MASENO UNIVERSITY

UNIVERSITY EXAMINATIONS 2016/2017

THIRD YEAR FIRST SEMESTER EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE IN APPLIED STATISTICS WITH INFORMATION TECHNOLOGY

MAIN CAMPUS

MAS 311: STATISTICAL DEMOGRAPHY I

Date: 6th December, 2016 Time: 8.30 - 11.30 am

INSTRUCTIONS:

- Answer question ONE and any other TWO questions.

QUESTION 1

(a) (*i*) What are demographic models? [1 mk]

(*ii*) Distinguish the two broad categories of demographic models giving an example of each. [4 mks]

(b) (*i*) What's a **life table**? [1 mk]

(*ii*) List the four sets of model life tables currently in use [2 mks]

(c) Three model life table systems have one major shortcoming that led to the need for a fourth one. Explain this shortcoming. [2 mks]

(d) Distinguish between **stable, quasi-stable** and **stationary** populations [8 mks]

(e) Outline the **four** main uses of the stable population model [2 mks]

(f) Imagine a female life table according to which $\frac{3}{4}$ of the initial cohort dies during the first 2 years of life. Deaths are evenly distributed throughout this period. Then no deaths occur until age 82 when all survivors perish.

(*i*) Sketch ℓ_x [1 mk]

(*ii*) Determine [5 mks]

(*) e_0^0

(**) e_2^0

(g) Show that in a stationary population $b=d=\frac{1}{e_0^0}=\frac{1}{T_0}$ [5 mks]

where b=birth rate

d= death rate

e_0^0=expectation of life at birth

T_0=total number of years lived by the cohort from birth.

QUESTION 2

(a) Suppose a life table in which the number of survivors declines linearly from 100 at age nought to 50 at age 20, remains at 50 until age 60, and then declines linearly to nought at age 80.

(*i*) What's the expectation of life at age [5 mks]

(*) nought

(**) 20

(***) 60

(*ii*) What's the average death rate of persons [2 mks]

(*) under 20 in this stationary population

(**) over 60?

(b) Two stable populations embody the same fertility schedule but different mortality schedules. In both populations, 20% of women between exact age 45 to 55 bear a female child annually, no child bearing occurring outside this span. In population A, there's no mortality until age 100, where all who reach that age die. In population B, 1% of each cohort dies within each single year of age, with no survivors beyond age 100.

(*i*) Calculate [7 mks]

(*) Gross Reproduction Rate (GRR)

(**) Net Reproduction Rate (NRR)

(***) Rate of growth r

for each.

(*ii*) Determine the [3 mks]

(*) birth rate for each

(**) death rate for each

(*iii*) Sketch the age distribution for each. [3 mks]

QUESTION 3

With two quite different schedules of mortality (P & Q), the average duration of life is the same. According to schedule P, there are no deaths until age 50; within each cohort the number of deaths above 50 is uniform at each age until age 100, beyond which there are no survivors.

According to schedule Q, within each cohort the number of deaths is the same at every age until age 50; from age 50 to 100, there's no mortality; all survivors die on attaining age 100.

(*i*) Sketch ℓ_x for each life table [1 mk]

(*ii*) What's [4 mks]

(*) the common e_0^o

(**) ℓ_{50} in Q?

Female populations with life tables P and Q are subject to the following fertility schedule: there are annually .120 female births for each woman between exact ages 20 and 30, and no births outside this span.

[7 mks]

(*iii*) What's

(*) Gross Reproduction Rate (GRR)

(**) Net Reproduction Rate (NRR)

(***) approximate value of r

in the two populations?

(*iv*) What's the birth rate in the stable population Q? [2 mks]

(*v*) What's the approximate birth rate in population P? [6 mks]

QUESTION 4

(*a*) In the analysis of stable populations, state **3** assumptions that must hold good. [3 mks]

(*b*) Outline **four** properties of the stable population model. [4 mks]

(c) Show that in a stable population the equation given below has one real solution $r=r_0$

$\int_a^b e^{-rx} p(x)f(x)dx=1$ [5 mks]

(d) Show that in a stable population the age structure is fixed and that

$C(x)=be^{-rx}p(x)$ [8 mks]

QUESTION 5

(*a*) Discuss in detail the four model life tables, clearly explaining how they were derived. With reference to the Coale and Demeny life tables, which family suits the African data? [10 mks]

(*b*) In the absence of adequate empirical data for selecting a family of model life tables, give **five** general guidelines that will narrow the possibilities and lead to a reasonable choice. [10 mks]