GRANDE PRAIRIE REGIONAL COLLEGE

Bachelor of Applied Forest Resource Management

FOREST MENSURATION I: FO2370

Pre-requisite: ST 1510 (Introduction to applied statistics)

Calender Description:
Sequential treatment of the collection of forest data. Design of a survey, location of points on the ground. The theory behind basic mensuration equipment and how to use it. How to make simple instruments to estimate tree height and DBH. Collection and compilation of data. Analysis of collected data. Development of volume tables, scaling, grading. Using the Global Positioning System (GPS). Aerial photographs, their interpretation and use in cover-type mapping, volume estimation etc. Measurement of other forest values, e.g. wildlife, recreation.

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Lectures:	Tuesday and Thursday	10:00 – 11:30	B304
Lab:	Thursday	14:30 – 17:30	B305

Course Description:
Forest mensuration is defined (Young and Giese, 1990) as "the science dealing with the measurement of volume, growth and development of individual trees and stands and the determination of various products obtainable from them". The 'various products' refers to fibre products and also to other forest values such as recreation, wildlife.
Our initial discussions will cover the purpose of forest mensuration, i.e. why do we need to measure and assess our forests? This discussion will lead us into the concept of the Annual Allowable Cut (AAC). Also, in the concept of modern forestry, it will lead us to consideration of other values of the forest resource such as wildlife and recreation.
From the philosophical consideration of the "why" of forest mensuration we will move to the more practical consideration of "how" it is done. We will look at the different aspects of forest mensuration by considering the steps a forester would follow to obtain information on the volume and growth of the forest.
The following are some of the steps he/she would consider in setting up an inventory survey, i.e. a timber cruise:

- Temporary versus permanent sample plots.
- Sampling intensities and stratified sampling.
- Laying out a cruise on a map or aerial photograph.
- Directional and measurement instruments needed.
- What information to collect.
- Contacting other Departments/Sections re collection of information.
- Collecting 'other than fibre' information.
- Running the cruise in the field, using different measurement equipment

- Recording information in the field, tally cards and data-loggers
- Analysis of the collected data

We will consider how cruise results can be used to develop growth and yield, and volume tables and how they can be used in mapping the forest.
Uses of regression in analysing forest data. Necessary properties of the data set. How regression can be used to predict values of 'difficult to collect' data.
The foregoing might be considered as 'pre-harvest' data collection and analysis.
In the 'post-harvest' situation we will look at scaling and grading of harvested timber.

The nature of tree and stand growth. Projection of stand growth – how to allow and account for ingrowth and mortality.

We will study the concept, principles and use of remote sensing, in particular aerial photographs, their interpretation and the advantages and disadvantages of stand mapping and volume estimation from aerial photographs.
How maps are created and how detail from aerial photographs can be transferred to maps.
As part of our course we will discuss the basic theory underlying the various mensuration instruments and we will see how, if we had to, we could design simple instruments to estimate measurements such as tree height, and diameter at breast height (DBH).

TEXTS AND REFERENCES

RECOMMENDED FOR PURCHASE

Avery, T.A. and H.E. Burkhardt. (1994). Forest Measurements. 4th Ed. McGraw-Hill, New York. 408 pp.

TEXTS AVAILABLE IN THE LIBRARY

Husch, B., Miller, C.I. and T.W Beers. (1993). Forest Mensuration. Krieger Publishing Company, Malabar, Florida. 402 pp.
Compendium of Canadian Forestry Statistics. (1996). Canadian Council of Forest Ministers.
Lillesand, T.M. and R.W. Kiefer. (1994). Remote Sensing and Image Interpretation. John Wiley & Sons, Toronto,
Paine, D.P. (1981). Aerial Photography and Image Interpretation for Resource Management. John Wiley & Sons, Toronto.
Philip, M.S. (1998). Measuring Trees and Forests. CABI Publishing, New York. 310 pp.
U.S.D.A., (1998). Elementary Forest Sampling. Agriculture Handbook #232.

SCIENTIFIC JOURNALS AND PERIODICALS AVAILABLE IN THE LIBRARY

Canadian Journal of Forest Research
Forestry Chronicle
Northern Journal of Applied Forestry
Silviculture

WEBSITE

www.canadian-forests.com; www.fs.fed.us

EXAMINATIONS AND MARK ALLOCATION

Mid-term examination	30%
Mid-term lab exam	10%
Assignments	15%
Final lab report	5%
Final examination	40%

LECTURE SCHEDULE

Introduction to Forest Mensuration **week 1**

- what is forest mensuration?
- occasions when we need measurements from the forest
- one-time measurements vs repeated measurements
- principles and units of measurement
- variables, precision and accuracy

Direction-finding in forestry **week 2**

- the compass
- the Global positioning System (GPS)

Field Measurements, Methods and Instruments

- linear measurement
- areal measurement

Forest Inventory Surveys (timber cruises)

- information required from a cruise, collecting information for other sections/agencies, including wildlife and recreation **week 3**
- design and layout of a cruise, temporary vs permanent sample plots
- Location of pre-set starting point or relocation of previously-run line
- horizontal point sampling, monareal plots, polyareal plots instruments needed for a cruise
- theoretical basis of the compass, hypsometers, dendrometers **week 4**
- GPS, principles and use **week 5**
- recording information in the field, tally cards, data-loggers **week 6**
- data entry to computer, analysis of data
- Regression analysis, assumptions
  - Importance in forestry
  - Regression in development of volume tables

Analysis of Tree and Stand Growth, Stand growth projection **week 7**

Growth modelling

- basics of modelling, information in – answers out.
- types of model, advantages and disadvantages

Scaling, grading and weight measurement **weeks 8, 9**

Aerial photographs

- Basic principles, cameras, filters, film type. Focal length – relationship to altitude and scale. Overlap of stereo pairs and between flight lines **week 10**
- stereoscopic vision, preparing photos and using the stereoscope **week 11**
- Displacement due to relief **week 11/12**
  - Determining tree height from single photo
  - Determining tree height by Parallax Wedge
- Other measures from photos; VCD, crown density
- Mosaics and orthophotos, what are they? how do we use them?
- Applications of aerial photographs in forestry species identification, cover-type mapping, volume estimation **week 13**

Mapping systems, cartography

- Latitude and longitude
- Township and range
- The Universal Transverse Mercator (UTM) grid
- Making maps from photographs **week 14**
  - planimetric and topographic
  - transferring detail from photograph to map

Other information-gathering systems, **week 15**

- satellite imagery, multi-spectral scanning, video

FO2370 LAB SCHEDULE 2003

Lab 1 **11-09-03** **GPS (Global Positioning System)**
- Use in different situations (open ground, open pine, closed canopy spruce)
- For each stand record PDOP, SNR, satellite health and accuracy
- Compare results for each stand type – explain

Lab 2 **18-09-03** Preparing for an inventory survey in Economy Creek Forest
- Identifying the productive area
- Identifying the stands to be surveyed
- What information to collect
- Survey methodology, plot size and shape
- Plot allocation
- The tally card and instruments needed

Lab 3 **25-09-03** **Conducting the survey at Economy Creek**

Lab 4 **02-10-03** **Conducting the survey at Economy Creek**

Lab 5 **09-10-03** Data entry and volume calc'ns from labs 3 and 4

Lab 6 **16-10-03** **Calculating the area of surveyed stands**
- The dot grid
- The planimeter

Lab 7 **23-10-03** **Stem analysis**
- Selecting the tree
- Marking, felling and sectioning

Lab 8 **30-10-03** **Site quality**
- Derivation and use of site index curves

Lab 9 **06-11-03** **Stand growth projections**
- Problem solving

Lab 10 **13-11-03** **Aspects of aerial photography**
- Solving mathematical problems to emphasise the relationship between scale, altitude, PSR, MSR

Lab 11 **20-11-03** **Aerial photographs**
- Preparing the stereo-pair for examination; principal points, conjugate points, line-of-flight
- Using 'displacement due to relief' to estimate tree height from a single photograph
- Using the parallax wedge to estimate tree height from the stereo-pair

Lab 12 **27-11-03** **Radial Line Triangulation (RLT)**
- A technique for transferring information (e.g. a newly-constructed road) from photo to map

Lab 13 **04-12-03** **Aerial photographs**
- Interpretation of cover-type, stand delineation from the photo

Ground truthing in the field

Students are expected to keep full notes and records of all lab activities. These will be taken in and graded at the end of the semester.