ASTR 425/525
Cosmology

Worksheet #2

Wednesday 08/20/2025

Question 1.

We would like to come up with a metric that would allow us to measure distances in our Universe. To be valid such metric must respect the cosmological principle, which implies an homogeneous and isotropic Universe. This puts strong constraints on the structure of the possible metric. Using spatial cartesian coordinates, the most general metric I can write down is

$$ds^2 = -f(t,x,y,z)dt^2 + g(t,x,y,z)dx^2 + h(t,x,y,z)dy^2 + l(t,x,y,z)dz^2. \tag{1}$$

(a) What conditions does isotropy put on the functions $f(t,x,y,z)$, $g(t,x,y,z)$, $h(t,x,y,z)$, and $l(t,x,y,z)$?

(b) What conditions does homogeneity put on the functions $f(t,x,y,z)$, $g(t,x,y,z)$, $h(t,x,y,z)$, and $l(t,x,y,z)$?