THE PUBLIC ACCOUNTANTS EXAMINATIONS BOARD

A Committee of the Council of ICPAU

CPA (U) EXAMINATIONS

LEVEL ONE

QUANTITATIVE TECHNIQUES - PAPER 2

TUESDAY 28 NOVEMBER, 2017

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 8 – 12.
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) The Uganda Consumer Advocacy Forum suspected that the packaging of cornflakes cereals contains less than the advertised weight of 426 grams per packet. A sample of 40 packets was taken and the following weights, in grams, were obtained:

448.7	403.3	440.2	437.4	434.5
420.3	409.0	428.0	443.0	423.2
440.2	431.7	426.0	414.6	431.7
397.6	434.5	397.6	434.5	411.8
426.0	417.5	420.3	432.2	437.4
428.8	414.6	431.7	451.6	440.2
437.4	437.4	417.5	445.9	448.7
417.5	437.4	428.8	437.4	443.0

Required:

(i) Starting with class intervals $395 \leq x < 405$, $405 \leq x < 415$ etc., form a frequency distribution table.

(2 marks)

(ii) Determine the percentage of packets containing less than 426 grams.

(2 marks)

(iii) Compute the mean and state whether the sample will be accepted given that the packets are accepted if their mean weight lies between 409.6 and 442.6 grams.

(5 marks)

(b) The following data shows the turnover, in million shillings, of a chain of supermarkets in Kampala for the years 2015 and 2016.

2015	2.0	3.5	4.0	4.2	5.1	2.4	3.0	4.2	5.2	6.0	7.0	8.2
2016	2.3	3.8	4.5	4.6	5.6	2.5	2.9	4.0	5.8	6.2	7.6	9.6

Required:

Construct a Z-chart for the data.

(11 marks)
(Total 20 marks)

Question 2

(a) Mr. Jabira is encouraged to play a game of tossing a fair die with faces numbered 1, 2, 3, 4, 5, and 6 so as to win some money. However, the game is structured in such a way that he may also lose money as explained below:

A throw that returns a prime number will cost him Shs $\frac{x}{3}$; an outcome of a non-prime even number will earn him Shs $5x$ and any other outcome will earn him Shs $2x$.

Required:

(i) Construct a frequency distribution for Mr. Jabira's earning after tossing the die once.

(4 marks)

(ii) Given that Mr. Jabira's expected earning is Shs 550,000; find the value of x.

(2 marks)

(b) The Communications Commission in their annual report on consumption of mobile network services indicated that mobile company Z had 35% of their clients using the mobile money service. If 12 customers are randomly picked from one of their sales points;

Required:

Find the probability that:

(i) exactly 4 customers; **(3 marks)**

(ii) between 4 and 8 customers, transacted on mobile money.

(3 marks)

(c) A car dealer in Jinja town has established that 52% of the cars he sells have no defects. The last batch of cars that he sold was 150.

Required:

Find the probability that at least 75 cars had defects **(4 marks)**

(d) A committee of 5 people is to be chosen from a group of 6 men and 4 women.

Required:

Determine the number of committees possible if the majority of the members on the committee are to be women.

(4 marks)

(Total 20 marks)

Question 3

(a) Graphically identify the **three** components of a quality control chart for the mean.

(2 marks)

(b) The following table shows the moisture content in bread which has stayed overnight in a refrigerator for a period of five days.

Day	1	2	3	4	5
Moisture (millitres)	33.8	34.0	34.1	33.9	34.2

Required:

Determine the percentage of mean moisture centred in the range $\bar{x} \pm 2s$.

(6 marks)

(c) A study was conducted among 100 professors from 3 different departments at a University College for their promotions. It was based on 3 categories of teaching, research and other university activities. The observed values of the number of professors promoted in each category are given in the following contingency table.

	Field of teaching			
Basis of promotion	Business	Science	Medicine	Total
Teaching	20	10	10	40
Research	10	10	15	35
Others	10	8	7	25
Total	40	28	32	100

Required:

(i) Construct a two-way contingency table with observed and expected values in each cell.

(6 marks)

(ii) Test, at 5% level of significance, the hypothesis: H_0 'there is no relationship between the basis of promotion and the field of teaching'.

(6 marks)
(Total 20 marks

Question 4

(a) Identify any **two** merits and any **two** demerits of the chain index method of computing index numbers.

(4 marks)

(b) A family's monthly shopping list in 2015 and 2016 included the following items:

		2015	2016
Item	Quantity	Unit price (Shs)	
Beans	10 kg	2,600	3,000
Rice	15 kg	3,500	4,200
Eggs	3 trays	9,000	10,000
Sugar	20 kg	3,600	5,000
soap	4 bars	4,000	4,500

Required:

(i) Compute the cost of living index using 2015 as a base year.

(6marks)

(ii) Comment on the result obtained in (b) (i) above. **(1 mark)**

(c) A hardware store cleared their electricity bill of Shs 90,000 using Shs 5,000 and Shs 1,000 notes. In all a total of 50 notes were used.

Required:

Using the graphical method, determine the notes of each denomination that were used.

(9 marks)
(Total 20 marks)

Question 5

(a) Distinguish between dependent and independent variables in regression analysis.

(2 marks)

(b) The weekly bonus, in thousands of shillings, for 7 scientists of different ages (in years) in an organisation is shown in the following table.

Age (x)	20	22	28	33	36	45	55
Bonus (y)	69.8	78.5	108.8	134.0	144.0	182.5	198.6

Required:

(i) Calculate the linear regression equation y on x using the least squares method.

(11 marks)

(ii) Explain what would happen to the gradient (slope) in (b) (i) above if all scientists had an increase of Shs 1,000 per week.

(2 marks)

(c) Bintu Company Ltd manufactures pavers and concrete blocks. The following is a minimisation linear programming problem for the company and its final tableau:

Minimise $3x + 4y$ subject to:

$$x - y \geq 0$$
$$3x - 4y \geq 0$$
$$x \geq 0, y \geq 0$$

Where x, y represent pavers and concrete blocks respectively.

Final simplex tableau of the minimisation problem.

x	y	u	v	r	solution
1	6	-1	0	0	11
0	5	3	1	0	16
0	2	4	0	1	-40

Required:

Determine the:

(i) dual to the minimisation linear programming problem.

(3 marks)

(ii) minimum value to the original problem.

(2 marks)

(Total 20 marks)

Question 6

(a) Explain two importances of time series. **(4 marks)**

(b) Mutara town council is planning to undertake a project involving five activities as indicated in the following table, all costs being in millions of shillings.

		Duration (days)		Cost	
Activity	Preceding activity	Normal	Crash	Normal	Crash
X	-	5	4	38	44
K	-	9	5	32	53
P	X	6	4	19	29
M	X	10	8	24	32
Z	K, P	6	4	22	38

Required:

(i) Draw the project network diagram. **(4 marks)**

(ii) Compute the project duration and total cost. **(4 marks)**

If an activity on the critical path with the lowest cost slope is reduced by two days;
Compute the:

(iii) new project duration. **(4marks)**

(iv) total cost. **(4marks)**

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

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

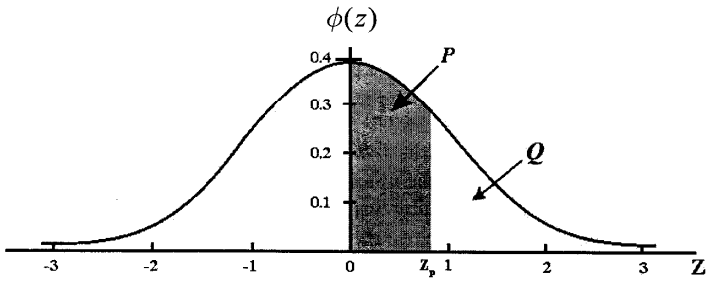
CUMULATIVE NORMAL DISTRIBUTION $P(z)$

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