RIVERWORLD BEINGS

Characterisation of the population of beings of **Riverworld**.

Riverworld is a fictional planet and the setting for a series of sci-fi books written by **Philip José Farmer**.
Riverworld is an artificial environment where all humans (and pre-humans) ever born who died after reaching 5 years old are reconstructed.
Most of the resurrected awaken in a body equivalent to that of their 25 year old selves, in perfect health and free of any previous genetic or acquired defects.

A friend of mine made fun of the book concept and claimed half of the beings ressucitated would be prehistorical.

This project is proving him wrong.

Definitions

- Begining of mankind : Homo Erectus, 700K BC, assuming all beings on Riverworld can walk
- End of mankind : 2016. In the book, all people die in 1983 after interacting with an alien civilisation.
- Child Mortality *CM* : death of infants and children under the age of five
- Infant Mortality *IM* : death of infants and children under the age of one
- Life Expectancy *LE* : average time a being is expected to live
- Life Adult Expectancy *LAE* : average time a being is expected to live if he reachs 5 years old

Datas

- Dataset compiled amongst considered sources
- The dataset consists of Point In Times (*PIT*)
- For each *PIT*, these metrics are available : year, beings count in millions, *LE*, *LAE*, *CM* and continental proportions
- Depending on sources, *CM*, *IM*, *LE* and/or *LAE* are provided or not. Some datas have been extrapolated. Underlying model : $LE = CM * 5/2 + LAE * (1 - CM)$
- Case of beings count in prehistorical times :
    - Beings counts estimation flucuates a lot. They can go as low as 1K individuals up to 100K
    - We have 3 milestones in our dataset : -700K (lower paleolithic), -50K (higher paleolithic) and -10K (begining of history)
    - For -10K, the poulation count is within the magnitude of the millions according to most of the sources. We kept the McEvedy estimation of 4 millions.
    - For -50K, we kept the higher estimation of Jean-Pierre Bocquet-Appel from his study of upper paleolithical meta populations. He found 30K individuals in the Aurignacien (-30K).
    - For -700K, we've assumed the population could not be higher than in -50K. We selected 10K individuals as 1K seemed very scary :-)
- Case of *LE* et *CM* for prehistorical times :
    - As for beings counts, the *LE* estimations vary greatly
    - The Kaplan study suggest hunter gatherer modern societies tell us how prehistoric men lived and died. The study suggests the *ALE* is around 50 years and the *CM* around 0.5
    - For reference, the *CM* of 1900 is 0.4 and the Scheidel estimation of Classic Rome *CM* is 0.5
    - We cowardly derived the *CM* of pre Roman times to 0.6

Calculus

- Linearity in between *PIT*s :
    - The underlying assumption is that the *PIT* metrics evolve linearly in between two *PIT*s
    - This assumption can be considered true from -700K to 1700, from 1700 to 1900, from 1900 to 1950 and from 1950 to today
    - The *PIT* resolution in the dataset is consistent with this observation
    - We then assume numerical midpoint integration is a reasonable estimation
- For the period *PIT 1 => PIT 2*
- *AB yx = Amount of Beings for year x*
- Elapsed Time *ET = y2 - y1*
- Average Amount of Beings for Period *AABP = (AB y2 + AB y1) / 2*
- LAE for Period *LAEP = (LAE y1 + LAE y2) / 2*
- Proportion of Adult Beings for Period *PABP = 1 - ((CM y1 + CM y2) / 2)*
- Thus Amount of Beings who were Born for Period *ABP = ET * AABP / LAEP*
- Thus Amount of Adult Beings who were Born for Period *AABP = ET * AABP * PABP / LEP*
- Another calculus method is to use a simpe model of population growth :
    - *AB y1 = Ce^(r * y1)* and *AB y2 = Ce^(r * y2)*
    - By integration, *ABP = ET * (AB y2 - AB y1) / (ln(AB y2) - ln(AB y1)) / LEP*
    - This method proved to be very similar to the naïve numerical integration we selected (cf Report - Figure 6)

Results

- The last report : ./output/report.pdf
- The last plots : ./output

Sources

- https://en.wikipedia.org/wiki/Human_evolution
- https://ourworldindata.org/child-mortality
- https://ourworldindata.org/infant-mortality
- https://en.wikipedia.org/wiki/Life_expectancy#Variation_over_time
- https://en.wikipedia.org/wiki/World_population#Past_population
- https://ourworldindata.org/world-population-growth
- http://www.unm.edu/~hkaplan/KaplanHillLancasterHurtado_2000_LHEvolution.pdf
- https://en.wikipedia.org/wiki/Prehistoric_demography
- https://en.wikipedia.org/wiki/World_population_estimates
- http://www.evolhum.cnrs.fr/bocquet/jas2005.pdf
- https://www.princeton.edu/~pswpc/pdfs/scheidel/040901.pdf
- https://scholarspace.manoa.hawaii.edu/bitstream/handle/10125/17288/AP-v47n2-190-209.pdf
- https://ourworldindata.org/world-population-growth
- http://www.math.hawaii.edu/~ramsey/People.html

Install

- `pip install --upgrade pip`
- `pip install -r requirements.txt --user`
- Fonts used in this project : `./resources/fonts`
- PDF dependencies :
    - mac : `brew cask install wkhtmltopdf`
    - linux : `apt-get install wkhtmltopdf`

Run

- Configuration is loaded from `config.ini`
- `python riverworld.py`

Credits

- Author : Lucas Mouilleron, http://lucasmouilleron.com
- Thanks to : Jean-Benoît Bourron, Romain Charlassier

RESULTS

Main Results

Metric	Value
total beigns ever born	60.3 billions
total adult beigns ever born	17.2 billions
proportion of alive beings amongst all beings ever born	9.4%
median year of adult beings ever born	1000
median year of beings ever born	0

Proportion Of Adult Beings Amongst All Adults Ever Born

Sub Population	Value
me	1.65806845229e-09%
Asians	52%
Paloelithical era	1.0%
Neolithical era	7.3%
-10K until the birh of Jesus Christ	22.0%
Classical Athens (508 BC - 322 BC) (with civil rights)	0.001%
Classical Athens (508 BC - 322 BC)	0.007%
Roman Republic (509 BC - 27 BC)	0.02%
Western Roman Empire (27 BC - 476 AD)	3.4%
after WWII	30%

Adult Beings Results

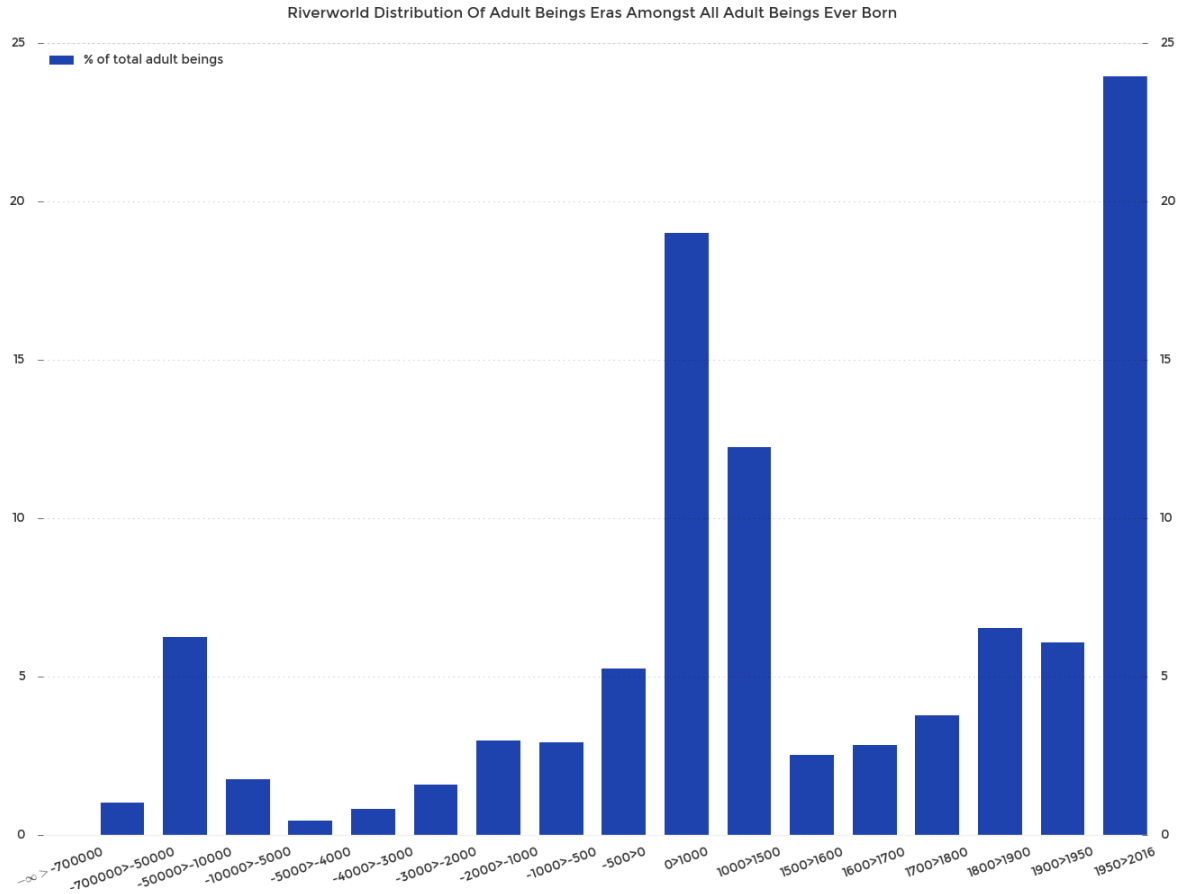

figure 1

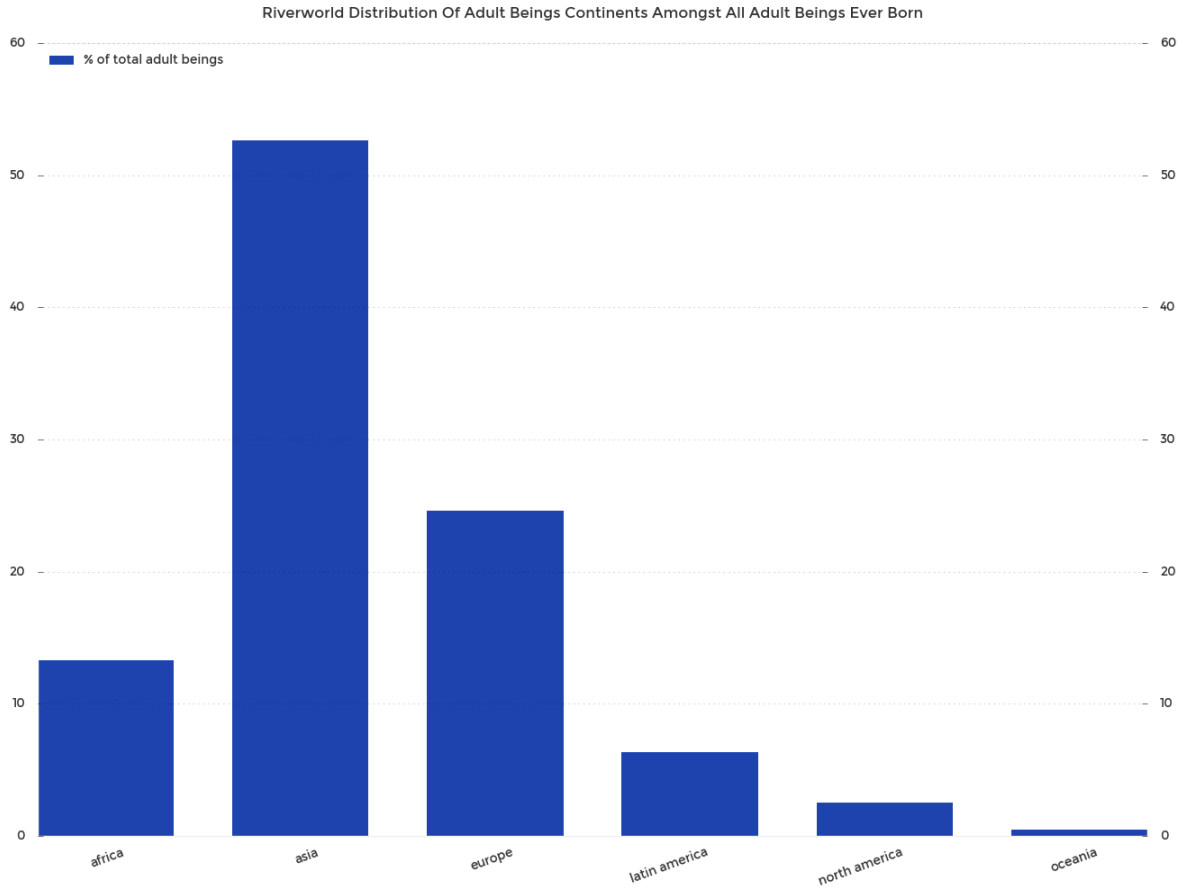

figure 2

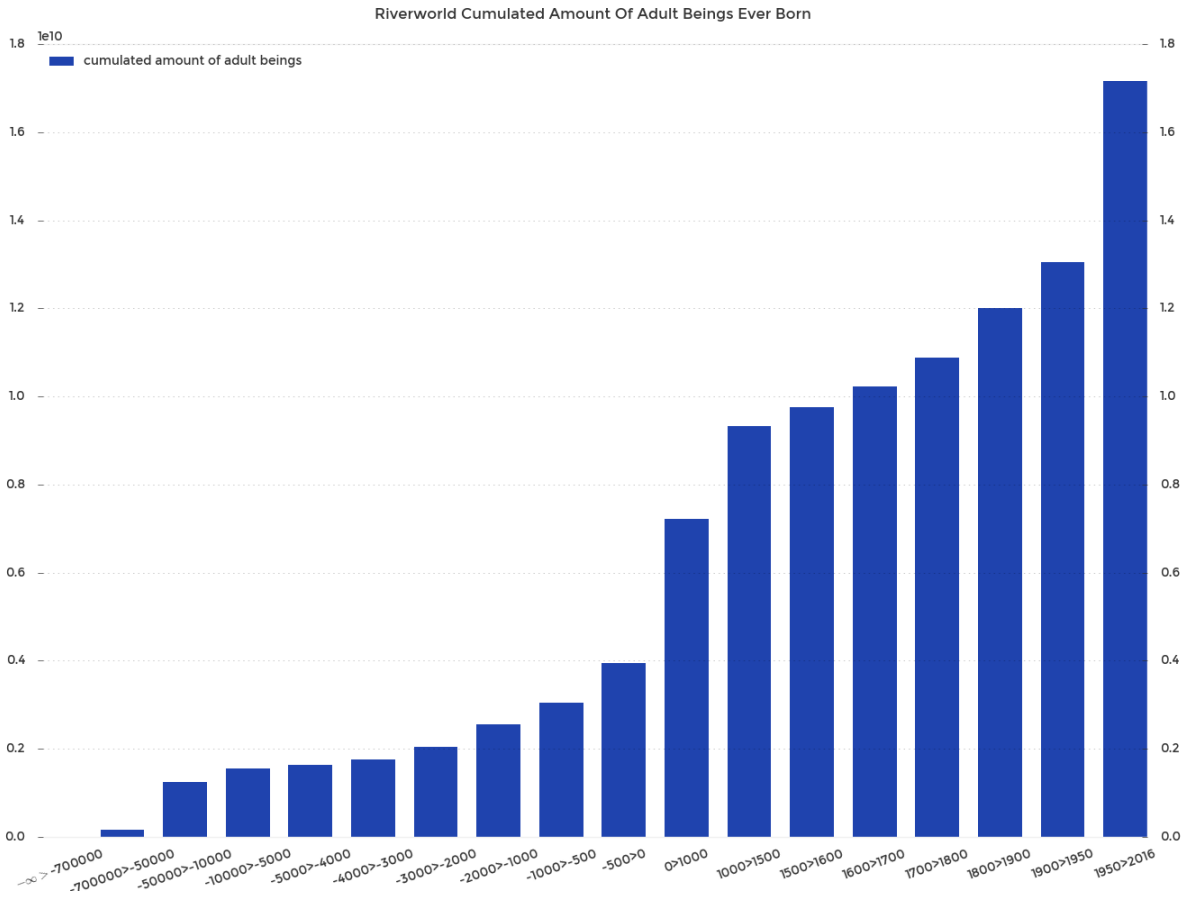
Riverworld Cumulated Amount Of Adult Beings Ever Born
1e10
cumulated amount of adult beings
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-∞>-700000
-700000>-50000
-50000>-10000
-10000>-5000
-5000>-4000
-4000>-3000
-3000>-2000
-2000>-1000
-1000>-500
-500>0
0>1000
1000>1500
1500>1600
1600>1700
1700>1800
1800>1900
1900>1950
1950>2016

figure 3

All Beings Results

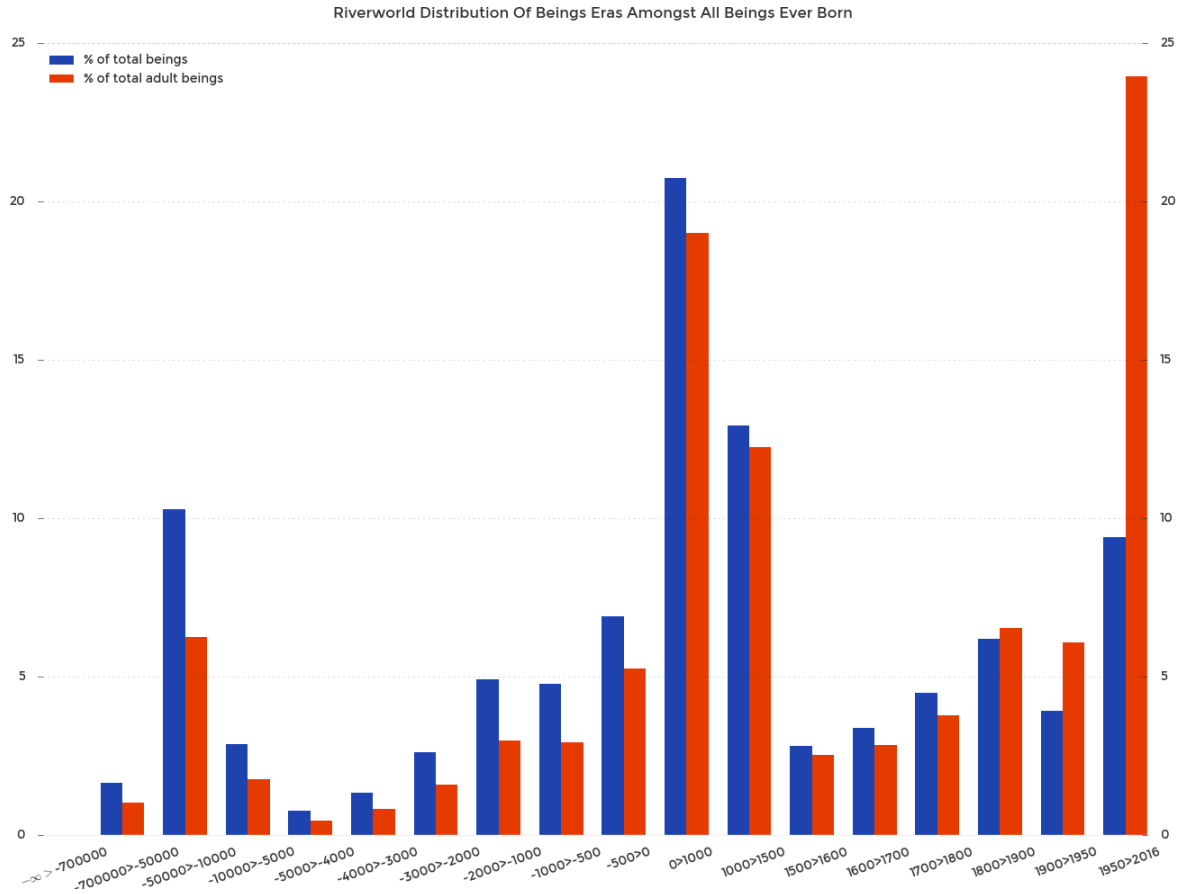

figure 4

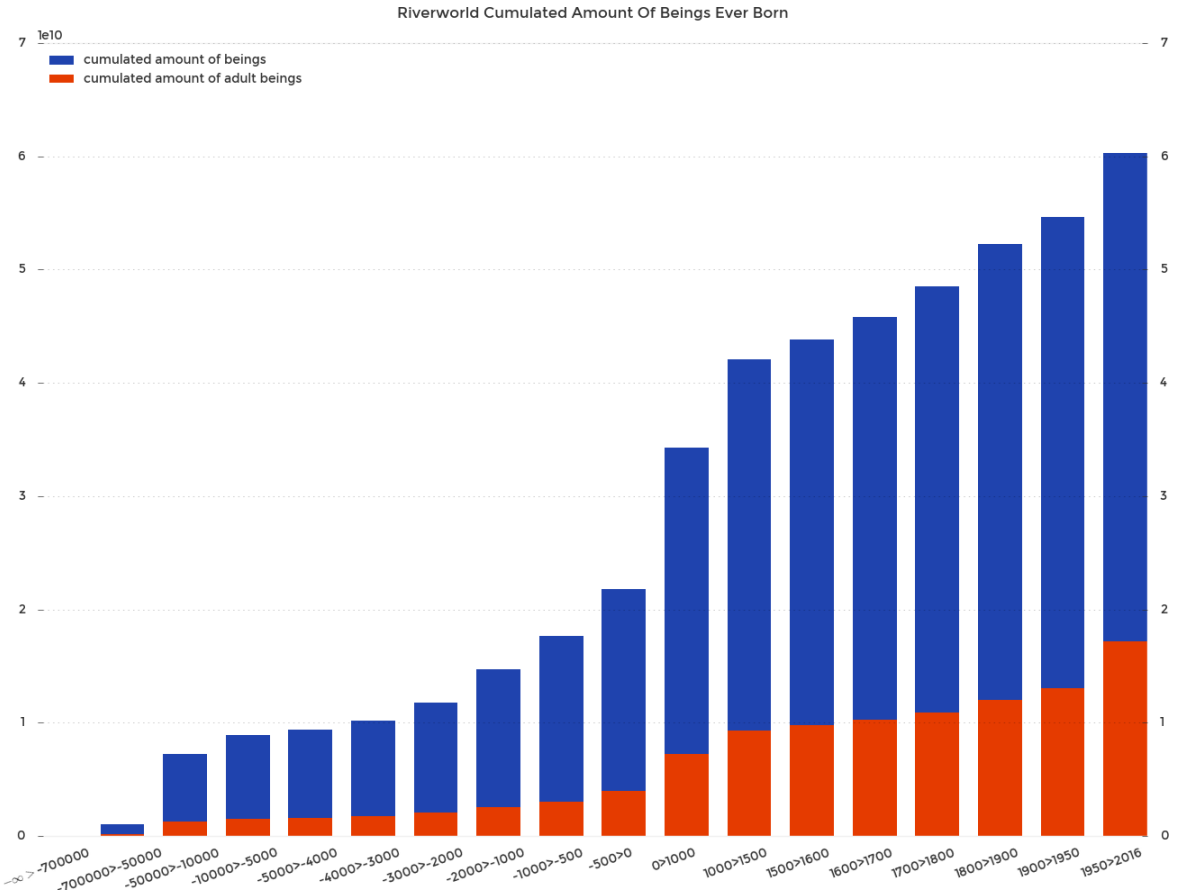

figure 5

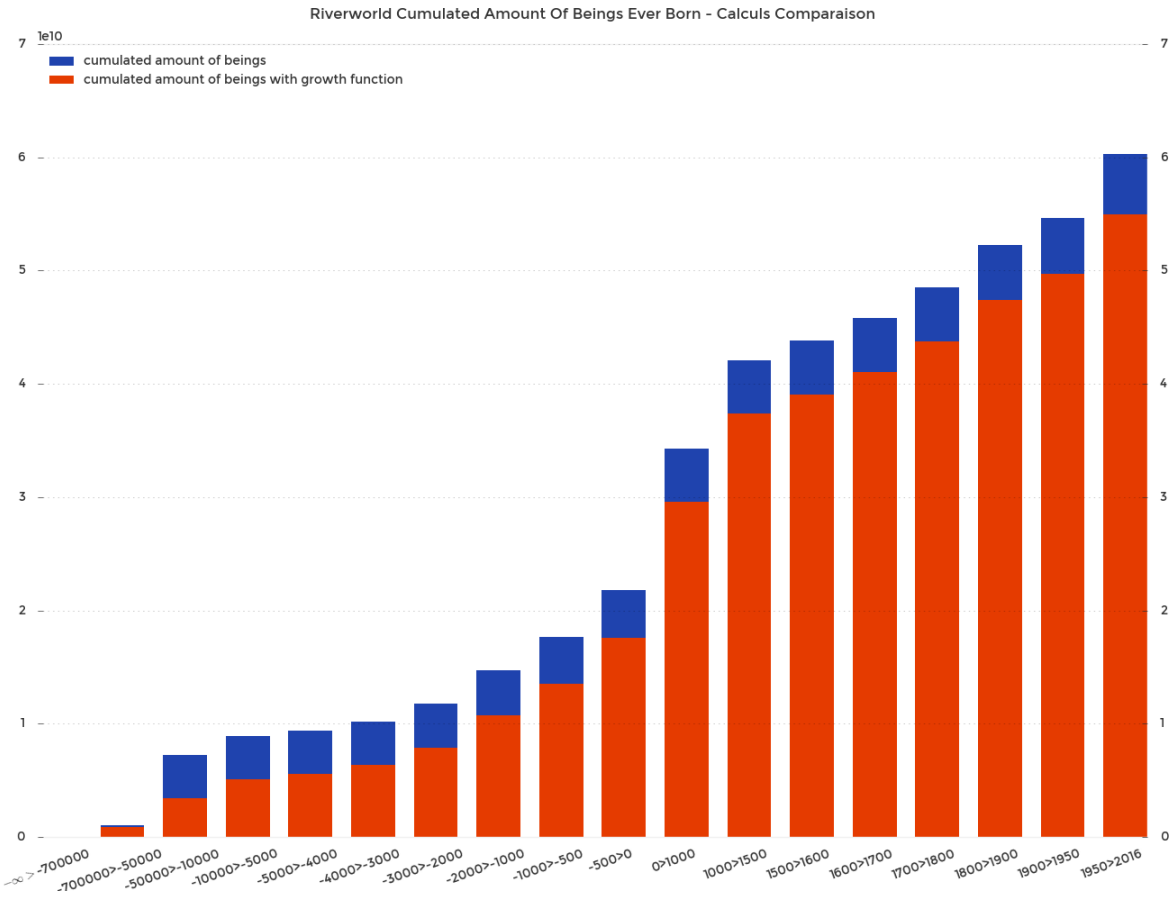
Riverworld Cumulated Amount Of Beings Ever Born - Calculs Comparaison
1e10
cumulated amount of beings
cumulated amount of beings with growth function
0
1
2
3
4
5
6
7
-∞ > -700000
-700000>-50000
-50000>-10000
-10000>-5000
-5000>-4000
-4000>-3000
-3000>-2000
-2000>-1000
-1000>-500
-500>0
0>1000
1000>1500
1500>1600
1600>1700
1700>1800
1800>1900
1900>1950
1950>2016

figure 6