

Lecture 1 - Introduction & Python Setup

Management Science

Dr. Tobias Vlček

About this Course

About me

- Field: Optimizing and simulating complex systems
- Languages: of choice: Julia, Python and Rust
- Interest: Modelling, Simulations, Machine Learning
- Teaching: OR, Algorithms, and Programming
- Contact: vlcek@beyondsimulations.com

...

Tip

I really appreciate active participation and interaction!

What is

Management

Science?

Photo by Patrick Konior on Unsplash

Management Science

Management science is an interdisciplinary field that applies research-based methods, such as modeling, statistics, and algorithms, to solve complex organizational problems and guide strategic decisions, seeking optimal or near-optimal outcomes across institutions, corporations, and governments.¹

...

It is not the science of management!

¹An Introduction to Management Science: Quantitative Approaches to Decision Making (15 ed.). Boston: Cengage Learning, Inc. 2019. ISBN 978-1-337-40652-9.

Course Outline

- Part I: Python Foundation (Lectures 1-3)
 - Variables, loops, functions, data science tools
- Part II: Management Science Tools (Lectures 4-9)
 - Monte Carlo, Scheduling, Routing, Metaheuristics
- Part III: Consulting Competition (Lectures 10-12)
 - Client briefings, development, final presentations

...

! Important

You're now consultants learning to solve real business problems!

From Amazon to Hospitals

Where Algorithms Make Millions

- Amazon: Routing algorithms save millions in delivery costs
- Uber: Real-time matching algorithms connect drivers and riders
- Hospitals: Scheduling algorithms optimize shifts and OR usage
- Airlines: Revenue algorithms price tickets dynamically
- Manufacturing: Production scheduling reduces waste and delays

...

Management Science is everywhere!

This Course Approach

The Consultant Mindset

- You'll work on business problems
- Learn to communicate solutions to non-technical clients
- Build practical tools that solve actual challenges
- Compete in a consulting competition with real scenarios

...

💡 Tip

Think like a consultant: What value does my solution bring to the business?

Course Structure

- 12 lectures of intensive learning
- 3 hours per lecture (with breaks!)
- Interactive format:
 - Concepts & Setup

- Hands-on Python notebooks
- Consulting Competition
- Final competition: Apply everything you've learned

...

Each lecture builds on the previous - attendance is important!

Grading

Grade Composition:

- Course has 100 points, 50 needed to pass
- 2 Assignments: 30 points each
- Final Consulting Project: 40 points

...

! Important

We will have several competitions including our final competition, where you will have the chance to earn bonus points!

Assignments

Assignment Strategy:

- Start with easy warm-ups in tutorials
- Progress to real-world problems
- All assignments have clear rubrics
- Bonus points for creative solutions!

...

⚠ Warning

Late submissions: -10% per day (max 3 days)

Learning Python

- In my experience, the best way to learn is by doing!
- Here, we will focus on decision algorithms
- You will start to learn Python by doing the tutorials

...

💡 Tip

Don't worry, I will help you out if you have any questions!

What to Expect

- No prior programming required - we start from zero!
- But experience is helpful!
- Fast-paced but with lots of support
- Practical focus - less theory, more doing
- Mistakes are welcome - they're how we learn

...

Tip

The course gets easier after week 3 - the hardest part is getting started!

Course Goals

By the end, you will be able to:

1. Write Python code to solve business problems
2. Apply algorithms for scheduling, routing, and optimization
3. Simulate uncertainty using Monte Carlo methods
4. Present solutions like a management consultant
5. Build tools that create business value

...

You'll leave with a portfolio of ideas to work on real solutions!

Why Python?

- Origins: Conceived in late 1980s as a teaching and scripting language
- Simple Syntax: Python's syntax is mostly straightforward and very easy to learn
- Versatility: Used in web development, data analysis, artificial intelligence, and more
- Community Support: A large community of users worldwide and extensive documentation

Help from AI

- You are allowed to use AI in the course
- I use it as well (e.g., Claude, ChatGPT, Gemini, ...)
- These tools are great for learning Python!
- Can help you a lot to get started with programming
- I will also teach you how to use it effectively

...

Warning

But you should not simply use them to replace your learning.

How to learn programming

My Recommendation

1. Be present: Attend the lecture and solve the tutorials
2. Put in work: Repeat code and try to understand it
3. Do coding: Run code, play around, modify, and solve
4. Compete: Participate in the competitions to learn

...

Tip

Great resources to start are books and small challenges. You can find a list of recommendations in the [literature recommendations](#).

Don't give up!

Programming is like learning to ride a bike

...

- You'll fall a few times
- It feels impossible at first
- Then suddenly... it clicks!

...

Important

Lectures 1-3 are the hardest. Push through and it gets much easier!

Setting up Python

What is an IDE?

- Integrated Development Environment = application
- It allows you to write, run and debug code scripts
- Other IDEs include for example:
 - [PyCharm](#) from JetBrains
 - [Zed](#)

Install VS Code

- Download and install from the [website](#)
- Built for Windows, Linux and Mac
- Install the [Python](#) and [Jupyter](#) extension
- Great! First steps are done

...

💡 Tip

Unsure on how to work with VS Code and notebooks? Ask me! I'm happy to help you out!

Installation of Python with `uv`

- We will use `uv` to install and manage Python versions
- It works on Windows, Mac and Linux
- It helps us to manage packages and virtual environments
- Now, we all [go here](#) and install `uv` and Python

...

💡 Tip

If the installation does not work, let me know!

Notebooks with `uv`

Quick Check

- Have you installed `uv` and initialized the project?
- Great! Before we continue, check the following:
 - ☐ You have a folder for the course
 - ☐ You have initialized `uv` with `uv init` inside the folder
 - ☐ You can see a file called `pyproject.toml` in the folder

...

⚠ Warning

Something not working yet? Ask me!

Using Notebooks

- Now we need to add a kernel to our project
- Run `uv add --dev ipykernel` from your terminal
- Now run `uv add jupyter` in the terminal
- This allows us to use `uv` Python in notebooks
- Done? Perfect. Now we can start!

Working with Notebooks

- Now you can download the files from the website

- Just click on one of the sessions and open it
- Select **Jupyter** on the right side
- Download and save the files to your course folder
- Open them and select “Open with Jupyter Notebook”

...

Tip

That was the hardest part today!

Any questions

so far?

What’s Next?

After the break, we’ll dive into:

- Tutorial 1: Variables and basic data types
- Tutorial 2: Lists and loops
- Tutorial 3: Conditionals and control flow

...





Note

Ready for the tutorials? Make sure your Jupyter notebook is working before we continue!

The End

That’s it for our introduction!

Make sure you have:

-  VS Code installed and running
-  Python environment set up with **uv**
-  Jupyter notebooks working
-  The tutorial files downloaded

...

Tip

Take a 10-minute break, then we’ll start with the interactive notebooks.

Literature

Interesting Literature on Algorithms

- Christian, B., & Griffiths, T. (2016). Algorithms to live by: the computer science of human decisions. First international edition. New York, Henry Holt and Company.²
- Ferguson, T.S. (1989) 'Who solved the secretary problem?', Statistical Science, 4(3). doi:10.1214/ss/1177012493.

Books on Programming

- Downey, A. B. (2024). Think Python: How to think like a computer scientist (Third edition). O'Reilly. [Here](#)
- Elter, S. (2021). Schrödinger programmiert Python: Das etwas andere Fachbuch (1. Auflage). Rheinwerk Verlag.

...

Note

Think Python is a great book to start with. It's available online for free. Schrödinger Programmiert Python is a great alternative for German students, as it is a very playful introduction to programming with lots of examples.

More Literature

For more interesting literature, take a look at the [literature list](#) of this course.

Bibliography

²A great inspiration to learn more about Algorithms!