An experimental analysis of over-confidence

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Abstract: The purpose of this paper is to experimentally demonstrate the existence of the bias of over-confidence as a human psychological bias. This bias was measured by three methods: the estimation interval, the frequency estimation method and the method of question with two answer choices. The estimation interval method finds a very wide bias compared to the other two methods, but overconfidence persists in the other two methods at lower levels. In the first experiment, monetary incentives have exacerbated the over-confidence because of the given compensation. This system has demonstrated that there is a strong link between over-confidence and risk taking. In the second experiment that used the method of question with two answer choices were given a different pay system and it was expected that overconfidence will be reduced by monetary incentives but the results show that the bias is not significantly reduced by these new monetary incentives. Similarly, the iteration that was made during the first experiment did not significantly reduce the bias.

Keywords: Over-confidence, uncertainty, monetary incentives; experiments.
JEL Classification: C91, D80, Z13

Introduction:

The behavior of financial markets is at the heart of behavioral finance. The experiments of psychologists continue to show that the investor is far from being placid and intellectually powerful relied on by financial and classical economic theory. Indeed, several scholar behaviors were identified by the followers of the behavioral paradigm: among others, the behavior of loss aversion, the behavior of over-confidence, availability behavior, representation behavior, r mimetic /follower behavior, the behavior of mental accounting and the behavior of mental anchor. However, there are other behaviors that are cited by proponents of this paradigm, but its importance is minimal.

The term over-confidence, for example, has been used to describe two distinct phenomena. The first is the tendency of individuals to express an excessive belief in their own abilities: for example the ability to drive peacefully (Svensen, 1981). The second phenomenon is the tendency of individuals to overestimate the precision of their knowledge.

If the over-confidence is a characteristic of invasive behavior, it will have profound implications for financial markets. Recently, quite a number of theoretical models of financial markets incorporate on-confident judgments (Odean, 1998, De Long, Shleifer, Summers and Waldmann, 1991 and Kyle and Wang, 1997).

The main objective of this paper is to experimentally analyze this behavior. The interval estimation method and the frequency estimation method will be used in the first part of the experiment. The method of question with two alternative responses will be used in the second part of the experiment. The purpose of using three different methods is to check through the comparison of results if overconfidence will be affected by the measurement method used.

From the beginning of the 70s to the 90s, there was a general consensus that judgments or responses in tests of the interval estimation method and the method of question with two alternative responses, showed a substantial and consistent over-confidence. In a review of previous studies of the method of two choices, Lichtenstein et al. (1982) reported that when participants state that they are 70% sure they have correctly answered, they are correct in less than 60% of time. Overconfidence measured by the method of interval or trusted domain is stronger. Russo and Schoemaker (1992) found that business managers are being asked of the confidence intervals of 90%, have the right answer in the area said between 42% and 62% of times. Confidence intervals 50% do contain the correct answer in only 20% of times.

Section 1: Method of estimation interval and method of estimation frequency

The objective of this experiment is to experimentally test the stability of the results in the work of interval estimation and frequency estimation.

In the first stage of the experiment, subjects are given 10 questions. Subjects must provide for each question, a lower and an upper limit so that the subjective confidence that the interval contains the correct answer is 90%. In the second stage, each subject was asked to estimate the number of intervals proposed in step 1 that contain the exact answer. In stage 3, they are asked to estimate the number of correct responses (number of intervals containing the correct answer) given by their colleagues. The estimates given by subjects in Stage 2 and Stage 3 are respectively the frequency estimation and the frequency estimation of others.

Stage 3 once completed, subjects are asked to, in a fourth stage to review the responses in stage 1. Thus the stage 4 is an iteration of stage 1. It is the same for stage 5 which is an iteration of stage 2. Stage 6 is an iteration of stage 3.

1.1. Models of experience and assumptions:

1.1.1. Participants and procedures:

Our first experiment is to involve 45 students in accounting at the Institut Supérieur de Gestion de Tunis. They are recruited following an announcement that invites students to participate in an experiment. These students are informed that the experiment consists of two sessions the first is free, the second is paid off.

In the paid session, participants will receive compensation in proportion to the correct answers. R is the total compensation received in the first experiment: R = 500 + 5000 / (b-a)
500 millimes be earned by any participant that provides an interval [a, b] containing the correct answer regardless of the width of the interval.
5000 millimes / (b-a) is the variable part of remuneration depends on the precision, that is to say, the width of the interval. A participant may gain accurate up to 5 dinars, the more the width increases the more variable pay decreases.
In the second and third step, a correct answer will be paid by 500 millimes. Steps 4, 5 and 6 concern the iteration and are similar to steps 1, 2 and 3.
The experiment involves six steps outlined below:

Step 1:

Participants are asked to answer ten general knowledge questions. It should be noted that these issues are not selected for the difficulty.Since the set is heterogeneous, the level of difficulty varies from one subject to another, a question may be considered difficult for a subject and easy for another.Subjects must answer these questions by an interval, providing its lower limit and upper limit so that their subjective confidence that the interval contains the true value is 90%. This step is called the interval estimate.

Step 2:

After answering the ten questions in the first stage, participants are asked to estimate how many of their own answers have contained the true value, that is to say, to give a rating out of ten. This is called frequency estimation or self-validation.

Step 3:

We ask each participant to estimate the average number of correct responses made by these colleagues (other participants). We mean by a correct response interval containing the true value regardless of accuracy. This is called frequency estimation of others.

Steps 4, 5 and 6:

They are similar to steps 1, 2 and 3. They concern iteration in the sense of giving a second chance for those who want to make adjustments to their ranges in step 4 by changing the lower bound, upper bound or both. Participants who do not want to make adjustments may mention that by confirming their answers. If a participant has made some adjustment in step 4, then he/she should provide a second frequency to estimate their own answer in step 5, and estimate a second frequency of the other in step 6.
As previously mentioned, this experiment has two sessions, the first is free, the second is paid off. Each session consists of six steps described above. The questions in both sessions are different but of the same type, that is to say that the sample is heterogeneous and is not selected for difficulty. The purpose of this change is to avoid the effect of learning that can bias the analysis.

Hypotheses and tests:

Let θ_1, θ_2 .... θ_6 be the population mean in each of the six steps in the free session and β_1, β_2 .... β_6 denote the population mean in each of the six steps in the paid session.

So θ_1 [β_1] refers to the average number that includes the true value in step 1 for the free session [pay]. θ_2 [β_2] refers to the estimated average frequency in Step 2 for the free session [pay]. θ_3 [β_3] refers to the estimated average frequency of the other session for free [pay].
θ_4 [β_4] θ_5 [β_5] and θ_6 [β_6] are strictly analogous to θ_1 [β_1] θ_2 [β_2] and θ_3 [β_3] on the iteration in the free session and pay respectively. Assumptions can be organized around four central points:
The comparison of over-confidence as measured by the method of estimation interval and the method of estimation frequency
Check if participants anticipate the over-confidence of others through the estimation of the frequency of others,
Capture the effect of iteration on the results, and
Determine the impact of monetary incentives on the behavior of individuals by comparing the free session and the session fee.
Comparison of over-confidence as measured by the method of confidence interval and the method of frequency estimation
In our experiment, we measure the over-confidence by two methods:
The method of the confidence interval or interval estimation used in step 1 and 4.
The method of estimating frequency used in step 2 and 5

Hypothesis 1: the range of over-confidence is greater than the frequency of over-confidence.

Free Session:

$(\theta_2 - \theta_1) < (9 - \theta_1)$ before iteration
$(\theta_5 - \theta_4) < (9 - \theta_4)$ after iteration

Paid session:

$(\beta_2 - \beta_1) < (9 - \beta_1)$ before iteration
$(\beta_5 - \beta_4) < (9 - \beta_4)$ after iteration
In the first case, we will see if the over-confidence as measured by the method of estimation interval is higher than that measured by the method of estimation frequency in the free session and the session fee, before and after iteration.
Estimated frequency of other
By examining the frequency estimation of others through step 3 and before step 6 iteration after iteration, it is expected that participants expect the over-confidence of others.

Hypothesis 2: Participants anticipate the over-confidence of others:

$\theta_n < 9$ for n = 3, 6 free session
$\beta_n < 9$ for n = 3, 6 paid session

Ii/ Iteration:

Participants can give an inconsistent answer, they are then asked to repeat the work of the estimate of the range they want. The iteration is not required, because a subject satisfied with his first answer may keep mentioning that.
In step 4, we recall about his answer by showing the lower and upper bound of the interval he has chosen. He then four choices:
Enter 0 for nothing fit
Type 1 only has to adjust, that is to say, the lower bound
Type 2 to adjust only b, that is to say, the upper bound
Type 3 to adjust a and b, that is to say, the two terminals
In step 5, which is the iteration of step 2, the subject has the choice of adjustment or maintenance of their response. Recall that in step 3, each subject was asked to estimate the average number of correct answers that his colleagues have conducted on the ten questions. In step 6, the subject has two choices:
Enter 0 for nothing fit
Type 1 to adjust the d, the average number of correct answers of other participants estimated in step 3
But it should be noted that the iteration will have the effect of anchor the concept that an interval of 90% confidence that actually involves 9 questions can be answered correctly on average. There is an element of learning for two reasons. First, the instructions are read and the other participants are to a

degree aware of their failure to comply with the instructions.

Hypothesis 3: The iteration will reduce the range of over-confidence that is overconfidence as measured by the method of estimating the range will be reduced by iteration.
$(9 - \theta_4)$ for the free session $<(9 - \theta_1)$
$(9 - \beta_4)$ for the paid session $<(9 - \beta_1)$
Iv / monetary incentives:
Our experience consists of two sessions, one is free and the other is paid for. To prevent participants from giving too wide intervals in the paid session in order to earn more money, we set a compensation system in a step that takes into account both accuracy and precision. We recall the compensation system in step 1:
R = 500 + 5000 / (b-a)
500 millimes will be won by any participant who provides an interval [a, b] containing the correct answer regardless of the width of the interval.

5000 millimes / (b-a) is the variable part of remuneration depends on the precision, that is to say, the width of the interval to ensure the 500 millimes, or they provide narrow intervals to minimize (b-a) and maximize their profits. This arbitration depends on the psychology of it is risk-averse and under-confident, it will expand the range. But his aversion to risk decreases and confidence increases, the width of the interval that will supply decreases.
Previous research (Davis and Holt, 1993, Smith 1991, Smith and Walker, 1993) believe that monetary incentives will align declaratory judgments and judgments true.One simple reason is that subjects spend more cognitive resources in the work where good performance is rewarded financially. The second reason for providing monetary incentives is that subjects may be reluctant to admit they have not followed the instructions in the work of estimating the range and thus exaggerates the estimated frequency to align with the estimate of the interval. This trend can be offset through monetary incentives as the self-validation is not without cost. Self-validation is manifested in steps 2 and 5 before and after iteration.
Previous researches also state that the subjects may be more predisposed to recognize the over-confidence of non-confidence on their own. This is the effect 'above average'. Since the estimated frequency of the other will be paid in the session fee, we will check whether the effect 'above average' will be reduced by monetary incentives.
Our goal in this section is to study the impact of monetary incentives on responses. If the over-confidence dominates the population of participants, it is expected that the range of over-confidence in the session fee will be greater than that of the free session. The study will be made also by topic, to see the change in this way from one person to another.

4-a hypothesis: The interval of over-confidence in the session fee is larger than that of the session
$(9 - \beta_1) > (9 - \theta_1)$ before iteration
$(9 - \beta_4) > (9 - \theta_4)$ after iteration
Our second objective in this section is to study the impact of monetary incentives on the estimated frequency. Since self-validation is paid, participants will try not to exaggerate.

Hypothesis 4-b: The monetary incentives will decrease the over-confidence as measured by the method of frequency estimation
$(\theta_2 - \theta_1) > (\beta_2 - \beta_1)$ before iteration
$(\theta_5 - \theta_4) > (\beta_5 - \beta_4)$ after iteration
Our third objective in this section is to study the impact of monetary incentives on estimating the frequency of others. Since this estimate is paid in steps 3 and 6. As we have already declared the subjects may be more predisposed to accept the over-confidence of other than their own over-confidence.

Hypothesis 4-c: The monetary incentives will reduce the effect 'above average'
$(\theta_2 - \theta_3) > (\beta_2 - \beta_3)$ before iteration
$(\theta_5 - \theta_6) > (\beta_5 - \beta_6)$ after iteration

Results:
Figure 1 below shows the average results in the six stages of the experiment for the free session and the session fee.
For the free session, the average number of correct answers in the work of estimating the range in step 1 (before iteration) is $\theta_1 = 4.555$ and in step 4 (after iteration) $\theta_4 = 4.644$. As for the session, the average number of correct answers before iteration $\beta_1$goes up to 2.111, and to β_4 (2.444) after iteration. The null hypothesis that the average number of correct answers is equal to 9 is rejected ($p < 0.001$)
$(9-\theta_1)>0$ p = 0.0000, t = 15.58071
$(9-\theta_4)>0$ p = 0.0000, t = 14.59608
$(9-\beta_1)>0$ p = 0.0000, t = 32.23227
$(9-\beta_4)>0$ p = 0.0000, t = 29.60109

Figure 1: Mean scores in the six stages of the experiment
These results indicate the presence of overconfidence in the performance estimation interval.
The test of Goodness-of-fit of the null hypothesis that the number of correct answers in step 1 and 4 follows a binomial distribution with probability 0.9 and a number of 10 independent trials confirm the results obtained by parametric tests ($p < 0.001$).
Comparison of over-confidence as measured by the method of confidence interval and the method of frequency estimation
Free Session:
In this section, we calculated θ_1 and θ_2, are the average number of correct answers in the work of estimating the range in step 1 and the estimated average frequency in step 2.
Overconfidence of the population is measured by two methods, the estimate of the range $(9-\theta_1)$, and the estimated frequency $(\theta_2 - \theta_1)$. We'll see if the over-confidence as measured by the method of interval estimation exceeds that measured by the method of estimating frequency and participant at the total population. As expected, the frequency estimates are not consistent with the number of correct responses in which participants were assigned to cover in their intervals.Before iteration, the subjects think that the average number of correct answers is ($\theta_2 = 6.082$). The average number of correct responses ($\theta 1 = 4.555$).Over-confidence measured by the method of estimation interval is 4.444 $(9-\theta_1)$.

Over-confidence measured by the method of estimating frequency is 1.533 $(\theta_2 - \theta_1)$, it is significant (p = 0.0000, t = 5.373864). The difference between the two methods is highly significant is 2.911 (4.444 to 1.533) in the free session ($p < 0.001$) confirming the hypothesis for a free session before iteration, that is to say $(\theta_2 - \theta_1) < (9-\theta_1)$. (See Appendix Table 1).
After the iteration, we follow the same approach. It has been calculated θ_4 and θ_5, are the average number of correct answers in the work of estimating

the range in step 4 and the estimated average frequency in step 5. The subjects think that the average number of correct answers ($\theta_5 = 6.533$), while the average number of correct answers is ($\theta_4 = 4.644$). Over-confidence measured by the method of the estimation interval is 4.355 ($9-\theta_4$). Over-confidence measured by the method of estimating frequency is 1.888 ($\theta_5-\theta_4$), it is significantly ($p = 0.0000$, $t = 6.363711$). The difference between the two methods is highly significant is 2.467 in the free session ($p < 0.001$) confirming the hypothesis for a free session after iteration ($\theta_5-\theta_4$) < ($9-\theta_4$). (See Appendix Table 2).

Session fee:

We will repeat the same work to verify if the results obtained for the free session are confirmed for the session fee. It has been calculated β_1 and β_2 which represent the average number of correct answers in step 1 and the estimated average frequency in step 2. (See Appendix Table 3).

Frequency estimates are not consistent with the number of correct responses in which participants were assigned to cover in their intervals. The subjects think that the average number of correct answers β_2 is 5.066. The average number of correct answers β_1 amounts to 2.111. Over-confidence measured by the method of the estimation interval is 6.888 ($9-\beta_1$). On the confidence measured by the method of estimating frequency is 2.955 ($\beta_2-\beta_1$), it is significant is 3.933 ($p < 0.001$) confirming the hypothesis for a session fee prior iteration ($\beta_2-\beta_1$) < ($9-\beta_1$). (See Appendix Table 3).

After iteration, we calculated that β_5 and β_4 represent the average number of correct answers in step 4 and the estimated mean frequency in step 5. (See Appendix Table 4).

Frequency estimates are not consistent with the number of correct responses in which participants were assigned to cover in their intervals. Participants felt that the average number of correct answers β_5 is 5.555. The average number of correct answers β_4 equals 2.444. On the confidence measured by the method of interval estimation ($9-\beta_4$) is 6.555. Over-confidence measured by the method of estimating frequency ($\beta_5-\beta_4$), amounts on average to 3.111 and is significant ($p = 0.0000$, $t = 11.59913$). The mean difference between the two methods, which is equal to 3.444, is highly significant either ($p < 0.001$) confirming the hypothesis after iteration 1.

Frequency estimates of others:

In the free session, the estimated average frequency of others ($\theta_3 = 5.844$) and ($\theta_6 = 6$) respectively before and after iteration. In the session fee, the estimated average frequency of others before β_3 iteration is 5.244.

After the iteration, the estimated average frequency of other β_6 amounts to 5.488.(See Figure 1). In addition, these estimates differ significantly from 9 ($p < 0.001$) confirming hypothesis 2. (See Appendix Table 5).

Iteration

The opportunity to review the subjective confidence intervals in step 4 was operated by 91% of participants in the free session, and 93% of participants in the session fee. The effect of using the iteration defined as the difference between the number of correct answers in steps 4 and 1 is 0.089 ($\theta1 = 4.555$; $\theta4 = 4.644$) in the free session and 0.333 ($\beta1 = 2.111$; $\beta\_4 = 2.444$) in the session fee. The over-confidence interval decreases with the iteration, but this decrease is not significant for the free session ($p = 0.2527$, $t = 1.15099$). By cons, it is significant for the session fee ($p = 0.0096$, $t = 2.708013$) which is consistent with the hypothesis 3.

($9-\beta1$) > ($9-\beta4$) for the paid session

Monetary incentives:

The effect of monetary incentives will be considered at each step before and after iteration, since the pricing is different from one stage to another. Recall that in step 1, the compensation system is R = 500 + 500 / (b-a). In step 2, if the participant correctly estimates the number of correct responses it has made in the first stage, he won 0.5 dinar. In step 3, if the participant correctly estimates the average number of correct responses made by his colleagues, he earns 0.5 dinar. The same principle is adopted for the iteration.

Participants in overconfidence resulted intervals are too narrow to maximize their gain, so ($\beta_1 = 2.111$), which represents the average number of correct answers is significantly lower ($\theta_1 = 4.555$). So, over-confidence as measured by the interval estimation in the session fee is higher than that measured in the free session. Overconfidence measured by the method of the estimation interval is 6.888 in the session fee prior iteration, and 4.444 in the free session before iteration. The difference is significant ($p = 0.0000$, $t = 7.558073$). After iteration ($\beta_4 = 2.444$) is significantly lower ($\theta_4 = 4.644$).

Therefore, the overconfidence as measured by the interval estimation in the paid session (6.555) is higher than that measured in the free session (4.355). The difference is significant ($p = 0.0000$). These results confirm the hypothesis 4-a:

($9 - \beta_1$) > ($9 - \theta_1$) before iteration

($9 - \beta_4$) > ($9 - \theta_4$) after iteration

In addition, we measured overconfidence per participant for this psychological bias varies from person to person. For example, we see over-confidence is highest among participants 13, 24, 28, 31, 32 and 34 and lowest among participants 3, 21 and 17 in the session fee prior iteration. Those for which it is discovered through a broad over-confidence intervals are given too narrow to maximize their gains, many of them were too close to the answer that is to say if they have just expanded their ranges they would have answered correctly, and that's what we are trying to demonstrate. People overestimate the precision of their knowledge by giving intervals too narrow. Monetary motivation, which involves the accuracy of the interval, caused the bias in over-confident participants. They are fans of the risk and want to maximize their gains. Plus this bias decreases as the data is less close intervals.

In step 2, self-validation is paid, so ($\beta_2 = 5.066$) and ($\theta_2 = 6.088$). The difference is significant ($p = 0.00004$, $t = 3.804027$). Monetary incentives encourage participants to think before giving their estimates and reduce the exaggeration of the estimates. After iteration ($\beta_5 = 5.555$) is less than ($\theta_5 = 6.533$). The difference is significant ($p = 0.0016$, $t = 3.367002$). Before iteration, over-confidence measured by the method of estimating frequency is 1.533 in the free session, and 2.955 in the session fee (see Table 1 and 3). After iteration, overconfidence is 1.888 in the free session, and 3.111 in the session fee (see Table 2 and 4). It is clear that the hypothesis is rejected 4-b. That is to say, over-confidence as measured by the estimated frequency is not reduced by monetary incentives. On the contrary, it increased by iteration of 1.422 ($p = 0.007$, $t = 3.659996$), and after iteration of 1.223 ($p = 0.0057$, $t = 2.907948$). This increase is due to the fact that the average number of correct responses in the session fee ($\beta_1 = 2.111$) was significantly lower than the average number of correct answers in the free session ($\theta_1 = 4.555$) before iteration. The same results are confirmed after iteration ($\beta_4 = 2.444$) is significantly lower ($\theta_4 = 4.644$). This is due to monetary incentives that led to the existence of the intervals are too narrow for lack of precision, thus the increase in number of wrong answers.

We can conclude that monetary incentives have caused an increase in overconfidence as measured by the interval estimate and the estimate of frequency.

In step 3, the estimated frequency of the other is paid. Before iteration, the effect 'above average' is 0.244 ($p = 0.3601$) for the free session, and -0.177

(p = 0.4599) for the session fee. Effect 'above average' is not significant in the session free of charge and pay before iteration. This effect decreased with monetary incentives, but this decrease was not significant (p = 0.1104) (See Table 7 in Appendix). After iteration, the effect of 'above average' is 0.533 (p = 0.0584) for the free session and 0.066 (p = 0.7902) for the session fee. Effect 'above average' is significant at 10% in the free session, but not significant in the session fee after iteration. This effect also decreased after iteration (p = 0.0983). This decrease is significant at 10%.(See Table 8 in Appendix).

Section 2: The method of question with two answer choices

The objective of this experiment is to measure overconfidence by a third method, called method of question with two answer choices. Subjects were two response alternatives, they must choose one to answer each question by giving a certain percentage of the response chosen on the scale [50% 100%]. We then studied the effects of monetary incentives on outcomes. This will be achieved by comparing the results of the free session and the session fee. The main objective of this third method is to compare the over-confidence as measured by three methods and see if the choice of scale measure may aggravate or alleviate this bias.

2.1 Models of the experience and assumptions:

2.1.1. Participants and procedures:

The experiment will involve 45 students at the ISG Tunis. In fact, the same students who participated in the first experiment participated also in the second and for having an adequate basis for comparison between the three methods. This experience is also composed of two sessions, one is free the other is paying.

In the session fee, participants will be paid in proportion of correct responses they made. We follow the compensation system as follows:

• In step 1, a correct answer is remunerated by 1 dinar.

• In step 2, a self-validation is properly remunerated by 0.5 dinar.

• In step 3, the estimated frequency of correct answer of others is paid by 0.5 dinar

The experiment has three steps described below (no iteration):

Step 1:

Participants must answer ten questions, choosing an alternative among the two alternatives proposed. Then they give a certain percentage of this response on the scale [50% 100%]. The percentage can not be less than 50% because it implies the choice of alternative.

Step 2:

We asked each subject to estimate the number of correct answers that he made the ten questions. This is the stage of self-validation.

Step 3:

We asked each subject to estimate the average number of correct answers that these colleagues have conducted on the ten questions.

As mentioned earlier, this experience also includes two sessions: the first is free and the second is paid off. Each session consists of three steps described above.The questions in both sessions are different but the same type that is to say that the sample is heterogeneous and is not selected for the difficulty. The purpose of this change is to avoid the effect of learning that can bias the analysis. It should be noted that the questions asked in the session free of the first experiment are identical to those raised in the free session of the second experiment. The questions asked in the session fee of the first experiment are identical to those asked in the session fee in the second experiment.

2.1.2 Assumptions and tests:

Are,

α_i: the population mean in step i (i = 1, 2 and 3) for the free session, and

λ_i: the population mean in step i (i = 1, 2 and 3) for the session fee.

So α_1 [λ_1] refers to the average number of correct answers in step 1 for the free session [paid]. α_2 [λ_2] refers to the estimated average frequency in Step 2 for the free session [pay]. α_3 [λ_3] refers to the estimate of the average frequency of the other session for free [pay]. α4 is medium confidence of participants in step 1 for the entire issue of the free session, λ4 is medium confidence of participants in step 1 for the entire question of the session fee.

Comparison of over-confidence as measured by the method of confidence interval and the method of question two answer choices:

In our experiment, we measured the over-confidence by the method of question two answer choices per participant for the entire population (see Table 1 and 2 in Appendix 2) to compare it with that measured by the method of confidence interval used in step 1 and 4 of the first experiment.

Hypothesis 1: over-confidence as measured by the method of the confidence interval is greater than that measured by the method of question two answer choices:

Free Session:

$(9-\theta_1) > (\alpha_4-\alpha_1)$

$(9-\theta_4) > (\alpha_4-\alpha_1)$

Paid Session :

$(9-\beta_1) > (\lambda_4-\lambda_1)$

$(9-\beta_4) > (\lambda_4-\lambda_1)$

In the first case, we will see if the over-confidence measured by the method of estimating the interval is greater than that measured by the method of question twoanswer choices in both free and paid sessions.

Frequency estimation of others:

By examining the frequency estimation of others through step 3, it is expected that participants expect the over-confidence of others.

Hypothesis 2: Participants anticipate the confidence of others:

α3 <α4 for free session

λ3 <λ4 for the paid session

Monetary incentives:

Our experiment consists of two sessions, the first is free and the second is paid off.It should be noted that the sample of questions is not the same for both sessions so as not to bias the results by the effect of learning. However, both samples includequestions of general knowledge in much the same type.

In the session fee, participants are paid for each correct answer of a dinar. So weexpected to exert more effort and thought to respond appropriately. Therefore, theoverconfidence as measured by the method of question two answer choices will usually be reduced by monetary

incentives.
In step 2, self-validation is paid to 0.5 dinar. It is expected that overconfidence as measured by the estimated frequency is reduced in this experiment.
In step 3, the estimated frequency of the other is paid to 0.5 dinar. It is expected that the effect 'above average' is reduced.

Hypothesis 3-a: of confidence measured by the method of question two answer choices will be reduced by the monetary incentives
$(\lambda 4-\lambda 1)<(\alpha 4-\alpha 1)$

Hypothesis 3-b: The monetary incentives will decrease the over-confidence as measured by the frequency estimation
$(\lambda 2-\lambda 1)<(\alpha 2-\alpha 1)$

Hypothesis 3-c: The monetary incentives will reduce the effect 'above average'
$(\lambda 2-\lambda 3)<(\alpha 2-\alpha 3)$

2.2 Results:
Figure 2 shows the mean scores in the three stages of the experiment for the free session and the session fee.
The average number of correct answers in the work of Open and answer choices in step 1 is ($\alpha 1 = 6.022$) in the free session, and ($\lambda 1 = 5.644$) in the session fee. Trust average ($\alpha 4 = 8.042$), and ($\lambda 4 = 7.467$) in the session fee. The null hypothesis that the number of correct answer is equal to the average confidence ($\alpha 1=\alpha 4$) is released to the free session ($p = 0.0000$, $t = 8.699101$). This same hypothesis is rejected in the session fee ($p = 0.0000$, $t = 6.432787$). Therefore, the method of question two alternative response is also evidence of the bias of over-confidence.

Figure 2: Mean scores in the three stages of the experiment
The nonparametric Wilcoxon Mann-Whitney equality of medians between the number of correct answers and medium confidence confirms the results from the t-test for both free session ($p = 0.0000$; value = 6.201565) pay for the session ($p = 0.0000$; value = 5.180748).

2.2.1. Comparison of the trust as measured by the method of confidence interval and the method of question two answer choices
a. Free Session:
Our goal is to test the hypothesis that over-confidence as measured by the method of interval estimation is higher than that measured by the method of question two answer choices. Overconfidence measured by the method of choice is Open and 2.02 in the free session. (See Table 1 of Appendix 2)
Overconfidence measured by the method of the estimation interval is 4.444 in the free session before iteration after iteration and 4.355.

The difference between the two methods is 2.242 ($p = 0.0000$, $t = 6.276677$) before iteration after iteration and 2.335 ($p = 0.0000$, $t = 6.124411$). This difference is highly significant confirming the hypothesis for a free session.
The test of equal median Wilcoxon Mann-Whitney confirmed the superiority of overconfidence as measured by the interval estimation method that measured by the method of Open and free choice in the session before iteration ($p = 0.0000$; value = 5.398630) and after iteration ($p = 0.0000$; value = 5.221096).

$(9-\theta 1) > (\alpha 4-\alpha 1)$
$(9-\theta 4) > (\alpha 4-\alpha 1)$

b. Paid Session
Our goal is to calculate $\lambda 1$ and $\lambda 4$ to determine the over-confidence as measured by the method of question two answer choices (see Table 2 of Appendix 2).
Overconfidence measured by the method of choice is Open and 1.823 in the session fee. Overconfidence measured by the method of the estimation interval is 6.888 in the session fee prior iteration, and 6.555 after iteration. The difference between the two methods is 5.065 before iteration ($p = 0.0000$, $t = 15.38705$) and 4.732 ($p = 0.0000$, $t = 14.36542$) after iteration. This difference is highly significant confirming the hypothesis for a session fee.
The test of equal median Wilcoxon Mann-Whitney confirmed the superiority of overconfidence as measured by the interval estimation method that measured by the method of choice in Open and before the session fee iteration ($p = 0.0000$; value = 7.779191) and after iteration ($p = 0.0000$; value = 7.866390).

$(9-\beta 1) > (\lambda 4-\lambda 1)$
$(9-\beta 4) > (\lambda 4-\lambda 1)$

2.2.2 Estimates of frequency of others
Estimates of average frequency of others ($\alpha 3 = 6.911$) in the free session and ($\lambda 3 = 6.288$) in the session fee as shown in Figure 2. We tested whether these estimates differ significantly from the $\alpha 4$ or medium confidence in the free session, and $\lambda 4$ in the session fee. $\alpha 4 = 8.042$ and $\lambda 4= 7.467$ (see Table 3 and 4 in Annex 2)
$\alpha 3 <\alpha 4$ and ($p = 0.0000$, $t = 5.716530$), the difference is significant. The hypothesis is confirmed in the free session.
$\lambda 3 <\lambda 4$ and ($p = 0.0000$, $t = 5.799388$) the difference is significant. So the hypothesis is confirmed in the session fee.

The test of equal median Wilcoxon Mann-Whitney confirmed these results both for the free session ($p = 0.0001$; value = 4.026781) than pay for the session ($p = 0.0000$; value = 4, 57 955).
Therefore, we can conclude that the participants expect the over-confidence of others.

2.2.3. Monetary incentives:
Overconfidence measured by the method of choice is Open and 2.02 in the free session and 1.823 in the session fee. We tested whether

overconfidence decreases by monetary incentives. The difference is 0.197 (p = 0.577). It is no longer significant, 3-a hypothesis is rejected. In addition, the test of equal median shows that overconfidence is not reduced by the monetary incentives (p = 0.3576).
The estimated frequency is $\alpha 2 = 7.177$ for the free session, and $\lambda 2 = 6.133$ for the session fee. Overconfidence measured by estimated frequency is 1.155 in the free session, and 0.489 in the session fee. It was verified that overconfidence decreases by monetary incentives but this decrease was not significant (p = 0.1372 for the t-test, p = 0.0886) led to the dismissal of the case 3-b.
The rejection of hypotheses 3-a and 3-b reflects the persistence of overconfidence. Indeed, this bias is not weakened by monetary incentives.
The estimate of the average frequency of others is $\alpha 3 = 6.911$ in the free session and $\lambda 3 = 6.288$ in the session fee. Effect 'above average' is 0.266 ($\alpha 2$-$\alpha 3$) in the free session and -0.155 ($\lambda 2$-$\lambda 3$) in the session fee. This effect decreased with monetary incentives (p = 0.0526). The decrease is significant at 10% assuming 3-c is checked. (See Tables 3 and 4 in Annex 2).

Conclusion:

We tried to measure and test the existence of the bias of over-confidence and to examine the sensitivity of this bias with respect to several factors. These factors are the method of measurement, monetary incentives and iteration.
The review of the literature tells us that overconfidence can be measured by three methods namely, the interval estimation method, the method of estimating frequency and method of question two choices. We have conducted an experiment involving students from the ISG Tunis in order to measure overconfidence through these three methods. The results of this experiment show the existence of this bias for the three methods and thus support the empirical evidence of Russo and Schoemaker (1992), Justin et al, (1999) and Cesarini et al, (2005), and Erev et al, (1994), and Klyaman et al, (1999).
At the sensitivity analysis of this bias, the tests show that the method of interval leads to higher steps in comparison with other methods. These results confirm the empirical evidence observed by Cesarini et al, (2005).
The study of the effect of monetary incentives on the level of overconfidence revealed conflicting results.

First, monetary incentives boost the level of overconfidence for the method of estimating the range as well as the estimation method of frequency. On the other hand, overconfidence is not significantly sensitive to monetary incentives when measured by the method of question two choices.
In our view, this discrepancy is explained by the form of compensation issues.Indeed, the level of experience with the first two methods, the existence of a variable component of compensation depending on the accuracy of answers prompted the subjects to take more risk by opting for more precise answers and less accurate in the session fee in the free session. So the number of correct responses decreased, and therefore, over-confidence has increased. As regards the method of question two choices, the form of total compensation fixed and independent of the accuracy of answers does not lead subjects to make a trade-off between accuracy and precision of the responses to the extent that it does not matter. As a result, the number of correct answers, and overconfidence were not significantly affected by monetary incentives.
Regarding the impact of iteration on overconfidence, the tests indicate the significance of it depends on the motivation of money. In the session fee, one observes that the subjects offered by reviewing their responses, wider intervals reflect better understanding of the concept of the range of 90%. So with the iteration, the number of intervals containing the correct answer has increased and overconfidence is significantly reduced. In the absence of monetary incentives, these mechanisms did not function properly and over-confidence is not affected by the iteration