Lecture 3: Understanding Cost Behaviour

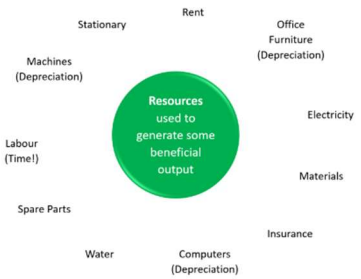
Lecture outline

- Introduction
- What is a cost?
- Basic cost terminology
- Cost behaviour
- Cost estimation
  - High-low method
  - Regression analysis
- Evaluating and choosing cost drivers
- Lecture demonstration problems: high-low method

1 – Introduction

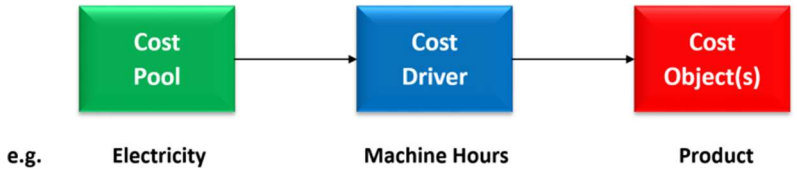
- Focuses on the analysis of costs and how they behave in relation to changes in a particular organisational activity (such as production volume).
- Knowing how costs vary by identifying the drivers of costs and being able to distinguish fixed from variable costs are essential to good management decision making.
- Many managerial functions in the planning and control areas require and rely on knowing how costs behave in relation to activities (e.g. production output/volume).
- Analysis of cost behaviour patterns allow managers to prepare standard costs, formulate budgets and to predict and control costs.

2 – What is a cost?



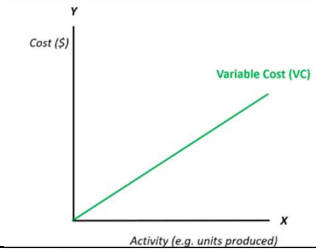
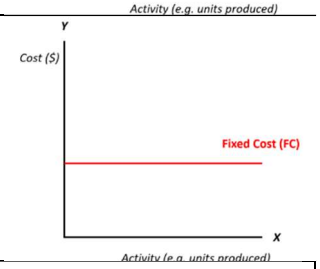
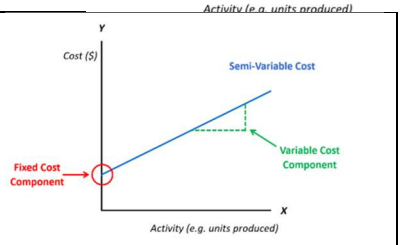
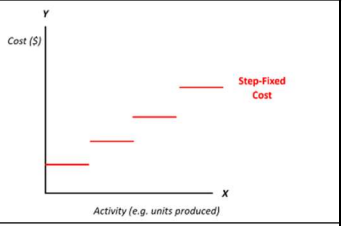
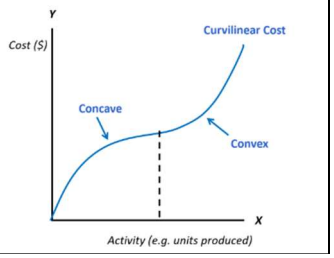
3 – Basic Cost Terminology

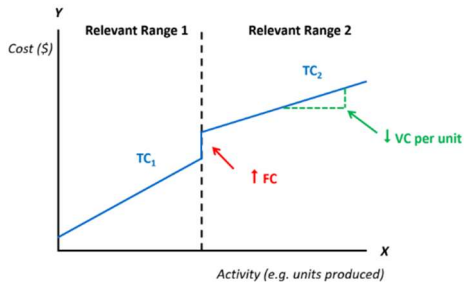
- **Cost pools:** Groups of a particular type of cost (e.g. material costs, labour costs, electricity costs, depreciation costs). Cost pools vary by the type of costs included and the level of aggregation.
- **Cost objects:** Factors or items in an organisation that are separated for measurement of their costs (e.g. products, departments, jobs, events). Costs are assigned from cost pools to these items.
- **Cost drivers:** Activities or factors that drive (cause) costs to be incurred. Drivers allow cost pools to be allocated to cost objects.



4 – Cost Behaviour

- **Cost behaviour:** The relationship between a cost and the level of activity that causes this cost (i.e. cost driver).
  - *Volume-based driver:* A cost driver that assumes that costs are driven by production or a factor related to production (e.g. machine hours)
  - *Non-volume-based driver:* A cost driver not directly related to production volume (e.g. number of deliveries)
- The basic (linear) cost function can be represented in the following manner:
  - **Y = a + bX** - Total Cost = FC + VC x Activity

Type	Graph
Variable costs: Costs that change in total in direct proportion to a change in activity.	
Fixed costs: Costs that remain unchanged in total as the level of activity varies. - *Discretionary cost:* Based on a managerial decision that can be changed relatively easily. - *Committed cost:* Results from the basic organisation structure and difficult to adjust in the short term.	
Semi-variable (mixed) costs: Costs that contain both fixed and variable components.	
Step-fixed costs: Costs that remain fixed within a certain range of activity, but change to a different amount outside that range.	
Curvilinear costs: Costs that exhibit cost behaviour that can be described by a curved line. Convex costs have increasing marginal costs. Concave costs have decreasing marginal costs.	

Relevant Range: Refers to the range of activity (i.e. the upper and lower limits of an activity) for which assumptions about cost behaviour hold. Assumptions made within one relevant range may not be valid in another range - VC per unit may change - Fixed costs are not constant Prediction of costs can only be done accurately within a known range	

5 – Cost Estimation

- **Cost estimation** is the process of determining the cost behaviour pattern of a particular cost item. **Cost prediction** is using knowledge of cost behaviour to forecast the level of cost at a particular level of activity
- The most important issue in estimating a cost function is to determine whether a **cause-and-effect relationship** exists between the activity or cost driver (X) and the resulting costs (Y). This may arise in several ways:
    - Physical relationship with the cost driver (engineered cost)
    - Contractual arrangement
    - Logic and knowledge of operations
- There are three methods to identify cause-and-effect relationships.
    - **Engineering Method:** Identifies the relationship that should exist between input and outputs. Relationships are determined through "time and motion" studies which observe the steps required and time taken to perform particular activities.
    - **Managerial Judgement:**
        - Conference Method - Estimates cost functions on the basis of opinion about costs and their drivers gathered from various departments of an organisation – purchasing, human resources, engineering, manufacturing, etc. This method relies on the expert knowledge and judgement of managers.
        - Account classification (Account analysis) - The account analysis method estimates cost functions by classifying cost accounts in the ledger as variable, fixed or mixed with respect to the identified cost driver. Typically managers use qualitative rather than quantitative analysis when making these cost classification decisions.
    - **Quantitative analysis:** These are formal analyses of cost relationships to fit mathematical equations (functions) to past data. There are six steps involved.
        - **Step 1:** Choose the dependent variable (the cost variable you want to estimate) E.g. Electricity cost in the manufacturing plant
        - **Step 2:** Identify the independent variable(s) (the activity or activities that cause the cost) E.g. Machine hours
        - **Step 3:** Collect data on the dependent variable and the cost driver(s) E.g. Monthly electricity cost for the last 12 months
        - **Step 4:** Plot the data – use a scatterplot to visually observe the relationship between the cost and its' driver(s)
        - **Step 5:** Estimate the cost function using *High-Low* or *Regression* analyses
        - Step 6: Evaluate the estimated cost function

- The four most important criteria in evaluating the cost function are:
  - Economic plausibility – Does the cost function make sense?
  - Goodness of fit – How well does the line fit the data points?
  - Slope of line – A relatively flat line indicates a weak or non-existent relationship between the activity and the cost. A steep line would indicate a stronger relationship.
  - Cost v benefit – A subjective estimate might be good enough!
- Incorrectly estimating the cost function has repercussions for cost management and cost control. Managers will have a reduced ability to make accurate plans and budgets and have less understanding of organisational processes.

Cost-Estimation: High-Low Method

The **high-low method** is a simple method for separating semi-variable costs into their **fixed** and **variable** components.

- **VC calculation:** Two periods of data (high and low) are chosen at based on the levels of **activity** – both levels should be within the *same relevant range*.

$$\frac{\text{Total Cost}_{High} - \text{Total Cost}_{Low}}{\text{Activity}_{High} - \text{Activity}_{Low}} = \text{VC per unit of activity}$$

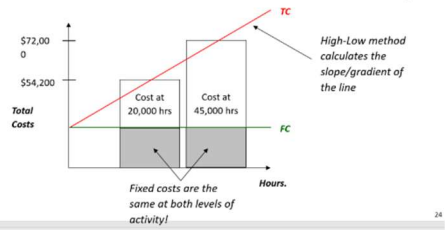
- **FC calculation:** Substitute the VC with either the high or low values into the total cost formula.

$$TC = FC + (VC \times Activity)$$

Select the highest and lowest values of the cost driver.

	Machine Hours	Electricity
Maximum Value	45,000	$72,000
Minimum Value	20,000	$54,200
Difference	25,000	$17,800

*Difference in costs are due to **variable costs** within the relevant range*

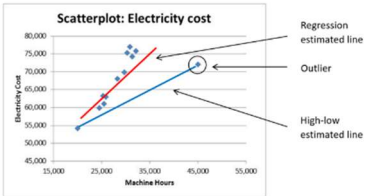


- The dependent variable (Y) is **electricity**. This is predicted or explained by the independent variable (X) of **machine hours**.
- There are two simplifying assumptions in the High-Low method:
  - Changes in the total costs of a cost object are explained by variations of a single cost driver.
  - Cost behaviour is adequately approximated by a linear cost function of the cost driver within the relevant range.
- More advanced statistical methods can overcome these limitations. They are still limited to a single relevant range.

Cost-Estimation: Regression Analysis

Regression analysis is a statistical method that measures the *average* amount of change in the dependent variable that is associated with a unit change in one or more independent variables. It has two advantages over high-low:

- All available data points are used (high-low uses just two data points). The difference can be seen in the scatterplot below.
- Multiple cost drivers can be used to estimate costs



Regression analysis for the previous example would give the following output:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.698
R Square	0.487
Adjusted R Square	0.436
Standard Error	5565.3
Observations	12

ANOVA

	df	SS	MS	F	Significance F
Regression	1	294540335.4	294540335.4	9.5096	0.0116
Residual	10	309729181.4	30972918.14		
Total	11	604269516.8			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	43293.4148	8110.6279	5.3379	0.0003	25221.8	61365.0	25221.8	61365.0
Machine Hours	0.8430	0.2734	3.0838	0.0116	0.2339	1.4521	0.2339	1.4521

Cost Function (Regression):

Cost Function (High-Low):