3: Statistical models are a cheap and quick way to make predictions about real-world situations.

(a) Give one other reason why statistical models are used.

(1)

Madison wants to develop a model to describe the relationship between the average daily temperature, t °C, and a household's daily gas consumption, d m^3, in winter.

Madison takes a random sample of 12 days in winter and codes the daily gas consumption so that $w = 11.5d$

These data are summarised as follows

$$S_{tt} = 26.43 \qquad S_{tw} = -91.55 \qquad \sum w = 339.25 \qquad \sum t = 9.1 \qquad \sum w^2 = 10\,036.45$$

(b) Show that $S_{ww} = 445.57$ to 2 decimal places.

(1)

(c) Find the value of S_{td} and the value of S_{dd}

(3)

(d) Find the product moment correlation coefficient between d and t

(2)

(e) Give an interpretation, in context, of your product moment correlation coefficient.

(1)

(f) Show that the equation of the regression line of w on t is

$$w = -3.46t + 30.9$$

where the values of the intercept and the gradient are given to 3 significant figures.

(3)

(g) Write down an equation of the regression line of d on t

(1)

(h) Using your equation in part (g)

(i) estimate the daily gas consumption in winter when the temperature is 2 °C

(ii) interpret the effect an increase of 1 °C in average daily temperature is expected to have on the daily gas consumption in winter.

(2)

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Question 3 continued

(Total for Question 3 is 14 marks)