MARS SURFACE DENSITY

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Abstract

I'm interesting in density of surface of Mars which I hope to achieve from dataset collected in the **Mars Crater Codebook**

1 Mars surface study

The formation of meteor(impact) crater consists from 3 phases/stages [3]:

1. Contact and compression
2. Excavation
3. Modification and collapse

On all of above stages deformation of the surface take place, but only of the 1-st stage - due to impact. Exactly on this stage deformation of surface described by **Newton's approximation for the impact depth** [4]: $D \approx L\frac{A}{B}$, where D,L,A,B are crater depth, meteor size, Mars and meteor density respectively. In this way, depth of craters depend from surface density and, as mentioned in [4], the lower the density the lower the depth. More over, [4] claim that depth to diameter ratio is a constant value is about 1/3 for not too large meteors (¡ 3-4 km). For giant meteors this ratio significantly less.
As noticed in [3], 92% of meteors in the Solar System are rocks, so we may take value B as constant, and exclude it form research.

$$R = \frac{D}{L}, \tag{1}$$

where D - crater depth, L - crater diameter
This expression is normalized depth of crater.

On the other hand expression (1) may be written as:

$$R \Rightarrow F_{1,2,3} + E_t, \tag{2}$$

where: $F_{1,2,3}$ - deformations of 3 phases of impact, E_t - wind erosion (because Mars has not any significant kind of erosion)

Wind erosion [2] inversely proportional to surface density, i.e crater depth will decrease more faster for sand then for rocks. In this way erosion only increase effect of deformation and may be left out. So (2) will look: R $\Rightarrow$F$_{1,2,3}$ for not too big craters.

On the 1-st stage (contact and penetration) diameter $\approx$ size of meteor (L) but after 3-nd stage it decrease up to 85% of the original size [1].

My **hypothesis** and **topic** is: given magnitudes of diameter and depth of Mars craters build classifier for surface density and using nearest craters coordinate predict surface density for any point on surface.

2 Mars Crater Variables

2.1 Variable Names

CRATER_ID, LATITUDE_CIRCLE_IMAGE, LONGITUDE_CIRCLE_IMAGE, DIAM_CIRCLE_IMAGE, DEPTH_RIMFLOOR_TOPOG
Unique Identifier: **CRATER_ID**

2.2 Variables with Descriptions

- CRATER_ID crater ID for internal sue, based upon the region of the planet (1/16ths), the pass under which the crate was identified, ad the order in which it was identified
- LATITUDE_CIRCLE_IMAGE latitude from the derived center of a non-linear least-squares circle fit to the vertices selected to manually identify the crater rim (units are decimal degrees North)
- LONGITUDE_CIRCLE_IMAGE longitude from the derived center of a non-linear least-squares circle fit to the vertices selected to manually identify the crater rim (units are decimal degrees East)
- DIAM_CIRCLE_IMAGE diameter from a non-linear least squares circle fit to the vertices selected to manually identify the crater rim (units are km)
- DEPTH_RIMFLOOR_TOPOG average elevation of each of the manually determined N points along (or inside) the crater rim(units are km)

References

[1] Stuart James Robbins. "Planetary Surface Properties, Cratering Physics, and the Volcanic History of Mars from a New Global Martian Crater Database". 2011.

[2] Wikipedia. *Aeolian processes*. URL: `https://en.wikipedia.org/wiki/Aeolian_processes`.

[3] Wikipedia. *Impact crater*. URL: `https://en.wikipedia.org/wiki/Impact_crater`.

[4] Wikipedia. *Impact depth*. URL: `https://en.wikipedia.org/wiki/Impact_depth`.