Models on the Peer Models Network

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Contents

Chapter 1

Introduction

Peer Models Network is an initiative to make models for healthcare decision-making accessible, transparent and interpretable to all British Columbians. With support from the Canada Foundation for Innovation, BC SUPPORT Unit and BC Academic Health Science Network, the Peer Models Network (PMN) aims to increase engagement between the modelling community and policymakers, interdisciplinary scholars, patients, journalists, and other members of the public.

The PMN centres around a software infrastructure called the Programmable Interface for Statistical and Simulation Models (PRISM). PRISM hosts models on the cloud and provides standard Application Programming Interfaces (APIs) that allows users of different levels of technical backgrounds to interact with models hosted on a cloud. Users can submit queries to cloud-hosted models through a multitude of software platforms, including Microsoft Excel, R, Python, bash scripts, Javascript and custom web apps. This enables direct access to users who lack either the software or hardware infrastructure or the technical expertise to set up models on their own devices. It also enables more technical users to integrate modes with other pieces of softwar

In its current implementation, PRISM can hosts models that are developed in R, including those that use `Cpp` and `STAN`.

Synchronous APIs calls are currently implemented and support for asynchronous calls that are required by extra long processing times is under active development.

Chapter 2

ACCEPT

Field	Value
Model Name	Acute COPD Exacerbation Prediction Tool (ACCEPT)
Modelling Team	RESP
Publication	doi:10.1016/S2213-2600(19)30397-2
Purpose	Predict probability, rate, and severity of COPD exacerbations
Video	The ACCEPT Model in 90 Seconds
Interviews	Amin Adibi on the ACCEPT Model for COPD: Why and How
Media	COPD exacerbations: finally, a more than ACCEPTable risk score
Web App	ACCEPT web App
R Package	accept
Excel Sheet	PC Version
API User Guide	Link

Chapter 3

BODE

Field	Value
Model Name	The Body-Mass Index, Airflow Obstruction, Dyspnea, and Exercise Capacity Index
Modelling Team	Celli et al.
Publication	10.1056/NEJMoa021322
Outcome	Mortality Risk
R Package	bode
API User Guide	Link

Chapter 4

CFMortality

Field	Value
Model Name	Mortality prediction models in cystic fibrosis
Modelling Team	Stanojevic et al.
Publication	10.1183/13993003.00224-2019
Outcome	Mortality Risk
Video	
R Package	cfmortality
API User Guide	Link

Chapter 5

CHDWilson

Field	Value
Model Name	Prediction of Coronary Heart Disease Using Risk Factor Categories
Modelling Team	Wilson et al.
Publication	10.1161/01.CIR.97.18.1837
Outcome	Coronary Heart Disease
Excel Sheet	PC Version
R Package	chdwilson
API User Guide	Link

Chapter 6

CODEXCOPD

Field	Value
Model Name	The CODEX (comorbidity, obstruction, dyspnea, and previous severe exacerbations) Index
Modelling Team	Almagro et al.
Publication	10.1378/chest.13-1328
Outcome	Survival and readmission at both 3 months and 1 year after hospital discharge for a COPD exacerbation
R Package	codexcopd
API User Guide	Link

Chapter 7

COVIDSEIR

Field	Value
Model Name	Bayesian SEIR model to estimate physical-distancing effects
Modelling Team	Anderson et al.
Publication	10.1101/2020.04.17.20070086
Outcome	COVID-19 Cases
R Package	covidseir
API User Guide	Link

Chapter 8

CVDAnderson

Field	Value
Model Name	Prediction of Coronary Heart Disease Using Risk Factor Categories
Modelling Team	Anderson et al.
Publication	10.1016/0002-8703(91)90861-B
Outcome	CHD, MI, CHD Mortality, Stroke, CVD, CVD Mortalitye
R Package	cvdanderson
API User Guide	Link

Chapter 9

EPIC

Field	Value
Model Name	Evaluation Platform in COPD (EPIC)
Modelling Team	RESP
Publication	doi:10.1177%2F0272989X18824098
Outcome	Patient-level outcomes, as well as mortality, prevalence, QALYs, costs, etc.
Video	The EPIC Model in 2 Minutes
Interviews	Mohsen Sadatsafavi on the EPIC Model
R Package	epicR
Excel Sheet	PC Version
API User Guide	Link

Chapter 10

FEV1

Field	Value
Model Name	Individualized prediction of lung-function decline in COPD
Modelling Team	RESP
Publication	doi:10.1503/cmaj.151483
Outcome	Lung function over next 11 years
Web App	FEV1 web App
Excel Sheet	PC Version
R Package	fev1
API User Guide	Link

Chapter 11

MMRCEA

Field	Value
Model Name	Cost-effectiveness evaluation of province-wide universal mismatch repair (MMR) reflex testing for lynch syndrome (LS) in British Columbia
Modelling Team	Centre for Clinical Epidemiology & Evaluation (C2E2)
Outcome	Costs, QALYs and life-years for the prevention and management of colorectal and endometrial cancers patients and their families
Excel Sheet	Pending
API User Guide	Link

Chapter 12

QRISK3

Field	Value
Model Name	10-Year Cardiovascular Disease Risk Calculator
Modelling Team	Hippisley-Cox et al.
Publication	10.1136/bmj.j2099
Outcome	10-yr risk of heart attack/stroke
R Package	QRISK3
API User Guide	Link

Chapter 13

API Users' Guide

13.1 ACCEPT

Cloud Access through R

Users can access models on the Peer Models Network using the `peermodels` R package, available on GitHub. The following code snippet illustrates how you can run the model for example patients provided in the `accept` package:

```
remotes::install_github (resplab/peermodels)
library(peermodels)
connect_to_model("accept", api_key = YOUR_API_KEY)
input <- get_default_input()
results <- model_run(input)
```

Cloud Access through Python

```
import json
import requests
url = 'https://prism.peermodelsnetwork.com/route/accept/run'
headers = {'x-prism-auth-user': YOUR_API_KEY}
model_run = requests.post(url, headers=headers,
json = {"func":["prism_model_run"],"model_input":[{"ID": "10001","male": 1,"age": 57,"smoker": 0,
print(model_run)
results = json.loads(model_run.text)
print(results)
```

Cloud Access through Linux Bash

In Ubuntu, you can call the API with `curl`:

```
curl \
-X POST \
-H "x-prism-auth-user: REPLACE_WITH_API_KEY" \
-H "Content-Type: application/json" \
-d '{"func":["prism_model_run"],"model_input":[{"ID": "10001","male": 1,"age": 57,"smok
https://prism.peermodelsnetwork.com/route/accept/run
```

13.2   BODE

Cloud Access through R

Users can access models on the Peer Models Network using the `peermodels` R
package, available on GitHub. The following code snippet illustrates how you
can run the model for example patient provided in the `bode` package:

```
remotes::install_github (resplab/peermodels)
library(peermodels)
connect_to_model("bode", api_key = YOUR_API_KEY)
input <- get_default_input()
results <- model_run(input)
```

Cloud Access through Linux Bash

In Ubuntu, you can call the API with `curl`:

```
curl \
-X POST \
-H "x-prism-auth-user: REPLACE_WITH_API_KEY" \
-H "Content-Type: application/json" \
-d '{"func":["prism_model_run"],"model_input":[{"FEV1": 40,"mMRC": 3,"BMI": 22,"walk":
https://prism.peermodelsnetwork.com/route/bode/run
```

13.3   EPIC

Cloud Access through R

Users can access models on the Peer Models Network using the `peermodels` R
package, available on GitHub. The following code snippet illustrates how you
can run the model for example patient provided in the `epicR` package:

```
remotes::install_github (resplab/peermodels)
library(peermodels)
connect_to_model("epic", api_key = YOUR_API_KEY)
input <- get_default_input()
results <- model_run(input)
```

13.4 FEV1

Cloud Access through R

Users can access models on the Peer Models Network using the `peermodels` R package, available on GitHub. The following code snippet illustrates how you can run the model for example patient provided in the `fev1` package:

```
remotes::install_github (resplab/peermodels)
library(peermodels)
connect_to_model("fev1", api_key = YOUR_API_KEY)
input <- get_default_input()
results <- model_run(input)
```

Cloud Access through Linux Bash

In Ubuntu, you can call the API with `curl`:

```
curl \
-X POST \
-H "x-prism-auth-user: REPLACE_WITH_API_KEY" \
-H "Content-Type: application/json" \
-d '{"func":["prism_model_run"],"model_input":[{"male":1,"age":70,"smoker":1,"FEV1":2.5,"height":
https://prism.peermodelsnetwork.com/route/fev1/run
```

13.5 CVDAnderson

Cloud Access through R

Users can access models on the Peer Models Network using the `peermodels` R package, available on GitHub. The following code snippet illustrates how you can run the model for example patient provided in the `cvdanderson` package:

```
remotes::install_github (resplab/peermodels)
library(peermodels)
connect_to_model("cvdanderson", api_key = YOUR_API_KEY)
input <- get_default_input()
results <- model_run(input)
```

Cloud Access through Linux Bash

In Ubuntu, you can call the API with `curl`:

```
curl \
-X POST \
-H "x-prism-auth-user: REPLACE_WITH_API_KEY" \
-H "Content-Type: application/json" \
-d '{"func":["prism_model_run"],"model_input":[{"age": 33,"gender": 1,"Tchol": 230,"EC(
https://prism.peermodelsnetwork.com/route/cvdanderson/run
```

13.6   CHDWilson

Cloud Access through R

Users can access models on the Peer Models Network using the `peermodels` R
package, available on GitHub. The following code snippet illustrates how you
can run the model for example patient provided in the `chdwilson` package:

```
remotes::install_github (resplab/peermodels)
library(peermodels)
connect_to_model("chdwilson", api_key = YOUR_API_KEY)
input <- get_default_input()
results <- model_run(input)
```

Cloud Access through Linux Bash

In Ubuntu, you can call the API with `curl`:

```
curl \
-X POST \
-H "x-prism-auth-user: REPLACE_WITH_API_KEY" \
-H "Content-Type: application/json" \
-d '{"func":["prism_model_run"],"model_input":[{"age": 55,"gender": 1,"TChol": 250,"LDI
https://prism.peermodelsnetwork.com/route/chdwilson/run
```

13.7   CFMortality

Cloud Access through R

Users can access models on the Peer Models Network using the `peermodels` R
package, available on GitHub. The following code snippet illustrates how you
can run the model for example patient provided in the `chdwilson` package:

```
remotes::install_github (resplab/peermodels)
library(peermodels)
connect_to_model("cfmortality", api_key = YOUR_API_KEY)
input <- get_default_input()
results <- model_run(input)
```

Cloud Access through Linux Bash

In Ubuntu, you can call the API with `curl`:

```
curl \
-X POST \
-H "x-prism-auth-user: REPLACE_WITH_API_KEY" \
-H "Content-Type: application/json" \
-d '{"func":["prism_model_run"],"model_input":[{"male": 0,"age": 57,"fvc": 66.7,"fev1": 47.4,"fev
https://prism.peermodelsnetwork.com/route/cfmortality/run
```

13.8   QRISK3

Cloud Access through R

Users can access models on the Peer Models Network using the `peermodels` R package, available on GitHub. The following code snippet illustrates how you can run the model for example patient provided in the `QRISK3` package:

```
remotes::install_github (resplab/peermodels)
library(peermodels)
connect_to_model("qrisk3", api_key = YOUR_API_KEY)
input <- get_default_input()
results <- model_run(input)
```

13.9   CODEXCOPD

Cloud Access through R

Users can access models on the Peer Models Network using the `peermodels` R package, available on GitHub. The following code snippet illustrates how you can run the model for example patient provided in the `codexcopd` package:

```
remotes::install_github (resplab/peermodels)
library(peermodels)
connect_to_model("codexcopd", api_key = YOUR_API_KEY)
input <- get_default_input()
results <- model_run(input)
```

Cloud Access through Linux Bash

In Ubuntu, you can call the API with `curl`:

```
curl \
-X POST \
-H "x-prism-auth-user: REPLACE_WITH_API_KEY" \
-H "Content-Type: application/json" \
-d '{"func":["prism_model_run"],"model_input":[{"age":40,"charlson":8,"FEV1":40,"mMRC"
https://prism.peermodelsnetwork.com/route/codexcopd/run
```

13.10 MMRCEA

Cloud Access through R

Users can access models on the Peer Models Network using the `peermodels` R package, available on GitHub. The following code snippet illustrates how you can run the model for example inputs provided by the modelling team:

```
library(peermodels)

connect_to_model("mmrcea", api_key = YOUR_API_KEY)

input <- get_default_input()

input$timeHorizon                                  <- 5
input$discountRate                                 <- 0.015
input$averageFamilyReferred                        <- 2
input$familyReferredHCP                            <- 1
input$adherenceIntensiveScreening                  <- 0.9
input$crcmmrDefReferredHCPIntArm                   <- 0.3
input$crcmmrDefReferredHCPmmrbrafCompArmVCHA       <-0.3
input$crcmmrDefReferredHCPmmrCompArmVCHA           <- 0.08
input$crcmmrDefReferredHCPmmrbrafCompArmVIHA       <- 0.08
input$crcmmrDefReferredHCPmmrCompArmOtherHA        <- 0.08
input$ecmmrDefReferredHCPIntArm                    <- 0.8

model_run(input)
```

13.11 COVIDSEIR

We have recently deployed the Bayesian SEIR model to estimate physical-distancing effects developed by Anderson et al to our cloud infrastructure. The current version of the R package deployed to the PRISM server is `covidseir` v0.0.0.9006.

The current implementation of the `covidseir` package is experimental and has some limitations, given the computational intensity of the model. Depending on

the number of `chains` and `iterations`, the `html` connection might be dropped for calls that more than a dozen minutes. Currently, fitting the model with default parameters takes about 5 minutes. We are actively working to implement asynchronous support which would email the results back to the user when hours long model runs are requested.

Cloud Access through R

Users can access models on the Peer Models Network using the `peermodels` R package, available on GitHub. The following code snippet illustrates how you can run the model for example patient provided in the `covidseir` package:

```
library(peermodels)
connect_to_model("covidseir", api_key = YOUR_API_KEY, bypass_router = T)
input <- get_default_input()
names(input)
input$daily_cases
results <- model_run(input)
names(results)
draw_plots()
```

The same workflow can be used to fit and run the model based on custom data. For example, the code snippet below, automatically downloads latest COVID-19 case numbers for British Columbia, and reruns the simulation using different assumptions.

```
library(stringr)
library(dplyr)
library(tidyr)
library(readr)
library(lubridate)
library(peermodels)

url <- "https://docs.google.com/spreadsheets/d/1ad7-09_Jn6AxsdkVPE33T-iLfGpPRmd3piXQqFiVeas/expor

CanadaCases <- read_csv(url)

covidCases <-  CanadaCases %>% rename (name = "prname") %>% rename (Cases = "numconf")  %>% mutat
  filter (name!="Canada") %>% filter (date!=today())

bcCases <- covidCases %>% filter (name == "British Columbia")

connect_to_model("covidseir", api_key = "YDbxcnNHmf4XoteSmCFHKx", bypass_router = T)

input <- get_default_input()
first <- length(bcCases$numtoday)-42+1
```

```
last <- length(bcCases$numtoday)
input$daily_cases <- bcCases$numtoday[first:last]

# Example assumed sampling fractions of positive cases:
s1 <- c(rep(0.1, 13), rep(0.2, length(input$daily_cases) - 13))

samp_frac_seg <- c(rep(1, 13), rep(2, length(input$daily_cases) - 13))
s2 <- rep(0.07, length(input$daily_cases)) # Assuming 7\% of positive individuals are

input$samp_frac_fixed <- rep(0.1, length(input$daily_cases))

input$fit_iter <- 100
input$chains <- 1

input$f_fixed <- rep(0.1, 90)
results <- model_run(input)

draw_plots()
```

Cloud Access through Python

Users can use Python to access covidseir model on the cloud. The simple code
snippet below runs the model with default inputs.

```
import json
import requests
url = 'http://model-covidseir.cp.prism-ubc.linaralabs.com/ocpu/library/covidseirPrism/
headers = {'x-prism-auth-user': 'YOUR_API_KEY'}
default_input = requests.post(url, headers=headers,json = {"func":["get_default_input"]
# json_default_input = json.loads(default_input.json()[0]) # OR:
json_default_input = json.loads(json.loads(default_input.text)[0])
response = requests.post(url, headers=headers,json = {"func":["prism_model_run"], "mode
results = json.loads(response.text)
```

Cloud Access through Linux Bash

In Ubuntu, you can call the API with curl:

```
curl \
-X POST \
-H "x-prism-auth-user: YOUR_API_KEY" \
-H "Content-Type: application/json" \
-d '{"func":["prism_model_run"],"model_input":{"daily_cases":[0,0,1,3,1,8,0,6,5,0,7,7,1
} ' \
http://model-covidseir.cp.prism-ubc.linaralabs.com/ocpu/library/covidseirPrism/R/gatewa
```