

# RIVERWORLD BEINGS

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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 resuscitated would be prehistorical.

This project is proving him wrong.

## Definitions

- Beginning 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 reaches 5 years old

## Datas

- Dataset compiled amongst considered sources :
  - until now `./data/population.csv`
  - including 2070 projections `./data/population-with-future.csv`
- 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 fluctuates 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 (beginning of history)
  - For -10K, the population 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 paleolithic 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 *PITs* :
  - The underlying assumption is that the *PIT* metrics evolve linearly in between two *PITs*
  - 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*
- $AB\ yx = \text{Amount of Beings for year } x$
- 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 To Be for Period  $PABTBP = 1 - ((CM\ y1 + CM\ y2) / 2)$
- Thus Amount of Beings who were Born for Period  $ABP = ET * AABP / LAEP$
- Thus Amount of Adult Beings who were Born for Period  $AABP = ET * AABP * PABTBP / LEP$
- Another calculus method is to use a simple 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://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/Life_expectancy#Variation_over_time)
- [https://en.wikipedia.org/wiki/World\\_population#Past\\_population](https://en.wikipedia.org/wiki/World_population#Past_population)
- <https://ourworldindata.org/world-population-growth>
- [http://www.unm.edu/~hkaplan/KaplanHillLancasterHurtado\\_2000\\_LHEvolution.pdf](http://www.unm.edu/~hkaplan/KaplanHillLancasterHurtado_2000_LHEvolution.pdf)
- [https://en.wikipedia.org/wiki/Prehistoric\\_demography](https://en.wikipedia.org/wiki/Prehistoric_demography)
- [https://en.wikipedia.org/wiki/World\\_population\\_estimates](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	12.2%
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	1.65808423041e-09% (1)
Asians	52% (9.03e+09)
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

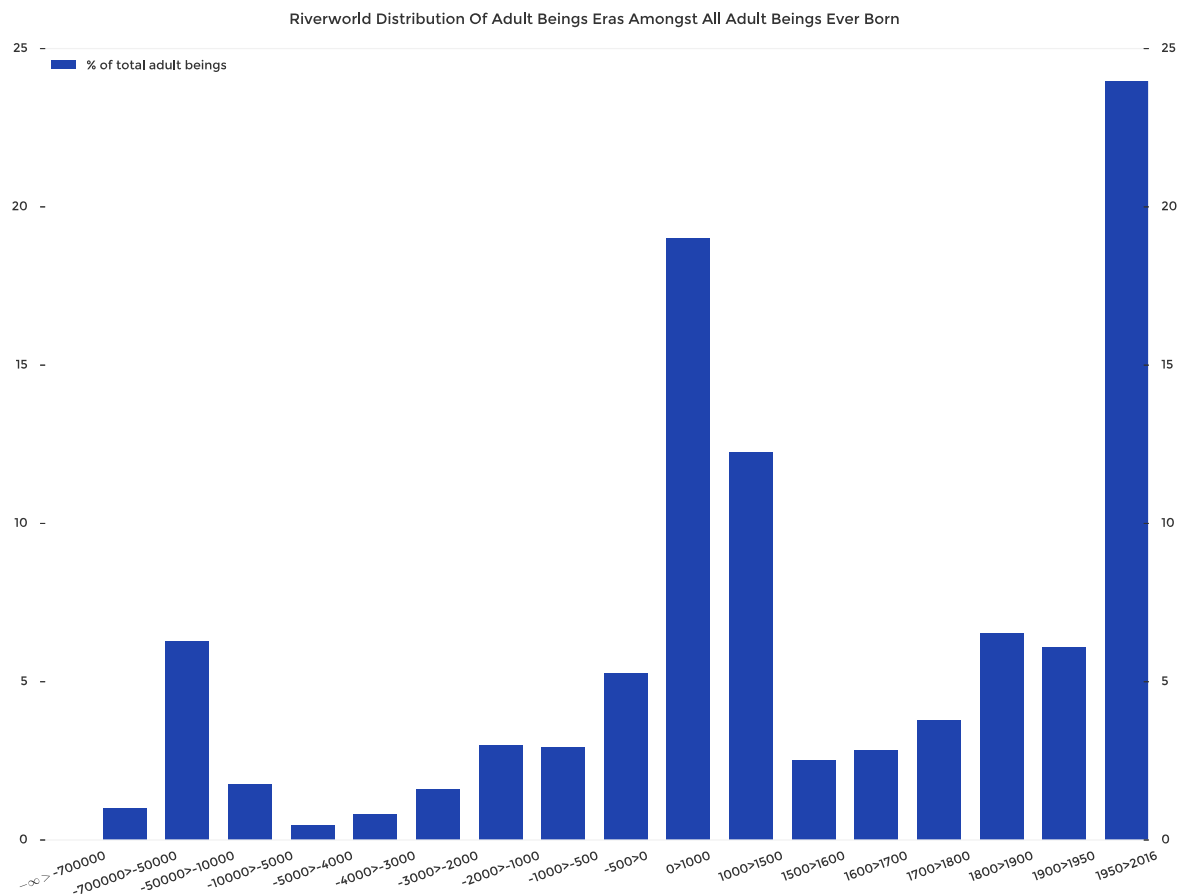


figure 1

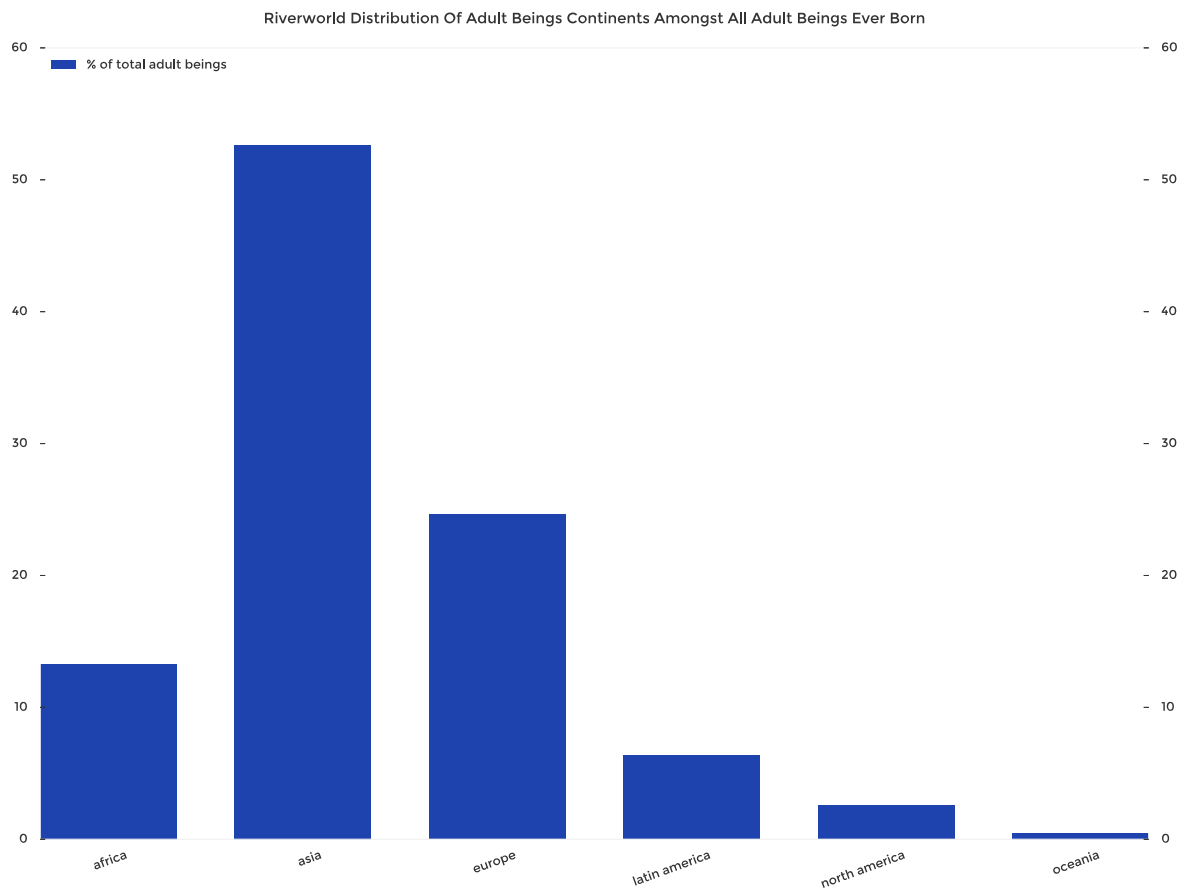


figure 2

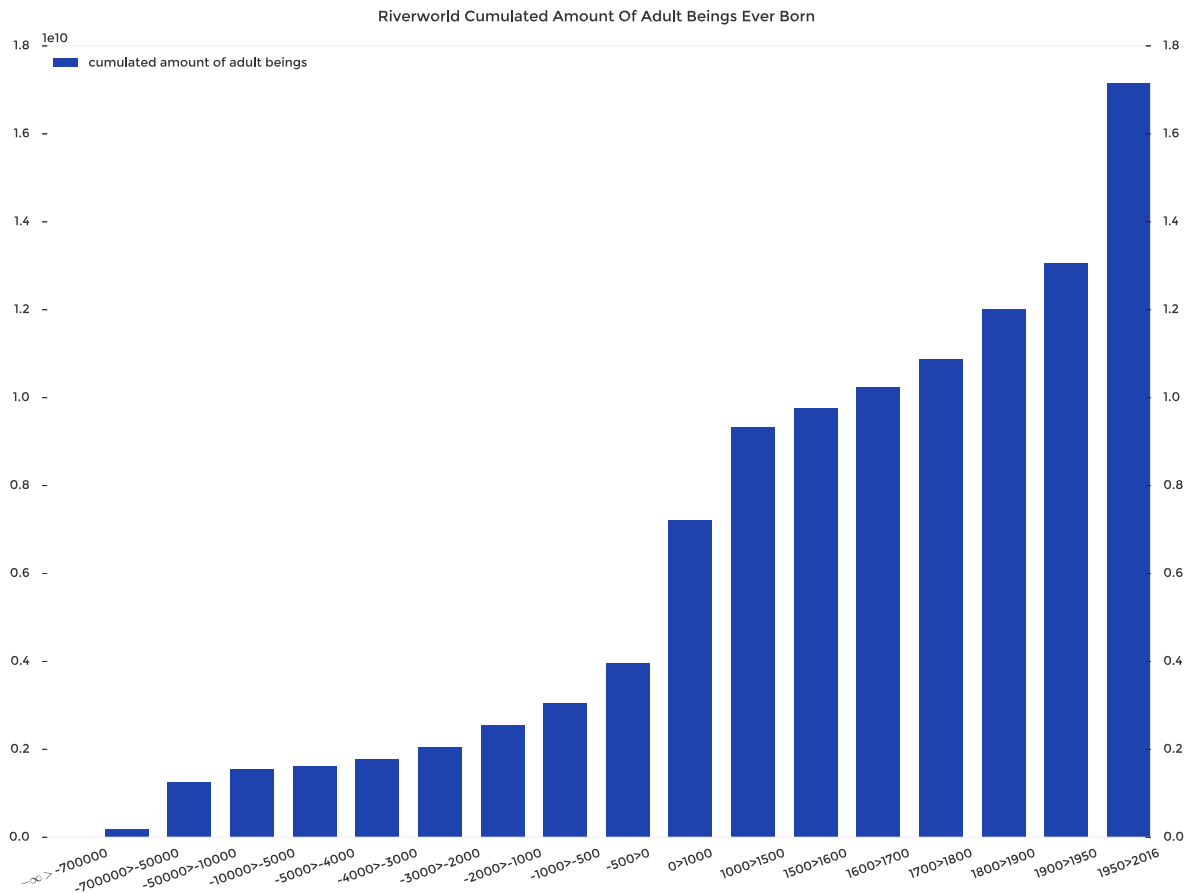
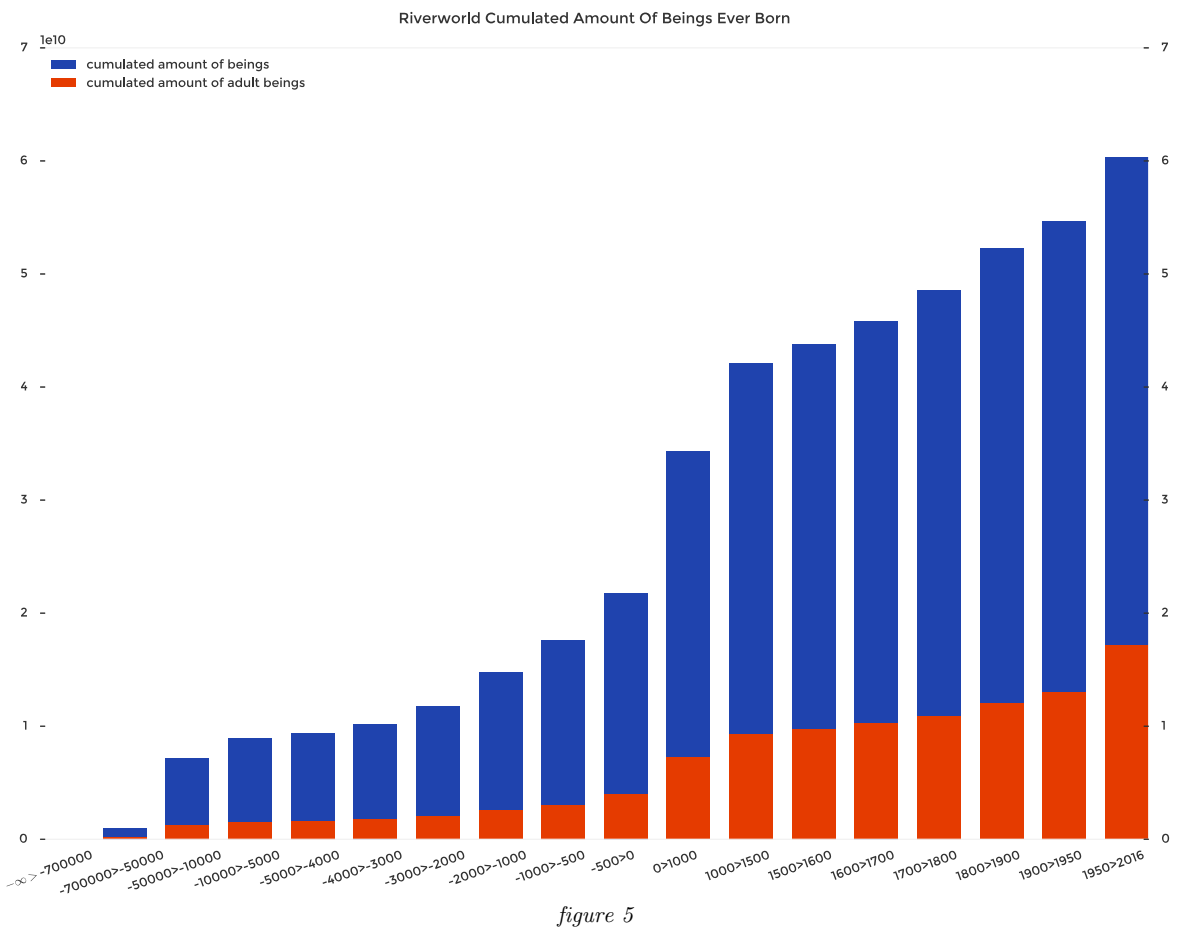
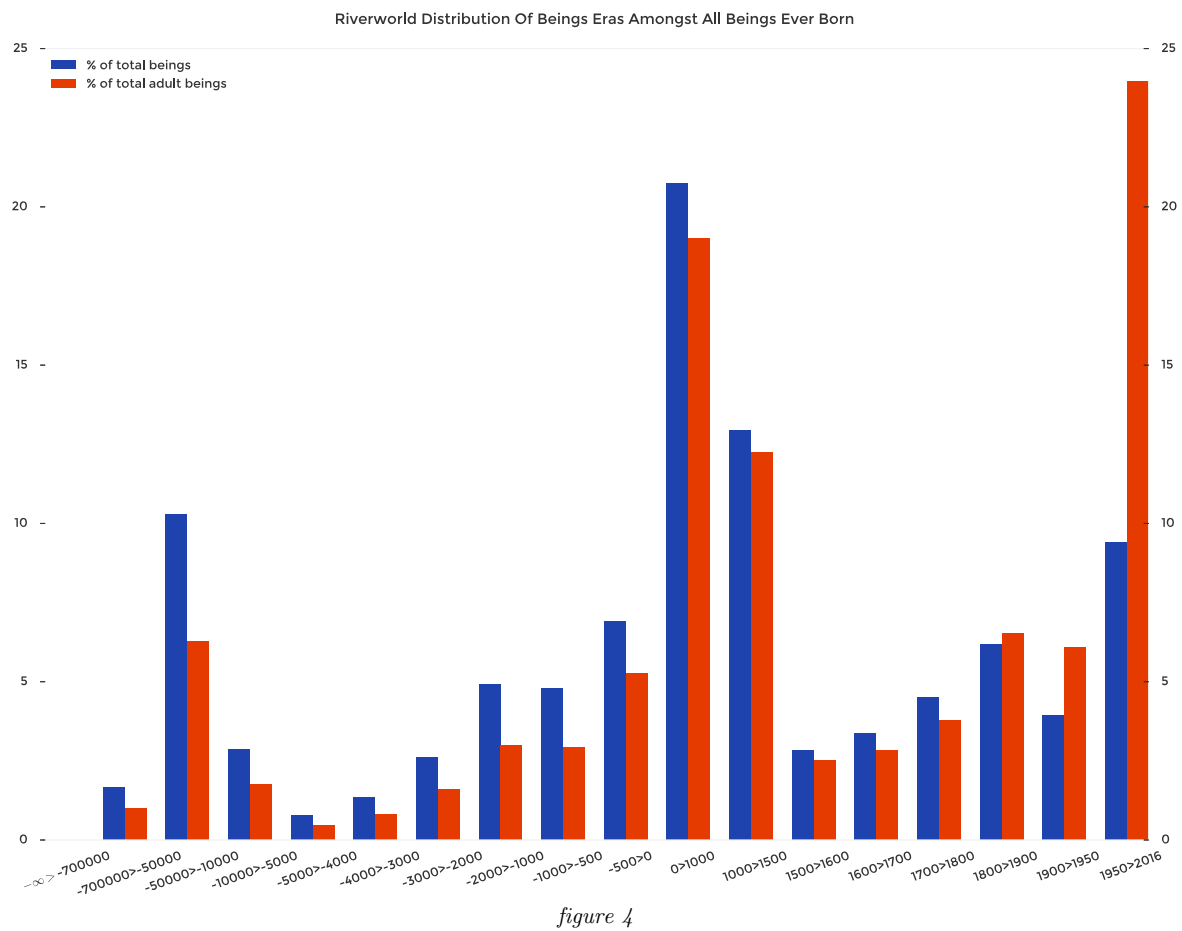


figure 3

# All Beings Results



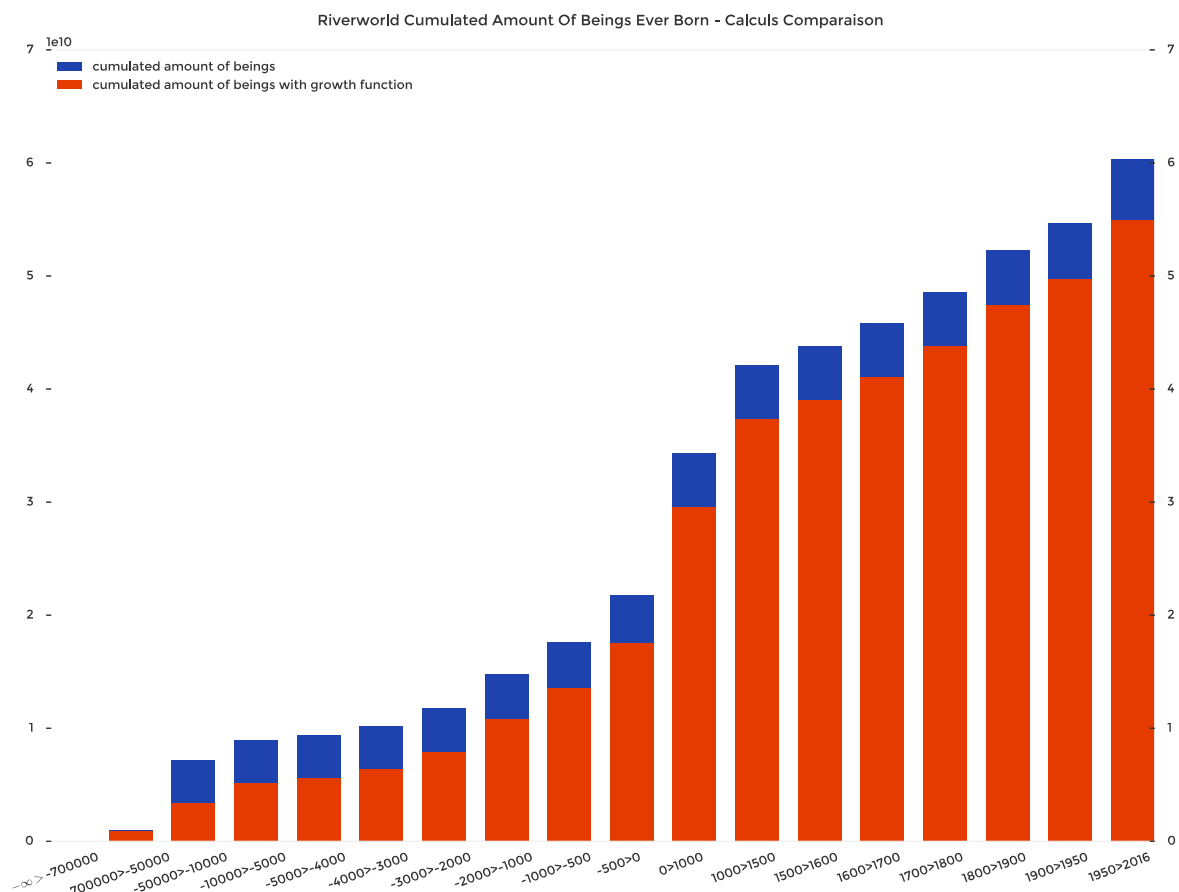


figure 6