Computer Engineering Department
King Fahd University of Petroleum and Minerals

COE 402: Computer Systems Performance Evaluation

First Major Exam
Date: April 3th, 2007

Time: 6:15PM – 8:00PM

Instructor: Dr. Uthman Baroudi

Student Name:----------
Student ID:----------

	Max	Earned
Question 1	60	
Question 2	80	
Total	140	

Notes:

Be a smart exam taker:
If you get stuck on one problem go on to another problem.
Don't waste your time giving irrelevant (or not requested) details.
Go over all questions and start with what you know first.
Read, think, state all your assumptions, and then answer.

Question # 1 (60 marks)

1) *(10 points)* Provide a one-sentence definition of following terms using provided space in the following table.

Term	Explanation
Reliability	
Availability	
Stretch factor	
Nominal capacity	
Harmonic mean	

2) *(10 points)* Define the following indices of dispersion and identify their use:
   a) Coefficient of Variation (C.O.V)
   b) Semi-Interquartile range (SIQR)

3) *(40 points)* suppose you are an employee of Saudi Telecom Company. The company is interested in choosing a high-speed wireless technology to expand its services. There are two alternatives: WiMax technology and HSDPA. Your boss asks you to design a study to choose one technology. Make a proposal for the first steps of this study.

High-Speed Downlink Packet Access (HSDPA) (Sometimes known as High-Speed Downlink Protocol Access) is a 3G mobile telephony protocol in the HSPA family, which provides a roadmap for UMTS-based networks to increase their data transfer speeds and capacity. Current HSDPA deployments now support 1.8 Mbit/s, 3.6 Mbit/s, 7.2 Mbit/s and 14.4 Mbit/s in downlink.

Further speed grades are planned for the near future. The networks are then to be upgraded to HSPA Evolved, which provides speeds of 42Mbit downlink in its first release[1].

In addition to supporting high data speeds, HSDPA greatly increases the capacity of the network. Current HSDPA networks have the capacity to provide each customer with 30 gigabytes of data per month in addition to 1000 minutes of voice and 300 minutes of mobile TV

WiMAX is defined as **W**orldwide **I**nteroperability for **M**icrowave **Acc**ess by the WiMAX Forum, formed in June 2001 to promote conformance and interoperability of the IEEE 802.16 standard, officially known as WirelessMAN. The Forum describes WiMAX as "a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to cable and DSL.The bandwidth and reach of WiMAX make it suitable for the following potential applications:

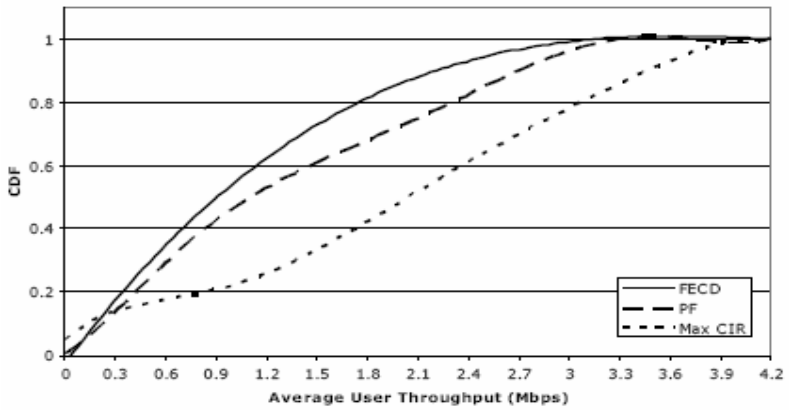
- Connecting Wi-Fi hotspots with each other and to other parts of the Internet.
- Providing a wireless alternative to cable and DSL for last mile (last km) broadband access.
- Providing high-speed data and telecommunications services.
- Providing a diverse source of Internet connectivity as part of a business continuity plan. That is, if a business has a fixed and a wireless internet connection, especially from unrelated providers, they are unlikely to be affected by the same service outage.
- Providing Nomadic connectivity

Refereence: http://en.wikipedia.org/wiki/

<u>This is an open problem, there is no right or wrong solution; use your imagination</u>.

Question # 2 (80 marks)

1) *(15 points)* The plot below shows the distribution of users' average throughputs under three algorithms: FECD, PF and Max CIR. Using these distributions, determine which algorithm shall provide the higher average user throughput and then the fairest algorithm (justify your answer). What if these CDFs are for the packet delay, which one will produce the minimum average packet delay?



2) *(20 points)*Consider the following claimed pdfs and CDFs, fill in the blank boxes in the table such that you have true pdfs and CDFs (**justify your answer**).

CDF	Range	Plot of CDF	Pdf	Plot of Pdf
$F(x) = 1 - x^{-a}$				
			Uniform(1,3)	

3) *(20 points)* let X and Y be the random variables with joint probability distribution given below. Answer the following questions:
   a) Is f(x,y) probably defined as a joint distribution function? Why?
   b) Find the expected value of (XY).
   c) Find the Cov(x,y)
   d) Are X and Y independent random variable? Why?

f(x,y)		x			
		0	1	2	
y	0	3/28	9/28	3/28	
	1	3/14	3/14		
	2	1/28			

4) *(15 points)* Which measure of Central Tendency should be used to summarize the following types of data (Justify your answer):

Type of Data	Central Tendency Index	**Justification**
Size of messages in a communication network		
Cache hit ratios over several levels of caches		
Type of microprocessor used in various workstations		
Execution time		
MIPS		

5) *(10 points)* Consider the following measurements for the performance improvements of the latest version of five layers of a new networking protocol. What is the average improvement per layer? Justify your answer.

Protocol layer	Performance improvement (%)
5	20
4	10
3	45
2	15
1	10