ASTR 368
HW #4

	$\langle B-V \rangle$	M/L $(M_\odot/L_\odot)$
1) Sa :	0.75	6.2
Sb :	0.64	4.5
Sc :	0.52	2.6
Sd :	0.47	~1
Im :	0.37	~1

a) G8, G2, F8, F6, F2 for Sa, Sb, Sc, Sd, Im

b) 0.9, 1.0, 1.2, 1.4, 1.5 $M_\odot$
0.66, 1.0, 1.68, 2.56, 3.89 $L_\odot$

so for average stars,

$\frac{M}{L}$ = 1.36, 1.0, 0.71, 0.55, 0.38 for Sa → Im

$$\left(\frac{M}{L}\right)_{tot} = \frac{M_* + M_{DM}}{L_*} = \frac{M_*}{L_*} + \frac{M_{DM}}{L_*}$$

$$\Rightarrow \frac{M_{DM}}{L_*} = 4.84,\ 3.5,\ 1.89,\ 0.45,\ 0.62$$

So it would appear that M_{DM} decreases throughout the sequence b

2) $\varphi(L)\,dL = \left(\frac{\varphi^*}{L^*}\right)\left(\frac{L}{L^*}\right)^{\alpha} e^{-\frac{L}{L^*}}\,dL$

Assume: $\alpha = -1$, $\varphi^* = 0.001\ \mathrm{Mpc}^{-3}$, $L^* = L_{MW}$

Want number density of galaxies with luminosities greater than L

$$\int_L^\infty \varphi(L)\,dL = \int_L^\infty \left(\frac{\varphi^*}{L^*}\right)\left(\frac{L}{L^*}\right)^{-1} e^{-\frac{L}{L^*}}\,dL$$

let $x = \frac{L}{L^*}$ $\quad dx = \frac{dL}{L^*} \Rightarrow dL = L^* dx$

$$\int_L^\infty \varphi(L)\,dL = \varphi^* \int_{L^*x}^\infty x^{-1} e^{-x}\,dx$$

This is of the form

$$\int x^n e^{ax}\,dx = \frac{(-1)^n}{a^{n+1}}\Gamma[1+n, -ax]$$

$n = -1$, $a = -1$

$$\Rightarrow \frac{-1}{-1^0}\Gamma[0, x] = -\Gamma[0, x]$$

so $$\int_L^\infty \varphi(L)\,dL = \varphi^* \cdot -\Gamma[0, L/L^*] \Big|_L^\infty$$

$$\Gamma[0, \infty] = 0$$ so

$$\int_L^\infty \varphi(L)\,dL = \varphi^* \Gamma[0, L/L^*]$$

b) $L = 0.5\,L_{MW},\ L_{MW},\ 2L_{MW}$

$$\int_{0.5L_{MW}}^\infty \varphi(L)\,dL = 0.001 \cdot \Gamma[0, 1/2]\ Mpc^{-3}$$

$$= 5.6\times10^{-4}\,Mpc^{-3}$$

$$\int_{L_{MW}}^\infty \varphi(L)\,dL = 0.001 \cdot \Gamma[0, 1]\ Mpc^{-3}$$

$$= 2.2\times10^{-4}\,Mpc^{-3}$$

$$\int_{2L_{MW}}^\infty \varphi(L)\,dL = 0.001 \cdot \Gamma[0, 2]\ Mpc^{-3}$$

$$= 4.5\times10^{-5}\,Mpc^{-3}$$