UNIVERSITY OF SWAZILAND

DEPARTMENT OF STATISTICS AND DEMOGRAPHY

MAIN EXAMINATION 2014

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 WORKINGS INCLUDING FORMULAE WHERE APPLICABLE.
REQUIREMENTS	:	CALCULATOR

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Question 1 **[Total=20 marks]**

A demographer assessing parity data for a certain developing country observed its poor quality and decided to apply an el-Badry technique. Given this information:

a. Briefly explain three possible errors that could have generated the poor parity data. [6]

b. State the reason that could have justified the demographer's application of the el-Badry technique on the observed data? [2]

c. What are the data requirements for the el-Badry technique? [2]

d. State one assumption of the el-Badry technique. [2]

After using the el-Badry technique, the demographer decided to use the Brass P/F ratio method to estimate fertility.

e. Which assumptions are required to apply the P/F ratio method? [4]

f. The demographer obtained a declining trend in the P/F ratios by age of the women. Explain the meaning of the derived P/F ratios for this developing country. [4]

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

Table 1 gives the data needed to calculate Coale's indices for Country A in year 1974. The estimated total number of births in Country A in 1974 was 3,689,000 and there was a negligible amount of illegitimacy.

Table1 Data for calculating Coale's indices for Country A, 1974

	Hutterite	Estimated population (000s)	
Age group	standard	all females	married females
15-19	0.300	3777	2432
20-24	0.550	3101	2828
25-29	0.502	2636	2494
30-34	0.447	2161	2012
35-39	0.406	1793	1606
40-44	0.222	1484	1211
45-49	0.061	1222	892

Using the data provided in Table 1:

a. Calculate Coale's Indices- I_f, I_g, I_h and I_m. [8]

b. Comment on your answers in part a). [4]

c. Without any computation or derivation, write down the two formulae to estimate the Coale-Trussell fertility schedule M and m scale parameters. [4]

d. What does the M and m scale parameters in part c) represent? [4]

Question 3 **[Total=40 marks]**

a. Explain what is meant by i) empirical models and ii) relational models [4]

b. State any three uses of model life tables; [3]

c. What is the advantage of using relational over empirical model life tables; [2]

d. Briefly explain the patterns of the Coale and Demeny model life tables; [12]

e. A demographer fitted a two-parameter Brass relational model life table from data observed in Country B in a certain year. The data showing the life table of mortality experience for Country B is shown in Table 2.

Table 2 Life table of mortality experience of Country B

Age	Standard		Fitted			
X	lx	logit lx	lx	logit lx	logit lx	lx
0	1		1			[redacted]
1	0.913	-1.175	0.932	[redacted]	-1.4104	[redacted]
5	0.725	-0.485	0.804	[redacted]	-0.6120	[redacted]
10	0.7	-0.424	0.792	[redacted]	-0.5414	[redacted]
15	0.682	-0.381			-0.4927	0.728
20	0.658	-0.327			-0.4299	0.703
25	0.629	-0.264			-0.3568	0.671
30	0.598	-0.199			-0.2812	0.637
35	0.564	-0.129			-0.2005	0.599
40	0.53	-0.060			-0.1211	0.560
45	0.494	0.012			-0.0378	0.519
50	0.457	0.086			0.0480	0.476
55	0.412	0.178	0.392	[redacted]	0.1539	[redacted]
60	0.361	0.286	0.335	[redacted]	0.2783	[redacted]
65	0.295	0.436	0.281	[redacted]	0.4518	[redacted]
70	0.222	0.627	0.216	[redacted]	0.6731	[redacted]
75	0.145	0.887			0.9738	0.125
80	0.076	1.249			1.3921	0.058
85	0.029	1.756			1.9776	0.019
			Alpha	[redacted]		
			Beta	[redacted]		

Using the data in Table 2 and showing your answers for the provided spaces in the same Table:

i. Compute the logit lx values for the observed data provided? [3]

ii. Determine the parameters alpha (α) and beta (β) in a Brass logit model life table fitted to all the data provided above. [12]

iii. Derive a fitted life table using the parameters derived in part b) and the standard provided. [4]

ANSWER EITHER

Question 4 **[Total=25 marks]**

A census for Country C was conducted in year 2002 and the information in Table 3 was observed which is used by a population analyst to estimate fertility using the Brass P/F ratio method as shown in Table 4.

Table 3: Number of women, W(i), children ever born, CEB, and births in the last 12 months B(i)

Age group	i	W(i)	CEB(i)	B(i)
15-19	1	766882	136575	56223
20-24	2	658857	689022	120600
25-29	3	513783	1065311	85742
30-34	4	360277	1088263	48182
35-39	5	268789	1101057	25718
40-44	6	239716	1215454	12168
45-49	7	191154	1088320	3002
Total		**2999458**	**6384002**	**351635**

Table 4: Application of Brass P/F ratio method to results of 2002 census, Country C

							K=	1.1536
Age group	P(i)	f(i)	Ø(i)	F(i)	P/F	w(i)	f+(i)	f*(i)
15-19	-------	-------	-------	-------	-------	-------	-------	0.1022
20-24	-------	-------	1.2818	0.9065	-------	0.108	0.1858	0.2143
25-29	-------	-------	2.1162	1.7949	1.1552	-------	-------	-------
30-34	-------	-------	-------	-------	-------	0.1216	-------	-------
35-39	-------	-------	3.2633	3.0849	-------	0.1576	0.092	-------
40-44	-------	-------	3.5171	3.42	1.4826	-------	0.0463	-------
45-49	5.6934	0.0157	-------	-------	1.5915		0.0122	0.014
TFR		3.6						

NB: You are provided with information in Tables 3 and 4 and formulae in the Appendix of this paper.

a) What are the assumptions for Brass P/F ratio of estimating fertility? [2]
b) State one advantage of using the Brass P/F ratio method [1]
c) List one disadvantage of this method. [1]
d) Defining the parameters P(i) to f*(i), fill in the blank spaces in Table 4. You may use the formulae and table coefficients in the appendix. [17]
e) How was the value K chosen, and why do you think this value was chosen this way. [2]
f) Using the data above, calculate the adjusted Total Fertility Rate : [2]

OR

Question 5 **[Total=25 marks]**

Using census data for Country C in year 2002 shown in Table 5, a demographer estimated male child mortality using the Brass Children Ever Born-Children Surviving technique as displayed in Tables 5 and 6. 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 5 Data 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 6 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 5 and 6 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 5 and 6. [6]
b) Fill in the blank spaces in Table 4 and Table 5 [18]
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.

APPENDIX

$$F(7) = \phi(6) + a(7)f(7) + b(7)f(6) + c(7)\phi(7)$$

$$f^{+}(i) = (1 - w(i-1))f(i) + w(i)f(i+1)$$

$$w(i) = x(i) + y(i)\frac{f(i)}{\phi(7)} + z(i)\frac{f(i+1)}{\phi(7)}$$

$$F(i) = \phi(i-1) + a(i)f(i) + b(i)f(i+1) + c(i)\phi(7)$$

$$f^{+}(7) = (1 - w(6))f(7)$$

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