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Stats 1 - January 2013

1. a) When $x = 0$, I would expect $a = 30$

b) i) From calc: $a = 31$ (intercept)

$b = -0.64$ (gradient)

$\rightarrow \quad y = 31 - 0.64x$

ii) Each hour the length of the candle reduces by 0.64 cm

iii) $x = 50 \rightarrow y = 31 - 0.64(50)$

$= -1$

Impossible to have negative height, so claim appears invalid.

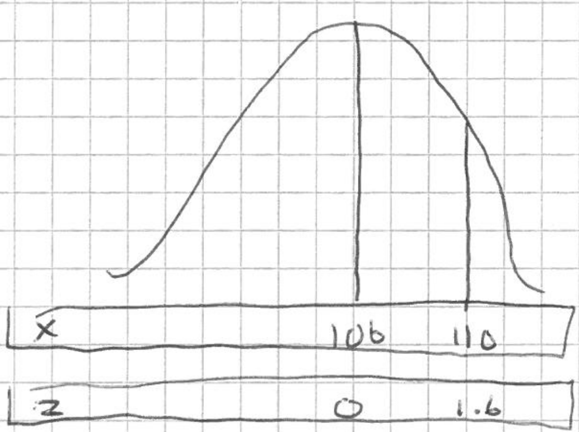
2. $X \sim N(106, 2.5^2)$

a) $P(X < 110)$

$= P\left(Z < \frac{110 - 106}{2.5}\right)$

$= P(Z < 1.6)$

$= 0.94520$



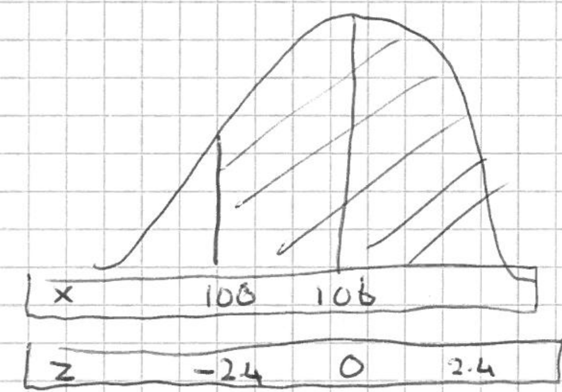
b) $P(X > 100)$

$= P\left(Z > \frac{100 - 106}{2.5}\right)$

$= P(Z > -2.4)$

$= P(Z < 2.4)$

$= 0.99180$

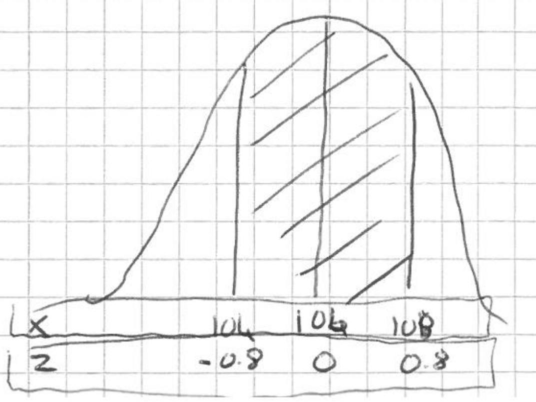


c) $P(104 < X < 108)$

$= P\left(\frac{104 - 106}{2.5} < Z < \frac{108 - 106}{2.5}\right)$

$= P(-0.8 < Z < 0.8)$

$= P(Z < 0.8) - P(Z < -0.8)$



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$= P(Z < 0.8) - (1 - P(Z < 0.8))$

$= 0.78814 - (1 - 0.78814)$

$= 0.57628$

d) $P(X = 106) = 0$

$\therefore P(X \neq 106) = 1$

(3) a) $E \sim B(40, 0.3)$

i) $P(E \leq 10) = 0.3087$ (from tables)

ii) $P(E \geq 15) = 1 - P(E \leq 14)$

$= 1 - 0.8074 = 0.1926$

iii) $P(E = 12) = {}^{40}C_{12} \times 0.3^{12} \times 0.7^{28}$

$= 0.1366$

b) $B(16, 0.20)$: MEAN $= np = 16 \times 0.2 = 3.2$

VAR $= np(1-p) = 16 \times 0.2 \times 0.8 = 2.56$

$B(16, 0.125)$: MEAN $= np = 16 \times 0.125 = 2$

VAR $= np(1-p) = 16 \times 0.125 \times 0.875 = 1.75$

c) i) From calc: $\Sigma x = 24$

$\bar{x} = 2$

$s = 1.59544\ldots \rightarrow s^2 = 2.54545\ldots$

ii) $B(16, 0.25)$: Different mean, although variance is similar

$B(16, 0.125)$: Same mean, but variance is a lot different.

$\therefore$ Neither model likely to be appropriate.

(4) a) i) From calc: $r = -0.32569\ldots$

ii) Weak negative linear correlation between marks in Paper I and Paper II

b) (1) Identify non-linear relationships.

(2) Identify any outliers

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b) ii) See Mark Scheme.

iii) Seems to be TWO separate correlations:
A to F & G to L

c) $\boxed{A \text{ to } F}$ $r = 0.9$

$\boxed{G \text{ to } L}$ $r = -0.75$

(5) a) i) $P(F \cap C) = 0.3$

ii) $P(G \cup S) = 0.3 + 0.15 = 0.45$

iii) $P(C \mid F) = \dfrac{0.3}{0.55} = 6/11$ or $0.5454\ldots$

iv) $P(R' \mid D) = \dfrac{0.25}{0.3} = 5/6$ or $0.83333\ldots$

v) $P(F \mid C') = \dfrac{0.25}{0.6} = 5/12$ or $0.41666\ldots$

b) $P(F \cap C) = 0.3$, $\therefore$ Both Days $= 0.3^2$

$P(F \cap G) = 0.25$, $\therefore$ Both Days $= 0.25^2$

$\therefore$ Total Probability $= 0.3^2 + 0.25^2 = 0.1525$

(6) a) $L \sim N(1005, 15^2)$

$\bar{L} \sim N(1005, 15^2/12)$

$P(\bar{L} < 1000)$

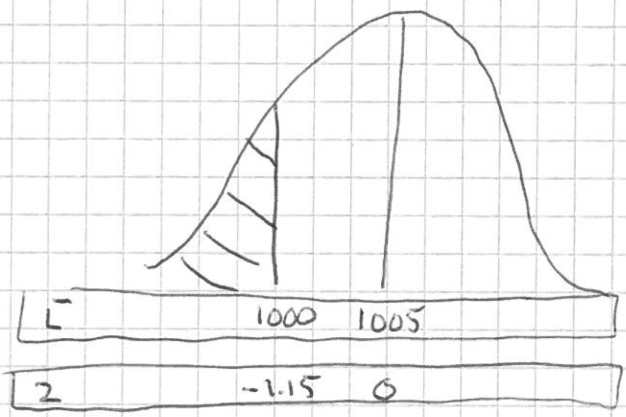
$= P\left(Z < \dfrac{1000 - 1005}{15/\sqrt{12}}\right)$

$= P(Z < -1.1547)$

$= P(Z < -1.15)$

$= 1 - P(Z < 1.15)$

$= 1 - 0.87493 = 0.12507$



b) $\bar{x} = 4.65$, $s = 0.15$, $n = 24$

99% Z multiplier (2 tailed) $= 2.5758$

$\mu = \bar{x} \pm z \times s/\sqrt{n}$

$\mu = 4.65 \pm 2.5758 \times 0.15/\sqrt{24}$

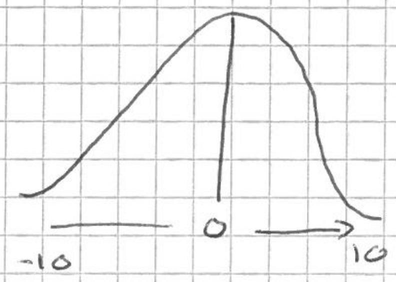
$\mu = 4.65 \pm 0.07886...$

$\mu = (4.5711, 4.7289)$

b) 4.5 lies outside the confidence interval and below the lower bound.

$\therefore$ Agree with manufacturer's claim.

7 a)



Expect vast majority of data to be within 3 SDs of mean.

$\therefore$ est $\sigma = 10/3 = 3\tfrac{1}{3}$

b) $\boxed{\text{MEAN}}$ 391 is sample mean

As machine is set to 415, this implies this is population mean.

These 2 values should be same/similar.

$\therefore$ Claim likely to be wrong

$\boxed{\text{SD}}$ 95.5g is sample SD

We have estimated population SD of $3\tfrac{1}{3}$

$\therefore$ claim also likely to be wrong.

c) Population mean $= 820$

$$\bar{y} = \frac{\sum y}{n} = \frac{8210.0}{10} = 821$$

$\therefore$ close to population mean

Population variance $= 3.3^2 = 10.89$

$$s^2 = \frac{\sum (y - \bar{y})^2}{n-1} = \frac{110}{9} = 12.222...$$

$\therefore$ close to population variance.

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