Plot_Proportion_Studies_0510

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read data

```
num_greedy_05_m30_pr2_11<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_R
num_patient_05_m30_pr2_11<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_
num_greedy_05_m30_pr2_12<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_R
num_patient_05_m30_pr2_12<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_
num_greedy_05_m30_pr2_13<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_R
num_patient_05_m30_pr2_13<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_
num_greedy_05_m30_pr2_14<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_R
num_patient_05_m30_pr2_14<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_
num_greedy_05_m50_pr2_11<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_R
num_patient_05_m50_pr2_11<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_
num_greedy_05_m50_pr2_12<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_R
num_patient_05_m50_pr2_12<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_
num_greedy_05_m50_pr2_13<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_R
num_patient_05_m50_pr2_13<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_
num_greedy_05_m50_pr2_14<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_R
num_patient_05_m50_pr2_14<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_
num_greedy_05_m70_pr2_11<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_R
num_patient_05_m70_pr2_11<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_
num_greedy_05_m70_pr2_12<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_R
num_patient_05_m70_pr2_12<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_
num_greedy_05_m70_pr2_13<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_R
num_patient_05_m70_pr2_13<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_
```

num_greedy_05_m70_pr2_14<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_R

```
num_greedy_05_m100_pr2_11<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_l
num_greedy_05_m100_pr2_11<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_l
num_patient_05_m100_pr2_11<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_
num_greedy_05_m100_pr2_12<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_
num_patient_05_m100_pr2_12<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_
num_greedy_05_m100_pr2_13<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_
num_patient_05_m100_pr2_13<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_
num_greedy_05_m100_pr2_14<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_
num_patient_05_m100_pr2_14<-read_excel("~/Desktop/Matching Market/Simulation/Simulation_0510/Simulation_0510/Simulation_0510/Simulation_0510/Simulation_0510/Simulation_0510/Simulation_0510/Simulation_0510/Simulation_0510/Simulation_0510/Simulation_0510/Simulation_
```

Part 1 - plot the loss

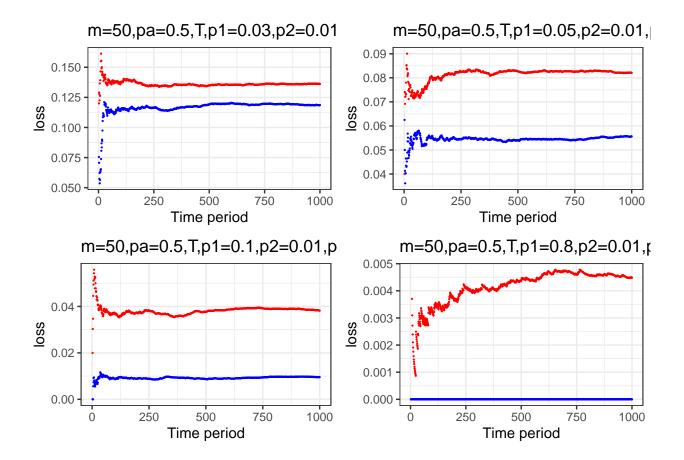
Market size m = 30

```
T=1000
p1 \leftarrow gplot(data = NULL, aes(x = c(1:T), y = loss)) +
 geom_point(data=num_greedy_05_m30_pr2_11,col="red",size=0.1) +
 geom_point(data=num_patient_05_m30_pr2_11,col="blue",size=0.1) +
 ylim(0.15, 0.25) +
 xlab("Time period")+
 labs(title = m=30, pa=0.5, T, p1=0.03, p2=0.01, pr=2) +
 theme bw()
#-----
p2 < -ggplot(data = NULL, aes(x = c(1:T), y = loss)) +
 geom_point(data=num_greedy_05_m30_pr2_12,col="red",size=0.1) +
 geom_point(data=num_patient_05_m30_pr2_12,col="blue",size=0.1) +
 xlab("Time period")+
 #ylim(-0.01, 0.01) +
 labs(title = m=30, pa=0.5, T, p1=0.05, p2=0.01, pr=2) +
#-----
p3 < -ggplot(data = NULL, aes(x = c(1:T), y = loss)) +
 geom_point(data=num_greedy_05_m30_pr2_13,col="red",size=0.1) +
 geom_point(data=num_patient_05_m30_pr2_13,col="blue",size=0.1) +
 #ylim(-0.01, 0.01) +
 xlab("Time period")+
 labs(title = m=30,pa=0.5,T,p1=0.1,p2=0.01,pr=2) +
 theme_bw()
p4 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = loss)) +
 geom_point(data=num_greedy_05_m30_pr2_14,col="red",size=0.1) +
```

```
geom_point(data=num_patient_05_m30_pr2_14,col="blue",size=0.1) +
  #ylim(-0.01, 0.01) +
  xlab("Time period")+
  labs(title = m=30, pa=0.5, T, p1=0.8, p2=0.01, pr=2) +
  theme_bw()
grid.arrange(p1,p2,p3,p4,nrow=2,ncol=2)
## Warning: Removed 3 rows containing missing values (`geom_point()`).
## Removed 3 rows containing missing values (`geom_point()`).
## Warning: Removed 1 rows containing missing values (`geom_point()`).
## Removed 1 rows containing missing values (`geom_point()`).
                                                     m=30,pa=0.5,T,p1=0.05,p2=0.01,
        m=30,pa=0.5,T,p1=0.03,p2=0.01
   0.250
                                                0.15
   0.225
S 0.200
                                              S0.10
                                                0.05
   0.175
                                                0.00
   0.150
                250
                        500
                                 750
                                        1000
                                                             250
                                                                      500
                                                                              750
                                                                                      1000
                    Time period
                                                                 Time period
       m=30,pa=0.5,T,p1=0.1,p2=0.01,p
                                                      m=30,pa=0.5,T,p1=0.8,p2=0.01,r
   80.0
   0.06
                                                0.010
SSO 0.04
                                                0.005
   0.02
   0.00
                                                 0.000
               250
                        500
                                750
                                                              250
                                                                      500
                                        1000
                                                                              750
                                                                                      1000
                    Time period
                                                                  Time period
```

Market size m = 50

```
#ylim(0.15,0.25)+
  xlab("Time period")+
  labs(title = m=50,pa=0.5,T,p1=0.03,p2=0.01,pr=2) +
  theme bw()
#-----
p2 < -ggplot(data = NULL, aes(x = c(1:T), y = loss)) +
  geom point(data=num greedy 05 m50 pr2 12,col="red",size=0.1) +
  geom_point(data=num_patient_05_m50_pr2_12,col="blue",size=0.1) +
  xlab("Time period")+
  #ylim(-0.01, 0.01) +
  labs(title = m=50, pa=0.5, T, p1=0.05, p2=0.01, pr=2) +
  theme bw()
p3 < -ggplot(data = NULL, aes(x = c(1:T), y = loss)) +
  geom_point(data=num_greedy_05_m50_pr2_13,col="red",size=0.1) +
  geom_point(data=num_patient_05_m50_pr2_13,col="blue",size=0.1) +
  #ylim(-0.01, 0.01) +
  xlab("Time period")+
  labs(title = m=50, pa=0.5, T, p1=0.1, p2=0.01, pr=2) +
  theme_bw()
#-----
p4 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = loss)) +
  geom_point(data=num_greedy_05_m50_pr2_14,col="red",size=0.1) +
  geom_point(data=num_patient_05_m50_pr2_14,col="blue",size=0.1) +
  #ylim(-0.01, 0.01) +
  xlab("Time period")+
  labs(title = m=50, pa=0.5, T, p1=0.8, p2=0.01, pr=2) +
  theme_bw()
grid.arrange(p1,p2,p3,p4,nrow=2,ncol=2)
## Warning: Removed 1 rows containing missing values (`geom_point()`).
## Removed 1 rows containing missing values (`geom_point()`).
```

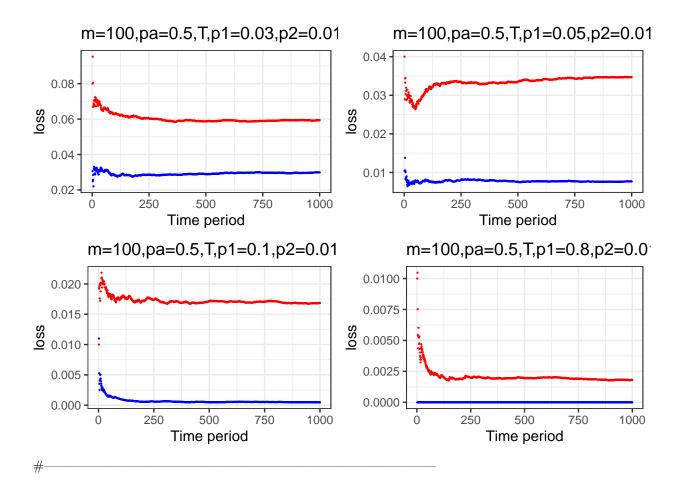


Market size m = 70

```
T=1000
p1 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = loss)) +
  geom_point(data=num_greedy_05_m70_pr2_11,col="red",size=0.1) +
  geom_point(data=num_patient_05_m70_pr2_11,col="blue",size=0.1) +
  #ylim(0.15, 0.25) +
  xlab("Time period")+
  labs(title = m=70,pa=0.5,T,p1=0.03,p2=0.01,pr=2) +
  theme_bw()
p2 < -ggplot(data = NULL, aes(x = c(1:T), y = loss)) +
  geom_point(data=num_greedy_05_m70_pr2_12,col="red",size=0.1) +
  geom_point(data=num_patient_05_m70_pr2_12,col="blue",size=0.1) +
  xlab("Time period")+
  #ylim(-0.01, 0.01) +
  labs(title = m=70, pa=0.5, T, p1=0.05, p2=0.01, pr=2) +
  theme_bw()
p3 < -ggplot(data = NULL, aes(x = c(1:T), y = loss)) +
  geom_point(data=num_greedy_05_m70_pr2_13,col="red",size=0.1) +
```

```
geom_point(data=num_patient_05_m70_pr2_13,col="blue",size=0.1) +
  #ylim(-0.01, 0.01) +
  xlab("Time period")+
  labs(title = m=70, pa=0.5, T, p1=0.1, p2=0.01, pr=2) +
  theme_bw()
p4 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = loss)) +
  geom_point(data=num_greedy_05_m70_pr2_14,col="red",size=0.1) +
  geom_point(data=num_patient_05_m70_pr2_14,col="blue",size=0.1) +
  #ylim(-0.01, 0.01) +
  xlab("Time period")+
  labs(title = m=70, pa=0.5, T, p1=0.8, p2=0.01, pr=2) +
  theme_bw()
grid.arrange(p1,p2,p3,p4,nrow=2,ncol=2)
## Warning: Removed 1 rows containing missing values (`geom_point()`).
## Removed 1 rows containing missing values (`geom_point()`).
                                                       m=70,pa=0.5,T,p1=0.05,p2=0.01
        m=70,pa=0.5,T,p1=0.03,p2=0.01
                                                 0.100 -
  0.100
                                                 0.075
  0.075
<u>8</u> 0.050
                                              <u>8</u> 0.050
  0.025
                                                 0.025
                 250
                         500
                                                               250
                                                                        500
                                 750
                                         1000
                                                                                750
                                                                                        1000
                    Time period
                                                                   Time period
       m=70,pa=0.5,T,p1=0.1,p2=0.01,p
                                                       m=70,pa=0.5,T,p1=0.8,p2=0.01,r
  0.06
                                                 0.003
  0.04
                                                 0.002
  0.02
                                                 0.001
  0.00
                                                 0.000
                250
                        500
                                 750
                                         1000
                                                               250
                                                                        500
                                                                                750
                                                                                        1000
                    Time period
                                                                   Time period
```

```
T=1000
p1 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = loss)) +
 geom_point(data=num_greedy_05_m100_pr2_11,col="red",size=0.1) +
 geom_point(data=num_patient_05_m100_pr2_11,col="blue",size=0.1) +
 #ylim(0.15, 0.25) +
 xlab("Time period")+
 labs(title = m=100, pa=0.5, T, p1=0.03, p2=0.01, pr=2) +
 theme bw()
#-----
p2 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = loss)) +
 geom point(data=num greedy 05 m100 pr2 12,col="red",size=0.1) +
 geom_point(data=num_patient_05_m100_pr2_12,col="blue",size=0.1) +
 xlab("Time period")+
 #ylim(-0.01, 0.01) +
 labs(title = m=100, pa=0.5, T, p1=0.05, p2=0.01, pr=2) +
 theme_bw()
#-----
p3 < -ggplot(data = NULL, aes(x = c(1:T), y = loss)) +
 geom_point(data=num_greedy_05_m100_pr2_13,col="red",size=0.1) +
 geom_point(data=num_patient_05_m100_pr2_13,col="blue",size=0.1) +
 #ylim(-0.01, 0.01) +
 xlab("Time period")+
 labs(title = m=100, pa=0.5, T, p1=0.1, p2=0.01, pr=2) +
 theme bw()
#-----
p4 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = loss)) +
 geom_point(data=num_greedy_05_m100_pr2_14,col="red",size=0.1) +
 geom_point(data=num_patient_05_m100_pr2_14,col="blue",size=0.1) +
 #ylim(-0.01, 0.01) +
 xlab("Time period")+
 labs(title = m=100, pa=0.5, T, p1=0.8, p2=0.01, pr=2) +
 theme_bw()
grid.arrange(p1,p2,p3,p4,nrow=2,ncol=2)
## Warning: Removed 1 rows containing missing values (`geom_point()`).
## Removed 1 rows containing missing values (`geom point()`).
```



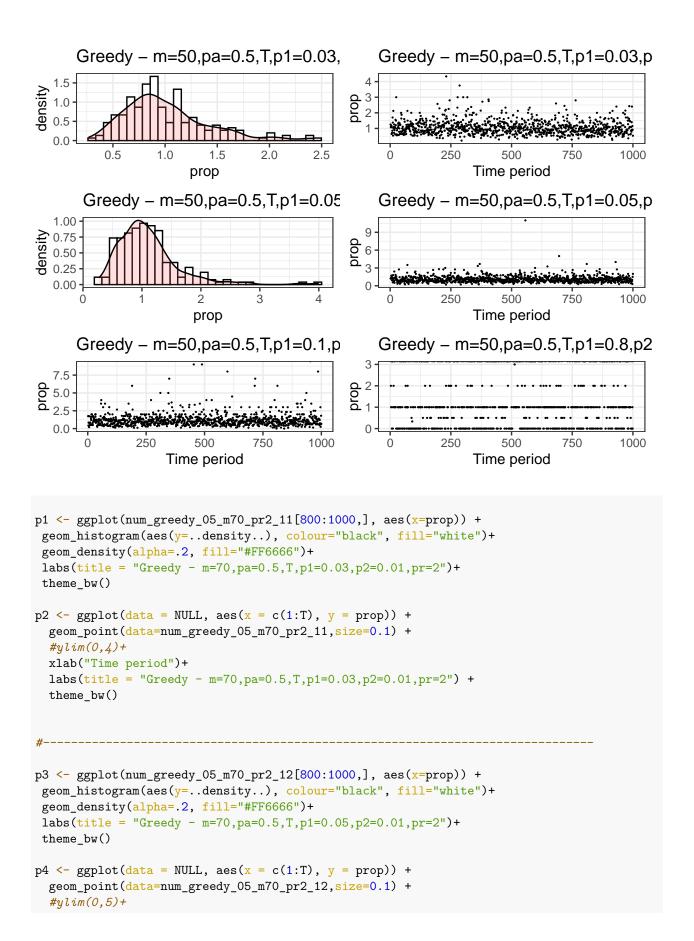
Part 2 - plot the distribution of proportion

2.1 Greedy algorithm plot

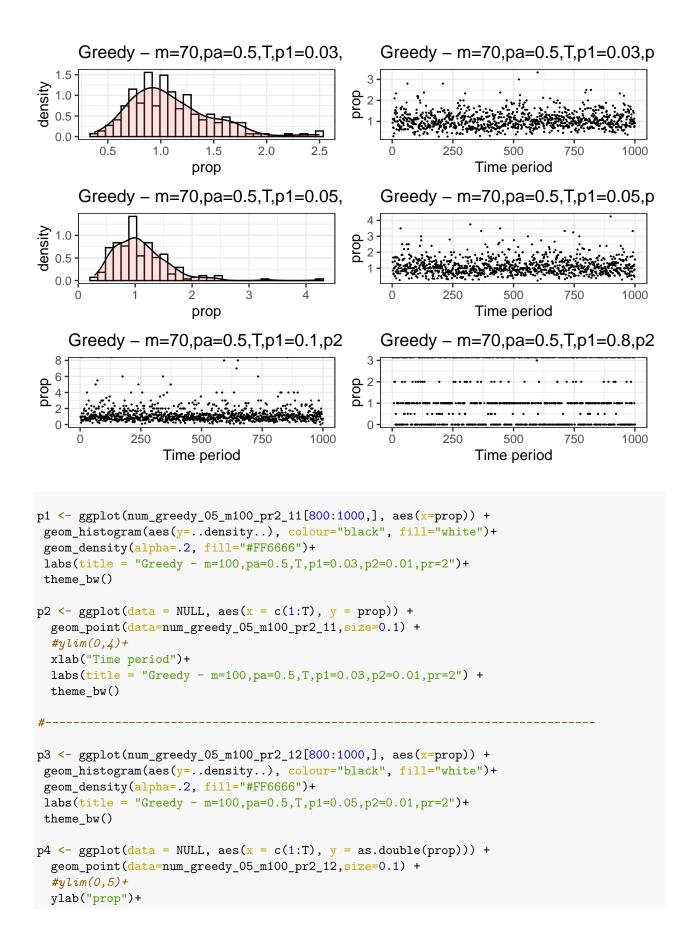
```
labs(title = "Greedy - m=30,pa=0.5,T,p1=0.05,p2=0.01,pr=2")+
 theme_bw()
p4 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = prop)) +
  geom_point(data=num_greedy_05_m30_pr2_12,size=0.1) +
  ylim(0,5)+
 xlab("Time period")+
 labs(title = "Greedy - m=30, pa=0.5, T, p1=0.05, p2=0.01, pr=2") +
  theme bw()
p5 <- ggplot(num_greedy_05_m30_pr2_13[800:1000,], aes(x=prop)) +
geom_histogram(aes(y=..density..), colour="black", fill="white")+
geom_density(alpha=.2, fill="#FF6666")+
labs(title = "Greedy - m=30,pa=0.5,T,p1=0.1,p2=0.01,pr=2")+
theme_bw()
p6 <- ggplot(\frac{data}{data} = NULL, aes(x = c(1:T), y = as.double(prop))) +
  geom_point(data=num_greedy_05_m30_pr2_13,size=0.1) +
  xlab("Time period")+
 ylab("prop")+
  ylim(0,6)+
  labs(title = "Greedy - m=30, pa=0.5, T, p1=0.1, p2=0.01, pr=2") +
  theme bw()
p7 <- ggplot(num_greedy_05_m30_pr2_14[800:1000,], aes(x=prop)) +
 geom_histogram(aes(y=..density..), colour="black", fill="white")+
geom_density(alpha=.2, fill="#FF6666")+
labs(title = "Greedy - m=30,pa=0.5,T,p1=0.8,p2=0.01,pr=2")+
theme_bw()
p8 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = prop)) +
  geom_point(data=num_greedy_05_m30_pr2_14,size=0.1) +
  xlab("Time period")+
  labs(title = "Greedy - m=30, pa=0.5, T, p1=0.8, p2=0.01, pr=2") +
 theme_bw()
grid.arrange(p1,p2,p3,p4,p6,p8,nrow=3,ncol=2)
2.1.1 market size m = 30
## Warning: The dot-dot notation (`..density..`) was deprecated in ggplot2 3.4.0.
## i Please use `after_stat(density)` instead.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 2 rows containing missing values (`geom_point()`).
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
## Warning: Removed 5 rows containing missing values (`geom_point()`).
## Warning: Removed 4 rows containing missing values (`geom_point()`).
      Greedy - m=30,pa=0.5,T,p1=0.03,
                                                   Greedy - m=30,pa=0.5,T,p1=0.03,p
  1.5
density
0.5
                                               brop 3
  0.0
                                                            250
                                                                     500
                                                                               750
                                                                                       1000
                                                                 Time period
                       prop
       Greedy - m=30,pa=0.5,T,p1=0.05
                                                   Greedy - m=30,pa=0.5,T,p1=0.05,p
  1.00
  0.75
                                               prop
  0.50
  0.25
  0.00
                                                            250
                                                                     500
                                                                               750
                                                                                       1000
                       prop
                                                                 Time period
    Greedy - m=30,pa=0.5,T,p1=0.1,p2
                                                     Greedy - m=30,pa=0.5,T,p1=0.8,p
                                                 Inf
2
\frac{\text{doud}}{2}
                                               prop
      0
              250
                       500
                                750
                                         1000
                                                             250
                                                                      500
                                                                               750
                                                                                       1000
                  Time period
                                                                  Time period
p1 <- ggplot(num_greedy_05_m50_pr2_11[800:1000,], aes(x=prop)) +
 geom_histogram(aes(y=..density..), colour="black", fill="white")+
 geom density(alpha=.2, fill="#FF6666")+
 labs(title = "Greedy - m=50,pa=0.5,T,p1=0.03,p2=0.01,pr=2")+
 theme_bw()
p2 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = prop)) +
  geom_point(data=num_greedy_05_m50_pr2_11,size=0.1) +
  #ylim(0,4)+
  xlab("Time period")+
  labs(title = "Greedy - m=50, pa=0.5, T, p1=0.03, p2=0.01, pr=2") +
  theme_bw()
p3 <- ggplot(num_greedy_05_m50_pr2_12[800:1000,], aes(x=prop)) +
 geom_histogram(aes(y=..density..), colour="black", fill="white")+
 geom_density(alpha=.2, fill="#FF6666")+
 labs(title = "Greedy - m=50, pa=0.5, T, p1=0.05, p2=0.01, pr=2")+
 theme_bw()
```

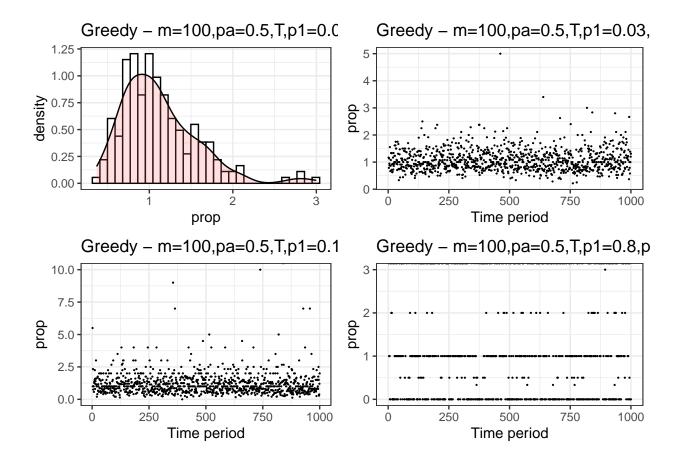
```
p4 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = prop)) +
  geom_point(data=num_greedy_05_m50_pr2_12,size=0.1) +
  #ylim(0,5)+
  xlab("Time period")+
  labs(title = "Greedy - m=50, pa=0.5, T, p1=0.05, p2=0.01, pr=2") +
  theme bw()
p5 <- ggplot(num_greedy_05_m50_pr2_13[800:1000,], aes(x=prop)) +
geom_histogram(aes(y=..density..), colour="black", fill="white")+
 geom_density(alpha=.2, fill="#FF6666")+
 labs(title = "Greedy - m=50,pa=0.5,T,p1=0.1,p2=0.01,pr=2")+
theme_bw()
p6 <- ggplot(data = NULL, aes(x = c(1:T), y = as.double(prop))) +
  geom_point(data=num_greedy_05_m50_pr2_13,size=0.1) +
  xlab("Time period")+
  ylab("prop")+
  labs(title = "Greedy - m=50, pa=0.5, T, p1=0.1, p2=0.01, pr=2") +
  theme_bw()
p7 <- ggplot(num_greedy_05_m50_pr2_14[800:1000,], aes(x=prop)) +
geom_histogram(aes(y=..density..), colour="black", fill="white")+
 geom_density(alpha=.2, fill="#FF6666")+
labs(title = "Greedy - m=50,pa=0.5,T,p1=0.8,p2=0.01,pr=2")+
theme_bw()
p8 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = as.double(prop))) +
  geom_point(data=num_greedy_05_m50_pr2_14,size=0.1) +
  xlab("Time period")+
  ylab("prop")+
  labs(title = "Greedy - m=50, pa=0.5, T, p1=0.8, p2=0.01, pr=2") +
  theme_bw()
grid.arrange(p1,p2,p3,p4,p6,p8,nrow=3,ncol=2)
2.1.2 \text{ market size m} = 50
## `stat bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom_point()`).
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom_point()`).
## Removed 1 rows containing missing values (`geom_point()`).
## Warning: Removed 213 rows containing missing values (`geom_point()`).
```



```
xlab("Time period")+
  labs(title = "Greedy - m=70, pa=0.5, T, p1=0.05, p2=0.01, pr=2") +
  theme_bw()
p5 <- ggplot(num_greedy_05_m70_pr2_13[800:1000,], aes(x=prop)) +
geom histogram(aes(y=..density..), colour="black", fill="white")+
 geom_density(alpha=.2, fill="#FF6666")+
labs(title = "Greedy - m=70,pa=0.5,T,p1=0.1,p2=0.01,pr=2")+
theme_bw()
p6 <- ggplot(\frac{data}{data} = NULL, aes(x = c(1:T), y = as.double(prop))) +
  geom_point(data=num_greedy_05_m70_pr2_13,size=0.1) +
  ylab("prop")+
 xlab("Time period")+
  labs(title = "Greedy - m=70, pa=0.5, T, p1=0.1, p2=0.01, pr=2") +
  theme_bw()
p7 <- ggplot(num_greedy_05_m70_pr2_14[800:1000,], aes(x=prop)) +
geom_histogram(aes(y=..density..), colour="black", fill="white")+
geom_density(alpha=.2, fill="#FF6666")+
labs(title = "Greedy - m=70,pa=0.5,T,p1=0.8,p2=0.01,pr=2")+
theme_bw()
p8 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = as.double(prop))) +
  geom_point(data=num_greedy_05_m70_pr2_14,size=0.1) +
  xlab("Time period")+
  ylab("prop")+
  labs(title = "Greedy - m=70, pa=0.5, T, p1=0.8, p2=0.01, pr=2") +
  theme_bw()
grid.arrange(p1,p2,p3,p4,p6,p8,nrow=3,ncol=2)
2.1.3 market size m = 70
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom_point()`).
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom point()`).
## Removed 1 rows containing missing values (`geom_point()`).
## Warning: Removed 221 rows containing missing values (`geom_point()`).
```



```
xlab("Time period")+
  labs(title = "Greedy - m=100, pa=0.5, T, p1=0.05, p2=0.01, pr=2") +
  theme_bw()
p5 <- ggplot(num_greedy_05_m100_pr2_13[800:1000,], aes(x=prop)) +
geom histogram(aes(y=..density..), colour="black", fill="white")+
 geom density(alpha=.2, fill="#FF6666")+
labs(title = "Greedy - m=100,pa=0.5,T,p1=0.1,p2=0.01,pr=2")+
theme_bw()
p6 <- ggplot(data = NULL, aes(x = c(1:T), y = as.double(prop))) +
  geom_point(data=num_greedy_05_m100_pr2_13,size=0.1) +
  xlab("Time period")+
 ylab("prop")+
  labs(title = "Greedy - m=100, pa=0.5, T, p1=0.1, p2=0.01, pr=2") +
  theme_bw()
p7 <- ggplot(num_greedy_05_m100_pr2_14[800:1000,], aes(x=prop)) +
geom_histogram(aes(y=..density..), colour="black", fill="white")+
geom_density(alpha=.2, fill="#FF6666")+
labs(title = "Greedy - m=100,pa=0.5,T,p1=0.8,p2=0.01,pr=2")+
theme_bw()
p8 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = as.double(prop))) +
  geom_point(data=num_greedy_05_m100_pr2_14,size=0.1) +
  xlab("Time period")+
  ylab("prop")+
  labs(title = "Greedy - m=100, pa=0.5, T, p1=0.8, p2=0.01, pr=2") +
  theme_bw()
grid.arrange(p1,p2,p6,p8,nrow=2,ncol=2)
2.1.4 \text{ market size m} = 100
## `stat bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom_point()`).
## Removed 1 rows containing missing values (`geom_point()`).
## Warning: Removed 218 rows containing missing values (`geom_point()`).
```



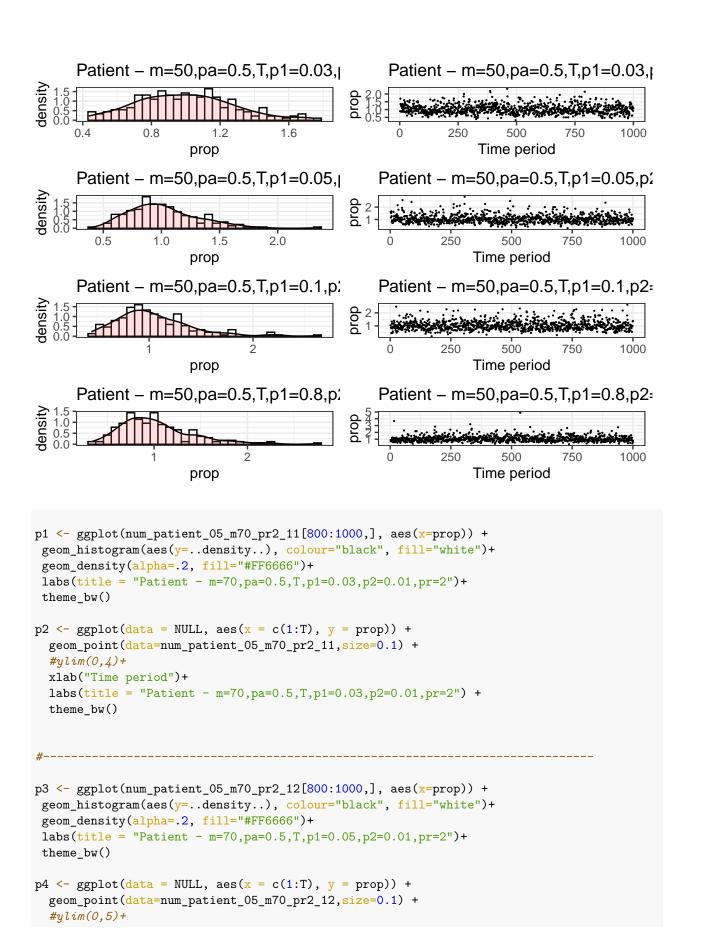
2.2 Patient algorithm plot

```
p1 <- ggplot(num_patient_05_m30_pr2_11[800:1000,], aes(x=prop)) +
geom_histogram(aes(y=..density..), colour="black", fill="white")+
geom_density(alpha=.2, fill="#FF6666")+
labs(title = "Patient - m=30,pa=0.5,T,p1=0.03,p2=0.01,pr=2")+
theme bw()
p2 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = prop)) +
  geom_point(data=num_patient_05_m30_pr2_11,size=0.1) +
  ylim(0,4)+
  xlab("Time period")+
  labs(title = "Patient - m=30,pa=0.5,T,p1=0.03,p2=0.01,pr=2") +
  theme_bw()
p3 <- ggplot(num_patient_05_m30_pr2_12[800:1000,], aes(x=prop)) +
geom_histogram(aes(y=..density..), colour="black", fill="white")+
geom_density(alpha=.2, fill="#FF6666")+
labs(title = "Patient - m=30,pa=0.5,T,p1=0.05,p2=0.01,pr=2")+
theme_bw()
p4 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = prop)) +
```

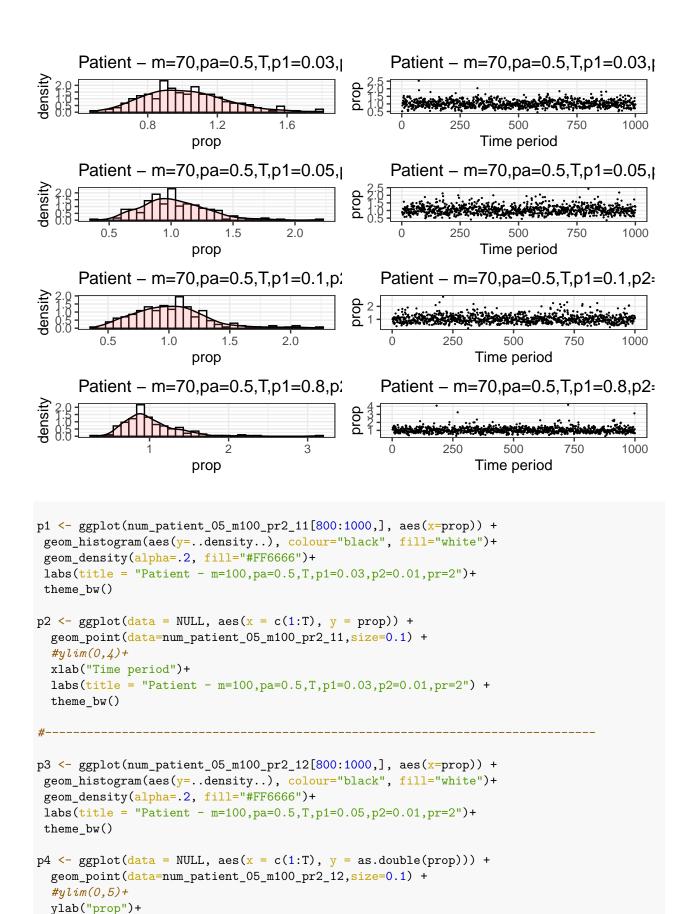
```
geom_point(data=num_patient_05_m30_pr2_12,size=0.1) +
  ylim(0,5)+
  xlab("Time period")+
  labs(title = "Patient - m=30,pa=0.5,T,p1=0.05,p2=0.01,pr=2") +
  theme_bw()
p5 <- ggplot(num_patient_05_m30_pr2_13[800:1000,], aes(x=prop)) +
geom_histogram(aes(y=..density..), colour="black", fill="white")+
geom_density(alpha=.2, fill="#FF6666")+
labs(title = "Patient - m=30,pa=0.5,T,p1=0.1,p2=0.01,pr=2")+
theme_bw()
p6 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = as.double(prop))) +
  geom_point(data=num_patient_05_m30_pr2_13,size=0.1) +
  xlab("Time period")+
  ylab("prop")+
  ylim(0,6)+
  labs(title = "Patient - m=30, pa=0.5, T, p1=0.1, p2=0.01, pr=2") +
  theme_bw()
p7 <- ggplot(num_patient_05_m30_pr2_14[800:1000,], aes(x=prop)) +
geom_histogram(aes(y=..density..), colour="black", fill="white")+
 geom_density(alpha=.2, fill="#FF6666")+
labs(title = "Patient - m=30,pa=0.5,T,p1=0.8,p2=0.01,pr=2")+
theme_bw()
p8 <- ggplot(\frac{data}{data} = NULL, aes(x = c(1:T), y = prop)) +
  geom_point(data=num_patient_05_m30_pr2_14,size=0.1) +
  xlab("Time period")+
  labs(title = "Patient - m=30,pa=0.5,T,p1=0.8,p2=0.01,pr=2") +
  theme_bw()
grid.arrange(p1,p2,p3,p4,p5,p6,p7,p8,nrow=4,ncol=2)
2.2.1 market size m = 30
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom_point()`).
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom_point()`).
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom_point()`).
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
## Warning: Removed 1 rows containing missing values (`geom_point()`).
      Patient – m=30,pa=0.5,T,p1=0.03,
                                                   Patient – m=30,pa=0.5,T,p1=0.03,p2
density
1.5
0.0
0.0
                  1.0
                                    2.0
                                                                      500
                                                                               750
                           1.5
                                                             250
                                                                                       1000
                                                                 Time period
                       prop
      Patient - m=30,pa=0.5,T,p1=0.05,i
                                                   Patient – m=30,pa=0.5,T,p1=0.05,p2
                                                                                       1000
                                                                 Time period
                       prop
      Patient - m=30,pa=0.5,T,p1=0.1,p2
                                                   Patient – m=30,pa=0.5,T,p1=0.1,p2=
density
0.0
0.0
                                               brop
645
                                                                                       1000
                                                             250
                       prop
                                                                 Time period
      Patient – m=30,pa=0.5,T,p1=0.8,p2
                                                   Patient – m=30,pa=0.5,T,p1=0.8,p2=
density
0.0
0.0
                                               prop
                                                            250
                                                                      500
                                                                               750
                                                                                       1000
                                                                 Time period
                       prop
p1 <- ggplot(num_patient_05_m50_pr2_11[800:1000,], aes(x=prop)) +
 geom_histogram(aes(y=..density..), colour="black", fill="white")+
 geom_density(alpha=.2, fill="#FF6666")+
 labs(title = "Patient - m=50,pa=0.5,T,p1=0.03,p2=0.01,pr=2")+
 theme_bw()
p2 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = prop)) +
  geom_point(data=num_patient_05_m50_pr2_11,size=0.1) +
  #ylim(0,4)+
  xlab("Time period")+
  labs(title = "Patient - m=50, pa=0.5, T, p1=0.03, p2=0.01, pr=2") +
  theme_bw()
p3 <- ggplot(num_patient_05_m50_pr2_12[800:1000,], aes(x=prop)) +
 geom_histogram(aes(y=..density..), colour="black", fill="white")+
 geom_density(alpha=.2, fill="#FF6666")+
 labs(title = "Patient - m=50,pa=0.5,T,p1=0.05,p2=0.01,pr=2")+
 theme bw()
p4 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = prop)) +
```

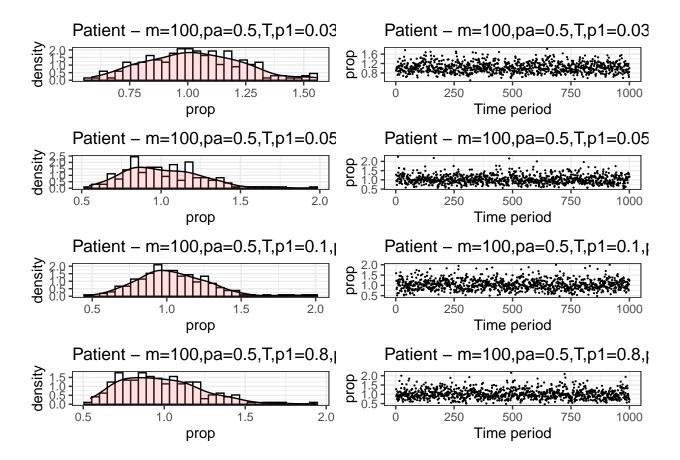
```
geom_point(data=num_patient_05_m50_pr2_12,size=0.1) +
  #ylim(0,5)+
  xlab("Time period")+
  labs(title = "Patient - m=50,pa=0.5,T,p1=0.05,p2=0.01,pr=2") +
  theme_bw()
p5 <- ggplot(num_patient_05_m50_pr2_13[800:1000,], aes(x=prop)) +
geom_histogram(aes(y=..density..), colour="black", fill="white")+
geom_density(alpha=.2, fill="#FF6666")+
labs(title = "Patient - m=50,pa=0.5,T,p1=0.1,p2=0.01,pr=2")+
theme_bw()
p6 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = as.double(prop))) +
  geom_point(data=num_patient_05_m50_pr2_13,size=0.1) +
  xlab("Time period")+
  ylab("prop")+
  labs(title = "Patient - m=50,pa=0.5,T,p1=0.1,p2=0.01,pr=2") +
  theme bw()
p7 <- ggplot(num_patient_05_m50_pr2_14[800:1000,], aes(x=prop)) +
geom_histogram(aes(y=..density..), colour="black", fill="white")+
 geom_density(alpha=.2, fill="#FF6666")+
labs(title = "Patient - m=50,pa=0.5,T,p1=0.8,p2=0.01,pr=2")+
theme_bw()
p8 <- ggplot(\frac{data}{data} = NULL, aes(x = c(1:T), y = as.double(prop))) +
  geom_point(data=num_patient_05_m50_pr2_14,size=0.1) +
  xlab("Time period")+
  ylab("prop")+
  labs(title = "Patient - m=50,pa=0.5,T,p1=0.8,p2=0.01,pr=2") +
  theme bw()
grid.arrange(p1,p2,p3,p4,p5,p6,p7,p8,nrow=4,ncol=2)
2.2.2 market size m = 50
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom_point()`).
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom_point()`).
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom_point()`).
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom_point()`).
```



```
xlab("Time period")+
  labs(title = "Patient - m=70,pa=0.5,T,p1=0.05,p2=0.01,pr=2") +
  theme_bw()
p5 <- ggplot(num_patient_05_m70_pr2_13[800:1000,], aes(x=prop)) +
geom histogram(aes(y=..density..), colour="black", fill="white")+
 geom_density(alpha=.2, fill="#FF6666")+
labs(title = "Patient - m=70,pa=0.5,T,p1=0.1,p2=0.01,pr=2")+
theme_bw()
p6 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = as.double(prop))) +
  geom_point(data=num_patient_05_m70_pr2_13,size=0.1) +
  ylab("prop")+
 xlab("Time period")+
  labs(title = "Patient - m=70,pa=0.5,T,p1=0.1,p2=0.01,pr=2") +
  theme_bw()
p7 <- ggplot(num_patient_05_m70_pr2_14[800:1000,], aes(x=prop)) +
geom_histogram(aes(y=..density..), colour="black", fill="white")+
geom_density(alpha=.2, fill="#FF6666")+
labs(title = "Patient - m=70,pa=0.5,T,p1=0.8,p2=0.01,pr=2")+
theme_bw()
p8 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = as.double(prop))) +
  geom_point(data=num_patient_05_m70_pr2_14,size=0.1) +
  xlab("Time period")+
  ylab("prop")+
  labs(title = "Patient - m=70,pa=0.5,T,p1=0.8,p2=0.01,pr=2") +
  theme_bw()
grid.arrange(p1,p2,p3,p4,p5,p6,p7,p8,nrow=4,ncol=2)
2.2.3 market size m = 70
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom_point()`).
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom point()`).
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom_point()`).
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom_point()`).
```



```
xlab("Time period")+
    labs(title = "Patient - m=100,pa=0.5,T,p1=0.05,p2=0.01,pr=2") +
    theme_bw()
p5 <- ggplot(num_patient_05_m100_pr2_13[800:1000,], aes(x=prop)) +
 geom histogram(aes(y=..density..), colour="black", fill="white")+
  geom_density(alpha=.2, fill="#FF6666")+
 labs(title = "Patient - m=100,pa=0.5,T,p1=0.1,p2=0.01,pr=2")+
 theme_bw()
p6 <- ggplot(\frac{data}{data} = NULL, \frac{data}{data} = nucleone = 
    geom_point(data=num_patient_05_m100_pr2_13,size=0.1) +
    xlab("Time period")+
    ylab("prop")+
    labs(title = "Patient - m=100,pa=0.5,T,p1=0.1,p2=0.01,pr=2") +
    theme_bw()
p7 <- ggplot(num_patient_05_m100_pr2_14[800:1000,], aes(x=prop)) +
 geom_histogram(aes(y=..density..), colour="black", fill="white")+
 geom_density(alpha=.2, fill="#FF6666")+
 labs(title = "Patient - m=100,pa=0.5,T,p1=0.8,p2=0.01,pr=2")+
 theme_bw()
p8 \leftarrow ggplot(data = NULL, aes(x = c(1:T), y = as.double(prop))) +
    geom_point(data=num_patient_05_m100_pr2_14,size=0.1) +
    xlab("Time period")+
    ylab("prop")+
    labs(title = "Patient - m=100,pa=0.5,T,p1=0.8,p2=0.01,pr=2") +
    theme_bw()
grid.arrange(p1,p2,p3,p4,p5,p6,p7,p8,nrow=4,ncol=2)
2.2.4 market size m = 100
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom_point()`).
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom point()`).
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom_point()`).
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## Warning: Removed 1 rows containing missing values (`geom_point()`).
```



Findings

- According to the plot of proportion of v_A to v_B, most of the distribution of proportion are all right-skewed distribution. In Patient algorithm, the density plots of proportion are all right-skewed distribution; while in Greedy algorithm, some of the density plot of the proportion could not be plotted due to many inf and 0 values, which indicates that one type agents would often vanish (become zero) under steady state. At this time, the dotplot of proportion would be shown as several horizontal lines, which means the value of proportion is among several fixed values. This case happens only when either compatible probability is rather large or newly coming agents arrive in the market in a higher rate.
- Based on these observations, we assume that the distribution of proportion is gamma distribution ${}^{\sim}\Gamma(\alpha,\beta)$.