ALUPE UNIVERSITY COLLEGE

... *Bastion of Knowledge*....

OFFICE OF THE DEPUTY PRINCIPAL
ACADEMICS, STUDENT AFFAIRS AND RESEARCH

UNIVERSITY EXAMINATIONS

2019 /2020 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER REGULAR EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE (APPLIED STATISTICS WITH COMPUTING)

COURSE CODE: STA 115

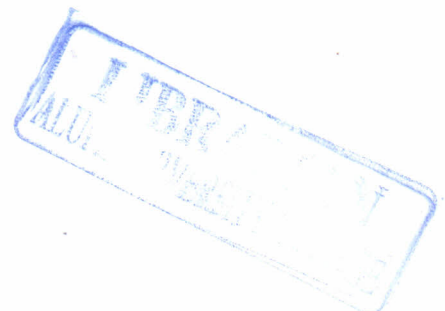**COURSE TITLE:** INTRODUCTION TO MATHEMATICS FOR FINANCE

DATE: 12TH OCTOBER, 2020   **TIME: 1400 – 1700 HRS**

INSTRUCTION TO CANDIDATES

- **SEE INSIDE**

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REGULAR – MAIN   EXAM

STA 115: INTRODUCTION TO MATHEMATICS FOR FINANCE

STREAM: ASC   **DURATION: 3 Hours**

INSTRUCTION TO CANDIDATES
Answer **ALL** questions from section A and any **THREE** from section B.
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SECTION A (31 marks): Answer ALL questions.
QUESTION ONE (16 Marks)

a) Discuss the following terms as used in finance   [4Marks]

   i)   Interest

   ii)   Breakeven point

   iii)   Mortgage

   iv)   Market Equilibrium

b) i) Differentiate between domain and range of the function
      [2Marks]

   ii) Given $f(x) = 2x^2 + 5x + 1$, find the value of f when x = 3; x = 2;
      [2Marks]

c) If the amount of £2000 was invested 3 years ago to have amount of £4000 now. At what rate
   is the amount discounted?
      [3Marks]
d) Show how the calculation of compound interest is an application of exponential function
   [2Marks]
e) Shadrack invests a bonus of £9000 at 6% annual interest compounded semiannually for4
   years. How much interest will she earn?   [3Marks]

QUESTION TWO (15Marks)

a) i) Give the difference between Nominal interest and effective interest   [1Mark]

    ii) What nominal rate, compounded quarterly, is equivalent to an effective annual rate of
    10%?   [2Marks]

b) Biologists studying salmon have found that the oxygen consumption of yearling salmon (in
    appropriate units) increases exponentially with the speed of swimming according to the
    function defined by $f(x) = 100e^{0.6x}$ where x is the speed in feet per second. Find the oxygen
    consumption;

    i) When the fish are still   [2Marks]

    ii) At a speed of 2 ft per second   [2Marks]

c) Let matrix **A** be
    $$A = \begin{bmatrix} 1 & 0 & 1 \\ 2 & -2 & -1 \\ 3 & 0 & 0 \end{bmatrix}$$ Find the inverse of **A**

                                                                                           [6Marks]
d) Solve the following equation; log x + log (x − 3) = 1, (assume base=10)   [2Marks]

SECTION B (39 marks)

QUESTION THREE 13MKS

a) Define the term perpetuity in finance   [2Marks]

b) Investment A: done by making payments of amount £50,000/= at the end of every year for 15
    years at the rate of interest of 8%. Investment B: made by payments of £60,000 at the
    beginning of every year for 13 years at an interest rate of 8%. If both investments are
    thereafter accumulated up to the end of the 20th year after which they are converted to
    perpetuity to be received at the end of every year. Determine which perpetuity gives a higher
    amount   [4Marks]

c) If you deposit £5000 into an account paying 6% annual interest compounded monthly, how
    long until there is £8000 in the account?   [3Marks]
d) Given the series payments of amount £2,000 made at the end of every year for ten years at an
    annual effective rate of   10%. Determine
    i)   Present value of the series   [2Marks]
    ii)   Accumulated value of the series of payments at t=10   [2Marks]

QUESTION FOUR 13MKS

A magazine article argued that the cause of the obesity epidemic is the decreasing cost of food (in real terms) due to the increasing surplus of food. As one piece of evidence, the following table was provided, which we have updated, showing. corn production (in billions of bushels) for selected years.

Year	Production (Billions of Bushels)
1930	1.757
1940	2.207
1950	2.764
1960	3.907
1970	4.152
1980	6.639
1990	7.934
2000	9.968
2010	11.112

a) Plot the data. Does the production appear to grow linearly or exponentially?   [6Marks]

b) Find an exponential function in the form of $p(x) = p_0 a^{x-1930}$ that models this data, where x is the year and $p(x)$ is the production of corn. Use the data for 1930 and 2010. Plot the function on the graph in (a)   [5Marks]

c) iii) Determine the expected annual percentage increase in corn production during this time.   [2Marks]

QUESTION FIVE 13MKS

a) Define the following terms   [3Marks]

   i)   Feasible region

   ii)   Constraints

   iii)   Feasible solution

b) A flight leaves New York at 8 P.M. and arrives in Paris at 9 A.M. (Paris time). This 13-hour difference includes the flight time plus the change in time zones. The return flight leaves Paris at 1 P.M. and arrives in New York at 3 P.M. (New York time). This 2-hour difference includes the flight time minus time zones, plus an extra hour since flying westward is against the wind. Find the actual flight time eastward and the difference in time zones.   [4Marks]

c) A restaurant owner orders a replacement set of knives, forks, and spoons. The box arrives containing 40 utensils and weighing 141.3 oz (ignoring the weight of the box). A knife, fork, and spoon weigh 3.9 oz, 3.6 oz, and 3.0 oz, respectively.

    (i)   How many solutions are there for the number of knives, forks, and spoons in the box?   [3Marks]

    (ii)   Find the solution with the smallest number of spoons.   [3Marks]

QUESTION SIX 13MKS

a) Give the difference between the following: [4Marks]
    i)   Annuity due and annuity immediate
    ii)   Row echelon form of a matrix and rank of a matrix

b) Use the Gauss-Jordan method to solve the system   [9 Marks]

$$x + 5z = -6 + y$$
$$3x + 3y = 10 + z$$
$$x + 3y = 10 + z$$

QUESTION SEVEN 13MKS

a) Find an equation of the line through (5,4) and (-10, -2).   [3Marks]

b) A Farmer raises only goats and pigs. She wants to raise no more than 16 animals, including no more than 10 goats. She spends $25 to raise a goat and $75 to raise a pig, and she has $900 available for this project. Each goat produces $12 in profit and each pig $40 in profit. How many goats and how many pigs should she raise to maximize total profit? Sketch the feasible region for the following set of constraints, and then find the maximum and minimum values of the objective function.   [10Marks]