1) a) Because you're picking from defined quotas you may build in a bias - your selection may not be random for what you want to test.

b) Use a Binomial dist^ $X \sim B(36, 0.08)$

Then $P(X=4) = (0.08^4)(0.92^{32})\,{}_{36}C_4$

$= 0.08^4\, 0.92^{32} \times \frac{36 \times 35 \times 34 \times 33}{24}$

$= \underline{0.1674}$

$P(X \geqslant 7) = 1 - P(X \leqslant 6)$

$= 1 - 0.9776$

$= \underline{0.0224}$

c) $P(\text{can dance tango} \mid \text{member of club}) = 0.4$

So $P(\text{member of uni \& can dance tango})$

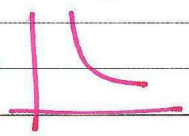
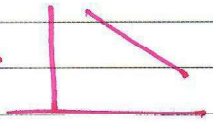
$= 0.08 \times 0.4 = \underline{0.032}$

d) We want $P(X \leqslant 2)$ where $X \sim B(50, 0.032)$

$= \underline{0.785}$

2) a) There is a (prob. quite small) negative correlation

b) The negative correlation would support Mark's thinking - though it's not necessarily causal, and it may be a small effect.

(You might even argue the curve should be  rather than 

indicating that there's an upper point in x where there's a strong preference for a low y

c) My calculation gives r, the product moment correlation, as -0.5446

- which it describes as a 'moderately negative correlation'.

d) Hypotheses:

H_0 there is no correlation
H_1 there is a negative correlation.

Use a 5% level of significance, on a sample of 16.

For this to be significant, the critical value is (-) 0.4259

So the value of -0.5446 is significant and supports Mark's hypothesis H_1.

3)a) Pressure is measured in Hecto Pascals (HPa)

b) Daily Mean Pressure mean $\mu_y = \frac{\Sigma y}{30} = \frac{214}{30}$

$= 7.133$

So 'decoding', mean $\mu_x = 1010 + \mu_y$

$= 1017.33$ HPa.

c) $SD = \sqrt{\frac{\Sigma y^2}{n} - \mu_y^2} = \sqrt{\frac{5912}{30} - 7.133^2}$

$= \sqrt{197.07 - 50.88}$

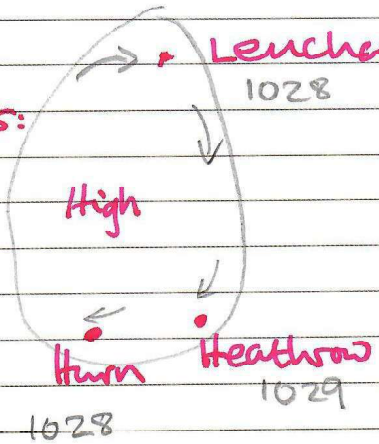
$= 12.09$

(and $SD_x = SD_y$)

So the SD of the Daily Mean Pressure is 12.09 HPa

d)

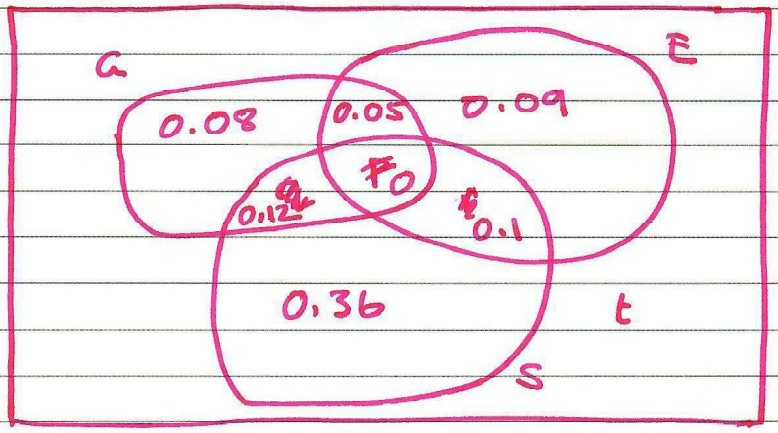
on 26/09/15:



All 3 readings are signif. higher than the mean μ_x, to the extent of 1 SD, so we can call this a region of high pressure.

So Hurn E
Heathrow NE
Leuchars W

4)



(what a palaver)

a) Prop of students reading only 1 mag

$= 0.08 + 0.09 + 0.36 = \underline{0.53}$

b) i) Since no students read all three, $P = 0$.

ii) $P(G) = 0.08 + 0.05 + P + q$

$= 0.13 + q \quad = 0.25$ (given)

So $q = \underline{0.12}$

c) $P(S|E) = \frac{5}{12}$

$P(S|E) = \frac{0 + r}{0 + r + 0.05 + 0.09} = \frac{r}{r + 0.14}$

So $5(r + 0.14) = 12r$

$0.7 = 7r \qquad \underline{r = 0.1}$

So $t = 1 - (0.08 + 0.12 + 0.05 + 0 + 0.09 + 0.1 + 0.36)$

$= 1 - 0.8$

$= \underline{0.2}$.

d) $P(S \cap E') = 0.12 + 0.36 = 0.48$. $P(G) = 0.08 + 0.05 + 0.12$

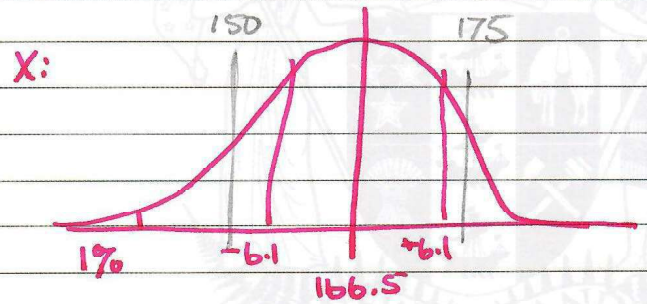
If these are ind^t then

$$P(S \cap E') \times P(G) = P((S \cap E') \cap G)$$

$$\underbrace{0.48 \times 0.25}_{0.12} = 0.12$$

So these are equal - so $S \cap E'$ and G are independent.

5) a)



Transform to the standard normal deviation

$$\bar{X} = \frac{X - 166.5}{6.1}$$

use standard table to find $\bar{x}$: $P(X \leq \bar{x}) = 1\%$

$$\bar{x} = -2.3263$$

giving $x = 152.31$

(or use a function like STDEV.INV(0.01, 166.5, 6.1) to get 152.31).

i.e. $k = 152.31$

b) We need to know:

$P(\text{height} \leq 150\text{ cm}) = \text{NORM.DIST}(150, 166.5, 6.1, \text{TRUE})$
$= 0.0034$

$P(\text{height} \leq 175\text{ cm}) = 0.9183$

So $P(150 \leq \text{height} \leq 175) = 0.9149$ ——— ①

c) And $P(\text{height} \leq 160) = 0.1433$

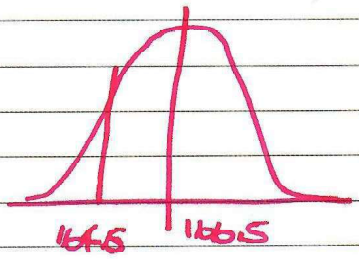
So $P(160 \leq \text{height} \leq 175) = 0.7716$ ——— ②

Putting ① & ② together:

$$P(\text{height} \geqslant 160 \mid 150 \leqslant \text{height} \leqslant 175)$$

$$= \frac{0.7716}{0.9149} = \underline{\underline{0.8434}}$$

d) The question here is:



Is a shift in mean to 164.6 significant?

We measure this using $N\left(166.5, \frac{\sigma}{\sqrt{n}}\right)$ where

$$\frac{\sigma}{\sqrt{n}} = \frac{7.4}{\sqrt{50}} = 1.0465.$$

and we use H_0 = no significant difference; H_1 = significant. and a 5% low-end sig. level. This produces a $P(x \leq 164.6)$ of 0.03471, which is < 0.05: so MIAs result is significant: there is sufficient evidence to support H_1.

6)

x	a	b	c
P(X=x)	$\log_{36} a$	$\log_{36} b$	$\log_{36} c$

$a < b < c$

a) At first this looks baffling but consider:

$\log_{36} a + \log_{36} b + \log c = 1$ since it's a prob. dist.

so $\log_{36}(abc) = 1$

or $abc = 36$

a, b, c are all integers, so they must be (unique) factors of 36, and none can be 1 since this would make $\log_{36} 1 = 0$.

So... 2, 3 and 6 are the only possibilities - giving probabilities:

i) $P(X = a) = \log_{36} 2$: $a = 2$

ii) $P(X = b) = \log_{36} 3$ $b = 3$

iii) $P(X = c) = \log_{36} 6$ $\left(= \frac{1}{2}\right)$ $c = 6$

b) $P(X_1 = X_2 = a) = (\log_{36} 2)^2 = \left(\frac{\log_{10} 2}{\log_{10} 36}\right)^2$

$+$ - - - - $b = (\log_{36} 3)^2 = \left(\frac{\log_{10} 3}{\log_{10} 36}\right)^2$

$+$ $c = (\log_{36} 6)^2 = \left(\frac{\log_{10} 6}{\log_{10} 36}\right)^2$

$= (0.0906 + 0.2276 + 0.6055) \times \frac{1}{2.4221}$

$= 0.3814$