ECE 358 - A1

Ariel Weingarten
#20366892

Alexander Maguire
#20396195

May 8, 2014

Problem 1:

The internet is a ”store-and-forward” network because it consists of quantized pieces of information called packets. Packets must be stored until the entire packet has arrived at the routing point before being retransmitted onwards (aka ”forwarding”).

Problem 2:

$$\begin{aligned} t &= 40GB \\ &\quad \times \frac{1024MB}{GB} \\ &\quad \times \frac{8b}{B} \\ &\quad \times \frac{1}{100Mbps} \\ &\quad \times \frac{minute}{60s} \\ &= 54.6minutes \end{aligned}$$

It is faster to send via the internet, since 54.6 minutes is definitely less than ”overnight”.

Problem 3a:

$$d_{prop} = m/s$$

Problem 3b:

$$d_{trans} = L/R$$

Problem 3c:

$$d_{e2e} = d_{prop} + d_{trans}$$

This is equivalent to the time to put the entire message onto the wire + the time for the last piece on the wire to arrive.

Problem 3d:

At $t = d_{trans}$, the last bit of the packet is at $d = 0$. It has just arrived onto the wire.

Problem 3e:

If $d_{prop} > d_{trans}$, the first bit of the packet is still on the wire at $t = d_{trans}$.

Problem 3f:

If $d_{prop} < d_{trans}$, the first bit of the packet has already arrived at Host B at time $t = d_{trans}$.

Problem 3g:

$$\frac{m}{s} = \frac{L}{R}$$
$$\frac{x}{2.5 \cdot 10^8 m/s} = \frac{120b}{56kbps}$$
$$x = 523.1km$$

Problem 4a:

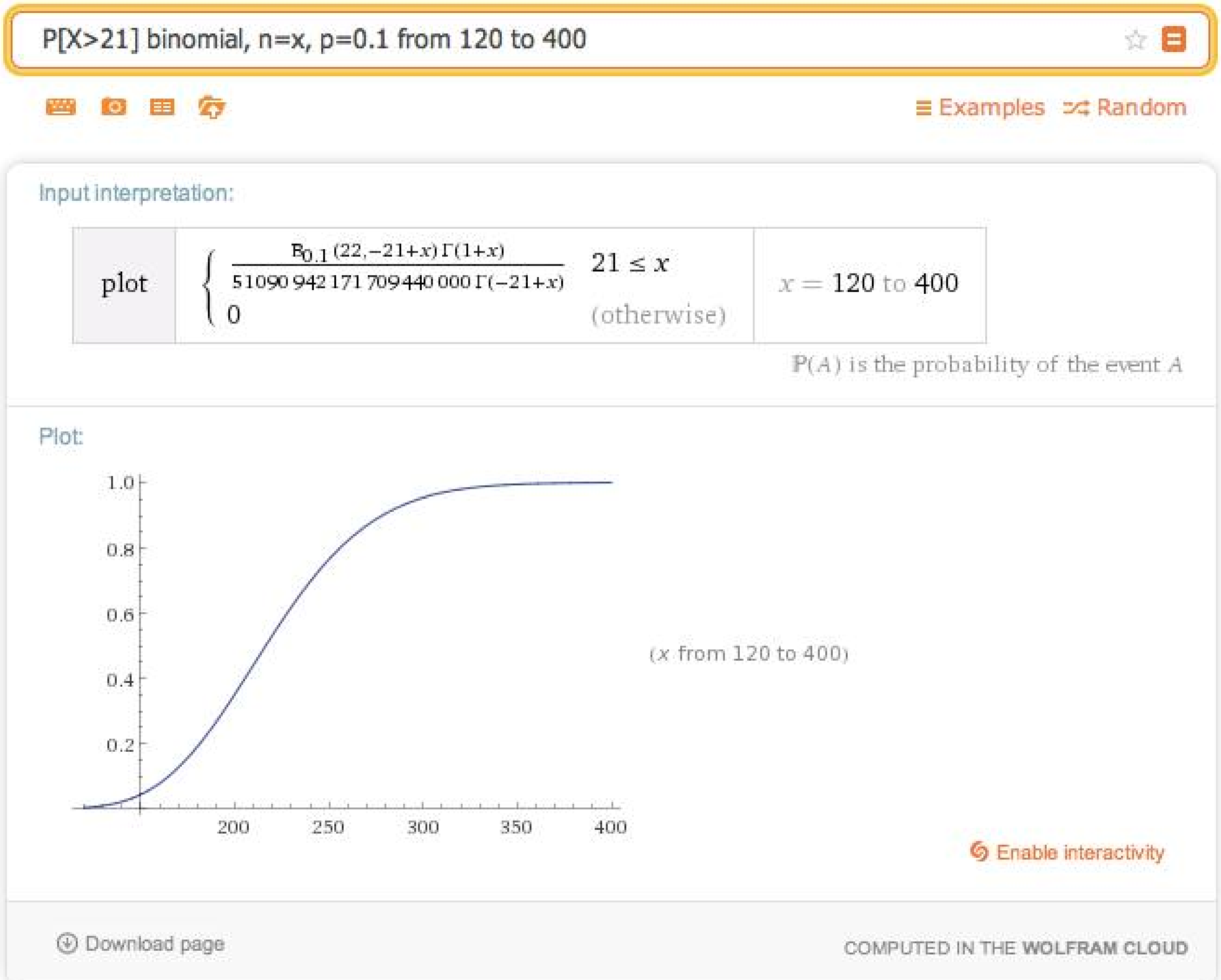
$$\frac{3Mbps}{150kbps/user} = 20users$$

Problem 4b:

$$\sum_{n=21}^{120} \binom{120}{n} 0.1^n \cdot 0.9^{120-n} = 0.00794$$

There is a 0.7% chance that 21 or more users are transmitting simultaneously.

Problem 4c:



As the number of users increases, it becomes more and more of a sure bet that more of them will be using the line simultaneously. This probability never approaches 1, since there is always a small chance, no matter how unlikely, that no users will be using the line.

Problem 5:

The queuing delay d for packet i is $d_i = i \cdot d_{trans}$. The average queuing delay is thus: let $d_{trans} = L/R$

$$\begin{aligned}
d_{avg} &= \sum_{i=0}^{n-1} i \frac{d_{trans}}{n} \\
&= \frac{d_{trans}}{n} \sum_{i=0}^{n-1} i \\
&= \frac{d_{trans}}{n} \frac{n(n-1)}{2} \\
&= d_{trans} \frac{(n-1)}{2}
\end{aligned}$$