THE UNIVERSITY *of York*

Degree Examination 2007

ENVIRONMENT DEPARTMENT

BSc in Environmental Science
Part 1a

QUANTITATIVE METHODS FOR STUDYING THE ENVIRONMENT
(ENVIRONMENTAL SCIENCE)

Time allowed: **one and a half hours**

Answer **ONE** question from **SECTION A** and **ONE** question from **SECTION B**

Statistical tables, calculator and graph paper will be provided

Pay adequate attention to spelling, punctuation and grammar, so that your answers
can be readily understood

SECTION A

Question 1

The demand for organic poultry can be modelled as

$$Q=18.75-5.7P$$

where Q is the per capita demand for organic poultry in kg/year, P is the wholesale price of organic poultry in £/Kg.

a) Find the revenue as a function of Q [**10 marks**]

b) Obtain the marginal revenue as a function of Q [**10 marks**]

c) Find the annual per capita revenue that will result at a demand level of 15 Kg of organic poultry per year [**10 marks**]

d) If a farmer breeds chickens at an average cost of 0.5£/Kg, find the annual profit function (π) in terms of the per capita demand for poultry [**10 marks**]

e) Evaluate $\pi^{'}(15) = \dfrac{\partial \pi(15)}{\partial P}$ and interpret your results [**10 marks**]

Question 2

Please, indicate whether the following statements are True or False by ticking in the True/False box as appropriate.
For every right answer you will receive 5 marks. For every wrong answer you will lose 5 marks.

	Question	True	False
1.	The derivative of a difference is the difference of the derivatives.		
2.	The integral of a difference is the difference of the integrals.		
3.	The derivative of $\ln(x^3 + 1)$ is $\ln(3x)$		
4.	$\int_b^a f(x)dx = F(a) - F(b)$ where F is the integral of f		
5.	The derivative of $2x$ is 2^{x-1}		
6.	If b(t) represents total benefits after t months, then total benefits from month a to month b are given by $\int_a^b b(t)dt$		
7.	The second derivative of $(3x+1)^2$ is 18		
8.	The second derivative of $(3x+10)^2$ is 18		
9.	The second derivative of $(3x+1)^3$ is $(162x+54)$		
10.	$\int_0^2 e^x dx = e^2$		

SECTION B

Question 1.

    a. Marine biologists have sampled 20 fish of a particular species in a marine protected area where no fishing is allowed. Recorded below are the lengths of the fish sampled in metres.

| 0.91 | 1 | 0.97 | 0.96 | 0.81 | 0.82 | 0.97 | 1.16 | 0.98 | 0.97 |
| 0.97 | 0.88 | 1.14 | 0.91 | 0.96 | 0.82 | 0.85 | 1.11 | 0.86 | 0.97 |

        i. Using the graph paper provided construct a histogram of the length variable. [7 marks]
        ii. Calculate the median and the interquartile range of the length varaible. [7 marks]
        iii. From the histogram and the statistics you have calculated, describe the shape, central tendency and dispersion of the data. [6 marks]
        iv. In the region where the marine protected area now is, historical records suggest that the average fish length prior to protection was 80 cm. Perform a hypothesis test that investigates whether or not the mean value for the marine protected area is significantly different to the historical mean. Use a significance level of 0.05 for your test. [12 marks]
        v. Assuming the population from which the marine protected area sample is taken is normally distributed. Construct a 95% confidence interval for the mean. [10 marks]

    b. Research on a campus has shown that 20% of students don't support a plastic recycling scheme in operation at the university. A student is carrying out a project to investigate reasons why these students don't approve of the scheme. The student has a list of 12 randomly selected students from which there is time during the project to interview 7 in depth about their views. What is the probability that all seven selected students don't support the recycling scheme. [8 marks]

Question 2.

a. 30-year average minmum temperature records for January (in $^\circ$C) are available for five locations in each of three river catchments. A researcher studying water quality in the catchments wishes to know if the catchments are comparable in terms of their January temperatures. Below is a partially completed ANOVA table, produced by the researcher.

	Sum of Squares	df	Mean Square	F
Between catchments	4.94			
Within catchments				
Total	6.53			

   i. Copy the ANOVA table to your answer booklet and complete the missing parts of the table. [14 marks]
   ii. State the null and alternative hypotheses that would be tested by such an ANOVA. [3 marks]
   iii. At a 0.05 significance level, would you reject or accept the null hypothesis on the basis of the completed ANOVA table? Explain why you have made your decision. [3 marks]

b. In the table below are the average minimum temperature values from part a) above. Also presented are the altitudes (in metres above sea-level) of the locations in the catchments where the records were made.

Temperature	Altitude
1.8	50
1.7	66
2.11	29
0.85	46
1.58	38
0.51	282
0.29	264
0.39	312
0.71	316
-0.11	306
1.44	50
1.68	56
1.18	50
1.44	56
1.96	52

   i. On the graph paper provided draw a scatterplot of the two variables with the temperature variable on the Y-axis and altitude on the X-axis. [5 marks]
   ii. Calculate the mean and standard deviation of the temperature variable. [5 marks]
   iii. The tables below represent the output from a simple least squares regression where temperature is the dependent variable and altitude is the independent variable.
      1) Write out the regression equation [5 marks]

2) Draw the line represented by this equation on the scatterplot. [5 marks]
3) How much of the variation in average minimum temperature appears to be explained by the altitude variable? [5 marks]
4) Is the altitude variable significant in the regression? Explain how you came to this answer. [5 marks]

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.865[a]	.748	.729	.35550

a. Predictors: (Constant), ALTITUDE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.810	.138		13.111	.000
	ALTITUDE	-4.87E-03	.001	-.865	-6.219	.000

a. Dependent Variable: TEMPERAT