THE COMPUTER PROGRAM DEVELOPMENT TO DETERMINE THE SHARES OF INHERITANCE FOR THREE TYPES OF HEIR

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Abstract: This research studied an Acehnese manuscript table about inheritance distribution. The purpose of the study was to create the general rules among the heir types in the table such that their shared priorities were obtained. With these priorities, the relations among the portions were known, making it possible to develop an algorithm and the computerized table for three types of the heir. This table consists of three types of an heir from the domain of ten types of heir selected in this research. The computer program was built by first determining the more important ones between the two related shares. From the total 120 cases investigated, four cases did not follow the developed priorities. The governing table for the three types of heir is expected to be the foundation to the determination of the shares for three types of the heir.
Keywords: Acehnese manuscript, types of heir, computer program.

Abstrak: Penelitian ini mengkaji isi sebuah tabel manuskrip Aceh tentang pembagian warisan sehingga didapatkan suatu ketentuan umum tentang prioritas dari bagian-bagian warisan tersebut. Dengan adanya prioritas ini, diperoleh suatu hubungan antar bagian warisan sehingga dapat dibangun suatu algoritma untuk komputerisasi tabel bagian tiga jenis ahli waris. Tabel ini berisi bagian tiga jenis ahli waris dari sepuluh jenis ahli waris yang dipilih sebagai domain. Program komputer ini dibangun dengan menentukan bagian yang lebih diprioritaskan di antara dua bagian. Dari total 120 kasus, terdapat empat kasus yang tidak mengikuti prioritas yang telah dibangun. Hasil berupa tabel tiga jenis ahli waris ini diharapkan menjadi dasar untuk penentuan tiga jenis ahli waris dari seluruh jenis ahli waris yang berjumlah 30 tersebut.
Kata kunci: manuskrip Aceh, jenis ahli waris, program komputer.

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Introduction

A manuscript about *fara'idh* 'inheritance' in the form of a table as shown in Fig. 1 had been found in Aceh, consists of the shares for one or two types of an heir from the total of 30 types that could be left by the deceased (Munzir, 2014).

Then Ernita, Arif, & Munzir (2014) extended the Acehnese *fara'idh* table to a new table consisting of the inheritance shares for three types of the heir by selecting 10 types of the heir as the domain from the total 30 types of heir written in the manuscript.

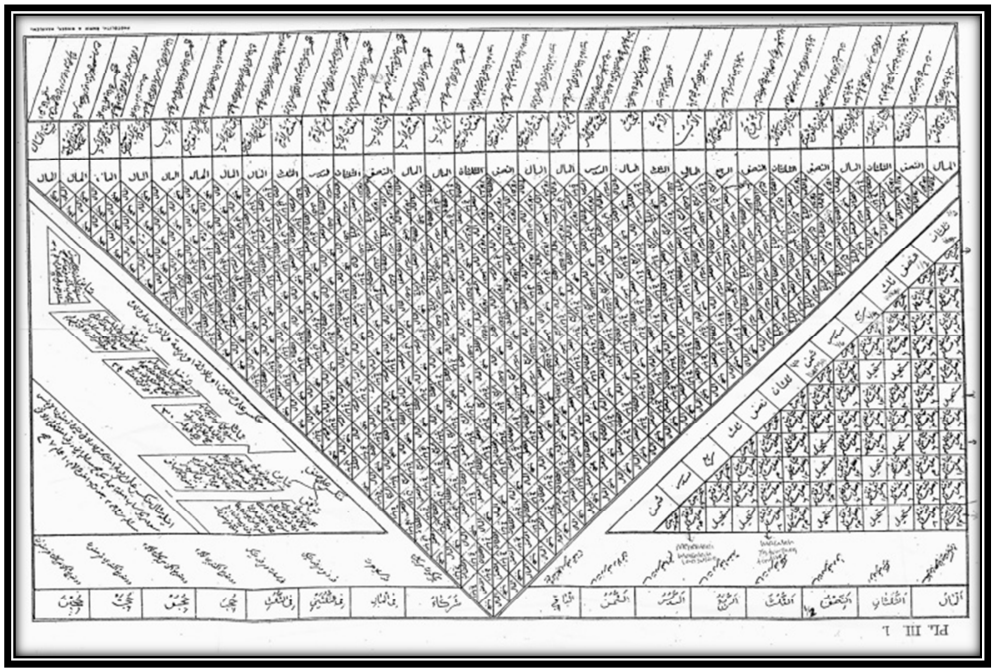

Figure 1. Manuscript table of *fara'idh* from Aceh (Munzir, Arif, & Harun, 2011)

The reduced number of heir types from the domain 30 to 10 was due to simplification of the computational work to determine the shares of three types of an heir from 4060 to 120 combinations, respectively (Muliana, 2020). The new table, which was determined manually using combinatorics, had 8 line blocks, each block containing three lines, and 36 columns. Combinatorics is concerned with selecting, arranging, constructing, classifying, and counting or listing things (Wilson, 2016). Besides, (Arif, 2014) made a new alternative toward the *fara'idh* problem by research in saving the inheritance share data by utilizing the computer. An algorithm to determine the saving pattern of the shares into the computer was developed to collect them together into a database through the research.

The manuscript has also been developed to a contemporary table by the digitalization work using Adobe Flash software (Purwanto, 2015). Besides, Hutoro (2016) developed internet-based learning to make this Islamic inheritance jurisprudence website to help people, especially Muslims, learn about inheritance law.

The calculation method of asset distribution of inheritance among the qualified heirs has been investigated. The study also aims to improve and facilitate people understanding in calculating *fara'idh* according to the law from

the Qur'an (Rahman, Yaakob, Fadzil, & Shaban, 2017). In the translation of a manuscript entitled *Kitab al-Wasaya*, Sanjaya (2018) discussed applying algebra in calculating will and inheritance with their various kinds of problems.

The best rules about the inheritance portions were determined in the QS An-Nisa (4): 7-8 and 11-12. The heirs that are not mentioned in the verses, such as grandparents, grandchildrens, uncles, and aunties, were stated in the hadiths. One of the hadiths was narrated by Imran bin Husain. Scholars wrote the rule in the *fiqh* books from all schools (Achyar, 2018). Another one was written in the *fara'idh* book of Bukhari, narrated by Ibnu Abbas r.a. (Baqi, 2017).

The *fara'idh* table contains the inheritance share data for each heir type in numbers and characters. The number forms of data are 1/2, 1/3, 2/3, 1/4, 1/6, and 1/8, while the character forms are rests, all belongings, allied, *'ashabah*, hindered, and impossible cases (Arif, 2011). The term *'ashabah* means having portions not determined in the Quran (Ash-Shabuni, 2019). The different data types would not cause problems when the table input is done manually, such as Ernita, Arif, & Munzir (2014). However, when the table is computerized, a table fulfillment rule is necessary to develop the computer program, determining the inheritance share for a certain heir type. The computer program also produces the table determining all shares for the combinations of three types of heir altogether.

The considerations mentioned addressing this study to create the general rules among the heir types in the table such that its share priorities were obtained. Then the relations among the portions were known, making it possible to develop an algorithm and the computerized table. This table consists of three types of an heir from the domain of ten types of heir selected in this research. The form of the computer program for three types of an heir from the 10 types of heir chosen as the domain in this research is expected to be the foundation for determining three types of heir for the whole 30 types in the manuscript. The computer program was implemented using the Matrix Laboratory (MATLAB) computer programming language software for technological usage.

MATLAB was developed by utilizing functions through simple and interesting numerical methods (Marwan, 2017). An algorithm to determine three types of heir using the computer was initiated by the declaration of all string forms of the share portions into numerical forms. After obtaining the conversion relations between the string heir data with the ones in the numerical format, the command was performed. A string in MATLAB software is a set of characters in an apostrophe (Attaway, 2009). Lines have a similarity with vectors in which each element is a single character. In other words, a string is a vector that consists of characters as its elements. The characters in this context include alphabets, numbers, punctuations, spaces, and character controls such as backspace or tab. The computer program in this research used the licensed version in Agreement.03/10PN 20352 of the MATLAB R2010a software.

Methodology

Data

The data used were sourced from a *fara'idh* table manuscript of Aceh. The shares of the inheritance that would be determined in the program were 10 types of heir selected from 30 types of heir considered in the manuscript.

Table 1. The symbols of types of the heir (Ernita, Arif, & Munzir, 2014)

Symbol	Heir
A	A son or more
B	A daughter
C	Daughters
D	A grandson or more from sons
E	A granddaughter from son
F	Granddaughters from sons
G	Husband
H	Wife (one or more)
I	Father
J	Mother

Table 2. The symbols of inheritance fractions (Ernita, Arif, & Munzir, 2014)

Symbol	Fraction
sd	A half (1/2)
st	One third (1/3)
dt	Two thirds (2/3)
se	One fourth (1/4)
sn	One sixth (1/6)
sl	One eighth (1/8)
sh	All of inheritance
si	Rest of inheritance
sk	Allied of inheritance
hj	Hindered of inheritance
hr	The portion of inheritance that is not written in the Quran
mu	Impossible

Table 3. Data of two types of the heir (Arif, 2014)

Types of heir	Types of heir									
	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*
A	*sh*	*hr*	*hr*	*sh*	*sh*	*sh*	*si*	*si*	*si*	*si*

Types of heir	Types of heir									
	A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*
B	*sk*	1/2	*sk*	1/2	1/2	1/2	1/2	1/2	1/2	1/2
C	*sk*	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3	2/3
D	*hj*	*si*	*si*	*sh*	*hr*	*hr*	*si*	*si*	*si*	*si*
E	*hj*	1/6	*hj*	*sk*	1/2	*hr*	1/2	1/2	1/2	1/2
F	*hj*	1/6	*hj*	*sk*	*sk*	2/3	2/3	2/3	2/3	2/3
G	1/4	1/4	1/4	1/4	1/4	1/4	1/2	*mu*	1/2	1/2
H	1/8	1/8	1/8	1/8	1/8	1/8	*mu*	1/4	1/4	1/4
I	1/6	1/6	1/6	1/6	1/6	1/6	*si*	*si*	*sh*	*si*
J	1/6	1/6	1/6	1/6	1/6	1/6	1/3	1/3	1/3	1/3

The types of heir and their inheritance share portions used in the program are given in Table 1 and Table 2 (Ernita, Arif, & Munzir, 2014), whereas the two types of the heir are shown in Table 3 (Arif, 2014). Here, each table's cell contains the share for a certain heir of the respected line left by the deceased together with another heir of the column.

The research method

The numerical research method for the research consisted of four stages: priority determination, algorithm development, computer programming, and the evaluation of the results (Muliana, 2020). The priority that is meant here is a rule which is more important among the shares of an heir. The priority is determined after investigating each claim in the table of three types of heir.

The algorithm's development aims to simplify the computer programming process by arranging steps in solving the problem to minimize the error. The coding of the computer program was done by using MATLAB software. The evaluation of the results was done manually by consulting the results from the simulation to scholars who know the *fara'idh* law.

Results and Discussions

Some gains on the *fara'idh* problem are known from the research results, which are: the rule of inheritance share priority determination; the computer program of the shares for three types of heir; and the table of the shares for three types of an heir from the domain of 10 types of the heir.

The determination of inheritance share priorities

The rule for determination was obtained from particular requirements of each share for a type of heir. This rule does not include the impossible cases when the heir combinations are not possible in reality (Muliana, 2020). The so-called impossible cases are:

1. Husband (*G*) together with wife (*H*). This case is impossible to happen in real life so that the share is mu (impossible) for any heir combination containing *G* and *H*.
2. A daughter (*B*) together with daughters (*C*). This case is impossible to happen in real life since the heir type *B*, in this case, is also included in *C* so that the share for the heir type *B* is mu for any case containing *B* and *C*.
3. A granddaughter (*E*) together with granddaughters (*F*). This case is impossible to happen in real life since the heir type *E*, in this case, is also included in *F*. So that the share for the heir type *B* is mu for any case containing *E* and *F*.

Considering the impossible cases which could happen, the priority rules were obtained (Muliana, 2020), and the relation for priority share is symbolized by ">":

rule for the heir type *A*: $mu > hr > si > sh$ ..... (1),
rule for the heir type *B*: $mu > sk > sd$ ..... (2),
rule for the heir type *C*: $mu > sk > dt$ ..... (3),
rule for the heir type *D*: $mu > hj > hr > si > sh$ ..... (4),
rule for the heir type *E*: $mu > hj > sk > hr > sn > sd > dt$ .... (5),
rule for the heir type *F*: $mu > hj > sk > sn > dt$ ..... (6),
rule for the heir type *G*: $mu > se > sd$ ..... (7),
rule for the heir type *H*: $mu > sl > se$ ..... (8),
rule for the heir type *I*: $mu > sn > dt > st > si > sh$ ..... (9),
rule for the heir type *J*: $mu > sn > st$ ..... (10).

From the rules (1) - (10) a general rule that holds among all shares was obtained:

$mu > hj > sk > hr > sn > sl > se > sd > dt > st > si > sh$..... (11).

Tabel 4. Cases do not follow the rule (11) (Muliana, 2020)

No	Cases	The heir that does not follow (11)	The share from the rule (11)	The real share
1	*CDE*	*E*	hj	sk
2	*CDF*	*F*	hj	sk
3	*GIJ*	*I*	si	st
4	*HIJ*	*I*	si	dt
5	*HIJ*	*J*	st	sn

However, some cases do not follow the rule (11) given in Table 4, i.e., *CDE*, *CDF*, *GIJ,* and *HIJ*.

Algorithm of determining shares for three types of heir

The computer program was developed by following the algorithm of determining shares for three types of the heir. The flowchart for the algorithm is presented in Fig. 2.

1. Shares of heir conversion from strings to numerics
2. The shares of two heir types data input $A(i, j)$
3. Determine the shares of the first heir type out of three types:
   a. Using the rule (11) $C(i, k) = A(i, j)$ or $C(i, k) = A(i, k)$
   b. Exception for impossible cases
   c. Cases do not follow the rule (11)
4. Determine the shares of the second heir type out of three types:
   a. Using rule (11) $C(j, k) = A(j, i)$ or $C(j, k) = A(j, k)$
   b. Exception for impossible cases
   c. Cases do not follow the rule (11)
5. Determine the shares of the third heir type out of three types:
   a. Using rule (11) $C(k, k) = A(k, i)$ or $C(k, k) = A(k, j)$
   b. Exception for impossible cases
   c. Cases do not follow the rule (11)

   Output the shares for heirs type 1, 2 and 3 consecutively: $C\ (i, k)$, $C(j, k)$, $C(k, k)$.

The computer program for the share table development

This computer program was developed by converting the formerly text types of data into numerical data to be solved together numerically (Arif, 2014). The resulting output was then converted back into text form and presented in a table form. The conversion was done by storing the greatest value to the most priority and the smallest value for the least one, as shown in the algorithm and flowchart.

The next stage was the data input of the shares for two types of the heir. The share for two types of the heir was written by the variable $A(i, j)$, which is the share of the heir located at line-i and column-j. Then the share for each of the three types was determined. This was done by utilizing rule (11) by looking at the priority of each share. The share for the first heir type was noted by the variable $C(i, k)$, for the second heir was indicated by the variable $C(j, k)$, and for the third heir by the variable $C(k, k)$. For cases of the shares for the first, the second, or the third types of heir which do not follow the rule (11), they were excepted.

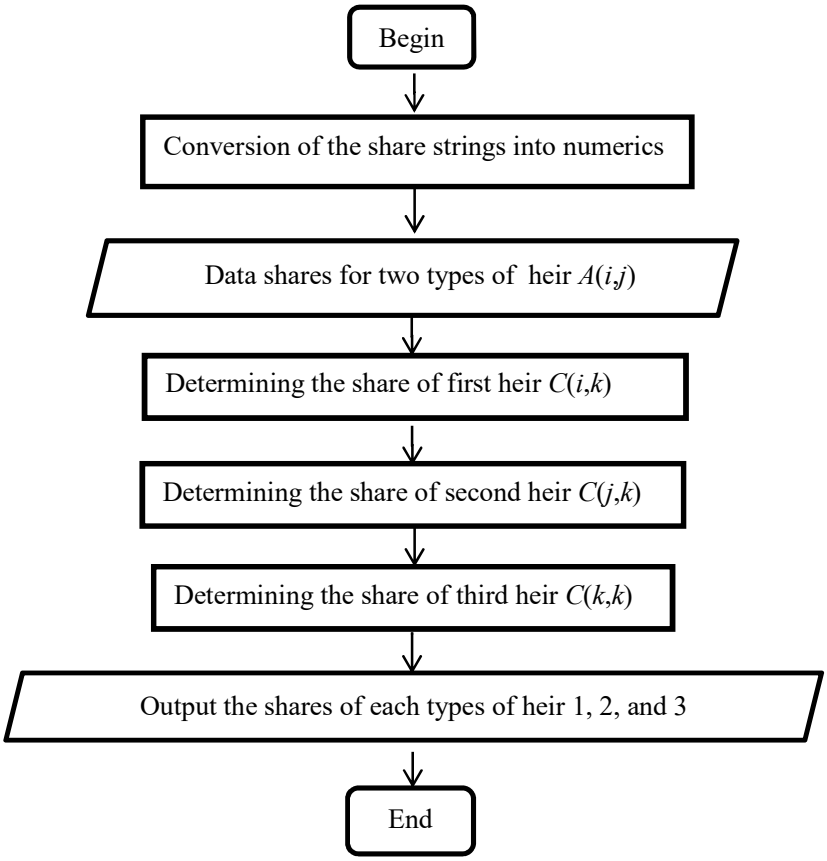

Figure 2. Flowchart for determining the shares for three types of heir

The computer program of the shares for three types of the heir was developed using MATLAB software. The first thing done in the program is to convert the string data into numerical form by giving weight values for each share and input the data into the array-formed variable for the shares. According to rule (11), the share *mu* is the highest priority, given the weight value 12. Next priorities are *hj*, *sk*, *hr*, *sn*, *se*, *sl*, *se*, *sd*, *dt*, *st* and *sh,* so the weight values for the consecutively ordered data elements are 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, and 1.

The shares of inheritance data were input in the form of arrays containing strings by two characters. A function was used to locate each of the share array lines in a separated cell from the variable for the results. Then the data of the shares for two types of heir were input according to the data contained in the *fara'idh* table manuscript. The input data were taken from a 10 × 10 matrix with elements compatible with the weights following the rule (11).

The formation towards the table for the shares for three types of the heir was first performed by writing the column and line titles of the table. The column titles contain the notes for the first and the second types of heir following the combination rule, whereas the line titles contain the notes for the third type of heir. The

determination of shares for three types of the heir was divided into the determination of shares for the first, the second, and the third types of the heir. The shares for the first type of heir were determined by using the rule (11), i.e., by looking at the shared priority between $A(i,j)$ or $A(i,k)$. If $A(i,j)$ is more important, then the share for the first type of heir is $A(i,j)$, on the contrary, if $A(i,k)$ is more important then the share for the first type of heir is $A(i,k)$.

For the cases in the determination of shares for the first types which do not follow the rule (11) were excepted, i.e., the impossible cases such as when the heir *G* meets with *H* (*GH*), the heir *B* meets *C* (*BC*) and the heir *E* meets *F* (*EF*). The same conditions also hold for the second and the third heirs.

The table of the shares for three types of heir

The table as the output of the MATLAB computer program is presented in Table 5, contains the shares from each combination of three types of heir out of 10 types of heir selected as the domain, with the form follows the combination rule. In other words, 3 elements are chosen from *A*, *B*, *C*, *D*, *E*, *F*, *G*, *H*, *I,* and *J*. The table is easier to be used to see the shares of the respected heir. For example, to see a son's share (*A*), it needs only to see columns 1 to 8.

To use the table, we first need to select the first and second types of heir located at the column titles, then select the third type located at the line title. After choosing the three types of heir that we want to know their shares, look at the respected cell to its line and column. The shares for the first, the second, and the third heir types were ordered down, contained in the cell with the order of the first line for the first type of heir; the second line for the second type of heir, and the third line is for the third type of heir.

Here is an example of the usage of the table. A person died and left heirs of a son, a grandson from a son, and a wife. Then the shares of each heir type are easily seen in Table 5. A son is symbolized by the variable *A*, a grandson from son is symbolized by *D*, so the column title chosen is *AD*. A wife is symbolized by *H* so that the line title chosen is *H*. Then the share of each heir can be seen from the appropriate cell with the column *AD* and the line *H,* which is at column-3 and line-6 containing si, hj, and sl. This means the share for the son is si (receives the rest of the inheritance), the share for the grandson from the son is hj (hindered in receiving the inheritance), while the share for the wife is sl (1/8) of the inheritance from her husband.

Conclusion

This research has produced a computer program written in MATLAB software to determine the shares for three types of heir out of the domain of the selected 10 types of the heir. The results cover all combinations for three types of heir for the selected domain, which occur in many cases. This computer program was built after doing some investigations toward the priorities of the shares for

heirs with the governed relations: $mu > hj > sk > hr > sn > sl > se > sd > dt > st > si > sh$. From 120 cases of three types of heir investigated in the research, 4 cases do not follow the above rule, namely *CDE*, *CDF*, *GIJ,* and *HIJ*.

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Table 5. Output table for three types of heir out of 10 heir types

C	hr mu sk																																			
D	hr sk hj	hr sk hj							mu dt si																											
E	hr sk hj	hr sk hj	sh hj hj						mu dt hj	sd hr sk						dt hr sk																				
F	hr sk hj	hr sk hj	sh hj hj	sh hj hj					mu dt hj	sd hr sk	sd hr sk					dt hr sk	dt hj hj					hr mu sk														
G	hr sk se	hr sk se	si hj se	si hj se	si hj se				mu dt se	sd si se	sd sn se	sd sn se				dt si se	dt hj se	dt hj se				hr sk se	hr sk se				mu sk se									
H	hr sk sl	hr sk sl	si hj sl	si hj sl	si hj sl	mu mu mu			mu dt sl	sd si sl	sd sn sl	sd sn sl	mu mu mu			dt si sl	dt hj sl	dt hj sl	mu mu mu			hr sk sl	hr sk sl	mu mu mu			mu sk sl	mu mu mu			mu mu mu					
I	hr sk sn	hr sk sn	si hj sn	si hj sn	si hj sn	si se sn	si sl sn		mu dt sn	sd si sn	sd sn sn	sd sn sn	sd se sn	sd sl sn		dt si sn	dt hj sn	dt hj sn	dt se sn	dt sl sn		hr sk sn	hr sk sn	si se sn	si sl sn		mu sk sn	sd se sn	sd sl sn		dt se sn	dt sl sn		mu mu mu		
J	hr sk sn	hr sk sn	si hj sn	si hj sn	si hj sn	si se sn	si sl sn	si sn sn	mu dt sn	sd si sn	sd sn sn	sd sn sn	sd se sn	sd sl sn	sd sn sn	dt si sn	dt hj sn	dt hj sn	dt se sn	dt sl sn	dt sn sn	hr sk sn	hr sk sn	si se sn	si sl sn	si sn sn	mu sk sn	sd se sn	sd sl sn	sd sn sn	dt se sn	dt sl sn	dt sn sn	mu mu mu	sd st st	se dt sn