中国从业人口生命表

CHINESE WORKING POPULATION LIFE TABLE

1989—1990

劳动部信息中心
Information Centre of Ministry of Labour

中国统计出版社
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祝贺我国第一部
从业人口生命表
诞生！

朱家颢
一九九〇·二·二十〇

加强劳动生命
科学研究
为劳动与社会
保障事业的发
展提供科学依
据

蒋正华
1994.3.26

感谢鹰星控股（中国）有限公司对此书的出版
给予的技术上的大力支持！

Many thanks to Eagle Star Holdings（China）
Ltd. for its great technical support to
this publication！

——《中国从业人口生命表》编委会

Editing Committee of

《Chinese Working Population Life Table》

谨对此书的出版表示衷心的祝贺！

Warmest congratulations on the publication
of this life table！

——鹰星控股（中国）有限公司主席
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序

中国是一个人口大国。由于其人口之多,也由于特定的历史和特定的环境所形成的人口特征,使中国人口问题成为全世界许多人口学专家所倾心研究的一门专门学问。

近年来,随着中国经济的发展和社会的进步,不仅对中国人口问题的研究越来越重要,而且对中国从业人口问题的研究也越来越重要。之所以说它重要,说穿了,是因为实际工作极为需要,而又缺乏可供使用的基础资料,以致制约了其它社会学研究的进一步深入。从业人口生命表就是这些基础资料中最为重要的一种。

在实际工作中,很多领域都需要从业人口的预期寿命、职业风险、不同地区与不同职业的从业人口生命规律和特征等重要数据。在改革中迅速发展的社会保险事业,无论是养老保险、失业保险,还是医疗保险、工伤保险,都迫切需要这些基本参数进行测算;各类保险公司开展的人寿保险、意外伤害保险、医疗保险等险种,也毫无疑问地需要这些参数;在就业指导、人力资源开发和职业技能开发、劳动安全与卫生监察管理和技术改造、医疗卫生和保健事业、计划生育工作、金融与投资工作、社会救济及残疾人事业、老龄工作等方面,也都非常需要这些基本参数。此外国家制订各种政策和计划的部门,社会各类研究机构和教育界,统计部门和信息部门,重要的行业、企业,来华投资的外商,甚至劳动者个人,也都对这种数据有明显的或潜在的需要。

但是这样重要的数据,我们直到现在还没有。中国缺少一部全面反应全国和各地区从业人口生命规律的生命表。由于第三次人口普查及其以前各次普查的调查结果无法用来编制从业人口生命表,因此也就无人能够从事这方面的研究。第四次人口普查虽未完全满足编制从业人口生命表的需要,但已能够提供一个基本依据了。

社会生活实际的需要和"四普"带来的一线希望,填补空白的强烈愿望,形成了我们编制《中国从业人口生命表》的巨大动力。经过一年的努力,中国第一部从业人口生命表终于诞生了。

象这样一部从业人口生命表,样本总体之大、数据之多,据我所知在世界各国还没有先例。这部生命表以提取和使用"四普"数据为基础,但在高龄段退休人口职业分类上参考了大量其他资料并进行了合理的推算,其数据可说是迄今为止可用性最佳的了。这部生命表综合采用了当今国际上流行的一些编制生命表的理论和方法,并编制了一套专用软件进行计算。

这部生命表的编制,不仅在高龄段退休人口职业分类上的推算独具特色,而且创造了我们称之为"ab 阶段法"的方法来推算普查时点前一年的生存人口数。同时,我们还提出了一个新的人口学指标 wd_x,即以从业人口和全部人口平均期望寿命之比为定义的从业人口生命质量系数。可以说,这部生命表期望在这三点上对人口学有新的贡献。

了解人口学的人们都知道,编制生命表是不能一劳永逸的。对于从业人口的生命状况,应进行定期调查,以便定期地补充和完善各种从业人口生命表。此外由于篇幅所限,本书提供了全国分职业大类的从业人口生命表和各地区全部从业人口的生命表,未能提供各地区分职业大类的从业人口生命表(当然,这在技术上是没有许多困难的,如果哪个地区需要,我们可以予以协助)。也可能这部生命表还有一些不尽人意的地方。但无论如何,我们还是应当为在未来若干年内有这样一部生命表做为基础资料而感到欣慰。

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这部生命表的编制,是劳动、人口、统计三界专家的集体成果。

劳动部信息中心的青年学者康怀宇同志,从英国伦敦市立大学精算科学系毕业回国后即作为执行主编从事了这部生命表的研究和编制工作。还有两位青年学者贾怀斌同志和翟燕立同志为解决这部生命表编制中的一些难点问题,做出了可贵的贡献。

北京经济学院人口研究所黄荣清教授,在百忙中协助进行了本书的审校工作。

国家统计局人口司的同志们为这部生命表的编制提供了重要的基础数据。

国家计划生育委员会陈胜利同志以及国内几位人口学专家给我们提供了非常有价值的咨询意见。

还有许多同事和朋友,为这本书的问世做了大量工作。在此,向所有参与了这部生命表编制、出版工作的专家、同事和朋友一并致以衷心的感谢。

《中国从业人口生命表》出版了,这是一件好事。但更重要的是各界人士如何充分开发和利用它,使它在社会生活和科学研究中发挥出应有的作用。我们愿与大家一起,为中国从业人口生命规律的研究做出更大的贡献。

<div align="right">

王 东 岩

1994 年 4 月 4 日

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Preface

China is a country with a large population. Because of such a population as well as the population characteristics developed by its specific history and environment, many demographers in the world are cordially studying the Chinese population issues as a special knowledge.

In recent years, with the economic development and social progress in China, it is not only more and more important to study Chinese population, but also to study Chinese working population. Why is it so important? In short, because it is urgently needed for the practical work, and yet the required fundamental data are so inadquate that it has restricted other social researches deeply. the Chinese working population life table just provides one area of the very important fundamental data.

In practice, the important data concerning the life expectancy and occupational risks of the working population, and the life laws and characteristics for the working population in different areas and different occupation are all needed for many areas of work. In reform process, the rapidly developing social insurance programs, whether the pension, unemployment, or the medical care and employment injury insurances are all in urgently need of these basic parameters to forecast the changing trends. No doubt, the life insurance, accident insurance and medical care insurance and etc. run by various kinds of insurance companies are all in need of these parameters. It is the case for the following: the employment guidance, human resource development and vocational skill development, labour safety and health inspection and administration and the technical innovation, medical and health development, the family planning, finance and investment, social relief and social programs for disabled, work for aged and etc. Besides, the line state departments for policy—making and planing in the country, different social research institutes and the education, the statistical departments and information departments, essential industries and enterprises, foreign investors and even the individual workers, all have explicit or potential need for these data.

Since the results of the third population census and censuses provious to it could not be used to chart out the life tables of the working population, nobody had been able to engage in this research. Although the fouth population census of China in 1990 could not completely satisfy the requirements for making the working population life tables, it can already provide the fundamental data required.

Practical needs of social life and a light brought from the "fourth population census", and a strong desire to fill up the vacuum have motivated us to compile the "Life Table for China's Working Population". The first book of the《Chinese Working Population Life Table》have been completed through one year's hard work.

As far as my personnal knowledge goes, such a life table in its magnitude of sampling base and numerousness of data is really unprecedented in the world. It has extracted and taken the "fourth population census" data as the basis for making the life tables. For the occupational classification of retired population of senior age group, we have reckoned reasonable figures while referring to a large number of other data. The data here can be described as optimum. Some prevailing

international theories and methods for setting up life tables have been incorporated in the composition of this table. And a set of special software for calculating the life tables have been developed for this purpose.

The compilation of this life table not only is unique in the constructive calculation of the occupational classification of the senior retired population, but also has created what we call "ab phase method", being used to reckon the number of population one year earlier. At the same time, we have introduced a new index for demography, i. e, The Life Quality Coefficient of the working population, which is the proportion of the life expectancy of the working population divided by the life expectancy of the entire population. We hope that the three points above can contribute to demography.

It is known to demorgraphers that the making of life tables can not be good for time. The life conditions of the working population should be studied regularly so that we can update and improve various kinds of life tables regularly. The book has supplied the life tables for the various kinds of occupations of the nationwide working population, and the working population life tables in different areas, it has not yet supplied the life tables for various kinds of occupations in different areas (of course, we have no difficulty in doing so and offering help if any areas need the life tables.). There might be some errors in the life tables. However, we should be gratified at having such a package of life tables as the fundamental materials for the coming years.

The compilation of the life tables is the collective results of labour scientists, demographers and statistics scientists.

Mr Kang Huaiyu, the youth scholar, graduated from the Department of Actuarial Science and Statistics, City University of London, has been the acting editor to deal with the research and composition of the life tables immediately after coming back to the Information centre of Ministry of Labour from England. Another two youth scholars, Mr Jia Huaibin and Mr Zhai Yanli have contributed a lot for solving some of the difficulties during the making of the life tables.

Professor Huang Rongqing from the Institute of Demographic Research, has taken time off his busy work to help us verify the book.

The colleagues from the Department of Population, the State Statistical Bureau of China have supplied the fundamental data for the making of life tables.

Mr Chen Shengli from the Committee of State Family Planning and some of the demographers in China have given valueable advices and suggestions.

Many other colleagues and friends of us have done a lot of work for the apperance of the book. Here, I would like to thank all of the experts, colleagues and friends for their participation in the making of the life tables and the publication of the book.

It is a good matter that "Chinese Working Population Life Table" has been published. What is more is how the personalities of various circles can fully develop and utilise it so that it can play an important role in social life and scientific researches. Please allow me to join hands with you in making a larger contribution to the studies of the Chinese Working Population.

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April 4, 1994
Wang Dongyan

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关于《中国从业人口生命表》的
技 术 说 明

  《中国从业人口生命表(1989—1990)》的编制是按原始数据的提取和整理、生命表的模型设计、算法设计、误差分析以及最后产生有关的生命表等步骤进行的。

  中国从业人口生命表的原始数据是根据第四次人口普查的原始数据,按性别、年龄别,分省、自治区、直辖市提取了七个职业大类的从业人口数据,以及离休、退休、退职人员数据,死亡人口也按七个职业大类提取。

  由于死亡人口在各个年龄组上按死者生前所从事的主要职业划分,因此要求生存人口也必须与之相对应,即不管哪一个年龄组,生存人口都必须归入其所从事的具体职业大类。但是,从65岁(有些职业大类从60岁)开始,各个职业大类的从业人员大部分已退休,而这部分人员的原职业未进行调查,这就给高龄段生命表的编制带来一定困难。为此,我们利用了建国以来我国进行的几次人口普查数据,以及有关的抽样调查资料,特别是参考了由社科院人口所牵头编写的《中国1987年60岁以上老年人口抽样调查资料》,进行了细致的研究和推算,最后整理出了生命表编制所需的全部原始数据。

  生命表的编制方法有多种,不同的调查数据,其生命表的编制方法也会有所不同。但是,不管哪一种生命表的编制方法,其基本原理都是一样的,即:

$$m_x = \frac{d_x}{\int_x^{x+1} l_t d_t}$$

$$q_x = \frac{d_x}{l_x}$$

$$q_x \approx \frac{m_x}{1+0.5 m_x}$$

  其中,m_x 为死亡率,q_x 为死亡概率,$[x, x+1)$ 为某一个具体年龄组。

  由于我们编制的从业人口生命表所采用的时间段为1989年7月1日至1990年7月1日,而生存人口只有1990年7月1日的数据,因此必须推算出1989年7月1日的生存人口数据。为了能得出1989年7月1日的生存人口数,我们用了以下公式:

$$P_x(-1) = \frac{P_{x+1}(0)}{p_x^{(0)}} \tag{1}$$

$$m_x = \frac{2D_x}{P_x(-1) + P_x(0)} \tag{2}$$

$$p_x^{(1)} = \begin{cases} \dfrac{1-0.5m_x}{1+0.5m_x}, & 15 \leqslant x < a \\ \dfrac{b-x}{b-a} \cdot \dfrac{1-0.5m_x}{1+0.5m_x} + \dfrac{x-a}{b-a} \cdot \exp(-m_x), & a \leqslant x \leqslant b \\ \exp(-m_x), & x > b \end{cases} \tag{3}$$

  其中 $P_x(-1)$ 为1989年7月1日的生存人口数,$P_x(0)$ 为1990年7月1日的生存人口数,$p_x^{(1)}$ 为 x 岁的存活概率,$p_x^{(0)}$ 为存活概率初值($0 < p_x^{(0)} \leqslant 1$),取定 $s > 0$(s 为临界控制值),当 $\max|p_x^{(1)} - p_x^{(0)}| < s$ 计算结束;否则修正 $p_x^{(0)} = (p_x^{(0)} + p_x^{(1)}) \times 0.5$,继续迭代,直到达到满意的精度为止。从而求出1989年7月1日的生存人口数。

  选择 a,b 两个结点的目的是使函数 $p_x^{(1)}$ 尽可能光滑,a,b 两点的确定方法如下:

  由于 a,b 两点主要受死亡人数及死亡年龄的影响,因此,设 $M_x =$ 死亡人数 x 死亡年龄,则 M_x 为一序列,对此序列做截断性数据分析及探索性数据分析,找出近似曲线的两个拐点,即求出 a,b 的值。例如,北京市女性从业人口生命表的 a,b 值如下图所示。

Mx—死亡人数 ∗ 死亡年龄

x—年龄
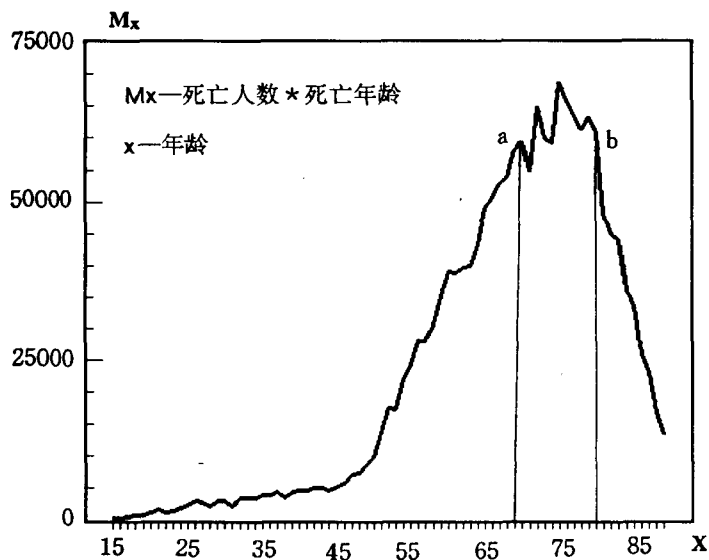
以下表 1、表 2 给出了各种从业人口生命表的 a,b 值：

表 1. 全国及市镇从业人口生命表的 a,b 值

	全国从业人口				全国市镇从业人口			
	男		女		男		女	
	a	b	a	b	a	b	a	b
总　　计	73	77	73	77	73	77	73	77
国家机关、党群组织负责人	73	77	73	77	73	77	73	77
各类专业、技术人员	73	77	73	77	73	77	73	77
办事人员和有关人员	73	77	73	77	73	77	73	77
商业、服务性工作人员	73	77	73	77	73	77	73	77
农、林、牧、渔劳动者	73	77	73	77	73	77	73	77
生产工人、运输工作和有关人员	73	77	73	77	73	77	73	77

表 2. 各省、自治区、直辖市从业人口生命表 a,b 值

	全部从业人口				市镇从业人口			
	男		女		男		女	
	a	b	a	b	a	b	a	b
北　京	75	79	75	79	72	76	75	79
天　津	75	79	75	80	72	76	70	75
河　北	72	76	75	80	72	76	75	80
山　西	72	76	73	77	72	76	73	77
内蒙古	70	75	71	75	72	76	71	75
辽　宁	75	79	76	8?	75	79	75	80
吉　林	71	75	72	77	72	76	71	75
黑龙江	68	74	68	74	68	74	68	74
上　海	75	79	76	82	73	77	71	75
江　苏	70	75	75	82	70	75	75	81
浙　江	72	76	75	82	72	76	75	82
安　徽	69	74	72	76	68	74	72	76
福　建	69	74	76	80	69	74	76	80
江　西	70	74	74	78	71	75	76	80
山　东	72	76	76	80	72	76	76	80
河　南	69	74	71	75	69	74	71	75
湖　北	69	75	73	77	69	75	73	77
湖　南	71	75	73	77	71	75	73	77
广　东	71	75	76	82	71	75	76	82
广　西	73	77	76	80	73	77	76	81
海　南	69	75	76	82	69	75	76	82
四　川	69	74	73	77	69	75	73	77
贵　州	72	76	73	77	71	75	73	77
云　南	72	76	74	78	72	76	74	78
西　藏	69	74	72	76	71	75	75	79
陕　西	71	75	71	75	71	75	71	75
甘　肃	69	74	71	75	69	74	68	74
青　海	70	74	70	74	68	74	70	74
宁　夏	72	76	71	75	70	74	72	76
新　疆	69	75	69	74	68	75	69	74

特殊工种的从业人口从 65 岁开始合并为一组,公式(3)改为:

$$p_x^{(1)} = \frac{1-0.5m_x}{1+0.5m_x}$$

生命表符号说明

x—年龄

q_x—x 岁人口的死亡概率

l_x—1,000,000 生存人口中年龄区间始点人数

d_x—1,000,000 生存人口中年龄区间内死亡人数

L_x—静态区间人年数

T_x—静态区间总人年数

e_x—该年龄区间平均期望寿命

wd_x—从业人口生命质量系数,该系数由王东岩先生提出,其计算方法如下:

$$wd_x = \frac{从业人口平均期望寿命}{全部人口平均期望寿命}(男性参考表 1-1,女性参考表 1-2)$$

所有生命表均使用 Foxbase 2.0 软件编制,所用图型均用图型软件 GB 绘制。

The Directions for 《Chinese Working Population Life Table》

The "Chinese Working Population Life Table(1989 — 1990)" is developed on basis of the following steps: collecting and handling the original data; designing model and algorithm of the life tables;analysing errors and finally producing the related life tables,and etc.

The original data for the life tables are collected from that of "fourth population census in 1990",which is divided as 7 occupational groups by sex,age,and by provinces,autonomous regions and municipalities,as well as retirement occupations and the data of the retired and the withdrawals,the data for deaths collected on the same classifications.

Since the deaths at different age groups are classified in accordance with their major occupations during their life time in different ages,hence,it is required that the existing population must correspond with the deaths,i. e, whatever age groups,the lives must be merged into a corresponding occupation. However,beginning from age 65 (some of the occupations from 60),most of the workers and staff have retired,and the original occupations have not been covered in the survey proceedings of this population census. Therefore,it is difficult for the establishment of the life tables for those who are at advanced age. Hence,we have utilised the data from several population census in China and the related information from sampling investigation, particularly referred to the "1987 Sampling Investigation Data for old age persons over 60" edited by the Institute of Population Research,Chinese Academy for Social Sciences,and carried out careful study and calculation and finally worked out all the necessary original data for the life tables.

There are several different methodologies to establish the life tables,using different investigation data. At the same time,the methods are different. But,whichever methods are adopted for producing the life tables are being used,their basic principles should be the same,i. e

$$m_x = \frac{d_x}{\int_x^{x+1} l_t d_t}$$

$$q_x = \frac{d_x}{l_x}$$

$$q_x \approx \frac{m_x}{1 + 0.5 m_x}$$

Among them,m_x is the mortality rate,and q_x is the probability of death,$[x,x+1)$ is a specific age group.

Since the time interval of our population life table establishment has been from 1 July,1989 to 1 July,1990,but the existing population data we have is only that of 1 July 1990 . Hence our reckoning for this time the lives data of 1 July,1989. For the purpose of arriving at the living population we have to utilise the following formula:

$$P_x(-1) = \frac{P_{x+1}(0)}{p_x^{(0)}} \tag{1}$$

$$m_x = \frac{2D_x}{P_x(-1) + P_x(0)} \tag{2}$$

$$p_x^{(1)} = \begin{cases} \dfrac{1 - 0.5 m_x}{1 + 0.5 m_x}, & 15 \leqslant x < a \\ \dfrac{b-x}{b-a} \cdot \dfrac{1 - 0.5 m_x}{1 + 0.5 m_x} + \dfrac{x-a}{b-a} \cdot \exp(-m_x), & a \leqslant x \leqslant b \\ \exp(-m_x), & x > b \end{cases} \tag{3}$$

Among them,$P_x(-1)$ is the lives data at 1 July,1989,$P_x(0)$ is the lives data at first of July,1990,$p_x^{(0)}$ is the probability of the lives,$p_x^{(0)}$ is the initial value ($0 < p_x^{(0)} \leqslant 1$),let $s > 0$ (s is the controlled minimum value),when $\max |p_x^{(1)} - p_x^{(0)}| < s$,then finish the calculation; otherwise let $p_x^{(0)} = (p_x^{(0)} + p_x^{(1)}) * 0.5$,continue iterative,until we obtain the satisfactory results. Thus the existing population of 1 July1989 could be extracted.

The purpose of selection of the two points of a,b is to make the function as smooth as possible,the method of

determination of the two points a and b is as follow:

Since the points a,b are mainly affected by the number of deaths and the deaths' age,hence,let $M_x =$ the number of death x the age of the deaths,M_x is a series,analysing the data using the trial method and cutting short method,seeking the two turning points over in the curve,the values of a,b will be found out. For example,the values of a,b for the working population life table in Beijing municipality(female)are shown in the following diagram:
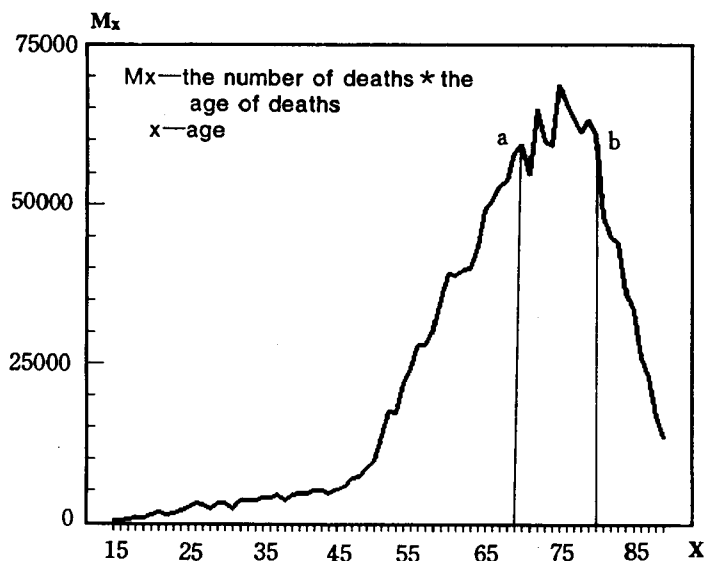

Table 1,2 give out the values of a,b in various kinds of working population life tables:

Table 1 the values of a,b of national working population

	Total WP				City and Town WP			
	Male		Female		Male		Female	
	a	b	a	b	a	b	a	b
Total	73	77	73	77	73	77	73	77
The PR	73	77	73	77	73	77	73	77
The HO	73	77	73	77	73	77	73	77
The CL	73	77	73	77	73	77	73	77
The CM	73	77	73	77	73	77	73	77
The AG	73	77	73	77	73	77	73	77
The PW	73	77	73	77	73	77	73	77

WP:the working population
PR:The life table for professional,technical staff
HO:The life table for heads in state organs,party and public organisations
CL:The life table for clerical and the related staff
CM:The life table for commercial and tertiary staff
AG:The life table for agricultural,forestry,animal husbandry and fishery
PW:The life table for production,transportation and the related workers

Table 2 the values of a,b of working population in different areas

	Total WP				City and Town WP			
	male		famale		male		female	
	a	b	a	b	a	b	a	b
Beijing	75	79	75	79	72	76	75	79
Tianjin	75	79	75	80	72	76	70	75
Hebei	72	76	75	80	72	76	75	80
Shanxi	72	76	73	77	72	76	73	77
Inner Mongolia	70	75	71	75	72	76	71	75
Liaoning	75	79	76	80	75	79	75	80
Jilin	71	75	72	77	72	76	71	75
Heilongjian	68	74	68	74	68	74	68	74
Shanghai	75	79	76	82	73	77	71	75
Jiangsu	70	75	75	82	70	75	75	81
Zhejiang	72	76	75	82	72	76	75	82
Anhui	69	74	72	76	68	74	72	76
Fujian	69	74	76	80	69	74	76	80
Jiangxi	70	74	74	78	71	75	76	80
Shandong	72	76	76	80	72	76	76	80
Henan	69	74	71	75	69	74	71	75
Hubei	69	75	73	77	69	75	73	77
Hunan	71	75	73	77	71	75	73	77
Guangdong	71	75	76	82	71	75	76	82
Guangxi	73	77	76	80	73	77	76	81
Hainan	69	75	76	82	69	75	76	82
Sichuan	69	74	73	77	69	75	73	77
Guizhou	72	76	73	77	71	75	73	77
Yunnan	72	76	74	78	72	76	74	78
Tibet	69	74	72	76	71	75	75	79
Shaanxi	71	75	71	75	71	75	71	75
Gansu	69	74	71	75	69	74	68	74
Qinghai	70	74	70	74	68	74	70	74
Ningxia	72	76	71	75	70	74	72	76
Xinjiang	69	75	69	74	68	75	69	74

The data of working population in special occupations are merged into one group from age 65,Hence the formula,as follows:

$$P_x(1) = \frac{1 - 0.5m_x}{1 + 0.5m_x}$$

The symbols in the life tables:

x—age

q_x—The probability of death

l_x—The stationery population

d_x—The death between ages x and x+1

L_x—The total population between ages x and x+1

T_x—The total population over age x at any time

e_x—The expection of life at age x

wd_x—The index of life quality for the working population at age x,whch is formulated by Mr. Wang Dongyan,
and calculated as follows:

$$wd_x = \frac{e_x \text{ for WP at age x}}{e_x \text{ for TP at age x(Table } 1-1 \text{ for male,} 1-2 \text{ for female)}} \quad \text{(where TP is the total population).}$$

All of the life tables are produced by the software of Foxbase 2.0,and the graphs are produced by a software called GB.

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