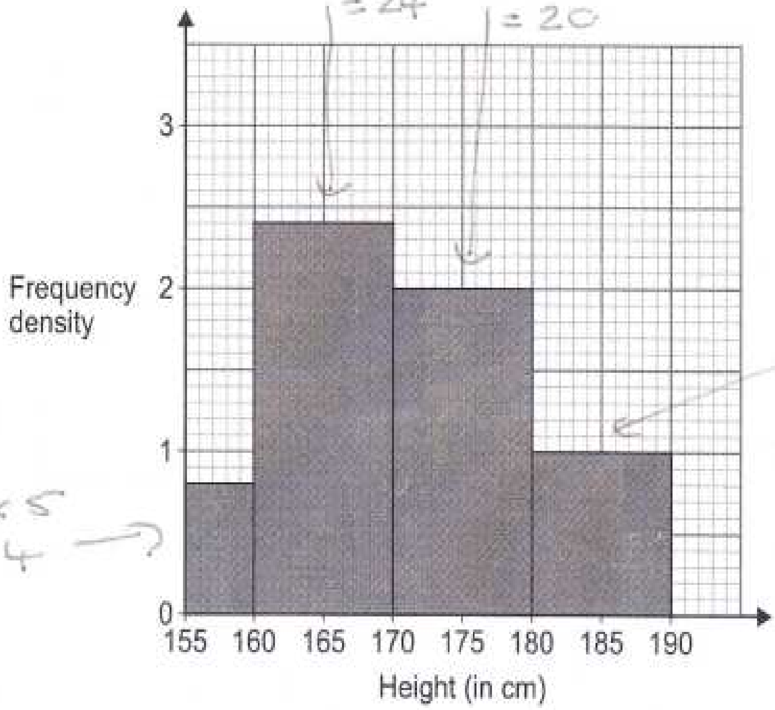
12 The histogram below shows the heights, in cm, of male A-level students at a particular school.

2.4×10 = 24

2×10 = 20



0.8×5 = 4

10×1 = 10

Total frequency = 58

Median = 29.5th value

Which class interval contains the median height?

Circle your answer.

[1 mark]

[155, 160) [160, 170) [170, 180) [180, 190]

11 Lenny is one of a team of people interviewing shoppers in a town centre.

He is asked to survey 50 women between the ages of 18 and 29

Identify the name of this type of sampling.

Circle your answer.

[1 mark]

simple random   stratified   quota   systematic

16 An educational expert found that the correlation coefficient between the hours of revision and the scores achieved by 25 students in their A-level exams was 0.379

Her data came from a bivariate normal distribution.

Carry out a hypothesis test at the 1% significance level to determine if there is a positive correlation between the hours of revision and the scores achieved by students in their A-level exams.

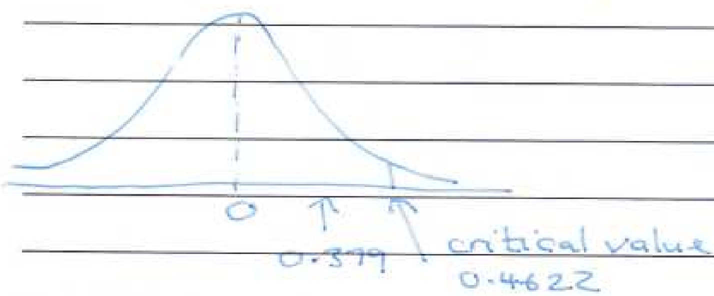
The critical value of the correlation coefficient is 0.4622

[4 marks]

$r = 0.379$

$H_0 : \rho = 0$ (no correlation)

$H_1 : \rho > 0$ (positive correlation)



As the test statistic $r = 0.379$
< 0.4622 (not in tail)
accept H_0

There is insufficient evidence to suggest there is a positive correlation between the hours of revision and the scores achieved in their A level exams

Turn over for the next question

14 A survey was conducted into the health of 120 teachers.

The survey recorded whether or not they had suffered from a range of four health issues in the past year.

In addition, their physical exercise level was categorised as low, medium or high.

50 teachers had a low exercise level, 40 teachers had a medium exercise level and 30 teachers had a high exercise level.

The results of the survey are shown in the table below.

	Low exercise	Medium exercise	High exercise
Back trouble	14	7	10
Stress	38	14	5
Depression	9	2	1
Headache/Migraine	4	5	5

14 (a) Find the probability that a randomly selected teacher:

14 (a) (i) suffers from back trouble and has a high exercise level;

[1 mark]

$\frac{10}{120}$

14 (a) (ii) suffers from depression.

[2 marks]

$\frac{9+2+1}{120} = \frac{12}{120}$

outside the box

14 (a) (iii) suffers from stress, given that they have a low exercise level.

[2 marks]

$\frac{38}{50}$

14 (b) For teachers in the survey with a low exercise level, explain why the events 'suffers from back trouble' and 'suffers from stress' are **not** mutually exclusive.

[2 marks]

$14 + 38 = 52$

$52 > 50$

↑ low exercise number

so back trouble and stress

cannot be mutually

exclusive

Turn over for the next question

14 It is known that a hospital has a mean waiting time of 4 hours for its Accident and Emergency (A&E) patients.

After some new initiatives were introduced, a random sample of 12 patients from the hospital's A&E Department had the following waiting times, in hours.

4.25	3.90	4.15	3.95	4.20	4.15
5.00	3.85	4.25	4.05	3.80	3.95

Carry out a hypothesis test at the 10% significance level to investigate whether the mean waiting time at this hospital's A&E department has changed. 2 tail test

You may assume that the waiting times are normally distributed with standard deviation 0.8 hours.

[7 marks]

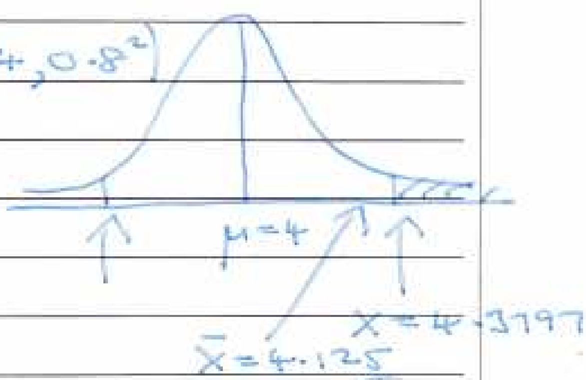
$\bar{x}$ = Sample mean = $(4.25 + 3.9 + 4.15 + 3.95 + 4.2 + 4.15 + 5 + 3.85 + 4.25 + 4.05 + 3.8 + 3.95) \div 12 = 4.125$

$\mu = 4$

$\sigma = 0.8$ $X \sim N(4, 0.8^2)$

$H_0: \mu = 4$

$H_1: \mu \neq 4$



5% lower tail

5% upper tail

Used a sample mean $\therefore \sigma = \frac{\sigma}{\sqrt{n}}$

$= \frac{0.8}{\sqrt{12}} = 0.2309$ (4dp)

Inverse normal

Area 0.95 (95%)

$\sigma = 0.2309$

$\mu = 4$

$x = 4.3797$

$\bar{x} < 4.3797$ so we accept H_0

There is insufficient evidence to suggest that the mean waiting time has changed

Do not write outside the box

17 Suzanne is a member of a sports club.

For each sport she competes in, she wins half of the matches. $X \sim B(n, 0.5)$

17 (a) After buying a new tennis racket Suzanne plays 10 matches and wins 7 of them.

Investigate, at the 10% level of significance, whether Suzanne's new racket has made a difference to the probability of her winning a match.

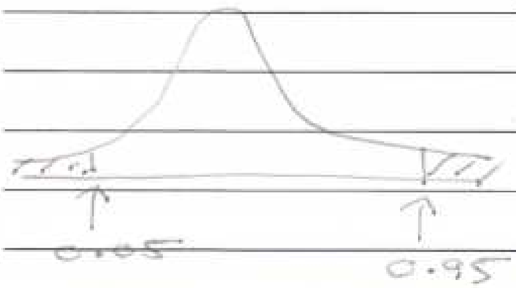
[7 marks]

X = number of matches won

$X \sim B(10, 0.5)$

$H_0: p = 0.5$ $H_1: p \neq 0.5$

2 tailed test



$P(X \leq 1) = 0.010742$ ← critical value

$P(X \leq 2) = 0.0546875$ ← 1st value above 0.05

$P(X \leq 6) = 0.828125$

$P(X \leq 7) = 0.9453125$

$P(X \leq 8) = 0.989257$ ← 1st value above 0.95

$\therefore$ Critical region is $X \leq 1$ $\therefore$

and $X \geq 9$

Binomial CD
$x = 8$
$n = 10$
$p = 0.5$
etc

$X = 7$ is not in the critical region $\therefore$ accept H_0

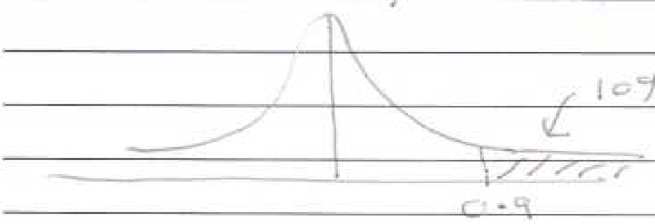
There is not sufficient evidence that Suzanne's new racket has made a difference.

17 (b) After buying a new squash racket, Suzanne plays 20 matches. Find the minimum number of matches she must win for her to conclude, at the 10% level of significance, that the new racket has improved her performance.

one tail test

[5 marks]

$X \sim B(20, 0.5)$



$H_0 : p = 0.5 \qquad H_1 : p > 0.5$

one tail test at 90%

Binomial CD

$x = 11$

$n = 20$

$p = 0.5$

$P(X \leq 11) = 0.74827$

$P(X \leq 12) = 0.86841$

$P(X \leq 13) = 0.94234 \leftarrow$ first one above 0.9

$\therefore$ add one — critical region $X \geq 14$

Minimum number of matches = 14

Turn over for the next question

17 Elizabeth's Bakery makes brownies.

It is known that the mass, X grams, of a brownie may be modelled by a normal distribution.

10% of the brownies have a mass less than 30 grams.

80% of the brownies have a mass greater than 32.5 grams.

17 (a) Find the mean and standard deviation of X.

[7 marks]

$X \sim N(\mu, \sigma^2)$

$P(X < 30) = 0.1$

Z value Inverse normal Area $= 0.1$ $\sigma = 1$ $\mu = 0$ $z_1 = -1.28155$

$P(X \leqslant 32.5)$ 0.2 $z_2 = -0.84162$

$z_1 = \frac{x-\mu}{\sigma}$ $-1.28155 = \frac{30-\mu}{\sigma}$ (1)

$z_2 = \frac{x-\mu}{\sigma}$ $-0.84162 = \frac{32.5-\mu}{\sigma}$ (2)

$-1.28155\sigma = 30 - \mu$ (1)

$-0.84162\sigma = 32.5 - \mu$ (2)

(2) − (1) gives $0.43993\sigma = 2.5$

$\sigma = 5.682722$

(1) gives $\mu = 30 + 1.28155 \times 5.682722$

$\mu = 37.2826$

$\mu = 37.3$ $\sigma = 5.68$ (3sf)

17 (b) (i) Find $P(X \neq 35)$

[1 mark]

17 (b) (ii) Find $P(X < 35)$

[2 marks]

Normal CD = 0.34276

Lower = 0 = 0.343 (3sf)

Upper = 35

$\sigma = 5.68$

$\mu = 37.3$

17 (c) Brownies are baked in batches of 13.

Calculate the probability that, in a batch of brownies, no more than 3 brownies are less than 35 grams.

You may assume that the masses of brownies are independent of each other.

[2 marks]

$Y \sim B(13, 0.343)$

Binomial CD

2: Variable

$P(Y \leq 3)$

$x = 3$

$= 0.296$

$N = 13$

$p = 0.343$