

**ISE 553: Modeling and Analysis of Supply Chains**  
**Spring 2024**

**Course section:** 1

**Credit hours:** 3

**Instructor:** Leila Hajibabai, Ph.D., Email: [lhajiba@ncsu.edu](mailto:lhajiba@ncsu.edu)

**Class location:** 4290 Fitts-Woolard Hall

**Class meeting time:** T Th (10:15 – 11:30 PM)

**Course website:** Moodle

**Office hours:** Th 3:00 PM – 4:00 PM or by appointment

<https://ncsu.zoom.us/j/96287908158?pwd=a1QwQ2lmSUh5b3lwQ1FaMWpnVGITUT09>

Meeting ID: 962 8790 8158; Passcode: 645453

**Teaching Assistant:** Hiruni Niwunhella

Email: [dhniwunh@ncsu.edu](mailto:dhniwunh@ncsu.edu)

Office hours: W 1:00 PM – 3:00 PM or by appointment

Office location: 4331/4333 Fitts-Woolard Hall, Desk #25

**Course Description:**

This course presents an overview of the basic issues and strategies involved in operating supply chains, from the design of the supply chain network through the management and location of inventories to the design and operation of the logistics systems that distribute goods from their source to the consumer using state of the art modeling tools available for their analysis.

**Course Objective:**

To expose students to the basic issues that need to be considered in operating supply chains, and the quantitative modelling tools available for their analysis. Emphasis is on using engineering models to develop insights into the behavior of these systems.

**Learning Outcomes:**

By the end of this course, students will:

- Be able to describe and implement commonly used order up to inventory policies for single-item single-location inventory systems.
- Apply data-driven analysis methods to compute the parameters of such inventory systems.
- Quantify the impact of stochastic variability in demand and supply on the inventory levels required to maintain specified customer service levels.
- Design inventory systems to take advantage of opportunities for risk pooling, such as inventory centralization, transshipment, and modular product design.
- Be able to compute effective inventory policies for serial multi-echelon supply chains.
- Understand and implement basic optimization models for supply chain network design and route planning
- Understand the basic components of logistics costs, and specific models and methods for operating these systems
- Understand how integrated supply chain models are developed and analyzed

**Course Textbook:**

- Snyder, L., Shen, Z. J. M., *Fundamentals of Supply Chain Theory*, John Wiley, 2019.
- Mark S. Daskin, Network and Discrete Location: Models, Algorithms, and Applications (2013), 2<sup>nd</sup> Edition, John Wiley & Sons, Inc., New York [ISBN: 978-0-470-90536-4].

**Supplementary readings:**

Additional materials may be assigned to supplement the text; these are freely available online from the NCSU Libraries.

**Prerequisites:**

ISE 361 and ST 372

**Preferred Method of Contact with Instructor:**

My preferred method of contact is email (page 1 of this syllabus). I strive to respond to your emails as soon as possible but allow between 24-48 hours for a response. Please use your NC State email when getting in touch with me as that is the preferred method of contact from the institution as well.

**Class Schedule:**

Week	Topic
1	Course introduction: Syllabus Fundamental issues and trade-offs in supply chain management
2	Facility location models
3	Un-capacitated and capacitated facility location models
4	Network design models; Location and allocation in supply chain design Transportation/distribution/logistics
5	Exam #1 review <b>Exam #1: Thursday February 8, 2024 (In Class)</b>
6	<i>Wellness Day (Tuesday February 13; NO CLASS)</i> Traveling Salesman Problem; Models and heuristics
7	Vehicle Routing Problem; Models and heuristics
8	Vehicle Routing Problem; Models and heuristics Integrated supply chain models
9	Supply chain structures – make to stock, customer order decoupling point,... Deterministic inventory models
10	<i>Spring Break (NO CLASS)</i>
11	Exam #2 review <b>Exam #2: Thursday March 21, 2024 (In Class)</b>
12	Deterministic inventory models Single-stage stochastic inventory models; continuous review
13	Defining and measuring service level in inventory systems
14	Pooling and flexibility Transshipments
15	Multi-echelon inventory models Network topologies; stochastic and guaranteed service models
16	Exam #3 review <b>Exam #3: Thursday April 25, 2024 at 12:00 PM – 2:30 PM (In Class)</b>

**Assessment:**

Each week’s materials will be available on Moodle as the semester progresses and students will be responsible for understanding the week’s deliverables (announced online). In this course, the primary methods to determine each student’s mastery of the material will be homework, case studies, and exams. Grading will be very particular on cases/assignments and careless mistakes are not overlooked. Therefore, there will be no surprise regarding the standards applied at the exam time. The performance of students enrolled in this class will be assessed using the following scoring system:

ASSIGNMENTS	% GRADING
a. Homework Assignments	10%
b. Case Studies	10%

c. Midterm Exams (Exams #1 & 2, each 25%)	50%
d. Final Exam (Exam #3)	30%
<b>TOTAL</b>	<b>100%</b>

**a) Homework Assignments (10%):**

Specific details for assignments will be posted on the course website. All assignments, unless otherwise announced by the instructor, must be submitted via Moodle. Each assignment will have a designated place to submit the assignment.

Assignments vary in complexity from small problems to mini-projects, based on the problem being discussed in the lectures. The primary objective of homework assignments is **learning**. Therefore, the intellectual collaboration on assignments is encouraged. Working together/discussing the solutions is an excellent way of doing that, however, each student is responsible to turn in their **unique** homework solutions **individually**. All assignments are due at the stated deadline on Moodle, which is in Eastern Standard Time and **late assignments will not be accepted without a University-approved excuse** as solutions will be posted on the course website shortly after the due date/time.

**b) Case Studies (10%):**

There will be two case studies (group-based or individual). Details on each case study will be discussed in class and provided on Moodle. Each case study will include a short report and some may include a short presentation. Case studies will cover 10% of your final grade.

**c) Midterm Exams (25% each):**

Your attendance at the midterm exams (Exams #1 and 2) is required.

**d) Final Exam (30%):**

The final exam will not be comprehensive, meaning that course materials will be tested once throughout the semester. The remaining course materials after the second midterm exam (Exam #2) will be tested in the final exam. Your attendance at the final exams is required.

**Grades and Grading Scale:**

Assignment of letter grades is based on earned percentage of points. Letter grades will correspond with the following percentages. All course requirements must be completed before a grade is assigned.

GRADE	A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
POINTS	97 ≤ < 100	93 ≤ < 97	90 ≤ < 93	87 ≤ < 90	83 ≤ < 87	80 ≤ < 83	77 ≤ < 80	73 ≤ < 77	70 ≤ < 73	67 ≤ < 70	63 ≤ < 67	60 ≤ < 63	0 ≤ < 60

**Other Statements and Policies:**

<p><b>Academic Integrity Policy</b></p>	<p><b>Academic Integrity:</b> Dishonesty is unfair to everyone, especially those who do their work honestly. Academic integrity will be fully prosecuted through the student conduct system. All work turned in with your name is assumed to be only your own work (<u>including homework assignments and cases</u>). If what you turn in duplicates others, then it is cheating (regardless of who copied who). Please review the Code of Student Conduct (<a href="http://policies.ncsu.edu/policy/pol-11-35-01">http://policies.ncsu.edu/policy/pol-11-35-01</a>), if any academic misconduct is suspected I will follow due procedure. Violations of academic integrity will be handled in accordance with the Student Discipline Procedures (NCSU REG 11.35.02).</p> <p><b>Honor Pledge:</b> Your signature on any test or assignment indicates, "I have neither given nor received unauthorized aid on this test or assignment."</p>
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<b>Class Attendance</b>	Refer to <a href="http://policies.ncsu.edu/regulation/reg-02-20-03">http://policies.ncsu.edu/regulation/reg-02-20-03</a> . Attendance is optional, and will not be collected to determine your grade.
<b>Pronoun Clause</b>	In an effort to affirm and respect the identities of all students in the classroom and beyond, please contact me if you wish to be referred to using a name and/or pronouns other than what is listed in the student directory.
<b>Accommodations for Disabilities</b>	Any student in this course, who has a disability which may prevent him/her from fully participating in class activities, should contact the instructor personally. Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with the Disability Resource Office at Holmes Hall, Suite 304, 2751 Cates Avenue, Campus Box 7509, 919-515-7653. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation (REG02.20.01). <a href="https://policies.ncsu.edu/regulation/reg-02-20-01">https://policies.ncsu.edu/regulation/reg-02-20-01</a>
<b>Non-Discrimination Policy</b>	NC State University provides equality of opportunity in education and employment for all students and employees. Accordingly, NC State affirms its commitment to maintain a work environment for all employees and an academic environment for all students that is free from all forms of discrimination. Discrimination based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation is a violation of state and federal law and/or NC State University policy and will not be tolerated. Harassment of any person (either in the form of quid pro quo or creation of a hostile environment) based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation also is a violation of state and federal law and/or NC State University policy and will not be tolerated. Retaliation against any person who complains about discrimination is also prohibited. NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at <a href="http://policies.ncsu.edu/policy/pol-04-25-05">http://policies.ncsu.edu/policy/pol-04-25-05</a> or <a href="https://oied.ncsu.edu/equity/policies/">https://oied.ncsu.edu/equity/policies/</a> Any person who feels that he or she has been the subject of prohibited discrimination, harassment, or retaliation should contact the Office for Institutional Equity and Diversity at 919-515-3148.
<b>Students in Stress/Distress</b>	As members of the NC State Wolfpack community, we each share a personal responsibility to express concern for one another and to ensure that this classroom and the campus as a whole remains a safe environment for learning. Occasionally, you may come across a fellow classmate whose personal behavior concerns or worries you. When this is the case, I would encourage you to report this behavior to the NC State Students of Concern website: <a href="http://studentsofconcern.ncsu.edu/">http://studentsofconcern.ncsu.edu/</a> . Although you can report anonymously, it is preferred that you share your contact information so they can follow-up with you personally.
<b>Requirements for Credit-Only (S/U) Grading</b>	In order to receive a grade of S, students are required to take all exams and quizzes, complete all assignments, and earn a grade of C- or better. Conversion from letter grading to credit only (S/U) grading is subject to

	<p>university deadlines. Refer to the Registration and Records calendar for deadlines related to grading. For more details, refer to <a href="http://policies.ncsu.edu/regulation/reg-02-20-15">http://policies.ncsu.edu/regulation/reg-02-20-15</a>. Please note that courses at 500 level and above cannot be taken for credit only.</p>
<b>Requirements for Auditors (AU)</b>	<p>Information about and requirements for auditing a course can be found at: <a href="http://policies.ncsu.edu/regulation/reg-02-20-04">http://policies.ncsu.edu/regulation/reg-02-20-04</a>.</p>
<b>Policies on Incomplete Grades</b>	<p>If an extended deadline is not authorized by the instructor or department, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions), or (b) the end of 12 months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as an attempted course on transcripts. The burden of fulfilling an incomplete grade is the responsibility of the student. The university policy on incomplete grades is located at <a href="http://policies.ncsu.edu/regulation/reg-02-50-3">http://policies.ncsu.edu/regulation/reg-02-50-3</a>.</p>
<b>Electronically Hosted Course Components</b>	<p>Students may be required to disclose personally identifiable information to other students in the course, via electronic tools like email or web-postings, where relevant to the course. Examples include online discussions of class topics, and posting of student coursework. All students are expected to respect the privacy of each other by not sharing/using information outside the course.</p> <p><b>Digital course components:</b> Moodle</p>
<b>Class Evaluations</b>	<p>Online class evaluations will be available for students to complete during the last two weeks of class. Students will receive an email message directing them to a website where they can login using their Unity ID and complete evaluations. All evaluations are confidential; instructors will never know how any one student responded to any question, and students will never know the ratings for any particular instructors. Evaluation website: <a href="https://classeval.ncsu.edu">https://classeval.ncsu.edu</a> • Student help desk: <a href="mailto:classeval@ncsu.edu">classeval@ncsu.edu</a> • More information about ClassEval: <a href="http://www2.acs.ncsu.edu/UPA/classeval/index.htm">http://www2.acs.ncsu.edu/UPA/classeval/index.htm</a></p>
<b>Polices, Regulations, and Rules (PRR)</b>	<p>Students are responsible for reviewing the PRRs which pertain to their course rights and responsibilities. These include:</p> <ul style="list-style-type: none"> <li>• <a href="http://policies.ncsu.edu/policy/pol-04-25-05">http://policies.ncsu.edu/policy/pol-04-25-05</a> (Equal Opportunity and Non-Discrimination Policy Statement)</li> <li>• <a href="http://oied.ncsu.edu/oied/policies.php">http://oied.ncsu.edu/oied/policies.php</a> (Office for Institutional Equity and Diversity)</li> <li>• <a href="http://policies.ncsu.edu/policy/pol-11-35-01">http://policies.ncsu.edu/policy/pol-11-35-01</a> (Code of Student Conduct) <a href="http://policies.ncsu.edu/regulation/reg-02-50-03">http://policies.ncsu.edu/regulation/reg-02-50-03</a> (Grades and Grade Point Average)</li> </ul>
<b>Course Content</b>	<p>Course material accessed from the course website is for the exclusive use of students who are currently enrolled in the course. Content from these systems cannot be reused or distributed without written permission of the instructor and/or the copyright holder. Duplication of materials protected by copyright, without permission of the copyright holder is a</p>

	violation of the Federal copyright law, as well as a violation of NC State University's Academic Integrity and Student Conduct Codes.
<b>Electronic Course Components</b>	Students may be required to disclose personally identifiable information to other students in the course, via electronic tools like email or web-postings, where relevant to the course. Examples include online discussions of class topics and posting of student coursework. All students are expected to respect the privacy of each other by not sharing or using such information outside the course.

**Subject to Change Notice:**

All material, assignments, and deadlines are subject to change with prior notice. It is the student's responsibility to stay in touch with the instructor, review the course site regularly, or communicate with other students, to adjust as needed if assignments or due dates change. Please remember to check your NC State email and the course website announcements frequently.

**Syllabus Disclaimer:**

The instructor views the course syllabus as an educational contract between the instructor and students. Every effort will be made to avoid changing the course schedule, but the possibility exists that unforeseen events will make syllabus changes necessary. Therefore, the instructor reserves the right to make changes to the syllabus as deemed necessary. Students will be notified in a timely manner of any syllabus changes face-to-face, via email, or in the course website announcements.

**Additional Notes (on COVID-19 issues):**

***Health and Participation in Class***

We are most concerned about your health and the health of your classmates and instructors/TAs.

- If you test positive for COVID-19, or are told by a healthcare provider that you are presumed positive for the virus, please work with your instructor on health accommodations and follow other university guidelines, including self-reporting: <https://healthypack.dasa.ncsu.edu/coronavirus/>. Self-reporting is not only to help provide support to you, but also to assist in contact tracing for containing the spread of the virus.
- If you feel unwell, even if you have not been knowingly exposed to COVID-19, please do not come to class.
- If you are in quarantine, have been notified that you may have been exposed to COVID-19, or have a personal or family situation related to COVID-19 that prevents you from attending this course in person (or synchronously), please connect with your instructor to discuss the situation and make alternative plans, as necessary.
- If you need to make a request for an academic consideration related to COVID-19, such as a discussion about possible options for remote learning, please talk with your instructor for the appropriate process to make a COVID-19 request.

***Health and Well-Being Resources***

These are difficult times, and academic and personal stress is a natural result. Everyone is encouraged to take care of themselves and their peers. If you need additional support, there are many resources on campus to help you:

- Counseling Center (<https://counseling.dasa.ncsu.edu/>)

- Health Center (<https://healthypack.dasa.ncsu.edu/>)
- If the personal behavior of a classmate concerns or worries you, either for the classmate's well-being or yours, we encourage you to report this behavior to the NC State CARES team: (<https://advising.dasa.ncsu.edu/resources-for-advisors/advisors-toolkit/cares/>)
- If you or someone you know are experiencing food, housing or financial insecurity, please see the Pack Essentials Program (<https://dasa.ncsu.edu/pack-essentials/>).

### ***Community Standards related to COVID-19***

We are all responsible for protecting ourselves and our community. Please see the community expectations and Rule 04.21.01 regarding Personal Safety Requirements Related to COVID-19 <https://policies.ncsu.edu/rule/rul-04-21-01/>

### ***Course Expectations Related to COVID-19:***

- **Personal Protective Equipment:** As a member of the NC State academic community you are required to follow all university guidelines for personal safety with face coverings, physical distancing, and sanitation. Face coverings are required in this class and in all NC State buildings. Face coverings should be worn to cover the nose and mouth and be close fitting to the face with minimal gaps on the sides. In addition, students are responsible for keeping their course/work area clean.
- **Course Attendance:** NC State attendance policies can be found at: <https://policies.ncsu.edu/regulation/reg-02-20-03-attendance-regulations/>. Please refer to this course's attendance, absence, and deadline policies for additional details. If you are quarantined or otherwise need to miss class because you have been advised that you may have been exposed to COVID-19, you should not be penalized regarding attendance or class participation. However, you will be expected to develop a plan to keep up with your coursework during any such absences. If you become ill with COVID-19, you should follow the steps outlined in the health and participating section above. COVID 19-related absences will be considered excused; documentation need only involve communication with your instructor.
- **Classroom Seating:** To support efficient, effective contact tracing, please sit in the same seat when possible and take note of who is sitting around you; instructors may also assign seats for this purpose.
- **Technology Requirements:** This course may require particular technologies to complete coursework. Be sure to review the syllabus for these expectations, and see [go.ncsu.edu/syllabus-tech-requirements](http://go.ncsu.edu/syllabus-tech-requirements) to find out more about technical requirements for your course. If you need access to additional technological support, please contact the Libraries' Technology Lending Service: <https://www.lib.ncsu.edu/devices>.

### ***Course Delivery Changes Related to COVID-19***

Please be aware that the situation regarding COVID-19 may change and the delivery mode of this course may need to change accordingly, including from in-person to online. Regardless of the delivery method, we will strive to provide a high-quality learning experience.

### ***Grading/Scheduling Changing Options Related to COVID-19***

If the delivery mode has a negative impact on your academic performance in this course, the university has provided tools to potentially reduce the impact:

- **Enhanced S/U Grading Option:** <https://studentservices.ncsu.edu/your-resources/covid-19/spring2020-sat-grading/>

- **Late Drop:** <https://studentservices.ncsu.edu/your-resources/covid-19/spring2020-latedrop/>

In some cases, another option may be to request an incomplete in the course. Before using any of these tools, discuss the options with your instructor and your academic advisor. Be aware that if you use the enhanced S/U, you will still need to complete the course and receive at least a C- to pass the course.

### ***Other Important Resources***

- Keep Learning: <https://dasa.ncsu.edu/students/keep-learning/>
- Protect the Pack FAQs: <https://www.ncsu.edu/coronavirus/frequently-asked-questions/>
- NC State Protect the Pack Resources for Students: <https://www.ncsu.edu/coronavirus/reactivating-campus/resources-for-students/>
- NC State Keep Learning, tips for students opting to take courses remotely: <https://dasa.ncsu.edu/students/keep-learning/>
- Introduction to Zoom for students: <https://youtu.be/5LbPzzPbYEw>
- Learning with Moodle, a student's guide to using Moodle: <https://moodle-projects.wolfware.ncsu.edu/course/view.php?id=226>

The Edward P. Fitts Department of Industrial & Systems Engineering seeks to create a learning environment that supports a diversity of thoughts, perspectives, and experiences while honoring the identities (including but not limited to race, gender, class, sexuality, religion, ability, etc.) of our students. To do so, we must acknowledge the inherent dignity and value of every person and strive to maintain a climate for work and learning based on mutual respect and understanding.

While we fully support and encourage open expression as a part of the process of academic discourse, we should engage one another with civility, sensitivity, and cordiality. In affirming our common humanity, we reject all forms of prejudice, discrimination, and bias. The process of learning often requires difficult and uncomfortable conversations that challenge our beliefs or the status quo. These new perspectives deepen our understanding, strengthen our community, and propel our innovation. Only through thoughtful engagement can we create an environment of inclusive excellence for all. As faculty, staff, and students we will navigate these challenges through dialogue, education, training, and development while adhering to our shared principles and community values.