By definition:

$$E[X|Y=y] = \sum_x x\, f_{x|y}(x|y) \quad , \quad f_{x|y}(x|y) = P(x|y)$$

$$E[X] = \sum_x x\, P(x)$$

So,

$$E[L] = \sum_n^m L\, P(L) \quad ; \quad E[L]L>n] = \sum_n^m L\, P(L|L>n)$$

We can assume: $\underbrace{P(L\leq n)}_{>0} + \overbrace{P(L>n)}^{>0} = 1$

So, $P(L\leq n) = 1 - P(L>n)$

And,

$$E[L|L>n] = \sum_L^m L(-P(L>n)+1) =$$

$$= \sum_L^n L - LP(L>n) =$$

$$= \sum_L^m L - L(1-P(L)-P(L<n)) =$$

$$= \sum_L^n L - L + LP(L) + LP(L<n) =$$

$$= \boxed{\sum_L^m L\underbrace{P(L)}_{>0} + L\underbrace{P(L<n)}_{>0} \geq \sum_L^m L\underbrace{P(L)}_{>0}}$$

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