# Fahrpläne

### Fahrplan Einleitung

* <https://www.eea.europa.eu/data-and-maps/indicators/passenger-and-freight-transport-demand/assessment>
* road transport (76 %) still claims the biggest share concerning transportation mode in 2016
* Impact on climate: Hwang, bmvi
* Effect on profitability (Fite): Auftragsplanung spart Geld durch weniger Leerfahrten, halbvolle Fahrten
* Lebensqualität für die Fahrer und lower turnover rate (Fite)
* Improve customer service? (Fite)

### Fahrplan Literaturübersicht

* Bisher: Modelle zur Gesamtstrukturierung: disaggregate/aggregate, mode split, i/o
* Transportation Modelin: Trip generation (choice of purpose), trip distribution (choice of destination), mode split (choice of vehicle), trip assignment (choice of path)
* Paper aufzählen, die was Ähnliches gemacht haben:

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| **Autor** | **Was passiert** |
| Taghizadeh | ANN für wettersensitive Einzelhandelsprodukte |
| Miller 2018 | ARIMA for FTL transportation prices |
| Gao | Combined Grey-ANN-SVM for FTL volume |
| Adhikari | Ensemble ANN for time series forecasting |

* Ordnen Nach: Allgemein Time Series, Methoden, Zielgröße
* Freight demand can be measured differently: volume, tkm,… as comparability is not the goal in this study, weight is perfectly fine
* Definition tkm: <https://www.destatis.de/DE/Publikationen/WirtschaftStatistik/Verkehr/Gueterverkehr2012_92013.pdf?__blob=publicationFile>

### Fahrplan Methodenselektion:

Balkin (2000): RNN können MA-Struktur in ARMA-Modellen abbilden; FNN können nur AR.

Dorffner über FANN: 



* Extra-Abschnitt über welches NN-Modell!!

Dorffner: FANN für AR-Modelle, JordanNN oder ElmanNN für ARMA-Modelle

Conclusion: If AR -> FNN, if ARMA -> RNN

* Nach Box-Jenkins gucken, was wir vorliegen haben!

### Fahrplan SARIMA:

Dorffner. For practical purposes, however, time is usually viewed in terms of discretetime steps.

If the vector x contains only one component, which is the case in many applications, one speaks of a univariate time series, otherwise it is a multivariate one

modeling of time series is implicitly contained in most instances of forecasting

Zhou:

Haben gute model selection tips für ARIMA

### Fahrplan Variablenselektion:

* Modell soll nicht überfrachtet werden

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| --- | --- |
| **Autor** | **Was passiert** |
| Fite | National/regional/local economic measures via correlation and stepwise multiple regression |
| ?? | Fuel price doch nicht gut |
| CHandrashekar | Beschreibt 3 Typen Filter, Wrapper, Embedded |

Fite: truckload companies haben über externe Variablen keine Kontrolle.

### Fahrplan ANN

Übersicht über ANN und Geschichte im Allgemeinen:

Universal function approximators

Dorffner: MLP\_ hidden units with sigmoidal transfer functions\_ \_\_\_\_ and radial basis

function networks \_RBFN\_ hidden units using a distance propagation rule

and a Gaussian\_ or other\_ transfer functions\_ \_\_\_􀀀

* Nicht nonparametrisch! Fixed number of layers

It becomes clear from equations \_ and \_\_ \_or \_\_ and \_\_\_ respectively\_

that an MLP or RBFN can replace the linear function of the AR-model in equation \_\_ by

an arbitrary non\_linear function FNN \_with NN being either MLP or RBF. This non\_linear function can be estimated based on samples from the series using one of the well\_known learning or optimization techniques for these networks \_e.g. backpropagation\_ conjugent gradient\_ etc.

single-layer perceptron = linear regression

Balkin: ANN in simplest form = AR, RNN = ARMA

Pinto sehr gut für Theorie!

Zhang für Auswahl von Structure

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| Autor | Wofür | Modell | Extra |
| Balkin | TSA | ARIMA mit FNN und RNN -> NN slightly > ARMA but RNN higher computation time |  |
| Adhikari | TSA | FANN (Feedforward ANN); EANN (Elman ANN) = RNN <https://en.wikipedia.org/wiki/Recurrent_neural_network#Elman_networks_and_Jordan_networks>  Keine activation function beschrieben | RBF; Ensemble mit ARIMA und SVR |
| Taghizadeh | Weather-sensitive retail products with external data | MLP (multi-layer perceptron) FANN, time-delay, bagging, RNN   * MLP am besten * Sigmoid function |  |
| Feng | Railway freight volume | DBN (deep-belief network)  Besser als SARIMA, DBN, back propagation neural network (log-sigmoid), Elman neural network (tan-sigmoid), and radial basis function neural network | Ensemble mit SARIMA; Gaussian particle swarm optimization for DBN model selection |
| Khandelwal | TSA | FANN mit logistic activation function | Hybrid mit ARIMA und DWT decomposition in lineare und nonlineare Teile |
| Kourentzes | TSA | MLP-FANN, hyperbolic tanh for hidden nodes and linear for output | Ensemble; Bagging und mean-median-mode; Kombination ist wichtig für accuracy; |
| Zhou | Short-term demand for LTL carrier | Three-layer MFNN, k.A. zu transfer function | NN-deseasonalized-detrended > ARIMA |
| Benkachcha | TSA | MLP-FANN with LM-learning algorithm, sigmoid and linear transfer functions | High accuracy with or without decomposition |
| Pinto | TSA | One layer FANN with LM-learning algorithm, logistic transfer function | Decomposition und dort local measures |

### Fahrplan Data Processing:

* fehlende Werte?
* Quartale berichtigen
* Umwandeln in „cal“
* One hot encoding
* Lags

Dorffner: In most cases\_ it is necessary to pre\_analyze\_

as well as preprocess the time series to ensure an optimal outcome of the

processing􀀀 One one hand\_ this has to do with the method employed\_ which

can usually extract only certain kinds of systematicities - i.e. usually those

that are expressed in terms of vector similarities- On the other hand,

it is necessary to remove known systematicities which could hamper the

performance [trends, cycles].

Prior knowledge [gained through preprocessing] should be handled explicitly

### Fahrplan zukünftiger Ausblick:

* Räumliche Vorhersagen (wohin geht am meisten?)
* Produkttypvorhersagen
* Kombinierte Modelle (bzw bagging) (Kourentzes usw) Kourentzes:

Apart from improving accuracy, using ensembles also avoids the problem of identifying and choosing the best trained network.There is a growing consensus that model combination has advantages over selecting a single model not only in terms of accuracy and error variability, but also simplifying model building and selection, and therefore the forecasting process as a whole

* Pinto: „Extrainfo“ aus der Zeitreihe (Struktur) mit nutzen
* Andere Kernels usw nutzen?

### Praxisteil

Variablenselektion:

Zhou:

However, LTL service providers mainly serve regional clients, and the regional demand and supply can not represent national economic activities completely. So it may have no obvious correlation between the macroeconomic indexes and demand of LTL service providers.

ANN:

Benkachcha: Thus for the multilayer perceptron used to forecast the time series the inputs are the past observations without removing the seasonal effect from the data series and the output is the future value. The MLP performs the following function mapping:

Where is the estimated output, is the training pattern which consist of a fixed number (n) of lagged observations of the series. With P observations for the series, we have P-n training patterns. There is no suggested systematic way to determine the number of the input nodes (n).