2019 NASP IMDS #13 - Instructional Plan

Title: Inventory/Monitoring and Decision Support (IMDS)
Dates: September 16-27, 2019
Class Location: Week 1: ILLC building, room 345/347
                              Week 2: LaSells Stewart Center, Ag Production Room

PERSONNEL
   Coordinator/Instructor: JB - **John Bailey** - Professor
            Instructor: DM – **Doug Maguire**, Professor
            Instructor: OK – **Olli-Pekka Kuusela**, Assistant Professor
            Instructor: MP – **Matt Powers**, Assistant Professor
            Instructor: ES – **Erin Smith-Mateja**, USFS-FVS Group
            Instructor: JJ - **James Johnston**, Senior Research Associate
            Instructor: BS – **Bogdan Strimbu**, Assistant Professor

COURSE OVERVIEW
This course spans two weeks (76 hours total) and includes *daily* progress assessments (quizzes), at-home exercises, and an integrative group project (with oral presentation). It addresses the eight basic NASP/IMDS topics at the specified contact-hour intensity (per Table 1). Instructors are identified by initials and color (above). The weekend field trip is not shown but is a *recommended* activity for all participants to reinforce IMDS concepts and share information.

Table 1. Schedule overview by instructor and topic. Field trips are noted in green shading.

	Monday	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
Week 1 (9/16 -20) ILLC building	JB - welcomes DM – Statistics overview (a.m.); OK – Investment analysis principles (p.m.)	DM - Statistical inference and principles (a.m.); MP –Inventor y and monitoring stats (p.m. field)	DM – Simple Regression and Covariance (a.m.); MP – Inventory and monitoring principles (p.m.)	MP - Samples to models to plans (a.m. field) ES- growth and yield models intro; FVS (p.m.)	ES- growth and yield models; FVS work (a.m.); JB – Density and productivity metrics (p.m.);
Week 2 (9/23 –27) LaSells Stewart Center	OK – Social cost/ benefit and risk analysis (a.m.); JJ – Law and policy for forest planning I (p.m.)	MP – Data mgt. and use; carbon (a.m. field); JJ - Law and policy for forest planning II (p.m.)	MP – Inventory and monitoring uses (a.m.) BS - Forest Regulation w/ exercise (p.m.)	JB – Modeling, projections and display (a.m.) BS - Landscape Planning tools (p.m.)	JB – Final quiz and project presentations + evaluations *(1/2 day only)*

The instructional plan on the following pages details each day by instructor, as well as general lecture and exercise intervals, describing:

- **learning objectives** (LO) for specific in-class/lab activities and field,
- content and flow of **lectures**, **computer and/or field exercises**, and
- important summary ideas and **discussion questions**.

Each day begins at 8:00 am in the **classroom** and concludes at 5:00 pm. Breakfast is provided at the hotel prior to class (*via* a coupon); there are breaks and a 1-hour lunch period at noon, typically using a campus dining card but …sometimes with catering. We alternate evening dinners between using the dining card and having an organized dinner at 6:30 pm, but participants can always make their own plans on their own schedule.

DAILY PLAN – WEEK #1; MONDAY
< Statistics pre-work assignment **DUE;** 20 points>
*Begins 8:00am in **ILLC 345/347** on the beautiful OSU campus, just up Western Blvd (east)*

Welcomes and introductions: 8:00-9:00 – John Bailey
1) Schedule, process, logistics and rules; questions; what you should learn; expectations?
2) **Project Assignment** – identify and form groups, schedule work

Monday morning: Overview of Statistics and Sampling for Mensuration – Doug Maguire
LO: Basic terms and concepts in forest mensuration, sampling and statistics
LO: Central tendency, variability, and complex distributions
Lecture blocks: 9:00-12:00
1) Concepts of statistics – what do you know and what do you use?
   a. Characterizations of distributions: Continuous vs discrete; shapes and names
   b. Descriptive measures
2) Measures of central tendency: mean, median, mode
3) Measures of spread; standard deviation, min/max, range; quartiles are good
4) Accuracy and Precision : Comparison vs estimation, representation and sampling
   a. Achieving representative samples
   b. Bias is a long-run property – using unbiased statistics
Ideas for discussion:
1) How can I characterize the distribution of my data?
2) How does the size of my sample affect my ability to characterize the distribution?
3) What do the distributions of common mensuration variables look like?

LUNCH CATERED TO ILLC

Monday afternoon: Economic Principles and Investment Analysis – Olli-Pekka Kuusela
LO: Project-level investment analysis
LO: Finding economics data on the web
Lecture blocks:
1) 1:00-2:00 – Arithmetic of investment analysis, with *Snack Break*
   a. Inflation, and simple discounting and compounding
   b. Series Equations
2) 2:00-3:45 – Using investment analysis
   a. NPV, BCR, and IRR
   b. Discount rates
Computer Exercises (**LAPTOPS REQUIRED**): 4:00-5:00
1) Compute nominal and real log price growth rates from ODF log price data.
2) Finding forest economics data on the web.

Discussion points:
1) How can investment analysis be used in forest planning?

*Group dinner at 6:30 **(American Dream Pizza: 214 SW 2nd St.)** – vans from the hotel at 6:20*

DAILY PLAN – WEEK #1; TUESDAY – FIELD GEAR DAY; LAPTOPS
<8:00am Quiz (**ILLC 345/347**) – on statistics; 20 points>

Tuesday morning: Sampling and Statistical Inference – Doug Maguire
>   LO: Basic terms and concepts in forest mensuration, sampling and statistics
>   LO: Relevant statistical concepts to real inventory and monitoring situations

Lecture blocks: 8:15-11:00, with a *morning break*
1. How do we know if a statistic is precise? What are sampling distributions?
2. Confidence interval for the mean and the standard error
3. Testing a statistical hypothesis: a T-test.
4. Achieving pre-set precision – the sample size equation

Computer Exercises (LAPTOPS REQUIRED): 11:00-12:00

Discussion points:
1) What is the difference between a standard error and a standard deviation?
2) Can we change the distribution of our data by increasing the sample size?
3) Can we change the sampling distribution of a mean by increasing the sample size?
4) Why is the purpose of our sampling needed to design the sampling plan?

LUNCH AT ARNOLD (campus dining cards)

Tuesday afternoon: Statistics for Inventories and Monitoring – Matt Powers
>   LO: Introduce forest inventories and current/appropriate uses for multiple objectives
>   LO: Relevant statistical concepts to real inventory and monitoring situations

Tuesday afternoon **field trip** to the McDonald-Dunn Forest: 1:00-5:00 (*vans from the hotel*)
1. Introduction to OSU's McDonald-Dunn Research Forest and OSU's CFIRP Study
2. Sampling for forest inventories: basic definitions and concepts
3. The role of randomization and replication in producing accurate and precise statistical descriptions for inventories/monitoring
4. Identifying scope of inference and avoiding *pseudoreplication*
5. Additional considerations when comparing treatments: controls and interspersion

Discussion points:
1) What guides your decisions when choosing sampling schemes for inventory and monitoring?
2) How do we determine what to use as a control when comparing treatments?

5:00 return to hotel; Dinner on you own, with campus dining card or individually on per diem

DAILY PLAN – WEEK #1; WEDNESDAY; LAPTOPS
<8:00 am Quiz (**ILLC**) – on inventory methods; 20 points>

Wednesday morning: Simple Regression and Covariance – Doug Maguire
>   LO: Relevant statistical concepts to real inventory and monitoring situations
>   LO: Correlation and regression analyses – computer lab exercises
>   LO: Relationships among time, tree growth, mortality and economics

Lecture blocks: 8:15-10:00
1) Introduction to correlation and regression – describing trends in means
2) Deciding if linear regression is an appropriate description
3) Confidence intervals for means and for future observations in linear regression.
4) Double sampling: Using regression to increase precision

Discussion points:
1) How many distributions does one regression line describe?
2) Why do we make the assumption that all the regression distributions have the same variance?

10:00-10:15 *Break*

Computer Exercises (LAPTOPS REQUIRED): 10:15-11:50; w*orking with regression*

LUNCH AT ARNOLD (campus dining cards)

Wednesday afternoon: Forest Inventory and Monitoring Principles – Matt Powers
>   LO: Sampling schemes and intensities, including permanent plots
>   LO: Sample size, stratification and proportional allocation of plots
>   LO: Basic terms and principles of monitoring relative to forest planning

Lecture blocks: 1:00-5:00, with *breaks*
1. Replication activity – applying concepts of *pseudoreplication* w/real data
2. Sampling error: sources of error and approaches to minimizing
3. Sampling designs (simple, systematic, stratified, double, cluster, and multi-stage)
4. Plot design (fixed vs variable radius, 3P, plot size, nested designs, edge effects)
5. Developing strategies for multiple objectives; considerations of scales and sample sizes
6. Sampling design activity
7. Sample size determination for different study designs: comparing equal vs proportional vs optimal for stratified designs

Discussion points:
1. When can/should you stratify your sampling design?
2. What drives your sampling (e.g., policy, statistics, resources, or objectives)?
3. What do you see the future holding for large-scale inventories and monitoring?

6:30 Group dinner at **El Sol de Mexico** *restaurant (1597 NW 9th St.); vans from hotel at 6:20*

DAILY PLAN – WEEK #1; THURSDAY – FIELD GEAR a.m.; LAPTOPS (p.m.)
<8:00 am Quiz DUE (**hotel lobby**) – on statistics; 20 points>

Thursday morning Field Trip to BLM land: 8:00am-1:00pm – Matt Powers
    LO: Basic terms and concepts in forest mensuration, sampling and statistics
    LO: Measures of tree productivity, site index and site class; site index charts

Instructional Points:
    1) Review of mensuration techniques (types and oddities) and stand dynamics
    2) Introduction to PNW trees, forest types, and regional management patterns
    3) Silviculture research plots relative to current management trends

Discussion points:
    1) What, if anything, makes silviculture and IMDS unique in the PNW?
    2) How will you carry this information back to your home offices?
    3) What are potential weaknesses in observed study designs?

BOX LUNCHES (at Hull Oakes Mill – 11:45 tour)

Thursday afternoon: Modeling – Erin Smith-Mateja
    LO: Compare growth models and project future stand conditions
    LO: Components of stand growth and yield tables
    LO: Example data sets including all the above elements – computer lab exercises

Lecture blocks: 1:30-2:45, then *Snack Break*
    1) Why models are used
    2) Types of Forest Growth Models
    3) Describe the primary components of an individual tree model
    4) Introduction to the Forest Vegetation Simulator

Computer exercise (LAPTOPS REQUIRED): 3:00-5:00
    1) Review FVS functions
    2) Begin FVS simulation exercises

Discussion points:
    1) Are our modeling tools adequate to address current issues in forest management? What do we do well and where do we need improvement?

5:00 return to the hotel; dinner on you own with campus dining card or individually on per diem

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DAILY PLAN – WEEK #1; FRIDAY – CHECK-OUT AT 7:45am; LAPTOPS
< 8:00 am Quiz DUE – on economics; 20 points >

Friday morning: Modeling (con't) – Erin Smith-Mateja
  LO: Example data sets including all the above elements – computer lab exercises
  LO: Compare growth models and project future stand conditions

Lecture blocks: 8:00-9:00
  1) **Project review/updates/Q&A – John Bailey**
  2) Addressing common issues about FVS modeling

Computer exercise (LAPTOPS REQUIRED): 9:00 -12:00, with a 10:00 *Morning Break*
  1) FVS review exercise
  2) Begin model runs for the **integrative group project**

Discussion points:
  1) What are the differences among FVS variants, and why?

LUNCH AT ARNOLD (campus dining cards)

Friday afternoon: Site Productivity, Density and Growth/Yield – John Bailey
  LO: Factors impacting site productivity in given situations
  LO: Explain the importance of manipulating site productivity and stand density
  LO: Terms, components and processes important to tree and stand growth

Lecture blocks: 1:00-5:00, with *Snack Breaks*
  1) Components of stand growth (birth, growth, and mortality)
  2) Basic concepts of site productivity and density as determinates of stand growth:
      a. Physiological mechanisms for growth, mortality, and competition
      b. Measures of site quality (direct and indirect); site index theory and use
      c. Measures of density; stand vs. tree plasticity and value
  3) Review of tree growth – primary and secondary – and its measurement/analysis
  4) PAI and MAI relative to stand dynamics; management options

Discussion points:
  1) **Why** are productivity and density so fundamental to management?
  2) How do inventory procedures impact forecasts of future stand conditions?

Leave from the hotel at 4:00pm for the beautiful Oregon Coast – with FIELD GEAR

Coast Weekend Field Trip

Friday:

Field trip: beginning **4:00pm**, with travel snacks
  1) Seeing forest management and stand development stages in the Oregon Coast Range.

Discussion points:
  1) What tools are available to manage density and mortality in Douglas-fir forests?
  2) How do these observations relate to "home" forests?

  *6:30pm Group dinner at **Mo's** (seafood);*
  9:00pm Bonfire on beach below Shilo Inn

Saturday:

  ***Buffet** breakfast at Shilo Inn - SUNSET ROOM IN "D" BUILDING (available 6:30-7:45).*

8:00am: departure for field trip (hosts: **Central Oregon Coast Ranger District**). We will tour some recent operations in the Siuslaw National Forest to see:
  • Stewardship commercial thinning sales (for promoting late-successional reserve habitat under the Northwest Forest Plan), and
  • Cape Perpetua National Scenic area (for recreation impacts/planning and general afternoon open wandering)

  Sandwich lunches at Cape Perpetua (Subway)

  6:30pm Group dinner at Rogue Brewery back in Newport, with brewery tours and shopping time.

Sunday:

  Breakfast at the Shilo Inn CAFE, charged to your room (and whenever you get up).

11:00am check-out and load vehicles; then four hours of free time (*lunch on your own*) in Newport until your return trip to Corvallis, which can be independent of my drive.

3:00pm Leave Shilo Inn parking lot for Corvallis Garden Hilton, arriving 4:00ish

  Dinner on you own, with dining card or individual on per diem

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DAILY PLAN – WEEK #2; MONDAY; LAPTOPS
<8:00 am Quiz on stand density/productivity (@ LaSells-Stewart Center); 20 points>

Monday morning: Economic Principles and Cost-Benefit Analysis – Olli-Pekka Kuusela
LO: Basic terms and principles of forest economics
LO: Social cost benefit analysis and what it entails

Computer Exercises (LAPTOPS REQUIRED): 8:15-9:00am
1) Generate FVS economic output
2) Evaluate output in spreadsheet

Lecture block: 9:00-11:00
1) Social cost benefit analysis (placing dollar values on what matters, and equity issues)
2) What is Economic Impact Analysis and how can it be used to support decision making?

Computer Exercises (LAPTOPS REQUIRED): 11:00-noon
1) Applications of social cost benefit analysis

Discussion points:
1) What role(s) can economics play in public forest land management decisions?
2) What cost benefit analysis can and cannot tell policy makers and forest managers.
3) What does the discount rate signify to public *vs.* private timberland owner?
4) What is the difference between economic values and economic impacts?

LUNCH AT ARNOLD (campus dining cards)

Monday afternoon: Policy and Legal Requirements for Planning, Part I – James Johnston
LO: Legal context for federal land management and planning
LO: Relationship between silvicultural treatments and federal environmental statutes
LO: Implications for current forest planning activities

Lecture blocks: 1:00-5:00; with *breaks*
1) Review and discussion of "**The Acts"** that influence forest planning directly
   a. National Forest Management Act (NFMA)
   b. Federal Land Policy and Management Act (FLPMA)
   c. National Environmental Policy Act (NEPA)

*6:30 Group dinner at local **Laughing Planet (downtown);** vans from hotel at 6:20pm*

DAILY PLAN – WEEK #2; TUESDAY – FIELD GEAR DAY
< 8:00 am Growth and Density exercise DUE (turned in at the hotel); 20 points >

Morning field trip: Field Data Collection and Management – Matt Powers
> LO: Field data collection, management and analyses
> LO: Synthesizing data/information into silvicultural prescriptions

8:00am departure from the hotel lobby:
Instructional block (in the field with surface fuels/regeneration data collection):
1) Preparing for field data collection: identifying objectives and appropriate sampling designs; preparing methodologies and required resources (e.g., datasheets)
   a. Field activity: sampling regeneration and fuels - preparing a study design and methodology
2) Field data management, archiving, and security
3) Summarizing and reporting forest inventory data: preparing concise and meaningful tables and figures for prescriptions and reports
   a. Multi-species stand and stock tables, diameter distributions

Discussion points:
1) How much do you use hardcopy vs electronic data recording? Pros and cons?
2) What field data do you need to sample at your sites for a prescription?
3) What other information do you need to gather and present in a prescription?

LUNCH – Philomath Woodsman Restaurant

Tuesday afternoon: Planning and Legal Requirements for Planning, Part II – James Johnston
> LO: Legal context for federal land management and planning
> LO: Relationship between silviculture treatments and federal environmental statutes
> LO: Implications for current forest planning activities

Lecture blocks: 1:00-5:00; with *breaks*
2) *Continue* review of "The Acts" that influence forest planning activities indirectly
   d. Endangered Species Act (ESA)
   e. Clean Water Act (CWA)
3) Recent legal cases that are influencing forest planning activities

Discussion Points:
1) What are the requirements under these various Acts, and how have they been interpreted by the agency through the CFRs?
2) How are the interpretations and implementations of the acts changing with recent court rulings and agency rulings?

Dinner on you own, with campus dining card or individually on per diem

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DAILY PLAN – WEEK #2; WEDNESDAY; LAPTOPS
<8:00 am Quiz (LaSells Ag. Leaders Room); on law and policy; 20 points>

Wednesday morning: Inventory and Monitoring uses – Matt Powers
> LO: Information needs assessments (e.g., for adaptive management)
> LO: Effectiveness, implementation and validation monitoring
> LO: Analyze and interpret monitoring data and incorporate into Forest Plan revisions

Lecture block: 8:15-noon, with *break*
1) Types of monitoring: implementation, effectiveness, compliance, validation, & others
2) Monitoring as a component of adaptive management
3) Monitoring and the LMP/RMP process
   a. Assessment, planning, and monitoring phases
   b. Key elements of a monitoring plan: goals/objectives/desired condition, monitoring questions and indicators
   c. Documentation in monitoring programs
4) Activity: developing a monitoring program

Discussion points:
1) How does monitoring fit into the big picture around the Agency?
2) Are the desired results being achieved currently relative to NEPA, NFMA, *etc*.?
3) How do we design monitoring plans that are adaptable to future technology and policy?

LUNCH AT ARNOLD (campus dining cards)

Wednesday afternoon: Forest Regulation – Bogdan Strimbu
> LO: Basic sustained yield principles related to timber resources and law, LTSY
> LO: Calculate and compare area and volume control
> LO: Basic harvest schedules and allocation problems
> LO: Regulation concepts with economic and sustainability principles

Lecture block: 1:00-2:45, then a *Break*
1) Sustained yield **definitions and principles**; even/uneven-aged management
   a. Area vs. volume regulation – where and when
2) Harvest scheduling and allocation; timber and non-timber resources
3) Spatial vs. non-spatial analysis

Computer exercises (LAPTOPS REQUIRED): 3:00-5:00
1) Binary-search forest regulation exercise – area control, volume control
2) Non-spatial regulation with timber/non-timber outputs

Ideas for discussion:
1) What is the desired future condition and dynamics?
2) How does one measure/inventory if one plan is better than another?
3) Balancing the means with the ends.

*6:30 QUICK group dinner at **Chipotles** near campus; walking from hotel at 6:20*

DAILY PLAN – WEEK #2; THURSDAY; LAPTOPS
<8:00am Quiz (**LaSells Ag. Leaders Room**) – on monitoring; 20 points>

Thursday morning: Model Projection, Language and Display – John Bailey
> LO: Components of stand growth and yield tables
> LO: Metrics of growth (e.g., density management diagrams)

Computer exercise (LAPTOPS REQUIRED): 8:15-noon, with *breaks*
1) Stand table projection (as a simple growth model)
2) Management impacts on tree and stand structure, value and wood quality
3) Language choices for written and oral communication
4) Effective presentation guidelines for variable audiences

Discussion points:
1) What confidence should we have in these simple tools and projections?
2) What about potential effects of climate change?

Work on any remaining FVS runs and summaries for the **Integrated Project**; presentation guidelines for written reports and oral presentations (including general tips)

LUNCH – Woodstock's delivery

Thursday afternoon: Forest Landscape Planning Tools – Bogdan Strimbu
> LO: Basic principles of land use planning and forest planning
> LO: Vegetation management and planning decisions at multiple scales
> LO: Connect natural resource policy and social impact analyses
> LO: Decision support modeling appropriate for Forest Planning issues
> LO: Integrate various inventory and socio-economic analyses

Lecture block: 1:00-2:45, then a *Snack*
1) Standard frameworks for **decision making**
2) Prescriptions – the key building blocks
3) Spatial goals and landscape planning
4) Available tools for forest planning

Computer exercises (LAPTOPS REQUIRED): 3:00-5:00
1) Planning for a *small* watershed – an example

Discussion points:
1) Why plan at all, and what is THE fundamental planning unit in forestry?
2) How do we balance growth and yield of timber vs. non-timber resources?
3) Is there a difference between a "goal" and a "constraint?"

Dinner on you own, with campus dining card or individually on per diem

DAILY PLAN – WEEK #2; FRIDAY
<8:00am Quiz (**LaSells Ag. Leaders Room**) – on regulation and planning; 20 points>

<Written Group Projects **DUE** (100 POINTS)>

Friday morning: Integrated Group Project presentations – John Bailey
        LO: Cement knowledge through personal examples and project work

8:15-11:00 Group presentations on modeling problem (20 points each)
        15 minutes per group, plus questions – *Morning Break* at the half-way point

11:00 Course Evaluations and "Awards"

BOX LUNCHES catered (sandwiches) – with farewells and wishes for safe travel.

Getting home:

Portland departures: HUT shuttle departs Corvallis Hilton Garden at **12:00pm**, arriving at PDX about 2:30pm

Campus dining hours: Week #1 – Arnold Dining Hall (Arn D) 5:00-7:00pm
                                                    Week #2 – normal fall hours throughout campus

OSU Wi-Fi Access: "visitor" – needs to be repeated every four hours.

Classmate Emails:

Integrative Group Project (4- or 5-person teams by region)

All silvicultural prescriptions have <u>three</u> fundamental components:
1. A detailed site/stand description with data that is relevant to published and interpreted forest management objectives and likely stand management actions,
2. Component silvicultural activities (tools and techniques) and their direct impacts on stand development and ecosystem processes/services, and
3. Anticipated, longer-term stand development and ecosystem responses following proposed management actions and an analysis of alternatives.

Silviculturists develop and choose their tools/techniques based more on anticipated long-term ecosystem development **RELATIVE TO** the management objectives than on current stand conditions. For this exercise (and to reinforce the learning objectives of the IMDS module of NASP), we will focus on the third and last component using an example stand for a home District within your group. You might look at each and ponder the advantages and disadvantages of each before you choose.

DUE Friday morning of week #2; 30-page maximum plus supporting tables/figures from the model runs. Your written presentations should have four parts:

Part I. Site/stand description (10 points) – Use summary model output and *appropriately* computed statistics to synthesize tables and figures that describe your existing stand and its projected development over time in the absence of future management (No Action).

Part II. Scoping summary (10 points) – Summarize the interested publics that you will need to engage, appropriate policies and procedures, and summarize three basic areas:
1) The extent of the land area of interest,
2) Broad planning objectives of the Forest, and
3) Specific laws and anticipated management/environmental issues for the stand.
This scoping effort should conclude with a brief introduction of at least three proposed "alternatives" that span the range of options available to address these management objectives and issues.

Part III. Prescription Alternatives (70 points) – The main portion of this project concerns the details associated with 4-5 silvicultural alternatives and their projected effects on growth and development, in general, for the stand – one each per group member independently. This is the true "prescription", describing each tool/technique and its application with a comprehensive timeline and justification of the various tools and techniques chosen as they were **modeled**. Each alternative should have a complete analysis of $\geq$50-year development (economic, ecological, and sociological responses) following implementation of the treatments, but focus attention on the most interesting scenarios. This section should consider all the decisions relevant to land management objectives and other scoping issues.

Part IV. Record of Decision (10 points) – Create a 1-page decision matrix (scoring) and associated synthesis text on a second page that summarizes the pros and cons of all alternatives (including a "no-action" alternative from the site description) for the stand. Consider legal, planning and economic dimensions as well as the basic data (statistics), model runs and silviculture. Assume you've done an EA with all consultations for the area.

Your oral presentations (Friday morning; 20 points) should **focus on** Parts III and IV after a quick introduction of I and II, since you all will only have 15 minutes to present; therefore, you should use only a few slides per alternative, so get to the point (*and practice it*).