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*Chronological distribution of the extant Roman bronze coins.*

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**Abstract:** The purpose of this study is to obtain an approximate comparative estimate of the quantities of extant Roman bronze coins dated to different periods. Supposing that for each particular kind the number of coins in different museums and private collections is in inverse proportion to the price of a coin of this kind, we construct and present a graph of the approximate chronological distribution of the extant Roman bronze coins. We obtain the information about the prices from the catalogue of David Sear “Roman Coins and Their Values” (Sear 1974). We use MS Excel and its electronic sheets to process the data and construct the graph.

## § 1. Introduction

Both archaeologists and historians pay great attention to the coin finds. The reason for this is that the coin finds give valuable information about the past of the country in which the coins were emitted, its economic development, trade relationships, religion, rulers. Another big advantage of the coin finds is that they are datable and thus they give chronological information about the archaeological evidence related to them which in many cases is of an irreplaceable benefit to the researchers.

For example, A. N. Kazhdan, the famous specialist in Byzantine history, draws conclusions about the economic life of the Empire on the basis of numerical data about the numbers of extant old Byzantine coins in museums and private collections dated to certain periods. He says: *“In the hands of today’s historians the coin, which has been a means of trade in ancient times, becomes evidence of the intensity of the trade: the abundance of coins excavated in a given old city<sup>1</sup> can serve as a serious argument, which proves the existence of manufacture in this city.”* (Kazhdan, 1954, p. 166)

Rome has had political and economic control over the Bulgarian lands for a long time. A great part of the old coins found in Bulgaria (about 2/3; see Vassilev, Velchev and Tabov, 2005) are Roman. This fact justifies the great interest of the Bulgarian researchers in Roman coins – gold and silver, bronze, and copper.

In this paper we aim to make an approximate **“comparative”** estimate of the quantities of extant Roman **“bronze”** coins (by saying “bronze” we mean any coins other than gold and silver ones). The research is based on the information published in the catalogue Sear, 1974. In this catalogue about 4330 different coins, dated to the period 269 B.C. - 518 A.D., are represented together with their numismatic values (prices). 2465 of them are “bronze” coins and we consider only these ones.

The above mentioned term “comparative” estimate means that we are not interested in the exact numbers of coins but in their proportions or, in other words, the amount for each period is rounded to one common coefficient of proportionality. Thus, on the basis of the graph that we built, we can compare the amounts of extant coins for each two periods of time.

## § 2. The Principle of Information Preservation in Investigations of Chronological Distribution of Coins

One very important question for our later conclusions is: can we draw a conclusion about the coinage “intensity” during different ages considering the dates of the coins? As previously mentioned, Kazhdan, following his intuitive motives and wide individual experience, believed that the answer of this question is positive.

We shall also rely on *the Principle of Information Preservation* offered by A. Fomenko<sup>6</sup> in the case of information found in historical texts. There this principle is formulated as follows: for each two periods of time it’s highly probable that more information exists from that period about which there originally has been more information in the historical texts. There is a large number of empirical evidence about the validity of this principle “at first approach” as a rough evaluation.

In the context of the coin problems which we consider, we offer the following *modification* (of course it is “at first approach” too, as a rough evaluation) of *the Principle of Information Preservation*:

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<sup>1</sup> Clearly this is true not only for a city, but also for a country or a region.

**It is highly probable that from periods of time during which more coins were emitted, there are more coins that have been found, as well.** (We suppose that the compared periods of time are chronologically close to one another and have equal lengths.)

We accept that this principle is true with “high probability” with the intention to use it in drawing our conclusions below. To make exact evaluations we need more information and data from more studies and experiments; but a rough justification of this wording also results from the analysis of the graph on fig.1 that we do below.

These considerations and explanations that we made and we continue below give us a ground to suppose that we can judge with high probability about the “intensity” of the bronze coinage in Rome during various periods by the chronological distribution of coins considered. Such intensity obviously depends to a very great extent on the conditions of the economy and commerce in Rome. Another factor that has influence on the coinage is the size of the Roman Empire.

### **§ 3. Methods**

The construction of the “chronological distribution” of a set of objects is based on the “volume function” introduced by A. Fomenko (Fomenko, 1981a and Fomenko, 1981b, pp. 211-212; for more details see also Fomenko and Rachev, 1990, pp. 187-206) and on the description of the chronological distribution of information in historical texts. In the paper of J. Tabov 2003 a generalization of such distribution is defined and another method of construction is offered. Its variations are used in constructing the specific “chronological distributions” (Chr.D.) of coin finds (Tabov et al. 2003; Tabov et al. 2004a; Tabov et al. 2005 and Vassilev et al. 2005), ancient manuscripts (Tabov et al. 2004b) and museum exhibits (Hristova and Dobрева 2004; Tabov and Tabova 2004).

To build the desired chronological distribution (Chr.D.), we need to know the **approximate relative number of coins of each kind**. Thus we could build the Chr.D. graph, i.e. **we could get the general outlook of the graph representing the Chr.D. with its clearly outlined maxima and minima, intervals in which its relevant function is increasing and decreasing.**

To obtain the approximate relative number of coins of each particular kind we are interested in, we use indirect information – the market price of the coins. As the commerce with coins has a long lasting tradition, the pricing therein follows certain rules. The numismatic value of a coin, which to a great extent forms its market price, depends on many factors, among which is the number of the coins for each particular kind as well. Other factors also influence the price, like the time when the coins are emitted, the material of which they are made, the nominal values of the coins, their subject and iconographic characteristics, the data obtained from the find, if the coin served payments or was used for ceremonial purposes, etc.

We assume that **the main factor in determining the price of a coin is the number of coins found that are the same as this coin**. In other words, the bigger the number of the extant coins of a certain kind, the lower the price of each of these coins. Furthermore, we have a reason to suppose that the relation “price-number of coins” is near to reverse proportion. Therefore we will consider below a model of the Chr.D. of the coins constructed under the assumption of the inverse proportion  $f(x)=k/x$ , where the number of coins  $f(x)$  depends on the catalogue price  $x$ ; here  $k$  is an appropriately selected constant.

#### § 4. Basic database

Each reviewed coin in the catalogue is dated; to do this, the periods of ruling of the relevant rulers are used. This gives the research a sufficient precision in regard to the dates.

To create the basic database, we use Excel to generate a table which consists of 2465 rows, corresponding to the number of coins processed, and 154 columns, each one corresponding to 5 years of the period covering the dates of the coins in the catalogue (269 B.C. – 498 A.D.). Only for the sake of convenience we added one year to the beginning of this period (270 B.C.) and two years to the end, which does not affect our results (the deviation is negligible). Therefore, the first column corresponds to the period 270 B.C. – 266 B.C., the second – to the period 265 B.C. – 261 B.C., ... and the last – to the period 495 A.D. – 500 A.D.

In the table obtained we first enter data about the studied set of coins.

For each coin, we know the period (periods) during which it was minted and its numismatic value (price). Each coin corresponds to a certain row in the table. In this row, or more precisely in those cells that are in the columns corresponding to (or, even more precisely, including) the coin's period of emission, we enter the result from the division of the price of the coin to the number of these cells.

For instance, if a coin is emitted during the period 247 – 264 in its row, in the cells which are placed in the columns corresponding to the periods 246 – 250, 251 – 255, 256 – 260 and 261 – 265 (in this case 4 cells in total), we enter  $x/4$  where  $x$  is the price of the coin in the catalogue.

In this way, we create the basic database that we will use to model the chronological distribution of coins.

#### § 5. The model of chronological distribution

Using the database created, we can now construct a model which represents the approximate shape of the Chr.D. of extant Roman bronze coins. Let us once again emphasize the fact that by the means of this method we cannot “count” the coins; we obtain only a rough picture of the distribution over time of the studied coins, i.e. taking into account the maxima and minima, the periods of increasing and decreasing we can make comparisons between the different periods.

As was already mentioned, to build the Chr.D. we will use the function  $f(x)=k/x$  to transform the database, where  $x$  is the price of the coin in the catalogue. Next, we have to choose a suitable coefficient  $k$ .

Since the value of the most expensive bronze coin is 4000, we choose for  $k$  the number 100 000, i.e.  $k=100\ 000$ . Hence, for the function  $f(x)$  we obtain  $f(x)=100\ 000/x$ .

We transform the data in the table, replacing  $x$  with  $f(x)$  in the cells in which we have already entered the price  $x$ . For the example given above of a coin dated to the period 247-264, in the relevant row, in the cells corresponding to the periods 246-250, 251-255, 256-260 and 261-265 (in this case 4 cells in total), we replace  $x$  with  $f(x)$  so that now in those cells we have  $f(x)/4=100\ 000/4x$  where  $x$  is the price of the coin in the catalogue.

Then, for each column we sum the values up and enter the result in this column. Thus, after doing these calculations, we obtain a row in which the final values are entered. These are the values of the function of chronological distribution of extant bronze coins.

To create the graph of this function we use the MS Excel Chart Wizard. Thus we obtain a “visual representation” of the chronological distribution of coins (fig. 1).

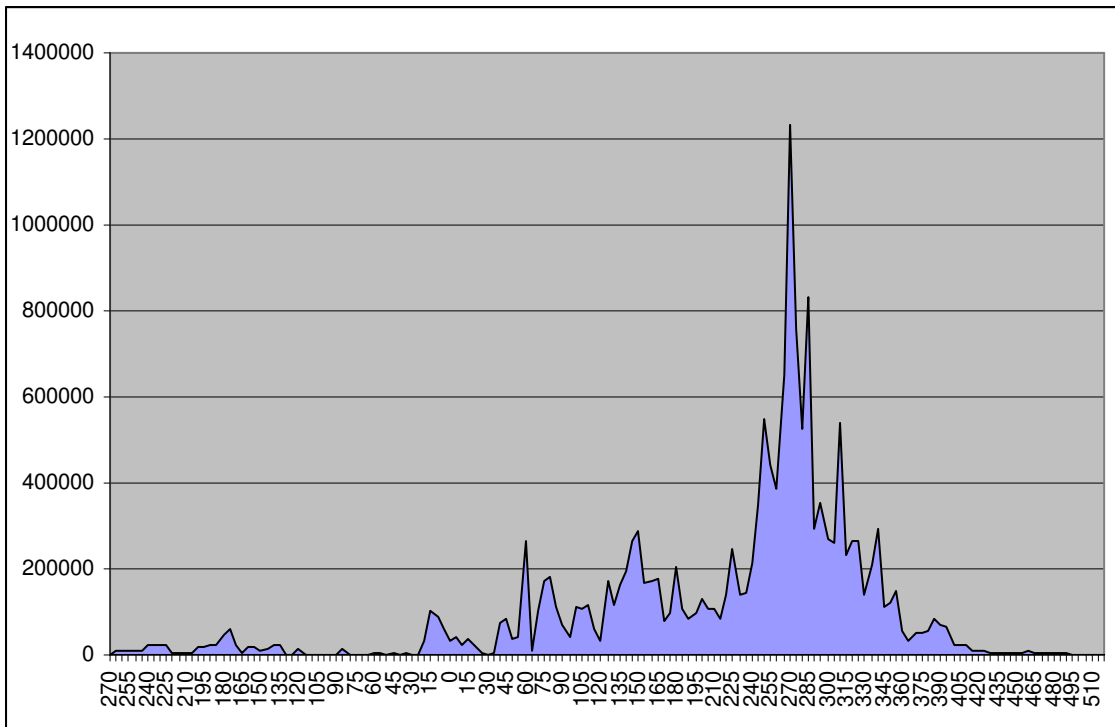


Figure 1. Graph of the chronological distribution of the extant Roman bronze coins.

We must point out that the numbers along the y-axis are conditional while the numbers along the x-axis are actual years of our era.

Since our research deals with approximations, it is both permissible and convenient to “smooth” the graph on fig.1. This can be done in a simple and natural way by transforming the total row calculated and written under the table, which contains the total values for each column obtained as a result of summing (i.e. for each of the 5-year intervals concerned); as we have already mentioned, these are the values of the function of chronological distribution of the studied bronze coins.

Under this row we make two more copies of the row and then we move the first new row one cell to the right and the second new row two cells to the right. In the obtained three-row table we sum up the three numbers in each column and enter the result just under them. The result is a new row, the numbers in which are the values of the “smooth” function of chronological distribution of the considered bronze coins. This graph is shown in fig. 2.

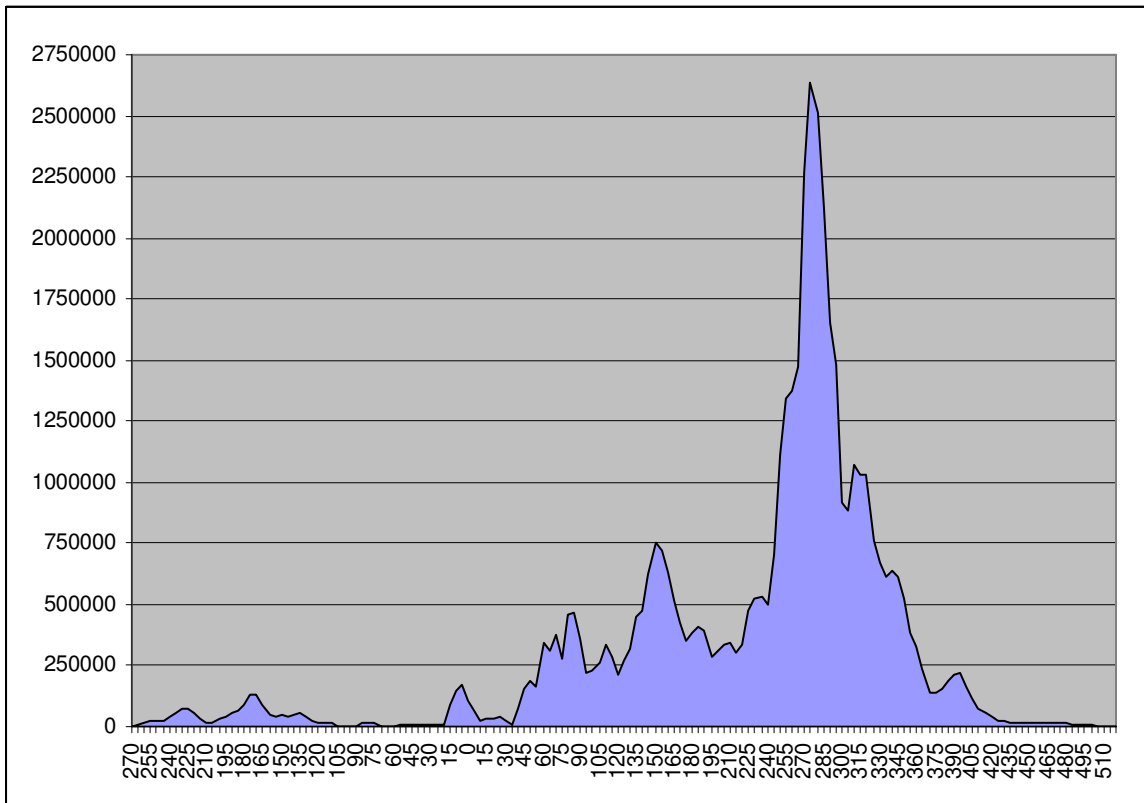


Figure 2. “Smooth” graph of the chronological distribution of the extant Roman bronze coins.

Comparing the two graphs, in fig. 1 and fig. 2, we can identify the resemblances and differences between them. The most important thing here is that in fig. 2 we really see the “smoothing” of the “frequent jags”, i.e. of the small local “fluctuations” of the graph, while at the same time the graph preserves the nature and scale of the larger alternations.

From these considerations it is clear that the graph in fig. 2 can also be considered as a graph of the chronological distribution of the studied set of coins. We will work with the second graph because it focuses the attention on the essential changes in the function values, neglecting the insignificant alternations.

Since each bronze coin has usually been used as means of payment during a longer period than the 5-year intervals chosen by us – quite often 15-20 and more years, the smooth graph in fig. 2 obtained in the described way represents quite well this real “inertness” of the bronze coin circulation.

## § 6. Graph Analysis

What conclusions and hypotheses can be drawn on the basis of the specific graph in fig. 2? We’ll consider briefly some of them.

It’s obvious that, depending on the height of the graph, the interval from 270 B.C. to 500 A.D. can be divided into the following periods:

- 1) from 270 B.C. to 50 A.D. when the height of the graph is low;
- 2) from 50 A.D. to 410 A.D. when the graph is high;
- 3) from 410 A.D. to 510 A.D. when the graph is low and gradually decreases to 0.

The reasons for the great number of extant bronze coins dated to the period 50 – 410 B.C., which indicates a big volume of the coinage, could be the following:

- the territorial expansion of the Roman Empire;
- the establishment of economic control over the territories, subordinated to Rome;
  - the establishment and support of a big army of professional soldiers to whom regular wages had to be paid;
- etc.

The great intensity of coinage at the very end of the 3rd century is of special interest.

It is natural to blame the decline of the volume of Roman bronze coinage during the last ninety years (410-500) on the decay of the Roman Empire. The Roman bronze coinage stops in 498 A.D. under the rule of Anastasius I when the emission of bronze coins under the Byzantine standards has started.

The low part of the graph during the period (270 B.C – 50 A.D.) can be made more precise and observed in more details. This can be done by “eliminating” the high maximum because it brings a scale over the y-axis that is not suitable for the low level of some parts of the graph. Obviously, it is enough to eliminate the data for the period 50 – 500 A.D. and to use only the data for the period before 50 A.D. When we do this we obtain only the left half of the chronological distribution graph examined by us; this is shown in fig. 3. Now some of the details are represented more clearly.

From these details, the most important seems to be that there aren't extant bronze coins dated to the period 125 B.C. - 20 B.C.; this possibly means that a relatively small number of coins has been emitted during this period.

What could explain this phenomenon? Were foreign bronze coins used in Rome during this period? Or coins minted in Rome were used but now the specialists cannot identify them as Roman coins?

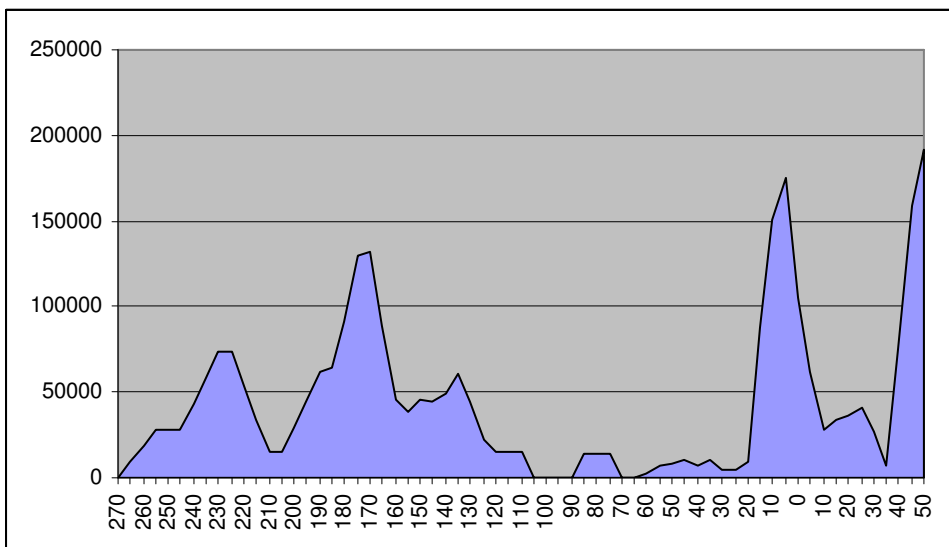


Figure 3. Graph of the chronological distribution of the extant Roman bronze coins from the period 270 BC – 50 AD.

Leibniz (1984) provides information that has a direct connection with these questions. According to him, the Roman Emperor Hadrian diligently collected the works of ancient authors and public figures in an attempt to keep their memory alive. Then, he ordered that coins should be cut in their faces instead of his own, which shows that his admiration for the



ancients was greater than his wish for grandeur. According to Leibniz, this is why most scientists today attribute all the coins engraved with the faces of Kimon, Miltiad, Plato, Aristotle, among others, to Hadrian's rule.

Also it is considered that «restored» «republican» coins (i.e. minted before the establishing of the Roman empire in 27 B.C.) were minted by the emperors Augustus, Trajan (meanwhile, during Trajan's rule about 30 denarii were emitted that copy republican models from II-I c. B.C.; for them the term «republican series of Trajan» is used; see Abramson 1995 p. 113), Mark Aurelius and other rulers (Abramson 1995 p. 144). In addition, both the technological details and the face of the «restored» coins were exactly like those from the times of the Roman Republic. For instance, «mint-worker Plavt» is inscribed over the corresponding coin emitted by Trajan; however, Plavt was a clerk at the Roman mint-yard whose work is dated towards 96 B.C. (Abramson 1995 p. 113).

In light of these facts, the improbably low value of the Chr.D. of extant Roman bronze coins dated to the period 130-30 B.C. and the high value for the periods of ruling of the above mentioned Roman emperors Trajan, Hadrian and Mark Aurelius pose an interesting and important problem: are the «restored» coins identified correctly? Is it possible that at least some of the coins thought to be «restored» are in fact «republican» coins minted during the Republican period of the country?

To find answers to questions like these we need further careful studies.

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