Intelligent Data Management - Exercise 2

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November 2, 2017

Assignment 1: Bonferroni's Principle

a) days with observation = 2000

$$\text{number of pairs of days} = \binom{2000}{2} \approx 2 \times 10^6$$

$$\text{number of suspected pairs} = 5 \times 10^{17} \times 2 \times 10^6 \times 10^{-18} = 1,000,000$$

b) The number of people observed was raised to 2 billion (and there were therefore 200,000 hotels).

$$\text{number of pairs of people} = \binom{2 \times 10^9}{2} \approx 2 \times 10^{18}$$

$$\text{chance same hotel} = \frac{10^-4}{2 \times 10^5} = 5 \times 10^{-10}$$

$$\text{chance same hotel on two different given days} = (5 \times 10^{-10})^2 = 2.5 \times 10^{-19}$$

$$\text{suspected pairs} = 2 \times 10^{18} \times 5 \times 10^5 \times 2.5 \times 10^{-19} = 250,000$$

c) We only reported a pair as suspect if they were at the same hotel at the same time on three different days.

$$\text{chance same hotel on three different days} = (10^{-9})^3 = 10^{-27}$$

$$\text{number of "triples" of days} = \binom{1000}{3} \approx 1.7 \times 10^8$$

$$\text{suspected pairs} = 5 \times 10^{17} \times 1.7 \times 10^8 \times 10^{-27} = 0.085$$

Assignment 2: Base of the natural logarithm

a) Approximations in terms of e

$$(1.01)^{500} = (1+0.01)^{500} = e^{0.01\times 500} = e^{5}$$
$$(1.05)^{1000} = (1+0.05)^{1000} = e^{0.05\times 1000} = e^{50}$$
$$(0.9)^{40} = (1-0.1)^{40} = e^{-0.1\times 40} = e^{-4}$$

b) Approximation of e^x with Taylor expansion:

$$e^{1/10} \approx 1 + \frac{1}{10} + \frac{1}{200} + \frac{1}{6000} + \frac{1}{240000} \approx 1.105$$

$$e^{-1/10} \approx 1 - \frac{1}{10} + \frac{1}{200} - \frac{1}{6000} + \frac{1}{240000} \approx 0.904$$

$$e^{2} \approx 1 + 2 + \frac{4}{2} + \frac{8}{6} + \frac{16}{24} \approx 7.000$$