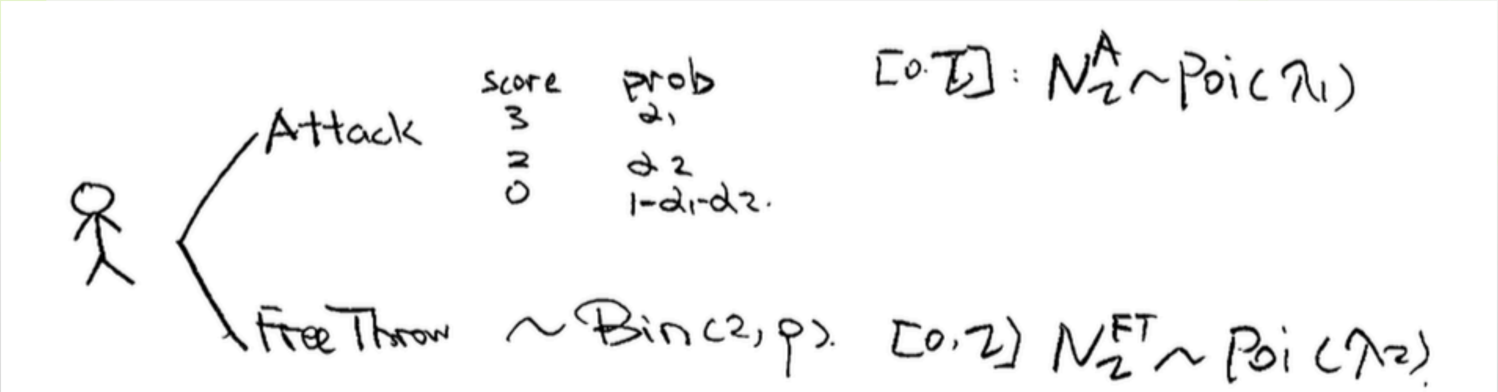
Sports Analytics Hackathon

Hack-A-Shaq

Report Structure

- Abstract
- Data and Variables
- Compound Poisson Process
- Monte Carlo Simulation
- Summary

Hack-A-Shaq



Attack or Free Throw:

In time[0,τ] before end of game:

Define the ***Compound Poisson Process***

\# Attack~ Poisson(λ_1);

Score{3,2,0} With Probability={α_1, α_2,1-α_1-α_2}

\# Free Throw~ Poisson(λ_2);

Score ~ Binomial (2, p)

Hack-a-Shaq with Compound Poisson Process

- Scenario One:

Attack~ Poisson(λ_1);

Score{3,2,0} With Probability={α_1, α_2,1-α_1-α_2}

- Expectation: $\lambda_1 * \tau * (3 * \alpha_1 + 2 * \alpha_2)$
- Variance: : $\lambda_1 * \tau * (9 * \alpha_1 + 4 * \alpha_2)$

Hack-a-Shaq with Compound Poisson Process

- Scenario Two:

Free Throw~ Poisson(λ_2);

Score ~ Binomial (2, p)

- Expectation: λ_2*τ*(2*p)
- Variance: : λ_2*τ*(2*p*q)

Monte Carlo Simulation

```
% Q2Q3
% Monte Carlo Simulation
% Setting Parameters
lambda1=1;
lambda2=1;
alpha1=0.2;
alpha2=0.3;
p=0.5;
% Setting number of loop to be Ten Thousand
NMCin=10000;
```

```
% Initialize Vector
AttackDist=zeros(NMCout,1);
FreeThrowDist=zeros(NMCout,1);
Attack=zeros(NMCin,1);
FreeThrow=zeros(NMCin,1);
```

MC Simulation _ Loops (10000)

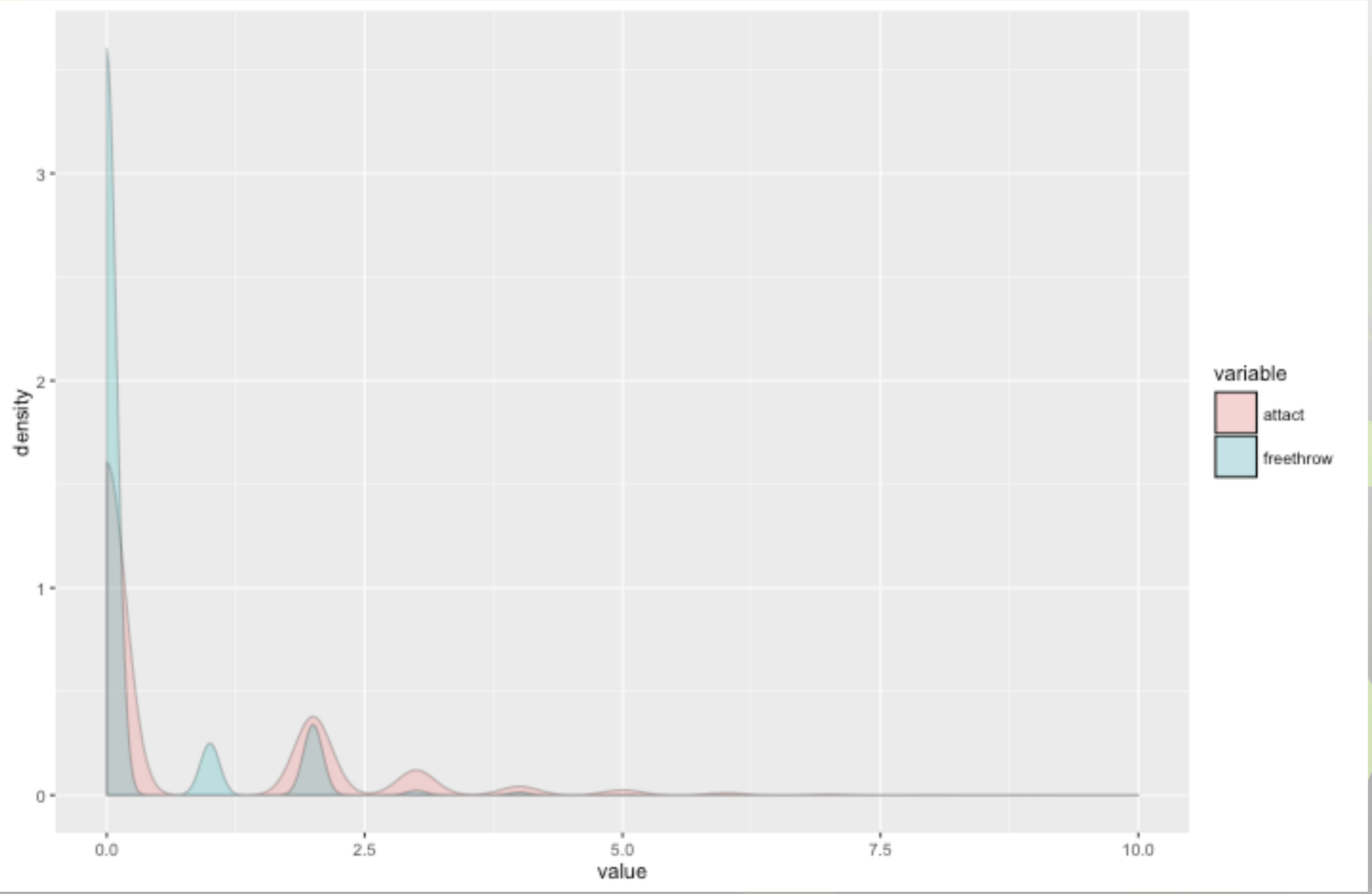
```
for it = 1:NMCin
      generate N1
      generate N2
      for i = 1:N2
           generate X2;
      end
      for j = 1:N1
           generate X1;
      end
end
```

```
% Assign Value to Vector
Attack(it,1)=sum(X1);
FreeThrow(it,1)=sum(X2);
% Visualization of the density
% Using "ksdensity" in Matlab
% or Using "ggplot" in R
```

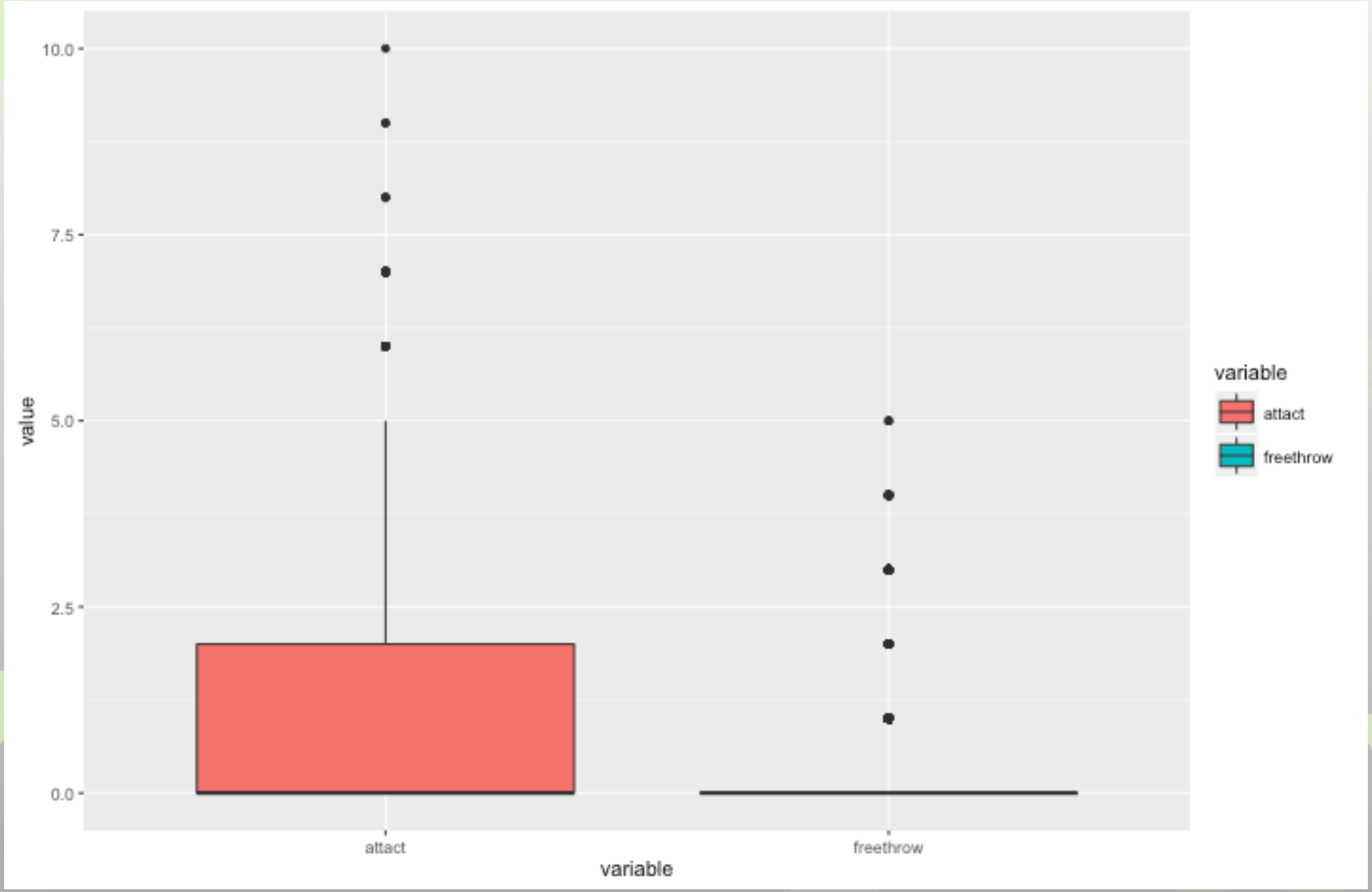
Case 1: λ1>λ2; E[X1]≈E[X2]

- Parameter
- $p=0.696$
- $\alpha_1=0.179$
- $\alpha_2=0.509$
- $\lambda_1=0.4305$
- $\lambda_2=0.1778$

Case 1: λ1>λ2; E[X1]≈E[X2]



Case 1: λ1>λ2; E[X1]≈E[X2]



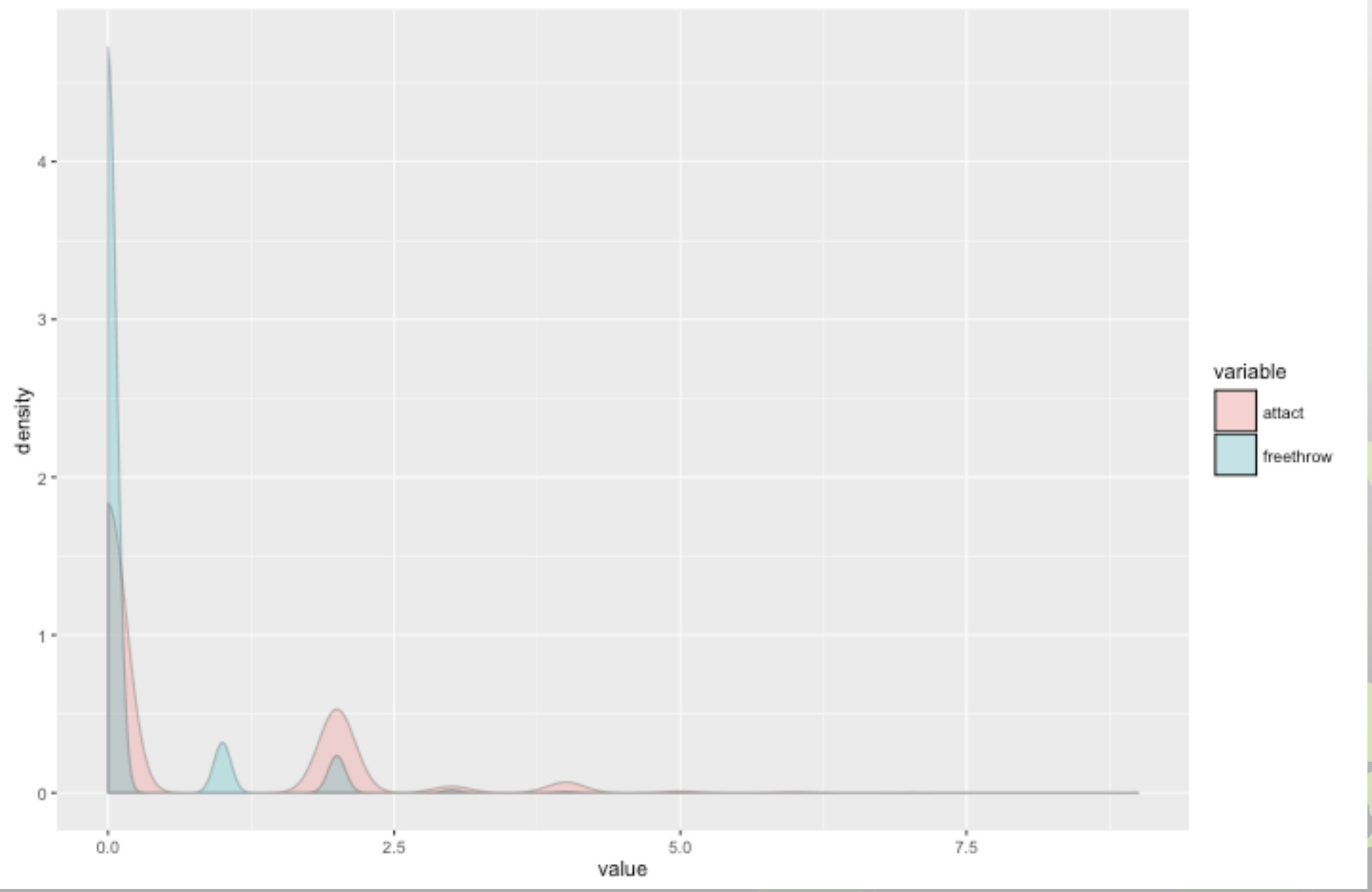
Case 2: Shaquille O'Neal $\lambda 1 >> \lambda 2$, $E[X1] \approx E[X2]$

- Parameter estimated for O'Neal[1]
- $p=0.5275$
- $\alpha_1=0.045$
- $\alpha_2=0.5829$
- $\lambda_1=0.4639$
- $\lambda_2=0.1417$

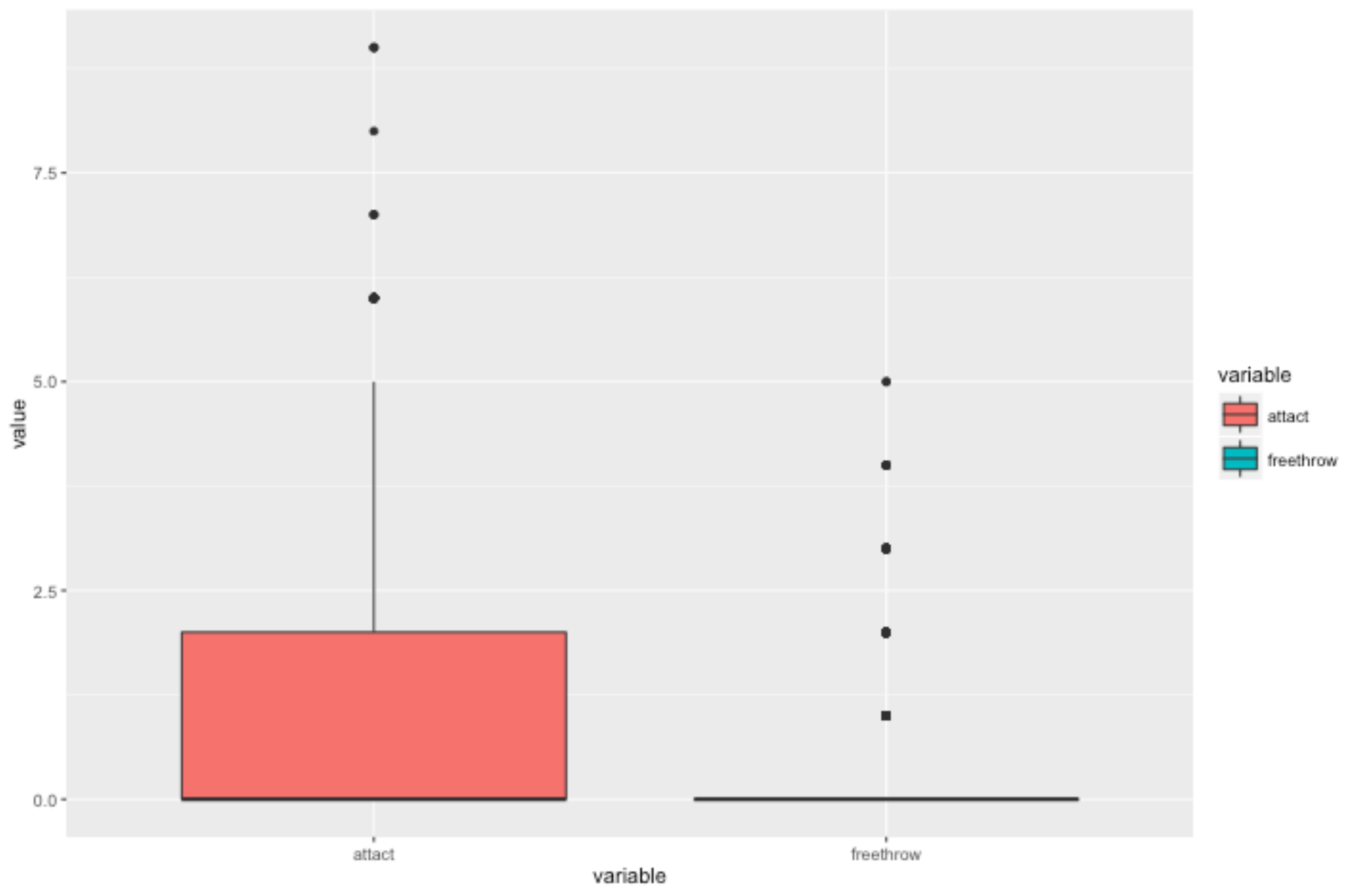
$\lambda_1 >> \lambda_2$

$E[X1] \approx E[X2]$

Case 2: λ1>>λ2, E[X1] ≈ E[X2]



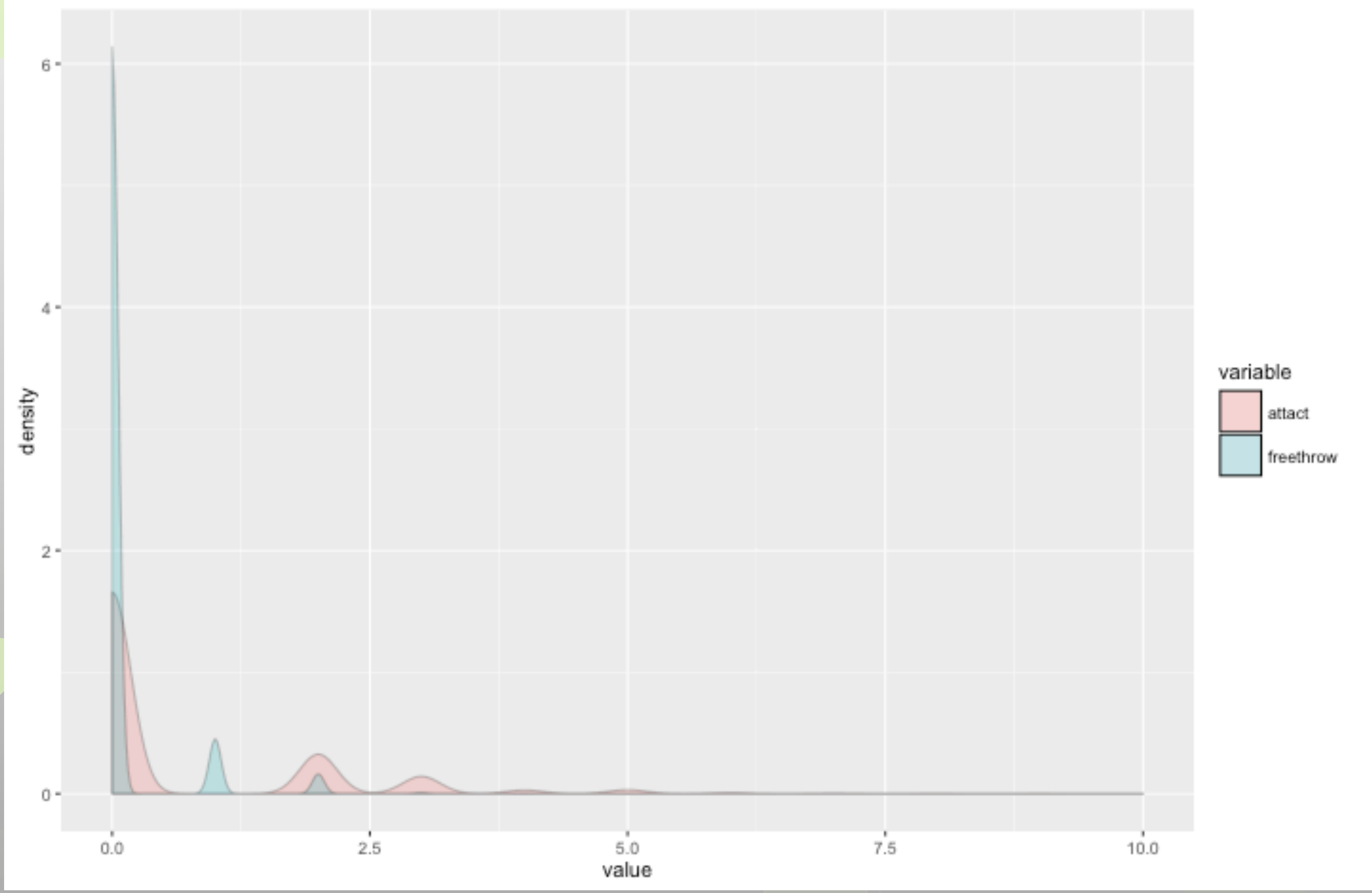
Case 2: $\lambda 1 >> \lambda 2$, $E[X1] \approx E[X2]$



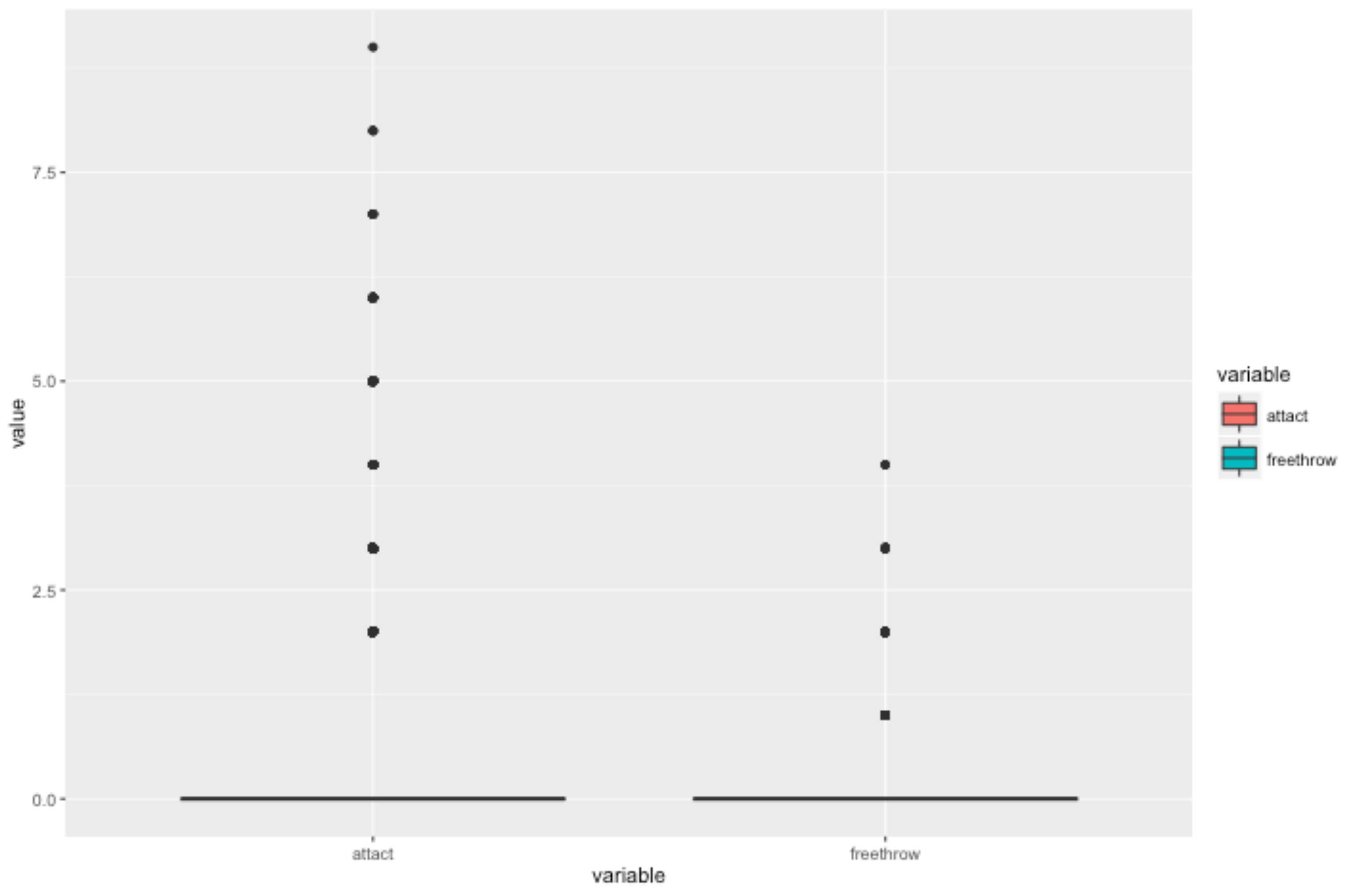
Case 3: $\lambda 1>\lambda 2$; $E[X1]>>E[X2]$

- Parameter estimated for Case 3
- $p=0.38$
- $\alpha_1=0.25$
- $\alpha_2=0.554$
- $\lambda_1=0.3472$
- $\lambda_2=0.1583$

Case 3: $\lambda1>\lambda2$; $E[X1]>>E[X2]$



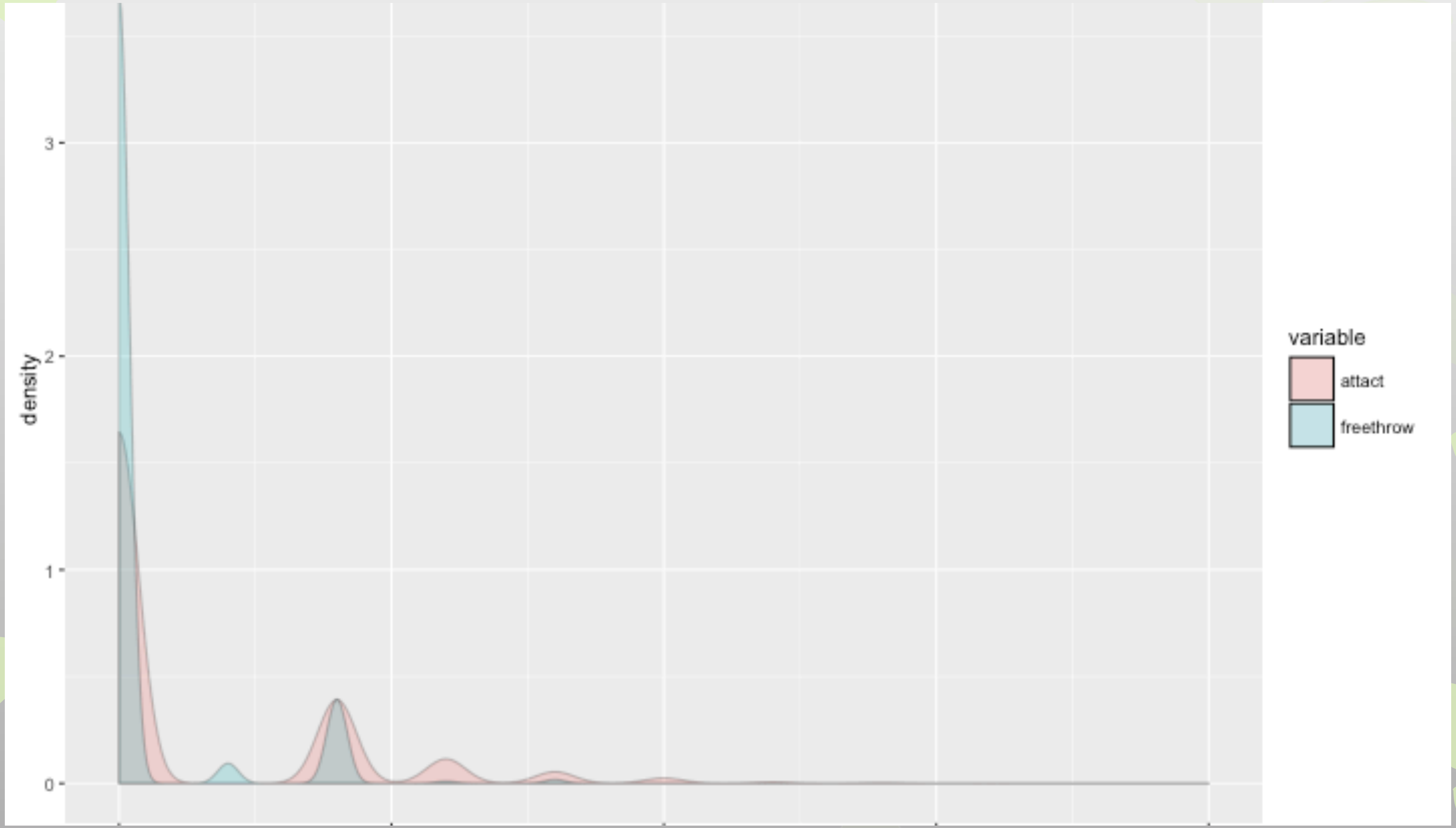
Case 3: λ1>λ2; E[X1]>>E[X2]



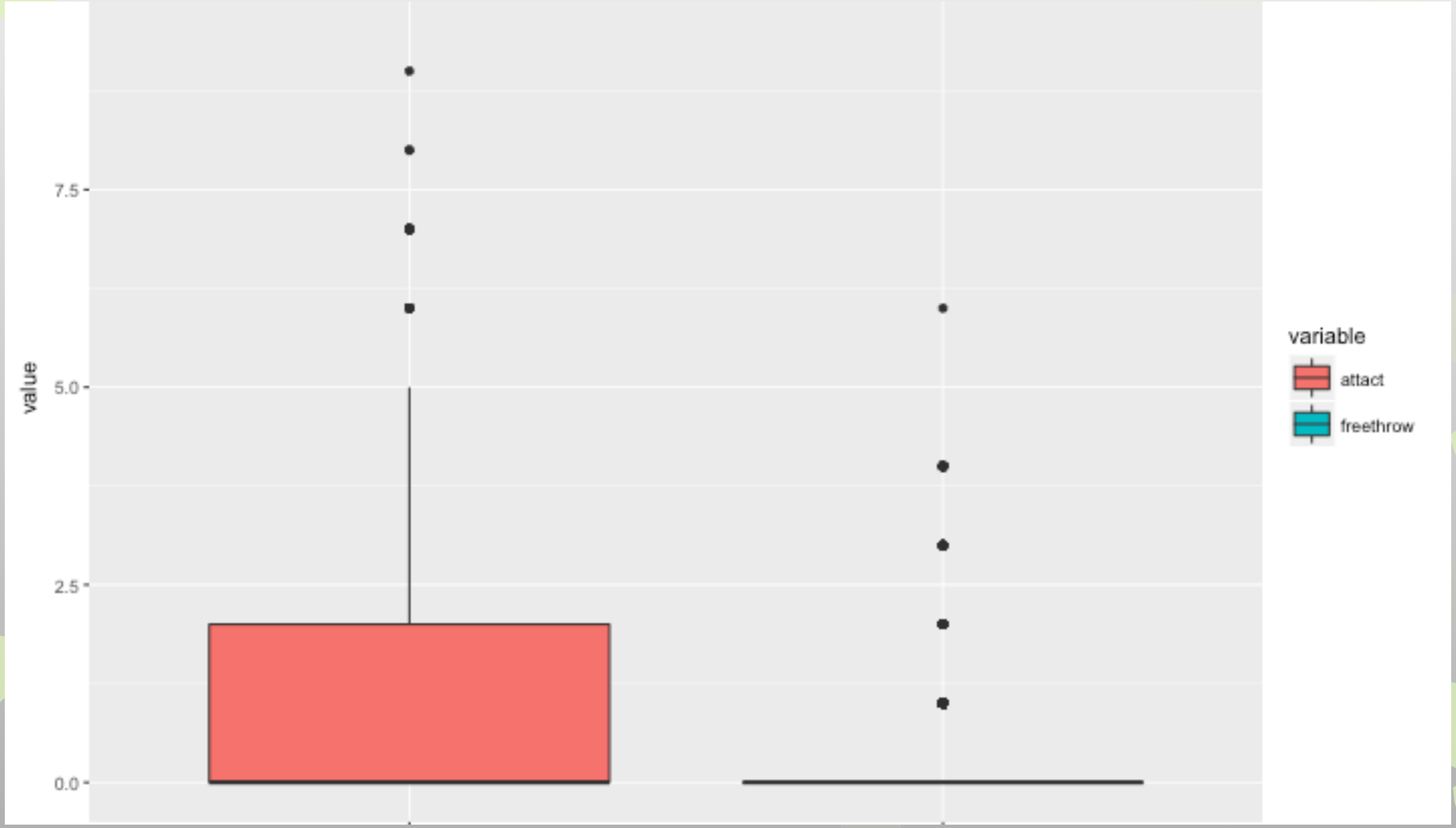
Case 4: $\lambda 1>\lambda 2$; $E[X2]>>E[X1]$

- Parameter estimated for Case 3
- $p=0.893$
- $\alpha_1=0.138$
- $\alpha_2=0.484$
- $\lambda_1=0.4916$
- $\lambda_2=0.125$

Case 4: λ1>λ2; E[X2]>>E[X1]



Case 4: λ1>λ2; E[X2]>>E[X1]



Summary: Hack-a-Shaq Strategy

Interrupt

- Organize attack quickly
- Unstable under pressure

Not Interrupt

- Stable and even better under pressure
- General cases

Doesn't Matter

- Lack accuracy

Summary: Hack-a-Shaq_Example

Interrupt

- Shaquille O'Neal
- Tim Duncan

Not Interrupt

- Calvin Murphy

Doesn't Matter

- Andre Drummond

The End