Basic introduction to Bayesian inference

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Today's plan

Part 1:

- Three ways to write (and read) a model
- (Generalised) linear regression

Part 2:

- How to make a model go?
- Interpreting outputs

We will not explicitly cover:

- Bayes theorem
- Priors

Why?

How Bayes reshaped my thinking (for better or worse):

1. I understand GLMs better
2. I stop worrying about p-values and start to be comfortable with uncertainties
3. I begin to see my model as modular; when it fails to converge, I understand which part was the culprit
4. It is slower, so you think harder about your model
5. I understand the meaning of each parameter, including the variance term
6. I can map my parameters to my questions
7. My models become **more purposeful**

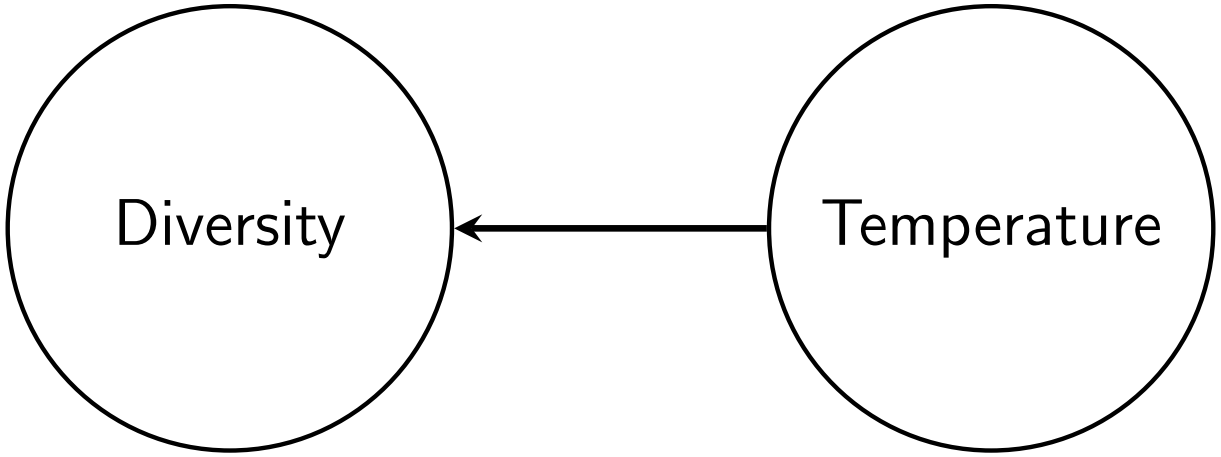
Three ways to write (and read) a model

1. Graphical
2. Code
3. Maths

Pair up

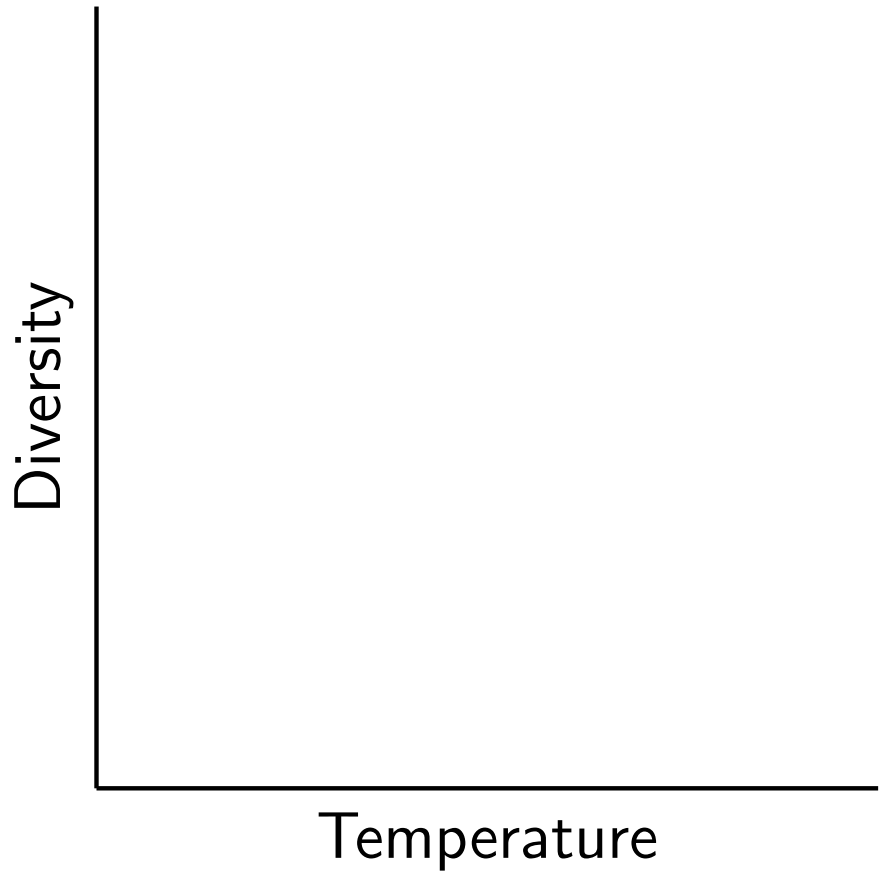
The graphical way

The effect of temperature on diversity.



The graphical way

The effect of temperature on diversity.



The code way

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lm(Y ~ 1 + X)
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The maths way

$$Y = a + bX + \epsilon$$

$$Y \sim \text{Normal}(\mu, \sigma_\epsilon)$$
$$\mu = a + bX$$

Back to the graphical way

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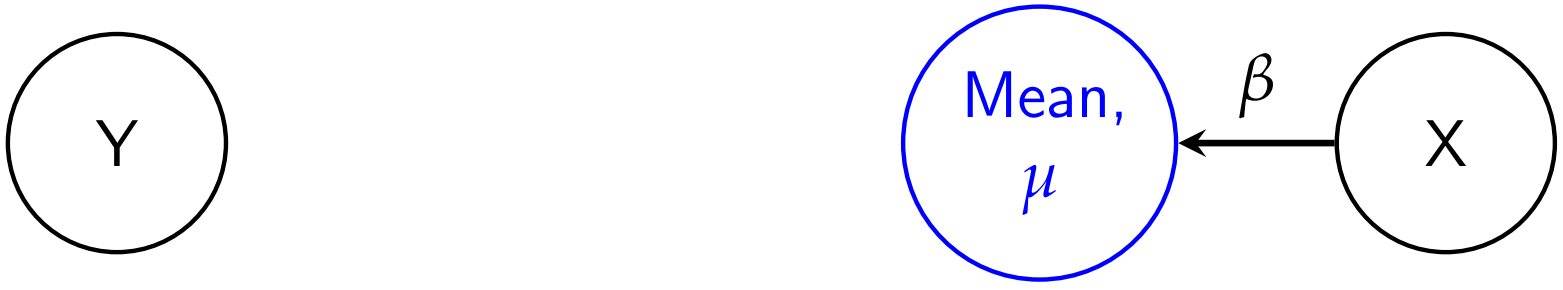
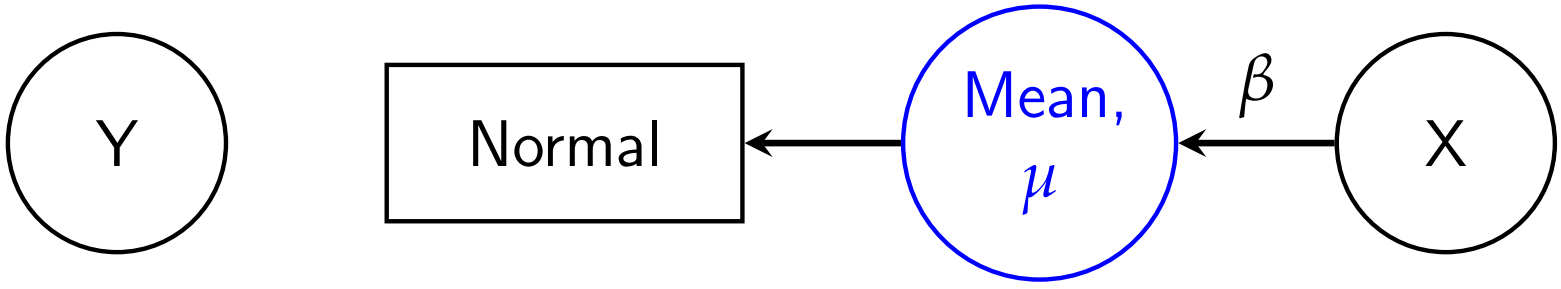


Back to the graphical way



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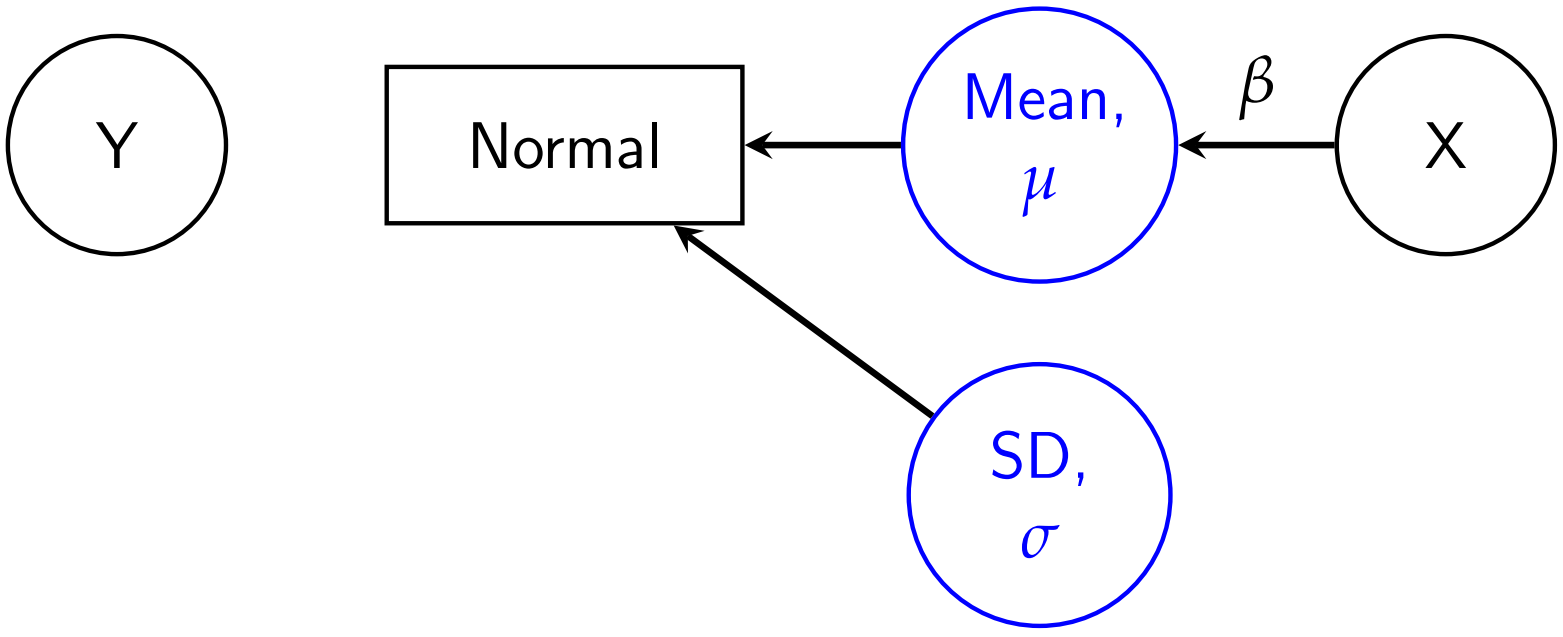

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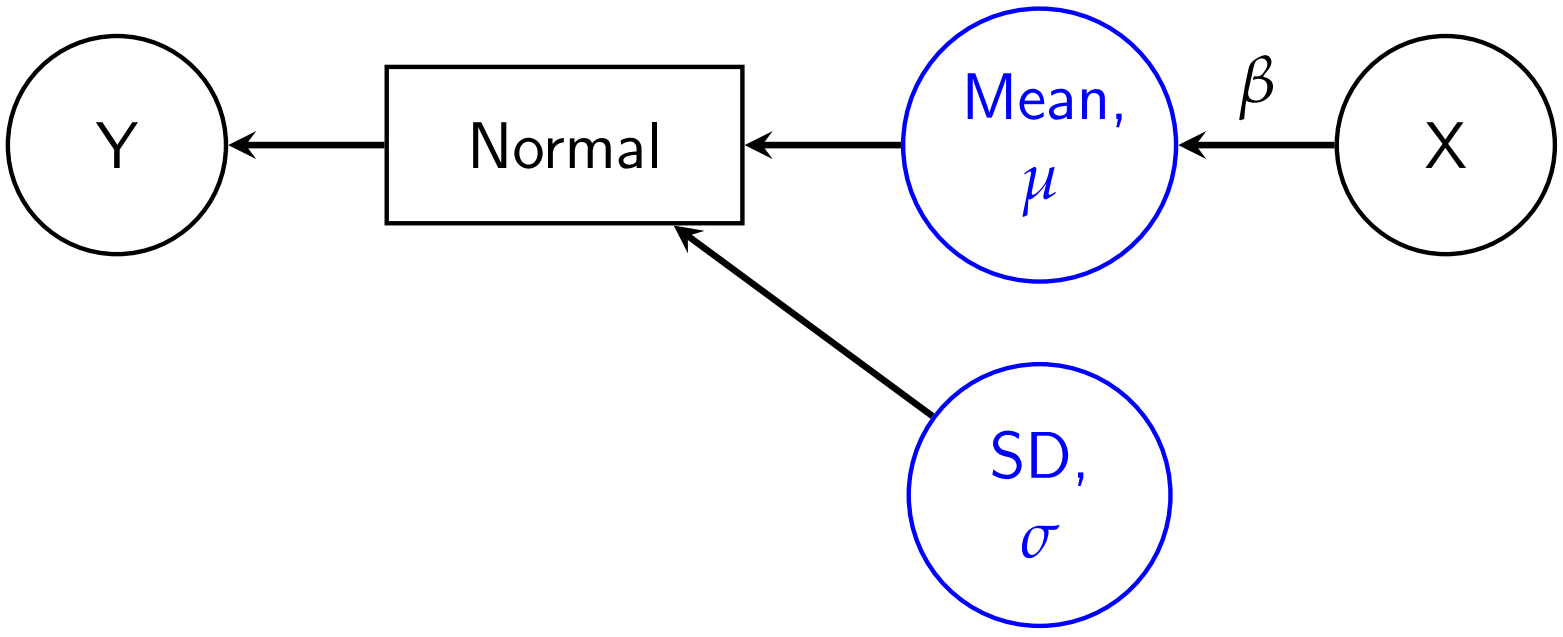

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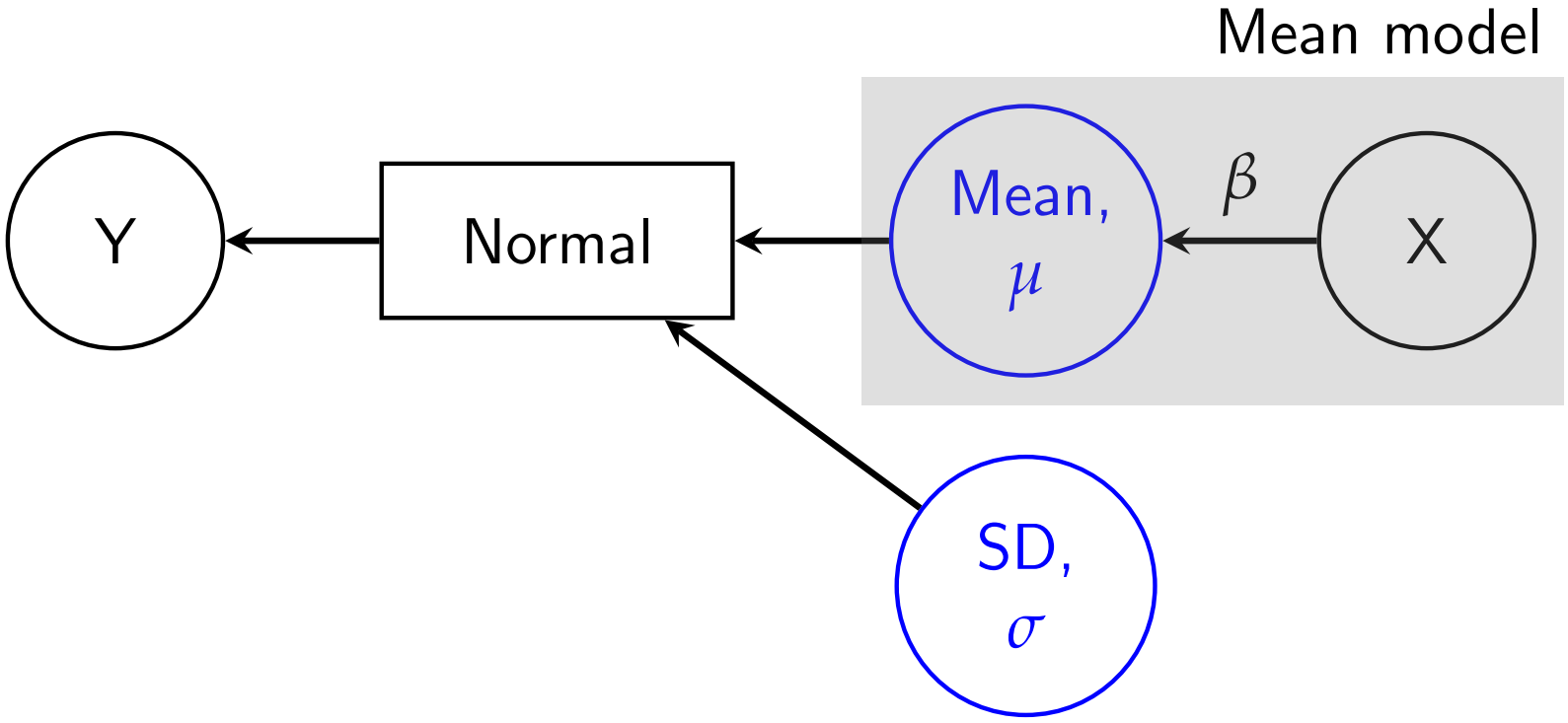

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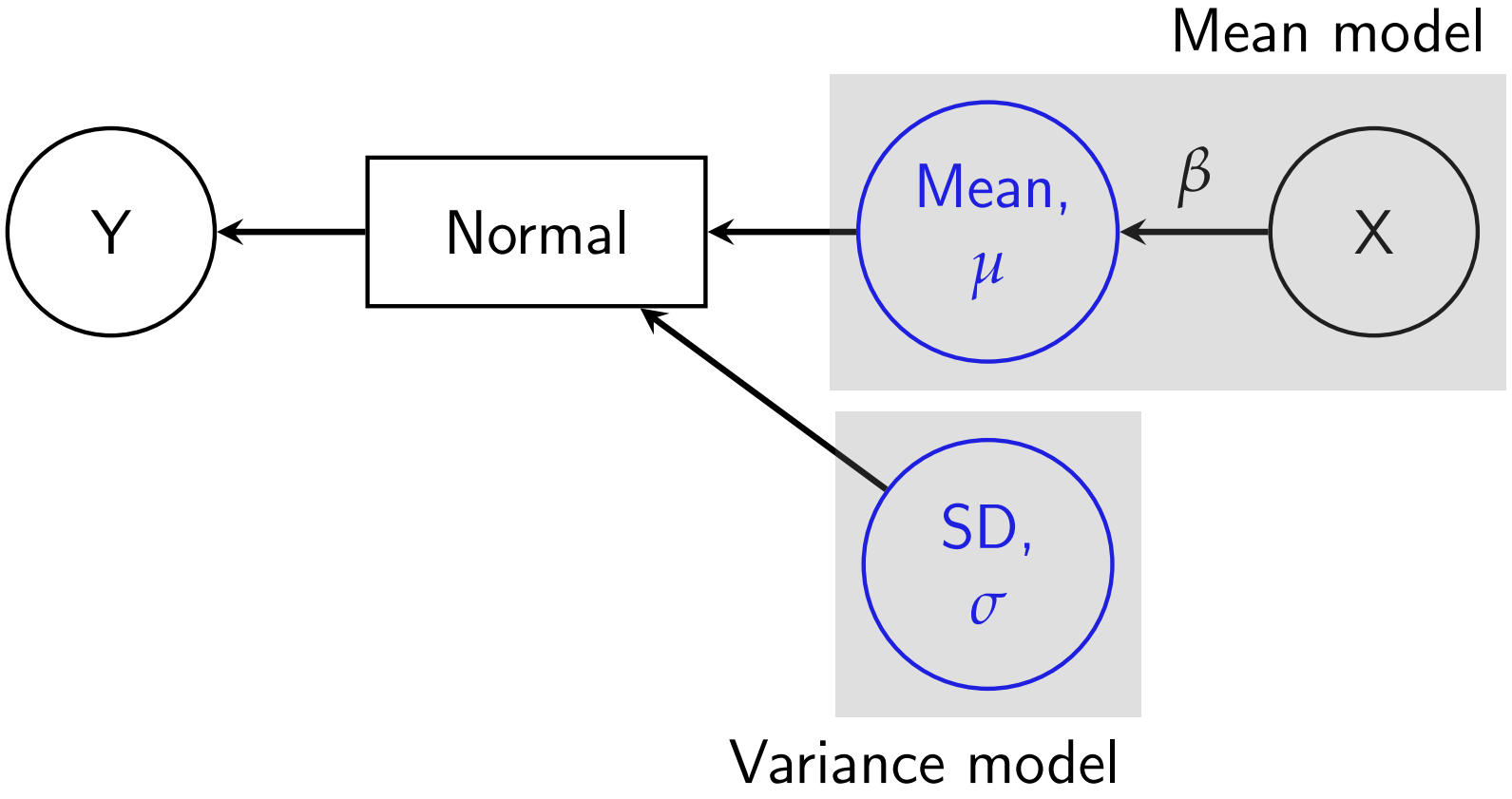

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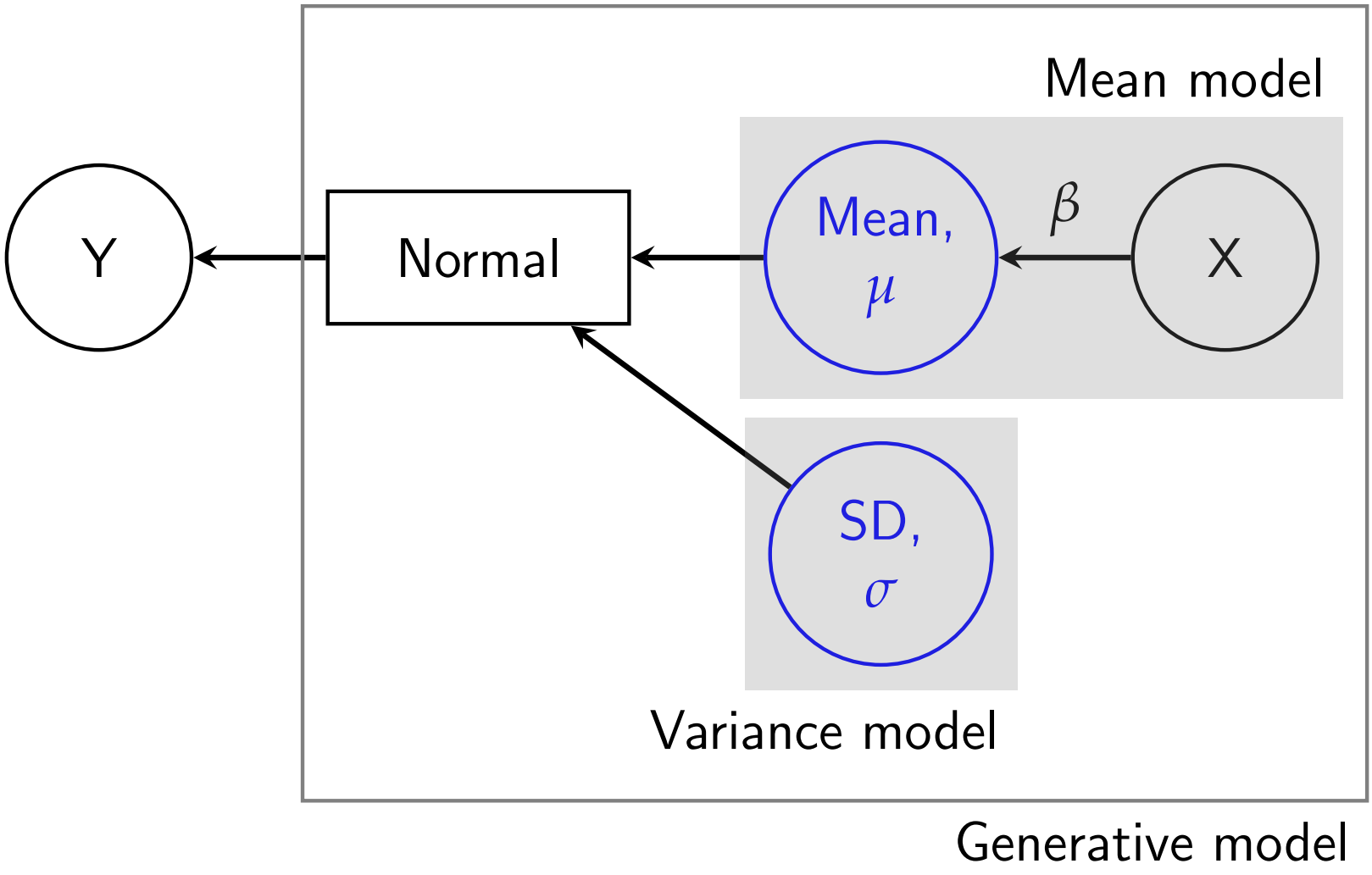

What happens if the response is not Normal?

$$Y \sim \text{Distribution}(\mu,\ \phi)$$
$$\text{Link-function}(\mu) = a + bX$$

When should I stop?

- Bayesian inference is flexible, therefore it is a rabbit hole
- When you spend too much time building ever more complex Bayesian models, it is probably a good time simplify your questions instead
- At which point you may find that you don't need Bayes anyways

I still use frequentist approach, and everytime I return to it, I realise how much more I appreciate frequentist because of what I have learnt from Bayesian inference.