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University of Oxford
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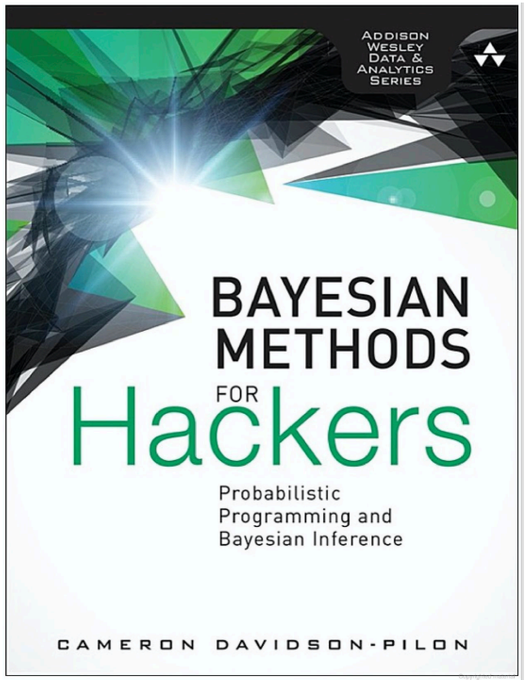
Probabilistic Machine Learning
Introduction

1. To understand the fundamentals of probability theory, Bayes rule and Bayesian inference.

2. To understand how to use PyMC3, a powerful probabilistic programming framework based on Python, to build sophisticated probabilistic models.

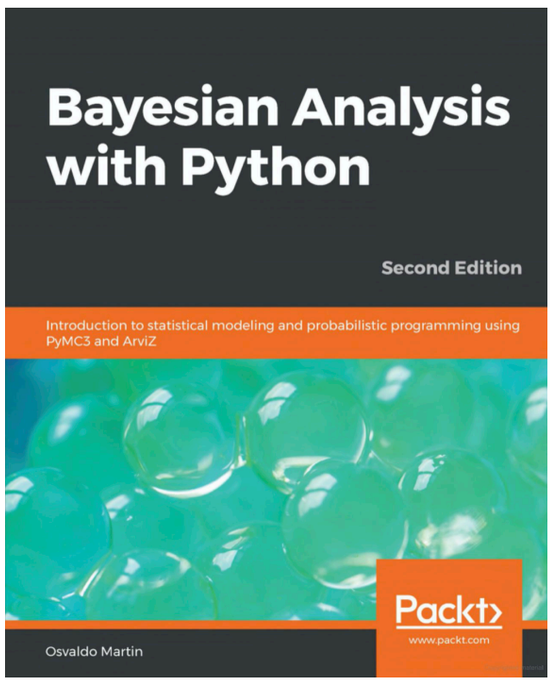
3. To develop experience applying these models to solve real-world machine learning and data analysis tasks.



Probabilistic Programming and Bayesian Methods for Hackers

Cameron Davidson-Pilon

https://camdavidsonpilon.github.io/Probabilistic-Programming-and-Bayesian-Methods-for-Hackers/



Bayesian Analysis with Python

Osvaldo Martin

GitHub

https://github.com/AlexRogersCS/probabilistic_machine_learning

PyMC3

https://docs.pymc.io

Google Colab Notebooks

https://colab.research.google.com/

Where are we going?

Vaccine Efficacy

Pfizer: Over 43,000 participants got the two doses of the vaccine or placebo. The same number of subjects was assigned to the treatment and control group. An efficacy of 95% implies that among 170 confirmed cases of COVID-19, 8 of them observed in the vaccine group.

Moderna: The vaccine is being tested in 30,000 people. Half received two doses of the vaccine, and half received a placebo. Of the 95 cases of covid-19, 90 were in the group that received the placebo.

AstraZeneca regimen 1: Regimen 1(first a half dose and at least a month later a full dose) with 2742 participants showed 90% efficacy implies that among 37 confirmed cases of COVID-19, 3 of them observed in the vaccine group.

AstraZeneca regimen 2: Regimen 2 (two full doses at least one month apart) with 8896 participants showed 62% efficacy implies that among 94 confirmed cases of COVID-19, 26 of them observed in the vaccine group.

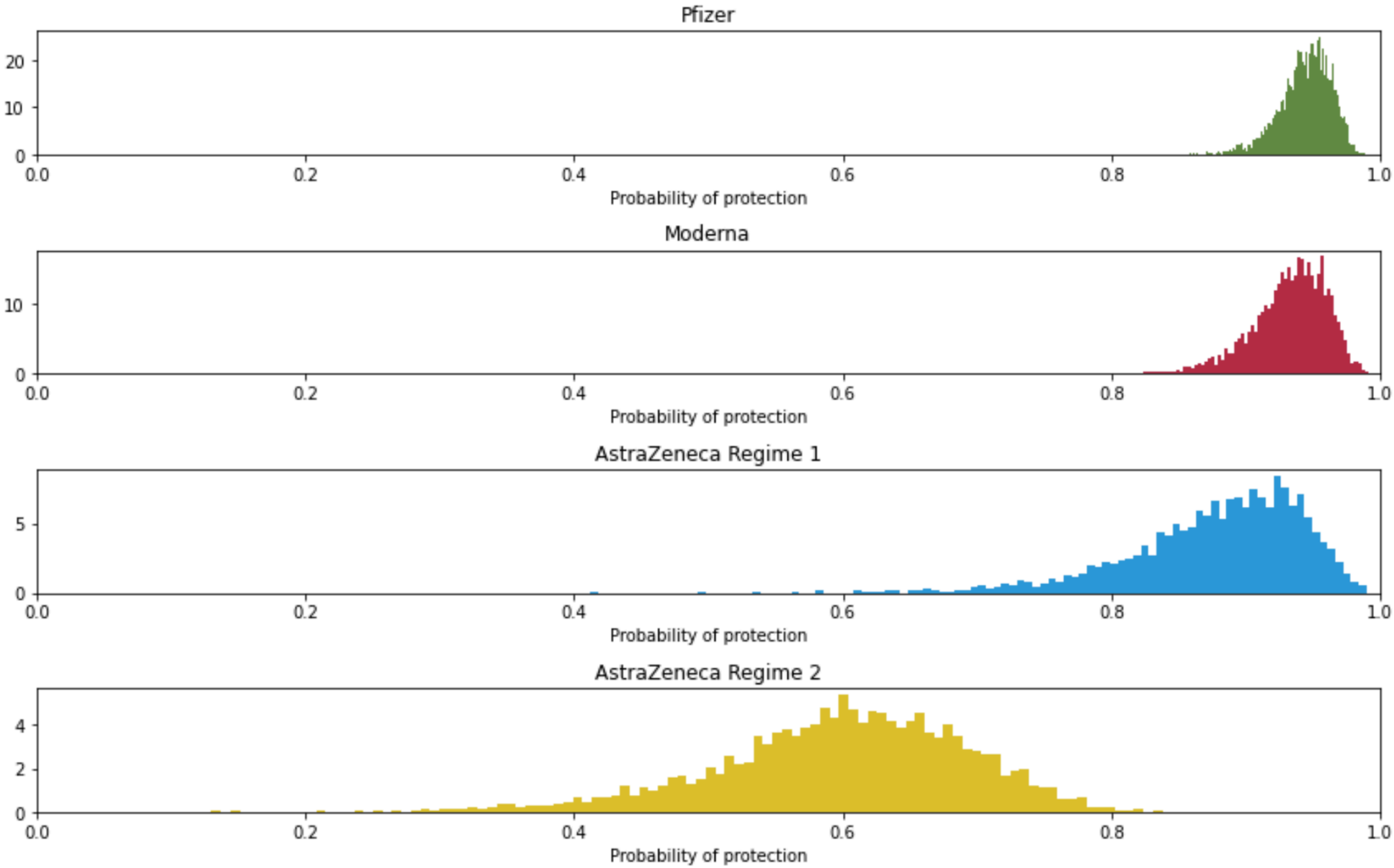
Vaccine Efficacy

Assume some unknown probability that trial participants exposed to infection will test positive during the trial.

Assume that those given the vaccine have the same risk of exposure but will only test positive if the vaccine fails to protect them.

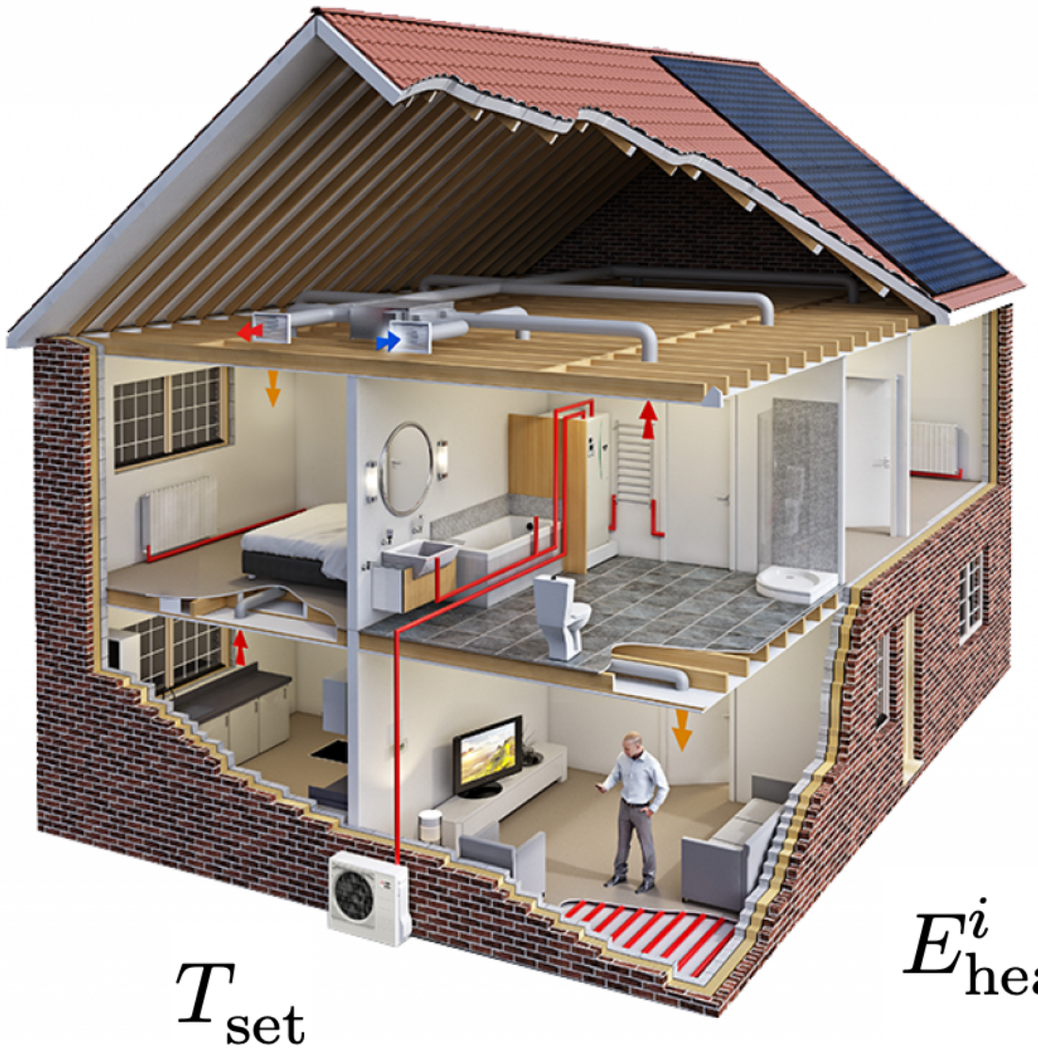
What is the probability of protection of each vaccine?

Vaccine Efficacy



An AI to Help Reduce Heating Bills

T^i_{ext}



T_{set}

$$24 \times \text{HPLC} \times \left(T_{\text{set}} - T^i_{\text{ext}}\right)$$

E^i_{heat}

$$E^i_{\text{heat}} = 24 \times \text{HPLC} \times \left(T_{\text{set}} - T^i_{\text{ext}}\right)$$

Heating off $\quad E^i_{\text{meter}} = E^i_{\text{app}} \qquad T^i_{\text{ext}} > T_{\text{set}}$

Heating on $\quad E^i_{\text{meter}} = E^i_{\text{heat}} + E^i_{\text{app}} \qquad T^i_{\text{ext}} \leq T_{\text{set}}$

An AI to Help Reduce Heating Bills