2.5 Linear and Non Linear Relationships

MPM1D

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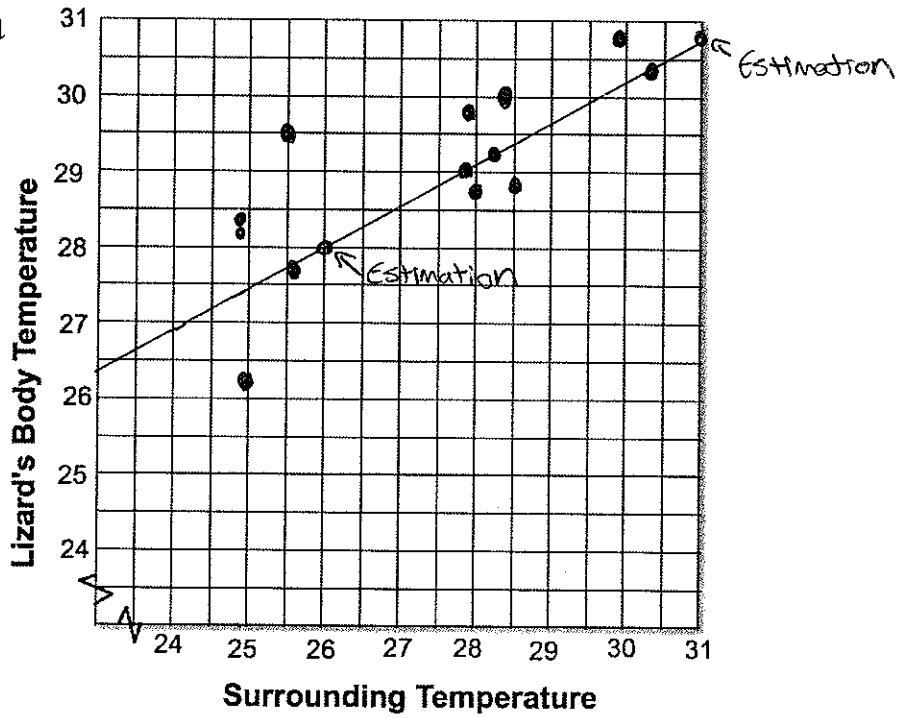
ANSWERS

Do It Now The gymnophthalmid lizard lives in the Amazon rainforest. Recent research found that this lizard keeps its body temperature close to the temperature of its surroundings. The table lists data from this research.

Surrounding Temperature (°C)	25.0	24.8	27.9	30.3	28.2	24.8	25.6	29.9	25.5	28.4	28.5	28.0	27.9
Lizard's Body Temperature (°C)	26.2	28.2	29.7	30.3	29.8	28.3	27.6	30.8	29.5	30.0	28.8	28.7	29.0

a) Graph the data



b) Draw a line of best fit

c) Estimate the lizard's body temperature if the surrounding temperature is 26°C. Is this interpolation or extrapolation?

28°C. This is interpolation.

d) Estimate the lizard's temperature if the surrounding temperature is 31 degrees Celcius. Is this interpolation or extrapolation?

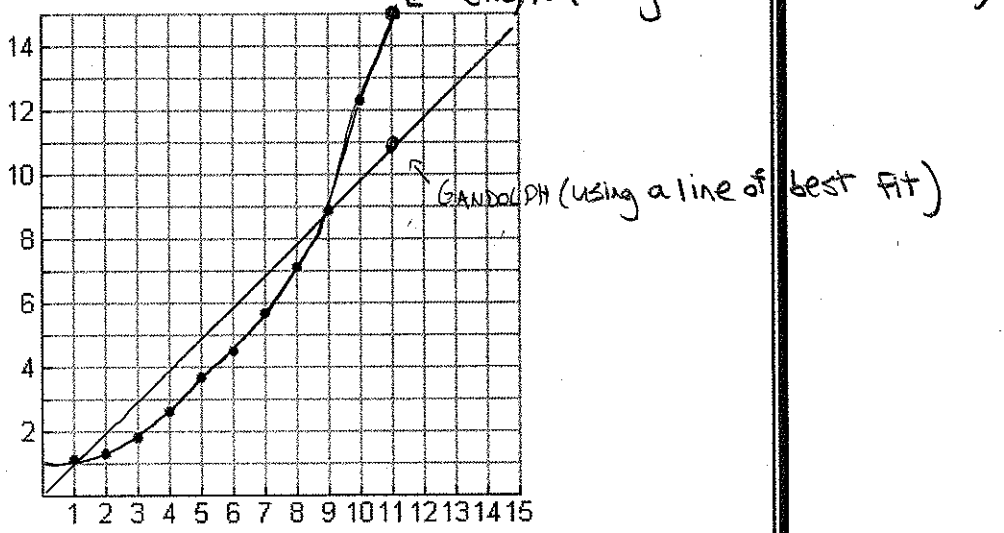
30.75°C. This is extrapolation.

Are all relationships linear? Is a line of best fit always appropriate?

Example 1:

A scatter plot of the following ten points is given below.

x	1	2	3	4	5	6	7	8	9	10
y	1.1	1.3	1.8	2.6	3.7	4.5	5.7	7.1	8.9	12.3



Gandolf predicts that when x is 11, y will be 11.
Merlyn predicts that when x is 11, y will be 15.

Who is correct? Why?

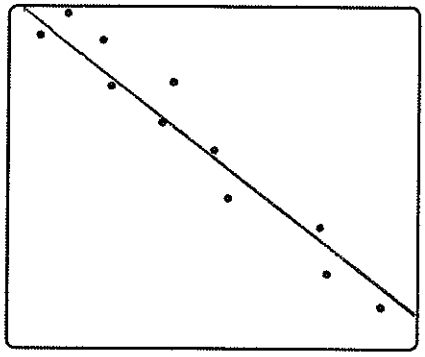
Merlyn is correct because the data does not follow a linear trend.

Many non-linear relations can be modeled with a curve of best fit.
You can draw curves of best fit using the same method as for a line of best fit. A curve of best fit should:

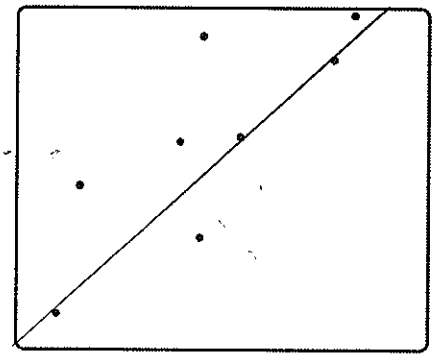
1. Pass through or close to as many points as possible,
2. Any points that are not on the curve should be distributed evenly above and below it.

Example 2: Describing Scatter Plots and Lines/Curves of Best Fit

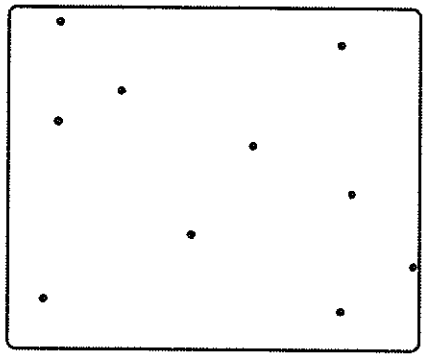
Draw a line or curve of best fit for each of the scatter plots below, if possible. Write two or three key words to describe each relation on the line below the scatter plot. (*positive relationship, negative relationship, no relationship, strong, weak, linear, non-linear*)



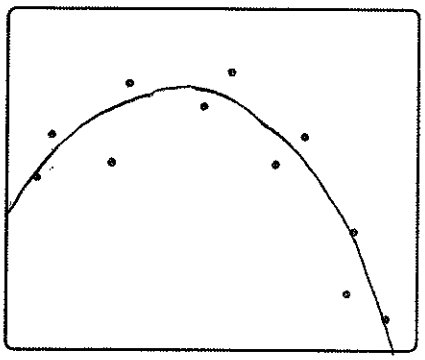
a) negative, strong, linear



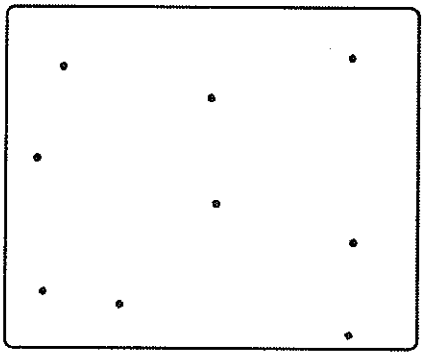
b) Positive, weak, linear



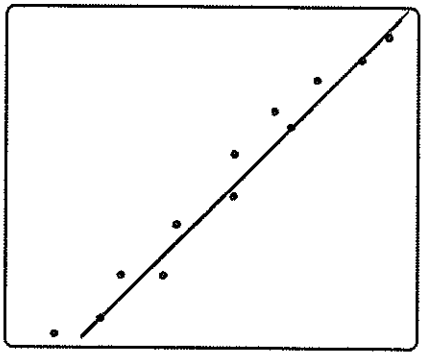
c) no relationship



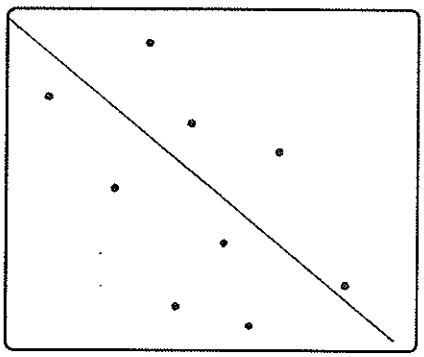
d) non-linear



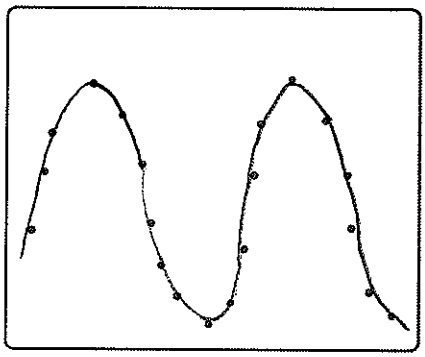
e) no relationship



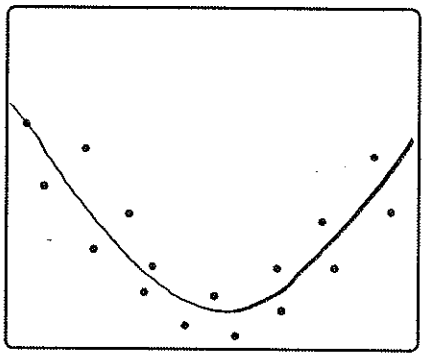
f) strong, positive, linear



g) weak, negative, linear



h) non-linear

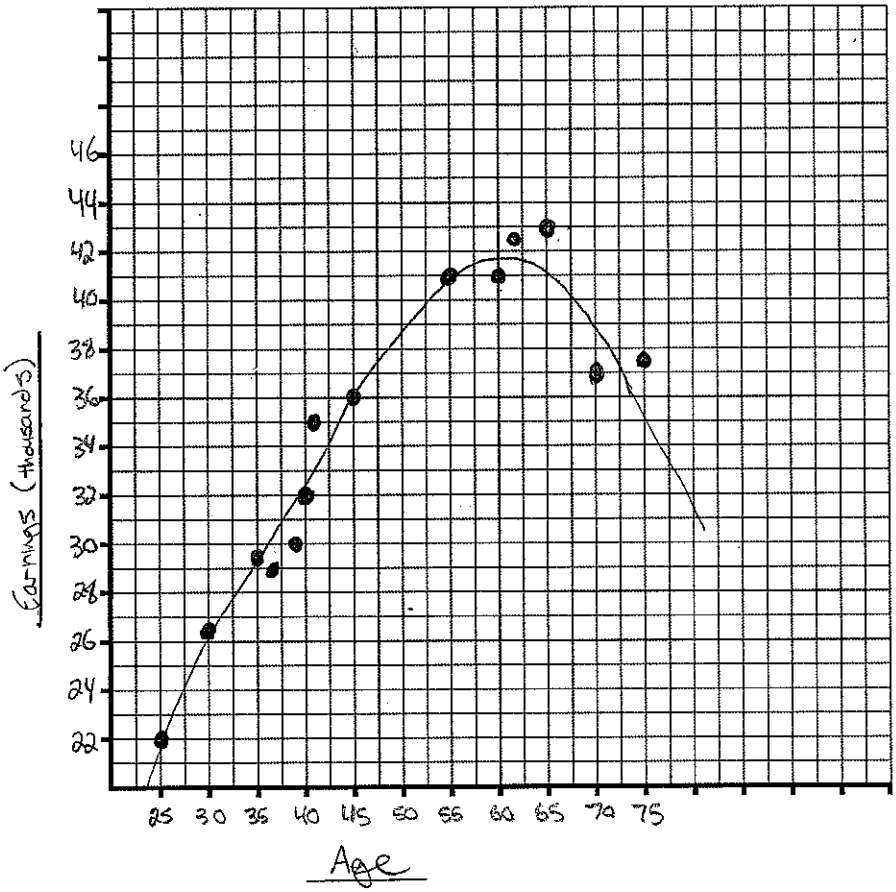


i) non-linear

Example 3: Test the hypothesis: The older you are, the more money you earn.

Plot the data on the scatter plot below, choosing appropriate scales and labels.

Age	Earnings ($)
25	22000
30	26500
35	29500
37	29000
38	30000
40	32000
41	35000
45	36000
55	41000
60	41000
62	42500
65	43000
70	37000
75	37500



a) Draw a curve of best fit. Describe the trend in the data.

Non-linear. Earnings increase up to age 65, then they decrease with age.

b) Does the data support the hypothesis? Give reasons to support your answer.
(Refer to the scatter plot.)

No, after the age of 65 you start to earn less money.

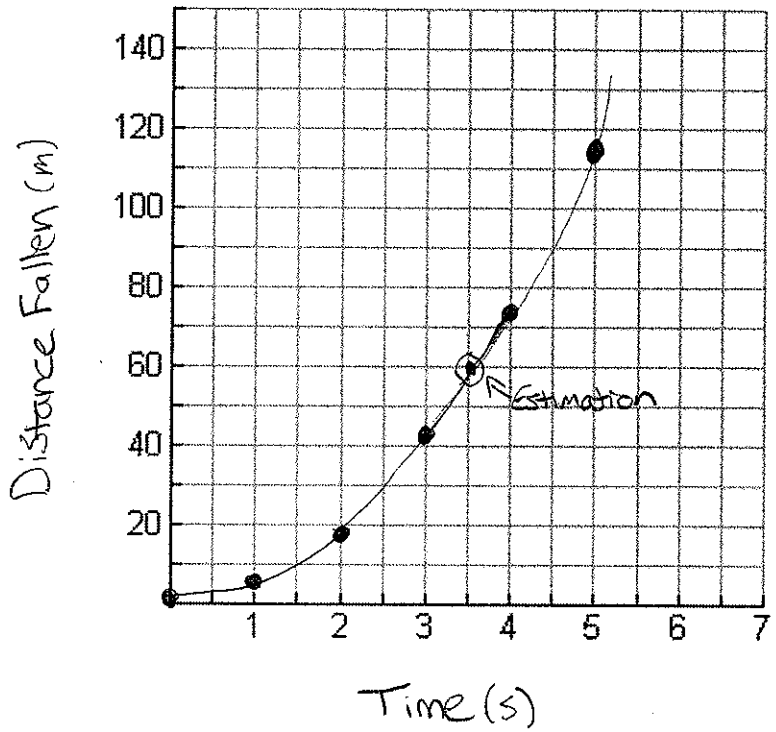
c) Explain why the data for ages over 65 do not correspond with the hypothesis.

That is a common time for retirement.

Example 4: A skydiver jumps from an airplane. The distance fallen and time taken are recorded in the table.

Time (s)	Distance (m)
0	0
1	5
2	19
3	42
4	74
5	115

a) Draw a scatter plot of the relation and draw a line or curve of best fit.



b) Classify the relation as linear or non-linear. Explain your choice.

Non-linear. As time increases, the rate of distance fallen is increasing. This causes the data to form a curve.

c) How far will the skydiver have fallen in 3.5 s?

60m. This is interpolation.