Banking multiplier background

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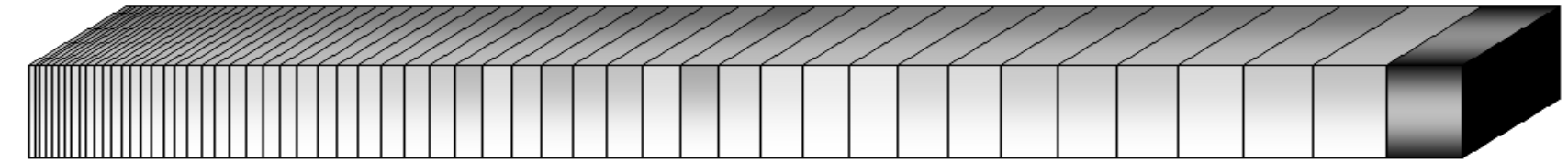
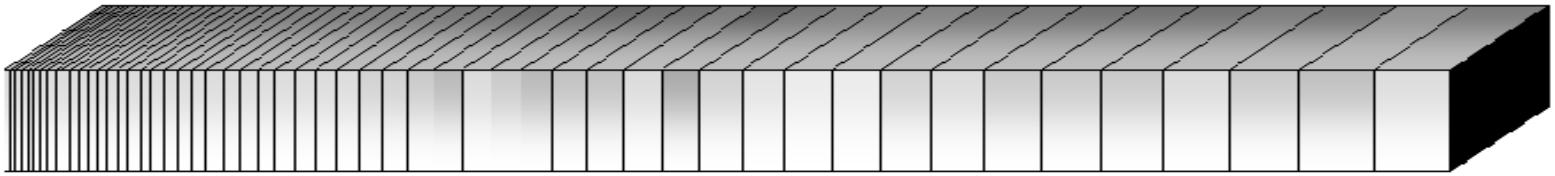
December, 2011



$$m = \sum_{i=1}^{n} (1 - R)^i$$



We begin with the classical banking multiplier

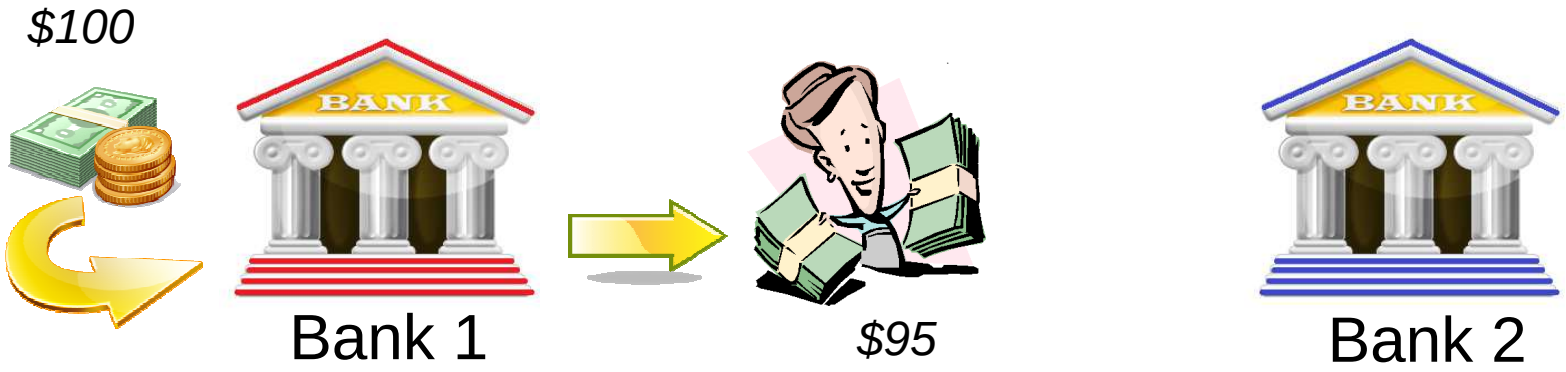
- The classic banking multiplier starts with the concept of reserves.
- Reserves allow new money to be created by banks through the issuance of loans. This happens because the requirement for physical money representation is eliminated.
- The banking multiplier is taught as:

$$m = \frac{1}{R} \qquad \textbf{(1)}$$

where ***R*** = capital reserve fraction

How does banking create money?

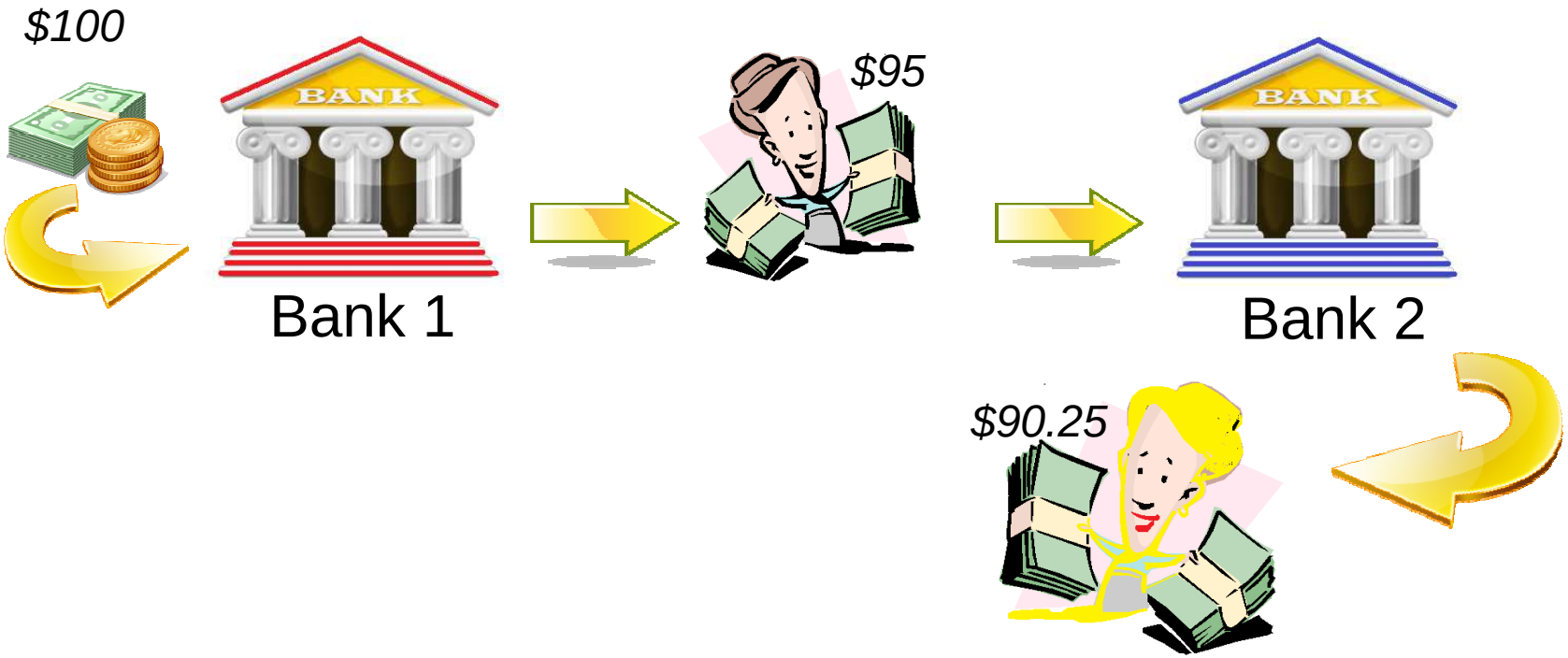
- To understand this we will use a simplified system with Zeke and Jane and two banks, bank 1 and bank 2.
- Zeke borrows from Bank 1 and deposits to Bank 2.
- Jane borrows from Bank 2 and deposits to Bank 1.
- These banks have a 5% reserve requirement.



- We will start with an initial deposit of $100 into Bank 1. With 5% reserve, Bank 1 can loan $95 to Zeke.

What happens with the first loan of $95?

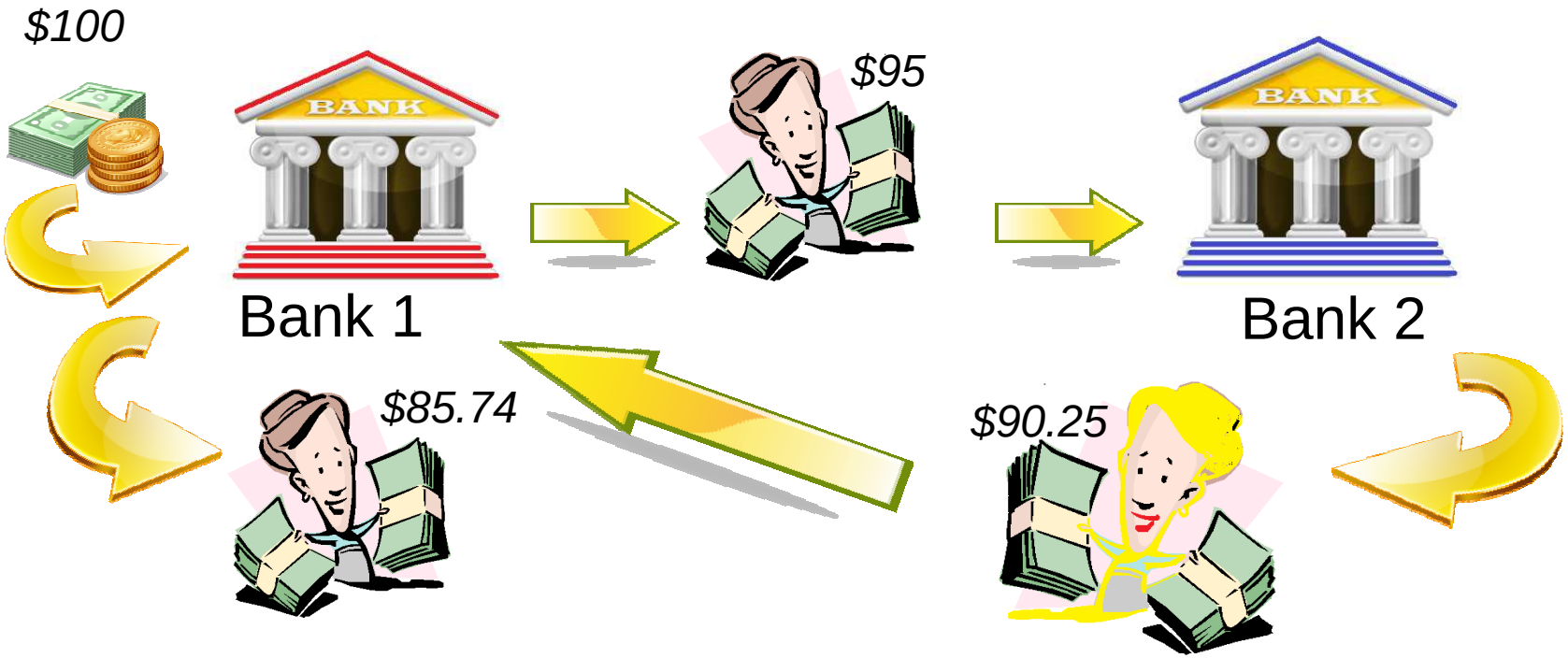
- Zeke deposits his newly created $95 into Bank 2.



- So now Bank 2 can loan Jane 95% of that new deposit originating from Zeke's loan he got from Bank 1. 95% of $95 = $90.25

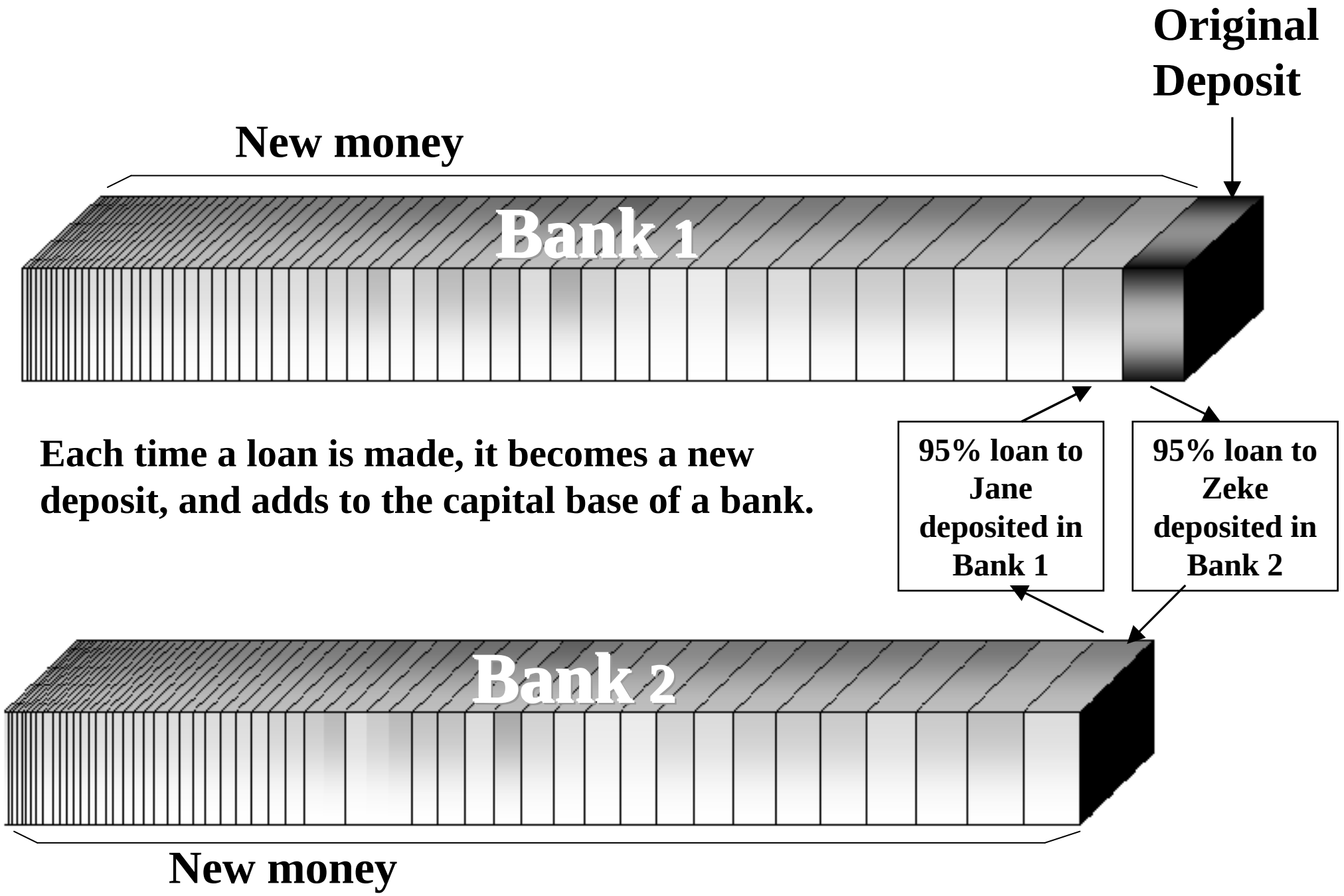
And so the $90.25 Jane deposits into Bank 1 becomes the basis for another loan, and the cycle repeats.

- Jane deposits her newly created $90.25 into Bank 1.



- So now Bank 1 can loan Zeke another 95% of that $90.25 new deposit originating from Jane's loan she got from Bank 2. 95% of $90.25 = $85.74

We can visualize this series.



Each time a loan is made, it becomes a new deposit, and adds to the capital base of a bank.

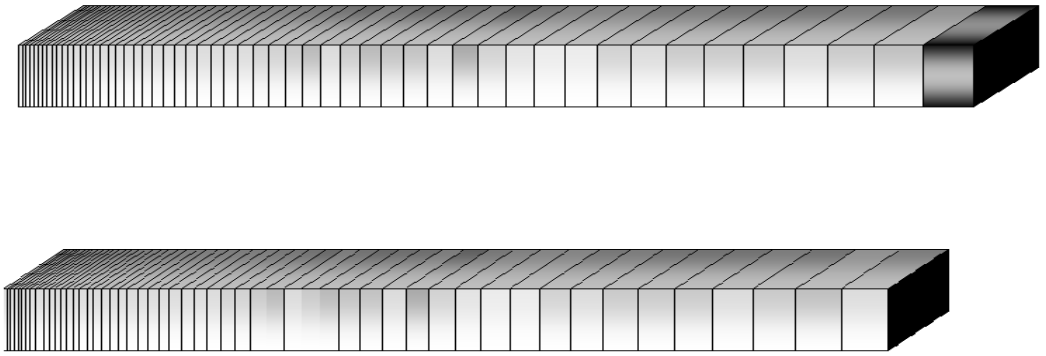
$ 100.00

Table of deposits to banks 1 and 2

$ 95.00	$ 56.88	$ 34.06	$ 20.39	$ 12.21	$ 7.31	$ 4.38	
$ 90.25	$ 54.04	$ 32.35	$ 19.37	$ 11.60	$ 6.94	$ 4.16	
$ 85.74	$ 51.33	$ 30.74	$ 18.40	$ 11.02	$ 6.60	$ 3.95	
$ 81.45	$ 48.77	$ 29.20	$ 17.48	$ 10.47	$ 6.27	$ 3.75	
$ 77.38	$ 46.33	$ 27.74	$ 16.61	$ 9.94	$ 5.95	$ 3.56	
$ 73.51	$ 44.01	$ 26.35	$ 15.78	$ 9.45	$ 5.66	$ 3.39	
$ 69.83	$ 41.81	$ 25.03	$ 14.99	$ 8.97	$ 5.37	$ 3.22	
$ 66.34	$ 39.72	$ 23.78	$ 14.24	$ 8.53	$ 5.10	$ 3.06	
$ 63.02	$ 37.74	$ 22.59	$ 13.53	$ 8.10	$ 4.85	$ 2.90	
$ 59.87	$ 35.85	$ 21.46	$ 12.85	$ 7.69	$ 4.61	$ 2.76	

In this table, n = 70 and R = 5%

Mathematically, the banking multiplier (*m*) is a summation



$$m = \sum_{i=1}^{n} (1 - R)^i \qquad \textbf{(2)}$$

- where ***R*** = capital reserve fraction
- ***i*** = iteration number on loans/deposits
- ***n*** = iteration limit

- This equation has an asymptote at equation 1.

$$m = \frac{1}{R} \qquad \textbf{(1)}$$

How does this equation behave?

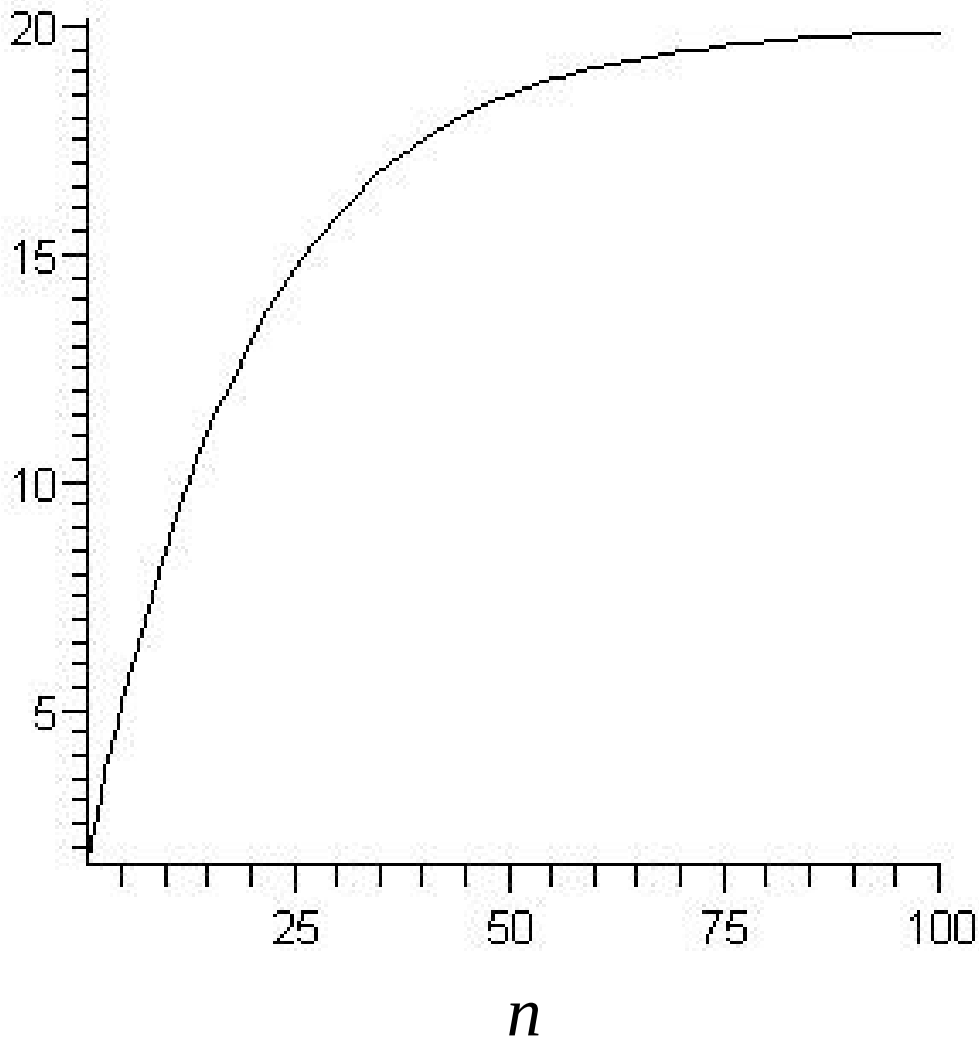
$$\sum_{i=1}^{10}(0.95)^i = 8.623998154$$

$$\sum_{i=1}^{20}(0.95)^i = 13.18876747$$

$$\sum_{i=1}^{40}(0.95)^i = 17.55826903$$

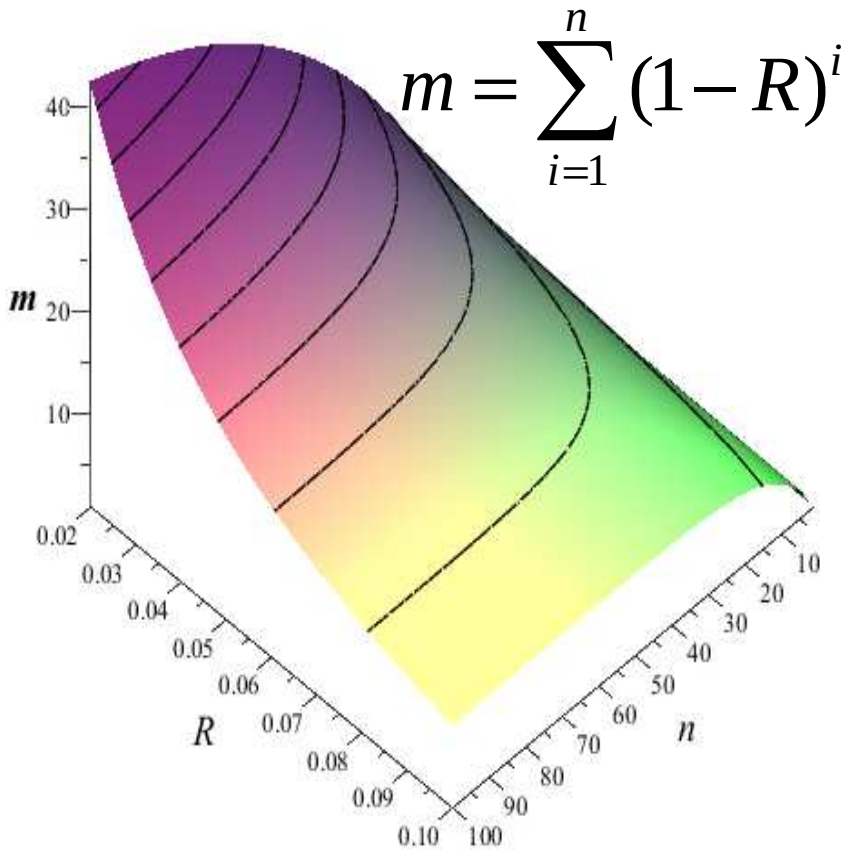
$$\sum_{i=1}^{80}(0.95)^i = 19.68620789$$

Etc.



We can render this banking multiplier (*m*) as an isosurface

- This isosurface plot shows how the money multiplier varies as iterations (*n*) go from 1 to 100.
- The reserve (*R*) parameter starts at 2% and increases to 10%.
- Most reserves in the USA and EU are around 5% to 7%.
- In the GFC, some formal reserves dropped as low as 2.4%. (Outside of central banks.)



Value of *m* as reserve and iterations vary
R = reserve fraction
n = iteration limit