The Islamic origins of Hypothesis Testing
الأصول الإسلامية لمنهج إختبار فرضيات البحث

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Plan

What:
- This research provides evidence that hypothesis testing (HT), from the science of statistical inference, has its origins in Quran.

How?
- Using Zarqa (2003) as a framework of Islamisation of economics, we situate HT specifically within the science’s descriptive statements, thus reinforcing its universality.
- Doing a comparative overview of conventional literature on HT, and that from Quran, to show the closeness of the methods.
- Filter the methodological tool ‘HT’ through the Qur’an

So:
- Discussing some implications of the research e.g. HT is a much older practiced method than may be commonly believed.
- A suggestion on how to teach HT to (Muslims)
- Perhaps a new dimension of the explanation of the verse?
Framework of Reference

• Zarqa (2003) defines science by distinguishing between its 3 constituents: descriptive statements (DS), normative statements (NS), & presumptions (P).
• **DS** describes a specific reality, it is a proposition of what is. It’s a predictive statement. So:
  – DS might be true/false or in/correct i.e. in/consistent with reality.
  – DS are malleable to testing & verification to establish their truthfulness or not.
  – e.g. increase in income → increase in consumption
• **NS** expresses an attitude towards what ought to be..., indicates preference of certain state of affairs, behaviour, or condition that might occur.
  – So “NSs 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” (p7).

➤ We can say that empirical sciences like physics & medicine are often **concentrated** on DSs, whereas other sciences like law or ethics often deal more in NSs (Zarqa, 2003).
Framework of Reference-cont

• Presumptions or values, the founding pillar of science stem from a general view of the universe -& to Man in social sciences- which could be “called philosophical bases of science” (Zarqa, P. 8, 2003).

This is true across all sciences. e.g.

– In physics the belief prior to any research that the universe & material therein are subject to stable laws that are amenable to discovery.

– In social sciences there lies the belief that human behaviour has a certain degree of regularity & stability…

• Example of DS, NS, and P: payment/receipt of Riba as an eco/fin activity:

  – As a DS, can be tested for its correctness or falsehood.

  – Is Riba il(ligimate)? The answer is a NS –judgement- as it expresses a preference: Haram (1 of the 5 rulings).

  – Finally, where is this rejection coming from? Islam as religion/world view.
Application To Islamic Economics...

- Applying this framework to the science of Islamic economics & finance (E&F) vis-à-vis that of conventional E&F we get

Diagram showing relationship between Islamic Economic Assumptions and those of Conventional Economics (adapted from (Zarqa, 2003))
Research gaps & aim

- In the process of Islamisation of knowledge -economics & finance- the task would be to work out 1, 2 & to **discover** 3 & 4.
- Sectors 3 & 4 would perhaps be more quickly identified where they have already been worked out in conventional economics/finance....
- A considerable research gap in the Islamisation of disciplines in general, Islamic E&F in particular, has been raised by many scholars. Zarqa, “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, 2003).
- Knowing that the Sharia texts, although mainly as source of NSs, but often involve DSs about various areas of life: economic, social, marketing, Physics....
- Working with this modified framework, **the current research aim** is to focus on one item from category 4 & show how this is true for HT. This will be done
  - 1\(^{st}\) by showing a method specifically out of the DSs box (4) straight from Quran,
  - 2\(^{nd}\) by comparing it to the already established tool from the DSs box from conventional economics and through this process showing that HT, **indeed**, belongs to category 4.
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, who intended evil to thy folk, save prison or a painful punishment? (25) He 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. (28)“
HT steps as per the Quran-1

• After whatever took place inside the castle/house (verses 23-24), the 1\textsuperscript{st} two characters of the case, the woman and Yusuf (AS), raced with one another to the door - but for different reasons (Al Zuhaili, 2009). 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 3\textsuperscript{rd} character, who is also the Master of the castle.
• At this moment, 1 -the wife of the master (the accuser) claimed that Yusuf (AS) tried to commit an odious act against her. Then she added “so what is the recompense for such a perpetuator save prison or painful punishment?”. 2- Yusuf (AS) defending himself against this accusation, stated his version of the event: it was her who tried seducing me.
• Here, 2 propositions have been stated: party 1 accuses party 2 of wishing to do harm/evil to her, and party 2 denies it.
HT steps as per The Quran-2

• The castle Master is presented with 2 opposing possibilities but only one of them can be true, however, in his capacity of judge, he is unable to work out which of the two propositions is true and thus he cannot adjudicate on the case.

• There comes a 4th character, identified as an expert witness (EW). The Quran has explicitly documented the EW 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.
  — Had the EW been from the family of the party the sentence was made in favour of, it would be easy to reject the testimony.

• After examining the case, the EW devises a key & systematic procedure to help the Master bring out the truth, & successfully adjudicate: Setting up 2 explicit hypotheses
  — $H_1$: “If his shirt is torn from the front, then she has told the truth, and he is of the liars”
  — $H_2$: “If it be that his shirt is torn from the back, then she has told a lie and he is of the truthful”.

• These Hs are of the format “if A is X then B is Y” which uses the observable (independent variable(s) to infer the unobservable (dependent variable(s)).
HT steps as per The Quran-3

• The story goes on, stating that after the 2 Hs were formulated, the shirt was examined.
• Very important to note here that the EW has stated the 2 Hs, referred to by Al-Sharawi (1997) as the decision rule & the judgement criteria, prior to seeing the shirt.
• The exact Arabic letter used is the 19th alphabet 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 shows the EW has set up the judgment criteria before seeing the shirt, establishing the ruling principle first then when s/he saw the shirt, and found it to be torn from the back, the Master referred to the judgement criteria through the 2 Hs, and he rejected $H_1$.
• He then delivered his conclusion, based on the evidence, that the Lady’s story must be dismissed in favour of Yusuf’s version, which is the adjudication of the case.
• The Master was helped to adjudicate and reach a just decision (الرازي).
Comparison with the Conventional Approach

• Theory-building: aim is to generate new propositions, e.g., through evidence drawn from the outcome of observations of instances of the subject of study.

• Theory-testing: aim is to test proposition(s) via selecting & conducting a test of one/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).

• HT, developed by Ronald Fisher & Karl Pearson & formalized by Jerzy Neyman & Egon Pearson is one of the cornerstones of modern statistics.

• In case study research HT “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).
HT process

a. Specify the problem that needs to be investigated & resolved within the sample/case(s) under investigation.

b. Decide on the Theory to be Tested

c. Formulate the Hs, **derived** from the proposition(s) of the theory to be tested, & **decide** about criteria upon which we decide that the claim being tested is true or not.

d. Observations of facts or measurement,

e. Conducting data analysis – comparing the observed pattern of scores with the predicted pattern, and decide whether to reject or support the hypothesis.
a. Specification of the problem:

• An important objective from this 1\textsuperscript{st} step is to better understand the kind of knowledge needed (Dul & Hak, 2008).

• Which is often, formulated in the form of a H or as a question in which a H is implied” (Dul & Hak, 2008).

✓ Looking back at the incident, we find 2 opposing claims, so only one of them is true. The \textbf{question} then is \textbf{which of the two characters is truthful?}
b. Conceptual model

• According to Al Shanguity (1995), 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 she was seducing him & he refused to give in to what she wanted, he would have tried to run away from her so his back would have been to her, & in trying to catch him she must have grabbed his shirt from the back & torn it there.

• The two propositions that could be gathered are:
  ✓ $P_1$: while attacking her face to face, she grabbed his shirt from the front
  ✓ $P_2$: while running away from her, she grabbed his shirt from the back.
c. Hypotheses formulation:

1-Hypothesis definition

• H is a tentative statement that makes a prediction, based on knowledge & research, about the relationship between two or more variables & 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 & dependent variable (Creswell, 1994)”, accounting for a set of facts that can be tested by further investigation.

✓ In our case, the 2 Hs 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.

• ....
c. Hypotheses formulation:

2-Purpose of Hs

• Hs formulation has been described in methodology as useful in many ways. Hs provide a sense of focus/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 or ignore, and for the former how they operationalise the concepts they represent.

✓ Looking back at our case we find that the EW devised the inference procedure stating the two Hs 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.
c. Hypotheses formulation:

3-Criteria required in a hypothesis:

• As hypotheses are considered to be the basis of any empirical study, they have to meet certain basic criteria. These, are clearly met in our Quranic story, include:

• They must have explanatory power: “the ability of a hypothesis or theory to effectively explain the subject matter it pertains to.

• They must be testable/falsifiable. If one cannot design the means to conduct the research, the Hs means nothing. Operationalization process translated the problem identified into falsifiable Hs.
d. Observations of facts:

• Throughout the methodology literature (e.g. Emeritus, Jacobs, Christine & Walker, 2014), it has been clearly emphasised that for a test of a H to be valid, the criteria (decision rules) 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”. This is so because hypotheses give direction to the collection & interpretation of data(Ary, Jacobs, Sorensen, & Walker (2014); Ary & Jacobs, 1976).

✓ The parallel of this guideline in the Quranic story is “and then when he saw his shirt....” That is, the witness 1st set up the Hs, which are the decision rules, then only after that s/he proceeded to the observations of facts.
d. Observations of facts: cont-

• The process of observations of facts, measurement, consists of 2 steps, collection of data & coding of the data.
• Collection involves:
  – Identification and selection of the object of measurement, (Yusuf’s shirt),
  – Extraction of evidence from the object of measurement (position of tear in Yusuf’s shirt: front/back), and
  – Recording of the evidence (tear at the back of Yusuf’s shirt).
• Coding is the categorisation of the data, so as to generate scores, with a score being a value assigned to a variable.
  ✔ A tear at the front of Yusuf’s shirt =1, and no tear at the back =0.
e. Data Analysis (DA): HT

• DA is the interpretation of the obtained scores to generate the study outcome. DA consists of testing the Hs, which entails comparing the facts as observed with the prediction expressed by the Hs. The result of the test is either confirmation or rejection of the H (Dul & Hak, 2008).

• **DA in case study research is qualitative** & is called ‘pattern matching’ (PM) where two or more patterns are compared by visual inspection in order to determine whether patterns match or not. PM in theory-testing is comparing an observed pattern with an expected pattern. It is a non-statistical test of the correctness of the H”(p.95).

• In our case, analysis was done through PM where the expected pattern or place of the tear was compared with the observed pattern or place of the tear by ....

• Going back to our null (H1) & alternative (H2) hypotheses:
  ✓ With H1, upon matching the observed place of tear (back) with the expected place of tear (front), no match was found, → H1 was rejected.
  ✓ With H2, when the pattern matching was done, the observed place of tear (back) was found to perfectly match the expected place of tear (back), → H2 was confirmed.
What about the power of the test?

- Type I error: when Null hypothesis is true but is rejected
- Type II error: when null hypothesis is false but erroneously fails to be rejected.
  - Type II seems to be more interesting and is expressed in statistics theory as the power of the test.
  - The lady is truthful!

a. evidence isn’t 100%
b. (Master + wife+ EW) # Yusuf the boy
c. Yusuf’s clean past
d. The wife of al-'Azeez said, "Now the truth has become evident. It was I who sought to seduce him, and indeed, he is of the truthful.
e. And a witness from her family testified
Conclusions, Implications, &

• This research has shown how HT is an organically Islamic method of solving problems.
• It has also shown the practical benefits of this procedure: it was the use of HT as a methodological procedure that helped establish justice as it is used in today’s courts.
• HT has been in practice for much longer than the impression we get from reading the conventional HT literature. The verses from the Quran tells us that HT dates back to at least Yusuf (AS)’s era.
• Importance of this research : the positive outcomes attributable to the confirmation that this process confirms to Islamic parameters are exponential.…
• In education. Memorising these verses & knowing the explanation provided in this research would greatly enhance the learning experience of students concerning HT which is often quite challenging, especially in comparison to learning other concepts or procedures such as average, mode, and median.
• A new dimension of the explanation of the verse? (Verse 2 Surat 2)
  والله أعلم