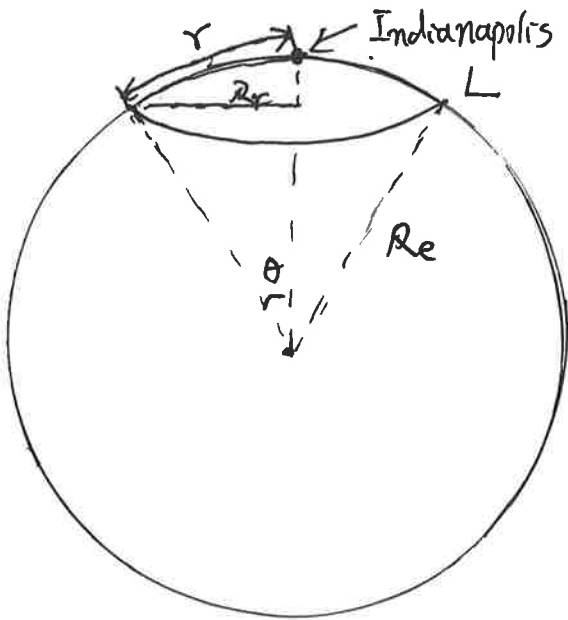


Yang Yang

If we model our earth as a perfect sphere, then any distance we measured is on the sphere surface.



Given the radius of the road is 500 mile, we can find the angle formed between the axis ~~the~~ connecting Indianapolis and the center of the earth and ~~the~~ the line connecting the any point of the road and the center of earth by $\theta = \frac{r}{R_e} = 0.12616 \text{ rad}$.

Then the road is a circle on ~~the~~ its own cross-section plane. Thus, we have the radius of the circle is

$$R_r = R_e \sin \theta = 498.67 \text{ mile}$$

Therefore we can find the length of the road by $L = 2\pi R_r = 3133.265 \text{ mile}$.

Then we can generalize our result as

$$L = 2\pi R_r = 2\pi R_e \sin \theta = 2\pi R_e \sin \frac{r}{R_e},$$

where r is the given radius of the road on the sphere surface and R_e is the radius of earth.