Continuous exposures and g-computation

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Normal regression estimates associations. But we want ***causal*** estimates: what would happen if ***everyone*** in the study were exposed to x vs if ***no one*** was exposed.

G-Computation/G-Formula

1. Fit a model for `y ~ x + z` where z is all covariates
2. Create a duplicate of your data set for each level of x
3. Set the value of x to a single value for each cloned data set (e.g `x = 1` for one, `x = 0` for the other)

G-Computation/G-Formula

1. Make predictions using the model on the cloned data sets
2. Calculate the estimate you want, e.g. `mean(x_1) - mean(x_0)`

Advantages of the parametric G-formula

Often more statistically precise than propensity-based methods

Incredibly flexible

Basis of other important causal models, e.g. causal survival analysis and TMLE

Greek Pantheon data (`greek_data`)

The name of a Greek god	A prognostic factor	The treatment, a heart transplant	The outcome, death
Rheia	0	0	0
Kronos	0	0	1
Demeter	0	0	0
Hades	0	0	0
Hestia	0	1	0
Poseidon	0	1	0
Hera	0	1	0
Zeus	0	1	1
Artemis	1	0	1
Apollo	1	0	1

+ 10 more rows

1. Fit a model for `y ~ a + l`

```
1 greek_model <- lm(y ~ a + l, data = greek_data)
```

2. Create a duplicate of your data set for each level of a

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3. Set the value of a to a single value for each cloned data set

The name of a Greek god	A prognostic factor	a	The outcome, death
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The name of a Greek god	A prognostic factor	a	The outcome, death
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Zeus	0	**1**	1
Artemis	1	**1**	1
Apollo	1	**1**	1

3. Set the value of a to a single value for each cloned data set

```r
#  set all participants to have a = 0
untreated_data <- greek_data |>
  mutate(a = 0)

#  set all participants to have a = 1
treated_data <- greek_data |>
  mutate(a = 1)
```

4. Make predictions using the model on the cloned data sets

```r
#  predict under the data where everyone is untreated
predicted_untreated <- greek_model |>
  augment(newdata = untreated_data) |>
  select(untreated = .fitted)

#  predict under the data where everyone is treated
predicted_treated <- greek_model |>
  augment(newdata = treated_data) |>
  select(treated = .fitted)

predictions <- bind_cols(
  predicted_untreated,
  predicted_treated
)
```

5. Calculate the estimate you want

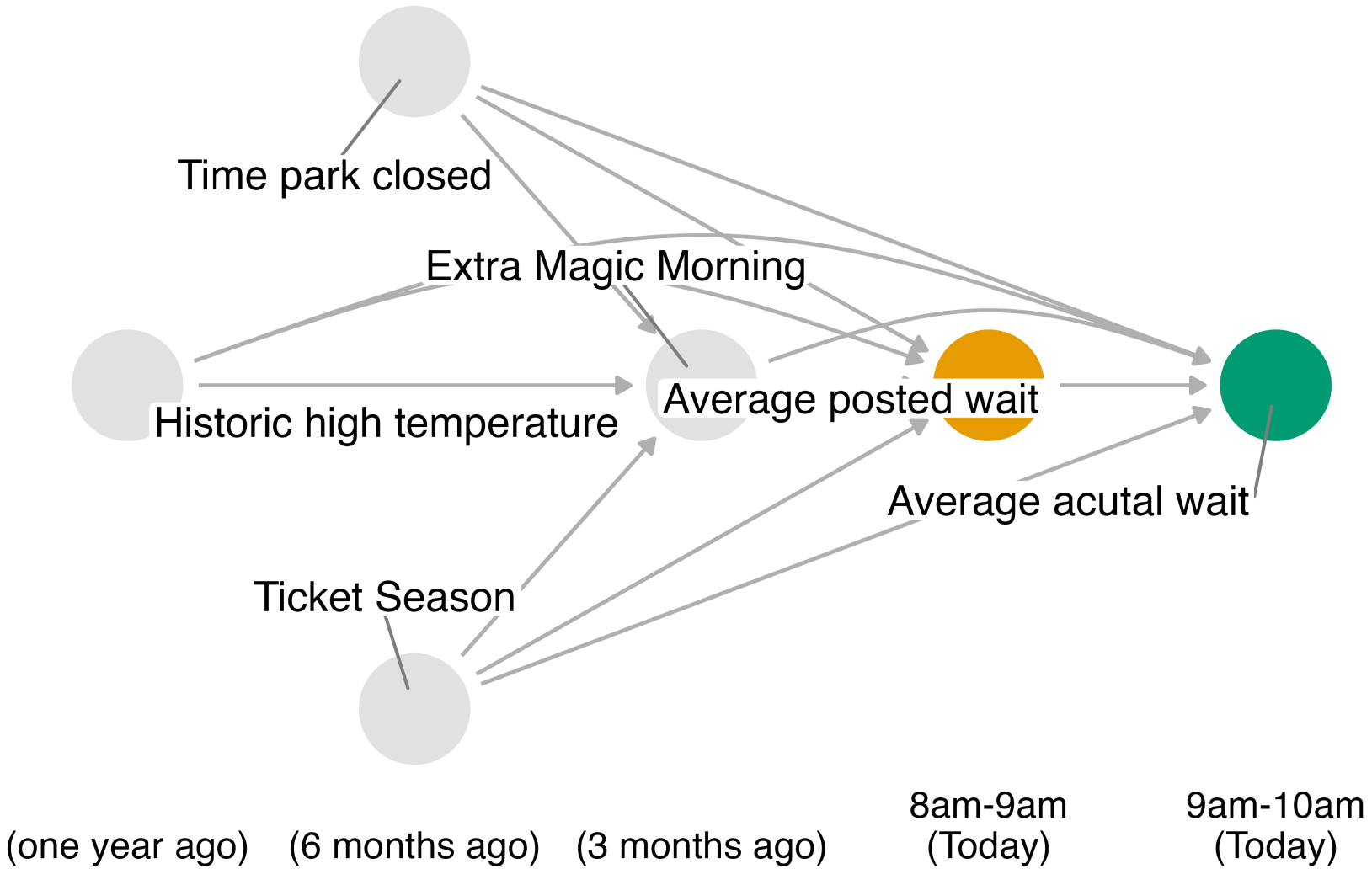
```r
predictions |>
  summarise(
    mean_treated = mean(treated),
    mean_untreated = mean(untreated),
    difference = mean_treated - mean_untreated
  )
```

```
# A tibble: 1 × 3
  mean_treated mean_untreated difference
         <dbl>          <dbl>      <dbl>
1          0.5            0.5          0
```

Continuous exposures

We recommend g-computation over propensity scores for continuous exposures because of stability issues

Do *posted* wait times at 8 am affect *actual* wait times at 9 am?



Your Turn

Work through Your Turns 1-3 in `10-continuous-g-computation-exercises.qmd`

10:00