Define, indicate what area(s) of the course connected to, and/or distinguish the difference between the following terms as appropriate to demonstrate what you know.

1. **Name six techniques you learned about in this course**

2. **"the fundamental rule"**

3. **Pareto and Kaldor-Hicks**

4. **outputs and outcomes**

5. **internal rate of return**

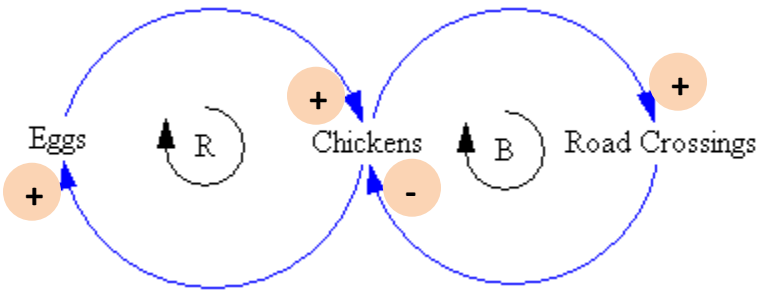
6. **benefit-cost ratio (explain/illustrate issues or problems)**

7. What is "step-wise refinement"?

8. A member of the public asks "where do discount rates come from?" Your (BRIEF) answer:

9. What are the probabilities of getting two of a kind (a match) when flipping two coins? When shaking two dice?

10. What do we call this kind of diagram?



11. Explain each of the plus or minus signs next to the circular labels. What do the R and B labels mean?

Our Case

Ourville is confronting "youth issues" this year. Your job in the mayor's office is to offer some basic analysis of some proposals and ideas that are being batted around.

Weekends at the Youth Justice Center

Our community's new neighborhood youth center is staffing its weekend response team. It will operate on Saturday nights, providing rapid intervention when the police bring in a young person for minor offenses in the hope of reaching a resolution short of a criminal charge.

Records from the last two years indicate that some Saturdays there are 0 cases, sometimes 1, 2,3, or 4 cases as shown in Table 1. So far, there have never been more than 4 cases in a single evening and we will proceed on the assumption that that holds.

Table 1

Cases Arriving	Probability	Cumulative Probability
0	0.20	0.20
1	0.40	0.60
2	0.20	0.80
3	0.15	0.95
4	0.05	1.00

12. Draw a chart to visualize this data. Use the opportunity to show how much of a chart wizard you have become.

Cases Arriving	Probability	Cumulative Probability
0	0.20	0.20
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You've been asked to set up a very simple Monte Carlo simulation of a typical year's operation of this new center. The first iteration of this model will simply use a random number function to simulate the number of cases arriving each Saturday night.

The spreadsheet we will use is shown below.

	A	B	C	D
1	Week	RandomNum	Clients	Weekly Average to Date
2	1			
3	2			
4	3			
5	4			
6	5			

13. Write a formula for cell C2 – for each week, how many clients show up based on the distribution given above.

14. Write a formula for cell D3 – in each week this should calculate the average number of clients per week since the beginning of the simulation.

Assuming you pick a random number R from the random number table below, explain how you would use it to decide how many clients arrived in a given time period.

46	59	97	39	7	31	18	83	1	38
11	30	8	69	16	77	22	57	92	7
60	67	80	58	36	69	65	20	0	99
20	56	55	11	11	12	17	28	30	74
98	30	50	76	86	42	94	82	19	22
32	1	16	3	5	9	40	93	94	45
59	65	70	70	81	63	26	76	2	21
91	11	63	62	37	22	40	61	69	81
18	83	9	48	89	92	69	99	29	77
56	75	93	17	5	71	17	81	7	65

15. Starting in the upper left of the table and moving down, simulate the first five time periods of this model. Put the appropriate numbers in columns B, C and D.

How to handle clients

Your supervisor has requested a flowchart representing the intake protocol the center will use. She provides the following description:

> *Police call the center. If there is a counselor available youth is brought to the center. Otherwise, transported to police station and processed in the usual manner (aka "normal arrest"). At the center, two things happen right away: client is asked to sit with intake staff and give basic information, counselor confers with police officer for details about the complaint. Then this material is handed to a counselor who looks to see if the youth has been at the center before (that is, is s/he a "repeat offender") because if so, s/he is not eligible for this alternative program. If the youth is a repeat visitor s/he is referred back to the police for "normal arrest" and s/he leaves with the police officers. If the youth is NOT a repeat visitor, then there is an immediate brief counseling session and then a call to parents or guardian and the police transport the youth home.*

16. Draw a flow chart showing this protocol. Don't worry about division of labor or time.

The premise of this program is that keeping a kid "out of the system" increases chances of future success and that it can be cheaper in the long run and better for the kid to handle first time offenders this way. In discussions about the program, questions arose about how much how commonly one time offenders do NOT re-offend.

Data collected over the last several years shows that of kids who get into trouble and get funneled into the youth justice system, 60% "learn a lesson" and stay out of subsequent trouble. The other 40% tend to re-offend within a year, usually in a more serious manner than before.

An experimental non-arrest alternative approach with first offenders has been underway for the last two years. Preliminary results indicate that of the kids who go through the program, **only 30% go on to re-offend**. Unfortunately, there is a downside to the gentler approach: those who re-offended, tend to do so in a much more serious manner than before (almost twice the level of those who had experienced conventional arrest). No one is quite sure of why this is – the research continues – but it informs our thinking about the problem.

Research analysts in the community's public policy office have been able to put some numbers on the cost of the alternative program, the cost of traditional arrest, and the average cost of the offense that re-offenders commit. These are shown in the decision tree below.

17. Pay attention at first only to the top 1/3 of the tree – the "no test" branch. Using the information above (it is all repeated in the diagram) fill in the boxes on this part of the tree.

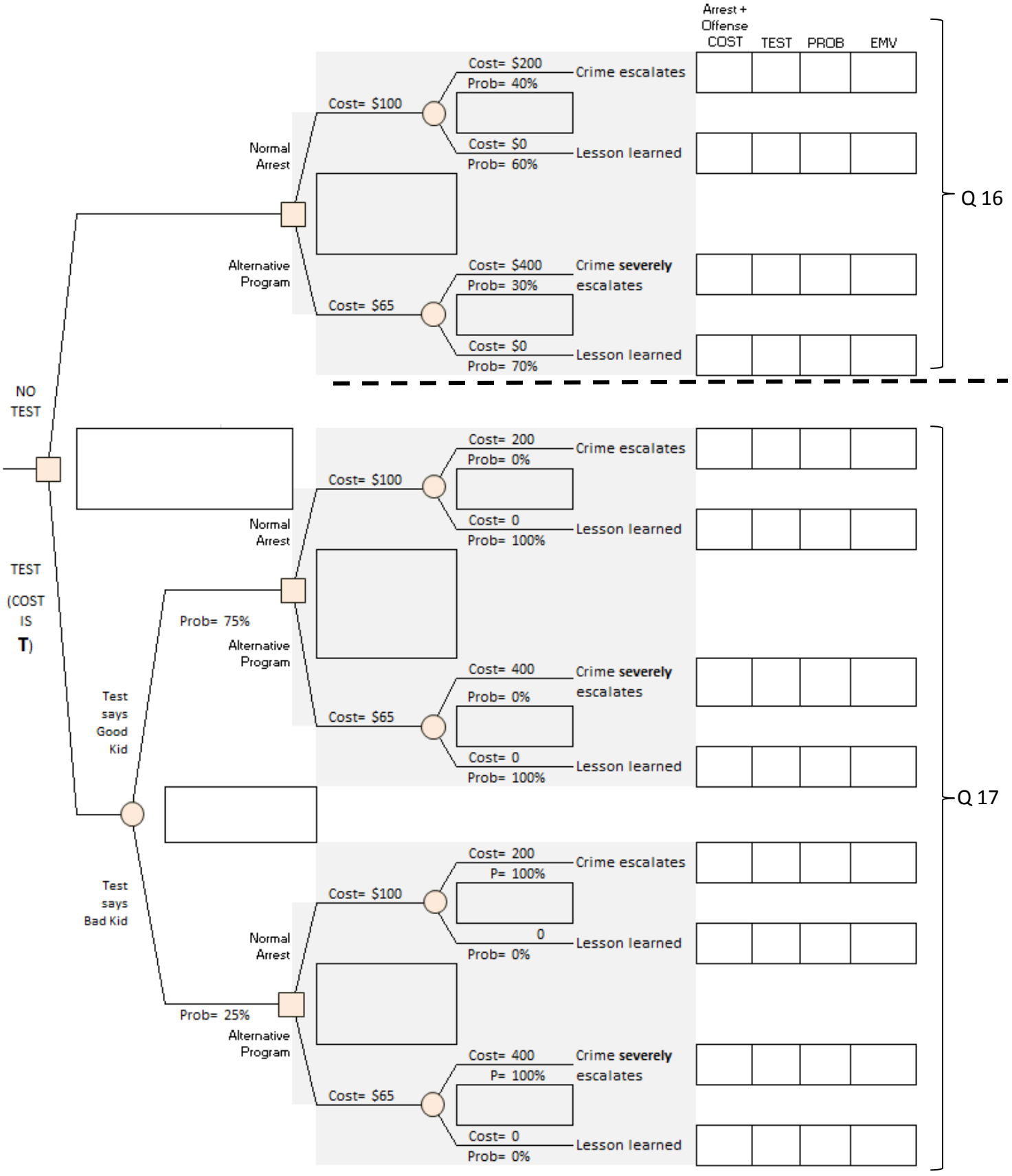
A colleague of yours mentions that the program could be more effective if there were an easy way to predict who might benefit from the alternative program. The data suggests that about 75% are "good kids" who would benefit from the alternative program and 25% are "bad kids" who will not (your supervisor says you'll have to find more neutral terms).

It turns out there is a test – it could be administered during the intake protocol, though it would take staff time and the police would have to wait for the results – that can give a good sense of whether the youth would benefit from the alternative approach. You have been given the task of deciding what an acceptable cost for this test would based on the information in hand.

18. Use the bottom two thirds of the decision tree to complete this preliminary analysis to determine how much we should be willing to pay for the test.

Note that the amounts here are all costs so we are trying to minimize rather than maximize.

NOTE: the cost of a given branch can include the cost of arrest plus cost of re-offense plus cost of testing.



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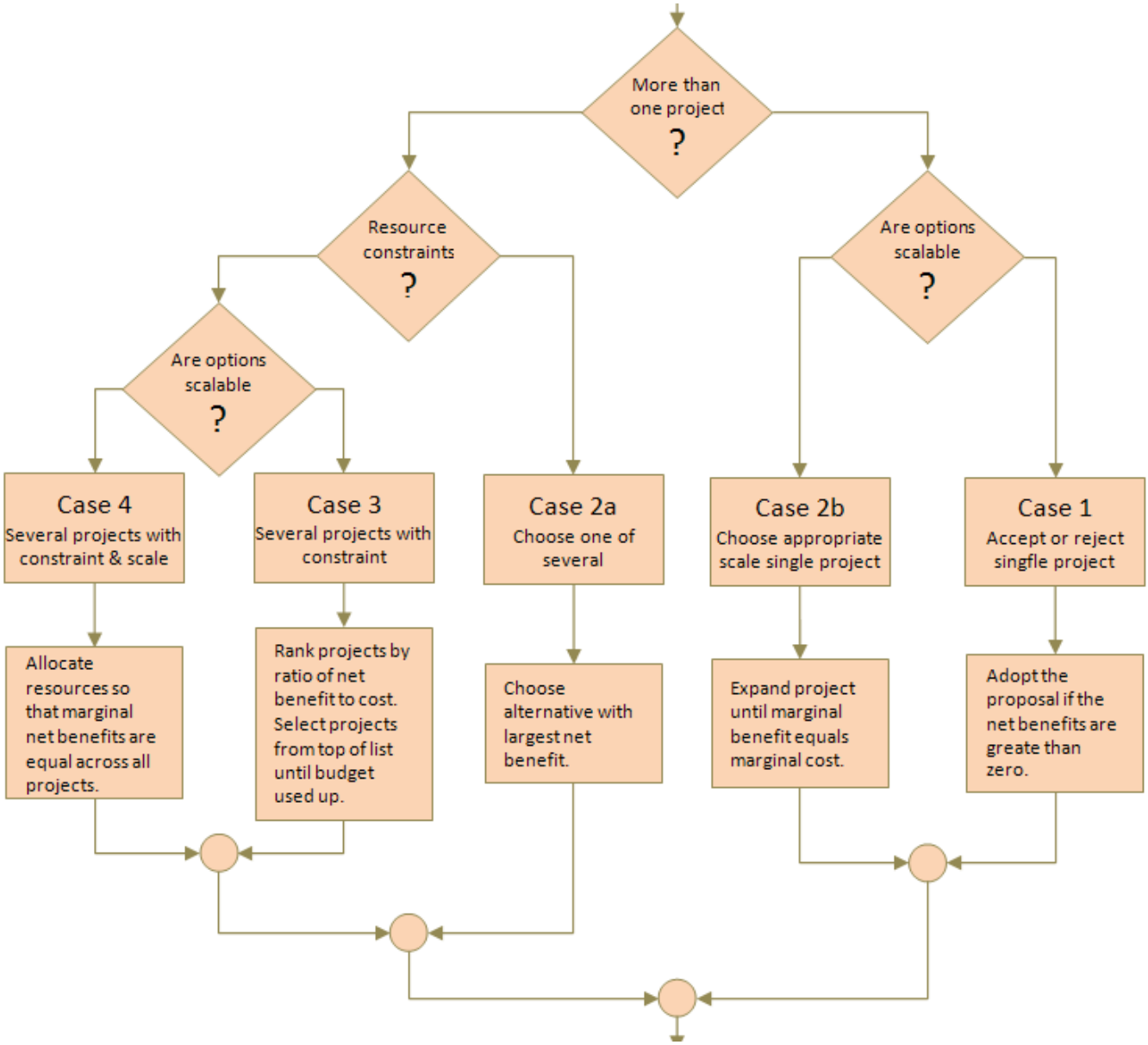

More than one project ?
Resource constraints ?
Are options scalable ?
Are options scalable ?
Case 4
Several projects with constraint & scale
Case 3
Several projects with constraint
Case 2a
Choose one of several
Case 2b
Choose appropriate scale single project
Case 1
Accept or reject singfle project
Allocate resources so that marginal net benefits are equal across all projects.
Rank projects by ratio of net benefit to cost. Select projects from top of list until budget used up.
Choose alternative with largest net benefit.
Expand project until marginal benefit equals marginal cost.
Adopt the proposal if the net benefits are greate than zero.

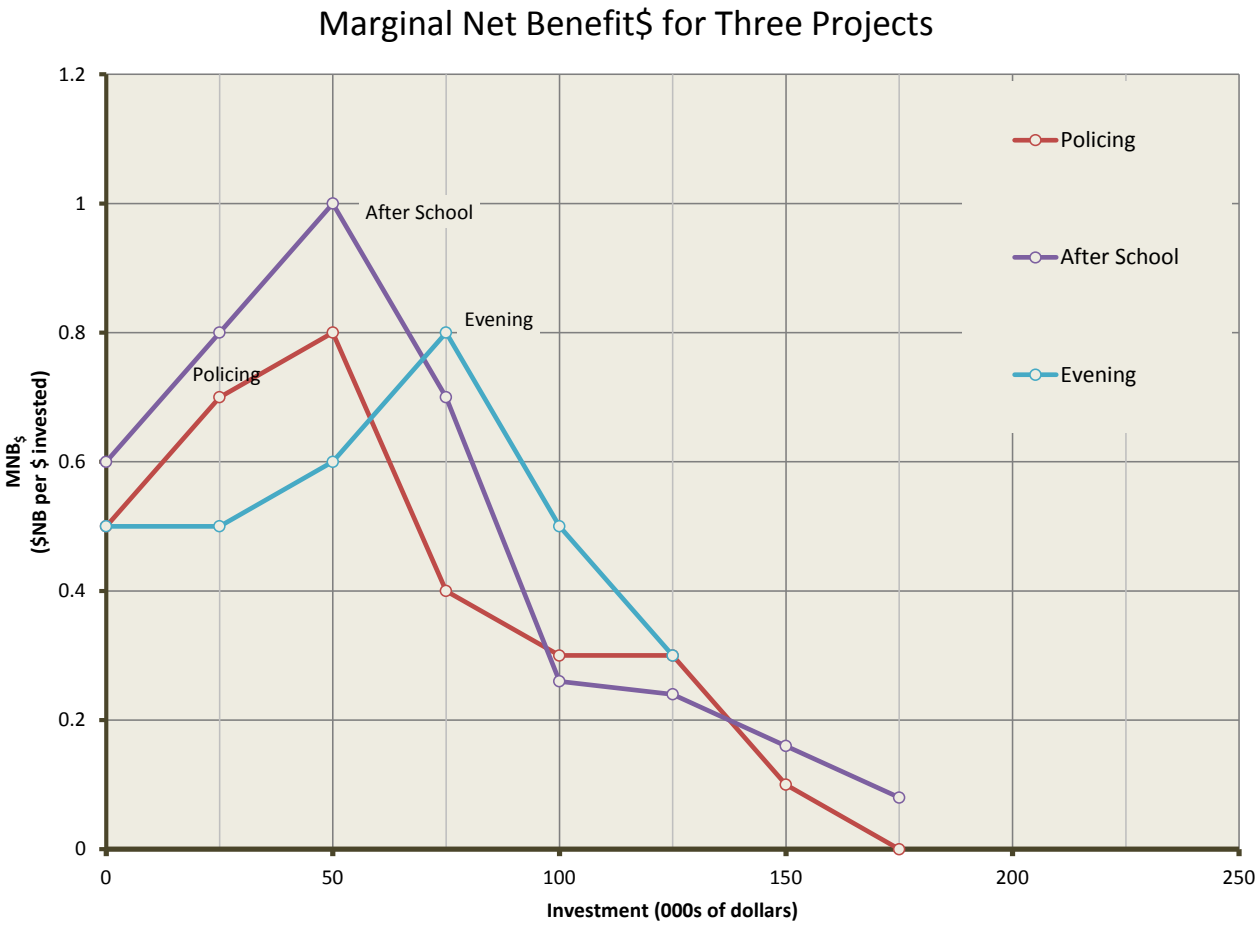
Along with the alternative arrest program, the town in considering a mix of extra community policing, after school programs and evening youth programs as a part of their comprehensive efforts.

Proposals are on the table for three interventions, each of which can be implemented at different levels. Costs and benefits have been calculated by our crack accounting team and are shown in table form and chart form.

Policing	Hours	Cost	Benefit	Net Benefits	$MNB_{\$}$ ($ per $ invested)
0	0	0	0	0	0.5
1	5	25	37.5	12.5	0.7
2	10	50	80	30	0.8
3	15	75	125	50	0.4
4	20	100	160	60	0.3
5	25	125	192.5	67.5	0.3
6	30	150	225	75	0.1
7	35	175	252.5	77.5	0
8	40	200	277.5	77.5	

After School	Slots	Cost	Benefit	NB	$MNB_{\$}$($ per $ invested)
0	0	0	0	0	0.6
1	100	25	40	15	0.8
2	200	50	85	35	1
3	300	75	135	60	0.7
4	400	100	177.5	77.5	0.26
5	500	125	209	84	0.24
6	600	150	240	90	0.16
7	700	175	269	94	0.08
8	800	200	296	96	

Evening	Slots	Cost	Benefit	NB	$MNB_{\$}$ ($ per $ invested)
0	0	0	0	0	0.5
1	100	25	37.5	12.5	0.5
2	200	50	75	25	0.6
3	300	75	115	40	0.8
4	400	100	160	60	0.5
5	500	125	197.5	72.5	0.3
6	600	150	230	80	



19. The town plans to invest approximately $300,000 in these programs. Decide how the funds ought to be divided up among the projects. Assume that you can allocate $25,000 at a time. Be sure to explain what you are doing.

Another part of the program will be a dropout prevention program at town high schools. The director has asked you to put together a stock and flow model showing the basics of how kids "flow" through the system. They give you the following information.

> *Kids enter the first year of high school, ninth grade, from several feeder schools. The high school tracks students year by year: 9th (freshmen), 10th (sophomores), 11th (juniors), 12th (seniors). They know that they lose students each year. Facing various problems (arrest, substance abuse, pregnancy, academic problems, etc.), some of the kids simply drop out of school each year — there is, one might say, "leakage" out of each class.*

20. What are the stocks?

21. What are the flows?

22. What are the informational variables in the model?

23. Draw the stock and flow diagram showing stocks, flows, valves, clouds.

24. There must be some question you studied really hard for and yet I did not ask it. Is there something you wish I'd asked because it would have let you demonstrate some competence? If so, write the question and answer it here.