

① (a) Stratified vs Simple: • It reduces the variability as you can estimate statistics for each strata instead of the entire sample as with srs. [2]
 • Stratified sampling is more representative than simple random sampling

(b) Stratified vs Quota: • Stratified is a random process compared to quota sampling so less bias with stratified sampling. [2]
 • In quota sampling, non-responses are not recorded. So stratified sampling might be a more suitable alternative if non-responses are important statistics.

② H_0 : There is no association between catching influenza and concentration of the new drug. [10]
 H_1 : There is an association between catching influenza and concentration of the new drug.

O_i	E_i	$\frac{O_i - E_i}{E_i}$	$(O_i - E_i)^2 / E_i$	\sum
12	135/11	12.27	0.006061	So $\chi^2 = 5.61456...$
15	162/11	14.27	0.005051	$= 5.61$ (3 s.f.)
29	260/11	23.63	1.2713	$\nu = 2$
23	312/11	28.36	1.01428	C.V $\chi^2_{2} (10\%) = 4.605$
9	155/11	14.09	1.9393	So, since $5.61 > 4.605$
22	186/11	14.09	1.53275	\therefore in critical region. Reject H_0

and accept H_1 . There is significant evidence to suggest that there is an association between catching influenza and concentration of the new drug.

③ (a) When the data isn't bivariate distributed bivariate normal. [1]
 (b) $\sum d^2 = 14$ [3]
 $\Rightarrow r_s = 1 - \frac{6 \times 14}{7 \times 48}$
 $= \frac{3}{4} = 0.75$

(c) $H_0: \rho_s = 0$ } C.V: 0.7143. Since 0.75 > 0.7143 then reject H_0 [4]
 $H_1: \rho_s > 0$ } and accept H_1 . There is significant evidence to suggest that there is a positive correlation between sales of ice-cream and sales of sunglasses.

(d) $H_0: \rho = 0$ } C.V: 0.6649. Since 0.65 < 0.6649 then accept H_0 . [2]
 $H_1: \rho > 0$ } There is insignificant evidence to suggest that there is a positive correlation between sales of ice-cream and sunglasses.

(e) Non-linear positive correlation. [1]

(4) $W \sim N(60, S^2)$ [5] 

(a) $W_1 - W_2 \sim N(0, 50) \Rightarrow P(|W_1 - W_2| > 2) = P(W_1 - W_2 > 2) + P(W_1 - W_2 < -2)$
 $= P(Z > \frac{1}{5}\sqrt{2}) + P(Z < -\frac{1}{5}\sqrt{2}) = P(Z > 0.28) + P(Z < -0.28)$
 $= 0.3897 + 0.3897 = 0.7794.$

(b) $C \sim N(40, 1.5^2) \Rightarrow Y = W_1 + \dots + W_{12} + C \sim N(760, 302.25)$ [3]
 $E(W_1 + \dots + W_{12} + C) = 12 \times 60 + 40 = 760$; $Var(W_1 + \dots + W_{12} + C) = 12 \times 45^2 + 1.5^2$

(c) $P(Y > 800) \Rightarrow P(Z > (800 - 760) / \sqrt{302.25}) = P(Z > 2.30)$ [2]
 $= 1 - 0.9893 = 0.0107.$

(5) (a) $H_0: \mu_E = \mu_{NE}$ Test-Statistic $Z = \frac{26.3 - 24.8}{\sqrt{0.589047619}} = 1.95$ [6]
 $H_1: \mu_E > \mu_{NE}$

Since critical region is $Z \geq 1.6449$ then $1.95 > 1.6449$ and reject H_0 .
 Accept H_1 . There is significant evidence to suggest that the mean capacity of those who exercise is greater than those who don't.

(b) Assumed that $S^2 = \sigma^2$. Assume sample sizes are large enough [2]

③ $\sum x = 35 \times 26.3 + 31.7 = 952.2$ [4]

$\sum x^2 = 34 \times 12.2 + 35 \times 26.3^2 + 31.7^2 = 25628.84$

So $s^2 = \frac{25628.84 - \frac{1}{36} \times 952.2^2}{35} = 12.7$ (3 s.f.)

⑥ * [8]

Number of suit cases	0	1	2, 3, 4
observed frequency	6	25	19
Expected frequency	12.01	13.23 20.58	17.41
$(O_i - E_i)^2/E_i$	3.0075	0.94929	0.14521

$\therefore \chi^2 = 4.10$ (3 s.f.) ; $V = 2$; C.V: $\chi^2_2 (5\%) = 5.991$

* H_0 : $B(4, 0.3)$ is a good model since $4.10 < 5.991$ accept H_0 .

H_1 : $B(4, 0.3)$ is not a good model $B(4, 0.3)$ is a good model.

⑦ [3]

$r = e^{-1.8} \times 100 \frac{1.8^2}{2} = 26.78$	0	1	2	3	4
$s = 16.07$	16.53 5	40	31	18	6
	E: 16.53	29.75	26.78	16.07	10.87

$\therefore \chi^2 = 14.65$ (0; - E)²/E: 8.0424 3.5315 0.66499 0.2318 2.1819

⑧ H_0 : Poisson is a good model. $V = 5 - 1 - 1 = 3$ [6]
 H_1 : no Poisson is not a good model. C.V: $\chi^2_3 (1\%) = 11.345$
 Since $14.65 > 11.345$ reject H_0 . Significant. Poisson not good model.

⑨ a) $19.5 \pm 1.6449 \times \frac{1.5}{\sqrt{50}} = [19.15\%, 19.85\%]$ [4]

b) Paul should recommend $\frac{1.5}{\sqrt{50}}$ by low than state fat content as 20% is above the interval. [2]

c) $P(\bar{X} - \mu > 0.5) \leq 0.05 \Rightarrow P(Z < \frac{0.5}{\sqrt{\frac{4}{n}}}) \leq \frac{0.05}{2} \Rightarrow \frac{0.5}{\sqrt{\frac{4}{n}}} \geq 1.6449$ [5]

$\Rightarrow \sqrt{n} \times \frac{0.5}{2} \geq 1.6449 \Rightarrow n \geq 43.3 \Rightarrow n_{min} = 44$