QLearningAnalysis

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```
Q_table <- read_csv("../../../StringQ_Qtable.csv")
```

```
## New names:
## * `` -> ...1
```

```
## Rows: 10000 Columns: 5
## -- Column specification -----------------------------------------------------
## Delimiter: ","
## chr (1): state
## dbl (4): ...1, act0, act1, argmax
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
qStats <- read_csv("../../../StringQ_stats.csv")
```

```
## Rows: 91506 Columns: 6
## -- Column specification -----------------------------------------------------
## Delimiter: ","
## dbl (6): state, timestep, episode, action, reward, duration
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
binQ_table = read_csv("../../../StringQ_rngBins_Qtable.csv")
```

```
## New names:
## * `` -> ...1
## Rows: 229 Columns: 5-- Column specification ---------------------------------------------------------
## Delimiter: ","
## dbl (5): ...1, state, act0, act1, argmax
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
binqStats = read_csv("../../../StringQ_rngBins_stats.csv")
```

```
## Rows: 180483 Columns: 6
## -- Column specification -----------------------------------------------------
## Delimiter: ","
## dbl (6): state, timestep, episode, action, reward, duration
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
#View(Q_table)
#View(qStats)
```

```
summary(binqStats)
```

```
##      state         timestep         episode        action
##  Min.   :3356   Min.   :  0.00   Min.   :   0   Min.   :0.0000
##  1st Qu.:4564   1st Qu.: 36.00   1st Qu.: 973   1st Qu.:0.0000
##  Median :5445   Median : 85.00   Median :1216   Median :0.0000
##  Mean   :5054   Mean   : 97.21   Mean   :1155   Mean   :0.4951
##  3rd Qu.:5545   3rd Qu.:153.00   3rd Qu.:1414   3rd Qu.:1.0000
##  Max.   :6775   Max.   :249.00   Max.   :1600   Max.   :1.0000
##      reward         duration
##  Min.   :  8.0   Min.   :  8.0
##  1st Qu.:151.0   1st Qu.:151.0
##  Median :241.0   Median :241.0
##  Mean   :195.4   Mean   :195.4
##  3rd Qu.:250.0   3rd Qu.:250.0
##  Max.   :250.0   Max.   :250.0
```

```
summary(binQ_table)
```

```
##       ...1          state          act0              act1
##  Min.   :  0   Min.   :3356   Min.   :-324.6405   Min.   :-324.062
##  1st Qu.: 57   1st Qu.:4446   1st Qu.:  -0.8217   1st Qu.:   0.000
##  Median :114   Median :5346   Median :   0.0000   Median :   0.000
##  Mean   :114   Mean   :5031   Mean   :  -6.7317   Mean   :  -6.745
##  3rd Qu.:171   3rd Qu.:5643   3rd Qu.:   0.0920   3rd Qu.:   0.000
##  Max.   :228   Max.   :6775   Max.   :   9.3565   Max.   :   9.286
##      argmax
##  Min.   :0.0000
##  1st Qu.:0.0000
##  Median :0.0000
##  Mean   :0.2882
##  3rd Qu.:1.0000
##  Max.   :1.0000
```
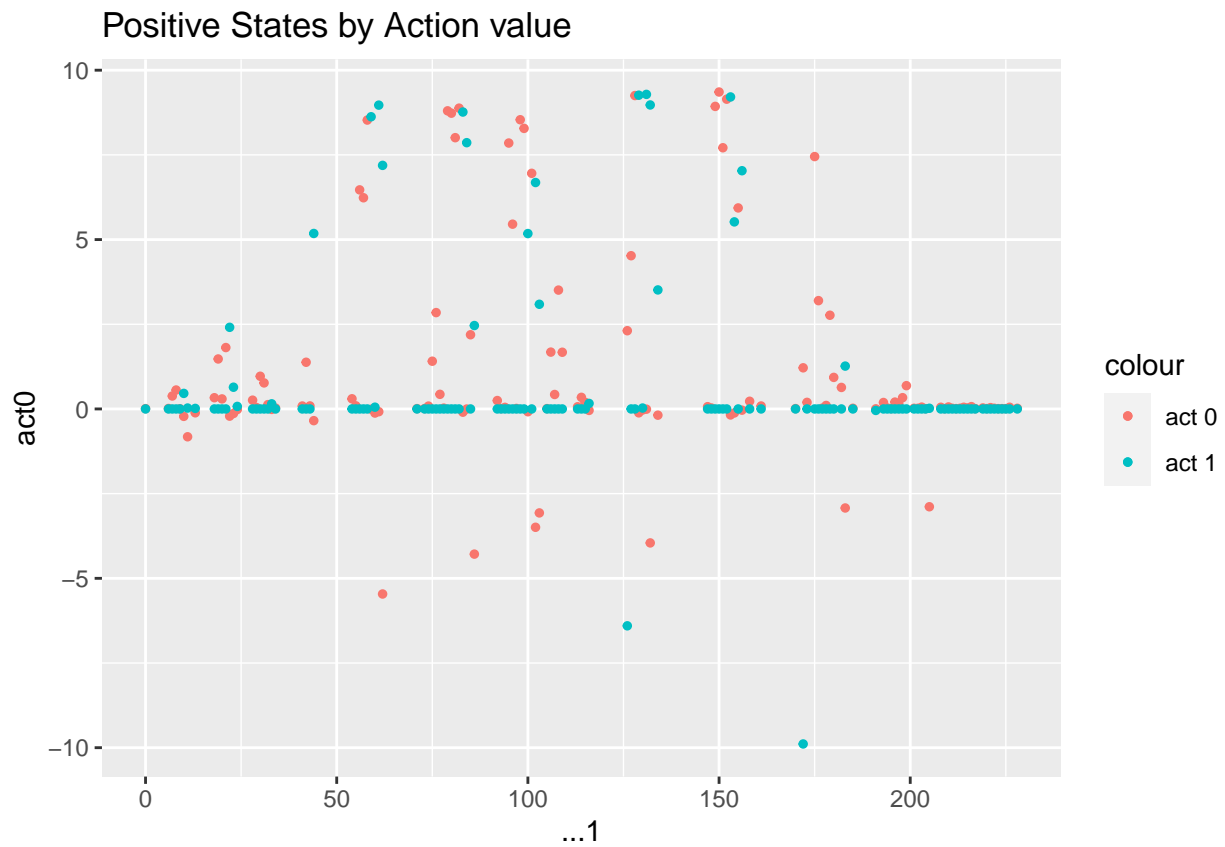
```
sd(binQ_table$act0)
```
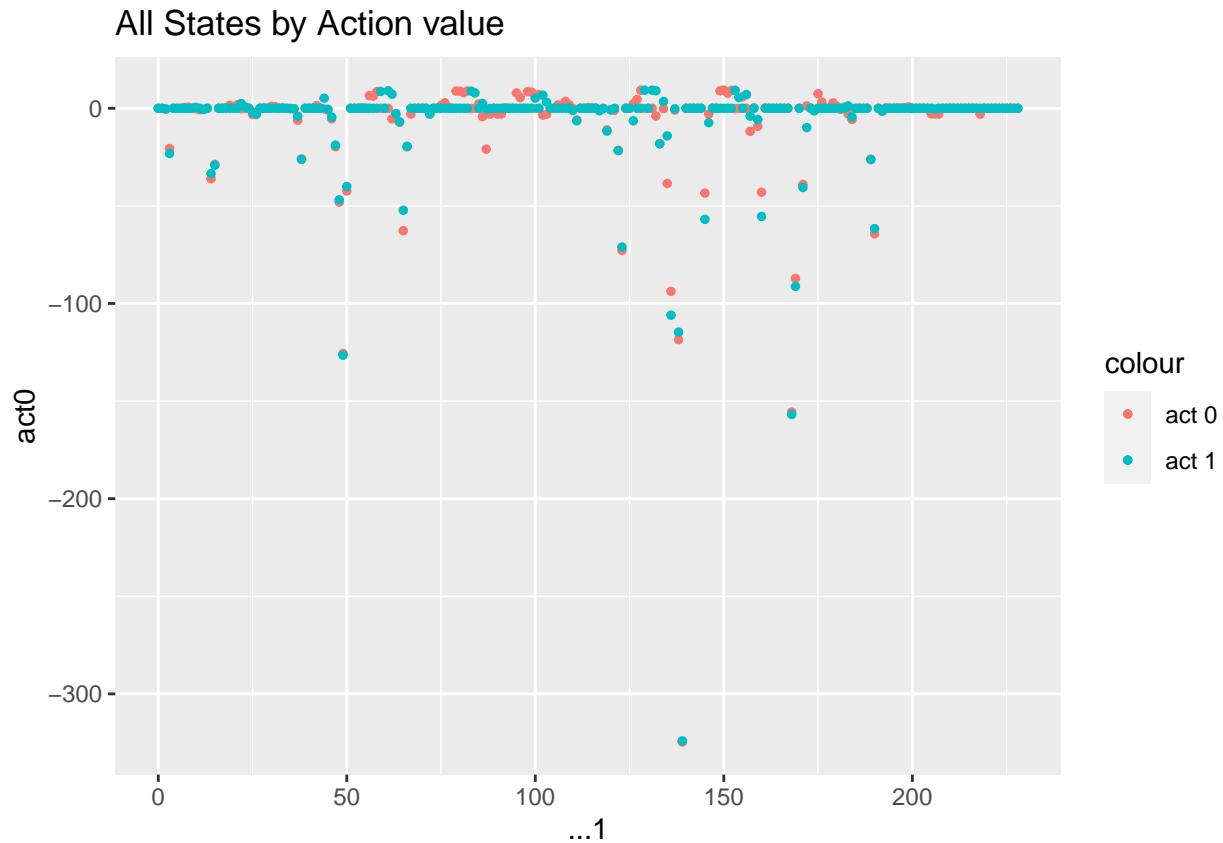
```
## [1] 29.44632
```

```
sd(binQ_table$act1)
```

```
## [1] 29.49676
```

```
binpos_states = as.data.frame(binQ_table %>% filter(act0 > 0 | act1 > 0))
ggplot(binpos_states,aes(x=...1)) +
  geom_point(aes(y=act0, colour="act 0"), size=1) +
  geom_point(aes(y=act1, colour="act 1"), size=1) +
  labs(title="Positive States by Action value")
```

Positive States by Action value

```
ggplot(binQ_table,aes(x=...1)) +
  geom_point(aes(y=act0, colour="act 0"), size=1) +
  geom_point(aes(y=act1, colour="act 1"), size=1) +
  labs(title="All States by Action value")
```

All States by Action value

```
# graph is similar to when all states are included
#plot(binqStats$timestep, factor(binqStats$state))
```

```
summary(Q_table)
```

```
##        ...1            state                act0               act1
##  Min.   :   0    Length:10000     Min.   :-328.1322   Min.   :-326.7142
##  1st Qu.:2500    Class :character  1st Qu.:   0.0000   1st Qu.:   0.0000
##  Median :5000    Mode  :character  Median :   0.0000   Median :   0.0000
##  Mean   :5000                      Mean   :  -0.1566   Mean   :  -0.1556
##  3rd Qu.:7499                      3rd Qu.:   0.0000   3rd Qu.:   0.0000
##  Max.   :9999                      Max.   :   8.2628   Max.   :   8.1181
##      argmax
##  Min.   :0.0000
##  1st Qu.:0.0000
##  Median :0.0000
##  Mean   :0.0063
##  3rd Qu.:0.0000
##  Max.   :1.0000
```

```
summary(qStats)
```

```
##      state           timestep          episode            action
##  Min.   :3356    Min.   :  0.00    Min.   :   0.0    Min.   :0.0000
##  1st Qu.:4565    1st Qu.: 23.00    1st Qu.: 707.0    1st Qu.:0.0000
##  Median :5456    Median : 58.00    Median : 951.0    Median :0.0000
##  Mean   :5215    Mean   : 73.97    Mean   : 874.9    Mean   :0.4751
##  3rd Qu.:5555    3rd Qu.:109.00    3rd Qu.:1091.0    3rd Qu.:1.0000
```

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```
## Max.   :6764   Max.   :249.00   Max.   :1200.0   Max.   :1.0000
##     reward          duration
## Min.   :  8.0   Min.   :  8.0
## 1st Qu.: 90.0   1st Qu.: 90.0
## Median :138.0   Median :138.0
## Mean   :148.9   Mean   :148.9
## 3rd Qu.:241.0   3rd Qu.:241.0
## Max.   :250.0   Max.   :250.0
```

```r
#plot(qStats$timestep, factor(qStats$state))
```
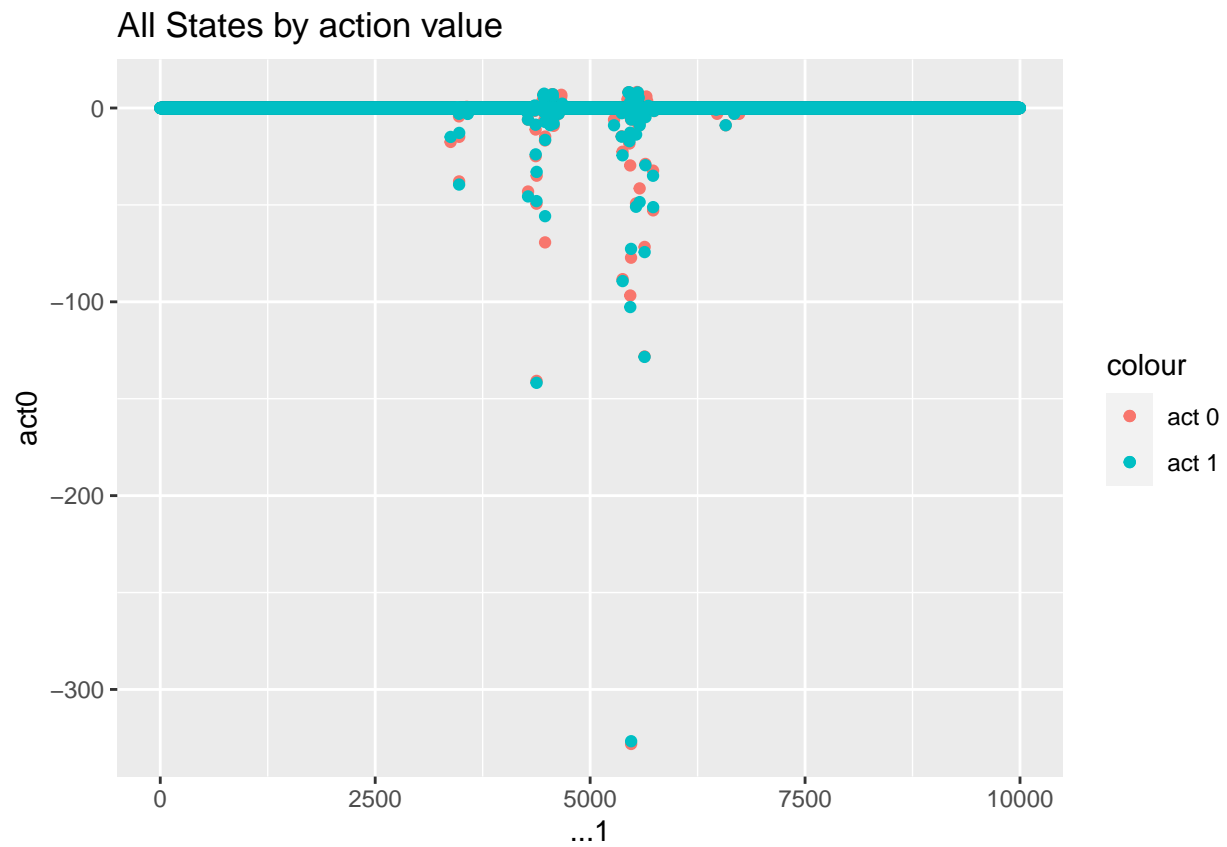
```r
updated_states = Q_table %>% filter(act0 != 0 | act1 != 0)
updated_states = as.data.frame(updated_states)
summary(updated_states)
```

```
##       ...1           state               act0              act1
## Min.   :3356   Length:191         Min.   :-328.1322   Min.   :-326.714
## 1st Qu.:4466   Class :character   1st Qu.:  -2.8865   1st Qu.:  -1.835
## Median :5346   Mode  :character   Median :   0.0098   Median :   0.000
## Mean   :5070                      Mean   :  -8.1983   Mean   :  -8.145
## 3rd Qu.:5649                      3rd Qu.:   0.0847   3rd Qu.:   0.000
## Max.   :6764                      Max.   :   8.2628   Max.   :   8.118
##     argmax
## Min.   :0.0000
## 1st Qu.:0.0000
## Median :0.0000
## Mean   :0.3298
## 3rd Qu.:1.0000
## Max.   :1.0000
```
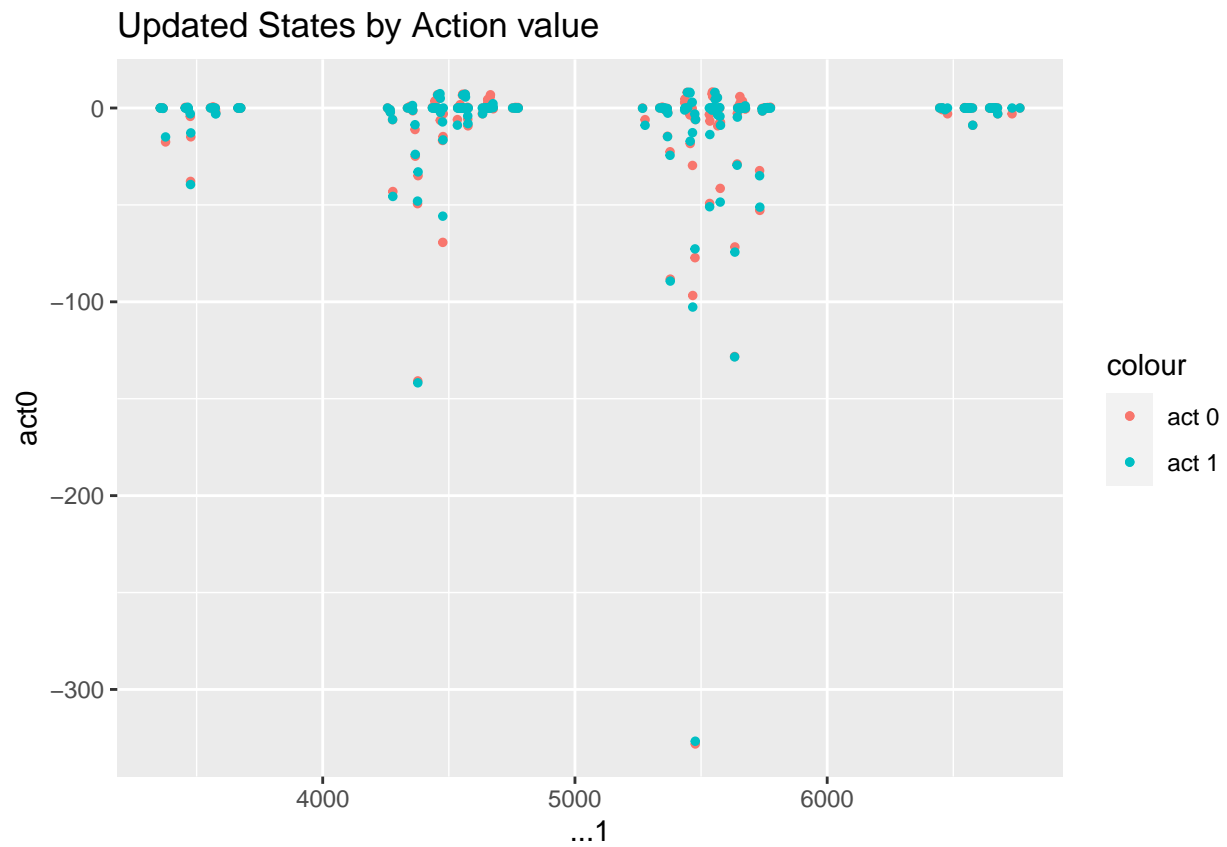
```r
pos_states = Q_table %>% filter(act0 > 0 | act1 > 0)
summary(pos_states)
```

```
##       ...1           state               act0              act1
## Min.   :3356   Length:121         Min.   :-6.32988   Min.   :-1.0453
## 1st Qu.:4543   Class :character   1st Qu.: 0.01000   1st Qu.: 0.0000
## Median :4775   Mode  :character   Median : 0.05896   Median : 0.0000
## Mean   :5113                      Mean   : 0.97177   Mean   : 0.7427
## 3rd Qu.:5665                      3rd Qu.: 0.39558   3rd Qu.: 0.0000
## Max.   :6764                      Max.   : 8.26281   Max.   : 8.1181
##     argmax
## Min.   :0.0000
## 1st Qu.:0.0000
## Median :0.0000
## Mean   :0.2066
## 3rd Qu.:0.0000
## Max.   :1.0000
```
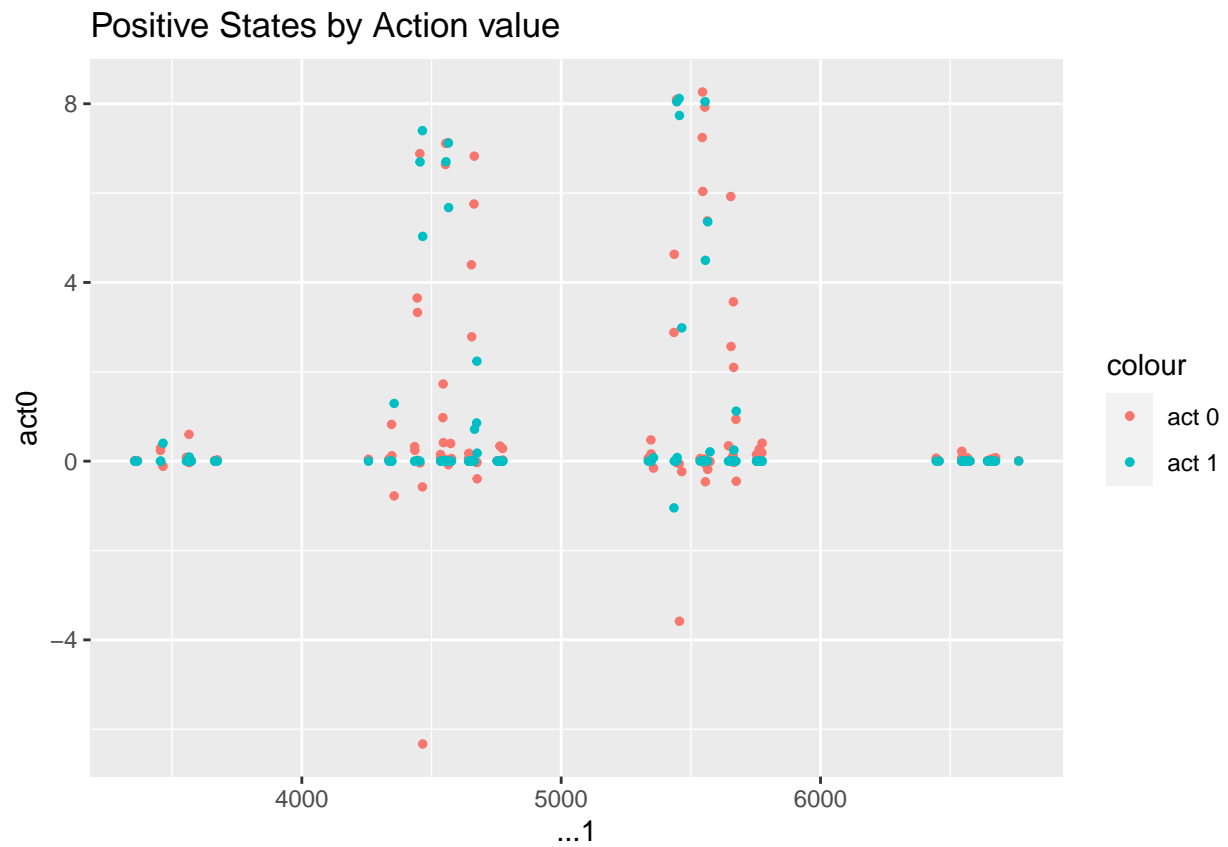
```r
ggplot(Q_table, aes(x=...1)) +
  geom_point(aes(y=act0, colour="act 0")) +
  geom_point(aes(y=act1, colour="act 1")) +
  labs(title="All States by action value")
```

All States by action value


```
ggplot(updated_states,aes(x=...1)) +
  geom_point(aes(y=act0, colour="act 0"), size=1) +
  geom_point(aes(y=act1, colour="act 1"), size=1) +
  labs(title="Updated States by Action value")
```
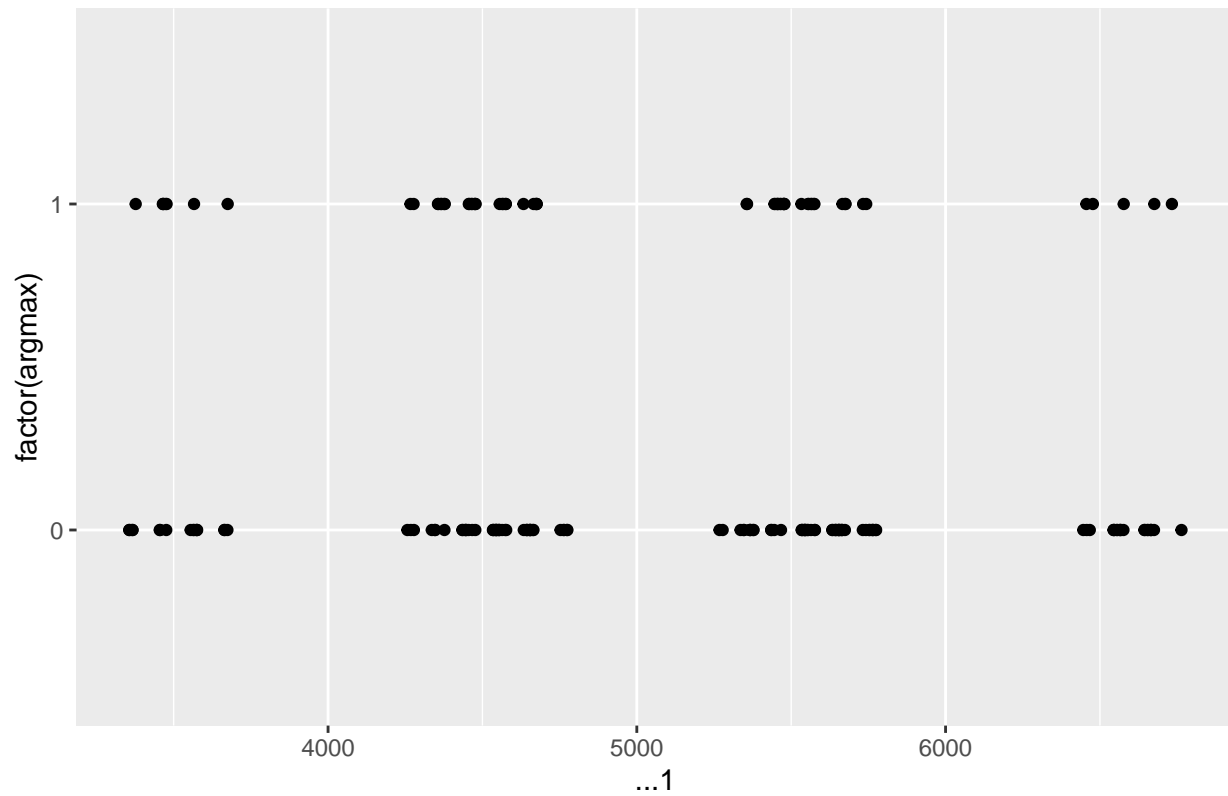
Updated States by Action value

```
ggplot(pos_states,aes(x=...1)) +
  geom_point(aes(y=act0, colour="act 0"), size=1) +
  geom_point(aes(y=act1, colour="act 1"), size=1) +
  labs(title="Positive States by Action value")
```

Positive States by Action value

```r
ggplot(updated_states, aes(x=...1, y=factor(argmax)) ) +
  geom_point() + labs(title="Updated States by Best Action")
```

Updated States by Best Action


```
ggplot(pos_states, aes(x=...1, y=factor(argmax)) ) +
  geom_point() + labs(title="Positive States by Best Action")
```

Positive States by Best Action


```
hist(pos_states$act0) # xlim = c(0,200))
```

Histogram of pos_states$act0

```
hist(pos_states$act1)
```

Histogram of pos_states$act1