UNIVERSITY OF SWAZILAND

MAIN EXAMINATION 2017

TITLE OF PAPER: DEMOGRAPHIC METHODS

COURSE NUMBER: DEM 202

TIME ALLOWED: 3 HOURS

INSTRUCTIONS: ANSWER QUESTION 1 AND ANY THREE QUESTIONS.
ALL QUESTIONS ARE WORTH 25 MARKS EACH.

REQUIREMENTS: CALCULATOR

THIS PAPER SHOULD NOT BE OPENED UNTIL PERMISSION HAS BEEN GIVEN BY THE INVIGILATOR

**Question 1 (Compulsory)**

a. Define and present the formulae for calculating the crude death rate and the age specific death rate (4)

b. Are these age indicators a) above dependent? Explain (2)

c. Why is it necessary to standardize rates? Which type of standardization do you prefer and why? (4)

d. How is the standard population selected? (3)

e. Using the indirect method of standardization compare and discuss the death rates for country A and B using the data provided in **table 1** below (12)

**Table 1:** Data from hypothetical countries

| **Age groups** | **Country A Population** | **Country B Population** | **Standard Population death rates per 1000** |
|---|---|---|---|
| 0-4 | 560 | 440 | 7.50 |
| 5-24 | 1800 | 1620 | 2.25 |
| 25-44 | 1820 | 1800 | 3.15 |
| 45-64 | 1440 | 1560 | 17.50 |
| 65+ | 620 | 700 | 117.50 |
| **All ages** | | | |
| **Crude death rate** | | | **18.55** |
| **Actual Deaths** | **116360** | **113170** | |

**Question 2**

a) If a cohort is defined as "professional soccer players," and the relevant life experience is defined as starting with the first game played as a professional and ending with the last game played as a professional, which of the following would not be a possible attrition factor? (3)

i. career-ending injury
ii. retirement
iii. death
iv. all of the above are possible attrition factors

c) Use the data presented in Table 1 below to compute the eventual probabilities of death for cause of death 1 and cause of death 2. Show all your calculations. (20)

**Table 1: Distribution of life table deaths by cause for males in country X, 1960**

| Age | ${}_nd_x$ | ${}_nq_x$ | $l_x$ | Deaths | Deaths[1] | Deaths[2] |
|---|---|---|---|---|---|---|
| 0-1 | 7230 | 0.07230 | 100000 | 2235 | 538 | 2 |
| 1-4 | 2566 | 0.02765 | 92770 | 654 | 140 | 13 |
| 5-9 | 768 | 0.00851 | 90204 | 142 | 10 | 8 |
| 10-14 | 569 | 0.00636 | 89436 | 87 | 1 | 5 |
| 15-19 | 570 | 0.00641 | 88867 | 72 | 2 | 4 |
| 20-24 | 793 | 0.00899 | 88298 | 87 | 0 | 6 |
| 25-29 | 712 | 0.00814 | 87504 | 67 | 0 | 7 |
| 30-34 | 854 | 0.00984 | 86792 | 70 | 2 | 4 |
| 35-39 | 1287 | 0.01497 | 85938 | 86 | 2 | 10 |
| 40-44 | 1849 | 0.02184 | 84651 | 103 | 1 | 23 |
| 45-49 | 2629 | 0.03175 | 82802 | 136 | 0 | 20 |
| 50-54 | 3615 | 0.04509 | 80173 | 159 | 3 | 46 |
| 55-59 | 4975 | 0.06498 | 76558 | 176 | 2 | 55 |
| 60-64 | 7979 | 0.11146 | 71583 | 233 | 4 | 74 |
| 65-69 | 10564 | 0.16609 | 63605 | 246 | 3 | 62 |
| 70-74 | 12107 | 0.22826 | 53040 | 246 | 5 | 47 |
| 75-79 | 13002 | 0.31765 | 40933 | 220 | 3 | 44 |
| 80-84 | 13724 | 0.49135 | 27931 | 169 | 5 | 23 |
| $85_+$ | 14207 | 1.0000 | 14207 | 154 | 5 | 13 |

d) Based on your calculations above, provide answers for the following questions:
   I. How many people die due to cause of death 1 after age 10? (1)
   II. Among 100 000 newborn children, how many will die at age 0 due to cause of death 2? (1)

**Question 3**

a) Define the following:
   I. Attrition factors (2)
   II. Right censoring (2)
   III. Migration expectancy (2)

b) What assumptions are made when constructing a clinical life table? (4)

c) Consider a prospective study designed to study time to death. The study involves 20 participants who are 65 years and older, enrolled over a 5 year period followed up to 24 years until they dies or the study ends or they drop out. The table below indicates when they enrolled and what subsequently happened to them during the observation period. Summarize the experience of the participants by constructing a clinical life table. (15)

**Table 2: Cohort study designed to study time to death**

| Participant Identification Number | Year of death | Year of last contact |
|---|---|---|
| 1 | | 24 |
| 2 | 3 | |
| 3 | | 11 |
| 4 | | 19 |
| 5 | | 24 |
| 6 | | 13 |
| 7 | 14 | |
| 8 | | 2 |
| 9 | | 18 |
| 10 | | 17 |
| 11 | | 24 |
| 12 | | 21 |
| 13 | | 12 |
| 14 | 1 | |
| 15 | | 10 |
| 16 | 23 | |
| 17 | | 6 |
| 18 | 5 | |
| 19 | | 9 |
| 20 | 17 | |

**Question 4**

a) A net nuptiality table is a type of double decrement table. Which are the forces of decrement and which state is being decremented? (3)

b) Define the following net nuptiality notation and provide a formula for their calculation: (10)

i. $1000q_x$
ii. $d'_x$
iii. $L'_x$
iv. $T'_x$
v. $e'_x$

c) Specify one disadvantage of migration expectancy as a measure of the occurence of migration? (2)

d) Using the data provided in Table 3 below, compute the migration expectancy for the United States. (10)

**Table 3: Migration expectancy for the United States,1997-98**

| Age | Total population (in thousands) | Movers (1997-98) | $l_x$ | $T_x$ |
|---|---|---|---|---|
| 1-4 | 15802 | 3552 | 99268 | 396721 |
| 5-9 | 20453 | 3526 | 99118 | 495329 |
| 10-14 | 19663 | 2755 | 99022 | 494883 |
| 15-19 | 19466 | 2864 | 98905 | 493650 |
| 20-24 | 17613 | 5607 | 98519 | 491362 |
| 25-29 | 18996 | 5442 | 98020 | 488766 |
| 30-34 | 20358 | 4267 | 97487 | 485746 |
| 35-39 | 22691 | 3568 | 96795 | 481820 |
| 40-44 | 21771 | 2570 | 95881 | 476549 |
| 45-49 | 18634 | 1798 | 94651 | 469305 |
| 50-54 | 15424 | 1242 | 92946 | 458779 |
| 55-59 | 12190 | 916 | 90406 | 443132 |
| 60-64 | 10065 | 574 | 86630 | 419530 |
| 65-69 | 9361 | 439 | 80870 | 385659 |
| 70-74 | 8512 | 389 | 73056 | 339620 |
| 75-79 | 6898 | 276 | 62422 | 280047 |
| 80-84 | 4383 | 186 | 49276 | 207474 |
| $85_+$ | 2928 | 130 | 36629 | 204073 |
| Total | 265208 | 40101 | | |

**Question 5**

a. What is a difference between a cohort and a period rate? (3)

b. Using data in **table 3** answer the questions below

i) What is the conventional infant mortality rate in year 1968? (3)

ii) What is the adjusted infant mortality rate for 1968 using the Cohort method? (3)

iii) Do the rates above differ? If so, why do they differ and which one would you prefer as a better indicator of infant mortality experience of this population? (2)

iv) What is the rationale behind adjusting the infant mortality rate? (3)

**Table 3.** You are given the following births and infants deaths recorded in Country X in 1967 and 1968.

| Year | Births cohorts | Age (yrs) | Deaths | Births |
|---|---|---|---|---|
| 1967 | 1967 | 0 | 2893 | 142471 |
| 1968 | 1967 | 0 | 481 | _____ |
| 1968 | 1968 | 0 | 2603 | 138214 |
| 1969 | 1968 | 0 | 302142471 | _____ |

c. Define maternal mortality rate (2)
d. Using the data provided in **table 4** calculate the maternal mortality rate and maternal mortality ratio for Country Y in 1990. (4)

**Table 4**: Data from Country Y in 1990

| | |
|---|---|
| Births | 4158212 |
| Maternal deaths | 343 |
| Women aged 15-49 | 65624 |

**Question 6**

a) What assumptions are made for the use of censored data? (4)

b) What data are required for constructing a net nuptiality table? (2)

c) Give 3 uses of the net nuptiality table. (6)

d) What is the intrinsic growth rate of a population? (2)

e) Outline 3 characteristics of a stable population. (3)

f) At the start of the $20^{th}$ century, China had an estimated $R_o$ of 0.81297 and $R_1$ of 23.52850. Calculate the mean length of a generation in China and the population's intrinsic rate of natural increase. (3)

g) Using the data for a growing Western population given in Table 4 below, compute the intrinsic growth rate for the population. (5)

**Table 4: Data for a growing Western population, 2000**

| Age | Mid point | Female ASFRs | Survival probability ($5L_x/5*l_0$) |
|---|---|---|---|
| 15-19 | 17.5 | 0.01326 | 0.97914 |
| 20-24 | 22.5 | 0.04324 | 0.97703 |
| 25-29 | 27.5 | 0.07812 | 0.97421 |
| 30-34 | 32.5 | 0.07113 | 0.97061 |
| 35-39 | 37.5 | 0.02906 | 0.96577 |
| 40-44 | 42.5 | 0.00506 | 0.95870 |
| 45-49 | 47.5 | 0.00013 | 0.94751 |