

The Islamic origins of Hypothesis Testing

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Abstract:

Using Zarqa's (Zarqa, 2003) framework for the Islamisation of economics this paper provides evidence that hypothesis testing (HT), the ubiquitously used and almost universally accepted research method, has its origins in Islam's first source of guidance, the Quran and situates it specifically within the science's descriptive statements, thus reinforcing its universality.

The paper provides a comparative overview of conventional literature on HT, and that from Quran, to show how closeness of the methods.

The paper concludes by discussing the implications of the research, one of which is that HT is a much older framework than may be commonly believed.

Introduction

For Muslims, a commitment to Islam is inherent in a happy and fulfilling life. Many Muslim academics are very concerned about the ‘halal-ness’ of methodologies they are taught and utilise in their research projects and, due to these considerations, tend to avoid some methods in order to ‘do no harm’. For this reason, and to make a general contribution to both the Islamisation of knowledge across the social sciences and to Islamic Economics, this paper investigates the origins and applicability of the ubiquitous methodology ‘hypothesis testing’. The starting point for this undertaking is a verse from Surah Yusuf, which will provide a case study for the investigation. The discussion will comprise an analysis from an Islamic perspective and then from a conventional methodological perspective. In this way, the paper will filter the methodological tool ‘hypothesis testing’ through the truth and wisdom found in the Qur’an. The implications of this paper, and its model, provide a starting point for other researchers, who can use their own academic specialisations to examine theories in common use through the filter of Islam, thus enabling the generation of a cohort of theories which are unquestionably halal and eminently suitable for use by Muslim scholars, or others interested in pure and ethical research frameworks (see Boulanouar and Boulanouar, 2013 for one such consideration).

Framework of Reference

(Zarqa, 2003) proposed a definition of science, which he considers to be in keeping with both the Islamic conception of what science is, and other modern definitions. He defines science by distinguishing between its three components: normative statements, descriptive statements, and presumptions.

An essential first step is to distinguish between a descriptive and a normative statement. Descriptive statements describe a specific reality, it is a proposition of what is, that is, a predictive statement. As a result, descriptive statements “might be true or correct, that is, they might be consistent with reality; they might as well be false or incorrect, that is, they might not be consistent with reality. Therefore, they are malleable to testing and verification to establish their truthfulness or falsehood” (Zarqa, 2003, p.6). Normative statements, on the other hand, “express an attitude towards what ought to be [...] indicate preference of certain state of affairs, behaviour, or condition that might occur” (Zarqa, 2003, p.6). Consequently, “normative statements cannot be described as true (i.e. consistent with reality) or false. However, these statements are likely to be **accepted** by us if they are compatible with our **values**, or **rejected** if they are opposed to them” (Zarqa, 2003, p.7).

From this brief discussion, we can say that empirical sciences such as physics and medicine are often concentrated on descriptive statements, whereas other sciences such as law or ethics often deal more in normative propositions (Zarqa, 2003).

It remains to say that the word ‘values’ mentioned above refers to presumptions¹, which is the 3rd component of science and its founding pillar (Zarqa, 2003). Presumptions, stem from a general view of the universe -and to Man in the case of social sciences- which could be “called philosophical bases of science” (P. 8). This is true across all sciences. “An example of such presumptions in physics is the belief, prior to any research that the universe and material therein are subject to stable laws that are amenable to discovery. Similarly, in the field of

¹ “An act or instance of taking something to be true or adopting a particular attitude toward something, especially at the start of a chain of argument or action”

social sciences, there lies the belief that human behaviour has a certain degree of regularity and stability. Thus presumptions are in fact descriptive statements about the universe, man or society, that could be described as starting points that are explicitly or implicitly taken as bases for building science.” (P. 8). In terms of usefulness, these presumptions function as source or “fountain from which the scientist gets his premises, which he uses to explain phenomena.” (P. 9)

Thus it is very important to note, however, that interpretation of descriptive statements is dependent on normative statements & Presumptions or values. So differences in explanation interpretation & recommendations of (results of) descriptive statements are from differences in of normative statements and presumptions (Elmessiri, 2006, Zarqa, 2003). This is so because, science cannot be just experiments or recording of observations, it must include interpretation (Mahjoob, 2006).

Applying this framework of science to the science of Islamic economics and finance vis-à-vis that of conventional economics and finance we get Figure 1 (below) where we distinguish six different categories of statements. Normative statements relating to Islamic Economics are labelled as category 1, normative statements peculiar to conventional Economics constitute category 5, and category 3 is the shared normative statements of Islamic and conventional economics. With regard to descriptive statements, those that are exclusive to Islamic economics and finance constitute category 2, category 6 are limited to conventional economics and finance, and those shared between the two are hosted in category 4.

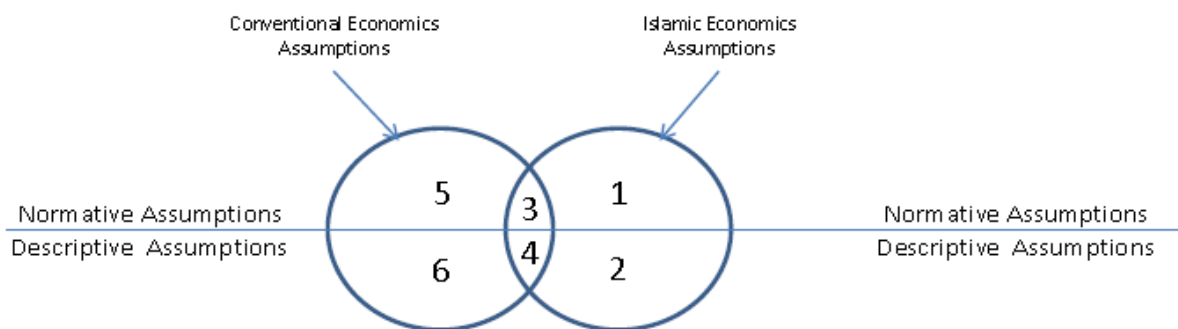


Figure 1: Diagram showing relationship between Islamic Economic Assumptions and those of Conventional Economics (adapted from (Zarqa, 2003))

To undertake a process of Islamisation of knowledge, in this case of economics and finance, the task would be to work out 1 and 2 and to discover 3 and 4. Sectors 3 and 4 would perhaps be more quickly identified, in the case where they have already been worked through in conventional economics.

A considerable research gap in the Islamisation of disciplines in general, and in Islamic economics and finance has been raised by many scholars in the field including Zarqa (2003) who “noticed that most contemporary writings about the Islamic quality of economics and other disciplines ignore the descriptive aspect of Islam, limiting their reference to the normative assumptions only” (P. 17).

Working with this modified Zarqa framework, the current research aim is to focus on one item from category 4 (overlap between Islamic and conventional descriptive assumptions) and show how this is true for hypothesis testing. This will be done by firstly showing a method specifically out of the descriptive statements box (or category 4) straight from Quran, the 1st source of guidance, then by comparing it to the already established tool from the descriptive statements box from conventional economics and through this process concluding that hypothesis testing belongs to category 4 of the framework as presented in figure 1 above.

Hypothesis Testing In the Islamic perspective

The verses of concern are from the chapter of Yusuf (Joseph), verses 25-28 which describe an incident between the Lady of the house and Yusuf: “And they raced with one another to the door, and she tore his shirt from behind, and they met her lord and master at the door. She said: What shall be his reward/recompense/penalty, who intended/wished/ evil to thy folk, save prison or a painful punishment? (25) (Joseph) said: She it was who asked of me an evil act. And a witness of her own folk testified: If his shirt is torn from the front, then she has told the truth, and he is of the liars. (26) And if his shirt is torn from behind, then she hath lied and he is of the truthful. (27) So when he saw his shirt torn from behind, he said: Lo! this is of the guile of you women. Lo! the guile of you is very great.”

HT steps as per The Quran

The Qur'an as a text is over 1400 years old. In terms of methodological presentation in general, a favourite style of the Quran is narrative and this example, too, is couched in a story.

After whatever took place inside the castle/house (verses 23-24), the first two characters of the case, the woman and Yusuf, raced with one another to the door - but for different reasons (الزحيلي, 1438). She, while trying to (catch and) force him into acting as she wished, pulled his shirt from behind, thus tearing it. Up until then they were alone so nobody could have seen or witnessed what happened between them. Then, on the other side of the door, they met her husband, the third character in the case, who is also the Master of the castle. At this moment, the wife of the master, the accuser, claimed that Yusuf tried to commit an odious act against her. Then she added “so what is the recompense for such a perpetrator save prison or painful punishment?”. Yusuf, however, defending himself against this accusation, stated his version of the event: it was her who tried seducing me. Here, two propositions have been stated, each claiming to be true by each from a different point of view: that of the accuser and that of the accused. In summary, party 1 accuses party 2 of wishing to do harm/evil to her, and party 2 denies it.

The Master of the castle is presented with two opposing possibilities or alternatives, while only one of them can be true, however, in his capacity of judge in this case, he is unable to work out which of the two propositions is true and thus he cannot adjudicate on the case. There comes a fourth and last character, identified as an expert witness. The Quran has explicitly documented the expert witness as being “of her own folk” i.e. from the family of the Lady of the house, the party that will eventually be identified as guilty (i.e. the witness will provide testimony against her kinswoman). Had the witness been from the family of the party the sentence was made in favour of, it would be easy to reject the testimony.

The expert witness, accepted by all 3 characters, after examining the case, devises a key and systematic procedure to help the Master bring out the truth, and successfully adjudicate. This procedure consisted of setting up two explicit hypotheses, the first (alternative hypothesis) being H1: “If his shirt is torn from the front, then she has told the truth, and he is of the liars”, and the second (null hypothesis) being H2: “If it be that his shirt is torn from the back, then she has told a lie and he is of the truthful”.

These hypotheses are of the format “if A is X then B is Y” which uses the observable to decide the unobservable.

The story goes on, stating that after the 2 hypotheses were formulated, the shirt was examined. It is very important to note here that the expert witness has stated the two hypotheses, referred to by Al-Sharawi (الشعراوي) as the decision rule and the judgement criteria, prior to seeing the shirt.

The exact Arabic letter used is the 19th Arabic alphabet letter which in grammar means ‘and then’. There is an order of events, 1st the setting up of the hypotheses, and then the examination of the shirt. This proves, in terms of the order of events, the expert witness has set up the judgment criteria before seeing the shirt, establishing the ruling principle first then when she saw the shirt, and found it to be torn from the back the Master referred to his judgement criteria through the 2 hypotheses, and he rejected the 1st or alternative hypothesis. He then delivered his conclusion, based on the evidence, that the Lady’s story must be dismissed in favour of Yusuf’s version, which the adjudication of the case. The Master was helped to adjudicate and reach a just decision(Ar-Razi).

Comparison with the Conventional Approach

In this section we will show how the Islamic treatment of hypothesis testing is the same as that in the conventional methodology literature. We will do this by describing briefly, from the literature, the key steps on how hypothesis testing is conducted and then illustrate this point using a comparative exercise.

Research can usefully be divided into theory-building and theory-testing (Colquitt and Zapata-Phelan (2003), Dul and Hak, 2008). The aim of the former is to generate new propositions, for example, through evidence drawn from the outcome of observations of instances of the subject of study. The aim of the latter, however, is to test proposition(s) via selecting and conducting a test of one or more propositions. "A test of a proposition is determining whether a hypothesis that is deduced from the proposition is confirmed or rejected in an instance of an object of study”(Dul & Hak, 2008, p. 290).

In case study research “hypothesis testing consists of comparing the “facts as observed” in the instances studied with the expectations formulated in the hypothesis, which is derived from the proposition. This “observation of facts” is called measurement, which itself consists of the collection of data and the coding of these data. The result of these two procedures is a score that represents the value of a concept in the observed instance of the object of study” (Dul & Hak, 2008, p. 87).

The whole process of hypothesis testing as per the conventional literature (Colquitt and Zapata-Phelan (2003), Dul and Hak, 2008; Frederick J Gravetter, and Larry B. Wallnau 2013; Neyman and Pearson, 1933) has been summarised in [Figure 2](#), below.

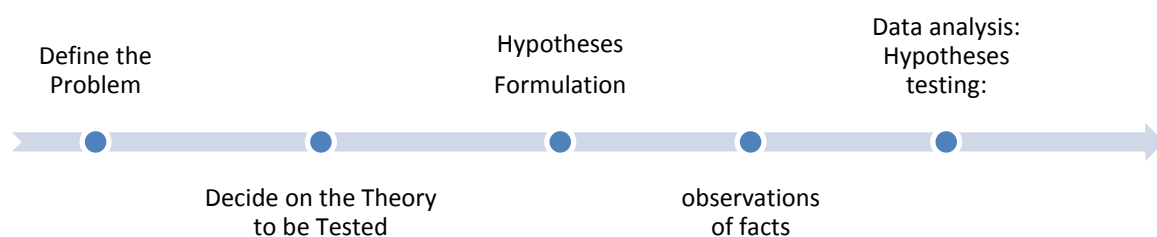


Figure 2: Stepwise approach to conducting hypothesis testing

The hypothesis testing process includes the following steps:

- 1- Specify the problem that needs to be investigated and resolved within the case under investigation.
- 2- Decide on the Theory to be Tested
- 3- Formulate the hypotheses, derived from the proposition(s) of the theory to be tested. As well as deciding about criterion/criteria upon which we decide that the claim being tested is true or not.
- 4- Observations of facts or measurement,

- 5- Conducting data analysis – comparing the observed pattern of scores with the predicted pattern, and decide whether to reject or support the hypothesis

Now we will elaborate on each one of these steps and show its equivalence from the hypothesis testing as per what has been distilled from the Quran.

1. Specification of the problem:

The first step is to identify the problem. An important objective from this step is to better understand the kind of knowledge needed (Dul & Hak, 2008). “This knowledge need is, often, formulated in the form of a hypothesis or as a question in which a hypothesis is implied” (Dul & Hak, 2008).

Looking back at the incident, we find two opposing claims, so only one of them is true. The question, then, is which of the two characters is truthful, the Lady or Yusuf?

2. Conceptual model:

The expert witness, in an effort to explain what happened and how it happened, must have formulated a theory to decipher what took place behind the closed doors. According to Shanguity, (الشقيطي), the witness must have reasoned like this: If he was attacking her, he must have been doing it facing her. She, however, trying to defend herself, must of grabbed his shirt from the front. If however, she was seducing him, and he refused to cooperate/give in to what she wanted, he would have tried to run away from her so his back would have been to her and in trying to catch him she must have grabbed his shirt from the back and torn it there.

The two propositions that could be gathered are:

P1-while attacking her face to face, she grabbed his shirt front the front, and

P2- While running away from her, she grabbed his shirt from the back.

3. Hypotheses formulation:

Hypothesis definition

A hypothesis is a tentative statement that makes a prediction, based on knowledge and research, about the relationship between two or more variables and proposing a possible solution to a problem or an explanation of some phenomenon (Ary, Jacobs and Razavieh, 1984; Creswell, 1994; Maxwell 2013). The prediction statement is presented as “the expected relationship between an independent and dependent variable (Creswell, 1994)”, accounting for a set of facts that can be tested by further investigation.

In the Quranic story, the two hypotheses stated a relationship between an observable variable – the location of the tear being at the front or at the back- and the dependent variable – who is the truthful and who is not - and proposes a solution to the problem raised.

On the relationship between ‘a proposition and its constituting concepts’ with a hypothesis and its constituting variables, (Dul & Hak, 2008) have said “a proposition is a statement about a relation between concepts. For testing, a proposition must be reformulated into a hypothesis. A hypothesis is a statement about a relation between variables in which the variable is a measurable indicator of the concept.” The two hypotheses that were formulated operationalize exactly the propositions formulated by the expert witness in the previous section. Furthermore, the propositions have been reformulated into hypotheses that operationalise the concepts of the propositions into variables with a clear relationship between the variables (the position of the tear-outcome), the measurable indicators of the concepts truthful vs liar and place of tear back vs front, respectively.

Formulation of the hypotheses has been described in the methodology literature as useful in many ways. Hypotheses provide a sense of focus and direction for the research efforts,

forcing the researchers to plainly state the purpose of their research endeavour, helping them to determine which variables to consider and those to ignore, and for those variables to consider how they operationalise the concepts they represent.

Looking back at our case (Qur'anic story) we find that the expert witness devised the inference procedure stating the two hypotheses to help him focus more on figuring out the truth from the lie. He boiled down the choice of variables to observable ones that would help in achieving his research aim.

Criteria required in a hypothesis:

Hypotheses, since they are considered to be the basis of any empirical study, have certain basic criteria which have to be met. Some of these criteria, which are clearly met in our Quranic story, include:

1. They must have explanatory power: “the ability of a hypothesis or theory to effectively explain the subject matter it pertains to. The opposite of explanatory power is explanatory impotence”.
2. They must be testable/falsifiable (Popper). If one cannot design the means to conduct the research, the hypothesis means nothing. Operationalization process spoken about above translated the problem identified into falsifiable hypotheses.

4. Observations of facts:

Throughout the methodology literature (e.g. Emeritus, Jacobs, Christine and Walker, 2014), it has been clearly emphasised that for a test of a hypothesis to be valid, the criteria (decision rules²) for the test must be clearly determined/stated before observations are collected or inspected. That is “before data are collected and analysed it is necessary to determine under what circumstances the hypothesis will be rejected or fail to be rejected”³. This is so because hypotheses give direction to the collection and interpretation of data (Ary, Jacobs, Sorensen, and Walker (2014); Ary and Jacobs, 1976). In fact formulating hypotheses after collecting data has been likened to throwing a dice then making a bet (Gravetter and Wallnau, 2013).

The parallel of this guideline in the Quranic story is “and then when he saw his shirt....” That is, the witness first set up the hypotheses, which are the decision rules, then only after that she proceeded to the observations of facts.

The process of observations of facts, also called measurement, consists of two steps, collection of data and coding of the data. The former involves:

- i. Identification and selection of the object of measurement, (Yusuf's shirt),
- ii. Extraction of evidence from the object of measurement (position of tear in Yusuf's shirt: front), and
- iii. Recording of the evidence (tear at the back of Yusuf's shirt).

Whereas the latter is about the coding of these data, which is the categorisation of the data, so as to generate scores, with a score being a value assigned to a variable. For example, a tear at the front of Yusuf's shirt = 1, and no tear at the back = 0.

² When a hypothesis is accepted and when it is rejected

³ <http://www.referenceforbusiness.com/management/Gr-Int/Hypothesis-Testing.html#ixzz4Bj7LLKda>

5. Data analysis: Hypotheses testing:

After the scores are generated through the measurement process, data analysis follows. Data analysis is the interpretation of the obtained scores to generate the study outcome. Data analysis consists of testing the hypotheses, and hypothesis-testing entails comparing the facts as observed with the prediction expressed by the hypothesis. The result of the test is either confirmation of the hypothesis or rejection (Dul & Hak, 2008).

Furthermore, “Data analysis in case study research is qualitative. Qualitative analysis is called “pattern matching”. Pattern matching is comparing two or more patterns by visual inspection in order to determine whether patterns match (i.e. that they are the same) or do not match (i.e. that they differ). Pattern matching in theory-testing is comparing an observed pattern with an expected pattern. It is a non-statistical test of the correctness of the hypothesis” (Dul & Hak, 2008, p. 95). In our case study, analysis was done through pattern matching where the expected pattern or place of the tear was compared with the observed pattern or place of the tear by visual inspection to determine whether they match or not.

Going back to the null and alternative hypotheses of the case, they, respectively, predicted the following “If his shirt is torn from the front, then the Lady has told the truth, and he is of the liars”, and “and if it be that his shirt is torn from the back, then the Lady has told a lie and he is of the truthful”. With the Null hypothesis, upon matching the observed place of tear (back) with the expected place of tear (front), no match was found, and the null hypothesis was rejected. However, the alternative hypothesis was confirmed because when the pattern matching was done, the observed place of tear (back) was found to perfectly match the expected place of tear (back).

Conclusions and implications

This paper has shown how hypothesis testing is an organically Islamic procedure/method of research. It has also shown the practical benefits of this procedure. In other words it was the use of hypothesis testing as a methodological procedure that helped establish justice as it is used in today’s courts where an expert witness is called on to give her view/assessment on something, where the judge/members of the jury can’t make a decision without input from an expert witness.

Finally, it is worth noting that another conclusion from this research is that HT has been in practice for much longer than the impression we get from reading the conventional Hypothesis testing literature. The verses from the Quran tells us that HT dates back to at least Yusuf’s era.

Finally, this paper adds to the reassurance of (particularly) Muslim researchers everywhere, that by first looking for guidance in Islamic sources, rather than conventional ones, halal methodologies and approaches can be pursued in research which can offer both ethical and just outcomes, as illustrated in the Islamic sources of guidance.

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