Logistics. Theory and Practice.

- **Logistics** is the art of managing the supply chain and science of managing and controlling the flow of goods, information and other resources like energy and people between the point of origin and the point of consumption in order to meet customers' requirements. It involves the integration of information, transportation, inventory, warehousing, material handling, and packaging.

Origins and definition

- The word of logistics originates from the ancient Greek logos (λόγος), which means *"ratio, word, calculation, reason, speech, oration"*.
- *The branch of science having to do with procuring, maintaining and transporting material, personnel and facilities.*

Logistician

- Sea
- Air
- Land
- Rail

Military logistics

- In military logistics, logistics officers manage how and when to move resources to the places they are needed. In military science, maintaining one's supply lines while disrupting those of the enemy is a crucial—some would say the most crucial—element of military stratagy, since an armed force without resources and transportation is defenseless

Medical logistics

- Medical logistics is the logistics of pharmaceuticals, medical and surgical supplies, medical devices and equipment, and other products needed to support doctors, nurses, and other health and dental care providers.

Business logistics

- Inventory management
- Purchasing
- Transportation
- Warehousing

- This can be defined as *having the right item in the right quantity at the right time at the right place for the right price*

Supply Chain Management Problems

- **Supply chain management (SCM)** is the process of planning, implementing, and controlling the operations of the supply chain as efficiently as possible. Supply Chain Management spans all movement and storage of raw materials, work-in-process inventory, and finished goods from point-of-origin to point-of-consumption.

- Distribution Network Configuration: Number and location of suppliers, production facilities, distribution centers, warehouses and customers.
- Distribution Strategy: Centralized versus decentralized, direct shipment, Cross docking, pull or push strategies.
- Information: Integration of systems and processes through the supply chain to share valuable information, including demand signals, forecasts, inventory and transportation
- Inventory Management: Quantity and location of inventory including raw materials, work-in-process and finished goods.
- Cash-Flow: Arranging the payment terms and the methodologies for exchanging funds across entities within the supply chain.

Activities/functions

- **Strategic**
- **Tactical**
- **Operational**

Strategic

- Strategic network optimization, including the number, location, and size of warehouses, distribution centers and facilities.
- Strategic partnership with suppliers, distributors, and customers
- Product design coordination so that new and existing products can be optimally integrated into the supply chain, load management
- Information Technology infrastructure to support supply chain operations.
- Where-to-make and what-to-make-or-buy decisions
- Aligning overall organizational strategy with supply strategy.

Tactical

- Sourcing contracts and other purchasing decisions.
- Production decisions including contracting, locations, scheduling, and planning process definition.
- Inventory decisions including quantity, location, and quality of inventory.
- Transportation strategy including frequency, routes, and contracting.
- Benchmarking of all operations
- Milestone payments

Operational

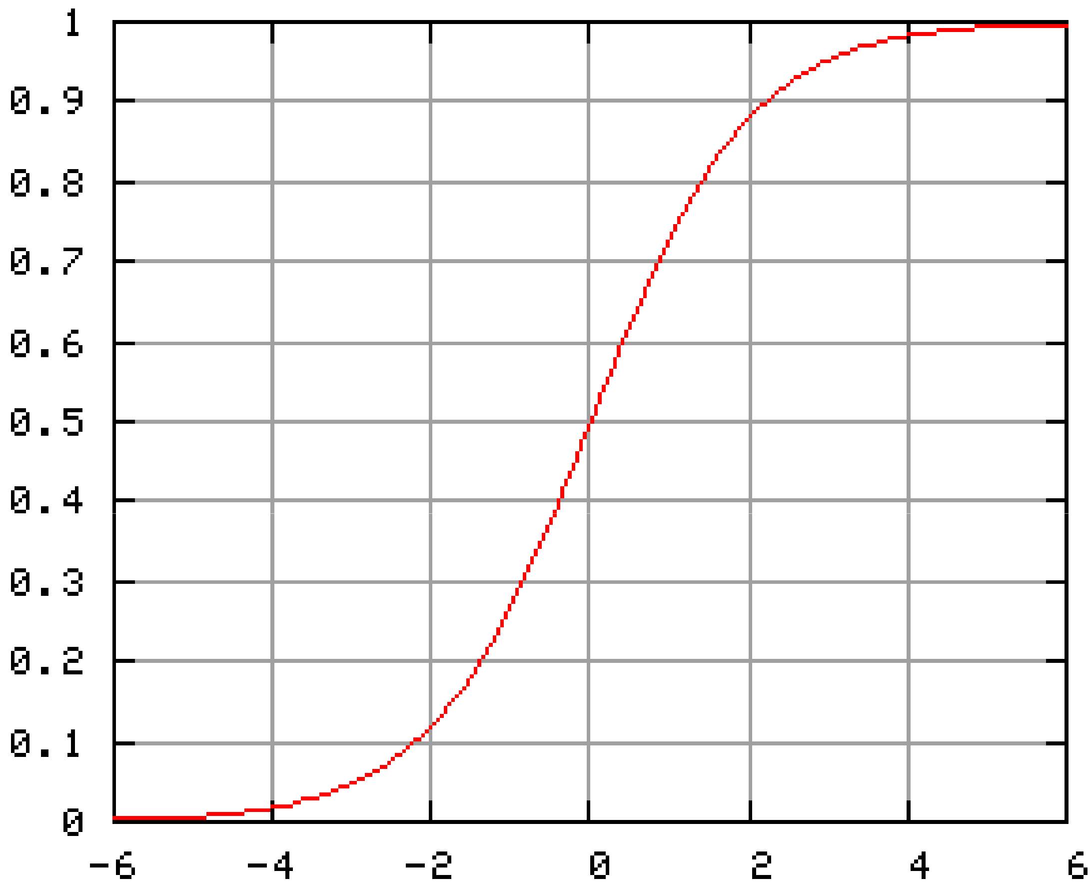
- Daily production and distribution planning
- Production scheduling for each manufacturing facility in the supply chain (minute by minute).
- Demand planning and forecasting , coordinating the demand forecast of all customers and sharing the forecast with all suppliers.
- Sourcing planning , including current inventory and forecast demand, in collaboration with all suppliers.
- Inbound operations-transportation from suppliers and receiving inventory.
- Production operations
- Outbound operations--fulfillment activities and transportation to customers.
- Order promising, accounting for all constraints in the supply chain, including all suppliers, manufacturing facilities, distribution centers, and other customers.

Production logistics

- The term is used for describing logistic processes within an industry. The purpose of production logistics is to ensure that each machine and workstation is being fed with the right product in the right quantity and quality at the right point in time.

Theoretical view

- A **sigmoid function** is a mathematical function that produces a **sigmoid curve** — a curve having an "S" shape. Often, *sigmoid function* refers to the special case of the logistic function

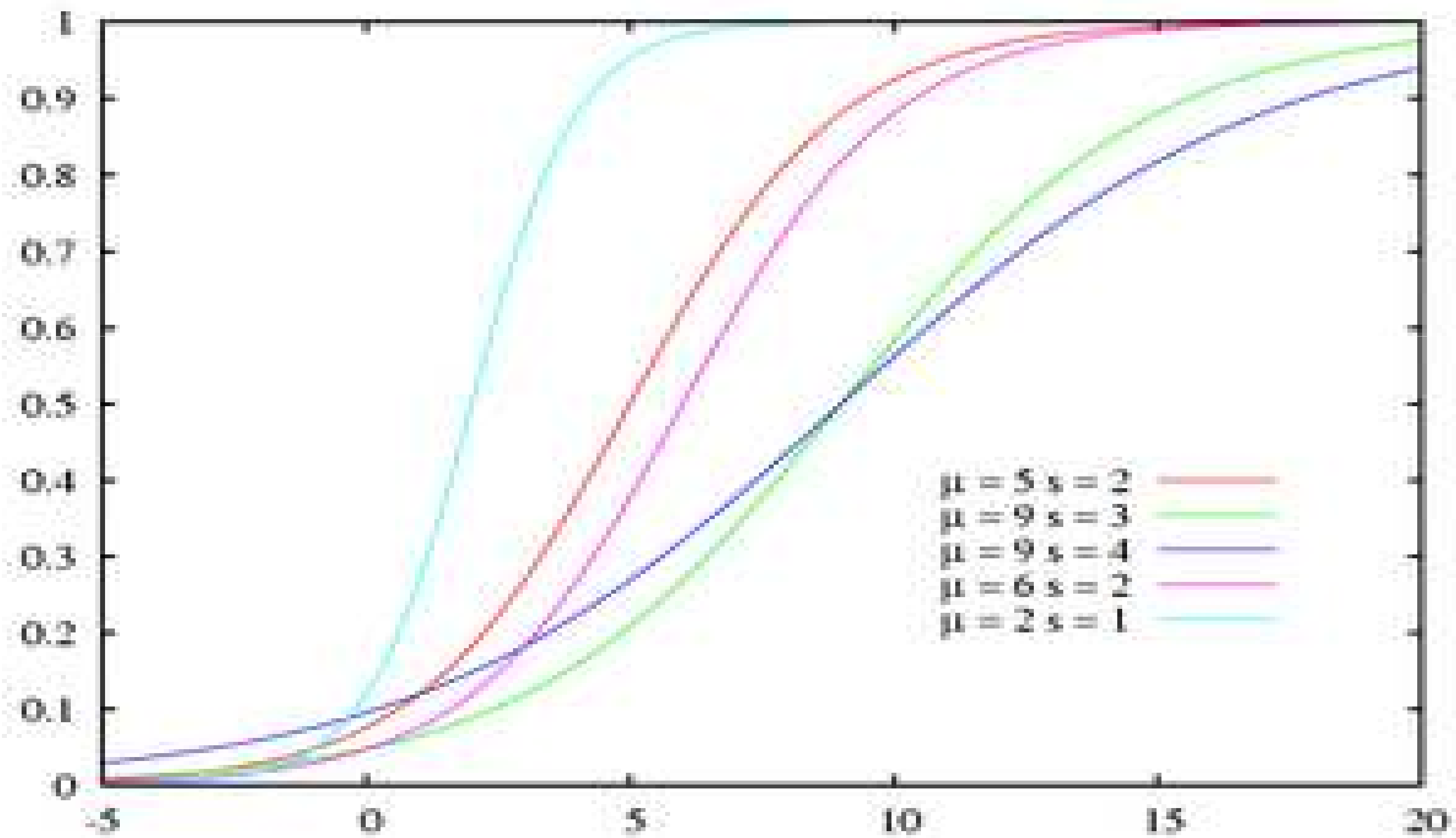


$$P(t) = \frac{1}{1+e^{-t}}.$$

Cumulative distribution function

- The logistic distribution receives its name from its cumulative distribution function (cdf), which is an instance of the family of logistic functions:

$$F(x;\mu,s) = \frac{1}{1+e^{-(x-\mu)/s}} = \frac{1}{2} + \frac{1}{2}\tanh\left(\frac{x-\mu}{2\,s}\right).$$

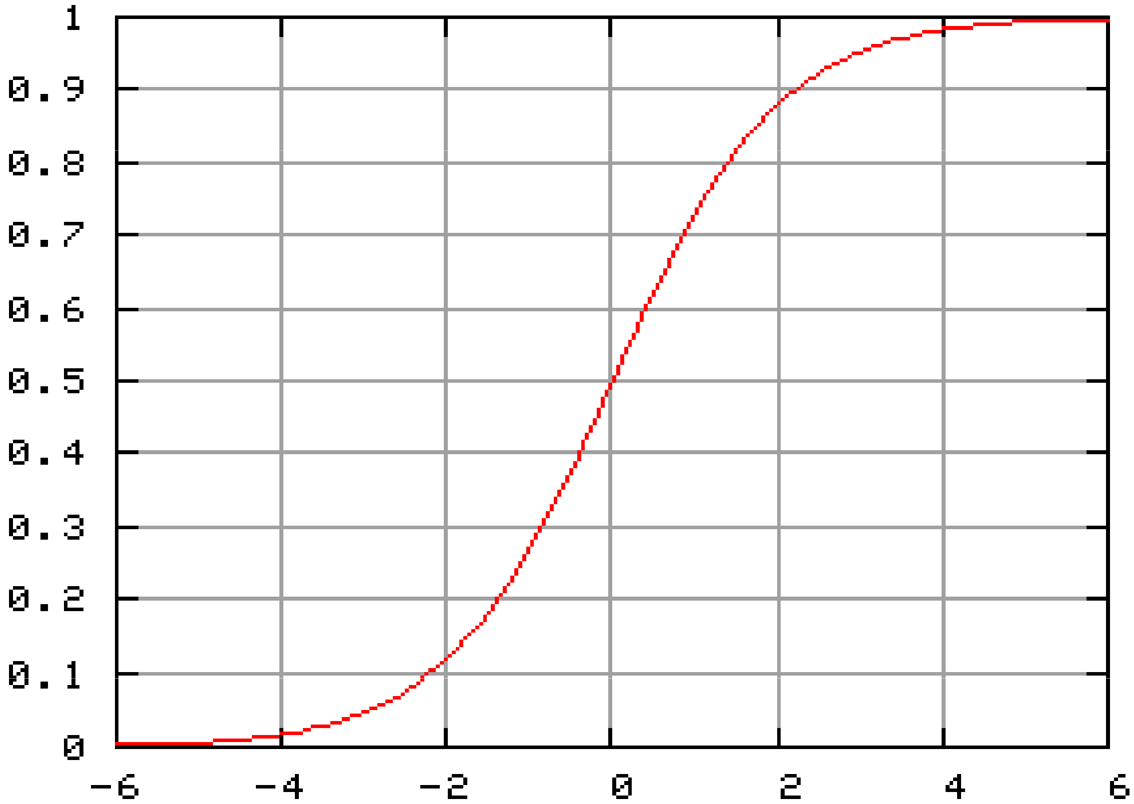


Logistic regression

- **logistic regression** is a model used for prediction of the probability of occurrence of an event. It makes use of several predictor variables that may be either numerical or categories. Logistic regression is used extensively in the medical and social sciences as well as marketing applications such as prediction of a customer's propensity to purchase a product or cease a subscription.
- For example, the probability that a person has a heart attack within a specified time period might be predicted from knowledge of the person's age, sex and body mass index.

Lay explanation

- An explanation of logistic regression begins with an explanation of the logistic function:



$$f(z) = \frac{1}{1 + e^{-z}}$$

- The logistic function, with *z* on the horizontal axis and *f(z)* on the vertical axis.
- The "input" is *z* and the "output" is *f*(*z*).

- The logistic function is useful because it can take as an input, any value from negative infinity to positive infinity, whereas the output is confined to values between 0 and 1. The variable *z* represents the exposure to some set of risk factors, while *f*(*z*) represents the probability of a particular outcome, given that set of risk factors. The variable *z* is a measure of the total contribution of all the risk factors used in the model and is known as the logit.
- The variable *z* is usually defined as

$$z = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \cdots + \beta_k x_k,$$

- where β_0 is called the "intercept" and β_1, β_2, β_3, and so on, are called the “regression coefficients" of x_1, x_2, x_3 respectively.

- The intercept is the value of *z* when the value of all the other risk factors is zero (i.e., the value of *z* in someone with no risk factors). Each of the regression coefficients describes the size of the contribution of that risk factor. A positive regression coefficient means that that risk factor increases the probability of the outcome, while a negative regression coefficient means that that risk factor decreases the probability of that outcome; a large regression coefficient means that that risk factor strongly influences the probability of that outcome; while a near-zero regression coefficient means that that risk factor has little influence on the probability of that outcome.

- The application of a logistic regression may be illustrated using a fictitious example of death from heart disease. This simplified model uses only three risk factors (age, sex and cholesterol) to predict the 10-year risk of death from heart disease. This is the model that we fit:
- $\beta_0 = -5.0$ (the intercept)
- $\beta_1 = +2.0$
- $\beta_2 = -1.0$
- $\beta_3 = +1.2$
- x_1 = age in decades, less 5.0
- x_2 = sex, where 0 is male and 1 is female
- x_3 = cholesterol level, in mmol/dl less 5.0

$$\text{risk of death} = \frac{1}{1+e^{-z}}, \text{ where } z = -5.0 + 2.0x_1 - 1.0x_2 + 1.2x_3.$$

- In this model, increasing age is associated with an increasing risk of death from heart disease (z goes up by 2.0 for every 10 years over the age of 50), female sex is associated with a decreased risk of death from heart disease (*z* goes down by 1.0 if the patient is female) and increasing cholesterol is associated with an increasing risk of death (z goes up by 1.2 for each 1 mmol/dl increase in cholesterol).
- We wish to use this model to predict Mr Smith's risk of death from heart disease: he is 50-years-old and his cholesterol level is 7.0 mmol/dl. Mr Smith's risk of death is therefore

$$\frac{1}{1+e^{-z}}, \text{ where } z = -5.0 + (+2.0)(5.0-5.0) + (-1.0)0 + (+1.2)(7.0-5.0).$$

- This means that by this model, Mr Smith's risk of dying from heart disease in the next 10 years is 0.08 (or 8%).

Formal mathematical specification

$$Y_i \sim B(n_i, p_i), \text{ for } i = 1, \dots, m,$$

- where the numbers of Bernoulli trials n_i are known and the probabilities of success p_i are unknown. An example of this distribution is the fraction of seeds (p_i) that germinate after n_i are planted.

- The model proposes for each trial (value of *i*) there is a set of explanatory variables that might inform the final probability. These explanatory variables can be thought of as being in a *k* vector X_i and the model then takes the form

$$p_i = \mathrm{E}\left(\left.\frac{Y_i}{n_i}\right| X_i\right).$$

- The logits of the unknown binomial probabilities (*i.e.*, the logarithms of the odds) are modeled as a linear function of the X_i.

$$\operatorname{logit}(p) = \log\left(\frac{p}{1-p}\right) = \log(p) - \log(1-p).$$

$$\operatorname{logit}(p_i) = \ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 x_{1,i} + \cdots + \beta_k x_{k,i}.$$

- Note that a particular element of X_i can be set to 1 for all i to yield an intercept in the model.
- The interpretation of the β_j parameter estimates is as the additive effect on the log odds ratio for a unit change in the jth explanatory variable.

- The **odds ratio** is a measure of effective size particularly important in logistic regression.
- It is defined as the ratio of the odds of an event occurring in one group to the odds of it occurring in another group, or to a sample-based estimate of that ratio. These groups might be men and women, an experimental group and a control, or any other dichotomous classification. If the probabilities of the event in each of the groups are *p* (first group) and *q* (second group), then the odds ratio is:

$$\frac{p/(1-p)}{q/(1-q)} = \frac{p(1-q)}{q(1-p)}.$$

- An odds ratio of 1 indicates that the condition or event under study is equally likely in both groups. An odds ratio greater than 1 indicates that the condition or event is more likely in the first group.. The odds ratio must be greater than or equal to zero. As the odds of the first group approaches zero, the odds ratio approaches zero. As the odds of the second group approaches zero, the odds ratio approaches positive infinity.

- For example, suppose that in a sample of 100 men, 90 have drunk wine in the previous week, while in a sample of 100 women only 20 have drunk wine in the same period. The odds of a man drinking wine are 90 to 10, or 9:1, while the odds of a woman drinking wine are only 20 to 80, or 1:4 = 0.25:1. Now, 9/0.25 = 36, so the odds ratio is 36, showing that men are much more likely to drink wine than women. Using the above formula for the calculation yields:

$$\frac{0.9/0.1}{0.2/0.8} = \frac{0.9 \times 0.8}{0.1 \times 0.2} = \frac{0.72}{0.02} = 36.$$

- This example also shows how odds ratios can sometimes seem to overstate relative positions: in this sample men are 90/20 = 4.5 times more likely to have drunk wine than women, but have 36 times the odds.

- The model has an equivalent formulation

$$p_i = \frac{1}{1+e^{-(\beta_0+\beta_1 x_{1,i}+\cdots+\beta_k x_{k,i})}}.$$

- This functional form is commonly called a single-layer perceptron or single-layer artificial neural network. A single-layer neural network computes a continuous output instead of a step function. The derivative of p_i with respect to $X = x_1 \ldots x_k$ is computed from the general form:
- $$y = \frac{1}{1+e^{-f(X)}}$$ easy to take $$y' = y(1-y)\frac{\mathrm{d}f}{\mathrm{d}X}$$

- where $f(X)$ is an analytic function in X. With this choice, the single-layer network is identical to the logistic regression model. This function has a continuous derivative, which allows it to be used in back-propagation.

Extensions

- Extensions of the model cope with multi-category dependent variables and ordinal dependent variables, such as polynomial regression. Multi-class classification by logistic regression is known as multinomial logit modeling. An extension of the logistic model to sets of interdependent variables is the conditional random field.

Logistic map

- The **logistic map** is a polynomial mapping, often cited as an archetypal example of how complex, chaotic behavior can arise from very simple non-linear dynamical equations. The map was popularized in a seminal 1976 paper by the biologist Robert May, in part as a discrete-time demographic model analogous to the logistic equation first created by Pierre Francois Verhulst. Mathematically, the logistic map is written

$$x_{n+1} = rx_n(1 - x_n)$$

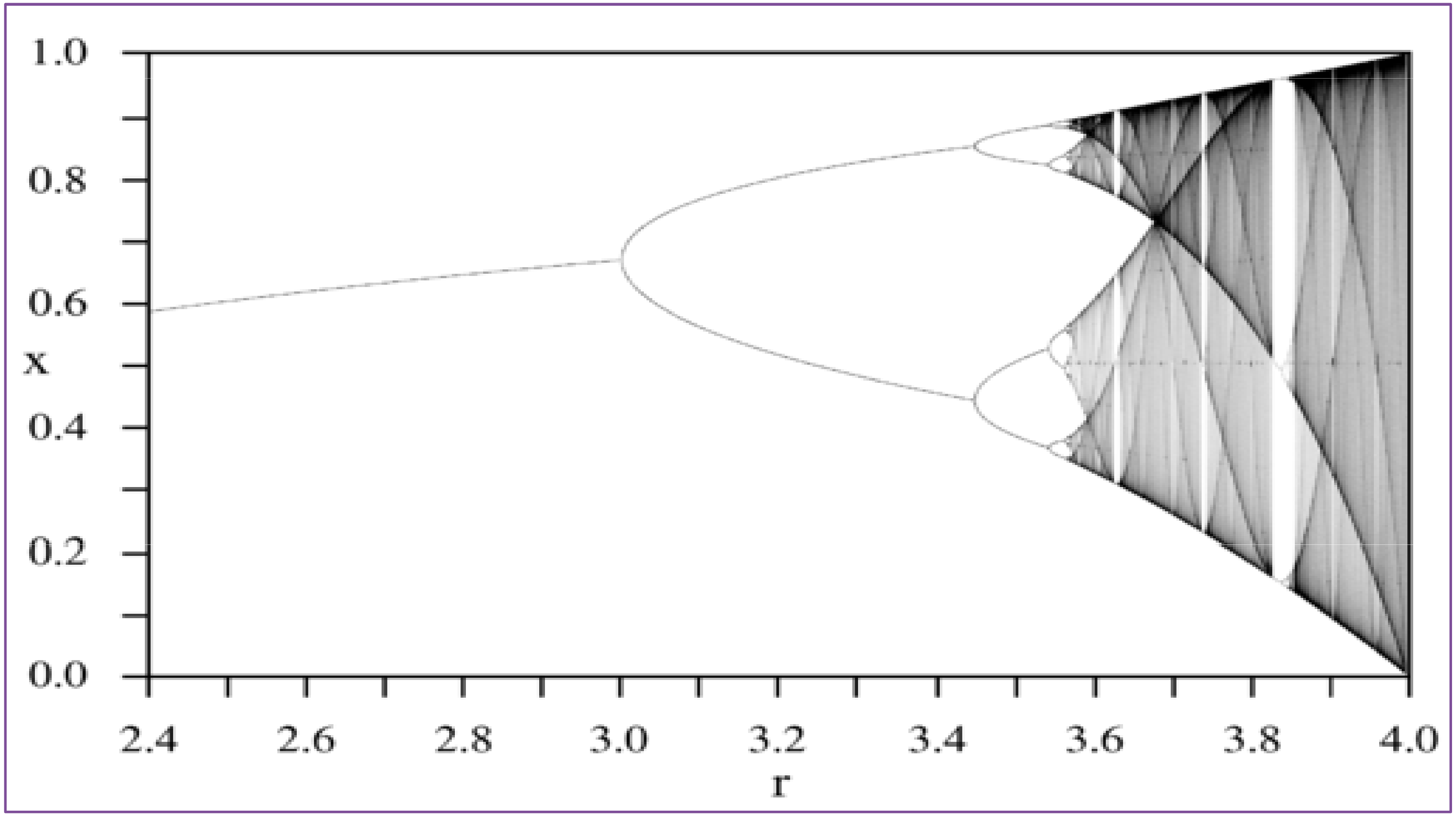
- x_n is a number between zero and one, and represents the population at year n, and hence x_0 represents the initial population (at year 0)
- r is a positive number, and represents a combined rate for reproduction and starvation.

Behaviour dependent on *r*

- By varying the parameter *r*, the following behaviour is observed
- With *r* between 0 and 1, the population will eventually die, independent of the initial population.
- With *r* between 1 and 2, the population will quickly stabilize on the value
- (r-1)/r, independent of the initial population. With *r* between 2 and 3, the population will also eventually stabilize on the same value
- (r-1)/r, but first oscillates around that value for some time. The rate of convergence is linear, except for *r*=3, when it is dramatically slow, less than linear.
- With *r* between 3 and (approximately 3.45), the population may oscillate between two values forever. These two values are dependent on *r*.

- With *r* increasing beyond 3.54, the population will probably oscillate between 8 values, then 16, 32, etc. The lengths of the parameter intervals which yield the same number of oscillations decrease rapidly.
- At *r* approximately 3.57 is the onset of chaos, at the end of the period-doubling cascade. We can no longer see any oscillations. Slight variations in the initial population yield dramatically different results over time, a prime characteristic of chaos.
- Most values beyond 3.57 exhibit chaotic behavior, but there are still certain isolated values of *r* that appear to show non-chaotic behavior; these are sometimes called islands of stability.
- Beyond *r* = 4, the values eventually leave the interval [0,1] and diverge for almost all initial values.

- A bifurcation diagram summarizes this. The horizontal axis shows the values of the parameter *r* while the vertical axis shows the possible long-term values of *x*.



- Bifurcation diagram for the Logistic map

Ricker model

- The Ricker model is a classic discrete population model which gives the expected number (or density) of individuals a_{t+1} in generation $t + 1$ as a function of the number of individuals in the previous generation,

$$a_{t+1} = a_t e^{r\left(1 - \frac{a_t}{k}\right)}$$

- Here r is interpreted as an intrinsic growth rate and k as the carrying capacity of the environment
- The Ricker model is a limiting case of the Hassell model which takes the form

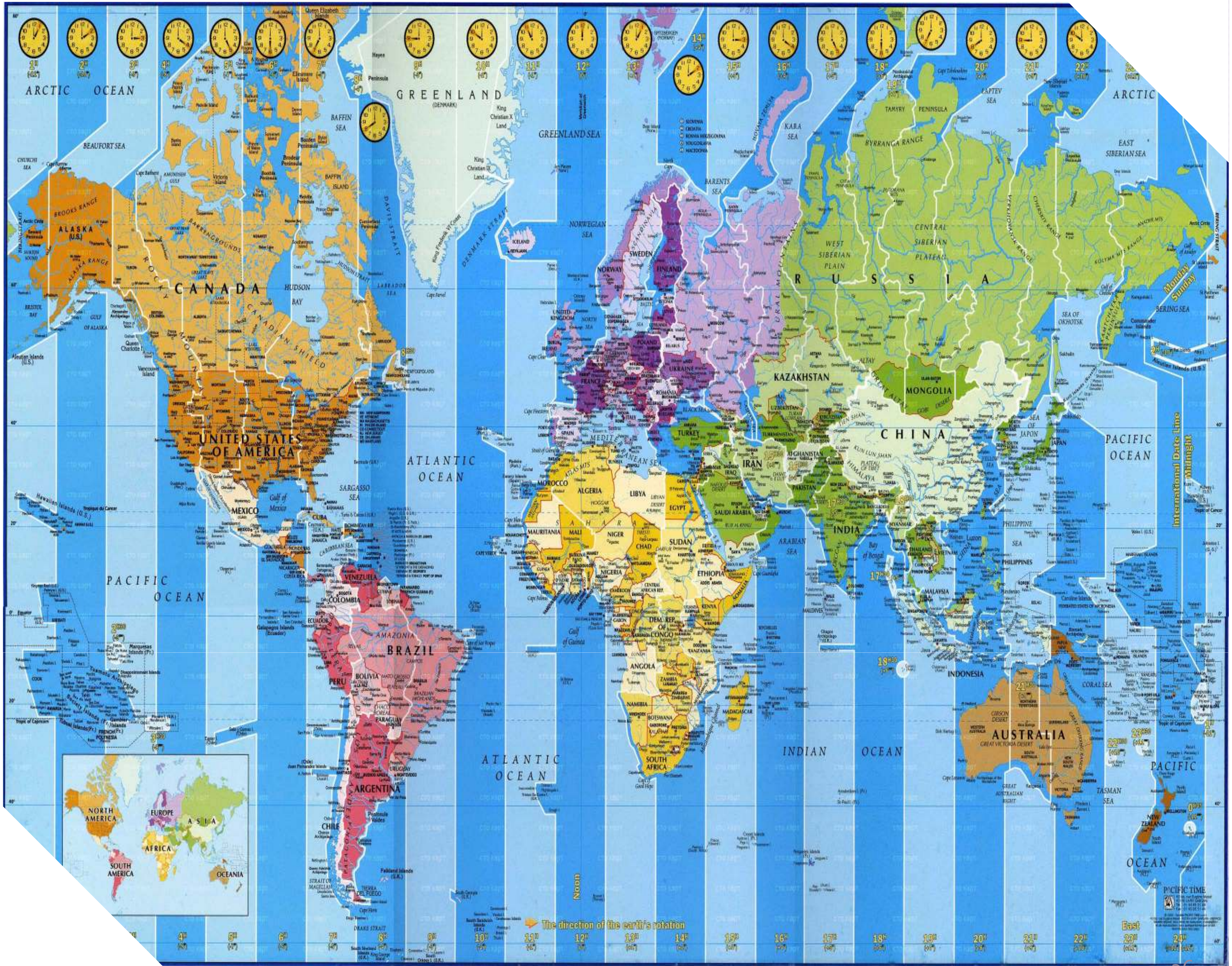
$$a_{t+1} = k_1 \frac{a_t}{(1 + k_2 a_t)^c}.$$

- Hence, and fortunately, even if we know very little about the initial state of the logistic map (or some other chaotic system), we can still say something about the distribution of states a long time into the future, and use this knowledge to inform decisions based on the state of the system.

Back to Practice.

- **Containerized cargo.**

- **Bulk Cargo.**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BARENTS SEA
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NEW ZEALAND
JAPAN
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CORAL SEA
TASMAN SEA
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SOUTH AMERICA
EUROPE
AFRICA
ASIA
OCEANIA
International Date Line Midnight
Monday Sunday
Noon
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East
PACIFIC TIME

- Warehouse
  - Trucking — Rail
    - Shipping
      - Trucking
        - Store
- Doremove
  - Shipping
    - Trucking


MAERSK LINE


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Steps of the business -first steps

- Chose the business
- Business-plan
- Bank
- Contract of financing
- Signing with a bank

-second steps

- Definition

- Searching

-third part

- Carry on negotiations with
- Negotiation of all conditions of contracts on the meetings;

-forth part

- open documentary irrevocable confirmed Letter of

- Signing the Contract with

- Sending application to the Bank for opening the Letter of Credit to the Maker – all terms of the letter of Credit has to be agreed in a Contract with a Maker;

-the last one

- Payments

- Receiving money from your Buyers.


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- Thank you for your attention!!