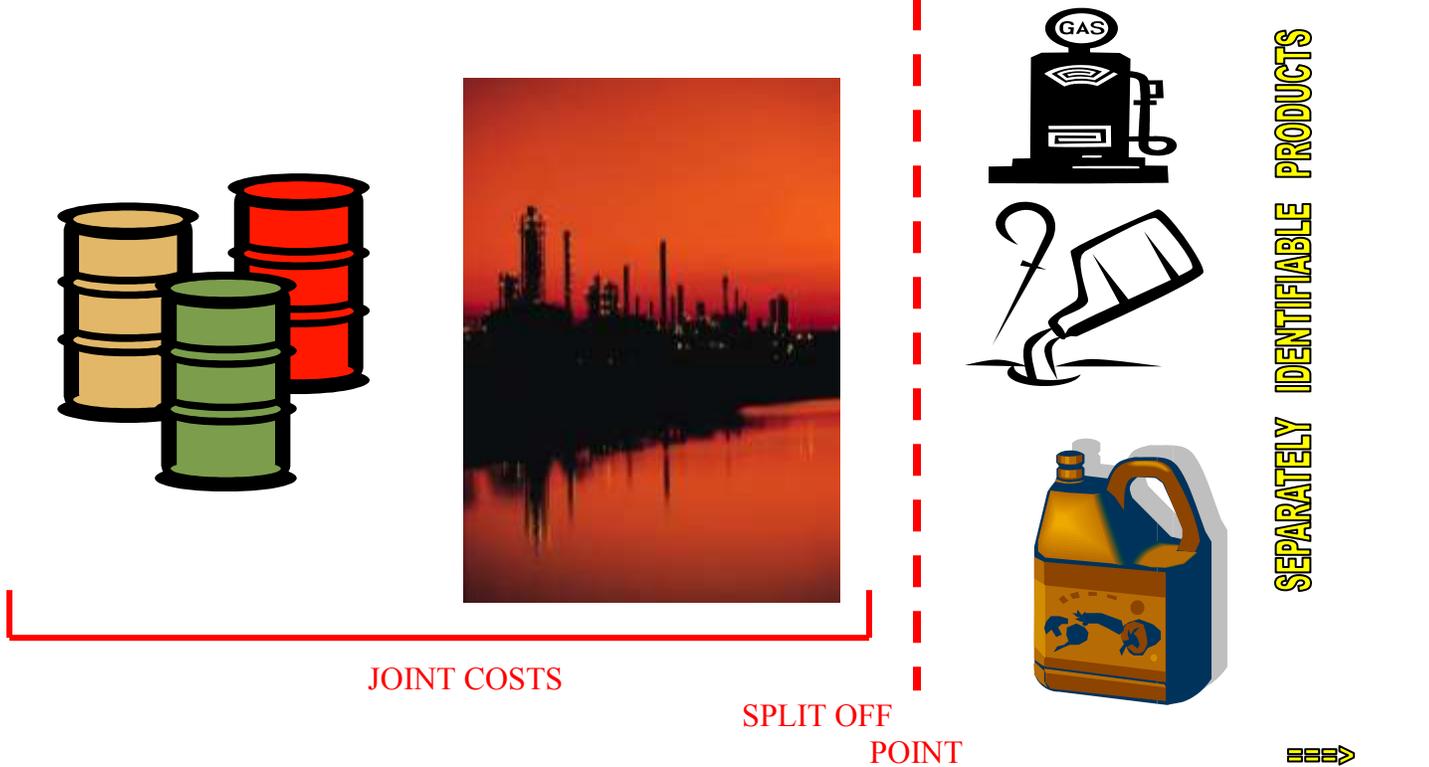


COST ALLOCATION: JOINT PRODUCT COSTS

The difficulty increases as a function of the number of products the company is turning out.



Problem is that we have a common raw material and a common process. For example, a cow (common product) goes into the slaughter house (common process) and multiple products come out the other end. Same is true of crude oil which goes through a refinery process to become multiple distinguishable products. The question is, how much of the common costs (called **joint costs**) do you assign to each individual product. These are called the **Joint** or **Common Costs**. There also exist the possibility of further processing the individual products, into different grades for example. But you only want to do so if it is profitable.



Two Problems:

- 1) How do we assign the costs which are common to the process to the separately identifiable products?
- 2) How do we decide which products are sold and which products are further processed at the split off point?

Example:

Say there are a certain number of products, A, B, and C. And we have the units that came out of the process at split off. We also have a sales price at split off (S.O.). And another sales price “if further processed”. Here Price is a per unit number and Value is a total cost number. Joint Costs represents the total common costs.

	<u>A</u>	<u>B</u>	<u>C</u>
Units @ Split Off	250	50	200
Sale Price @ Split Off	30	10	20
Sale Price if Further Processed	70	20	45
Cost of Further Process	3,500	500	5,500
Joint Costs	total = \$1,000		

It turns out there are 4 different ways to come up with the allocation of that \$1000.

① Physical Measure

Allocate on the basis of the volume that came out for each measure. Add the total quantity that came out and divide by the quantity that went in. We have our units at split off so lets allocate the cost.

Physical Measure

	<u>A</u>	<u>B</u>	<u>C</u>	<u>Total</u>
Units @ Split Off	250	50	200	500
Percent to Total	50%	10%	40%	100%
Joint Costs * % = Allocation	\$ 500	\$ 100	\$ 400	\$ 1,000
Joint Costs	\$ 1,000			

A, B, and C are the separate products which came out of the common process from the common raw material. Percent to Total is the ratio of the separate distinguishable product to the total raw material which entered the process.

Now we take the Joint Costs (which is the cost of conversion for all the products) and multiply by the percentages of each product. This gives us our allocation of conversion costs to each separate product.

Example, product A gets $\$1,000 * 50\% = \500 . Product B gets $\$1,000 * 10\% = \100 .

The problem with the physical measure method is that there is not relationship between the value of something versus the cost you are allocating to it. You could have \$500 allocated to A but the value of A may be \$300. So now every time you make a sale of A you are taking a loss. That’s a problem, no relation to the value of something. This lead to the invention of the most popular method...

② Relative Sales Value at Split Off Method

Value is the key word here, as opposed to price. Because price is per unit while value is weighted by the number of units that came out. So you would take the units at split off and multiply by the sales price at split off and that gives us our sales value at split off.

Relative Sales Value @ Split Off

	<u>A</u>	<u>B</u>	<u>C</u>	<u>Total</u>
Units @ Split Off	250	50	200	500
Percent to Total	50%	10%	40%	100%
Joint Costs * % = Allocation	500	100	400	1,000
<u>Relative Sales Value @ Split Off</u>				
Units @ Split Off	250	50	200	500
x Sales Price @ Split Off	30	10	20	
= Sales Value @ Split Off	7,500	500	4,000	12,000
Percent to Total	62.50%	4.17%	33.33%	100%
Joint Costs x % = Allocation	\$ 625	\$ 42	\$ 333	\$ 1,000

Multiply units at split off by sales price at split off. This gives sales value. Total for the Total Sales Price at Split Off. Now take the ratios to the Product Sales Value at Split Off.

Example: Product A has a Percent to Total of $\$7,500/12,000 = 62.5\%$.

Now we find our Joint Costs Allocation by multiplying our Total Joint Costs by the Percent to Total of each product.

Example: Product A has an Allocation of $\$1,000 * 62.5\% = 625$.

This is unquestionably the easiest and most popular method. We can do it at the split off instantly and don't have to figure out if you should process further or not. And you can be assured there is a relationship between cost and price and do not have to worry about a possible aberration where a product is being sold for less than its cost.

Now when you look at this you have to make a decision. Up to now we have only looked at cost and how to apportion. The money is already spent. But when it comes to the question of whether we sell or process further at the split off point we have to make an economic decision. We haven't spent that money yet, it's something we are thinking of doing. That is an **economic decision point**.

This condition leads us to a new methodology...

③ Sell or Process Further Analysis

The last two methods of allocation (following) require a decision in this area. We have to know if we are going to sell or process further before we use the following two methods.

We will look at the sales value of further processed. They only gave us the prices but we need the value. Take the units and multiply by the sales price if further processed which gives us the sales value if further processed.

<u>Sell or Process Further Method</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Total</u>
Sales Value if Further Processed				
Units	250	50	200	500
x Sales Price if Further Processed	x 70	x 20	x 45	
= Sales Value if Further Processed	17,500	1,000	9,000	27,500
-- Sales Value @ Split Off	7,500	500	4,000	12,000
Increase in S.V. if F.P.	10,000	500	5,000	15,500
Costs of Further Process	(3,500)	(500)	(5,500)	
Net Gain/Loss of F.P.	6,500	-	(500)	

The question is how does the Sales Value If Further Processed compare with the Sales Value at Split Off? How much more are we going to make by applying the further processing? This is the Increase in Sales Value if Further Processed line.

All that is well and good but have we looked at the Cost of Further Processing? Must subtract this cost and find the Net Gain or Loss if Further Processed. This line is very interesting. We can see that we want to further process A but, unless there is a compelling reason, we do not want to further process B and we would never further process C because that's leaving us with a loss.

What we do now is circle our decisions. In the case of A we are going to further process which means we are actually going to end up with the sales value if further processed and the costs if further processed. In the following procedures we will have to use these numbers and we don't want to get confused. In the case of B we are not going to further process and we are ultimately going to be getting the sales value at split off and we will incur no cost of further process. Same with C, we get the value at split off and we do not further process.

These circled amounts are the Ultimate Sales Value.

④ Estimated Net Realizable Value (NRV) Method

This method basically says that we are going to look at the ultimate sales value (the circled amounts in the last method) after this decision.

Estimated Net Realizable Value Method

	<u>A</u>	<u>B</u>	<u>C</u>	<u>Total</u>
Ultimate Sales Value	17,500	500	4,000	22,000
Less Cost of Further Processing	(3,500)	-	-	(3,500)
Net Realizable Value	14,000	500	4,000	18,500
Percent to Total	75.68%	2.70%	21.62%	100.00%
Joint Costs x % of Allocation	<u>757</u>	<u>27</u>	<u>216</u>	<u>1,000</u>

TOTAL JOINT COSTS 

From the Sell or Process Further Analysis above we know we are going to further process A and achieve a Sales Value if Further Processed of \$17,500. We are not going to further process B or C and so will achieve their Sales Value at Split Off of \$500 and \$4,000. We sum these to find our Ultimate Sales Value of \$22,000. Now we will subtract the Cost of Further Processing, in this case only one circled item above, \$3,500 for A. This difference gives us our estimated **Net Realizable Value** for each product and we total this line for \$18,500 (this is the “Total” in “Percent to Total”). Now we solve for the Percent to Total line which is the Product total divided by the sum of the three product totals.

Example: A is $\frac{14,000}{18,500} = 75.68\%$

The sum of the product Percent to Totals will be 100%. Now we multiply these percentages by the total Joint Costs which we remember from above was \$1,000.

Key here is that when there are abnormalities between cost allocation and value it leads to decision making which is inappropriate and unprofitable. We spent \$1,000 and we achieved a value of \$12,000 (**did he mean to say \$22,000 here?**) which came out in 3 different types of products. The margin ultimately is $12,000 - 1,000 = 11,000$. All we are really doing is spreading it across each product line proportionately.

⑤ Constant Gross Margin Percent Estimated Net Realizable Value Method

This is very similar to the estimated NRV but we add one other component. We take the **Ultimate Sales Value** and subtract not only the **Cost of Further Processing** but also the **Joint Costs** and this gives us our **Gross Margin**.

So we have the Ultimate Sales Value, \$17,500, we have \$500 and \$4,000 adding up to \$22,000. **We have our costs of further processing but only for A**, our Joint Cost we know in total are \$1,000 but we do not know how to allocate them. The difference here is the gross margin, \$17,500. What we want to find out is how can we allocate the joint costs so that we can get not just the constant gross margin but the constant gross margin percent. Take this \$17,500 and divide by the gross value of revenue of \$22,000 and find out that the gross margin percent is 79.545%. And we will make that percent constant among the three products.

Constant Gross Margin % Estimated Not Realizable

	<u>A</u>	<u>B</u>	<u>C</u>	<u>Total</u>
Ultimate Sales Value	17,500	500	4,000	22,000
Less Cost of Further Processing	(3,500)			(3,500)
Net Realizable Value	14,000	500	4,000	18,500
Percent to Total	75.68%	2.70%	21.62%	100.00%
Joint Costs x % of Allocation	757	27	216	1,000

Constant Gross Margin % Estimated NRV

Ultimate Sales Value	17,500	500	4,000	22,000
-- Cost of Further Processing	(3,500)	-	-	(3,500)
-- Joint Costs	(80)	(102)	(818)	(1,000)
= Gross Margin	13,920	398	3,182	17,500

$$\frac{17,500}{22,000} = 79.545\%$$

IN THIS METHOD WE ARE SOLVING FOR THE BOTTOM LINE FIRST AND THEN GOING BACK TO SOLVE FOR THE JOINT COSTS BY DIFFERENCE.

The items circled in green we know, \$22,000 is the total ultimate sales value and we solve for the total gross margin, \$17,500, because we know the total cost of further processing, \$3,500, and the total joint costs, \$1,000. Now we take the ratio

Total Costs Lowest = $(121 \times 28.5) + 9,464 = 12,912.50$ of total gross margin to total ultimate sales value and apply this percentage to each of the individual product ultimate sales values. Finally, we solve for each of the product joint costs values (allocations) by taking the difference of that products gross margin and cost of further processing and ultimate sales value (we find the value which makes the summation true).

For example, we take \$17,500 and multiply it by 79.545%, that will give me \$13,920. We will do the same for products B and C. Allocated by difference are the individual product joint costs.

Anomalies, cases where the facts defy the allocations. At this point compare the allocations amongst the 4 methods. For example, the allocation for product A changed from \$500, \$625, \$757, and finally \$80. How does this make any sense? The answer is it doesn't make any sense in terms of the allocation but it does make sense in terms of the goal. In the last method the goal is to get the gross margin percent equivalent on every product. If that is the goal then we must use the allocation amounts we solved for above.

Some companies will be concerned about ending up showing huge profit margins on a product like A and low profit margins on products like B and C (because they were not further processed) and will use the last two methods to spread out what shows up on their bottom line. Keep in mind A might not be a high volume seller but if it holds all the profitability that could be a problem.

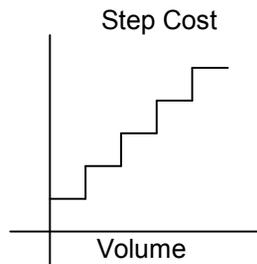
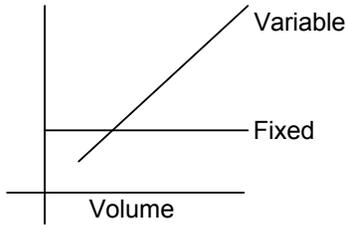
As we see here the amount of funds which were made due to further processing of A were very significant. It more than doubled its value at the cost of a further expenditure. This was not the case with B and C. B made no additional money so there is no reason to further process. In the case of C there is no question that there is no value in further processing. Maybe we would double the sales if C is further processed but the cost of further processing is far greater.

How would we handle a depreciation component of the further process costs? We would have to cover our replacement costs. One thing we will find out is that when we come to economic decision making it becomes very important to focus in on the difference between BOOK LOSSES like depreciation versus CASH LOSSES. The reason is that we could make the mistake of not further processing an item which has a depreciation value. You might decide that the cost of depreciation makes the burden too great and decide not to further process. What would we be losing? We would be losing an increase of \$5,000 when our cash costs are only going up \$4,500. That being the case, on an incremental basis (on a cash flow basis) you'd actually be losing out on \$1,000 of cash flow. When we get to relevant costing we will find that looking at things on a cash basis can make a big difference on the decisions we make. Whether we close a plant or keep it open, whether we outsource or keep work within, or whether we sell or process further.

GAAP does not talk a whole lot about cost allocation. GAAP has a lot to do with financial reporting. Once we assign the cost as long as we inventory and expense it properly GAAP will be satisfied. All the methods we've seen above are acceptable under cost accounting practices. GAAP does not get into cost allocation methodology. CPA's generally go along with any reasonable method of cost allocation. Unreasonable allocations create anomalies and would have to be reported. Reasonableness is the key.

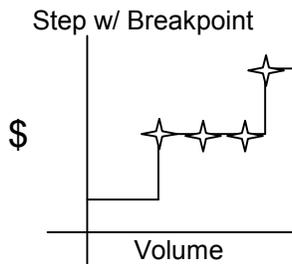
COST BEHAVIOR PATTERNS

We already know cost behavior patterns. For instance we know the pattern of fixed and variable costs. There are others...



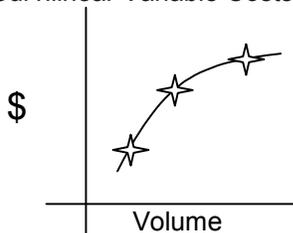
If the steps are wide it is considered to be a Step Fixed Costs. If the steps are narrow it is considered to be a Step Variable Costs. Example: say you are projecting supervisory costs. Consider that all costs do not move to a single volume, there can be costs that move to different kinds of volumes. Say the span of control of a supervisor is 10 to 1 and at the moment the ratio is 1 to 6. Then it increases to 7, and 8 to 1. Still OK. The costs are stable over that given period. But

then they hit a point supervisor. Now they another supervisor.



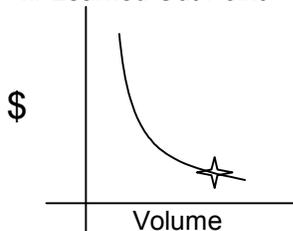
where they are at 9 plus employees per have hit the break point and have to hire

Curvilinear Variable Costs



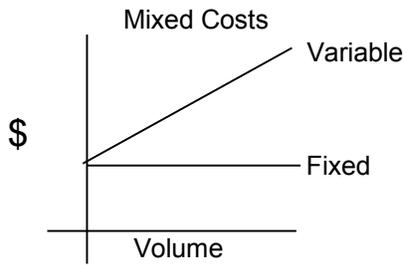
Curvilinear is an example of a variable costs with volume discounts. It's variable with breakpoints due to volume discount.

Learning Curve w/ Learned Out Point

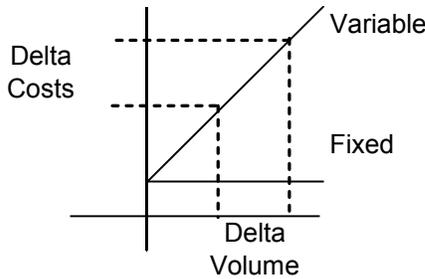


Take for example a shop which has custom products. Building unique products is always high on the learning curve. In the beginning the learning adds a great deal of costs. But as they build more and more then unit costs comes down significantly until they reach the Learned Out Point. Says if you give me enough volume I can do this very well.

Mixed Costs



We will focus on something called Mixed Costs. Mixed Costs has a component of fixed costs and a component of variable costs. Example, say we are leasing copiers and pay a fixed costs of \$100 per month for the lease and a variable costs of \$0.02 per copy for supplies.



There are different ways to figuring out an estimation for a mixed costs. One way is to look at two points of volume. In this period, the two points of volume, there can only be a change in one variable. The only variable that can change is the Variable Costs. If we compare the number of units that moved to the amount of costs that moved we can come up with the Variable Rate and figure out what

the fixed costs is. Lets take an example:

	<u>Units</u>	<u>Dollars</u>
Highest	4,980	\$390,700
Lowest	<u>2,180</u>	<u>\$180,000</u>
DELTA	2,800	\$210,700

This method is called the **HIGH LOW METHOD**. Look at units and dollars and we will see how it changes between two points. We will use the highest and lowest points but will find that this approach has some issues. We take a look at how much it moved, 2800 units, how many dollars did it change by, \$210,700, and we'll see if we can estimate a variable rate. (Always dollars over units).

$$\text{Variable Rate} = \frac{\$}{\text{Units}} = \frac{\$210,700}{2800} = \$75.25 \text{ per unit}$$

This says that if we were projecting we would be able to use this rate to find out how much incremental costs we were incurring per unit. Now we will go on to figure out what the fixed costs is. We know the formula...

$$\text{Total Costs} = \text{Variable Costs} + \text{Fixed Costs}$$

$$\text{Total Costs}_{4000} = (75.25 \times 4000) + 15,955 = 316,955$$

$$\text{Total Costs}_{\text{highest}} = \$390,700 = (4980 \times 75.25) + \text{Fixed Costs}$$

$$\text{Solve for Fixed Costs} = \$15,955$$

The equation for Total Costs is now...

$$\text{Total Costs} = 75.25 \times \text{Units} + 15,955$$

Prove the lowest...

$$\text{Total Costs}_{\text{low}} = (75.25 \times 2180) + 15,955 = 180,000 \quad \checkmark$$

Now solve at a particular number of units...

$$\text{Total Costs}_{4000} = (75.25 \times 4000) + 15,955 = 316,955$$

So if we are projecting 4000 units this year we can now say the total costs will be \$316,955.

HOMEWORK

Problem 16-27, page 588 **PLUS CONSTANT GROSS MARGIN PERCENT.**

Has 4 products. Product C is fully processed by the split off point, can't process it any further. A, B, and D can be further processed into Super A, B, and D. In December the split off point volume was ABCD as follows. Joint Costs are \$100,000. A, B, and D were further refined and then sold. Ignore this fact. We will find out if in fact they should have sold, have they made a correct economic decision. IGNORE THE FACT THAT THEY SOLD IT. They tell us what the costs of further refining are and the revenues if they further process. Also the sales value at split off. Between the two sets of computations we have to do a sell or process further analysis.

DO:

1. Physical Measure
2. Sales Value At Split Off
3. Sell or process Further Analysis
4. NRV
5. Constant Gross Margin Percent

EXAM

They give us the sales value at split off so we don't have to compute

$$\text{Value} = \text{units} * \text{price}$$

But we will have to solve for the value on the exam.

Problem 10-23, page 367

This problem deals with the whole issue of estimating a fixed costs. Costs vs Reports.

Given both sets over 10 weeks, we do not have to plot the relationship.

DO #2, use the high low method to compute the cost function.

WE SHOULD COMPUTE THE HIGHEST AND LOWEST ACTIVITY LEVEL.

Compute the cost function, cost formula.

Also, estimate what we project the cost of 400 reports to be.