

# Chapter 5

## Forecasting Exponential Decline

### ABSTRACT

*Production and Economic Forecast Using Exponential Decline forecasts production, revenues, and present value based on exponential decline. The exponential decline pattern for oil production is represented using the formula  $q = q_1 e^{-at}$ , where  $q_1$  is the annual production for the first year and  $a$  is the (fixed) annual percentage decline rate. Uncertain input factors include 1) Yearly production (YrlProd), represented by Lognormal distribution; 2) Decline rate (Declrate), represented by Lognormal distribution; 3) GOR (constant Gas-Oil-Ratio), represented by Triangle distribution; 4) Price of gas, represented by Normal distribution; 5) Price of oil, represented by Normal distribution; and 6) Rate of increase of oil and gas prices, which are represented by Normal distributions embedded in the Revenue formulas. For each year, a new sample is drawn from a new Normal distribution, modelling variation from year to year. Outputs are defined as 1) Total NPV and 2) Oil-Gros, or production, for each year.*

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# INTRODUCTION

## Decline Curve

The decline curve is a method for estimating reserves and predicting the rate of oil or gas production. It typically shows the pace at which production is expected to decline over the lifetime of an energy asset. Peak oil refers to the hypothetical point at which global crude oil production will hit its maximum rate, after which production will start to decline. This concept is derived from geophysicist Marion King Hubbert's "peak theory," which states that oil production follows a bell-shaped curve.

In the traditional vision of peak oil, the production decline accelerates as the cost of extracting new reserves grows. This would put pressure on existing reserves that are drawing down over time. If new reserves are not brought online more rapidly than the existing reserves drawdown, then peak oil has been reached. Peak oil has been declared several times, but each deceleration has proved premature because of new extraction technologies like hydraulic fracturing and better surveying techniques.

- Peak oil is a hypothetical scenario where oil production hits a maximum rate and begins to decline.
- When peak oil is reached, the discovery of new reserves cannot keep pace with the decline in existing reserves.
- Although declared several times, peak oil has not happened thanks to new technology that helped sustain oil production, keeping global supplies flowing.
- Peak oil might also happen due to declining demand, which would result from more efficient technologies and alternative energy sources.
- Studies of climate change suggest that a decline in oil consumption in favour of alternative energy sources will be necessary to avert catastrophic climate change.

Because oil is a non-replenishing resource, there is a limit to how much the world can extract and refine. However, the scenario of total depletion is just one version of peak oil. In theory, peak oil can be brought on by the

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