UNIVERSITY OF BOLTON

BUSINESS AND CREATIVE TECHNOLOGIES

ACCOUNTANCY PATHWAY

SEMESTER 2 EXAMINATIONS 2010/11

QUANTITATIVE METHODS FOR ACCOUNTANTS

MODULE NO: ACC1009

Date: 2nd June 2011 **Time: 10:00am – 1:00pm**

INSTRUCTIONS TO CANDIDATES:

There are SIX questions on this paper.

All questions carry equal marks.

Answer FOUR questions.

You MAY NOT answer MORE THAN TWO questions from SECTION A.

You MUST answer AT LEAST TWO questions from SECTION B.

Calculators may be used, but full explanations and working must be shown.

CANDIDATES REQUIRE:

Formula Sheets, which include Statistical Tables.

Graph paper – cm/mm (five sheets)

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SECTION A

(ANSWER NO MORE THAN 2 QUESTIONS)

1. ID Electronics produces two IPod Docks. A complex model, the Internet Radio Plus Dock, IRPD, on which they make a unit profit of £30, and a much simple version, the Sound Dock, SD which is worth £20 profit per unit.

   Each IRPD requires half an hour in assembly time, 10 minutes of packaging time, and 4 minutes of testing in quality control.

   The SD involves only 12 minutes of assembly time per unit, and an equal allocation of 10 minutes per dock for both packaging and testing.

   A maximum weekly allocation of 40 hours of assembly time, 20 hours of packaging time, and 16 hours and 40 minutes of testing time in quality control is available in total for the two models.

   ID has firm orders for 20 IRPDs per week, and 40 SDs per week.

   Required:

   a) Formulate ID's problem as a linear programming problem to establish output levels which will maximize their potential weekly profit.
   (8 Marks)

   b) Present the information in a graphical form, and make use of the diagram to calculate and recommend the optimum solution to ID.
   (10 Marks)

   c) Calculate and explain the significance of the relevant shadow prices.
   (7 Marks)

   TOTAL 25 MARKS

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2. As a part of a significant production planning exercise, a manufacturing company has attempted to predict their level of defective items produced at different levels of output. The estimates given below are based upon the use of currently available machinery with the available factory space.

Output Level (000s)	Percentage of Output Perfect
2	99
4	98
6	95
8	94
10	90
12	88
14	70

a) Calculate the Pearson product moment correlation coefficient, between the percentage of the output which is perfect, and the output levels at which the percentages were achieved.

Explain fully the meaning and significance of your result.

(8 Marks)

b) Calculate the least squares best regression line to fit the data, and draw a graph of the scatter diagram with superimposed best line.

(9 Marks)

c) The company is interested in making predictions. Estimate the percentage of output which would be likely to be perfect at planned future levels of: i) 9000 units, and ii) 17000 units. Discuss the validity and reliability of these predictions. Give a full explanation of the strengths, weaknesses, and problems associated with the methods you use.

(8 Marks)

TOTAL 25 MARKS

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3. a) A financial advisor is consulted by a very large company about a potential investment for their pension scheme of £4.5 million in the futures market. There exists the possibility of investing the sum for a period of 4 years, at a choice of best rates which they can expect to receive of either 3.3% compounded annually, or 3.2% compounded quarterly. Calculate both prospective future values of the investment. Which would the advisor recommend as the better option for the investment?

(8 marks)

b) A wealthy private client of the same financial advisor has met the flat rate £50,000 minimum deposit conditions for a mortgage with the Property National Bank. The client can also afford to make a monthly net repayment on this mortgage of £820 and wishes to take out a 25 year repayment mortgage with Property National who are offering a rate of 4.5% per annum. The mortgage will be for the difference between the purchase price of any new house, and the £50,000 deposit. What is the maximum price for the range of houses that the advisor should tell the client he can afford to purchase?

(9 marks)

c) The same private client is also seeking advice about the value of a new car which he intends to purchase for £23000. If in the first four years the vehicle is expected to depreciate by 16% per annum. What will the advisor tell his client that the car will be worth at the end of this period? What would the value be, if the advisor used the straight-line depreciation method?

(8 marks)

TOTAL 25 MARKS

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SECTION B

(ANSWER AT LEAST 2 QUESTIONS)

4. a) A manufacturing company bids for three future expansion projects. The first is for a small new Factory Space for which the probability of success is 50%. The second is described as Office Space with a success probability of only 40%. The third is described as Warehousing, with a 60% chance of a successful bid. Calculate with full explanation . . .

i) the probability of succeeding with all 3 bids.

ii) the probability of a single successful bid.

ii) the probability of succeeding with exactly 2 bids.

(6 Marks)

b) In the same manufacturing company a well tried and tested process has revealed the following characteristics. Each machine involved is either correctly adjusted (88% of the time) or incorrectly adjusted.

If the machine is correctly adjusted it produces defective units of output only 3% of the time, but if an incorrectly adjusted machine is allowed to carry on producing output, 75% will be defective.

i) During a randomly selected machine production run, what is the probability that a single randomly selected unit of output will be defective? (You are advised to make use of tree diagram)

(8 Marks)

ii) When a randomly selected unit is defective, what is the probability that it came from an incorrectly adjusted machine which must be repaired?

(6 Marks)

iii) If a second unit is then selected at random and proves not to be defective, using the most recent prior probabilities established in b), what is the probability that this second unit was produced by a correctly adjusted machine? (You are again advised to make use of tree diagram)

(5 Marks)

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5. a) A large organisation has recently introduced a new telephone exchange with multiple extensions for a very large staff. It is established that an average of 1.4 callers daily are lost before reaching the required extension.

i) Use the formula for the appropriate probability distribution to determine the probability of a 100% successful day.

(4 Marks)

ii) Use the formula for the appropriate probability distribution to determine the probability of losing exactly five calls in a working week (assume a 5-day working week).

(4 Marks)

b) In general 85% of clients have been completely happy with this style of telephone exchange. In a small sample of 7 recent customers who have been asked for their views.

i) Use the formula for an appropriate probability distribution to determine the probability that no clients are unhappy.

(4 Marks)

ii) Use the formula for the appropriate probability distribution to find the probability that three or more clients are unhappy.

(4 Marks)

c) The length of time taken to install new telephone exchanges in organisations with over 1000 employees using telephones is highly variable. One major company estimates such job times to be normally distributed with a mean job time of 21 days and standard deviation of 3.5 days.

i) If this company guarantees installation inside 30 days, what percentage of customers will be disappointed?

(3 Marks)

ii) Inside how many days are the fastest 20% of jobs completed?

(3 Marks)

iii) If the company was willing to risk disappointing as many as 2% of customers, to what would it reduce the guarantee?

(3 Marks)

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6. A medium sized company has experienced a very rapid turnover of staff as it has modernised its procedures over the five years from 2006 up to the present time. The senior management are interested in a more numerical and statistical analysis of the way in which the profile of the staff in terms of their ages may have changed over the period. The statistics which have been collected and calculated so far, from random samples of 100 members of staff in 2006, and 100 current staff members, are made available below.

AGES	2006 PROFILE	2011 PROFILE
Under 25	**6**	**24**
25 and under 35	**18**	**48**
35 and under 45	**56**	**16**
45 and over	**20**	**12**

2006		2011	
Mean	**40**	Mean	
Standard Error	**0.937**	Standard Error	
Median		Median	
Mode	**40**	Mode	**30**
Standard Deviation	**9.374**	Standard Deviation	
Sample Variance	**87.879**	Sample Variance	
Skewness	**0.019**	Skewness	**0.928**
Range	**40**	Range	**40**
Count	**100**	Count	**100**

a) Missing from the table above are the old and new Medians. Produce a cumulative frequency graph with both years on one pair of axes. Illustrate on the graph, and estimate from the graph, two Median ages. (You are advised to adopt a minimum age of 15, and a maximum of 65 here in part a) and in part b), below.) **(9 marks)**

b) Also missing from the table are the Mean, sample Standard Deviation, Standard Error and sample Variance for 2011. Use the tabular method to calculate the mean and SD from the 2011 sample. Make use of these values, to calculate the 2011 Variance and Standard Error. **(9 marks)**

c) Produce a neat complete version of the table of comparative statistics above, in your answer book. Make use of your CF Graph, and the full range of statistics now available to you, to compare and contrast the current staff age distribution, with that in 2006. **(7 marks)**

TOTAL 25 MARKS

END OF QUESTIONS

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Useful Formulae for Quantitative Methods for Accountants

Descriptive Statistics (original data)

Sample Mean

$$\bar{x} = \frac{\sum x}{n}$$

Sample Variance

$$S^2 = \frac{\sum x^2 - \left(\sum x\right)^2 / n}{n-1}$$

Sample Standard Deviation

$$S = \sqrt{\frac{\sum x^2 - \left(\sum x\right)^2 / n}{n-1}}$$

Descriptive Statistics (grouped data)

Sample Mean

$$\bar{x} = \frac{\sum f \cdot m}{n}$$

Where m is the midpoint of each class interval and f is the number of values in that class interval.

Sample Variance

$$S^2 = \frac{\sum f \cdot m^2 - \left(\sum f \cdot m\right)^2 / n}{n-1}$$

Sample Standard Deviation

$$S = \sqrt{\frac{\sum f \cdot m^2 - \left(\sum f \cdot m\right)^2 / n}{n-1}}$$

Median

$$Median = L + \frac{k}{f} \cdot w$$

where L = lower limit of class containing the median

k = n/2 - number of data values (C.F.) preceding the median class

f = frequency in the median class

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$W = class\ width$

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Probability

Addition Rule $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

or (special case) $P(A \text{ or } B) = P(A) + P(B)$ *A and B mutually exclusive*

Multiplication Rule $P(A \text{ and } B) = P(A) \times P(B)$ *A and B independent*

but generally $P(A \text{ and } B) = P(A) \times P(B/A)$

Conditional probabilities $P(A/B) = \frac{P(A \text{ and } B)}{P(B)}$ *and hence Bayes Theorem*

Permutations and Combinations

Permutations $${}^{n}P_{r} = \frac{n!}{(n-r)!}$$

Combinations $${}^{n}C_{r} = \frac{n!}{r!(n-r)!}$$

Probability Distributions

Binomial Distribution $$P(r) = {}^{n}C_{r}\, p^{r} (1-p)^{n-r}$$

where n is the number of trials and p is the probability of a success in each trial.

Poisson Distribution $$P(r) = \frac{e^{-m} m^{r}}{r!} \qquad \text{for } r = 0, 1, 2, 3\ldots$$

where r is the number of occurrences of a particular event over a certain unit of time or space, and m = the average number of such occurrences per unit of time or space.

Normal Distribution $$Z = \frac{x - \mu}{\sigma}$$

where μ is the average value of the random variable x, and σ is the standard deviation of the distribution of x.

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Confidence Intervals $\mu = \bar{x} \pm z\frac{\sigma}{\sqrt{n}}$ 95%, z = 1.96; 99%, z = 2.58 (2.576)

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Financial Mathematics

SIMPLE INTEREST $A_n = P(1 + in)$

COMPOUND INTEREST $A_n = P(1 + i)^n$

DEPRECIATION $A_n = P(1 - i)^n$

STRAIGHT LINE DEPRECIATION $A_n = P(1 - in)$

FUTURE VALUE (Of A_0) $A_n = A_0(1 + i)^n$

PRESENT VALUE (Of A_n) $A_0 = A_n(1 + i)^{-n}$

REPAYMENT of ANNUITY (Of A_0) $R = \dfrac{i A_0}{1 - (1 + i)^{-n}}$.

PRESENT VALUE of the ANNUITY $A_0 = \dfrac{R[1 - (1 + i)^{-n}]}{i}$

Correlation and Regression

Pearson Product Moment Correlation Coefficient

$$r = \frac{n \times \sum xy - \sum x \times \sum y}{\sqrt{[(n \times \sum x^2 - (\sum x)^2)(n \times \sum y^2 - (\sum y)^2)]}}$$

Regression Line of Best Fit $y = a + bx$

Where

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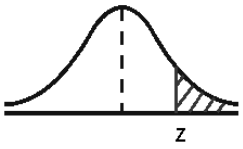
$$b = \frac{n \times \sum xy - \sum x \sum y}{[n \times \sum x^2 - (\sum x)^2]} \quad \text{And} \quad a = \bar{y} - b\bar{x}$$

Areas in the tail of the NORMAL DISTRIBUTION

The table gives the probabilities in the tail of the standard normal distribution, ie the probability that a standardised Normal variable selected at random will be greater than a value of z (= $\frac{x - \mu}{\sigma}$).



z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641
0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019

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2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
3.5	0.0002									
3.6	0.0002									
3.7	0.0001									
3.8	0.0001									
3.9	0.0000									
4.0	0.0000									