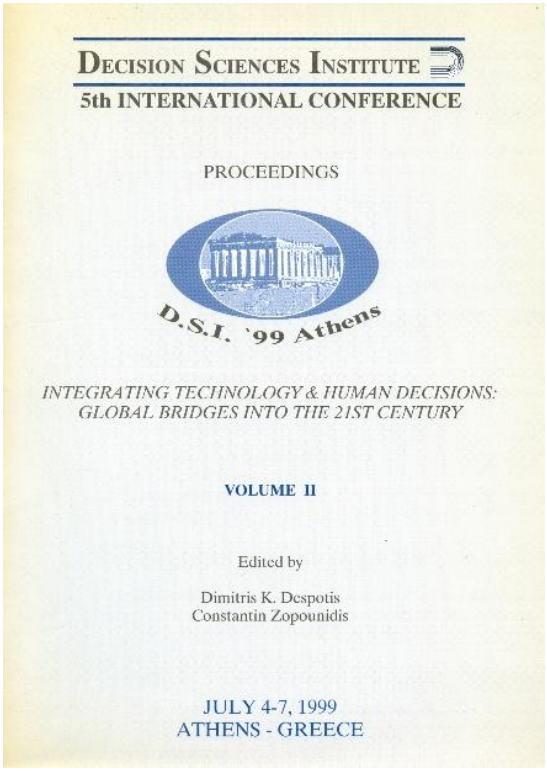


MODELS OF FORECASTING TO COURT TERMS OF QUANTITIES OF HYDROCARBONS TO TRANSPORT AND TO EXPORT BY THE ALGERIAN OIL COMPANY SONATRACH

S. Adjabi, D. Aissani, S. Meftali , S. Haddad
Laboratory LAMOS, University of Bejaia, Algeria

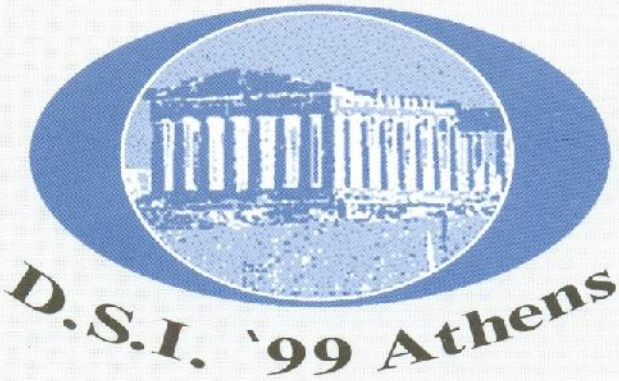
ABSTRACT

These last years, the discovery of many oil layers and the development of the partnership with foreign compa nies permit to the Algerian oil company Sonatrach to consider a significant increase of hydrocarbons production on the horizon 2001. This growth of production requires the mobilisation of important human and material resources. In view to plan and optimise its investments, this company, must therefore predict with a high precision the hydrocarbons quantities that will be transported on the pipelines network for the few years to come. The objective of this work is to elaborate ARMA-type mathematical prediction (based on Box and Jenkins method) for the yearly quantities of hydrocarbons to be transported on Haoud el Hamra– Bejaia (OB1) pipeline as well as those that will be exported off Bejaia harbour. The difference observed between the forecasts, obtained using Box and Jenkins method and the Sonatrach company forecasts shows the necessity to take into consideration not only the historic data, but also the production growth announced, the law that governs the oil economy, the hydrocarbons international market situation as well as the equipment renovation.

DECISION SCIENCES INSTITUTE

5th INTERNATIONAL CONFERENCE

PROCEEDINGS



INTEGRATING TECHNOLOGY & HUMAN DECISIONS: GLOBAL BRIDGES INTO THE 21ST CENTURY

VOLUME II

Edited by

Dimitris K. Despotis
Constantin Zopounidis

JULY 4-7, 1999
ATHENS - GREECE

MODELS OF FORECASTING TO COURT TERMS OF QUANTITIES OF HYDROCARBONS TO TRANSPORT AND TO EXPORT BY THE ALGERIAN OIL COMPANY SONATRACH

S. Adjabi, D. Aissani, S. Meftali , S. Haddad
Laboratory LAMOS, University of Bejaia, Algeria

ABSTRACT

These last years, the discovery of many oil layers and the development of the partnership with foreign compa nies permit to the Algerian oil company Sonatrach to consider a significant increase of hydrocarbons production on the horizon 2001. This growth of production requires the mobilisation of important human and material resources. In view to plan and optimise its investments, this company, must therefore predict with a high precision the hydrocarbons quantities that will be transported on the pipelines network for the few years to come. The objective of this work is to elaborate ARMA-type mathematical prediction (based on Box and Jenkins method) for the yearly quantities of hydrocarbons to be transported on Haoud el Hamra– Bejaia (OB1) pipeline as well as those that will be exported off Bejaia harbour. The difference observed between the forecasts, obtained using Box and Jenkins method and the Sonatrach company forecasts shows the necessity to take into consideration not only the historic data, but also the production growth announced, the law that governs the oil economy, the hydrocarbons international market situation as well as the equipment renovation.

BOX AND JENKINS METHODOLOGY

The Box-Jenkins methodology [1] [2] is a statistically sophisticated way for building forecast ARMA models (auto-regressive moving average models) which best represent a time series. This technique has many advantages over other methods of time series analysis because it allows for models building in both seasonal and non seasonal time series case, extracts a great deal of information from the historical time series data and it is statistically accurate.

This method identifies a possible useful model from a general class of ARMA models. After the estimation, the chosen model is then diagnostically checked against the historical time series to see if it describes accurately the time series. If the residuals between the forecast and the actual series is a white noise, then the chosen model is said to be a good fit. However, if the chosen model is not satisfactory, the process is repeated using other ARMA models until a satisfactory model is found..

MODELLING

Preliminary analysis of data

The collected data from the company Sonatrach, show that the balance between quantities transported by pipeline OB1 (Haoud el Hamra-Bejaia) and abductions to Bejaïa is respected.

- In 1959, receipts to the marine terminal as well as exports off the harbour of Bejaïa were very reduced , because the pipeline OB1 had just been put in service.
- Over the period going from 1960 to 1962, we note a considerable increase of these same quantities. It is essentially due to the installation of new pumping stations along the pipeline OB1.
- From 1963 to 1971, (between the recovery of independence of Algeria and the nationalisation of hydrocarbons) the intensive exploitation of pipeline OB1 explains the apparition of a peak on the graph representing the series of exported quantities, as well as on that of the transported ones.
- From 1972 to 1996, the company Sonatrach was responsible for all buildings realisations.

The data not having been collected in the same system working conditions, we preferred not to take into account the observations corresponding to the period spanning from 1959 to 1971 (before the nationalisation of hydrocarbons).

The variances of the two series are spanning too high (strong scattering with regard to the mean). That is why we applied a logarithmic transformation on each of the two series in view to obtain a reasonable variances value.

Export hydrocarbons quantities Modelling

Model identification

We can see clearly in the graph of figure 1 that the series does not present any tendency nor seasonality. Examining the correlogram and the partial correlogram , we note that the auto correlation trails off exponentially to zero and only the first partial auto correlation is statistically meaningful. Therefore, we consider for this series an auto regressive model (AR(1)) of order 1 with constant C, which has the following form:

$$X_t = C + \phi X_{t-1} + \varepsilon_t$$

Parameters estimation

The estimation of the parameter ϕ gives $\phi = 0.95901 < 1$, which means that this process is stationary. Using the test

of Student (statistic t = 12.9527), we find that this is meaningful at 0% level.

Model validation

The statistics of the Khi2 on the auto correlation which is approximately distributed as a χ^2 with 11 degrees of freedom is equal to 6.4483. This value does not exceed the value given on the Pearsons's table (19.675), so we can consider that the residuals ε_t of the chosen model correspond to a white noise process.

Finally the model of this series can be written under the form:

$$X_t = 0.66683 + 0.95901\, X_{t-1} + \varepsilon_t$$

with X_t = Log Y_t (Y_t corresponding to the original series)

Transport hydrocarbons quantities modelling

Model identification

We can see clearly in the graph of figure 2 that the series doesn't present any tendency or seasonality. Examining, the correlogram and the partial correlogram, we note that the auto correlation trails off exponentially to zero and only the first partial auto correlation is statistically meaningful. Therefore, we consider for this series an auto regressive model (AR(1)) of order 1 with constant C, which has the following form:

$$X_t = C + \phi X_{t-1} + \varepsilon_t$$

Parameters estimation

The estimation of the parameter ϕ gives $\phi = 0.957853 < 1$, that means that this process is stationary. Using the test of Student (statistic t = 12.6217), we find that this is meaningful at the 0% level.

Model validation

The statistics of the Khi2 on the auto correlation which is approximately distributed as a χ^2 with 11 degrees of freedom is equal to 6.4171. This value does not exceed the value given on the Pearsons's table (19.675), so we can consider that the residuals ε_t of the chosen model correspond to a white noise process.

Finally the model of this series can be written under the form:

$$X_t = 0.68232 + 0.95853\, X_{t-1} + \varepsilon_t$$

with X_t = Log Y_t (Y_t corresponding to the original series)

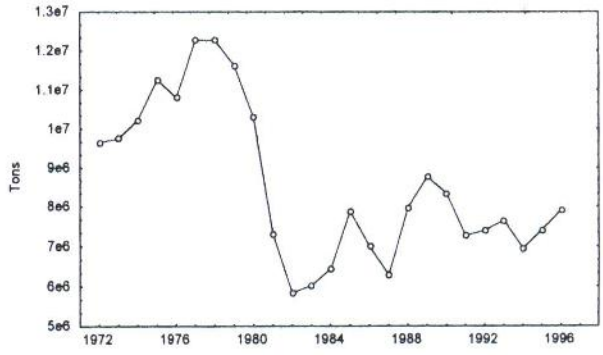


Figure 1: Exported quantities of hydrocarbons from 1972 to 1996

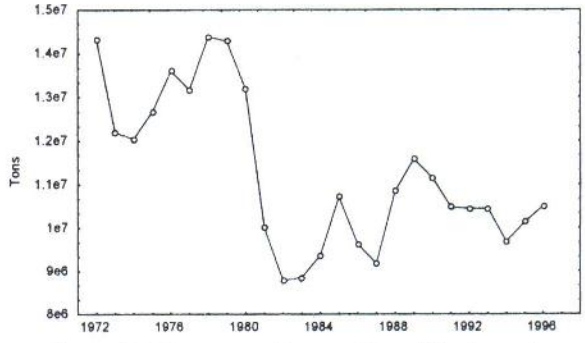


Figure 2 : Transported quantities of hydrocarbons from 1972 to 1996

SONATRACH FORECASTS

The forecasts put forward by the company Sonatrach are based on a national production for the year 2000 of 1 000 000 Barrel per day against 750 000 Barrel per day today, that is an increase of 33% over the four coming years. The growth of the production is going to generate a significant increase of crude oil and condansat quantities to be transported using the pipeline (H-E-H - Béjaïa) in 2001. That is 10 000 000 tons of crude oil and 4 000 000 tons of condansat.

DISCUSSION

This study shows clearly that the obtained forecasts using Box and Jenkin method are likely to correspond to real figures since it shows a steady growth of hydrocarbons quantities to be exported off Bejaia harbour as well as those to be transported using the OB1 pipeline over the considered period (5 years). The forecasts are indeed justified by the realisations carried out by the company Sonatrach over last two years (1997 and 1998).

The mean deviation between our derived forecasts and those obtained by the company Sonatrach is 1 778 203 tons (see figures 3 and 4). This difference may be explained by the fact that our forecasts have been established only on the basis of the historical data while those given by the company have been derived taking into account : the production growth, the laws governing the oil economy, the hydrocarbons international market

situation and the equipment improvements and renewal sought.

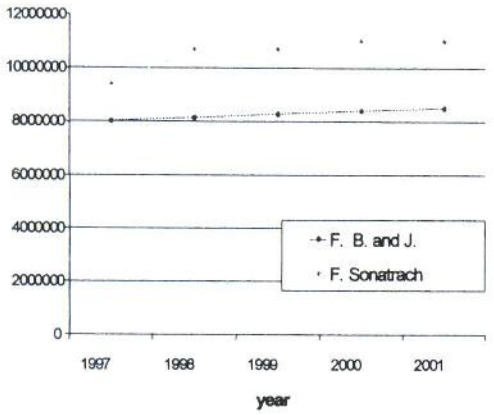


Figure 3: Export quantities forecasts comparison

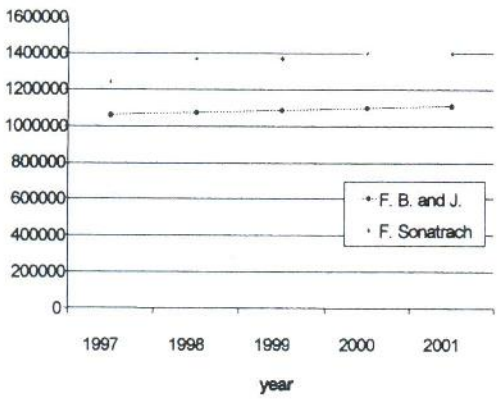


Figure 4: Transport quantities forecasts comparison

REFERENCES

[1] BOX ,G.E.P. and JENKINS, G. (1976), Time Series Analysis, Forecasting and Control, Revised ed, Holden-Day;
San Fransisco.

[2] MELARD, G. (1990), Méthodes de prévision à court terme, Editions de l'Université de Bruxelles.

MODELS OF FORECASTING TO COURT TERMS OF QUANTITIES OF HYDROCARBONS TO TRANSPORT AND TO EXPORT BY THE ALGERIAN OIL COMPANY SONATRACH

S. Adjabi, D. Aissani, S. Meftali , S. Haddad
Laboratory LAMOS, University of Bejaia, Algeria

ABSTRACT

These last years, the discovery of many oil layers and the development of the partnership with foreign compa nies permit to the Algerian oil company Sonatrach to consider a significant increase of hydrocarbons production on the horizon 2001. This growth of production requires the mobilisation of important human and material resources. In view to plan and optimise its investments, this company, must therefore predict with a high precision the hydrocarbons quantities that will be transported on the pipelines network for the few years to come. The objective of this work is to elaborate ARMA-type mathematical prediction (based on Box and Jenkins method) for the yearly quantities of hydrocarbons to be transported on Haoud el Hamra– Bejaia (OB1) pipeline as well as those that will be exported off Bejaia harbour. The difference observed between the forecasts, obtained using Box and Jenkins method and the Sonatrach company forecasts shows the necessity to take into consideration not only the historic data, but also the production growth announced, the law that governs the oil economy, the hydrocarbons international market situation as well as the equipment renovation.