Worksheet 5

Math 202

Monday, April 29, 2021

Write down your group members' names and email addresses. How far did they get on last week's worksheet? Catch each other up, and finish analyzing the three cylindrical projections from last week: how much do they stretch east-west miles, north-south miles, and square miles, depending on the latitude β? Plug in some actual values of β, like $30°$, $45°$, and $60°$, to get a feeling for what you're really talking about.

If you're making a map, you might want is angles between roads on the map to be the same as the angles between the actual roads on the earth. Discuss why none of the three projections you've looked at preserves angles, except maybe at the equator. (Consider a 1 mile by 1 mile square on the earth, and a diagonal drawn across it at a 45 degree angle, and think about the east-west and north-south stretching that you've seen.)

A map projection that preserves angles is called *conformal*. The defining properties of the Mercator projection are that it's cylindrical and conformal. How much must it stretch a north-south mile to accomplish this, as a function of the latitude β? Is it more or less than the other projections you've looked at? How much does a square mile get stretched? Again, plug in some actual numbers.

Can you find y as a function of β to give the north-south stretching required by the Mercator projection? (When you took $y(\beta)$ and found the amount of stretching, it involved the derivative $y'(\beta)$, so going the other way will involve an integral.)

Another thing you might want a map to do is to preserve areas. You've seen that the Lambert cylindrical projection preserves areas but not angles, and that the Mercator projection preserves angles but not areas. Discuss whether any cylindrical projection can preserve both.