Project 2

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605.462 Data Visualization

21 February, 2017

1 Data

The data chosen for this project is a collection of measurements from an instrument on-board the Hubble Telescope. During normal operations, the Cosmic Origins Spectrograph periodically measures internal characteristics of the instrument. These can be used by scientists and engineers to monitor and diagnose issues with the instrument.

This dataset has 201008 records with 13 variables. Each record represents a collection of measurements and metadata from a given time sample on the instrument. A description of each variable is given in the table below.

Variable	Type	Description
id	ordinal numeric	record ID in the database
obsname	nominal	name of the source observation
rootname	nominal	rootname of the source observation
detector	nominal	data detector label used during the observation
date	ordinal numeric	date of the measurement in decimal year
dark	ordinal numeric	measured dark-rate on the detector
ta_dark	ordinal numeric	measured dark-rate on the detector with no filtering
latitude	ordinal numeric	spacecraft latitude during measurement
longitude	ordinal numeric	spacecraft longitude during measurement
sun_lat	ordinal numeric	solar latitude during measurement
sun_lon	ordinal numeric	solar longitude during measurement
temp	ordinal numeric	instrument temperature
file_id	ordinal numeric	ID of the source datafile

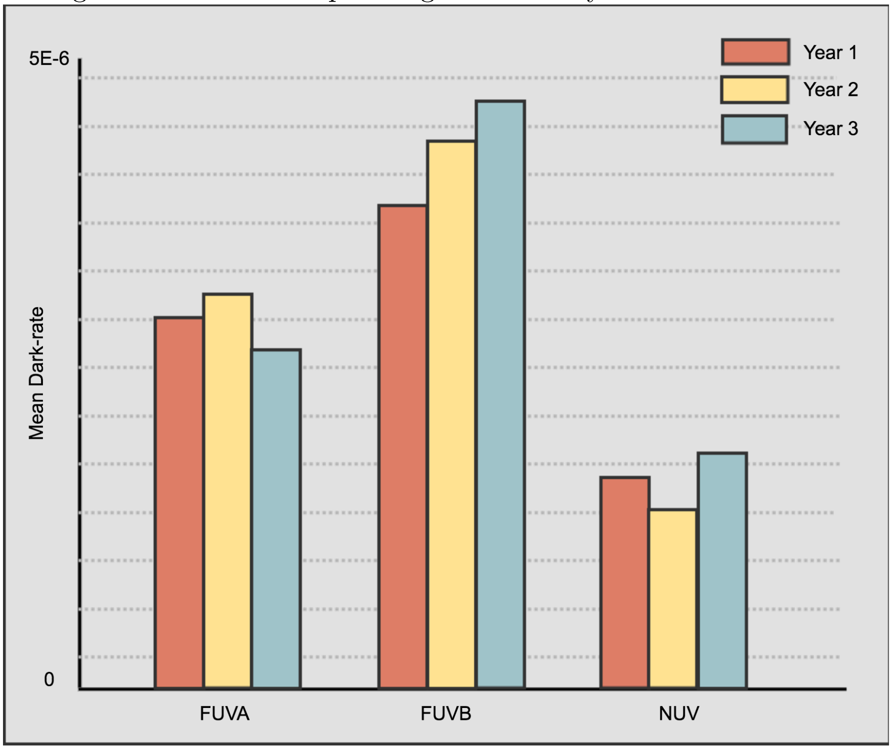
2 Possible Questions

This rich dataset prompts many questions which, due to its large size, are difficult to understand straight from the data. A few possible questions include:

1. Which detector has the highest dark-rate?
2. How are the measurements distributed in latitude and longitude?
3. How has the dark-rate changed over time?
4. Is there a correlation between dark-rate and temperature?
5. How many datasets have been taken for each detector?

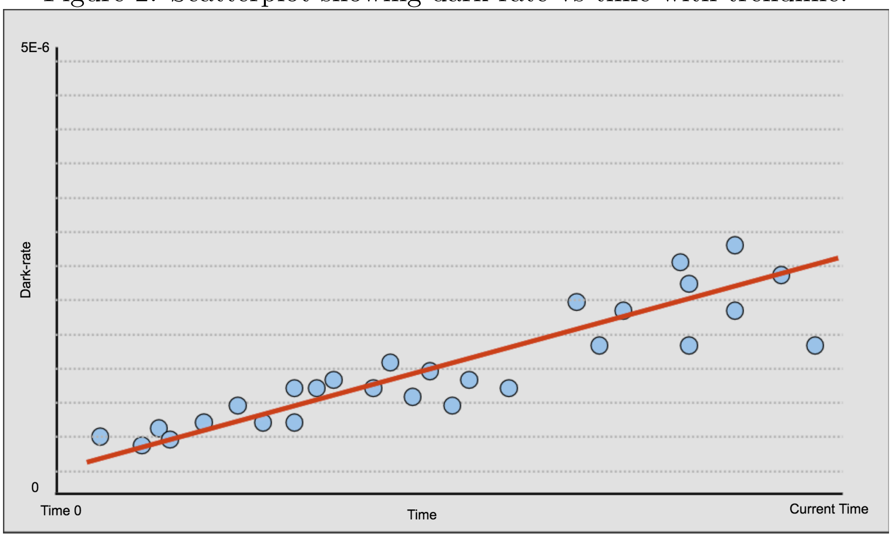
3 Visualizations

Figure 1: Bar chart separating dark-rate by detector and time.



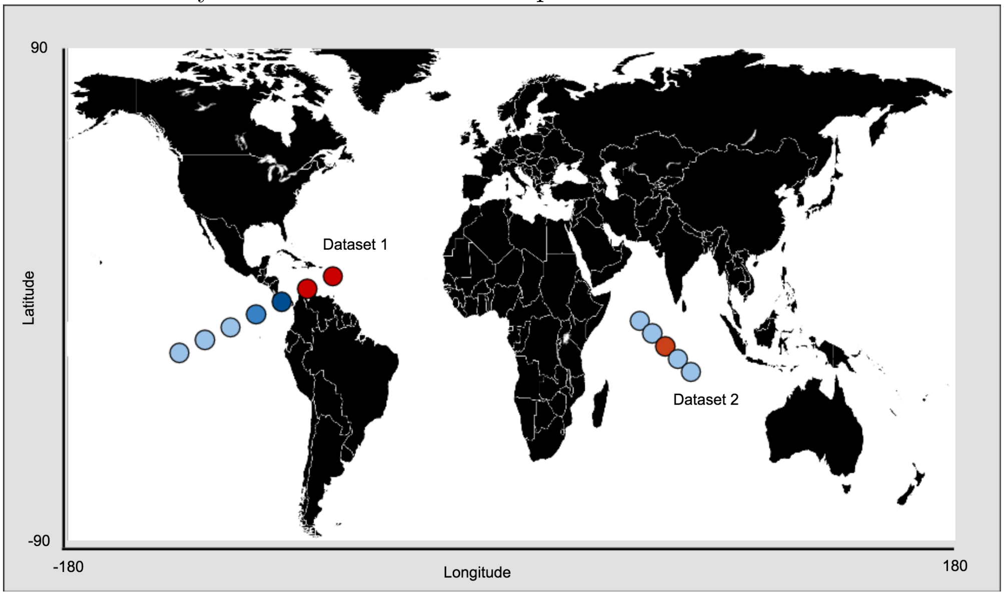
To answer question 1, "Which detector has the highest dark-rate?", a simple bar chart can be used to clearly express the data. Bars for the yearly dark-rate average for each of the 3 individual detectors would be plotted. The yearly averages would be grouped around detector, and color-coded by year to allow quick comparison across both time and detector. This colormap for year would not be a gradient, but instead would be distinct unique colors to make comparisons easier.

Figure 2: Scatterplot showing dark-rate vs time with trendline.



To answer question 3, "How has the dark-rate changed over time?", a scatter plot with trendline would help view the behavior over time. This is a very simple visualization that only shows the data-points, in a single color, with no connecting lines. Since the measurements are independent, connecting lines would mis-represent the data by hinting at an interpolation between measurements. Drawn with the data would be a trendline showing the fitted behavior. Due to the large dataset and numerous outliers, the viewer is at risk of mis-interpreting the long-term behavior.

Figure 3: Dataset by dataset dark-rate scatterplot overlaid on the surface of the Earth.



To answer question 2, "How are the measurements distributed in latitude and longitude?", I designed a scatterplot overlaid on a map of the earth. Latitude and longitude make up the y and x axes. However, since raw coordinates are hard for a viewer to associate with a geographic location, a simple map of the world would be displayed as the backdrop. Each individual observation would then be plotted as a series of circles color-coded by dark-rate. A text-field giving the observation name would be tied to the orbital path. Since this representation could rapidly fill up with too many points, this visualization would need to be used on a subset or would need an interactive component to hide observations not selected by a cursor.