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During two voyages of the HMS Paramore, Edmond Halley collected data on magnetic declination at various points in the Atlantic Ocean. Magnetic declination is the angular difference between magnetic north and geographical or true north for any point on the earth's surface. Following these voyages, in 1701 Halley published a map showing isogones, or lines of equal magnetic declination, over the Atlantic Ocean. Such a map was presented as a possible solution to finding longitude at sea. Halley did not reveal the data analytic techniques that he used in his map construction and they remain unknown to this day. Using some mathematical tools of his day, namely arithmetical averages and Newton's divided difference method to fit a line to data, a plausible method for the map's construction is given. Not enough data was collected that would allow for the construction of all the isogones on the published map. A method is suggested whereby Halley imputed data for his map construction. (Received August 24, 2015)