# CERTIFIED PUBLIC ACCOUNTANT

# FOUNDATION LEVEL 1 EXAMINATION

## F1.1: BUSINESS MATHEMATICS AND QUANTITATIVE METHODS

## DATE: THURSDAY 30, MAY 2024

## INSTRUCTIONS:

1. **Time allowed: 3 hours 15 minutes** (15 minutes reading and 3 hours 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.
5. The question paper should not be taken out of the examination room

## QUESTION ONE

**(a) Differentiate between overlapping sets and equal sets as used in set theory** (2 Marks)

**(b)** The Institute of Certified Public Accountants of Rwanda (ICPAR) runs three types of training programs namely; the training of trainers (TOT), the continuous professional development (CPD) and annual training conference (ATC). The institute recently conducted a survey to determine the training preference of 200 CPA members. The following results were obtained from the survey.

96 members attend TOT
36 members attend CPD
52 members attend ATC
16 members attend TOT and ATC
16 members attend TOT and CPD
6 members attend CPD and ATC
6 members attend all the three training programs

**Required:**

**(i) Represent the above information using a Venn diagram** (8 Marks)
**(ii) Calculate the number of members who attend TOT but did not attend CPD** (2 Marks)
**(iii) Calculate the number of members who attend ATC and CPD but did not attend TOT** (2 Marks)
**(iv) Calculate number of members who attend none of the above trainings** (2 Marks)
**(v) State four applications of set theory in solving mathematical problems** (4 Marks)
**(Total: 20 Marks)**

## QUESTION TWO

**(a)** The following table displays the range of marks scored in Business Mathematics and Quantitative Method as recorded by the Institute of Certified Public Accountants of Rwanda (ICPAR).

| Marks | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | 45-49 | 50-54 |
|---|---|---|---|---|---|---|---|
| Frequency | 9 | 17 | 21 | 18 | 15 | 9 | 11 |

**Required:**

**(i) Calculate the lower quartile of the above data** (8 Marks)
**(ii) Outline any three characteristics of mean deviation** (3 Marks)

**(b)** In a survey on malnutrition was done in a GATARE cell. A random sample of 10 residents was taken and they were asked their ages and weights. The complete data of the ages and weights in kilograms is provided and summarized in the table below.

| Resident | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| **Age x** (years) | 9 | 5 | 40 | 30 | 25 | 15 | 17 | 12 | 22 | 38 |
| **Weight y** (kilograms) | 14 | 10 | 65 | 43 | 38 | 20 | 40 | 15 | 45 | 56 |

**Required:**

**(i) Calculate the correlation coefficient for the survey between age and weight of the residents of GATARE cell and interpret your results.** (7 Marks)

**(ii) Solve for the coefficient of determination for the data provided from the survey and interpret your results.** (2 Marks)

**(Total: 20 Marks)**

**QUESTION THREE**

**(a) State three uses of index numbers as applied in statistics**. (3 Marks)

**(b)** The table below shows the prices and quantities of Fresh Food Grocery Ltd for the years 2022 and 2023.

| **Year** | | **Commodity** | | | |
|---|---|---|---|---|---|
| | | **Bananas** | **Potatoes** | **Mangoes** | **Oranges** |
| **2022** | **Price (FRW/kg)** | 500 | 350 | 900 | 600 |
| | **Quantity (Kilograms)** | 50 | 90 | 150 | 100 |
| **2023** | **Price (FRW/kg)** | 700 | 450 | 1,000 | 800 |
| | **Quantity (Kilograms)** | 70 | 110 | 120 | 80 |

**Required:**

**(i) Calculate the simple price indices of the four commodities given above in the table and interpret your results.** (4 Marks)

**(ii) Compute the Laspeyre's price index from the data provided in the table above taking 2022 as the base.** (6 Marks)

**(c)** A survey of the incomes of MUHOZA Sector conducted in 2019 indicated that the annual income of the people in this sector is normally distributed with a mean of FRW 800,000 and a standard deviation of FRW 200,000.

**Required:**

**Calculate the probability** that if a person is selected at random from MUHOZA sector will have an annual income:

**(i) Less than FRW 600,000** (1Mark)

**(ii) Between FRW 600,000 and FRW 800,000** (2 Marks)

**(iii) Between FRW 800,000 and FRW 1,200,000** (2 Marks)
**(iv) More than FRW 1,200,000** (2 Marks)
**(Total: 20 Marks)**

**QUESTION FOUR**

**(a) List down any four properties of a binomial experiment** (4 Marks)
**(b)** INGAGI Lounge Ltd operates night clubs and bars in Musanze city. The Lounge's Chief Accountant CPA Makenzi has established that in the year ended 31st December 2022, 20% of the VAT filing periods with a refundable value added tax (VAT) were not audited by the Revenue Authority (RA) for a refund to be processed. At the beginning of the year of 2023 the accountant has 80 tax periods with a VAT refund claim not yet audited.

**Required:**

**(i) The probability that exactly 7 tax periods will not eventually be audited** (4 Marks)
**(ii) The expected number and standard deviation of the tax periods that will end up not being audited.** (8 Marks)
**(iii) The probability that at most 20 tax periods will not be audited.** (4 Marks)
**(Total: 20 Marks)**

**QUESTION FIVE**

**(a) Explain the following terms as used in game theory**

**(i) Saddle point** (1 Mark)
**(ii) Dominance rule** (1 Mark)
**(iii) Pure strategy game** (1 Mark)
**(iv) Prisoners Dilemma** (1 Mark)

**(b)** UMOJA Rwanda Ltd (UR) is a medium sized entity that produces body lotions in Kimironko industrial park. Following the recent inflation rise, employees have claimed a top up on their salaries through their union. KIME&CPA Associates, a consultant firm of UR prepared the following payoff matrix showing probable percentages of increment.

| | | UR Strategies | | |
|---|---|---|---|---|
| | | **S1** | **S2** | **S3** |
| Employees union strategies (U) | **U1** | 3 | 2 | 4 |
| | **U2** | 2 | 4 | 6 |
| | **U3** | 1 | 2 | 4 |

**Required:**

**(i) Determine the strategies that each of the parties would play in order to optimize the value of the game.** (10 Marks)
**(ii) Compute the value of the game and interpret its meaning.** (2 Marks)

**(c)** To make a considerable decision, you need to rely on sources of evidences while deciding, not only the quantitative aspect but also its quality. Sometimes to use 100% data seems to be very hard, it is in this context that samples should be considered.

**Required:**
**State four merits of purpose sampling as applied to sampling techniques** (4 Marks)
**(Total: 20 Marks)**

**QUESTION SIX**

**(a)** The following data relates to the profits of each month of the year 2021 reported by MUGEMA Ltd:

| Month | Profits (FRW "million" |
|---|---|
| January | 42 |
| February | 40 |
| March | 41 |
| April | 43 |
| May | 38 |
| June | 43 |
| July | 36 |
| August | 39 |
| September | 37 |
| October | 39 |
| November | 42 |
| December | 43 |

**Required:**

**(i) Forecast the profits of January of the year 2022 using exponential smoothing for MUGEMA Ltd. (Exponential smoothing constant α = 0.5)** (7 Marks)

**(ii) Explain four uses of time series analysis in forecasting** (4 Marks)

**(b)** The total revenue of Brave Ltd is given by a quadratic function $R = 21x^2 - x - 16$ (in FRW'000') and total cost function $C = \frac{x^3}{3} - 3x^2 + 9x$ (in FRW'000') where x represents units products.

**Required:**

**(i) Calculate the marginal cost for Brave Ltd at an output of 100 units.** (2 Marks)

**(ii) Determine the level of output that maximizes revenue and solve for the maximum revenue.** (3 Marks)

**(iii) Find the level of output that maximizes profit and hence maximum profit for the company.** (4 Marks)

**(Total: 20 Marks)**

**QUESTION SEVEN**

**(a)** The distribution below provides the weights of people in a certain community in the Northern province in Rwanda

| Class | 0-20 | 20-40 | 40-60 | 60-80 | 80-100 | 100-120 | 120-140 | 140-160 | Total |
|---|---|---|---|---|---|---|---|---|---|
| Frequency | 10 | 15 | 15 | 20 | 8 | 8 | 6 | 8 | 90 |

**Required:**

**Compute the median from the data given in table above.** (5 Marks)

**(b)** An examination paper is composed of 60 questions. Eight students got, 35, 37, 30, 33, 36, 35, 39 and 37. Use assumed mean of 35.

**Required:**
**Find the standard deviation for the marks obtained using assumed mean method.**
(10 Marks)

**(c)** MUHORA Cooperative in the Eastern province recently produced a report to the district about their coffee production in thousands of tons for the last five years as follows:

| Years | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|
| Production (in tons) | 45 | 40 | 42 | 55 | 50 |

**Required:**

**Present the above data about coffee production on a bar chart** (5 Marks)
**(Total: 20 Marks)**

# End of Question Paper

## Standard Normal Table

| Z | 0.00 | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 |
|---|---|---|---|---|---|---|---|---|---|---|
| -3.4 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0003 | 0.0002 |
| -3.3 | 0.0005 | 0.0005 | 0.0005 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0004 | 0.0003 |
| -3.2 | 0.0007 | 0.0007 | 0.0006 | 0.0006 | 0.0006 | 0.0006 | 0.0006 | 0.0005 | 0.0005 | 0.0005 |
| -3.1 | 0.0010 | 0.0009 | 0.0009 | 0.0009 | 0.0008 | 0.0008 | 0.0008 | 0.0008 | 0.0007 | 0.0007 |
| -3.0 | 0.0013 | 0.0013 | 0.0013 | 0.0012 | 0.0012 | 0.0011 | 0.0011 | 0.0011 | 0.0010 | 0.0010 |
| -2.9 | 0.0019 | 0.0018 | 0.0018 | 0.0017 | 0.0016 | 0.0016 | 0.0015 | 0.0015 | 0.0014 | 0.0014 |
| -2.8 | 0.0026 | 0.0025 | 0.0024 | 0.0023 | 0.0023 | 0.0022 | 0.0021 | 0.0021 | 0.0020 | 0.0019 |
| -2.7 | 0.0035 | 0.0034 | 0.0033 | 0.0032 | 0.0031 | 0.0030 | 0.0029 | 0.0028 | 0.0027 | 0.0026 |
| -2.6 | 0.0047 | 0.0045 | 0.0044 | 0.0043 | 0.0041 | 0.0040 | 0.0039 | 0.0038 | 0.0037 | 0.0036 |
| -2.5 | 0.0062 | 0.0060 | 0.0059 | 0.0057 | 0.0055 | 0.0054 | 0.0052 | 0.0051 | 0.0049 | 0.0048 |
| -2.4 | 0.0082 | 0.0080 | 0.0078 | 0.0075 | 0.0073 | 0.0071 | 0.0069 | 0.0068 | 0.0066 | 0.0064 |
| -2.3 | 0.0107 | 0.0104 | 0.0102 | 0.0099 | 0.0096 | 0.0094 | 0.0091 | 0.0089 | 0.0087 | 0.0084 |
| -2.2 | 0.0139 | 0.0136 | 0.0132 | 0.0129 | 0.0125 | 0.0122 | 0.0119 | 0.0116 | 0.0113 | 0.0110 |
| -2.1 | 0.0179 | 0.0174 | 0.0170 | 0.0166 | 0.0162 | 0.0158 | 0.0154 | 0.0150 | 0.0146 | 0.0143 |
| -2.0 | 0.0228 | 0.0222 | 0.0217 | 0.0212 | 0.0207 | 0.0202 | 0.0197 | 0.0192 | 0.0188 | 0.0183 |
| -1.9 | 0.0287 | 0.0281 | 0.0274 | 0.0268 | 0.0262 | 0.0256 | 0.0250 | 0.0244 | 0.0239 | 0.0233 |
| -1.8 | 0.0359 | 0.0351 | 0.0344 | 0.0336 | 0.0329 | 0.0322 | 0.0314 | 0.0307 | 0.0301 | 0.0294 |
| -1.7 | 0.0446 | 0.0436 | 0.0427 | 0.0418 | 0.0409 | 0.0401 | 0.0392 | 0.0384 | 0.0375 | 0.0367 |
| -1.6 | 0.0548 | 0.0537 | 0.0526 | 0.0516 | 0.0505 | 0.0495 | 0.0485 | 0.0475 | 0.0465 | 0.0455 |
| -1.5 | 0.0668 | 0.0655 | 0.0643 | 0.0630 | 0.0618 | 0.0606 | 0.0594 | 0.0582 | 0.0571 | 0.0559 |
| -1.4 | 0.0808 | 0.0793 | 0.0778 | 0.0764 | 0.0749 | 0.0735 | 0.0721 | 0.0708 | 0.0694 | 0.0681 |
| -1.3 | 0.0968 | 0.0951 | 0.0934 | 0.0918 | 0.0901 | 0.0885 | 0.0869 | 0.0853 | 0.0838 | 0.0823 |
| -1.2 | 0.1151 | 0.1131 | 0.1112 | 0.1093 | 0.1075 | 0.1056 | 0.1038 | 0.1020 | 0.1003 | 0.0985 |
| -1.1 | 0.1357 | 0.1335 | 0.1314 | 0.1292 | 0.1271 | 0.1251 | 0.1230 | 0.1210 | 0.1190 | 0.1170 |
| -1.0 | 0.1587 | 0.1562 | 0.1539 | 0.1515 | 0.1492 | 0.1469 | 0.1446 | 0.1423 | 0.1401 | 0.1379 |
| -0.9 | 0.1841 | 0.1814 | 0.1788 | 0.1762 | 0.1736 | 0.1711 | 0.1685 | 0.1660 | 0.1635 | 0.1611 |
| -0.8 | 0.2119 | 0.2090 | 0.2061 | 0.2033 | 0.2005 | 0.1977 | 0.1949 | 0.1922 | 0.1894 | 0.1867 |
| -0.7 | 0.2420 | 0.2389 | 0.2358 | 0.2327 | 0.2296 | 0.2266 | 0.2236 | 0.2206 | 0.2177 | 0.2148 |
| -0.6 | 0.2743 | 0.2709 | 0.2676 | 0.2643 | 0.2611 | 0.2578 | 0.2546 | 0.2514 | 0.2483 | 0.2451 |
| -0.5 | 0.3085 | 0.3050 | 0.3015 | 0.2981 | 0.2946 | 0.2912 | 0.2877 | 0.2843 | 0.2810 | 0.2776 |
| -0.4 | 0.3446 | 0.3409 | 0.3372 | 0.3336 | 0.3300 | 0.3264 | 0.3228 | 0.3192 | 0.3156 | 0.3121 |
| -0.3 | 0.3821 | 0.3783 | 0.3745 | 0.3707 | 0.3669 | 0.3632 | 0.3594 | 0.3557 | 0.3520 | 0.3483 |
| -0.2 | 0.4207 | 0.4168 | 0.4129 | 0.4090 | 0.4052 | 0.4013 | 0.3974 | 0.3936 | 0.3897 | 0.3859 |
| -0.1 | 0.4602 | 0.4562 | 0.4522 | 0.4483 | 0.4443 | 0.4404 | 0.4364 | 0.4325 | 0.4286 | 0.4247 |
| -0.0 | 0.5000 | 0.4960 | 0.4920 | 0.4880 | 0.4840 | 0.4801 | 0.4761 | 0.4721 | 0.4681 | 0.4641 |
| 0.0 | 0.5000 | 0.5040 | 0.5080 | 0.5120 | 0.5160 | 0.5199 | 0.5239 | 0.5279 | 0.5319 | 0.5359 |
| 0.1 | 0.5398 | 0.5438 | 0.5478 | 0.5517 | 0.5557 | 0.5596 | 0.5636 | 0.5675 | 0.5714 | 0.5753 |
| 0.2 | 0.5793 | 0.5832 | 0.5871 | 0.5910 | 0.5948 | 0.5987 | 0.6026 | 0.6064 | 0.6103 | 0.6141 |
| 0.3 | 0.6179 | 0.6217 | 0.6255 | 0.6293 | 0.6331 | 0.6368 | 0.6406 | 0.6443 | 0.6480 | 0.6517 |
| 0.4 | 0.6554 | 0.6591 | 0.6628 | 0.6664 | 0.6700 | 0.6736 | 0.6772 | 0.6808 | 0.6844 | 0.6879 |
| 0.5 | 0.6915 | 0.6950 | 0.6985 | 0.7019 | 0.7054 | 0.7088 | 0.7123 | 0.7157 | 0.7190 | 0.7224 |
| 0.6 | 0.7257 | 0.7291 | 0.7324 | 0.7357 | 0.7389 | 0.7422 | 0.7454 | 0.7486 | 0.7517 | 0.7549 |
| 0.7 | 0.7580 | 0.7611 | 0.7642 | 0.7673 | 0.7704 | 0.7734 | 0.7764 | 0.7794 | 0.7823 | 0.7852 |
| 0.8 | 0.7881 | 0.7910 | 0.7939 | 0.7967 | 0.7995 | 0.8023 | 0.8051 | 0.8078 | 0.8106 | 0.8133 |
| 0.9 | 0.8159 | 0.8186 | 0.8212 | 0.8238 | 0.8264 | 0.8289 | 0.8315 | 0.8340 | 0.8365 | 0.8389 |
| 1.0 | 0.8413 | 0.8438 | 0.8461 | 0.8485 | 0.8508 | 0.8531 | 0.8554 | 0.8577 | 0.8599 | 0.8621 |
| 1.1 | 0.8643 | 0.8665 | 0.8686 | 0.8708 | 0.8729 | 0.8749 | 0.8770 | 0.8790 | 0.8810 | 0.8830 |
| 1.2 | 0.8849 | 0.8869 | 0.8888 | 0.8907 | 0.8925 | 0.8944 | 0.8962 | 0.8980 | 0.8997 | 0.9015 |
| 1.3 | 0.9032 | 0.9049 | 0.9066 | 0.9082 | 0.9099 | 0.9115 | 0.9131 | 0.9147 | 0.9162 | 0.9177 |
| 1.4 | 0.9192 | 0.9207 | 0.9222 | 0.9236 | 0.9251 | 0.9265 | 0.9279 | 0.9292 | 0.9306 | 0.9319 |
| 1.5 | 0.9332 | 0.9345 | 0.9357 | 0.9370 | 0.9382 | 0.9394 | 0.9406 | 0.9418 | 0.9429 | 0.9441 |
| 1.6 | 0.9452 | 0.9463 | 0.9474 | 0.9484 | 0.9495 | 0.9505 | 0.9515 | 0.9525 | 0.9535 | 0.9545 |
| 1.7 | 0.9554 | 0.9564 | 0.9573 | 0.9582 | 0.9591 | 0.9599 | 0.9608 | 0.9616 | 0.9625 | 0.9633 |
| 1.8 | 0.9641 | 0.9649 | 0.9656 | 0.9664 | 0.9671 | 0.9678 | 0.9686 | 0.9693 | 0.9699 | 0.9706 |
| 1.9 | 0.9713 | 0.9719 | 0.9726 | 0.9732 | 0.9738 | 0.9744 | 0.9750 | 0.9756 | 0.9761 | 0.9767 |
| 2.0 | 0.9772 | 0.9778 | 0.9783 | 0.9788 | 0.9793 | 0.9798 | 0.9803 | 0.9808 | 0.9812 | 0.9817 |
| 2.1 | 0.9821 | 0.9826 | 0.9830 | 0.9834 | 0.9838 | 0.9842 | 0.9846 | 0.9850 | 0.9854 | 0.9857 |
| 2.2 | 0.9861 | 0.9864 | 0.9868 | 0.9871 | 0.9875 | 0.9878 | 0.9881 | 0.9884 | 0.9887 | 0.9890 |
| 2.3 | 0.9893 | 0.9896 | 0.9898 | 0.9901 | 0.9904 | 0.9906 | 0.9909 | 0.9911 | 0.9913 | 0.9916 |
| 2.4 | 0.9918 | 0.9920 | 0.9922 | 0.9925 | 0.9927 | 0.9929 | 0.9931 | 0.9932 | 0.9934 | 0.9936 |
| 2.5 | 0.9938 | 0.9940 | 0.9941 | 0.9943 | 0.9945 | 0.9946 | 0.9948 | 0.9949 | 0.9951 | 0.9952 |
| 2.6 | 0.9953 | 0.9955 | 0.9956 | 0.9957 | 0.9959 | 0.9960 | 0.9961 | 0.9962 | 0.9963 | 0.9964 |
| 2.7 | 0.9965 | 0.9966 | 0.9967 | 0.9968 | 0.9969 | 0.9970 | 0.9971 | 0.9972 | 0.9973 | 0.9974 |
| 2.8 | 0.9974 | 0.9975 | 0.9976 | 0.9977 | 0.9977 | 0.9978 | 0.9979 | 0.9979 | 0.9980 | 0.9981 |
| 2.9 | 0.9981 | 0.9982 | 0.9982 | 0.9983 | 0.9984 | 0.9984 | 0.9985 | 0.9985 | 0.9986 | 0.9986 |
| 3.0 | 0.9987 | 0.9987 | 0.9987 | 0.9988 | 0.9988 | 0.9989 | 0.9989 | 0.9989 | 0.9990 | 0.9990 |
| 3.1 | 0.9990 | 0.9991 | 0.9991 | 0.9991 | 0.9992 | 0.9992 | 0.9992 | 0.9992 | 0.9993 | 0.9993 |
| 3.2 | 0.9993 | 0.9993 | 0.9994 | 0.9994 | 0.9994 | 0.9994 | 0.9994 | 0.9995 | 0.9995 | 0.9995 |
| 3.3 | 0.9995 | 0.9995 | 0.9995 | 0.9996 | 0.9996 | 0.9996 | 0.9996 | 0.9996 | 0.9996 | 0.9997 |
| 3.4 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9997 | 0.9998 |

# BLANK PAGE