

such as t , F , and χ^2 , are used in hypothesis testing as a means of evaluating the likelihood that an observed pattern of results is attributable to chance. This likelihood is reflected in the p -values that accompany observed values of test statistics, with values lower than .05 indicating, by convention, statistical significance.

A related use of formulas is for the computation of effect sizes, which are means of indexing the practical, as opposed to statistical, significance of a research finding. A frequently used effect size, d , is attributable to the American psychological researcher Jacob Cohen. The formula for computing d is:

$$\frac{M_1 - M_2}{\sigma}$$

Here, M_1 and M_2 are means on some outcome for two groups and σ is a standard deviation, either for one of the groups or for a “pooled” standard deviation. The resultant value is the difference between the two groups in standard deviation units, which is interpreted with reference to criteria for small, medium, and large effects, as described by Cohen. Other effect sizes can be generated using formulas specific to the statistical model used to analyze the data.

Mathematical reasoning is a routine activity in quantitative social science research. At the most fundamental level, mathematical formulas are, in some instances, used to define and predict variables. In all cases, mathematical formulas are used to construct test statistics required for hypothesis testing. Increasingly, these test statistics are accompanied by effect sizes, which make use of output from statistical analyses to construct indexes of practical significance. For these reasons, social scientists routinely use mathematical reasoning in their work.

SEE ALSO *Methods, Quantitative; Models and Modeling; Quantification; Social Science; Statistics; Statistics in the Social Sciences*

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FORWARD AND FUTURES MARKETS

Futures markets and forward markets trade contracts that determine a current price for a commodity transaction designated to take place at a later date. Despite being fundamental to financial and commodity trading, there is some confusion over the precise definition of futures and forward contracts. While common usage sometimes defines *futures* and *forwards* as synonyms, a futures contract is a specialized form of forward contract that is standardized and traded on a futures exchange. As such, a technical distinction is required between futures markets and forwards markets. Some forward contracts, such as those traded on the London Metals Exchange, have many features of futures contracts. Other types of forward contracts are more complicated, such as the forward contracting provisions embedded in long-term oil delivery contracts. While it is tempting to claim that futures contracts represent an evolution of forward trading, much twenty-first-century progress in contract design has come in over-the-counter (OTC) trading, the primary venue for many types of forward contracting.

HISTORY OF FORWARD AND FUTURES CONTRACTS

The history of forward contracts can be traced back to ancient times. Due to the difficulties of transport and communication, trading based on samples was common and some form of forward contracting was essential. The contracting process usually involved only the producers and consumers of the goods being traded. During the sixteenth century, liquidity of forward markets was substantially increased by the emergence of the Antwerp bourse. By the mid-seventeenth century, forward markets had developed to where the Amsterdam bourse featured both forward and option contracts for commodities, such as wheat and herring, and for foreign stocks and shares. The beginning of trade in futures contracts is usually traced to mid-nineteenth-century Chicago, where the Board of Trade—founded in 1848—transacted the first “time contract” in 1851. The grain trade of that era typically involved merchants at various points along major waterways purchasing grain from farmers which was then held in storage, often from fall or winter into spring. In order to avoid the risk of price fluctuation and to satisfy bankers, merchants started going to Chicago to transact contracts for future, spring delivery of grain. The contracts set a price for delivery of a standardized grade at a later delivery date. While these early contracts were similar to modern futures contracts, some terms and conditions of these time contracts were specific to the original parties to the transaction, as with a forward contract.

THE FUTURES CONTRACT AND THE FUTURES EXCHANGE

A significant difference between futures and forward contracts arises because futures contracts are legally required to be traded on futures exchanges while forwards are usually created by individual parties operating in the decentralized OTC markets. Because a futures contract is transacted on an exchange, the traders originating the contract use the exchange clearinghouse as the counterparty to their trade. While both a short trader (seller) and long trader (buyer) are required to create a futures contract, both traders execute the trade with the clearinghouse as the direct counterparty. This allows a futures contract to be created without the problems associated with forward contracting, which typically depends on the creditworthiness of the counterparty. By design, futures contracts are readily transferable via the trading mechanisms provided by the exchange. Because forward contracts depend on the performance of the two original parties to the contract, these contracts are often difficult to transfer. One practical implication of this difference is that if a futures trader wants to close out a position, an equal number of offsetting contracts for that commodity month is transacted and the original position is cancelled. Forward contracts are usually offset by establishing another forward contract position with terms as close as possible to those in the original contract. Unless the forward contract provides a method for cash settlement at delivery, this will potentially involve two deliveries having to be matched in the cash market on the delivery date.

To facilitate exchange trading, futures contracts possess a number of key features, especially standardization and marking to market. The elements of standardization provided by the futures contract and by the rules and regulations of the exchange governing such contracts involve: the deliverable grade of the commodity; the quantity deliverable per contract; the range of quality within which delivery is permissible; the delivery months; and, the options associated with the specific grade and date of delivery that is permissible. Standardization is achieved by making each futures contract for a given commodity identical to all other contracts except for price and the delivery month. In addition to standardization, forwards and futures also differ in how changes in the value of the contract over time are handled. For futures, daily settlement, also known as marking to market, is required. In effect, a new futures contract is written at the start of every trading day with all gains or losses settled through a margin account at the end of trading for that day. This method of accounting requires the posting of a “good faith” initial margin deposit combined with an understanding that, if the value in the margin account falls below a maintenance margin amount, funds will be transferred into the account

to prevent the contract from being closed out. On the other hand, settlement on forward contracts usually occurs by delivery of the commodity at the maturity of the contract. Hence, futures contracts have cash flow implications during the life of the contract while forwards usually do not.

MODERN USAGE OF FORWARD AND FUTURES CONTRACTS

In modern markets, considerable variation is observed in the relative use of forward or futures contracting across commodity markets. For example, in currency markets, the large value and volume of many individual trades has the bulk of transactions for future delivery conducted in the currency forward market. Exchange traded currency futures contracts are an insignificant fraction of total trading volume in the global currency market. As trading in forwards is closely integrated with cash market transactions, direct trading in forward contracts is restricted to the significant spot market participants, effectively the largest banks and financial institutions. Because currency forward contracts do not have regular marking to market, restricted participation is needed to control default risk. As such, differences in the functioning of futures and forward markets impacts the specific method of contracting selected for conducting commodity transactions. For example, in contrast to forward trading, futures markets are designed to encourage participation by large and small speculative traders. The increased participation of speculators not directly involved in the spot market provides an important source of additional liquidity to futures markets not available in forward markets. In order to achieve this liquidity certain restrictions are imposed on trading, such as limits on position sizes and the imposition of filing requirements. By restricting participation to large players in the commodity market, many of the restrictions required for the functioning of futures markets are not present in forward markets.

SEE ALSO *Bubbles; Bull and Bear Markets; Contango; Discounted Present Value; Equity Markets; Expectations; Financial Instability Hypothesis; Financial Markets; Future Prices; Hedging; Interest Rates; Liquidity; Policy, Monetary; Selling Long and Selling Short; Selling Short; Speculation; Spot Market; Spreads; Yield Curve*

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FOSSILS

SEE *Archaeology*.

FOUCAULT, MICHEL

1926–1984

Michel Foucault was a French philosopher who wrote widely on the history of thought. His influences include philosophers of science, such as his mentor Georges Canguilhem, but also Maurice Blanchot and Friedrich Nietzsche, from whom he derived his influential methodological notion of genealogy. Though Foucault's oeuvre treats seemingly disparate historical topics ranging from psychiatry to structuralism and on from sexuality to liberalism, a concern with the issues of knowledge and power as they constellate around the formation of subjectivities forms a constant, discernible thread.

Foucault's first major works are studies of psychiatry and mental illness. In *Madness and Civilization* (1961), Foucault examined how madness, the classical age inverse of reason, was systematized into the modern psychological category of mental illness. *The Birth of the Clinic* (1963) marks the beginning of Foucault's archaeological period, and examines the development of the perceptive apparatus of modern medicine. His attention to clinical confinement is demonstrative of his concern with dividing practices that progressively split certain individuals off from the social body.

The subsequent *Archaeology of Knowledge* (1969), Foucault's only methodological treatise, draws on the broad-sweep historiographical innovations of the Annales School to elaborate discursive formations as an analytical frame. In his archaeology of structuralism, *The Order of Things* (1966), Foucault historicized these discursive structures into distinct epistemes, which serve as the "condition of possibility" for knowledge. Tracing epistemic transformations in thought from the classical to the modern age, Foucault scrutinized the rise of man as the subject of the human sciences.

In his later work, Foucault shifted his approach to a process he called genealogy, which explicitly linked his analyses of knowledge to social structures of power. He argued against a purely repressive notion of power, elaborating instead on his oft-quoted maxim that "power is pro-

ductive." In *Discipline and Punish* (1975), Foucault developed an explicit relationship between forms of knowledge of the body and the evolution of the modern prison system; disciplinary power, Foucault argued, arrays and organizes bodies into "analytical space," producing a logic that generalized itself from its application in concrete technologies such as the nineteenth-century Panopticon penitentiary to the level of society. In the first volume of his three-part *History of Sexuality* (1976), Foucault characterized disciplinary power as an anatomo-politics that operates on the level of the body, and juxtaposed it to its complement, bio-politics, which functions on the level of a population whose life forces it seeks to optimize. These populations, Foucault argued, are constituted in part via discourses about sexuality. In the second two volumes of his *History*, *The Use of Pleasure* (1984), and *The Care of the Self* (1984), Foucault turned to the processes of self-constitution in Greek and Roman sexual practices. The planned fourth and fifth volumes of the series remained unwritten upon Foucault's premature death at the age of fifty-eight.

Foucault's activism often related to the themes of his work. He advocated for penal reform and gay rights, and was associated with the anti-psychiatry movement. In his interviews and lectures, particularly those delivered at the Collège de France from the 1970s to 1984, Foucault reformulated many of the themes of his books into analyses applicable to the contemporary political situation. He responded to the ascendance of neoliberalism in the 1970s by refining his concept of bio-politics into that of governmentality, a governmental rationality operating in the realm of political economy.

Several scholars argued with Foucault over issues of historical accuracy, while others have contended that his attempts to transcend reason as the grounds of the subject's constitution remain methodologically fettered because they presuppose the existence of that self-same subject. Nevertheless, Foucault's many anglophone interpreters have ensured the profound methodological and theoretical impact of his work in many disciplines, including anthropology, gender studies, history, literature, post-colonial studies, and sociology.

SEE ALSO *Critical Theory; Habermas, Jürgen*

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