

Correlations

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The major coal-producing states of India are – Chhattisgarh, Jharkhand, Madhya Pradesh, Maharashtra, Odisha and West Bengal. Year-wise data of their coal production (by million tonnes) is obtained from the Ministry of Coal, Government of India.

The Human Development Index is a statistic composite index of life expectancy, education, and per capita income indicators. The Human Development Indices (HDI) of these states, for the respective years is also obtained. Having formatted this data appropriately (in the form of a csv file), we can run the correlation program (attached), year-by-year to observe trends of correlation between coal production and HDI for these states.

The correlation program yielded the following output -

```
{'2008-09': -0.31460968255253, '2009-10': -0.398033972359728, '2010-11': -0.4546535360567665, '2011-12': -0.5481503173895977, '2012-13': -0.6502932700135343, '2013-14': -0.6792387607345645, '2014-15': -0.7352954432069241, '2015-16': -0.7904234269517392, '2016-17': -0.6332021060388048, '2017-18': -0.6959481148872885, '2018-19': -0.6854232575659955}
```

The average correlation is -0.5986610807052248

Year	Correlation between Coal Production and HDI
2008-09	-0.31460968255253
2009-10	-0.398033972359728
2010-11	-0.4546535360567665
2011-12	-0.5481503173895977
2012-13	-0.6502932700135343
2013-14	-0.6792387607345645
2014-15	-0.7352954432069241
2015-16	-0.7904234269517392
2016-17	-0.6332021060388048
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The average correlation is -0.5986610807052248.

Hence, the correlation is a moderate-to-high negative correlation.

In India, 55% of domestic energy needs are met by coal. In these states, coal is the major contributor to the economy, even though the region is rich in other minerals and natural resources. The coal production industry employs a very large number of people and could positively impact income and local economic development.

However, despite this, there is a negative correlation between coal production and HDI. As mentioned earlier, HDI is a composite statistic index, which consists not just of per capita income, but also of education indicators and life expectancy indicators.

Though coal production could potentially boost per capita income, its effects on the health of citizens, and incentives to pursue education, are negative.

Workers who are engaged in the production are exposed to coal on a regular basis, are prone to being affected by pulmonary diseases such as asthma, infection, COPD and cancer. Further, coal production results in the release of pollutants into the environment. These decrease the life expectancy of the people in these areas.

Workers who are engaged in coal production are often not educated. Their children, too, are not encouraged to go to school, setting up a vicious circle, where education is never a priority. Further, despite a legal ban on child labour, children are engaged in activities directly or indirectly related to coal production.

Hence, though coal production has the potential to boost incomes of workers, thus enhancing per capita income, overall, it contributes negatively to the health and education of workers, and to the environment.

Therefore, since HDI is a composite of life expectancy, education and income indices, we can observe a negative correlation between coal production and HDI.

(Continued below - comparison of HDI vs. GDP)

Also, to add to the analysis, if we run the correlation program for coal production and GDP for ten years, we get –

```
{'Chhattisgarh': 0.9766559553159574, 'Jharkhand': -0.42274871530062563, 'Madhya Pradesh': 0.9219679083345924, 'Maharashtra': 0.6195719030558503, 'Orissa': 0.9450165269190877, 'West Bengal': 0.8156943519047618}
```

The average correlation is 0.642692988371604

State	GDP
Chhattisgarh	0.9766559553159574
Jharkhand	-0.42274871530062563
Madhya Pradesh	0.9219679083345924
Maharashtra	0.6195719030558503
Odisha	0.9450165269190877
West Bengal	0.8156943519047618

The average correlation is 0.642692988371604.

In general, there is a fairly high positive correlation between coal production and GDP over a period of ten years (nominal GDP is used for calculation here since base years over the ten-year period are different).

Hence, as a comparison between GDP and HDI, we see the correlation with coal production is highly positive in case of GDP and moderate-to-high in case of HDI.

GDP only reflects the economy, while HDI is a composite of income, health and education.

Thus, for such an analysis of the impact of coal production, HDI gives us a more broader understanding of the standards of living of citizens, in contrast to GDP, which can only reflect the general economic activity.