

Section 2: Testing for correlation

Exercise level 3 (Extension)

1. The table gives the altitude x (in metres) above sea level and the mean air temperature y (in °C) for 10 weather stations taken at random.

x	2	7	12	40	76	99	135	163	235	307
y	9.7	10.7	9.9	10.4	9.5	9.2	9.2	9.4	8.7	7.5

- Draw a scatter diagram of the data of y against x .
 - Calculate the mean values of x and y . Mark (\bar{x}, \bar{y}) on the diagram and draw the line of regression of y on x by eye through the mean point.
 - Calculate the correlation coefficient from a calculator or spreadsheet.
 - From your diagram estimate the equation of your line of regression in the form $y = a + bx$.
 - Estimate the mean air temperature at places a) 200m and b) 450m above sea level.
2. In an attempt to increase the yield (kg/h) of a process, the percentage of a certain additive, x , is varied by a technician, while keeping other conditions as constant as possible.

% additive	x	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
yield	y	127.6	130.2	132.7	133.6	133.9	133.8	133.3	131.9

- Calculate the product moment correlation coefficient for the data
 - Stating your hypotheses clearly, test at the 5% significance level whether there is evidence of a positive correlation between x and y within the whole population.
 - Draw a scatter diagram of the data of y against x
 - Draw a line of regression through the data, using the mean value (\bar{x}, \bar{y}) as one point on this line.
 - The technician reports that an effective way to increase the yield is to make the percentage additive as large as possible. Criticise the report.
3. It is suspected that two quantities Q and W are related according to the formula $Q = aW^b$ where a and b are constants.

Observations of Q and W were made as follows.

W	13	16	20	25	32	40	50	60
Q	71	40	50	32	24	31	25	16

- Show that the formula is equivalent to $\log_{10} Q = \log_{10} a + b \log_{10} W$
- Plot a scatter diagram of $\log_{10} Q$ against $\log_{10} W$
- Estimate the equation of the line of regression of $\log_{10} Q$ on $\log_{10} W$ by drawing an estimate of the line going through the mean point.
- Estimate a and b .

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4. The mass of the heart and the mass of the liver in mice is sampled as follows. The mass is given in units of 0.01g.

Heart	20	16	20	21	26	24	18	18
Liver	230	126	203	241	159	230	140	242

Test at the 5% significance level whether this provides evidence that the masses of heart and liver in mice are positively correlated.