COUNTRY REPORT TURKEY

This document sets out basic mortality information for Turkey for the use of the International Actuarial Association's Mortality Working Group.

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NEW RESEARCH

NEW MORTALITY TABLE

The latest available Turkey mortality table which covers 2015 is provided by Turkish Statistical Institute (TURKSTAT).

MORTALITY TABLES[1]

Undersecretariat of Treasury of Turkey coordinated a working group from Hacettepe University, Başkent University, Marmara University and BNB Consulting Firm in order to develop National Mortality Tables between 2009 and 2013.

1. Turkey Female-Male Life (TRH-2010)
2. Turkey Female-Male Insured Life (TRSH-2010)
3. Turkey Female-Male Annuitant Life (TRHA-2010)
4. Social Security System Female-Male Life (SGK-2008)

TRH 2010

First, 15 different population census data sets by gender and age are organized between 1927 and 2000. Unknown (population) data is distributed to each age group except 1930 and 1940. To obtain the population data by gender and age in 1935, projections are made from 1927 based on some basic assumptions. It is supposed that the age structure of Hatay and Turkey is the same in 1935. Since there is not an available census data in 1995, an interpolation method is applied to the census data sets for 1990 and 2000 depending on gender and age to derive a reasonable input for those years.

Second, Preston-Bennet method is applied to the whole data sets between 1930 and 2000 depending on the time intervals 5, 10, 15 and 20. In this way, numerous mortality data is generated based on various regression models such as exponential, linear, multiplicative and reciprocal regression models. While the dependent variable is defined as mortality rates, the independent variable is supposed as years in these models. It is concluded that *multiplicative regression model* is better than the others to represent Turkish mortality rates for female and male populations.

The projections are made depending on the following models:

[1] Insurance Information and Monitoring Center. Mortality tables, 2016. http://www.sbm.org.tr/tr/Sayfalar/MortaliteTablosu.aspx.

Table 1: Projection model for female population

Parameter set for the projection	
General model	$Y = aX^{b}$
Model	$Y = 2.02545X^{0.334885}$
Correlation coefficient	r=0.9388
Explanatory variable	$R^2 = 88.14\%$
Estimated standard error	s= 0.105405

Table 2: Projection model for male population

Parameter set for the projection	
General model	$Y = aX^{b}$
Model	$Y = 2.32198X^{0.237929}$
Correlation coefficient	r=0.8322
Explanatory variable	$R^2 = 69.26\%$
Estimated standard error	s= 0.135982

The last age is chosen as 100 in the above models. The mortality rates between zero and 4 is determined based on MortPak which is a software package developed by United Nations for demographic measurement in developing countries. The mortality rates after age 4 are calculated according to Karup King method.

TRSH-2010 AND TRHA-2010

First, all available data from *Insurance and Reinsurance Association of Turkey*, *Insurance Information and Monitoring Center*, *MERNIS Database*, *Social Security Institution of Turkey* is investigated in detail. Since there is not sufficient number of data for annuitant population, the available data is used for constructing TRSH-2010 at the first stage. A data format is specified and a set of 13,332,687-recorded data is collected from different insurance companies, which are actively traded in life insurance in Turkey such as Anadolu Hayat Emeklilik, Yapı Kredi Emeklilik, Avivasa Emeklilik, Garanti Emeklilik and Groupama Emeklilik between 2004 and 2008. Moreover, a set of 16,726-death records are extracted. On the other hand, only 36% of all recorded data is suitable to use when wrong entries are eliminated.

After that, crude mortality rates between ages 17 and 80 for female population and between ages 18 and 75 for male population are derived and smoothed by applying Whittaker-Henderson graduation method. The obtained mortality rates are compared with the ones in CSO-1980, CSO-2001 and TRH-2010.

Coale-Demeny model life tables are investigated for the countries which have population, insured and annuitant life tables so that to decide the mortality rates in TRHA-2010. Age-specific reduction factors are determined by considering the relation between these tables in the relevant countries. Last, these factors are applied to TRSH-2010 in order to derive the rates in TRHA-2010.

RESEARCH IN PROGRESS

NEW MORTALITY TABLES AND MORTALITY PROJECTION

A working group from the Department of Actuarial Sciences in Hacettepe University is currently doing a project to improve the earlier insured and annuitant tables. It will be obtained Turkey Female - Male Insured Life (TRSH – 2014) and Turkey Female – Male Annuitant Life (TRHA – 2015) Tables. Moreover, a mortality projection until 2035 will be produced with the corresponding confidence intervals for both genders. Interested members can see the following link for detailed information: http://www.tsb.org.tr/en.aspx?pageID=914

COUNTRY BACKGROUND

Turkey has a young population. According to the recent population statistics provided by TURKSTAT, the population census data of Turkey between 1975 and 2015 is given as follows:

Table 3: Total number of population of Turkey between 1975 and 2015

Year	Total Number of Population
2014-2015	78 741 053
2013-2014	77 695 904
2012-2013	76 667 864
2011-2012	75 627 384
2010-2011	74 724 269
2009-2010	73 722 988
2008-2009	72 561 312
2007-2008	71 517 100
1995-2000	60 752 995
1985-1990	49 986 117
1980-1985	44 078 033
1975-1980	38 395 730

Table 3 states that the total population increased rapidly between 1975 and 2000. Although we still observe an increase in the whole population, this is mostly because of the migration from other countries.

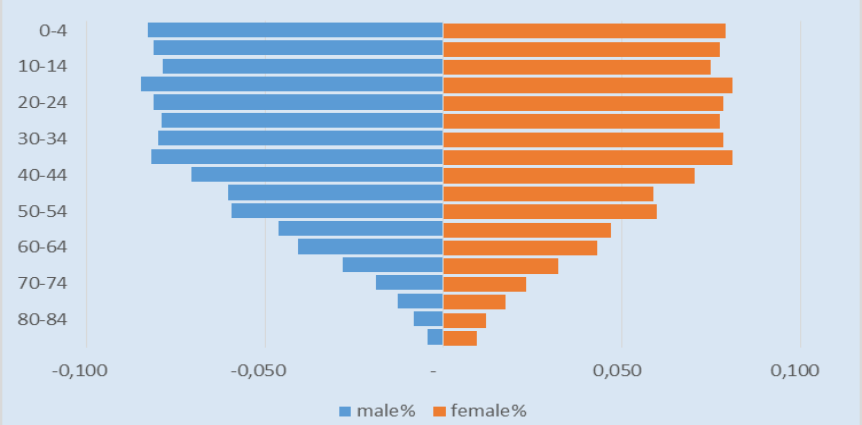
Population censuses in Turkey are conducted officially. After the foundation of the Republic, the first census of population was held in 1927. From 1935 to 1990 censuses of population were held in each 5-year period. After 1990, population censuses have been decided to be carried out in years ending with 0 by a law. After 2007, the census data is determined in line with a new system called *Address-Based Population Registration System (ABPRS)*[2].

POPULATION

DEMOGRAPHICS

The Table below summarises basic information on population of Turkey.

[2] Turkish Statistical Institute, http://www.tuik.gov.tr/PreTablo.do?alt_id=1068

Basic Information	
Current population (2016)	79.8m estimate
Current period life expectancy (2015)	
- **At birth**	Males: 75.3 and Females: 80.7[3]
- **At 65**	Males: 16.2 and Females: 19.4[4]
Population Pyramid (2016) [5]	

POPULATION MORTALITY TABLES

POPULATION MORTALITY IMPROVEMENTS

For calibration of the mortality model, we use Turkish male and female populations for ages zero to 80 in 5-year age bands between 1938 and 1995. This data sets are provided in an MSc thesis by Yıldırım (2010)[6]. The Preston-Bennett method is applied for the derivation of data sets. The data after 1995 is not considered due to two reasons: First, the data sets between 1996 and 2006 are based on different counting systems. Since the people who live in town/township are not taken into account, the census data does not represent the whole country. Second, there is an inconsistency in terms of expected life times based on ABPRS which came into force in 2007.

We apply the classical Lee-Carter (LC) model to predict future mortality rates. Hence, we can follow the two stage estimation procedure suggested by Lee and Carter (1992)7 to derive parameters $\beta(x)$ and $\kappa(t)$ in the following equation:

$$\log\left(m(x,t)\right)=\alpha(x)+\beta(x)\,\kappa(t)+\xi(x,t).$$

[3] Turkish Statistical Institute, http://www.tuik.gov.tr/PreHaberBultenleri.do?id=18618
[4] Turkish Statistical Institute, http://www.tuik.gov.tr/PreHaberBultenleri.do?id=18618
[5] Turkish Statistical Institute, http://www.tuik.gov.tr/PreTablo.do?alt_id=1068

[6] F. Yıldırım. Modeling of Turkish mortality with Lee-Carter and Fuzzy Lee-Carter. Master's thesis, Hacettepe University, 2010

[7] R.D. Lee and L.R. Carter. Modelling and forecasting U.S. mortality. Journal of the American Statistical Association, 419:659-675, 1992.

The time-series common risk factor $\kappa(t)$ is modeled using the construction given as below:

$$\kappa(t) = c_1 + \kappa(t-1) + \zeta(t),$$

where c_1 is the drift term. Here, $\zeta(t)$ is independent and identically distributed $N(0, \sigma^2)$ random variable. The standard deviation of $\zeta(t)$ process, σ, is calculated using $\kappa(.)$.

According to Liu and Yu[8], in order to make forecast for $\kappa(t)$ at time $t_0 + n$, given the data available up to time t_0, the following formula can be applied:

$$\kappa(t_0 + n) = nc_1 + \kappa(t_0) + \sum_{t=t_0}^{t_0+n} \zeta(t), \qquad (1)$$

where $n = 1, 2, \ldots$.

We calibrate the estimated $\kappa(t)$s to derive parameters c_1 and σ. Figure 1 presents the estimated $\kappa(t)$s based on the female and male populations. While the estimated values of $\kappa(.)$ for male population suggest $c_1 = -0.324$ and $\sigma = 0.187$, the corresponding values are equal to $c_1 = -0.465$ and $\sigma = 0.178$ for female population.

The general level of mortality is decreasing according to the estimated $\kappa(t)$s for both population. The figure exhibits that the decrement in $\kappa(t)$s is more rapid for female population. This pattern suggests the improvement in the mortality rates for all ages which is also called as longevity risk.

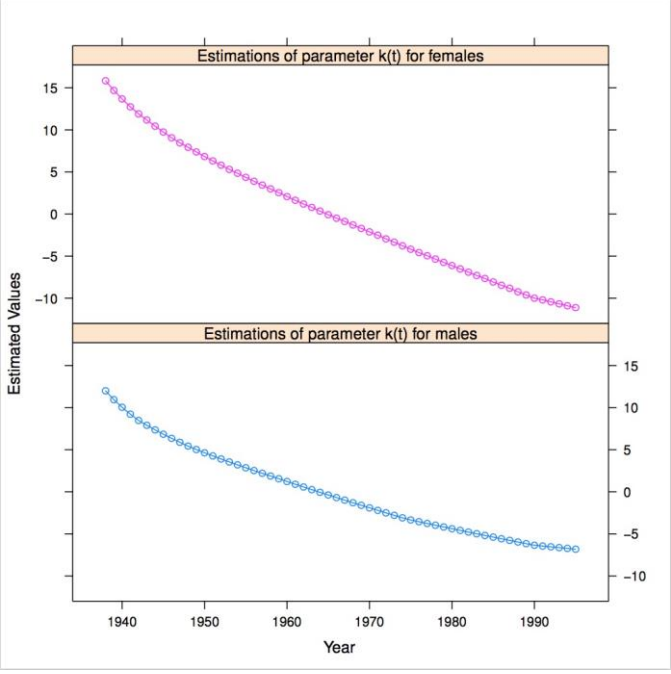


Figure 1: Estimation of parameter κ(t) using Lee-Carter model for both female and male populations

[8] X. Liu and H. Yu. Assessing and extending the Lee-Carter model for long-term mortality prediction. Technical report, The Living to 100 Symposium, 2011.

Figure 2 displays the estimated $\beta(.)$s in line ages between 0 and 80 for both populations. The improvement in the mortality rates is decreasing when the age increases.

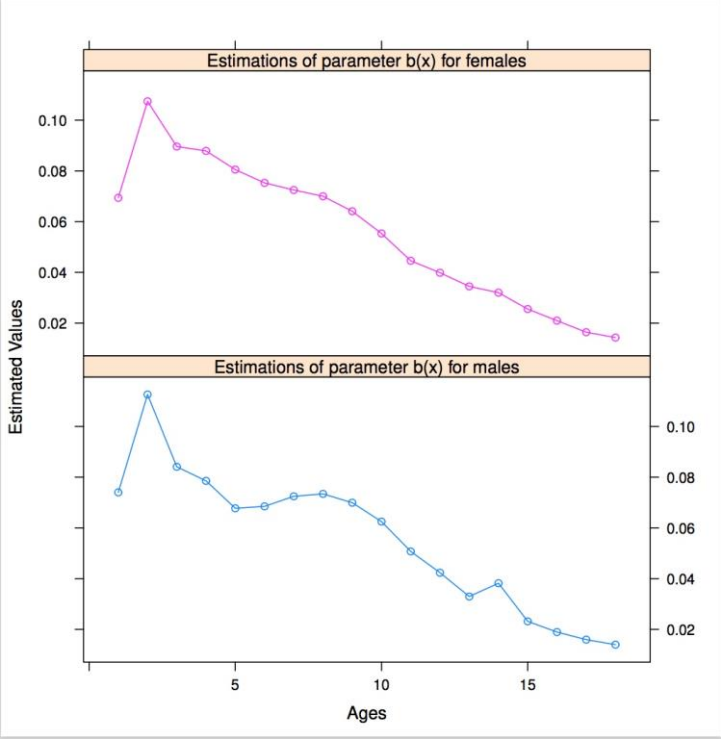


Figure 2: Estimation of parameter β(t) using Lee-Carter model for both female and male populations

The estimated mortality improvement of Turkish female and male populations for aged 65 is given in Figure 3 between 1995 and 2035. The projection is based on 5000 simulations according to Eq.(1). As it is also stated in Figure 1, the mortality improvement for both populations is continuing. On the other hand, we still expect to see higher survival rates for female population than the male counterparts in the future.

Karabey et al. (2016)[9] fit the LC model, Poisson log-bilinear model and two-factor model of Cairns-Blake and Dowd to Turkish male population for ages 65 and 80 between 1938 and 1995 for pricing future bonds based on the EIB/BNP longevity bond pricing methodology. They compare the observed death rates with the ones produced by the mortality models and conclude that CBD model is fitted better than the other two model.

[9] U. Karabey, S. Şahin, and A. Arık. Pricing Turkish longevity risk. International Journal of Ecological Economics and Statistics, 37, 2016.

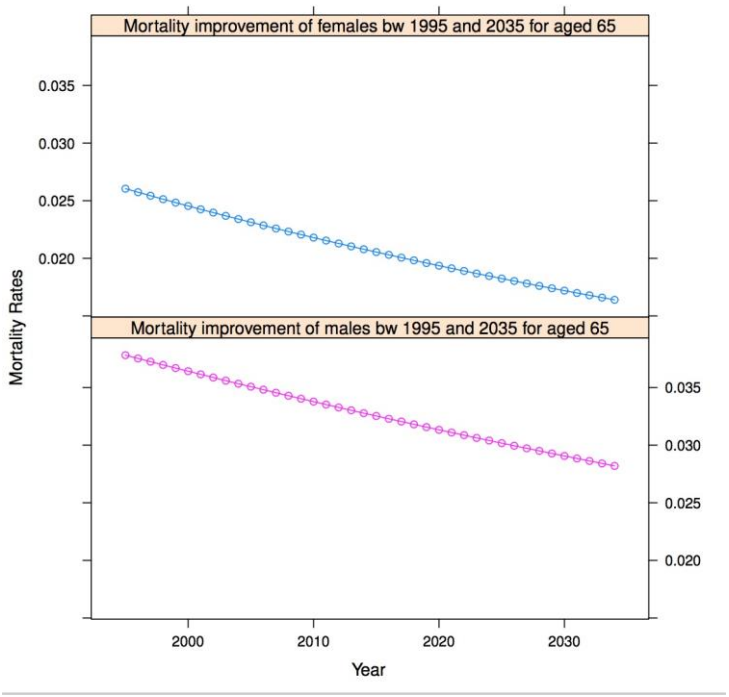


Figure 3: Estimated mortality improvement for aged 65 for both female and male populations

PROTECTION INSURANCE

MARKET BACKGROUND

Products available in Turkey are presented in the following table based on the total number of policies for life insurance[10].

Table 4: Total number of policies for life insurance products in 2012

	Policy	Number
Individual	**One Year Term Life Insurance**	3 073 901
	Term Life Insurance	499 482
	Permanent Life Insurance	805 918
Group	**One Year Term Life Insurance**	7 325 129
	Term Life Insurance	1 501 870
	Permanent Life Insurance	21 268
	Total	13 227 568

MORTALITY TABLES

The mortality tables, TRH-2010 and TRSH-2010, are offered for the usage of the insurance companies. A brief summary of the tables, which are applicable to the tariffs and life insurance products, is given in the earlier parts of the document.

[10] http://www.aktuerlerdernegi.org/staticfiles/files/irat_sigortalar%C4%B1_(27aral%C4%B1k2012_-_aktuerler_dernegi).pdf

MORTALITY IMPROVEMENTS

There is no national study related to the mortality improvements particularly for life insurance protection. On the other hand, TRSH-2010 has been updating and a new version, which is called TRSH-2014, will be available soon.

RETAIL LONGEVITY PROTECTION

MARKET BACKGROUND

There are two main types of pension in Turkey: state pension from the government[11] or private pensions[12]. The social security system is based on the pay-as-you-go method. Since Turkish social security system had various problems after 1990s due to early retirement, high rates of unregistered employment, low rates of contributions etc., a reform was realized in 2008. As a result, a set of changes related to the retirement age, contribution rates and pension replacement rate were held. Current social security system provides a protection against death, disability and survival statues.

MORTALITY TABLES

TRHA-2010, which is explained earlier parts of the report, is available.

MORTALITY IMPROVEMENTS

The annuity market in Turkey is underdeveloped. Therefore, there is no sufficient and reliable data to build a national annuitant data. A national annuitant table, TRHA-2010, was obtained in 2010 with the aid of the insured life table. TRHA-2010 has been updating and a new version, which is called TRHA-2015, will be available soon.

[11] http://www.sgk.gov.tr/wps/portal/sgk/en/detail/social_security_system/social_security_system
[12] http://www.egm.org.tr/?sid=1

RELEVANT ORGANISATIONS

DETAILS ON GOVERNMENT STATISTICS DEPARTMENT

Turkish Statistical Institute (TURKSTAT) - http://www.tuik.gov.tr/Start.do

ACTUARIAL SOCIETY OF THE COUNTRY

The Actuarial Society of Turkey[13], which was founded in 1951, has 159 full and 8 honorary members. The main goal of the Society is the advancement of the body of knowledge of actuarial science in Turkey which is applied to life, property, casualty and similar risk exposures.

INSURANCE REGULATOR

Undersecretariat of Treasury[14] set the necessary rules within the scope of the rules of the relevant insurance laws via the Insurance Supervision Board in order to guarantee the development and stability of insurance sector and private pension system in Turkey.

[13] http://www.aktuerlerdernegi.org/?sid=83

[14] http://www.treasury.gov.tr/en-US/Pages/About-Us-Insurance?nm=837%20