

## Level 3 Certificate in Business Statistics



International  
Qualifications from EDI

### Annual Qualification Review

2009

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## INTRODUCTION

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The annual qualification review provides qualification-specific support and guidance to centres. This information is designed to help teachers preparing to teach the subject and to help candidates preparing to take the examination.

The reviews are published in September and take into account candidate performance, demonstrated in both on demand and series examinations, over the preceding 12 months. Global pass rates are published so you can measure the performance of your centre against these.

The review identifies candidate strengths and weaknesses by syllabus topic area and provides examples of good and poorer candidate responses. It should therefore be read in conjunction with details of the structure and learning objectives contained within the syllabus for this qualification found on the website.

The review also identifies any actual or proposed changes to the syllabus or question types together with their implications.

## PASS RATE STATISTICS

The following statistics are based on the performance of candidates who took this qualification between 1 October 2008 and 30 September 2009.

Global pass rate            75.14%

Grade distributions

Pass	15.60%
Credit	25.90%
Distinction	33.65%

## GENERAL STRENGTHS AND WEAKNESSES

### Strengths

- Answers supported by clear workings
- Structured layout to answers

### Weaknesses

- Parts of questions omitted
- Errors in copying data from questions
- Wrong method chosen to answer the question, for example, two sample mean test used instead of a paired sample mean test or multiplicative method used in the calculation of the seasonal rather than the additive method.

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## TEACHING POINTS BY SYLLABUS TOPIC

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### Syllabus Topic Area 1: Quantitative Information

This topic area usually forms a sub-part of a series of questions.

Specific recommendations to candidates are:

- all graphs need a title.
- make sure you answer the question asked rather than the one to which an answer is known.

### Syllabus Topic Area 2: Descriptive Statistics

The calculation of measures of location and dispersion are the basis for further calculations often relating to Syllabus Area 5 - Statistical Inference. Miscalculations in the answers to means, etc can lead to the cumulative loss of marks which significantly reduces the overall marks for the question.

For Index Numbers candidates need to recognise that information needs to be broken down, for example, total cost may need to be divided by the relevant weight to find the unit cost. Candidates are expected to adjust indices and apply the index numbers to past sums of money.

Teaching Points:

- the mid-point of grouped data needs to be correctly calculated.
- candidates need to be able to identify accurately which data are the frequencies (f) and which the variable (x).
- candidates who find the standard deviation using either  $s = \sqrt{\frac{\sum(x - \bar{x})^2}{n}}$  or  $s = \sqrt{\frac{\sum f(x - \bar{x})^2}{\sum f}}$  are more likely to calculate the correct answer.
- candidates calculating Index Numbers should remember that multiplication takes place before addition.

### Syllabus Topic Area 3: Forecasting

Responses to this part of the syllabus are some of the best.

Teaching Points:

- care should be taken to distinguish between the dependent and independent variable. The order in which the data is present is not necessarily indicative of the nature of the data.
- interpretation of the results for the correlation coefficient and the regression equation can be required.
- students are not expected to calculate adjusted average seasonal variations.

#### **Syllabus Topic Area 4: Uncertainty**

Answers concerning the Normal Distribution are generally correct. Questions concerning the addition and subtraction rules divide between those which are confident and accurate and those which show little apparent knowledge and understanding.

Teaching Points:

- students should be able to calculate the mean and standard deviation for joint normal distributions.
- questions may be set on Venn diagrams.

#### **Syllabus Topic Area 5: Statistical Inference**

This forms the core of the level 3 syllabus and a number of whole questions or part questions are set on this area in each examination. Many candidates provide correct answers to these questions. However, the opening comment referring to missing answers which omit part of the question, for example:

Series 3 2008 Q 6 (a) Explain when you would use the Chi-squared ( $X^2$ ) test of significance restricts the range of marks the candidate can achieve.

Teaching Points:

- candidates must be able to distinguish between a paired comparison test and a two means t test and apply the appropriate test.
- candidates should be able to identify the correct form of the alternative hypothesis and the appropriate critical value of z or t.
- care should be taken when looking up the critical t or chi-squared value that the correct tables are used.

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## EXAMPLES OF CANDIDATE RESPONSES

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- (a) Describe the situations in which you would use each of the two regression equations (y on x and x on y) for a given set of data. (2 marks)

The following data shows the annual % unemployment rate and average % increase in wages for a European country over a 10 year period.

Year	1	2	3	4	5	6	7	8	9	10
Unemployment rate %	2.8	2.4	3.4	3.1	2.7	2.8	3.7	3.0	3.0	2.1
Wage increase %	4.6	3.5	5.1	4.0	3.9	4.4	6.0	5.5	4.6	2.4

- (b) Find the equation of the regression line which would enable you to estimate the % increase in wages for a change in the % unemployment rate. (10 marks)
- (c) Given that the value of the **coefficient of determination** for this data is 0.8, test whether this shows that the correlation coefficient is significantly different from zero. (6 marks)
- (d) Explain whether your answers to parts (b) and (c) justify the view that low unemployment and low wage inflation can exist together. (2 marks)

**(Total 20 marks)**

ANSWER A - FAIL RESPONSE

Q4

a)

b) regression line

x	y	xy	x <sup>2</sup>	y <sup>2</sup>
2.8	4.6	12.88	7.84	21.16
2.4	3.5	8.4	5.76	12.25
3.4	5.1	17.34	11.56	26.01
3.1	4.0	12.4	9.61	16
2.7	3.9	10.53	7.29	15.21
2.8	4.4	12.52	7.84	19.36
3.7	6.0	22.2	13.69	36
3.0	5.5	16.5	9	30.25
3.0	4.6	13.8	9	21.16
2.1	2.4	5.04	4.41	5.76
$\Sigma x = 29$	$\Sigma y = 44$	$\Sigma xy = 131.62$	$\Sigma x^2 = 86$	$\Sigma y^2 = 203.16$

$$b = \frac{n \Sigma xy - (\Sigma x)(\Sigma y)}{n \Sigma x^2 - (\Sigma x)^2}$$

$$= \frac{(10)(131.62) - (29)(44)}{(10)(86) - (29)^2}$$

$$= \frac{40.2}{19}$$

$$= 2.116$$

$$a = \frac{\Sigma y}{n} - \frac{b \Sigma x}{n}$$

$$a = \frac{44}{10} - \frac{(2.116)(29)}{10}$$

$$a = -1.736$$

regression line =  $\hat{y} = a + bx$

$$\hat{y} = -1.736 + 2.116x$$

c)  $H_0 = 0, H_1 \neq 0$

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

$$t = \frac{0.8\sqrt{10-2}}{\sqrt{1-0.8^2}}$$

$$= 3.77$$

Reject  $H_0 = 0$  since  $3.77 \neq 0$

Answer A - Fail Response.

- The answer had the virtue of attempting and gaining marks on part b) of the question with a minor arithmetical error.
- The candidate gained a mark for recognising and stating the formula for the significance test for a coefficient of correlation..

However the weaknesses are, for example:

- Part (a) and d) were not attempted
- In part (c) the null and alternative hypotheses was incorrectly stated
- It was not realised that the coefficient of correlation had to be derived from the coefficient of determination

No critical value has been stated making it impossible to draw conclusion.

**ANSWER B – MARGINAL PASS**

QUESTION 4

a SITUATIONS TO USE EACH TWO REGRESSION EQUATIONS

- PLOTTING GRAPH
- ~~DRAWING STRAIGHT LINE IN A GRAPH~~
- SIMULTANEOUS EQUATION

b LET UNEMPLOYMENT RATE % = x  
LET WAGE INCREASE % = y

YEAR	x	y	x <sup>2</sup>	xy
1	2.8	4.6		
2	2.4	3.5		
3	3.4	5.1		
4	3.1	4.0		
5	2.7	3.9		
6	2.8	4.4		
7	3.7	6.0		
8	3.0	5.5		
9	3.0	4.6		
10	2.1	2.4		
	$\Sigma x = 29$	$\Sigma y = 44$	$\Sigma x^2 = 86$	$\Sigma xy = 131.41$

EQUATION OF REGRESSION LINE

$$y = a + bx$$

$$b = \frac{n \Sigma xy - (\Sigma x)(\Sigma y)}{n \Sigma x^2 - (\Sigma x)^2}$$

$$= \frac{10(131.41) - (29)(44)}{10(86) - (29)^2}$$

$$= \frac{38.4}{19}$$

$$= 2.02$$

$$a = \frac{\Sigma y}{n} - \frac{b \Sigma x}{n}$$

$$= \frac{44}{10} - \frac{2.02(29)}{10}$$

$$= -1.46$$

$$\therefore y = -1.46 + 2.02x$$

QUESTION 4

< COEFFICIENT OF DETERMINATION =  $r^2$

$$\therefore r = \sqrt{0.8}$$
$$= 0.894$$

$$\text{TEST SIGNIFICANCE, } t = \frac{r \sqrt{n-2}}{\sqrt{1-r^2}}$$
$$= \frac{0.894 \sqrt{10-2}}{\sqrt{1-0.8^2}}$$
$$= \frac{2.52861385}{0.36}$$
$$= 0.910$$

\therefore CORRELATION COEFFICIENT IS SIGNIFICANTLY DIFFERENT FROM ZERO.

Answer B – Marginal Pass

The calculations in part b) and c) are correct.

Part (a) was attempted but the response was incorrect.

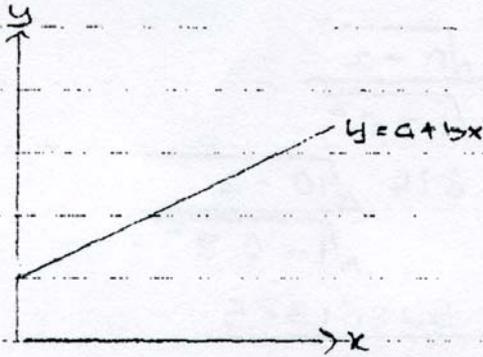
Part (c) was attempted but the answer was inadequate: lacking hypotheses, critical t value and conclusions.

Part (d) was not attempted

ANSWER C - GOOD PASS

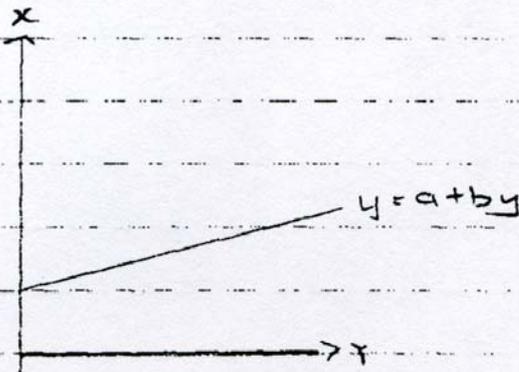
Question 4

a)  $y = a + bx$



We can estimate dependent variable in  $y$  when independent variable  $x$  is given

~~$x = a + by$~~



We can estimate dependent variable in  $x$  when independent variable  $y$  is given

b) Let  $x =$  unemployment rate %

$y =$  wage increase %

Year	$x$	$y$	$x^2$	$y^2$	$xy$
1	2.8	4.6	7.84	21.16	12.8
2	2.4	3.5	5.76	12.25	8.4
3	3.4	5.1	11.56	26.01	17.3
4	3.1	4.0	9.61	16.00	12.4
5	2.7	3.9	7.29	15.21	10.5
6	2.8	4.4	7.84	19.36	12.3
7	3.7	6.0	13.69	36.00	22.2
8	3.0	5.5	9.00	30.25	16.5
9	3.0	4.6	9.00	21.16	13.8
10	2.1	2.4	4.41	5.76	5.0
	$\sum x = 29$	$\sum y = 44$	$\sum x^2 = 86$	$\sum y^2 = 203.16$	$\sum xy = 131$

Equation of regression line,  $y = a + bx$

$$b = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2}$$

$$= \frac{10(131) - (29)(44)}{10(86) - 29^2}$$

$$= 2.0053$$

$$a = \frac{\sum y}{n} - b \frac{\sum x}{n}$$

$$= \frac{44}{10} - 2.0053 \left( \frac{29}{10} \right)$$

$$= -1.4154$$

$$\therefore y = -1.4154 + 2.0053x$$

$$\begin{aligned}
 c) \quad r^2 &= 0.8 \\
 r &= \sqrt{0.8} \\
 &= 0.8944
 \end{aligned}$$

$H_0$ : The correlation coefficient is not significantly different from zero.  
 $H_1$ : The correlation coefficient is significantly different from zero.

$$\begin{aligned}
 \text{Level of significance, } \alpha &= 0.05 \\
 \text{Degree of freedom} &= n-2 \\
 &= 10-2 \\
 &= 8
 \end{aligned}$$

Critical value,  $t_{0.025, 8} = 2.31$

Critical region: Reject  $H_0$  at 5% level of significance if  $|t| > 2.31$

$$\begin{aligned}
 \text{Test statistic, } t &= \frac{r \sqrt{n-2}}{\sqrt{1-r^2}} \\
 &= \frac{0.8944 \times \sqrt{10-2}}{\sqrt{1-0.8944^2}} \\
 &= 5.656
 \end{aligned}$$

Decision: Reject  $H_0$  at 5% level of significance since  $t$ -statistic  $5.656 > 2.31$

Conclusion: The correlation coefficient is significantly different from zero.

d) The low unemployment and low wage inflation can exist together.

This is because value of product moment correlation is between -1 and +1 and the  $b$  of the regression can be calculate.

Answer C Good Pass

The candidate presents a perfect answer to parts a), b) and c) of the question but made an incorrect response to part d).

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and performance

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