Chris Park (Kyungmook) M07068980
CS6097Wireless Net — Fall 2014
Due: Sep 10th 2014 6:00PM
P2.2, P2.3, P2.4, P3.2, P3.4, P3.7

Homework 1

Problem 1

P2.2: A random digit generator on a computer is activated three times consecutively to simulate a random three-digit number.

(a) **How many random three-digit numbers are possible?**
If we include 0 as the first digit,
10 * 10 * 10 = 1000
1000numbers are possible.

(b) **How many numbers will begin with the digit 2?**
First digit is fixed; therefore, 1 * 10 * 10 = 100
100
numbers will begin with the digit 2.

(c) **How many numbers will end with the digit 9?**
Last digit is fixed; therefore, 10 * 10 * 1 = 100
100
numbers will end with the digit 9.

(d) **How many numbers will begin with the digit 2 and end with the digit 9?**
The first and the last digits are fixed; therefore, 1 * 10 * 1 = 10
10
numbers will begin with the digit 2 and end with the digit 9.

(e) **What is the probability that a randomly formed number ends with 9 given that it begins with a 2?**
Given the number begins with the digit 2, 100 numbers will be formed.
Out of the 100 numbers, 10 numbers will end with the digit 9.
Therefore, the probability that a randomly formed number ends with 9 given that it begins with a 2 is 10/100 = 0.0

Problem 2

P2.3: A snapshot of the traffic pattern in a cell with 10 users of a wireless system is given as follows:

User Number	1	2	3	4	5	6	7	8	9	10
Call Initiation Time	0	2	0	3	1	7	4	2	5	1
Call Holding Time	5	7	4	8	6	2	1	4	3	2

(a) **Assuming the call setup/connection and call disconnection time to be zero, what is the average duration of a call?**

Let
t_{init} = call initiation time
t_{hold} = call holding time
n_{users} = number of users
λ = arrival rate
μ = service rate

$\lambda = \frac{\sum CallInitiationTime}{NumberOfUsers} = 2.5$

$\mu = \frac{\sum CallHoldingTime}{NumberOfUsers} = 4.2$

W_s = Average dwell time

$W_s = \frac{1}{\mu - \lambda} = 0.5882$

(b) **What is the minimum number of channels required to support this sequence of calls?** L_s = Average number of customers who are waiting for service
$L_s = 1.4706$
$\therefore$ We need at minimum two channels to support this sequence of calls.

(c) Show the allocation of channels to different users for part (b) of this problem.

(d) Given the number of channels obtained in part (b), for what fraction of time are the channels utilized?

Problem 3

P2.4: A department survey found that four of ten graduate students use CDMA cell phone service. If three graduate students are selected at random, what is the probability that the three graduate students use CDMA cell phones?

$P = 4 \div 10 \cdot 3 \div 9 \cdot 2 \div 8 = 1 \div 30$

Problem 4

P3.2: Consider an antenna transmitting a power of 5W at 900 MHz. Calculate the received power at a distance of 2km if propagation is taking place in free space.

Problem 5

P3.4: The transmission power is 40W, under a free-space propagation model,

(a) What is the transmission power in unit of dBm?

(b) The receiver is in a distance of 1000 m; what is the received power, assuming that the carrier frequency fc = 900 MHz and Gt = Gr = 0 dB?

(c) Express the free space path loss in dB.

Problem 6

P3.7: Consider an antenna transmitting at 900 MHz. The receiver is traveling at a speed of 40 km/h. Calculate its Doppler shift.