

# MBA8419

# Decision Making Technologies

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INTRODUCTION – FALL 2022

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# Analytics

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Three definitions of « analytics » according to INFORMS(\*):

- A synonym for « statistics » ou « metrics »
- A synonym for « data science »
- **Quantitative approaches to tackle decision making in an organizational context**

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(\*) INFORMS: Defining analytics: a conceptual framework

<https://www.informs.org/ORMS-Today/Public-Articles/June-Volume-43-Number-3/Defining-analytics-a-conceptual-framework>



Word cloud « Analytics » (Wikipedia)

<https://www.wordclouds.com/>



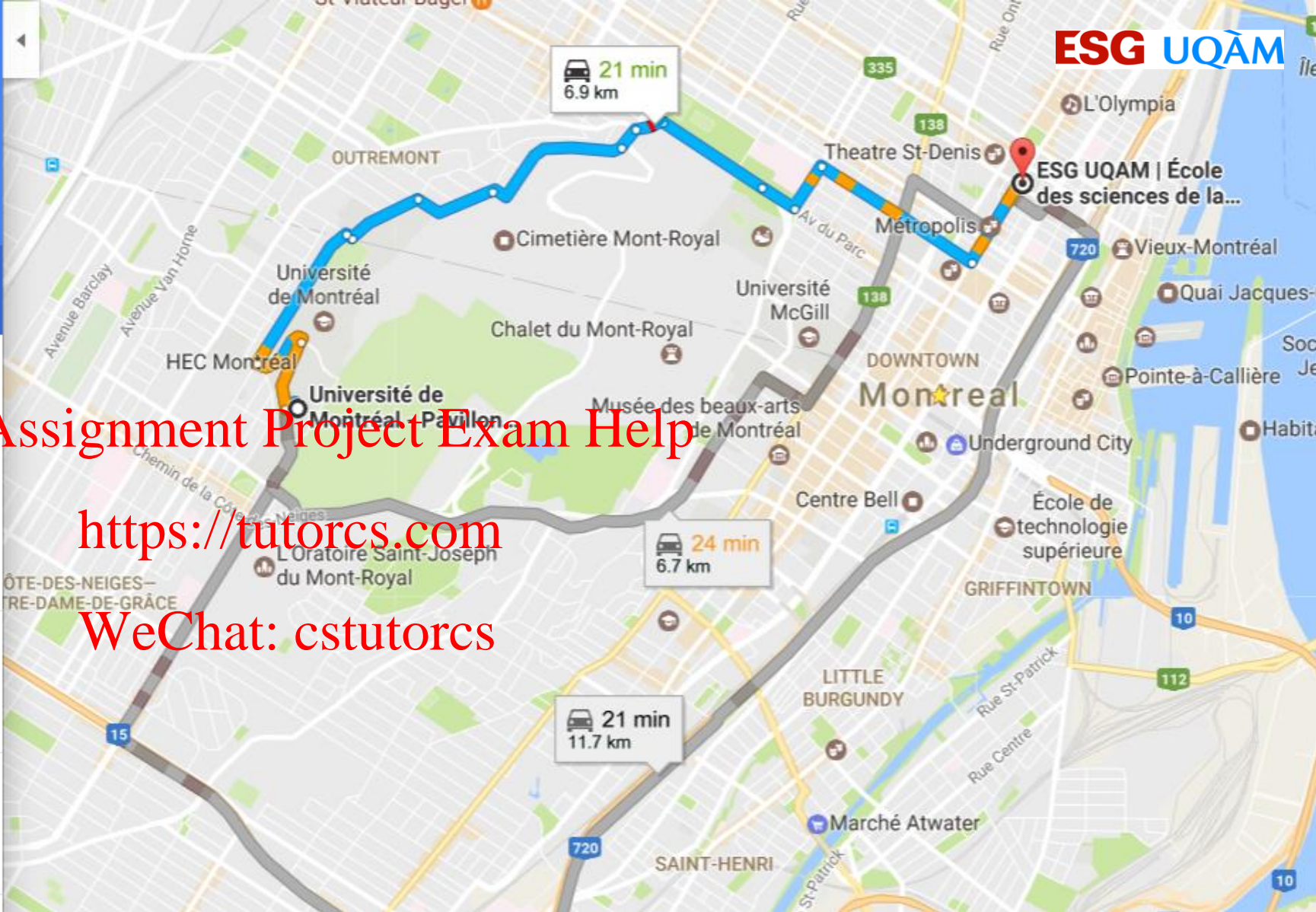
Navigation app interface showing routes from Université de Montréal - Pavillon André to ESG UQAM | École des sciences de la g.

Leave now

OPTIONS

Send directions to your phone

|   |        |         |
|---|--------|---------|
| via Boulevard du Mont-Royal               | 21 min | 6.9 km  |
| Fastest route, lighter traffic than usual |        |         |
| <a href="#">DETAILS</a>                   |        |         |
| via Autoroute 720 E                       | 21 min | 11.7 km |
| via Rue Sherbrooke O/QC-138 E             | 24 min | 6.7 km  |
| The usual traffic                         |        |         |



The shortest path problem: find the fastest path, based on quantifiable / measurable information

# Examples: descriptive, predictive and prescriptive business analytics

|                     | Descriptive Analytics   | Predictive Analytics  | Prescriptive Analytics  |
|---------------------|---|---|---|
|                     | What happened?  | What will likely happen?  | How should we act?  |
| Marketing           | How many sales did marketing campaign A generate?                                       | How many sales will marketing campaign B generate?                              | How should we organize the next marketing campaign to maximize sales?                   |
| Finance             | How much annual return did mutual fund A generate the last 5 years?                     | How much annual return will mutual fund B generate next year ?                  | Which mutual funds should be positioned in a portfolio to maximize the expected return? |
| Production planning | What were the customer demands for product X in region A throughout the last 12 months? | What customer demand can we expect for products X and Y in region B next month? | How many units of products X and Y should we produce to maximize total sales profit?    |

Source: <http://gestisoft.com/differences-entre-lintelligence-daffaires-et-lanalyse-predictive/>

# Operations Research (OR)

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- OR is part of analytics: **prescriptive analytics**

Several definitions:

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- OR is the discipline of **scientific methods** used to make **better decisions**.
- OR proposes **conceptual models** to **analyze complex situations** and enables decision makers to take efficient decision.
- OR is a discipline at the intersection of mathematics, economy and computer science.
- OR is naturally related to the **industry** and plays a vital role in its competitiveness..

# Operations Research (OR)

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- Objective:
  - Propose decisions to make the best with our available means.
- This assumes that we are able to.
  - Take measurements
  - According to certain performance indicators
- Indicators:
  - *Costs*
  - *Profit*
  - *Service quality*
  - *Customer satisfaction*

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\* De la présentation « Recherche Opérationnelle et Génie Industriel », J-C Billaut, ROADEF

# An optimization model (alias decision making technology)

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- Objective:
  - **Propose decisions** to **make the best** with our available means.
- Minimize (reduce)
  - costs*
  - number of errors*
  - waiting time*
- or Maximize (increase)
  - profit*
  - services frequency*
  - product offer diversity*
- by adjusting the decision variables
  - production quantity of product x*
  - frequency of bus 51 between 7h00 and 9h00*
  - number of salespersons to hire*
- and respecting the constraints and requirements
  - do not exceed the available budget*
  - hire at least one sales person per department*
  - respect the maximum capacity of available resources*

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# Implementation of an optimization model

## - Who has the last word?

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- The manager !
    - She defines the mandate of the « consultants » (internal or external)
    - She interacts with them to elaborate the model
    - She validates the results
  - Analytics is an essential “tool box” of future managers
  - The manager needs to understand the methods and techniques used to:
    - Model the problem
    - Solve the model
    - Analyze the solution
- In order to be able to
- Discuss with the consultants, understanding the important details and be able to judge whether the project was a success, or not.
  - Understand which data is required to nourish the model and to make efficient decisions.
- Objective of the course:
- Enable the students with the tools to play such a role.

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# Cours objectives

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The objective of the course is to introduce to the student a systematic **methodology to provide decision support** to complex planning problems. After the course, students should know how to use such methodology in order to model some of the most common planning problems, i.e., those that are often found in practice. In this context, the course has 3 principal objectives: :

- 1) Understand the **role of decision making technologies** in an enterprise, know its **possibilities** and its **limitations**, and be able to identify the circumstances in which optimization models can be useful.
- 2) Be able to identify and structure an optimization model given a planning context, i.e., identify the decision variables, the necessary constraints, the objective function and choose a judge the appropriateness of a solution method.
- 3) Have an understanding how to **analyze the proposed solutions** to conclude whether those are feasible in practice, and how to estimate whether such optimized solution is effectively more efficient than current planning practices.

# Introduction of the lecturer

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- Sanjay Dominik Jena  
Associate professor, Department of Analytics, Operations and Information Technologies, ÉSG UQÀM
- Experience / training:
  - AXA Insurances; B.Sc. Comp Sc. (FH Koin); M.Sc. R.O. (PUC-Rio); Ph.D. R.O. (UdeM); Postdoc. (MIT SMART)
- Expertise and research interests:
  - Operations research; mathematical optimization
  - Optimization under uncertainty
  - Data science and machine learning
  - Applications: logistics and transportation; facility location; revenue management; project management
- Affiliation to research centers:
  - *Interuniversity research center for enterprise networks, logistics and transportation (CIRRELT)*
  - *Excellence research chair in Data Science for Real-time decision making*
  - *Research center for intelligent<sup>2</sup> management of complex systems (CRI<sup>2</sup>GS)*
- Industrial partners:
  - BIXI, Netlift, Cascades, JDA Labs, FPInnovations, GAPSO Analytics

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# Course plan

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- Session 1 - Introduction & LP

- watch videos
- 20h00 -22h30: live course / Q & A

- Session 2 - Network models

- watch videos
- 20h00 -22h30: live course / Q & A

- Session 3 – Integer programming

- watch videos
- 20h30 -22h30: live course / Q & A

- Session 4 – Revision

- 20h30 -22h30: live course / Q & A

- Final exam (individual)

## Evaluation

- Final exam (individual): 100%
- Communication during exam not allowed
- Exchange of information between teams for practical for not allowed
- Any type of plagiat or cheating: course failed.

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