**EXERCISE 1.**The hourly wages in a particular industry are normally distributed with mean $13.20 and standard deviation $2.50. A company in this industry employs 40 workers, paying them an average of $12.20 per hour. Can this company be accused of paying substandard wages? Use an α = .01 level test. *(Wackerly, Ex.10.18)*

*CHECK: statistic: -2.5298221281347035, pvalue= 0.005706018193000826*

*xbar= 12.20 # sample mean*

*s = 2.5 # pop. std*

*n = 40 # sample sayısı n>30 olduğundan dolayı z testini kullandım.*

*#left tailed bir dağılım söz konusu.*

*alfa=0.01*

H0: mu = 13.20

H1: mu < 13.20

z\_test = (xbar-13.20)/ (s/np.sqrt(n))

z\_test -2.5298221281347035

p\_value = stats.norm.cdf(z\_test)

p\_value 0.005706018193000826

alpha = 0.01

if p\_value < alpha:

print("Reject the Null")

else:

print("Fail to reject")

Reject the Null

Bu durumda bahse konu iş kolunda saatlik ücretin % 90 güvenilirlikle istatiksel anlamda 13.20 nin altında olması gerekir ve bu durumda bu iş kolunda faaliyet gösteren fabrikada seçilen çalışanların 12.20 saatlik ücret alıyoruz diye firmayı şikayet edemezler.

**EXERCISE 2.**Shear strength measurements derived from unconfined compression tests for two types of soils gave the results shown in the following document (measurements in tons per square foot). Do the soils appear to differ with respect to average shear strength, at the 1% significance level?

[***Results for two type of soils***](https://docs.google.com/spreadsheets/d/1f2odmgDboIVuSV-A5gmuC25ppqQ5g1OIIF4h5EOqUcI/edit?usp=sharing)

*CHECK: statistic: 5.1681473319343345, pvalue= 2.593228732352821e-06*

soil = pd.read\_csv("soil.csv", sep=",", na\_values = ".")

soil.head()

# H0: mu1 = mu2

# H1: mu1 != mu2

n1 = 30

xbar1= soil.Soil1.mean() 1.6918

std1 = soil.Soil1.std() 0.20690284243310078

n2 = 35

xbar2= soil.Soil2.mean() 1.4171142857142855

std2 = soil.Soil2.std() 0.2191842860711146

sp2=((std1\*std1\*(n1-1))+(std2\*std2\*(n2-1)))/(n1+n2-2)

sp2 0.04563292607709749

t\_test1= (xbar1-xbar2)/np.sqrt((sp2/n1)+(sp2/n2))

t\_test1 5.168147331934331

p\_value = 2\*stats.t.cdf(-t\_test1, 63) #two tailed bir dağılım olduğundan küçük olan değeri 2 ile çarptık.

p\_value 2.5932287323528494e-06

alpha = 0.01

if indTest.pvalue < alpha:

print("Reject the Null")

else:

print("Fail to reject")

Reject the Null

% 99 güvenilirlikte iki grubun ortalamaları arasında istatiksel olarak anlamlı bir fark vardır.

2. yöntem:

soil\_new = soil.dropna(how="any", subset=["Soil1"])

#H0: The population variances are equal

#H1: There is a difference between the variances in the population

leveneTest = stats.levene(soil\_new.Soil1, soil.Soil2)

leveneTest LeveneResult(statistic=0.31486292982090475, pvalue=0.5767018253541134)

alpha = 0.01

Burada pvalue alfadan büyük çıktığından dolayı H0 hipotezini fail to reject yani reddemiyoruz. İki grubun varyansları arasında anlamlı bir farklılık yokmuş diyebiliriz.

# H0: mu1 = mu2

# H1: mu1 != mu2

indTest = stats.ttest\_ind(soil\_new.Soil1, soil.Soil2)

indTest Ttest\_indResult(statistic=5.1681473319343345, pvalue=2.593228732352821e-06)

alpha = 0.01

if indTest.pvalue < alpha:

print("Reject the Null")

else:

print("Fail to reject")

Reject the Null

% 99 güvenilirlikte iki grubun ortalamaları arasında istatiksel olarak anlamlı bir fark vardır.

**EXERCISE 3.**The following dataset is based on data provided by the World Bank (https://datacatalog.worldbank.org/dataset/education-statistics). World Bank Edstats.  [***2015 PISA Test Dataset***](https://docs.google.com/spreadsheets/d/14rVnIUfEm3CuK9bSvS5253RHWzQhXOuNc0I-cCkgpR8/edit?usp=sharing)

1. Get descriptive statistics (the central tendency, dispersion and shape of a dataset’s distribution) for each continent group (AS, EU, AF, NA, SA, OC).
2. Determine whether there is any difference (on the average) for the math scores among European (EU) and Asian (AS) countries (assume normality and equal variances). Draw side-by-side box plots.

*CHECK: statistic=0.870055317967983, pvalue=0.38826888111307345*

*df = pd.read\_csv("2015 PISA Test - Sheet1.csv", sep=",", na\_values = ".")*

*df.head(5)*

*df.groupby("Continent\_Code", axis=0, as\_index=True).describe()*

*dfmath = df.loc[:,["Continent\_Code","Math"]]*

*dfmath*

*dfeu = dfmath[dfmath.Continent\_Code=="EU"]*

*dfeu.head()*

*dfas = dfmath[dfmath.Continent\_Code=="AS"]*

*dfas.head()*

*# H0: mu1 = mu2*

*# H1: mu1 != mu2*

*normal dağılım gösterdiği ve varyans homojenliğine sahip olduğu belirtildiğinden dolayı bunlar için hipotez kurulmamıştır.*

*indTest = stats.ttest\_ind(dfeu.Math, dfas.Math)*

*indTest* Ttest\_indResult(statistic=0.870055317967983, pvalue=0.38826888111307345)

*alpha = 0.05*

*if indTest.pvalue < alpha:*

*print("Reject the Null")*

*else:*

*print("Fail to reject")*

Fail to reject

*H0 hipotezini reddedemiyoruz. Bundan dolayı % 95 güvenilirlikte iki bölgenin math ortalamaları arasında istatiksel olarak anlamlı bir fark yoktur diyebiliriz.*

**EXERCISE 4.**The sample dataset has placement test scores (out of 100 points) for four subject areas: English, Reading, Math, and Writing. Students in the sample completed all 4 placement tests when they enrolled in the university. Suppose we are particularly interested in the English and Math sections, and want to determine whether students tended to score higher on their English or Math test, on average. We could use a paired t test to test if there was a significant difference in the average of the two tests.

[***Sample Dataset 2014***](https://docs.google.com/spreadsheets/d/101-7v9ljXKHkRL5j2xFT2yfncHNw7PZcD5kBfrXcv90/edit?usp=sharing)

*CHECK: statistic=36.312568981719856, pvalue=3.0710987192210606e-128*

df = pd.read\_csv("students\_2014 - students\_2014.csv", sep=",", na\_values = ".")

df = df.loc[:,["ids","Math","English"]].dropna()

df.English.value\_counts(dropna=False)

# H0: d\_bar = 0 MUmath = MUenglish

# H1: d\_bar != 0

pairedtest = stats.ttest\_rel(df.English, df.Math, alternative="two-sided")

pairedtest

alpha = 0.05

if pairedtest.pvalue < alpha:

print("Reject the Null")

else:

print("Fail to reject")

Reject the Null

pvalue alfadan küçük olduğundan dolayı H0 hipotezini reddediyoruz.

% 95 güvenilirlikle English testinin ortalaması ile Math testinin ortalaması arasında istatiksel olarak anlamlı bir fark vardır.