1.

GT \ Pred	A	B	C	Recall
A	100	10	20	$\frac{100}{130}$
B	15	90	30	$\frac{90}{135}$
C	0	20	120	$\frac{120}{140}$
Precision	$\frac{100}{115}$	$\frac{90}{120}$	$\frac{120}{170}$	

2.

$$\text{macro Precision} = \frac{1}{3}\left(\frac{100}{115} + \frac{90}{120} + \frac{120}{170}\right)$$

$$= \frac{3637}{4692} \doteq 0.775 \#$$

$$\text{macro Recall} = \frac{1}{3}\left(\frac{100}{130} + \frac{90}{135} + \frac{120}{140}\right)$$

$$= \frac{626}{819} \doteq 0.764 \#$$

3.

① macro F1

$$= \frac{1}{3}\left(\frac{2\times\frac{100}{115}\times\frac{100}{130}}{\frac{100}{115}+\frac{100}{130}} + \frac{2\times\frac{90}{120}\times\frac{90}{135}}{\frac{90}{120}+\frac{90}{135}} + \frac{2\times\frac{120}{170}\times\frac{120}{140}}{\frac{120}{170}+\frac{120}{140}} \right)$$

$$= \frac{59300}{77469} \fallingdotseq 0.765 \#$$

② macro F1

$$= \frac{2\times\frac{1}{3}\left(\frac{100}{115}+\frac{90}{120}+\frac{120}{170}\right)\times\frac{1}{3}\left(\frac{100}{130}+\frac{90}{135}+\frac{120}{140}\right)}{\frac{1}{3}\left(\frac{100}{115}+\frac{90}{120}+\frac{120}{170}\right)+\frac{1}{3}\left(\frac{100}{130}+\frac{90}{135}+\frac{120}{140}\right)}$$

$$= \frac{40472536}{53243055} \fallingdotseq 0.760 \#$$

4.

micro Precision

$$= \frac{100 + 90 + 120}{115 + 120 + 170}$$

$$= \frac{62}{81} \fallingdotseq 0.765 \#$$

micro Recall

$$= \frac{100 + 90 + 120}{130 + 135 + 140}$$

$$= \frac{62}{81} = 0.765 \#$$

5.

① $MSE_X = \frac{1}{5}[(11-12)^2 + (12-13)^2 + (13-14)^2 + (14-15)^2 + (15-16)^2]$

$= 1\#$

$MSE_Y = \frac{1}{5}[(21-22)^2 + (12-13)^2 + (3-4)^2 + (14-15)^2 + (25-26)^2]$

$= 1\#$

② $\bar{a} = \frac{1}{5}(11+12+\cdots+15) = 13$

$RSE_X = \frac{(11-12)^2 + (12-13)^2 + \cdots + (15-16)^2}{(11-13)^2 + (12-13)^2 + \cdots + (15-13)^2}$

$= \frac{5}{4+1+0+1+4} = \frac{1}{2}\#$

$RSE_Y = \frac{(21-22)^2 + (12-13)^2 + (3-4)^2 + (14-15)^2 + (25-26)^2}{(21-15)^2 + (12-15)^2 + (3-15)^2 + (14-15)^2 + (25-15)^2}$

$= \frac{1}{58}$

③ $S_P = \frac{\Sigma(p-\bar{p})^2}{n-1} = \frac{4+1+0+1+4}{5-1} = \frac{5}{2}$

$S_\theta = \frac{\Sigma(a-\bar{a})^2}{n-1} = \frac{4+1+0+1+4}{5-1} = \frac{5}{2}$

$S_{P\theta} = \frac{\Sigma(p-\bar{p})(a-\bar{a})}{n-1} = \frac{2\times2+1\times1+0\times0+1\times1+2\times2}{5-1} = \frac{5}{2}$

$r_{\lambda} = \frac{S_{P\theta}}{\sqrt{S_P S_\theta}} = \frac{\frac{5}{2}}{\sqrt{\frac{5}{2}\times\frac{5}{2}}} = 1$ #

④ $S_P = \frac{(22-16)^2+(13-16)^2+(4-16)^2+(15-16)^2+(26-16)^2}{5-1}$

$= \frac{145}{2}$

$S_\theta = \frac{(21-15)^2+(12-15)^2+(3-15)^2+(14-15)^2+(25-15)^2}{5-1}$

$= \frac{145}{2}$

$$S_{PQ} = \frac{(22-16)(21-15)+(13-16)(12-15)+(4-16)(3-15)+(15-16)(14-15)+(26-16)(25-15)}{5-1}$$

$$= \frac{145}{2}$$

$$r_y = \frac{S_{PQ}}{\sqrt{S_P S_Q}} = \frac{\frac{145}{2}}{\sqrt{\frac{145}{2}\times\frac{145}{2}}} = 1 \#$$

6.

$$\frac{1}{F_2} = \frac{1}{1+2^2}\times\frac{1}{P} + \frac{2^2}{1+2^2}\times\frac{1}{r}$$

$$\Rightarrow F_2 = \frac{5Pr}{r+4P} \#$$

$$\frac{1}{F_{0.5}} = \frac{1}{1+0.5^2}\times\frac{1}{P} + \frac{0.5^2}{1+0.5^2}\times\frac{1}{r}$$

$$\Rightarrow F_{0.5} = \frac{1.25Pr}{r+0.25P} \#$$