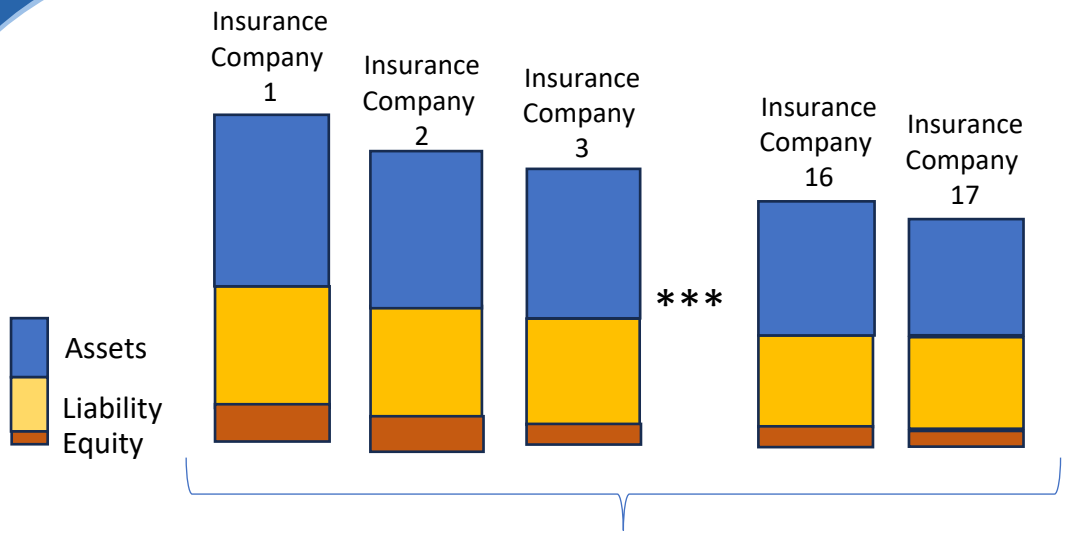
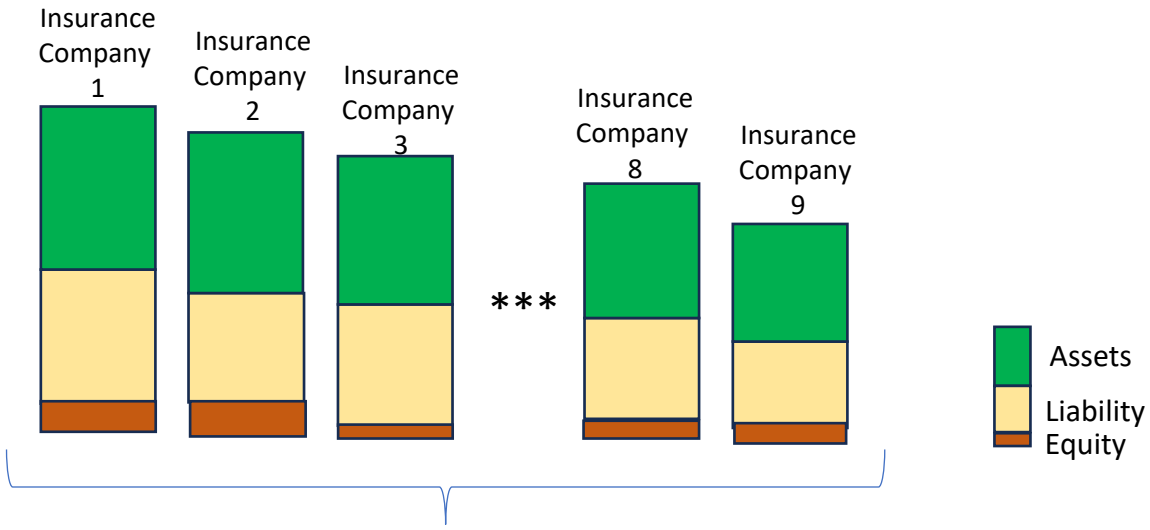
RISK INSUFFICIENCY ASSESSMENT OF GUARANTEED RESERVES IN INSURANCE PAYMENTS

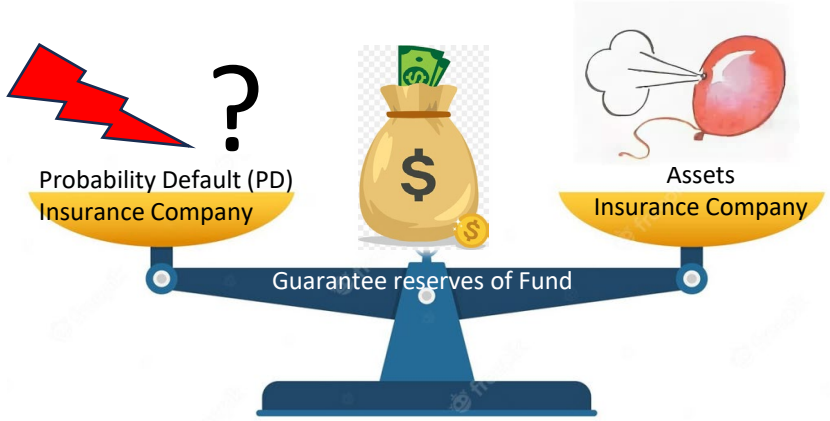
INSURANCE PAYMENT GUARANTEE FUND

Almaty, 2023

The role of the IPGF in the risk of default







INSURANCE PAYMENT GUARANTEE FUND

Determining the Probability of Default using a rating.

FitchRatings

Fitch Global Corporate Finance Average Cumulative Default Rates: 1990–2021

(%)	Year One	Year Two	Year Three	Year Four	Year Five	Year Six	Year Seven	Year Eight	Year Nine	Year Ten
AAA	0,11	0,23	0,36	0,49	0,62	0,76	0,91	1,06	1,21	1,37
AA	0,05	0,05	0,05	0,05	0,05	0,06	0,06	0,06	0,06	0,08
A	0,05	0,14	0,24	0,33	0,43	0,55	0,73	0,89	1,09	1,27
BBB	0,12	0,33	0,60	0,88	1,22	1,55	1,81	2,08	2,40	2,77
BB	0,60	1,68	2,74	3,77	4,65	5,45	6,06	6,59	7,11	7,63
B	2,09	5,14	7,66	9,32	10,43	11,31	12,11	12,50	12,57	12,78
CCC to C	23,34	30,62	33,69	35,76	36,99	39,01	40,63	41,34	40,71	40,28
Investment Grade	0,08	0,22	0,38	0,54	0,73	0,92	1,09	1,26	1,46	1,66
Speculative Grade	2,64	4,88	6,63	8,03	9,08	10,03	10,77	11,20	11,55	11,94
All Global Corporate Finance	0,76	1,43	1,97	2,40	2,76	3,10	3,38	3,57	3,75	3,94

Fitch Global Corporate Finance Average Cumulative Default Rates: 1990–2021

Modifier Level

(%)	Year One	Year Two	Year Three	Year Four	Year Five	Year Six	Year Seven	Year Eight	Year Nine	Year Ten
AAA	0,11	0,23	0,36	0,49	0,62	0,76	0,91	1,06	1,21	1,37
AA+	-	-	-	-	-	-	-	-	-	-
AA	-	-	-	-	-	-	-	-	-	-
AA–	0,08	0,08	0,08	0,09	0,09	0,09	0,10	0,10	0,10	0,14
A+	-	0,06	0,10	0,15	0,20	0,25	0,31	0,35	0,40	0,42
A	0,07	0,20	0,36	0,51	0,69	0,86	1,08	1,33	1,65	1,85
A–	0,06	0,15	0,23	0,28	0,34	0,47	0,69	0,86	1,05	1,35
BBB+	0,08	0,14	0,26	0,47	0,64	0,96	1,11	1,23	1,39	1,62
BBB	0,06	0,29	0,54	0,82	1,22	1,54	1,80	2,13	2,48	2,77
BBB–	0,23	0,60	1,04	1,42	1,89	2,24	2,64	3,01	3,53	4,19
BB+	0,26	1,27	2,37	3,20	3,92	4,67	5,43	6,16	7,05	7,73
BB	0,48	1,46	2,31	3,76	4,98	5,56	6,21	6,59	6,93	7,60
BB–	1,11	2,37	3,64	4,49	5,20	6,29	6,66	7,09	7,37	7,56
B+	1,48	3,75	6,06	7,91	8,77	9,40	10,23	10,44	10,58	11,01
B	2,08	5,35	8,48	10,35	11,69	12,88	13,96	14,78	15,41	15,47
B–	3,03	6,95	8,78	9,84	10,95	11,70	12,00	11,96	11,10	11,33
CCC to C	23,34	30,62	33,69	35,76	36,99	39,01	40,63	41,34	40,71	40,28

\+ Having a rating - it is easy to determine the PD

\- In Kazakhstan, not all companies have a rating

\- Ranking is not done frequently.

Determining the Probability of Default using Logit model

Five-factor Altman model

$$Z = 0{,}717 \times X1 + 0{,}847 \times X2 + 3{,}107 \times X3 + 0{,}42 \times X4 + 0{,}998 \times X5$$

were,

X1 - Working Capital / Total Assets.
X2 - Retained Earnings / Total Assets.
X3 - Earnings Before Interest and Taxes / Total Assets.
X4 - Market Value Equity / Book Value of Total Liabilities.
X5 - Sales / Total Assets.

If **Z < 1.23**, the company is declared **bankrupt**,
if Z is between 1.23 and 2.89, the situation is uncertain,
if **Z is greater than 2.9**, then the company is considered stable and **financially stable**.

- Different macroeconomic situations in different countries, requires constant recalculation of coefficients

- there is no analysis of the dependence of financial indicators on macroeconomic development.

Stochastic model

Data

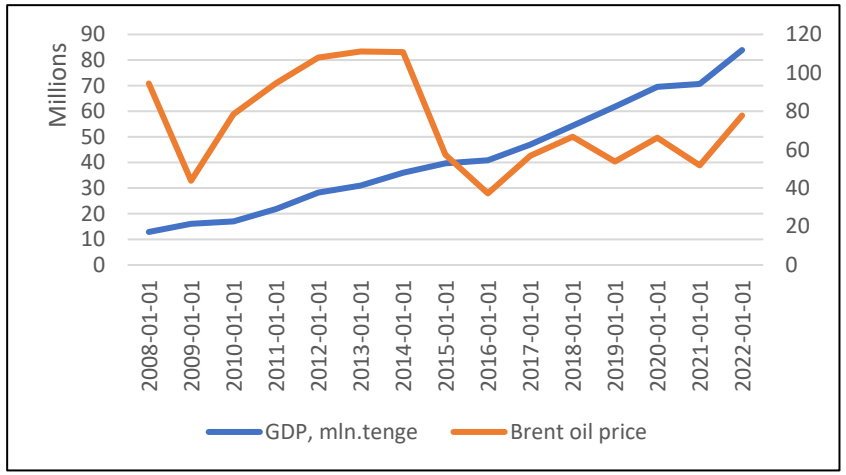
			01.01.2008	01.04.2008	01.07.2008	01.10.2008	01.01.2009	01.04.2009	01.07.2009	01.10.2009	01.01.2010	...	01.01.2022	01.04.2022	01.07.2022	01.10.2022	01.01.2023	Mean	StanDev
macroeconomic parameters	1	GDP, mln.tenge	12 849 794	3 207 244	7 195 599	11 803 581	16 052 919	3 055 264	6 709 781	11 220 900	17 007 647	...	83 951 588	19 695 593	39 613 715	65 487 798	101 522 984	26 735 030,1	20 980 588,2
	2	Inflation	118,8	119,1	120,0	113,9	109,5	108,8	106,9	105,8	106,2	...	108,4	113,2	115,0	117,7	120,3	108,7	4,2
	3	Exchange KZT/USD	120,3	120,69	120,75	119,84	120,79	151,08	150,43	150,95	148,46	...	431,8	466,31	470,34	476,71	462,65	265,4	122,8
	4	Index KASE	2590,32	2597,46	2603,35	1432,84	903,55	683,21	1088,96	1539,05	1768,26	...	3675,28	3347,71	2674,63	3083,79	3251,64	1 785,2	812,5
	5	Brent oil price	94,47	100,5	140,44	99,45	43,85	48,37	69,9	68,92	78,49	...	77,78	104,39	111,63	85,32	85,99	78,3	26,2
non-Life	6	Insurance premiums	156 927 216	49 737 243	86 638 852	119 922 287	142 899 838	35 795 741	70 605 553	97 136 244	121 998 022	...	434 794 350	153 468 871	284 447 144	404 734 376	522 475 949	165 573 265	101 102 662
	7	Insurance payments	49 401 913	13 825 356	31 158 105	48 686 488	56 118 969	5 545 855	13 881 268	18 796 624	27 657 337	...	95 300 266	27 370 605	60 691 909	110 257 623	153 222 838	45 894 551	36 960 663
	8	Assets	210 387 831	247 265 896	269 980 509	264 674 968	250 979 574	277 276 755	284 820 740	286 026 842	274 445 872	...	1 048 975 704	1 133 030 224	1 136 182 209	1 131 584 625	1 147 069 906	572 977 223	268 108 482
	9	reserves	80 471 389	99 218 979	98 369 067	89 090 400	78 197 621	95 570 384	100 877 623	98 282 851	88 497 946	...	354 432 129	423 239 820	445 534 320	449 792 930	435 170 015	201 267 083	98 689 403
	10	Equity	119 514 246	131 218 660	152 088 398	153 575 140	156 490 060	160 734 564	158 789 376	172 521 183	170 697 765	...	598 904 439	603 296 209	592 677 927	607 364 612	601 579 656	331 974 297	149 156 646
	11	Retained earnings	51 371 414	11 666 885	32 677 337	34 025 996	40 436 042	10 678 432	19 920 652	28 866 708	170 697 765	...	71 603 751	23 625 471	52 034 003	65 405 893	73 585 138	37 705 891	30 218 714
	12	Solvency margin ratio	2,14	2,46	2,47	2,43	2,07	2,33	2,31	2,20	2,23	...	7,44	5,74	5,71	5,90	6,27	4,6239	2,0803
Life	6	Insurance premiums	5 544 045	1 511 211	3 373 661	5 215 556	7 111 265	1 857 568	4 370 646	6 993 964	10 478 440	...	380 022 005	78 443 798	161 445 998	273 104 243	377 121 833	72 843 976	85 642 890
	7	Insurance payments	705 393	270 667	616 744	943 848	1 340 123	362 084	749 869	1 279 419	2 172 455	...	35 304 220	10 055 865	20 123 612	29 495 736	43 116 244	10 915 950	9 038 408
	8	Assets	13 168 224	13 940 262	15 974 336	16 064 052	17 843 324	17 512 387	19 312 551	21 175 816	22 806 345	...	779 636 757	775 609 579	833 086 735	886 238 809	919 544 452	253 508 574	252 582 888
	9	reserves	5 888 437	6 548 756	7 269 473	7 571 777	8 068 015	8 436 267	9 723 474	10 931 079	12 513 593	...	537 037 661	571 923 484	604 702 933	651 676 045	660 777 898	188 047 563	183 339 506
	10	Equity	6 762 518	6 937 035	8 242 414	8 052 473	9 439 297	8 755 083	9 200 903	9 825 640	9 782 262	...	142 555 658	134 653 015	148 485 121	155 588 676	173 616 522	47 190 538	44 570 401
	11	Retained earnings	483 906	169 583	509 234	710 471	1 466 168	516 623	890 342	1 212 583	862 091	...	142 555 658	5 644 104	24 322 049	34 694 804	59 012 827	11 010 651	20 490 180
	12	Solvency margin ratio	1,62	1,47	1,72	1,65	1,41	1,66	1,89	1,91	1,80	...	2,68	1,68	1,85	1,99	2,23	1,9184	0,4158

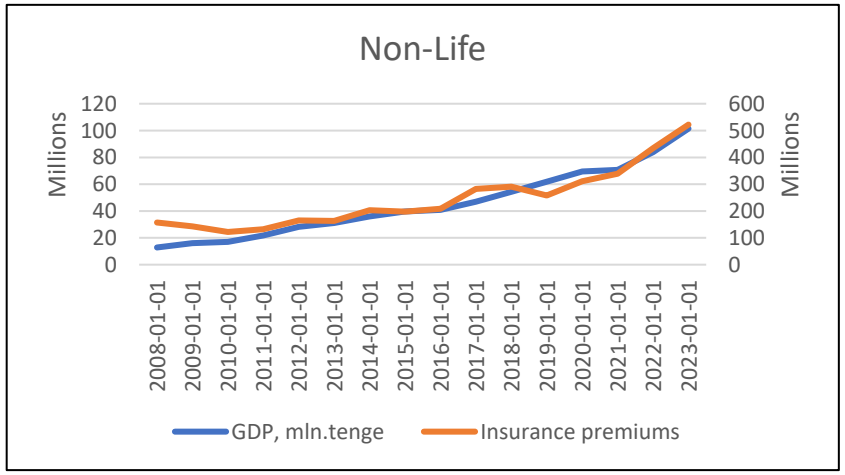
Means **σ**

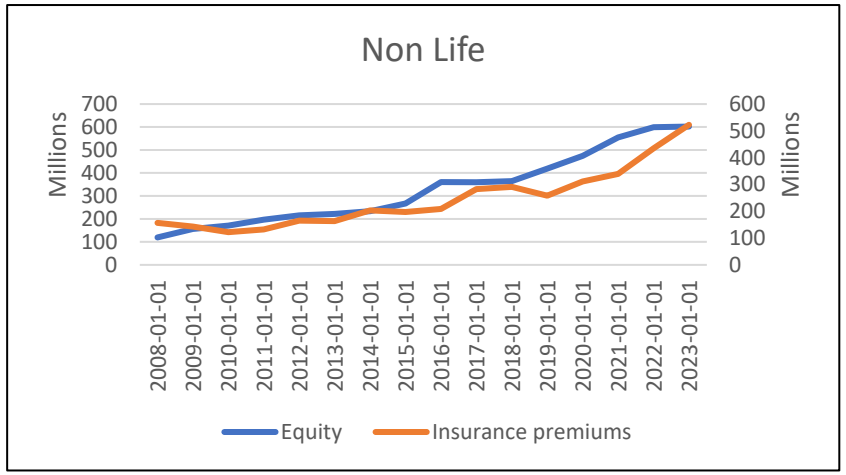
NB: The model uses relative values, i.e. next year to the previous year.

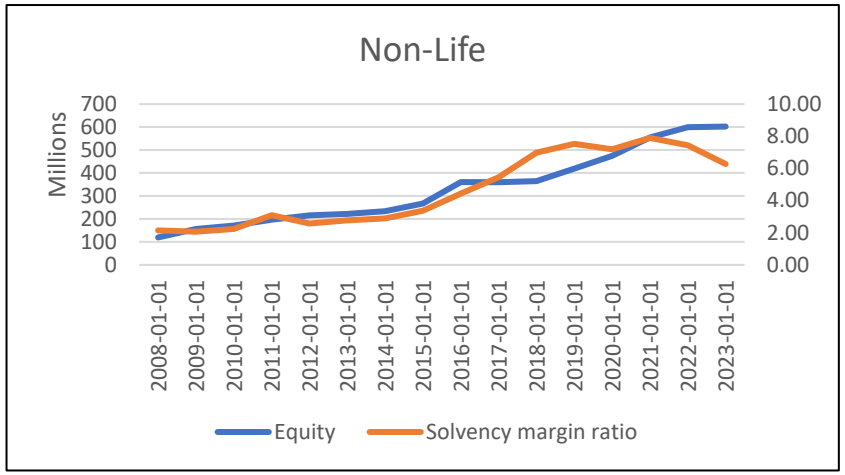
Stochastic model

An overview of the correlation of some parameters



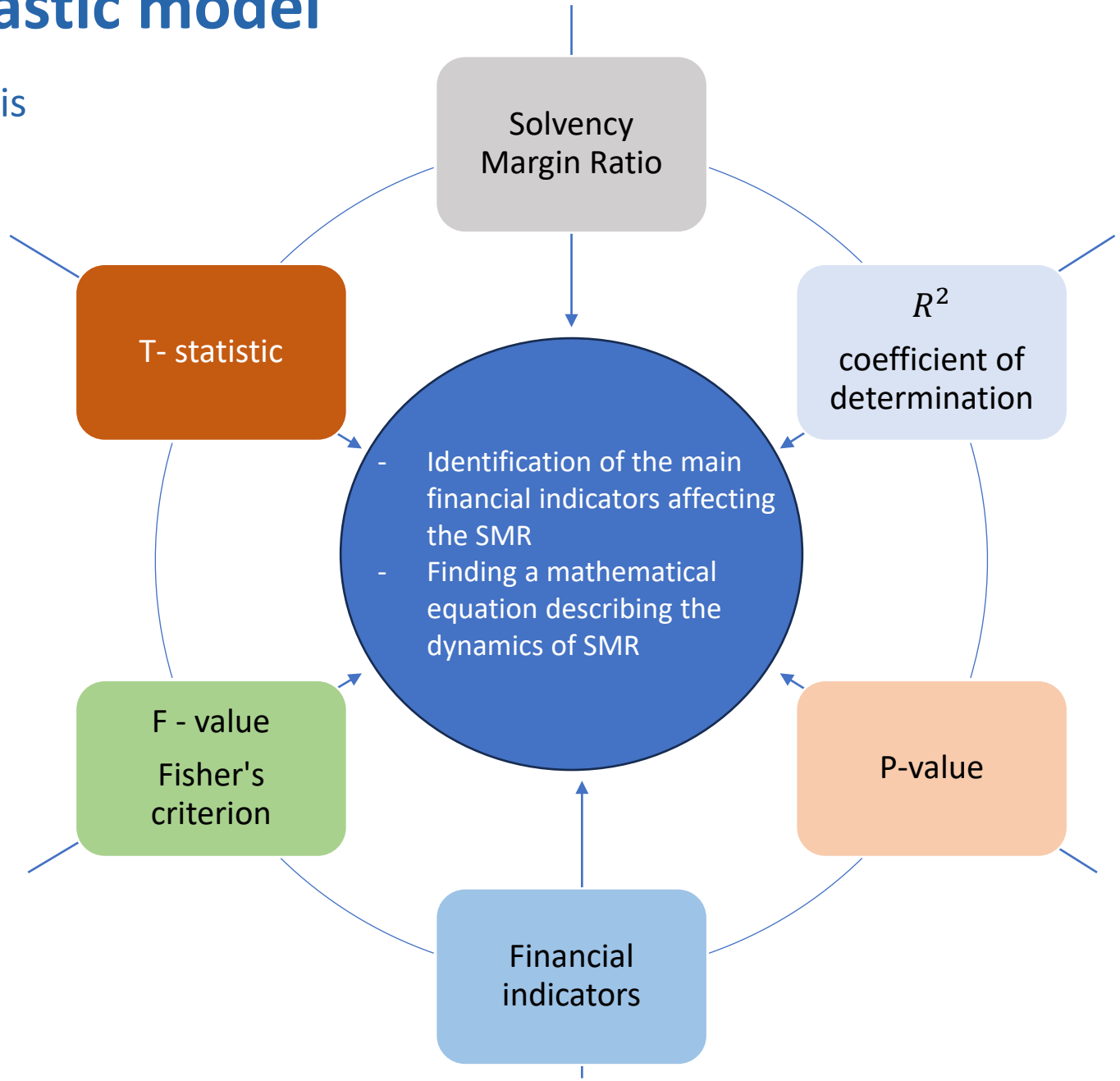






Stochastic model

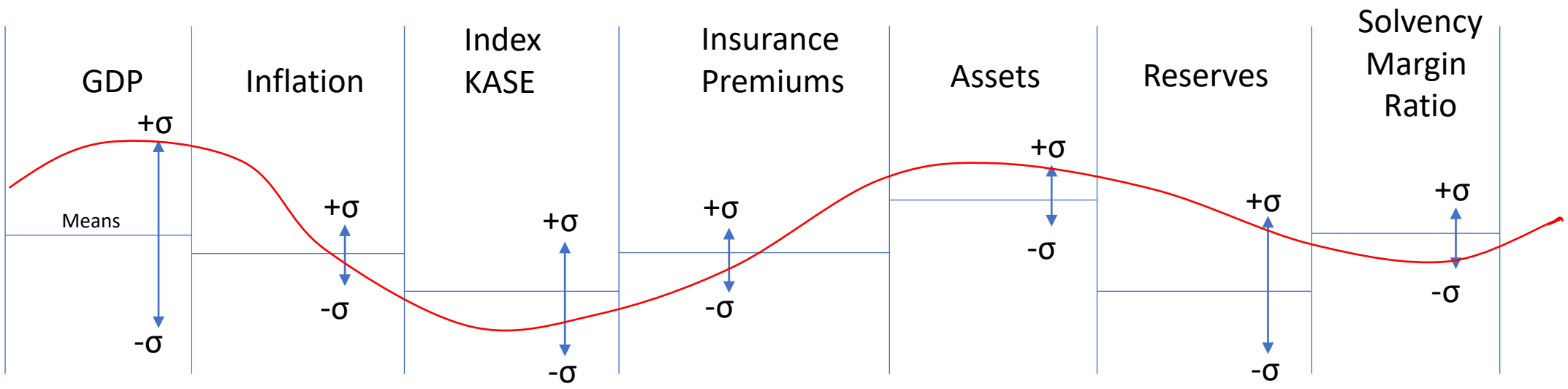
Regression analysis



Stochastic model

Matrix Cholecky

$$\rho_X = M = \begin{pmatrix} 1 & \rho_{12} & \rho_{13} & \rho_{14} \\ \rho_{21} & 1 & \rho_{23} & \rho_{24} \\ \rho_{31} & \rho_{32} & 1 & \rho_{34} \\ \rho_{41} & \rho_{42} & \rho_{43} & 1 \end{pmatrix} = CC^T = \begin{pmatrix} c_{11} & 0 & 0 & 0 \\ c_{21} & c_{22} & 0 & 0 \\ c_{31} & c_{32} & c_{33} & 0 \\ c_{41} & c_{42} & c_{43} & c_{44} \end{pmatrix} * \begin{pmatrix} c_{11} & c_{21} & c_{31} & c_{41} \\ 0 & c_{22} & c_{23} & c_{24} \\ 0 & 0 & c_{33} & c_{34} \\ 0 & 0 & 0 & c_{44} \end{pmatrix}$$



Means, σ - taken from the data (slide 5)

Stochastic model

Monte Carlo method

Monte Carlo Method: Random Number Generation

	1	2	3	4	5	6	7
1	0,1786	0,1500	0,0982	0,6277	0,1970	0,3173	0,6809
2	0,8673	0,4269	0,7185	0,9605	0,9974	0,8914	0,0524
3	0,4256	0,5355	0,8872	0,2076	0,0564	0,8217	0,4406
4	0,0778	0,9425	0,7605	0,5714	0,1193	0,1027	0,6352
5	0,5140	0,0367	0,0581	0,5094	0,1587	0,0698	0,1754
6	0,9615	0,5187	0,6310	0,5064	0,5659	0,6613	0,4297
7	0,3553	0,8342	0,3996	0,3802	0,0664	0,1972	0,6202
8	0,1553	0,3526	0,8740	0,1950	0,3814	0,9664	0,4413
9	0,2794	0,5606	0,3356	0,5496	0,5465	0,5213	0,2789
10	0,3784	0,5759	0,0157	0,0694	0,8398	0,4246	0,1493
11	0,7271	0,0147	0,4341	0,4405	0,8051	0,4409	0,1121
12	0,4620	0,5817	0,2244	0,6313	0,6131	0,3383	0,5048
13	0,8675	0,9056	0,7073	0,3822	0,6595	0,5576	0,4458
14	0,7820	0,2079	0,0502	0,7114	0,3387	0,9871	0,9671
15	0,7055	0,6860	0,5593	0,1901	0,3159	0,2715	0,4027
16	0,5817	0,2749	0,1969	0,1174	0,0763	0,7246	0,0927
17	0,3850	0,2238	0,7385	0,9706	0,1505	0,3423	0,8955
...	...	...	...	...	...	...	...
9 995	0,2690	0,1928	0,9549	0,3089	0,4159	0,7898	0,0999
9 996	0,0321	0,2761	0,5313	0,4162	0,2696	0,8174	0,3328
9 997	0,9609	0,4268	0,8140	0,4123	0,7819	0,5088	0,6635
9 998	0,3242	0,1689	0,3028	0,2400	0,9015	0,1139	0,9508
9 999	0,1054	0,8728	0,6276	0,1043	0,6229	0,8657	0,1310
10 000	0,6640	0,6130	0,2671	0,5049	0,9359	0,0970	0,2305

	1	2	3	4	5	6	7
	GDP	Inflation	KASE Index	Insurance Premiums	Assets	Reserves	SMR
expected value - means	1,140	1,000	1,097	1,706	1,485	1,621	2,312
Standard deviation - σ	0,091	0,046	0,409	1,043	0,309	0,488	0,840

Matrix Cholecky

	GDP	Inflation	KASE Index	Insurance Premiums	Assets	Reserves	SMR
GDP	1,000	0,309	0,164	0,336	0,343	0,450	-0,408
Inflation	0,000	0,951	-0,043	-0,287	-0,139	-0,340	0,051
KASE Index	0,000	0,000	0,986	0,209	-0,120	-0,151	0,208
Insurance Premiums	0,000	0,000	0,000	0,872	0,313	0,511	0,265
Assets	0,000	0,000	0,000	0,000	0,866	0,504	-0,036
Reserves	0,000	0,000	0,000	0,000	0,000	0,379	-0,439
SMR	0,000	0,000	0,000	0,000	0,000	0,000	0,724
RandNumber (0,1)	0,6640	0,6130	0,2671	0,5049	0,9359	0,0970	0,2305
Normal distribution	0,423	0,287	-0,622	0,012	1,521	-1,299	-0,737
Correlated Data	1,179	1,019	0,870	1,644	1,950	1,849	2,058

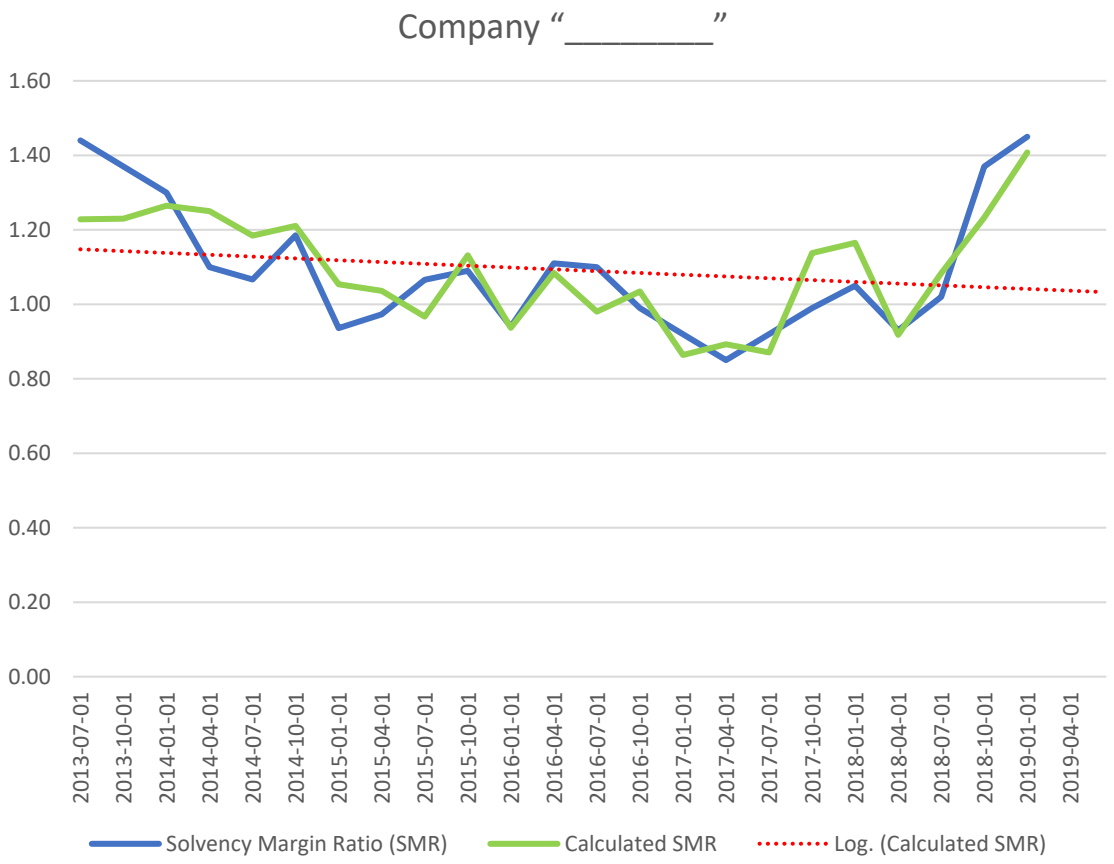
	1	2	3	4	5	6	7
	GDP	Inflation	KASE Index	Insurance Premiums	Assets	Reserves	SMR
	1,179	1,019	0,870	1,644	1,950	1,849	2,058
1	1,057	0,942	0,533	1,709	1,283	1,469	2,917
2	1,242	1,008	1,408	3,875	2,507	3,207	0,889
3	1,123	1,001	1,571	1,135	0,913	1,053	2,027
4	1,011	1,049	1,260	1,053	0,943	0,515	3,741
5	1,144	0,923	0,498	1,934	1,359	1,528	1,962
6	1,301	1,027	1,350	2,399	1,704	2,099	1,504
7	1,107	1,037	0,953	0,952	0,982	0,793	2,913
8	1,048	0,969	1,497	0,931	1,188	1,426	1,896
9	1,087	0,999	0,885	1,476	1,476	1,568	2,092
10	1,112	1,004	0,207	-0,275	1,647	1,519	1,130
11	1,195	0,914	1,109	2,398	1,865	2,275	1,240
12	1,132	1,008	0,782	1,750	1,604	1,698	2,448
13	1,242	1,073	1,369	1,548	1,608	1,660	1,866
14	1,211	0,976	0,502	2,373	1,606	2,498	2,158
15	1,189	1,029	1,185	0,984	1,303	1,199	2,067
16	1,159	0,977	0,778	0,691	1,067	1,290	0,820
17	1,155	1,037	1,654	0,663	0,963	1,045	0,875
...	...	...	...	...	...	...	...
9995	1,110	1,012	0,443	1,974	1,392	1,967	1,336
9996	1,084	0,954	1,753	1,664	1,289	1,477	1,600
9997	0,972	0,948	1,015	1,059	1,127	1,270	2,309
9998	1,301	1,017	1,578	2,371	1,834	2,113	2,032
9999	1,099	0,952	0,876	1,078	1,774	1,636	3,591
10000	1,179	1,019	0,870	1,644	1,950	1,849	2,058

Sum(SMR<1,0)

$$Probability\ Default(PD) = \frac{SUM\ (SMR < 1{,}0)}{10000}$$

Stochastic model

An example of an insurance company whose license was suspended



		%
Number of pessimistic scenarios SMR < 1.0	2925	29,3%
Number of pre-pessimistic scenarios 1.0 > SMR < 1.05	977	9,8%
Number of scenarios SMR > 1.05	6 098	61,0%
TOTAL Scenarios	10 000	

39%

Probability Default (PD)

	SMR
Percentile, 10%	0,872
Percentile, 25%	0,977
Percentile, 50%	1,099
Percentile, 75%	1,216

Stochastic model

Risk insufficiency assessment of reserves of Fund

	№	Name	Probability of default (PD)	General reserves, thousand tenge	Reserve of guaranteed classes, thousand tenge	Expected loss, thousand tenge (2)×(4)
	A	1	2	3	4	6
General insurance companies (non-Life)	1	Company 1	3,10%	10 923 317	867 415	26 890
	2	Company 2	5,51%	194 607 734	19 833 055	1 093 127
	3	Company 3	6,05%	28 187 017	10 135 741	613 320
	4	Company 4	5,90%	54 175 329	9 160 891	540 493
	5	Company 5	8,33%	652 268	498 944	41 582
	6	Company 6	9,06%	3 892 479	3 547 854	321 305
	7	Company 7	9,21%	35 302 393		
	8	Company 8	9,95%	12 641 139	5 222 058	519 705
	9	Company 9	11,26%	0	2 598 260	292 644
	10	Company 10	14,55%	27 806 114	319 753	46 525
	11	Company 11	16,45%	19 691 436	5 925 211	974 775
	12	Company 12	17,43%	15 093 729	3 873 378	675 131
	13	Company 13	19,87%	9 560 877	3 811 118	757 421
	14	Company 14	22,13%	5 260 308	1 310 312	289 971
	15	Company 15	21,87%	0	3 873 378	846 964
	16	Company 16	22,89%	6 005 073	18 704	4 281
	17	Company 17	26,14%	6 911 107	2 003 303	523 730
	TOTAL			**430 710 320**	**72 999 375**	**7 567 862**
	The reserve for guaranteeing insurance payments, formed by the Fund for the non-Life industry					**9 339 138**
	Sufficiency of reserve for the non-Life industry		**Excess(+)/shortage(-) of formed reserves over the expected loss in the amount of:**			**1 771 276**

	№	Name	Probability of default (PD)	General reserves, thousand tenge	Reserve of guaranteed classes, thousand tenge	Expected loss, thousand tenge (2)×(4)
	A	1	2	3	4	6
Life insurance company	1	Company 1	0,30%	45 258 395	34 916 704	104 750
	2	Company 2	0,30%	40 054 759	23 127 521	69 522
	3	Company 3	2,84%	203 807 529	118 459 387	3 368 049
	4	Company 4	3,43%	18 700 082	171 127	5 873
	5	Company 5	6,22%	219 807 867	148 245 138	9 217 887
	6	Company 6	8,74%	6 800 349	6 475 229	566 034
	7	Company 7	11,20%	55 545 879	43 609 546	4 884 269
	8	Company 8	14,61%	31 004 647	30 768 331	4 494 899
	9	Company 9	16,42%	39 798 391	36 790 096	6 040 583
	TOTAL			**660 777 898**	**442 563 079**	**28 751 865**
	The reserve for guaranteeing insurance payments, formed by the Fund for the Life industry					**1 628 041**
	Sufficiency of reserve for the Life industry		**Excess(+)/shortage(-) of formed reserves over the expected loss in the amount of:**			**-27 123 824**

Stochastic model

Regression analysis and mathematical equation Solvency Margin Ratio (SMR)

$$\boldsymbol{Calculation\ SMR = Y + (K1 \times X1) + (K2 \times X2) + (K3 \times X3) + (K4 \times X4) + (K5 \times X5) + (K6 \times X6)}$$

date	X1	X2	X3	X4	X5	X6	factual data	Calculation SMR
	Insurance premiums	insurance payments	Assets	Insurance reserves	Equity	Retained earnings	Solvency Margin Ratio	
01.01.2009	8 832 826	2 107 676	4 906 900	2 929 711	1 756 210	663 808	1,10	**0,80**
01.01.2010	2 959 960	272 510	4 395 699	1 401 597	2 738 063	1 000 262	2,21	**2,10**
01.01.2011	5 077 600	335 055	5 219 571	2 601 287	2 124 317	69 018	1,80	**1,38**
01.01.2012	5 199 913	656 290	5 959 563	3 018 003	2 664 614	53 189	1,59	**1,59**
01.01.2013	4 768 102	969 272	5 969 173	2 848 683	2 315 355	54 219	1,20	**1,21**
01.01.2014	7 057 071	792 760	6 202 604	3 147 462	2 309 690	20 259	1,16	**1,19**
01.01.2015	7 751 968	1 928 662	6 215 807	2 993 145	2 941 903	8 132	1,03	**1,65**
01.01.2016	10 579 840	1 720 255	9 137 032	5 083 135	3 189 446	757 675	0,56	**0,72**
01.01.2017	9 605 260	2 186 676	8 843 493	5 062 155	3 342 314	238 023	0,84	**0,98**
01.01.2018	9 487 739	1 884 191	9 468 018	3 530 263	4 193 367	229 609	1,74	**1,77**
01.01.2019	6 283 026	2 124 089	8 668 252	3 895 814	3 899 128	-91 970	1,44	**1,67**
01.01.2020	10 883 502	2 472 465	10 850 619	5 388 877	4 396 368	356 033	1,01	**1,29**
01.01.2021	7 379 759	2 639 620	10 092 611	3 944 494	5 394 575	1 154 481	2,54	**2,33**
01.01.2022	10 218 683	2 092 459	13 012 252	5 959 143	6 102 202	799 703	2,28	**2,13**
01.01.2023	15 048 302	4 374 104	12 428 159	6 911 107	4 381 649	-1 451 629	1,15	**0,84**

Regression statistics	
Multiple R	0,88
R-square	0,78
Normalized R-square	0,61
standard error	0,36
Observations	15

Analysis of variance

	df	*SS*	*MS*	*F*	*Significance F*
Regression	6	3,5623	0,5937	4,7021	0,0243
Remainder	8	1,0101	0,1263		
Total	14	4,5725			

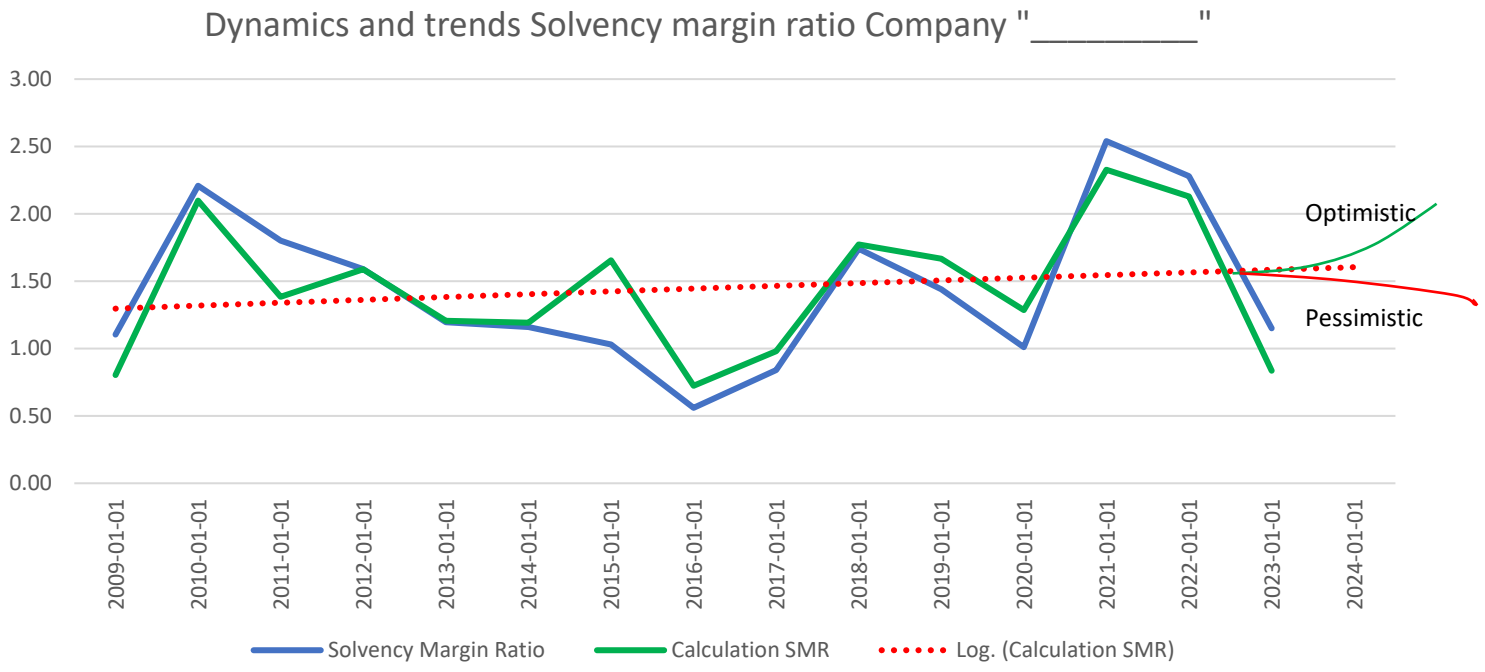
		Odds	*standard error*	*t-statistic*	*P-Value*	*bottom 95%*	*Top 95%*	*Lower 95.0%*	*Top 95.0%*
Y-intersection		1,1761101	0,3792370	3,1012532	0,0146380	0,3015879	2,0506322	0,3015879	2,0506322
Insurance premiums	K1	0,0000000	0,0000001	0,2255423	0,8272125	-0,0000002	0,0000003	-0,0000002	0,0000003
insurance payments	K2	-0,0000002	0,0000002	-0,6584390	0,5287460	-0,0000007	0,0000004	-0,0000007	0,0000004
Assets	K3	-0,0000003	0,0000003	-0,9203556	0,3842997	-0,0000011	0,0000005	-0,0000011	0,0000005
Insurance reserves	K4	-0,0000001	0,0000003	-0,2609040	0,8007571	-0,0000008	0,0000007	-0,0000008	0,0000007
Equity	K5	0,0000010	0,0000005	1,9855382	0,0823398	-0,0000002	0,0000021	-0,0000002	0,0000021
Retained earnings	K6	-0,0000002	0,0000002	-0,9257351	0,3816611	-0,0000007	0,0000003	-0,0000007	0,0000003

+ On the basis of historical data, we find the dependence of the SMR on financial indicators. The approximation quality criterion (objective function) is usually the root mean square error (R-square) and Fisher criteria (Significance F);

+ Green highlights the coefficients that most affect the SMR, in our example - the SMR of this insurance company in the historical period was strongly influenced by the behavior of **equity.**

Stochastic model

Forecast of financial stability



1. Definition of the main financial indicators of insurance companies affecting on SMR

2. Calculation of the Solvency Ratio by a mathematical equation and finding a trend

3. Solvency margin forecast:
   - based on optimistic, realistic, pessimistic scenarios for the development of the macroeconomics of Kazakhstan, taking into account the development of the world economy
   - Determination of the financial performance of an insurance company based on the development strategy, operational and investment risks

\+ Individual approach in determining the premium rate taking into account the risk profile of the insurance company

\+ The possibility of conducting a stress test of the financial stability of an insurance company under the influence of global and country macroeconomic trends, political and natural influences.

Thank you for your attention!