

Uncovering the Behaviours of Stars

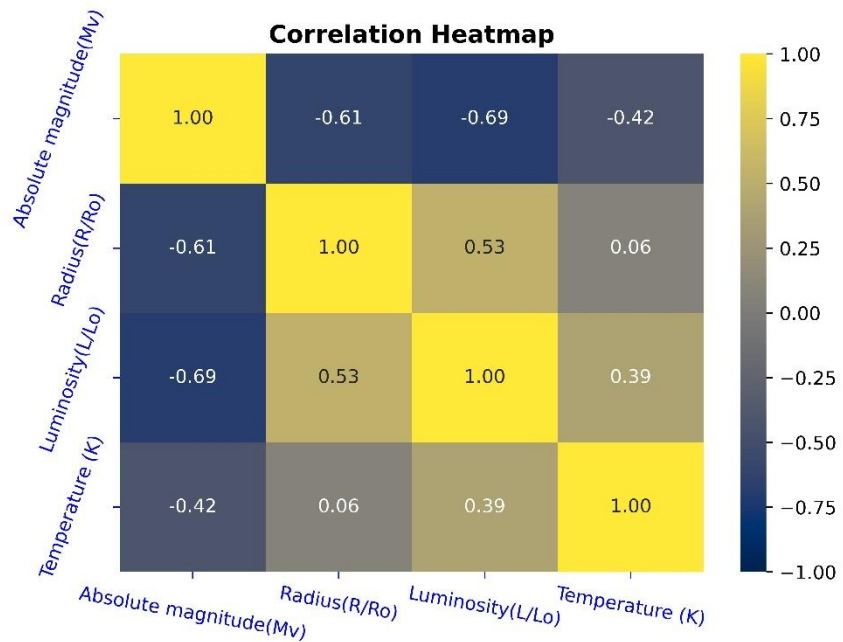
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This report evaluates a dataset containing data about stars. The objective here is to, uncover how the properties of stars differ from each other on the basis of their behaviour. The dataset consists of four key variables namely: temperature, luminosity, radius and absolute magnitude, along with, star type, colour, and spectral class.

Visualisation and Finding►

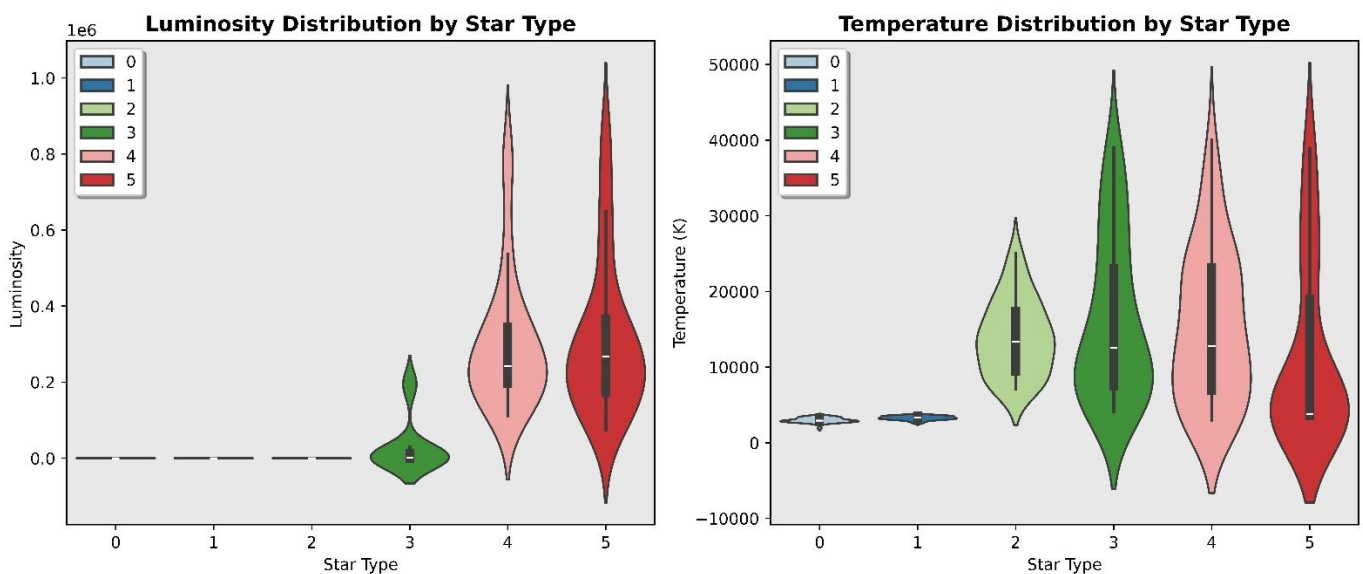
■ Relationship between key features

The heatmap provides a correlation between the variables, that reveals interesting patterns in the dataset. The highest positive correlation between luminosity and radius means larger stars tend to be brighter and strongest negative correlation of luminosity and absolute magnitude indicate brighter stars have lower magnitude values. Temperature and luminosity have a moderate positive correlation which, initiates a deep-dive on how they play a significant role for the classification of stars.



■ Luminosity and Temperature by Star Types

Distribution of Features Across Star Types

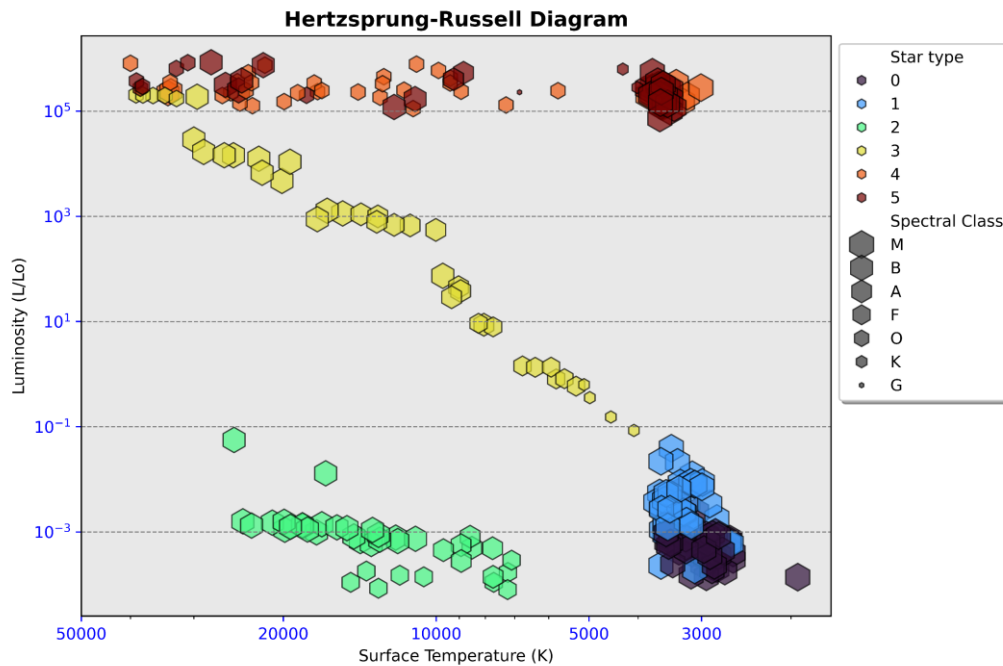


Before we dig into the classification, the violin plots provide the distribution of luminosity and temperature across different star types.

For Star Types 0, 1 and 2, luminosity plots are barely visible indicating a densely concentrated luminosity value close to zero. While Star Type 3 with varying luminosities, suggest the stars of diverse energy outputs, Star Type 5 reflects high luminosity likely the stars near the end of their life cycle.

The temperature plots of first two types display the stars having lower temperatures but Star Type 3 and 4 suggest stars of broad temperature range. **Star Type 5** has median value near to Type 0 and 1 referring similar central tendency but thermal variability within this star types.

■ Hertzsprung-Russell Diagram

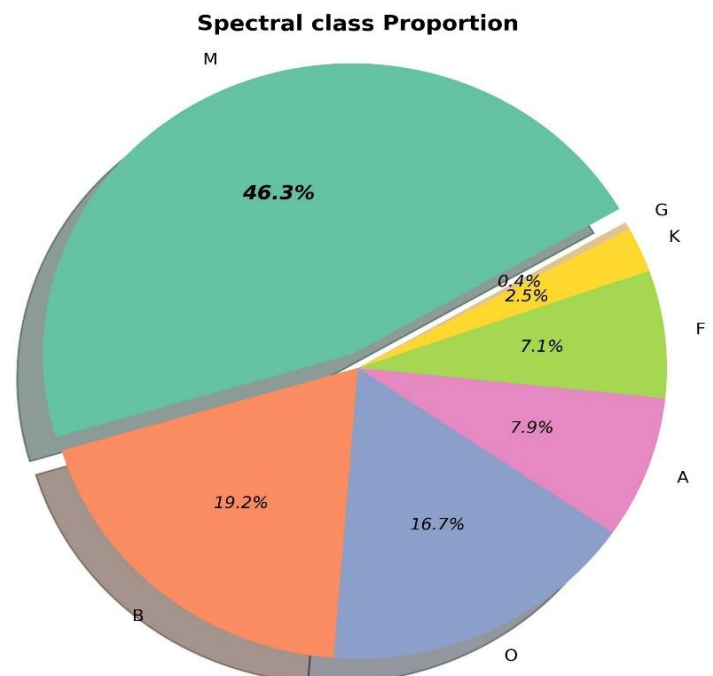


The scatter plot between luminosity and temperature gives valuable insights into the star's evolution. **main sequence stars** are along a diagonal band with hotter stars being more luminous representing the stable phase of hydrogen fusion in their cores. **Star Type 0, 1** in the lower right suggest that cooler stars in **pre-main sequence** stages.

Star Type 4, 5 show high luminosity with temperatures ranging from 40,000 to 3,000 K such as supergiants. The presence of **red giants** (cooler but more luminous stars) in the upper-right and **white dwarfs** mostly star type 2 reveal stars at various stages of their life cycle from young, low-mass stars to older, highly evolved ones.

■ Proportion by spectral class

Based on HR diagram and Pie chart, most of the red giants and pre-main sequence stars are of Spectral class M with dominance of 46%. G-class stars with 0.4% stand out as supergiants showcasing exceptional luminosity. Other spectral classes are distributed across various types featuring a diverse representation of stellar evolution. The data suggests that cooler stars are more abundant, as seen in both the plots, with massive stars being relatively less in the dataset.



Tables

Descriptive Statistics of the variables

	Temperature (K)	Luminosity(L/L _o)	Radius(R/R _o)	Absolute magnitude(M _v)
count	240.0	240.0	240.0	240.0
mean	10497.4625	107188.361635	237.157781	4.382396
std	9552.425037	179432.24494	517.155763	10.532512
min	1939.0	8e-05	0.0084	-11.92
25%	3344.25	0.000865	0.10275	-6.2325
50%	5776.0	0.0705	0.7625	8.313
75%	15055.5	198050.0	42.75	13.6975
max	40000.0	849420.0	1948.5	20.06

The statistics reveals a mean temperature of 10,497 K and average radius of 237.16 from 0.0084 to 1,948.5, while the absolute magnitude spans from -11.92 to 20.06, reflecting a wide range of stellar characteristics.

Mean Values for Star Properties by Star Type

Star Type	Absolute magnitude(M _v)	Luminosity(L/L _o)	Radius(R/R _o)	Temperature (K)
0	17.5635	0.000693	0.110015	2997.95
1	12.539975	0.005406	0.348145	3283.825
2	12.5825	0.002434	0.010728	13931.45
3	-0.367425	32067.386275	4.4303	16018.0
4	-6.369925	301816.25	51.15	15347.85
5	-9.65425	309246.525	1366.8975	11405.7

The table showcases a range of stellar properties, from faint, cool Type 0 stars (magnitude 17.56, luminosity 0.0007 , temperature 2,998 K) to highly luminous Type 5 stars (magnitude -9.65, luminosity 309,246.53 temperature 11,406 K), highlighting diverse evolutionary stages.

Conclusion

The report explores the diversity of stars by linking their classifications with their properties and stages of evolution. Using various visualizations, it highlights the connections between star types, providing a clear understanding of their life cycles and significance in the universe.