

THE PUBLIC ACCOUNTANTS EXAMINATIONS BOARD
A Committee of the Council of ICPAU

CPA (U) EXAMINATIONS

LEVEL ONE

QUANTITATIVE TECHNIQUES - PAPER 5

THURSDAY, 21 JUNE 2012

INSTRUCTIONS TO CANDIDATES

1. Time allowed: **3 hours 15 minutes**.
The first 15 minutes of this examination have been designated for reading time. You may not start to write your answer during this time.
2. Section **A** has **four** questions and only **three** are to be attempted. Each question carries 20 marks.
3. Section **B** has **three** questions and only **two** are to be attempted. Each question carries 20 marks
4. Formulae and tables are provided on pages 10 - 12.
5. Write your answer to each question in a separate answer booklet.
6. Please, read further instructions answer booklet, before attempting any question.

SECTION A

Attempt three of the four questions in this section.

Question 1

- (a) State the statistical measures of location associated with normal distributions.

(3 marks)

- (b) Distinguish between discrete and continuous data, giving at least two examples of each.

(4 marks)

- (c) The following monthly pay data was collected from different companies:

Monthly earnings (Shs'000')	Number of companies
260 – 280	8
280 – 300	14
300 – 320	16
320 – 340	15
340 – 360	9
360 – 380	7
380 – 400	6
400 – 420	5

Required:

- (i) Represent the data on a histogram.

(3 marks)

- (ii) Determine the mode, mean and median salaries from the data.

(10 marks)

(Total 20 marks)

Question 2

- (a) A function is given by $y = x^3 - 27x + 3$

Required:

- (i) Find the values of x at which turning points occur.

(4 marks)

- (ii) Distinguish between maximum and minimum turning points.

(5 marks)

- (b) The cost of a machine is Shs 1,800 and revenue in shillings from sales is given by $R = 5000x - 20x^2$ where x is the number of machines.

Required:

Find the:

- (i) number of machines that maximizes revenue. (3 marks)
 - (ii) number of machines that maximizes profit. (6 marks)
 - (iii) break-even number of machines. (2 marks)
- (Total 20 marks)**

Question 3

- (a) Distinguish between mean deviation and dispersion. (2 marks)
- (b) A marketing department of a company believes that the quality of gas is related to its country of origin. A research was commissioned to investigate the popularity of six leading brands of gas. Two different panels tested the gas products and ranked them in order of quality. To avoid bias, the brand names were withheld and substituted with labels A to F. The results of the blind test were as follows:

Product	Panel 1	Panel 2
A	3	2
B	4	4
C	5	3
D	2	6
E	6	5
F	1	1

Required:

- (i) Calculate Spearman's rank correlation coefficient. (2 marks)
- (ii) Find out whether there is any statistical evidence to suggest that the tastes of gas consumers are related to the country of origin. (2 marks)

- (c) A manager wanting to determine the relationship between the company's advertising expenditure and the sales revenue, in million shillings, collected the following data over a period of 8 years.

Advertising (x)	Sales (y)
4	47
5	111
6	124
12	240
13	211
16	276
17	309
18	259

Require:

- (i) Calculate the linear regression equation that best fits the data. **(10 marks)**
- (ii) Interpret the gradient. **(2 marks)**
- (iii) Estimate the sales revenue when advertising costs are 15 million. **(2 marks)**
- (Total 20 marks)**

Question 4

- (a) For the past 200 days, the sales of bread from a bakery have been as follows:

Daily sales (loaves)	No. of days
0	10
100	60
200	60
300	50
400	20

Required:

Determine the expected (mean) sales of bread.

(4 marks)

- (b) A machine produces aluminum cylinders, the diameters of which are approximately normally distributed. A sample of $n = 5$ was taken whose mean diameter, $\bar{x} = 2.135$ cm. Based on past experience, the process standard deviation $\sigma = 0.002$ cm.

Using $\bar{x} \pm 3\left(\frac{\sigma}{\sqrt{n}}\right)$ for control limits:

Required:

Find the upper and lower 3- σ control limits for determining whether the process is in control if further samples are taken.

(4 marks)

- (c) A company has been sued by its workers for discrimination, harassment and poor working conditions. After various discussions with attorneys representing the workers, the company's counsel offered to settle out of court for Shs 8 million. According to them, the company would have a 40% chance of winning if the case were to go to court. Even if the company won, the legal fees would be approximately Shs 1 million. If the company lost, the damage would be much higher, with the combination of the plaintiff's award and legal expenses amounting to an estimated Shs 12 million. The alternatives, states of nature, payoffs and probabilities faced by the company are summarised in the following table:

Company alternatives	In a court trial company will	
	Win (Prob. = 0.4)	Lose (Prob. = 0.6)
Settle out of court	-8	-8
Go for trial	-1	-12

Required

- (i) Calculate the expected monetary value for each decision alternative.

(4 marks)

- (ii) State the best alternative the company should take.

(2 marks)

- (iii) Calculate the expected value of perfect information.

(6 marks)**(Total 20 marks)**

SECTION B

Attempt two of three questions in this section.

Question 5

- (a) After completing a CPA(U) course, a student applied for a job in two different organizations. The probability that he/she gets a job in the first organization is $\frac{2}{5}$ and the probability that he/she gets a job in the second organization is $\frac{4}{5}$.

Required:

Find the probability that he/she gets:

- (i) both jobs.
- (ii) only one job.

(4 marks)

- (b) The number of hours worked in a day by public servants is taken to be normally distributed with a mean of 6.4 hours and a standard deviation of 1.2 hours. Workers are selected at random from various public institutions.

Required:

Find the probability that a worker selected works for:

- (i) less than 6 hours.
- (ii) between 6 and 7 hours.

(5 marks)**(5 marks)**

- (c) A manufacturing company wants to find out the reasons for the changes in its expenditure over the past five years. Managers argued that such changes could have been due to changes in price or changes in volume of its purchases. For analysis, the table below shows the purchases.

	Quantity in tones ('000)		Price (Shs million)
Year	1998	2003	1998
Metal products	160	150	124
Chemicals	157	233	108
Stationery	104	135	99
Drugs	44	42	42

Required:

Calculate a Laspeyre's quantity index.

(6 marks)**(Total 20 marks)**

Question 6

- (a) Data on sales were used to develop seasonal indices of 84.2, 109.9, 94.8 and 112. The simple linear trend line for the data used is given by $y = 278.9 + 6.46t$.

Required:

- (i) Use the trend line to obtain forecasts of y when $t = 37, 38, 39$ and 40 .

(4 marks)

- (ii) Adjust the trend values for seasonal variation using the seasonal indices in the order given.

(4 marks)

- (b) You are given the following data for a linear programming problem where the objective is to maximize the profit from three non-fractional resources to two non-negative activities.

Resources	Resource usage per unit of each activity		Amount of resources available
	Activity 1	Activity 2	
1	2	1	10
2	3	3	18
3	2	4	20
Contribution per unit	Shs 2,000	Shs 3,000	

Required:

- (i) Formulate a linear programming model for this problem.

(5 marks)

- (ii) Use the graphical method to solve this model.

(3 marks)

- (iii) Find the resources of each activity that maximizes the objective function.

(4 marks)**(Total 20 marks)**

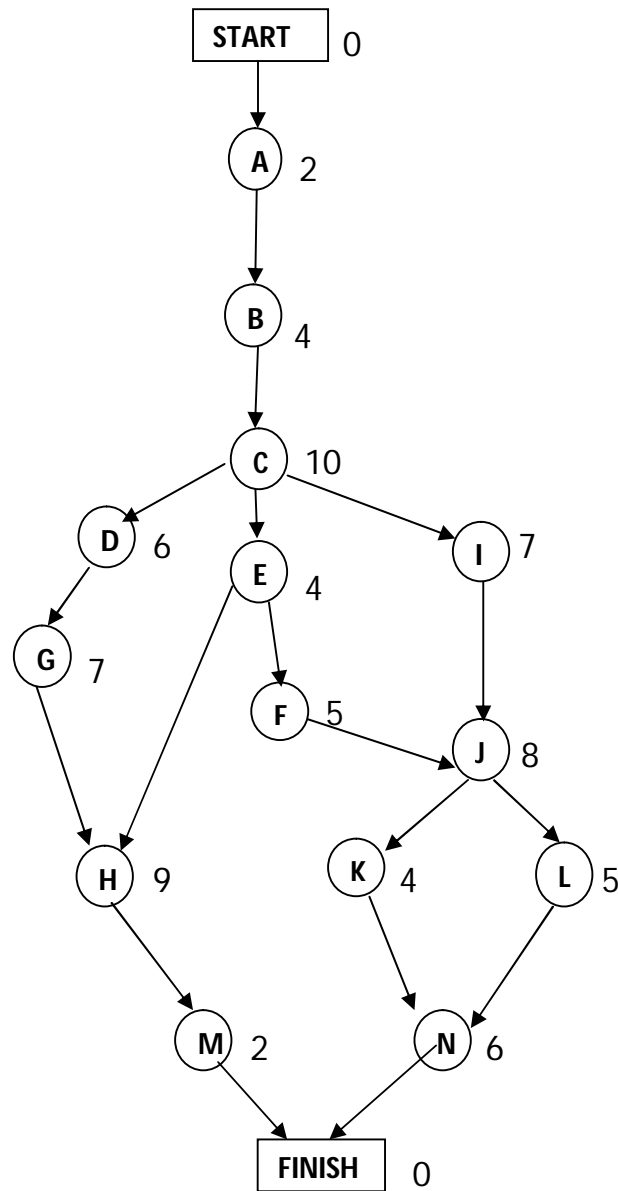
Question 7

(a) Define the following terms as applied in project planning:

- (i) Path.
- (ii) Length of path.
- (iii) Cycle.

(3 marks)

(b) The project network for Reliable Construction Company is shown with its estimation of duration in weeks of each activity.



Required:

- (i) Write all the project paths from start to finish.
(6 marks)
- (ii) Find the critical path of the project and the duration it takes.
(6 marks)
- (c) It is believed that the average number of workers employed by companies in Uganda is 130, with a standard deviation of 30 workers. A sample of 100 companies was taken that revealed the average number to be 123 workers.

Required:

Test the belief at 5% level of significance.

(5 marks)

(Total 20 marks)

FORMULAE

- 1 Spearman's rank correlation coefficient $R_s = 1 - \frac{6 \sum d^2}{n(n^2 - 1)}$
- 2 Regression analysis equations (i) $b = \frac{n(\sum xy) - (\sum x \sum y)}{n(\sum x^2) - (\sum x)^2}$
(ii) $a = \bar{y} - b\bar{x}$
- 3 Laspeyres' quantity index $= \frac{\sum q_n p_0}{\sum q_0 p_0} \times 100$
- 4 Probabilities associated with z - score $z = \frac{x - \mu}{\frac{\sigma}{\sqrt{n}}}$
- 5 Test for significance for a large sample $z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$
- 6 Interpolation formula (i) Median $= L_M + \left(\frac{\frac{N}{2} - F_M}{F_M} \right) C$
(ii) Mode $= L + \left(\frac{D_1}{D_1 + D_2} \right) C$

NORMAL DISTRIBUTION $N(0,1) \phi(Z)$											SUBTRACT								
Z	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
0.0	0.3989	3989	3989	3988	3986						0	1	1	1	1	2	2	2	3
0.1	0.3970	3965	3961	3956	3951	3984	3982	3980	3977	3973	0	1	1	2	2	3	3	4	4
0.2	0.3910	3902	3894	3885	3876	3945	3939	3932	3925	3918	1	1	2	3	3	4	5	6	6
0.3	0.3814	3802	3790	3778	3765	3867	3857	3847	3836	3825	1	2	3	4	4	5	6	7	8
0.4	0.3683	3668	3653	3637	3621	3752	3739	3725	3712	3697	1	2	3	4	5	6	7	8	10
0.5	0.3521	3503	3485	3467	3448	3605	3589	3572	3555	3538	1	3	4	6	7	8	10	11	13
0.6	0.3332	3312	3292	3271	3251	3429	3410	3391	3372	3352	2	3	5	6	8	10	11	13	14
0.7	0.3123	3101	3079	3056	3034	3230	3209	3187	3166	3144	2	4	6	8	10	11	13	15	17
0.8	0.2897	2874	2850	2827	2803	3034	3011	2989	2966	2943	2	5	7	9	11	14	16	18	21
0.9	0.2661	2637	2613	2589	2565	2780	2756	2732	2709	2685	2	5	7	10	12	14	17	19	22
1.0	0.2420	2396	2371	2347	2323	2541	2516	2492	2468	2444	2	5	7	10	12	14	17	19	22
1.1	0.2179	2155	2131	2107	2083	2299	2275	2251	2227	2203	2	5	7	10	12	14	17	19	22
1.2	0.1942	1919	1895	1872	1849	2059	2036	2012	1989	1965	2	5	7	10	12	14	16	18	21
1.3	0.1714	1691	1669	1647	1626	1826	1804	1781	1758	1736	2	5	7	9	11	14	16	18	21
1.4	0.1497	1476	1456	1435	1415	1604	1582	1561	1539	1518	2	4	7	9	11	13	15	18	20
1.5	0.1295	1276	1257	1238	1219	1394	1374	1354	1334	1315	2	4	6	8	10	12	14	16	18
1.6	0.1109	1092	1074	1057	1040	1200	1182	1163	1145	1127	2	4	6	8	9	11	13	15	17
1.7	0.0940	0925	0909	0893	0878	1006	0989	0973	0957	0940	2	3	5	7	8	10	12	14	15
1.8	0.0790	0775	0761	0748	0734	0863	0848	0833	0818	0804	2	3	5	6	8	9	11	12	14
1.9	0.0656	0644	0632	0620	0608	0721	0707	0694	0681	0669	1	3	4	5	7	8	9	10	12
2.0	0.0540	0529	0519	0508	0498	0596	0584	0573	0562	0551	1	2	4	5	6	7	8	10	11
2.1	0.0440	0431	0422	0413	0404	0488	0478	0468	0459	0449	1	2	3	4	5	6	7	8	9
2.2	0.0355	0347	0339	0332	0325	0396	0387	0379	0371	0363	1	2	3	4	4	5	6	7	8
2.3	0.0283	0277	0270	0264	0258	0317	0310	0303	0297	0290	1	1	2	3	4	4	5	6	6
2.4	0.0224	0219	0231	0208	0203	0246	0246	0241	0235	0229	1	1	2	2	3	4	4	5	5
2.5	0.0175	0171	0167	0163	0158	0198	0194	0189	0184	0180	0	1	1	2	2	3	3	4	4
2.6	0.0136	0132	0129	0126	0122	0151	0147	0143	0139	0135	0	1	1	1	2	2	2	3	3
2.7	0.0104	0101	0099	0096	0093	0116	0113	0110	0107	0104	0	1	1	1	1	2	2	2	3
2.8	0.0079	0077	0075	0073	0071	0100	0097	0095	0093	0091	0	1	1	1	1	1	2	2	3
2.9	0.0060	0058	0056	0055	0053	0091	0088	0086	0084	0081	0	1	1	1	1	1	1	2	3
3.0	0.0044	0033	0024	0017	0012	0080	0077	0075	0073	0071	1	2	3	4	5	6	7	8	9
3.1						0060	0057	0055	0053	0051	1	1	2	2	3	4	4	5	5
3.2						0048	0046	0044	0042	0040									
3.3						0037	0035	0033	0031	0029									
3.4						0027	0025	0023	0021	0019									
3.5						0018	0016	0014	0012	0010									
3.6						0009	0007	0005	0003	0002									
3.7						0006	0004	0002	0001	0000									
3.8						0001	0000	0000	0000	0000									
3.9						0000	0000	0000	0000	0000									
4.0						0000	0000	0000	0000	0000									

The functions tabled are:

$$\phi(Z) = \sqrt{\frac{1}{2\pi}} \exp\left(-\frac{1}{2}Z^2\right), \text{ where } \phi(Z) \text{ is the probability density of the standardized normal distribution } N(0,1)$$

CRITICAL POINTS OF THE NORMAL DISTRIBUTION Z_p

P	Q	z	P	Q	z	P	Q	z
.00	.50	0.000	.460	.040	1.751	.490	.010	2.326
.05	.45	0.126	.462	.038	1.774	.491	.009	2.366
.10	.40	0.253	.464	.036	1.799	.492	.008	2.409
.15	.35	0.385	.466	.034	1.825	.493	.007	2.457
.20	.30	0.524	.468	.032	1.852	.494	.006	2.512
.25	.25	0.674	.470	.030	1.881	.495	.005	2.576
.30	.20	0.842	.472	.028	1.911	.496	.004	2.652
.35	.15	1.036	.474	.026	1.943	.497	.003	2.748
.40	.10	1.282	.476	.024	1.977	.498	.002	2.878
.45	.05	1.645	.478	.022	2.014	.499	.001	3.090
.450	.050	1.645	.480	.020	2.054	.4995	.0005	3.291
.452	.048	1.665	.482	.018	2.097	.4999	.0001	3.719
.454	.046	1.685	.484	.016	2.144	.49995	.00005	3.891
.456	.044	1.706	.486	.014	2.197	.49999	.00001	4.265
.458	.042	1.728	.488	.012	2.257	.499995	.000005	4.417

CUMULATIVE NORMAL DISTRIBUTION $P(z)$											ADD								
z	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
0.0	0.0000	0040	0080	0120	0160	0199	0239	0279	0319	0359	4	8	12	16	20	24	28	32	36
0.1	0.0398	0438	0478	0517	0557	0596	0636	0675	0714	0753	4	8	12	16	20	24	28	32	36
0.2	0.0793	0832	0871	0910	0948	0987	1026	1064	1103	1141	4	8	12	15	19	22	27	31	35
0.3	0.1179	1217	1255	1293	1331	1368	1406	1443	1480	1517	4	8	11	15	19	22	26	30	34
0.4	0.1554	1591	1628	1664	1700	1736	1772	1808	1844	1879	4	7	11	14	18	22	25	29	32
0.5	0.1915	1950	1985	2019	2054	2088	2123	2157	2190	2224	3	7	10	14	17	21	24	27	31
0.6	0.2257	2291	2324	2357	2389	2422	2454	2486	2517	2549	3	6	10	13	16	19	23	26	29
0.7	0.2580	2611	2642	2673							3	6	9	12	15	19	22	25	28
					2704	2734	2764	2794	2823	2852	3	6	9	12	15	18	21	24	27
0.8	0.2881	2910	2939	2967	2995	3023					3	6	8	11	14	17	20	22	25
							3051	3078	3106	3133	3	5	8	11	13	16	19	22	24
0.9	0.3159	3186	3212	3238	3264	3289					3	5	8	10	13	16	18	21	23
							3315	3340	3365	3389	2	5	7	10	12	15	17	20	22
1.0	0.3413	3438	3461	3485	3508						2	5	7	10	12	14	17	19	22
						3531	3554	3577	3599	3621	2	4	7	9	11	13	15	18	20
1.1	0.3643	3665	3686	3708							2	4	6	8	11	13	15	17	19
					3729	3749	3770	3790	3810	3830	2	4	6	8	10	12	14	16	18
1.2	0.3849	3869	3888	3907	3925						2	4	6	8	10	11	13	15	17
						3944	3962	3980	3997	4015	2	4	5	7	9	11	13	14	16
1.3	0.4032	4049	4066	4082	4099	4115	4131	4147	4162	4177	2	3	5	6	8	10	11	13	14
1.4	0.4192	4207	4222	4236	4251	4265	4279	4292	4306	4319	1	3	4	6	7	8	10	11	13
1.5	0.4332	4345	4357	4370	4382	4394	4406	4418	4429	4441	1	2	4	5	6	7	8	10	11
1.6	0.4452	4463	4474	4484	4495	4505	4515	4525	4535	4545	1	2	3	4	5	6	7	8	9
1.7	0.4554	4564	4573	4582	4591	4599	4608	4616	4625	4633	1	2	3	3	4	5	6	7	8
1.8	0.4641	4649	4656	4664	4671	4678	4686	4693	4699	4706	1	1	2	3	4	4	5	6	6
1.9	0.4713	4719	4726	4732	4738	4744	4750	4756	4761	4767	1	1	2	2	3	4	4	5	5
2.0	0.4772	4778	4783	4788	4793	4798	4803	4808	4812	4817	0	1	1	2	2	3	3	4	4
2.1	0.4821	4826	4830	4834	4838	4842	4846	4850	4854	4857	0	1	1	2	2	2	3	3	4
2.2	0.4861	4864	4868	4871	4875	4878	4881	4884	4887	4890	0	1	1	1	2	2	2	3	3
2.3	0.4893	4896	4898	4901	4904	4906	4909	4911	4913	4916	0	0	1	1	1	2	2	2	2
2.4	0.4918	4920	4922	4925	4927	4929	4931	4932	4934	4936	0	0	1	1	1	1	1	2	2
2.5	0.4938	4940	4941	4943	4945	4946	4948	4949	4951	4952									
2.6	0.4953	4955	4956	4957	4959	4960	4961	4962	4963	4964									
2.7	0.4965	4966	4967	4968	4969	4970	4971	4972	4973	4974									
2.8	0.4974	4975	4976	4977	4977	4978	4979	4979	4980	4981									
2.9	0.4981	4982	4982	4983	4984	4984	4985	4985	4986	4986									
3.0	0.4987	4990	4993	4995	4997	4998	4998	4999	4999	5000									

The table gives $P(z) = \int_0^z \phi(z) dz$

If the random variable Z is distributed as the standard normal distribution $N(0,1)$ then:

1. $P(0 < Z < z_p) = P(\text{Shaded Area})$
2. $P(Z > z_p) = Q = \frac{1}{2} - P$
3. $P(Z > |z_p|) = 1 - 2P = 2Q$

