INSTITUTE OF CERTIFIED PUBLIC ACCOUNTANTS OF RWANDA
Driving Sustainable Performance

Associate of IFAC

CERTIFIED PUBLIC ACCOUNTANT

FOUNDATION 1 EXAMINATION

F1.1: BUSINESS MATHEMATICS AND QUANTITATIVE METHODS

MONDAY: 6 JUNE 2016

INSTRUCTIONS:

1. **Time Allowed: 3 hours 15 minutes** (15 minutes reading and 3hours writing).
2. This examination has **seven** questions and only **five** questions are to be attempted.
3. Marks allocated to each question are shown at the end of the question.
4. Show all your workings, where applicable.

QUESTION ONE

a) The CEO of Kigali Publishing Company Ltd has to make a decision whether to accept an offer for a copyright of Frw 1,240,000 for three years from Tafu Book Sellers Ltd or one from Bako Book Sellers Ltd offering Frw 1,600,000 for five years.

Required:

(i) Calculate the present value of each option if the interest rate is fixed at 9% over the lifetime of the agreement. **(6 Marks)**

(ii) Advise the CEO on which option to accept. **(2 Marks)**

b) Kirehe Plastics Limited has bought a new machine for its plastic molding line for Frw 750,000. This machine is expected to have a useful life of seven years with a scrap value of Frw 102,041.

Required:

(i) Using the straight line method, determine the annual depreciation. **(3 Marks)**

(ii) Using the reducing balance method, determine the:

- Value of the asset after nine years, if the rate of the depreciation is compounded at 14 % per annum. **(4 Marks)**
- Rate of depreciation required to give a depreciated value of Frw 204,081.6 after nine years. **(5 Marks)**

(Total 20 Marks)

QUESTION TWO

(a) Explain any four major uses of statistics. **(4 Marks)**

(b) Rutagengwa Accountancy Training Institute is set to open in Rwamagana District. In a bid to understand the trend in performance in one of the core subjects, the management obtained the following data from a sister institute:

Marks	Number of candidates
$0 \leq x \leq 10$	6
$10 \leq x \leq 20$	13
$20 \leq x \leq 30$	30
$30 \leq x \leq 40$	26
$40 \leq x \leq 50$	25
$50 \leq x \leq 60$	18
$60 \leq x \leq 70$	2

Required:

(i) Construct a cumulative frequency curve for the performance above. **(6 Marks)**

(ii) Use the curve in b (i) above and use it to estimate the median mark, upper quartile and the lower quartile. **(4 Marks)**

(iii) Determine the semi-interquartile range. **(2 Marks)**

(c) A researcher, after completing one of his experiments, established that for (n) observations of a random variable, X, $\sum x^2=1200$, $\overline{X}=\sqrt{50}$ and the standard deviation of X was $\sqrt{10}$.

Required:

Determine the value of (n). **(4 Marks)**

(Total 20 Marks)

QUESTION THREE

Using examples, distinguish between discrete and continuous data. **(2 Marks)**

(a) The attendance at Kivu Night Club follows a normal distribution, with a mean of 120 people and standard deviation of 18 people.

Required:

Calculate the probability that on a given night:

(i) 92 people or more attend. **(5 Marks)**

(ii) Between 101 and 122 people attend. **(5 Marks)**

(b) The probability of a faulty call on hotline for an ambulance is 0.003. If 1,000 calls are made on a given day, calculate the probability of there being less than five faulty calls on any one day. **(8 Marks)**

Hint: Use a Poisson distribution. **(Total 20 Marks)**

QUESTION FOUR

(a) (i) Clearly distinguish between a sampling frame and sampling design. **(2 Marks)**

(ii) Response and non–response forms of bias affect conclusions drawn from sample survey. Explain how the two occur in a sample survey. **(2 Marks)**

(b) In a recent survey financed by Ministry of youth and sports, respondents were asked "Is it proper for a husband in a marriage to refuse to have more children when his wife still wants do so?"

Of the 598 respondents asked, 366 said (YES) and 232 said (NO). Assuming the sample was randomly selected.

Required:

(i) Determine the 99% confidence interval for the population proportion who said YES. **(6 Marks)**

(ii) Determine the 95% confidence interval for those who said NO. **(3 Marks)**

(iii) Compare the results in (i) and (ii) above. **(1 Mark)**

(c) Urusaro Distilled Water Battery Dealers Ltd produces distilled water for motor boat batteries. In their current advertisement, they claim that their distilled water lasts 20,000 km on average in a motor boat battery.

Angel Fishing Company (AFC) requires distilled water for their motor boat batteries. AFC has decided to test 16 sets of their batteries with distilled water from Urusaro Distilled Water Battery Dealers Ltd. They have established that the distilled water runs for 19,500 km with a standard deviation of 1,200 km.

Required:

Test Urusaro Distilled Water Battery Dealers Ltd's claim against AFC's requirement at 5% level of significance. **(6 Marks)**

(Total 20 Marks)

QUESTION FIVE

(a) Distinguish between correlation coefficient and coefficient of determination. **(2 Marks)**

(b) Outline any three components of a time series. **(3 Marks)**

(c) The table below shows a sample of ten steel rods whose lengths (cm) and weights (gm) were taken from a factory.

Length(l)	56	35	54	42	37	51	38	55	46	44
Weight(w)	55	30	52	42	32	50	39	46	31	42

Required:

Calculate the Spearman's coefficient of correlation between the length and the weight. **(6 Marks)**

(d) The table below shows data of KIVU Fish Processing Company Limited about the fish processed in (tons) and the cost of electricity in (Frw)

Output (tons), x	Cost of Electricity (Frw '000'), y
40	81.2
68	95.5
94	116
75	94.8
55	89
95	110
82	105
103	125
89	110
110	138

Required:

(i) Calculate the least squares regression line of y on x and interpret your result. **(8 Marks)**

(ii) Use your regression line in d (i) above to predict the cost of electricity at output level 115 tons. **(1 Mark)**

(Total 20 Marks)

QUESTION SIX

(a) Using illustrations, distinguish between a transportation problem and an assignment problem. **(6 Marks)**

(b) A company that manufactures dishwashers has three factories A, B and C and four warehouses located at P, Q, R and S. The dish washers' requirements at each factory, warehouse requirements and transport costs per dishwasher to be transported are shown in the table below:

	Unit transport cost (Frw '000')				**Factory requirement**
Warehouse	P	Q	R	S	
Factory A	19	30	50	10	7
Factory B	70	30	40	60	9
Factory C	40	8	70	20	18
Warehouse requirement	5	8	7	14	34

The initial feasible tableau that represents the above problem is shown below.

	Unit transport cost (Frw '000')				
Warehouse	P	Q	R	S	Factory requirement
Factory A	19 **5**	30 **2**	50	10	7
Factory B	70	30 **6**	40 **3**	60	9
Factory C	40	8	70 **4**	20 **14**	18
Warehouse requirement	5	8	7	14	34

Required:

(i) Explain what the boxed values in the table represent. **(1 Mark)**

(ii) Determine the transport cost for the allocation in the initial feasible tableau**.** **(2 Marks)**

(c) Kigali Workshop Ltd produces two types of photo frames; landscape and portrait. Each photo frame requires cutting, assembling and vanishing. A landscape photo frame takes 20 minutes to cut to right size, 10 minutes to be assembled and 10 minutes to be vanished and on completion costs Frw 6,000. A portrait photo frame takes 10 minutes to cut to right size, 20 minutes to be assembled and 60 minutes to be vanished and on completion costs Frw 18,000. In any production run, it is necessary to schedule at least 8 hours for cutting, at least 10 hours for assembling and 18 hours for vanishing.

Required:

(i) Formulate a linear programming primal problem model for the problem. **(3 Marks)**

(ii) Determine both the primal and dual problems for the problem. **(1 Mark)**

(iii) Use simplex tableau method to determine the photo frames of each type that should be produced during one run. Hence determine the minimum cost that would be incurred. **(7 Marks)**

(Total 20 Marks)

QUESTION SEVEN

(a) Define the term 'critical path' in network analysis. **(2 Marks)**

(b) Sons' Consult Limited was awarded a contract to construct a modern building at Gatuna boarder. The project coordinator approved the schedule of activities as shown in the table below:

Activity	Preceding activity	Duration (weeks)
A	-	4
B	A	7
C	A	5
D	A	6
E	B	2
F	C	3
G	C	5
H	E,F	11
I	D,G	7
J	H,I	4

Required:

(i) Draw a network for the project and state all the possible paths. **(7 Marks)**

(ii) Determine the Earliest Start Time (EST) and the Latest Start Times (LSTs) for every activity. **(8 Marks)**

(iii) Identify the critical path for the project. **(1 Mark)**

(iv) Find the shortest duration of the project. **(1 Mark)**

(v) Name the activities that are associated with the float in the network. **(1 Mark)**

(Total 20 Marks)

End of question paper

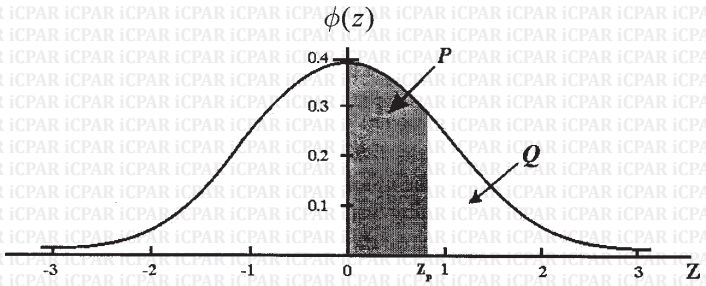
CUMULATIVE NORMAL DISTRIBUTION $P(z)$

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. $P(o < Z < z_p) = P$(Shaded Area)
2. $P(Z > Z_p) = Q = ½ - P$
3. $P(Z' > |Z_p|) = 1 - 2P = 2Q$



PERCENTAGE POINTS OF STUDENT'S t – DISTRIBUTION t_Q

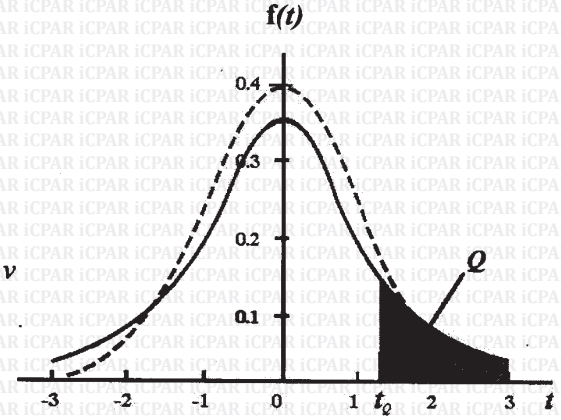
	Probability*									
ν	0.25	0.10	0.05	0.025	0.01	0.005	0.0025	0.001	0.0005	Q
	0.50	0.20	0.10	0.050	0.02	0.010	0.0050	0.002	0.0010	$2Q$
1	1.000	3.078	6.314	12.71	31.82	63.66	127.3	318.3	636.6	
2	0.816	1.886	2.920	4.303	6.965	9.925	14.09	22.33	31.60	
3	0.765	1.638	2.353	3.182	4.541	5.841	7.453	10.21	12.92	
4	0.741	1.533	2.132	2.776	3.747	4.604	5.598	7.173	8.610	
5	0.727	1.476	2.015	2.571	3.365	4.032	4.773	5.893	6.869	
6	0.718	1.440	1.943	2.447	3.143	3.707	4.317	5.208	5.959	
7	0.711	1.415	1.895	2.365	2.998	3.499	4.029	4.785	5.408	
8	0.706	1.397	1.860	2.306	2.896	3.355	3.833	4.501	5.041	
9	0.703	1.383	1.833	2.262	2.821	3.250	3.690	4.297	4.781	
10	0.700	1.372	1.812	2.228	2.764	3.169	3.581	4.144	4.587	
11	0.697	1.363	1.796	2.201	2.718	3.106	3.497	4.025	4.437	
12	0.695	1.356	1.782	2.179	2.681	3.055	3.428	3.930	4.318	
13	0.694	1.350	1.771	2.160	2.650	3.012	3.372	3.852	4.221	
14	0.692	1.345	1.761	2.145	2.624	2.977	3.326	3.787	4.140	
15	0.691	1.341	1.753	2.131	2.602	2.947	3.286	3.733	4.073	
16	0.690	1.337	1.746	2.120	2.583	2.921	3.252	3.686	4.015	
17	0.689	1.333	1.740	2.110	2.567	2.898	3.222	3.646	3.965	
18	0.688	1.330	1.734	2.101	2.552	2.878	3.197	3.610	3.922	
19	0.688	1.328	1.729	2.093	2.539	2.861	3.174	3.579	3.883	
20	0.687	1.325	1.725	2.086	2.528	2.845	3.153	3.552	3.850	
21	0.686	1.323	1.721	2.080	2.518	2.831	3.135	3.527	3.819	
22	0.686	1.321	1.717	2.074	2.508	2.819	3.119	3.505	3.792	
23	0.685	1.319	1.714	2.069	2.500	2.807	3.104	3.485	3.767	
24	0.685	1.318	1.711	2.064	2.492	2.797	3.091	3.467	3.745	
25	0.684	1.316	1.708	2.060	2.485	2.787	3.078	3.450	3.725	
26	0.684	1.315	1.706	2.056	2.479	2.779	3.067	3.435	3.707	
27	0.684	1.314	1.703	2.052	2.473	2.771	3.057	3.421	3.690	$\frac{120}{\nu}$
28	0.683	1.313	1.701	2.048	2.467	2.763	3.047	3.408	3.674	
29	0.683	1.311	1.699	2.045	2.462	2.756	3.038	3.396	3.659	
30	0.683	1.310	1.697	2.042	2.457	2.750	3.030	3.385	3.646	4
40	0.681	1.303	1.684	2.021	2.423	2.704	2.971	3.307	3.551	3
60	0.679	1.296	1.671	2.000	2.390	2.660	2.915	3.232	3.460	2
120	0.677	1.289	1.658	1.980	2.358	2.617	2.860	3.160	3.373	1
∞	0.674	1.282	1.645	1.960	2.326	2.576	2.807	3.090	3.291	0

The function tabulated is t_Q defined by

$$\int_{t_Q}^{\infty} f(t)dt = Q; \quad f(t) = \frac{(\frac{1}{2}\nu - \frac{1}{2})!}{\sqrt{(\nu\pi)(\frac{1}{2}\nu - 1)!}} \cdot \frac{1}{(1 + t^2/\nu)^{(\nu+1)/2}}$$

where $f(t)$ is the probability density of the t-distribution.
Interpolation ν-wise should be linear in $120/\nu$ for $\nu > 30$.
Use (i) upper row for one tail-tests
(i) lower row for two tail-tests
If x is a random variable with the t-probability distribution for ν degrees of freedom, the probability that $x > t_Q$ is Q and the probability that $|x| > t_Q$ is 2Q.

The graph shows the form of the distribution for $\nu = 2$. The shaded area represents the probability Q. For large ν the distribution approximates to the normal distribution N(0,1), shown by the dotted line.



Present value interest factor of $1 per period at i% for n periods, PVIFA (i,n).

Period	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487
4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.170
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791
6	5.795	5.601	5.417	5.242	5.076	4.917	4.767	4.623	4.486	4.355
7	6.728	6.472	6.230	6.002	5.786	5.582	5.389	5.206	5.033	4.868
8	7.652	7.325	7.020	6.733	6.463	6.210	5.971	5.747	5.535	5.335
9	8.566	8.162	7.786	7.435	7.108	6.802	6.515	6.247	5.995	5.759
10	9.471	8.983	8.530	8.111	7.722	7.360	7.024	6.710	6.418	6.145
11	10.368	9.787	9.253	8.760	8.306	7.887	7.499	7.139	6.805	6.495
12	11.255	10.575	9.954	9.385	8.863	8.384	7.943	7.536	7.161	6.814
13	12.134	11.348	10.635	9.986	9.394	8.853	8.358	7.904	7.487	7.103
14	13.004	12.106	11.296	10.563	9.899	9.295	8.745	8.244	7.786	7.367
15	13.865	12.849	11.938	11.118	10.380	9.712	9.108	8.559	8.061	7.606
16	14.718	13.578	12.561	11.652	10.838	10.106	9.447	8.851	8.313	7.824
17	15.562	14.292	13.166	12.166	11.274	10.477	9.763	9.122	8.544	8.022
18	16.398	14.992	13.754	12.659	11.690	10.828	10.059	9.372	8.756	8.201
19	17.226	15.678	14.324	13.134	12.085	11.158	10.336	9.604	8.950	8.365
20	18.046	16.351	14.877	13.590	12.462	11.470	10.594	9.818	9.129	8.514

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