Teaching Pack:

Amua Modeling Platform

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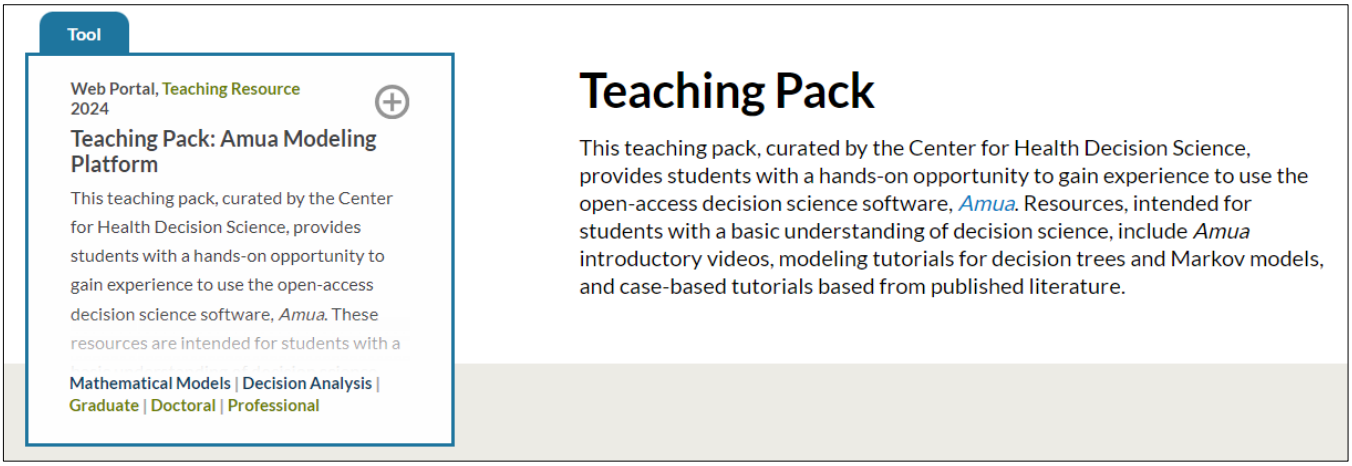
Overview



This teaching pack, curated by the Center for Health Decision Science, provides students with a hands-on opportunity to gain experience to use the open-access decision science software, *Amua*. These resources are intended for students with a basic understanding of decision science. Materials include *Amua* introductory videos, basic decision modeling tutorials for decision trees and Markov models, and case-based tutorials based on analyses in published literature.

About Amua

Amua, the Swahili word meaning "decide"/"solve", is an open source modeling framework and probabilistic programming language for decision analysis developed by CHDS faculty Dr. Zachary Ward.

About the Alan Colowick Innovation Fund

This teaching pack was created with funding from CHDS's Alan Colowick Innovation Fund, established with the generous support of Dr. Alan Colowick. The Innovation Fund allows CHDS to pursue high-value opportunities and initiatives that align with its core mission. Colowick was inspired to incorporate Decision Science into his practice of medicine and subsequent roles in the pharmaceutical and biotech industries as a result from a course he took with CHDS' Milton Weinstein during his MPH training at the Harvard T.H. Chan School of Public Health. The Innovation Fund provides graduate students in decision science the opportunity to serve as Educational Innovation Scholars and work with faculty mentors on novel instructional models, short-form multimedia content, and case-based learning experiences for one to two semesters.

Selected Resources – At a Glance

Video. Videos: Amua and Tutorial Introduction
Videos: Amua and Tutorial Introduction. Teaching Pack: *Amua Modeling Platform*. Center for Health Decision Science, Harvard T.H. Chan School of Public Health 2024.
https://repository.chds.hsph.harvard.edu/repository/3965

Tutorial/Primer. Tutorial: Building Decision Trees
Tutorial: Building Decision Trees. Teaching Pack: *Amua Modeling Platform.* Center for Health Decision Science, Harvard T.H. Chan School of Public Health 2024.
https://repository.chds.hsph.harvard.edu/repository/3985

Exercise. Lab: Giant Cell Arteritis Decision Tree Model
Lab: Giant Cell Arteritis Decision Tree Model. Teaching Pack: *Amua Modeling Platform*. Center for Health Decision Science, Harvard T.H. Chan School of Public Health 2024.
https://repository.chds.hsph.harvard.edu/repository/3978

Exercise. Lab: Autoimmune Encephalitis Decision Tree Model
Lab: Autoimmune Encephalitis Decision Tree Model. Teaching Pack: *Amua Modeling Platform*. Center for Health Decision Science, Harvard T.H. Chan School of Public Health 2024.
https://repository.chds.hsph.harvard.edu/repository/3986

Tutorial/Primer. Tutorial: Introduction to Programming Decision Trees
Tutorial: Introduction to Programming Decision Trees. Teaching Pack: *Amua Modeling Platform*. Center for Health Decision Science, Harvard T.H. Chan School of Public Health 2024.
https://repository.chds.hsph.harvard.edu/repository/3968

Article. Modeling the Effectiveness of Initial Management Strategies for Ductal Carcinoma in Situ
Soeteman DI, Stout NK, Ozanne EM et al. Modeling the Effectiveness of Initial Management Strategies for Ductal Carcinoma in Situ. Journal of the National Cancer Institute 2013; 105 (11): 774-781.
https://doi.org/10.1093/jnci/djt096

Tutorial/Primer. Tutorial: Using Fire in Forest Management: Decision Making under Uncertainty
Tutorial: Using Fire in Forest Management: Decision Making Under Uncertainty. Teaching Pack: *Amua Modeling Platform*. Center for Health Decision Science, Harvard T.H. Chan School of Public Health 2024.
https://repository.chds.hsph.harvard.edu/repository/3967

Article. Using Fire in Forest Management: Decision Making under Uncertainty
Cohan D, Haas SM, Radloff DL, Yancik RF. Using Fire in Forest Management: Decision Making under Uncertainty. Interfaces 1984; 14: 8-19. https://www.jstor.org/stable/25060604
Not Open Access

Tutorial/Primer. Tutorial: CEA of Alternative Colorectal Cancer Screening Strategies in High-Risk Individuals
Tutorial: CEA of Alternative Colorectal Cancer Screening Strategies in High-Risk Individuals. Teaching Pack: *Amua Modeling Platform*. Center for Health Decision Science, Harvard T.H. Chan School of Public Health 2024.
https://repository.chds.hsph.harvard.edu/repository/3969

Article. CEA of Alternative Colorectal Cancer Screening Strategies in High-Risk Individuals
Benamouzig R, Barré S, Saurin J-C et al. Cost-Effectiveness Analysis of Alternative Colorectal Cancer Screening Strategies in High-Risk Individuals. Therapeutic Advances in Gastroenterology 2021; 14.
https://doi.org/10.1177/17562848211002359

Annotated Bibliography

Video. Videos: Amua and Tutorial Introduction
Videos: Amua and Tutorial Introduction. Teaching Pack: *Amua Modeling Platform*. Center for Health Decision Science, Harvard T.H. Chan School of Public Health 2024.
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These multimedia segments, produced by the CHDS Media Hub, include four videos that introduce the decision science software *Amua*. The videos provide helpful reference before and/or while completing the teaching pack's tutorial exercises.

Videos include:

- Amua Tutorials: Introductions (~2 min). This video briefly introduces *Amua* and reviews the guiding principles of the platform.
- Amua Tutorials: Basic Layout (~5 min). This video reviews how to use and navigate *Amua* and demonstrates the main building blocks to use when developing models.
- Amua Tutorials: Decision Trees (~10 min). This video provides a step-by-step on how to build decision trees using *Amua*.
- Amua Tutorials: Markov Models (~13 min). This video provides a step-by-step on how to build Markov models using *Amua*.

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This tutorial illustrates the basic steps needed to develop decision trees in *Amua* using a disease screening example. It details the process of how to build the structure of a decision tree, parameterize the model with probabilities and relevant outcomes (i.e., life expectancy), evaluate three alternative screening strategies in a baseline scenario, and perform one-way sensitivity analyses to assess the robustness of the results to different parameter values.

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This tutorial walks through the development of a decision tree model focused on Giant Cell Arteritis. It describes how to build the model structure, assign probabilities and outcomes based on imperfect test

characteristics and epidemiologic estimates, evaluate alternative treatment strategies, and conduct one-way sensitivity analyses to assess which model parameters may impact the optimal treatment choice.

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Exercise. Lab: Autoimmune Encephalitis Decision Tree Model
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This tutorial walks through the development of a decision tree model based on a published cost-effectiveness analysis of routine screening for autoimmune encephalitis in patients with first-episode psychosis in the United States based on the published article: Ross EL, Becker JE, Linnoila JJ, Soeteman DI. Cost-Effectiveness of Routine Screening for Autoimmune Encephalitis in Patients with First-Episode Psychosis in the United States. J Clin Psychiatry 2020; 82 (1): 19m13168. The tutorial describes how to build the model structure, parameterize the model probabilities and outcomes based on epidemiological and clinical data, evaluate alternative screening strategies, and perform sensitivity analyses including threshold analyses to assess at what parameter values the optimal strategy may change.

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Tutorial/Primer. Tutorial: Introduction to Programming Decision Trees
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CHDS repository link: https://repository.chds.hsph.harvard.edu/repository/3968
This self-directed tutorial walks through the development of a decision tree using *Amua* to evaluate three initial management strategies for ductal carcinoma in situ (DCIS) based on a published analysis: Soeteman DI, Stout NK, Ozanne EM et al. Modeling the Effectiveness of Initial Management Strategies for Ductal Carcinoma in Situ. J Natl Cancer Inst 2013; 105 (11): 774-781. The tutorial describes how to build the model structure, parameterize the model probabilities and outcomes based on clinical information, and evaluate the optimal treatment strategy.

About the Alan Colowick Innovation Fund

The case-based tutorials in this teaching pack were created with support from the CHDS Alan Colowick Innovation Fund, established with the generous support of Dr. Alan Colowick. The Innovation Fund supports graduate students in decision science to serve as "Educational Innovation Scholars" and work with faculty to broaden the scope and reach of educational efforts to develop novel instructional models, short-form multimedia content, and case-based learning experiences.

Article. Modeling the Effectiveness of Initial Management Strategies for Ductal Carcinoma in Situ
Soeteman DI, Stout NK, Ozanne EM et al. Modeling the Effectiveness of Initial Management Strategies for Ductal Carcinoma in Situ. Journal of the National Cancer Institute 2013; 105 (11): 774-781. https://doi.org/10.1093/jnci/djt096
CHDS repository link: https://repository.chds.hsph.harvard.edu/repository/3977
This paper compares alternative strategies to manage ductal carcinoma in situ (DCIS). The authors used a disease simulation model to simulate the clinical events after six treatments (lumpectomy alone, lumpectomy with radiation, lumpectomy with radiation and tamoxifen, lumpectomy with tamoxifen, and mastectomy with and without breast reconstruction). Outcomes included disease-free, invasive disease-free, overall survival and breast preservation. Data were from the published literature.

The results showed that for women aged 45 years at diagnosis, both mastectomy and lumpectomy with radiation and tamoxifen were associated with a 12 month increase in overall survival relative to lumpectomy alone. Adding radiation therapy to lumpectomy was associated with a 6-month increase in overall survival but decreased long-term breast-preservation outcomes. Adding tamoxifen improved long-term breast-preservation outcomes. The authors baseline results and sensitivity analyses suggest that treatment decisions can be informed by patient preferences and tradeoffs between breast preservation and chance of recurrence.

Tutorial/Primer. Tutorial: Using Fire in Forest Management: Decision Making under Uncertainty
Tutorial: Using Fire in Forest Management: Decision Making Under Uncertainty. Teaching Pack: *Amua Modeling Platform*. Center for Health Decision Science, Harvard T.H. Chan School of Public Health 2024. https://repository.chds.hsph.harvard.edu/repository/3967
CHDS repository link: https://repository.chds.hsph.harvard.edu/repository/3967
This self-directed tutorial is for a decision analytic model related to the execution and management of prescribed burns within forests. This tutorial builds upon the work of the publication: Cohan D, Haas SM, Radloff DL, Yancik RF. Using Fire in Forest Management: Decision Making Under Uncertainty. Interfaces 1984; 14 (5): 8-19. *Not open access.*

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Not Open Access
CHDS repository link: https://repository.chds.hsph.harvard.edu/repository/3974
Prescribed fires are fires that are started under controlled conditions. This is an important strategy used by professionals in modern forest management. Designing, planning, and executing strategies that rely on prescribed fires is challenging because of multiple uncertainties (e.g., weather, fire behavior, etc.). In this paper, decision analysis techniques are used to evaluate prescribed fire decisions in three national forest case study applications.

Tutorial/Primer. Tutorial: CEA of Alternative Colorectal Cancer Screening Strategies in High-Risk Individuals
Tutorial: CEA of Alternative Colorectal Cancer Screening Strategies in High-Risk Individuals. Teaching Pack: *Amua Modeling Platform*. Center for Health Decision Science, Harvard T.H. Chan School of Public Health 2024. https://repository.chds.hsph.harvard.edu/repository/3969
CHDS repository link: https://repository.chds.hsph.harvard.edu/repository/3969
This self-directed tutorial is about a decision analytic model of Alternative Colorectal Cancer Screening Strategies in High-Risk Individuals. This tutorial is based on the publication: Benamouzig R, Barré S, Saurin J-C et al. Cost-Effectiveness Analysis of Alternative Colorectal Cancer Screening Strategies in High-Risk Individuals. Therapeutic Advances in Gastroenterology 2021; 14.

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Article. CEA of Alternative Colorectal Cancer Screening Strategies in High-Risk Individuals
Benamouzig R, Barré S, Saurin J-C et al. Cost-Effectiveness Analysis of Alternative Colorectal Cancer Screening Strategies in High-Risk Individuals. Therapeutic Advances in Gastroenterology 2021; 14. https://doi.org/10.1177/17562848211002359
CHDS repository link: https://repository.chds.hsph.harvard.edu/repository/3975
Fecal occult blood testing with an immunochemical test (FIT) is generally considered as the most cost-effective alternative in colorectal cancer screening programs for average risk individuals without family history. Colorectal screening guidelines recommend colonoscopy every 3-5 years for high-risk individuals with a family history. The authors use a microsimulation model of the natural history of colorectal cancer (CRC) to compare the costs, quality-adjusted life years, and cost effectiveness associated with several screening strategies in high-risk individuals, using a lifetime time horizon. Data were from the published literature.

The results showed that compared with no screening, colonoscopy and sigmoidoscopy at a 30% uptake were the most effective strategies (46.3 and 43.9 QALY/1000) but are associated with high cost-effectiveness ratios. Compared with colonoscopy, if screening based on FIT is associated with a higher participation rate, it can achieve a similar effectiveness at a lower cost. Multiple sensitivity analyses are presented.