

**DSO 565 – Supply Chain Analytics– Spring 2021**

(3 Units, two sessions per week with total of 3 hours)

<b>Time:</b>	Monday, Wednesday 5:00-6:20 p.m.	<b>Room:</b>	Online
<b>Instructor:</b>	Dr. Robert Wang	<b>Office:</b>	BRI 307E
<b>E-mail:</b>	<a href="mailto:wangrobe@marshall.usc.edu">wangrobe@marshall.usc.edu</a>	<b>Telephone:</b>	TBD
<b>Office hours:</b>	TBD, and by appointment		

<b>COURSE DESCRIPTION</b>
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**COURSE SCOPE AND TEACHING APPROACH**

While other courses currently offered may nominally focus on a similar topic, this course will provide students with unique, in-depth insight into four areas of Supply Chain Management: ***Data Driven Decision Making, Solving Real-World Problems, Utilizing Scalable Technology,*** and ***Current Industry Best Practices.*** Each of the four aspects are heavily emphasized to develop the knowledge and skills students need to meet the demands in today’s job market and to begin a successful career. Most of the lecture contents, projects, and data used in the course are drawn from many years of first-hand management consulting practices in different industries, and internal consulting which involved the development of innovative supply chain solutions for a major CPG company. We designed the course with one simple ***goal*** in mind: ***to prepare you well for your first job and your long-term career.*** The business concepts, problem solving approach, technical skills, and business practices you will learn from this course will prepare you for your job interviews, help you to perform the most challenging assignments on your first job, and position you well for the modern supply chain management career.

***Data-Driven Decision Making***

Data-driven approach means to make decisions relying on a sophisticated system of predictive, and prescriptive analytical information and solutions developed within an organization. This analytical system is highly automated, run and managed by a team of data scientists and subject matter experts. Data-driven decision-making requires an analytical mind set, and an organizational structure and culture centered on analytics. Decisions must be made based on facts, rather than gut feeling or intuition because our personal experience is always biased and incomplete. With the advancement and adoption of Business Analytics, Data Science, and Artificial Intelligence, data-driven decision making has become the modern approach of supply chain management. Because of this new development, a general business understanding is no longer adequate in the workplace. Most competitive companies expect advanced, in-depth skills from students entering to the job market.

An ability to analyze and draw insights from data is a critical skill to have. At the beginning of the course, you will be provided with a large database with a comprehensive set of real supply

chain data from a major food and nutrition manufacturing and distribution company. It includes but not limited to the following data:

- Demand Forecast
- Order History
- Shipment History
- Inventory History
- Material Master
- Customer Master
- Location Master

This dataset serves as a common thread and a real-world business case to be discussed throughout the entire course. As the course unfolds, we will cover the following topics

- Demand Planning
- Inventory Management
- Supply Planning or MPS
- Distribution Requirement Planning (DRP)
- Transportation
- Supply Chain Network Design

For each topic, the dataset will be used as a basis for principle and concept discussion, classroom demonstrations, data visualization, and student projects. You not only get to experience what is like to work with real-world ERP data, but also get exposed to the potential data issues you could run into. You will have the opportunity to learn a great deal about business terminology, business functions and processes, supply chain network, and organizational structure just from visualizing and analyzing the dataset. As you progress along the course, your understanding and knowledge will build very quickly. At the end of the course, you will have not only learned supply chain management, but also know the underlying company dynamics and its business process inside out. The exposure to, and the learning and insights you will develop from the realistic problems and issues discussed in the class would be equivalent to 1-2 years of working experience in a large manufacturing and distribution company.

### ***Practical Problem Solving***

One of challenges that many students face when they start their career fresh from school is that there seems to be a significant gap between what they learned from school and what is expected of them to know from the job. This course is designed to address the challenge at its root. On the surface, the course may seem to cover the common topics without anything special. Under the hood, however, the approach and techniques used to discuss and solve the issues are all proven effective in real world. In fact, some of the methods introduced in the course may not be found in any textbook, but they are widely endorsed by industry practices. Coming out of the course, you will find yourself speaking a similar business language, thinking and using similar problem-solving approaches to the people who will interview you and work with you in the future. This will dramatically improve your chance to get a dream job upon graduation, perform well in your first job, and lead you to a successful career.

### ***Scalable Technology***

Companies looking for solutions to manage their supply chain, often use different technologies than those typically taught and used in the classroom. The most effective business solutions developed and deployed in real-world organizations need to be scalable and have the capability to be industrialized. It is of a great advantage for students have proficiency in scalable, industrialized technologies when they are on job market. This course will introduce you the latest technology in Data Visualization, Optimization Solver Engine, Database, and high-level Programming Language, etc. You will learn to use the following tools and software throughout the course in solving problems:

- Tableau Data Visualization
- Python (Jupyter Notebook)
- Gurobi Solver
- Relational Database
- Excel Solver
- Excel Pivot Table
- Interactive Inventory Calculator

It is important to note that the focus of the course is not on technologies, rather it is on Supply Chain Management. There are many dedicated courses out there for technologies. This course brings the popular technologies together as tools or enablers and makes use of them in the supply chain context. You will learn how the technologies are deployed and add value in real businesses.

### ***Industry Best Practice***

For every topic covered in the course, we will allocate sometime to discuss its business processes and common organizational structures in different industries. This gives you the perspective of how the issue and processes are managed in real-world, and what are best practices around it. We will also discuss change management, which is so important when a new business solution or process is being implemented. Throughout the course of the semester, you will be exposed to and learn to solve a variety of common problems and to work on improvement projects that are faced by supply chain professionals. You will learn and use the tools and software that are being used in industries. Everything you learn from this course, from supply chain principles to software tools, will be a significant addition to your current resume.

Obviously, the great benefits of the course come with a steep price tag – you will need to put a lot of work into it. The course is not a passive knowledge feeder. It requires your commitment, and initiative on your part to do well. The most effective way of learning is by doing. There will be many tutorials, and hands-on exercises that you may need to work through outside the classroom, particularly if you do not have an extensive database or technical background. The course is designed to be an invitation, an inspiration, and a discipline to keep you focused, and to learn some highly in-demand skills that you would not likely to acquire otherwise on your own in a short amount of time.

### ***Course Overview***

To show the unique approach and the practical perspective of the course, a Course Overview (Appendix) is provided in end of the syllabus. The course overview highlights the main topics discussed in each of the 6 supply chain areas. It also outlined the requirements for the 4 project assignments to be completed by the students. At the end of the deck, we also shared some of the feedbacks provided by the previous students who took the course.

## **COURSE OBJECTIVES**

This course is mainly designed for residential (on-campus) master programs. Students with a few years of working experience, and some quantitative background will find it a natural fit and a great extension for their learning experience. With a minor modification of replacing the Network Optimization by Cost Benefit Analysis in the later part of the syllabus, the technical complexity of the course is greatly reduced, and the course will fit for the on-line programs as well.

Upon successful completion of this course, you will be able to:

1. Articulate the philosophy and approach in data-driven Supply Chain Management.
2. Understand the important role of change management, develop key skills to implement new business solutions and processes.
3. Explain the key principles of Supply Chain Planning, and a typical end-to-end planning process flow
4. Perform inventory optimization by identifying the main inputs that affect the inventory level, perform inventory optimization, and set inventory targets
5. Evaluate a variety of business constraints and inputs in Supply Planning, and develop a realistic constrained model to optimize Master Production Schedule
6. Assess various cost drivers for supply chain network, and develop a realistic model to optimize supply chain network to minimize the total delivered costs

## **COURSE MATERIALS**

### ***Textbook:***

*Supply Chain and Logistics Management Made Easy: Methods and Applications for Planning, Operations, Integration, Control and Improvement, and Network Design*, by Paul A. Myerson (Author), Pearson FT Press; 1 Edition (May 10, 2015).

### ***Recommended Readings:***

*Truckload Transportation: Economics, Pricing & Analysis* by Leo J. Lazarus, Monument Press, 2010.

### ***Software***

To avoid technical issues, it is highly recommended to use a PC with windows 10 installed. Access Database is used throughout the course to store and analyze a very large dataset provided. Mac does not natively support Access Database. If you have to use a Mac, please configure a virtual window environment to act as a PC computer. Here is a list of software that will need to be installed:



- Approach                    40%
- Creativity                    20%
- Correctness                20%

For each project assignment, you need to outline your thinking process and your approach in solving the problem. As you can see this is the most important part of evaluation. To obtain the highest score in Approach, you need to demonstrate clarity and logicity. There may be different approaches to solve a problem, a simplest and most creative method will get you the highest score on Creativity. Not all the assignments have a standard answer, but some quantitative analyses do have a correct answer. You will still get partial credit even if you failed on Approach, Creativity, and Correctness as long as you have demonstrated your effort. Your attention to detail, thoroughness, and willingness in trying are what I am looking for on the Effort category. Failure to submit an assignment on time will result in score of zero for the assignment.

Due to the technical nature of the material, helping each other within the class is highly encouraged. Helping is showing how to perform a task, not performing the task on another's behalf. ***Do not share your assignment files with your classmates! Plagiarism will not be tolerated.*** You can provide support via discussion board where everyone can benefit, or you can help in a one-on-one base. As a courtesy, anyone who received significant help should acknowledge the contributors in their homework. Making a public recognition of the specific contributions of colleagues is a professional practice that displays the recognizer in the best light as an appreciative team player.

### Projects and Exercises

Learning is a direct function of the number of hours you put in. The most effective way of learning is by doing. It is particularly true for this course as the nature of the course is hands-on. Since nobody can learn for you, project submission is an important component in the grade evaluation. The project in this course maybe unlike your typical assignments in your other courses. They are drawn from real projects. In some cases, you are asked to prepare a presentation. To do well for the course, you must take each project seriously.

We can only cover some basic software features or functions in the classroom. To maximize your learning experience and to do well for the class, you are expected to spend [at least 4 - 6 hours per week](#) outside of the classroom learning the software. The more work you do outside of the classroom, the more you will learn, and get out from this course. In addition to the software tutorials provided below, YouTube videos, reading materials and exercises will be provided to you. The exercises will not be graded, but without the effort you made on these exercises you may not be able to complete the homework projects, and worst of all, to keep up with the class.

## **TUTORIALS AND SELF STUDIES REQUIRED TO MASTER THE COURSE**

Here we provide you with a list of tutorials, YouTube videos, and other materials to be mastered to increase your success in this course. You don't have to go through them all if you are already comfortable with some of topics. On the other hand, you should not limit yourselves to the list if you find them inadequate or you want to learn more. Everyone's background is different, and therefore you should adjust your learning process to your own situation. Thanks to the Internet, there are innumerable resources for learning at hand. Identifying your learning needs and acquiring the knowledge yourself using the resources available to you has become an essential capability of a successful professional. You don't need to time the tutorials with the progress of the course. In fact, I would highly recommend that you go through the list ahead whenever you have time for two good reasons. Your learning would be more effective when you prepare the subject prior to the class session. You also can manage your time much more effectively by spreading your work load. You will find that some tutorials worth going over multiple times.

**Access Database:**

Relational Database Concept (5 mins): [Relational Database Concepts](#)

Database Design Basics: [Database design basics](#)

Access Database Basics 01 (23mins): [How to create tables](#)

Access Database Basics 02 (16mins): [How to link tables and field](#)

Access Database Basics 03 (14mins): [How to create a query: Part 1](#)

Access Database Basics 04 (21mins): [How to create a query: Part 2](#)

Access Database Basics 05 (63mins): [More advanced query](#)

Access Functions: [A Comprehensive List](#)

**Excel Pivot Table:**

Excel Pivot Table Tutorial (6mins): [Basic](#)

**Tableau Tutorials (Recommended List): [Latest Link](#)**

- Getting Started
  - Getting Started (25 mins)
  - The Tableau Interface (4 mins)
- Connecting to Data
  - Getting Started with Data (6 mins)
  - Managing Metadata (4 mins)
  - Managing Extracts (4 mins)
- Visual Analytics (115 mins)
  - Go over as many as you can
- Mapping
  - Getting Started with Mapping (3 mins)
  - Maps in Tableau (4 mins)
- Calculations
  - Getting Started with Calculation (3 mins)
  - Calculation Syntax (4 mins)
  - Introduction to LOD Expressions (6 mins)
  - Intro to Table Calculations
  - Aggregate Calculation (4 mins)

- Why is Tableau Doing That?
  - Understanding Pill Types (5 mins)
  - Aggregation, Granularity ... (4 mins)
- Dashboards (36 mins)
  - Go over as many as you can

**Optimization Overview:**

Math Programming Modeling Basics: [A Short Introduction](#)

**Python for Data Analysis:**

You are recommended to take a proposed 2.5-hour online class before you enroll into this class, or once enroll you will be asked to do this online training if you don't have any Python experience. The suggested class is available for free for USC students via [www.lynda.com](http://www.lynda.com). Lynda is "leading online learning platform that helps anyone learn business, software, technology and create skills to achieve personal and professional goals." (lynda.com). The proposed class is titled "Python: Data Analysis" by Michele Vallisri (Director's Fellow at JPL). Here is brief description of the course:

- Course Description: This course provides an opportunity to learn about two Python packages: Numpy and Pandas. Michele Vallisneri shows how to set up the analysis environment and provides a refresher on the basics of working with data containers in Python. Then he jumps into: the power of arrays, indexing, and DataFrames in NumPy and Pandas. He also walks through two sample big-data projects: one using NumPy to analyze weather patterns and the other using Pandas to analyze the popularity of baby names over the last century.
- Topics:
  1. Python Installation and Setup
  2. Data Containers
  3. Intro to Numpy
  4. Weather Data with Numpy
  5. Intro to Pandas
  6. Baby Names with Pandas

**Gurobi Solver Package:**

The following tutorials are for Gurobi Package for Python. You need to go over them prior to the lecture sessions.

Gurobi with Python (54 mins): [Introduction](#)

Gurobi with Python (59 mins): [Advanced](#)

Gurobi with Python (53 mins): [A very inspiring show case](#)

**MIDTERM AND FINAL EXAM**

There will be a midterm and a final exam, and they will contain both qualitative and quantitative questions. The questions are formulated to evaluate the level of your understanding about the key concepts and insights we developed over the course. The best way to prepare for the exams is to review what we have covered in the classroom and homework, and make sure that you fully

understand them. The exams will be closed book, and no “cheat-sheet” is allowed. Again, the exams are not designed to test your memorization, rather to evaluate your understanding of the subject.

If there are extenuating circumstances that prevent you from taking the tests, you must discuss the reason with me well before the time of the exam. You will not be given a make-up exam unless you obtain a permission from me in advance. In addition, you must be able to document the extenuating circumstance. If you miss the exam due to a medical emergency that can be documented and verified, then a make-up exam will be given. Otherwise, a grade of zero will be given for the missed exam. Note that a make-up exam cannot be taken before the actual exam date!

### **CLASS CONTRIBUTION**

Class contribution requires that you study the tutorials, do exercises, and prepare yourselves well before each session of the class. For the nature of this course, keeping up or even trying to be ahead of the curve will be important for doing well in class contribution. You don't have to be right to get contribution credit, your preparation and thoughtfulness is what matters most.

Individual contribution requires attendance in class and will be based on the quality of each student's contribution to class discussion. “Quality” reflects many factors – for example, occasional thoughtful comments, questions and sharing of answers to problems that reflect effort are far more important in determining “quality” than are continual comments and questions that do not reflect thoughtfulness. Absence from class means that the maximum contribution score of zero.

I reserve the right to lower your contribution points for unprofessional conduct in class or not being prepared to discuss homework problems assigned. Unprofessional conduct includes, but is not limited to, coming to class late, leaving during the class, interrupting class with talking, noise from your cell phone; using a laptop or phone to text or email, or engaging in activities not supporting your learning in the day's class, not respectfully paying attention to classmates' questions or answers, and so forth.

The first opportunity to maintain your contribution grade will be the assignment to self-assess your proficiency in each software language, the amount of time needed to gain basic proficiency in each language and schedule the time to learn those areas where you have assessed a deficiency that may impact your success in the source. Your proficiency will enable you to thoughtfully contribute your perspective on the software's benefit to supply chain management. Without that, you will be ill prepared to contribute to our exploration of the tools for optimal supply chain management.

### **GETTING HELP**

If you have questions about any aspect of the course, you can always talk to me. If it is a quick question, you can contact me before or after the class. If you need more time or privacy, you can come to my office hours. If you cannot make my office hours, you can contact me and we can arrange for an alternative time. The best way to reach me is by e-mail.

## GRADING

Graded work will be posted on the Blackboard. Disputes over graded material should be brought to my attention as soon as possible.

## NOTICE ON ACADEMIC INTEGRITY

The use of unauthorized material, communication with fellow students during an examination, attempting to benefit from the work of another student, and similar behavior that defeats the intent of an examination or other class work is unacceptable to the University. It is often difficult to distinguish between a culpable act and inadvertent behavior resulting from the nervous tensions accompanying examinations. Where a clear violation has occurred, however, the instructor may disqualify the student's work as unacceptable and assign a failing mark on the paper.

Academic dishonesty includes: (*Faculty Handbook*, 1994: 21---22):

- ❖ Examination behavior --- any use of external assistance during an examination shall be considered academically dishonest unless expressly permitted by the teacher.
- ❖ Plagiarism --- the appropriation and subsequent passing off of another's ideas or words as one's own. If the words or ideas of another are used, acknowledgment of the original source must be made through recognized referencing practices.
- ❖ Other types of academic dishonesty --- submitting a paper written by or obtained from another, using a paper in more than one class without the teacher's express permission, obtaining a copy of an examination in advance without the knowledge and consent of the teacher, changing academic records outside of normal procedures and/or petitions, using another person to complete homework assignments without the knowledge or consent of the teacher.

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, "Behavior Violating University Standards" <https://policy.usc.edu/scampus-part-b/>. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

<b>STATEMENT ON ACADEMIC CONDUCT AND SUPPORT SYSTEMS</b>
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## **Support Systems:**

*Counseling and Mental Health - (213) 740-9355 – 24/7 on call*

[studenthealth.usc.edu/counseling](http://studenthealth.usc.edu/counseling)

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

*National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call*

[suicidepreventionlifeline.org](http://suicidepreventionlifeline.org)

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

*Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call*

[studenthealth.usc.edu/sexual-assault](http://studenthealth.usc.edu/sexual-assault)

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

*Office of Equity and Diversity (OED) - (213) 740-5086 | Title IX – (213) 821-8298*

[equity.usc.edu](http://equity.usc.edu), [titleix.usc.edu](http://titleix.usc.edu)

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

*Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298*

[usc-advocate.symplicity.com/care\\_report](http://usc-advocate.symplicity.com/care_report)

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, and response.

*The Office of Disability Services and Programs - (213) 740-0776*

[dsp.usc.edu](http://dsp.usc.edu)

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

*USC Campus Support and Intervention - (213) 821-4710*

[campussupport.usc.edu](http://campussupport.usc.edu)

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

*Diversity at USC - (213) 740-2101*

[diversity.usc.edu](http://diversity.usc.edu)

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

*USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call*

[dps.usc.edu](http://dps.usc.edu), [emergency.usc.edu](http://emergency.usc.edu)

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

*USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call*

[dps.usc.edu](http://dps.usc.edu)

Non-emergency assistance or information.

*Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)*

[ombuds.usc.edu](http://ombuds.usc.edu)

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

## **STUDENTS WITH DISABILITIES**

USC is committed to making reasonable accommodations to assist individuals with disabilities in reaching their academic potential. If you have a disability which may impact your performance, attendance, or grades in this course and require accommodations, you must first register with the Office of Disability Services and Programs ([www.usc.edu/disability](http://www.usc.edu/disability)). DSP provides certification for students with disabilities and helps arrange the relevant accommodations. Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to your TA) as early in the semester as possible. DSP is located in GFS (Grace Ford Salvatori Hall) 120 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776. Email: [ability@usc.edu](mailto:ability@usc.edu).

## **EMERGENCY PREPAREDNESS/COURSE CONTINUITY**

In case of a declared emergency if travel to campus is not feasible, the *USC Emergency Information* web site (<http://emergency.usc.edu/>) will provide safety and other information, including electronic means by which instructors will conduct class using a combination of USC's Blackboard learning management system ([blackboard.usc.edu](http://blackboard.usc.edu)), teleconferencing, and other technologies.

**STATEMENT ON TECHNOLOGY USE**

Please note that communication devices such as cell phones, smart phones, tablets, etc. capable of sending and/or receiving electronic communication and all entertainment devices are to be turned off and kept off throughout the class session. Receiving or sending communication or entertainment during class disrupts the learning environment and is rude to those around you.

**Detailed Course Plan (Tentative)****Week 01: 01/11/21 & 01/13/21 - Introduction (Chapter 2)**

- ❖ Reading: Chapter 2
- ❖ Course Introduction
  - Course Overview
  - Rules and Policy
  - Expectations
- ❖ Supply Chain Process Overview
  - Organization Structure
  - Planning Process
  - Network Visualization
- ❖ Software Installation
  - See links in the Course Materials section
- ❖ Access Database and Pivot Table
  - Supply Chain Dataset Walk-Through
  - Table, Query
  - Link data to Excel Pivot Table

**Week 02: 01/18/21 Martin Luther King Day (Holiday) & 01/20/21 – Access Database**

- ❖ Develop Basic Access Database Skill
  - Data Aggregation Using Group By
  - Various Types of Queries: Union, Update, Append, Delete, etc.
  - Table Join: Inner Join vs. Outer Join
- ❖ Learn Supply Chain Network through Data
  - Develop Basic Queries to Pull Summarized Data
  - Learn company's business through the summarized volume
  - Plant, DC, and Customer Ship-To
  - Product Hierarchy
  - Customer Hierarchy
  - Shipment Payload
- ❖ Project Demo: Dynamic Payload Report
  - Payload by Plant
  - Payload by Customer Ship-To

**Week 03: 01/25/21 & 01/27/21 - Demand Planning Principle (Chapter 3)**

- ❖ Reading: Chapter 3
- ❖ Demand Planning Overview
  - Forecast Principles
  - Key Components of Forecasting
  - Types of Forecasting
  - Forecasting Approach
  - Forecast Lags, and Its Application
  - Forecast Accuracy by Lag
- ❖ Introduction to Tableau Visualization
  - Tableau Interface Overview
  - Connection to Database
  - Classroom Demo: Sales by Week
- ❖ Tableau Tutorials
  - Getting Started
  - Connecting to Data
- ❖ Exercise: Forecast Accuracy Visualization
  - Dynamic Forecast Accuracy
  - By Product Hierarchy
  - By Network
  - Drill-down to Product

**Week 04: 02/01/21 & 02/3/21 Forecast Application**

- ❖ Forecast Aggregation
  - One Forecast Principle
  - Forecast aggregation for different needs
  - Forecast Aggregation using Database
  - Forecast Accuracy Calculation with Aggregation
  - Various Accuracy Measures and Business Implications
- ❖ Forecast Application
  - Weeks (Days) Cover Calculation
  - Safety Stock
  - Use of Forecast for Inventory Planning
  - Use of Forecast for Production Planning
  - Use of Forecast for DRP
- ❖ Tableau Visualization
  - Develop Simple Visualization
  - Aggregation and Filter
  - Geo Mapping
- ❖ Tutorials
  - More Tableau Tutorials and Exercises

**Week 05: 02/08/21 & 02/10/21 Inventory Optimization (Chapter 4)**

- ❖ Reading: Chapter 4
- ❖ Inventory Management Introduction
  - Types of Inventory
  - Drivers for Each Inventory Type
  - Dive into Safety Stock
- ❖ Interactive Inventory Calculator
  - Calculate all 4 types of Inventory Interactively
  - Understand all Input Parameters and their Impact to Inventory
  - Weeks Cover Calculation
- ❖ Inventory Simulation Model
  - Identify all 10 Parameters that can Influence Inventory Decision
  - Understand the Impact of each Parameter to Different Inventories
- ❖ Project 1: Supply Chain Network Visualization
  - Network Locations: Plants, DCs, and Customers
  - Supply and Delivery Move
  - Volume Visualization
  - Project 1 due date: Week 6: 02/17/21

**Week 06: 02/15/21 President's Day (Holiday) & 02/17/21 – A Depp Dive to Safety Stock**

- ❖ Project 1 due 2/17/21
- ❖ In Depth Discussions about Safety Stock
  - Various Service Level Measurements
  - Service Level and Safety Stock Impact
  - How to Set Service Level Target
  - We Create Our Own Forecast Errors
- ❖ Tableau Skills
  - Use of Product Hierarchy for Roll-Up and Drill-Down
  - Combine Multiple Data sources
  - Calculation
- ❖ Project 2: Inventory Optimization
  - Inventory Visualization
  - Develop an Inventory Visualization Report
  - Visualize Current Inventory Level and Cost
  - Project 2 due date: Week 7: 02/24/21

**Week 07: 02/22/21 & 02/24/21 - A Data-Driven Approach for Inventory Management**

- ❖ Project 2 due 2/24/21
- ❖ A Data-Driven Approach for Inventory Management
  - Inventory Management System
  - How to Manage Input Data
  - System Architecture
  - Organization Structure

- ❖ Project 3: Inventory Optimization
  - Expand the project to Inventory Reduction
  - Conduct an Inventory Reduction Pilot (POC) for a Group of 40 Products
  - Using the data provided to calculate optimal inventory level
  - Estimate savings based on your calculation
  - Prepare a presentation to give your CSO an update for your findings
  - Project 3 due date: Week 8: 03/03/21

**Week 08: 03/01/21 & 03/03/21 Wrap Up Inventory and Mid-Term**

- ❖ Project 3 due 03/03/21
- ❖ Additional Optional Topics and Wrap-Up
  - Salvage Inventory Model
  - On-going Inventory Management Process
  - Inventory Reduction Approach
- ❖ Mid-Term: Close-Book
  - Date: March 03, 2021
  - Closed Notes/Book
  - No Cheat Sheet

**Week 09: 03/08/21 & 03/10/21 - Supply Planning -- A Realistic Approach (Chapter 5)**

- ❖ Reading: Chapter 5
- ❖ Supply Planning
  - Master Production Schedule (MPS)
  - Short-term Production Scheduling
  - Business Environment and Key Constraints
  - Interactions with other Planning Functions
  - Basic EPQ Model
- ❖ Realistic MPS Optimization Model
  - Understand Key Concepts: Production Line, Setup Cost, Run-Rate, Line Capacity, Min/Max Inventory Targets, Inventory Cost, and Production Cost
  - Learn to use OpenSolver to develop a realistic MPSO model using Excel
  - Simulate and Understand various parameters and their impact to the production plan and costs
  - Compare the model with EOQ
- ❖ Understand the Insights from the MPSO model
  - Production Resources Shared by Multiple Products
  - Seasonal vs Regular Products
  - Impact of Change-Over cost

**Week 10: 03/15/21 & 03/17/21 - Spring Recess**

**Week 11: 03/22/21 & 03/24/21 - A Data-Driven Approach for Supply Planning**

- ❖ Manage Salvage and Waste
  - Warehouse Shelf Life
  - Salvage Prediction Model
  - Potential Salvage Alter Model
  - Manage Salvage Proactive vs Reactive
- ❖ Role of Supply Planning
  - Traditional vs Data-Driven Approach
  - Develop a MPS Optimization System
  - System Architecture
  - Organization Structure
- ❖ Additional Topics in Supply Planning
  - Multi-Production Sourcing
  - Production Sourcing and its Impact to Supply Chain Network
  - Plant Direct
- ❖ Project: Production Planning
  - Develop Your Own Supply Planning Models
  - Two Products share a production line with capacity constraint
  - Develop a Production Plan using EPQ model
  - Develop Optimization model using Open-Solver to generate a plan
  - Compare the two plans, and draw insights

**Week 12: 03/29/21 & 03/31/21 - DRP**

- ❖ Business Objective and Constraints
  - Business Objectives
  - Inventory Strategy: Push vs Pull
  - Multi-Production Sourcing
  - Inventory Target
  - Managing DC Storage Capacity
  - Load Optimization
  - Managing Salvage
- ❖ Introducing Python: A Powerful Language for Data Science
  - Jupyter Interface Overview
  - Language Basic
- ❖ Tutorials
  - Complete “Python: Data Analysis” online course by yourself

**Week 13: 04/05/21 & 04/7/21 - Transportation and Network Modeling (Chapter 7)**

- ❖ Reading: Chapter 7
- ❖ Transportation: A Practical Overview
  - Transportation Modes
  - Common Carriers
  - Private vs Dedicated vs Regular Fleets
  - Route Guide
  - Truck Equipment

- Transportation Economics and Costs
- Carrier Management
- ❖ Network Model Overview
  - Strategic vs Operational Models
  - Scope of the Model
  - Costs Included in the Model
- ❖ Gurobi Package for Python Tutorials
  - Complete the online tutorials

**Week 14: 04/12/21 & 04/14/21 - A Boundary Realignment Model (Chapter 15)**

- ❖ Reading: Chapter 15
- ❖ Develop a Conceptual Model
  - Model Dimensions and Index Set
  - Input Data
  - Decision Variables
  - Objective Functions
  - Constraints
- ❖ Develop Data Model
  - Data Model Design in Access Database
  - Input Data Preparation
  - Output Data
- ❖ Introduce Python Gurobi Data Structure
  - Multi-Dictionary
  - Dictionary
  - Tuplelist
- ❖ Convert the Conceptual Model into a Python Model
  - ODBC Data Connection
  - Input Data Preparation in Database

**Week 15: 04/19/21 & 04/21/21 - Develop Model Result Visualization**

- ❖ Develop Model Report
  - Access Macro for Model Result Refresh
  - Design Model Result Visualization
  - Prepare Data feed for Visualization
- ❖ Expand the Model for Network Design
  - Scenario Management Data Model Design
  - Expand Python Model
  - Add Greenfield Scenarios
  - Add Fixed Cost Scenarios
  - Run Models and Manage Results
- ❖ Project 4: Network Optimization
  - Develop A Model Result Visualization
  - Scenario Summary
  - By Storage View
  - Boundary Map View

- Prepare a Presentation for Final Recommendation
- Project 4 due date: Week 16: 04/26/21

**Week 16: 04/26/21 & 04/28/21 - Expand the Model for Network Design**

- ❖ Project 4 due 4/26/21
- ❖ Continue material from week 15
- ❖ Wrap-Up and Course Review

**Week 17: Final (During the week of May 5<sup>th</sup> through May 12<sup>th</sup>)**

- ❖ Final Exam
  - The date/time of the Final Exam is determined by the University. For the date and time of the final for this class, consult the USC *Schedule of Classes* at [www.usc.edu/soc](http://www.usc.edu/soc). Select the corresponding semester to view and click on the “Final Examinations Schedule” link on the left side of the screen.
  - Closed Notes/Book
  - No Cheat Sheet

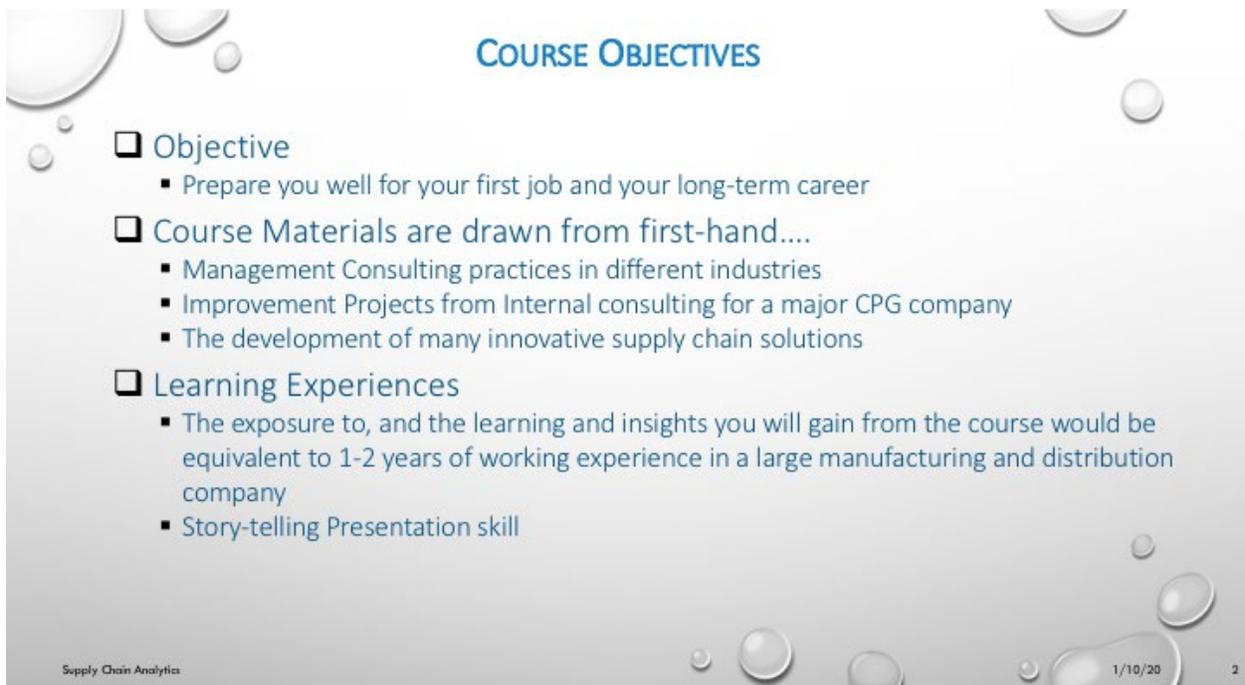
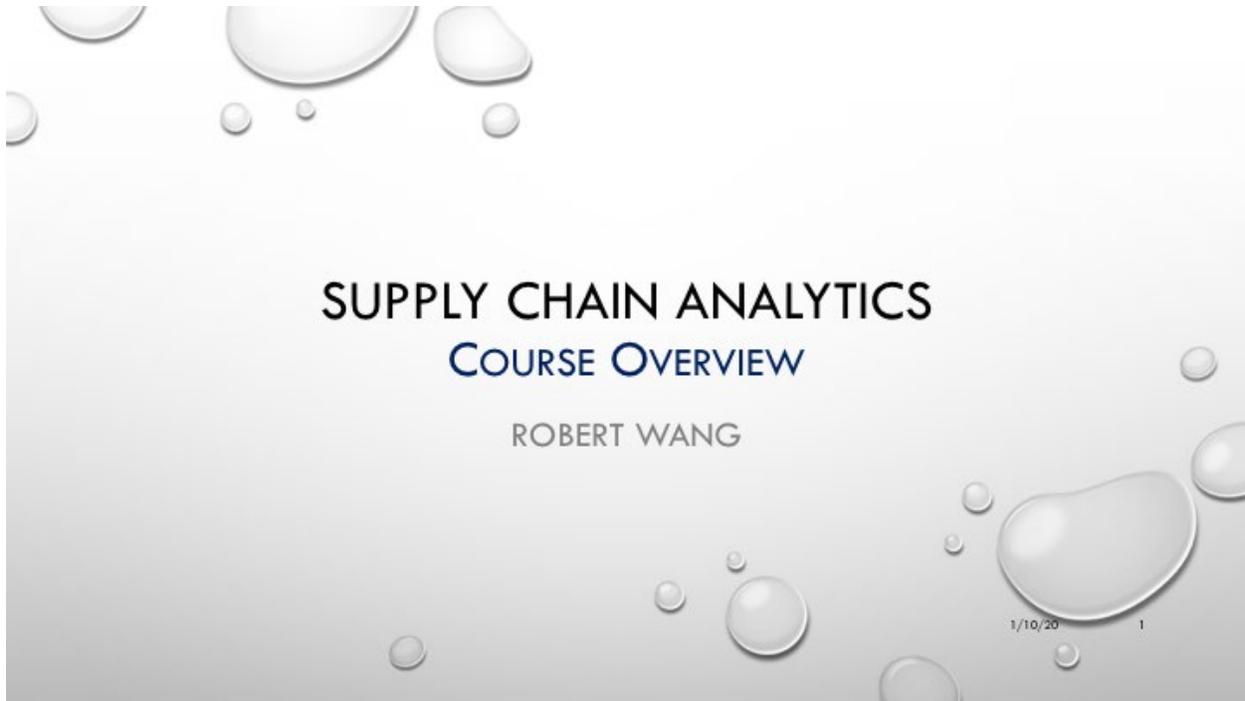
## Appendix I. MARSHALL GRADUATE PROGRAMS LEARNING GOALS

### How DSO 565 Contributes to Marshall Graduate Program Learning Goals

Marshall Graduate Program Learning Goals	Objectives that support this goal	Assessment Method*
<p><b><i>Learning Goal #1: Develop Personal Strengths.</i></b>  <b>Our graduates will develop a global and entrepreneurial mindset, lead with integrity, purpose and ethical perspective, and draw value from diversity and inclusion.</b></p>		
1.1 Possess personal integrity and a commitment to an organization's purpose and core values.	N/A	
1.2 Expand awareness with a global and entrepreneurial mindset, drawing value from diversity and inclusion.	1-6	Project 1-4
1.3 Exhibit awareness of ethical dimensions and professional standards in decision making.	1-6	Project 1-4
<p><b><i>Learning Goal #2: Gain Knowledge and Skills.</i></b>  <b>Our graduates will develop a deep understanding of the key functions of business enterprises and will be able to identify and take advantage of opportunities in a complex, uncertain and dynamic business environment using critical and analytical thinking skills.</b></p>		
2.1 Gain knowledge of the key functions of business enterprises.	1-6	Project 1-4, Mid-Term and Final
2.2 Acquire advanced skills to understand and analyze significant business opportunities, which can be complex, uncertain and dynamic.	1-6	Project 1-4, Mid-Term and Final
2.3 Use critical and analytical thinking to identify viable options that can create short-term and long-term value for organizations and their stakeholders.	1-6	Project 1-4, Mid-Term and Final
<p><b><i>Learning Goal #3: Motivate and Build High Performing Teams.</i></b>  <b>Our graduates will achieve results by fostering collaboration, communication and adaptability on individual, team, and organization levels.</b></p>		
3.1 Motivate and work with colleagues, partners, and other stakeholders to achieve organizational purposes.	1-3	Project 1-4

<p>3.2 Help build and sustain high-performing teams by infusing teams with a variety of perspectives, talents, and skills and aligning individual success with team success and with overall organizational success.</p>	<p>1-3</p>	<p>Project 1-4</p>
<p>3.3 Foster collaboration, communication and adaptability in helping organizations excel in a changing business landscape.</p>	<p>1-3</p>	<p>Project 1-4</p>

## Appendix: Course Overview



## TEACHING APPROACH FOCUSING ON....

- ❑ **Data-Driven Decision Making**
  - Decision making based on facts vs. experience or intuition
  - Foundation for modern adoption of AI, Big Data, and Analytics technologies
- ❑ **Solving Real-World Problems**
  - The entire course is a giant case study
  - Use of real supply chain data set from a top CPG company
  - All problems and exercises are drawn from real-world projects
- ❑ **Scalable Technology**
  - Learn the latest software and tools
  - Develop critical analytical skills
  - Tableau Data Visualization
  - Gurobi (Optimization) Solver
  - Relational Database
  - Python Jupyter Notebook
- ❑ **Industry Best Practice**
  - Investigate common supply chain issues faced by companies
  - Learn the most effective problem solving approaches
  - Prepare you well for your first job and interviews

## SUPPLY CHAIN FUNCTIONAL KNOWLEDGE DEVELOPMENT

- ❑ **Demand Planning**
  - Demand Planning Principles
  - Collaborative Planning Process
  - Forecast Accuracy
  - Accuracy KPI Reporting through product hierarchy (5 levels of product grouping)
  - Forecast Lags and their Applications
- ❑ **Supply Planning**
  - Manufacturing Environments and Constraints
  - Costs Impacted: Labor, Inventory, Change-Over, Overtime, Shortage, and Salvage costs
  - Realistic MPS Model using Solver to minimize total costs
  - Comparison to EOQ
- ❑ **Inventory Optimization**
  - Investigate 4 types of Inventory: Safety, Cycle, Build, and Pipeline
  - Analyze 12 inventory drivers
  - Understand weeks cover and its calculation
  - Optimize customer service level
  - Develop inventory optimization framework
  - Manage salvage or waste
  - Explain working capital impact
  - Identify Inventory Strategy using product segmentation
- ❑ **DRP and Deployment**
  - Investigate various deployment strategy: push vs. pull
  - Discuss various inventory strategy: centralized vs. distributed
  - Explain various network configurations, and their applications
  - Manage network capacity with dynamic deployment model
  - Optimize supply flow with production Multi-Sourcing
- ❑ **Transportation**
  - Transportation Modes
  - Shipment payload and costs
  - Common carriers and private fleet
  - Transportation cost structure and various cost components
  - Carrier bid and management process
  - Load tendering process
  - FIMC: Freight Market Intelligence Consortium
- ❑ **Network Design and Optimization**
  - Boundary Realignment vs Network Design Models
  - Costs impacted by Network Optimization
  - Network green field study
  - Model development with Python
  - Data model development with Rational Database
  - Model insights development with Tableau Visualization

## ANALYTICAL SKILL DEVELOPMENT

- ❑ Full Size Supply Chain (ERP) Data
  - Data Set used as a business case
    - 4 networks with 3,500 products, 150 plants, 30 DCs, and 5,000 customers
    - Real data, real business insights
    - Used for all projects, exercises, and classroom illustrations
  - Transaction Data (history)
    - Sales Order History
    - Shipment History
    - Inventory History
  - Planning Data (forward looking)
    - Demand Planning
    - Production Planning
  - Master Data
    - Material Master
    - Customer Master
    - Location Master
    - Product Hierarchy
- ❑ Understand Data
  - Identify data structure and its business meaning
  - Visualize data with Tableau and Pivot Table
  - Query data to answer business questions
- ❑ Use of Relational Database
  - Develop basic query skills to aggregate, combine, filter, and update data at various levels of details
  - Join data from various tables
  - Prepare data feed for optimization model and Tableau visualization
- ❑ Create Tableau Visualization
  - Develop basic skills to create visualization and dashboard
  - Link live data from database
  - Develop supply chain flow with Geo-Mapping
  - Tell an End-to-End story with a story-board
- ❑ Build Optimization Model
  - Develop Excel-based Supply Planning model
  - Create Network Optimization models with Python
  - Understand optimization solver and its applications

Supply Chain Analytics

1/10/20

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## COURSE PROJECTS

- ❑ Project 1: Inventory Optimization
  - Use the inventory data set provided
  - Visualize inventory level and cost through product hierarchy (5 different levels of grouping) for all 5000 products.
  - Ability to calculate, aggregate, and drill down inventory weeks cover, holding cost, and cost of capital at 5 different levels of product hierarchy
  - Optimize inventory for a Beverage product group (about 40 products) using Inventory Calculator.
  - Identify optimal inventory level for Safety, Cycle, Pre-Build, and Pipeline stock using the methodology learned from the class
  - Estimate Inventory cost reduction opportunity for each business division
  - Develop and Present project approach and findings
- ❑ Project 2: Production Planning
  - Develop an Excel Model for weekly Production Plan over 52-week time horizon
  - Multiple products shares a production line with limited line capacity
  - Overtime can be used if line capacity is not enough for certain weeks
  - Production plan must maintain 3 weeks of minimum inventory cover
  - Setup cost and change-over time need to be considered for each production run
  - Calculate costs impacted: Labor, Over-time, Setup, Inventory Hold costs
  - Optimize production plan using solver to minimize total costs
  - Develop production plan for various what-if scenarios
  - Calculate safety, cycle, and build stock for each scenarios
  - Compare optimized plan against EOQ, and explain the weakness of EOQ model

Supply Chain Analytics

1/10/20

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## COURSE PROJECTS (CON'T)

### Project 3: Network Visualization

- Develop a location-based network visualization with 3 types of locations: Plants, DCs, and Customers for 4 different networks: Ambient, Chilled, Frozen, and Nutrition
- Visualize Inbound or Outbound volume on a Map with Product Hierarchy and Network Filter
- Develop DC to Customer shipment boundary visualization Map
- Visualize customer delivery boundary by 4 different networks
- Prepare database queries to feed visualization data to Tableau
- Write project approach to outline thinking process and steps

### Project 4: Network Optimization

- Develop a network design model with Python that includes supply move (from plant to DC) and delivery move (from DC to Customer) for the Ambient network
- The model must capture the following costs: Supply Move, Delivery Move, DC (Fixed), and Handling (Variable)
- The model should be developed at product level details (about 2,500 products) with 120 plants, and 3,000 customers
- Establish a baseline scenario of 6 DCs with supply and delivery moves, and 4 types of costs
- Create 5 different green field scenarios with the number of DCs range from 3 to 7. DC can be optimally selected by the model from a pre-identified list of 25 potential sites
- Run all the scenarios through the python model to find optimal DC site selection and network flow
- Develop a Tableau dashboard to present the model results and draw insights
- Present key findings and give recommendation

## FEEDBACK FROM PREVIOUS STUDENTS

"I would like to thank you for your enthusiasm and willingness to teach us this semester. I really enjoyed this course and I enjoyed even the challenges that I faced. I learned a lot and I feel that I have discovered my interest in the transportation field." – Christina Kyriakopoulou

"I am currently doing a supply chain internship at Coca-cola Thailand. Since the first day of work, I found that the work is very identical to your teaching and assignments. Everything we did in the course was very useful and very practical, especially the use of Microsoft Access and Tableau software. I really enjoyed your class and hopefully you will continue teaching this course at Marshall in the future. Thank you so much for teaching and sharing your experience." – Kant Kulpiyavaja

"There was not a single day that I didn't miss your class after we finished it. We have learn so much from it and all that we learned are skills that we can practically apply to our careers. The reason I'm saying this is because that I have started a summer internship not long ago, as a logistic data analyst at VIPSHOP, and I have to say that I now wish that I have paid more attention in your class. To put this in Chinese, I'm literally feeling that "学到用时方很少". It's been a valuable experience taking your class and having you as my professor. Thank you very much for putting so much effort in educating us and providing us such a great course. Thank you Professor Wang!" – Shan Huang

"When we had a review session, many of us mentioned how your class was very nice and could be put in the first semester. I personally suggested that your class be put in the Fall Semester as we really learnt a lot from it and that 2/3 lectures have the Introduction for your SCM class." – Soumyo Ganguly

### More from evaluations:

"Prof Wang is the most dedicated Professor I have met. He is always available to students' questions and his only goal is for us to learn as much as possible from him. He spent countless hours preparing this course. Although this is his first course taught at USC, his class has been extremely useful. I truly appreciate his efforts and willingness to share his knowledge with students."

"Good course methodology. Very analytical and practical. Always guiding students. Can add value to any project."

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