1) A population of students each took two different tests, A sample of 30 students was taken from the population and their scores on the two tests were recorded. A product moment correlation coefficient of 0.4125 was calculated.

Test whether or not this shows evidence of positive correlation between the test scores:

a) at the 5% level

b) at the 1% level

$H_0 : \rho = 0$

$H_1 : \rho > 0$

$n = 30$

$r = 0.4125$

a)

From the table, critical values of r for a 5% significance level with a sample size of 30 students are r = +/- 0.3061, so the critical region is when $r > 0.3061$

$0.4125 > 0.3061$. The observed value of r lies outside of the critical region, so there is not enough evidence to reject the null hypothesis at the 5% significance level, meaning there is not sufficient evidence to claim their is correlation between the results of the two exams.

From the table, critical values of r for a 1% significance level with a sample size of 30 students are r = +/- 0.4226, so the critical region is when $r > 0.4226$

$0.4125 < 0.4226$ The observed value of r lies within the critical region, so there is enough evidence to reject the null hypothesis at the 1% significance level, meaning there is sufficient evidence to claim their is correlation between the results of the two exams.

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3) The table shows the engine sizes, E litres, and fuels economies, M miles per gallon, for a sample of six cars

a) Calculate the product moment correlation coefficient for these data, correct to 3 sf figures

b) For these data, test $H_0 : \rho = 0$ against $H_1 : \rho \neq 0$, using a 5% significance level

c)

$r = 0.72776348...$

$r = 0.728$ 3sf

b)

From the table, critical values of r for a 5% significance level with a sample size of 6 students are r = +/- 0.7293, so the critical region is when $r < -0.7293$ or $r > 0.7293$

$0.728 < 0.729$. The observed value of r lies outside of the critical region, so there is not enough evidence to reject the null hypothesis at the 5% significance level, meaning there is sufficient evidence to claim their is correlation between the size of an engine and the miles per gallon

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5) A city council collects data on the population densities i ndifferent areas of the city, in people per hectare, and the distances of those areas from city centre, in km. It calculates the product moment correlation coefficient between the two sets of data and finds it to be -0.51

Given that the council collected data from 24 sample areas, test, at the 1% level of significance the claim that there is a negative correlation between population density and the distance from the city centre. State your hypothesis clearly.

$H_0 : \rho = 0$

$H_1 : \rho < 0$

$n = 24$

sig level = 1%

$r = -0.51$

From the table, critical values of r for a 1% significance level with a sample size of 24 sample areas are r = -/+ 0.4716, so the critical region is when $r < -0.4716$

$-0.4716 < -0.51$. The observed value of r is lies outside of the critical region, so there is not enough evidence to reject the null hypothesis at the 1% significance level, meaning there is not sufficient evidence to claim their is correlation between population density and distence from city centres.

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7) Data on the daily mean temperature and the rainfall is taken from the large data set for Perth in August 2015. A meteorologist finds that the product moment correlation coefficient for these data is -0.833. Given that the researcher tests for negative correlation at the 0.5% level of signifcance, and concludes that the value is signifcant, find the smallest possible sample size.

$H_0 : \rho = 0$

$H_1 : \rho < 0$

$n = unknown$

sig level = 0.5%

$r = -0.8330$

From the table, critical values of r for 0.5% significance level with a sample size of unknown must be (since the meteoroligists concluded significant) r < -0.8330. The first result less than 0.8330 is 0.7977, which means the sample was 9

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8) The mercalli scale and the richter scale are both used to measure earthquakes. The mercalli scale is based on structural damage to buildings and the richter scale is based on the amplitude of the ground vibrations. The table shows data from eight earthquakes

a) calculate, to 3 dp, the product moment correlation coefficient between M and R

It is suggested that there is linear correlation between the structural damage and ground vibrations caused by an earthquake.

b) Test this suggestion at the 1% significance level, stating your null and alternate hypotheses clearly.

c)

$r = 0.812426158...$

$r = 0.812$ 3sf

b)

$H_0 : \rho = 0$

$H_1 : \rho \neq 0$

sig level = 0.5% (1% /2)

$n = 8$

From the table, the critical values of r for 0.5% significance level with a sample size of 8 earthquakes are r=+/- 0.8343. So the critical regions are when $r < -0.8343$ or $r > 0.8343$

$0.8124 < 0.8343$. The observed value of r lies outside of the critical region, so there is not enough evidence to reject the null hypothesis at the 1% significance level, meaning there is sufficient evidence to claim there is linear correlation between the structural damage and ground vibrations caused by an earthquake.