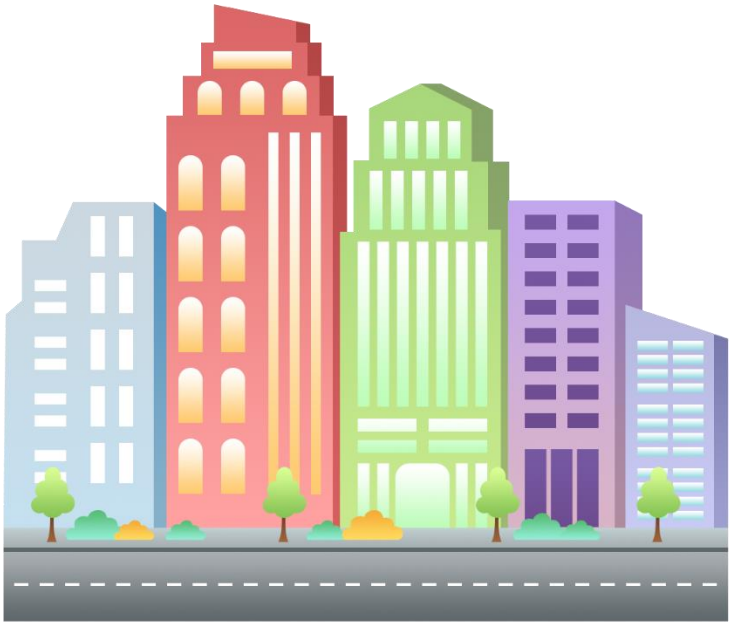


Setting a Marked Price for a Property

Have you ever wondered why two houses that seem similar can have very different prices? Welcome to the activity of real estate pricing! We will explore how to set a marked price for a property using mathematical modelling. Real estate pricing is not only based on location but also influenced by many factors, such as the floor area and age of the building.

Imagine you are a real estate agent trying to determine the best price for a property. You have lots of data – the marked prices of various properties along with their corresponding floor areas and ages of buildings. Your task is to use this data to build models that can predict the price of a property.

By analysing how different factors impacts the price, you can create mathematical models. This activity will equip you with the skills to make informed and strategic pricing decisions. Get ready to become a savvy real estate expert!

Setting a marked price for a property

Worksheet 1

Activity 1A

To recall prerequisite knowledge.

1. Before we dive into the complexities of real estate pricing, let's start with a simpler problem. We first print some booklets for promotion.

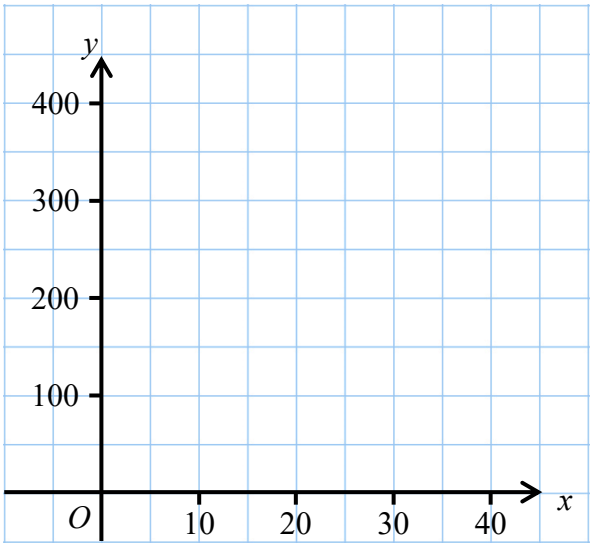
   (a) The cost \$$y$ of printing x booklets is calculated by the following formula:

   $$y = 5x + 100$$

   Find the cost of printing 50 booklets.

   (b) For a linear equation in two unknowns, we can plot its graph.
   Consider the equation in (a), $y = 5x + 100$.
   Complete the following table and draw its graph.

x	10	20	30
y			



Activity 1B

To plot graphs and formulate models using MS Excel.

2. In Question 1(a), we can use $y = 5x + 100$ to calculate the cost \$$y$ of printing x booklets. In Question 1(b), we have plotted the graph of the equation. The graph is a straight line.

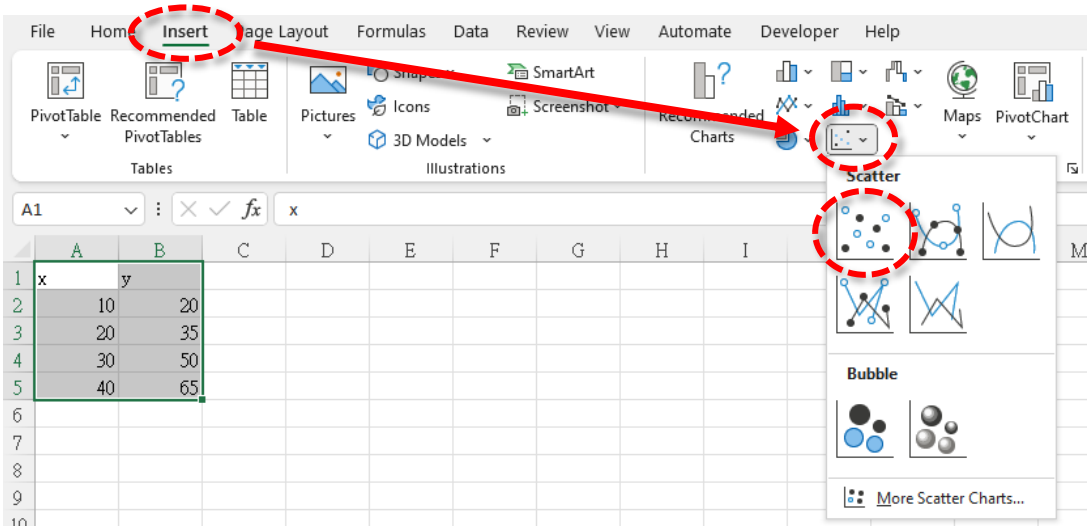
   $y = 5x + 100$ can be regarded as a *model* that describes the relationship between _____ and _____.

3. In some situations, however, we do not have the model at the very beginning. For example, the time required (y) in minutes for Machine A to print x booklets is recorded in the following table.

Number of booklets (x)	10	20	30	40
Time required (y)	20	35	50	65

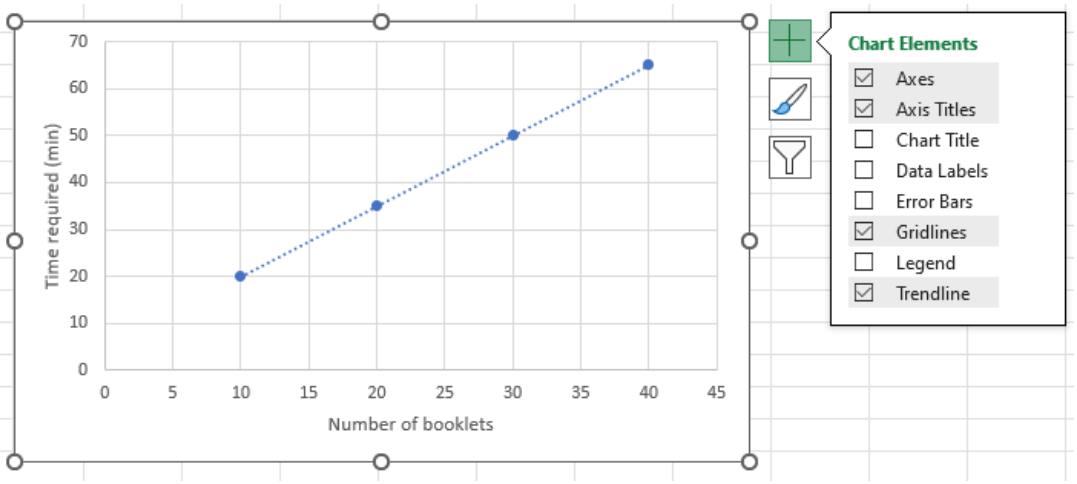
We can plot the graph and formulate the model using MS Excel.

Step	Description
i.	Input the data to MS Excel as in the following figure.
ii.	Plot the graph. • Select the heading and the data • Click Insert → Scatter



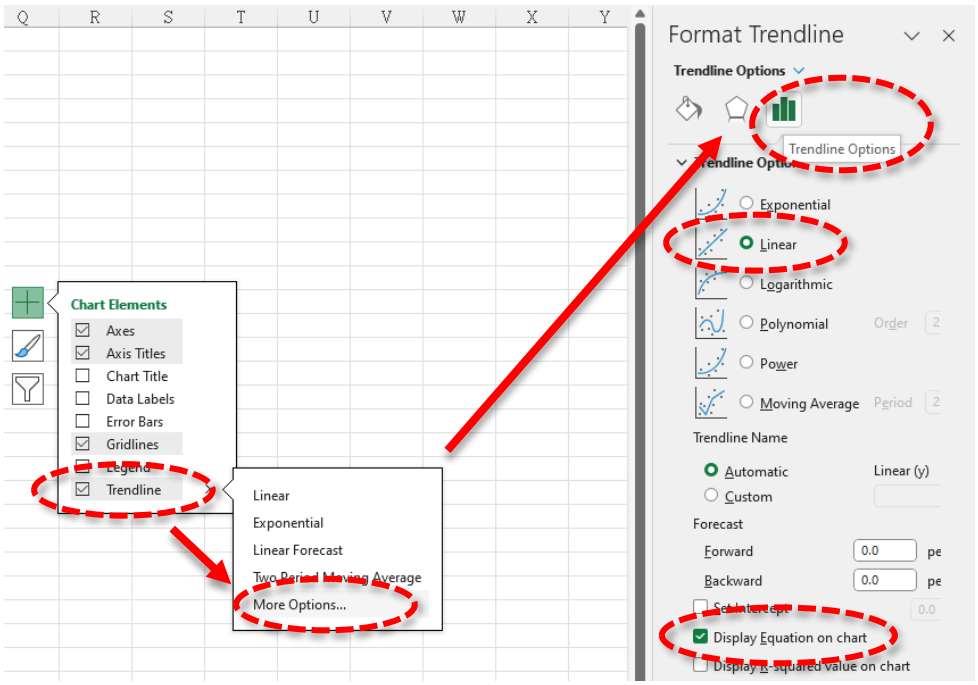
(cont.)

Step	Description
iii.	Select Chart Elements as in the following figure. • Axes • Axis Titles: Name the title of *x*-axis as "Number of booklets" and the title of *y*-axis as "Time required (min)" • Gridlines • Trendline



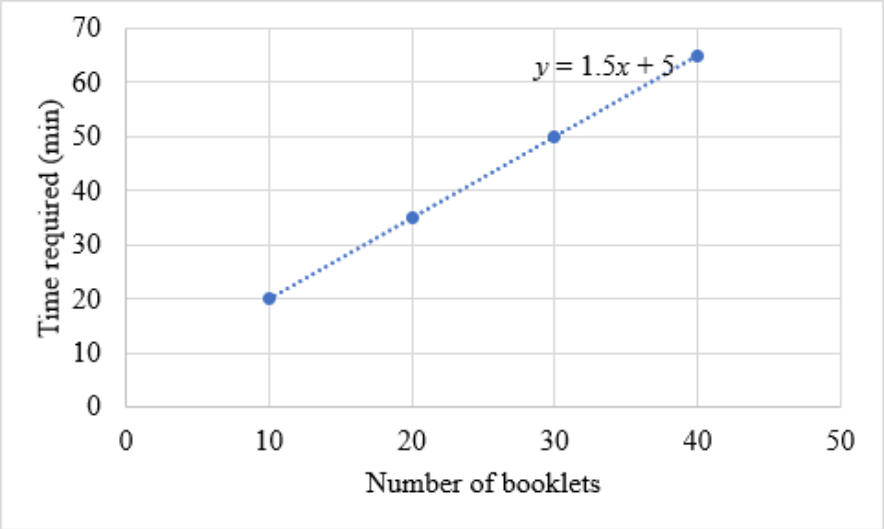
iv. Display the equation on the graph.

- Click Trendline → More Options → Trendline Options
- Select Linear and Display Equation on chart



(cont.)

Step	Description
v.	Refine the design of the graph. For example: • Adjust the size of the graph • Modify the font and font size



4. _____ is a model that describes the relationship between _____ and _____.

   Using this model, we can estimate the time required according to how many booklets we are going to print.

5. Using the model in Question 4, estimate the time required to print 80 booklets.

6. In the real world, it is not always possible to find a straight line that passes through all data points. However, we are able to observe a general trend. For example,

   the *more* booklets we print, the __*more / less*__ the time is required.

   In this case, we have to find a line of best fit. That is a line that minimises the distance between the line and data points. Finding this line involves some advanced mathematics and statistics knowledge. Still, MS Excel can formulate the line of best fit based on our input data.

7. The following table shows the time required (y) in minutes for Machine B to print x booklets.

Number of booklets (x)	10	20	30	40
Time required (y)	21	34	49	67

   Using MS Excel, plot a graph and formulate a model that describes the relationship between the number of booklets to print and the time required.

8. Using the model in Question 7, estimate the time required to print 80 booklets.

9. What are the assumptions and limitations of the model in Question 7?

Setting a marked price for a property

Worksheet 2

Activity 2

To use data of marked prices of properties alongside their corresponding floor areas to formulate a model.

1. If we own a property in Hong Kong, what information do we need when setting a marked price for the property?

_____

_____

_____

_____

2. The following figure shows some real data of the marked prices of some properties and their corresponding floor areas.

	A	B
1	Floor area	Marked price
2	363	468
3	443	530
4	430	490

Floor area in sq. ft.

"萬" means 10,000
i.e., $4,980,000

Source: https://www.scmp.com/business/article/3186280/loss-making-deals-hong-kongs-secondary-home-market-jump-sellers-take-hit

Generally speaking, what is the relationship between the floor areas and the marked prices of properties?

The *larger* the floor area, the ___*higher / lower*___ the marked price of the property.

3. Input the data to MS Excel. For simplicity, you may use the input format as shown on the right-hand side of the above figure.

4. Plot a graph and formulate a model (Model A) that describes the relationship between the floor areas (x) and the marked prices of properties (y).

5. Given that the floor area of a property is 420 sq. ft.
   Using Model A in Question 4, suggest a marked price for the property correct to 3 significant figures.

6. The following figure shows the marked price of the property in reality.
   Are the actual marked price and the modelling outcome in Question 5 different? What are some possible reasons?

7. What are the assumptions and limitations of Model A in Question 4?

Setting a marked price for a property

Worksheet 3

Activity 3

To use data of marked prices of properties alongside their corresponding ages of buildings to formulate a model.

1. Let's consider the ages of buildings. The following figure shows the year of completion of each building.

	A	B
1	Age of building	Marked price
2	37	468
3	32	530
4	34	490

= 2023 – 1989

The year of setting the marked price

The year of completion of the building

Generally speaking, what is the relationship between the ages of buildings and the marked prices of properties?

The *greater* the age of the building, the ___*higher / lower*___ the marked price of the property.

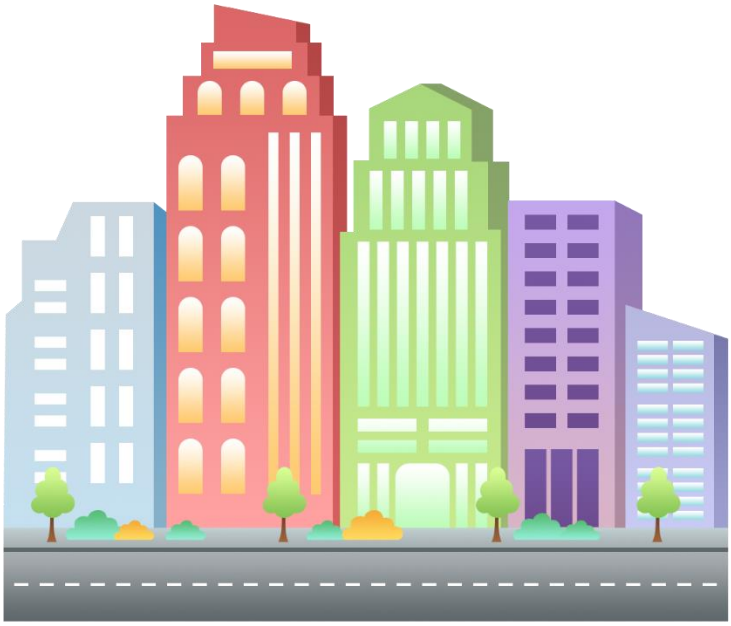
2. Input the data to MS Excel. To calculate the ages of buildings, you may use the formula as shown on the right-hand side of the above figure.

3. Plot a graph and formulate a model (Model B) that describes the relationship between the ages of buildings (x) and the marked prices of properties (y).

4. For the property shown in the following figure, the year of completion of its building is 1985.
   Using Model B in Question 3, suggest a marked price for the property correct to 3 significant figures.

5. Comparing the suggested marked prices of Model A (Question 5 in Activity 2) and Model B (the above question), which one is closer to the actual marked price of the property? How can we interpret this observation?

6. What are the assumptions and limitations of Model B in Question 3?



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Setting a marked price for a property

Worksheet 1

Activity 1A

To recall prerequisite knowledge.

1. Before we dive into the complexities of real estate pricing, let's start with a simpler problem. We first print some booklets for promotion.

   (a) The cost \$$y$ of printing x booklets is calculated by the following formula:

   $$y = 5x + 100$$

   Find the cost of printing 50 booklets.

Put $x = 50$ into the equation.

$$y = 5(50) + 100$$
$$= 350$$

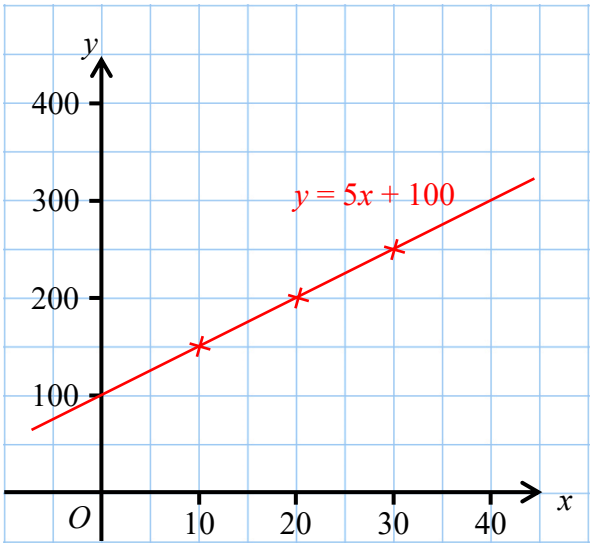
$\therefore$ The cost of printing 50 booklets is \$350.

(b) For a linear equation in two unknowns, we can plot its graph.

Consider the equation in (a), $y = 5x + 100$.

Complete the following table and draw its graph.

x	10	20	30
y	150	200	250



Activity 1B

To plot graphs and formulate models using MS Excel.

2. In Question 1(a), we can use $y = 5x + 100$ to calculate the cost \$$y$ of printing x booklets. In Question 1(b), we have plotted the graph of the equation. The graph is a straight line.

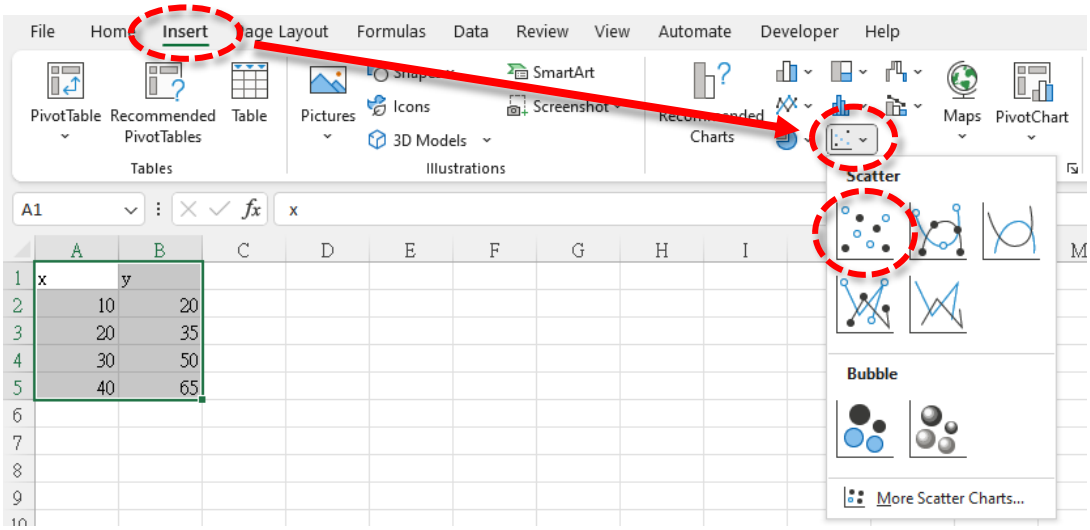
   $y = 5x + 100$ can be regarded as a *model* that describes the relationship between the number of booklets to print and the cost required.

3. In some situations, however, we do not have the model at the very beginning. For example, the time required (y) in minutes for Machine A to print x booklets is recorded in the following table.

Number of booklets (x)	10	20	30	40
Time required (y)	20	35	50	65

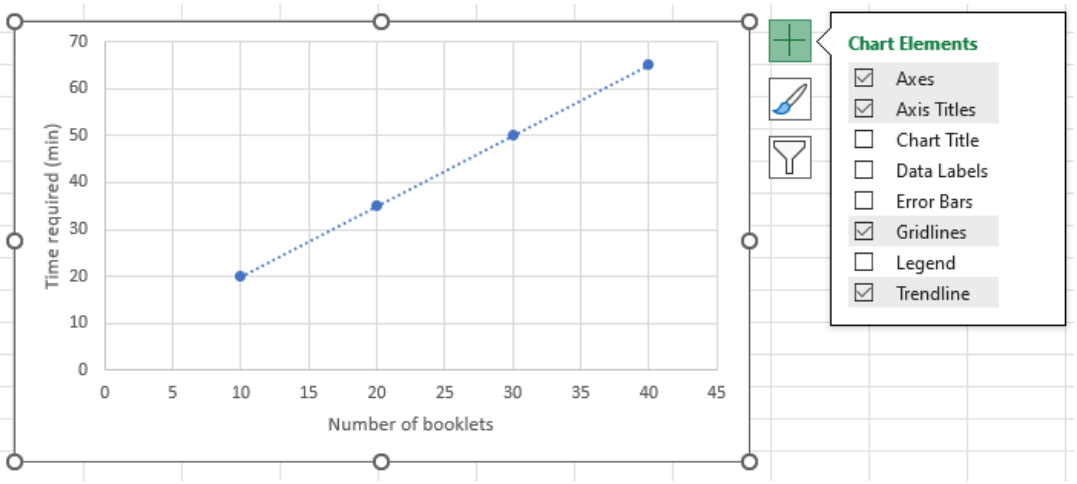
We can plot the graph and formulate the model using MS Excel.

Step	Description
i.	Input the data to MS Excel as in the following figure.
ii.	Plot the graph. • Select the heading and the data • Click Insert → Scatter



(cont.)

Step	Description
iii.	Select Chart Elements as in the following figure. • Axes • Axis Titles: Name the title of *x*-axis as "Number of booklets" and the title of *y*-axis as "Time required (min)" • Gridlines • Trendline



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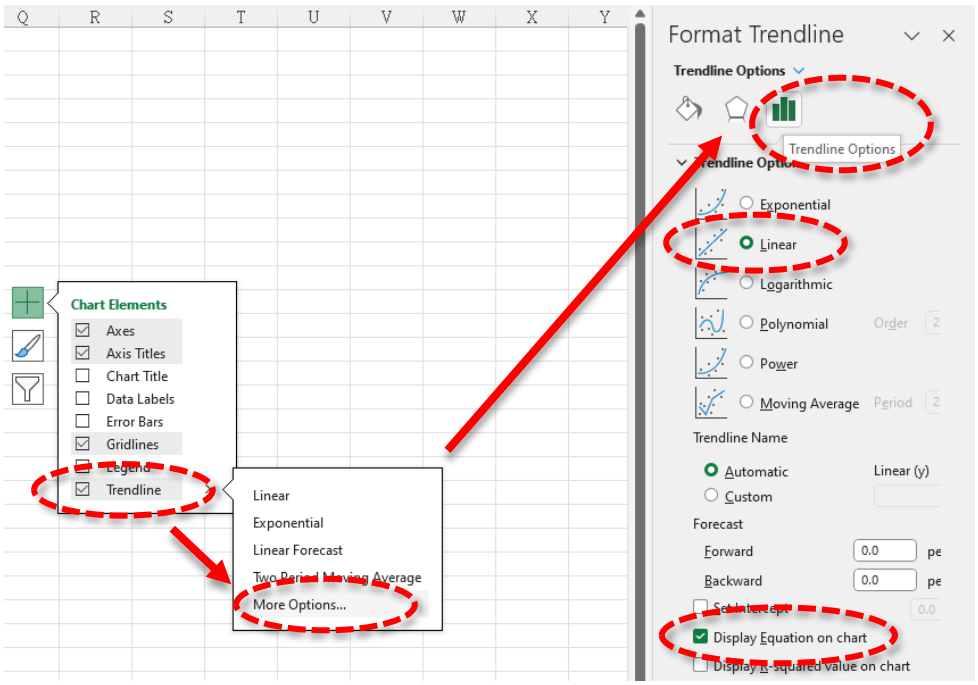
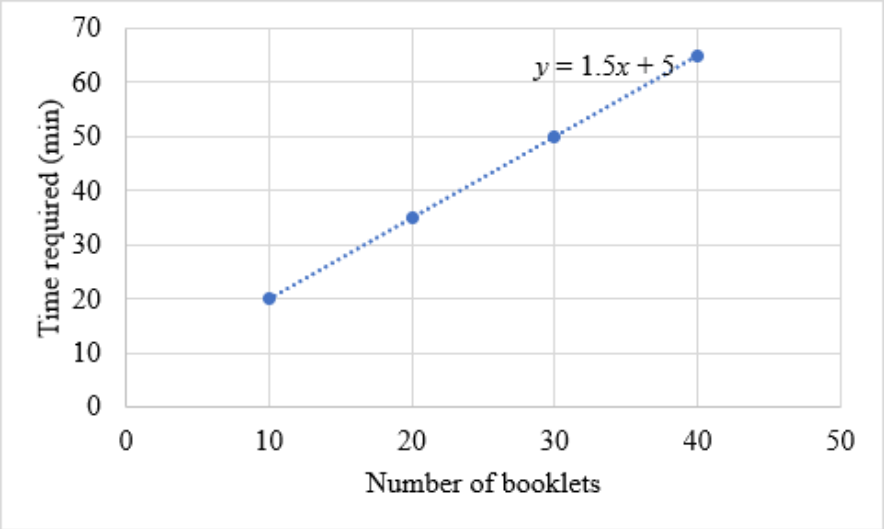
- Click Trendline → More Options → Trendline Options
- Select Linear and Display Equation on chart



(cont.)

Step	Description
v.	Refine the design of the graph. For example: • Adjust the size of the graph • Modify the font and font size



4. _____$y = 1.5x + 5$_____ is a model that describes the relationship between _____the number of booklets to print_____ and _____the time required_____.

Using this model, we can estimate the time required according to how many booklets we are going to print.

5. Using the model in Question 4, estimate the time required to print 80 booklets.

Put $x = 80$ into $y = 1.5x + 5$.

$y = 1.5(80) + 5$

$= 125$

$\therefore$ The time required to print 80 booklets is estimated at 125 minutes.

6. In the real world, it is not always possible to find a straight line that passes through all data points. However, we are able to observe a general trend. For example,

the *more* booklets we print, the _*more* / *less*_ the time is required.

In this case, we have to find a line of best fit. That is a line that minimises the distance between the line and data points. Finding this line involves some advanced mathematics and statistics knowledge. Still, MS Excel can formulate the line of best fit based on our input data.

7. The following table shows the time required (y) in minutes for Machine B to print x booklets.

Number of booklets (x)	10	20	30	40
Time required (y)	21	34	49	67

Using MS Excel, plot a graph and formulate a model that describes the relationship between the number of booklets to print and the time required.

The model is $y = 1.53x + 4.5$.

8. Using the model in Question 7, estimate the time required to print 80 booklets.

Put $x = 80$ into $y = 1.53x + 4.5$.

$$y = 1.53(80) + 4.5$$
$$= 126.9$$

$\therefore$ The time required to print 80 booklets is estimated at 127 minutes.

9. What are the assumptions and limitations of the model in Question 7?

Assumptions:

1. Linear relationship
2. No other factors

Limitations:

1. Oversimplification
2. Dependence on a small amount of data

Setting a marked price for a property

Worksheet 2

Activity 2

To use data of marked prices of properties alongside their corresponding floor areas to formulate a model.

1. If we own a property in Hong Kong, what information do we need when setting a marked price for the property?

> Size and layout: Floor area, number of rooms, bathrooms, and kitchens.
> Condition: New, renovated, or need for refurbishment.
> Property type: Private housing estate, public housing estate, or village house.
> Facilities: Swimming pool, gym room, and parking.
> Location: Proximity to transportation, schools, shopping centres.

2. The following figure shows some real data of the marked prices of some properties and their corresponding floor areas.

	A	B
1	Floor area	Marked price
2	363	468
3	443	530
4	430	490

Floor area in sq. ft.

"萬" means 10,000
i.e., $4,980,000

Source: https://www.scmp.com/business/article/3186280/loss-making-deals-hong-kongs-secondary-home-market-jump-sellers-take-hit

Generally speaking, what is the relationship between the floor areas and the marked prices of properties?

The *larger* the floor area, the ___*higher* / *lower*___ the marked price of the property.

3. Input the data to MS Excel. For simplicity, you may use the input format as shown on the right-hand side of the above figure.

4. Plot a graph and formulate a model (Model A) that describes the relationship between the floor areas (x) and the marked prices of properties (y).

The model is $y = 0.6026x + 298.11$.

5. Given that the floor area of a property is 420 sq. ft.
Using Model A in Question 4, suggest a marked price for the property correct to 3 significant figures.

Put $x = 420$ into $y = 0.6026x + 298.11$.

$$y = 0.6026(420) + 298.11$$
$$= 551.202$$

$\therefore$ The marked price for the property can be \$5,510,000.

6. The following figure shows the marked price of the property in reality.
Are the actual marked price and the modelling outcome in Question 5 different? What are some possible reasons?

Absolute error

$$= \$(580 - 551) \times 10,000$$
$$= \$290,000$$

Percentage error

$$= \frac{290,000}{5,800,000} \times 100\%$$
$$= 5\%$$

Our suggested marked price is about 5% lower than the actual marked price. The owner may think that other factors, such as the scenic view and recent renovation of the property, have enhanced its value.

7. What are the assumptions and limitations of Model A in Question 4?

Assumptions:

1. Linear relationship
2. No other factors

Limitations:

1. Oversimplification
2. Dependence on a small amount of data

Setting a marked price for a property

Worksheet 3

Activity 3

To use data of marked prices of properties alongside their corresponding ages of buildings to formulate a model.

1. Let's consider the ages of buildings. The following figure shows the year of completion of each building.

	A	B
1	Age of building	Marked price
2	37	468
3	32	530
4	34	490

= 2023 – 1989

The year of setting the marked price

The year of completion of the building

Generally speaking, what is the relationship between the ages of buildings and the marked prices of properties?

The *greater* the age of the building, the ___*higher* / *lower*___ the marked price of the property.

2. Input the data to MS Excel. To calculate the ages of buildings, you may use the formula as shown on the right-hand side of the above figure.

3. Plot a graph and formulate a model (Model B) that describes the relationship between the ages of buildings (x) and the marked prices of properties (y).

The model is $y = -6.5156x + 718.51$.

4. For the property shown in the following figure, the year of completion of its building is 1985.
Using Model B in Question 3, suggest a marked price for the property correct to 3 significant figures.

The age of the building
$= 2023 - 1985$
$= 38$
Put $x = 38$ into $y = -6.5156x + 718.51$.
$y = -6.5156(38) + 718.51$
$= 470.9172$
$\therefore$ The marked price for the property can be \$4,710,000.

5. Comparing the suggested marked prices of Model A (Question 5 in Activity 2) and Model B (the above question), which one is closer to the actual marked price of the property? How can we interpret this observation?

For Model A, there is a difference of \$290,000. But for Model B, there is a difference of \$1,090,000. In this case, the suggested marked price of Model A is closer to the actual marked price than that of Model B.
Compared with the floor area, the age of a building may be less influential on the marked price of a property.

6. What are the assumptions and limitations of Model B in Question 3?

Assumptions:
1. Linear relationship
2. No other factors

Limitations:
1. Oversimplification
2. Dependence on a small amount of data