S1 JUNE 11

1) $S_{yy} = \Sigma y^2 - (\Sigma y)^2 \div n = 4305 - 181^2 \div 8 = 209.875$ (2)

b) $r = \dfrac{S_{xy}}{\sqrt{S_{xx} \times S_{yy}}} = \dfrac{-23726.25}{\sqrt{209.875 \times 3535237.5}} = \underline{-0.871}$ (2)

c) evidence to suggest negative corellation, the higher the height above sea level, the lower the temperature. (1)

d) $\Sigma h = \dfrac{\Sigma x}{1000}$ $\quad \Sigma h^2 = \dfrac{\Sigma x^2}{1000^2}$

$$S_{hh} = \Sigma h^2 - \frac{(\Sigma h)^2}{n} = \frac{\Sigma x^2}{1000^2} - \frac{\left(\frac{\Sigma x}{1000}\right)^2}{n} = \frac{\Sigma x^2}{1000^2} - \frac{(\Sigma x)^2}{1000^2 n}$$

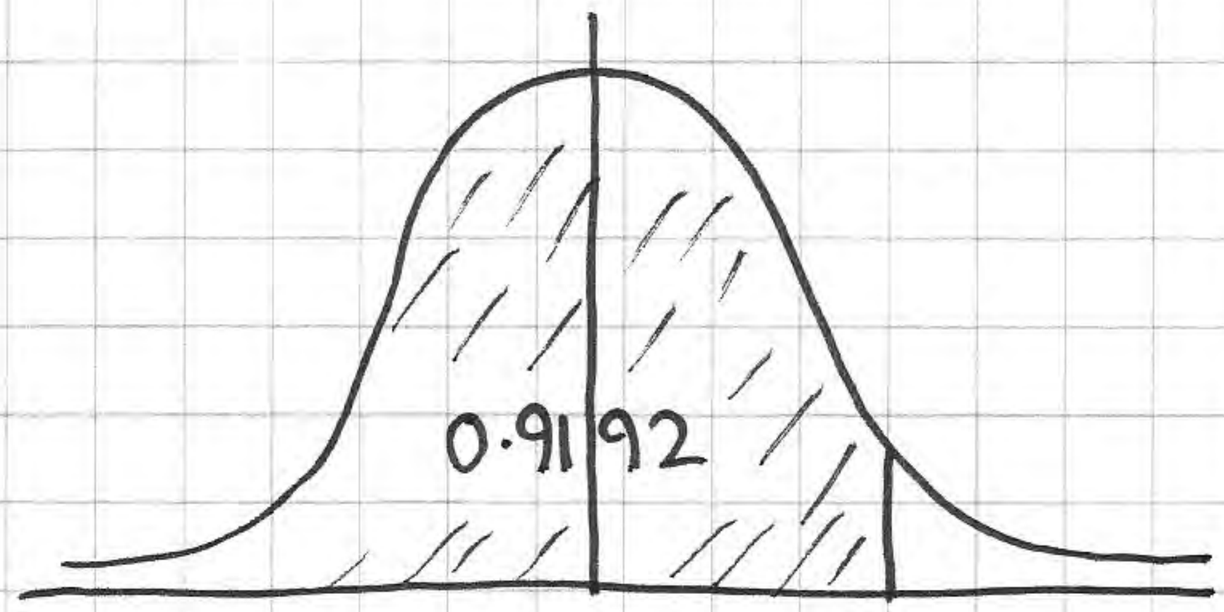
$$\Rightarrow S_{hh} = \frac{1}{1000^2}\left(\Sigma x^2 - \frac{(\Sigma x)^2}{n}\right) \Rightarrow S_{hh} = \frac{1}{1000^2} S_{xx}$$

$\Rightarrow S_{hh} = 3535237.5 \div 1000^2 = \underline{3.5352375}$ (1)

e) $r = \underline{-0.871}$ PMCC is unaffected by codings. (1)

2) $X \sim N(\mu, 5^2)$

$P(X < 23) = 0.9192$

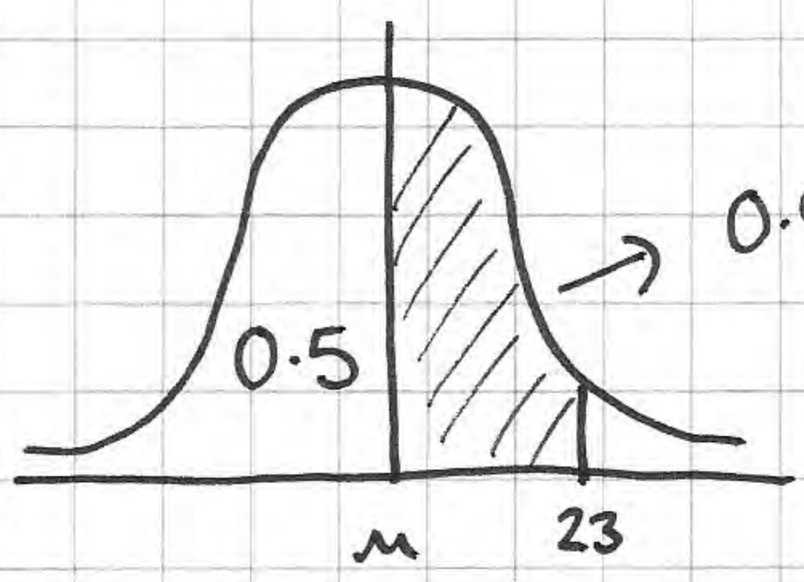


$\dfrac{23-\mu}{5} = 1.4$

$\Rightarrow 23 - \mu = 7$

$\Rightarrow \underline{\mu = 16}$ (4)

b)



$0.9192 - 0.5$

$= \underline{0.4192}$ (1)

3) $a = 0.1 \quad b = 0.4 \quad c = 0.2$ (5) ?

b)

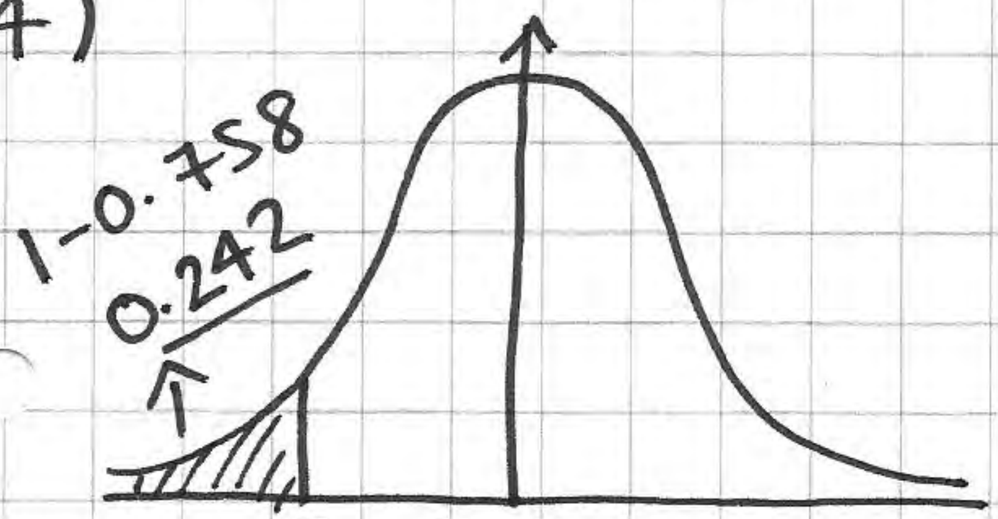
$3y+2$	5	8	11	14
p	0.1	0.4	0.3	0.2

$P(3Y+2) \geq 8$

$= 0.4 + 0.3 + 0.2$

$= \underline{0.9}$ (2)

4)



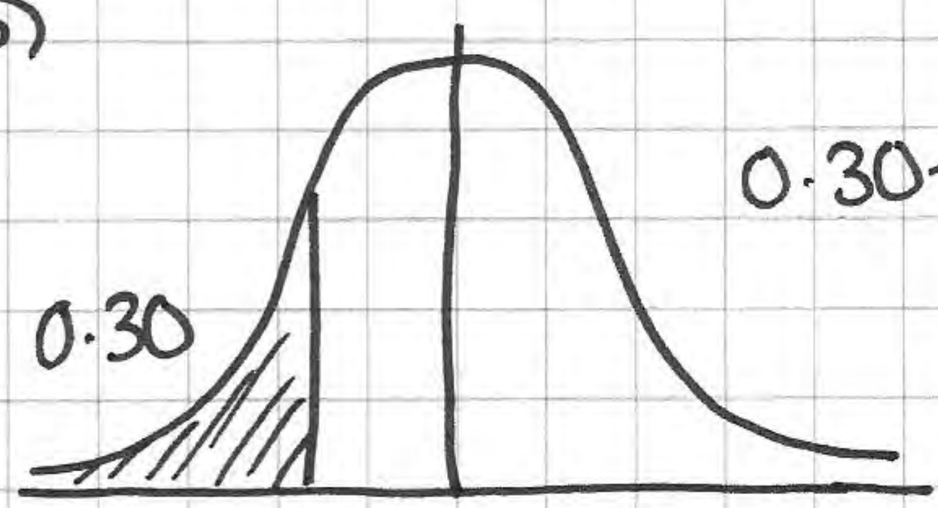
$\frac{15 - 16.12}{1.6}$

$= -0.7$

$0.7 \rightarrow 0.758$

$P(x < 15) = \underline{0.242}$ (3)

b)



$\frac{t - 16.12}{1.6} = -0.5244$

$t - 16.12 = -0.83904$

$t = \underline{15.28\,s}$ (4)

5)

Time	Mid-point, x	Frequency, f
2 - 8	5	2
9 - 12	10.5	7
13 - 15	14	5
15.5 16 - 18 18.5	17	8
19 - 22	20.5	4
23 - 30	26.5	4

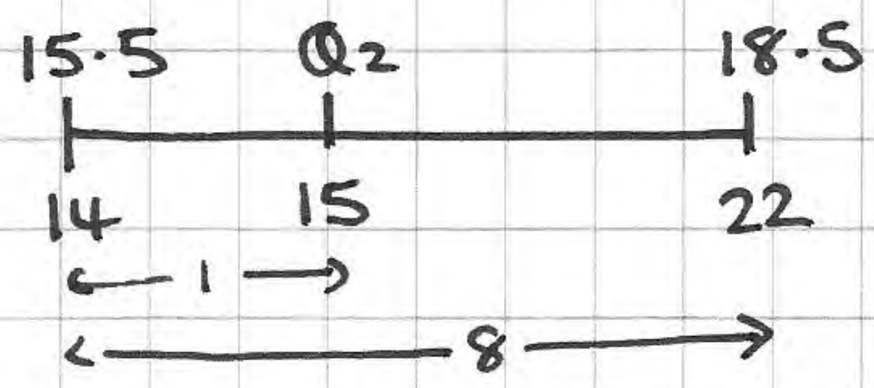
2
9
14 → 15th
22
26
30

$\Sigma f = 30$

a) 10.5 (1)

(You may use $\sum fx^2 = 8603.75$)

b)



$$\frac{Q_2 - 15.5}{3} = \frac{1}{8}$$

$$Q_2 = \frac{1}{8} \times 3 + 15.5 = 15.875$$

$$\simeq \underline{15.9} \quad (2)$$

c) $\Sigma fx = 2\times5 + 7\times10.5 + \ldots = 477.5$

$$\bar{x} = \frac{\Sigma fx}{n} = \frac{477.5}{30} = 15.916\dot{} \simeq \underline{15.9}$$

$$Sxx = 8603.75 - 477.5^2 \div 30 = 1003.541\ldots$$

$$sd = \sqrt{\frac{Sxx}{n}} = \underline{5.78} \quad (3sf) \qquad (5)$$

d) mean ≃ median data is almost symmetrically shewed.

mean $\pm$ 2 sd = (4.33, 27.5) (1)

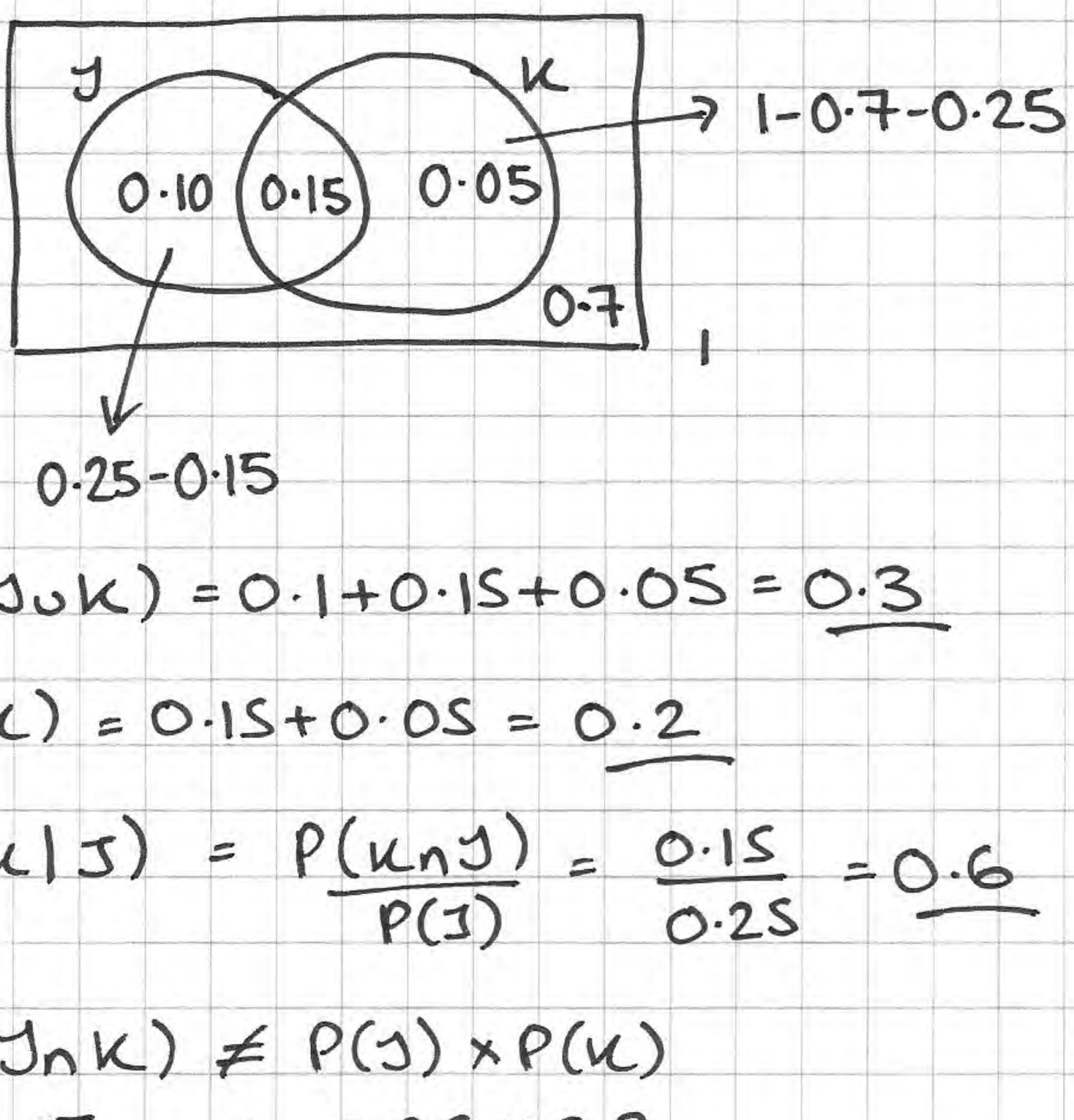
So normal distribution seems suitable.

e) $Q_2 - Q_1 < Q_3 - Q_2$

$13 - 8.5 < 21 - 13 \Rightarrow$ positive skew. (2)

$4.5 < 8$

6)



a) $P(J \cup K) = 0.1 + 0.15 + 0.05 = \underline{0.3}$ (1)

b) $P(K) = 0.15 + 0.05 = \underline{0.2}$ (2)

c) $P(K|J) = \frac{P(K \cap J)}{P(J)} = \frac{0.15}{0.25} = \underline{0.6}$ (3)

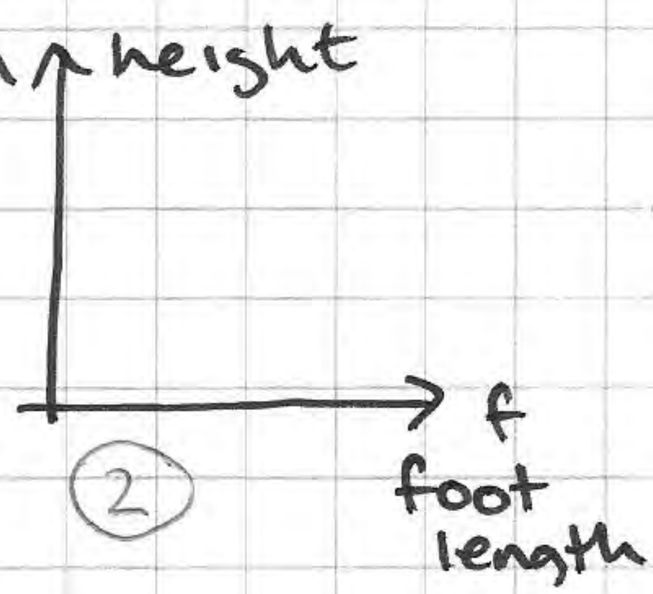
d) $P(J \cap K) \neq P(J) \times P(K)$

$0.15 \neq 0.25 \times 0.2$

$0.15 \neq 0.05 \Rightarrow$ Not Independent (2)

e) teacher's suspicions seem valid. There is evidence to suggest that one being late is dependent upon the other being late. (1)

7) $h = a + bf \Rightarrow h \to y \quad f \to x$



(2)

a) $S_{fh} = \Sigma fh - \Sigma f \times \Sigma h \div n$

$S_{fh} = 25291 - 186 \times 1085 \div 8 = \underline{64.75}$

b) $b = \frac{S_{fh}}{S_{ff}} = \frac{64.75}{39.5} = 1.63924\ldots \simeq 1.64$

$a = \bar{h} - b\bar{f} = \left(\frac{1085}{8}\right) - 1.63924\ldots \times \left(\frac{186}{8}\right) = 97.5126\ldots$

$\simeq 97.5$

$h \simeq 97.5 + 1.64f$

(5)

c) $h \approx 97.5 + 1.64 \times 25 \approx \underline{138}$ (3sf) (2)

d) It seems reasonable to assume that foot length and height are correlated, so the estimation would appear to be reliable as 25cm is within our data set. (PMCC = 0.87)

However, 8 children is a very small sample size, so recording the results for more children of a similar age would lead to more reliable estimations. (2)

e) unreliable, we only have evidence to support the estmation of a child's height. (1)

8)

S	0	1	2	4	5
P	p	0.25	0.25	0.2	0.2

a) $p = \underline{0.1}$ (2)

b) $E(S) = 0 + 0.25 + 0.5 + 0.8 + 1 = \underline{2.55}$ (2)

c) $E(S^2) = 0 + 1^2 \times 0.25 + 2^2 \times 0.25 + 4^2 \times 0.2 + 5^2 \times 0.2 = \underline{9.45}$ (2)

d) $V(S) = E(S^2) - E(S)^2 = 9.45 - 2.55^2 = \underline{2.9475}$

e) $P(5,5) = 0.2 \times 0.2 = \underline{0.04}$ (2)

f) $P(4,4,4) = 0.2 \times 0.2 \times 0.2 = 0.008$
$P(4,4,2)$
$P(4,2,4) = 3 \times 0.2 \times 0.2 \times 0.25 = \underline{0.03}$ +
$P(2,4,4)$

$\underline{0.038}$ (4)

g) $P(5',5,5)$
$P(5,5',5) = 2 \times 0.8 \times 0.2 \times 0.2 = \underline{0.064}$ (3)