# 2020 NASP IMDS #14 – Distance Instructional Plan

**Title**: Inventory/Monitoring and Decision Support (IMDS)
**Dates**: September 14-25, 2020

**PERSONNEL**

Coordinator/Instructor: JB - **John Bailey** - Professor
Instructor: MP – **Matt Powers**, Assistant Professor
Instructor: ES – **Erin Smith-Mateja**, USFS-FVS Group
Instructor: MC – **Mindy Crandall**, Assistant Professor
Instructor: BS – **Bogdan Strimbu**, Assistant Professor

**UNIT OVERVIEW**

This unit still spans two weeks (76 hours total) that includes six hours of synchronous contact time most days in the form of morning and afternoon blocks facilitated by *Microsoft Teams*, two hours of asynchronous at-home exercises, a mix of ***daily*** progress assessments (quizzes), and an integrative group project (with oral presentation). It addresses the eight basic NASP/IMDS topics at the specified contact-hour intensity (Table 1); instructors are identified by initials and color (above).

**Table 1. Schedule overview by instructor and topic.**

| | Monday | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|---|
| **Week 1** **(9/14 -18)** | JB – welcomes and statistics overview (a.m.); MC – Investment analysis principles (p.m.) | JB - Statistical inference and principles (a.m.); MP – Inventory and monitoring statistics (p.m.) | JB – Simple Regression and Covariance (a.m.); MP – Inventory and monitoring principles (p.m.) | ES- growth models and FVS (a.m.); FVS group project work (p.m.) | ES- FVS group project work (a.m.); JB – Density and productivity metrics (p.m.); |
| **Week 2** **(9/21 –25)** | MC – Social cost/ benefit and risk analysis (a.m.); MP – Inventory and monitoring uses (p.m.) | BS - Forest Regulation w/ exercise (a.m.) MP – Collection and management of data (p.m.) | MC - Law and policy for forest planning I (a.m.) JB – Modeling, projections and display (p.m.) | MC – Law and policy for forest planning II (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 the material for each day as arranged by the instructor, as well as general lecture and exercise schedule, describing:

- **learning objectives** (LO) for specific "in-class" live lecture and exercise activities,
- content and flow of **lectures**, **computer exercises and/or group work**, and
- important summary ideas and **discussion questions**.

Each day begins at 8:00 am PDT on *Microsoft Teams* and concludes at 3:00 pm PDT; morning/ evening assignments that are time-zone sensitive with be provided each day. There are regular breaks during 3-hour unit blocks, plus a 1-hour lunch period between blocks beginning at 11:00 PDT.

## DAILY PLAN – WEEK #1; MONDAY

< Statistics pre-work assignment **DUE;** 20 points>

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**Monday morning: Welcomes and introductions: 8:00-9:00 PDT – John Bailey**

1) Schedule, process, logistics and rules; questions; what you should learn; expectations?
2) **Project Assignment/Details** – identify and form groups, schedule work

**Overview of Statistics and Sampling for Mensuration: 9:00**

LO: Basic terms and concepts in forest mensuration, sampling and statistics
LO: Central tendency, variability, and complex distributions

Lecture blocks: 9:00-11:00

1) Concepts of statistics – what do you need to know, and what do you use?
    a. Characterizations of distributions: Continuous vs. discrete
    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 – avoiding bias
    b. Achieving enough observations in your sample

Ideas for discussion:

1) How can I best characterize my data and communicate them to an audience?
2) How does the size of my sample affect my ability to characterize the distribution?

**LUNCH BREAK**

**Monday afternoon: Investment Analysis Principles – Mindy Crandall**

LO: Project-level investment analysis
LO: Finding economics data on the web

Lecture blocks:

1) 12:00 – 1:15 – Arithmetic of investment analysis
    a. Inflation, and simple discounting and compounding; series equations
    b. Hands-on: Calculate simple analysis
2) 1:15 – 3:00 – Using investment analysis (short break at 2pm)
    a. NPV, BCR, and IRR
    b. Discount rates
    c. Comparing rotation ages and alternative silvicultural regimes

Computer/Calculator Exercises:

1)Build management timelines and compute NPV of a prescription
2)Compute CMAI and LEV using excel, compare optimal rotation ages.

Discussion points:

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

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## DAILY PLAN – WEEK #1; TUESDAY

<8:00am Quiz **DUE** on economics; 20 points>

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**Tuesday morning: Sampling and Statistical Inference – John Bailey**

LO: Basic terms and concepts in forest mensuration, sampling and statistics
LO: Central tendency, variability, and complex distributions

Lecture blocks: 8:00-11:00

1. Confidence intervals for the mean and the standard error
2. Testing a statistical hypothesis: a simple T-test.
3. Achieving pre-set precision/power; sample size calculation

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) Why is the purpose of our sampling necessary in order to design the sampling plan?

**LUNCH BREAK**

**Tuesday afternoon: Statistics for Inventories and Monitoring – Matt Powers**

LO: Basic terms and concepts in forest mensuration, sampling and statistics
LO: Introduce forest inventories and current/appropriate uses for multiple objectives
LO: Relevant statistical concepts to real inventory and monitoring situations

Lecture blocks: 12:00-3:00

1. Sampling for forest inventories: basic definitions and concepts
2. Sampling error: sources of error and approaches to minimizing
3. The role of randomization and replication in producing accurate and precise statistical descriptions for inventories/monitoring
4. Replication activity – applying concepts of *pseudoreplication* w/ real data
5. Identifying scope of inference and avoiding *pseudoreplication*
6. Additional considerations when comparing treatments: controls and interspersion
7. What makes an appropriate control? - activity

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?

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## DAILY PLAN – WEEK #1; WEDNESDAY

<8:00 am Quiz **DUE** on statistics; 20 points>

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**Wednesday morning: Simple Regression and Covariance – John Bailey**

LO: Correlation and regression analyses – computer lab exercises
LO: Relationships among time, tree growth, mortality and economics

Lecture blocks: 8:00-11:00

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?

**LUNCH BREAK**

**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: 12:00-3:00

1. Sampling designs (simple, systematic, stratified, double, cluster, and multi-stage)
2. Plot design (fixed vs variable radius, 3P, plot size, nested designs, edge effects)
3. LIDAR and other remote sensing-based inventories
4. Developing strategies for multiple objectives; considerations of scales and sample sizes
5. Sampling design activity
6. 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?

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## DAILY PLAN – WEEK #1; THURSDAY

<8:00 am Quiz **DUE** on inventory methods; 20 points>

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**Thursday: Growth Modeling and FVS – 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: 8:00-11:00

1) Why models are used in general, and for tree growth and yield
2) Types of Forest Growth Models
3) Describe the primary components of an individual tree model
4) Introduction to the Forest Vegetation Simulator
    a. Review FVS functions
    b. 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?

**LUNCH BREAK**

Lecture blocks: 12:00-3:00

1) Integrative Group Project review/updates/Q&A **– John Bailey**
2) Addressing common issues about FVS modeling **– Erin Smith-Mateja**
3) Begin model runs for the integrative group project

Discussion points:

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

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## DAILY PLAN – WEEK #1; FRIDAY

< 8:00 am Quiz **DUE** on growth modeling; 20 points >

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**Friday morning: Growth Modeling and FVS (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: 8:00-11:00

1) FVS review exercise
2) Complete multiple model runs for the **integrative group project**

Discussion points:

1) What FVS outputs are most valuable to your project, and why?

**LUNCH BREAK**

**Friday afternoon: Site Productivity, Density and Growth/Yield – John Bailey**

LO: Factors impacting site productivity in given situations
LO: Measures of tree productivity, site index and site class; site index charts
LO: Explain the importance of manipulating site productivity and stand density
LO: Terms, components and processes important to tree and stand growth

Lecture blocks: 12:00-3:00

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

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) ***Why*** are productivity and density so fundamental to management?
4) How do inventory procedures impact forecasts of future stand conditions?

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## DAILY PLAN – WEEK #2; MONDAY

<8:00 am Quiz **DUE** on density and productivity; 20 points>

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**Monday morning: Cost-Benefit Principles of SFM – Mindy Crandall**

LO: Basic terms and principles of forest economics
LO: Social cost benefit analysis and what it entails

Lecture blocks:

1) 8:15 – 9:15 am – Social cost benefit analysis and how it relates to forestry
    a. Types of values
    b. The Ecosystem Services framework
2) 9:15 – 10:15 – Economic values and economic impacts
    a. What is Economic Impact Analysis and how can it be used?
    b. Tools for non-market valuation
3) 10:15 – 11:00 – Wicked problems in forestry: incorporating values and trade-offs in managing for old-growth. Read *Latta & Montgomery* (2004) and (2007) prior to class.

Discussion points:

1) What role(s) can economics play in public forest land management decisions?
2) What can/can't cost benefit analysis tell policy makers and forest managers?
3) How can economics inform complex issues like managing for old-growth?

**LUNCH BREAK**

**Monday afternoon: 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: 12:00-3:00

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. Policy – monitoring links: activity
    b. Assessment, planning, and monitoring phases
    c. Key elements of a monitoring plan: goals/objectives/desired condition, monitoring questions and indicators
    d. 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?

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## DAILY PLAN – WEEK #2; TUESDAY

< 8:00 am Quiz **DUE** on economics; 20 points >

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**Tuesday morning: 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: 8:00-11:00

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:

1) Binary-search forest regulation exercise – area control, volume control
2) Non-spatial regulation with timber/non-timber outputs

Discussion points:

1) What is the implication of having desired future conditions and dynamics?
2) How does one measure/inventory if one plan is better than another?
3) Balancing the means with the ends.

**LUNCH BREAK**

**Tuesday afternoon: Field Data Collection and Management – Matt Powers**

LO: Field data collection, management and analyses
LO: Synthesizing data/information into silvicultural prescriptions

Lecture block (12:00-3:00):

1) Preparing for field data collection: identifying objectives and appropriate sampling designs; preparing methodologies and required resources (e.g., datasheets)
    a. 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?

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## DAILY PLAN – WEEK #2; WEDNESDAY

<8:00 am Quiz **DUE** on monitoring and data management; 20 points>

**Wednesday morning: Policy and Legal Requirements for Planning, Part I – Mindy Crandall**

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) 8:10 – 8:45 am – Overview of the federal legal environment
2) 9:00 – 10:30 am – Review and discussion of "**The Acts"** that influence forest management and planning directly
    a. National Forest Management Act (NFMA) and companion acts
    b. National Environmental Policy Act (NEPA)
3) 10:30 – 11:00 am – Introduction to the Endangered Species Act (ESA)

Discussion points:

1) Where do policy implications come into silvicultural prescriptions?

**LUNCH BREAK**

**Wednesday afternoon: Modeling, Language and Display – John Bailey**

LO: Components of stand growth and yield tables
LO: Metrics of growth (e.g., density management diagrams)

Lecture blocks: 12:00-3:00

1) Stand table projection (as a simple growth model); Density Management Diagrams
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)*

## DAILY PLAN – WEEK #2; THURSDAY

<8:00am Quiz **DUE** on policy and law; 20 points>

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**Thursday morning: Policy and Legal Requirements for Planning, Part II – Mindy Crandall**

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
LO: Connect natural resource policy and social impact analyses

Lecture blocks:

1) 8:10 – 10:00 am. ***Continue*** review of "The Acts" that influence forest planning activities indirectly
    a. Endangered Species Act (ESA)
    b. Clean Water Act (CWA)
    c. Clean Air Act (CAA)
2) 10:15 – 11:00 am. Discussion: 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?

**LUNCH BREAK**

**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: 12:00-3:00

1) Standard frameworks for **decision making**
2) Spatial goals and landscape planning
3) Available tools for forest planning

Computer exercises

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?"

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## DAILY PLAN – WEEK #2; FRIDAY

<8:00am Quiz **DUE** 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

8:00-10:30 Group presentations on modeling problem (20 points each)

**15 minutes per group**, plus questions – *Break* at the half-way point

**10:30-11:00 Course Evaluations and "Awards" Ceremony; Adjourn**

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

All silvicultural prescriptions have three 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**; 40- to 50-page maximum text with supporting tables/ figures. 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 an introduction of the 4-5 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 is concerned with 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 in detail with a comprehensive timeline and justification of each as **modeled**. Each alternative should have a complete analysis of ≥50-year development (economic, ecological, and sociological responses) following implementation, but focus strengths in meeting objectives. This section should consider all relevant land management objectives and scoping issues.

**Part IV. Record of Decision (10 points) –** Create a 1-page decision matrix (scoring table) and associated synthesis text that summarizes the pros and cons of all alternatives (including a "no-action" alternative from the site description). Consider social, legal, planning and economic dimensions as well as the basic data (statistics), model runs and silvicultural complexity. Assume that 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 total to present; therefore, you should use only a few slides per alternative, and get to the point.