Build, update, and query causal models with `CausalQueries`: Cheat Sheet

1. Make your model

`CausalQueries` works with models that assume a causal structure over **binary nodes**.

a. Make your model

Provide a causal structure connecting nodes using **dagitty** syntax.

```
model_1 <- make_model("X -> Y; Z -> Y")         # simple
model_2 <- make_model("Z -> X -> Y; X <-> Y")  # with confounding
```

b. Optionally: refine your model

Set restrictions ***(to rule out some nodal types)***

```
# naming types
make_model("X -> M -> Y") |>
  set_restrictions(labels = list(M = c("10", "11"), Y = "00"))

# using logical statements
make_model("X -> Y") |>
  set_restrictions(statement = "Y[X=1] > Y[X=0]")

# natural language helpers
make_model("X -> Y") |> set_restrictions(decreasing("X", "Y"))
```

Set priors ***(to make use of prior knowledge)***

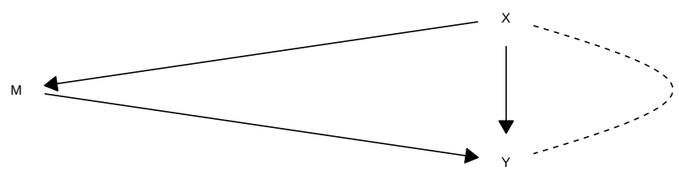
```
make_model("X -> Y") |> set_priors(distribution = "jeffreys")

make_model("X -> Y") |>
  set_priors(statement = "Y[X=1] > Y[X=0]", alphas = .25)
```

Set parameters ***(to imagine a particular world)***

```
make_model("X -> Y") |>
  set_parameters(statement  = "Y[X=1] > Y[X=0]", parameters = .5)
```

c. Graph your model

```
make_model("X -> M -> Y <- X; X <-> Y") |> plot()
```



d. Inspect your model

```
make_model("X -> Y") |> inspect("nodal_types")
make_model("X -> Y") |> inspect("causal_types")
```

2. Update your model

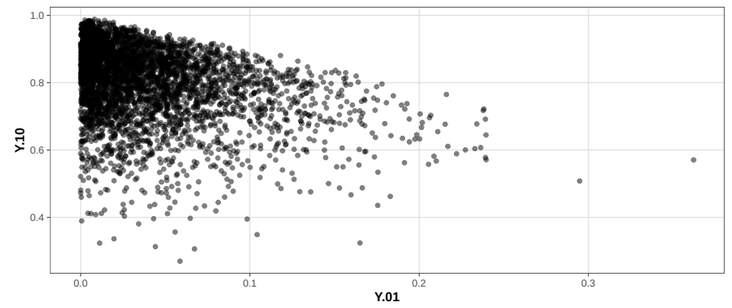
To update, pass the model and data to `update_model()`.

Data can be complete or missing at random.

```
model <- make_model("X -> M -> Y")
data  <- data.frame(X = 0:1, M = 1:0, Y = 0:1) |> uncount(10)

model <- update_model(model, data)
```

Posterior distributions on parameters can be accessed directly (via `grab` or `inspect`) or when you query the model.

```
model |> grab("posterior_distribution") |>
  ggplot(aes(Y.01, Y.10)) + geom_point(alpha = .5)
```



Use additional Stan arguments to control updating

Other Stan arguments can be passed to `update_model()`:

- `iter` sets the number of iterations (and ultimately posterior draws)
- `chains` sets the number of chains (parallel chains can speed things up)
- many other options via `?rstan::stan`

Causal syntax

`CausalQueries` uses a causal syntax that lets you describe arbitrary observational or controlled values of a node. Square brackets indicate controlled values (implied application of the "do" operator).

An observational query: types that produce `Y == 1`.

```
make_model("X -> M -> Y <- X") |>
  get_query_types("Y==1")
```

A simple counterfactual query: types that produce `Y == 1` when `X` is set to 1.

```
make_model("X -> Y") |>
  get_query_types("Y[X=1]==1")
```

A complex query: types for which `Y == 1` when `X=1` and `M` is held constant at the value it would take if `X` were 0.

```
make_model("X -> M -> Y") |>
  get_query_types("Y[M=M[X=0], X=1]==1")
```

We provide helpers for common causal statements (`increasing`, `decreasing`, `interacts`, etc.), which are useful for querying models or setting restrictions.

3. Query your model

Formulate a causal query using causal syntax and put the query to the model.

Provide:

- causal queries (`queries`)
- conditions (`given`)
- which parameters to use (`using`)

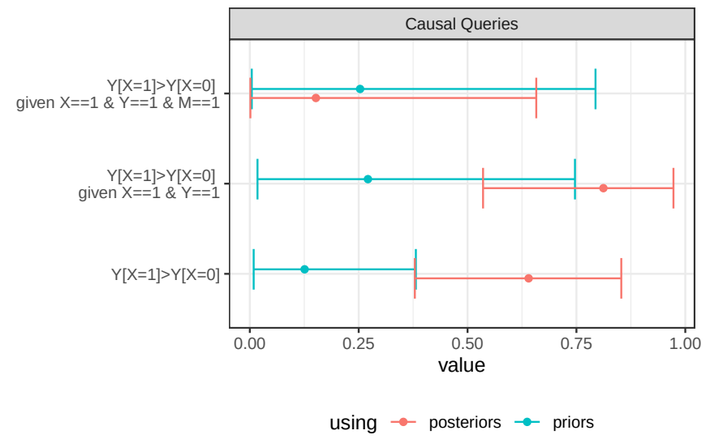
```
model <- make_model("X -> M -> Y")

results <- model |>
  query_model(
    queries = list(
      ATE = "Y[X=1] - Y[X=0]",
      POS = "Y[X=1] > Y[X=0]"
    ),
    given = c(
      "All",
      "X==1 & Y==1",
      "X==1 & Y==1 & M==0"
    ),
    using = c("parameters", "priors")
  )
```

Putting it all together

```
results <-
  make_model("X->M->Y") |>
  update_model(data) |>
  query_model(
    query = "Y[X=1]>Y[X=0]",
    given = c("All", "X==1 & Y==1", "X==1 & Y==1 & M==1"),
    using = c("priors", "posteriors")
  )
```

and view as table or plot:

```
plot(results)
```



`CausalQueries` makes it easy to make, update, and query causal models defined over binary variables. Model parameters are defined using potential outcomes and updated with `rstan`. For more see https://integrated-inferences.github.io/ CC BY SA package version 1.4.4 • Updated: 2026-01-25