Portfolio 1

2-3 pages of text 3\*2400= 7200 characters

# Explain the beta-binomial model for inferring rates. Present the theta, alpha, and beta parameters, and their interpretation. You may refer to the chicken example, or one of your own. Use figures to support your answer where appropriate.

Generally speaking

JAGS:

**model{**

**theta ~ dbeta(1, 1) (alpha - success, beta - misses, so 1-1 is basically no information)**

**for (t in 1:ntrials) {**

**G[t] ~ dbinom(theta) G at every trial is distributed binomially with a parameter theta (that is fixed)**

**}**

**}**

* Plate notation for visualizing graphs
  + Circle is continuous
  + Square is discrete

* Shaded- observable
* Unshaded - latent

* A frame around shapes and t subscript - t-trials
* A bigger frame around the whole thing and s subscript - s subjects

* Arrow - deterministic relationship

Choosing priors:

What possible values are there?

* Theta is a probability - must be between 0 and 1
  + No knowledge - uniform distribution
  + Truncated normal distribution
  + Beta distribution
    - Theta s ~ Beta(alpha, B)
      * Alpha - number of succeses
      * B = number of failures
      * We want the distribution to peak at theta - the most likely value
        + The area under the curve has to sum up to 1
        + E.g. at 30 trials, a =10 correct , b = 20 failures (.33 is most likely value of theta - where beta disrtibution peaks)
        + E.g. at 2 trials, a = 1 correct, b = 1 failure -> all values from 0 to 1 are equally likely - we are equally uncertain about them -> distribution is uniform but is cut off ay 0 and 1.

* G s,t ~ Binomial(Theta s, 1)

The beta-binomial model

* Cognitive Model: A formal theory of the cognitive process which generates behavior on some task or set of tasks
* A mathematical formalization of a verbal theory of the internal causes of human behavior
* A graphical model?
* ***The purpose is Inference***: The process of expressing and updating beliefs about the cognitive processes generating behavior
* Theta – skill in the chicken example – a latent variable, unknown parameters of distributions
* Arrow = “sampled from”, or better “distributed as”
* Interpretation: guess-accuracy (observable variable) follows some distribution with parameter θ

A **binomial distribution** can be thought of as simply the probability of a SUCCESS or FAILURE outcome in an experiment or survey that is repeated multiple times.

The Beta-Binomial distribution always has more spread (variance) than its best fitting Binomial distribution, because the Beta distribution adds extra randomness. Thus, when a Binomial distribution does not match observations, because the observations exhibit too much spread, a Beta-Binomial distribution is often used instead.

# Compare the beta binomial and learning model covered in class.

Learning model -> ## Model 2: learning model

We need a fixed starting theta and a fixed alpha (learning rate)

Theta will be updated in every trial according to the learning rule

#theta in every trial is determined by the previous trial's theta in the power of 1 over 1+learning rate ('the learning rule')

#fixed parameters (learning rate alpha and starting skill level theta)

alpha <- .05

theta1 <- .5

ntrials <- 100

# Explain the concepts of model and parameter recovery, and present the results of model and parameter recovery studies for the beta binomial and learning models. Use figures where relevant.

* Theoretically meaningful and interpretable – choice of model structure and parameters not arbitrary, designed to capture causal theory
* Not interchangeable with other models – if you knew your model was true, could you distinguish inference from it from false alternatives?
* Meaningful and interpretable parameters – if you knew the true values of your model’s parameters, could you infer them accurately and precisely from data?

# What can you say about these models from these studies?