Question Number	Scheme	Marks
1 (a)	**Advantages:**	
	— does not require the existence of a {sampling frame / population list	
	— field work can be done quickly as representative sample can be achieved with a small sample size	
	— costs kept to a minimum (cheaply)	
	— administration relatively <u>easy</u> any one	B1
	— non-response not an issue	
	Disadvantages:	
	— not possible to estimate sampling errors	
	— interviewer choice and may not be able to judge easily / may lead to bias	
	— non-response not recorded any one	B1
	— non-random process	(2)
(b)	**Advantages:**	
	— <u>random process</u> so possible to <u>estimate sampling errors</u>	
	— free from <u>bias</u>	
	any one	B1
	Disadvantages:	
	— not suitable when sample size is large	
	— <u>sampling frame</u> required which <u>may not exist</u> or may be difficult to construct for a large population.	
	any one	B1 (2)
	NO REPETITION / OPPOSITES	TOTAL 4

Question Number	Scheme	Marks
2 (a)	$\bar{X} \sim N\left(90, \frac{S^2}{100}\right)$ ie. $N_9(90, 0.25)$ Application of <u>central limit theorem</u> as (sample large)	M1A1 B1 (3)
(b)	$P(\bar{X} \geqslant 91) = 1 - P\left(Z < \frac{91-90}{0.5}\right)$ Stand. $= 1 - P(Z < 2)$ $= 1 - 0.9772$ $= 0.0228$ awrt 0.0228	M1A1 A1 (3) Total 6
3 (a)	$H_0 : \mu_A = \mu_B$, $H_1 : \mu_A \neq \mu_B$ M_1, M_2 OK both	B1
	$S_e = \sqrt{\frac{47^2}{70} + \frac{23^2}{90}} \left(= \sqrt{37.43492..}\right)$	M1A1

	Test statistic is $\pm \frac{198-201}{S_e} = \pm 0.4903$ awrt ± 0.49
	                     M1A1 probab awrt 0.312
	                     B1 probab cv 0.025
		M1A1

	$cv = (\pm) 1.96$	B1
	Insufficient evidence to reject H_0, no significant difference between the mean cholesterol content of the two samples. (require correct comparison for ✓) context required.	A1✓ (7)
(b)	- require 1 egg from each of 70 chickens of diet A to ensure <u>independence</u>, similarly for diet B. - no chickens in common between the two samples to ensure <u>independence</u> - not same chickens on diet A and diet B because if it were we need to do a <u>paired</u> analysis. Any 1	B1, B1 (2)
		Total 9

4.

Rank:

Shop	Distance	Price	d	d²
A	1	9	8	64
B	2	7	5	25
C	3	10	7	49
D	4	6	2	4
E	5	4	1	1
F	6	8	2	4
G	7	2	5	25
H	8	1	7	49
I	9	5	4	16
J	10	3	7	49

ranking M1

Reverse ranking on price, $\Sigma d^2 = 44$
theirs

$$286 \quad \Sigma d^2 \quad \text{M1,A1}$$

(a) $r_s = 1 - \dfrac{6 \times 286}{10(100-1)} = -0.73 \text{ or } \dfrac{-11}{15} \text{ or } -0.733$ M1 A1

awrt

or 0.733 for $\Sigma d^2 = 44$ (5)

(b) $H_0 : \rho = 0$ B1

$H_1 : \rho < 0$ ($H_1 : \rho > 0$ if reverse ranking)   B1

cv $= -0.5636$ (0.5636)   B1

Reject H_0, evidence there is a significant
negative correlation between the price of an
ice cream and the distance from a tourist attraction.   B1

(Ice cream gets cheaper further from the tourist attraction)   (4)

(−cv from correct table required)   (position in context)

TOTAL 9

5.   M = wt of male worker $M \sim N(78.5, 12.6^2)$
     F = wt of female worker $F \sim N(62.0, 9.8^2)$

(a) $W = M_1 + \cdots + M_7 + F_1 + \cdots + F_8$

E(W) = 7 × 78.5 + 8 × 62.0 = 1045.50   awrt 1050 M1A1

Var(W) = 7 × 12.6² + 8 × 9.8² = 1879.64   1880 M1A1   (4)

(b) <u>Independent.</u>   (used in Variance formula)   B1   (1)

(c) $P(W > 1090) = P\left(z > \dfrac{1090 - 1045.5}{\sqrt{1879.64}}\right)$ M1

= P(z > 1.03   )   awrt 1.03   A1

= 1 − 0.8485   1− H1

= 0 · 1 5 1 5   A1   (4)

AWRT(0·152)

⑨

6. H_0 : No association between age and colour

(independent)　　　B1

H_1 : Association between age and colour

(Not independent)　B1

O	E	$\frac{(o-E)^2}{E}$
12	12·08	0·3657...
6	7·92	0·4654...
10	9·52	0·0242...
7	7·48	0·0308...
6	8·4	0·6857...
9	6·6	0·8727...

at least one

$\frac{RT \times CT}{GT}$, B11　M1A1

$\frac{(o-E)^2}{E}$　M1A1

3sf or better

$\sum \frac{(o-E)^2}{E} = 2.4446...$

$\sum , 2.44$　M1A1 (awrt)

$\nu = (3-1)(2-1) = 2 , \chi^2_c = 5.991$　B1 B1√

Insufficient evidence to reject H_0.

No association between age and colour　A1√ (11)

(cv for correct htn for ft)　TOTAL 11

7.(a) $\bar{x} = \frac{500}{10} = 50$　M1A1

$s^2 = \frac{1}{9}\left(25001.74 - \frac{500^2}{10}\right) = 0.193$

(Hairs)　awrt 0.193　M1A1A1 (5)

(b) limits are 50 ± 1.966　B1 1.96　M1B1

$= (49·02, 50·98)$　awrt 49(0), 51(0)　A1A1 (4)

(c) Confidence interval is

(Hairs)　(Hairs)

$\left(50 - \frac{2.5758 \times 0.5}{\sqrt{10}} , 50 + \frac{2.5758 \times 0.5}{\sqrt{10}} \right)$　B1 2.5758　M1 B1 A1√

$= (49.59273, 50.40727..)$

awrt　awrt
49.6 , 50.4　A1 A1 (5)

use of estimate in (a) in (b) AND (c) assume MISREAD.　TOTAL 14

8 (a) $B_{?}(5, 0.5)$ M IA1
                                                                          (2)

(b) $H_0 : B(5, 0.5)$ is a suitable model   (good fit)   B1 ✓
       $H_1 : B(5, 0.5)$ is not a suitable model (not a good fit)
                                          ✓ for $\hat{p} = 0.466$.

No. of heads	0	1	2	3	4	5
Expected	3.125	15.625	31.25	31.25	15.625	3.125
Actual	6	18	29	34	10	3

100 P(f=x) for Bin, 1 correct = A1
All correct = A1
3 sf or better   M1A1A1

	O	E	$\frac{(O-E)^2}{E}$
0 or 1	24	18.75	1.47
2	29	31.25	0.162
3	34	31.25	0.242
4 or 5	13	18.75	1.763

grouped O and E
All correct 2sf or better.   M1A1

$$\sum \frac{(O-E)^2}{E} = 3.6373$$

$\sum$ required, answer 3.64   M1A1

$\nu = 4 - 1 = 3$, $\chi^2_3(0.10) = 6.251$ B1√B1✓

Insufficient evidence to reject H_0
$B(5, 0.5)$ is a suitable model.
No evidence that coins are biased   ↦A1 ✓
                                                   (11)

                                                TOTAL 13

ungrouped gives answer 5.44, $\nu = 5$, $\chi^2_5 = 9.236$
~~for either taken as appropriate~~