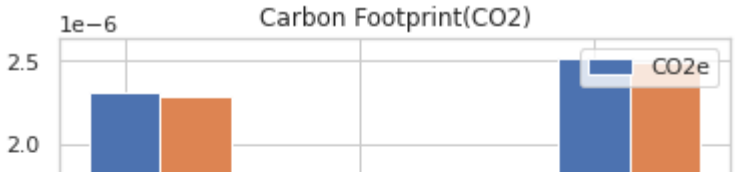





```
from matplotlib.pyplot import *
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_bern.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
```

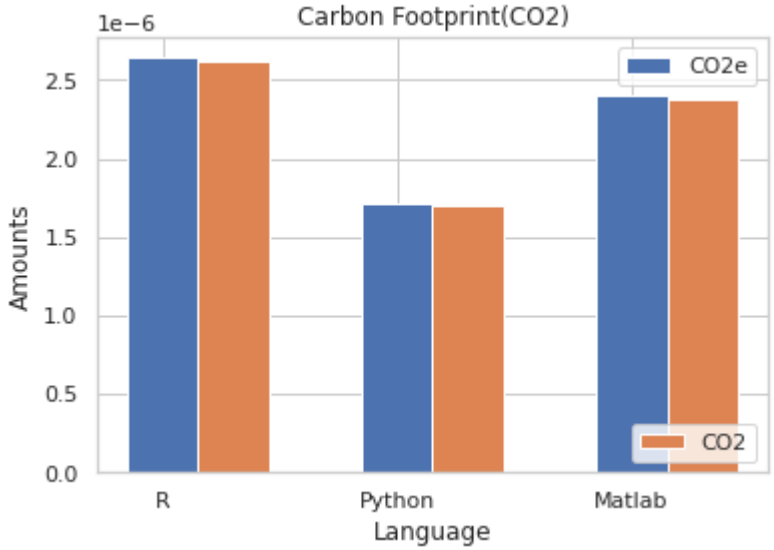
```
gca().add_artist(l1)
plt.show()
```

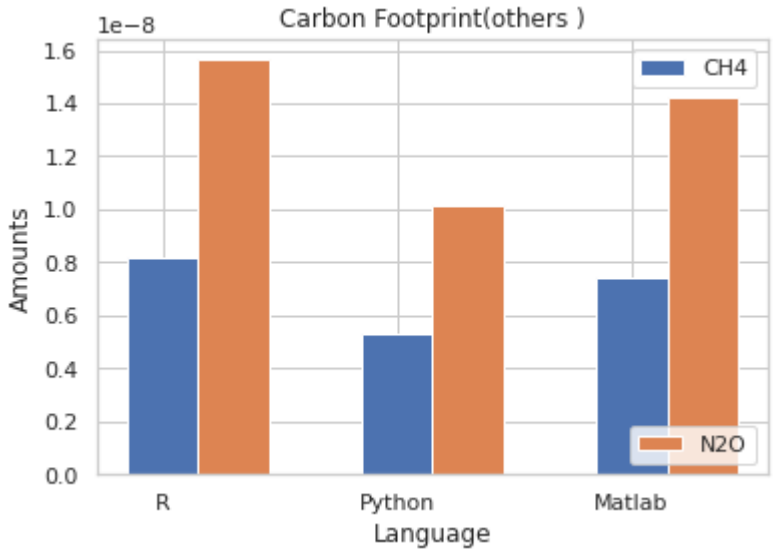
```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_bern.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```




```
from matplotlib.pyplot import *
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_bino.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_bino.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```

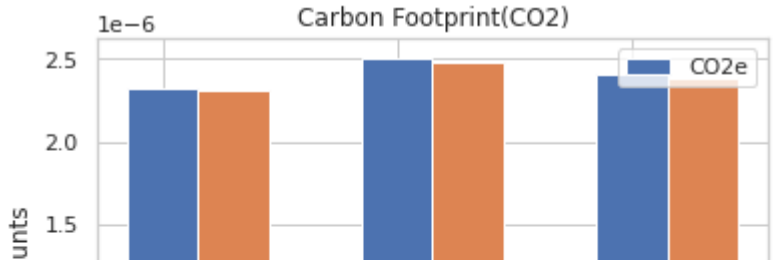





```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_boxplot.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
```

```
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

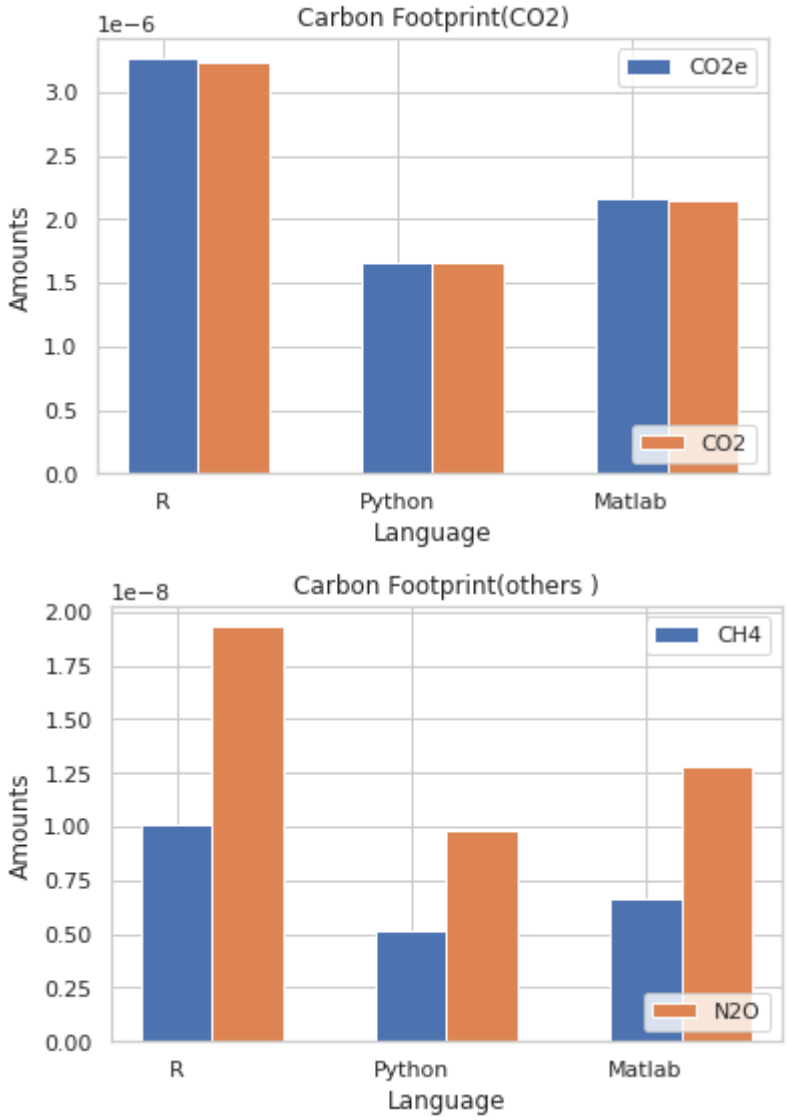
```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_boxplot.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```




```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_chisq.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_chisq.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
```

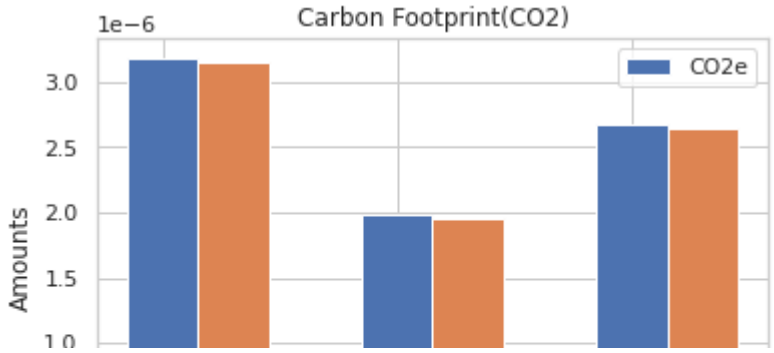
```
gca().add_artist(l1)
plt.show()
```




```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_cohen.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
```

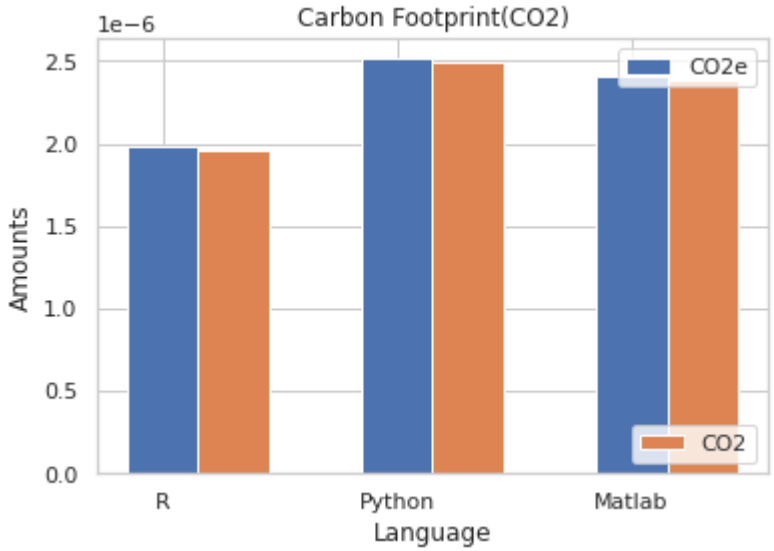
```
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

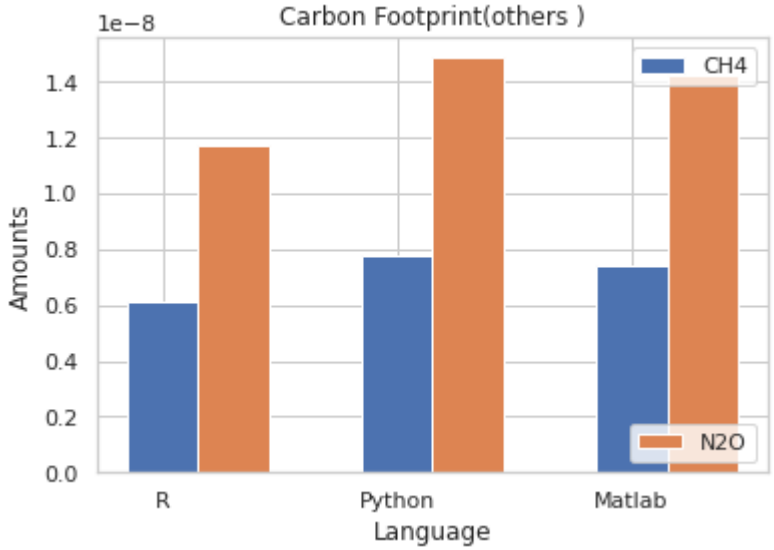
```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_cohen.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```




```
from matplotlib.pyplot import *


import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_corr.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()



import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_corr.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
```

```
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```

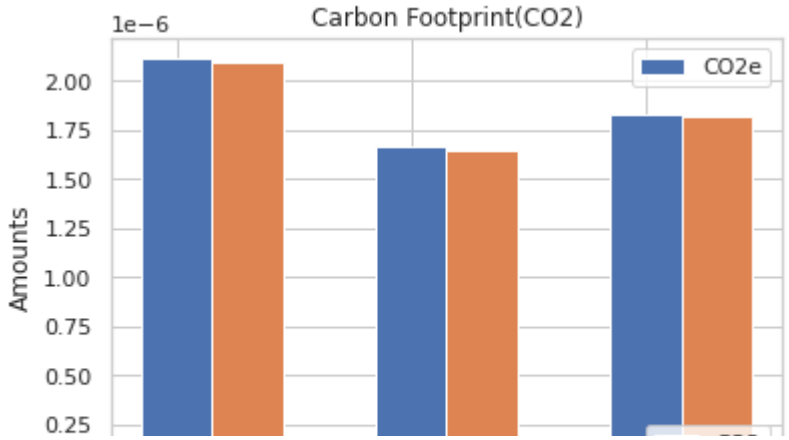





```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_count.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
```

```
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

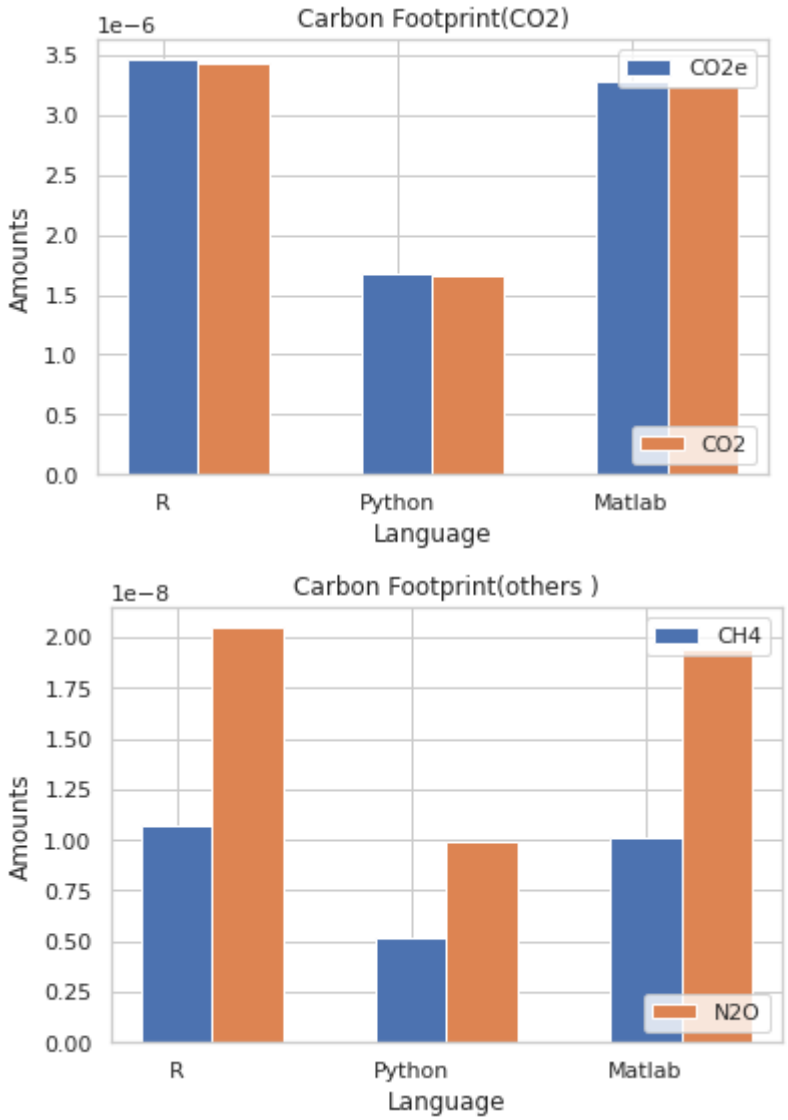
```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_count.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```




```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_cumfreq.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_cumfreq.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
```

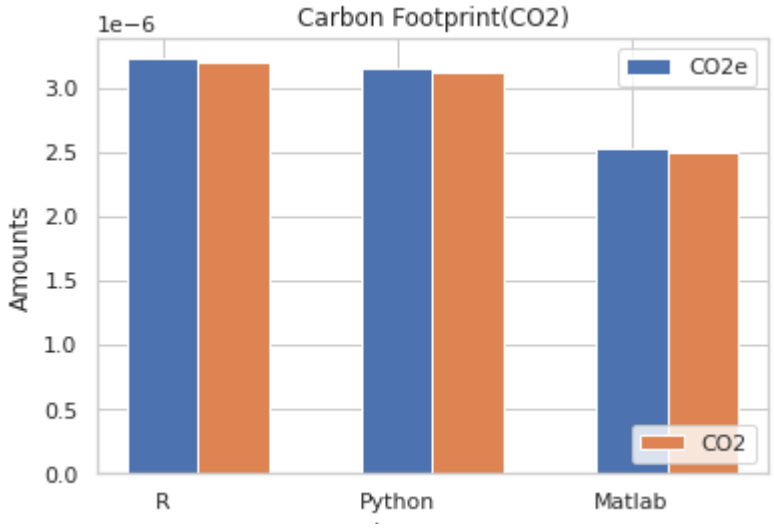
```
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```




```
from matplotlib.pyplot import *


import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_gmean.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
```

```
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

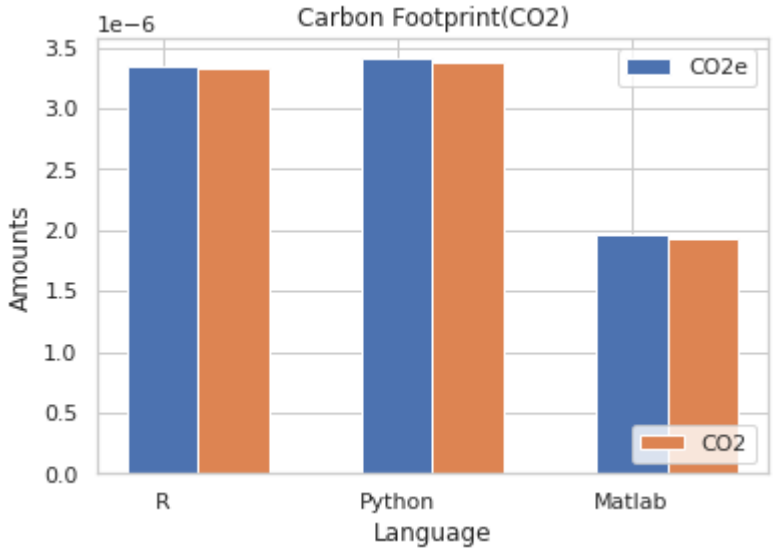
```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_gmean.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```

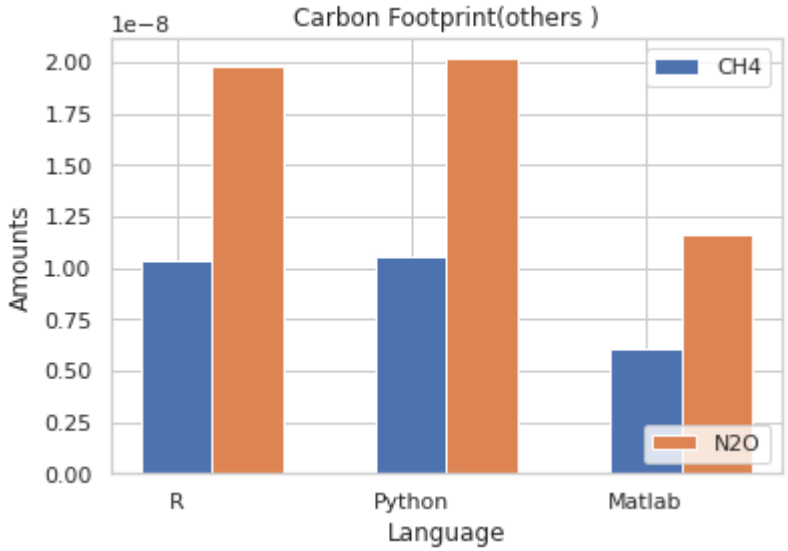



```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_hist.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_hist.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
```

```
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```

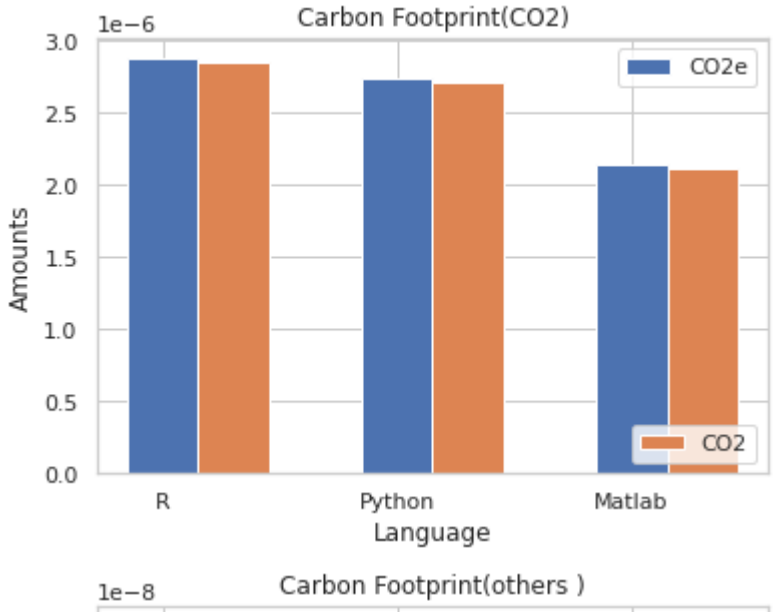





```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_hmean.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
```

```
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

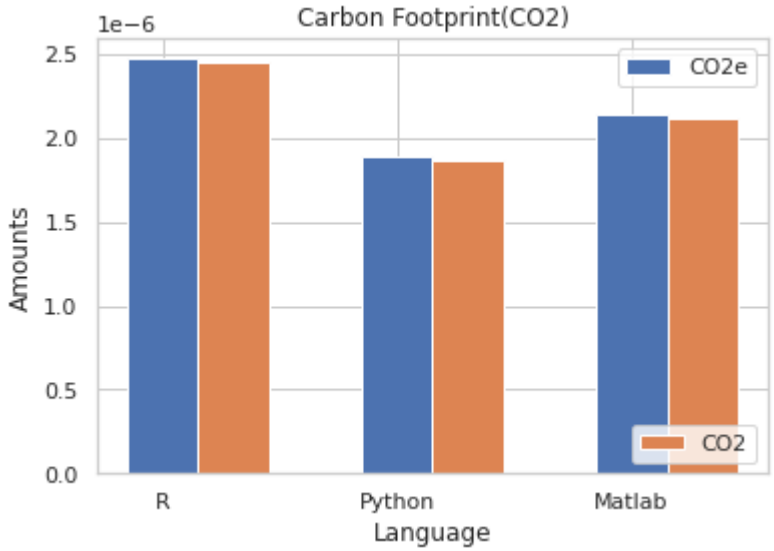
```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_hmean.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```

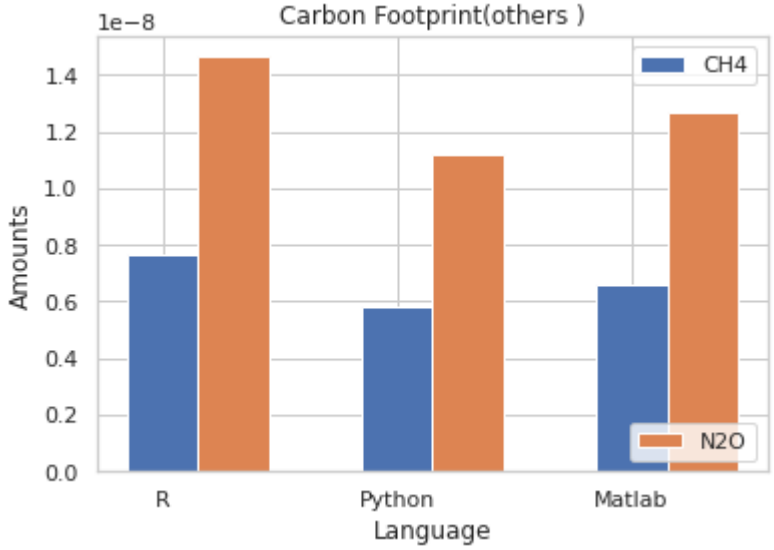



```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_iqr.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_iqr.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
```

```
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```

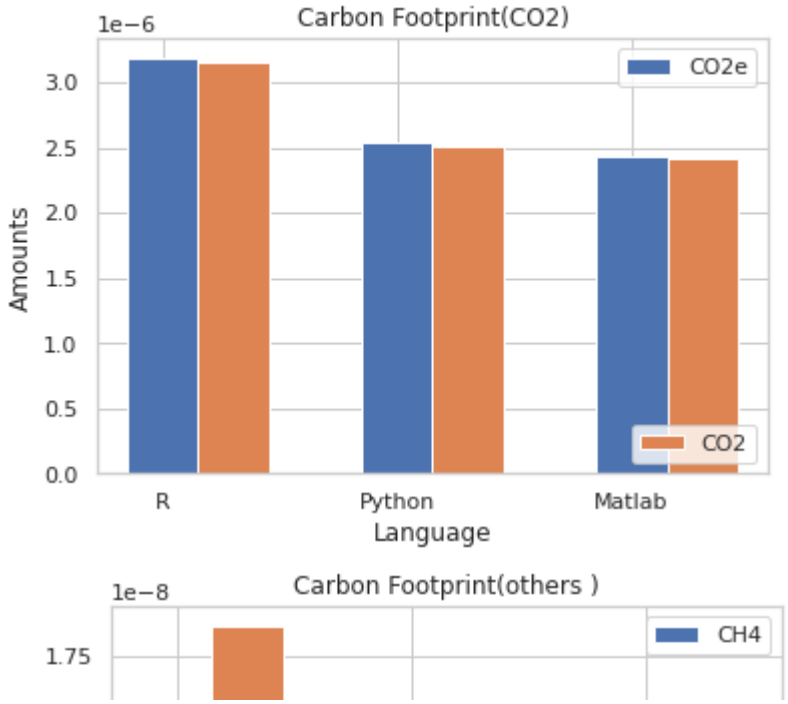





```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt
```

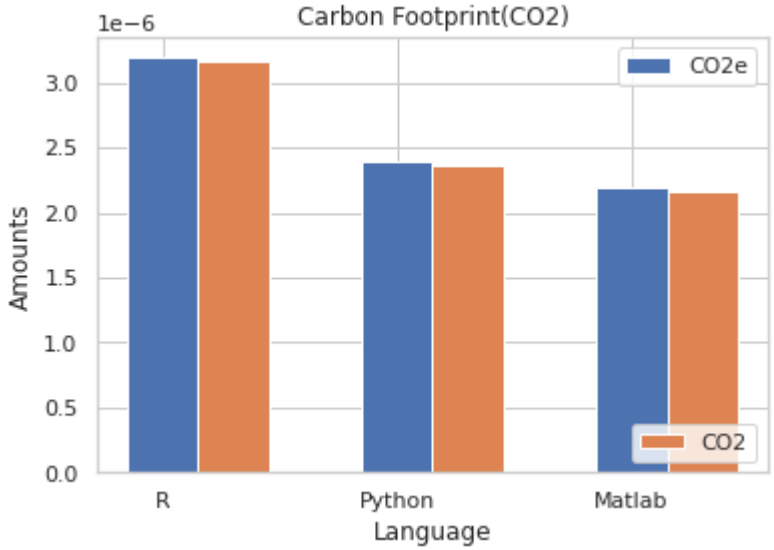
```
df = pd.read_excel('Overall_linreg.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

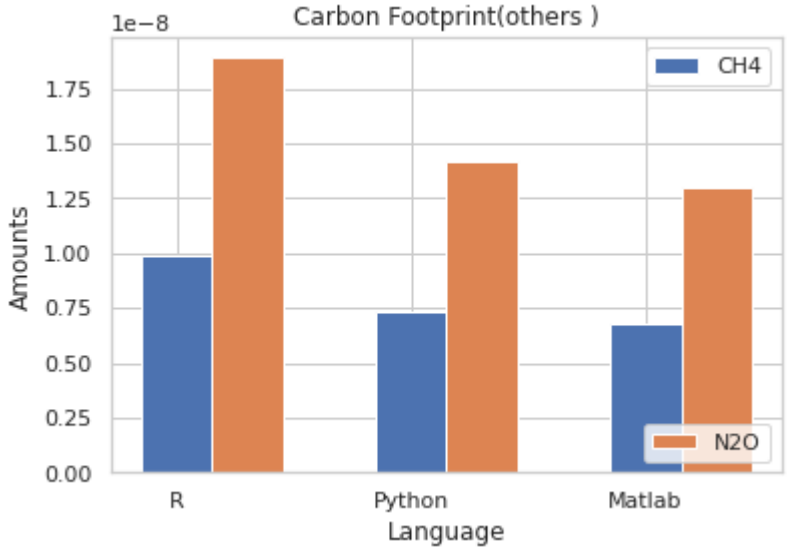
```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_linreg.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```




```
from matplotlib.pyplot import *


import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_loaddata.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()



import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_loaddata.xlsx', sheet_name='Sheet1')
```

```
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```

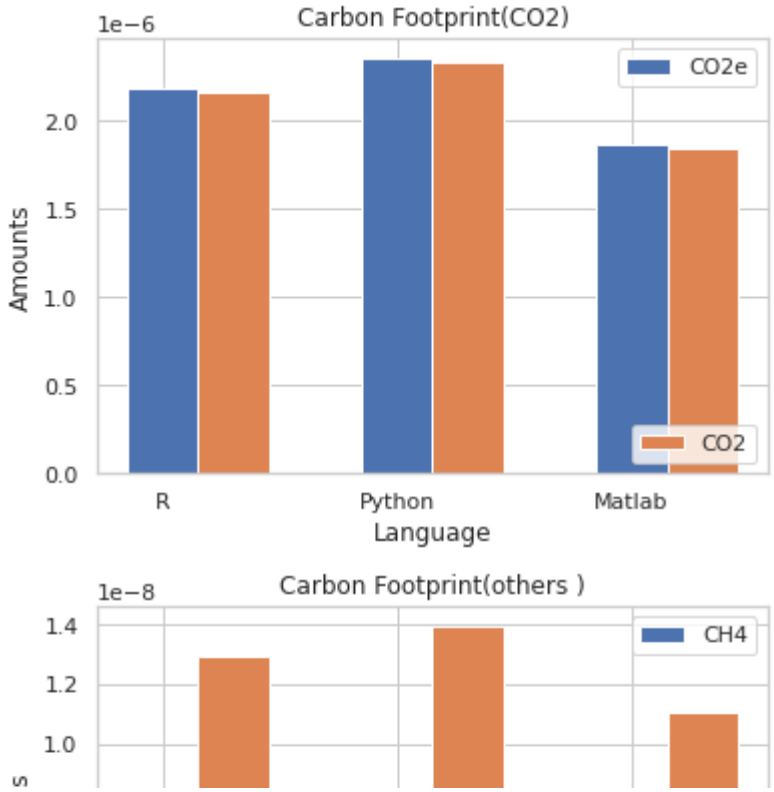





```
from matplotlib.pyplot import *


import numpy as np
import pandas as pd
```

```
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_mean.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

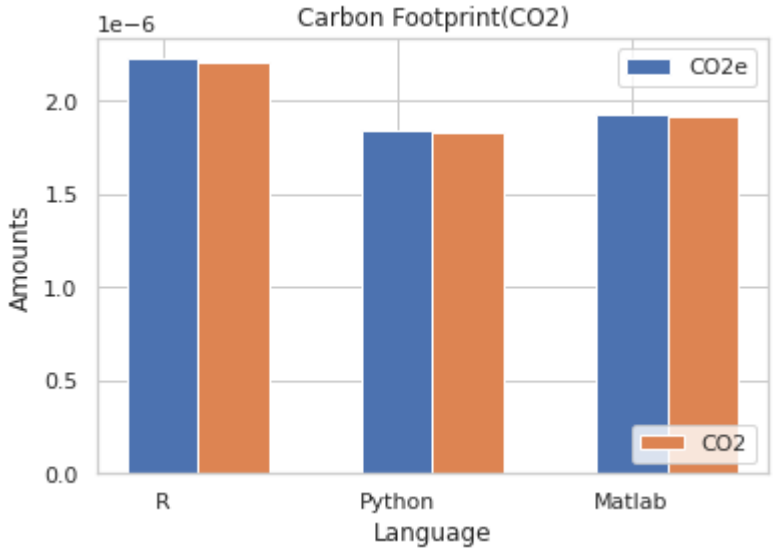
```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_mean.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```

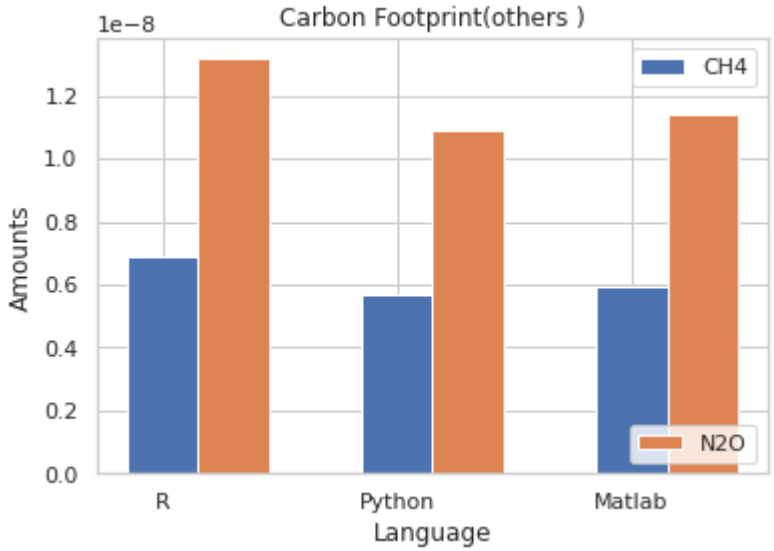



```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_median.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt
```

```
df = pd.read_excel('Overall_median.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```

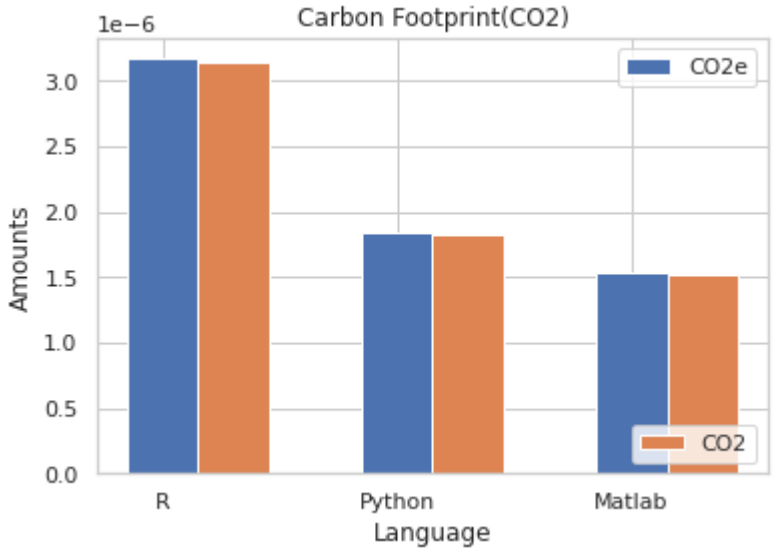


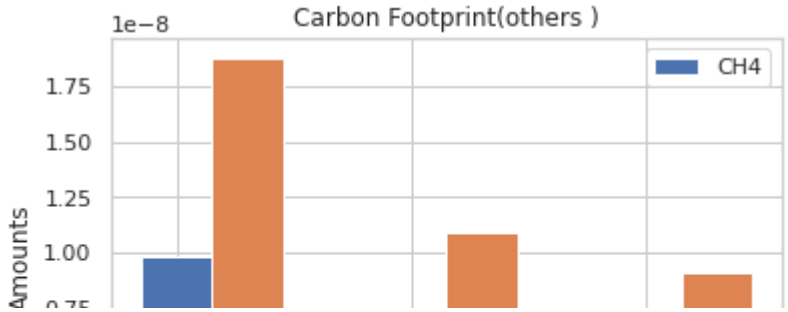



```
from matplotlib.pyplot import *
```

```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_mode.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_mode.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```

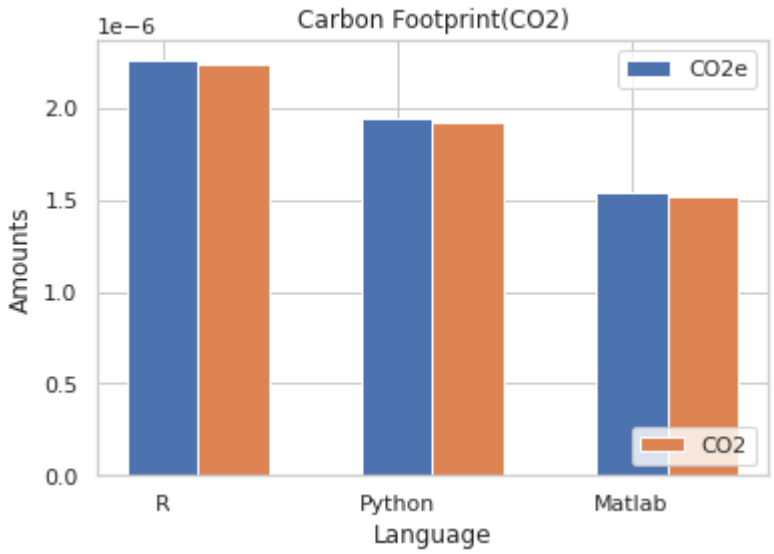


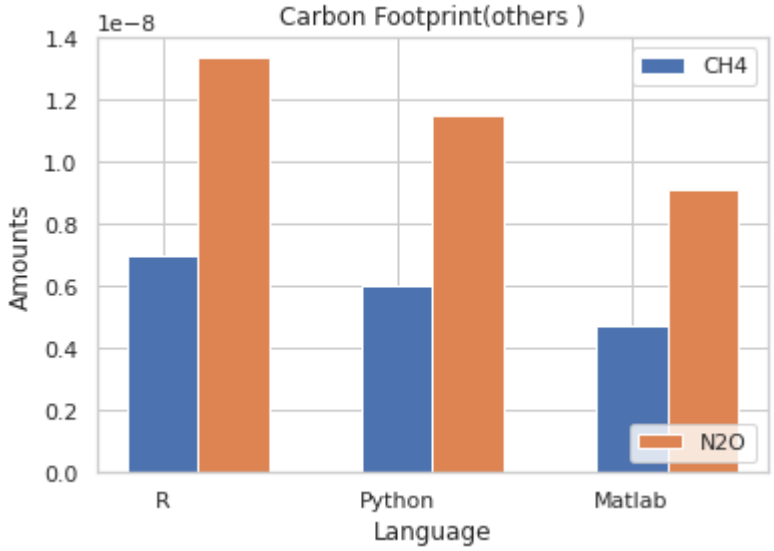



```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_norm.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

```
import numpy as np
import pandas as pd
```

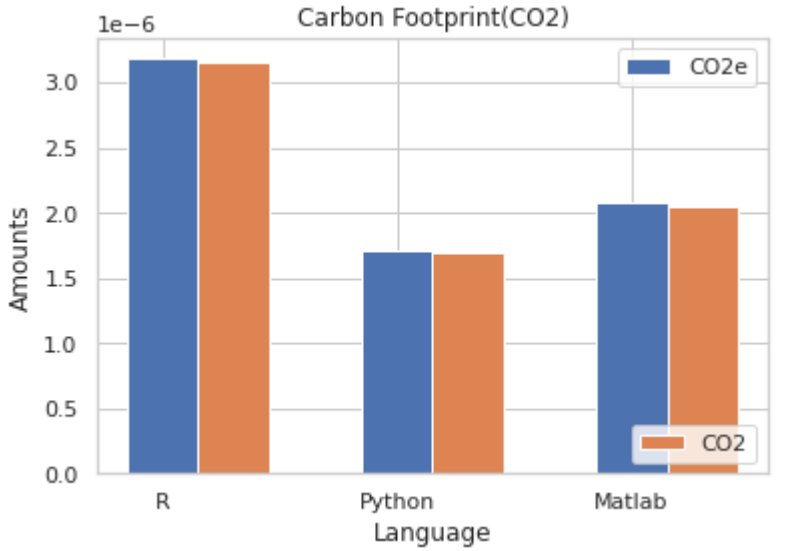
```
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_norm.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```

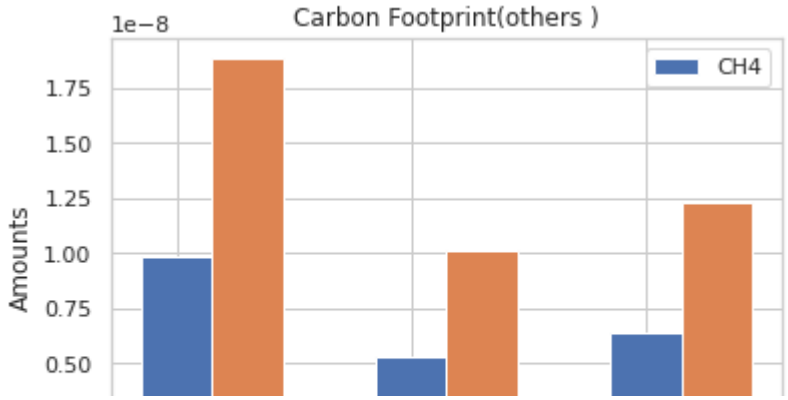




```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_percentile.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_percentile.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```



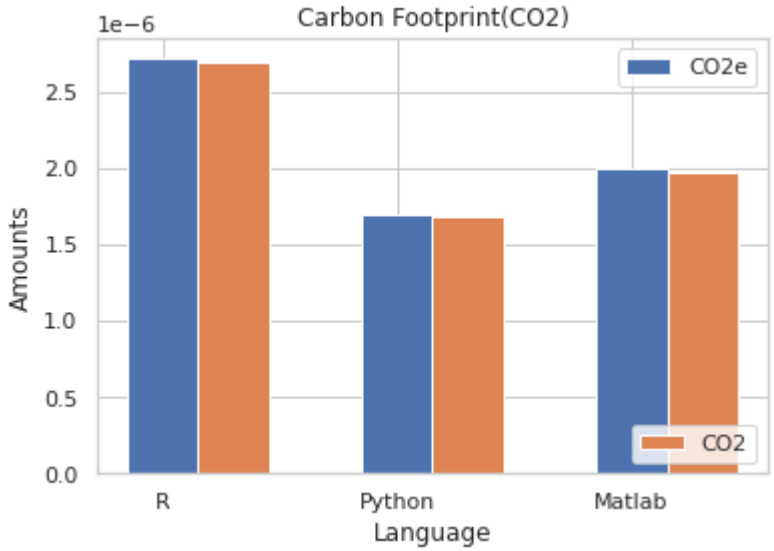


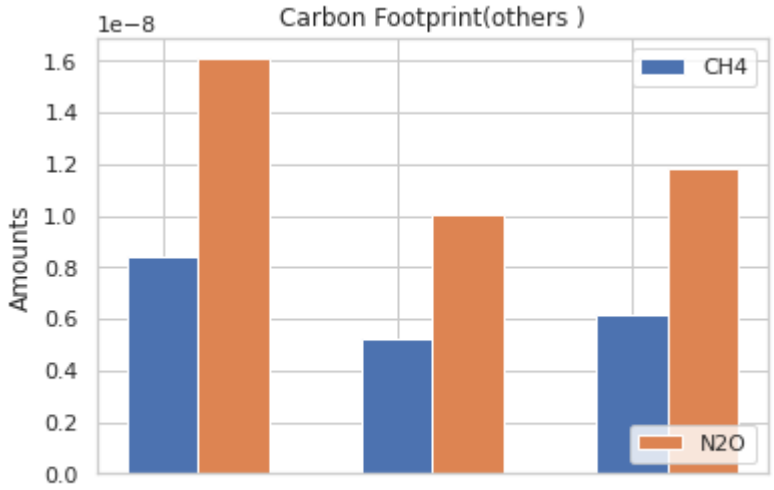

```
from matplotlib.pyplot import *
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_poisson.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_poisson.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```

```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_quantile.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

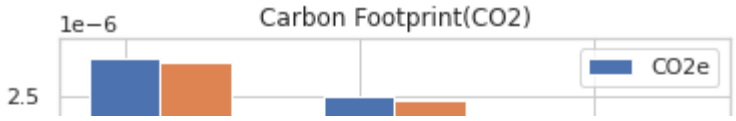
```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_quantile.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```





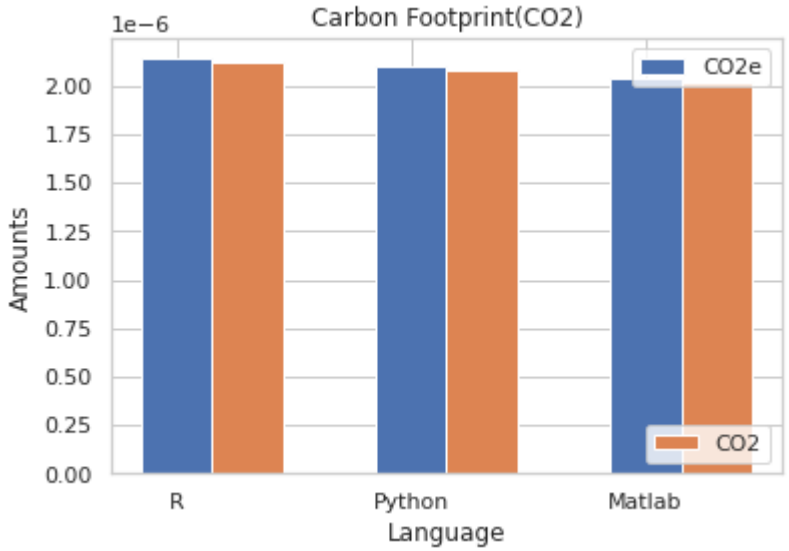

```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_range.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

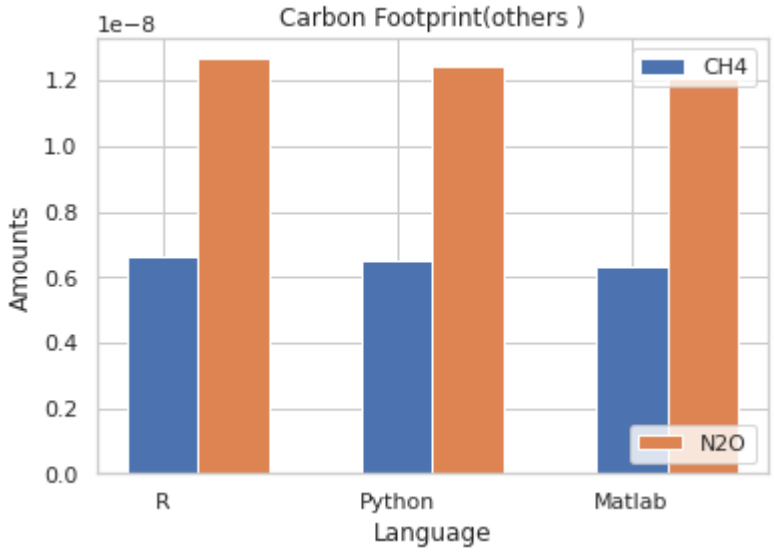
```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_range.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```




```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_scatter2d.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

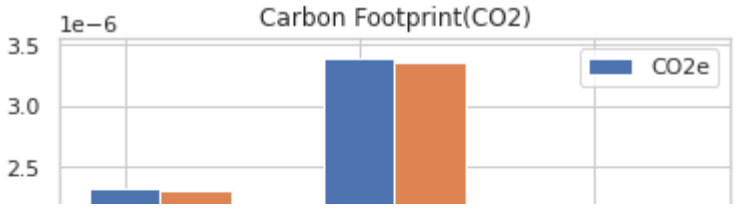
```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_scatter2d.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```






```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_scatter3d.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
```

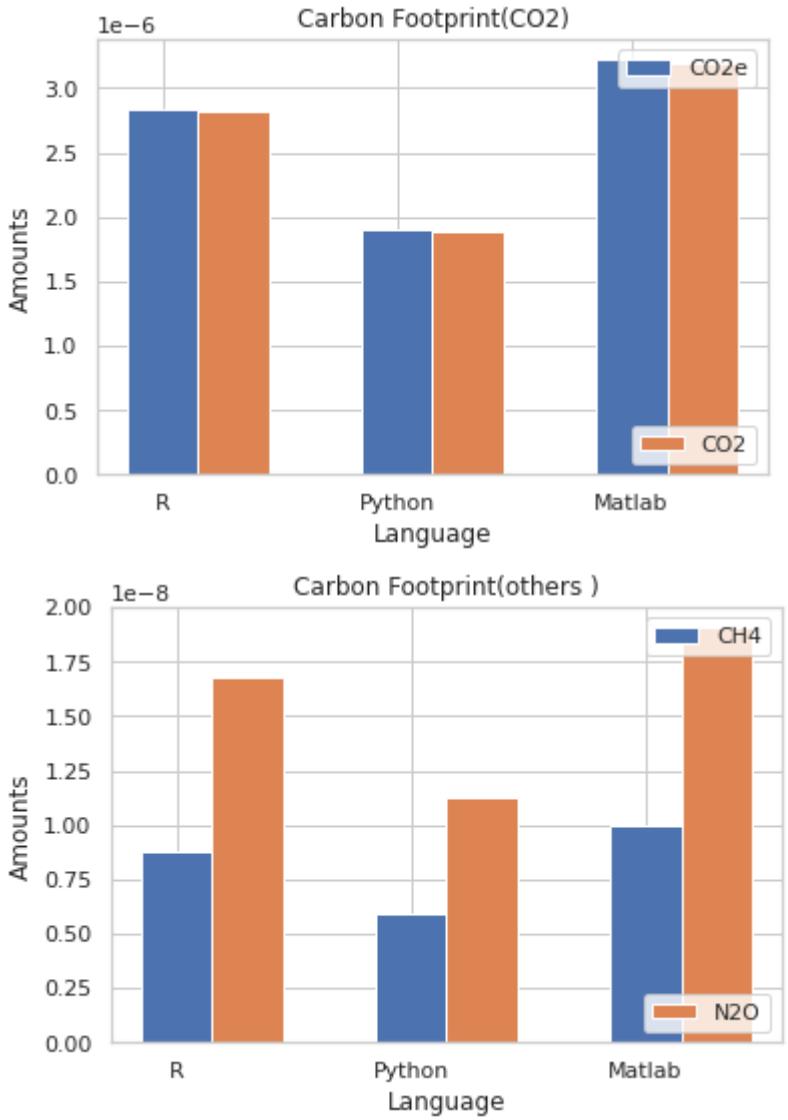
```
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()



import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_scatter3d.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```




```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_skew.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_skew.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
```

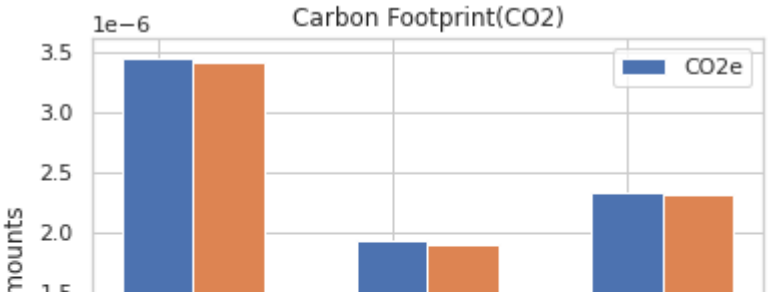
```
plt.show()
```




```
from matplotlib.pyplot import *


import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_stddev.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
```

```
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

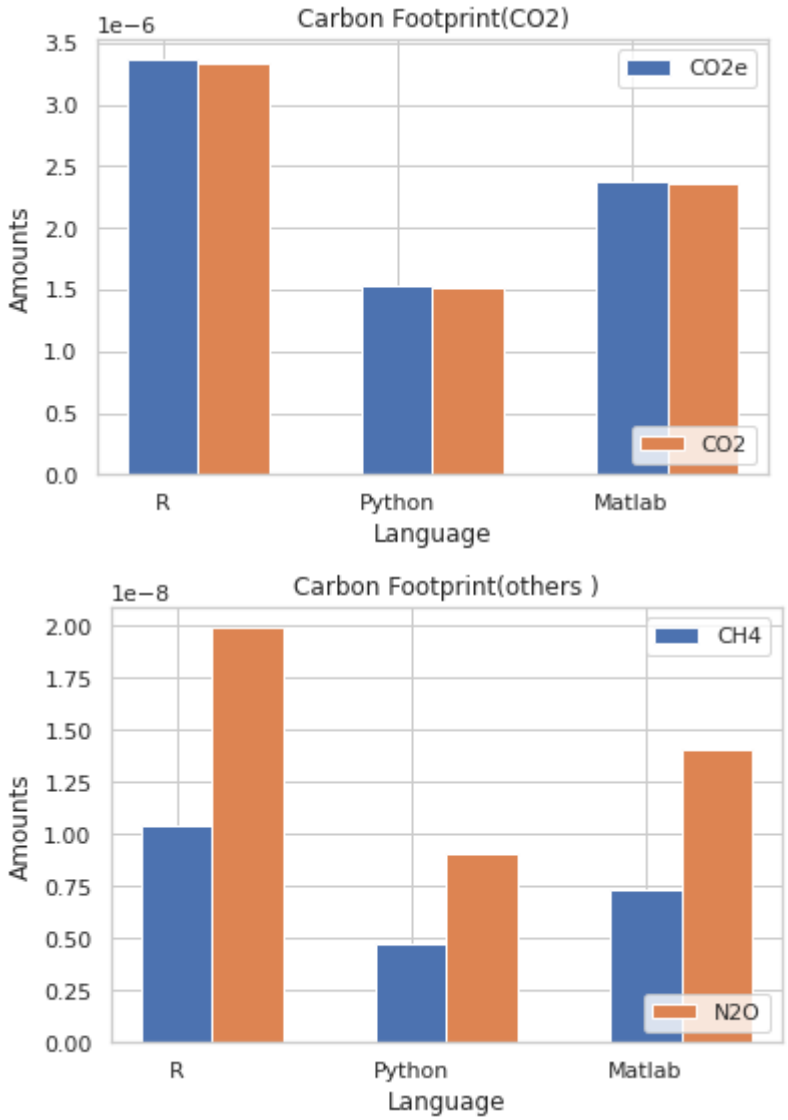
```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_stddev.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```




```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_summary.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_summary.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
```

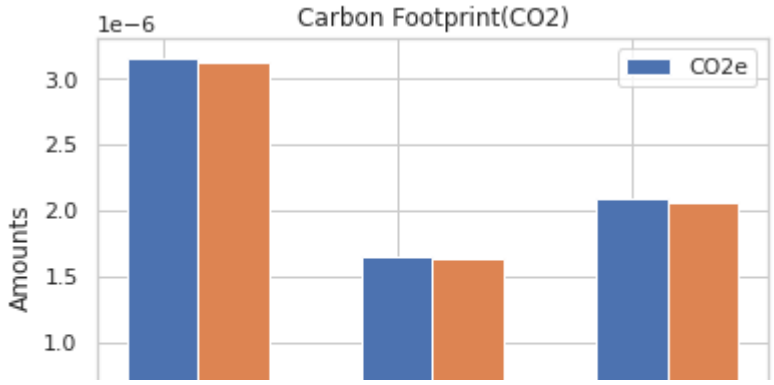
```
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```




```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_ttest.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
```

```
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

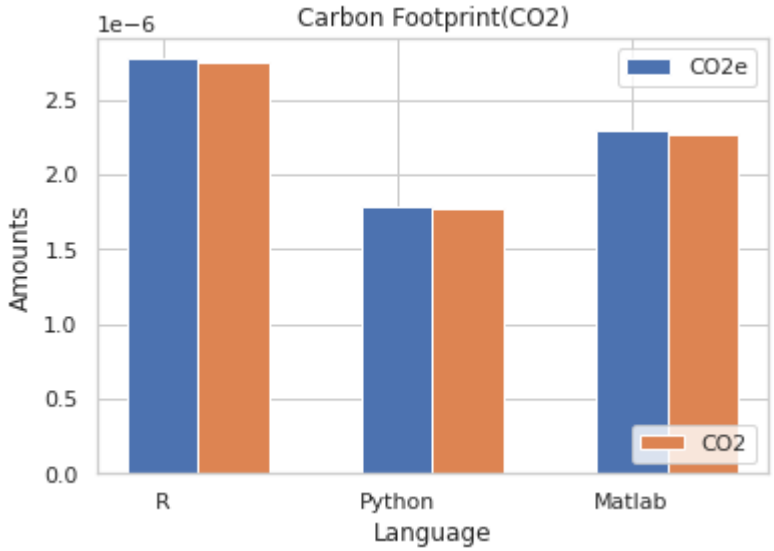
```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_ttest.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```

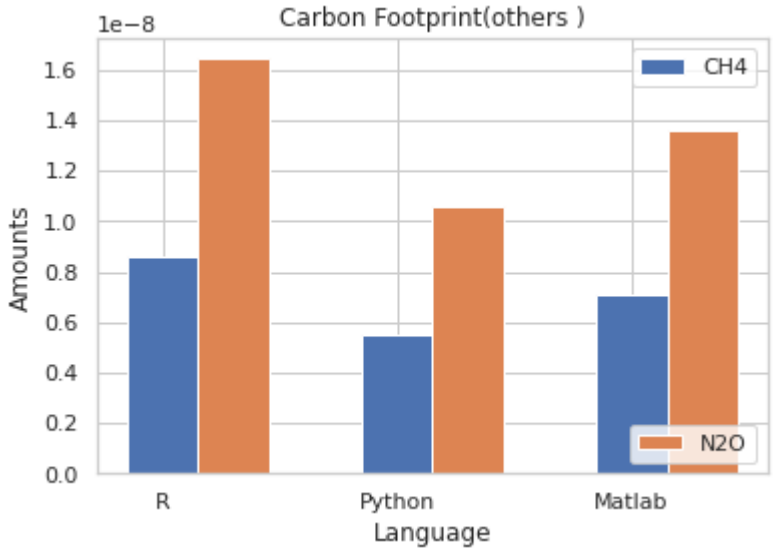



```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_var.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_var.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
```

```
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```

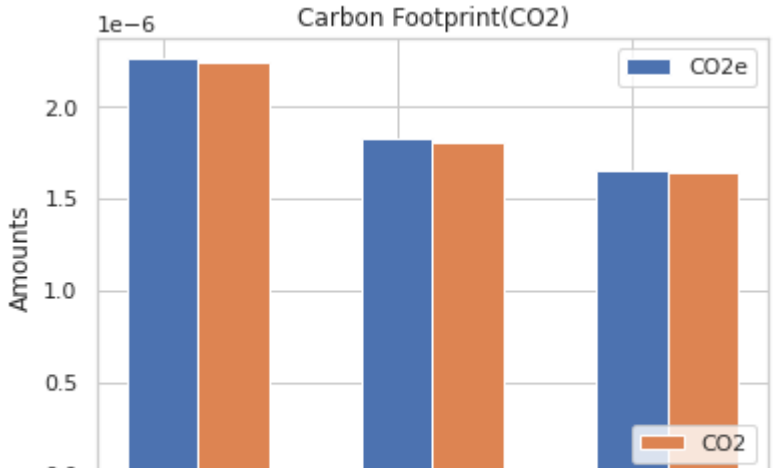





```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_wil1.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
```

```
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

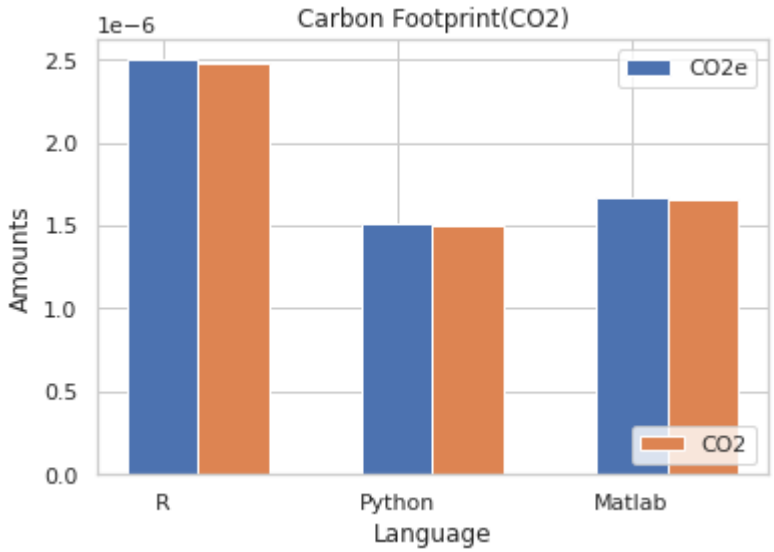
```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_wil1.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```

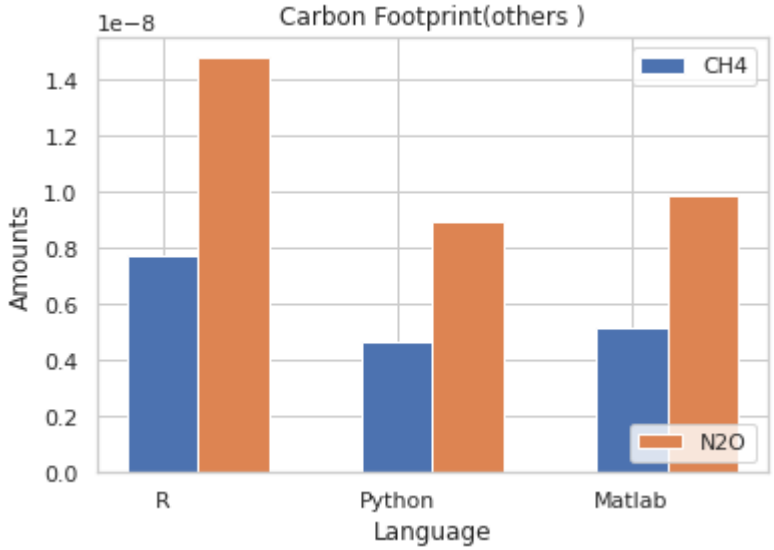



```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_wil2.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_wil2.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
```

```
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```

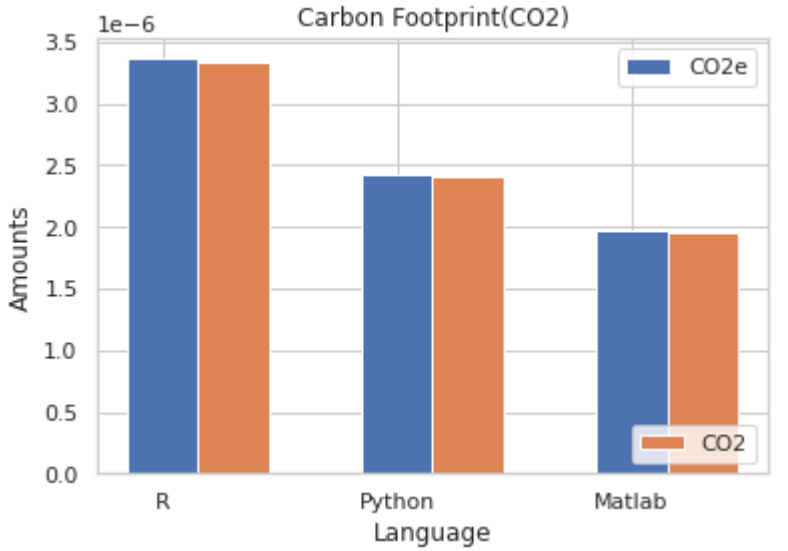


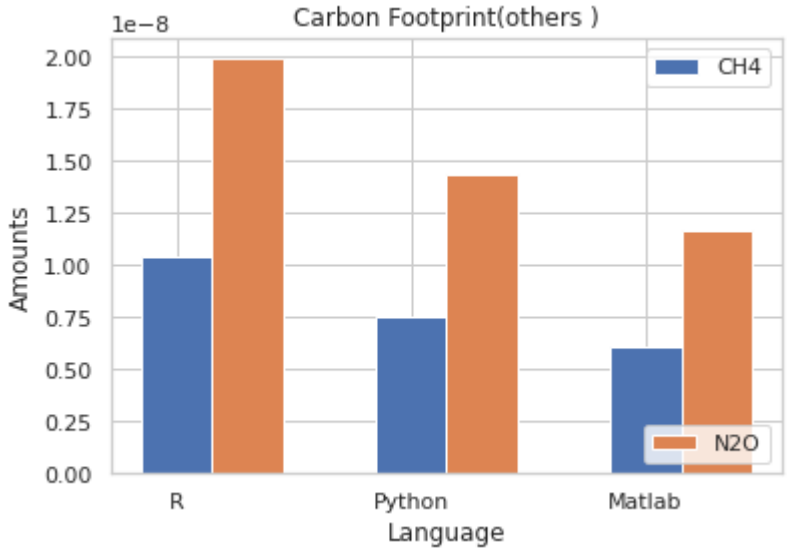



```
from matplotlib.pyplot import *

import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_wmean.xlsx', sheet_name='Sheet1')
data1 = df['kg CO2e']
data2 = df['kgCO2']
```

```
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(CO2)')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CO2e"], loc=1)
l2 = plt.legend([b2], ["CO2"], loc=4)
gca().add_artist(l1)
plt.show()
```

```
import numpy as np
import pandas as pd
from pandas import Series, DataFrame
import matplotlib.pyplot as plt

df = pd.read_excel('Overall_wmean.xlsx', sheet_name='Sheet1')
data1 = df['kgCH4']
data2 = df['kgN2O']
width =0.3
labels = ['R', 'Python', 'Matlab']
plt.xticks(range(len(df)), labels)
plt.xlabel('Language')
plt.ylabel('Amounts')
plt.title('Carbon Footprint(others )')
b1 = plt.bar(np.arange(len(data1)), data1, width=width)
b2 = plt.bar(np.arange(len(data2))+ width, data2, width=width)
l1 =plt.legend([b1], ["CH4"], loc=1)
l2 = plt.legend([b2], ["N2O"], loc=4)
gca().add_artist(l1)
plt.show()
```


Carbon Footprint(CO2)
1e−6
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Amounts
CO2e
CO2
R
Python
Matlab
Language


Carbon Footprint(others)
1e−8
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Amounts
CH4
N2O
R
Python
Matlab
Language