Problem 1:
(a)
$$L = \sum_{i=1}^{n} \ln \lambda^{i} (i\lambda)^{i} + \sum_{d=1}^{n} (\ln \lambda_{i} d e^{-\lambda_{i} d} + \ln \lambda_{i} d e^{-\lambda_{i} d})^{n}$$

 $\sum_{i=1}^{n} \ln \frac{e^{-\lambda y_{i} d}}{(\lambda y_{i}, d)^{n}}$
 $\nabla_{\lambda} L = \sum_{i=1}^{n} (\frac{y_{i}}{\lambda} - \frac{(1-y_{i})}{1-\lambda})^{n} = 0 = \sum_{i=1}^{n} (\frac{y_{i}(1-\lambda)}{\lambda(1-\lambda)} - \lambda(1-y_{i}))^{n}$
 $\ln y_{i}^{i} - \lambda = \sum_{i=1}^{n} (\frac{y_{i}^{i}}{\lambda(1-\lambda)} - \frac{y_{i}^{i}}{\lambda(1-\lambda)})^{n}$

$$=\frac{n}{2}\frac{y'-z}{z(1-z)}=\frac{n}{2}\frac{y'-z}{z(1-z)}-\frac{nz}{1-z}=0 \quad \hat{z}=\frac{z}{n}$$

$$=\frac{z}{i-1}\frac{y'-z}{z(1-z)}=\frac{z}{i-1}\frac{z}{z(1-z)}-\frac{nz}{1-z}=0 \quad \hat{z}=\frac{z}{n}$$

$$=\frac{z}{i-1}\frac{y'-z}{z(1-z)}=\frac{z}{i-1}\frac{z}{z(1-z)}-\frac{z}{i-1}=0 \quad \hat{z}=\frac{z}{n}$$

$$=\frac{z}{i-1}\frac{y'-z}{z(1-z)}=\frac{z}{i-1}\frac{z}{z(1-z)}-\frac{z}{i-1}=0 \quad \hat{z}=\frac{z}{n}$$

$$=\frac{z}{i-1}\frac{y'-z}{z(1-z)}=\frac{z}{i-1}\frac{z}{z(1-z)}-\frac{z}{i-1}=0 \quad \hat{z}=\frac{z}{n}$$

$$=\frac{z}{i-1}\frac{y'-z}{z(1-z)}=\frac{z}{i-1}\frac{z}{z(1-z)}-\frac{z}{i-1}=0 \quad \hat{z}=\frac{z}{i-1}\frac{z}{n}$$

$$=\frac{z}{i-1}\frac{z}{z(1-z)}-\frac{z}{i-1}=0 \quad \hat{z}=\frac{z}{i-1}\frac{z}{n}$$

$$=\frac{z}{i-1}\frac{z}{z(1-z)}-\frac{z}{i-1}\frac{z}{z}=0 \quad \hat{z}=\frac{z}{i-1}\frac{z}{n}$$

$$=\frac{z}{i-1}\frac{z}{z}+\frac{z}{i-1}\frac{z}{z}=0 \quad \hat{z}=\frac{z}{i-1}\frac{z}{n}$$

(b)
$$\nabla L = \begin{cases} \lambda_{i,d} & -1 + \frac{1}{\lambda y_{i,d}} + \frac{\lambda_{i,d}}{\lambda y_{i,d}} \\ \lambda_{i,d} & -1 + \frac{1}{\lambda y_{i,d}} + \frac{\lambda_{i,d}}{\lambda y_{i,d}} \end{cases} = 0$$

$$\begin{cases} \lambda_{i,d} & -1 + \frac{1}{\lambda y_{i,d}} + \frac{\lambda_{i,d}}{\lambda y_{i,d}} \\ \lambda_{i,d} & -1 + \frac{\lambda_{i,d}}{\lambda y_{i,d}} + \frac{\lambda_{i,d}}{\lambda y_{i,d}} \end{cases}$$

$$\begin{cases} \lambda_{i,d} & -1 + \frac{\lambda_{i,d}}{\lambda y_{i,d}} + \frac{\lambda_{i,d}}{\lambda y_{i,d}} \\ \lambda_{i,d} & -1 + \frac{\lambda_{i,d}}{\lambda y_{i,d}} + \frac{\lambda_{i,d}}{\lambda y_{i,d}} \end{cases}$$

 $\lambda_{i,d}^{\Lambda} = \frac{1+\sum_{i=1}^{n} y_{i}^{i} x_{i,d}}{1+\sum_{i=1}^{n} y_{i}^{i}} (d=1, -, D)$

(b)
$$PL = \begin{cases} \lambda_{i,d} & -1 + \overline{\lambda}y_{i,d} \end{cases}$$

$$\begin{cases} \lambda_{i,d} & -1 + \overline{\lambda}y_{i,d} \end{cases} = 0$$

$$\begin{cases} \lambda_{i,d} & -1 + \overline{\lambda}y_{i,d} \end{cases} = 0$$

$$\lambda_{i,d} = \frac{1 + \overline{\lambda}(i+y_{i})}{1 + \overline{\lambda}(i+y_{i})} \quad (d = 1, ..., D)$$

(b)
$$\nabla L = \begin{cases} \lambda_{i,d} & -1 + \frac{\lambda_{i,d}}{\lambda_{i,d}} \end{cases} + \sum_{i=1}^{N} (i-y_{i}) (-1 + \frac{\lambda_{i,d}}{\lambda_{i,d}}) = 0$$

$$\begin{cases} \lambda_{i,d} & -1 + \frac{\lambda_{i,d}}{\lambda_{i,d}} + \sum_{i=1}^{N} (i-y_{i}) \chi_{i,d} \end{cases} = 0$$

$$\lambda_{i,d} = \frac{1 + \sum_{i=1}^{N} (i-y_{i}) \chi_{i,d}}{\lambda_{i,d}} \qquad (d = 1, \dots, D)$$

Problem 2:

(a)

| 33, | 0 | |
|-------|------|------|
| 0 | 2156 | 631 |
| | (OV | 1713 |
| 41713 | | |

 $Precision = \frac{2156 + 1115}{4600} \times 0.841$

(b) We can see from the plot that " \(\chi_b\)" for "free" and "!" in "spam" are very different from those in "emnil". This way indicate that "free" and "!" appear move of ten in "span" them they appear in "emails". They can serve as good features in learning process.

(C) K-nn Classifier have a higher precision in general in this case than the Novive Rayer Classifier. We may just choose

K- wn classifier in this case.