Assignment 2

Remember in all of the problems described here that transmission rates always use the decimal prefixes (e.g., 1K = 1000), whereas storage measurement use binary prefixes (e.g., 1K = 1024).

1. (30%) A storage device was put into service and the data in the table below was collected on its availability and unavailability during the next few years.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
In Service	400		350		300		270		250		220		200		210		200		200		180
In Repair		5		5		5		5		5		5		6		6		6		6	

The upper row contains the number of days before a repair was necessary, and the lower row, how long the repair took before it was put back into service.

(a) For each column, compute and provide in a table, the MTTF and availability of the storage device from when it was first put into service until the end of the time period specified by that column. For example, the MTTF for the second column is 400, and the availability is 400/405=0.987

(b) Repeat what you did in part (a) but this time compute the MTTF and availability using only the 8 most recent time periods, starting with column 8, e.g., 1 to 8, 2 to 9, 3 to 10, and so on.)

(c) Which way is a better indication of the time to next failure, and why?

2. (30%) A hard drive has16,384 cylinders. Each track has 128 sectors, each holding 4096 bytes of data. There are 10 data recording surfaces. The disk operates at 15,000 RPM. The disk heads can travel an average of 250 tracks per millisecond. The average transfer rate from the disk to the controller's internal buffers is 50 MB/second. Controller overhead is about 500 microseconds per transfer.

(a) Calculate the total capacity of the disk.

(b) Calculate the average time to read 20,480 bytes stored in a single cylinder and sector.

(c) Suppose that sectors are numbered 0 to 127, and tracks are numbered starting with 0 in the outermost track. To maximize performance, consecutive blocks are stored first by cylinder, then by sector, then inwards on the next track. For example, the first 40,960 bytes of a file are stored in the 10 surfaces of sector 0 in track 0, the next 20,480 bytes in sector 1 of track 0, and so on up to sector 127 of track 0. The next 20,480 bytes are stored on track 1. Assume the disk rotates counterclockwise. Which sector on track 1 should be read next, assuming the objective is to maximize performance? Remember that the head has to be moved over the track before the data can be read.

3. (10%) A NAND Flash memory card has a data transfer rate of 40 MB/second. The controller transfer rate is 500 MB/second. What is the average time to read a 4096 byte block?

4. (30%) Suppose that a computer has a 2 GHz clock, and that the instructions in the operating system that are executed to perform polling operations use 500 clock cycles. If polling were actually used with the following devices, what would be the overhead to poll each, with the given characteristics, and what would the peak bandwidth be?

(a) Keyboard: can send a packet up to 30 times per second, each containing up to three bytes.

(b) USB 2.0 external disk: can transfer 1 byte at a rate of 60 MB/second.

(c) SATA hard disk: transfers 8-word blocks at a peak rate of 80 MB/second.