# Film Studies and Statistical Literacy

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**Abstract**

The purpose of this paper is to establish the relevance of statistical literacy to Film Studies in higher education. In this paper I argue statistical literacy comprises a set of skills and attitudes necessary for all film scholars and that it is a significant failing of film education in the UK that these skills and attitudes do not form a part of the curriculum for film students with negative consequences for their understanding of research on the cinema and their employability post-graduation.

Keywords: statistical literacy, Film studies, higher education, employability

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**Introduction**

In October 2012 the British Academy published Society Counts: Quantitative Skills in the Social Sciences and the Humanities, a position statement expressing concern over the lack of quantitative skills affecting students, teachers, and researchers in these subject areas and the impact on UK's status as a world leader in research and higher education, on the employability of graduates, and on the competitiveness of the UK's economy.

> There is a skills deficit. In higher education, almost all disciplines require quantitative capacity, but students are often ill-equipped to cope with those demands. They then leave university with skills inadequate to the needs of the workplace – be it in business, public sector or academia. Students are graduating with little confidence in using what skills they do have, having had little practice in applying them. ... There is a dearth of candidates with good quantitative skills to go forward to doctoral training, and an inadequate supply of graduates with the numerical skills that are in demand in the workplace. (2012: 2)

The British Academy (2012: 2-4) notes that 'many students enter higher education with poor numerical skills, little confidence in their mathematical abilities or an appreciation of their relevance,' the 'long-standing lack of emphasis on quantitative methods in many courses and programmes of study,' 'the dearth of academic staff able to teach quantitative methods in ways that are relevant and exciting to students,' and students' lack of awareness of the value of quantitative skills for future employment as factors behind the failure to develop quantitative skills in the social sciences and humanities.

As a part of the humanities, Film Studies is not immune from these problems, and at present no Film Studies degree programme in the UK provides any instruction in statistical literacy to under- or post-graduate students. There is no requirement for film students to develop their numeracy, their statistical literacy or their ability to use quantitative methods, despite the value employers attach to such skills (see Tariq, et al., 2010: 7-9). Though there have been long-standing concerns regarding the quantitative skills of arts graduates (Green et al., 1983), research on statistics and its relationship to Film Studies and/or any of its cognate disciplines is almost non-existent. In fact, I have been able to find just a single conference paper discussing statistical literacy in relation to any of these subjects: Zandpour and Rimmer (2006) noted that in the US statistics instruction for students with majors in media, communications, and journalism was rare, while students taking such courses failed to perceive any relationship between statistical literacy and their degree subject. Along with many other disciplines in the humanities, Film Studies has simply failed to grasp the importance of statistical literacy to everyday life, to students' employability, and to the specific demands of the discipline. This paper seeks to take the first step in making progress in this area by establishing the relevance of statistical literacy to Film Studies in higher education. Specifically, I argue that statistical literacy comprises a set of skills and attitudes necessary for all film scholars and that it is a significant failing of film education in the UK that these skills and attitudes do not form a part of the curriculum for film students, with negative consequences for students' understanding of research on the cinema and their employability post-graduation. In the next section I set out some definitions of statistical literacy and related concepts. In light of these definitions I argue the importance of statistical literacy in Film Studies in three areas: understanding research in Film Studies; bridging the gap between the humanities and science, technology, engineering, and mathematics (STEM) subjects; and developing the employability of graduates.

**Statistical literacy, mathematics, and the liberal arts**

The concept of literacy has come to mean the 'idea of being able to find one's way around some kind of system, and to "know its language" well enough to make sense of it,' and foregrounds the notion of being able to 'make meaning' as either a producer or consumer within that system (Lankshear & Knobel, 2003: 15). Internationally, education has become focussed on developing a range of literacies as skills that enable individuals the access and use knowledge and information (UNESCO, 2006: 150-151), including scientific literacy (Hazen & Trefil, 2009), computer literacy (Robinson, 2009), financial literacy (Mason & Wilson, 2000), media literacy (Potter, 2013), statistical literacy (Gal, 2002), visual literacy (Felten, 2008), and 'new literacies' associated with digital technologies (Leu et al., 2004) amongst others.

*Statistical literacy* may be defined as 'the ability to understand and critically evaluate statistical results that permeate our daily lives – coupled with the ability to appreciate the contributions that statistical thinking can make in public and private, professional and personal decisions' (Wallman, 1993: 1). Numeracy is the ability to use mathematics effectively in everyday life, but statistical literacy goes beyond this to add the ability to read and communicate using quantitative information: 'That makes it literate as opposed to just numerate. It adds words in as well, so you need to be able to know what the words mean when you are communicating. It isn't just about the figures' (Holmes, 2003: 2).

Statistical literacy is directly relevant to the humanities, though it rarely features:

> the ability to read and interpret summary statistics in the everyday media: in graphs, tables, statements, surveys and studies. Statistical literacy is needed by data consumers – students in non-quantitative majors: majors with no quantitative requirement such as political science, history, English, primary education, communications, music, art, and philosophy. (Schield, 2010: 135)

One of the problems with introducing statistics into a humanities curriculum is that most students on humanities courses will have limited mathematical skills and/or low confidence in the skills they do possess. Many students may in fact be put off by the fact that film courses have some statistical content because they view it as mathematics. This problem has been widely recognised in the literature on statistical literacy, and although numeracy is a pre-requisite for statistical literacy advocates of statistical literacy stress that it is not the same as mathematics. Statistical literacy promotes conceptual and contextual understanding over the ability to calculate statistics (Cobb & Moore, 1999); and David S. Moore argues that statistical reasoning is one of the liberal arts because it is a flexible and broadly applicable mode of thinking that prepares students to participate in society.

> Statistics is a *general* intellectual method that applies wherever data, variation, and chance appear. It is a *fundamental* method because data, variation, and chance are omnipresent in modern life. It is an *independent* discipline with its own core ideas rather than, for example, a branch of mathematics. (1998: 1254, original emphasis)

From this perspective, the emphasis in early statistical education should be on statistical thinking rather than on statistical methods, prioritising conceptual understanding rather than computational recipes. Though it may seem contrary to the goals of teaching statistics, a first course in statistics does not seek to develop statisticians. Rather it seeks to develop a set of skills and attitudes that allow scholars to be able to engage with the information presented to them:

> [W]e want our students to be good 'statistical citizens', understanding statistics well enough to be able to consume the information that they are inundated with on a daily basis, think critically about it, and make good decisions based on that information. (Rumsey, 2002)

A similar approach is proposed by Milo Schield, who argues that statistical thinking is a form of critical thinking:

> Statistical literacy, critical thinking about statistics as evidence, is an integral component of a liberal education since a key goal of statistical literacy is helping students understand that statistical associations in observational studies are contextual: their numeric value and meaning depends on what is taken into account. The need to deal with context and confounding is ubiquitous to all observational studies whether in business, the physical sciences (e.g. astrophysics), the social sciences, or the humanities. (Schield, 2004: 18)

Introducing the topic in this way to students already familiar with critical thinking should make it easier to encourage them to engage with data-based arguments. It is in this context that we understand Schield and Shuman Schield's (2006) observation that 'statistical literacy is to statistics what art appreciation is to art'. Another perspective is to view statistical literacy as 'a bridge between quantitative information and social meaning' as a part of a quantitative rhetoric which focuses on 'critical thinking, analysis of argumentation and persuasion, and an ability to interpret statistics in context' (Schmit, 2010).

A list of goals for students in developing statistical literacy is provided by Gal and Garfield (1997: 3-5), and includes:

- understanding the principles and processes of scientific discovery,
- understanding the role of statistics in scientific discovery,
- understanding the logic of statistical reasoning,
- understanding statistical terms,
- the ability to interpret results presented in tabular, numerical, and graphical form, and
- to be aware of possible source of variation and bias,
- the ability to communicate using statistical and probabilistic terminology properly,
- developing a critical stance towards research that purports to be based on data,
- developing the confidence and willingness to engage with quantitative research.

The purpose in obtaining these skills is to become a statistical thinker 'able to critique and evaluate results of a problem solved or statistical study' (Ben-Zvi & Garfield, 2004: 7).

Statistical literacy is different from statistical competence, in which individuals function as data producers and analysers in producing original empirical research rather than consumers presented with a completed study. Naturally, we want students to develop the necessary skills that will allow them to produce high quality original research, and, as I demonstrate below, research in Film Studies requires the ability to design studies, collect and manage data, perform statistical analyses, and communicate those results. These competencies depend on statistical literacy – just as you cannot write without being able to read, you cannot become competent in statistical methods without first understanding the role of statistics in empirical research, the ability to communicate ideas in tables, numbers, or graphs, or the willingness to engage with quantitative methods. Every film student needs to be statistically literate, but only those who

wish to engage in quantitative research requiring the use of statistical methods need to master procedural skills.

**Understanding research in Film Studies**

The study of film is a diverse field comprising four distinct but related areas of inquiry:

- Industrial analysis: the political economy and organisation of film industries; technologies of film production, distribution, and exhibition; practices of film production, distribution, and exhibition; government policies, etc.
- Textual analysis: representation and the symbolic meanings of film; film form; film style; narrative/non-narrative structure, etc.
- Ethnographic analysis: the composition of audiences; rituals of cinema-going and film experiences; cultural meanings and issues of identity, etc.
- Cognitive-psychological analysis: the viewer's perception of a film; communication and information in the cinema; psychological processes of meaning-making in the cinema; the psychological basis of the viewer's response to a film, etc.

Films can be analysed as institutionally produced commercial commodities that function as cultural artefacts inscribed with meanings which are then consumed and interpreted by audiences, whose experience of the cinema is predicated on cognitive-psychological processes of perception and comprehension. Film Studies can be defined as a research programme analysing films in institutional, textual, ethnographic, and cognitive-psychological terms.

Statistics is relevant to each of these four areas and students will encounter information presented in the numerical, graphical, and tabular form in whatever aspect of the cinema they choose to study. Statistical summaries feature in many Film Studies texts, in newspaper and magazine articles on the cinema, and in official reports and the statistical yearbooks produced by national film bodies. Film scholars will also encounter more advanced methods in research from disciplines such as neuroscience or economics where scientific and statistical knowledge is commonplace. To illustrate the use of statistics in Film Studies the following provides an example from each of the four areas identified above.

To begin with economics, Candace Jones (2001) combines historical and economic research in a study of the emergence of the institutional rules and competitive dynamics in the first decades of the American film industry. Combining archival data with historical analysis she describes the shift from the technology era of 1895 to 1910, in which market dominance was asserted through patent control, to a content-based era (1911 to 1920) inaugurated by the rise of the feature film and of entrepreneurs who would go on to become the studio heads of the classical Hollywood era. This article presents quantitative information in a variety of formats. Line charts are used as a graphical method of showing trends over time of the number of films released, the number of firms operating in the industry, along with other economic and demographic data; and are also used to present survival data on the longevity of firms. Numerical information is provided as frequency data or percentages and in tabular form. Statistical methods used in analysing economic data include paired t-tests with one-tailed p-values, the variance of a sample, and the Herfindal index (which measures the size and power of firms).

Turning to audience research, John Sedgwick (2009) describes a quantitative method for analysing film popularity, arguing that 'economic reasoning and statistical methods have a part to play in presenting knowledge about filmgoing that is not otherwise discoverable and even expressible' (53); and applies this method to data from the ledgers of the Regent Cinema in Portsmouth revealing differences in preferences among audiences attending films at the Regent

and those attending at other cinemas in the city. This approach involves calculating a popularity statistic (POPSTAT) that takes into account the gross of a cinema relative to the mean for all cinemas, the duration of a film's release and its billing status, and weighs this information accordingly. Sedgwick uses ordinary least squares regression to fit the POPSTAT scores to the recorded attendances to determine the extent to which attendances can be used to determine the popularity of films. This information is depicted graphically as a scatterplot of the residuals between the predicted and the observed POPSTAT scores against attendance, while the coefficient of determination is employed as a measure of the explanatory power of the regression model. Other statistical terms used include descriptive statistics (mean, standard deviation), 'expectation' and 'expected values', and 'statistical significance' and 'confidence level'. Sedgwick describes his approach to measuring film popularity as 'rare' not only because of the scarcity of historical data on cinema attendances but also because 'quantitative approaches to analyses are not widely practiced' (47).

As an example of the application of statistical methods to film style, my study of the impact of sound technology on the editing style of Laurel and Hardy shorts compared the shot length distributions of silent and sound films featuring the duo (Redfern, 2012). The results indicated that while there is a significant difference in the editing of these films that occurs with the coming of sound, this difference is smaller than that associated with Hollywood films in general and this may be attributed to the continuity of a mode of production, of creative personnel, and a particular kind of film comedy. The statistics used to describe the shot length distribution of each film include the five-number summary (minimum, maximum, lower and upper quartiles, and the median) along with Qn as a robust estimate of scale; and this information is presented in tabular form. Statistical methods used include the Mann-Whitney U test with two-tailed p-values as a test of the null hypothesis of stochastic equality, the probability of superiority as a measure of effect size, and the Hodges-Lehman median difference with accompanying confidence interval as an estimate of the effect of sound technology. Boxplots display the data graphically.

Finally, in a much publicised study of the relationship between film style and cognition, James Cutting, Jordan De Long, and Christine Nothelfer (2010) use a range of methods to understand how editing patterns in Hollywood cinema are related to patterns of attention. They employ a negative exponential function fitted to the partial autocorrelation functions of shot length data to derive a modified autoregressive index as a continuous measure of the local relations between shots. They also examine the statistical relationship between this index and the average shot length using correlation coefficients and confidence intervals, with accompanying t-statistics and p-values, concluding that Hollywood film has become increasingly clustered in packets of shots of similar length since the 1930s but that this is not an artefact of decreases in the mean shot lengths in films. In order to explore the global editing structure of Hollywood films the authors use Fourier analysis of the standardised shot length data to identify the presence of $1/f$ noise, and conclude that Hollywood films have increasingly conformed to this structure reflecting the $1/f$ noise pattern of mental processes. A range of descriptive statistics (mean, standard deviation, root mean squared deviation) and graphical methods (including correlograms, scatterplots, box plots, and periodograms) communicate the detailed quantitative information in this article.

Clearly understanding research on all the different aspects of the cinema requires a high level of statistical literacy. Film scholars need to develop a set of attitudes towards empirical, data-driven research on the cinema that recognises the role such methods play in research in Film Studies. This includes appreciating how quantifying concepts such 'popularity' and the use of numerical indexes to represent attributes of objects of inquiry (firm size, shot clustering, etc.) can help us to analyse the behaviour of audiences, the history of the film industry, changes in film style, and so on; and recognising how statistical methods enables us to analyse large number of

films and make general statements about them in a field dominated by interpretative studies of small numbers of texts. Film scholars need to develop a range of skills so that when presented with a piece of research utilising statistical methods they are able to:

- evaluate the experimental design of a study;
- comprehend statistical concepts such as 'distribution,' 'model,' 'significance,' 'confidence,' 'robustness,' 'residual,' 'non-linear,' 'function,' etc.;
- appreciate the need to use summary statistics to describe a data set and the ability to interpret information presented in numerical form;
- interpret information presented in a wide range of graphical and tabular formats;
- describe the relationship between samples and populations, and comprehend the role of statistical inference in making statements about the latter on the basis of the former;
- describe the logic of statistical hypothesis tests and interpret the results of such tests; and
- evaluate the conclusions of a piece of research derived from statistical analysis.

Finally, film scholars need to develop the confidence to express their informed opinion about the use of statistics in research in Film Studies.

In order to achieve these goals it is essential to recognise that statistical literacy should not be relegated to generic 'research skills' courses as an adjunct to other topics in Film Studies. It is necessary to combine statistical literacy with subject specific tuition so that statistical thinking develops in relation to real world problems that demonstrate the importance of such knowledge for understanding the cinema and to reduce the cognitive burden placed on students by presenting statistical concepts and ideas in a framework they already understand (Yilmaz, 1996). In practical terms, this means writing explicit learning outcomes for statistical literacy into degree specifications and course design, deliberate teaching of statistical literacy contextualised within the broader scope of the study of film, and explicit assessment of students' statistical literacy in their work.

**Science education and the humanities**

The recent film policy review published by the Department for Culture, Media and Sport (DCMS) noted there exists an artificial division between the arts and humanities and the sciences in education in the UK, and that this is unhealthy for the film industry in particular.

There is no division between Film Studies and science at the level of content or of the research practices of film scholars since the methods and knowledge derived from the latter are intimately a part of every aspect of research and learning in the former. Understanding the cinema depends on knowledge derived from physics (the properties of light and sound), material science (how an image is produced on film stock), technology and computer science (how cameras function), physiology and neuroscience (how we perceive films), psychology (how we experience films), sociology (human social activity in relation to the cinema) and economics and marketing (the film industry) in addition to humanistic modes of inquiry (historical research, philosophical approaches, narrative inquiry, textual analysis, etc.).

A key step in establishing the relevance of statistical literacy in Film Studies lies in overcoming such long-standing hostility to applying 'scientific' methods in subjects traditionally viewed as the 'humanities.' It is not a question of making Film Studies 'scientific' or of abandoning the subject's roots in the humanities to place it in the service of science. It is a matter of recognising that the distinction between the sciences and the humanities is wholly false and that defining Film Studies as an autonomous discipline within the humanities cuts scholars off from potentially useful ways

of understanding the cinema. It is necessary to stop thinking of 'Film Studies' as a subject with clearly defined norms and cultural values, epistemologies and methodologies that separate it from other subjects and to start thinking of the cinema as a complex object of inquiry ('the study of film') that requires scholars to embrace the ontological, epistemological and methodological ecumenism essential to understanding its many dimensions. It is a matter of providing film students with the full range of skills and knowledge they need to understand the cinema flexibly, pragmatically, and collaboratively rather than inculcating them with a narrow epistemological and methodological purism (Onwuegbuzie & Leech, 2005).

Every film student should learn how a digital camera produces an image because philosophical debates about the ontology of the cinema depend precisely on such knowledge, and any scholar who lacks a basic scientific grounding will only be able to make the most superficial contribution to our understanding of the cinema.

**Statistical literacy and employability**

Yorke (2006: 8) defines employability in higher education as 'a set of achievements – skills, understandings and personal attributes – that make graduates more likely to gain employment and be successful in their chosen occupations, which benefits themselves, the workforce, the community and the economy'. Numeracy, statistical literacy, and quantitative skills clearly fall within this definition and are highly valued by employers (Durrani & Tariq, 2012) but the British Academy and the Royal Statistical Society (via its 'Get Stats' programme) note that there is 'a generic deficit in quantitative capacity in our country and specifically, in the preparation of many students who study social science and humanities subjects' (British Academy/Get Stats 2011: 3).

Raising students' awareness of the employability aspects of statistical literacy has a key role to play in attracting students studying film to courses dealing with quantitative information. Research on attitudes to quantitative and qualitative research methods shows many students arrive at university with firmly fixed opinions regarding their research orientation and that many have strongly negative perceptions of quantitative methods (Murtonen, 2005); and that students experience 'statistics anxiety' when asked to use statistical concepts, solve problems in statistics, or evaluate information presented in statistical form (Onwuegbuzie et al. 1997; Zeidner 1991). This is especially the case for students in the humanities (Gillespie 1998). Research has shown achievement in statistics education is related to perceptions of the use and value of quantitative methods (see Evans, 2007: 24-25 for a review), but many students are unaware of the career advantages of good quantitative skills (MacInnes, 2009).

**Conclusion**

There are many obstacles to embedding statistical literacy in Film Studies in higher education: attitudes to empirical research in subjects traditionally regarded as the humanities must be transformed; the benchmarking for Film Studies degrees will need to be re-written to require students to obtain quantitative skills; lecturers will require training in statistical methods and in teaching statistical literacy; and students' awareness of the importance of quantitative skills needs to be developed. None of these problems are insurmountable. This article has taken the first step by demonstrating that statistics are to be found in every area of research on the cinema and that statistical literacy comprises a set of skills and attitudes all film scholars ought to possess in order to comprehend and evaluate this research; that there is nothing for Film Studies to fear in looking beyond the humanities; and that by introducing statistical literacy into the curriculum we better prepare students (and lecturers) for work and life.

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