

PREDICCION DE CARACTERISTICAS COMPLEJAS *en los tiempos de COVID-19*



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University of Wisconsin

UW-MADISON
ANIMAL SCIENCES



Dairy Science



Fiddler on the Roof

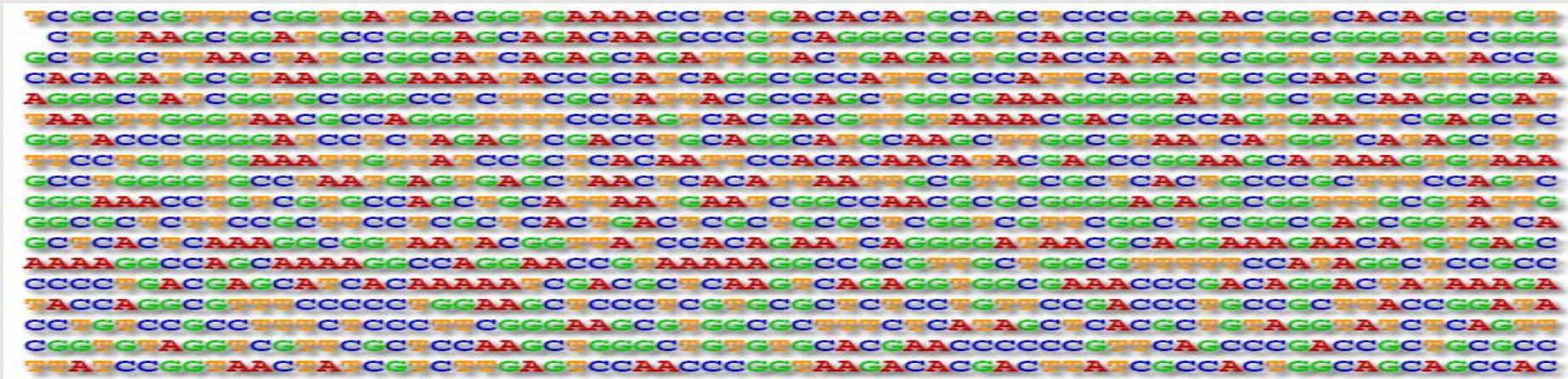


TOPICOS A DISCUTIR

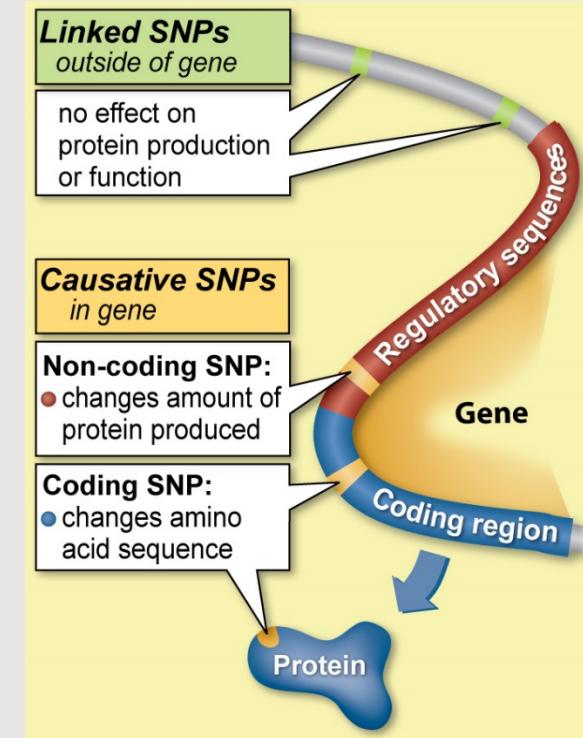
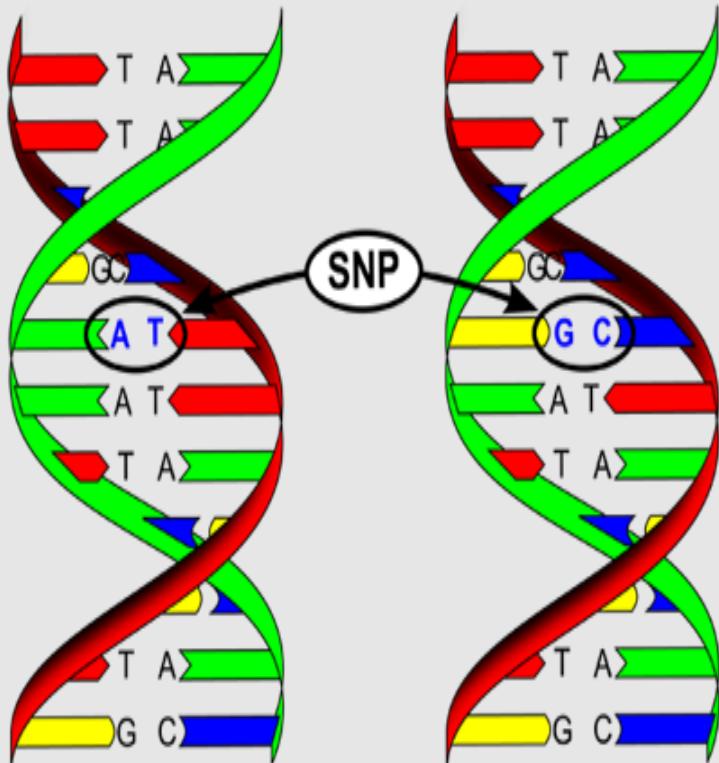
- Perspectiva: metodos empleados en mejoramiento genetico animal
- Descripcion de la pandemia de COVID-19: **16 paises**
- Uruguay y contexto regional
- Estimacion de “R” (numero de infecciones/infecto)
- Modelo predictivo (simple) del numero de casos diarios
- Evaluacion de predicciones via “RANDEMIAS”
- Inmunidad de “rodeo” [si Uruguay fuera Suecia...]
- Comentarios miscelaneos

MASSIVE NUMBERS OF MOLECULAR MARKERS AVAILABLE: DNA sequences

(cattle: 3 Gb; maize: 2500 Mb)

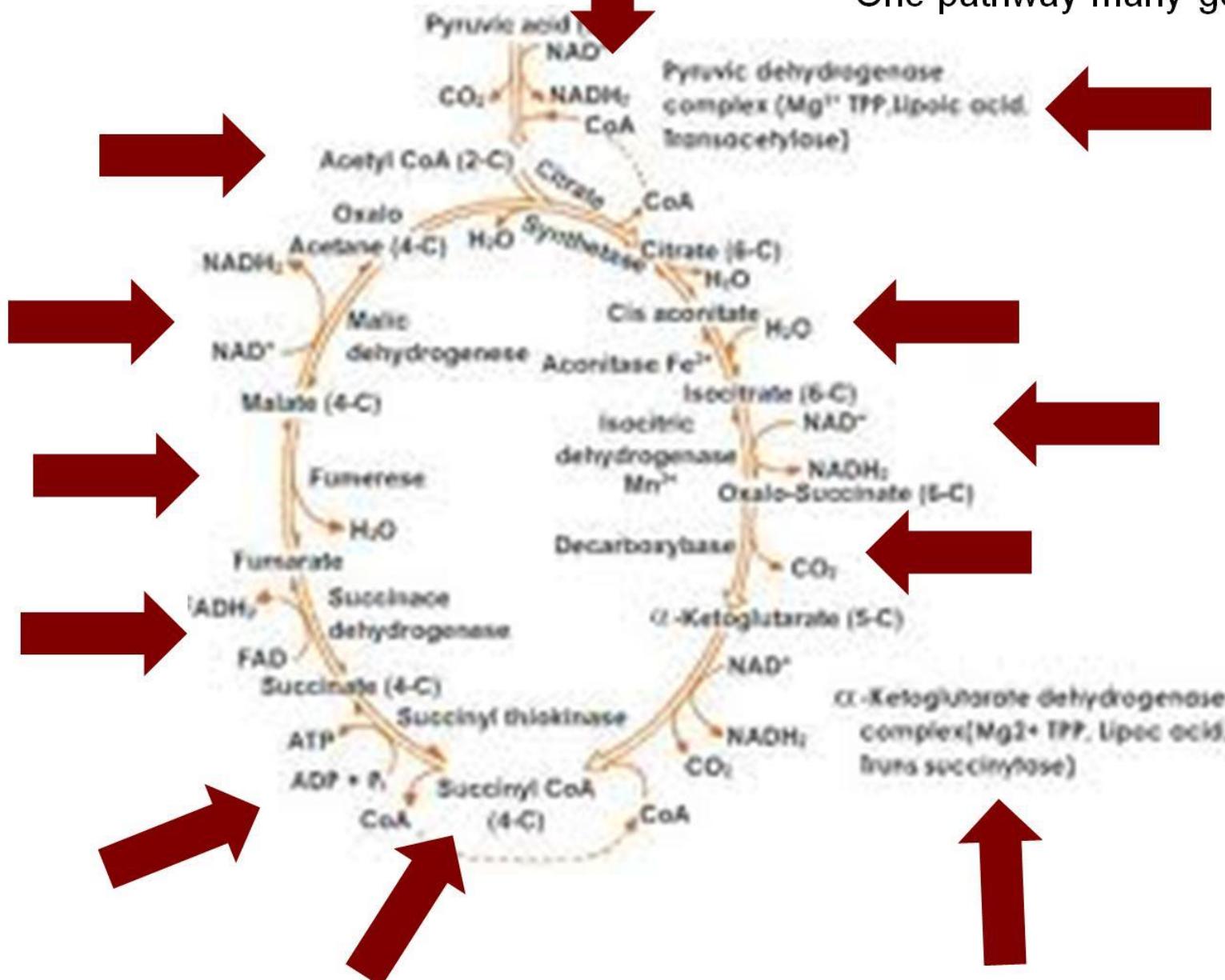


A grid of DNA sequence data for cattle, showing multiple lines of sequence with colored bases (A, T, C, G) representing different individuals or samples.

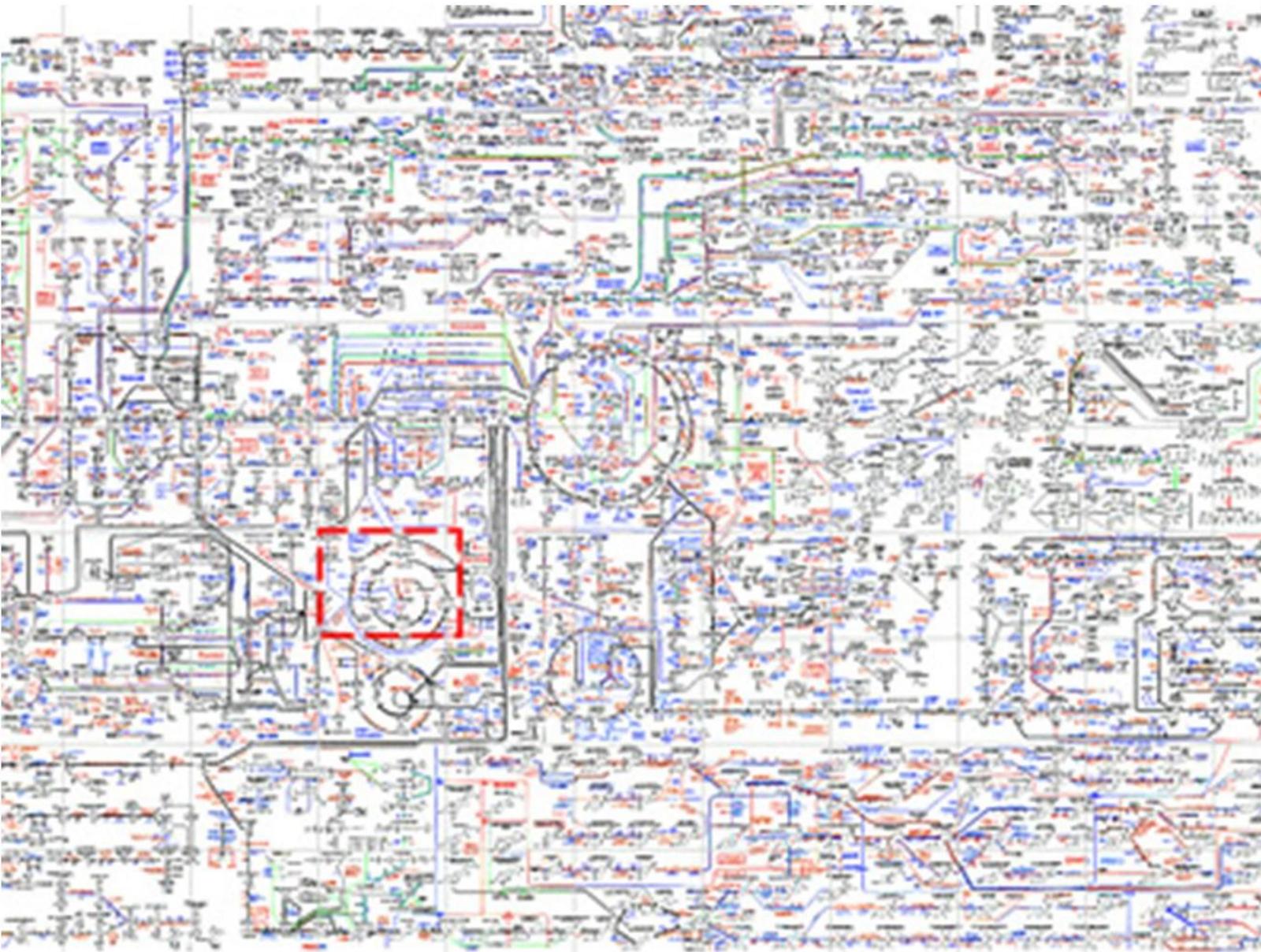


Enzymes in the Krebs cycle

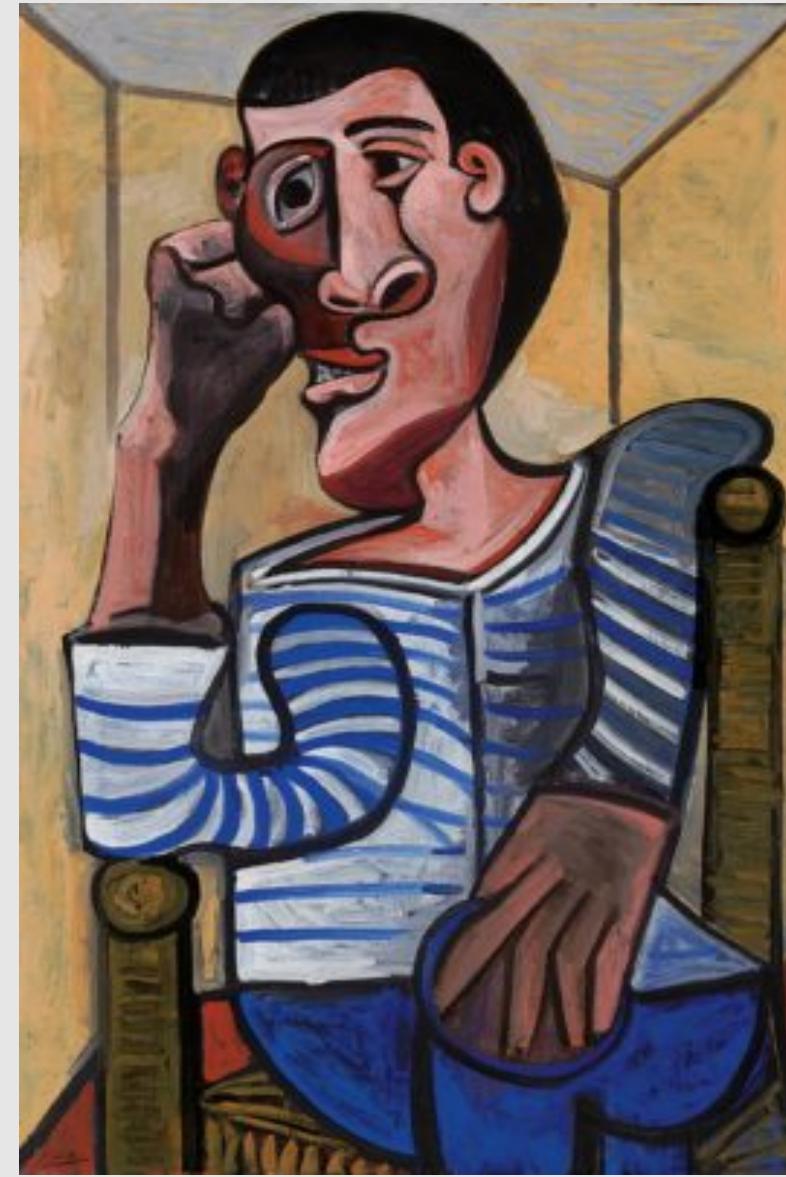
One gene-one enzyme
One pathway- many enzymes
One pathway-many genes



A “complex” trait involves many metabolic pathways: Roche’s Chart



BIOLOGIA-ABSTRACCIONES



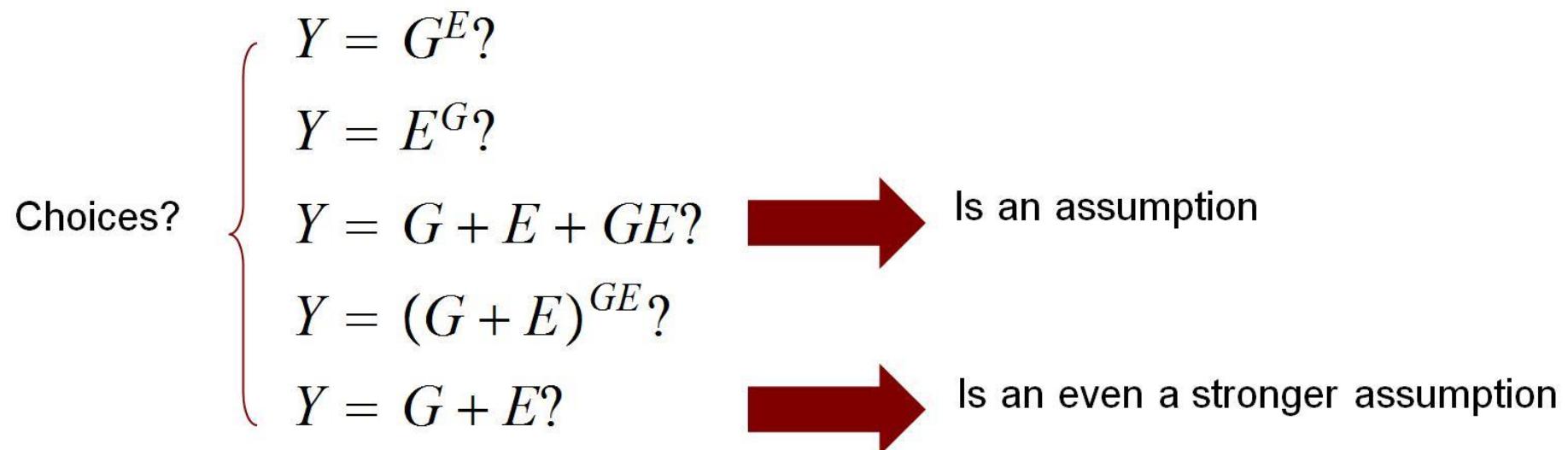
Coping with complexity

(WELCOME TO THE WORLD OF ABSTRACTIONS)

First assumption: there is a genetic signal and an environmental signal

Second assumption: the joint effect translates into a phenotype y

$$Y = f(G, E) \quad \text{For some UNKNOWN function } f$$



Fisher, R. A. 1918. The correlation between relatives on the supposition of Mendelian inheritance. Transactions of the Royal Society of Edinburgh 52:399-433.

XV.—The Correlation between Relatives on the Supposition of Mendelian Inheritance. By R. A. Fisher, B.A. Communicated by Professor J. ARTHUR THOMSON. (With Four Figures in Text.)

(MS. received June 15, 1918. Read July 8, 1918. Issued separately October 1, 1918.)

C O N T E N T S.

	PAGE
1. The superposition of factors distributed independently	402
2. Phase frequency in each array	402
3. Parental regression	403
4. Dominance deviations	403
5. Correlation for parent; genetic correlations	404
6. Fraternal correlation	405
7. Correlations for other relatives	406
8. Epistacy	408
9. Assortative mating	410
10. Frequency of phases	410
11. Association of factors	411
12. Conditions of equilibrium	412
13. Nature of association	413
14. Multiple allelomorphism	415
15. Homogamy and multiple allelo	416
16. Coupling	416
17. Theories of marital correlations	417
18. Ancestral correlations (second theories)	418
19. Numerical values of association	419
20. Fraternal correlation	420
21. Numerical values for environment ratios; analysis of variance	421
22. Other relatives	422
23. Numerical values (third theory)	423
24. Comparison of results	424
25. Interpretation of dominance ratios	425
26. Summary	426



IX. *On the Mathematical Foundations of Theoretical Statistics.*

By R. A. FISHER, M.A., Fellow of Gonville and Caius College, Cambridge; Chief Statistician, Rothamsted Experimental Station, Harpenden.

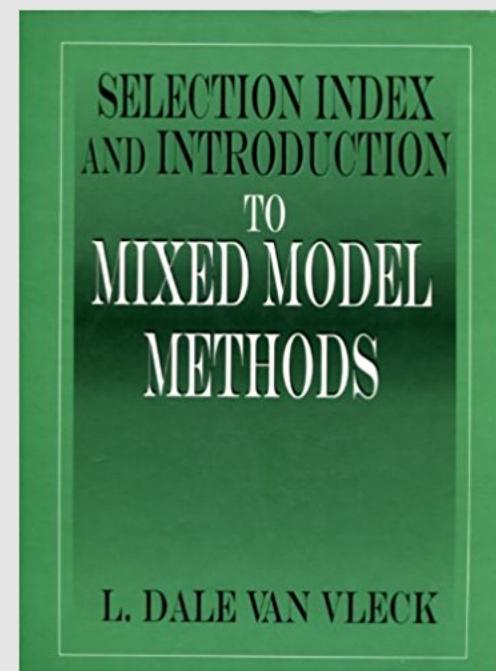
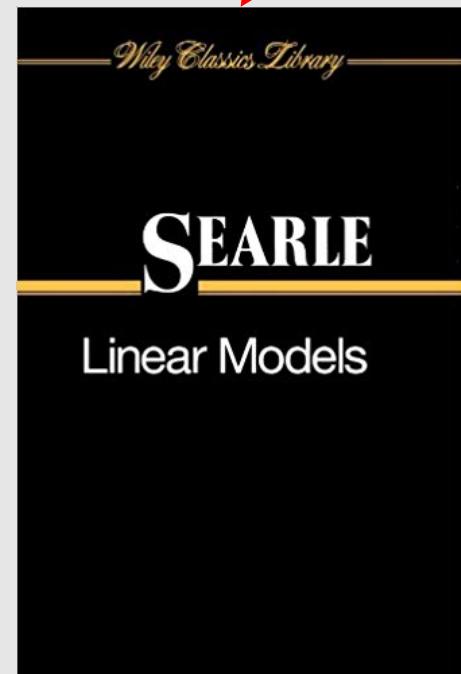
Communicated by DR. E. J. RUSSELL, F.R.S.

Received June 25.—Read November 17, 1921.

CONTENTS.

Section	Page
1. The Neglect of Theoretical Statistics	310
2. The Purpose of Statistical Methods	311
3. The Problems of Statistics	313
4. Criteria of Estimation	316
5. Examples of the Use of Criterion of Consistency	317
6. Formal Solution of Problems of Estimation	323
7. Satisfaction of the Criterion of Sufficiency	330
8. The Efficiency of the Method of Moments in Fitting Curves of the Pearsonian Type III	332
9. Location and Scaling of Frequency Curves in general	338
10. The Efficiency of the Method of Moments in Fitting Pearsonian Curves	342
11. The Reason for the Efficiency of the Method of Moments in a Small Region surrounding the Normal Curve	355
12. Discontinuous Distributions	356
(1) The Poisson Series	359
(2) Grouped Normal Data	359
(3) Distribution of Observations in a Dilution Series	363
13. Summary	366

Charles R. Henderson y DG
University of Illinois
Urbana, 1987



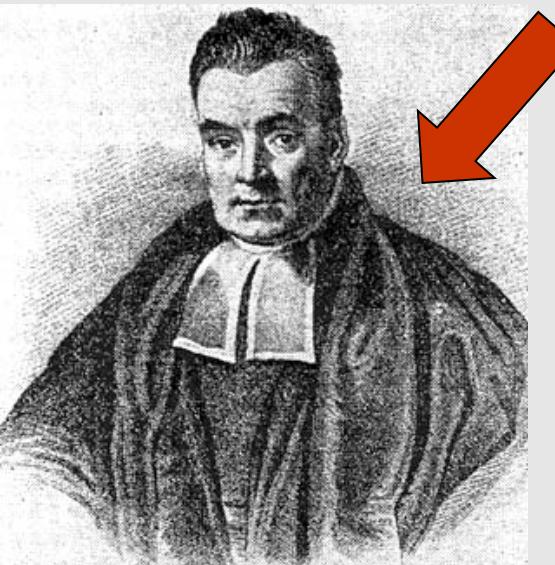
BAYESIAN INFERENCE AND THE NEO-BAYES-LAPLACE REVOLUTION (James-Stein, Lindley, Box, Zellner...)

Rev. Thomas Bayes

1702 London, England

1761 Tunbridge Wells, Kent, England

1763. "An essay towards solving a problem in the doctrine of chances".
Philosophical Transactions of the Royal Society of London **53**, 370-418.



Pierre-Simon Laplace

1749 Beaumont-en-Auge, France
1827 Paris, France

1774. "Mémoire sur la probabilité des causes par les événements".
Savants étranges **6**, 621-656. *Oeuvres* **8**, 27-65

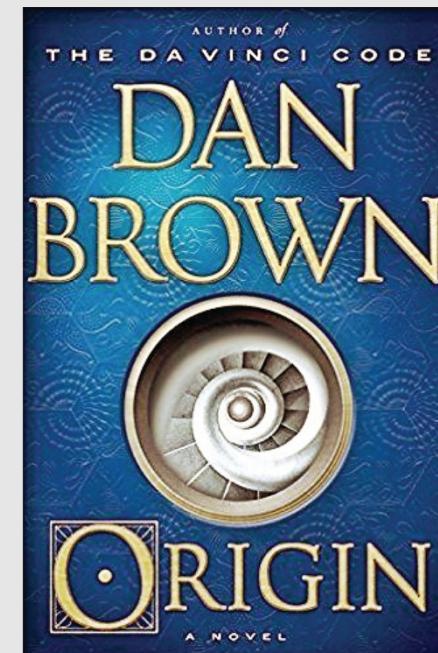
The era of machine learning and artificial intelligence

“BIG data”

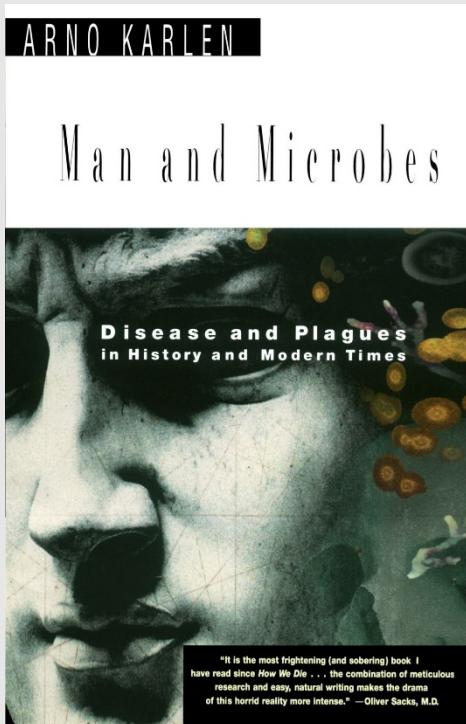
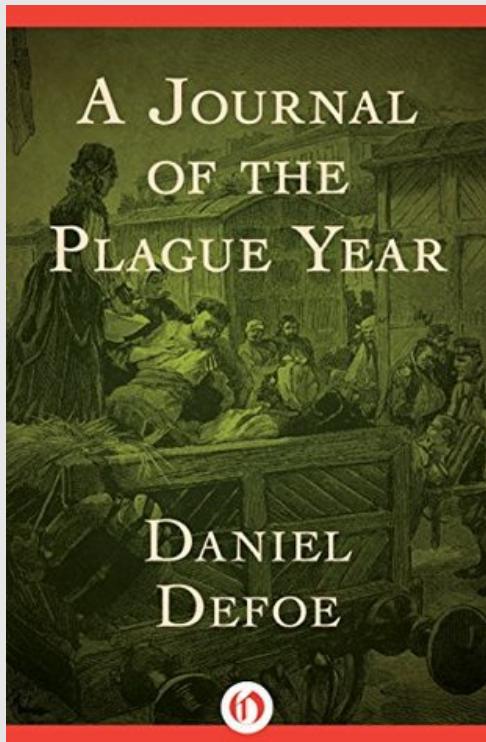
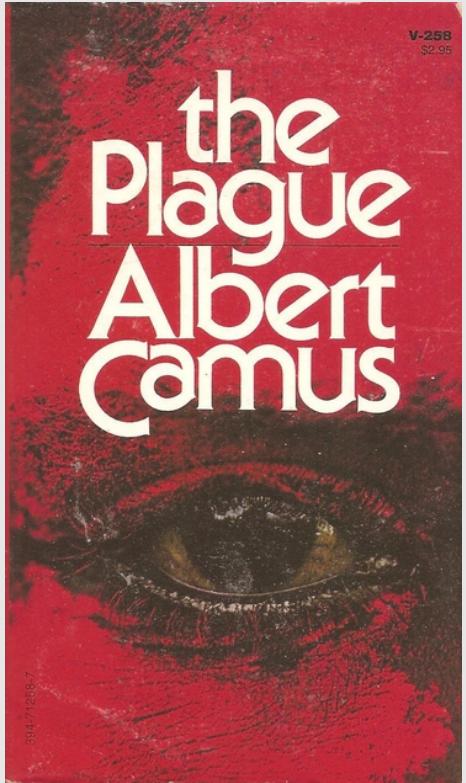
(largely non-parametric)

NEW METHODS COMING...

The return of the neural
networks...



QUE HACEMOS DURANTE EL STAY-AT-HOME???



EPIDEMOLOGIA CASERA!!!



World Map



U.S. Map



Critical Trends

COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU)

Total Confirmed

7,185,573

Confirmed Cases by Country/Region/Sovereignty

1,973,803 US

707,412 Brazil

484,630 Russia

290,576 United Kingdom

276,146 India

241,966 Spain

235,561 Italy

199,696 Peru

191,522 France

186,506 Germany

175,927 Iran

172,114 Turkey

142,759 Chile

120,102 Mexico

108,571 Saudi Arabia

Admin0 Admin1 Admin2

Last Updated at (M/D/YYYY)

6/9/2020, 3:33:25 PM



188
countries/regions

Lancet Inf Dis Article: [Here](#). Mobile Version: [Here](#).

Lead by [JHU CSSE](#), Technical Support: [Eri Living Atlas team](#) and [JHU APL](#). Financial Support: [JHU](#) and [NSF](#). Click [here](#) to donate to the CSSE dashboard team, and other JHU COVID-19 Research Efforts. [FAQ](#). Read more in this [blog](#). [Contact Us](#).

Global Deaths
408,954

111,751 deaths
US

40,968 deaths
United Kingdom

37,134 deaths
Brazil

34,043 deaths
Italy

29,299 deaths
France

27,136 deaths
Spain

14,053 deaths
Mexico

[Global Deaths](#) [Global Recovered](#)

US State Level
Deaths, Recovered

30,458 deaths, 67,687 recovered
New York US

12,303 deaths, 27,941 recovered
New Jersey US

7,353 deaths, recovered
Massachusetts US

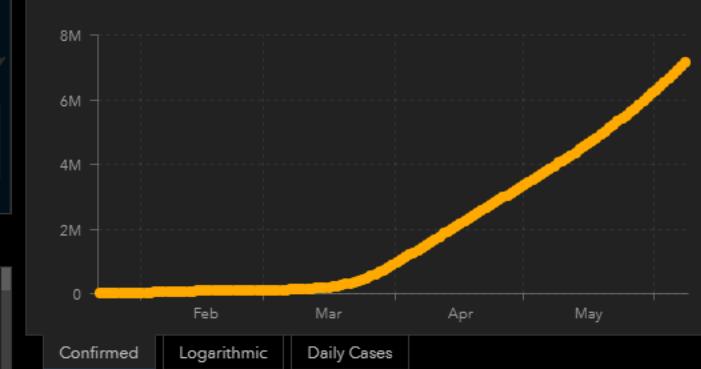
6,018 deaths, recovered
Illinois US

6,014 deaths, 53,670 recovered
Pennsylvania US

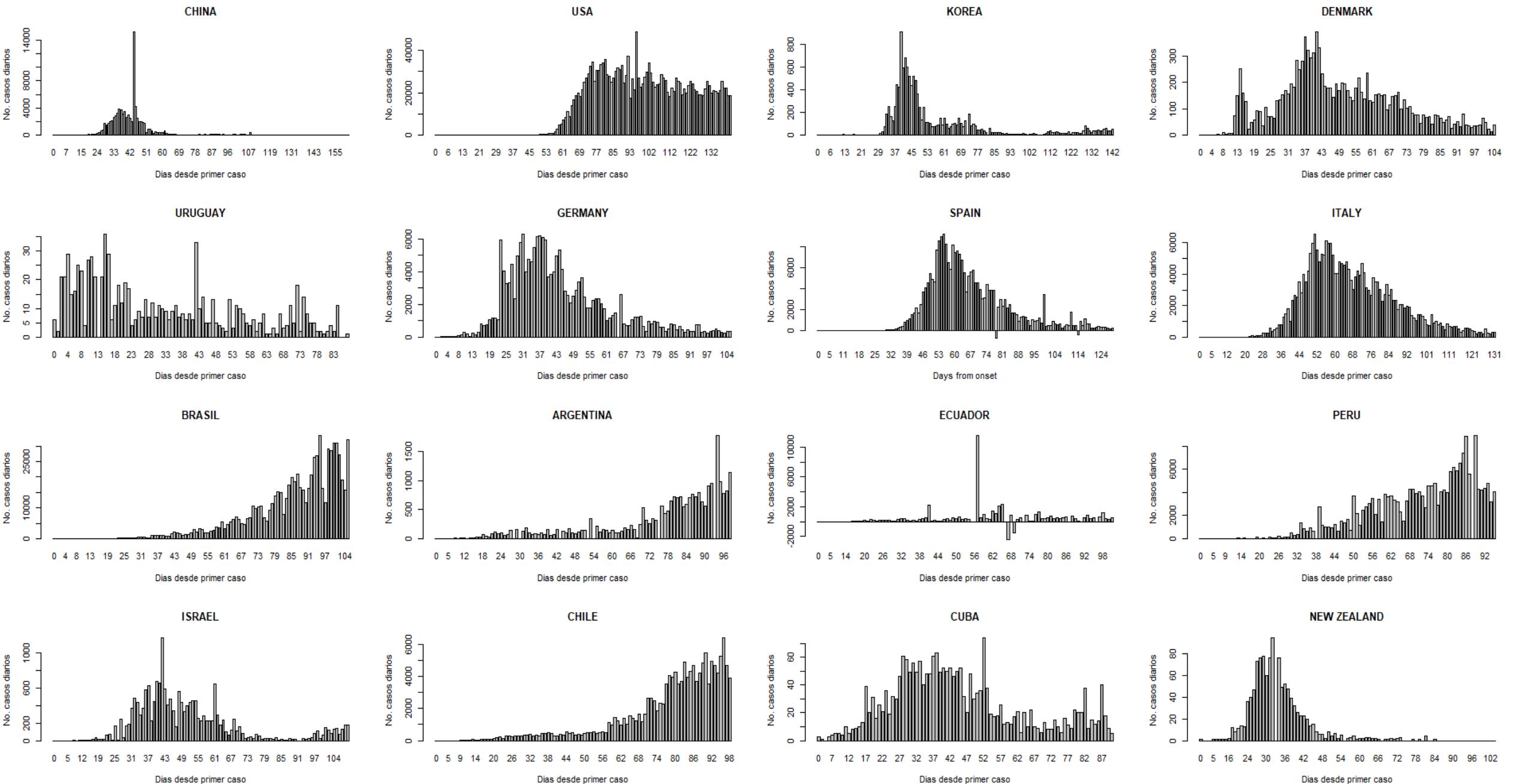
5,912 deaths, 42,041 recovered
Michigan US

4,681 deaths, recovered
California US

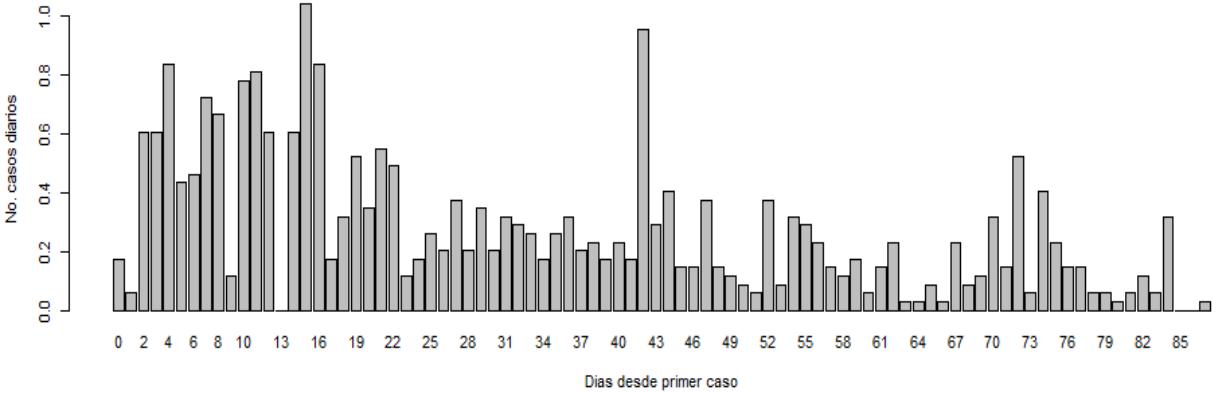
[US Deaths, Recovered](#)



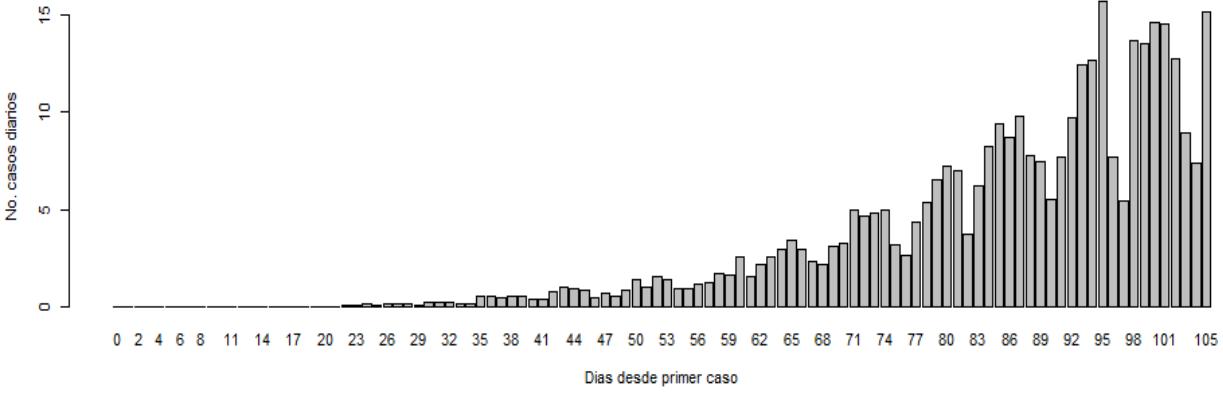
PANDEMIA EN 16 PAISES: 10 DE JUNIO- 2020 10:45 CST



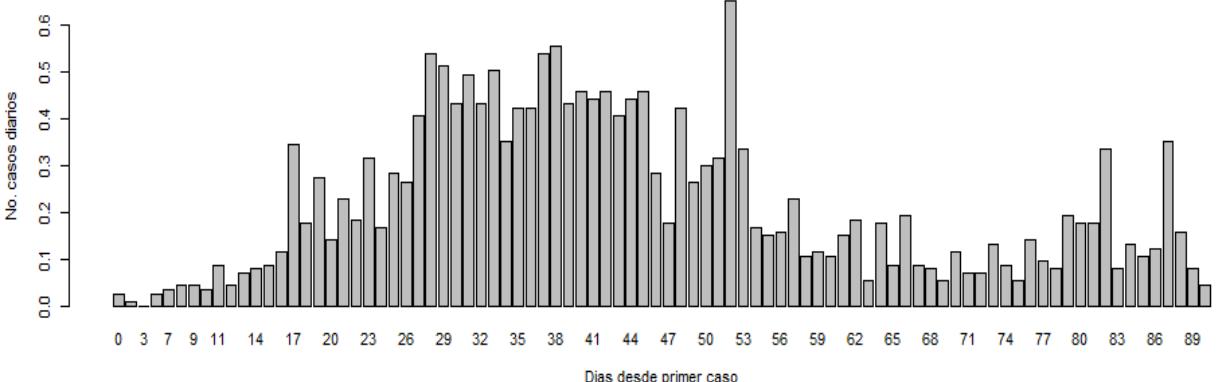
URUGUAY JUNIO 10
Casos diarios por 100 mil habitantes



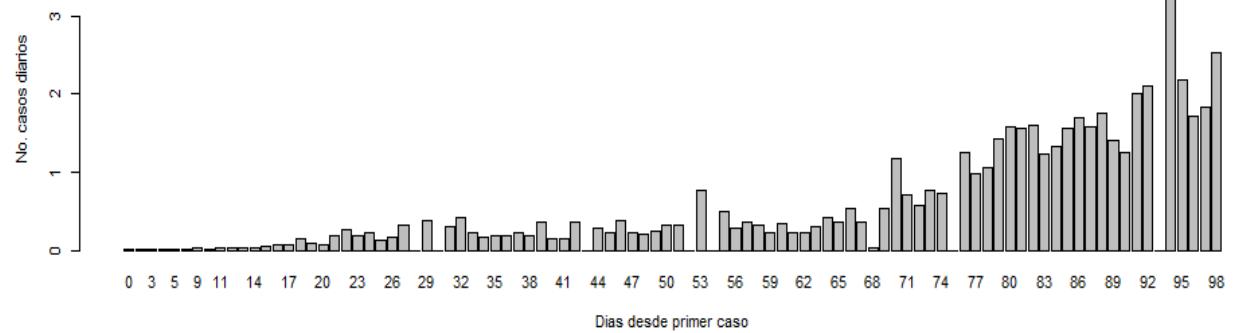
BRASIL JUNIO 10
Casos diarios por 100 mil habitantes



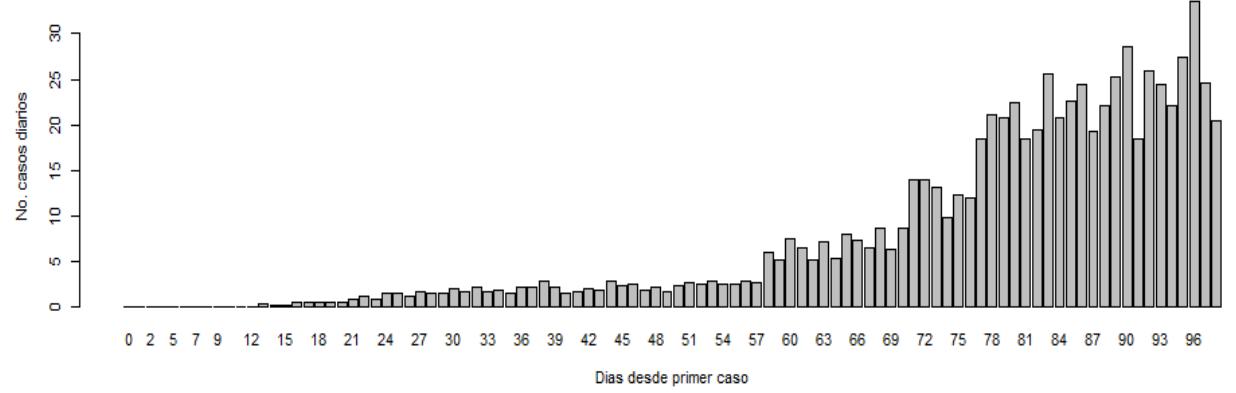
CUBA JUNIO 10
Casos diarios por 100 mil habitantes



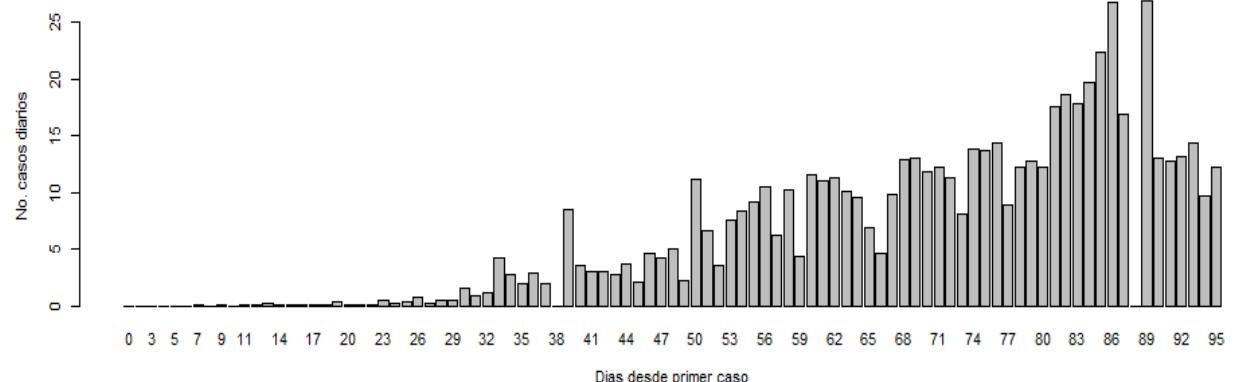
ARGENTINA JUNIO 10
Casos diarios por 100 mil habitantes



CHILE JUNIO 10
Casos diarios por 100 mil habitantes



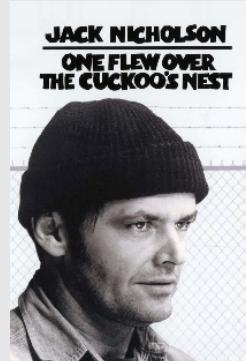
PERU JUNIO 10
Casos diarios por 100 mil habitantes



Marzo 15



Marzo 30



Abril 26



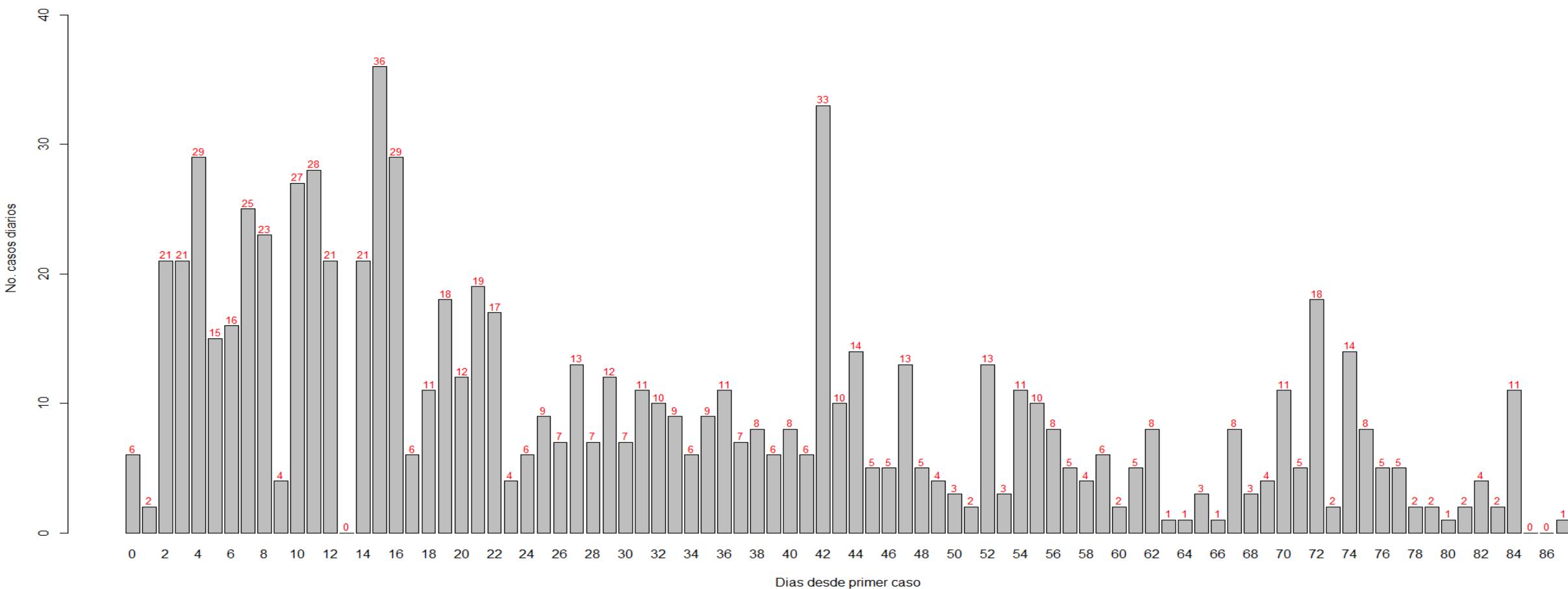
Mayo 26



EVOLUCION DE LA EPIDEMIA

URUGUAY-JUNIO 10

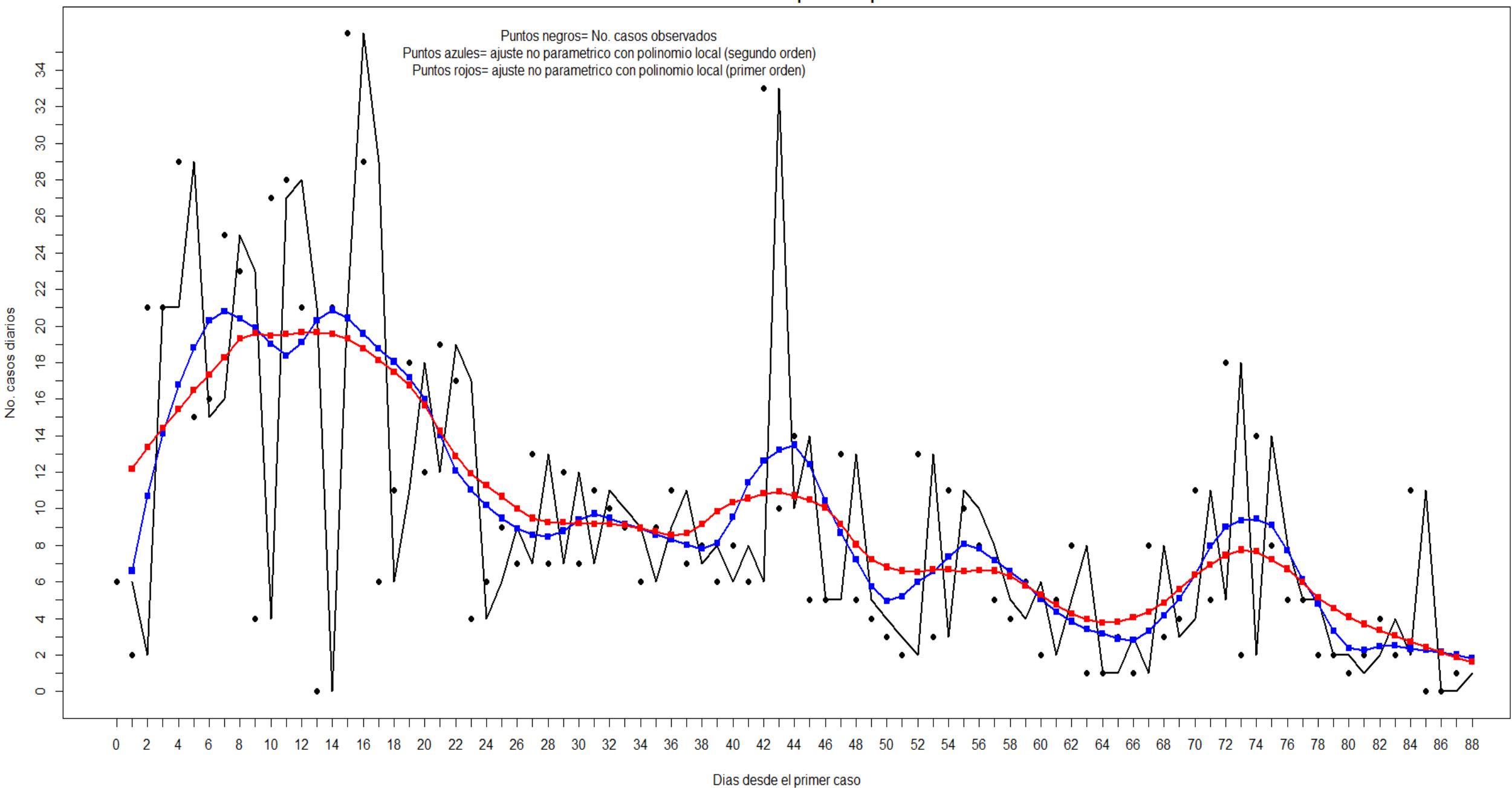
BASE DE DATOS: <https://www.ecdc.europa.eu>



EPIDEMIA EN URUGUAY A JUNIO 9-DESCRIPCION ESTADISTICA

Base de datos: <https://www.ecdc.europa.eu>

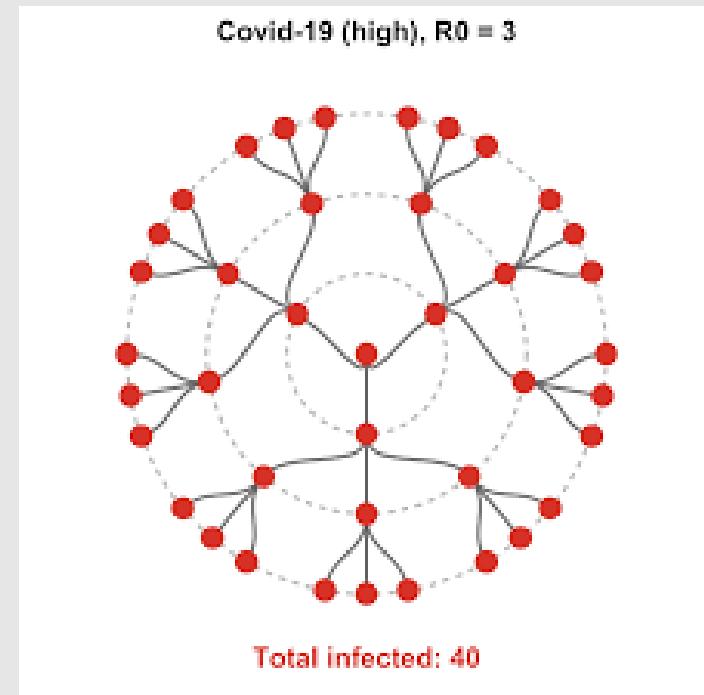
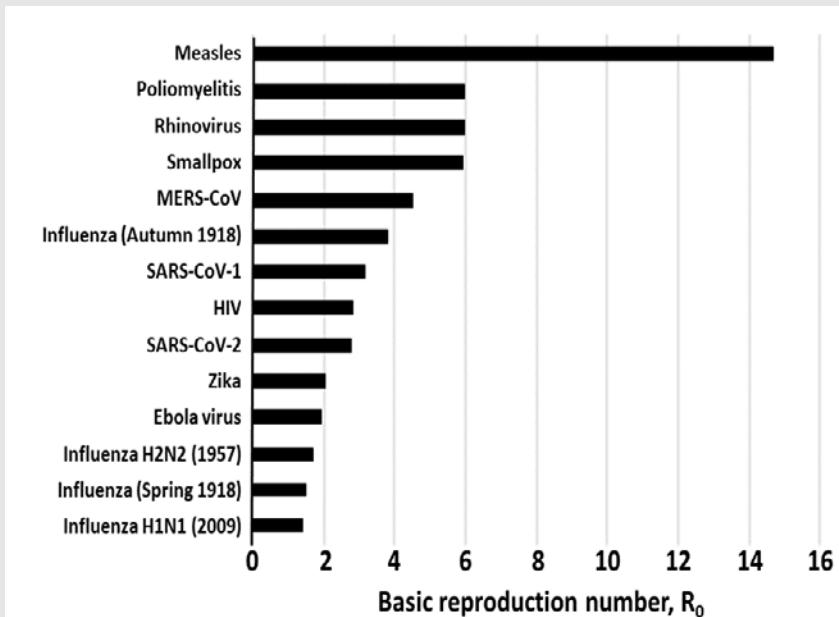
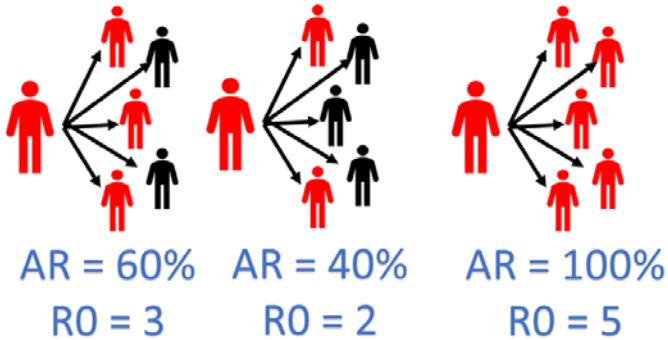
Nota: curvas son descriptivas-no predictivas



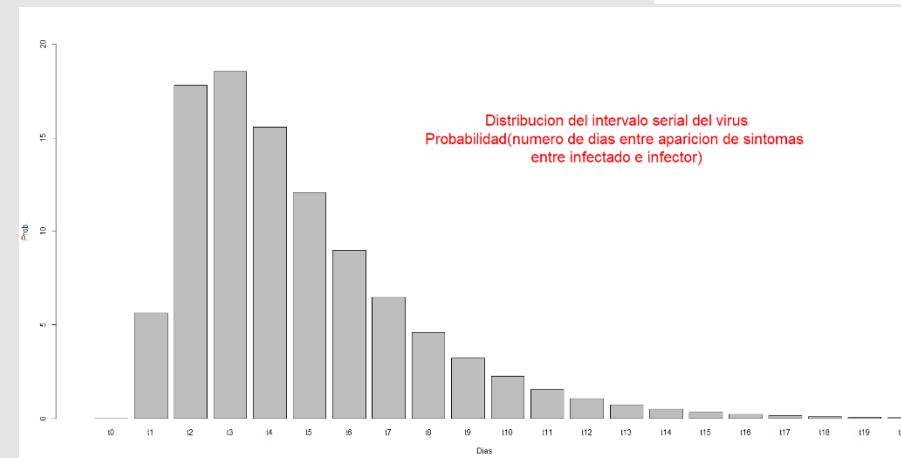
NUMERO DE REPRODUCCION DEL VIRUS:

R= numero promedio de infectados por infector

Basic Reproduction Number (R_0) = Attack Rate * Contacts



N_0	.	.	.	.	.	.	.
$N_1 = X_{01}$	.	.	.	.	.	.	.
$N_2 = X_{02} \quad X_{12}$	.	.	.	.	.	.	.
$N_3 = X_{03} \quad X_{13} \quad X_{23}$	.	.	.	.	.	.	.
$N_4 = . \quad X_{14} \quad X_{24} \quad X_{34}$	.	.	.	.	.	.	.
$N_5 = . \quad . \quad X_{25} \quad X_{35} \quad X_{45} \quad .$	.	.	.	.	.	.	.
$N_6 = . \quad . \quad . \quad X_{36} \quad X_{46} \quad X_{56} \quad .$	.	.	.	.	.	.	.
\vdots	$X_{47} \quad X_{57} \quad X_{67}$	.	.



ESTIMACION DE R Y PREDICCION DE NUMERO DE CASOS

Inferencia

Teorema de Bayes

$$= \frac{p(R_t | \text{Casos "nuevos", Casos "viejos", supuestos iniciales})}{\int \Pr(\text{Casos "nuevos"} | R_t, \text{Casos viejos, supuestos}) p(R_t | \text{Casos "viejos", supuestos}) dR_t}$$

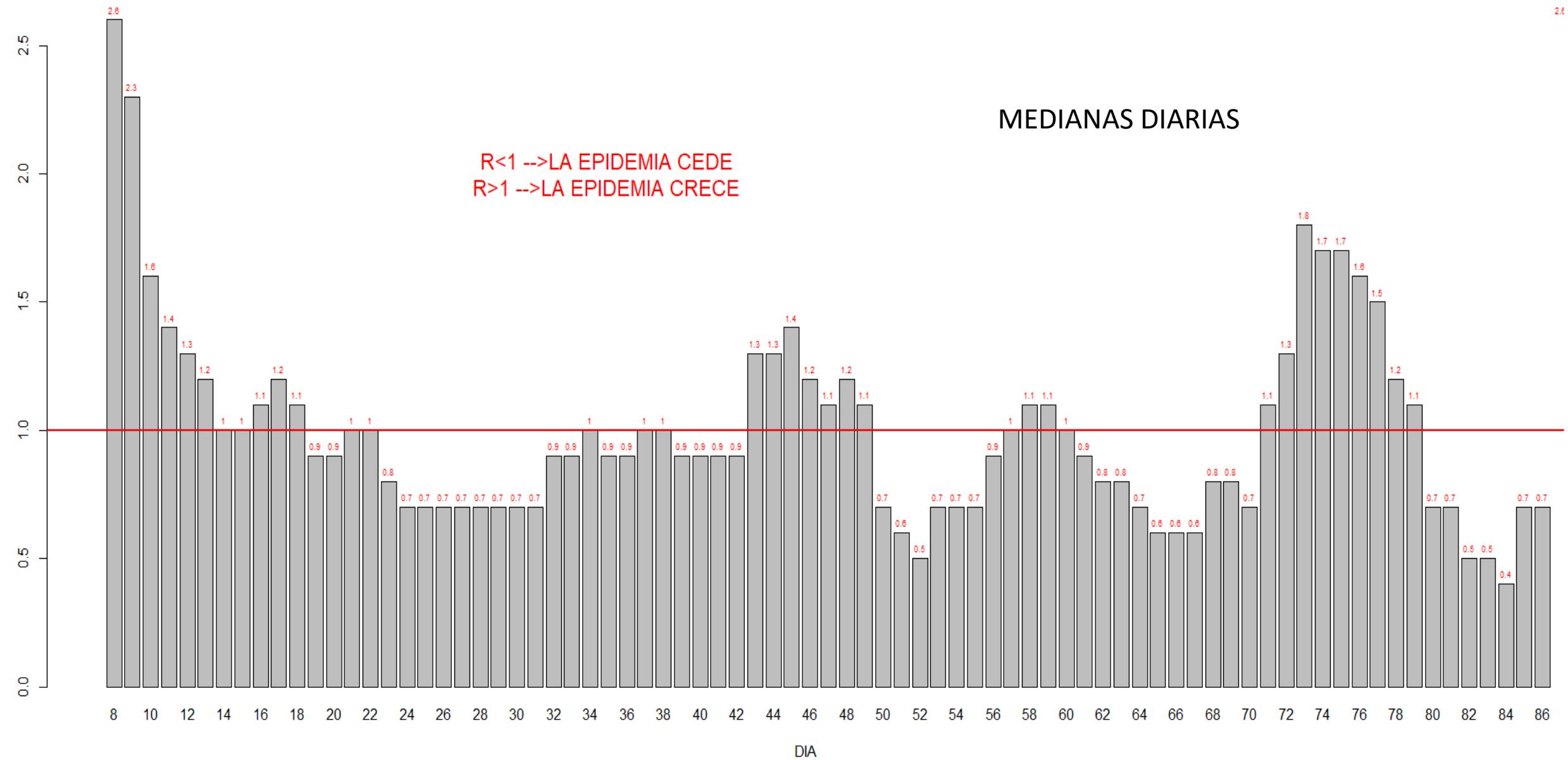
Prediccion

Distribucion Predictiva

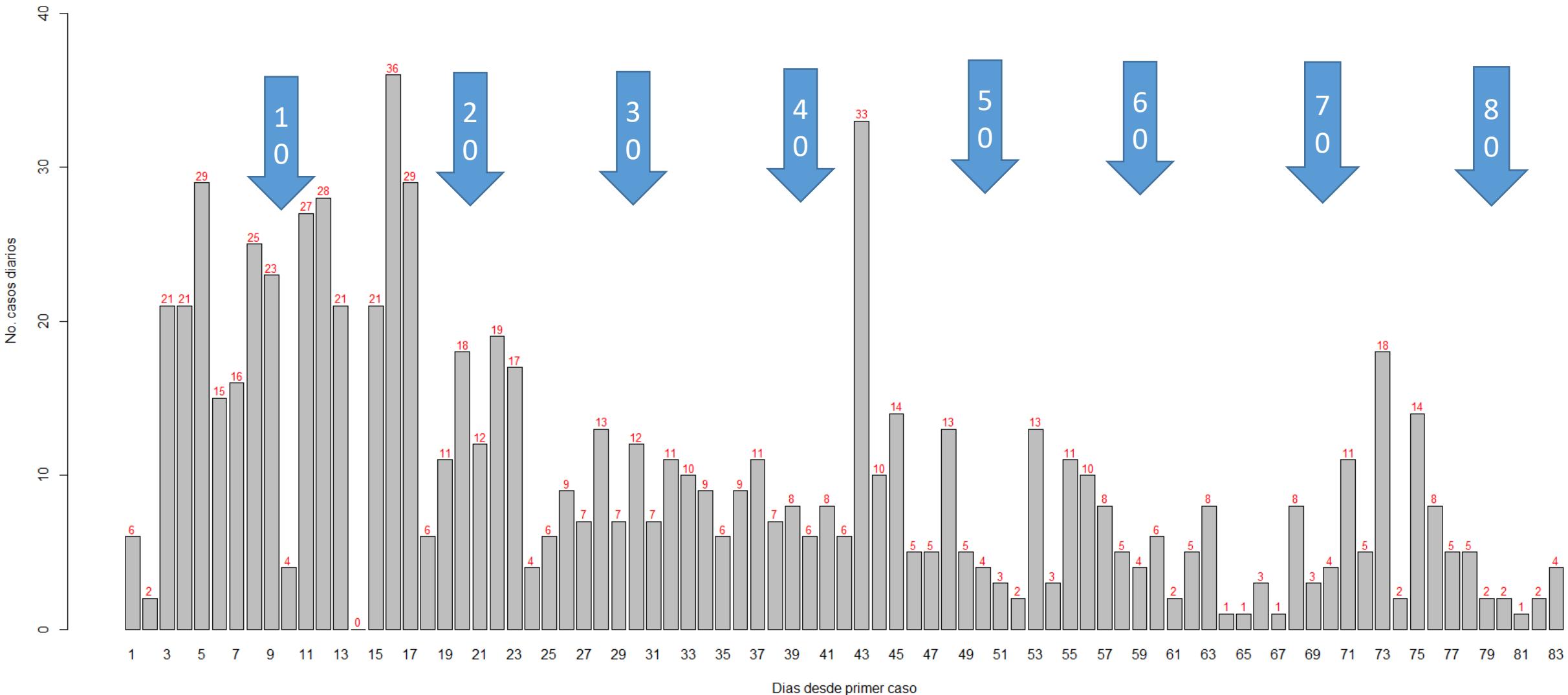
$$\Pr(\text{Casos futuros} | \text{Casos "N", Casos "V", supuestos})$$

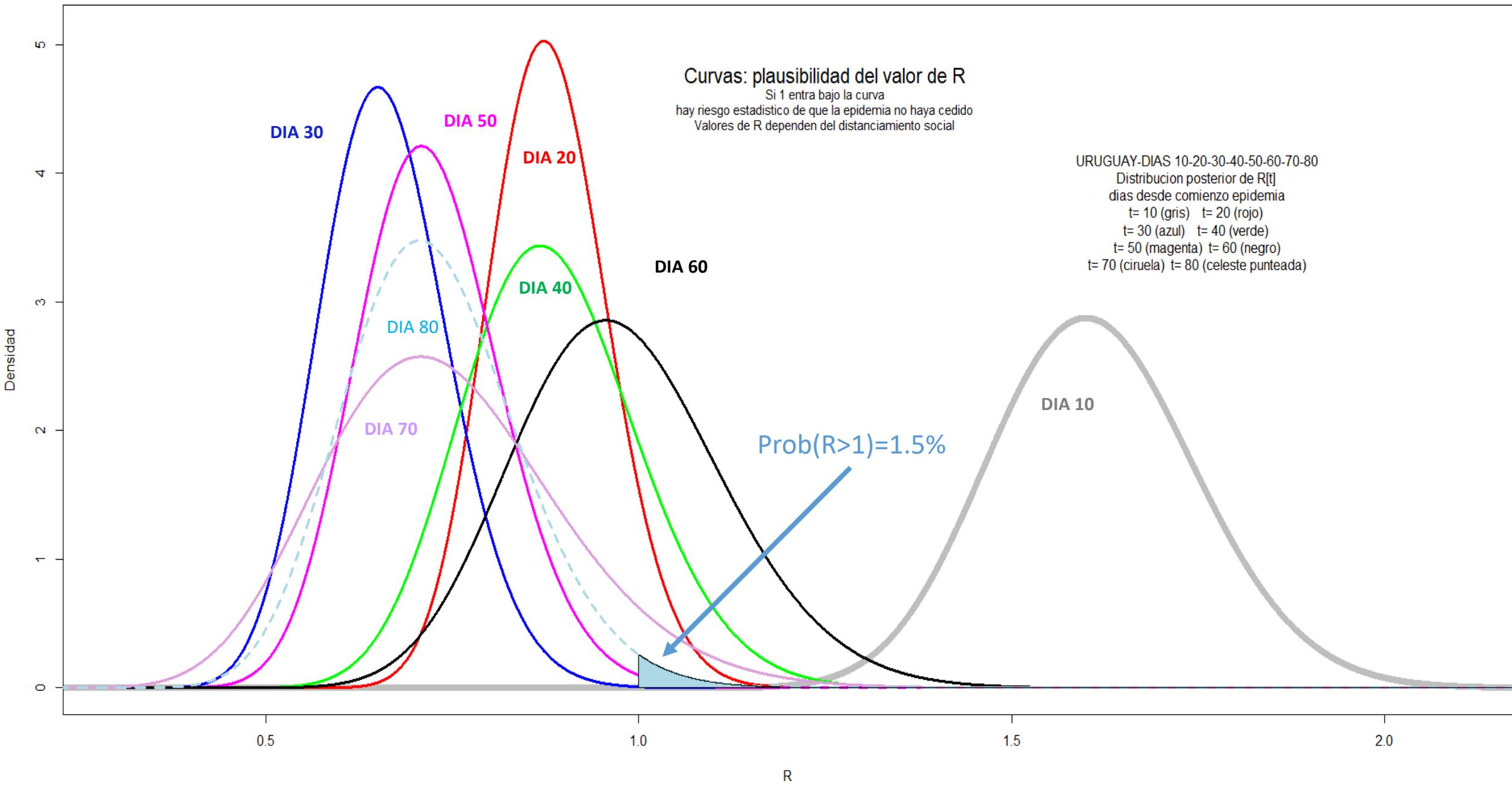
$$= \int \Pr(\text{Casos futuros} | R_t, \text{Casos "N" y "V", supuestos}) p(R_t | \text{Casos "N" y "V", supuestos iniciales}) dR_t$$

EVOLUCION DE R (numero reproduccion del virus)
URUGUAY-JUNIO 8



EVOLUCION DE LA EPIDEMIA
URUGUAY-JUNIO 4
BASE DE DATOS: <https://www.ecdc.europa.eu>

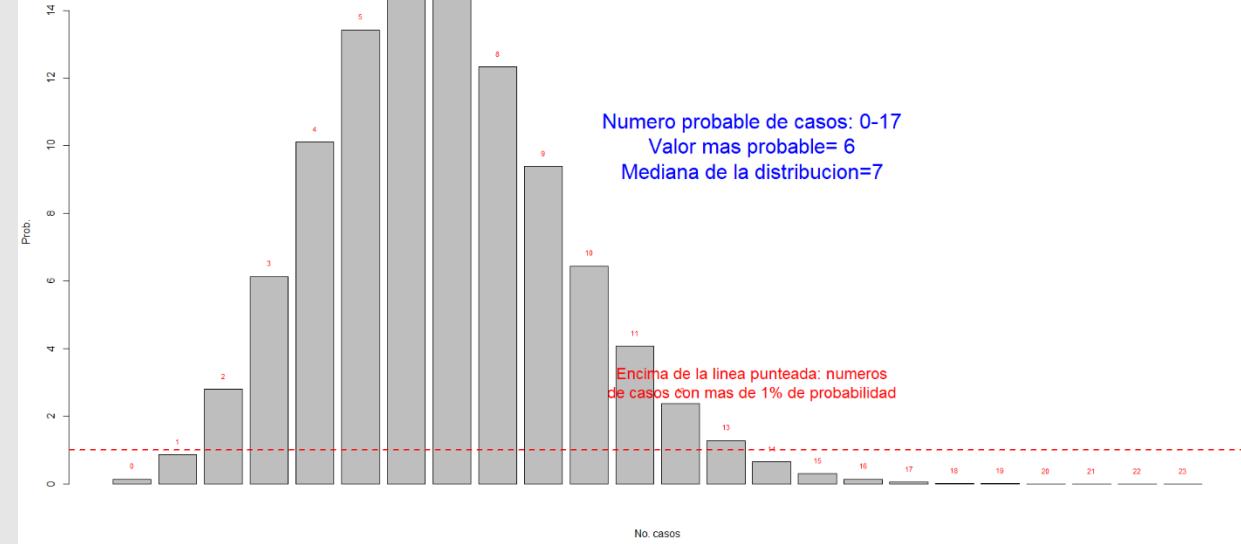




Numero esperado de casos DIA 10 :
0-23

Numero probable de casos: 0-17
Valor mas probable= 6
Mediana de la distribucion=7

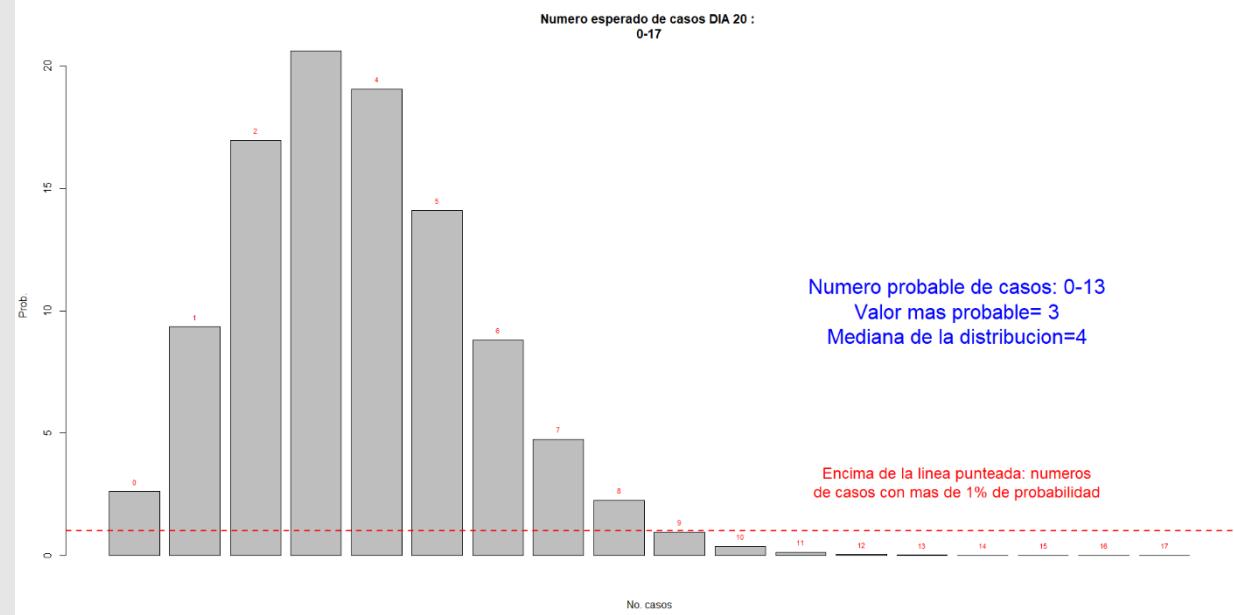
Encima de la linea punteada: numeros
de casos con mas de 1% de probabilidad



Numero esperado de casos DIA 20 :
0-17

Numero probable de casos: 0-13
Valor mas probable= 3
Mediana de la distribucion=4

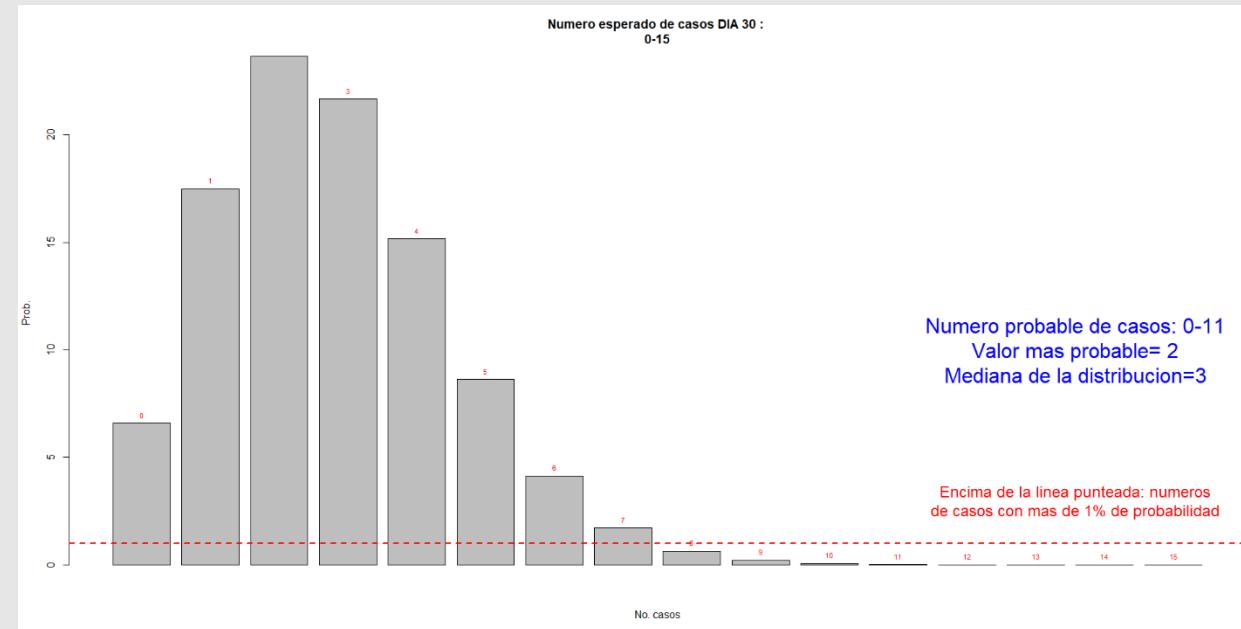
Encima de la linea punteada: numeros
de casos con mas de 1% de probabilidad



Numero esperado de casos DIA 30 :
0-15

Numero probable de casos: 0-11
Valor mas probable= 2
Mediana de la distribucion=3

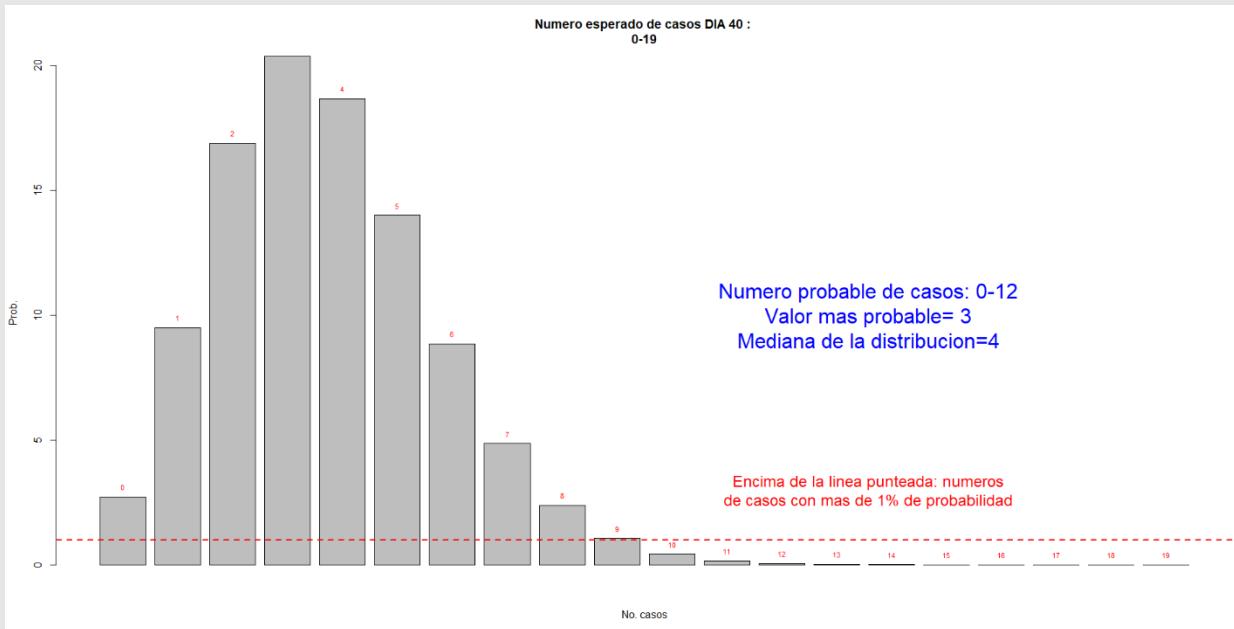
Encima de la linea punteada: numeros
de casos con mas de 1% de probabilidad

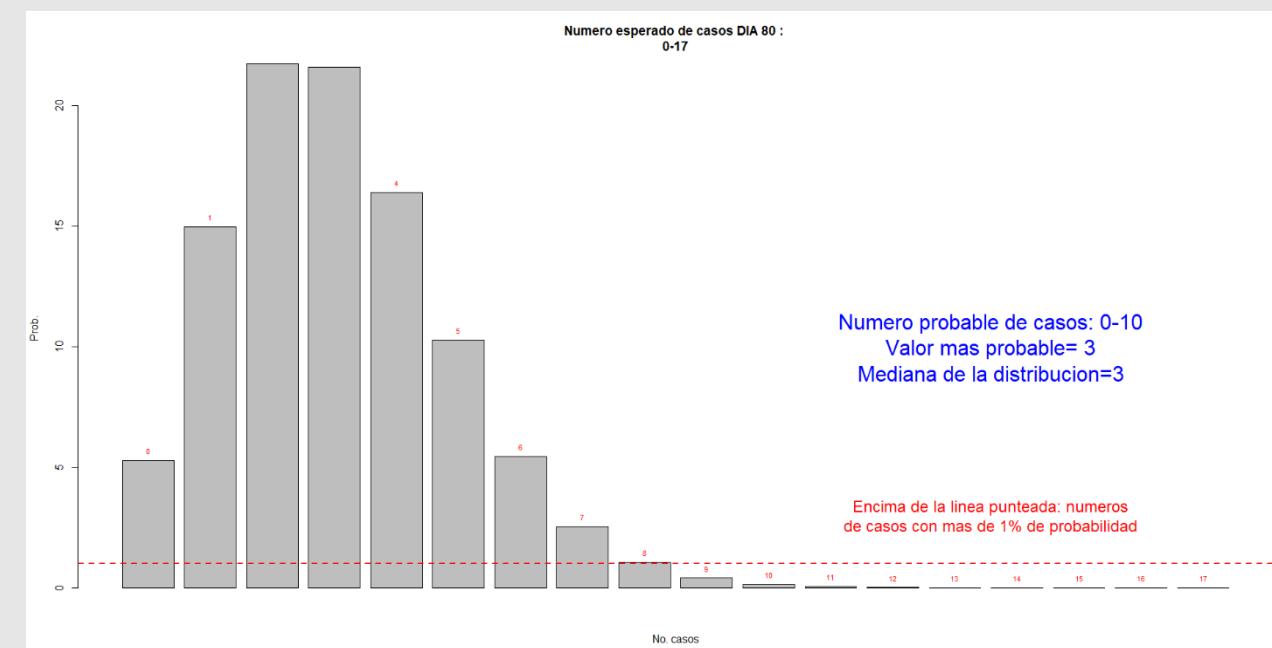
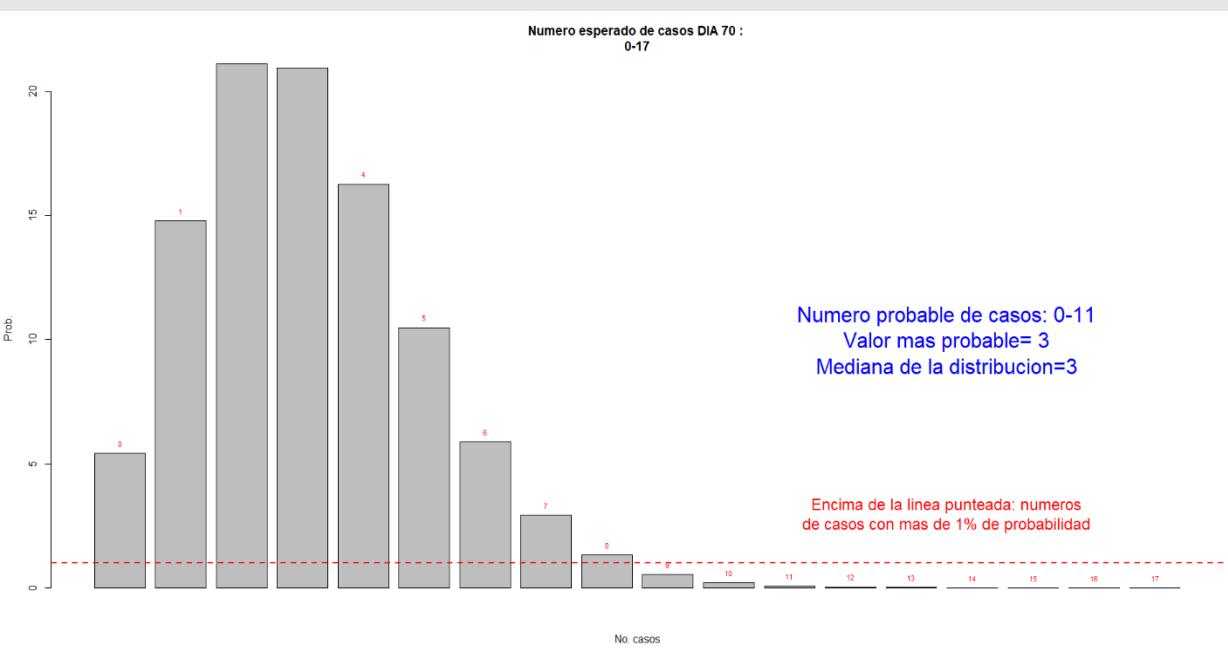
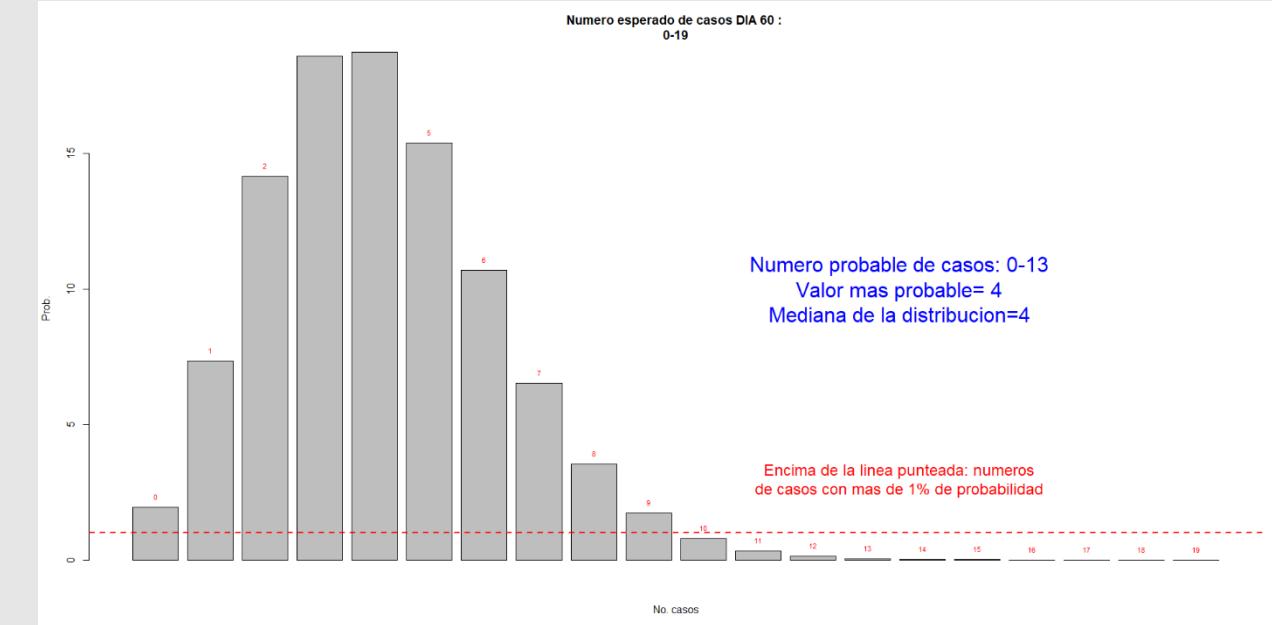
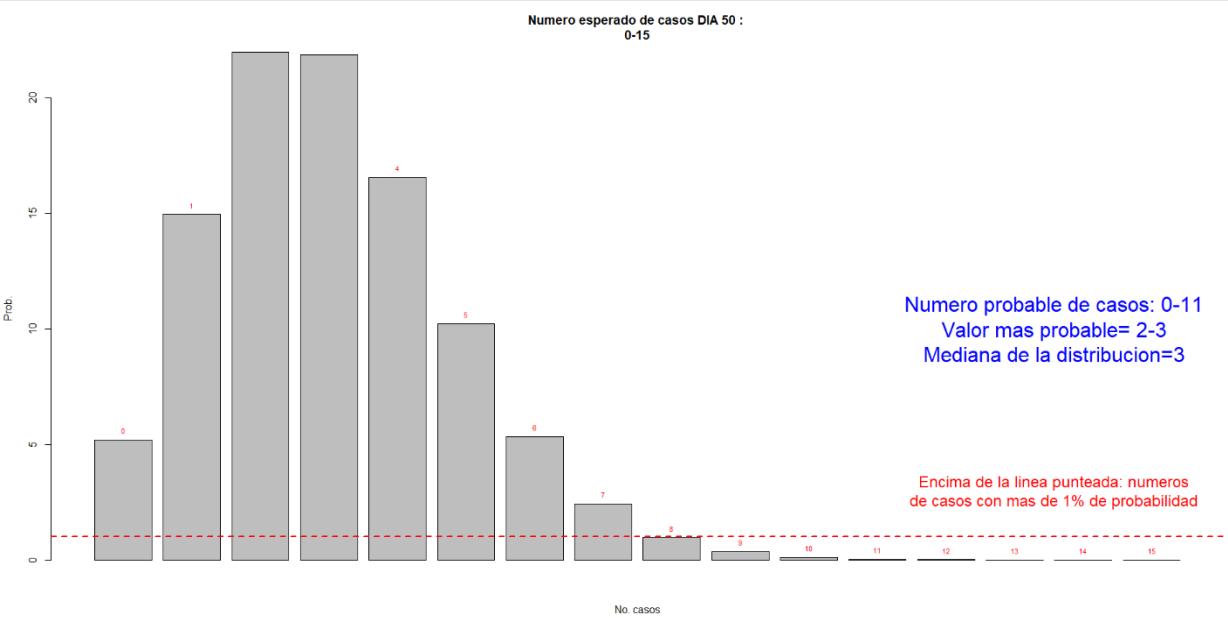


Numero esperado de casos DIA 40 :
0-19

Numero probable de casos: 0-12
Valor mas probable= 3
Mediana de la distribucion=4

Encima de la linea punteada: numeros
de casos con mas de 1% de probabilidad





COMO EVALUAR SI LAS PREDICCIONES SON BUENAS O MALAS?

- SE NECESITARIA COMPARAR CON OTRA “MAQUINA” PREDICTIVA, QUE NO DISPONEMOS
- ENTONCES, COMPARAMOS CON LA PEOR MAQUINA PREDICTIVA: ENTROPIA, CAOS



RANDEMIA

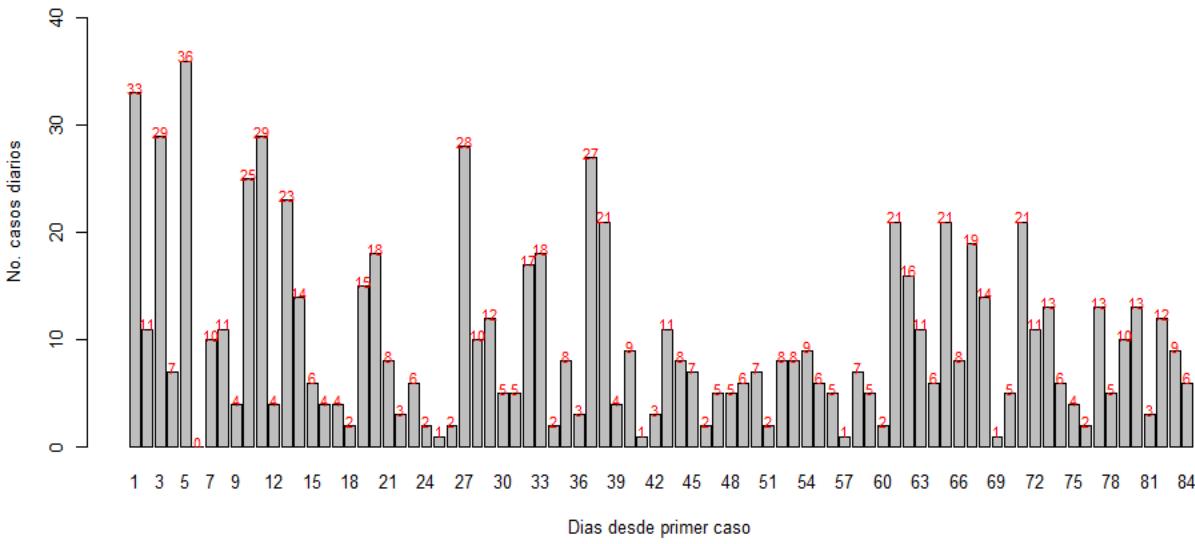
(R:“RANDOM”,“ALEATORIO”)

2.11×10^{132} RANDEMIA

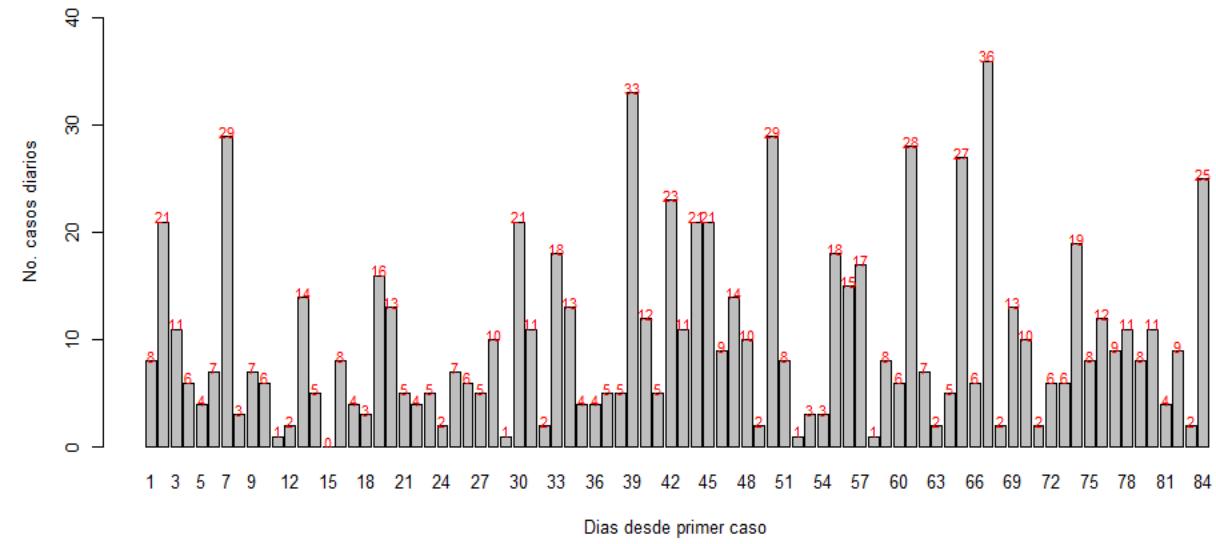


SARS-cov-2
Gusano Loco

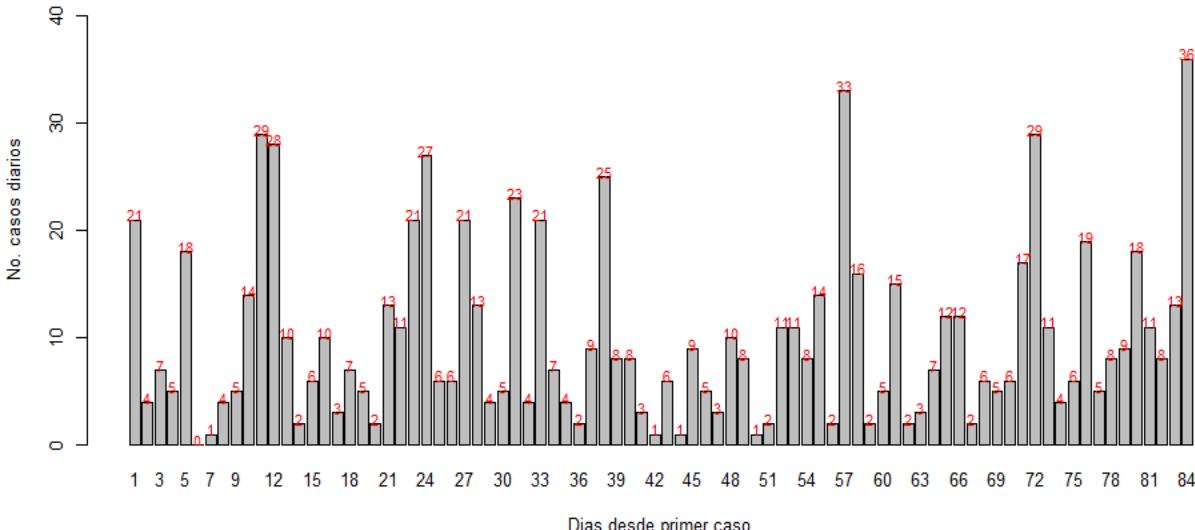
EVOLUCION DE RANDEMIA 1
URUGUAY-JUNIO 6
BASE DE DATOS: <https://www.ecdc.europa.eu>



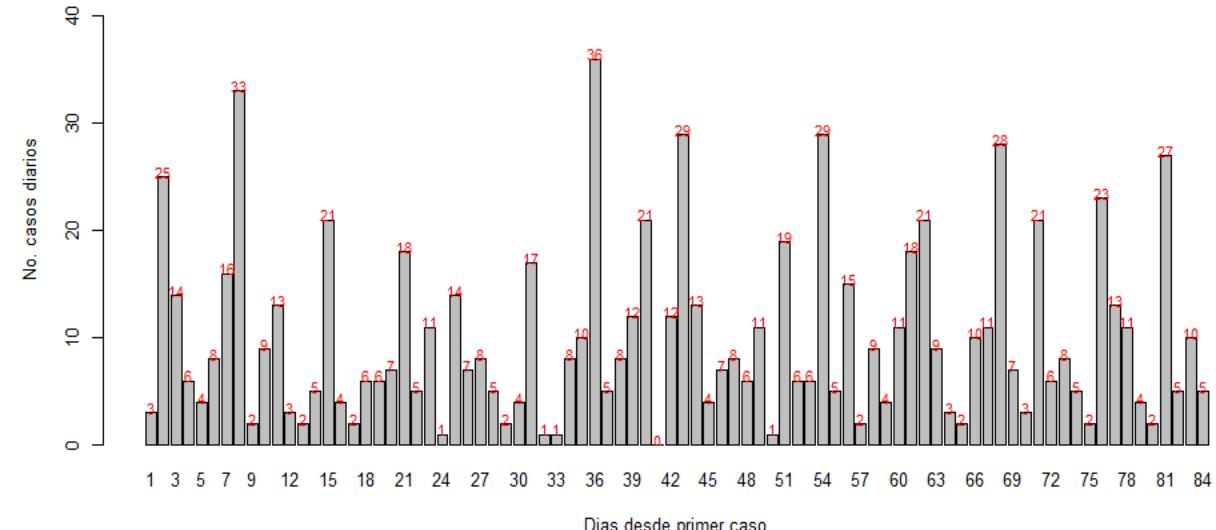
EVOLUCION DE RANDEMIA 2
URUGUAY-JUNIO 6
BASE DE DATOS: <https://www.ecdc.europa.eu>



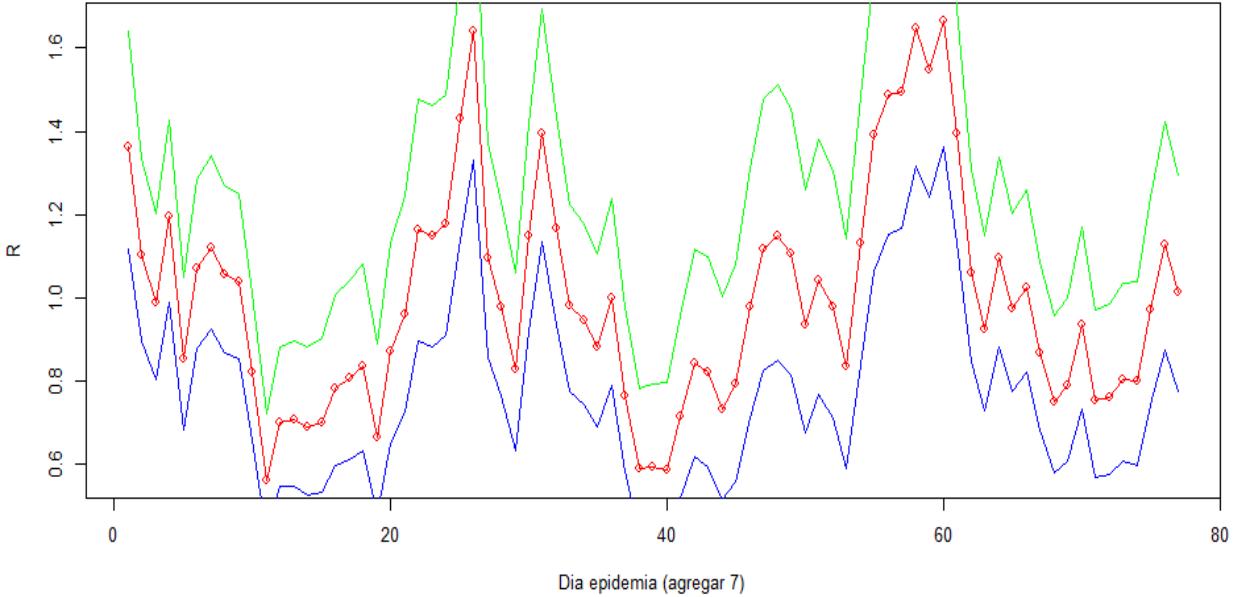
EVOLUCION DE RANDEMIA 3
URUGUAY-JUNIO 6
BASE DE DATOS: <https://www.ecdc.europa.eu>



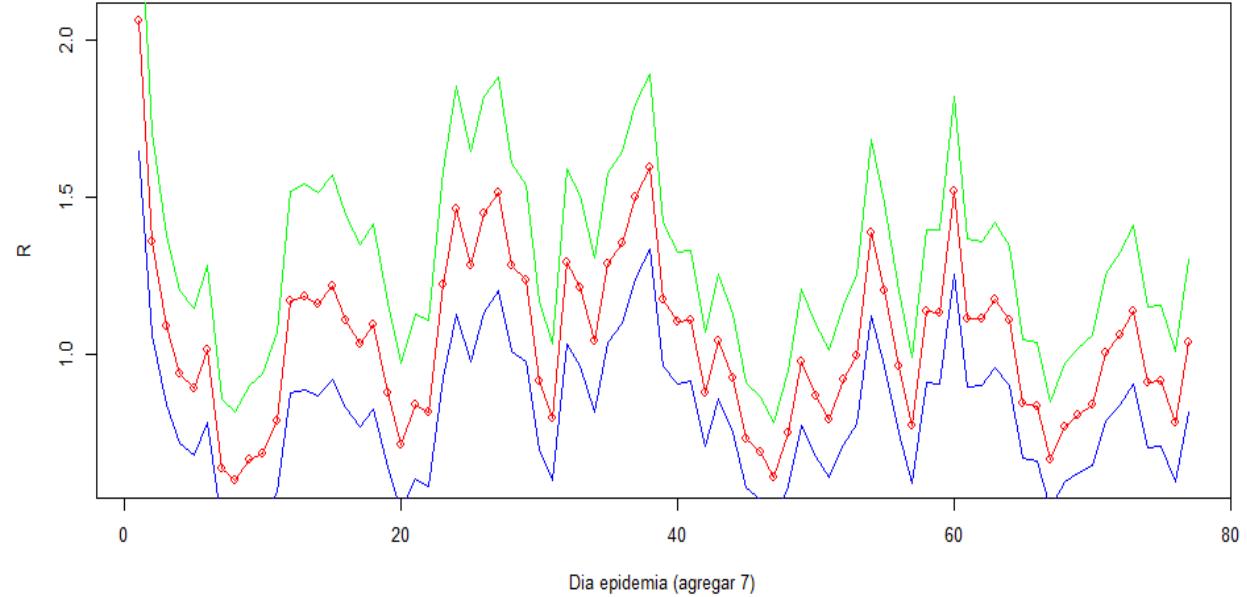
EVOLUCION DE RANDEMIA 4
URUGUAY-JUNIO 6
BASE DE DATOS: <https://www.ecdc.europa.eu>



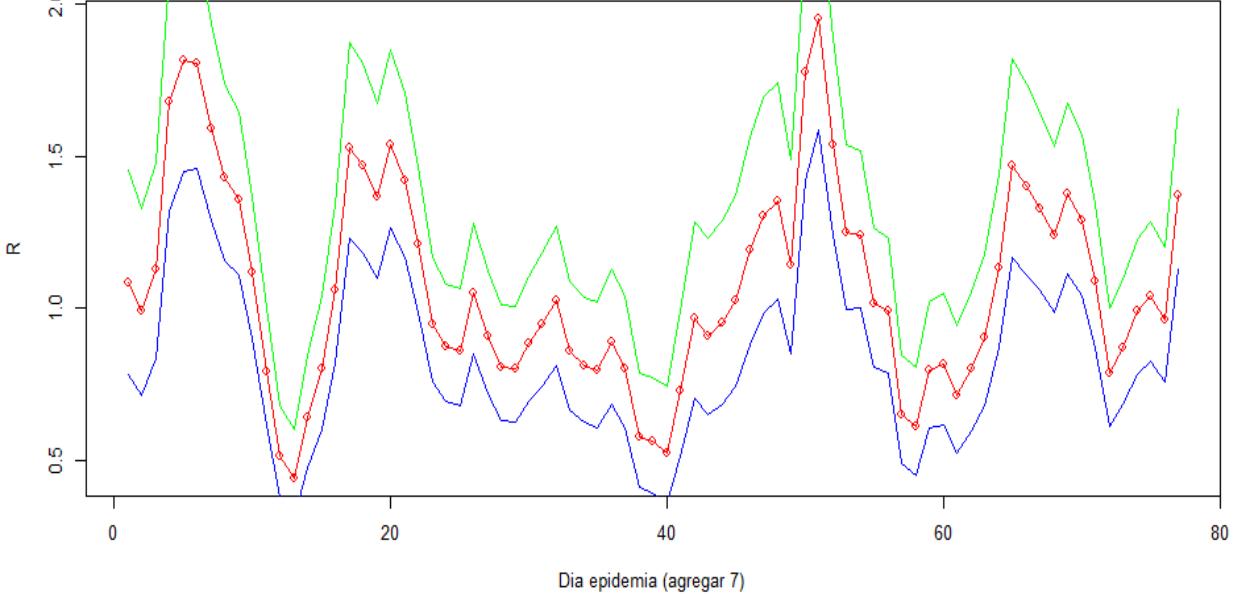
R=rojo
Percentil 2.5% = azul Percentil 97.5% = verde
RANDEMIA 1



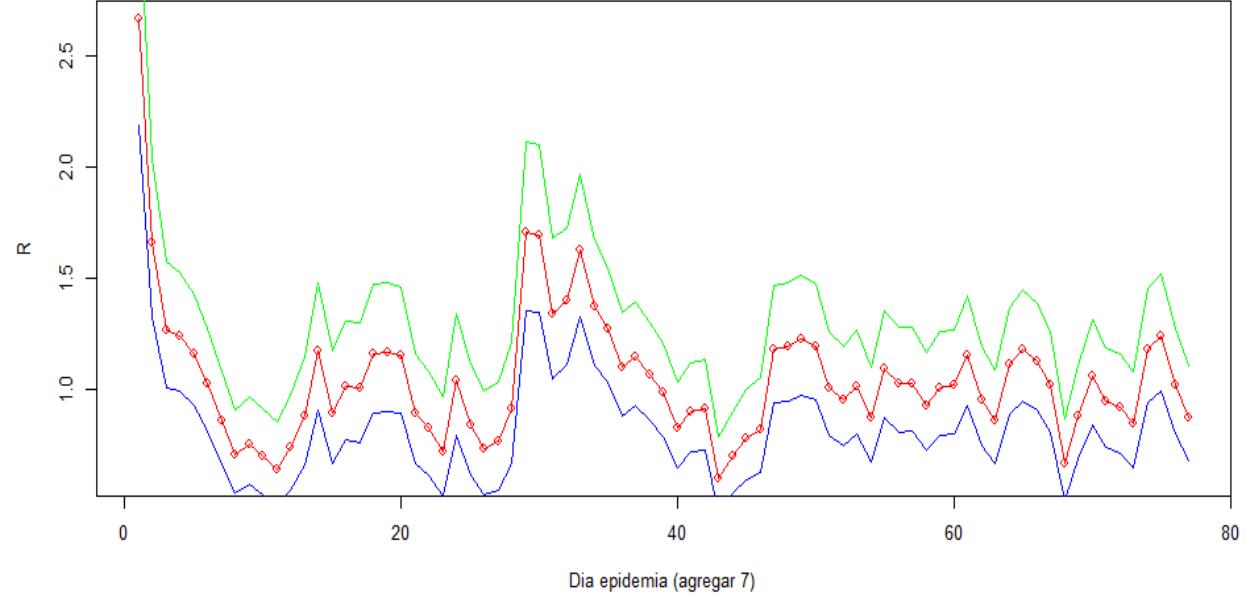
R=rojo
Percentil 2.5% = azul Percentil 97.5% = verde
RANDEMIA 2



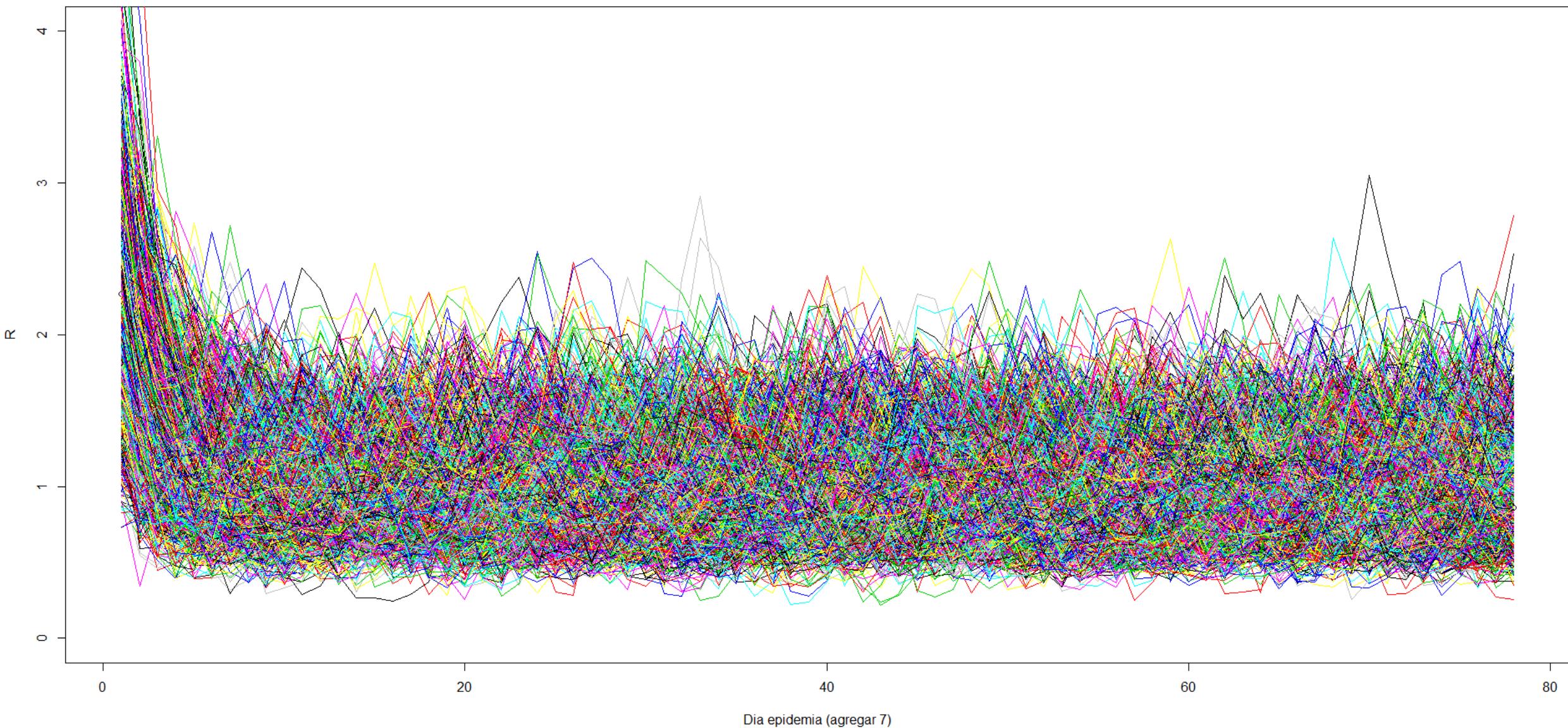
R=rojo
Percentil 2.5% = azul Percentil 97.5% = verde
RANDEMIA 3



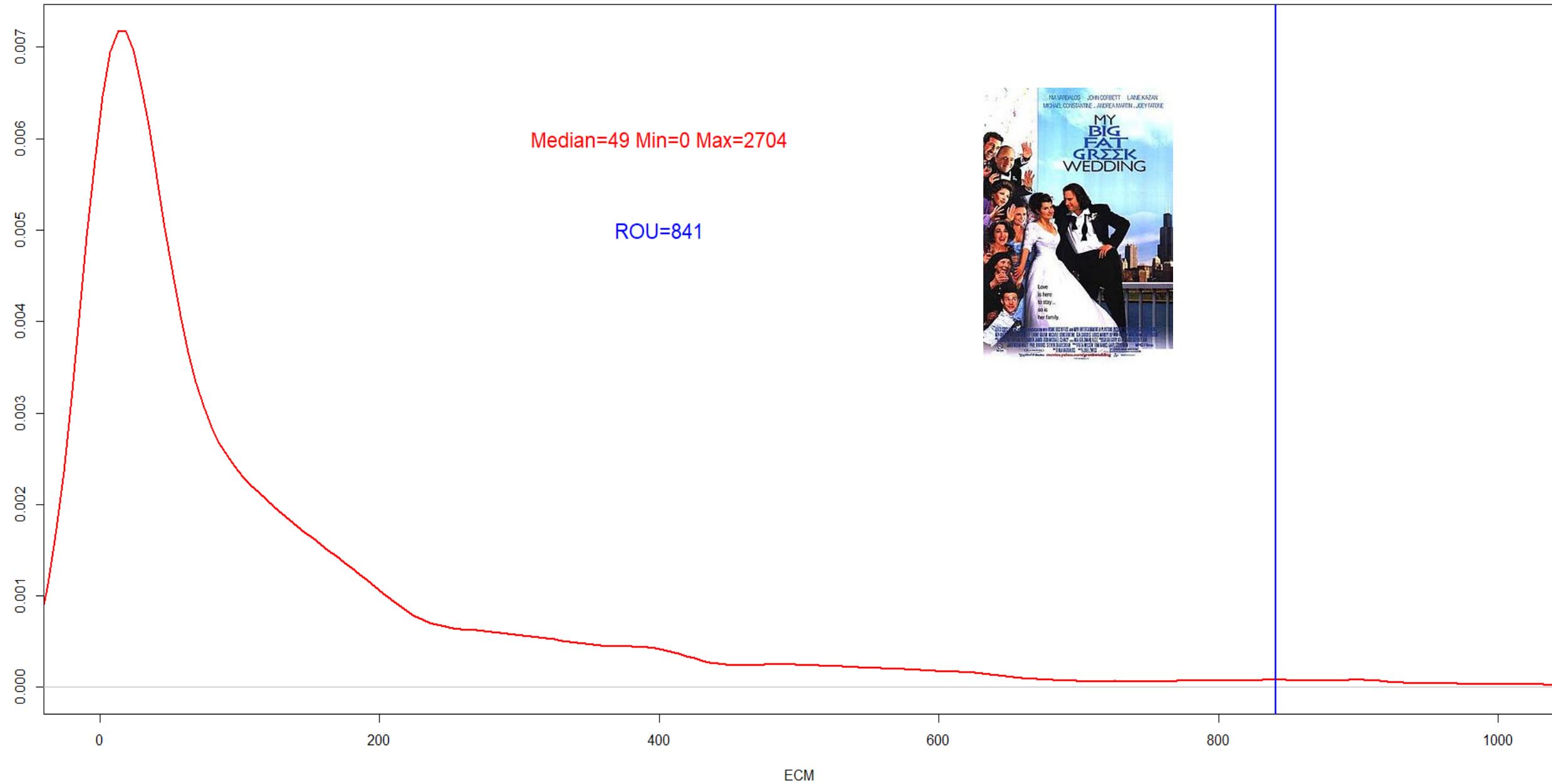
R=rojo
Percentil 2.5% = azul Percentil 97.5% = verde
RANDEMIA 4



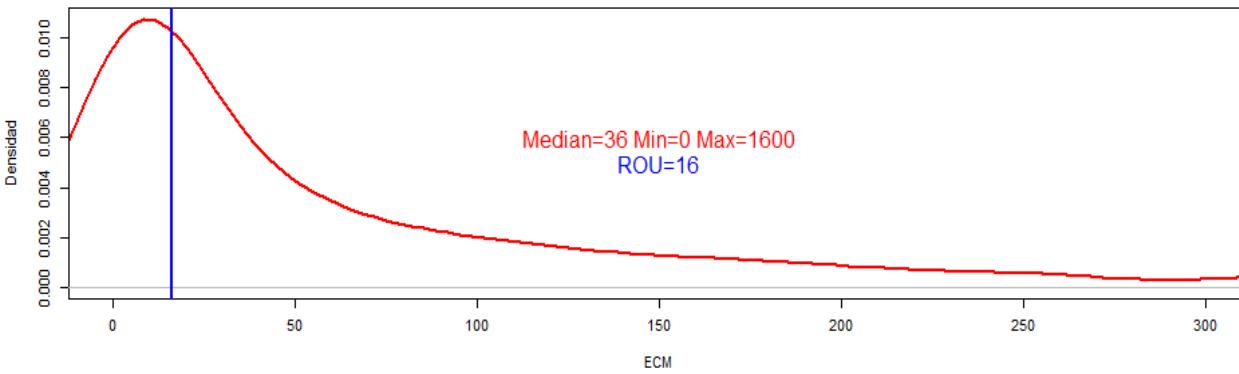
2000 RANDEMIAS R (medianas)



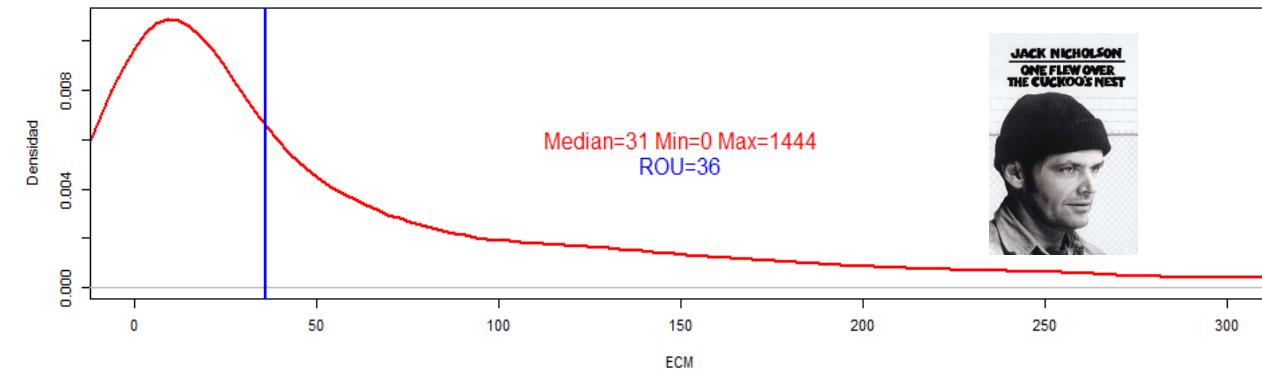
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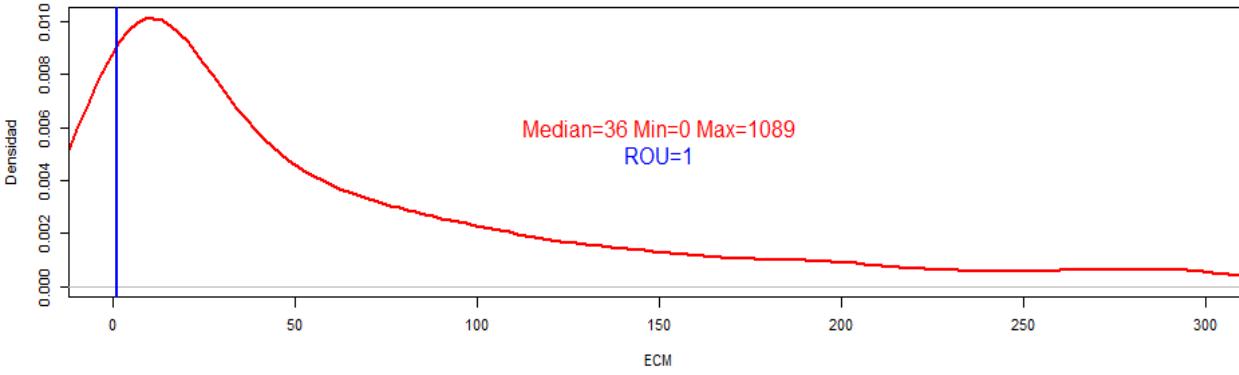
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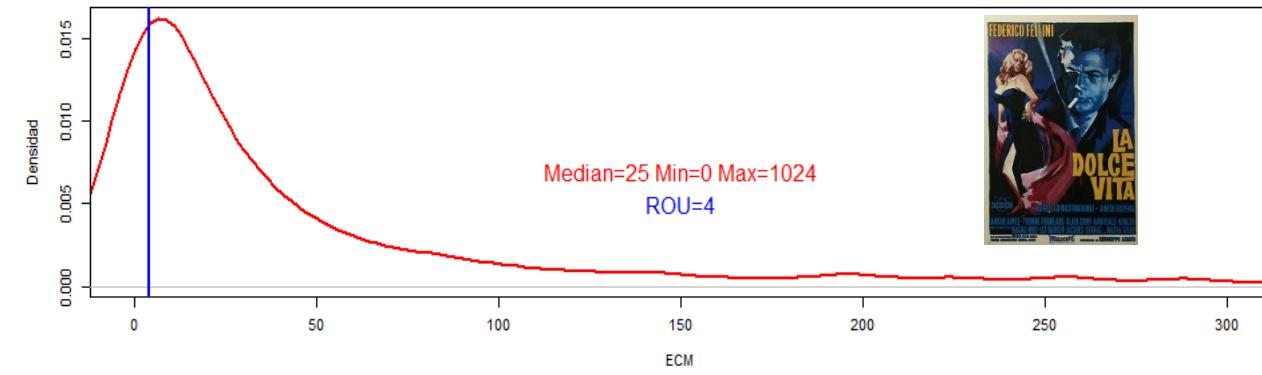
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DIA 30



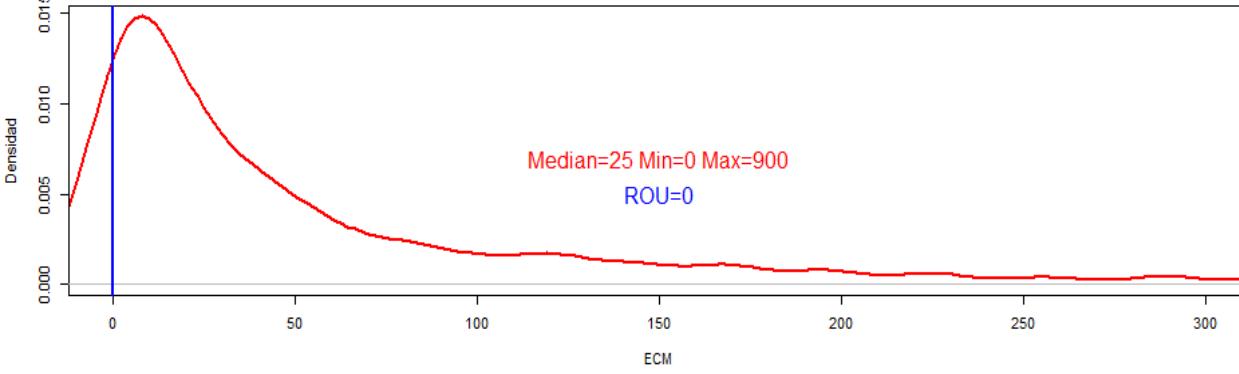
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DIA 40



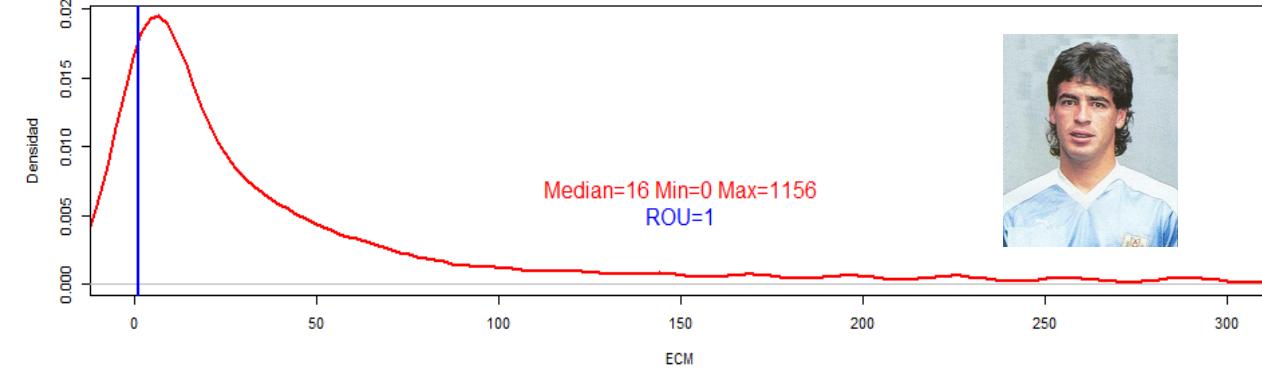
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DIA 50



ERROR CUADRATICO MEDIO: 2000 RANDEMIAS
DIA 60



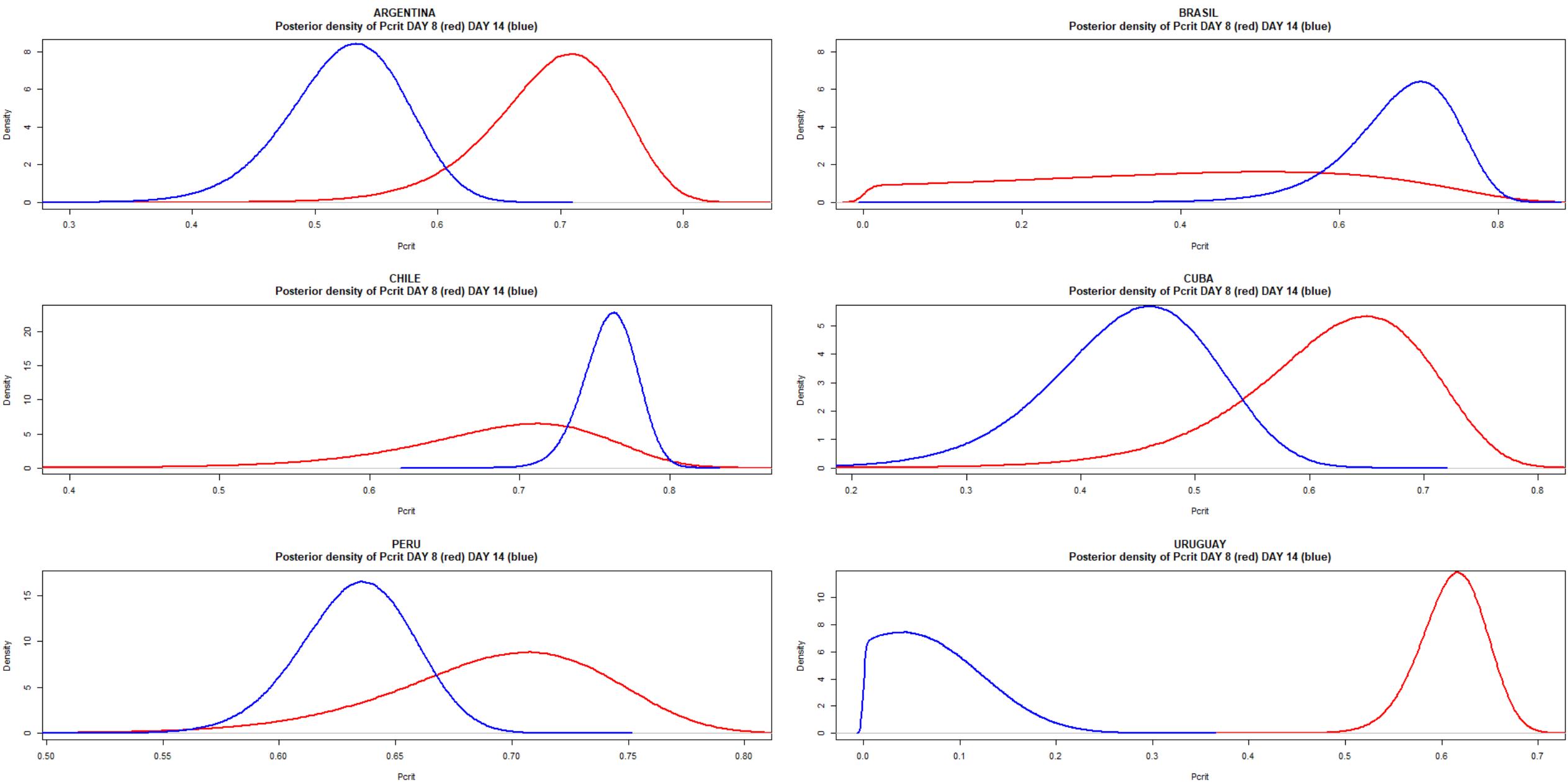
ERROR CUADRATICO MEDIO: 2000 RANDEMIAS
DIA 70



SI FUERAMOS COMO SUECIA...



DENSIDAD POSTERIOR DE P_{crit} (porcentaje minimo infectados para “inmunidad rebaño”)



	PAIS	POBLACION (millones)	Tests/ millon	Casos/ millon	Muertes/ millon	PBI 2020(%)	
	SUECIA	10.1	27290	4431	462	-5.1	
	ALEMANIA	83.8	51917	2218	105	-6.1	
	DINAMARCA	5.8	121992	2063	102	-4.5	
	NORUEGA	5.4	47487	1577	44	-6.0	
	EEUU	330.9	63484	6038	339	-3.8	
	URUGUAY	3.5	13829	243	7	-----	
	REINO UNIDO	67.9	82241	4217	597	-8.7	

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nydailynews.com/news/national/my-fox-news-pete-hegseth-coronavirus-course-herd-immunity-20200507-hegseth7?utm_term=.5dnn-h337e-story.html

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By BRIAN NIEMIETZ NEW YORK DAILY NEWS | MAY 07, 2020 | 3:58 PM



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f t



Divarande otatemedicinprofil Annika Lindé tillsammans med Anders Tegnell, som då var avdelningschef på Socialstyrelsen. Arkivbild Foto: Beril Ericson / TT

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Sweden's lax COVID-19 response caused too many deaths, country's top epidemiologist says

By Ingrid Larson | Staff Writer 4 days ago

The country should have done more, he says.

Comments (0)



Anders Tegnell, the state epidemiologist of the Public Health Agency of Sweden, at a press briefing in April 2020. Image: AP/TT/Magnus Karlsson

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“CASE FATALITY” RATES (%) POR EDAD (Natale et al. 2020)

https://ec.europa.eu/knowledge4policy/publication/covid-19-cases-case-fatality-rate-age_en

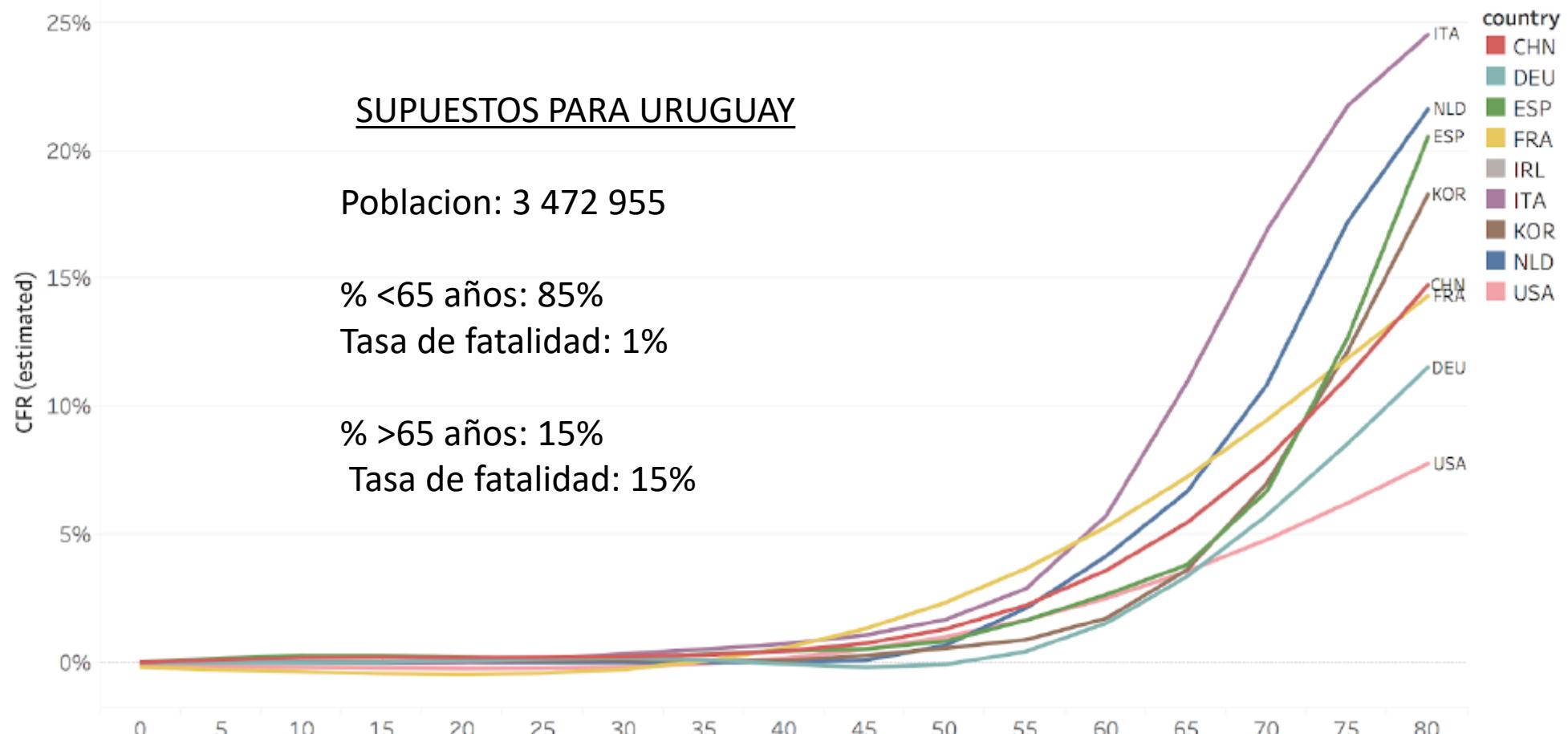
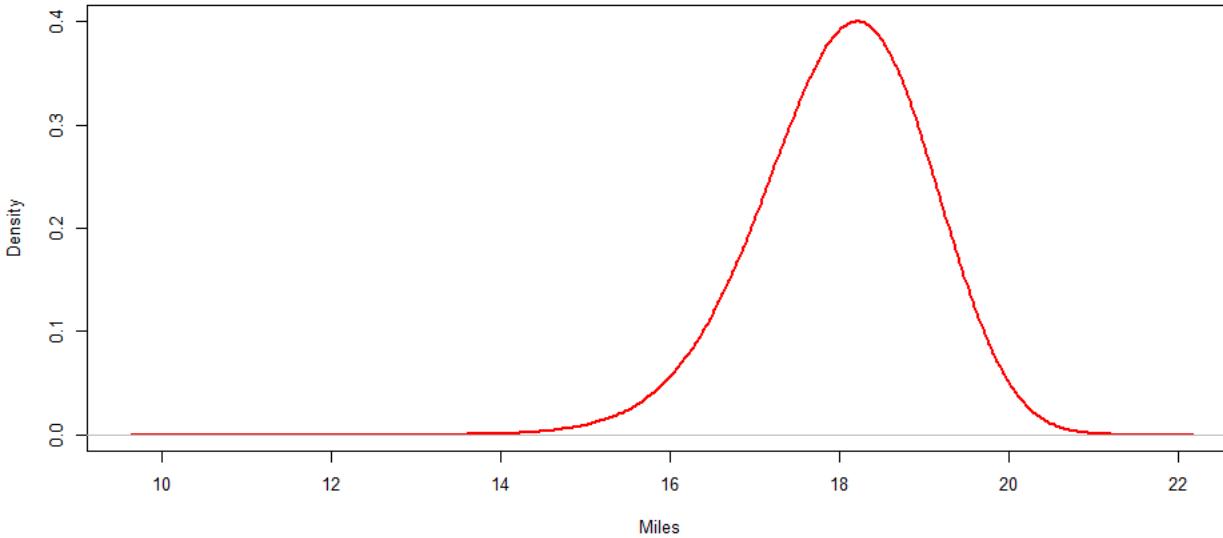


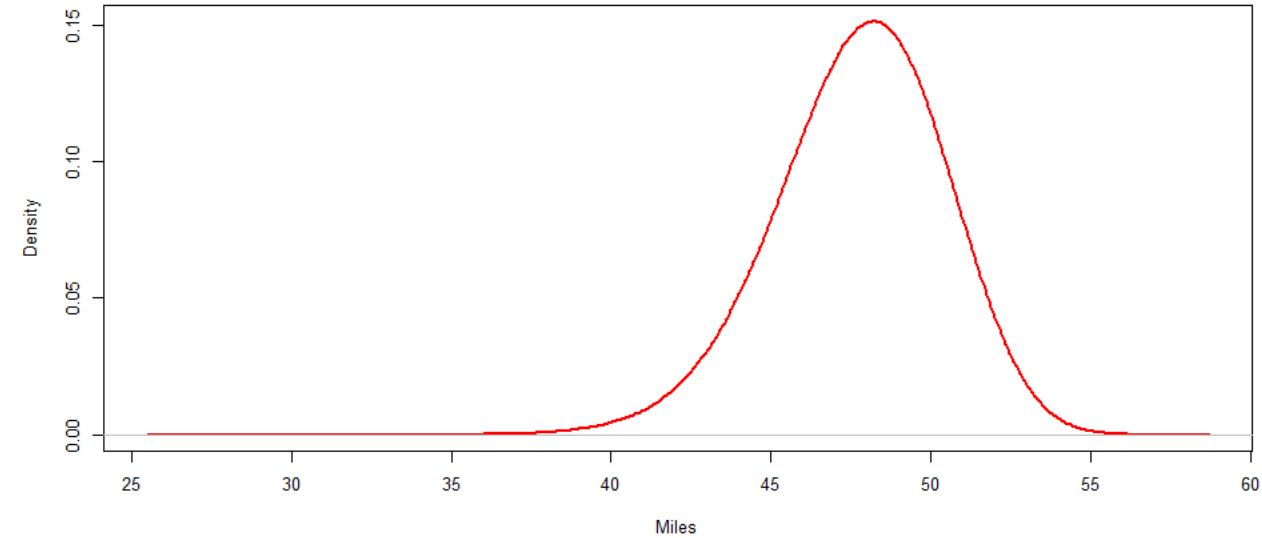
Figure 2 COVID-19 cases and CFR by harmonised 5-years age groups.

DISTRIBUCION DE MUERTES SEGUN EDAD PARA DOS POLITICAS HERD IMMUNITY

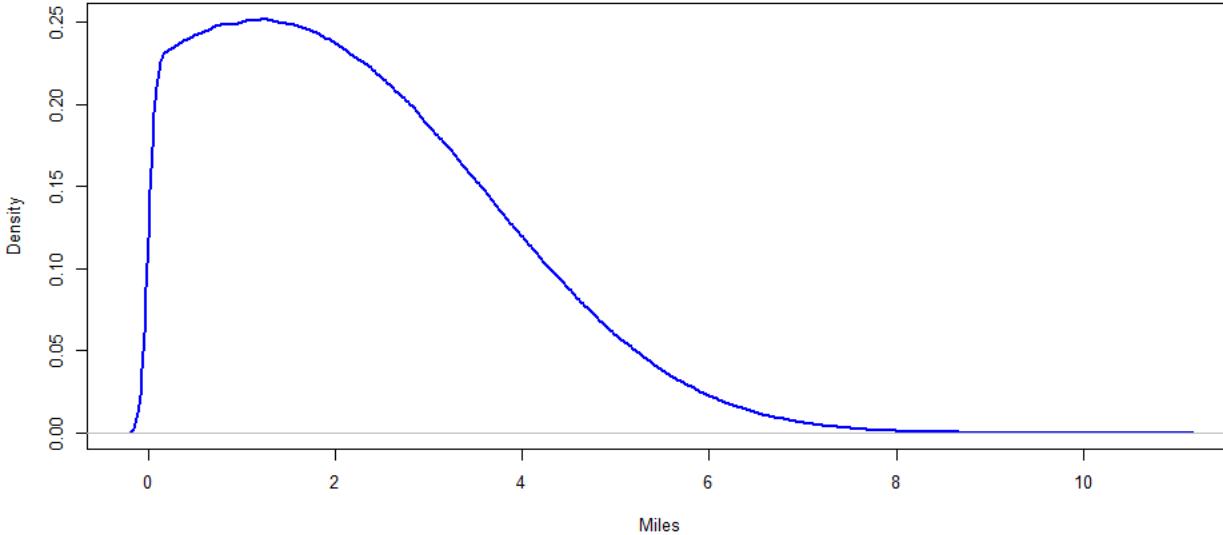
Distribucion casos fatales <65 años
minimo para inmunidad R[8]



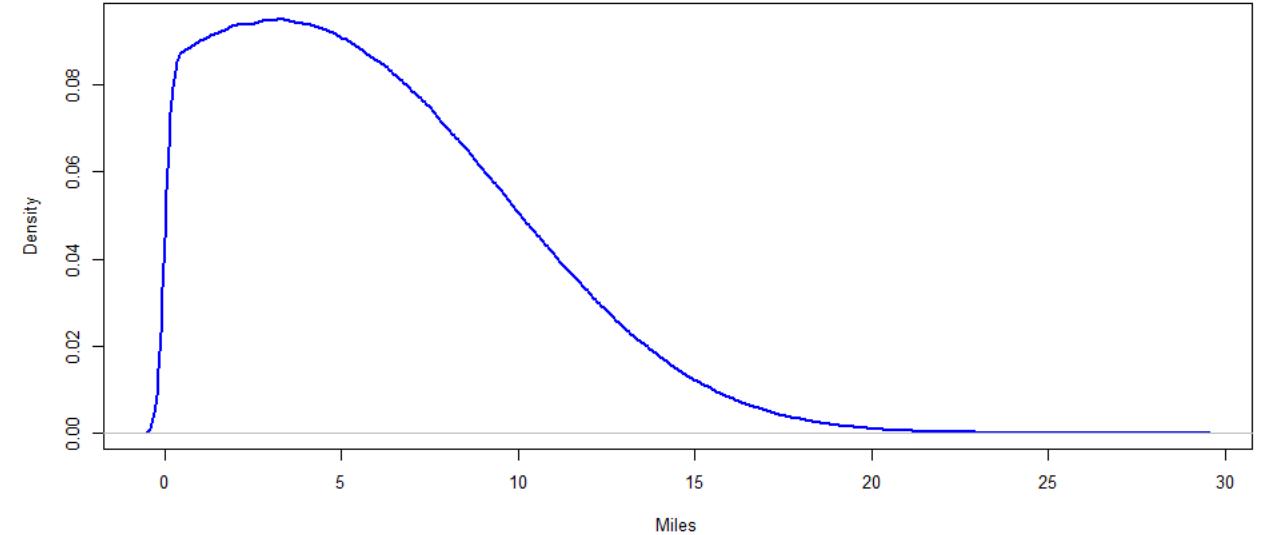
Distribucion casos fatales >65 años
minimo para inmunidad R[8]



Distribucion casos fatales <65 años
minimo para inmunidad R[14]



Distribucion casos fatales >65 años
minimo para inmunidad R[14]



“PUTTING THE RISK OF COVID-19 IN PERSPECTIVE” (New York City)

David Roberts, New York Times

- “Micromorts” (Unidad, 1 en 1 millon chances de morirse en un dia)
- Dia comun y corriente (1 micromort)
- Anestesia general (5 micromorts por operacion)
- Paracaidismo (7 micromorts por salto)
- Andar 70km diarios en motocicleta (11 micromorts)
- Combatir en Afganistan en 2010 (25 micromorts)
- Parto (210 micromorts)
- Trepar mas de 8 mil metros en el Himalaya (10 mil micromorts)
- Vivir en Michigan durante la epidemia 11 micromorts
- Vivir en NY durante la epidemia 50 micromorts adicionales
- Vivir en NY, ser “mayorcito, contraer COVID: ➔
ligeramente menos riesgoso que ser piloto de la RAF y bombardear Alemania en cuatro misiones
durante la Segunda Guerra mundial

“Maracana de la pandemia”? (visto desde la distancia...)



- Se sabia que, tarde o temprano, SARS-COV-2 llegaria (equipamiento, camas CTI, etc.)
- Uruguay no es un “hub” (contrariamente a Milan, Frankfurt, NY City, etc.)
- Baja densidad demografica
- Decidida y rapida accion gubernamental. Alto nivel de testaje (regional). Control focos.
- Uso de evidencia y de asesoramiento cientifico (“Triunvirato”, apoyado por un batallon de científicos y medicos)
- Politica de switches, jugando el “partido en La Paz” (Radi et al.), sin demorar cambios (OWT)
- Consenso politico sobre las medidas (de “estado”)
- Sistema de salud estructurado
- Excelente cobertura de atencion primaria
- Uruguayos: respondieron ante la emergencia
- **NZ (islas) “erradico” el virus: 18 dias consecutivos sin ningun caso nuevo**
- **Jacinda Ardern no enfrenta el “riesgo Brasil”**

