

UNIVERSITY OF SWAZILAND
DEPARTMENT OF STATISTICS AND DEMOGRAPHY
MAIN EXAMINATION 2013

TITLE OF PAPER : **INDIRECT TECHNIQUES OF DEMOGRAPHIC ESTIMATION**

COURSE CODE : **DEM 303**

TIME ALLOWED : **THREE (3) HOURS**

INSTRUCTIONS : **ANSWER QUESTION 1, 2, 3 AND EITHER QUESTION 4 OR 5;
SHOW ALL YOUR WORKINGS WHERE APPLICABLE.**

REQUIREMENTS : **CALCULATOR**

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

Question 1**[Total=17 marks]**

- a. Compare and contrast direct and indirect methods of demographic estimation? You are required to briefly explain four key points on each method. [8]

- b. The Coale and Trussell fertility model is expressed in the form:

$$r(a)/n(a) = M.e^{m.v(a)}$$

- i. For the purpose of fitting m and M parameters, transform the above equation into a linear regression equation by taking natural logarithms. [2]
- c. Suppose the linear equation you obtained above is fitted to data using a least-squares method to fit this line and the value of the intercept is -0.892 while that of slope is 1.703;
- i. what are the corresponding values of m and M? [3]
- ii. what are the meaning of m and M values obtained above? [4]

Question 2**[Total=28 marks]**

- a. Explain what is meant by demographic models? [2]
- b. Describe any two uses of model life tables; [2]
- c. State any two limitations of model life tables; [2]
- d. Find the value ${}_4q_1$ corresponding to level 13.5 in the female North Princeton model life table; [4]
- e. Find the value ${}_3d_2$ corresponding to level 14.6 in the female North model life table; [4]
- f. What is the probability of surviving to age 4 in a population whose probability of surviving to age 5 is 0.785? Assume the male North model is applicable; [6]
- g. Using the North model, compute the relative percentage change in the under 5 female mortality when the level changes from 10 to 11; and [3]
- h. What population characteristics would lead a demographer to elect the Princeton North model life table as a standard? [5]

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

Question 3

[Total=20 marks]

Consider the developing country A whose mortality experience is represented by the life table in Table 1.

Table 1: Mortality experience: Country A

Age x	Number surviving to age x out of 100,000 births
15	96457
20	95800
25	94912
30	94042
35	93044
40	91645
45	89537
50	86259

Using the data in Table 1, and the General Standard life table in APPENDIX:

- a. What is meant by a relational system of model life tables?. [2]
- b. Determine the parameters alpha (α) and beta (β) in a Brass logit model life table fitted to all ages or the data provided above. [10]
- c. Interpret the values of the Brass parameters obtained in part b); [4]
- d. Derive a fitted life table using the parameters derived in part b) and the General standard; and [2]
- e. Compare the fitted life table values with the observed ones. [2]

ANSWER EITHER

Question 4

[Total=25 marks]

As a population analyst employed by the Central Statistics Office you are tasked to estimate child mortality for Swaziland using the 1997 census data. Describe in detail the method you would use, clearly stating your assumptions, data requirements, computational procedure, and limitations of the method you have chosen.

OR

Question 5

[Total=25 marks]

- a. Describe in detail **ANY ONE** of the following methods used when estimating mortality:
- i) Widowhood method; or
 - ii) Brass growth balance method.

Note: Make sure to explain the purpose, assumptions, data requirements, computational procedure (including formulae), and limitations of the method.

APPENDIX

Table A1: Brass General and African Standard life table l_x 's values

Age x	General Standard l_x	Age x	African Standard l_x
0	1	0	1
1	0.8499	1	0.8802
2	0.807	2	0.8335
3	0.7876	3	0.8101
4	0.7762	4	0.7964
5	0.7691	5	0.7863
10	0.7502	10	0.7502
15	0.7362	15	0.7362
20	0.713	20	0.713
25	0.6826	25	0.6826
30	0.6525	30	0.6525
35	0.6223	35	0.6223
40	0.5898	40	0.5898
45	0.5535	45	0.5535
50	0.5106	50	0.5106
55	0.4585	55	0.4585
60	0.3965	60	0.3965
65	0.321	65	0.321
70	0.238	70	0.238
75	0.1516	75	0.1516
80	0.0768	80	0.0768
85	0.0276	85	0.0276
90	0.0059	90	0.0059
95	0.0006	95	0.0006
100	0	100	0

Source: Carrier and Hobcraft (1973)

TABLE 227. FEMALE PROBABILITY OF SURVIVING FROM BIRTH, $l(x)$, NORTH MODEL

Level	Probability of surviving from birth, $l(x)$									
	$l(1)$	$l(2)$	$l(3)$	$l(4)$	$l(5)$	$l(10)$	$l(15)$	$l(20)$	$l(25)$	$l(30)$
1.....	0.68027	0.59707	0.54585	0.50719	0.47783	0.41664	0.38879	0.36233	0.33468	0.30493
2.....	0.70798	0.62931	0.58089	0.54433	0.51658	0.45647	0.42870	0.40206	0.37399	0.34357
3.....	0.73285	0.65879	0.61320	0.57878	0.55265	0.49416	0.46675	0.44023	0.41205	0.38134
4.....	0.75539	0.68592	0.64316	0.61087	0.58637	0.52990	0.50309	0.47693	0.44891	0.41822
5.....	0.77595	0.71104	0.67108	0.64091	0.61801	0.56387	0.53785	0.51225	0.48461	0.45421
6.....	0.79483	0.73440	0.69720	0.66912	0.64780	0.59622	0.57115	0.54626	0.51920	0.48931
7.....	0.81226	0.75622	0.72173	0.69569	0.67592	0.62708	0.60308	0.57905	0.55272	0.52353
8.....	0.82842	0.77668	0.74483	0.72078	0.70253	0.65657	0.63373	0.61067	0.58521	0.55689
9.....	0.84347	0.79591	0.76664	0.74454	0.72777	0.68479	0.66320	0.64120	0.61672	0.58941
10.....	0.85753	0.81405	0.78729	0.76708	0.75175	0.71182	0.69154	0.67068	0.64728	0.62111
11.....	0.87070	0.83119	0.80687	0.78851	0.77457	0.73775	0.71883	0.69917	0.67693	0.65200
12.....	0.88305	0.84739	0.82544	0.80886	0.79628	0.76259	0.74507	0.72666	0.70565	0.68204
13.....	0.89451	0.86319	0.84391	0.82936	0.81831	0.78822	0.77212	0.75483	0.73483	0.71235
14.....	0.90498	0.87810	0.86140	0.84874	0.83906	0.81261	0.79809	0.78216	0.76351	0.74247
15.....	0.91512	0.89247	0.87813	0.86714	0.85864	0.83564	0.82270	0.80820	0.79099	0.77149
16.....	0.92492	0.90605	0.89388	0.88447	0.87710	0.85736	0.84599	0.83295	0.81724	0.79939
17.....	0.93435	0.91887	0.90871	0.90078	0.89450	0.87787	0.86803	0.85646	0.84230	0.82617
18.....	0.94337	0.93096	0.92267	0.91615	0.91093	0.89724	0.88890	0.87879	0.86622	0.85184
19.....	0.95199	0.94236	0.93583	0.93064	0.92645	0.91556	0.90868	0.90004	0.88904	0.87645
20.....	0.96018	0.95311	0.94822	0.94432	0.94114	0.93294	0.92747	0.92027	0.91084	0.90004
21.....	0.96795	0.96323	0.95993	0.95727	0.95508	0.94946	0.94537	0.93957	0.93171	0.92269
22.....	0.97535	0.97287	0.97111	0.96968	0.96850	0.96545	0.96272	0.95834	0.95204	0.94482
23.....	0.98177	0.98036	0.97935	0.97852	0.97783	0.97598	0.97427	0.97140	0.96725	0.96225
24.....	0.98782	0.98713	0.98662	0.98620	0.98585	0.98491	0.98393	0.98211	0.97936	0.97601

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

Level	Probability of surviving from birth, $l(x)$									
	$l(1)$	$l(2)$	$l(3)$	$l(4)$	$l(5)$	$l(10)$	$l(15)$	$l(20)$	$l(25)$	$l(30)$
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