

# Prediction

For other uses, see Prediction (disambiguation).

A **prediction** (Latin *præ-*, “before,” and *dicere*, “to say”)



The Old Farmer's Almanac is famous in the US for its (not necessarily accurate) long-range weather predictions.

or **forecast** is a statement about the way things will happen in the future, often but not always based on experience or knowledge. While there is much overlap between *prediction* and *forecast*, a *prediction* may be a statement that some outcome is expected, while a *forecast* is more specific, and may cover a range of possible outcomes. A “prediction” may be contrasted with a “projection”, which is explicitly dependent on stated assumptions.

Although guaranteed accurate information about the future is in many cases impossible, prediction can be useful to assist in making plans about possible developments; Howard H. Stevenson writes that prediction in business "... is at least two things: Important and hard."<sup>[1]</sup>

## 1 Informal prediction

Outside the rigorous context of science, the term “prediction” is often used to refer to an informed guess or opinion. A prediction of this kind might be inductively valid if the predictor is a knowledgeable person in the field and is employing sound reasoning and accurate data. Large corporations invest heavily in this kind of activity to help focus attention on possible events, risks and business opportunities, using futurists. Such work brings together all available past and current data, as a basis to develop reasonable expectations about the future.

## 2 Statistics

More formal and systematic predictions can be made by the testing of formal hypotheses using statistical methods. Ideally formal hypotheses are constructed connecting systematic knowledge of an area which is often generated through a literature review. In addition, clear and well thought out reasons for the predicted relationship exist.<sup>[2][3]</sup>

In statistics, prediction is a part of statistical inference. One particular approach to such inference is known as predictive inference, but the prediction can be undertaken within any of the several approaches to statistical inference. Indeed, one description of statistics is that it provides a means of transferring knowledge about a sample of a population to the whole population, and to other related populations, which is not necessarily the same as prediction over time. When information is transferred across time, often to specific points in time, the process is known as forecasting.

In many applications it is possible to estimate the models that generate the observations. If models can be expressed as transfer functions or in terms of state-space parameters then smoothed, filtered and predicted data estimates can be calculated.<sup>[4]</sup> If the underlying generating models are linear then a minimum-variance Kalman filter and a minimum-variance smoother may be used to recover data of interest from noisy measurements. These techniques rely on one-step-ahead predictors (which minimise the variance of the prediction error). When the generating models are nonlinear then stepwise linearizations may be applied within Extended Kalman Filter and smoother recursions. However, in nonlinear cases, optimum minimum-variance performance guarantees no

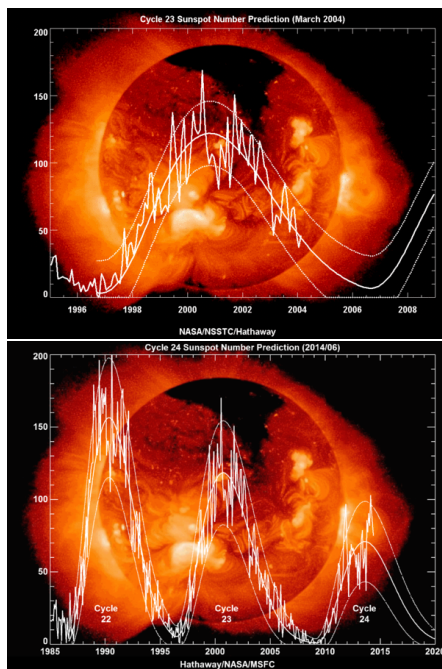
longer apply.

Statistical techniques used for prediction include regression analysis and time series analysis, and their various sub-categories such as ordinary least squares, logistic regression, autoregressive moving average models, and vector autoregression models.

To use regression analysis for prediction, data are collected on the variable that is to be predicted, called the **dependent variable** or **response variable**, and on one or more variables whose values are **hypothesized** to influence it, called **independent variables** or **explanatory variables**. A functional form, often linear, is hypothesized for the postulated causal relationship, and the **parameters** of the function are estimated from the data—that is, are chosen so as to optimize in some way the fit of the function, thus parameterized, to the data. That is the estimation step. For the prediction step, explanatory variable values that are deemed relevant to future (or current but not yet observed) values of the dependent variable are input to the parameterized function to generate predictions for the dependent variable.

Before finding a mathematical relationship between the variables, one must decide what series of data to compare. Here **big data** multiply the areas explored and improve the chances of finding correlations between phenomena between which no connection was suspected before.

### 3 Prediction in science



NASA's 2004 predictions of the solar cycle, which were inaccurate (predicting that solar cycle 24 would start in 2007 and be larger than cycle 23), and the refined predictions in 2012.

In science, a prediction is a rigorous, often quantitative, statement, forecasting what will happen under specific conditions; for example, if an apple falls from a tree it will be attracted towards the center of the earth by **gravity** with a specified and constant acceleration. The scientific method is built on testing statements that are **logical consequences** of scientific theories. This is done through **repeatable experiments** or **observational studies**.

A scientific theory which is contradicted by observations and evidence will be rejected. New theories that generate many new predictions can more easily be supported or **falsified** (see **predictive power**). Notions that make no **testable** predictions are usually considered not to be part of science (**protoscience** or **nescience**) until testable predictions can be made.

Mathematical equations and models, and **computer models**, are frequently used to describe the past and future behaviour of a process within the boundaries of that model. In some cases the **probability** of an outcome, rather than a specific outcome, can be predicted, for example in much of quantum physics.

In microprocessors, **branch prediction** permits avoidance of **pipeline emptying** at **branch instructions**. In engineering, possible failure modes are predicted and avoided by correcting the mechanism causing the failure.

Accurate prediction and forecasting are very difficult in some areas, such as natural disasters, **pandemics**, **demography**, **population dynamics** and **meteorology**. For example, it is possible to predict the occurrence of solar cycles, but their exact timing and magnitude is much more difficult (see picture to right).

#### 3.1 Scientific hypothesis and prediction

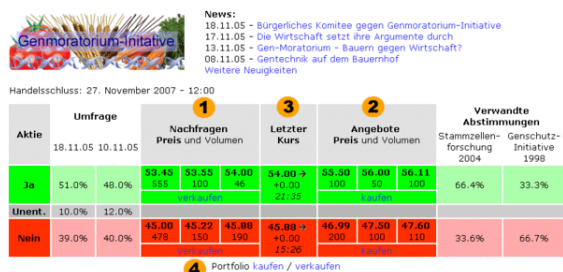
Established science makes useful predictions which are often extremely reliable and accurate; for example, eclipses are routinely predicted.

New theories make predictions which allow them to be disproved if the predictions are not borne out in reality. For example, in the early 20th century the scientific consensus was that there existed an absolute frame of reference, which was given the name *luminiferous ether*. The existence of this absolute frame was deemed necessary for consistency with the established idea that the speed of light is constant. The famous **Michelson-Morley experiment** demonstrated that predictions deduced from this concept were not borne out in reality, thus disproving the theory of an absolute frame of reference. The special theory of relativity was proposed by Einstein as an explanation for the seeming inconsistency between the constancy of the speed of light and the non-existence of a special, preferred or absolute frame of reference.

Albert Einstein's theory of **general relativity** could not easily be tested as it did not produce any effects observable on a terrestrial scale. However, the theory predicted

that large masses such as stars would bend light, in contradiction to accepted theory; this was observed in a 1919 eclipse.

## 4 Finance



### Prediction market

Mathematical models of stock market behaviour (and economic behaviour in general) are also unreliable in predicting future behaviour. Among other reasons, this is because economic events may span several years, and the world is changing over a similar time frame, thus invalidating the relevance of past observations to the present. Thus there are an extremely small number (of the order of 1) of relevant past data points from which to project the future. In addition, it is generally believed that stock market prices already take into account all the information available to predict the future, and subsequent movements must therefore be the result of unforeseen events. Consequently, it is extremely difficult for a stock investor to anticipate or predict a stock market boom, or a stock market crash. In contrast to predicting the actual stock return, forecasting of broad economic trends tends to have better accuracy. Such analysis is provided by both non-profit groups (including government departments and think-tanks<sup>[5]</sup>) as well as by for-profit private institutions (including brokerage houses<sup>[6]</sup> and consulting companies<sup>[7]</sup>).

Some correlation has been seen between actual stock market movements and prediction data from large groups in surveys and prediction games.

An actuary uses actuarial science to assess and predict future business risk, such that the risk(s) can be mitigated. For example, in insurance an actuary would use a life table (which incorporates the historical experience of mortality rates and sometimes an estimate of future trends) to project life expectancy.

## 5 Sports

Predicting the outcome of sporting events is a business which has grown in popularity in recent years. Handicappers predict the outcome of games using a variety of

mathematical formulas, simulation models or qualitative analysis. Early, well known sports bettors, such as Jimmy the Greek, were believed to have access to information that gave them an edge. Information ranged from personal issues, such as gambling or drinking to undisclosed injuries; anything that may affect the performance of a player on the field.

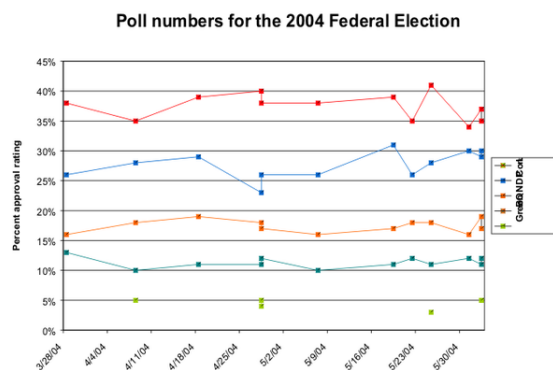
Recent times have changed the way sports are predicted. Predictions now typically consist of two distinct approaches: Situational plays and statistical based models. Situational plays are much more difficult to measure because they usually involve the motivation of a team. Dan Gordon, noted handicapper, wrote "Without an emotional edge in a game in addition to value in a line, I won't put my money on it".<sup>[8]</sup> These types of plays consist of: Betting on the home underdog, betting against Monday Night winners if they are a favorite next week, betting the underdog in "look ahead" games etc. As situational plays become more widely known they become less useful because they will impact the way the line is set.

The widespread use of technology has brought with it more modern sports betting systems. These systems are typically algorithms and simulation models based on regression analysis. Jeff Sagarin, a sports statistician, has brought attention to sports by having the results of his models published in USA Today. He is currently paid as a consultant by the Dallas Mavericks for his advice on line-ups and the use of his Winval system, which evaluates free agents. Brian Burke, a former Navy fighter pilot turned sports statistician, has published his results of using regression analysis to predict the outcome of NFL games.<sup>[9]</sup> Ken Pomeroy is widely accepted as a leading authority on college basketball statistics. His website includes his College Basketball Ratings, a tempo based statistics system. Some statisticians have become very famous for having successful prediction systems. Dare wrote "the effective odds for sports betting and horse racing are a direct result of human decisions and can therefore potentially exhibit consistent error".<sup>[10]</sup> Unlike other games offered in a casino, prediction in sporting events can be both logical and consistent.

Nowadays sport betting is a huge business; there are many websites (systems) alongside betting sites, which give tips or predictions for future games. Some of these prediction websites (tipsters) are based on human predictions, but others on computer software sometimes called prediction robots or bots. Prediction bots can use different amount of data and algorithms and because of that their accuracy may vary.

## 6 Opinion polls

In politics it is common to attempt to predict the outcome of elections via political forecasting techniques (or assess the popularity of politicians) through the use of opinion



*Approval ratings (percentages) for the 2004 Canadian federal election*

polls. Prediction games have been used by many corporations and governments to learn about the most likely outcome of future events.

## 7 Supernatural prediction

Main article: [Prophecy](#)

Predictions have often been made, from antiquity until the present, by using [paranormal](#) or [supernatural](#) means such as [prophecy](#) or by observing [omens](#). Methods including [water divining](#), [astrology](#), [numerology](#), [fortune telling](#), [interpretation of dreams](#), and many other forms of [divination](#), have been used for millennia to attempt to predict the future. These means of prediction have not been proven by scientific experiments.

In literature, vision and prophecy are literary devices used to present a possible timeline of future events. They can be distinguished by vision referring to what an individual sees happen. The [New Testament](#) book of [Revelation \(Bible\)](#) thus uses vision as a literary device in this regard. It is also prophecy or prophetic literature when it is related by an individual in a [sermon](#) or other public forum.

[Divination](#) is the attempt to gain insight into a question or situation by way of an [occultic](#) standardized process or ritual.<sup>[11]</sup> It is an integral part of [witchcraft](#) and has been used in various forms for thousands of years. Diviners ascertain their interpretations of how a querent should proceed by reading signs, events, or [omens](#), or through alleged contact with a [supernatural](#) agency, most often describe as an [angel](#) or a [god](#) though viewed by Christians and Jews as a [fallen angel](#) or [demon](#).<sup>[12]</sup>

## 8 Prediction in fiction

Fiction (especially [fantasy](#), [forecasting](#) and [science fiction](#)) often features instances of prediction achieved by unconventional means.

- In [fantasy literature](#), predictions are often obtained through [magic](#) or [prophecy](#), sometimes referring back to old traditions. For example, in [J. R. R. Tolkien's](#) *The Lord of the Rings*, many of the characters possess an awareness of events extending into the future, sometimes as prophecies, sometimes as more-or-less vague 'feelings'. The character [Galadriel](#), in addition, employs a water "mirror" to show images, sometimes of possible future events.
- In some of [Philip K. Dick's](#) stories, mutant humans called *precogs* can foresee the future (ranging from days to years). In the story called *The Golden Man*, an exceptional mutant can predict the future to an indefinite range (presumably up to his death), and thus becomes completely non-human, an animal that follows the predicted paths automatically. Precogs also play an essential role in another of Dick's stories, *The Minority Report*, which was turned into a film by [Steven Spielberg](#) in 2002.
- In the *Foundation* series by [Isaac Asimov, a mathematician finds out that historical events \(up to some detail\) can be theoretically modelled using equations, and then spends years trying to put the theory in practice. The new science of \[psychohistory\]\(#\) founded upon his success can simulate history and extrapolate the present into the future.](#)
- In [Frank Herbert's](#) sequels to 1965's *Dune*, his characters are dealing with the repercussions of being able to see the possible futures and select amongst them. Herbert sees this as a trap of stagnation, and his characters follow a so-called "Golden Path" out of the trap.
- In [Ursula K. Le Guin's](#) *The Left Hand of Darkness*, the humanoid inhabitants of planet Gethen have mastered the art of prophecy and routinely produce data on past, present or future events on request. In this story, this was a minor plot device.

## 9 See also

- [Forecasting](#)
- [Famous predictions](#)
- [Futures studies](#)
- [Predictability](#)
- [Prediction market](#)
- [Predictive medicine](#)
- [Reference class forecasting](#)
- [Regression analysis](#)
- [Trend estimation](#)

## 10 References

- [1] Stevenson, Howard, ed. *Do lunch or be lunch*. Boston: Harvard Business School Press, 1998
- [2] Shields, Patricia and Rangarjan, N. 2013. *A Playbook for Research Methods: Integrating Conceptual Frameworks and Project Management*. Stillwater, OK: New Forums Press. See Chapter three for an extended discussion the development of hypotheses and examples of statistical tests. This chapter is devoted to explanation, which is the other side of the coin of prediction. If a phenomenon is explained sufficiently, it should be possible to predict also.
- [3] Patricia M. Shields, Hassan Tajalli (2006). "Intermediate Theory: The Missing Link in Successful Student Scholarship". *Journal of Public Affairs Education* 12 (3): 313–334.
- [4] Einicke, G.A. (2012). *Smoothing, Filtering and Prediction: Estimating the Past, Present and Future*. Rijeka, Croatia: Intech. ISBN 978-953-307-752-9.
- [5] Tembarai Krishnamachari, Rajesh. "Economic and geopolitical prognosis for 2015", a sample forecasting report published by the well-known non-profit think-tank South Asia Analysis Group, Paper 5856, Jan 2015.
- [6] Fidelity. "2015 Stock Market Outlook", a sample outlook report by a brokerage house.
- [7] McKinsey Insights & Publications. "Insights & Publications".
- [8] Gordon, Dan (2005). *Beat the Sports Books*. New York, United States: Cardoza. ISBN 978-1-5804-2174-4.
- [9] Burke, Brian (2008). "NFL Win Prediction Methodology".
- [10] Dare, William H (2006). *Risk Return and Gambling Market Efficiency* (PDF). Oklahoma City, United States: Oklahoma State University.
- [11] Peek, P.M. *African Divination Systems: Ways of Knowing*. page 2. Indiana University Press. 1991.
- [12] *Definition of divination*
  - Rescher, Nicholas (1998). *Predicting the future: An introduction to the theory of forecasting*. State University of New York Press. ISBN 0-7914-3553-9.

## 11 Text and image sources, contributors, and licenses

### 11.1 Text

- **Prediction** *Source:* <http://en.wikipedia.org/wiki/Prediction?oldid=666539551> *Contributors:* The Anome, SimonP, DavidLevinson, Apollia, Patrick, Michael Hardy, Kku, Minesweeper, Ronz, Emperorbma, Charles Matthews, Quaballa, Hyacinth, David Shay, Wetman, Jusjih, Shantavira, Robbot, Zandperl, Pablo-flores, Ancheta Wis, Elf, Fastfission, Jrdioko, Andycjp, MarkSweep, Karol Langner, Pgreenfinch, Arcturus, Jayjg, Dbachmann, El C, Spalding, Foobaz, Pearle, Nsaa, Mdd, Arthena, Trjumpet, SMesser, Randy Johnston, Mel Etitis, 2004-12-29T22:45Z, Pol098, Btyner, Mandarax, BD2412, Rjwilmsi, Pjetter, TheRingess, Nguyen Thanh Quang, FlaBot, DVdm, The Rambling Man, YurikBot, X42bn6, Conscious, Big Brother 1984, AeonicOmega, Semperf, Jkelly, Zzuuzz, BorgQueen, Wikiant, Allens, TLSuda, Pentasyllabic, Tom Morris, Luk, SmackBot, Amcbride, Vald, Ikip, Jacek Kendysz, IntoTheNIGHT, Gilliam, Hraefen, Chris the speller, Bluebot, MalafayaBot, Octahedron80, Nbarth, Baxter42, Robma, Postagoras, Wordy McWordWord, Dacoutts, RJBurkhart, SashatoBot, Bydand, Scoty6776, 16@r, Martian.knight, Hu12, K, Joseph Solis in Australia, Tawkerbot2, Mellery, Gpianoni, Amysearch415, Gregbard, ProfessorPaul, Ubiq, Skittleys, Dancter, Doug Weller, SteveMcCluskey, Lindsay658, Gimmetrow, Thijs!bot, SusanLesch, Phanerozoic, JAnDbot, Athkalani-enwiki, Kaobear, Pi.1415926535, TAnthony, Acroterion, Bongwarrior, VoABot II, Snowded, Gabriel Kielland, Davies69, Cmf576, Apdevries, CrazedObsession3, Mickyfitz13, Pilgaard, MistyMorn, Fk750, Jorfer, Biglovinb, Artyboy, Tkgd2007, Birczanin, VolkovBot, Childhoodsend, Cosmic Latte, Rescherpa, Asarlai, Rei-bot, Crohnie, Optigan13, Zhenqinli, Suriel1981, Rurik3, Klenole, Sue Rangell, AlleborgoBot, Brenont, Tresiden, Nihil novi, Sunrise, Svick, Melcombe, Astrologist, Invertzoo, Martarius, ClueBot, SalineBrain, The Thing That Should Not Be, Taroaldo, Meowbbish, Bklyntech, TypoBoy, Byron755, Excirial, Anonymous101, WernR, Vegetator, Margarida75, Ps07swt, Comensky, Shashankshekharpanda, Cheapskate08, Saeed.Veradi, Addbot, Bastion Monk, Favonian, Tassedethe, Ehrenkater, Verbal, Lightbot, Bultro, Gail, Rradulak, Yobot, Jan Arkesteijn, Zagothal, AnakngAraw, Examtester, AnomieBOT, Galoubet, Chyen, Materialscientist, Лъчезар, Busvbtjdy, J JMesserly, GrouchoBot, Athanasius1, Pinethicket, Tom.Reding, Motahhari, Shanmugamp7, Merlion444, Christopheranton, Lotje, TBloemink, Duoduoduo, Twotwelve666, Mikor1, Ericbe, RenameUser01302013, Crno morj slano morje, LandalaEng, Econ2010, ClueBot NG, Reganater, Amr.rs, 123Hedgehog456, Ymblanter, Wasbeer, Mark Arsten, Blue Mist 1, Ryan060823, Keshraj, Visionsfutures, Greentrancer, EricVanZandt, Delphenich, My name is not dave, Ginsuloft, Yeda123, DrMusi, Quantres, Datawhiz and Anonymous: 160

### 11.2 Images

- **File:2004\_canadian\_election\_approval\_ratings\_June\_2.png** *Source:* [https://upload.wikimedia.org/wikipedia/commons/4/43/2004\\_canadian\\_election\\_approval\\_ratings\\_June\\_2.png](https://upload.wikimedia.org/wikipedia/commons/4/43/2004_canadian_election_approval_ratings_June_2.png) *License:* Public domain *Contributors:* Transferred from en.wikipedia *Original artist:* Original uploader was Zanimum at en.wikipedia
- **File:Hathaway\_Cycle\_24\_Prediction.png** *Source:* [https://upload.wikimedia.org/wikipedia/commons/0/0d/Hathaway\\_Cycle\\_24\\_Prediction.png](https://upload.wikimedia.org/wikipedia/commons/0/0d/Hathaway_Cycle_24_Prediction.png) *License:* Public domain *Contributors:* NASA *Original artist:* David Hathaway
- **File:Old\_Farmer's Almanac\_1793\_cover.jpg** *Source:* [https://upload.wikimedia.org/wikipedia/commons/2/2f/Old\\_Farmer's\\_Almanac\\_1793\\_cover.jpg](https://upload.wikimedia.org/wikipedia/commons/2/2f/Old_Farmer's_Almanac_1793_cover.jpg) *License:* Public domain *Contributors:* Digitized image from <http://www.almanac.com/about/ofacovers.php> *Original artist:* Not given.
- **File:Prediction\_market\_-\_example\_GUI\_-\_2.gif** *Source:* [https://upload.wikimedia.org/wikipedia/commons/5/55/Prediction\\_market\\_-\\_example\\_GUI\\_-\\_2.gif](https://upload.wikimedia.org/wikipedia/commons/5/55/Prediction_market_-_example_GUI_-_2.gif) *License:* CC-BY-SA-3.0 *Contributors:* selbst gemacht *Original artist:* Micha L. Rieser
- **File:Question\_book-new.svg** *Source:* [https://upload.wikimedia.org/wikipedia/en/9/99/Question\\_book-new.svg](https://upload.wikimedia.org/wikipedia/en/9/99/Question_book-new.svg) *License:* Cc-by-sa-3.0 *Contributors:*  
Created from scratch in Adobe Illustrator. Based on Image:Question book.png created by User:Equazcion *Original artist:* Tkgd2007
- **File:SSN\_Predict\_NASA.gif** *Source:* [https://upload.wikimedia.org/wikipedia/commons/a/af/SSN\\_Predict\\_NASA.gif](https://upload.wikimedia.org/wikipedia/commons/a/af/SSN_Predict_NASA.gif) *License:* Public domain *Contributors:* <http://solarscience.msfc.nasa.gov/predict.shtml>  
  
[http://solarscience.msfc.nasa.gov/images/ssn\\_predict\\_1.gif](http://solarscience.msfc.nasa.gov/images/ssn_predict_1.gif)  
<http://science.nasa.gov/ssl/PAD/SOLAR/sunspots.htm>  
  
*Original artist:* Original graphics by Dr. David H. Hathaway, animation by Michael Ronayne.
- **File:Wiki\_letter\_w\_cropped.svg** *Source:* [https://upload.wikimedia.org/wikipedia/commons/1/1c/Wiki\\_letter\\_w\\_cropped.svg](https://upload.wikimedia.org/wikipedia/commons/1/1c/Wiki_letter_w_cropped.svg) *License:* CC-BY-SA-3.0 *Contributors:*
- Wiki\_letter\_w.svg *Original artist:* Wiki\_letter\_w.svg: Jarkko Piironen

### 11.3 Content license

- Creative Commons Attribution-Share Alike 3.0