Data, Models, and Decisions I
Department of Public Administration and Policy
University at Albany
Midterm Quiz—Spring, 2006

_____

(Your name)

Exam Instructions. Complete the problems below in the spaces provided. Continue your work on the back of the exam sheet, if necessary. Show **all** of your work and reasoning--partial credit will be awarded on all questions. Save arithmetic computations, if necessary, for last. I am interested more in your ability to set up problems than in arithmetic. Work quickly and try not to leave any questions unanswered. Read through the exam before you start your work. Make sure you have all seven pages. Good Luck!

1. Forecasting the Number of PCs that will need Security Upgrades. (35 points). You have been hired to work in the Cyber Security and Assurance Office of UpState University. Your job is to provide analytic support to the Director in determining levels of effort and budgets that will be necessary to keep all administrative and research computers on campus secure and safe from viruses and hackers. A chief concern is keeping all of the software on all of the University's computers current, and up-to-date with all necessary patches and firewalls to protect against the latest generation of attackers.

Your boss has told you that for purposes of forecasting workload in the Cyber Security and Assurance Office, all PCs can be classified into one of three categories. PCs are considered "New Machines" only for the first year after they were purchased and put into use. Machines are considered "Middle-Aged" during their second and third year of operations. During this period they are more susceptible to attack and need more attention from Cyber Security staff. After three years, all machines are considered to be "Old Machines" and are at highest risk of being compromised and need the most care and attention. According to University Policy, every year one third of the Old Machines are pulled from service. Half of those pulled from service are thrown out and the University replaces them with New Machines. The other half of the machines pulled from Service are reconditioned and Placed back into service, being reclassified as "Middle-Aged Machines". The initial inventory of machines is 1,000 New Machines, 100 Middle Aged Machines, and 0 Old Machines.

A. Draw a Stock and Flow Diagram that can be used to capture the flow of PCs as they age and are upgraded on campus.

B. Working in the space below, hand write in a set of equations into the spreadsheet grid that could be used to simulate the system that you have sketched in Part A above.

	A	B	C	D	E
1	**Variable Name**	**Year Zero**	**1**	**2**	**3**
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

C. The University's policy for dealing with New Machines is to give them all necessary operating system patches as such patches are announced. On average this level of maintenance costs $200 per year (including staff time) and the average annual probability that a machine will be compromised is .001 (that is about one in a thousand new machines has some sort of compromise in its first year of operation). Middle Aged Machines need operating system patches plus periodic upgrades to their firewalls, spy ware, and virus detection software. The Office of Cyber Security estimates that it will cost $500 per middle aged machine per year to complete this maintenance. Middle Aged Machines run a one in a hundred risk of some sort of compromise by attack or virus for each year that they are in operation. Old Machines cost the same to maintain as Middle Age Machines. However, their level of performance is lower and in addition their risk of some sort of compromise by attack or virus for each year in operation is estimated to be twice that for Middle Aged Machines or two in a hundred. It costs $700 to upgrade an old machine to middle age, $100 to dispose of an Old Machine and it costs $4,500 to purchase and install a New PC.

In the space below, write a series of differences equations that can
(1) estimate the annual cost of maintaining the fleet of PCS including maintenance charges, disposal charges, and purchases of new system, and
(2) estimate the expected number of system compromises (virus or hacker attacks) for all machines.

D. A colleague of yours has claimed that the University's PC aging system is actually a Markov Process and can be modeled as such. Evaluate your colleague's claim. If you believe that the system you have sketched in Part A above can not be modeled as a Markov Process, explain why in the space below. If you believe that the system you have sketched in Part A above can be modeled as a Markov Process, explain why and show what you believe the state transition matrix would be. If you need additional information to get the best answer to this question, what additional information would you need.

2. Which Enterprise-Wide Security System to Install. (35 Points). One of the major costs of Cyber-Security at UpState University is dealing with intrusions once they have happened. Estimates are that on average it costs $5,000 per intrusion to clean up the mess (this is the direct cost to your department and does not count for possible missing or corrupted data on the part of users). So you department is considering purchasing an Enterprise-wide protection system that can cut down on intrusions beyond the protection that can be gained by protecting individual PCs. If no action is taken, past records indicate that your system will face 40 intrusions per year (each of which will cost your department $5,000)

The PROTECT-ALL enterprise software claims to be able to protect all machines at the University and it comes in two versions. The newest release of PROTECT-ALL is estimated to eliminate all intrusions (that is zero intrusions per year), if the installation succeeds on your site. However, if the installation is deemed to be a failure, then the newest release will unfortunately allow up to 20 intrusions. Last year's version of PROTECT-ALL if successful is estimated to allow only 3 successful intrusions per year. But if installation is not successful, it could let in put to 15 intrusions per year (the older version is more stable). Success or failure does not depend on the characteristics of the PROTECT-ALL software; rather it depends on the configuration, characteristics, and use of the network being protected. Industry estimates are that the old and new versions have an equal probability of being successful. The probability of a successful installation is .6. The newest version of PROTECT-ALL software costs $110,000 per year. Last Year's version costs $100,000 per year.

As it turns out, an independent consultant claims to be able to test whether or not your installation will succeed or fail. And the initial asking price for the test is open to negotiation.

A. In the space below, set up the decision tree that you can use to analyze this situation.

B. In the absence of any test information from the independent consultant, what should your division do? . If you need additional information to get the best answer to this question, what additional information would you need.

C. Assume that the information coming back from the consultant about the success or failure of the PROTECT-ALL software is perfect. What is the most that you would be willing to pay for this test? . If you need additional information to get the best answer to this question, what additional information would you need.

3. Estimating the Budget for PC Maintenance (30 Points). The office of Cyber Security maintains a spreadsheet containing information on the date of purchase and the date of last full upgrade for all PCs at the University. Part of the spreadsheet is presented below. The "Service Need Classification" is a simple calculation. If a computer was purchased or had a full upgrade within the past two years (that is within 2 years of "Today's Date" as listed on the spreadsheet) then it is considered needing "Lo" maintenance. If both the initial purchase date and the last full upgrade were more than two years ago, then the Service Need Classification is "High". Lo need machines are budgeted for $200 per year for maintenance. High need machines are budgeted for $500 per year for maintenance.

	A	B	C	D	E	F	G
1		**Today's Date**	**3/22/06**				
2		**PC Owner**	**Initial Purchase Date**	**Date of Last Full Upgrade**	**Service Need Classification**	**Estimated Maintenance Cost This Machine**	
3		Andersen	12/14/02	12/14/02	High	500	
4		Richardson	3/18/03	2/15/06	Lo	200	
5		Rohrbaugh	11/04/05	11/04/05	Lo	200	
	Insert Rows 6 through 924 here						
925		Williams	7/11/01	8/12/05	Lo	200	
926	**SUMMARY STATISTICS**	**923**				**$276,900**	
927		**Total Number of PCs**				**Total Estimated Maintenance Cost**	

For each of the cell addresses given below, type in a formula that will work for a most general case:

F926=

B926=

E3=

F3=

(5 Point Bonus)

TEAR OFF THIS SHEET AND TAKE IT HOME WITH YOU FOR BONUS A QUESTION

Create a Vensim Model that can be used to answer Question 1 on this exam. Just tear off this sheet and take it home to work on. Bonus Answers must be turned in no later than close of business, Friday, March 24. The problem is repeated below:

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A. Draw a Stock and Flow Diagram that can be used to capture the flow of PCs as they age and are upgraded on campus.

B. Do not repeat Part B because the Bonus should be a Vensim Model, not an EXCEL spreadsheet

C. The University's policy for dealing with New Machines is to give them all necessary operating system patches. On average this level of maintenance costs $200 per year (including staff time) and the average annual probability that a machine will be compromised is .001 (that is about one in a thousand new machines has some sort of compromise in its first year of operation). Middle Aged Machines need operating system patches plus periodic upgrades to their firewalls, spyware, and virus detection software. The Office of Cyber Security estimates that it will cost $500 per middle aged machine per year to complete this maintenance. Middle Aged Machines run a one in a hundred risk of some sort of compromise by attack or virus for each year that they are in operation. Old Machines cost the same to maintain as Middle Age Machines. However, their level of performance is lower and in addition their risk of some sort of compromise by attack or virus for each year in operation is estimated to be twice that for Middle Aged Machines or two in a hundred. It costs $100 to dispose of an Old Machine and it costs $4,500 to purchase and install a New PC. In the space below, write a series of differences equations that can
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