



Exemplar 2 : Awareness of Estimation

Objective: To develop an awareness of estimation

Key Stage: 3

Learning Unit: Numerical Estimation

Materials Required : Worksheets

Prerequisite Knowledge: Manipulations on numbers

Description of the Activity:

1. The teacher divides students into groups.
2. The teacher distributes Worksheet 1, which consists of an activity to demonstrate the use of estimation in daily life.
3. In Worksheet 1, students are required to make the estimates by themselves first and then discuss their results among the group members.
4. The teacher should bring to the attention of the students that it is an estimation activity, therefore calculating tools should not be used. Answers are NOT required to be exact.
5. The teacher invites students to present their answers and explain how they get their answers.
6. The teacher distributes Worksheet 2. The activity in this worksheet is designed for students to work on their own. They should not discuss with their classmates.
7. After completion, the teacher invites some students to present their results and strategies used.
8. After the presentation, a discussion on the reasons for estimation in various daily life situations could be conducted.
9. As a follow-up activity, the teacher can ask students to look for some real situations where estimation instead of accurate calculations could be used and to discuss them in the next lesson.

Worksheet 1 : Estimating a bill for dinner

Your group is going to have dinner in a restaurant. Here is the menu of the restaurant.

MENU		
2-course meal : soup & main course		\$ 68
3-course meal : soup, main course & desert		\$ 98
Soft drink	\$ 9 per glass	
Hot tea	\$ 12 per cup	
Mineral water	\$ 18 per bottle	

- Record the number of meals ordered from your group.

Number of 2-course meals: _____

Number of 3-course meals: _____

- Members in your group wish to order drinks with their meals. Record the number of drinks below.

Number of soft drinks: _____

Number of cups of hot tea: _____

Number of bottles of mineral water: _____

- Estimate the bill for your group.

Estimated charge for the meals	\$
Estimated charge for the drinks	\$
Estimated total	\$

- If the restaurant adds a 10% service charge on the bill of the food and drinks, estimate the total amount of money your group has to pay.

- If the members in your group decide to share the bill equally, estimate the amount of money each one has to pay.

Worksheet 2 : Estimating an online purchase

You are going to buy some books from an online bookstore in U.S.A. The prices of all books sold in this bookstore are in U.S. dollars.

1. You want to buy three books from this bookstore and their prices are US\$13.95, US\$20.95 and US\$39.95.

The estimated total price of these books is _____

2. You choose to ship the books by air. The cost for sending the books in this way is US\$21.75. There is also a handling charge of US\$5.90 per book. Estimate the total charge for the purchase (in US dollars).

3. Assuming that US\$1 = HK\$7.8, estimate the total amount in Hong Kong dollars that you need to pay for this order.

Notes for Teachers:

1. The teacher should emphasize to the students that accuracy is not of the paramount importance in estimation. Students do not have to worry that they cannot obtain exact answers in the activities.
2. Through discussion among group members, students can compare their estimates with each other and check the reasonableness of the answers obtained in the worksheet.
3. The followings are suggested answers for the discussion on why estimation is used in various daily life situations:
 - a) Constraints force estimation

The constraints include:

 - i) Value unknown
An estimation has to be made if the value under consideration is not known.
For example: The population of China and that of HKSAR; the unemployment rate in Hong Kong in 2002, etc.
 - ii) Variations of value
A value may be different when it is measured at different times.
For example: Air Pollution Index.
 - iii) Limitations in measurement
Physical measurements are, in most cases, not exact. To measure the precise length of an object is almost impossible and measuring devices have imperfections.
For example: To measure the exact time required to run 100m by a stopwatch is not possible.
 - iv) Estimate in and estimate out
A value may itself be an estimate. Any further value derived from it is just another estimate.
For example: the area of a rectangle calculated from the measured length and width is an estimate.

b) Estimation increases clarity

Although precision is an important idea that should not be underrated, an estimate gives a clearer picture than the precise figure in some occasions.

Example 1: It is sufficient for a mathematics teacher to remember the numbers of candidates sitting for Additional Mathematics and Mathematics in 1996 as around 20 000 and 90 000 rather than the exact numbers 22 313 and 90 279 respectively.

Estimates can also simplify calculations.

Example 2: It is easier to estimate the value of 21π to 66 when π is taken to be $\frac{22}{7}$ instead of 3.1415926....

c) Estimation gives consistency

Sometimes estimation is inevitable because the original data are inexact, but the particular choice of accuracy is chosen to be consistent from day to day, from month to month, etc.

Example 1: The median age of HK population increased from 28.2 years old (1 decimal place) in 1985 to 33.6 years old (1 decimal place) in 1995.

Consistency in estimates also arises from conventions or regulations or from a desire to have data of uniform appearance in tables, charts or graphs.

Example 2: The line graph for exchange currency rates for each day.
Example 3: The world records in swimming competitions are always kept to the nearest hundredth of a second.

d) Checking reasonableness of results

As calculators and computers are more and more popular, students always use them in computations. The results obtained from them may sometimes be unreasonable simply because of pressing a wrong key or typing one more or less digit. It is important for students to build up the habit of estimating the magnitude of the answer and to check the reasonableness of the results obtained from calculators or computers.