



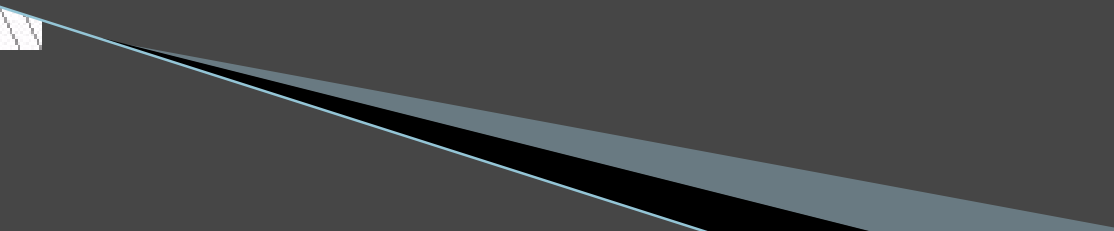
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# Longevity Risk Existence Analysis:

Case in Beijing

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- ▶ Abstract
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  - ▶ Our goal
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# Abstact

- ▶ In the large cities in China, particularly in Beijing, along with the rising life standard, the increasingly serious problems in environment, work pressure and food quality cast more doubt on the so-called longevity. Thus, based on the relatively complete demographic data, exploration of the existence of longevity in Beijing, through the study in the oldest population, is meaningful to the following discussion of longevity risk in China.

# Abstact

- ▶ The main objective of this paper is to offer a detailed analysis of the changes of life expectancy and mortality rate of old ages in Beijing so as to illustrate the existence of longevity. Starting from the construction of life table of the old (60 years and older) in Beijing using the data of the national demographic census in 2010. Then the life expectancy of this group of people can be extrapolated from this life table. The Gompertz model will be used to estimate the mortality rate for people who are between 60 to 84 years-old while the improved Coale-Kister model will be applied to the oldest-old in Beijing who is 85 years old or older.

# Background

Mortality



Worse environment,  
food quality,  
Serious disease like  
cancer

Better medical  
treatment,  
Consumption

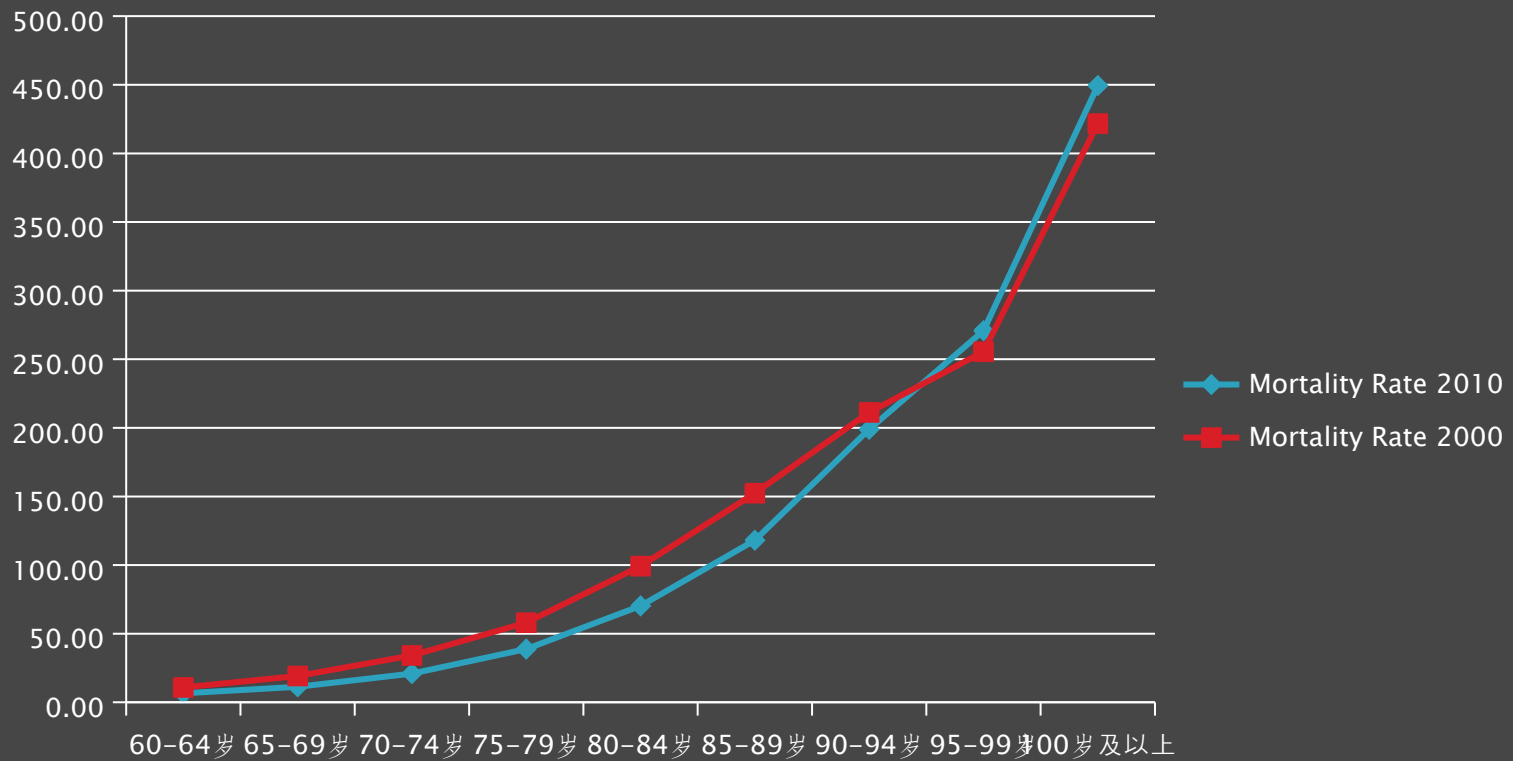
Longevity



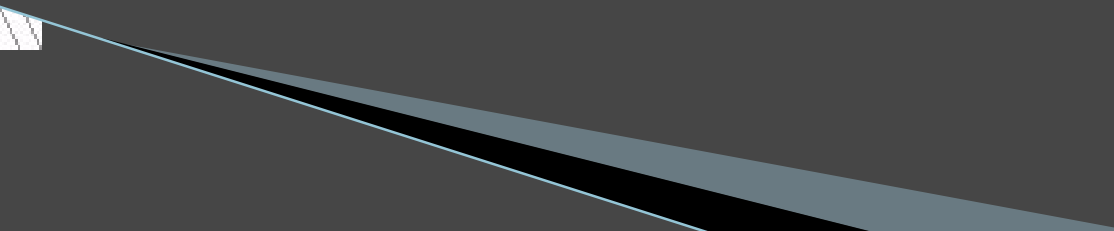
# Background

## Mortality Rate Comparison

Unit:0.1%



# Our goal

- ▶ Construction of life table of the old (60 and older)
  - ▶ Smoothing model estimation and comparison
  - ▶ Smoothed life table
  - ▶ Life expectancy calculation and comparison
  - ▶ Longevity risk measurement
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# Our Method

- ▶ Life table construction directly from data

# Our Method

- ▶ Life table construction directly from data

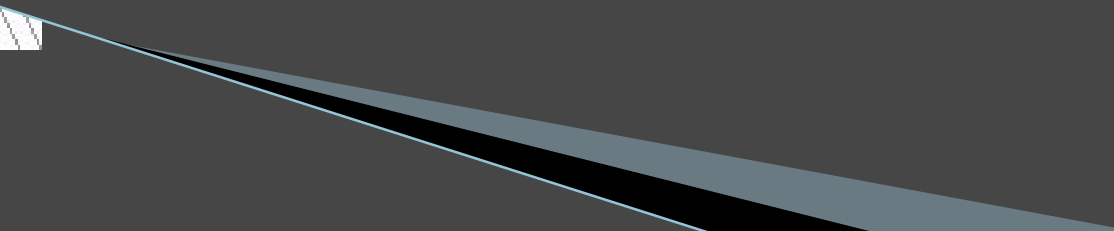
	Nx平均人口	Dx死亡人口	Mx中心死亡率	Qx死亡率	Px	tPx	Lx	ex
60	179473	935	5.21	5.19616	0.99480	0.99480	1.00000	23.00365
61	145476	888	6.10	6.08553	0.99391	0.98875	0.99480	22.00884
62	137560	875	6.36	6.34073	0.99366	0.98248	0.98875	21.02009
63	133346	998	7.48	7.45640	0.99254	0.97515	0.98248	20.03761
64	127637	1036	8.12	8.08399	0.99192	0.96727	0.97515	19.06246
65	107117	972	9.07	9.03322	0.99097	0.95853	0.96727	18.09519
66	96492	936	9.70	9.65348	0.99035	0.94928	0.95853	17.13665
67	100893	1149	11.39	11.32382	0.98868	0.93853	0.94928	16.18737
68	102455	1244	12.14	12.06863	0.98793	0.92720	0.93853	15.24884
69	99151	1439	14.51	14.40864	0.98559	0.91384	0.92720	14.32164
70	100847	1592	15.79	15.66267	0.98434	0.89953	0.91384	13.40779
71	101493	1780	17.54	17.38574	0.98261	0.88389	0.89953	12.50826
72	107252	2199	20.50	20.29504	0.97970	0.86595	0.88389	11.62437
73	99873	2378	23.81	23.53007	0.97647	0.84558	0.86595	10.75841
74	99193	2678	27.00	26.63831	0.97336	0.82305	0.84558	9.91283
75	92188	2894	31.39	30.90727	0.96909	0.79761	0.82305	9.08978
76	86067	3020	35.09	34.48390	0.96552	0.77011	0.79761	8.29217
77	74059	2946	39.78	39.00334	0.96100	0.74007	0.77011	7.52206
78	63667	2821	44.31	43.34835	0.95665	0.70799	0.74007	6.78198
79	57806	2833	49.01	47.83659	0.95216	0.67412	0.70799	6.07399
80	53018	3074	57.98	56.34680	0.94365	0.63614	0.67412	5.39987
81	44141	2851	64.59	62.56792	0.93743	0.59634	0.63614	4.76373
82	38483	2789	72.47	69.93923	0.93006	0.55463	0.59634	4.16739
83	28973	2378	82.08	78.84091	0.92116	0.51090	0.55463	3.61276
84	25320	2259	89.22	85.40803	0.91459	0.46727	0.51090	3.10186

# Our Method

- ▶ Life table construction directly from data

85	21899	2219	101.33	96.44259	0.90356	0.42220	0.46727	2.63459
86	17954	1972	109.84	104.11822	0.89588	0.37824	0.42220	2.21239
87	14317	1736	121.25	114.32339	0.88568	0.33500	0.37824	1.83414
88	11220	1561	139.13	130.07795	0.86992	0.29143	0.33500	1.49914
89	8760	1268	144.75	134.97981	0.86502	0.25209	0.29143	1.20772
90	6390	1122	175.59	161.41566	0.83858	0.21140	0.25209	0.95563
91	4718	874	185.25	169.54414	0.83046	0.17556	0.21140	0.74423
92	3704	782	211.12	190.96458	0.80904	0.14203	0.17556	0.56867
93	2623	626	238.66	213.21524	0.78678	0.11175	0.14203	0.42664
94	1937	450	232.32	208.14060	0.79186	0.08849	0.11175	0.31489
95	1352	322	238.17	212.82222	0.78718	0.06966	0.08849	0.22640
96	1074	301	280.26	245.81461	0.75419	0.05253	0.06966	0.15675
97	720	199	276.39	242.83100	0.75717	0.03978	0.05253	0.10421
98	518	137	264.48	233.58912	0.76641	0.03049	0.03978	0.06444
99	312	118	378.21	318.05928	0.68194	0.02079	0.03049	0.03395
100岁及以上 上	<b>563</b>	<b>253</b>	<b>449.38</b>	366.93254	0.63307	0.01316	0.02079	0.01316

# Our Method

- ▶ Method used to estimate
  - ▶ Logistic
  - ▶ Kannisto
  - ▶ Quadratic
  - ▶ Gompertz
  - ▶ Weibull
  - ▶ Heligman & Pollard
- 

# Beijing 60-99

Model	Expression	R <sup>2</sup>
Logistic	$x \frac{1.94710 e^{3 \cdot 60.124 x}}{15.0210(1) e^{60.124 x}}$	
	$x \frac{8.4910 e^{60.112 x}}{18.4910(1) e^{60.112 x}}$	
	$x e^{15.9021464410 x^{42}}$	
	$x \frac{6.7410 e^{60.112 x}}{e^{60.112 x}}$	
	$x \frac{0.019515010 e^{40.0789 x}}{e^{40.0789 x}}$	
	$x \frac{1.2710 x^{188.76}}{x^{188.76}}$	
	$q_x \frac{1.8410 e^{50.102 x}}{11.8410 e^{50.102 x}}$	

# Beijing Age 60–85

Model	Expression	R <sup>2</sup>
Logistic	$x \cdot 5.2210 \cdot \frac{1.1110 \cdot e^{60.133x}}{14.3210(1) + e^{60.133x}}$	
	$x \cdot \frac{2.2210 \cdot e^{60.128x}}{12.2210(1) + e^{60.128x}}$	
	$x \cdot e^{0.1020 \cdot 0.05554 \cdot x^{42}}$	
	$x \cdot 3.5010 \cdot e^{60.121x}$	
	$x \cdot 6.05104 \cdot e^{460.120x}$	
	$x \cdot 2.0810 \cdot 188.63x$	
	$q_x \cdot \frac{2.7210 \cdot e^{60.125x}}{12.7210 + e^{60.125x}}$	

# Beijing Age 85–99

Model	Expression	R <sup>2</sup>
Logistic		
Kannisto	$x \frac{1.6110 e^{60.105x}}{11.6110(1) e^{60.105x}}$	
	$x e^{28.605030x^2}$	
	$x 7.5610 e^{50.0853x}$	
	$x 0.1675.6710 e^{30.0453x}$	
	$x 7.4310 x^{177.852}$	
	$q_x \frac{5.0410 e^{50.0909x}}{15.0410 e^{50.0909x}}$	

# Conclusion

