In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import scipy.stats as stats
from scipy.stats import ttest_1samp
from statsmodels.stats.power import tt_ind_solve_power
```

T test

A t test is inferntial statistics which is used to determine if there is a significant difference betweenthe means of two groups which may be related in certain features

T-test has 2 types: 1) One sampled t test 2) Two sampled t test

```
t= (sample mean - population mean) / standard error
```

In [2]:

```
ages=[10,20,35,50,28,40,55,18,16,55,30,25,43,18,30,28,14,24,16,17,32,35,26,27,65,18,43,23,21,20,19,70]
```

In [3]:

```
ages_mean=np.mean(ages)
print(ages_mean)
```

```
30.34375
```

In [4]:

```
#Lets take sample
sample_size=10
age_sample=np.random.choice(ages,sample_size)
age_sample
```

Out[4]:

```
array([25, 43, 16, 14, 55, 43, 20, 43, 55, 20])
```

In [5]:

```
from scipy.stats import ttest_1samp
```

In [6]:

```
ttest,p_value=ttest_1samp(age_sample,30)
```

In [7]:

```
print(p_value)
```

```
0.5197410381677416
```

In [8]:

```
if p_value < 0.05:
    print("We are rejecting null hypothesis")
else:
    print("We are accepting null hypothesis")
```

```
We are accepting null hypothesis
```

In [9]:

```
df=pd.read_excel('D:/D Backup/AG/Anita G/Msc I FDS Practicals 2021/result.xlsx')
df
```

Out[9]:

	Roll No	Name	Sub1	Sub2	Sub3	Total	Result
0	101	Akash	45	45	45	135	P
1	102	Manoj	35	45	42	122	P
2	103	Mrunal	29	26	30	85	P
3	104	Saurabh	38	35	29	102	P
4	105	Ashish	41	40	34	115	P
5	106	Sudhir	46	62	41	149	P
6	107	Ria	29	48	27	104	P
7	108	Prathana	43	33	33	109	P
8	109	Mihika	37	30	38	105	P
9	110	Shaurya	33	31	41	105	P

In [10]:

```
df.describe()
```

Out[10]:

	Roll No	Sub1	Sub2	Sub3	Total
count	10.00000	10.000000	10.000000	10.000000	10.000000
mean	105.50000	37.600000	39.500000	36.000000	113.100000
std	3.02765	6.168018	10.783217	6.236096	18.241893
min	101.00000	29.000000	26.000000	27.000000	85.000000
25%	103.25000	33.500000	31.500000	30.750000	104.250000
50%	105.50000	37.500000	37.500000	36.000000	107.000000
75%	107.75000	42.500000	45.000000	41.000000	120.250000
max	110.00000	46.000000	62.000000	45.000000	149.000000

Hypothesis Testing or Significance Testing Hypothesis testing is a set of formal procedures used by statisticians to either accept or reject statistical hypotheses. Statistical hypotheses are of two types:

Null hypothesis, H0 - represents a hypothesis of chance basis.

Alternative hypothesis, Ha - represents a hypothesis of observations which are influenced by some non-random cause.

(1) check if total mean value of marks is not more than 113.

Null Hypothesis will be

Ho : mu <= 113

Alternate Hypothesis will be

Ha : mu > 113

One way hypothesis

In [11]:

```
Ho = "mu <= 113"
# alt hyp
Ha = "mu > 113"
# alpha
al = 0.01
# mu -> mean
mu = 113
# tail type
tt = 1
# data
marks = df['Total'].values
print("Ho:", Ho)
print("Ha:", Ha)
print("al:", al)
print("mu:", mu)
print(marks)
print("")
```

```
Ho: mu <= 113
Ha: mu > 113
al: 0.05
mu: 113
[135 122  85 102 115 149 104 109 105 105]
```

In [12]:

```
ts, pv = ttest_1samp(marks, mu)
print("t-stat",ts)
print("p-vals",pv)
t2pv = pv
t1pv = pv*2
print("1t pv",t1pv)
print("2t pv",t2pv)
```

```
t-stat 0.01733524930528476
p-vals 0.9865473848679749
1t pv 1.9730947697359498
2t pv 0.9865473848679749
```

In [13]:

```
if tt == 1:
    if t1pv < al:
        print("Null Hypothesis: Rejected")
        print("Conclusion:",Ha)
    else:
        print("Null Hypothesis: Not Rejected")
        print("Conclusion:",Ho)
else:
    if t2pv < al/2:
        print("Null Hypothesis: Rejected")
        print("Conclusion:",Ha)
    else:
        print("Null Hypothesis: Not Rejected")
        print("Conclusion:",Ho)
```

```
Null Hypothesis: Not Rejected
Conclusion: mu <= 113
```

Two way Hypothesis

In [14]:

```
# null hyp
Ho = "mu = 113"
# alt hyp
Ha = "mu != 113"
# alpha
al = 0.05
# mu - mean
mu = 113
```

In [15]:

```
# tail type
tt = 2
# data
marks = df['Total'].values
# print
print("Ho:", Ho)
print("Ha:", Ha)
print("al:", al)
print("mu:", mu)
print(marks)
print("")
```

```
Ho: mu = 113
Ha: mu != 113
al: 0.05
mu: 113
[135 122  85 102 115 149 104 109 105 105]
```

In [16]:

```
ts, pv = ttest_1samp(marks, mu)
print("t-stat",ts)
print("p-vals",pv)
t2pv = pv
t1pv = pv*2
print("1t pv",t1pv)
print("2t pv",t2pv)
```

```
t-stat 0.01733524930528476
p-vals 0.9865473848679749
1t pv 1.9730947697359498
2t pv 0.9865473848679749
```

In [17]:

```
if tt == 1:
    if t1pv < al:
        print("Null Hypothesis: Rejected")
        print("Conclusion:",Ha)
    else:
        print("Null Hypothesis: Not Rejected")
        print("Conclusion:",Ho)
else:
    if t2pv < al/2:
        print("Null Hypothesis: Rejected")
        print("Conclusion:",Ha)
    else:
        print("Null Hypothesis: Not Rejected")
        print("Conclusion:",Ho)
```

```
Null Hypothesis: Not Rejected
Conclusion: mu = 113
```

AB Testing

AB testing is essentially an experiment where two or more variants of a page are shown to users at random, and statistical analysis is used to determine which variation performs better for a given conversion goal.

In [18]:

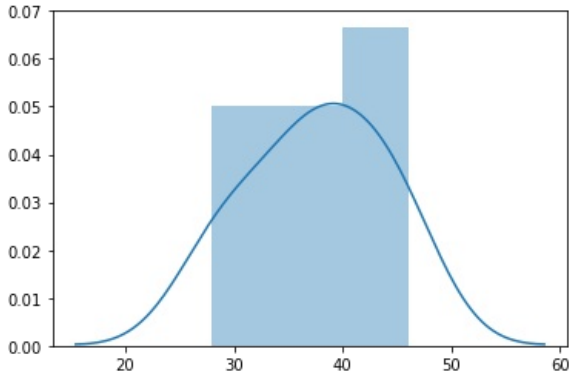
```
subj1 = np.array([45,36,29,40,46,37,43,39,28,33])
subj2 = np.array([40,20,30,35,29,43,40,39,28,31])
```

In [19]:

```
sns.distplot(subj1)
```

Out[19]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x15617b3d0d0>
```

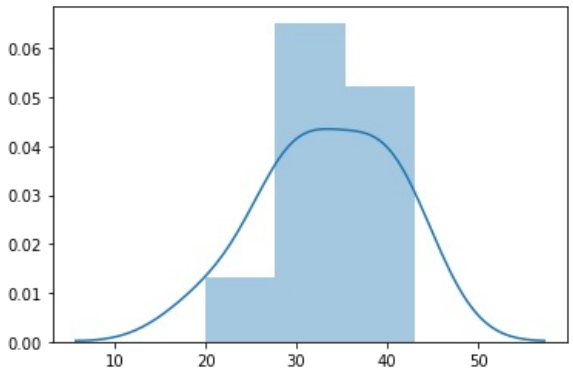


In [20]:

```
sns.distplot(subj2)
```

Out[20]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x156193c75e0>
```



The two hypotheses for this particular two sample t-test are as follows:

H0: μ1 = μ2 (the two population means are equal)

HA: μ1 ≠μ2 (the two population means are not equal)

In [21]:

```
t_stat, p_val= stats.ttest_ind(subj1,subj2)
t_stat , p_val
```

Out[21]:

```
(1.365908039538178, 0.18879292981719703)
```

In [22]:

```
#perform two sample t-test with equal variances
stats.ttest_ind(subj1, subj2, equal_var=True)
```

Out[22]:

```
Ttest_indResult(statistic=1.365908039538178, pvalue=0.18879292981719703)
```

The t test statistic is 1.3659 and the corresponding two-sided p-value is 0.1887. Because the p-value of our test (0.1887) is greater than alpha = 0.05, we fail to reject the null hypothesis of the test.

We do not have sufficient evidence to say that the mean marks of sub1 and subj2 between the two is different.

In [ ]:

```

```