

Predicciones sobre CoViD-19

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ANÁLISE MATEMÁTICA E OPTIMIZACIÓN



- Predicciones

- Predicciones

Tabla Modelo Lineal.

	C:H1-lw	C:H1-fit	C:H1-up	C:H2-lw	C:H2-fit	C:H2-up
España	41805	46480	51154	44021	54981	65941
Andalucía	2558	2851	3145	2704	3392	4080
Aragón	806	896	985	874	1084	1294
Asturias	698	779	860	719	909	1098
Baleares	532	589	646	589	722	856
Canarias	590	656	721	635	789	943
Cantabria	485	535	585	570	688	806
Cataluña	8678	9621	10564	9225	11429	13632
Castilla.La.Mancha	2628	2927	3225	2851	3547	4244
Castilla.y.León	2669	2961	3252	2898	3580	4263
C..Valenciana	2241	2505	2769	2312	2927	3543
Extremadura	671	747	824	690	869	1047
Euskadi	2893	3214	3535	3045	3798	4551
Galicia	1524	1702	1879	1652	2064	2476
Madrid	12628	14084	15540	12866	16279	19693
Murcia	413	461	508	411	522	633
Navarra	1014	1151	1296	1017	1347	1676
La.Rioja	826	921	1015	846	1067	1289

Table: Previsión número de casos confirmados: Modelo lineal- Horizonte 1 y 2 días.

Tabla Modelo Aditivo.

	C:H1-lw	C:H1-fit	C:H1-up	C:H2-lw	C:H2-fit	C:H2-up
España	40131	46144	52157	39673	51009	62389
Andalucía	2471	2811	3192	2471	3187	3913
Aragón	773	888	1003	774	992	1210
Asturias	699	806	913	748	954	1161
Baleares	531	606	681	636	779	923
Canarias	562	647	731	568	728	887
Cantabria	497	563	629	604	731	857
Cataluña	7970	9179	10389	8036	10342	12647
Castilla.La.Mancha	2563	2949	3335	2929	3663	4397
Castilla.y.León	2460	2830	3206	2535	3248	3961
C..Valenciana	2237	2584	2932	2502	3172	3841
Extremadura	636	726	825	636	799	989
Euskadi	2761	3173	3586	2751	3532	4313
Galicia	1484	1718	1951	1624	2073	2521
Madrid	12352	14189	16059	12352	15350	18914
Murcia	405	467	529	426	544	662
Navarra	1044	1264	1483	1191	1637	2082
La.Rioja	802	874	995	831	1062	1294

Table: Previsión número de casos confirmados: Modelo Aditivo - Horizonte 1 y 2 días.

Tabla Ratio Incremento Modelo Lineal.

	RI:H1-lw	RI:H1-fit	RI:H1-up	RI:H2-lw	RI:H2-fit	RI:H2-up
España	0.054	0.172	0.289	0.110	0.386	0.662
Andalucía	0.035	0.154	0.273	0.094	0.373	0.651
Aragón	0.064	0.181	0.299	0.153	0.429	0.706
Asturias	0.054	0.177	0.299	0.087	0.372	0.657
Baleares	0.112	0.231	0.351	0.232	0.510	0.789
Canarias	0.060	0.177	0.295	0.140	0.416	0.692
Cantabria	0.140	0.258	0.376	0.341	0.618	0.895
Cataluña	0.103	0.223	0.343	0.173	0.453	0.733
Castilla.La.Mancha	0.066	0.187	0.308	0.157	0.439	0.721
Castilla.y.León	0.085	0.203	0.322	0.178	0.455	0.733
C..Valenciana	0.034	0.156	0.278	0.067	0.351	0.635
Extremadura	0.055	0.175	0.294	0.085	0.366	0.646
Euskadi	0.061	0.178	0.296	0.116	0.392	0.668
Galicia	0.077	0.202	0.328	0.168	0.459	0.750
Madrid	0.022	0.140	0.258	0.042	0.318	0.594
Murcia	0.072	0.196	0.320	0.067	0.355	0.642
Navarra	0.000	0.135	0.278	0.003	0.328	0.653
La.Rioja	0.030	0.148	0.266	0.054	0.331	0.607

Table: Previsión Ratio incremento casos confirmados: Modelo lineal- Horizonte 1 y 2 días.

Tabla Ratio Incremento Modelo No Paramétrico.

	RI:H1-lw	RI:H1-fit	RI:H1-up	RI:H2-lw	RI:H2-fit	RI:H2-up
España	0.008	0.086	0.165	0.000	0.189	0.413
Andalucía	0.037	0.116	0.194	0.032	0.256	0.479
Aragón	0.016	0.095	0.173	0.000	0.203	0.427
Asturias	0.024	0.103	0.181	0.000	0.198	0.421
Baleares	0.075	0.154	0.234	0.113	0.337	0.561
Canarias	0.006	0.085	0.163	0.000	0.189	0.414
Cantabria	0.087	0.166	0.244	0.137	0.361	0.585
Cataluña	0.063	0.141	0.220	0.078	0.302	0.525
Castilla.La.Mancha	0.043	0.121	0.200	0.028	0.252	0.475
Castilla.y.León	0.057	0.135	0.213	0.072	0.295	0.519
C..Valenciana	0.161	0.241	0.321	0.150	0.374	0.597
Extremadura	0.097	0.175	0.254	0.138	0.361	0.584
Euskadi	0.001	0.080	0.159	0.000	0.179	0.403
Galicia	0.061	0.139	0.217	0.000	0.209	0.432
Madrid	0.000	0.070	0.149	0.000	0.160	0.384
Murcia	0.069	0.148	0.226	0.079	0.302	0.526
Navarra	0.012	0.090	0.168	0.000	0.193	0.416
La.Rioja	0.000	0.058	0.137	0.000	0.140	0.365

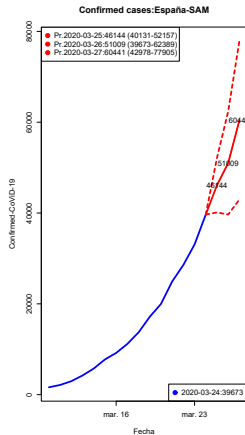
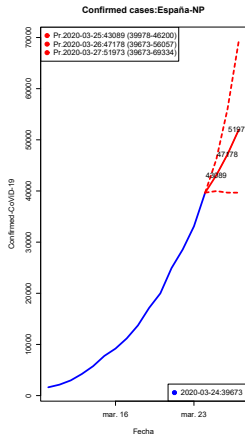
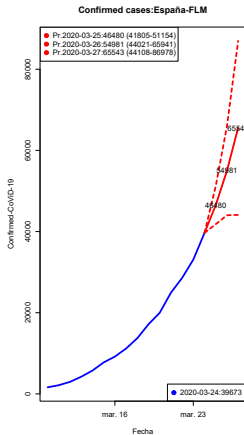
Table: Previsión Ratio incremento casos confirmados: Modelo No Paramétrico
 - Horizonte 1 y 2 días.

Tabla Ratio Incremento Modelo Aditivo.

	RI:H1-lw	RI:H1-fit	RI:H1-up	RI:H2-lw	RI:H2-fit	RI:H2-up
España	0.012	0.163	0.315	0.000	0.286	0.573
Andalucía	0.000	0.137	0.292	0.000	0.290	0.583
Aragón	0.020	0.172	0.323	0.021	0.308	0.596
Asturias	0.056	0.217	0.379	0.129	0.441	0.752
Baleares	0.112	0.267	0.423	0.330	0.629	0.928
Canarias	0.010	0.161	0.311	0.021	0.306	0.592
Cantabria	0.169	0.325	0.480	0.421	0.717	1.014
Cataluña	0.013	0.167	0.321	0.022	0.315	0.608
Castilla.La.Mancha	0.040	0.196	0.353	0.188	0.486	0.784
Castilla.y.León	0.000	0.150	0.303	0.030	0.320	0.610
C..Valenciana	0.032	0.193	0.353	0.155	0.463	0.772
Extremadura	0.000	0.141	0.297	0.000	0.255	0.554
Euskadi	0.012	0.163	0.314	0.008	0.295	0.581
Galicia	0.049	0.214	0.379	0.148	0.464	0.781
Madrid	0.000	0.149	0.300	0.000	0.243	0.531
Murcia	0.052	0.212	0.372	0.106	0.411	0.717
Navarra	0.030	0.246	0.462	0.175	0.613	1.052
La.Rioja	0.000	0.090	0.240	0.036	0.324	0.613

Table: Previsión Ratio incremento casos confirmados: Modelo Aditivo - Horizonte 1 y 2 días.

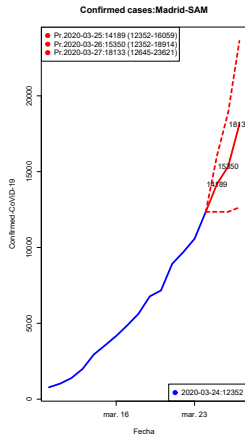
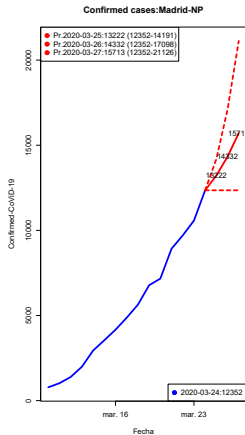
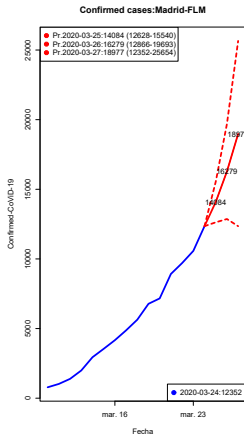
Confirmed cases: España



◀ Confirmados

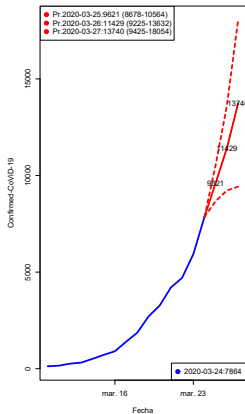
◀ Fallecidos

Confirmed cases: Madrid

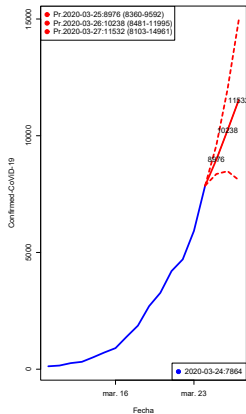

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Confirmed cases: Cataluña

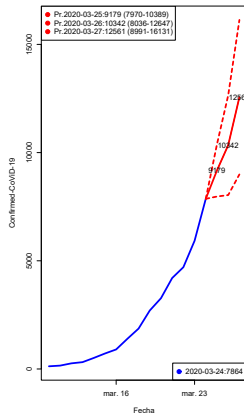
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Confirmed cases:Cataluña-NP



Confirmed cases:Cataluña-SAM

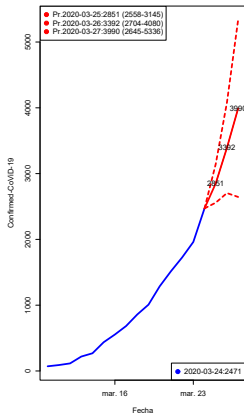


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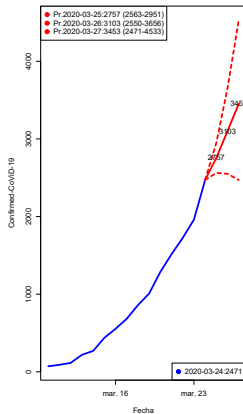
◀ Fallecidos

Confirmed cases: Andalucía

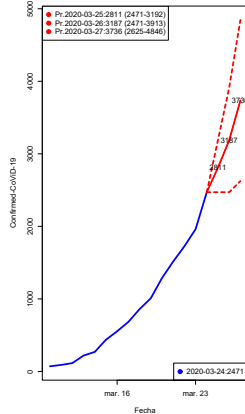
Confirmed cases:Andalucia-FLM



Confirmed cases:Andalucia-NP



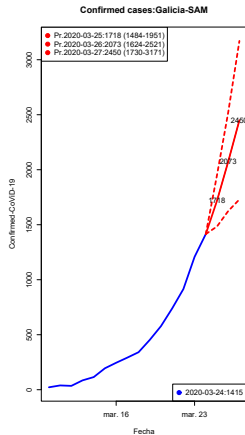
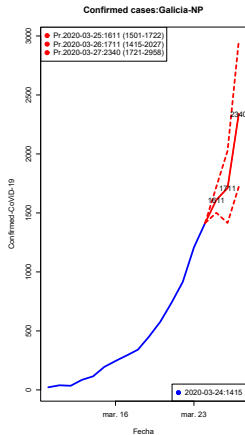
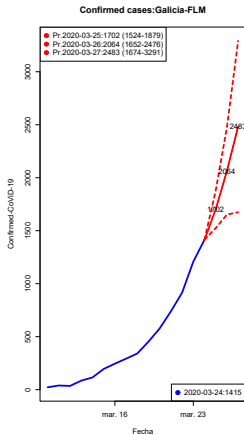
Confirmed cases:Andalucia-SAM



◀ Confirmados

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Confirmed cases: Galicia

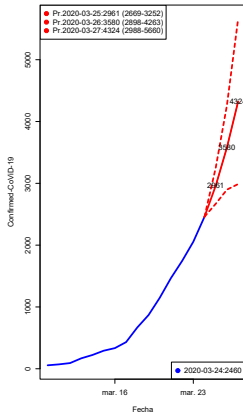


◀ Confirmados

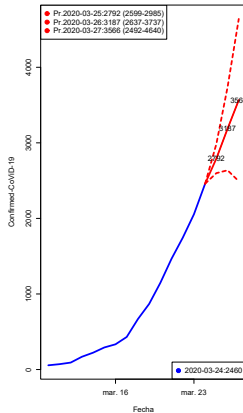
◀ Fallecidos

Confirmed cases: Castilla y León

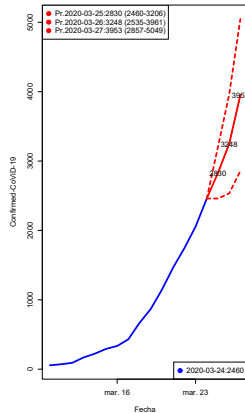
Confirmed cases:Castilla.y.León-FLM



Confirmed cases:Castilla.y.León-NP



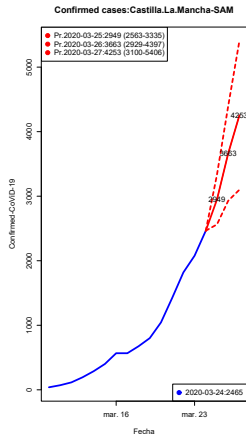
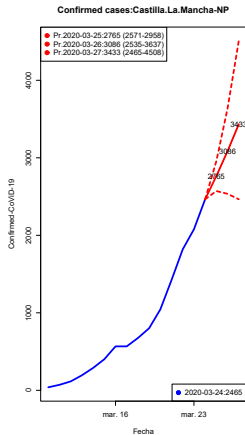
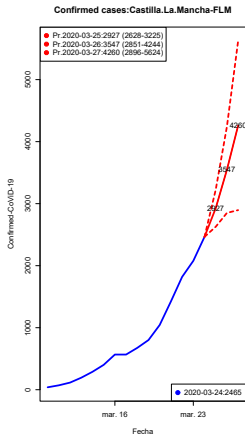
Confirmed cases:Castilla.y.León-SAM



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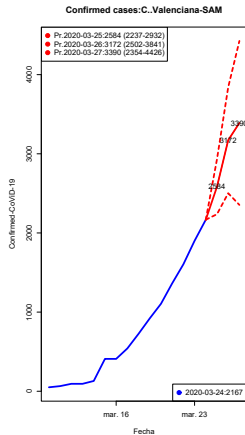
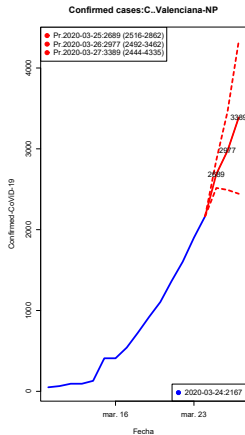
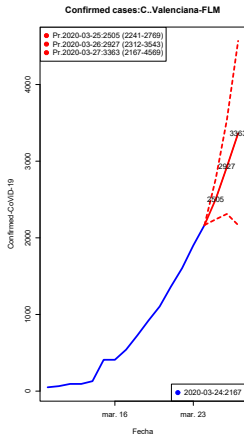
Confirmed cases: Castilla-La Mancha



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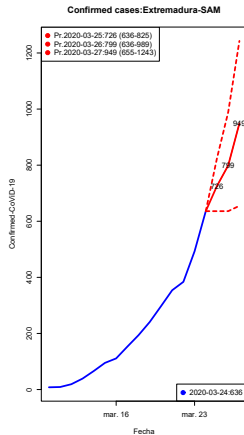
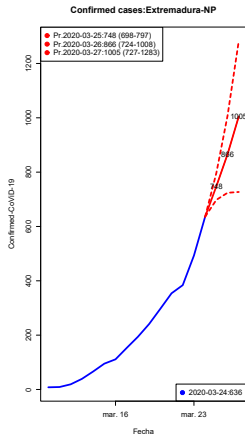
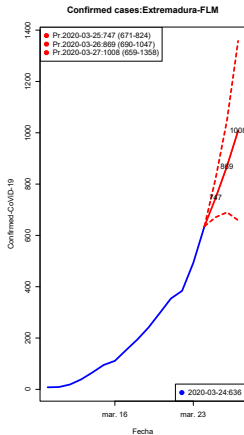
Confirmed cases: C. Valenciana



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Confirmed cases: Extremadura

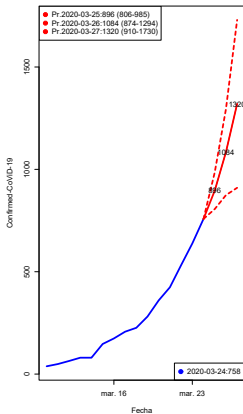


◀ Confirmados

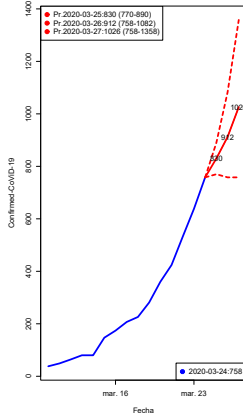
◀ Fallecidos

Confirmed cases: Aragón

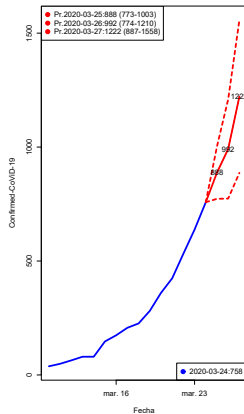
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Confirmed cases:Aragón-NP



Confirmed cases:Aragón-SAM

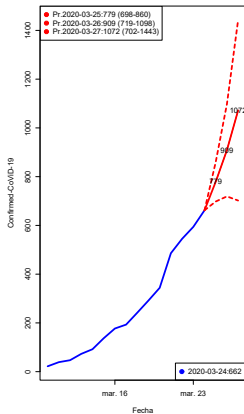


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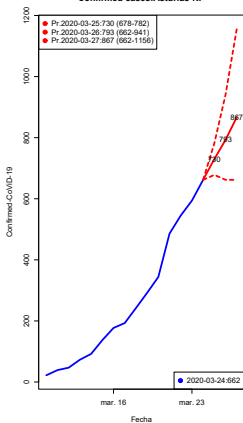
◀ Fallecidos

Confirmed cases: Asturias

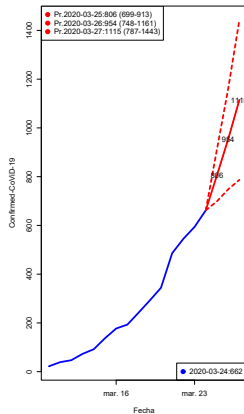
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Confirmed cases:Asturias-NP



Confirmed cases:Asturias-SAM

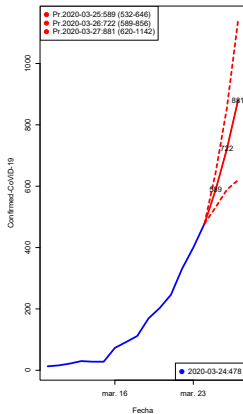


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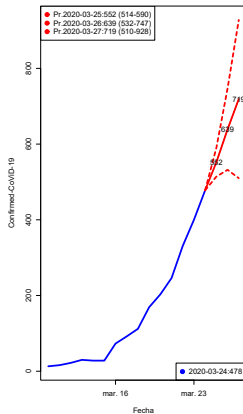
◀ Fallecidos

Confirmed cases: Baleares

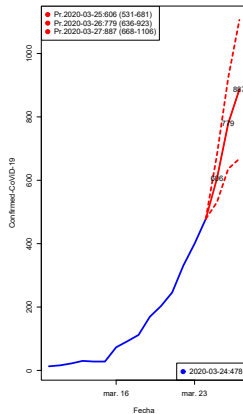
Confirmed cases:Baleares-FLM



Confirmed cases:Baleares-NP



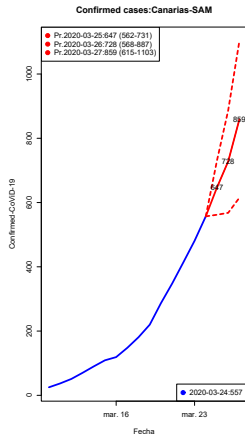
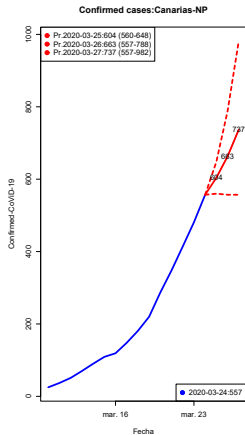
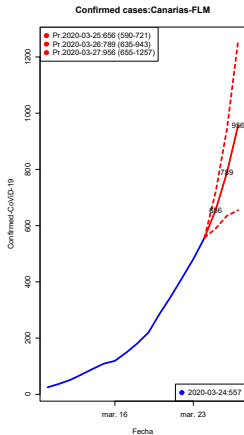
Confirmed cases:Baleares-SAM



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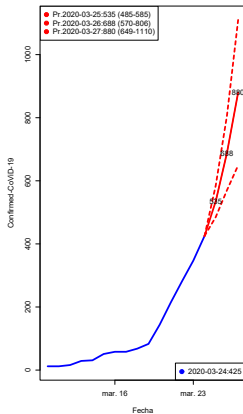
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Confirmed cases: Canarias

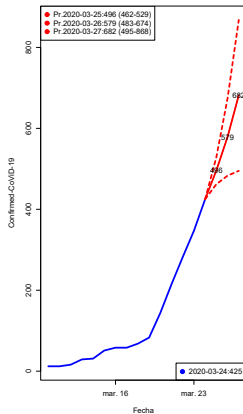

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Confirmed cases: Cantabria

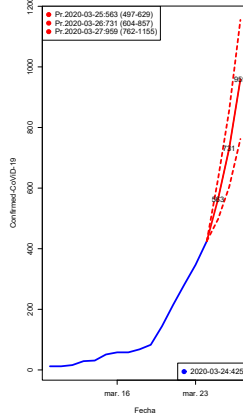
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Confirmed cases:Cantabria-NP



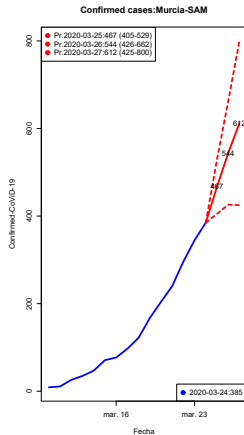
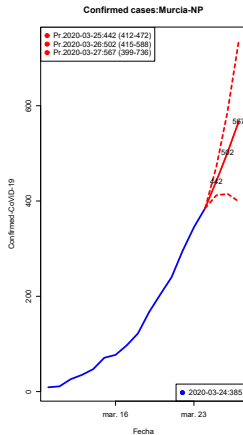
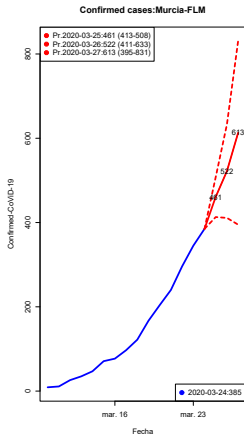
Confirmed cases:Cantabria-SAM



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Confirmed cases: Murcia

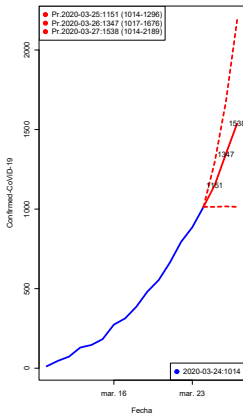


◀ Confirmados

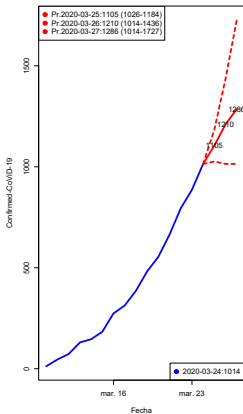
◀ Fallecidos

Confirmed cases: Navarra

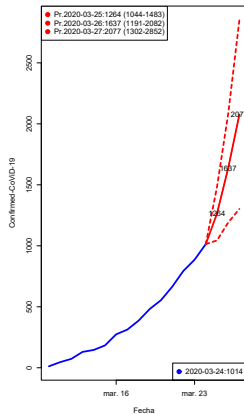
Confirmed cases:Navarra-FLM



Confirmed cases:Navarra-NP

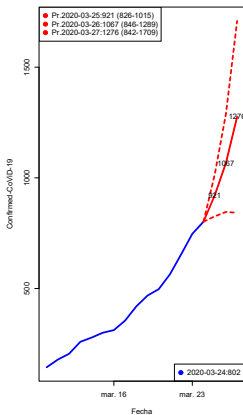


Confirmed cases:Navarra-SAM

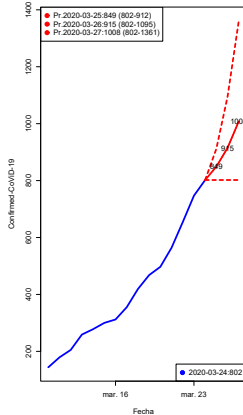


Confirmed cases: La Rioja

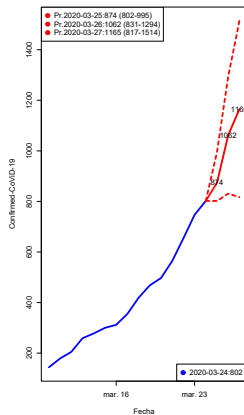
Confirmed cases:La.Rioja-FLM



Confirmed cases:La.Rioja-NP



Confirmed cases:La.Rioja-SAM



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► Euskadi ► Madrid ► Mod Lineal ► Mod NP ► Mod Aditivo

Horiz	Medida	FLM	NP	SAM
H1	σ_R^2	0.068	0.058	0.059
H1	$\sigma_R^2(rob.)$	0.05	0.011	0.036
H1	r^2	0.24	0.483	0.334
H2	σ_R^2	0.2	0.189	0.171
H2	$\sigma_R^2(rob.)$	0.164	0.074	0.133
H2	r^2	0.377	0.524	0.462
H3	σ_R^2	0.516	0.541	0.452
H3	$\sigma_R^2(rob.)$	0.451	0.167	0.341
H3	r^2	0.416	0.505	0.484

Aunque los valores de r^2 son más altos que para el número de casos, la predicción para ciertas series se vuelve más caótica como efecto del número de datos y su alta dependencia.

Tabla Fallecidos Modelo Lineal.

	F:H1-lw	F:H1-fit	F:H1-up	F:H2-lw	F:H2-fit	F:H2-up
España	3066	3478	3891	3433	4173	4913
Andalucía	102	115	129	117	142	166
Castilla.La.Mancha	259	294	328	314	376	437
Castilla.y.León	151	170	189	180	214	248
Cataluña	351	393	435	433	508	584
Euskadi	145	164	182	159	193	227
Madrid	1698	1944	2189	1816	2254	2692

Table: Previsión fallecidos: Modelo lineal- Horizonte 1 y 2 días.

Tabla Fallecidos Modelo No Paramétrico.

	F:H1-lw	F:H1-fit	F:H1-up	F:H2-lw	F:H2-fit	F:H2-up
España	3326	3484	3642	3815	4211	4606
Andalucía	127	132	137	161	174	187
Castilla.La.Mancha	263	276	288	342	373	405
Castilla.y.León	152	159	166	184	202	221
Cataluña	355	372	388	411	452	494
Euskadi	146	154	162	157	177	197
Madrid	1858	1947	2036	2063	2288	2513

Table: Previsión fallecidos: Modelo No Paramétrico - Horizonte 1 y 2 días.

	R:H1-lw	R:H1-fit	R:H1-up	R:H2-lw	R:H2-fit	R:H2-up
España	0.137	0.290	0.443	0.273	0.548	0.822
Andalucía	0.167	0.323	0.478	0.343	0.622	0.901
Castilla.La.Mancha	0.199	0.358	0.517	0.452	0.736	1.020
Castilla.y.León	0.212	0.365	0.517	0.446	0.719	0.993
Cataluña	0.244	0.393	0.541	0.533	0.800	1.067
Euskadi	0.088	0.228	0.367	0.197	0.450	0.702
Madrid	0.106	0.266	0.425	0.183	0.468	0.753

Table: Previsión Fallecidos Ratio incremento: Modelo lineal- Horizonte 1 y 2 días.

◀ Confirmados

◀ Fallecidos

	R:H1-lw	R:H1-fit	R:H1-up	R:H2-lw	R:H2-fit	R:H2-up
España	0.233	0.292	0.351	0.415	0.562	0.708
Andalucía	0.454	0.510	0.567	0.846	0.990	1.135
Castilla.La.Mancha	0.218	0.275	0.332	0.579	0.725	0.870
Castilla.y.León	0.220	0.278	0.335	0.482	0.628	0.774
Cataluña	0.259	0.317	0.375	0.455	0.601	0.748
Euskadi	0.098	0.156	0.215	0.181	0.327	0.474
Madrid	0.211	0.269	0.326	0.344	0.490	0.637

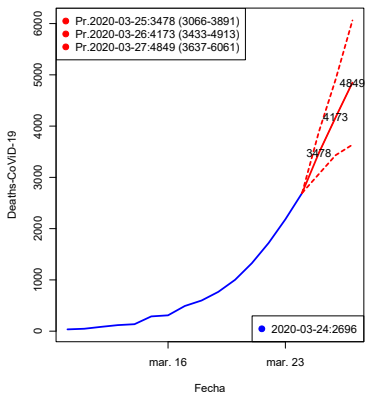
Table: Previsión Fallecidos Ratio incremento: Modelo No Paramétrico - Horizonte 1 y 2 días.

◀ Confirmados

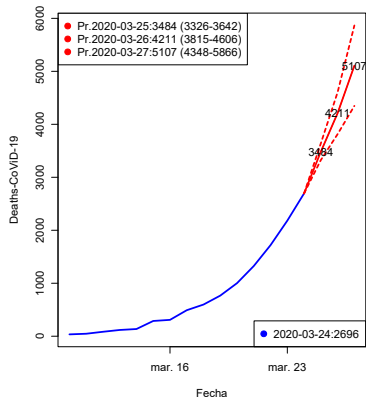
◀ Fallecidos

Fallecidos: España

Deaths cases:España-FLM



Deaths cases:España-NP

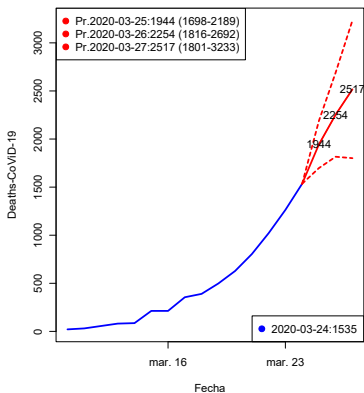


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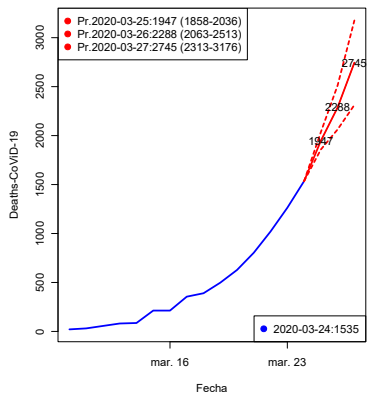
◀ Fallecidos

Fallecidos: Madrid

Deaths cases:Madrid-FLM



Deaths cases:Madrid-NP

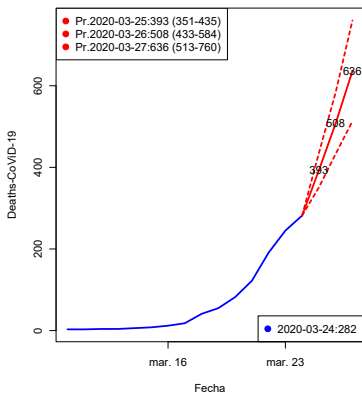


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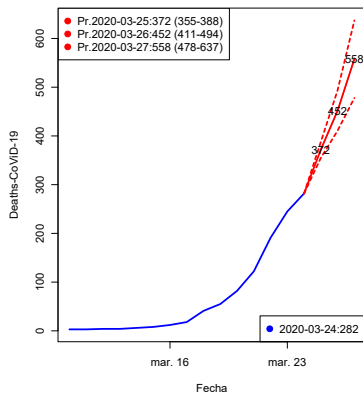
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Fallecidos: Cataluña

Deaths cases:Cataluña-FLM



Deaths cases:Cataluña-NP

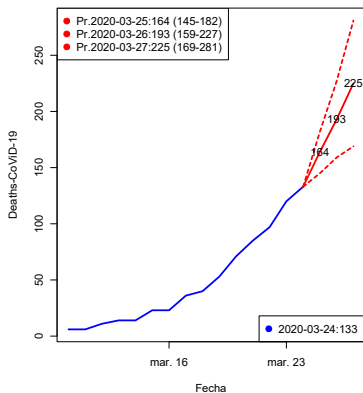


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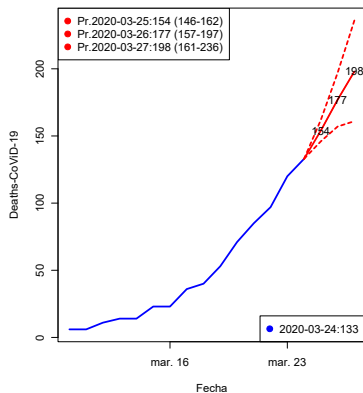
◀ Fallecidos

Fallecidos: Euskadi

Deaths cases:Euskadi-FLM



Deaths cases:Euskadi-NP

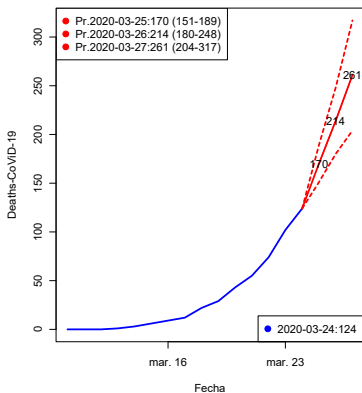


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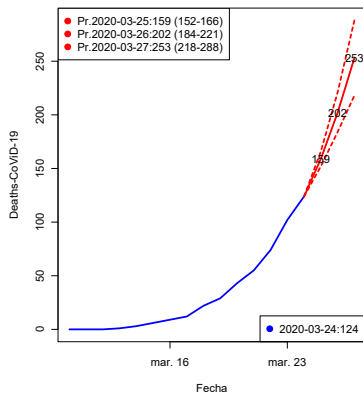
◀ Fallecidos

Fallecidos: Castilla y León

Deaths cases:Castilla.y.León-FLM



Deaths cases:Castilla.y.León-NP

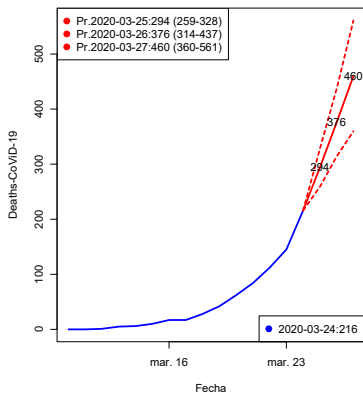


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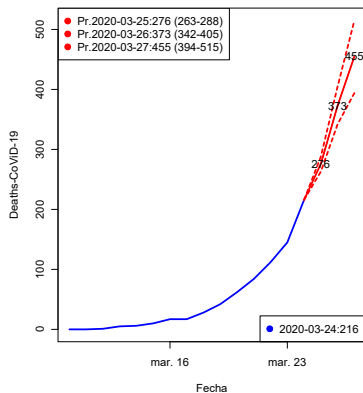
◀ Fallecidos

Fallecidos: Castilla-La Mancha

Deaths cases:Castilla.La.Mancha-FLM



Deaths cases:Castilla.La.Mancha-NP

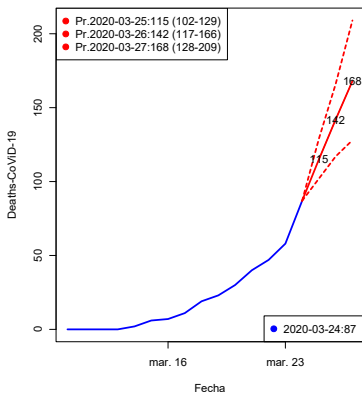


◀ Confirmados

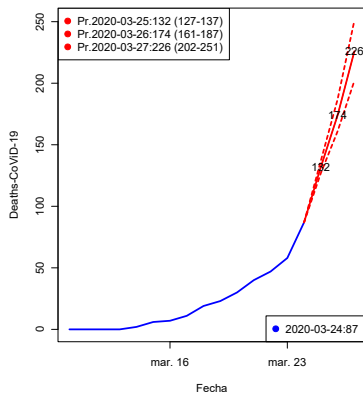
◀ Fallecidos

Fallecidos: Andalucía

Deaths cases:Andalucía-FLM



Deaths cases:Andalucía-NP



◀ Confirmados

◀ Fallecidos

Breve descripción del Modelo de predicción

Objetivo: Predecir ratio de incremento a 1, 2, o 3 días: $r^{(k)}(t) = \frac{x_{t+k} - x_t}{x_t + 1}$

Información usada: Pasado de esta variable a un retardo durante los últimos 15 días: $R^{(1)} = \{r^{(1)}(-14), \dots, r^{(1)}(0)\}$.

Datos para alimentar el modelo:

https://github.com/CSSEGISandData/COVID-19/tree/master/csse_covid_19_data/csse_covid_19_time_series/. Algunas series de tiempo (como el Cruise Ship) son filtrados por inconsistencia, presunta falta de veracidad o por valores bajos. En la predicción final se reconstruye el número de casos esperado.

Se construyen tres modelos funcionales de la regresión general: $r^{(k)}(0) = f(R^{(1)}) + \epsilon$ donde la diferencia radica en la forma de la función f

- Lineal: $f(R^{(1)}) = \int_{-14}^0 R^{(1)}(t)\beta(t)dt$
- NP: f es una estimación no paramétrica tipo núcleo.
- SAM: f es una combinación aditiva de funciones suaves de las componentes principales.