Exam 1 Key

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1. Parrots

a. Use binomial distribution on each parrot

```
## # A tibble: 3 x 4
##   name     left right   prob
##   <chr>   <dbl> <dbl>  <dbl>
## 1 Charlie    14     6 0.0370
## 2 Lara       13     7 0.0739
## 3 Polly      12     8 0.120
```

b. likelihood

```
## [1] 0.0003282955
```

c. MLE proportion & likelihood

MLE proportion =

```
## [1] 0.65
```

Likelyhood =

```
## # A tibble: 3 x 5
##   name     left right   prob mle_prob
##   <chr>   <dbl> <dbl>  <dbl>    <dbl>
## 1 Charlie    14     6 0.0370    0.171
## 2 Lara       13     7 0.0739    0.184
## 3 Polly      12     8 0.120     0.161
```

```
## [1] 0.005094652
```

`dbinom()` on combined data = 1pt

d. Bayes' Theorem

$$P(data) = 0.000328 \times 0.5 + 0.005095 \times 0.5 = 0.002711$$

$$P(model_1|data) = \frac{0.000328 \times 0.5}{P(data)}$$

$$P(model_2|data) = \frac{0.005095 \times 0.5}{P(data)}$$

- $P(model_1|data) = 0.0605382$
- $P(model_2|data) = 0.9394618$

e. Informative priors

$$P(data) = 0.000328 \times 0.53 + 0.005095 \times 0.47 = 0.002568$$

$$P(model_1|data) = \frac{0.000328 \times 0.53}{P(data)}$$

$$P(model_2|data) = \frac{0.005095 \times 0.47}{P(data)}$$

- $P(model_1|data) = 0.067743$
- $P(model_2|data) = 0.932257$

2. Galls

a. Intercept only

```
## (Intercept)
##   0.5348837
```

b. Effect of size class

```
##     size<12.5     size>18.0 size13.0-17.5
##     0.8666667     0.0625000     0.7500000
```

c. LRT

6 points for LRT:

```
## Likelihood ratio test
##
## Model 1: cbind(successes, failures) ~ 1
## Model 2: cbind(successes, failures) ~ -1 + size
##   #Df   LogLik Df  Chisq Pr(>Chisq)
## 1   1 -16.8804
## 2   3  -3.5586  2 26.644  1.638e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

2 pts for correct decision 2 pts for justification with LRT:

There are significant differences among size classes. The p-value is less than 0.05

d. Confidence intervals

```
##                       2.5 %    97.5 %
## size<12.5     0.642352007 0.9765105
## size>18.0     0.003673243 0.2474233
## size13.0-17.5 0.472324456 0.9311378
```

Parasitism success is significantly lower for galls > 18mm in diameter. The 95% confidence interval for this size class does not overlap the 95% CIs of the other size classes.

3. Coffee dieback

a. LRT for effect of fruit on dieback

```
## Likelihood ratio test
##
## Model 1: cbind(dieback, alive) ~ 1
## Model 2: cbind(dieback, alive) ~ jun_frt
##   #Df  LogLik Df  Chisq Pr(>Chisq)
## 1   1 -44.621
## 2   2 -44.584  1 0.0735     0.7863
```

1 pt for justification ($p > 0.05$)

b. AIC for null, effect of fruit, or effect of farmer

```
##          df      AIC
## m0        1 91.24108
## m_frt     2 93.16761
## m_farmer  3 76.62377
```

The model for different dieback proportion for each farmer has the lowest AIC and is the therefore the best model out of the three.

c. Scope of inference

Costa Rican coffee farms (from this time period, if you're not willing to assume that this year was a random sample of all years).

4. Monarchs

a. Write the glm

```
m1 <- glm(count_total ~ year, offset = log(num_sites), family = poisson, data = monarchs_sub)
```

b. Write equation with coefficients

```
## (Intercept)        year
## 38.95246820 -0.01576024
```

$$log(monarchs/site) = 38.952 - 0.0157 * year$$

c. Predict monarchs per site in 2012

```
## (Intercept)
##    1398.106
```