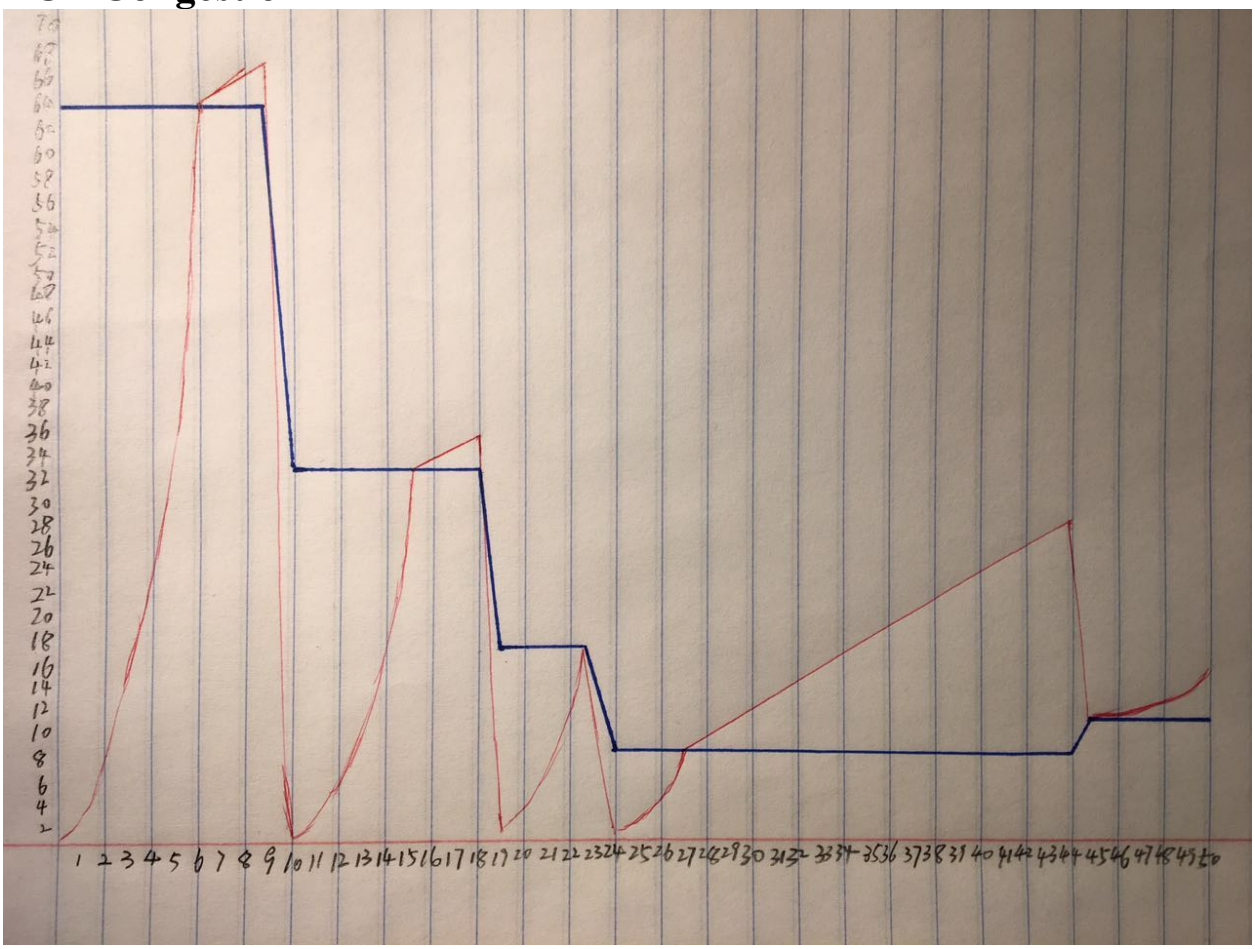
TCP Congestion



Random Early Detection

a. TempP = MaxP × (AvgLen − MinThreshold) / (MaxThreshold−MinThreshold)
= MaxP × ½ = 0.08 × ½ = 0.04
Since, P = TempP/(1−count×TempP)
P_1 = 0.04 / (1 - 0.04) = 4.17%
P_{15} = 0.04 / (1 – 15* 0.04) = 10%

b. To calculate the probability that none of 15 packets are dropped, we need to calculate the probability that none of previous 14 packets are dropped then times the probability that current packet (15) is not dropped. To get the probability that none of 14, we need to get 13, so on… And for each packet, the probability that all packets are not dropped to the packet i is not dropped is 1 - (0.04/ (1- i * 0.04)). Thus, we get (1 - (0.04/ (1- 1 * 0.04))) * (1 - (0.04/ (1- 2 * 0.04))) …* (1 - (0.04/ (1- 15 * 0.04))) = 0.375

TCP and Network Delay

a. For first case, it sends packets and it would receive ACK for second packet after 4s.
For second case, it sends packets and it would receive ACK for last packets after 100ms.

b. Initial Congestion Window: 6
   Base RTT = 4
   β is one packet per second
   For first case, 6/4 - 4/16 > 1, it would decrease window.
   For second case, 6/4 - 6/4.6 < 1, it would increase window.

Fair Queueing

a. A E J Q K B F L R M N C S G O D H T I P
b. A E J Q K B C L M N D F R O P S G H T I