

$$\begin{aligned}
0 \leq (x_B^\lambda)_j &= e_j \sum_{i=0}^{\infty} (-\lambda E_B)^i x_B^* \\
&= e_j (I - \lambda E_B + \sum_{i=2}^{\infty} (-\lambda E_B)^i) x_B^* \\
&= e_j x_B^* - \lambda e_j E_B x_B^* + \lambda^2 e_j E_B^2 \sum_{i=0}^{\infty} (-\lambda E_B)^i x_B^*
\end{aligned}$$