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Problem 5-1: Role of Preferential Attachment

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$$\frac{dk_i}{dt} \approx m\Pi k_i \approx m \cdot \frac{1}{m_0 + k - 1} = \frac{m}{m_0 + t - 1} \tag{5.12}$$

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$$m\left[1 + \log \frac{m_0 + t - 1}{m_0 + 1 - m_0 + (m_0 + t - 1)\exp\left(1 - \frac{k}{m}\right)}\right]$$

$$= m\left[1 + \log(m_0 + t - 1) - \log(m_0 + t - 1)\exp\left(1 - \frac{k}{m}\right)\right]$$

$$= m\left[1 + \log(m_0 + t - 1) - (\log m_0 + t - 1) - \log\left(\exp\left(1 - \frac{k}{m}\right)\right)\right]$$

$$= m\left[1 - 1 + \frac{k}{m}\right]$$

$$= k$$

5

$$P(k) = \frac{dP(k)}{dk} = \frac{e^{1-\frac{k}{m}}}{m}$$

Problem 5-2: Friendship Paradox

1

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People with lots of friends are more likely to be counted as one of your friends in the first place.

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Problem 5-3: Barabási-Albert Model

For source code, see `asg005.ipynb`

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	Practical Results	Analytical Results
Number of Nodes	105	105
Number of Edges	310	310
Sum of Node Degree	620	-

Based on these values, we can confirm that our `barabasi_albert` function is correct

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	Practical Results	Analytical Results
Average Clustering Coefficient	0.0512	0.0475
Diameter	5	3.575
γ	10.9	3

We obtained a higher value for the diameter of our generated network than the expected value according the lecture slides. However it is not too far off, and the formula presented in the lecture is for the average diameter of all possible Barabási-Albert networks based on their size, so it is OK to deviate slightly from this average.