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STAT 460
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9.3.36

The work for the given problem is shown below. The data sets and the difference of the data sets are shown in cell 1 along with the number of observations and the relevant RV for the t-test with n-1 degrees of freedom.

The summary of the sample statistics is shown as the output of cell 2 along with the t-test results below. It can be concluded that with a p-value = 0.064 which is greater than our significance level of 0.01, we fail to reject the null hypothesis. There is not sufficient evidence that the mean difference between unabraded and abraded condition breaking loads (in kg/25 mm width) is different from 0.

```
data1 = np.array([36.4,55.0,51.5,38.7,43.2,48.8,25.6,49.8])
data2 = np.array([28.5,20.0,46.0,34.5,36.5,52.5,26.5,46.5])
d     = data1 - data2

n = len(d)
T = common.T(n-1)
```

```
dbar = np.mean(d)
std  = np.sqrt(n/(n-1))*np.std(d)
std_err = std/np.sqrt(n)

t = (dbar - 0)/std_err
alfa = 0.01
p = 1 - T.cdf(t)
print('n =',n)
print('dbar =',dbar)
print('std =',std)
print()
print('t =',t)
print('p-value =',p)
print('Reject H0:',p<alfa)
```

```
n = 8
dbar = 7.25
std = 11.86278695272381

t = 1.7286070074537991
p-value = 0.0637553997390875
Reject H0: False
```

9.4.52

The work is shown below in the first screenshot for this problem, and the conclusions are shown in the second screenshot. A 95% confidence level was chosen since it is the most moderate, but it may be prudent to select a different confidence level based on the implications of the study.

```
n1  = 395
s1  = 224
p1h = s1/n1
q1h = 1-p1h

n2  = 266
s2  = 126
p2h = s2/n2
q2h = 1-p2h
```

```
def CI(CL):
    Z    = common.NORMAL(0,1)
    alfa = (1-CL)
    z    = abs(Z.percentile(alfa/2))
    unc  = z*np.sqrt(p1h*q1h/n1 + p2h*q2h/n2)
    return (p1h-p2h)-unc,(p1h-p2h)+unc,

for _ in [0.9,0.95,0.99]:
    lower,upper = CI(_)
    print('''
    At the %d%% confidence level, we find that the difference
    in the proportion of elementary and high school teachers
    who are very satisfied with their work is between %.3f and
    %.3f.'''%(_*100,lower,upper))

print('''
    -> Taking the 95% confidence level as the most moderate,
    we conclude that the elementary school teachers are, on
    average, more statisfied with their work than high school
    teachers.''')
```

```
At the 90% confidence level, we find that the difference
in the proportion of elementary and high school teachers
who are very satisfied with their work is between 0.028 and
0.158.

At the 95% confidence level, we find that the difference
in the proportion of elementary and high school teachers
who are very satisfied with their work is between 0.016 and
0.171.

At the 99% confidence level, we find that the difference
in the proportion of elementary and high school teachers
who are very satisfied with their work is between -0.008 and
0.195.

-> Taking the 95% confidence level as the most moderate,
we are 95% confident that elementary school teachers are, on
average, more statisfied with their work than high school
teachers.
```