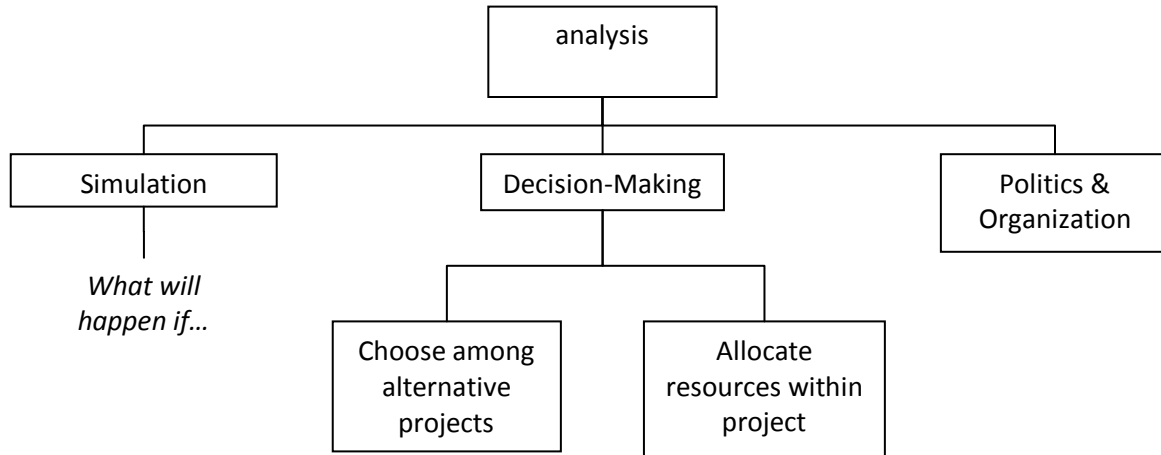


Topics



Section Zero :Prerequisite Skills

Instructions etc. This section is to measure how well you grasp what could be considered “pre-requisites” for the skills covered in this class. We test for these because the course is designed to introduce these as needed rather than to blindly assume that all students come to the course with all of these already in place.

1. Sketch the graph of these two lines

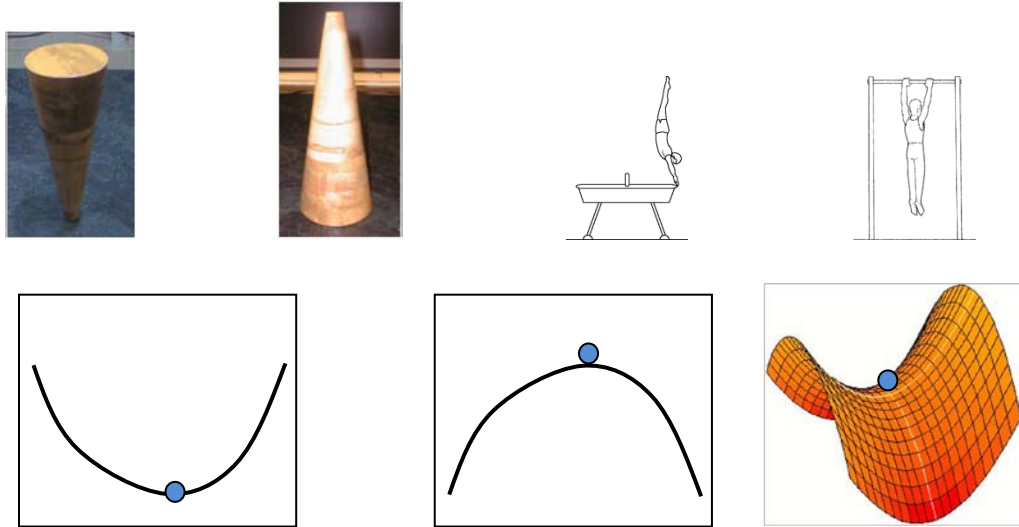
$$3x + 4y = 12$$

$$-2x + 4y = 8$$

2. Show, by calculating, what the (x,y) value of their intersection is.
3. In a weird game, we shake two dice and flip two coins. Assuming honest dice and coins, what's the probability of getting either matches on the dice but no matches on the coins or matches on the coins by not on the dice?
4. Which of the following represent linear processes?
 - a. One youth agency is estimated to be able to reduce delinquency by 15%. Two agencies would be able to reduce it by 27%, three by 37%, and five agencies by 50%.
 - b. We predict that 25 people will show up at the protest no matter what. Further, all of our research shows that for each \$100 we spend in public relations and networking, we can expect 12 more people to show up.

c. Sales tax revenues are 8% of retail sales.

5. Label each of the following as representing either stable or unstable equilibria.



6. Write out a difference equation for compound interest.

7. Write out the most basic version of a difference equation.

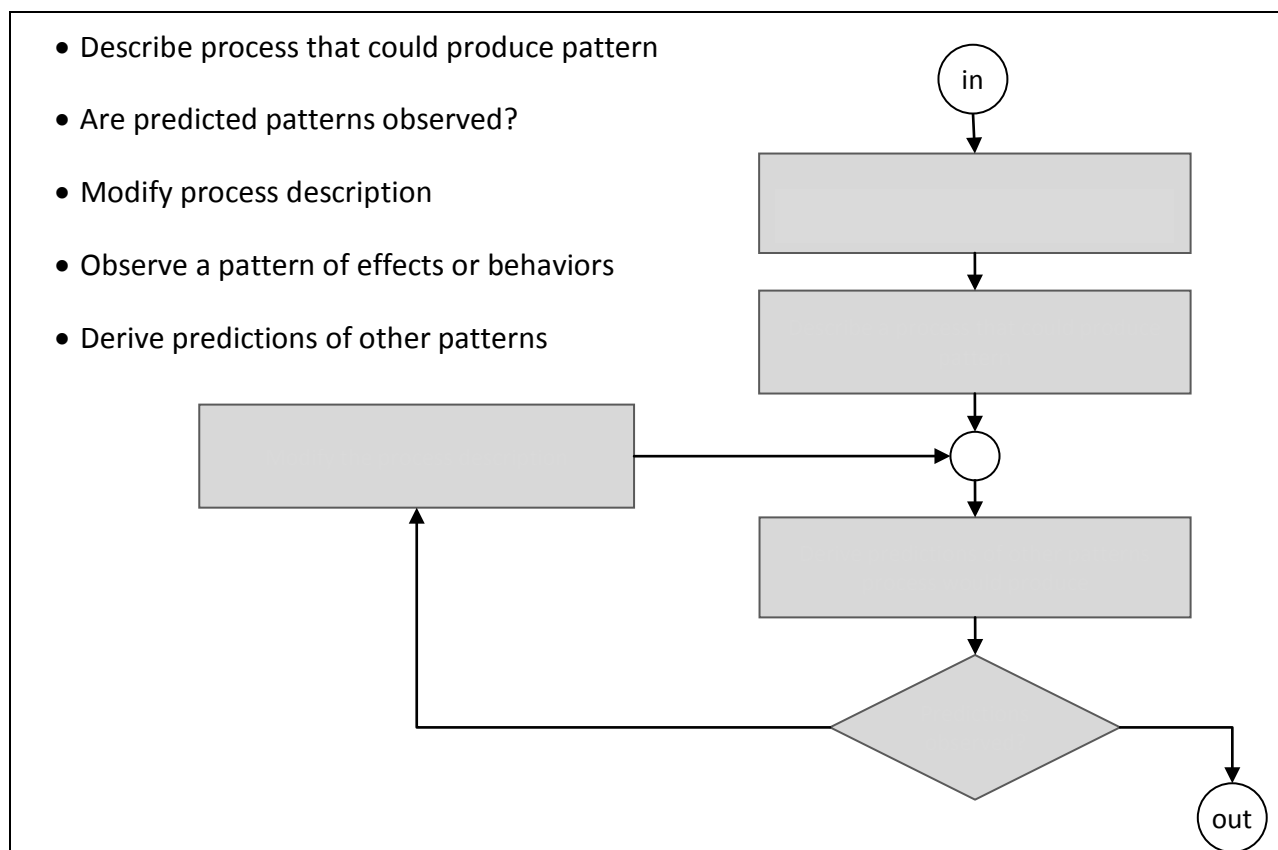
8. Calculate the *marginal* benefit column for the column below

Level	Cost	Benefit	Marginal Benefit
1	100	250	
2	200	400	
3	300	550	
4	400	650	
5	500	700	

9. Translate the following into inequalities.

- I can only spend as much cash as in my wallet on dinner, dessert, drinks, and a tip and I really want to have dinner and drinks though I might pass on dessert.
- You are managing a youth shelter. Kids present with an array of personal challenges, each of which require different levels of attention from your staff. Clients with issue A require 4 hours of attention per week. Issue B, about 2 hours, C requires 16, and D 7. Your budget allows you to staff 75 hours per week.
- Breakfast is some eggs, some pancakes, some bacon. You have to have at least twice as many pancakes as eggs. You can't have fewer than 2 strips of bacon.

10. March & Lave describe a process that includes the following. Process that could produce an observed pattern. Predictions. Observed patterns. Put these into this flow chart and write a short paragraph describing the general process of model building as an explanatory endeavor.



Section One : Problem Recognition, Technique Repertoire

Instructions, etc. Consider each of the following case scenarios. Imagine you are in an interview the interviewer has presented the scenario to you not with the hope that you can work through a full analysis on the spot, but rather with the hope that it will give you an opportunity to demonstrate your capacity to recognize the type(s) of problem this is and that you can draw on a repertoire of analytical techniques you'd explore for looking at it. Write one or two concise paragraphs that explain what techniques you think you'd try and why and how you'd start to set it up. Your answer is meant to demonstrate your ability to match technique to problem your general grasp of the technique (it's purpose, the kinds of problems it works on, etc.) not all of its mechanical details.

11. **EXAMPLE.** Suppose you are in charge of a new government incentive and public awareness program designed to get more people to choose alternative transportation to work. It provides subsidies, rebates, and such to make getting to work by other than driving alone more attractive. You've been given rather free rein in terms of the size of the program – so now you have to figure out how much of the program to implement. How do you think this through?
12. You have been assigned to assess a social services project meant to address the "continuum of care" around family homelessness. The continuum of care concept is based on the idea that in a problem like homelessness affected persons pass through stages both on the way into and out of the problem. At different stages, different services are needed (e.g., a homeless family needs

emergency shelter NOW; a family living in a shelter needs resources and contacts to enable them to move into transitional housing; a family in transitional housing may need help assessing what kind of permanent housing is appropriate to their situation; a family teetering on the edge of losing its home may need mortgage support). Traditionally, agencies specialize in particular stages and may not collaborate at all with agencies concerned with other stages.

Your client has a simple request. It wants to build an analytical picture of "the problem" and the stages that families pass through on the into and out of homelessness. They have categorized some of the stages:

Pre-at-risk families who are currently doing well but who could themselves at risk with the loss of a job or other unanticipated circumstance. We think of these families as "pre-at-risk" and there are services targeted at "risk prevention" – educating homeowners about re-finance options, renters' legal aid, etc.

Families at risk of homelessness. Families currently with a home but at risk for losing the home due to foreclosure or because of behavioral problems (drugs, etc.) on the part of adults in family.

Currently Homeless Families. Families currently living "on the street."

Emergency Shelter Families. Short term, safe and decent shelter provided as an alternative to the streets. Families currently staying in emergency shelters. Time in shelters varies depending on, among other things, availability of staff to assist in placements in transitional housing and the availability of transitional housing.

Families currently in transitional housing. Families who have moved out of emergency shelters but have not found permanent housing. The program here consists of training and assessment. Training is about financial management, job skills, employment finding, etc. The assessment is to determine whether on-going support will be needed to help these families succeed.

Families in permanent housing. Client families who have been placed in permanent (usually rental) housing. Ongoing services such as those mentioned above under "pre-at-risk" are often appropriate on an ongoing basis for these families.

Families in permanent supportive housing. Families in need of special services to make their continued tenure in permanent housing viable. These include services such as education, employment assistance, health care, substance abuse treatment and mental health care, child care, and transportation.

What kind of a model would you suggest building?

13. An Oakland youth oriented non-profit is considering building a new headquarters. Funding is all lined up. The building being considered will cost 1.75 million. The net savings in rent and utilities and such over the years net out to 1.5 million. Maintenance on the new building is expected to be 750,000 over the period in question. Should they go ahead with the project?

14. You're in charge of new public service program. A "tour of duty" for a volunteer has four periods of six months (they refer to them as intro, service 1, service 2, and outro). You expect 25% of volunteers to re-up for another tour when they are done. If you have a target number of volunteers, say, 1000 on duty at any given time, and expect a 10% attrition at each transition, how many recruits do you need in first few years of operation?
15. Every year 10 percent of the public housing units in Oakfrisco deteriorate to the point where they are uninhabitable and must be demolished. Current plans and budget constraints call for the construction of 800 new units per year. Is there an equilibrium number of housing units? Is it a stable equilibrium?
16. You are a consultant to an agency that is planning a new legal aid clinic. Luckily, you have a fair bit of data about the problems that are out there and the kinds of services needed to address them (that is, how much lawyering it typically takes for different kinds of problems). The current model for staffing such a clinic involves three types of personnel – reception/intake, case summarization and assignment, and legal assistance. How might we start to think about appropriate levels of staffing?
17. City officials are considering four different approaches to relieving pressure on the local housing market. Cost estimates for projects A, B, C, and D have been obtained. For each project experts have also estimated the expected benefits in terms of taxes, savings on services, etc. What's next?
18. A community non-profit was founded with a generous grant of one million dollars which is invested as an endowment earning 10% annually. Basic operational costs – without doing any programming at all – are 100,000 per year. Programming costs will run to 200,000 a year. It expects to be able to fundraise at the level of 150,000 per year. For how many years should it delay providing services if it wants to be sustainable over the long haul?
19. You have been asked to study the process by which families apply for and receive public housing. In particular, you have been asked to come up with suggestions for dealing with the currently multi-year period it takes for applications to be acted on. Ideas?
20. The DMV is mindful of its poor reputation for service. You are employed as a consultant to help them deal with it. In particular, they are trying to figure out whether some sort of appointment system will be effective both in terms of customer satisfaction and overall productivity. What sort of analysis might you suggest to understand the problem better?
21. County officials are looking at six different programs for responding to the foreclosure crisis. Each of the programs can be implemented at different "levels" – say 1 through 5. Estimates of costs and effects are available. Decision-makers are open to a mix of programs. How to proceed?
22. In Millswell Heights, a small city, all budget allocations are adjusted in response to the size of a problem area two years before. Take crime: the city has 1000 police officers and grows the force each year based on crime rate. Research shows that, other things being equal, each on-duty officer contributes to a set amount of crime reduction (and, decreases in force size are associated with a parallel increase). Ethnographic evidence suggests that criminals at large

"reproduce" (through recruitment or bad influence) so that crime tends to "spread" on its own. How will this play out over time? Can we build a model to help study the influence of the policy variables here (#police funded per level of crime) and the environmental variables (police "effectiveness" and criminal "reproduction" rate)?

23. Among other things, the city of San Oaklando has a homelessness problem and a "youth" problem. As it plans for use of the stimulus funds it will receive from the feds, you have been asked to come up with an analysis showing what the optimal split is between the amount to spend on homelessness and youth. Ignore, for now, the fact that some youth may be homeless.
24. When policy makers were cooking up the stimulus package, they had lots of projects to choose from and every one of these projects could be small, medium, large, really large, or really really large. What techniques (other than pure political considerations) might they use to figure out which ones to fund at what level? When we have the mix right, what should be true?
25. A criminologist and an activist decide to collaborate on a project designed to reduce prison population. In the spirit of starting simple, they identify 4 states in which people can find themselves: never imprisoned; incarcerated; on parole; post-parole. The period of time in their analysis will be one year. Suppose 70% of the population has never been incarcerated. Each year 2% of these people are imprisoned. Of those currently incarcerated, 5% are released each year onto parole. Average parole is 5 years so that a person on parole has a 20% chance of finishing parole. Those on parole have a 10% chance of finding themselves back in prison in any given year. Individuals who are post parole have a 4% chance of returning to prison in any given year.
26. A recent NYT article described attempts at "potty parity" at the new baseball parks in NY. You've been commissioned to think about the same in conjunction with a new Oakland facility. What modeling tools might you use?
27. Describe how to set up the following problem. There are many inefficient and dirty older cars still in use. Future generations are harmed by the wasted fuel and added pollution these cars represent. A proposal is in the works to pay people a bonus to trade them in. How should we think about this? In your preliminary thinking, ignore any economic stimulus effects. You can bring that in later if you wish.
28. In anticipation of a big and costly flu season, we are considering a number of options – public awareness campaigns about washing hands, subsidized flu shots, recommendations about staying home when sick, etc. Help the county supervisors figure out how best to spend public money on this problem.
29. How helpful would increases in the number of flu-shots be? We have some data on how effective flu-shots are and how infectious those with flu are. We wonder what flu season would look like if the rate of flu-shots were, say, to double or the virulence or infectiousness of the virus were to change.
30. You work for TSA and you are asked to sit in on a meeting about whether or not to use thermal scanners (they detect people with fevers) at airports to prevent people who might have flu from boarding aircraft. Two types of scanners are being considered. You hear from experts

that about 60% of the time when scanner A says "fever" the person really does have a fever but that 40% of the time they don't. The A scanner also misses about 25% of the people with fevers (says they don't have a fever when in fact they do). Scanner type B, which costs almost twice as much per unit, has 85% correct positive results and 95% correct negative results. An experienced TSA official reminds those at the meeting that past experience suggests that just putting up a sign and running TV ads gets 50% of people with fevers to self identify. Where would you go with this material?

31. Lots of talk recently about green this and green that. Homeowners, cities, counties, states and the federal government all have to figure out whether to invest in green technologies of various kinds. Typically these things have big up front costs and relatively long pay back periods. How does one best think about which ones make sense?
32. Your department is given the responsibility of ranking 5 alternative ways for a small college to change the way it administers tests to students with documented disabilities. The solutions are more and less suitable along a number of dimensions: cost, disruption of existing practices, legal liability, convenience for faculty, convenience for student services. Your supervisor asks you to describe at least four different ways to rank the alternatives along with the pros and cons of each.
33. Your client is charged with coming up with solutions to the problem of a lack of recreation in Mapletown. Proposals include park rehabilitation, a rec center, sports fields, a music and performance space, summer arts programs, and a street festival.
34. El Oakalo, CA is a small town with a beautiful new public aquatics facility with a great pool and very nice surrounding areas. Since it was built with taxpayer money, it's free to town residents. Unfortunately, there's not a lot to do in town and so everybody shows up -- even folks who have no interest in swimming and just want to sit around under beach umbrellas. Regulations restrict the number of people on site to 575 and this means that lots of swimmers face big delays before they can get in the pool. Help!
35. Burtonville has minimum requirements for the number of patrol officers on duty during each 4-hour period, as shown in Table 11-3. There are no part-time patrol officers, and union regulations prohibit split shifts. Hence each officer works eight consecutive hours. Work out a daily shift schedule that employs the fewest police officers.

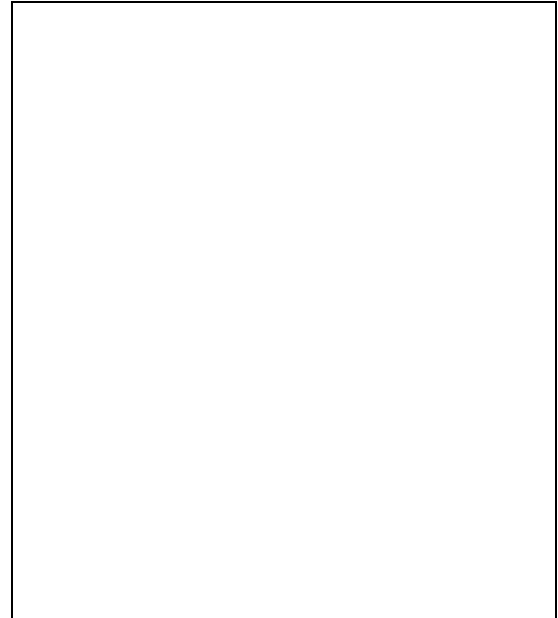
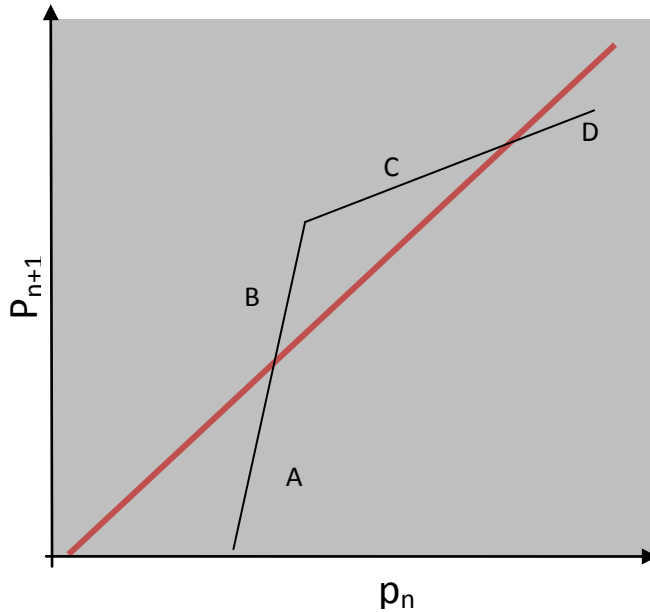
Assume that all work shifts begin on four hour boundaries and that overlapping shifts are allowed (that is, it is OK to have some officers work, say, from midnight to 8 a.m. and others working 4 a.m. to noon).

36. A non-profit supplier of after-school materials has orders for 600 copies from San Francisco and 400 copies from Sacramento. The organization has 700 copies in a warehouse in Novato and 800 copies in a warehouse in Lodi. It costs \$5 to ship a text from Novato to San Francisco, but it costs \$10 to ship it to Sacramento. It costs \$15 to ship from Lodi to San Francisco, but it costs \$4 to ship it from Lodi to Sacramento. How many copies should the organization ship from each warehouse to San Francisco and Sacramento to fill the order at the least cost?

37. The city manager asks you to look into unemployment services in your community. Given rising levels of layoffs, plant closings, and so on, she wants some new estimates of the likely size of the unemployed workforce and the length of time people in the community are likely to be unemployed.
38. The head of parks and recreation has asked you to evaluate the question of whether or not public swimming pools should be charging a fee or not, and if so, how much. What can you contribute to the conversation?
39. A series of unfortunate events – poorly repaired apartments that burned, corrupt brokers taking tenants' money, secrecy about rents, and control of rental properties by a few giant landlords – has led to the rental market in San Frando basically grinding to a halt. Any ideas on how to think about these problems and interventions you might suggest?
40. Swine flu has emerged in Mexico City. You are charged with coming up with a protocol for Oakland schools so that decisions about whether or not to close them can be made rapidly. It's not an easy decision because closing the school for one day now will cost a lot in overtime later. On the other hand, the health care costs of a pandemic could be enormous. Where to go with this?
41. We must choose between two energy saving projects. For each one we have data on how long it will take to install, what the payment schedule will be and how much each will let us save over the years along with projected maintenance costs.

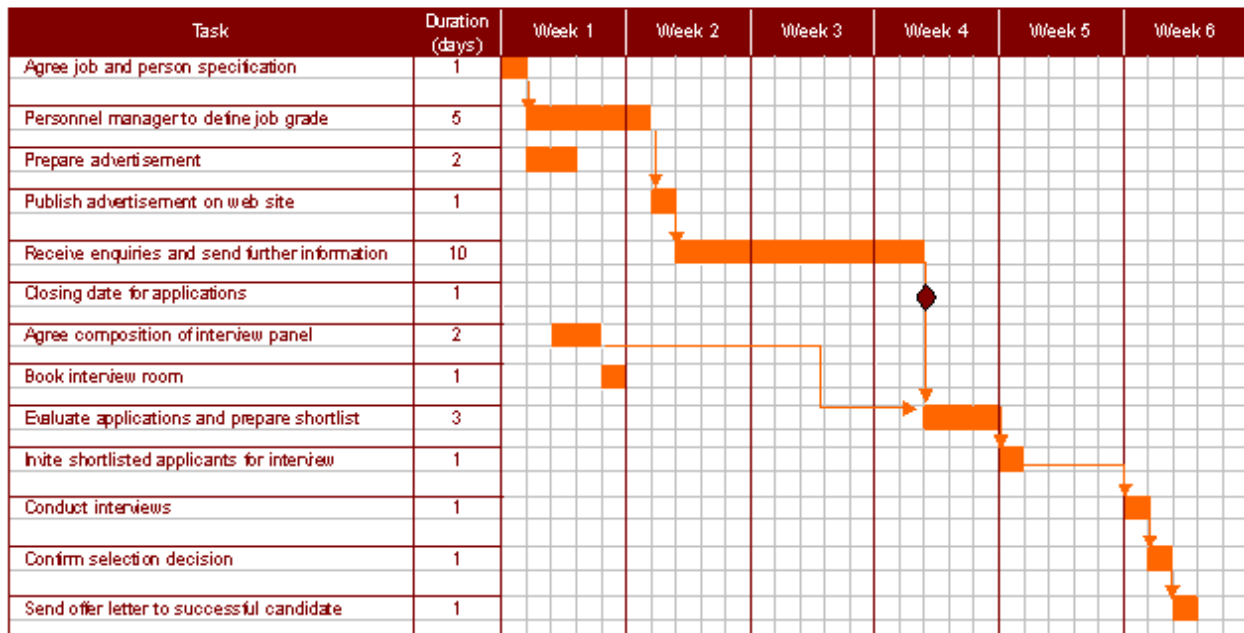
Section Two: Making Sense of Results

- Based on what we have learned about how the slope affects the type of equilibrium, draw arrows on the black line in this diagram to indicate where the system would go in the four labeled sections A, B, C, and D.

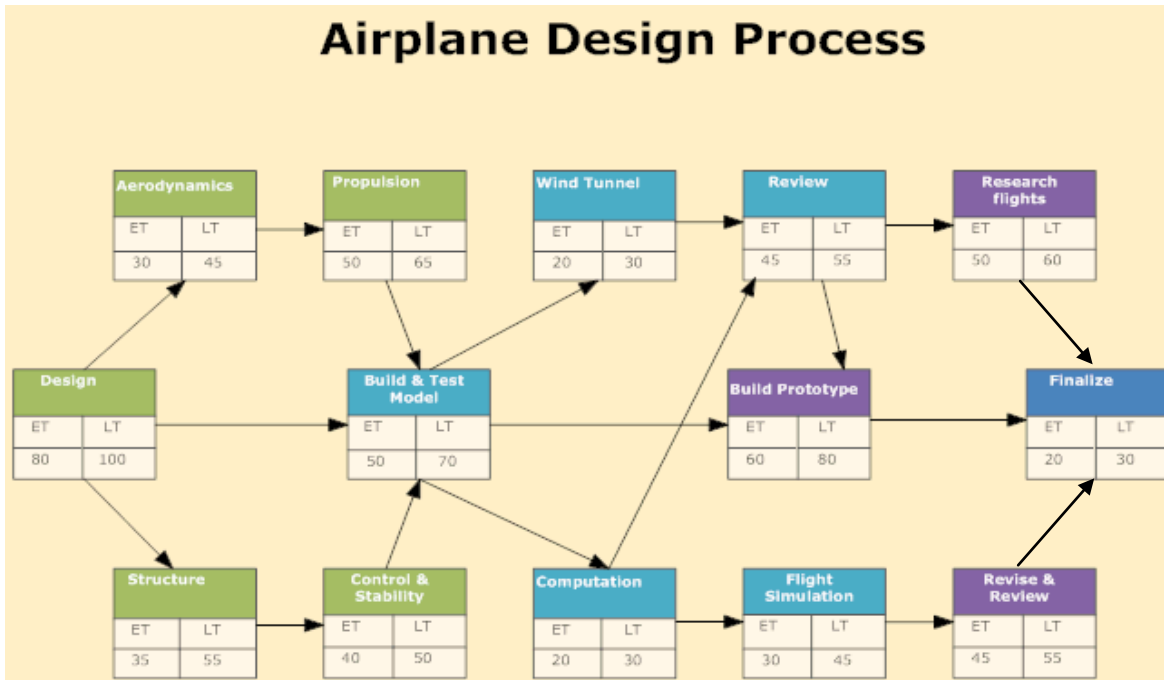


- Look at this Gantt chart and answer the following questions: Excluding weekends, how many days will the project take to complete? What two activities are the immediate predecessors of "Evaluate applications and prepare shortlist"?

Example Gantt Chart showing key dependencies in a recruitment process



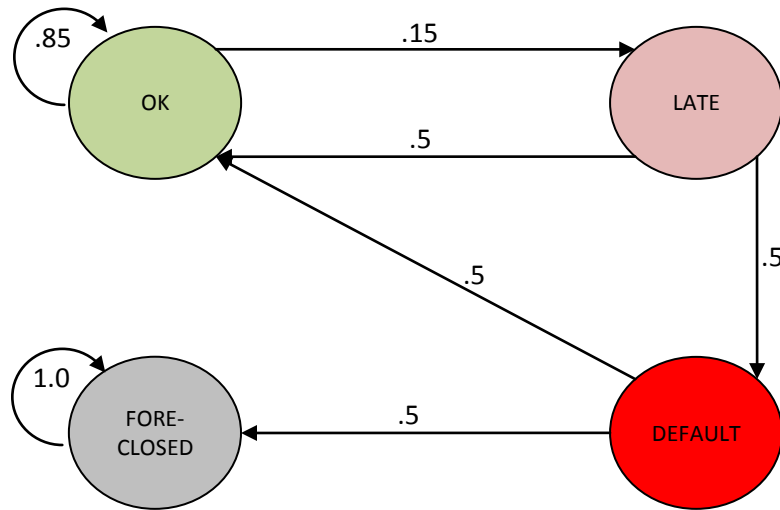
43. Consider this PERT chart illustrating the process of designing an airplane. In each box you will see the number of days we expect the subprocess to take (ET) and the longest amount of time it can be expected to take with delays and problems and such. How long do we expect the process to take from start to finish?



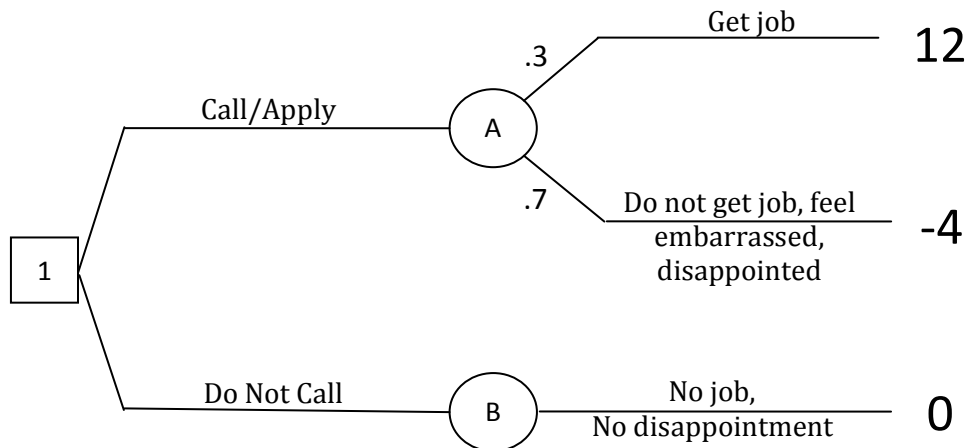
44. You are working for a counseling service that will be contracting with the Veterans Administration to provide counseling for returning Iraq war vets. A part of the proposal that must be submitted needs to justify the length of sessions that you plan to use. Five minutes “turnaround time” is required between clients. Previous research has provided estimates of how much “impact” different length sessions have. These are measured in terms of “benefit to client” on a 0 through 15 scale.

Length of Session	Total Time	Clients Seen Per Week	Cost	Marginal Cost per 10 minutes	Estimated Benefit to Client	TB	
10	15	160	12.50	12.50	1	160	
20	25	96	20.83	12.50	3	288	
30	35	68	29.17	12.50	7	272	
40	45	53	37.5	12.50	10	530	
50	55	43	45.83	12.50	12	516	
60	65	37	54.17	12.50	13	481	
90	95	25	79.17	12.50	15	375	

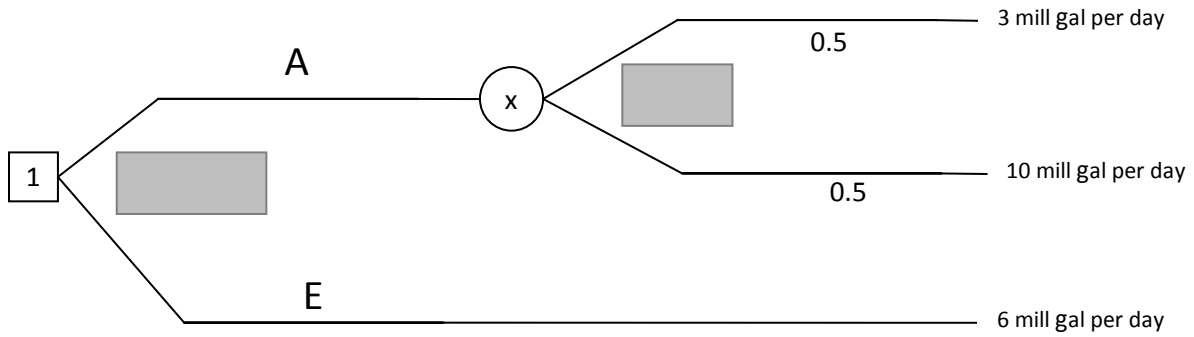
45. Look at this diagram about the fate of mortgages and tell us what happens to mortgages that are late.



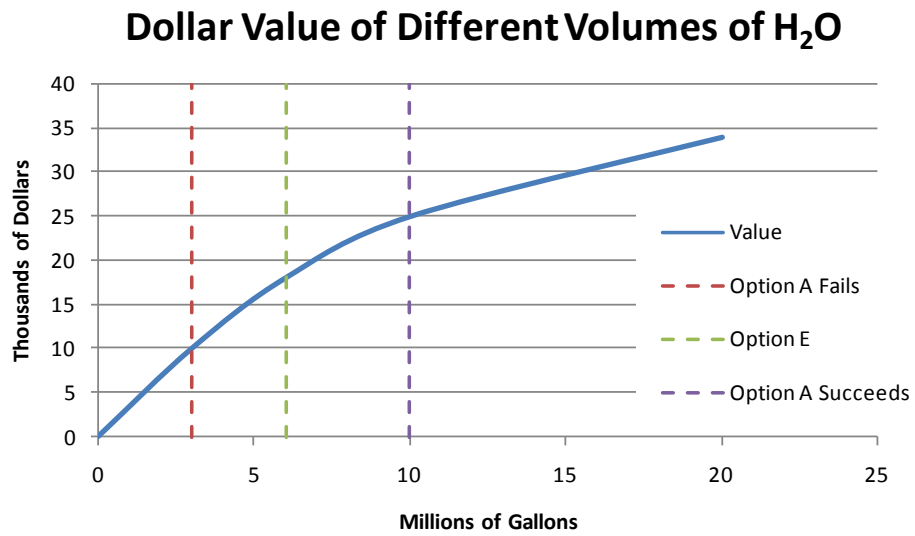
46. In the diagram above, label the states that are absorbing, transient and identify any cyclical chains.
47. What is the expected value of the chance node A? What is the decision and value of the choice node 1?



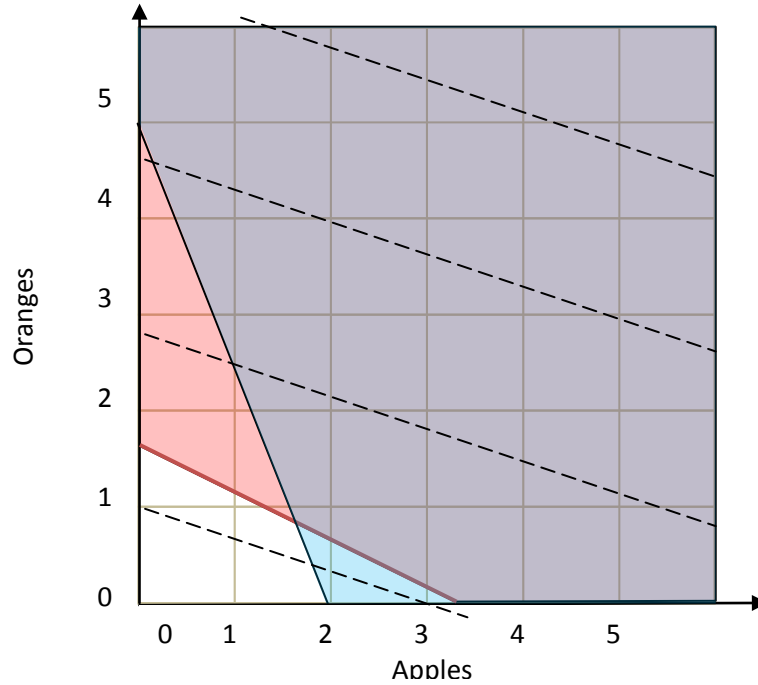
48. Consider a seaside desert oasis that depends on machinery for its freshwater. A salesperson has come into the mayor's office to sell her a new desalinization plant, A which, when it works well can produce 67% more water than the alternative plant E. The problem is that the new machinery is not completely dependable. Half the time it only produces half as much as the existing plant. Assuming we are risk neutral, what's the right decision?



49. Suppose the oasis uses the first few million gallons for absolutely essential purposes (irrigation, drinking, etc.). It decides that the "value" of the different amounts looks like below. What's the key issue here and how does it change how we think about this problem?



50. Let's say that to survive, we need 100 units of vitamin A and 100 units of vitamin B per day. An apple provides 30 units of A and 50 units of B. An orange provides 60 units of A and 20 units of B. An apple costs 1 dollar and an orange costs 3 dollars. What's the cheapest way to get the nutrition you need? Label the lines in the diagram below and indicate how it gives the answer to this problem.



Section Three: Doing

51. Consider the following rankings of several alternative projects under consideration at your agency. Cheaper is better. High political attractiveness is better. Higher effectiveness is better.

Alternative	Cost	Political Attractiveness	Actual Effectiveness
Option A	100	Not	84
Option B	300	Not	67
Option C	300	High	49
Option D	200	Medium	93

- Is any option strictly dominated by another?
- Suppose Cost is more important than political attractiveness is more important than effectiveness. Give a lexicographic ordering of the alternatives.
- Suppose we are satisficing and our standards are: it has to cost less than 300 and at least a little bit politically attractive. What are our choices?
- Suppose we have an objective function that goes like this:

Rank options on each factor. In the case of ties, split the sum (i.e., a tie for 2nd place would split 2nd and 3rd and each would get 2.5). Add up the point scores.

What option do we choose?

52. Translate this description into a state diagram. A population consists of people who play it safe, and daredevils. From year to year, most (97%) safe-players stay that way, but 2% turn into daredevils. About 1% of the safe-players die each year. By contrast, 10% of daredevils die each year and another 10%, seeing that, switch to playing it safe. All the other daredevils stick with the program.
53. A population of weasels is growing at rate of 3% per year. Let w_n be the number of weasels n years from now and suppose that there are currently 350 weasels.
- Write a difference equation which describes how the population changes from year to year.
 - Solve the difference equation of part (a). If the population growth continues at the rate of 3%, how many weasels will there be 15 years from now?
 - Plot w_n versus n for $n = 0, 1, 2, \dots, 100$.
 - How many years will it take for the population to double?
54. We have decided to spend 1 billion (1000 million) dollars on a stimulus package. There is a debate, though, about whether to spend it on tax cuts or infrastructure. Research suggests that

the multiplier effect for tax cuts is **a** and for infrastructure it is **b**. We also know that congressional republicans will not sign on to a package that has less than 100 million in tax cuts and democrats won't sign on for a bill that has less than 300 in infrastructure spending. What's the best mix, in terms of A and B?

55. You are working for an agricultural cooperative which is helping local farmers figure out how to optimize the mixture of crops they plant. A typical farmer has 10 acres to plant in wheat and rye. She has to plant at least 7 acres. However, she has only the equivalent of \$1200 to spend and each acre of wheat costs \$200 to plant and each acre of rye costs \$100 to plant. Moreover, the farmer has to get the planting done in 12 hours and it takes an hour to plant an acre of wheat and 2 hours to plant an acre of rye. If the expected profit is \$500 per acre of wheat and \$300 per acre of rye how many acres of each should be planted to maximize profits?
56. I am considering buying a new or a used car. My time horizon is ten years. The new car cost is 25000. The used car cost is 12000. I have reason to believe I'll pay 1000 each year in maintenance on the used car. On the new car, I expect to pay nothing for the first five years and average of 250 each year thereafter for routine maintenance. If the used car is a lemon, however, it's likely that the maintenance costs will be twice as high. All of my research suggests that on this model and year used vehicle there is a 25% chance it is a lemon. There is a rigorous test available that can give me a more or less certain answer but it's pricey. That is, if the car passes the test it is 95% certain that the car is not a lemon and if the car fails there is a 95% chance that it is a lemon. How much is the maximum I should be willing to pay for the test.
57. A British political magazine specializes in publishing embarrassing details of the private lives of opposition party members. The editors are aware of a scandalous rumor about a prominent politician and wish to proceed with the story in a manner which maximizes expected net income. The risk of an expensive libel action cannot be ignored and the editors estimate that the effects of such an action will be a cost of \$125,000 net if lost, taking into account possible fines, legal costs, effects on future sales, and so on, and zero if won. These costs, and the probability of losing, estimated to be 0.2, are, they believe, independent of whether or not the rumor is true. However, the probability of the politician suing does depend on whether the rumor is true and they estimate that the probability of his taking legal action is 0.3 if the rumor is true and 0.9 if it is not. They currently estimate the probability of the rumor being true at 0.5.

They have three possible courses of action: (1) dropping the story, (2) publishing immediately or (3) hiring a private detective to investigate the rumor further so that after his report they could take a decision on whether or not to publish. The private detective they have in mind would cost \$25,000, and he is infallible. The probability of being sued depends only on whether the rumor is true or not.

They estimate extra net income (gross of any costs of legal activity) from increased circulation if they publish to be \$50,000, and this would be independent of the truth of the story. What should they do? How much is the detective worth? [<http://www2.gsu.edu/~dscthw/8350/myoxford.html>]

Mnemonics, Techniques, Lists

58. What are the five standard benefit-cost scenarios?
59. What are the four standard linear programming models?
60. Five steps process that is the framework of the entire Stokey & Zeckhauser book.
61. Five propositions of public choice
62. Six kinds of market failure.
63. Four ad hoc procedures for estimating social welfare (277)
64. Limit alternatives, consider only changes, effective income, aggregate individual welfares
65. Two reasons government action may be desirable (c14).
66. Seven Techniques discussed in this course.

Study Guide: Concepts

absorbing state	folding back/averaging out	optimum/pessimum
adverse selection (c14)	free rider (315)	Pareto criterion
Arrow's impossibility theorem (C13)	Fundamental Model of Choice (22-44)	Pareto optimal
chance node	Fundamental Rule of Benefit/Cost (136-45)	Poisson distribution
choice node	future value	possibility frontier
constant returns	indifference curve/map	present value
constraint	inequality	public good
control or design variables	information asymmetry (c14)	queue discipline
cost benefit analysis	internal rate of return	Rawls' veil of ignorance (275)
cost-effectiveness	Kaldor-Hicks (c13)	redistribution
Critical path	law of diminishing returns	risk
cyclical chain	lexicographic ordering	risk neutrality/aversion (216)
deadweight loss	linear/non-linear	satisficing
descriptive/positive vs. prescriptive/normative	marginal benefit (141)	shadow price
discount rate	marginal cost (141)	social discount rate
discounted cash flow	market failures (c14)	social surplus
divisibility	market power	social welfare function
dominate	market for lemons (MMMB)	transaction cost (c14)
efficiency	Markov chain/process	transient state
EMV (210)	matrix	transitive preferences
expected value	moral hazard (c14)	tree flipping
EVPI (220)	multiple attribute problem	unstable equilibrium
externality (c14)	negative discount rate	utility
false negative	net present value	value of information (219)
false positive	objective function	weighted average
feasible set	opportunity cost	willingness to pay