

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
```

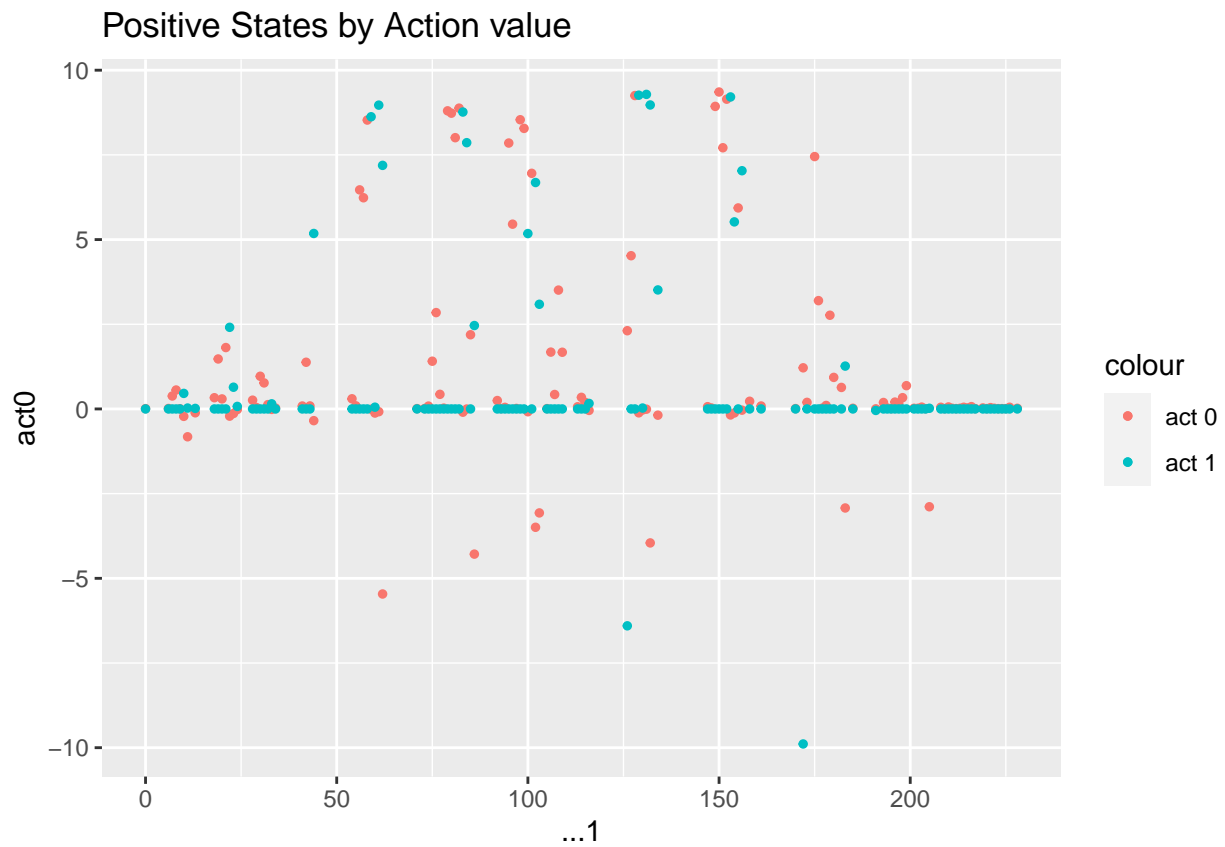
```
sd(binQ_table$act0)
```

```
## [1] 29.44632
```

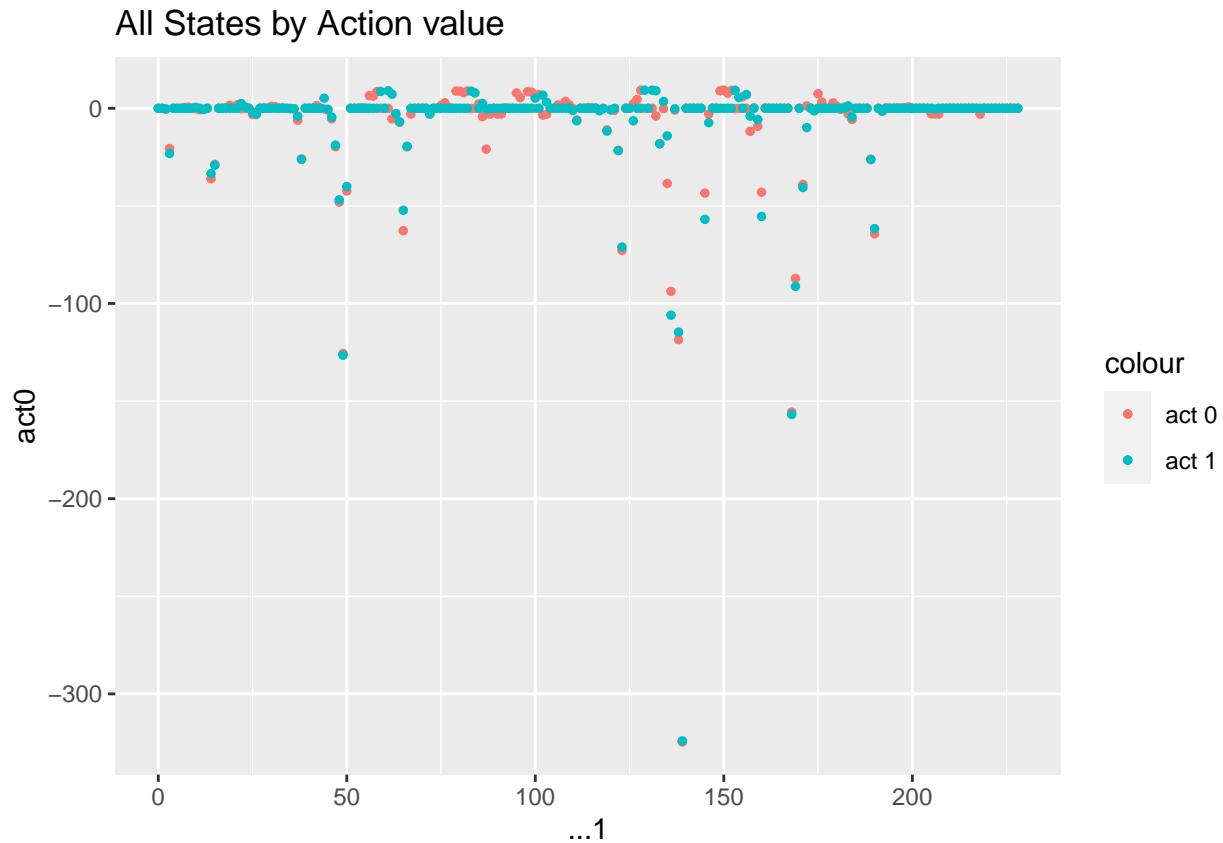
```
sd(binQ_table$act1)
```

```
## [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")
```



```
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")
```



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

```
## 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
```

```
#plot(qStats$timestep, factor(qStats$state))
```

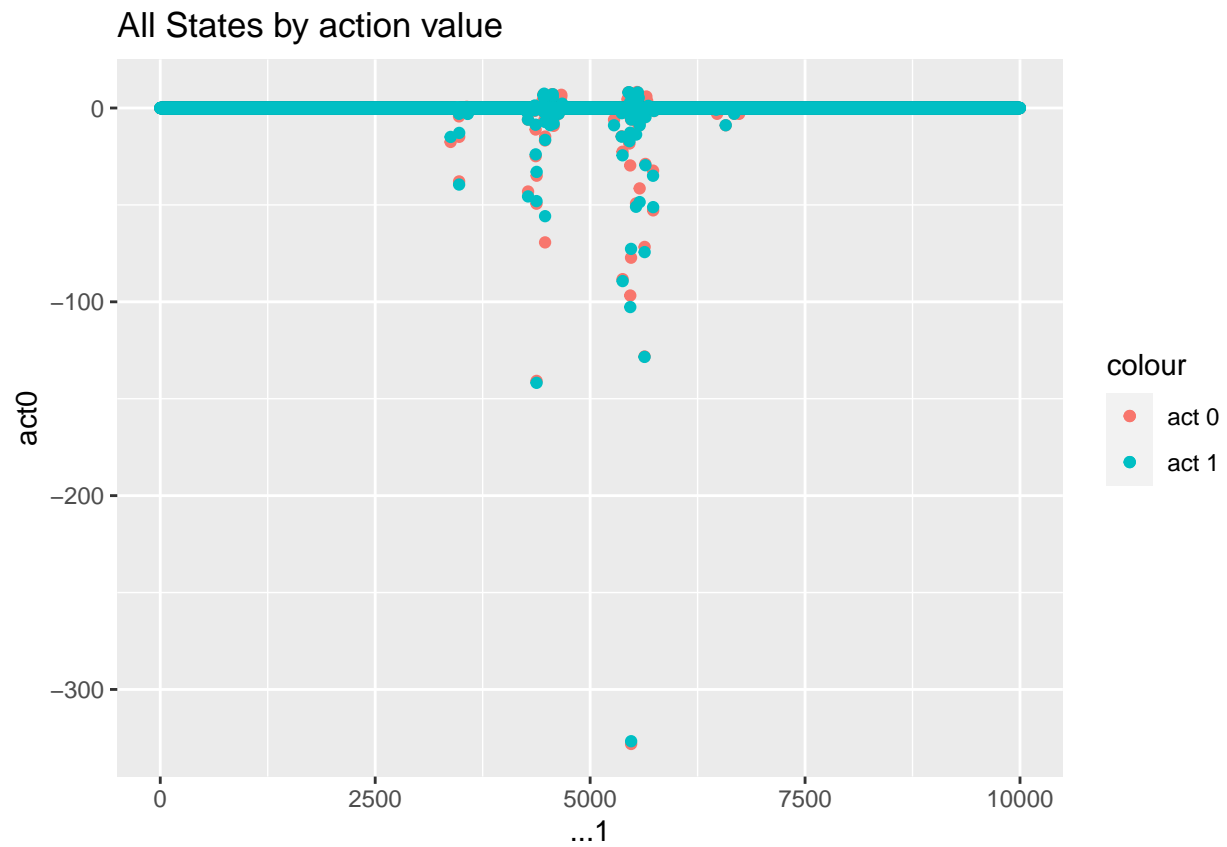
```
updated_states = Q_table %>% filter(act0 != 0 | act1 != 0)
updated_states = as.data.frame(updated_states)
summary(updated_states)
```

```
##      ...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
```

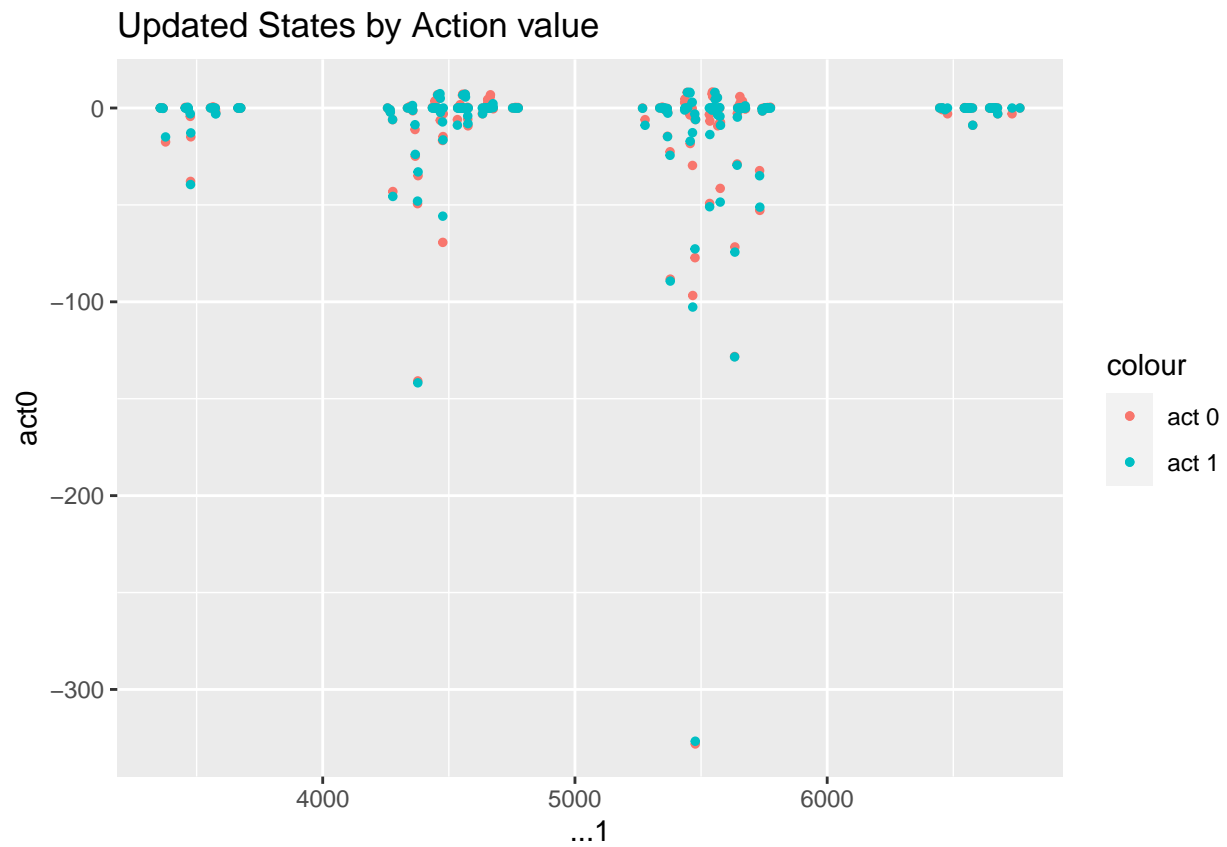
```
pos_states = Q_table %>% filter(act0 > 0 | act1 > 0)
summary(pos_states)
```

```
##      ...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
```

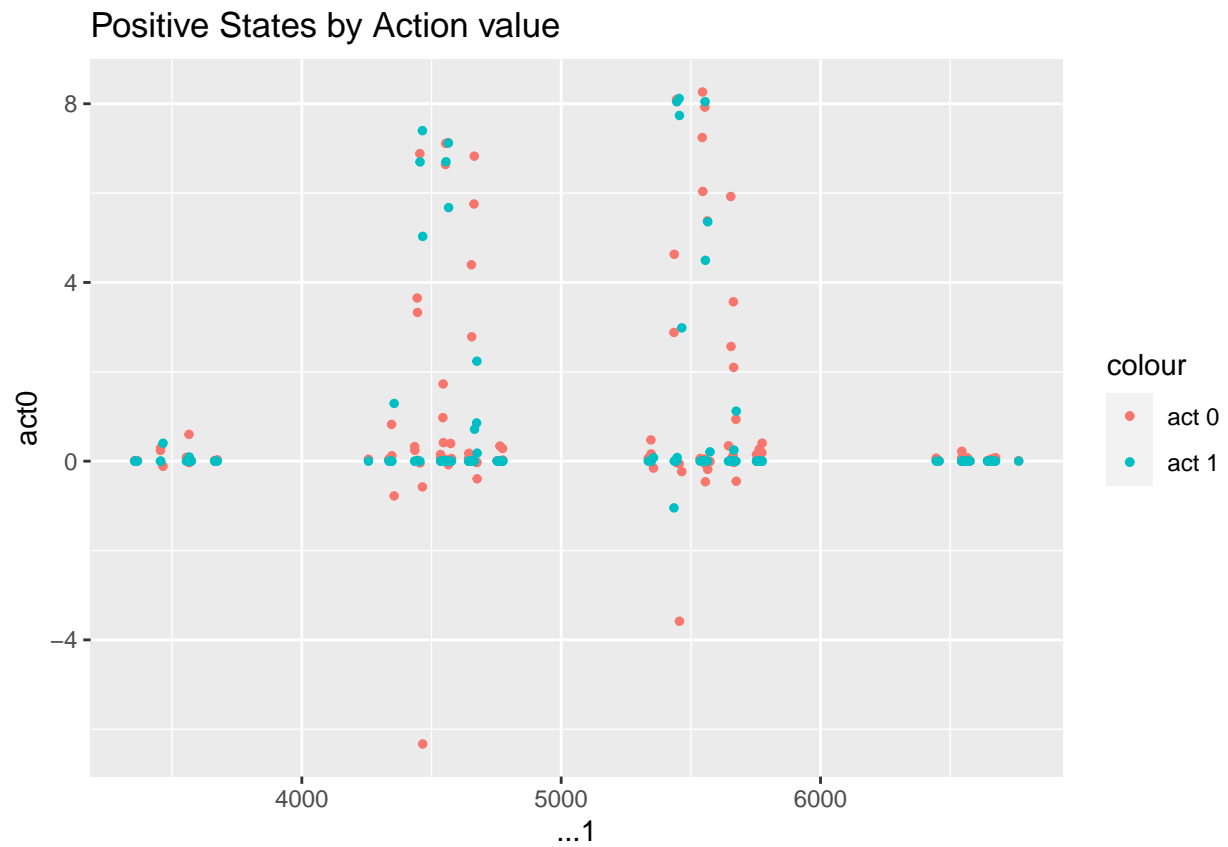
```
ggplot(Q_table, aes(x=...1)) +
  geom_point(aes(y=act0, colour="act 0")) +
  geom_point(aes(y=act1, colour="act 1")) +
  labs(title="All States by action value")
```



```
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")
```

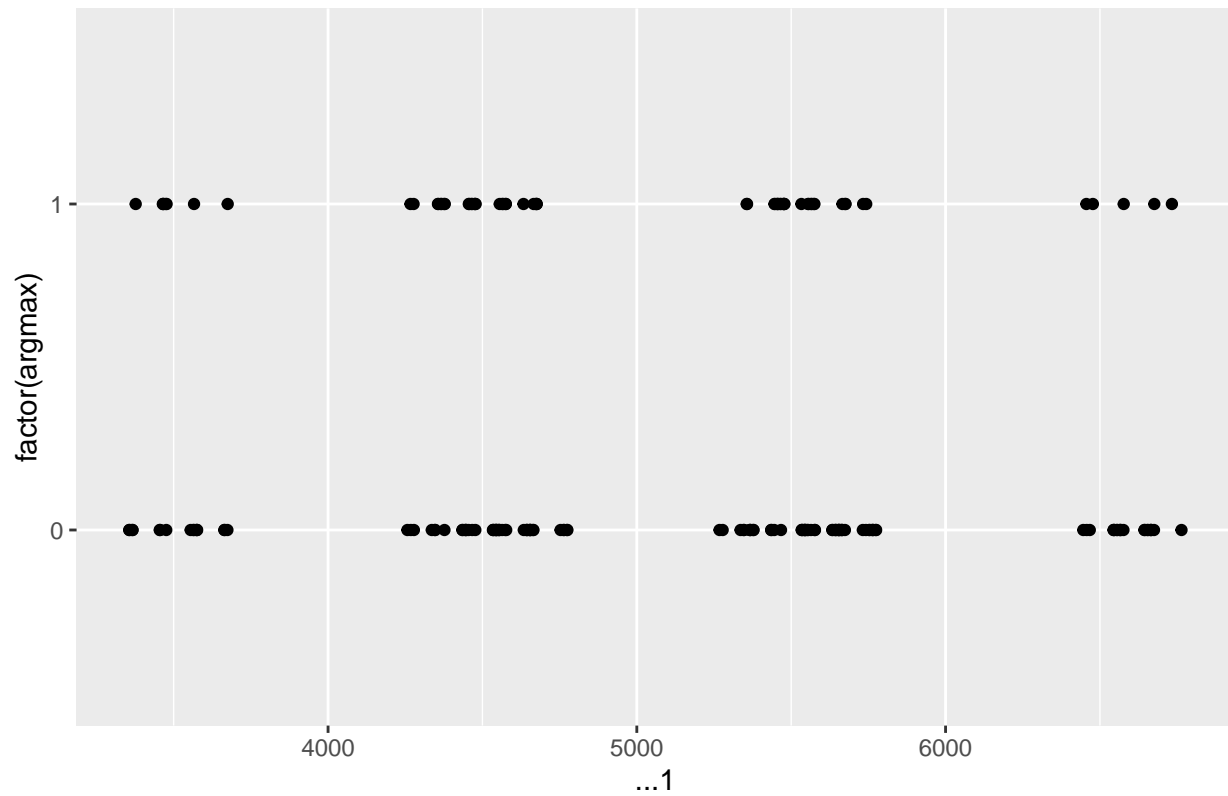


```
ggplot(pos_states,aes(x=...1)) +  
  geom_point(aes(y=act0, colour="act 0"), size=1) +  
  geom_point(aes(y=act1, colour="act 1"), size=1) +  
  labs(title="Positive States by Action value")
```



```
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")
```

The scatter plot displays the relationship between the number of non-zero elements in the first matrix (x-axis) and the number of non-zero elements in the product matrix (y-axis). The x-axis ranges from approximately 3500 to 7000, with major ticks at 4000, 5000, and 6000. The y-axis ranges from 0 to 3, with major ticks at 1, 2, and 3. There are two distinct horizontal clusters of data points: one at y=1 and another at y=2. The y=1 cluster consists of approximately 25 points, and the y=2 cluster consists of approximately 25 points. The points are distributed across the x-axis range, showing that the number of non-zero elements in the product matrix is independent of the number of non-zero elements in the first matrix.

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

A histogram showing the frequency distribution of the variable `pos_states$sact0`. The x-axis is labeled `pos_states$sact0` and ranges from approximately -7 to 10, with major ticks at -5, 0, 5, and 10. The y-axis is labeled `Frequency` and ranges from 0 to 60, with major ticks at 0, 20, 40, and 60. The distribution is unimodal and slightly right-skewed, with the highest frequency (approximately 70) occurring in the bin centered around 1. Other notable frequencies include approximately 23 for the bin centered around -1, and approximately 8 for the bins centered around 3 and 6.

Bin Range	Frequency
-7 to -6	1
-6 to -5	0
-5 to -4	0
-4 to -3	1
-3 to -2	0
-2 to -1	23
-1 to 0	23
0 to 1	70
1 to 2	70
2 to 3	7
3 to 4	5
4 to 5	5
5 to 6	8
6 to 7	8
7 to 8	1
8 to 9	0
9 to 10	2

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

Histogram of pos_states\$act1

