

Assignment 2 Part 1 Support

(MIPS exercise 20.9) Let $X_1, \dots, X_n \stackrel{iid}{\sim} \text{Bernoulli}(p)$ and consider two estimators for p :

$$T_1 = \bar{X}, T_2 = \min(X_1, \dots, X_n)$$

The MSE for each estimator are

$$\text{MSE}(T_1) = p(1-p)/n, \text{MSE}(T_2) = p^n - 2p^{n+1} + p^2$$

Let's plot these as a function of p , for different values of n .

```
# Define a function for both
MSE_T1 <- function(p,n) p*(1-p)/n
MSE_T2 <- function(p,n) p^n - 2*p^(n+1) + p^2

# Write a function to make the plot of p for fixed n
make_plot <- function(n) {
  tibble(x = c(0,1)) %>%
    ggplot(aes(x = x)) +
    theme_bw() +
    stat_function(fun = MSE_T1,args = list(n = n)) +
    stat_function(fun = MSE_T2,args = list(n = n),linetype = 'dashed') +
    labs(title = paste0("MSE for n = ",n),
         subtitle = "T1 (Solid) vs T2 (Dashed)",
         x = "p",
         y = "MSE"
    )
}

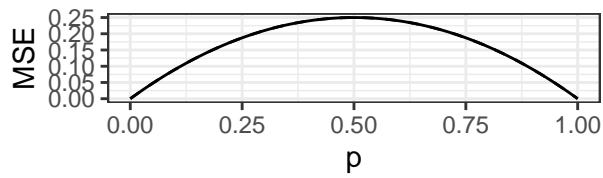
library(patchwork)
```

```
## Warning: package 'patchwork' was built under R version 4.0.3
```

```
(make_plot(1) | make_plot(5)) /
(make_plot(10) | make_plot(20)) /
(make_plot(50) | make_plot(100))
```

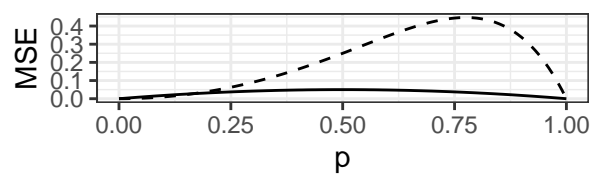
MSE for $n = 1$

T1 (Solid) vs T2 (Dashed)



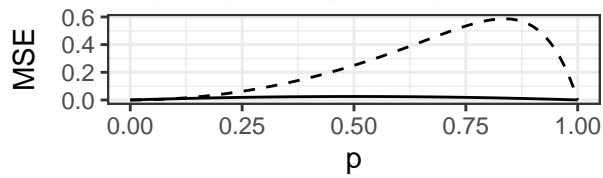
MSE for $n = 5$

T1 (Solid) vs T2 (Dashed)



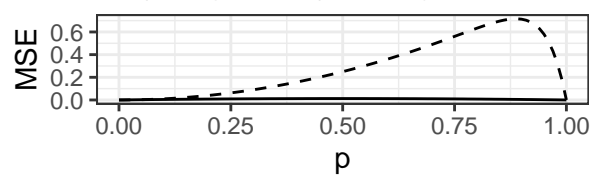
MSE for $n = 10$

T1 (Solid) vs T2 (Dashed)



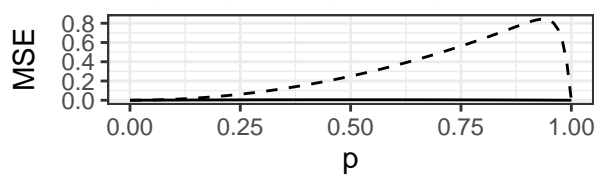
MSE for $n = 20$

T1 (Solid) vs T2 (Dashed)



MSE for $n = 50$

T1 (Solid) vs T2 (Dashed)



MSE for $n = 100$

T1 (Solid) vs T2 (Dashed)

