ASTR 425/525
Cosmology

Worksheet #4

Wednesday 08/27/2025

Question 1.

Since every object in an expanding Universe is receding from all other objects (neglecting peculiar velocity), one can think of redshift as a Doppler shift caused by the receding source of light.

Using the standard relativistic formula for the observed wavelength of light emitted by a source receding from us with speed v

$$\frac{\lambda_{\rm obs}}{\lambda_{\rm em}} = \frac{\sqrt{1+v}}{\sqrt{1-v}}, \tag{1}$$

show that in the limit that $v \ll 1$, we have that the redshift is simply $z \simeq v$ at leading order.

Question 2.

The discovery that galaxies that are further away from us recedes faster (i.e. the Hubble-Lemaître law) was a groundbreaking moment in cosmology. However, the early estimates of the Hubble constant H_0, first by Hubble (1929) and then by Humason (1931) were far from accurate. For instance, Humason measured a galaxy at a distance of 25 Mpc receding from us at 12,000 km/s, and another at a distance of 4 Mpc receding from us at 2,500 km/s. Given only these two measurements, what value of the Hubble constant would Humason have inferred? How does it compare to the current value of $H_0 \sim 70$ km/s/Mpc?