MATHEMATICS AND STATISTICS 1.4

Apply linear algebra in solving problems
Online practice assessment task

Fred's fishy forecast

Fred's Fish Company needs to use a local courier van company to deliver fresh fish to restaurants and shops in the Auckland region. Fred sells fish to locations in Central Auckland, the North Shore and West Auckland:

- 50% of customers are in Central Auckland, which involves distances of up to 5 km;
- 30% of customers are on the North Shore which involves distances from 5–15 km;
- 20% of customers are in West Auckland which involves distances from 15–30 km.

Ron is considering three reputable local companies which have refrigerated vans available for food deliveries: *FastCool*, *QuickChill* and *GoCold*.

Getty Images – Image Source

Each company has a different price structure according to their pick-up charge and the distances that the goods need to be transported.

- *FastCool* charges $20 to pick up the goods plus $1.80 per kilometre.
- *QuickChill* charges according to the formula $C = 1.25d + 30$, where d is the distance in kilometres and C is the cost in dollars.
- *GoCold* charges as shown on the graph below. A distance of 30 km costs $97.

Van charges
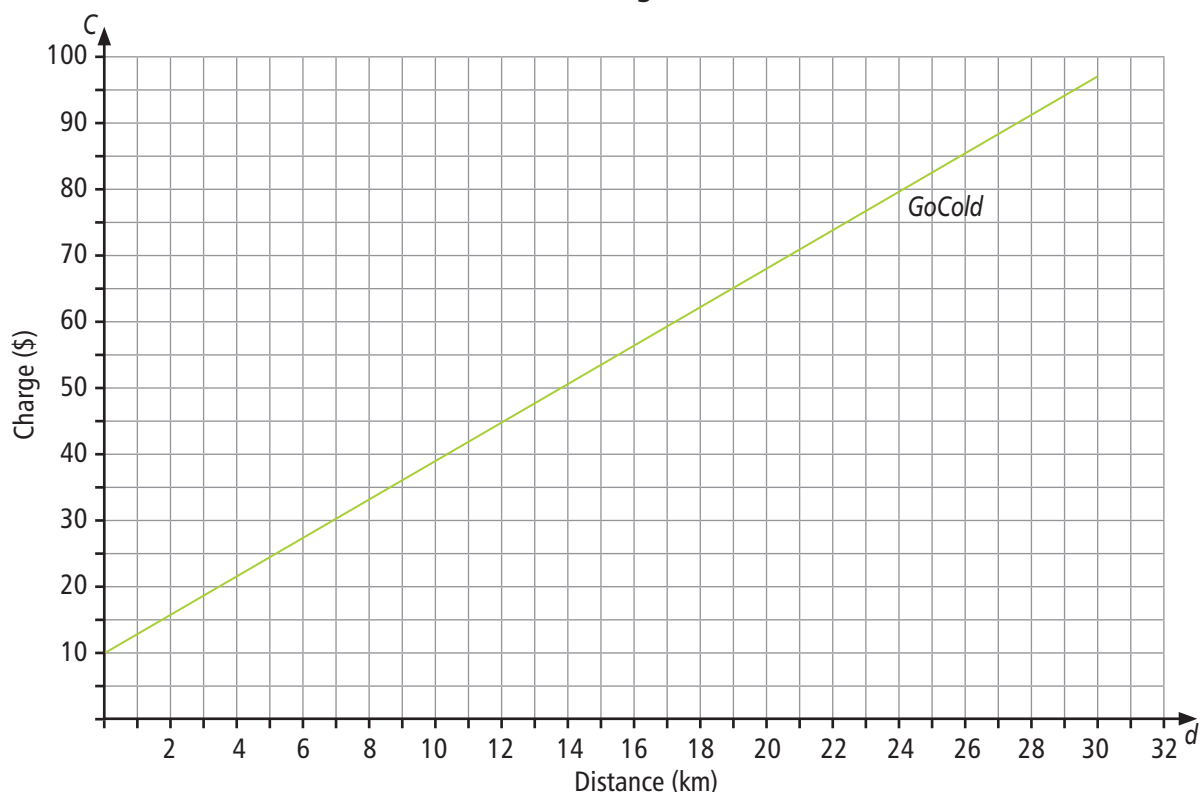
Your task is to analyse and compare the costs of the three companies so that Fred can make the best decision about which company to choose to make deliveries for his business.

Fred's fishy forecast solution

Answers will vary, examples are shown.

FastCool: has a line with gradient 1.8 (or $\frac{9}{5}$) and vertical intercept 20, so its equation is:

$C = 1.8d + 20$ or $C = \frac{9}{5}d + 20$

QuickChill: the formula $C = 1.25d + 30$ shows that the charge per kilometre is $1.25 and the pick-up charge is $30.

GoCold: the line has a vertical intercept of 10 which means that the pick-up charge is $10. The line has a gradient of $\frac{87}{30}$ or 2.9 which means that the charge per kilometre is $2.90.

So the equation of the *GoCold* line is $C = 2.9d + 10$

The graph shows the charge lines for the three companies.

Van charges
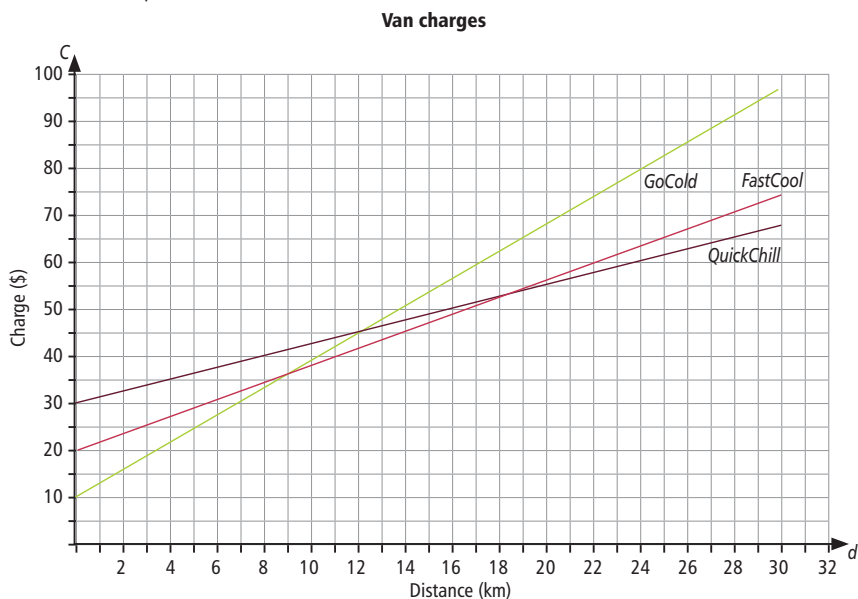
Solving simultaneously the three points of intersection on the graph have coordinates

(9.09,36.36) – this means that *GoCold* and *FastCool* both charge $36.36 for 9.09 km

(12.12,45.15) – this means that *GoCold* and *QuickChill* both charge $45.15 for 12.12 km

(18.2,52.7) – this means that *QuickChill* and *FastCool* both charge $52.70 for 18.2 km

- *GoCold* is cheapest for distances up to 9.1 km
- No van company is cheaper than *FastCool* for distances of 9.1–18.2 km.
- *QuickChill* is cheapest for distances over 18.2 km.

Only 20% of deliveries are over 15 km, so *QuickChill* is not a good choice as it is only cheapest for longer distances.

50% of deliveries are for distances under 5 km when *GoCold* is cheapest. Also *GoCold* is cheapest for deliveries of up to around 9 km, which could involve up to half of the North Shore deliveries (mean distance of delivery to North Shore is 10 km). So *GoCold* could be cheapest for 70–75% of Fred's deliveries.

For North Shore deliveries of 9–15 km the extra cost of using *GoCold* instead of *FastCool* is up to $6.50 per delivery (a 15 km delivery by *GoCold* is $53.50 compared to $47 from *FastCool*).

For every 100 deliveries, 50 go to Central Auckland, 30 go to the North Shore and 20 go to West Auckland. The table below shows the mean charges for the average distance to each area (e.g. distances to the North Shore are from 5–15 km which is an average distance of 10 km), plus the weighted average cost for each company, calculated using

(50 × CA + 30 × NS + 20 × WA) ÷ 100, where CA is the mean cost of a delivery to Central Auckland, etc.

Average charge			
	Central Auckland 2.5 km	North Shore 10 km	West Auckland 22.5 km	Weighted average cost
GoCold	$17.25	$39	$75.25	$35.38
FastCool	$24.50	$38	$60.50	$35.75
QuickChill	$33.13	$42.50	$58.13	$40.94

This also puts *GoCold* as the cheapest on average.

If *GoCold* could be persuaded to have no pick-up fee for longer trips to West Auckland, and/or to reduce its charge per kilometre, then *GoCold* would be a clearer winner for Fred.