

QQQ – Further Statistics 2 – Chapter 6 – Further Hypothesis Tests (Version 1)

Total Marks: 25

(25 = Platinum, 23 = Gold, 20 = Silver, 17 = Bronze)

1.

- (a) Find the value of the constant a such that

$$P(1.690 < \chi_7^2 < a) = 0.95$$

(2)

The random variable Y follows an F -distribution with 6 and 4 degrees of freedom.

- (b) (i) Find the upper 1% critical value for Y .

- (ii) Find the lower 1% critical value for Y .

(2)

(Total 4 marks)

Edexcel S4 June 2013 (R) Q1

2. Gina receives a large number of packages from two companies, A and B . She believes that the variance of the weights of packages from company A is greater than the variance of the weights of packages from company B .

Gina takes a random sample of 7 packages from company A and an independent random sample of 10 packages from company B . Her results are summarised below

$$\bar{a} = 300 \quad S_{aa} = 145\,496 \quad \bar{b} = 233.4 \quad S_{bb} = 56\,364.4$$

[You may assume that the weights of packages from the two companies are normally distributed.]

Test Gina's belief. Use a 5% level of significance and state your hypotheses clearly.

(6)

(Total 6 marks)

Edexcel A2 October 2020 Q1

3. George owns a garage and he records the mileage of cars, x thousands of miles, between services. The results from a random sample of 10 cars are summarised below.

$$\sum x = 113.4 \quad \sum x^2 = 1414.08$$

The mileage of cars between services is normally distributed and George believes that the standard deviation is 2.4 thousand miles.

Stating your hypotheses clearly, test, at the 5% level of significance, whether or not these data support George's belief. **(7)**

(Total 7 marks)

Edexcel S4 June 2013 Q1

4. A machine is filling bottles of milk. A random sample of 16 bottles was taken and the volume of milk in each bottle was measured and recorded. The volume of milk in a bottle is normally distributed and the unbiased estimate of the variance, s^2 , of the volume of milk in a bottle is 0.003

(a) Find a 95% confidence interval for the variance of the population of volumes of milk from which the sample was taken. **(5)**

The machine should fill bottles so that the standard deviation of the volumes is equal to 0.07

(b) Comment on this with reference to your 95% confidence interval. **(3)**

(Total 8 marks)

Edexcel S4 June 2008 Q5

Solutions

1.

Mark scheme (a)

Scheme	Marks
$P(X > 1.690) = 0.975$	
$P(X > a) = 0.025$	M1
$a = 16.013$	A1
	(2)

Notes

M1 for using 0.025

Mark scheme (b)

Scheme	Marks
Upper critical value of $F_{6,4} = 15.21$	B1
Lower critical value of $F_{6,4} = \frac{1}{9.15} = 0.109$	B1
	(2)
	(4 marks)

Notes

2nd B1 either $\frac{1}{9.15}$ or awrt 0.109

2.

Scheme	Marks	AO
$H_0 : \sigma_a^2 = \sigma_b^2 \quad H_1 : \sigma_a^2 > \sigma_b^2$	B1	2.5
$s_a^2 = \frac{145\,496}{6} = [24\,249.33 \dots]$ [6262.711...]	M1	1.1b

$F_{6,9} = \frac{\text{"24 249.33 ..."}}{\text{"6262.711 ..."}}$	M1	2.1
$= 3.872 \dots$	A1	1.1b
$F_{6,9}$ (5% one-tail) c.v. = 3.37	B1	1.1b
Significant, there is evidence to support Gina's belief	A1	2.2b
	(6)	
	(6 marks)	

Notes

1st B1 for both hypotheses in terms of σ .

1st M1 for at least one of the s^2 calculations correctly attempted

NB $s_a = 155.72 \dots$ accept awrt 156 and $s_b = 79.137 \dots$ accept awrt 79.1

2nd M1 for a correct calculation of the test statistic (ft their s^2)

1st A1 for awrt 3.87

2nd B1 for correct cv awrt 3.37

2nd A1 for a correct conclusion mentioning Gina's belief (o.e.)

3.

Scheme	Marks
$H_0 : \sigma^2 = 2.4^2 \quad H_1 : \sigma^2 \neq 2.4^2$	B1
$s^2 = \frac{1414.08 - 10 \times \left(\frac{113.4}{10}\right)^2}{9} = 14.236$	M1 A1
$\chi^2 = \frac{9s^2}{\sigma^2} = \frac{9 \times 14.236}{2.4^2} = 22.24375$	M1 A1
Critical Value $\chi_9^2(0.025) = 19.023$	B1
Significant result, there is evidence of a change in standard deviation <u>or</u> the data do not support George's belief	Alcso
	(7)
	(7 marks)

Notes

1st **B1** Both hypotheses, must use σ . Allow $H_0 : \sigma = 2.4$ $H_1 : \sigma \neq 2.4$

1st **M1** correct method used

1st **A1** awrt 14.2

2nd **M1** $\chi^2 = \frac{9 \times \text{"their } s^2\text{"}}{2.4^2}$

2nd **A1** awrt 22.2

2nd **B1** for critical value, this should be compatible with their alternative hypothesis (16.919 for one tail test)

3rd **A1ft** fully correct solution only

4.

Mark scheme (a)

Scheme	Marks
Confidence interval = $\left(\frac{15 \times 0.003}{27.488}, \frac{15 \times 0.003}{6.262} \right)$	M1 B1 B1
= (0.00164, 0.00719)	A1 A1
	(5)

Mark scheme (b)

Scheme	Marks
$0.07^2 = 0.0049$	M1
0.0049 is within the 95% confidence interval.	A1
There is no evidence to reject the idea that the standard deviation of the volumes is 0.07 or The machine is working well.	A1
	(3)

Notes

(corrected from the printed mark scheme: the scheme prints "... the standard deviation of the volumes is not 0.07"; since 0.0049 lies inside the interval the conclusion is that it is 0.07)