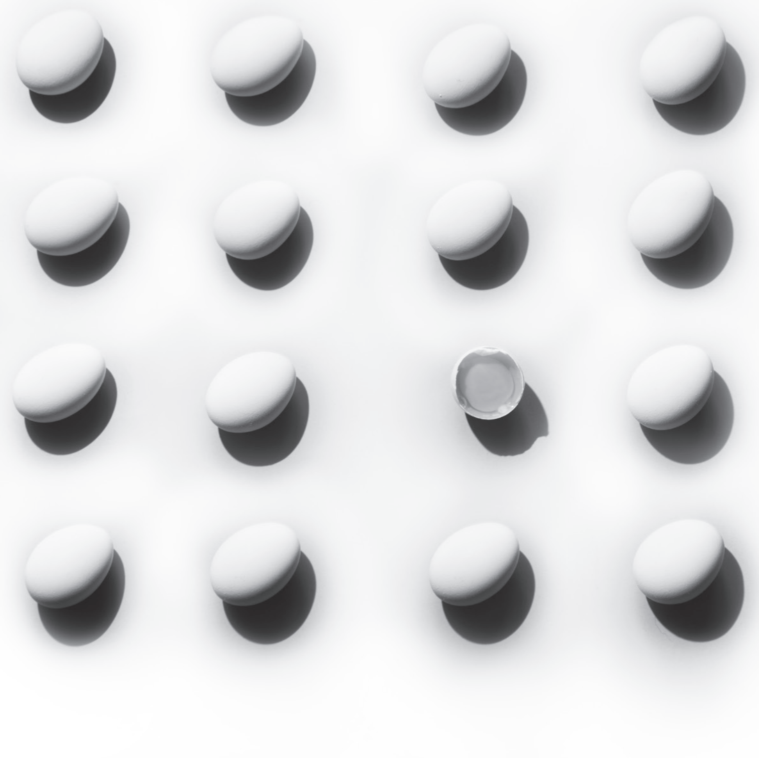
Matthew Loveless

POLITICAL ANALYSIS

A Guide to Data & Statistics



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ABOUT THE AUTHOR

Matthew Loveless is an Associate Professor in the Department of Political and Social Sciences at the University of Bologna (Italy). He is also co-founder of the Center for Research and Social Progress (cersp.org). He has taught quantitative methods to undergraduate and graduate students since 2003. He has held academic positions in the United States (Georgetown University; University of Mississippi), the United Kingdom (Nuffield Fellow, Oxford; University of Kent), and Italy (Jean Monnet Fellow, European University Institute, Florence; University of Bologna) in addition to visiting positions at Sciences Po – Institut d'Etudes Politiques de Grenoble (France), the University of Georgia (USA), Davidson College (USA), St. Antony's College (Oxford, UK), Mannheimer Zentrum für Europäische Sozialforschung (Germany), and the University of Debrecen (Hungary). His research interests include the field of Political Behavior in Europe, particularly as it relates to how individuals perceive and make sense of politics (recent examples focusing on political attitudes include *International Political Science Review*, *Political Studies*, the *Journal of European Public Policy*). Recent publications also include co-authored work that incorporate party competition with recent publications in *Government and Opposition*, *Electoral Studies*, and the *Journal of Common Market Studies*. He lives with his family in Italy.

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THE SCIENTIFIC METHOD AND STATISTICS

LEARNING OUTCOMES

In this chapter, you will be able to

- Critically engage the use of science as a means to understand political phenomena.
- Identify key elements of the Scientific Method.
- Assess how statistics can be used to achieve many of the aims of scientific research.
- Articulate the points of alignments between the Scientific Method and the statistical approach to data analysis.
- Recognize the difference between 'doing statistics' and 'doing science'.
- Situate the role of statistics and the Scientific Method within the wider discipline of Political Science and International Relations (IR).

Introduction

The goal of this book is to present an understanding of how statistics come to represent relationships among data and, in turn, why this is useful to the scientific study of politics. To do so, we must engage what it means to do science at all. This chapter is an introductory discussion of what the scientific method is and how statistics can aid scientific study. Key characteristics of scientific study are mapped onto the use and techniques of statistical analysis. It also highlights the distinctive power of statistical analysis including the abilities of description, inference, and control.

Why Science?

Science is one of several ways to understand the world. This is a fairly broad definition but underpinning this definition is the assumption that the world is ultimately knowable and that we are able to converge on that knowledge through the application of an agreed-upon and rigorous methodology, called the scientific method. The **Scientific Method** – capital S, capital M – is an objective and replicable analysis of data which results in evidence which can be used to assess proposed explanations for a relationship and whether we can export the resultant explanation to other phenomena. The use of the scientific method progresses collective knowledge by replicating, challenging, and advancing the body of theoretical knowledge of a discipline.

The actual methods and tools used in pursuit of the Scientific Method, within and across disciplines, may differ. Social scientists don't stuff people in test tubes and chemists don't ask molecules how they feel about democracy as a form of government. However, they share key design and analytical elements. At its simplest, in order to achieve a scientific understanding of the world, the scientific method includes a transparent and replicable description of the research design and analysis, a rigorous attempt to identify and explain the relationship under investigation, and a means to assess the appropriate inferences from the results.

What Makes Scientific Research Scientific?

What are these characteristics and practices of applying science that provide access to this specific 'scientific' understanding of the world? Within the disciplines of the social sciences, and Political Science in particular, what made our study more scientific or rigorous has been formally questioned and discussed in the literature several times.

Taking one prominent example, in 1994, leading scholars in the Political Science fields of Political Methodology, International Relations, and Comparative Politics argued that both empirical qualitative work and quantitative work aligned with the core tenets of the scientific method. Gary King, Robert Keohane, and Sidney Verba (KKV), respectively, argued that, done correctly, these disparate approaches (in their various modes) could contribute meaningfully to the scientific advancement in Political Science. That is, using empirical qualitative methods – like document analysis, interviews, or case studies – or quantitative methods – like statistics and experiments – were indistinguishable from one another as scientific endeavours as long as they exhibited core characteristics of the scientific method.

Frankly, science is analytically promiscuous. All forms of empirical work, whether qualitative or quantitative, can adhere to the methods and choices necessary for scientific results. In this way, the authors were trying to reconcile adherents of various approaches by asserting that scientific research has the following characteristics: the content is the method, the conclusions are uncertain, the procedures are public, and the goal is inference. All achievable in many different ways.

Since then and continuing on to today, there has been a lot of discussion about the comprehensiveness and correctness of their criteria. What has remained unassailable are three bedrock principles of scientific research:

1. A transparent and replicable description of the research design and analysis.
2. An attempt to identify and explain the relationship under investigation.
3. The ability to make appropriate inferences from the results of the research.

This applies to research in Political Science just as it does for the physical sciences. For example, Political Scientists may use an experimental approach to isolate the impact of a key variable. The design and implementation of that experiment will differ only in the choice of tools from astrophysicists' experiments in the Large Hadron Collider. The design rules and analytical rigors of experimentation are precisely the same. Thus, for all approaches, the three principles of scientific research, if adhered to as closely as possible, offer the greatest opportunity in creating a greater scientific understanding of the world.

The ultimate goal of scientific research is to understand and even explain as much as we can with as little as we can. The scientific method is the means to do that, by creating research that produces results we can be confident about and use to explain even more. Or put another way, while scientists are interested in their research question, they are more interested in what their questions can tell us about phenomena just beyond their question. We seek to generalize – to explain a class of event – from the objective analysis of what we can observe. And in order to achieve the ability to make such inferences – Principle Number 3 – we must first pass through Principle Numbers 1 and 2. This is the demanding part of science. With the goals of explanation and even generalization, our ability to be confident in our conclusions is predicated on our practice of science.

KKV said it best, 'the content is the method'. Perhaps unintentionally echoing Marshal McLuhan's famous 'the medium is the message', it means that reliable and valid results suitable for inference are achieved in a systematic way. Science is the *method* of inquiry. Science is the scientific method. As the saying goes, science is as science does.

Principle Number 1: The scientific method requires a transparent and replicable description of the research design and analysis

There's a lot to unpack here. First, whatever approach or method one chooses – by which we are talking about examples such as web scraping, document analysis, interviews, large-*N* statistics studies, case studies, experiments, quasi-experiments, surveys, and on and on – the choices that we make in what to research, what to measure, what to control for, what to include, what to exclude, and how to estimate the relationships we are interested in, not only shape what we will find (a larger question) but also require an accurate, comprehensive, and objective description of all the steps of your analysis. Many of these elements of research will be discussed in the subsequent chapters. However, the motivation for transparency and replication are distinguishing characteristics of the scientific method.

Scientific study is a public procedure. A scientific study outlines the means for others to replicate the work. That is, the methodology for attaining the results must be detailed to the extent that that replication is possible. Why is **replication** (and its **transparency**) so important to the character of science? While research can be guided by previous work and the constraints of the data, ultimately, how a researcher chooses to investigate a question is up to him/her. These choices – as we will see in the following chapters – have a profound effect on the results. Therefore, a replicable description of the methodology allows for others to critique or reproduce them (often in order to find out why they are so good or, sometimes, so bad).

For example, when two scientists are studying the same thing and come to different conclusions, their peers investigate the method for arriving at the competing explanations and determine which appeals to rigorous science. When scientists – not interpretivists – reach a disagreement about a conclusion, they set about the task of finding out who is wrong (or less wrong, in any case). Further rigorous testing produces more evidence in which to determine the fitter of the two explanations (or not!). It is an attempt to approach 'truth'. Not 'The Truth' but, as Dennett calls it, the '…ho hum truth about this particular factual disagreement' (2006: 262).

Published scientific findings are given a great deal of weight and importance. The reason is that for an academic article to be published, it must pass through the process of 'peer-review' in which several experts anonymously read and review every aspect of a potential article. These academic 'peers' poke and prod all of the methodological, theoretical, and stylistic elements in the article and – if they unanimously agree that the article has potential – suggest ways that the author must strengthen the article before being published. This process is necessarily difficult and demanding and in being so, creates better, more replicable, and transparent research. What nearly all forms of peer-review have in common is that the results of research are nearly secondary to how you arrived at them. Science is not advanced by secrecy, sabotage, or trickery. It is advanced by openness, honesty, and transparency (as ideals).

A secondary effect of transparency and replicability is holding the researcher themself to a high standard. Science is sometimes defended as being **objective**. It is not. Efforts are made, however, to try to make it the least **subjective** (if that helps). That is, we seek to eliminate or, more accurately, minimize the influence of our own prejudices and biases. As Max Weber points out, there is no objective science, but the conscious effort to adhere to an agreed-upon method of inquiry as well as the exposure to the strong light of public procedure has the effect of attenuating any overt or unintended subjective bias that might get introduced into our research.

The subjectivity of the formal scientific method is akin to a pilot flying a plane. There are a lot of rules designed to guide a plane in the most efficient but safest route to our destination that each pilot must follow. For example, when the pilot is ready for take-off, s/he doesn't just slam the throttle forward and careen across the tarmac willy-nilly. Take-off procedures, exit patterns, altitudes, landing procedures, and even ground manoeuvres are all tightly controlled to produce an individual and collective success in moving people around by airplane. At the same time, each of the hands that are on the yoke, those in control of each individual plane following these rules, are individual pilots who make crucial adjustments and decisions as well as take key actions that affect the journey (as well as collective outcome). As with pilots, the likelihood of our success as scientists – individually and collectively – is served by adherence to the rules originating from conscious design and experience.

Supporting the demand for objectivity, the scientific approach is a positivist approach – as opposed to a normative approach. **Normative** approaches are concerned with whether things are as they should be or whether they ought to be different (read: better). A **positivist** approach focuses on what *is*, not what we want something to be. To say that normative studies – often found in political theory or philosophy – are ‘not scientific’ is not to diminish this enormously valuable area of research, both independent of and complementary to empirical studies. Rather it is to highlight the importance, in pursuing objectivity, of forcing us to maintain eye contact with facts.

We can be motivated by our normative concerns but ask non-normative questions for the reason of producing convincing evidence. That is, Political Scientists’ own values can lead them to study particular phenomenon. For example, in studies of voter turnout, our research often focuses on what policies *increase* turnout, not *decrease* turnout. We study turnout because higher turnout seems ‘better’ for democracy. In International Relations, the study of conflict, war, and diplomacy is (hopefully) normatively guided by the notion that less war and conflict is preferred. This doesn’t necessarily affect our conclusions, but it can affect what researchers choose to study.

In this way, a positivist approach appeals to objectivity in our research as the scientific method peddles in facts. A country with fair elections is a democracy. In Italy, 39% of the citizens voted for the Communist Party. Income inequality in the United States, as measured by the Gini coefficient, is 0.48 (in 2019). ‘Normative’, on the other hand, is evaluative and value-laden and describes ‘how things *should* be’. All countries should be democracies. Too many Italians voted for the Communist Party. The level of income inequality in the United States is unacceptable. While the distinctions are fairly obvious with these examples, as we will see in the scientific study of politics, this distinction can be hard to maintain, even if we want to.

Principle Number 1 leads us to the revelation that the scientific method doesn’t describe what we study, it describes how we study it.

Principle Number 2: The scientific method attempts to identify, isolate, and explain the relationship under investigation

Principle Number 2 is the irreplaceable bridge linking Principle Number 1 to Principle Number 3. Scientific knowledge seeks to move beyond mere description to explanation. We do so in two complementary ways.

One, scientific knowledge tries to – if only partially – explain how the world works through the use of theory. The scientific method relies on the body of theoretical knowledge to advance our collective knowledge by developing, testing, and, when necessary, abandoning theories. Theory explains. The use of theory in scientific study cannot be overstated, and to give it sufficient attention we will investigate the contribution and use of theory in the next chapter.

Let’s say that we are interested in whether citizens’ education levels affect their propensity to vote in national parliamentary elections. You have been studying this relationship and identify a theory that suggests it is easier for educated citizens to gather and process information about politics and therefore they are more likely to vote because the costs of voting are lower for them (as an information-seeker).

One way to bring some evidence to bear on this question is to analyse some data. So, before the last Bundestag elections in Germany, we ask 1,000 Germans about their education and voting and determine that within this group of German citizens, people with higher levels of education voted more often. We might *describe* the results this way: In this group of Germans in the past national election, the more highly educated voted more often than less educated ones. However, we might *explain* the results this way: The evidence supports our theoretical expectation that more educated Germans are more likely to vote because it is easier for them to gather and process information about politics, in turn lowering the costs of voting.

The second means to identify and explain a relationship is through control. While description represents a step in the explanatory process, explanation is predicated on the ability to not only identify the relationship in which we are interested but to also isolate in order to evaluate the nature of that relationship, controlling for potential intervening or moderating influences. That is, the goal of control is to be able to distinguish between the essential – the 'signal' of the relationships in which we are interested – and non-essential – the noise of the buzzing, complex world around it.

Here, in the attempt to identify and explain the relationship under investigation, we are challenged to determine whether this relationship exists and whether it continues to exist even when we consider all of the other possible explanations for why a German citizen may choose to vote (age, gender, income, political apathy, etc.…). Exerting control over any number of other explanations (ahem, theories) allows us to determine whether the relationship exists – even in the presence of competing explanations. This imperative of the scientific method allows us to weight our explanation in accordance with how well it explains. Therefore, Principle Number 2 – attempts to identify, isolate, and explain the relationship under investigation – increases the confidence that we are describing and explaining the relationship in which we are interested by the formal process of testing of competing explanations.

The demanding principle of transparency and replicability (Principle Number 1) as well as the often-challenging methodological principle of control (Principle Number 2) are steps to the final and definitive goal of scientific research.

Principle Number 3 – The scientific method seeks to derive and make appropriate inferences from the results of our research

If we have adhered to the first two Principles and conducted our research as best we can, we should arrive at results that we can have confidence in. This is the prized opportunity to speak beyond the evidence at hand. We can make inferences; to infer the results of our study to a larger class of events.

Inference is not the same as prediction. Recall our educated German voters above. I might make *predictions* from the results in a number of ways. If I wanted to make a low-risk prediction, I might stick with the same group and same event and argue that in the next Bundestag election, more educated Germans will vote at a higher rate than less educated Germans. I might, based on the confidence I have in my results, aim a little farther by making a prediction about a *similar* event. For example, I might argue that in the upcoming *Bundesrat* election, more educated Germans will vote at a higher rate than less educated Germans. Again, depending on the confidence I have in the results, I might even make a prediction beyond this group of German voters and argue that, for all European countries' national parliamentary elections or European parliamentary elections, more educated Europeans will vote at a higher rate than less educated European voters in that same country. These are a small sample of several predictive statements we could make and represent **descriptive inference**, a projection of what to *expect* from what we know onto new events.

GENERALIZATION AND INFERENCE

In Social Science, the words 'inference' and 'generalization' are sometimes used interchangeably. For casual use, the main idea is similar enough not to create a problem. However, technically, inference refers to the estimation of population parameters from sample data. Generalization is part of the process of theory-building, determining how far what we have learned can be extended to explain a class of events.

Perhaps visually:

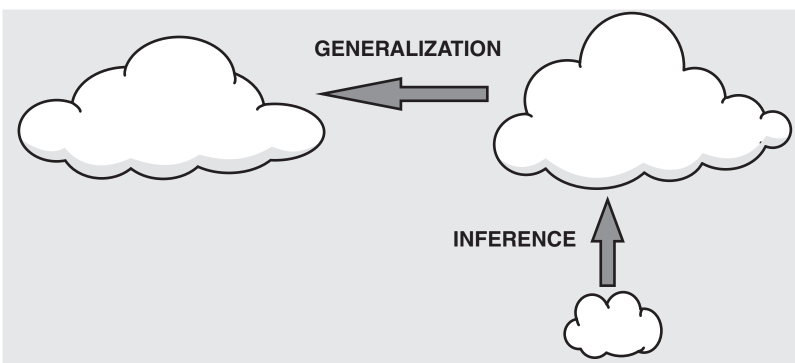

Figure 1.1 Generalization and Inference

For consistency throughout this textbook, inference will be a technical term relating samples to populations and generalization will refer to the (theoretical) process of seeking to explain related phenomena between populations.

However, our goal of scientific research is to be in the position to make inferences beyond the cases under investigation. What we would infer is not an expectation of an outcome (i.e., a prediction) but rather the explanation itself. That is, any inference that we make would carry with it the causal implication embedded in our explanation (our theory). Thus, if we have a great deal of confidence in our study of voting Germans, we might infer that more educated Germans will vote more in the next Bundestag or Bundesrat election than less educated Germans, or even that higher educated EU citizens will vote more in the next European national parliamentary elections than less educated ones *because* it is easier for educated citizens to gather and process information about politics and they are therefore more likely to vote because the costs of voting are lower for them. This projection of what *explains* the relationship we have observed onto new events is called **causal inference**.

Thus, both types of inference involve generalizing the results of our study to a larger class of events. This involves both what we expect to see – i.e., a prediction – and why we would expect to see it – i.e., the causal explanation. Our ability to make inferential claims rests not on any specific action we take at this stage, but rather on our adherence to the rigors of the scientific method up to this point and drawing appropriate conclusions from our empirical analysis. And the ability to derive and make appropriate inferences from the results of our research also improves our theoretical knowledge. In fitting pieces to the collective process of understanding, bit by bit, more and more phenomena, our incremental steps advance scientific knowledge.

A Quest for Certainty

There is, however, a thorny difference between prediction and inference. While we can observe an outcome to confirm or disconfirm a prediction, we cannot reliably observe an inferred causal mechanism in the same way. Scientifically, methodologically, we strive for having confidence in the results of our study. Unfortunately, our confidence in our ability to make such strong inferential claims rests on a debate that has resisted consensus. This debate might be called an elusive quest of certainty.

There are fundamentally two types of scientific knowledge about the world. To compare them, imagine a black box with a lever on one side and a hole on the other. When you pull the lever, a little red ball rolls out. We can imagine a more sophisticated black box, for example, one in which you must pull the lever twice quickly to produce the little red ball, but for simplicity, we know that pulling the lever produces the little red ball. What more do you need to know? If you want a little red ball, pull the lever. Scaling this up, as long as we can predict political, social, and economic relationships, knowing the intricacies of the exact causal link is not all that important.

The other approach wants a fuller answer. *How* does pulling the level produce the little red ball? This approach wants to open the box and articulate the mechanism. It wants to see the dials, levers, knobs, and teethed wheels that link the lever to the red ball. For this approach, in order to decipher the 'real' world, we need to know the 'real' reason things happen.

Which one is best? While there are persuasive arguments on both sides (for space and sanity, we will not take these up here), there is no consensus. And for the day-to-day activity of doing science, it doesn't really matter. However, one's response to this question may depend on your level of comfort with uncertainty. And in a bigger sense, it does kind of matter.

Why do we bring up a quest for certainty here? It is important – blinking red light important – to distinguish between a statement 'proved' true and a statement that we have a great deal of confidence in. The former, more formally known as **deterministic confirmation**, is the conclusion that, given the right set of explanatory variables, the world is entirely predictable. The latter, more formally known as **probabilistic confirmation**, takes the stance that random variation exists in the world and there is nothing you can do about it.

> Deterministic confirmation according to Pierre-Simon Laplace: 'We may regard the present state of the universe as the effect of its past and the cause of its future. An intellect which at a certain moment would know all forces that set nature in motion, and all positions of all items of which nature is composed, if this intellect were also vast enough to submit these data to analysis, it would embrace in a single formula the movements of the greatest bodies of the universe and those of the tiniest atom; for such an intellect nothing would be uncertain and the future just like the past would be present before its eyes.' (1951: 4)

Impressive! Deterministic confirmation would then be big-t True! It is this way – and no other! Such knowledge is undoubtedly a great deal for a scientist to get excited about. It may not, however, be unfair to point out that we do not have Laplace's knowledge of 'all forces that set nature in motion, and all positions of all items of which nature is composed'. And it would be a challenge to do so.

Lest you despair, the scientific method allows us to inch toward deterministic confirmation. We can shrink our orbit toward the ideal state of perfect knowledge through probabilistic confirmation of our research. Probabilistic confirmation – the ability to obtain results that we can have a high degree of confidence in – is also 'true'. Small-t true. True in a qualified manner. That is, although we don't know the motion and positions of all forces, we can – with a rigorous design and analysis – derive a level of confidence from our results to forward scientific research. There is little doubt that a rigorous methodology takes us closer to this final goal. However, even if we were to design the perfect research and make no mistakes, the best that we could reasonably be is quite certain.

You may have noticed a distinguishing hallmark of scientific inquiry is its sometimes frustrating temerity. This is why a professor, cornered at a cocktail party and asked about something related to his/her research, will invariably respond, 'Well, you see, it depends....'. That we cannot control for everything underpins the natural and cultivated hesitancy that many scientists share. For these scientists, 'prove' is not how to think about theory and theory testing. It is what the leading prosecutor does during a courtroom drama on television using corroborating video, audio, eye-witness reports, and DNA evidence to show that the defendant was at the scene of the crime. We test, we update, we precise, we improve, but never 100% prove.

Scientific research must qualify its conclusions with how certain we are that what we are saying is correct (or more accurately, it is often reported as how *unlikel*y that our answer is *incorrect*). In a sense, this is the humility of a scientific worldview. Certainty in the complex, interactive world is unattainable for myriad reasons. Yet, if we strive in the direction of certainty, we improve the reliability, validity, honesty, and certainty of our conclusions. It is the embrace of uncertainty that both requires scientists to acknowledge the limitations of every study as well as allows them to make inferential claims. Thus, uncertainty is to be taken seriously. We want to have a great deal of confidence in our findings – achieved primarily through a rigorous, scientific approach. But what we really end up hoping for is the ability to be more right than wrong.

'To be uncertain is uncomfortable, but to be certain is ridiculous' – Chinese proverb

ON KNOWING

There is a larger debate looming in the background. In fact, there are two larger debates, one nested in the other.

The discussion in this chapter centres on science and its attempts to decode and understand the world. Despite popular perception, the Scientific Method can encompass both quantitative methods – such as statistics – and qualitative methods. As long as the design, analysis, and interpretation adhere to the core principles of science, a wide variety of analytical approaches qualify as 'scientific'. Yet, there are some key qualitative methodologies, such as ethnography and discourse analysis, that represent a branch of inquiry at odds with science.

Scientific inquiry is a positivist approach. This is an epistemological term. **Epistemology** asks 'What do you know?' and 'How do you know it?'. Or, more pointedly, 'What is the nature of knowledge and the methods of gaining such knowledge?'. Therefore, a **positivist** epistemological position is one in which the world is 'out there' and can be understood through rigorous examination. Not unsurprisingly, this sounds a lot like our definition of the scientific method in which the world is knowable and the most effective means to do so is science using rigorous, quantitative methods.

The alternative to a positivist epistemological position is an interpretivist epistemological position. Unlike positivists – who see reality as ultimately knowable and converging on a singular truth – **interpretivists** insist that objectivity is impossible as individuals are complex, and what we observe requires an interpretation of the motivations and beliefs of individuals that constitute social reality. That is, reality – rather than being something 'out there' to decode – is created by individuals in a society that must be reveal its underlying significance. Simply, reality cannot be measured, it must be interpreted. This approach requires a dramatically different methodology to go about finding out what is happening. Theoretical approaches such as feminism, Marxism, and queer theory assert that reality as well as knowledge are both constructed by social conflicts.

Is there tension between these groups? A bit, perhaps.

And this contest goes even further back, not in time, but in our thinking about knowing. The central debate in **ontology** precedes even this contest to ask, 'What is the nature of existence? What is real? What is true?'. That is, how do we know anything at all? On one side of this ontological debate, is a simple observation that the world waits to be understood. What is real and what is true are observable and manifest in the world before one's eyes. This is the foundation for the objectivists/positivists who not only think this is not only obvious but are also determined to find the means to do so.

On the other side, the notion that the world is just 'out there', observable and manifest, to be understood, is dismissed entirely. Instead, reality (and any attempted knowledge of it) originates from social and individual construction and cannot be understood otherwise – outside our subjective experience. Here we find the postmodernism, structuralists (and post-structuralists), and even post-positivists (and critical realists). Thus, unlike a scientific approach of systematic search for an underlying and objective order, reality is entirely subjective.

This ontological, epistemological, and methodological debate continues to resist resolution.

Science as a Way of Knowing

There are other ways of understanding the world. Science takes a clear stance that the world is discoverable – at least to the extent of our best understanding of it. The scientific approach, however, is not alone. In addition to – or even in place of – a scientific worldview, one can have, for example, a mystic or religious understanding of the world. Or one can insist that objectivity in discovery overlooks crucial animating features of the world. Or one can dismiss our ability to know anything at all about the world, placing it off limits to any feeble attempts to do so. Each approach has its own methodology and beliefs in pursuit of truth.

But, stepping out of the academic mindset for just a second, let's back up even further. Before methods and before approaches, let's ask, what's wrong with common sense?

Imagine the first time someone sees the moon. Unaided common sense is unlikely to lead us to the knowledge that the moon is a rock that is in a near perfect orbit around this planet – which is also round – and is held in place by the same invisible distortion of spacetime that holds your feet to the ground. That is, while common sense appeals to logic – inasmuch as it makes some sense – and may even be empirical as it does not contradict actual observation, there is a limit to the testable validity of common sense. Without the rigors of the scientific investigation of data, common sense is *more likely* to be subject to the errors of inaccurate or selective observation, overgeneralization, and illogical reasoning. In other words, it has been the characteristics and – admittedly imperfect – practice of obtaining a scientific understanding of the world that has allowed us to understand and even appreciate it even more.

Coming back to the realm of study, at the starting line of even thinking about understanding the world sits the post-modernist. He radically dismisses any epistemological assumptions in the use of science with the goal, not to formulate an alternative set of assumptions but, to register the impossibility of establishing *any* such underpinning for knowledge and to become comfortable with the absence of certainty. A post-modernist approach seeks to avoid judgment and locate – rather than discover – meaning focusing on the unique aspects rather than science's objective appeal to generalization (trying to understand and even explain the world with the little part we actually observe). This is a healthy and vigorous debate.

CHECK OUT POSTMODERNISM

Dickens, David R. and Andrea Fontana. 2015. *Postmodernism and Social Inquiry*. Routledge.

At the same time, prominent methodological alternatives to a strict scientific methodology have also arisen in Political Science and International Relations in particular. One is constructivism, originating from a largely interpretivist approach, which evaluates the world as socially constructed. In constructivism, agency and structure are mutually constituted, in turn viewing the international system as a composition of both material and ideational elements. That is, in order to understand or evaluate phenomena in the study of International Relations, we must take into account the social context (i.e., what lies beyond mere material reality) including the dynamic effect of ideas and beliefs in world politics. Such a method clearly challenges the strict scientific view of the nature of both reality and knowledge in International Relations.

CHECK OUT CONSTRUCTIVISM

Hay, Colin. 2015. 'Social Constructivism' in M. Bevir and R.A.W. Rhodes (eds) *The Routledge Handbook of Interpretive Political Science*. Routledge, pp. 99 – 112.

Another notable alternative is gender theory. The primary intervention these approaches offer is the direct confrontation with objectivity, particularly in terms of methodology in which knowledge-making is open to myriad voices and inputs. These approaches ask whether the evaluation of political phenomena through the lens of gender reveal a deeper embeddedness of inequality. What do categories of gender (such as masculinity and femininity) offer us when thinking about issues like diplomacy, economic relations, or warfare? Are there institutional hierarchies structured around gender? How do men's and women's distinctive experiences inform our understanding of politics? For example, to what extent do gendered leadership differences manifest different political outputs? Does the gendering of political institutions shape their implications in choices and outcomes? And ultimately, what is the value of using gendered identity as a dimension, versus a separate intersectionality that may arise from alignments that traverse other socio-demographic dimensions or experiences?

These three examples are challenges to how science approaches understanding. Although unlike the somewhat antagonistic stance of postmodernism, both constructivism and feminist political theory overlap in some areas with scientific methodology but also retain unique knowledge elements that distinguish their approach. In one way or another, each of these paradigms share the belief in the discovery of truth (for the post-modernist, it is simply a null set). Here, we take the scientific method not as the only approach, only as the most common one.

CHECK OUT FEMINISM

Ferguson, Michaele L. 2017. 'Neoliberal feminism as political ideology: Revitalizing the study of feminist political ideologies' *Journal of Political Ideologies* 22(3): 221–235.

Statistics: Description, Inference, and Control

Statistics is the mathematical management and handling of data for analysis and provides three key analytical tools: description, inference, and control. These tools allow for the rigorous testing of theory and thus larger claims about the nature of the relationship under investigation.

Description: Unlike other empirical – often qualitative – approaches, statistics can force researchers to make some concessions in order to make concepts measurable. For statistical analysis, the data to be analysed must be to some extent mathematically tractable. This presents us with some issues with which to contend. However, statistics does offer something other methods do not: uncertainty, or more specifically, a measure of uncertainty. Statistics takes uncertainty seriously by providing indicators of how certain (or uncertain) we, unlike our qualitative counterparts, can be that our result is likely to be 'The Result'. *Hint:* There is always some uncertainty. However, a low level of uncertainty means that we can have a high degree of confidence in the results. This power to have confidence in our descriptions (and ultimately, inferences) distinguishes statistics as a powerful analytical tool.

Inference: As a direct function of the abilities to provide measures of uncertainty as well as control for competing explanations, we are offered enormous power to make inferences, that is, more general claims based on the results of our research. We are able to speak to a class of events rather than only the ones in our sample.

Control: Statistics allow the research to impose upon the data techniques with which we can control for competing explanations (think: competing explanations/theories). In doing so, we can isolate and assess the relationship in which we are interested. Statistical control not only most closely resembles the gold standard of experimental control, it can control for a great deal more than other approaches.

Together, the Illustrious Triumvirate of description, inference, and control imbue statistical analysis with a difficult-to-compete-with analytical power at achieving the core aims of the Scientific Method and the scientific study of politics.

Doing Statistics is Not Doing Science

Statistics are seemingly ubiquitous in Political Science research. Scientific reports, publications, and books brim with statistics and appendices filled with even more frightening statistics. Statistics as a tool of scientific research do have a large role. Some might argue an oversized role. However, while this book is about statistics and supports the proper use of statistics, the use of statistics is not, for Political Science or other disciplines, an all-powerful technique that allows us to easily, completely, and perfectly answer every question. Nor is it, and this is the entire point of this opening chapter, a replacement or proxy for science (itself not an all-powerful means to definitively prove things).

It is undeniable that statistics are one of the most well-known and visible investigative tools. While impressive and visible, statistics only reflect key elements of the vastly more impressive foundation of the scientific method. *Doing statistics is not doing science*. Neither does it make you a scientist. Statistics can be a very effective tool in bringing scientific research to fruition but it does not – and cannot – replace the necessary elements of scientific inquiry. Conflating the two can lead to misconceptions about what it is we are trying to achieve. That is, again, if the only tool you have is a hammer, you tend to see every problem as a nail.

The goal of this book is to offer an understanding of *how statistics come to represent relationships among data* and in doing so, inform your understanding of their place in the long line of necessary elements of the scientific method. Also, using statistics looks cool.

Allow me to re-phrase.

To a certain audience, using statistics has an undeniable aesthetic and analytical appeal. They look complex and important. They have been and will be around for a long time. Everything you will learn in this book is unlikely to change in your lifetime (if there will be any developments, they will occur somewhere beyond the neighbourhood of Chapter 18).

More importantly, using statistics in a vacuum is a waste of time. On its own, devoid of context, statistics is a math game. Put in some numbers, pull the handle, see what comes out. The techniques are useful only in that we employ them both correctly and well. This is precisely what the discussion about science and the scientific method is about. Without a reason to use statistics, whether it is to explain a change in wheat futures, the origins of roller skates, or faked UFO sightings, is to be flipping a coin. Forever.

Or maybe it makes more sense to think of statistics as just a woodchipper. It is a tool. If you put something in it, it will give you a result. If you want wood chips, put wood in the woodchipper. If you want soap chips, put in soap. If you want confetti, put in paper. However, if you want to landscape your garden and you need to clear a fallen tree, all of a sudden, a woodchipper just got a lot more useful to achieve the specific goal of clearing the fallen tree which services the larger goal of the landscaped garden. This is the relationship of statistics to the Scientific Method – capital S, capital M.

Statistics are used in service of scientific research. It is the scientific methods that insists on how you define and intend to measure something. Statistical analysis merely reveals what the method has assembled. In other words, what you find has a great deal more to do with what you do before you open your first dataset.

Why Do We Confuse Statistics for Science?

So, why are they so often confused for one another? Doing statistics is confused for doing science because doing statistics looks similar to the three Principles of scientific research. That is, they look like each other. If our goals of the scientific method are to develop and test theories that can explain a class of events and well as to achieve inference – not only the descriptive inference of prediction but also the causal inference of 'scientific' explanation, that is, to explain beyond our results, then statistics provide the most compelling approach.

Table 1.1 The Scientific Method and Statistics

	The Scientific Method	Statistics
Principle Number 1	A transparent and replicable description of the research design and analysis.	Statistics has an internal formal rigor grounded in the use of mathematics as its language which eases the handling of assumptions and estimating results. As such, statistics techniques follow a formal methodology specifically to enable replicability.
Principle Number 2	To identify, isolate, and explain the relationship under investigation.	Statistics exposes patterns. It summarizes data, variables, and relationships between variables. Crucially, outside the laboratory, statistics is the most effective method for exerting control of large arrays of competing explanations in scientific studies.
Principle Number 3	Steps to assess the appropriate inferences from the results.	Statistics has an explicit use for and reporting of variance which, in its most advanced form, is a measure of (un)certainty. Using this, we have the ability to make qualified inferences about unobserved phenomena.

Hence, it is a lot easier to see the element of the Scientific Method as statistics formalizes key elements of the scientific method, its power of description, inference, and control. Thus, outside of a laboratory, statistics, used correctly, can provide us with the ability to make strong scientific claims. But it is just one of many tools of the social scientist. Statistics are very good at helping us strive to attain specific and rigorous standards of the scientific method but cannot be treated as a replacement.

Statistics is classically divided into two complementary and essential parts, both covered in this book, called Descriptive Statistics and Inferential Statistics. **Descriptive statistics** allow us to describe and summarize data for consumption and analysis. **Inferential statistics** allow us to know is whether the relationship (i.e., the observed pattern in the data) can be inferred to apply more generally to the population (from which the sample was drawn). Both forms introduce and use methods of control in order to achieve these outcomes. As we progress through the book, it will become obvious that while Descriptive statistics has a great deal to offer, Inferential statistics is the workhorse of modern research.

Now, let's get on with it.

End of Chapter Summary

- Science, as a method of inquiry, is one way to understand the world. It is popular but not the only one.
- The scientific method – a.k.a. the Scientific Method – is an objective and replicable analysis of data which results in evidence which can be used to assess proposed explanations for a relationship and whether we can export the resultant explanation to other phenomena.

- The scientific approach is a positivist – or non-normative – approach such that it appeals to objective facts rather than how things should be.
- Inference can take two forms: descriptive inference or causal inference.
- Science provides probabilistic confirmation rather than deterministic confirmation.
- Statistics provide three key analytical tools – description, inference, and control – which allow for the rigorous testing of theory and thus larger claims about the nature of the relationship under investigation.
- Doing statistics is not doing science. Neither does using statistics make you a scientist.
- Statistics has two complementary and essential parts: Descriptive statistics and Inferential statistics.
- Science doesn't describe what we study, it describes how we study it.

Glossary

- **Science** is one of several ways to try to understand the world.
- **Scientific Method** is an objective and replicable analysis of data which results in evidence which can be used to assess proposed explanations for relationships and whether what we find can be exported to explain other related phenomena.
- **Replication:** The methodology can be performed by someone else, following instructions, and produce the same results.
- **Transparency:** A clear and comprehensive reporting of our methodology including variables, data, conceptual and operational choices, and analytical approach.
- **Objective:** The factual, unfeeling, undistorted intellectual grasp of an object or event that exists.
- **Subjective:** The perception of an object or event that emanates from ourselves: our perspectives, biases, and preferences.
- **Epistemology** is a branch of philosophy concerned with how we come to know things.
- **Ontology** is a branch of metaphysics that is concerned with the state of being or the nature of existence.
- **Positivist** (a.k.a. *non-normative*) refers to the empirical description or investigation of 'how things are'.
- **Interpretivist:** Focuses on intentionality of the actors by interpreting motives, beliefs, and/or reasons of actors and institutions as a means to understand political realities.
- **Normative** refers to the orientation of 'how things should or ought to be'.
- **Descriptive inference** is the projection of what we have observed toward what we can expect from new or unobserved events.
- **Causal inference** is the projection of our *explanation* of what we have observed toward an *explanation* for new or unobserved events.

- **Deterministic confirmation** is the conclusion that, given the complete set of explanatory variables, the world is entirely predictable.
- **Probabilistic confirmation** is the result of making our best guesses about how the world works, with a high – albeit unavoidably *partial* – level of control of a complex, dynamic reality.
- **Statistics** is the mathematical manipulation of data for analysis.
- **Descriptive statistics** allow us to describe and summarize data on hand for consumption and analysis.
- **Inferential statistics** allow us to know whether the observed pattern in the data on hand can be inferred to apply to the population (from which our data was drawn).

Questions

1. Another textbook might describe scientific knowledge as *subject to empirical verification*, *non-normative*, *transmissible*, *general*, and *explanatory*. Take two of these concepts, provide a definition for each of them, and explain why they are important for the development of knowledge in the social sciences.
2. Briefly explain the jump from descriptive to causal inference.
3. Explain why we need to point out that doing statistics can be a part of, but cannot replace, doing science.
4. Werner Heisenberg wrote in *Physics and Philosophy: The Revolution in Modern Science* (1958: 38), '…what we observe is not nature in itself but nature exposed to our method of questioning.' This refers to many aspects of scientific investigation. However, one might interpret this as meaning that the subjective choices we make, no matter how strict our adherence to the objective application of the scientific approach, are crucial to what we find. How does this apply to our discussion of the Scientific Method above?
5. Do adherents of deterministic confirmation watch the weather forecast before leaving the house? Less sarcastically, our ability to predict one aspect of reality – the weather – is at best probabilistic and such 'inferior knowledge' is of no use to someone requiring absolute certainty. Can we live – and even progress our knowledge – with only best guesses about how reality really works?
6. Take a look at the end of this article: Peffley, Mark and Robert Rohrschneider. 2003. 'Democratization and Political Tolerance in Seventeen Countries: A Multi-level Model of Democratic Learning' Political Research Quarterly 56(3): 243–257.
7. Do the authors include a normative discussion in the conclusion or the final few paragraphs? If so, briefly summarize this discussion.
8. Given the three Principles for the Scientific Method above, which is the most important? The least important? Why?

Annotated References and Further Reading

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After more than one hundred years, this book continues to serve as a cornerstone for empirical research in the social sciences.

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Heisenberg provides for scientists of all stripes lessons in our shared form of thinking as well as its undeniable shortcomings common across all fields of inquiry. A seminal work of scientific thought.

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If you wanted to know more about how science progresses to accumulate knowledge across different scientific disciplines.

Popper, Karl. 1959. *The Logic of Scientific Discovery.* London: Hutchinson & Co.

Like Durkheim, a classic that has application even though written in the middle of last century. Nearly as good as anything on the market today.

Signposts to Research and Empirical Examples

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