Covid -19 Impact on mortality and on Life Technical Provisions

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Introduction

We try to understand what impacts the Covid – 19 outbreak could have on technical provisions (reserves for balance sheet or Solvency purposes) in a Life Insurance Entity.

Those impacts are “potential” because depend on the assumptions about the medium and long term tails of pandemic risks.

Before, I show which data are essential to pay attention for measuring Covid 19.

Data about daily cases, deaths, recoveries as well as statistics such as R(t) index and weekly cases per 100000 exposures (inhabitants) are essentials.

The acquaintance of vaccination trends is important, as well.

Furthermore, prior to worry about reserves, we have to understand what are the sudden effects on profits and losses and on net assets of the additional actual claims for Covid - 19

Contagion risk. Weekly cases: last 19 till to end of March 2022

in dark blue and italics: weekly cases / 100000 >=400
in light blue and italics: weekly cases / 100000 >=200
in light pink and italics: weekly cases <=50

Contagion | Rate x 100

Rt x 100, 81st week	Rt x 100, 82nd week	Rt x 100, 83rd week	Rt x 100, 84th week	Rt x 100, 85th week	Rt x 100, 86th week	Rt x 100, 87th week	Rt x 100, 88th week	Rt x 100, 89th week	Rt x 100, 90th week	Rt x 100, 91st week	Rt x 100, 92nd week	Rt x 100, 93rd week	Rt x 100, 94th week	Rt x 100, 95th week	Rt x 100, 96th week	Rt x 100, 97th week	Rt x 100, 98th week	Rt x 100, 99th week	Zone	Region
122	117	111	110	109	110	105	115	97	66	66	104	114	114	108	104	98	110	124	C	Abruzzo
132	122	125	150	156	149	172	201	159	88	53	80	89	87	79	83	99	119	123	S	Basilicata
143	121	109	98	94	89	79	108	102	53	42	48	30	73	79	76	85	110	110	NE	South Tirol
100	102	111	114	117	116	105	102	85	57	61	85	86	80	119	126	98	84	101	S	Calabria
116	108	105	108	108	115	158	174	109	59	76	80	85	87	87	88	96	116	129	S	Campania
127	131	127	114	114	120	143	163	138	109	104	90	69	58	59	70	88	111	125	N	Emilia Romagna
122	107	105	101	102	100	109	132	131	96	74	76	96	93	76	72	80	105	126	NE	Friuli Venezia Giulia
117	107	105	101	100	104	110	100	80	80	122	110	91	86	87	92	96	117	124	C	Lazio
136	134	123	116	120	115	112	112	102	109	123	102	79	68	71	78	89	106	109	NW	Liguria
134	132	124	118	114	125	181	195	147	95	71	80	68	62	69	83	94	113	128	NW	Lombardia
123	126	129	120	112	117	120	109	99	162	194	157	120	81	58	78	88	111	87	C	Marche
119	164	148	77	75	99	127	166	140	106	134	147	145	130	112	114	126	113	112	C	Molise
128	129	133	132	132	131	150	159	131	96	76	60	56	54	57	67	81	102	121	NW	Piemonte
104	100	107	116	120	128	147	168	150	121	130	128	83	94	81	91	105	120	135	S	Puglia
133	121	108	107	117	122	136	154	129	85	77	82	89	87	90	83	93	116	121	S	Sardegna
110	105	102	106	114	122	126	117	80	53	88	87	87	98	106	98	102	112	107	S	Sicilia
109	108	114	122	122	130	150	147	115	97	114	105	88	73	71	79	93	116	131	C	Toscana
120	137	140	132	126	120	143	186	189	151	127	100	74	63	67	72	81	100	117	NE	Trentino
114	103	96	116	134	146	171	141	108	91	101	112	111	103	101	117	164	201	188	C	Umbria
188	196	159	122	109	112	128	148	141	107	80	68	55	46	60	80	95	106	118	NW	Valle D'aosta
133	135	131	118	115	114	115	125	124	114	110	96	81	76	81	87	93	109	125	NE	Veneto

Contagion risk. Weekly cases

The contagion risk R(t) depends on the rate of increase / decrease of new cases compared to the actual cases

The number of weekly cases per 100.000 inhabitants is more intuitive.

The report unveils the trend over the last nineteen weeks until end of March 2022.

Do contagion and weekly cases provide the same information?

When Covid – 19 is light for a long period of time or, at odds, significant for a long period, they seem to consistent each other: look at the initial period, at the end November, when pandemic was light, 20th November corresponds to a minimum of active cases.

Look at he most recent weeks when pandemic has been important, 23rd February and 30th March have relative maximum active cases.

However, when pandemic is rising, R(t) appears on delay: look at 94th week which relates to the 23rd February peak and, nonetheless, many R(t) are green, below 1. There, the number of cases per 100.000 looks more quickly updated.

Contagion risk. Weekly cases. View of midst September 2021

in light blue and italics: weekly cases / 100000 >=200
in light pink and italics: weekly cases <=50

Contagion Risk	Rate x 100																
Region	**average first 10 weeks**	**average weeks 11-20**	**average weeks 21-30**	**average weeks 31-40**	**average weeks 41-50**	**average weeks 51-60**	**Rt x 100, 61st week**	**Rt x 100, 62nd week**	**Rt x 100, 63rd week**	**Rt x 100, 64th week**	**Rt x 100, 65th week**	**Rt x 100, 66th week**	**Rt x 100, 67th week**	**Rt x 100, 68th week**	**Rt x 100, 69th week**	**Rt x 100, 70th week**	**Rt x 100, 71th week**	**Zone**
Abruzzo	59	96	125	91	96	78	*103*	*119*	*114*	*106*	*118*	*124*	114	106	101	*85*	*78*	C
Basilicata	13	23	119	89	121	93	*99*	*96*	*97*	*120*	*146*	148	148	148	141	124	101	S
South Tirol	50	87	138	94	81	87	*62*	*99*	*133*	*136*	*115*	*92*	94	92	81	93	102	NE
Calabria	28	58	118	89	103	75	*77*	*90*	*91*	*117*	*136*	117	108	108	109	98	84	S
Campania	58	98	130	79	118	75	*75*	*108*	*120*	*119*	*118*	117	119	110	95	*90*	*85*	S
Emilia Romagna	79	83	121	92	99	77	*69*	*92*	*127*	165	167	132	109	95	89	85	81	N
Friuli Venezia Giulia	70	73	127	88	97	75	*80*	*93*	*112*	*128*	*141*	*143*	*117*	*97*	96	96	95	NE
Lazio	96	80	114	90	97	76	*69*	*85*	126	163	141	89	83	89	85	*78*	*76*	C
Liguria	65	112	114	93	102	76	*64*	*101*	*150*	*188*	187	136	107	105	104	95	85	NW
Lombardia	85	91	138	95	97	75	*66*	*91*	*126*	*150*	*140*	*120*	*102*	*88*	*86*	*92*	*97*	NW
Marche	70	85	116	92	99	83	*59*	*97*	*127*	*134*	190	199	160	121	86	94	114	C
Molise	50	25	122	116	114	75	*23*	*12*	*2*	*25*	*30*	*37*	*42*	*60*	*101*	*102*	*136*	C
Piemonte	68	90	140	84	103	71	*58*	*85*	*129*	*167*	*182*	*142*	*109*	*100*	*99*	*97*	*91*	NW
Puglia	59	86	125	97	104	79	*64*	*79*	*108*	*140*	*160*	*144*	*130*	*115*	*101*	*92*	*85*	S
Sardegna	23	79	97	84	102	73	*108*	*135*	191	219	161	113	93	82	88	81	*62*	S
Sicilia	55	112	119	89	97	82	*68*	*90*	120	150	156	130	119	*119*	*116*	99	83	S
Toscana	80	98	132	89	110	78	*61*	*94*	*137*	178	195	160	126	109	99	89	83	C
Trentino	54	96	118	85	95	86	*72*	*90*	*128*	*183*	*183*	*118*	98	*111*	107	*93*	*86*	NE
Umbria	47	81	125	97	93	86	*85*	*89*	*107*	152	181	139	104	92	86	83	82	C
Valle D'aosta	41	41	139	85	128	82	*76*	*68*	*34*	*59*	*135*	161	161	137	*94*	*63*	*75*	NW
Veneto	83	110	127	89	102	76	*69*	*112*	*160*	185	168	124	101	89	89	88	84	NE

Contagion risk. Weekly cases

The report unveils the trend over the last ten weeks until 15th September 2021 as well as R(t) from the beginning of survey averaged in clusters 10 weeks wide.

Did contagion and weekly cases supply the same information?

Yes in most of cases. You can see how regions Abruzzo and Trentino drop below R(t) in the last week and at the same time weekly cases drop below 0.5

Nevertheless there are some apparent inconsistencies. For example, Lombardia, Veneto and Sardegna have their R(t) below 1 over the last 3 weeks, any way only Lombardia shows weekly cases below 0.5 since a long period before.

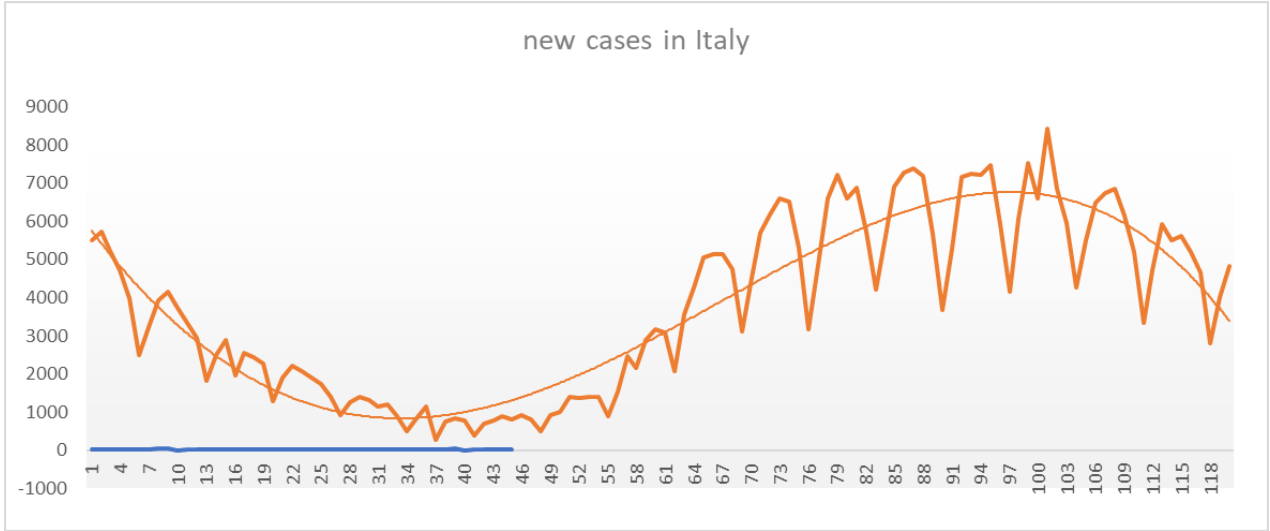
New cases (1/2)

The graph refers to the last 120 days till to September 15th 2021.

The new cases have a trend consistent with R(t) and weekly cases.

We can note how the trend of decrease coincides with the trend shown in the previous exhibit.

The weekly falls depends on the reduced number of tests carried out On Saturdays and on Sundays (reported 1 day later)

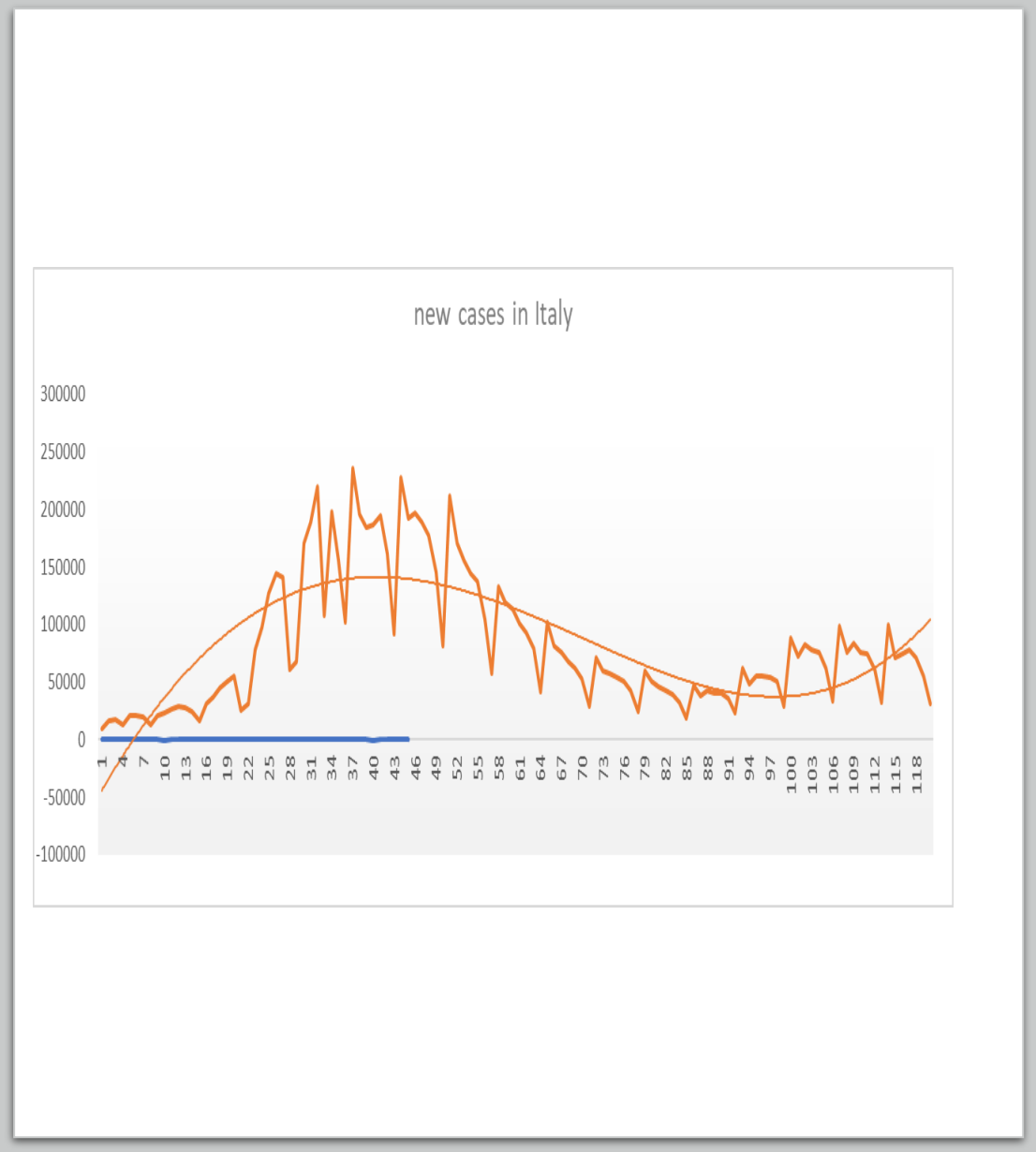


New cases (2/2)

The graph refers to the last 120 days till to April 4th 2022.

We can note how the 2 trends of increase coincides with the trend shown in the R(t) and Number of Cases exhibit.

The temporary decline between Omicron (peak on day 37, January 11 2022, 236k new cases) and New Omicron (peak on day 114, March 29 2022, 99k new cases) matches the period of green R(t)



Lethality rates up to September 2021

Exhibit 1a | update 15 Sept

age	Men cases	Men deaths	% Men cases	Women cases	Women deaths	average mortality rate
0-19	385.731	17	52,0%	355.625	16	0,004%
20-29	296.601	45	51,5%	279.770	28	0,013%
30-39	285.514	174	49,0%	297.127	104	0,048%
40-49	349.500	823	47,7%	383.816	360	0,16%
50-59	383.177	3.372	49,0%	398.334	1.331	0,60%
60-69	255.334	9.728	51,8%	237.175	3.725	2,73%
70-79	179.903	22.070	50,7%	175.257	10.613	9,20%
80-89	107.917	28.267	41,0%	155.573	23.847	19,78%
>=90	22.013	8.674	24,4%	68.315	16.358	27,71%
TOT	2.265.690	73.170	49,1%	2.350.992	56.382	2,81%

age	men	new deaths last 8 weeks	women
until 39	15		14
40-49	36		23
50-59	117		61

Lethality rates. The view on 15° september 2021

Lethality rates measure the frequencies of deaths of Covid – 19 cases. At last, it's a good measure of the probability to die once having infected by Coronavirus.

Frequencies had not materially changed from 1st wave (February –June 2020).

Apparently, the ratio between deaths and total cases had reduced from 1st Wave to the others. However, if we look at the ratios for each class age, the frequency has not changed. The overall reduction is then due to the younger age on average of new cases occurred since March 2021 who, of course, have had a good reaction to the flue compared to old ages.

Covid -19 had bitten more often young people since March 2021 because most of old people had been vaccinated in the meantime.

No changes of mortality rates within same age classes entails the new variants of Coronavirus provided the same mortality risks as of the original 1st wave virus.

Plenty of young people has been dying for the previous 8 weeks. Note also how women died no less than men at ages below 40. Girl deaths were even the same as boys looking at the overall pandemic period: look at ages <20

Lethality rates up to March 2022

Exhibit 1a		update 30 Mar 2022				
age	Men cases	Men deaths	% Men cases	Women cases	Women deaths	average mortality rate
0-19	1.695.798	26	51,1%	1.619.553	27	0,002%
20-29	889.306	76	49,0%	925.175	40	0,006%
30-39	916.916	249	46,1%	1.070.585	146	0,020%
40-49	1.089.775	1.020	45,8%	1.287.384	481	0,06%
50-59	1.030.183	4.101	47,7%	1.131.695	1.688	0,27%
60-69	620.797	11.505	49,0%	647.022	4.651	1,27%
70-79	406.823	26.043	49,1%	422.268	12.971	4,71%
80-89	218.183	34.003	41,8%	304.201	28.860	12,03%
>=90	42.546	11.026	26,1%	120.721	19.896	18,94%
TOT	6.910.327	88.049	47,9%	7.528.604	68.760	1,09%

age	men	new deaths last 7 weeks	women
until 39	41		25
40-49	52		38
50-59	219		108

Lethality rates. The view at the end of March 2022

Frequencies have materially reduced from the end of 3rd wave.

During Omicron, deaths have been lower.

The refreshed lethality rates have more the halved until age class 60-69, then halved in age class 70-79 and reduced materially for older ages as well.

Nevertheless, the number of death cases is significant because of the high number of cases: Omicron and new Omicron are highly contagious compared to the previous variants.

Look at the number of deaths over the last 7 weeks.

The question is: how the vaccine has reduced the lethality rates?

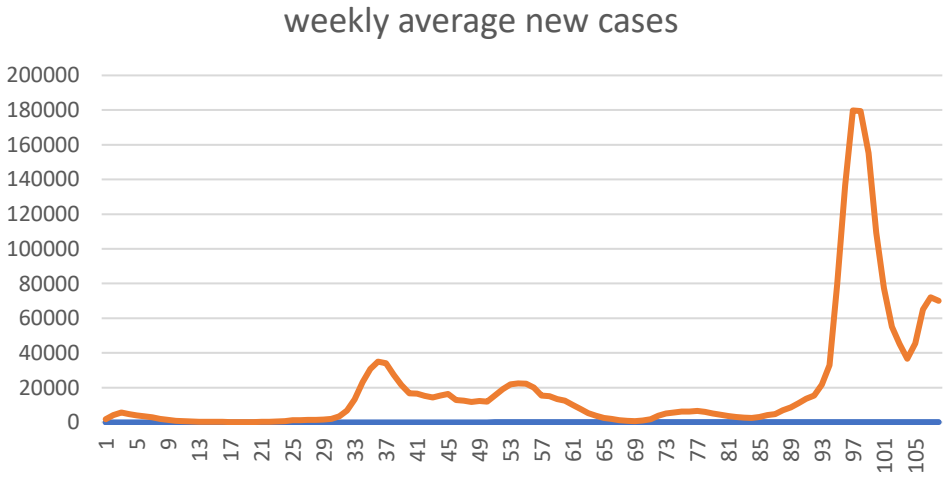
Waves (1/2)

Six waves so far.

The first wave started in China, then spread to Iran and, in Europe, took root in Italy from the end of February 2020.

The 2nd wave began on late August 2020, through the same original variant. It explains the most part of death cases: 60 thousands, 37,5% of the overall deaths incurred till to end of 3/2022.

The 3rd wave started in UK on late December 2020 and arrived in Italy during the 3rd decade of February 2021. it was the first variant of original SARS-CoV-2, called "*alfa*" (few cases were due to variant Beta, as well). Less deaths than 2nd wave thanks to the vaccine



wave	week peek	worst peak begins on	new cases	overall deaths	accum.deaths	end period	VoC	Origin
1	3	21/03/2020	5.640	35.234	35.234	14/08/2020		China
2	36	07/11/2020	34.946	60.001	95.235	19/02/2021		
3	54	13/03/2021	22.373	32.402	127.637	03/07/2021	Alfa	UK
4	77	21/08/2021	6.601	3.880	131.517	16/10/2021	Delta	India
5	97	08/01/2022	179.734	24.092	155.609	04/03/2022	Omicron	South Africa
6 (*)	107	19/03/2022	72.155	4.300	159.909	04/04/2022	Omicron 2	

Note - (*): ongoing

Other Variants of Concern: Gamma since 01/2021 - Japan; Brasil. Spread during Delta

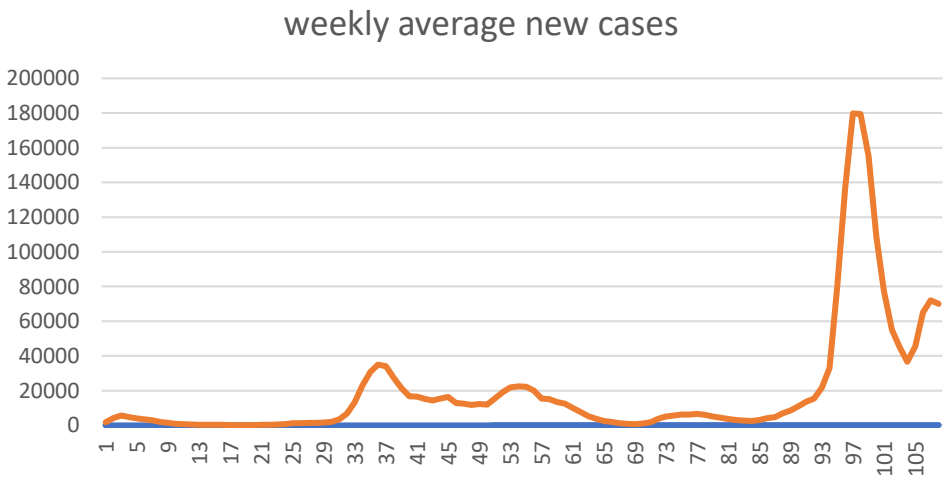
Beta since 9/2020 - South Africa. Spread during Alfa

Waves (2/2)

The 4th wave started in India and arrived in Italy in half July 2021. Its name is Delta; however, cases were also due to Beta during the same period, though with a lower contribution. Few cases and, above all, few deaths thanks to the vaccine

The 5th wave is Omicron and started on late October 2021, more significantly perceived from early December 2021. We can appreciate the high number of cases (weekly peak almost 180k kept for 2 weeks). Few slides ahead unveil the impact of vaccination.

The last wave is a variant of Omicron: we are now living its likely plateau



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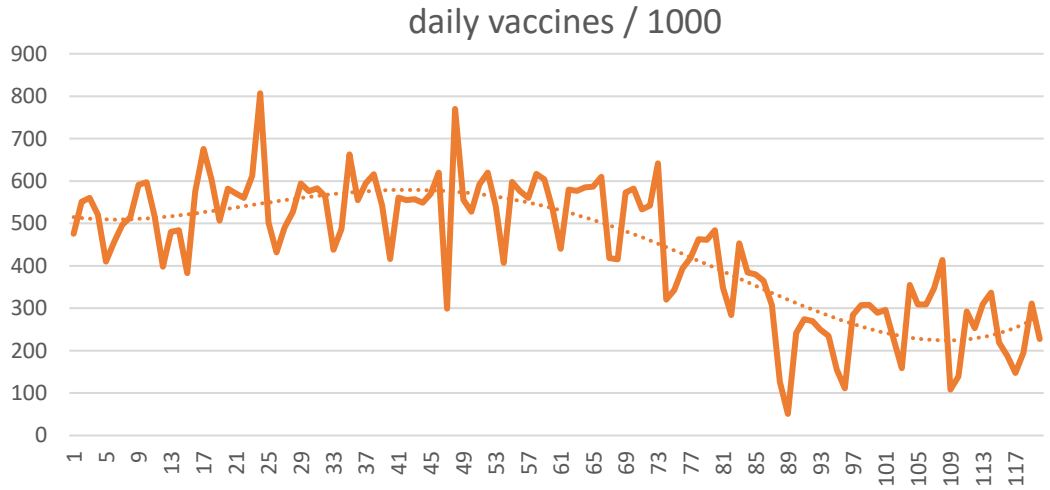
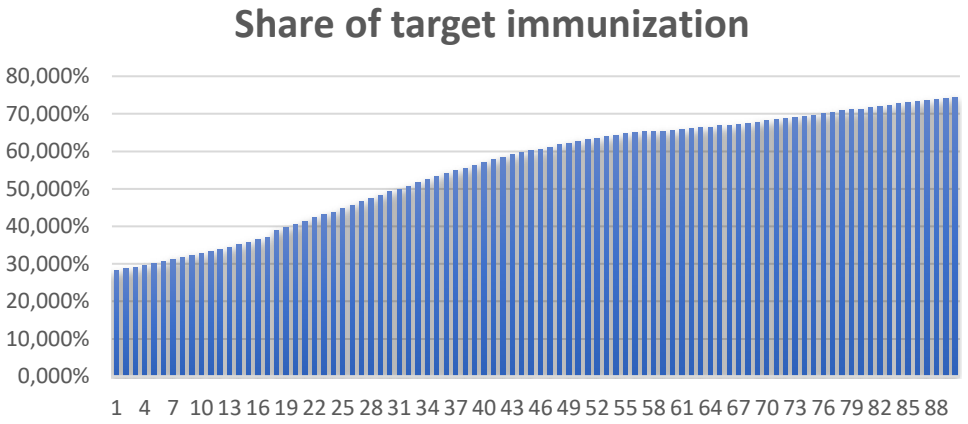
Beta since 9/2020 - South Africa. Spread during Alfa

Vaccination. View of 15° September 2021

Daily vaccinations had succeeded until beginning of July. The 1st graph shows data during the last 120 days until 15 September. The number had declined in July for a temporary shortage of available doses in Italy, later on for people working holidays and, in September, for the rare willingness to be vaccinated (no vax – fear – unawareness of Covid – 19 circulation).



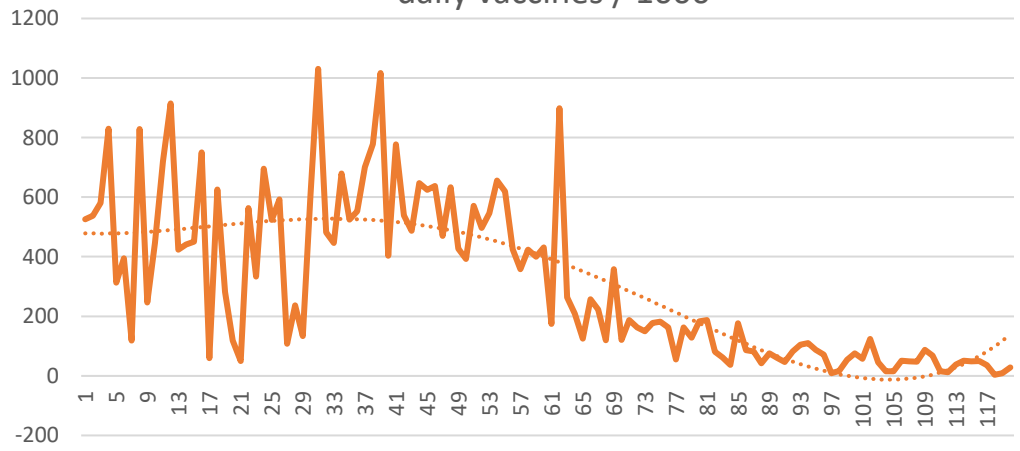


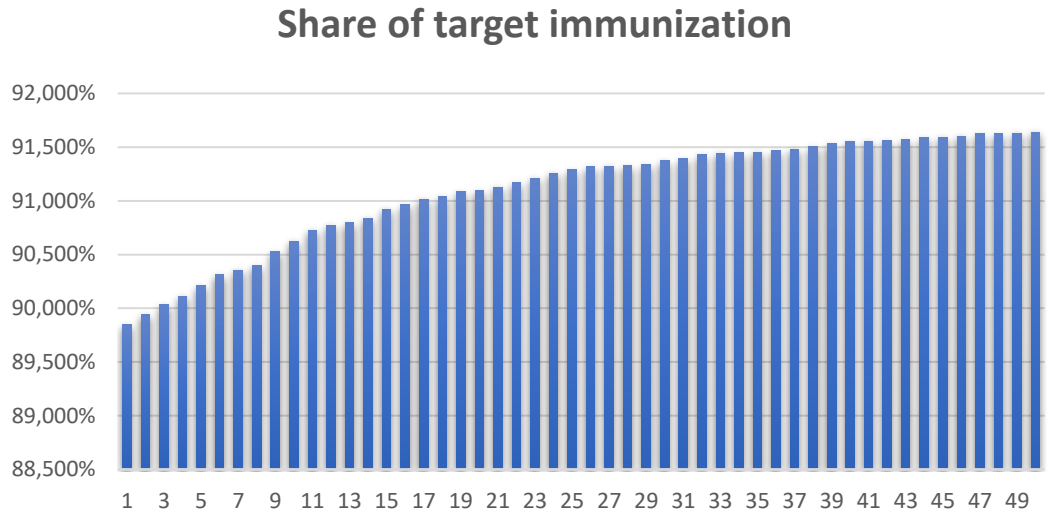
The share of target immunization (see the graph over the previous 90 days) is shown in respect to 90% of Population, independent of age.

On 18 September, 3,4 million citizens over 50 were still not vaccinated and 12.5% of available doses (11.6 million out of 93.7) were yet waiting to be used.

Vaccination. View of 4° April 2022

Daily vaccinations have succeeded until beginning of February, mainly for 3rd doses “booster” which have covered up to 38816 people (having reached the important number 34886 yet on 5th February)





Booster represents 28,6% of total vaccinations. Booster covers 75% of daily vaccinations on average since early March. Since 1st March 2022 there’s no day with more than 150 vaccinations albeit young people below 12 are invited.

Vaccination. Impacts. View at the end of March 2022

				share of events incurred to not vaccinated	mitigation of vaccination (see note)	tot events last month	observed in
Population over 11	Share of infections last month people not fully vaccin: 1-alfa			21,72%	43,48%	1.594.849	25/2-27/3
Share of fully vaccinated (*)	Share of deaths last month people not fully vaccinated: 1-alfa			34,47%	22,94%	3.798	04/2-06/3
V/(V+N)=beta 89,23%	age	men	new deaths last 7 weeks		women		
(*)at the mid of	until 39	41			25		
observations	40-49	52			38		
	50-59	219			108		
	Share of hospitaliz.last month people not / fully vaccinated: 1-alfa			27,58%	31,69%	17.536	11/2-13/3

		under 12
pop over 11	54.009.945	6.295.756
vaccinated	49.315.000	1.120.000
pop tot	60.305.701	

Note. How I calculate the mitigation of vaccine
The effect of vaccinarion means how much the probability to incur the event is reduced thanks to the vaccination.
The event is either death, or infection or hospitalization V stands for vaccinated: 2 or 3 doses

a Note: I know Vm/(V+N)=alfa that is the cases incurred on vaccinated V divided all the population V+N. Note that 1-alfa=Nm/(V+N)

b I want to know x=[Vm/V]/[Nm/N] that is the probability to incur in infection for vaccinated divided the probability to incur infection for non vaccinated

c X can be shown as [(N*Vm)/(V*Nm)]=x --> x=alfa/(1-alfa)*(N/V) referred to as "mitigation effect" in the exhibit

Vaccination. Impacts. View at the end of January 2022

				share of events incurred to not vaccinated	mitigation of vaccination (see note)	tot events last month	observed in
Share of fully vaccinated (*)	Share of deaths last month people not fully vaccinated: 1-alfa			45,25%	20,75%	7.435	17/12-16/01
V/(V+N)=beta 85,36%	age	men	new deaths last 8 weeks		women		
(*)at the mid of	until 39	50			26		
observations	40-49	94			53		
	50-59	362			171		
	Share of hospitaliz.last month people not / fully vaccinated: 1-alfa			38,78%	27,06%	44.173	24/12-23/01

Mitigation was slightly more efficient 3 months before.

		under 12
pop over 11	54.009.945	6.313.689
vaccinated	46.505.000	400.000
pop tot	60.323.634	

Mortality rates in the Life Insurance Portfolio (1/3)

The next slides provide answer on whether so many deaths have materially affected the P&L of a Life Insurance Entity.

I proceed step by step on the reasoning.

Question 1: what kind of balance sheet / financial statement should I consider?

Answer: the impact is the quite the same irrespective of I am looking at Local GAAP (i.e. Italian one), Solvency II, IFRS4 and even IFRS17.

The last one prescribes that any experience variance of cash outflows having insurance characteristics shall be recognized in profits & losses.

The impact in Solvency II is only in term of net assets since there's no P&L to be done.

Question 2: How can I disclose the impacts to P&L (and to Net Assets)?

Answer: I have to measure the capital at risk on claims, both settled and outstanding. That's true in Local GAAP and in IFRS4.

In Solvency II the impact is the difference between the sum assured and the opening best estimate + risk margin: it's slightly greater than in local GAAP & IFRS4.

Mortality rates in the Life Insurance Portfolio (2/3)

Question 2: How can I disclose the impacts to P&L (and to Net Assets)?

Answer: In IFRS17 I measure

(1)the experience variance of

a) the expected death benefits in excess of deposit (non – distinct investment component) compared to
b) the corresponding deaths incurred,

(2)partially offset by release of risk adjustment.

Since the first term *(1a) is deemed to be nil (*)*, the impact is the same as Solvency II, if risk margin and risk adjustment are similar (**).

The adverse impact of (1b) shall be recognized in P&L.

There are other not material side impacts which, anyway, maybe recognized against the Contractual Service Margin rather than to P&L.

(*): The first term is void as the opening PVFCF does not allow for extra – mortality for pandemic

(**): Note that risk adjustment could not include the CAT risk for pandemic

Mortality rates in the Life Insurance Portfolio (3/3)

Question 3: is there any provision for pandemic risk?

Answer: Yes, in Solvency II. The CAT risk allows for adverse changes of net assets if a CAT risk (i.e. pandemic risk) incurs over the next 12 months.

The probability is set to 0.5% and the metric is the VAR → the corresponding mortality rates are 0.15% irrespective on age. The additional rate is applied (added) to the basis mortality rates for every age and only for the next 12 months of projections, without any consideration of long term effects.

Question 4: how many deaths Solvency II SCR CAT risk (standard formula) has foreseen compared to the actual Covid – 19 claims?

Answer: the SF CAT risk forecast was 188.400 deaths for pandemic risk over 25 months, just above the actual deaths, namely 160.000 which then figures out 84,9% of it.

Question 5: has the Solvency II Cat risk provided the same outcome experienced in Covid – 19?

Answer: No, the adverse impact in term of capital at risk has been only 5-15% of the prevision of CAT Risk according to the Solvency II SCR Standard Formula, that is 6% - 18% of SCR CAT prevision should deaths be the same.

The next slides try to explain why the impact has been so immaterial despite the good prevision in terms of number of deaths

Low impact on P&L (1/4)

Selection

The next exhibit shows the relationship between the health status, before Covid – 19, and mortality.

The most part of deaths relates to people with a previous history of at least 3 serious diseases, prior to being struck by Covid – 19

At odds, the major part of people insured in “term insurance” have had at most 1 critical illness.

Thus, 86% of customers subject (i.e. exposed) to Covid – 19 lethality were not insurable for coverage with important exposures in term of capitals at risk, namely term insurance.

Deaths for number of contextual illness/disease			
0	2,90%	mean	3,7
1	11,60%	mean square error	2,05
2	18,10%	**Updated to 21 July**	
>=3	67,40%		

Deaths for number of contextual illness/disease			
0	2,90%	mean	3,7
1	11,30%	mean square error	2,1
2	17,90%	**Updated to 10 Jan 22**	
>=3	67,90%		

Low impact on P&L (2/4)

Selection

Deaths for Complication			
Insufficienza respiratoria		93,3%	Respiratory failure
Danno renale acuto		25,4%	Acute kidney damage
Danno Miocardico Acuto		10,4%	Acute myocardial damage
Sovrainfezione		21,0%	superinfection
Shock	Update on 10 Jan 22	N/A	Shock

Partially vaccinated: only 1 out of 2 doses

	Update on 10 Jan 22	since Feb 21			
		not vaccinated	partially vaccinated	wholly vaccinated	since Mar 20
Deaths: mean age		78,6	82,6	84,7	80
Deaths: % women		41,2%	55,2%	39,9%	43,8%
deaths: contextual illness. Mean		3,9	5	4,9	3,7
	St.dev	2,2	2,2	2,5	2,1
	0	3,0%	0,0%	0,6%	2,9%
	1	10,2%	3,4%	6,2%	11,3%
	2	17,0%	12,1%	9,5%	17,9%
Update on 10 Jan 22	>=3	69,8%	84,5%	83,7%	67,9%

Time Lag, last 6 months		days	from --> to
sintomi --> decesso	Update on 10 Jan 22	13	syntoms --> death
sintomi -- > ricovero in ospedale		5	syntoms --> hospitalization
ospedalizzazione --> decesso		8	hospitalization ---> death
di cui senza rianimazione		7	thereof without artifcial ventilation
di cui con precedente rianimazione		13	thereof with artifcial ventilation

Low impact on P&L (3/4)

Selection

The next exhibit shows details of critical illnesses suffered by people died for Covid – 19.

Red indicates increase from the previous report, while green denotes decrease. The statistic of 5th October 2021 is not shown here

Deaths for kind of contextual illness/disease			Updated to 21 July
cardiopatia ischemica		28,1%	ischemic heart disease
fibrilazione atriale		24,5%	atrial fibrilation
scompenso cardiaco		15,7%	heart failure
ictus		11,5%	stroke
ipertensione arteriosa		65,8%	hypertension
diabete mellito		29,3%	diabetes mellitus
demenza		23,6%	dementia
BPCO	smoking behaviour	17,2%	Chronic Obstructive Pulmonary Disease
Cancro attivo ultimi 5 anni		16,3%	Active cancer last 5 years
Epatopatia cronica		5,0%	Chronic liver disease
Insufficienza renale cronica		21,2%	Chronic renal failure
HIV		0,2%	HIV
malattie autoimmuni		4,6%	autoimmune diseases
obesità		11,3%	obesity
insufficienza respiratoria		6,8%	respiratory failure
dialisi		2,2%	dialysis

Deaths for kind of contextual illness/disease			Updated to 10 Jan
cardiopatia ischemica		28,2%	ischemic heart disease
fibrilazione atriale		25,1%	atrial fibrilation
scompenso cardiaco		16,0%	heart failure
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Cancro attivo ultimi 5 anni		16,1%	Active cancer last 5 years
Epatopatia cronica		5,1%	Chronic liver disease
Insufficienza renale cronica (5th October)		21,2%	Chronic renal failure
HIV		0,2%	HIV
malattie autoimmuni		4,7%	autoimmune diseases
obesità		11,6%	obesity
insufficienza respiratoria		N/A	respiratory failure
dialisi		2,3%	dialysis

Low impact on P&L (4/4)

Age

- The most part of deaths are concentred at ages above 75.

Term insurance in Italy generally covers until age 75.

Unit linked contracts can often cover additional mortality benefits for ages well above 75, anyway supplying a lower guarantee.

Note that the current local regulation (unit linked) is under review on this subject → the additional cover might increase for old ages in the forthcoming years.

If so, the price could increase as well, should Covid – 19 have long term adverse effects.

Mortality price could be applied either via the gross management fees or via front end loadings on premium or via detached premiums.

- The SCR CAT risk has wrongly foreseen an additional constant mortality for every age whereas, in contrast, the Covid – 19 mortality has struck older people largely more than young people

If impact on P&L is not so immaterial at all

In case impact has been serious, there are a couple of possible reasons:

Not accurate selection of policyholders in term insurance. Even anti (adverse) selection at entry.

Collective (group) contracts whose heads insured are not subdued to any medical check before insurance

Assumptions for technical provisions (1/5)

The question is: should actuaries propose change of mortality assumptions for running technical provisions?

In Italy, those changes, if done, would be applicable to the **Solvency II Best Estimates** (and indirectly to the risk margin).

In next future, they would applicable to **IFRS17** fulfilment cash flows.

- PVFCF
- Risk Adjustment

However, the adverse impact would be immediately recognized into CSM, hence the adverse impact would be delayed and recognized smoothly over the residual lifetime of portfolio.

IFRS17: frequent updates [of mortality assumptions due to Covid – 19 long term effects] do not work well in case the entity waives to the “interim reporting”

Solvency II: Standard Formula risk margin shall necessary reflect proportionally the changes of mortality assumptions being used for the best estimates

IFRS17: Risk Adjustment does not necessary suffer a proportional impact from the changes of mortality assumptions for the PVFCF if the approach is via statistical inference

Assumptions for technical provisions (2/5)

The question is: should actuaries propose change of mortality assumptions for running technical provisions?

In Italy, those changes, if done, would be applicable to Local GAAP as well.

Local GAAP reserves would be subject to the test for the eventual recognition of additional reserves for mortality. Additional reserves are likely due if original pricing assumptions (being used also for reserving as reserving assumptions are generally locked in at inception) are insufficient compared to post Covid – 19 mortality assumptions.

Changes of Local GAAP reserves reflect immediately in IFRS4 reserves even though an additional formal Liability Adequacy Test is necessary

Assumptions for technical provisions (3/5)

The question is: should actuaries propose change of mortality assumptions for running technical provisions?

Changes of mortality assumptions mean “long term” i.e. permanent effects of Covid -19.

There’s no evidence of long term effects of Covid – 19

However, there’s some evidence that 1st wave cases, recovered after hospitalization, have died for causes other than Covid -19 over the following 12 months, with frequencies well higher than the relevant peers, even 8 times more.

If confirmed in the long term, Mortality assumption need to be refreshed for Technical Provisions.

For example, if X% of entity heads insured have survived from Covid – 19 and the long term tail is represented by the vector y1, y2, ….yt (yi> 0 for every i>0), then the new mortality rate for a given age z, projected t years after the valuation date, is refreshed as follows:

$$q(z,t) = q(z,0) * (1 + x\%y_t) \qquad [1]$$

Where q(z,0) is the mortality rate for a customer never affected by Covid - 19

Assumptions for technical provisions (4/5)

An additional consideration relates to people who, despite they have never been affected by Covid -19, will suffer from higher mortality rates than before Covid – 19 time

They may include:

- Non - vaccinated
- Vaccinated who give up hospitalization in case of illnesses other than Covid - 19

These phenomena might occur if Covid -19 will continue during the next years, although with low cases compared to the period 2/2020 – current.

If so, there's some shortage of attention to other critical illnesses; in some cases, people could waive hospitalization if they fear sharing spaces near Covid – 19 patients.

That said, if (1-X%) of entity heads insured have never been affected by Covid – 19 and the long term tail is represented by the vector w1, w2, ….wt (wi> 0 for every i>0), then the new mortality rate for a given age z, projected t years after the valuation date, is refreshed as follows:

$$q(z,t) = q(z,0) * [1 + x\%y_t + (1 - x\%)w_t] \quad [2]$$

Where q(z,0) is the mortality rate for a customer before Covid – 19 outbreak

Assumptions for technical provisions (5/5)

Someone believes that people died for Covid – 19 would have died for other reasons over the next 3-5 years.

Therefore, those survived have more life expectancy than people exposed before Covid – 19 outbreak

If so, we could manage the change of reserves with the same equation [2] where w(t) is <0.

This event is called “accelerated death” [of weak people during Covid – 19 outbreak].

See, for example IAALS 12/10/2021 “the impact of Covid – 19 on higher – age mortality” by Andrew Cairns.

Diversification with longevity (risk) exposure

If insurers believe on long term tail and hence, they refresh their reserving assumptions of mortality for term insurance and any other business subject to mortality risks such as participating endowment contracts,

if they deem there's no evidence of anti / adverse selection of their customers,

then, they can assume that the same mortality refresh could be applied to life contingent annuities and to any other business exposed to longevity risks (including Long Term Care).

Such a diversification could be able to offset the adverse impact seen in term insurance, at least in part.

Asset and Liability matching

As for the Asset Liability Management, the increase of mortality assumptions made on contracts exposed to mortality and longevity, is in any case able to reduce the duration of liabilities.

If the insurer does not reflect such a change on management actions of the assets underlying the technical provisions, the portfolio becomes exposed to interest rate risk up (increase of interest rates) as well as more to the increase of credit spreads, i.e. the adjustment with liquidity premium or volatility adjustment or any similar measure reflecting part of credit spreads on the liability side might become less efficient

Non – Covid 19 update of mortality assumptions (1/2)

This page deals with the concern of updating the long term mortality assumptions independent on the consequences, if any, of Covid – 19 outbreak.

The problem consists in the capacity to interpret the entity experience mortality over years 2020 and 2021 net of Covid – 19 effects.

I show two possible and opposite situations. The portfolio under examination (term insurance) is likely to be in the midst of them.

Case 1: individual contracts low exposed to Covid – 19 thanks to the preliminary selection of risks.

If so, the entity keeps a database with capital at risks settled or reserved as outstanding limited to deaths directly caused by Covid – 19.

The actuary could link these data with the general deaths incurred by the entity in the same period for cleaning the overall deaths so that to identify the non – Covid 19 death incurred

Non – Covid 19 update of mortality assumptions (2/2)

Case 2: collective contracts without risk selection

The actuary could compare the change of entity specific mortality against the change of mortality of national (general) population in the same period. As regards general population, the actuary shall measure what change is due to the trend and what is due to the temporary increase by Covid – 19.

For example, the ISTAT mortality table for year 2019 is unaffected by Covid - 19 whereas 2020 and 2021 do so.

The relative increase (for each age) of mortality rates may be assumed to be due to solely Covid – 19.

Those rates of increase, eventually adjusted if the observation period is shorter than 1 year (*), are deducted from the overall observed actual mortality rates (**)

At last, the actuary deducts the Covid – 19 additional & temporary mortality from the entity specific data experience .

(*): year 2020 was exposed to 10 out of 12 months to Covid - 19 outbreak. Thus, the increase of annual mortality rate y% shall be adjusted by 1/0.833 → x = y/0.833

(**) deaths incurred (actual cases) from March to December 2020 are reduced by x%

Problems of data interpretation (1/3)

The question is:

Are deaths due to Covid- 19? Alternatively, deaths incurred are associated to Covid – 19 only because they are affected but, nevertheless, people die for other (more serious) reasons

Statistical analyses could help

We could check whether R(t) and lethality rates follow the same pattern or whether they are correlated.

The more R(t), the more the lethality rate: this might be interpreted as the most part of deaths incurred in people infected are due to the infection rather than to other causes.

An Idea is the usage of “Variance Analyses” (ANOVA) by means we could understand whether the lethality rate is more important – on average - during the waves than during quit periods.

In doing so, we have to choose appropriate grouping of data, for example up to 11 clusters corresponding to 6 waves and 5 intermediate periods of quit between them.

Problems of data interpretation (2/3)

The question is:

An alternative Idea is the usage of “principal components”, as they could provide a different kind of answers:

1. What are the factors explaining deaths of people infected?
2. How they are important?
3. In which directions they move?

For example, we can build 12 clusters, where 6 relate to each wave and the remainder 6 to the corresponding periods of low contagion.

The sample could be figured out by a KPI based on deaths - for example lethality rates – measured on weekly basis (number of weeks = sample dimension >=12; it must be the same for all the 12 clusters).

Perform the evaluation of 12 principal components from the covariance matrix (or from the correlation matrix)

Problems of data interpretation (3/3)

(1) Principal components are independent one another and

(2) are ordered from the most important to the less important, in accordance with their “eigenvalues”. Each eigenvalue is associated to a mean square error (sum of variances = 1) and

(3) to an eigenvector (sum of cross product between every couple of them = 0; second moment = 1/dimension for each of them =1/12).

Look graphically the eigenvectors and pay attention to their sign and intensity (how they are tall): we could have the answer!

If we would like to perform previsions & forecast of the KPI (variables) via stochastic simulation:

The eigenvalue (k) is a linear combination of 12 variables used for sampling, whose weights are the (coefficients) elements of eigenvector (k)→ the variable (j) that we would like to foresee is a linear combination of each eigenvalue (k) multiplied its mean square error, multiplied the element (j) of eigenvector (k)

The eigenvalue (i) maybe estimated by assuming an appropriate PDF and then through pseudo-random numbers.

Do not use all the eigenvalues, just only the most important h<k that explain at least 80% of variance.

Data sources

Data about Covid – 19 are available, amongst the others,

in

www.governo.it

lab.gedidigital.it

www.epicentro.iss.it

www.worldmeters.info