

Spring 2010: CS769 Homework 1  
Reference Solution

Junming Sui (reviewed by Tuo Wang)

February 1, 2010

**Answer 1**

$$\begin{aligned}
x + 6 &= x^2 \\
x^2 - x - 6 &= 0 \\
(x + 2)(x - 3) &= 0 \\
x = -2 &\text{ or } x = 3
\end{aligned}$$

**Answer 2**

Denote  $f(x) = \frac{1}{1+e^{-x}}$ , then

$$f'(x) = \frac{-1}{(1+e^{-x})^2} \times (-e^{-x}) = \frac{e^{-x}}{(1+e^{-x})^2}$$

**Answer 3**

$(x, y)$  is on the unit circle, so let  $x = \sin \alpha$  and  $y = \cos \alpha$ ,  $\alpha \in [0, 2\pi]$ , then  $f(x, y) = \sin \alpha + \cos \alpha = \sqrt{2} \sin(\alpha + \frac{\pi}{4})$ . So, the minimum value of  $f(x, y)$  is  $-\sqrt{2}$ , when  $\alpha = (\frac{3}{2} - \frac{1}{4})\pi = \frac{5}{4}\pi$ , i.e.  $x = y = -\frac{\sqrt{2}}{2}$ .

**Answer 4**

$$p(x) = \frac{1}{\sqrt{2\pi\frac{1}{2\lambda}}} e^{-\frac{(x-0)^2}{2\frac{1}{2\lambda}}} = \frac{1}{\sqrt{\pi/\lambda}} e^{-\lambda x^2}$$

$$\log p(x) = -\lambda x^2 - \frac{1}{2} \log(\pi/\lambda)$$

**Answer 5.1**

There are 33,345 *word tokens* and 2,245 *word types*.

**Answer 5.2**

The top 10 most frequent words are

word type	count
,	2418
the	1618
'	1106
.	961
and	810
to	720
a	620
it	596
she	545
of	499

**Answer 5.3**

see figures on next page.

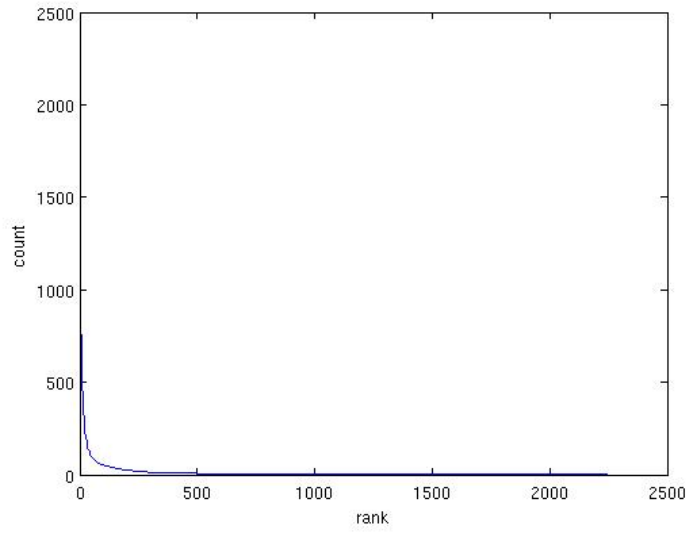


Figure 1: rank vs. count

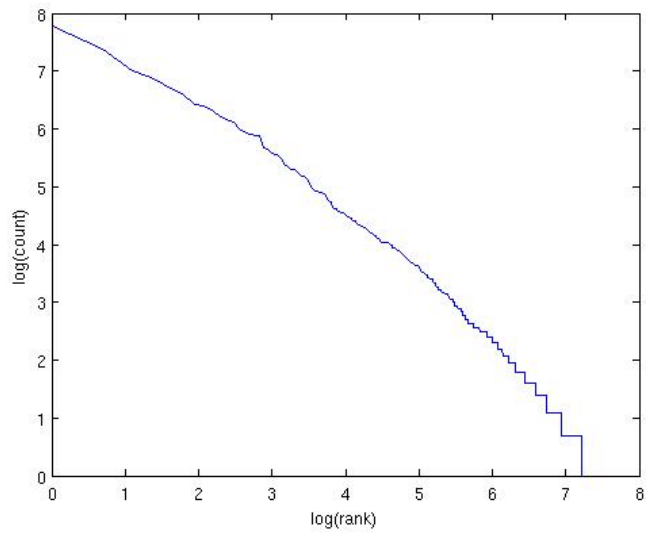


Figure 2: log-rank vs. log-count

**Answer 5.4**

$p = \text{polyfit}(\log(r), \log(f), 1);$

$p = -1.3278 \ 10.0814$

$f = \exp(-1.3278 \log(r) + 10.0814) = 23894r^{-1.3278}.$

That is  $a = 23894$ ,  $b = -1.3278$ .