

ID: \_\_\_\_\_

**Software Metrics  
Comprehensive Exam  
Fall, 2005**

I. (15 points)

Software Director: "I've asked you to meet with me today because I understand that you have a background in software metrics and I've decided to start a metrics program. I'm supposed to be in charge of software development, but I find it impossible to get a straight story about anything in my department. All I know is this: our software is consistently over-budget and behind schedule. Every week at our status meeting, our software leads report the percentage completion of their tasks, but once they reach the 90% completion point, they stay there for weeks and weeks. In fact, the time to get from 90% to 100% is often longer than the time it took to reach 90% in the first place. Our initial releases to our customers are so full of bugs that I've had to become a public relations expert just to keep our customers from canceling our contracts.

"Since you know something about metrics, I have decided to make you leader of our new improvement initiative. I have prepared a memo instructing our group leaders to begin measuring everything that they are doing and to report all of those metrics to me at our weekly meeting. Is that the right thing to do or do you recommend another approach?"

Your response:

II. (15 points)

One month later...

Director: "You are to be congratulated. The approach that you recommended seems to be the correct one. You have focused us on a set of key metrics that should help us to improve our performance, but still a small enough set to be collected inexpensively. However... , the group leaders say they are reluctant to collect this Line-Of-Code metric that you think is so important. They say that it is meaningless; that it is ill-defined. Does it mean executable statements? Logical or physical statements? Data declarations? Comments? What should we say to the group leaders to help them see our point of view?"

Your response:

Director: "I can hardly wait to get these Line-Of-Code counts. Then I will be able to determine the productivity of each programmer in our department, so I can get rid of the poor producers."

Your response:

III. (15 points)

Two weeks later...

Director: "I see that you have recommended that we use LOC estimates as a measure of the size of the new software that we are planning. But my problem is estimating cost and schedule, not size. How can LOC estimates help me with cost and scheduling?"

Your response:

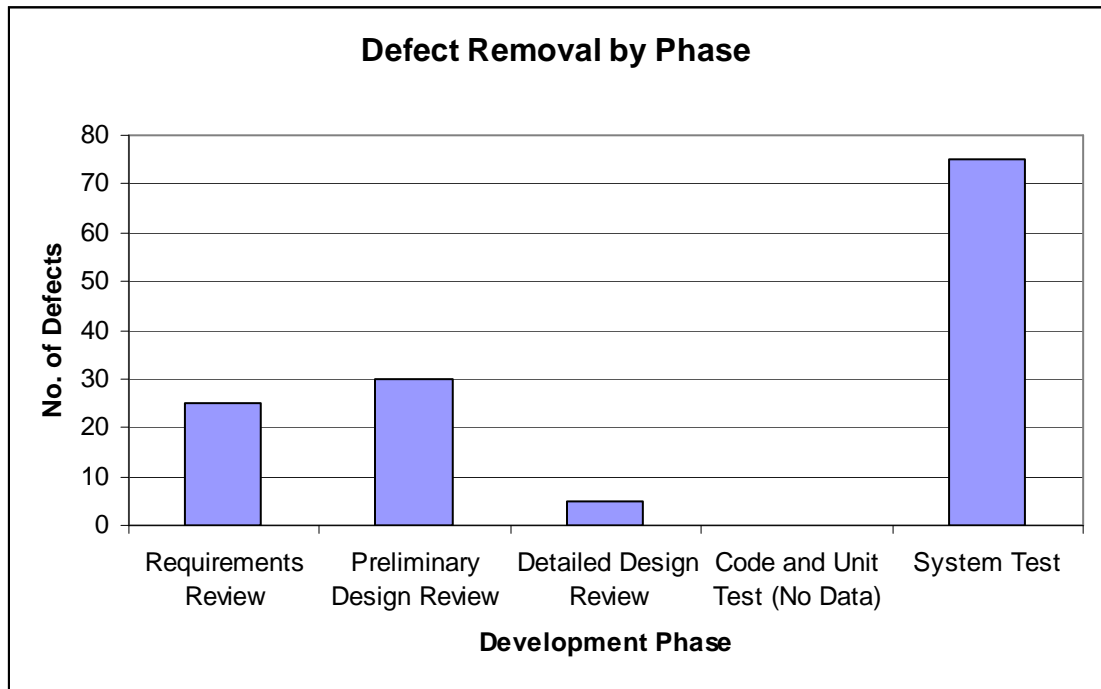
Director: "Sounds like a lot of calculation. Are there any Off-the-Shelf software packages that can help or should we just write our own?"

Your response:

IV. (5 points)

One month later...

Director: "You have included measures of the Defect Removal Effectiveness of our Reviews and Testing in your Measurement Implementation Plan. One of our group leaders tells me that she has already collected some data from her recent project. Here it is:



"So, let's calculate our Defect Removal Effectiveness Metrics. What did you say? We don't have enough data for the calculation? What's missing?"

Your response:

- V. (20 points)  
 One year later...  
 Director: "Well, we just completed our first project under your Measurement Implementation Plan. We have a full set of defect data cross-classified by Origin and 'Where Found'."

		Defect Origin							Total
		Requirements Specification Phase	Top-Level Design Phase	Detailed Design Phase	Coding Phase	Integration and Test Phase	System Test Phase	Post-Release Phase	
<b>Where Found</b>	Requirements Specification Review	5							5
	Preliminary Design Review	3	6						9
	Critical Design Review	0	2	10					12
	Code Reviews	0	2	10	34				46
	Integration and Test	4	1	7	12				24
	System Test	5	1	4	13				23
	Post Release	2	1		3				6
	Total	19	13	31	62	0	0	0	125

"Now, what is our over-all Review Effectiveness, our over-all Test Effectiveness and our over-all Defect Removal Process Effectiveness? But, most importantly, do the data indicate where we should invest next year's improvement budget?"

Your response (leave answers as fractions):

VI. (20 points)

One month later...

Director: "Several of our group leaders tell me that we might improve our defect removal effectiveness if we were to calculate McCabe's Cyclomatic Complexity measure for each of our modules during design and coding. I've picked out this algorithm. Please draw a flowgraph and explain what McCabe's Complexity measure is actually measuring."

```
public static void bubbleSort( int[] data, int n )
{
    int numSorted;
    int index;
    int temp;

    numSorted = 0;
    while( numSorted < n )
    {
        index = 1;
        while( index < n - numSorted )
        {
            if ( data[index] < data[index - 1 ] )
            {
                temp = data[index];
                data[index] = data[index - 1];
                data[index - 1] = temp;
            }
            index++;
        }
        numSorted++;
    }
}
```

Your response:

VII. (5 points)

Two months later...

Director: "Now that we have made McCabe's Cyclomatic Complexity measure a required metric for all of our programs, the group leaders for our Object Oriented development projects tell me that it's not very effective for them. Do you think they are telling me the truth? If so, what are some alternative metrics that they might use that will provide them with similar information?"

Your response:

VIII. (5 points)

Eighteen Months into the Metrics Effort

Director: "Well, we have come a long way in the past 18 months. We now have our cost and scheduling under an acceptable level of control. We have greatly improved our review and test processes. And, most importantly, the customers are reporting a marked improvement in the quality of our delivered software. In recognition of the role that you have played in our improvement efforts, I would like for you to have this tee shirt with a hand-painted logo: METRICS GENIUS. The company is also awarding you dinner for two at Ethel and Fred's Country Kitchen.

"I hate to cut the ceremony short, but I'm meeting with the board of directors this afternoon to receive my bonus check, stock options and promotion to Vice President of Software Development. Enjoy your shirt and your dinners...."

Your response: