UNIVERSITY OF SWAZILAND

DEPARTMENT OF STATISTICS AND DEMOGRAPHY

MAIN EXAMINATION 2016

TITLE OF PAPER	:INDIRECT TECHNIQUES OF DEMOGRAPHIC ESTIMATION
COURSE CODE	:DEM 303
TIME ALLOWED	:THREE (3) HOURS
INSTRUCTIONS	:ANSWER QUESTIONS 1, 2, 3 AND EITHER 4 OR 5 SHOW ALL YOUR FORMULAE AND WORKINGS WHERE APPLICABLE.
REQUIREMENTS	: CALCULATOR

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

Question 1 **[Total= 40marks]**

a. What is meant by a relational model life table? [4]
b. State any three uses of Brass logit life table system [3]
c. What is the advantage of Brass relational system over an empirical model life table?; [2]
d. The Brass logit life table system can be expressed mathematically as follows:
$\lambda(l_x) = \alpha + \beta\lambda(l_x^s)$
   i. Briefly explain what is meant by the above mathematical expression? [3]
   ii. Define the parameters alpha (α) and beta (β) in a Brass logit model life table [4]
   iii. Explain the meaning of α and β range (low or high) of values [6]
   iv. Write down the formula for computing λl_x. [2]
e. The values of α and β in the logit model life table are obtained after fitting a straight line in some way.
   i. State how the straight line is obtained [3]
   ii. Which commands in excel would you write to obtain α and β values? [2]
   iii. Give the formulae you would use to obtain the same answers as above for α and β using a calculator [4]
   iv. Using your formulae in e iii and data given in table below , calculate α and β [3

age	standard logits	observed logits
1	-1.70593	-2.05952
5	-1.5524	-1.83178
55	-1.05987	-0.95938
65	-0.7579	-0.69315

i. Give a formula to derive a fitted life table using the parameters derived above [4]

Question 2 **[Total=20 marks]**

A recent graduate in Census Statistical Office is given Census data in Table Q2.1obtained on children ever born and births in the last 12 months for women in country X in 2004. Based on these data, an attempt was made to estimate fertility using the Trussell variant of Brass P/F ratio method. The results are presented in Table Q2.1 using standard symbols (in Manual X of United Nations).

Table Q2.1: Application of Brass P/F ratio method to, Country X

										K=1.499	
i	Age	W(i)	CEB(i)	B(i)	P(i)	f(i)	Φ(i)	F(i)	w(i)	f+(i)	P(i)/F(i)	f*(i)
1	15-19	3014706	1160919	320406	0.385	0.1063	0.5314	0.237	0.087	0.1262	1.622	0.1892
2	20-24	2653155	4901382	609269	-------	-------	-------	-------	-------	-------	-------	-------
3	25-29	2607009	9085852	561494	3.485	0.2154	2.7565	2.338	0.111	0.2131	1.490	0.3194
4	30-34	2015663	9910256	367833	4.917	0.1825	3.6689	3.323	0.121	0.1783	1.479	0.2673
5	35-39	1771680	10384001	237297	5.861	0.1339	4.3386	4.094	0.205	0.1310	1.432	0.1964
6	40-44	1479575	9164329	95357	6.194	0.0644	4.6609	4.579	0.167	0.0568	1.353	0.0852
7	45-49	1135129	6905673	38125	6.084	0.0336	4.8288	4.790		0.0280	1.270	0.0420

You are provided with information in Tables Q2.1 and table coefficients of the P/F ratio method in the Appendix of this paper.

a) With aid of formulae for the parameters P(i) to f*(i), fill in the blank spaces for agegroup 20-24 in Table Q2.1 [8]

b) The value K=1.499 was chosen as an average of the age groups for index i=2, 3 and 4. Explain why this value was chosen in this manner? [1]

c) Write down two assumptions of the Brass P/F ratio of estimating fertility? [2]

d) State one advantage of using the Brass P/F ratio method [1]

e) List one disadvantage of this method. [1]

f) After applying the P/F ratio method it was noticed that errors in the average number of children ever born per woman, by age of the woman affect the results. Then the demographer applied the El-Badry method before using the relational Gompertz method as an alternative method of estimation.

i. Why was the El-Badry technique applied? [2]

ii. State the assumption of the El-Badry method [1]

iii. State two advantages of applying the relational Gompertz model [2]

iv. Outline two assumptions for the relational Gompertz Model [2]

Question 3 **[Total=20 marks]**

Using census data for Country C in year 2002 shown in Table Q3.1, a demographer estimated male child mortality using the Brass Children Ever Born-Children Surviving technique as displayed in Tables Q3.1 and Q3.2. The demographer assumed mortality follows the North model life table which is provided in the Appendix. Coefficients for estimation of child mortality multipliers and for estimation of the reference period are also provided in the Appendix.

Table Q3.1Data observed for Country C required for Brass Children Ever Born: Children Surviving technique computations

Age group	Index	W_i	CEB_i	CS_i	CD_i	P_i	D_i
15-19	1	766882	69352	64317	-------	-------	-------
20-24	2	658857	347375	319447	-------	-------	-------
25-29	3	513783	535319	489377	-------	-------	-------
30-34	4	360277	546691	500238	-------	-------	-------
35-39	5	268789	555112	507881	-------	-------	-------
40-44	6	239716	612986	552286	-------	-------	-------
45-49	7	191154	548148	482831	-------	-------	-------
Total		**2999458**	**3214983**	**2916377**			

Table Q3.2 Brass Children Ever Born: Children Surviving technique

Age i	K_i	Age x	q_x	t_x	Reference date	l_x	Mortality level
15-19	1.0400	1	0.07551	1.0354	2001.7	0.92449	17.3
20-24	-------	2	-------	---------	2000.4	--------	------
25-29	0.9347	3	0.08022	4.2615	1998.5	0.91978	18.7
30-34	0.9705	5	0.08246	6.5338	1996.2	0.91754	19.2
35-39	1.0328	10	0.08787	9.0691	1993.7	0.91213	19.6
40-44	1.0203	15	0.10104	11.7851	1991.0	0.89896	19.3
45-49	1.0030	20	0.11952	14.6755	1988.1	0.88048	19.0

Given the data provided Tables Q3.1 and Q3.2 and appropriate Life Tables in the Appendix.

a) Define the parameters CD_i, P_i, D_i, q_x, t_x, and l_x in Tables Q3.1 and Q3.2 [3]
b) Fill in the blank spaces in Tables Q3.1 and Q3.2 [16]
c) Comment on the levels of child mortality in this Country [1]

Note: Copies of the relevant life tables are provided at the end of this paper.

ANSWER EITHER

Question 4 **[Total=20 marks]**

a. Describe in detail the characteristics of each region of the Coale and Demeny (Princeton) regional model life tables. [16]

b. Outline two limitations of the Princeton model life tables [2]

c. The first set of United Nations model life tables were developed using one mortality parameter. State two limitations in this procedure to compute the United Nations model life tables. [2]

OR

Question 5

Write brief, but critical notes on the purpose, data required, assumptions and/or limitations of the **TWO** following indirect estimation methods.

a. Brass growth balance method [10]

b. Preston and Coale method [10]

APPENDIX

Table A1:Table Coefficients for F(i)

Age group	a(i)	b(i)	c(i)
15-19	2.531	-0.188	0.0024
20-24	3.321	-0.754	0.0161
25-29	3.265	-0.627	0.0145
30-34	3.442	-0.563	0.0029
35-39	3.518	-0.763	0.0006
40-44	3.862	-2.481	-0.0001
45-49	3.828	0.016*	-0.0002

Table A2: Table Coefficients for $f^{+}(i)$

Age group	x(i)	y(i)	z(i)
15-19	0.031	2.287	0.114
20-24	0.068	0.999	-0.233
25-29	0.094	1.219	-0.977
30-34	0.12	1.139	-1.531
35-39	0.162	1.739	-3.592
40-44	0.27	3.454	-21.497

Table A3: Coefficients of estimation of child mortality Multipliers, Trussell variant: North Model

Age group	ai	bi	ci
15-19	1.1119	-2.9287	0.8507
20-24	1.2390	-0.6865	-0.2745
25-29	1.1884	0.0421	-0.5156
30-34	1.2046	0.3037	-0.5656
35-39	1.2586	0.4236	-0.5898
40-44	1.2240	0.4222	-0.5456
45-49	1.1772	0.3486	-0.4624

Table A4: Coefficients for estimation of the reference period t(x), North Model

Age group	ai	bi	ci
15-19	1.0921	5.4732	-1.9672
20-24	1.3207	5.3751	0.2133
25-29	1.5996	2.6268	4.3701
30-34	2.0779	-1.7908	9.4126
35-39	2.7705	-7.3403	14.9352
40-44	4.152	-12.2448	19.2349
45-49	6.965	-13.916	19.9542

TABLE 228. MALE PROBABILITY OF SURVIVING FROM BIRTH, $l(x)$, NORTH MODEL

	Probability of surviving from birth, l(x)									
Level	*l(1)*	*l(2)*	*l(3)*	*l(4)*	*l(5)*	*l(10)*	*l(15)*	*l(20)*	*l(25)*	*l(30)*
1	0.62883	0.54784	0.49858	0.46197	0.43413	0.37865	0.35414	0.33041	0.29946	0.26970
2	0.66077	0.58341	0.53637	0.50141	0.47482	0.41960	0.39484	0.37056	0.33867	0.30777
3	0.68944	0.61599	0.57133	0.53813	0.51289	0.45855	0.43384	0.40930	0.37688	0.34525
4	0.71541	0.64603	0.60383	0.57247	0.54862	0.49563	0.47123	0.44669	0.41407	0.38206
5	0.73911	0.67387	0.63419	0.60470	0.58227	0.53101	0.50711	0.48278	0.45025	0.41816
6	0.76087	0.69979	0.66265	0.63504	0.61405	0.56480	0.54158	0.51762	0.48544	0.45353
7	0.78096	0.72404	0.68942	0.66369	0.64412	0.59713	0.57473	0.55129	0.51965	0.48816
8	0.79959	0.74678	0.71467	0.69080	0.67265	0.62809	0.60662	0.58383	0.55292	0.52203
9	0.81694	0.76819	0.73854	0.71652	0.69976	0.65778	0.63734	0.61530	0.58527	0.55516
10	0.83314	0.78839	0.76117	0.74095	0.72557	0.68627	0.66694	0.64574	0.61672	0.58754
11	0.84833	0.80749	0.78266	0.76421	0.75017	0.71365	0.69548	0.67519	0.64730	0.61918
12	0.86256	0.82556	0.80306	0.78633	0.77361	0.73992	0.72297	0.70365	0.67697	0.65002
13	0.87589	0.84328	0.82344	0.80870	0.79749	0.76689	0.75116	0.73264	0.70693	0.68090
14	0.88772	0.85920	0.84186	0.82897	0.81916	0.79161	0.77715	0.75958	0.73511	0.71031
15	0.89926	0.87456	0.85954	0.84838	0.83990	0.81537	0 80222	0.78571	0.76263	0.73921
16	0.91045	0.89005	0.87707	0.86725	0.85969	0.83814	0.82634	0.81097	0.78941	0.76751
17	0.92126	0.90473	0.89368	0.88518	0.87855	0.85994	0.84949	0.83534	0.81539	0.79513
18	0.93167	0.91855	0.90937	0.90218	0.89652	0.88076	0.87169	0.85880	0.84055	0.82201
19	0.94164	0.93156	0.92416	0.91829	0.91362	0.90065	0.89294	0.88135	0.86485	0.84811
20	0.95115	0.94378	0.93811	0.93355	0.92989	0.91963	0.91327	0.90300	0.88829	0.87339
21	0.96019	0.95524	0.95126	0.94801	0.94538	0.93776	0.93273	0.92379	0.91088	0.89784
22	0.96870	0.96595	0.96365	0.96175	0.96021	0.95510	0.95137	0.94378	0.93272	0.92160
23	0.97647	0.97484	0.97341	0.97222	0.97124	0.96781	0.96513	0.95938	0.95113	0.94280
24	0.98394	0.98310	0.98234	0.98170	0.98117	0.97916	0.97745	0.97326	0.96721	0.96113

Source: United Nations (1983) Manual X