

# S1 Summer 2013

$$1(i) \text{ mean } \bar{x} = \frac{\sum x}{n}$$

$$= \frac{24940}{100}$$

$$= \underline{249.4} \text{ g}$$

$$\text{standard dev. } s_x = \sqrt{\frac{\sum x^2 - n\bar{x}^2}{n-1}}$$

$$= \sqrt{\frac{6240780 - 100(249.4)^2}{99}}$$

$$= \underline{14.5} \text{ g (3.s.f.)}$$

*show full working*

$$(ii) y = 0.9x - 15 \quad \text{this is a LINEAR CODING question!}$$

$$\bar{y} = 0.9\bar{x} - 15$$

$$= 0.9(249.4) - 15$$

$$= \underline{209.5} \text{ g (4.s.f.)}$$

$$S_y = 0.9 S_x$$

$$= 0.9(\underline{14.5})$$

$$= \underline{13.0} \text{ g (3.s.f.)}$$

*remember, + constant does not affect standard deviation*

$$2(i) {}^5C_2 \times {}^5C_1 \text{ is no. of ways to choose 2W and 1M}$$

$$\frac{10}{10} C_3 \quad " " " " " \quad \text{3 people from 10}$$

$$= \frac{5}{12} = \underline{0.417} \text{ (3.s.f.)}$$

*use EXACT value*

$$(ii) X \sim \text{Bin}(4, \frac{5}{12}) \quad \rightarrow X \text{ is no. of evens with 2W and 1M}$$

*it's a good idea to state the distribution*

$$P(X \geq 3) = 1 - P(X \leq 2)$$

$$= P(X=3) \text{ or } P(X=4)$$

$$= {}^4C_2 \left(\frac{5}{12}\right)^3 \left(\frac{7}{12}\right)^1 + \left(\frac{5}{12}\right)^4$$

$$= \underline{0.199} \text{ (3.s.f.)}$$

$$2 | 3 \rightarrow 4$$

*but not on tables,  
quicker to use "3 or 4"*

$$3.(i) X \sim \text{Bin}(50, 0.1) \quad \rightarrow X \text{ is no. of underweight bags}$$

$$P(X=5) = {}^{50}C_5 (0.1)^5 (0.9)^{45}$$

$$= \underline{0.185} \text{ (3.s.f.)} \leftarrow \text{state rounding used in final answer}$$

*it's a new binomial distribution now.*

$$(ii) Y \sim \text{Bin}(20, 0.1) \quad \rightarrow Y \text{ is no. of underweight bags in box}$$

$$P(Y \geq 1) = 1 - P(Y=0)$$

$$= 1 - 0.9^{20}$$

$$= \underline{0.878} \text{ (3.s.f.)}$$

3(iii)  $Z \sim \text{Bin}(48, 0.878)$   $Z$  is no. of boxes with  $\geq 1$  underweight  
 ↗ yet another different binomial distribution

$$\begin{aligned}E(Z) &= np \\&= 48(0.878) \\&= \underline{42.2} \quad (3\text{s.f.})\end{aligned}$$

↖ make your working clear in a "show that" question

$$4.(i) P(X=15) = \frac{3}{6} \times \frac{2}{5} \times \frac{1}{4}$$

$$= 0.05$$

I used stats mode on a calculator, but it would be best to write out working to ensure marks are gained.

$$\checkmark = 15(0.05) + 1010(0.45) + \dots \text{etc}$$

$$\begin{aligned}\circ (ii) E(X) &= \sum r (P(X=r)) \\&\mu = \underline{1508} \quad (3\text{s.f.})\end{aligned}$$

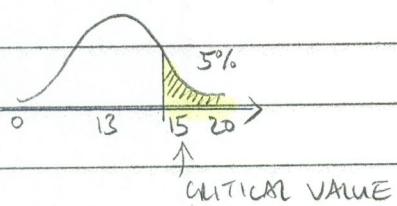
$$\begin{aligned}Var(X) &= \sum r^2 (P(X=r)) - \mu^2 \\&= 2718068 - (1508)^2 \\&= \underline{445500} \quad (4\text{s.f.})\end{aligned}$$

5(i) If just guessing, they'd be equally likely to correctly or incorrectly identify which type of water they have

(ii) We're testing to see if people "do better" than they would by just guessing.  
 ↗ find the important words from the question.  
 ↗ show full working.

○ (iii) 1-tail test, 5% sig. level

12 | 13 | 14



$$\begin{aligned}P(X \geq 13) &= 1 - P(X \leq 12) \\&= 1 - 0.8684 \\&= 0.1316\end{aligned}$$

$> 5\% \therefore 13$  does not lie in

CRITICAL REGION

or: finding critical region:

must state this!

$$P(X \geq 14) = 1 - P(X \leq 13) = 1 - 0.9423 = 0.0577 > 5\%$$

$$P(X \geq 15) = 1 - P(X \leq 14) = 1 - 0.9793 = 0.0207 < 5\%$$

Critical region is  $15 \leq X \leq 20$ .

↖ learn how to write a conclusion correctly!

Result is NOT SIGNIFICANT.  $\therefore$  Accept  $H_0$ . We DO NOT have SUFFICIENT EVIDENCE to suggest people can identify bottled or tap water.

↖ must be in context (don't just say " $H_0$ ")

6. (i) median value is  $\left(\frac{25+1}{2}\right)^{\text{th}} \text{ value} = 13^{\text{th}} \text{ value} = \underline{3.32} \text{ kg}$

$Q_1$  is  $\left(\frac{12+1}{2}\right)^{\text{th}} \text{ value} = 6.5^{\text{th}} \text{ value} = \underline{2.82 + 2.84} = \underline{2.83}$

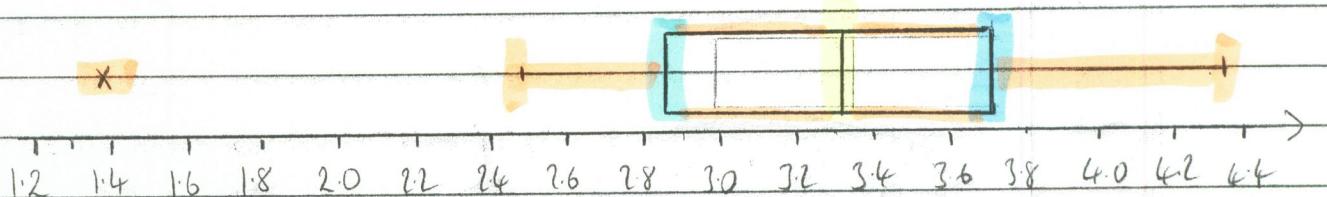
make sure you know the method MEI requires you to use to find  $Q_1$  and  $Q_3$  (it's NOT  $\frac{1}{4}$  and  $\frac{3}{4}$ ) !!

$Q_3$  is  $\left(13 + 6.5\right)^{\text{th}} = 19.5^{\text{th}}$  value =  $\underline{3.70 + 3.72} = \underline{3.71}$

$$\begin{aligned} \text{IQR} &= Q_3 - Q_1 \\ &= 3.71 - 2.83 \\ &= \underline{0.88} \text{ kg} \end{aligned}$$

show the quartiles used to find IQR

(ii) without outlier, lowest value becomes 2.50.



birth weights in kg

$\checkmark Q_3$  not the median!

$\nwarrow$  must have a correct, sensible, scale.

(iii) outliers are  $> 3.71 + 1.5(0.88) = 5.03$   $\leftarrow$  show these values  
or  $< 2.83 - 1.5(0.88) = 1.51$   $\underline{(\text{both of them!})}$

$\checkmark Q_1$  not the median!

$\therefore 1.39$  is the only outlier. No particular reason to suggest this is not a valid part of data, so do not exclude.

(iv) median is 100<sup>th</sup> value = 3.5 kg

$Q_1$  is 50<sup>th</sup> value = 3.12 kg

$Q_3$  is 150<sup>th</sup> value = 3.84 kg

again, state the values

$\text{IQR} = Q_3 - Q_1$

you're using for  $Q_1$  and  $Q_3$ .

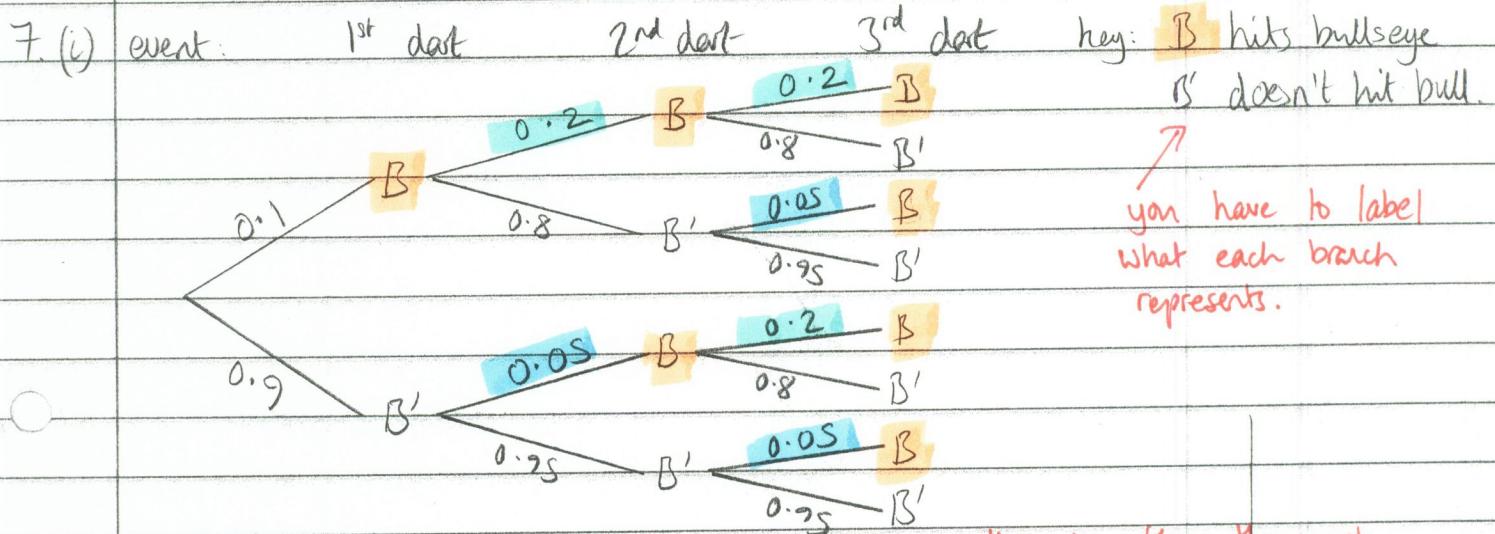
$$= 3.84 - 3.12$$

$$= \underline{0.72} \text{ kg}$$

this must be in context (use words from the question)

(v) Female babies tend to have lower weights on average than male. There is greater variation in the weights of the female babies than the male.

6. (ii) weighing more than any female  $\Rightarrow$  weighing  $> 4.34$   
 approx 9 males weigh  $> 4.34$   
 $\therefore$  prob is  $\frac{9}{200} \times \frac{8}{199} = 0.00181$  (3 s.f.)  
 must show this working!



(ii)

(A)  $P(\text{"at least one"}) = 1 - P(\text{"none"})$

 $= 1 - 0.9(0.95)^2$ 
 $= 0.188$  (3 s.f.)

(B)  $P(BBB' \text{ or } B'B'B' \text{ or } B'B'B) = 0.1(0.8)(0.95) + 0.9(0.05)(0.8) + 0.9(0.95)(0.05)$

 $= 0.155$  (3 s.f.)

(iii)  $P(\text{exactly one} | \text{at least one}) = \frac{P(\text{exactly one} \cap \text{at least one})}{P(\text{at least one})}$

 $= \frac{0.155}{0.188}$  ← using exact values
  $= 0.824$  (3 s.f.)

(iv) either hits all three with first 3 darts, or hits none in hint 3,  
 then all 3 in darts 4,5,6.

$P(BBB \text{ or } B'B'B' \text{ or } BBB)$

 $= 0.1(0.2)^2 + 0.9(0.95)^2 (0.05)(0.2)^2$ 
 $= 0.00562$ 

try to picture the scenario.  
 think carefully, write what happens in words first,  
 before trying to calculate the probability!