THE PUBLIC ACCOUNTANTS EXAMINATIONS BOARD

A Committee of the Council of ICPAU

CPA (U) EXAMINATIONS

LEVEL ONE

QUANTITATIVE TECHNIQUES - PAPER 2

SATURDAY 25 AUGUST, 2018

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. This examination contains **six** questions and only **five** questions are to be attempted. Each question carries 20 marks.
3. Formulae and tables are provided on pages 7 - 11.
4. Write your answer to each question on a fresh page in your answer booklet.
5. Please, read further instructions on the answer booklet, before attempting any question.

*Attempt **five** of the **six** questions*

Question 1

(a) List **three** demerits of using interview as a method of data collection. **(3 marks)**

(b) Iwarata Company Ltd deals in fruit export on behalf of farmer groups producing fruits commercially in the Eastern district of Soroti. The following table shows a record of their average weekly exports in metric tonnes:

Weight	Number of consignments
10-20	4
20-30	8
30-40	15
40-50	20
50-60	24
60-70	16
70-80	10
80-90	3

Required:

(i) Plot a Lorenz curve to represent the above data. **(3 marks)**

Compute the:

(ii) weekly mean weight. **(3 marks)**

(iii) modal weight. **(3 marks)**

(iv) Karl Pearson's coefficient of skewness given the standard deviation as 16.6958 metric tonnes. **(2 marks)**

(c) The statistics department in one of the universities conducted a survey of income distribution among the business community in the neighbourhood. The following data shows the results of the survey.

Capital (Shs million)	20-30	30-40	40-50	50-60	60-70	70-80
Frequency	18	26	40	30	16	10

Required:

(i) 80^{th} percentile weight. **(5 marks)**

(ii) Outline the purpose of a Lorenz curve. **(1 mark)**

(Total 20 marks)

Question 2

(a) Explain the following terms as used in statistics:

(i) Point estimator **(2 marks)**

(ii) Confidence interval. **(2 marks)**

(b) A firm produces electric bulbs. A random sample of 1,000 bulbs has a mean life for each bulb equal to 1,200 hours and standard deviation of 210 hours.

Required:

Calculate the 95% level of confidence for the population mean life of the bulbs.

(4 marks)

(c) The table below shows pay-offs, in million shillings, for three activities X, Y, Z and the states of nature P, Q and R.

Activity	State of nature (Pay-offs)		
	P	Q	R
X	-120	200	260
Y	80	400	-260
Z	100	-300	600
Probability	0.3	0.5	0.2

Required:

(i) Construct a decision tree for the above data.

(4 marks)

(ii) Using the expected monetary value method, determine the best course of action and justify your answer.

(8 marks)

(Total 20 marks)

Question 3

(a) (i) Describe the characteristics of a Poisson distribution. **(4 marks)**

(ii) An events management company has a number of wedding cars which it hires out during the week. The daily demand for a car follows a Poisson distribution with mean 3.5.

Required:

Compute the probability of days on which 2 cars were demanded.

(5 marks)

(b) A soft drinks factory based in Kawempe uses three lines K, Q, and R to produce 45%, 30% and 25% of its total production respectively. The percentage of sub-standard drinks from the three lines are 5%, 6% and 9% respectively. Given that a soft drink is selected at random;

Required:

using Bayes' theorem, compute the probability that the drink selected:

(i) is not sub-standard. **(4 marks)**

(ii) and found to be sub-standard was produced by line Q. **(3 marks)**

(c) A refugee agency is to choose 5 refugees, at random, from a group containing 5 men, 3 women and 6 children, to be relocated to a less congested camp.

Required:

Compute the probability that exactly 3 of those chosen will be men.

(4 marks)

(Total 20 marks)

Question 4

(a) Distinguish between marginal cost and marginal revenue. **(2 marks)**

(b) JL Apparels produces and sells school attires to various schools within Kampala. The total cost function C for producing and marketing q units of their products is given by $C(q) = 5q^3 - 20q^2 - 30{,}000q + 300{,}000$.

Required:

(i) Find the total cost when the output is equal to 300 units.

(2 marks)

(ii) Find the marginal cost when the output is equal to 300 units.

(4 marks)

(c) The table below shows commodity prices (in Shs) and quantities (kg) in two different years.

	2014		2016	
Commodity	Price	Quantity	Price	Quantity
Sorghum	5,200	100	6,000	150
Beans	4,000	80	5,000	100
Maize	2,500	60	5,000	72
Peas	12,000	30	9,000	33

Required:

Compute the price index numbers for 2016 taking 2014 as the base year and comment on your results using:

(i) Laspeyre's method. **(6 marks)**

(ii) Paasche's method. **(6 marks)**

(Total 20 marks)

Question 5

(a) State the importance of correlation. **(2 marks)**

(b) Students at Summit Training Institute did mock examinations in Economics and Quantitative Methods (QM) in preparation for the ICPAU June 2018 examinations and obtained the following scores:

Economics(x)	40	75	60	35	86	44	55	70	80	65
QM (y)	40	85	68	42	90	45	64	76	81	49

Required:

Using the Karl Pearson's method, compute the correlation coefficient between scores in Economics and Quantitative Methods.

(10 marks)

(c) KK Bakery bakes cakes and bread. Each cake and loaf of bread earns a profit of Shs 300 and Shs 400 respectively. To produce a unit product of each, KK uses machine and labour hours as shown in the table below:

	Machine (hours)	Labour (hours)
Cake (x)	5	5
Loaf of bread (y)	3	7
Total available	101	181

Required:

(i) Construct a linear programming model for the above data.

(3 marks)

(ii) Determine the optimal solution using the simplex tableau method.

(5 marks)

(Total 20 marks)

Question 6

(a) Wotile factory located in Namanve manufactures high quality tiles. Its average monthly output, in metric tonnes, of the various products in 2016 are given in the following table:

Month(x)	January	February	March	April	May	June	July	August
Output(y)	8.0	7.5	6.1	8.0	9.5	10	12	8.7

Required:

(i) Using the least squares method, determine the trend line of y on x (y= a + bx).

(9 marks)

(ii) Using the trend line in (i) above, estimate the output of Wotile factory in September 2016.

(1 mark)

(b) Kitiibwa Quirinos is the Supervising Engineer in KQ Engineering Consult Ltd. The job at hand has been categorised into three stages. The first stage of the job is to be handled according to the following precedence schedule of activities:

Activity	Preceding activity	Duration (days)
P	-	18
Q	P	14
R	P	15
S	R	16
T	Q	15
U	T,S	14
V	Q	12
W	R	13
X	U,V,W	17

Required:

(i) Draw a network diagram for the first stage of the project.

(4 marks)

(ii) Identify all the possible paths and determine the critical path.

(3 marks)

(iii) If the duration of activity R is reduced to 10 days; obtain the new critical path.

(3 marks)

(Total 20 marks)

FORMULAE

1. Combination $^{n}C_{r} = \frac{n!}{(n-r)!r!}$
2. Permutations $^{n}p_{r} = \frac{n!}{(n-r)!}$
3. Mean of the binomial distribution = np
4. Standard deviation = $\sqrt{npq}$
5. Variance of the binomial distribution = $np(1-p)$
6. Standard error of population proportion $S_{ps} = \sqrt{\frac{pq}{n}}$
7. Spearman's rank correlation coefficient $r = 1 - \frac{6\sum d^2}{n(n^2-1)}$
8. Product moment coefficient of correlation = $\frac{n\sum xy - \sum x \sum y}{\sqrt{(n\sum x^2 - (\sum x)^2) \times (n\sum y^2 - (\sum y)^2)}}$
9. Cost slope = $\frac{\text{crash cost – normal cost}}{\text{normal time – crash time}}$
10. Harmonic mean (ungrouped data) $hm = \frac{n}{\sum \frac{1}{x}}$
11. Sample mean $\bar{x} = \frac{\sum x}{n}$
12. Harmonic mean (grouped data) $hm = \frac{n}{\sum \frac{f}{x}}$
13. Quartile coefficient of dispersion = $\frac{Q_3 - Q_1}{Q_3 + Q_1}$
14. Mean $\bar{x} = A + \frac{\sum fd}{\sum f}$ or Mean $\bar{x} = \frac{\sum fx}{\sum f}$
15. Median $= Lb + \left(\frac{\frac{N}{2} - Cfb}{fm} \right) C$
16. Mode $= lm + \left(\frac{d_1}{d_1 + d_2} \right) C$

FORMULAE

17. Variance $Var(x) = \frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2$

18. Standard deviation $\delta = \sqrt{\frac{\sum fx^2}{\sum f} - \bar{x}^2} \qquad = \sqrt{\frac{\sum f(x-\bar{x})^2}{\sum f}}$

19. Sample standard deviation $s = \sqrt{\frac{\sum (x-\bar{x})^2}{n-1}}$

20. Least squares regression equation of y on x is given by; $y = a + bx$

    Where; $b = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - \left(\sum x\right)^2}$ and $a = \frac{\sum y}{n} - \frac{b\sum x}{n}$

21. Least squares regression equation of x on y is given by; x = c +dy

    Where $c = \frac{\sum x}{n} - \frac{d\sum y}{n}$ and $d = \frac{n\sum xy - \sum x \sum y}{n\sum y^2 - (\sum y)^2}$

22. Standardizing normal. $z = \frac{\bar{x} - \mu}{\sigma}$

23. Confidence interval for sample mean $= \bar{x} \pm t_{\alpha/2} \frac{s}{\sqrt{n}}$

24. $\chi^2 = \sum \frac{(O-E)^2}{E}$

25. Confidence interval of proportion $= p \pm z_{\alpha/2} \sqrt{\frac{pq}{n}}$

26. Pearson coefficient of skewness $Sk = \frac{(\bar{x} - \text{mode})}{s_d}$ or $Sk = \frac{3\left(\bar{x} - median\right)}{s_d}$

27. Expectation = $\sum xP(X = x)$

28. Laspeyres' price index = $\frac{\sum (p_1 \times q_0)}{\sum (q_0 \times p_0)} \times 100$

29. Weighted aggregate price index $= \frac{\sum wv_n}{\sum wv_0} \times 100$

30. Additive law of probability; $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

31. Conditional probability $P\left(A/B\right) = \frac{P(A \cap B)}{P(B)}$

32. Independence of A, B $P\left(A/B\right) = P(A) or P(A \cap B) = P(A) \times P(B)$

FORMULAE

33. Continuous compounding $A = P(1+r)^n + \frac{b(1+r)^n - b}{r}$

34. Quotient rule of differentiation $f = \frac{vu^1 - uv^1}{v^2}$; where $f = \frac{u}{v}$

35. $Paasche'sModel = \frac{\sum(p_1 \times q_1)}{\sum(q_1 \times p_0)} \times 100$

36. $PoissonModelP(X = x) = e^{-\lambda}\frac{\lambda^x}{x!}$

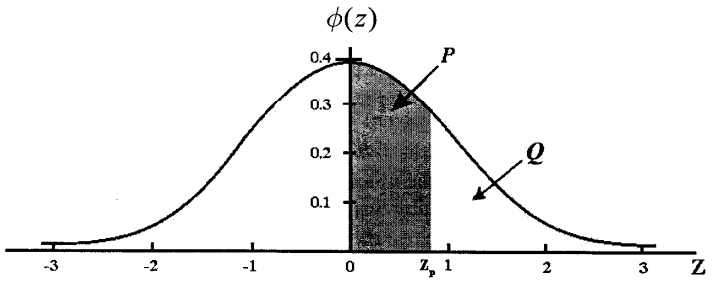
CUMULATIVE NORMAL DISTRIBUTION $P(z)$

Z	0	1	2	3	4	5	6	7	8	9	ADD 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	4957	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. $P(\text{o} < Z < z_p) = P(\text{Shaded Area})$
2. $P(Z > Z_p) = Q = ½ - P$
3. $P(Z > |Z_p|) = 1 - 2P = 2Q$



PERCENTAGE POINTS OF THE CHI-SQUARE (χ^2) DISTRIBUTION χ^2_Q

	Probability Q									
ν	0.995	0.990	0.975	0.950	0.100	0.050	0.025	0.010	0.005	0.001
1	0.0^4393	0.0^3157	0.0^3982	0.0^2393	2.706	3.841	5.024	6.635	7.879	10.83
2	0.0100	0.0201	0.0506	0.1026	4.605	5.991	7.378	9.210	10.60	13.82
3	0.0717	0.1148	0.2158	0.3518	6.251	7.815	9.348	11.34	12.84	16.27
4	0.2070	0.2971	0.4844	0.7107	7.779	9.488	11.14	13.28	14.86	18.47
5	0.4117	0.5543	0.8312	1.145	9.236	11.07	12.83	15.09	16.75	20.52
6	0.6757	0.8721	1.237	1.635	10.64	12.59	14.45	16.81	18.55	22.46
7	0.9893	1.239	1.690	2.167	12.02	14.07	16.01	18.48	20.28	24.32
8	1.344	1.646	2.180	2.733	13.36	15.51	17.53	20.09	21.95	26.12
9	1.735	2.088	2.700	3.325	14.68	16.92	19.02	21.67	23.59	27.88
10	2.156	2.558	3.247	3.940	15.99	18.31	20.48	23.21	25.19	29.59
11	2.603	3.053	3.816	4.575	17.28	19.68	21.92	24.73	26.76	31.26
12	3.074	3.571	4.404	5.226	18.55	21.03	23.34	26.22	28.30	32.91
13	3.565	4.107	5.009	5.892	19.81	22.36	24.74	27.69	29.82	34.53
14	4.075	4.660	5.629	6.571	21.06	23.68	26.12	29.14	31.32	36.12
15	4.601	5.229	6.262	7.261	22.31	25.00	27.49	30.58	32.80	37.70
16	5.142	5.812	6.908	7.962	23.54	26.30	28.85	32.00	34.27	39.25
17	5.697	6.408	7.564	8.672	24.77	27.59	30.19	33.41	35.72	40.79
18	6.265	7.015	8.231	9.390	25.99	28.87	31.53	34.81	37.16	42.31
19	6.844	7.633	8.907	10.12	27.20	30.14	32.85	36.19	38.58	43.82
20	7.434	8.260	9.591	10.85	28.41	31.41	34.17	37.57	40.00	45.31
21	8.034	8.897	10.28	11.59	29.62	32.67	35.48	38.93	41.40	46.80
22	8.643	9.542	10.98	12.34	30.81	33.92	36.78	40.29	42.80	48.27
23	9.260	10.20	11.69	13.09	32.01	35.17	38.08	41.64	44.18	49.73
24	9.886	10.86	12.40	13.85	33.20	36.42	39.36	42.98	45.56	51.18
25	10.52	11.52	13.12	14.61	34.38	37.65	40.65	44.31	46.93	52.62
26	11.16	12.20	13.84	15.38	35.56	38.89	41.92	45.64	48.29	54.05
27	11.81	12.88	14.57	16.15	36.74	40.11	43.19	46.96	49.64	55.48
28	12.46	13.56	15.31	16.93	37.92	41.34	44.46	48.28	50.99	56.89
29	13.12	14.26	16.05	17.71	39.09	42.56	45.72	49.59	52.34	58.30
30	13.79	14.95	16.79	18.49	40.26	43.77	46.98	50.89	53.67	59.70
40	20.71	22.16	24.43	26.51	51.81	55.76	59.34	63.69	66.77	73.40
50	27.99	29.71	32.36	34.76	63.17	67.50	71.42	76.15	79.49	86.66
60	35.53	37.48	40.48	43.19	74.40	79.08	83.30	88.38	91.95	99.61
70	43.28	45.44	48.76	51.74	85.53	90.53	95.02	100.4	104.2	112.3
80	51.17	53.54	57.15	60.39	96.58	101.9	106.6	112.3	116.3	124.8
90	59.20	61.75	65.65	69.13	107.6	113.1	118.1	124.1	128.3	137.2
100	67.33	70.06	74.22	77.93	118.5	124.3	129.6	135.8	140.2	149.4

The function tabulated is χ^2_Q defined by

$$\int_{\chi^2_Q}^{\infty} f(x)dx = Q; \quad f(x) = \frac{1}{2^{\nu/2}(\frac{1}{2}\nu - 1)!} x^{\nu/2-1} e^{-x/2} (x > 0)$$

where $f(x)$ is the probability density of the χ^2 distribution for ν degrees of freedom. Interpolation ν-wise for $\nu > 30$ gives adequate values (but errors up to 5 units in the last figure may occur for the smaller ν). For $\nu > 100$ the distribution of $\sqrt{(2\chi^2)}$ is approximately normal with mean $\sqrt{(2\nu - 1)}$ and unit variance.

Note: $0.0^4 2 = 0.00002$
$0.0^3 3 = 0.0003$
$0.0^2 4 = 0.004$