Statistic estimates for historic events

Dmitrii Kouznetsov*

Mizugadro, Japan

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Abstract. Relation between abolishment of Separation of Powers and the event of a collapse of the empire is considered. For various epochs and various countries, Duration is defined as length of the time interval between the two events:
(a) The Federal Law of an empire eliminates the Separation of Powers. Here, this event is denoted with term «Nulling«; for each case, it sets zero at the time scale
(b) The empire is broken, the administrative system is destroyed and created again. This event is denoted with term «Collapse».
The 5 examples of couples of events (a,b) are identified in the open access documents. They refer to (1) England of Cromwell, (2) France of Napoleon Buonaparte, (3) Italy of Mussolini, (4) Germany of Hitler, (5) Soviet Union of Brezhnev.
Duration is measured in years, assuming that 1year=365.24days; in all the 5 cases, the Duration D happens to be between 7 and 20. Known values of D are treated as primary experimental data. The 3 modes of distribution of Duration are considered:
Model First: Normal distribution of D.
Model Second: Normal distribution of log2(D).
Model Third: Gamma distribution of D with 5 degrees of freedom.
For each of these 3 models, the parameters of the distribution are evaluated from the experimental data.
The 6th example refers to the putin's RF. To year of submission of this paper, the 6th case is not yet completed and can be used for the testing (confirmation of refutation) of the the models suggested. For the 6th case, all the 3 models give similar forecasts; they agree with the simple estimate. Assuming that the Nulling for the RF happens in year 2020, the collapse of RF is expected to happen no late than year 2040 with significance level 83%.

*DmitriiKouznetsov@gmail.com

1 Introduction

In this article, I treat History as science. Each scientific concept is assumed to satisfy the 6 *TORI axioms* [1]: Applicability, Verifiability, Refutability, Selfconsistence, Correspondence, Simplicity. Each of these requirements is not new; but the combination gives the strong criterion to distinguish Science from other kinds of the Human Knowledge. Initially, these axioms had been developed for the Laser Science, but they happen to be useful for other sciences too. Here I apply these axioms to Historic Science. In particular, the refutability is essential; it makes difference between sciences and religions, legends, arts.

Here the «observable» is an event, reported in publications available in free access and accepted (not denied) by the most of researchers. The most documented cases refers to monopolization of all the branches of power by a single usurper. - Whenever he/she is believed to be a wise prudent leader of a stupid bloody war criminal. In such a way, any moral qualification of historic personages falls out of the scope of this analysis.

Many cases of autocracies, kingdoms, pahants and other types of monarchies are documented. Practically, namely monarchies dominate as the Human History during the last few kilo years; the democracy as a base of the administrative system is relatively rare social social phenomenon. Many cases of collapse of an empire are documented. Several cases of collapse of democracy are documented. But it is really a rare case, when some empire, having democratic Laws, turns them ti autocracy, negating, cancelling the separation of power. I have found the only 6 cases of such a kind. Five of them are followed by the collapse of the empire. Note, that in this approach, i do not care, how well the separation of power had been implemented. The matter is that it has been officially declared, them officially negated. For this paper, the primary date comes from the free access publications [2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12]. Only the 6 events of documented official cancelling of separation of power are found. These data are collected in the table below.

n	**nulling**	**collapse**	**country**	**days**	D, y.	$\log_2(D)$	**refs**
1	1653.12.16	1661.04.23	**eng**	2685	7.3513	2.8780	[2, 3]
2	1802.08.04	1815.11.20	**fra**	4856	13.2953	3.7328	[4, 5]
3	1928.05.17	1947.12.27	**ita**	7163	19.6116	4.2936	[6, 7]
4	1933.03.24	1945.05.08	**ger**	4428	12.1235	3.5997	[8, 9]
5	1977.10.07	1991.08.20	**sov**	5065	13.8675	3.7936	[10, 11]
6	2020.03.11	**not yet**	**RF**	2k−8k?	7 − 20?	3 − 5?	[12, ?]

In the table, the first column numerates the cases documented. At the moment of submission, the last, 6th case is not yet finished; so; the only 5 rows of the table are taken into account in the statistical analysis.

The column «nulling» refers to the date of nulling (at the level of the Federal Law) of separation of powers.

The column «collapse» refers to the date of the first document that confirms the beginning of the collapse.

The column «collapse» gives the identifier of the country: England, France, Italy, Germany, Soviet Union, Russian Federation

The column «days» count the days between the dates specified.

The column «D» in namely duration measured in years. In the calculus, I keep 4 significant figures after the decimal dot. These digits may help to trace, to check my calculus: if one perform the similar analysis, one is supposed to get the same numbers. However only one or two first digits may have some forecasting meaning.

The column $\log_2(D)$ refers to the binary logarithm of the duration (measured in years).

The last column shows the references, from where the dates of the «nulling» and the «collapse» are extracted.

In general, from the table, one already may conclude, that any new case of cancelling (at the level of the Federal Law) of separation of powers in any empire, will be followed by the collapse of this empire within 7-20 years.

Collelagues often ask about probability: «What is probability that the empire collapses during certain time interval?»

In order to talk about the probability, the measure norm at some space of elementary events needs to be defined. This can be done only within some model.

In thus article, I consider 3 such models. In order to begin with, I chose 3 simple models; perhaps, the simplest 3 I can invent.

Model First assumes the identical independent normal distribution of durations D.

Model Second assumes the identical independent normal distribution of $\ln_2(D)$.

Model Third assumes the Gamma-distrubution durations D with 5 degrees of freedom. I provide some speculations in order to justify, why namely 5 degrees of freedom are expected to be most realistic: in this model, the «branches of power» collapse one by one: Legislative (beginning with the nulling of the Federal Law), Executive, Judical, informational (Media of mass information) and, en fin, religious, that determines the behavior of the individuals.

En fin, I compare the predictions of all the 3 models. Their forecasts look very similar. The Duration for each new case is unlikely to happen significantly smaller, than the minimal of the values observed, and unlikely to happen significantly bigger, than the maximal of observed values.

For the case of RF of century 21, assuming that the «nulling» [12] happened in 2020, such a «finger estimate» gives the prediction of collapse of the Russian Federation. Within the models suggested, the collapse of RF is expected to happen in the time interval between 2028 and 2042.

2 Model First (linear time scale)

The Model First is based on the following postulate:

Durations for all human civilizations, societies are distributed independently and have the same Gassian (normal) distribution with some mean value X_0 and some width σ_0.

There is no ab initio model for the collapses of an empire the pretends to be democratic and the recognizes itself as a dictatorship with the mulling; we do not know values X_0 nor that of σ_0. I try to extract maximal information from the empirical data.

We nave $N=5$ completed cases in the Table 1. From the first 5 rows of the Table, I estimate the following quantities:

the sample mean

$$t = \tilde{X} = \frac{1}{N}\sum_{i=1}^{N} X_i \approx 13.2498 \quad \text{[years]}$$

The sample spread

$$s = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}\left(X_i - \tilde{X}\right)^2} \approx 4.3851 \quad \text{[years]}$$

Scale for the Student distribution as the likelihood density for the sample mean

$$c = \frac{s}{\sqrt{N}} = \sqrt{\frac{1}{N(N-1)}\sum_{i=1}^{N}\left(X_i - \tilde{X}\right)^2} \approx 1.9611 \quad \text{[years]}$$

As it is mentioned in the Introduction, I keep 4 decimal figures after a decimal point in order to simplify the tracing of the calculus; everyone performing the same calculus is supposed to get the same values. However, only first two digits in these estimates may have some predictive meaning.

Here I measure time in years. As a reminder, these units are indicated in rectangular parenthesis at each formula when the value suggested have sense of time.

For the sample with N cases, the likelihood density $f(t)$ for X_0 to have value t is expressed through the Student Distribution with $N{-}1$ degree of freedom:

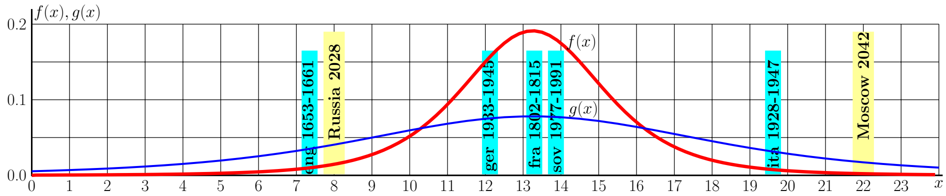
Let

$$\text{Student}_\nu(t) = \frac{\text{Factorial}\left(\frac{\nu-1}{2}\right)}{\sqrt{\pi\ \nu}\ \text{Factorial}\left(\frac{\nu}{2}-1\right)} \left(1+\frac{t^2}{\nu}\right)^{-(\nu+1)/2}$$

Then

$$f(x) = \frac{1}{c}\text{Student}_{N-1}\left(\frac{x-\tilde{X}}{c}\right)$$

This function is shown in figure below with red curve.



The five blue bars show the 5 observed values X of the Duration.

The two yellow bars show the values for the RF (Moscovia]of century 21) taken from the sci-fi

[13, 14]. These «yellow» values are not taken into account at the calculus; but they shows what would the artists expect for the 6ht row of the table above - as soon as the case will be completed.

The blue curve refers to the similar distribution g for the next measurement X_{N+1} under condition that the first N values are already observed;

$$g(x) = \frac{1}{c_1}\text{Student}_{N-1}\left(\frac{x-\tilde{X}}{c_1}\right)$$

Here parameter

$$c_1 = s\sqrt{1+1/N} \approx 4.8037 \text{ [y,]}$$

determines the scale of the distribution.

Under condition, that the first N quantities X have given values, the likelihood $p_{\text{mean}}(A,B)$ that the interval (A,B) includes value X_0 is expressed through the likelihood density f; the similar relation refers to the probability $p_{\text{next}}(A,B)$ that the interval (A,B) includes value X_{N+1} that is not yet measured:

$$p_{\text{mean}}(A,B) = \int_A^B f(x)\ \mathrm{d}x \quad , \quad p_{\text{next}}(A,B) = \int_A^B g(x)\ \mathrm{d}x$$

Within the given model, in many cases, the likelihood can be treated as if it would be a probability.

For distribution densities f and g, the spread («standard error») appears as follows:

$$v = \sqrt{\int_{-\infty}^{\infty} f(x)\ (x - \tilde{X})^2\ \mathrm{d}x}\quad ,\quad w = \sqrt{\int_{-\infty}^{\infty} g(x)\ (x - \tilde{X})^2\ \mathrm{d}x}$$

Usually it is denoted with letter σ, but we deal with several spreads; so, we need a specific letter for each of the spreads.

Case of N observations refers to function $\mathrm{Student}_{N-1}$. For this function, the spread is

$$\mathrm{Spread}_N = \sqrt{\int_{-\infty}^{\infty} \mathrm{Student}_{N-1}(x)\ x^2\ \mathrm{d}x} = \sqrt{\frac{N-1}{N-3}}$$

The mean-square deviation v of estimate $\tilde{X}$ from the «true» historic constant X_0 appears as follows:

$$v = c\sqrt{\mathrm{Dispersion}_N} = c\sqrt{\frac{N-1}{N-3}} = \sqrt{\frac{1}{N(N-3)} \sum_{i=1}^{N} \left(X_i - \tilde{X}\right)^2} \approx 2.7734 \text{ [y.]}$$

$$w = c_1\sqrt{\mathrm{Dispersion}_N} = c_1\sqrt{\frac{N-1}{N-3}} = \sqrt{\frac{N+1}{N(N-3)} \sum_{i=1}^{N} \left(X_i - \tilde{X}\right)^2} \approx 6.7934 \text{ [y.]}$$

The formulas shows why the deal with only 3 historic cases would not be sufficient to estimate the standard error of sample mean $\tilde{X}$, id est, the deviation from the «true value» X_0.

In our case, roughly, the estimate $\tilde{X}$ may deviate from the «true value» X_0 for a quantity of order of 3 years. The next measurement $\tilde{X}_{N+1}$ is expected to deviate from the estimate $\tilde{X}$ for a quantity of order of 7 years.

The likelihood densities distributions f and g for these quantities is expressed through the Student Distribution with $N-1$ degrees of freedom.

Note, that the estimate w for the uncertainty of the next measurement happens to be significantly bigger, that naive estimate

$$\sqrt{c^2 + s^2} \approx 4.8037 \quad \text{[years]}$$

for the uncertainty of sum of two independent normally distributed quantities with uncertainties s and c. This estimate seems to be not correct.

Various naive estimates similar to that above are wifely used by the specialists. The confusion with mistaken estimates of the uncertainties is recognized [15, 16, 17, 18, 19, 20].

3 Model Second

Model Second is based on the following postulate:

Binary logarithms of Durations measured in years for all human civilizations, societies are distributed independently and have the same Gaussian (normal) distribution with some mean value L_0 and some width ℓ_0.

The base of the logarithm and the unit of time (e.g., years) do not serve as adjustable parameters in this model; they affect the scale of representation of data but do not affect the likelihood-based estimates or predictions.

Within this model, we have N measurements $L_i = \log_2(X_i)$ and these logarithms are independent random quantities distributed with the same parameters L_0 and ℓ_0.

From these values, I try to estimate L_0, ℓ_0 and plot
the likelihood distribution density F for the estimate $T = \tilde{L}$ and
the likelihood distribution density G for next measurement $L_{N+1} = \log_2(X_{N+1})$
and
the likelihood distribution density $h(x) = \frac{G(\log_2(x))}{x\ \ln(2)}$ for the next measurement $X_{N+1} = \exp_2(L_{N+1})$.

For this model, denoting various estimates, I use capital Latin letters, to avoid confusion with analogous parameters of Model First denoted with the lowercase letters.

I calculate the sample mean value

$$T = \tilde{L} = \frac{1}{N} \sum_{i=1}^{N} L_i \approx 3.6596$$

This mean value corresponds to duration

$$\exp_2(T) \approx 12.6369 \text{ [years]}$$

This quantity appears as mean geometric value of N observed values of Duration. As expected, the mean geometric happens to slightly less than the mean arithmetic, id est, the sample mean.

Continue the similar calculations, as in Model First, I evaluate the sample variance

$$S = \sqrt{\frac{1}{N-1} \sum_{i=1}^{N} (L_i - T)^2} \approx 0.5099$$

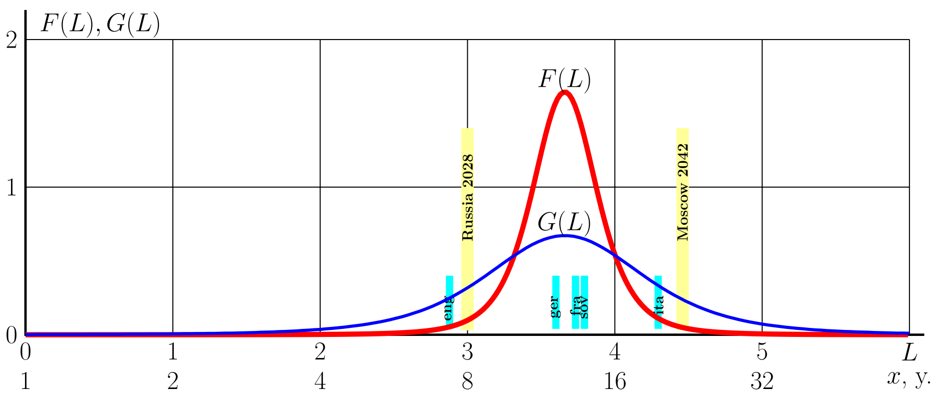
and the scale C for the Student distribution of the sample mean

$$C = \frac{S}{\sqrt{N}} = \sqrt{\frac{1}{(N-1)N} \sum_{i=1}^{N} (L_i - T)^2} \approx 0.2280$$

Now I express the likelihood distribution density $F(L)$ for the mean value L_0 to have value L:

$$F(L) = \frac{1}{C}\ \mathrm{Student}_{N-1}\!\left(\frac{L-T}{C}\right)$$

This function is shown with red curve in the figure below:



The blue bars show the 5 observed values of the logarithm, id est, $L_i = \log_2(X_i)$.
The yellow bars show the two values from sci-fi (that are not taken into account at the computation).
The blue curve shows the likelihood density function $G(L)$ for the logarithm L_{N+1} of the next measurement to gets value L, under condition that previous N measurements gave values L_i):

$$G(L) = \frac{1}{C_1}\ \mathrm{Student}_{N-1}\!\left(\frac{L-T}{C_1}\right)$$

In analogy with Model First, the parameter C_1 is estimated as follows:

$$C_1 = S\ \sqrt{1+1/N} \approx 0.5585$$

In the similar way I evaluate the spread for the sample mean and the spread V the sample mean

$$V = \sqrt{\int_{-\infty}^{\infty} F(L)\ (L-T)^2\ \mathrm{d}L\ } = \sqrt{\frac{N-1}{N-3}}\ C \approx 0.3225$$

and the spread for the estimate $T\!=\!\tilde{L}$ for the next value:

$$W = \sqrt{\int_{-\infty}^{\infty} G(L)\ (L-T)^2\ \mathrm{d}L\ } = \sqrt{\frac{N-1}{N-3}}\ C_1 \approx 0.7899$$

As in the Model First, this spread is bigger than the naive estimate

$$\sqrt{C^2 + S^2} \approx 0.5585$$

Finally, I evaluate the sigma interval for the next value of L:

$$T \pm W \approx 2.8697, 4.4494$$

and for the next value X_{N+1} in this model:

$$\exp_2(T \pm W) \approx 7.3091, 21.8481 \text{ [years]}$$

These are values that are supposed to be compared with the next measurement - perhaps, as soon as the row 6 in the First Table be completed.

4 Model Third

The two models above show that the mean value of Duration is similar to its spread. This provokes the seduction to suggest even simpler model with single adjusting parameter (mean value) instead of two (mean value and the spread). Such a model is considered in this section.

Assume, that in our era, any prosper and/or powerful country has 5 relatively independent branches of power, 5 basic institutions:
1. Legislative (making and modifying the Laws: parliament)
2. Executive (government, President, prefectures, police, army)
3. Judical (Courts, judges)
4. Informative (TV, internet, radio, newspapers)
5. Religious (religious communities, Churches, Synagogues, Mosques, etc.)

Assume, the usurper and his accomplices dismount the institutions mentioned, replace them with the imitations, one by one; and fall of each of them appears as the exponential decay. This leads to the model with the cascade of exponential decays.

Assume that all the decay rates per each institution mentioned are equal. (Anyway, we have no way to estimate decay rate of each institution having only 5 measurements.)

The assumptions above gives the model with single parameter. The probability distribution density appears as Gamma Distribution with $\alpha = 5$ degrees of freedom. Hope, the number of degrees of freedom $\alpha = 5$ in this model will not be confused with number $N = 5$ of values of duration, available at the moment of preparation of this article.

The resulting probability density function

$$\psi(x) = \text{Gamma}(\alpha, \theta, x) = \frac{1}{\Gamma(\alpha)\ \theta^\alpha}\ x^{\alpha-1} \exp(-x/\theta)$$

Here, character Γ denotes the Gamma function; $\Gamma(z) = (z+1)!$

For this distribution, the mean value

$$\int_0^\infty \psi(x)\ x\ \mathrm{d}x = \theta\alpha$$

As α is already fixed, the native estimate for the second parameter is just

$$\theta = \tilde{X}/\alpha = t/5 \approx 2.6500 \text{ [years]}$$

At least, such a choice reproduces the sample mean value.

The spread is estimated as follows:

$$\sqrt{\int_0^\infty \psi(x)\ (x-t)^2\ \mathrm{d}x} = \sqrt{\alpha}\theta = \frac{\tilde{X}}{\sqrt{\alpha}} = \frac{t}{\sqrt{\alpha}} \approx \frac{13.2498}{\sqrt{5}} \approx 5.9255 \text{ [years]}$$

In this model, each branch of power lasts of order of 3 years before to fall allowing the next one also to fall, to collapse, to decay with the similar rate; each crime in the chain appears as a trigger of the next crime, until the collapse of the country. Similar mechanism scaled down to only few participants makes the plot of movie «The Domino Principle 1977» [21].

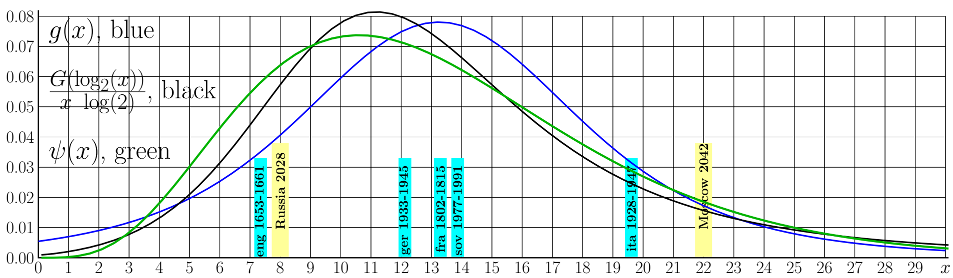
While we do not know exact mean value X_0, we have to interpret function ψ as an approximation, even within this model; so ψ appears as a likelihood density distribution.

It may have sense to compare predictions of the 3 models above.

For this comparison, I express the likelihood density function $h(x)$ for the next value X_{N+1} to get value x in Model Second:

$$h(x) = \frac{G(\log_2(x))}{x\ \ln(2)} \text{ [years}^{-1}\text{]}$$

This function is shown with the black curve in the figure below:



For comparison, the likelihood density $g(x)$ for the next value X_{N+1} to have value x in the Model First is shown with blue line; it is the same curve as the blue curve in section about Model First; the only scale in the ordinate axis is a little bit stetted to show better curves. The dark green curve represents likelihood density distribution for the next measurement in Model Third; it is scaled Gamma Distribution with 5 degrees of freedom; the scale is chosen to reproduce the sample mean $\tilde{X}$. The blue and yellow bars are repeated from the picture of section «Model First»; so, I do not describe them again.

5 Comparison

The estimates for the two models above (Model First and Model Second) are compared in the table below:

quantity	Normal distrib. of D	Normal distrib. of $\log_2(D)$
kind of distrib.	$X \sim \mathcal{N}(X_0, \sigma_0^2)$	$L = \log_2 X \sim \mathcal{N}(L_0, \ell_0^2)$
sample mean	$t = \frac{1}{N}\sum_{n=1}^{N} X_n \approx 13.2498$ [y.]	$T = \frac{1}{N}\sum_{n=1}^{N} L_n \approx 3.6596$ $\exp_2(T) \approx 12.6369$ [y.]
sample spread	$s = \sqrt{\frac{1}{N-1}\sum_{n=1}^{N}(X_n - t)^2}$ [y.] $s \approx 4.3851$ [y.]	$S = \sqrt{\frac{1}{N-1}\sum_{n=1}^{N}(L_n - T)^2}$ $S \approx 0.5099$
scale for mean	$c = \sqrt{\frac{1}{(N-1)N}\sum_{n=1}^{N}(X_n - t)^2}$ $c \approx 1.9611$ [y.]	$C = \sqrt{\frac{1}{(N-1)N}\sum_{n=1}^{N}(L_n - T)^2}$ $C \approx 0.2280$
density for mean	$f(x) = \frac{1}{c}\text{Student}_{N-1}\left(\frac{x-t}{c}\right)$ [y.$^{-1}$]	$F(L) = \frac{1}{C}\text{Student}_{N-1}\left(\frac{L-T}{C}\right)$
spread for mean	$v = \sqrt{\int_{-\infty}^{\infty} f(x)\ (x-t)^2\ \mathrm{d}x}$ $v = \sqrt{\frac{N-1}{N-3}}\ c \approx 2.7734$ [y.]	$V = \sqrt{\int_{-\infty}^{\infty} F(L)\ (L-T)^2\ \mathrm{d}L}$ $= \sqrt{\frac{N-1}{N-3}}\ C \approx 0.3225$
scale for next	$c_1 = s\sqrt{1 + 1/N} \approx 4.8037$ [y.]	$C_1 = S\sqrt{1 + 1/N} \approx 0.5585$
density for next	$g(x) = \frac{1}{c_1}\text{Student}_{N-1}\left(\frac{x-t}{c_1}\right)$ [y.$^{-1}$]	$G(L) = \frac{1}{C_1}\text{Student}_{N-1}\left(\frac{L-T}{C_1}\right)$
spread for next	$w = \sqrt{\int_{-\infty}^{\infty} g(x)\ (x-t)^2\ \mathrm{d}x}$ $w = \sqrt{\frac{N-1}{N-3}}\ c_1 \approx 6.7934$ [y.]	$W = \sqrt{\int_{-\infty}^{\infty} G(L)\ (L-T)^2\ \mathrm{d}L}$ $W = \sqrt{\frac{N-1}{N-3}}\ C_1 \approx 0.7899$
naive for next	$\sqrt{s^2 + c^2} \approx 4.8037$ [y.]	$\sqrt{S^2 + C^2} \approx 0.5585$
sigma interval for mean	$t \pm v \approx 10.4764, 16.0232$ [y.]	$T \pm V \approx 3.3371, 3.9820$ $\exp_2(T \pm V) \approx 10.1058, 15.8020$ [y.]
sigma interval for next	$t \pm w \approx 6.4564, 20.0433$ [y.]	$T \pm W \approx 2.8697, 4.4494$ $\exp_2(T \pm W) \approx 7.3091, 21.8481$ [y.]

In model Third, the mean for the next value is the same as Model First; $t \approx 13.2498$ [y].
The estimate of the spread ≈ 5.9255 [y.] of the next value X_{N+1} is also similar to $w \approx 6.7934$ [y.] in Model First.
However, in the Model Third, the spread for the next value depends on number α of branches of power we have counted. This number appears as a priori assumption about the Gamma Distribution used in Model Third.

6 Simple estimate

This section provides a simple estimate that does not rely on any parametric model of the distribution of Duration. It gives a distribution-free bound relative to the observed maximum. Assume, $D_1, \ldots, D_{N+1}$ are independent and identically distributed continuous random variables.

Consider the probability that the $(N+1)$-th observation exceeds all previous ones:

$$P(D_{N+1} > \max(D_1, \ldots, D_N)).$$

Since all $(N+1)!$ orderings of the sample are equally likely, and in exactly $N!$ of them the last observation is the largest, we obtain:

$$P(D_{N+1} > \max(D_1, \ldots, D_N)) = \frac{N!}{(N+1)!} = \frac{1}{N+1}.$$

For $N = 5$, this gives:

$$P = \frac{1}{6} \approx 0.17.$$

Therefore, with probability $5/6 \approx 83\%$, the next observation does not exceed the maximum of the observed sample.

In the present data, the maximal observed duration is approximately 19.6 years. Thus, under the assumptions above, the next duration is expected to be below this value with probability about 83%.

This estimate is distribution-free and does not depend on the specific models considered in the previous sections. It relies only on the assumption of independent and identically distributed observations.

7 Discussion

The 3 models above suggest that if the Federal Law breaks the principle of separation of powers, then, the empire collapses after a dozen years.
All the 3 models suggest, that Duration of any country after such a nulling is of order of 13 years plus-minus 6 years.

The precision of the predictions is not too good. The error of the estimate of the duration for a next case happens to be comparable to its value. Several digit are kept in the estimates in order to simplify the tracing of the calculus described.

Adding of new cases can enrich the statistics; improving the precision of the estimate $\tilde{X}$ of some "true mean value"X_0 within each of the models. However, the precision of prediction of Duration for any new case is expected to remain of order of few years. In such a way, we seem to reach the limit of the models.

The improvement of the precision of the forecast seem to require taking into account other parameters of an empire, that pretends to be a republic but eliminates the Separation of powers. The phenomenological modeling could be performed if more cases are added to Table 1.

The results of all the 3 models are similar. Since the elimination of Separation of powers, the state lasts from few years to a couple of tens of years.

The estimate for Collapse of the USSR by Andrei Amalrik [22] also happened to be not so precise; the relative error of the prediction happens to be or order its half. In 1969, Amalrik expected the USSR to collapse to year 1984 (1984-1969=15 [years]) while it collapsed, roughly, in 1991, id est, lasted 22 years (1991-1969=22 [years]) instead of 15 years expected.

Attempts of usurpation of power are observed in various epochs and in various countries. Stable democracies resist it, giving no way to apply the models above. The attempt of American President to break the American Constitution and to serve the third Presidential term («Civil War 2024» and «Trump Forever») can be considered [23, 24]. Such a destruction of the Constitution can be interpreted as elimination of Separation of powers (cutting the three with at least 3 branches of power: Executive, Legislative, Judicial). At the moment of preparation of this article, no document is found to confirm the successful passing of such a project through the legislative system of the USA. In sigh a way, yet, within the models considered, no certain prediction about the collapse of USA can be formulated. However, if success of the project «TrumpForever» in the USA Congress and the USA Senate, the American case falls into the area of applicability of the models suggested and also can be used for the testing.

The same may refer to any other country. Up to my knowledge no such a model had been published previously. The models above give a hint for construction and testing of other refutable historic models, based on various (and perhaps completely different from the above) observations. Upon the verification(s) with a posteriori observations, such a model(s) can be useful in the practical activity.

The analysis above is suggested for scientific interest. However, in century 21, the example with the collapse of RF may be import for Europe and, especially, for the Baltic countries, due to apparent attempts of the Moscovian administration to extend the Putin world war to the central Europe [25]. European history shows that empires, before collapsing, often launch major wars. Historical models thus point to the need to take seriously the danger posed by a country that rejects the separation of powers at the federal level.

8 Conclusion

Duration is defined as time between the two events:
1. The federal law of an empire eliminates the previously declared separation of powers.
2. The empire collapses, its political and administrative system is reinstalled.

For Duration, the 6 examples are mentioned in Table 1.
At the moment of loading of the article, the last, 6th case is not yet completed, but it can be used for the future testing the models suggested.

The three models are considered
with the Normal Distribution of Duration (Model First),
with the Normal Distribution of logarithm of Duration (Model Second) and with the Gamma Distribution of Duration (Model Third).
All the three models give similar predictions for the next value of Duration; it is expected to be of order of 13 years.

The simple estimate gives the similar prediction: any new measurement of Duration should give value less than 20 years at significance level 83%.

The likelihood distribution density $f(t)$ for the mean Duration X_0 to have value x and the likelihood distribution density $F(L)$ for the mean binary logarithm of Duration L_0 to have value L are shown in the figures for these two models. The likelihood density for the next value X_{N+1} to have value x is plotted in the last figure for all the 3 models above.

In Model First, it is expressed with function $g(x)$ [years^{-1}] through the Student Distribution.

In Model Second, it is expressed with function $h(x) = \frac{G(\log_2(x))}{x\ \log(2)}$ [years^{-1}]

In Model Third, it is expressed with function $\psi(x) = \mathrm{Gamma}(\alpha, \theta, x) = \frac{1}{\Gamma(\alpha)\ \theta^\alpha}\ x^{\alpha-1} \exp(-x/\theta)$ through the Gamma Distribution.

These functions allow the comparison with the future measurement(s).

All the 3 models give similar predictions about any country that at the level of the Federal Law abandons the principle of Separation of powers: the administrative system of such a country is expected to last approximately 11-13 years (from 6 to 22 years). According to these models, the putin's RF is expected to collapse between years 2027 and 2042. These estimates shows qualitative agreement with independent forecasts from the sci-fi (years 2028 and 2042).

9 Acknowledgement

Author appreciates the critic by Reviewer 1 for indicating the mistakes in estimate of the dispersion of the mean value by the results of only 3 measurements. This mistake is corrected in the current version: two more cases of abolishment of separation of power in the European history are found and are taken into account. The additional data slightly reduce the expected value for the next Duration, but do not affect the main conclusion. In this version, the «finger estimates» are replaced with accurate calculus.

Author appreciate the critics by Reviewer 2 for indicating, that it is not good to deal with only a single model (normal distribution of Duration) and for the suggestion to consider also the model with normal distribution of logarithm of Duration.

Author appreciates the critics by Editor. The relation to Baltic countries is mentioned in the Discussion.

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estimates, but the most popular are confidence intervals (CIs): intervals that contain the true parameter value in some known proportion of repeated samples, on average. The width of confidence intervals is thought to index the precision of an estimate; CIs are thought to be a guide to which parameter values are plausible or reasonable; and the confidence coefficient of the interval (e.g., 95 %) is thought to index the plausibility that the true parameter is included in the interval. We show in a number of examples that CIs do not necessarily have any of these properties, and can lead to unjustified or arbitrary inferences. ..

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