THE PUBLIC ACCOUNTANTS EXAMINATIONS BOARD

A Committee of the Council of ICPAU

CPA (U) EXAMINATIONS

LEVEL ONE

QUANTITATIVE TECHNIQUES - PAPER 2

TUESDAY 29 MAY, 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 9 – 13.
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) Distinguish between the following terms as applied in statistics:

(i) 'Decision rule' and 'decision tree'.

(2 marks)

(ii) 'Variable' and an' attribute'.

(2 marks)

(b) The table below shows the weekly wages of 100 workers on a flower farm in Katunda village. Study it and answer the questions that follow:

Weekly wage (Shs '000')	Number of workers
20-24	10
25-29	16
30-34	26
35-39	28
40-44	10
45-49	8
50-54	2

Required:

Compute the:

(i) mean wage using Shs 37,000 as a working mean.

(5 marks)

(ii) median wage.

(3 marks)

(iii) standard deviation.

(5 marks)

(iv) Karl Pearson's coefficient of skewness and comment on the skewness of the wages.

(3 marks)

(Total 20 marks)

Question 2

(a) Define the following terms as used in sampling theory:

(i) 'Sample'.

(1 mark)

(ii) 'Sample space'.

(1 mark)

(b) A banking hall supervisor at Abacus Bank Ltd established that in a given hour, the number of clients X entering a hall is according to the probability distribution given in the table below:.

X	11	12	13	14	15
$P(X = x)$	b	$\frac{2}{5}$	$4b$	$\frac{1}{5}$	b

Required:

Determine the:

(i) value of b.

(3 marks)

(ii) average number of tellers the supervisor will recommend to the bank manager so as to attend to all clients at once during the given hour.

(4 marks)

(iii) expected value of X^2.

(3 marks)

(c) A new water bottling factory that has just installed new machinery carried out a test on all its equipment before starting on full scale operation. The number of equipment, m, that did not operate perfectly, were according to faulty equipment function $f(m) = 3m^2 - 2m - 40.$

Required:

Find the value of m by the method of completing squares for which $f(m) = 0.$

(4 marks)

(d) Familya Accountants Ltd interviews, recruits and mentors trainee accountants for different firms. During a recent recruitment process, a sample of 15 applicants was interviewed. The probability that an applicant would fail an interview was $\frac{2}{3}$.

Required:

Find the:

(i) probability that between 8 and 10 applicants passed the interview.

(2 marks)

(ii) standard deviation of the applicants that passed the interview.

(2 marks)

(Total 20 marks)

Question 3

(a) (i) Distinguish between hypothesis and hypothesis testing.

(2 marks)

(ii) A busy restaurant in the centre of artisan workshops in Kampala buys fruits in bags towards festive seasons. In order to ensure the quantity of the fruits packed in the bags were accurate, a sample of 360 bags was tested and it yielded a mean weight of 100 kg and standard deviation of 15 kg.

Required:

Estimate the 99% confidence interval of the mean weight of all the bags bought by the restaurant.

(5 marks)

(b) A manager of a private security organisation believes that the mean wage of a private guard is Shs 135,000 per month with a standard deviation of Shs 30,000. However a random sample of 120 private guards revealed that the mean wage is Shs 132,000 per month.

Required:

Test the manager's belief at 5% level of significance.

(6 marks)

(c) A bakery uses three basic raw materials; baking flour, yeast and fruit flavors. The following purchasing manager's records show the purchases made for 2016 and 2017.

	2016		2017	
Item	Quantity	Price	Quantity	Price
		Shs '000'		Shs '000'
Flour(kg)	10,000	2,000	12,000	2,200
Yeast(packets)	3,000	845	35,000	600
Flavor(packets)	1,500	620	2,000	650

Required:

(i) Taking 2016 as a base year, compute Paasche's quantity index.

(6 marks)

(ii) comment on the bakery's consumption of the raw materials in the given period.

(1 mark)

(Total 20 marks)

Question 4

(a) Distinguish between 'slack variable' and 'surplus variable' as used in simplex method of solving linear programming problem models.

(2 marks)

(b) The solar technology company manufactures three different types of calculators; scientific (X_1) business (X_2) and graphic (X_3). The three types have production requirements summarized in the initial simplex tableau below.

X_1	X_2	X_3	S_1	S_2	S_3	p	
5	7	10	1	0	0	0	90,000
1	3	4	0	1	0	0	30,000
1	1	1	0	0	1	0	9,000
-6	-13	-20	0	0	0	1	0

The final tableau after several iterations is given below.

X_1	X_2	X_3	S_1	S_2	S_3	p	
0	$\bar{}\frac{1}{3}$	0	1	$\bar{}\frac{5}{2}$	0	0	1,000
0	$\frac{2}{3}$	1	0	$\frac{1}{4}$	0	0	7,000
1	$\frac{1}{3}$	0	0	$\bar{}\frac{1}{4}$	1	0	2000
0	$\frac{7}{3}$	0	0	5	0	1	152,000

Required:

(i) Explain how to obtain a pivot entry in the initial tableau.

(3marks)

(ii) Determine the values of S_1, S_2 and S_3 in the final tableau and explain what they represent.

(2 marks)

(iii) Determine the values of X_1, X_2 and X_3 and state the maximum value of the associated linear programming model.

(3 marks)

(c) A factory uses x inputs to get y units of output. If the output values are given by $y=(x-2)^3(x+2)$; find $\frac{dy}{dx}$ in descending powers of x

(4 marks)

(d) In a busy factory that uses perishable goods, all raw material delivered to the factory in a day must be processed that very day. In case many deliveries are received in a day, more machines must be used to avoid wastage. In respect to this, a profit function $y = 12x - 2a - ax^2$ was designed where x is the number of machines used, a number of deliveries received in a day and y the profit earned in million shillings.

Required:

If on a particular day, three deliveries of raw materials were received,

determine:

(i) the number of processing machines that should be used on that day in order maximize profit.

(4 marks)

(ii) the maximum profit.

(2 marks)
(Total 20 marks)

Question 5

(a) Distinguish between correlation and causation.

(2 marks)

(b) In a wealth creation scheme, the youth are advised to start investing in saving schemes that earn interest. A youth from Mukatasa parish has invested Shs 65,000 in three investment schemes namely A, B & C that offer 6%, 8% and 9% compound interest per year respectively. The total interest earned in the three schemes at the end of the year amounted to Shs 48,000 and the interest earned from scheme C was Shs 600 more than the interest earned from scheme B.

Required:

Determine the amount of money that was invested in each saving scheme.

(7 marks)

(c) An NGO in a suburb of Kampala needs the following time (in days) and costs (in Shs) to run its activities in a month.

Activity	Time	Cost
A – B	10	10,000
A – E	9	40,000
B – C	8	70,000
A – D	6	60,000
E - D	7	30,000
C - D	4	50,000

Required:

(i) Sketch the activity on node network.

(3 marks)

(ii) For each node determine the earliest start time and latest start time.

(5 marks)

(iii) Compute the total running costs of the NGO in a month.

(3 marks)

(Total 20 marks)

Question 6

(a) State **two** advantages of the moving average method for measuring secular trend.

(2 marks)

(b) The manager of Berikito Abattoir received the document with the information from the records officer at the end of the first quarter of 2015 as in the table below.

	Slaughter record											
	January				February				March			
Week	1	2	3	4	1	2	3	4	1	2	3	4
No. of Animals	12	40	69	22	19	42	72	28	22	48	81	31

Required:

(i) Compute the five weekly moving averages of Berikito Abattoir

(3 marks)

(ii) Plot the data values and the moving averages on the same graph and hence determine the trend.

(5marks)

(c) A research bureau would like to establish the correlation between the class of individuals in peri-urban areas and their choice of means of transport while going to work. 180 working adults were interviewed and the data obtained was recorded in the following table.

	Means of Transport				
Class	Walk	Taxi	Drive	Ride	Total
High	18	23	18	34	93
Middle	20	21	12	34	87
Total	38	44	30	68	180

Required:

(i) Make a contingency table for the expected values (E) from the above table of the observed values (O).

(4 marks)

(ii) Given that the assertion of the research bureau is 'the class of an individual and the means of transport are independent';

Required:

Use the Chi-square test to determine whether research bureau's assertion is valid at 95% level of significance.

(6 marks)
(Total 20marks)

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 $\delta = \sqrt{\frac{\sum fx^2}{\sum f} - \bar{x}^2} \quad = \sqrt{\frac{\sum f(x-\bar{x})^2}{\sum f}}$

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; $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

FORMULAE

31.	Conditional probability $P\left(A/B\right)=\frac{P(A\cap B)}{P(B)}$	
32.	Independence of A, B $P\left(A/B\right)=P(A) or P(A\cap B)=P(A)\times P(B)$	
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.	$PoissonModelP\left(X=x\right)=e^{-\lambda}\frac{\lambda^x}{x!}$	
37.	Compound Interest =	$P\left(1+\frac{r}{100}\right)^n$

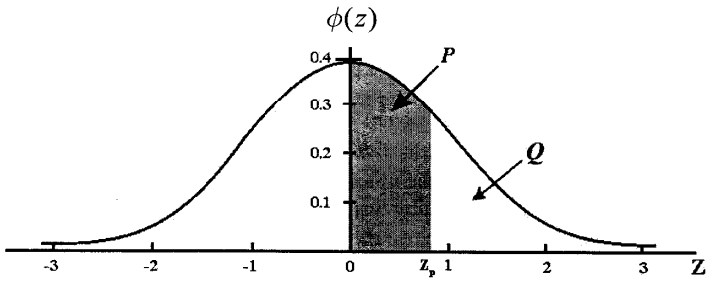
CUMULATIVE NORMAL DISTRIBUTION $P(z)$

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