

## Standard Costs and Variances

## Everything starts with a budget

- ▶ We can conduct variance analysis at any level of the organization.
- ▶ We can use decomposition of variances to isolate the causes.
- ▶ This tells us which parts of our forecasts were wrong.

# Logical flow

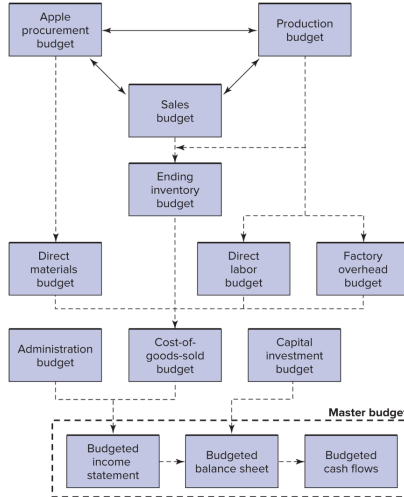


Figure 1: Logical flow

Example: Sandy Cove Bank

## Sandy Cove Bank

- ▶ Sandy Cove is a new small commercial bank in Sandy Cove, Michigan.
- ▶ The bank limits interest rate risk by matching the maturity of its assets to the maturity of its liabilities.
- ▶ By maintaining a spread between interest rates charged and interest rates paid, the bank plans to earn a small income.

## Sandy Cove Bank

- ▶ Management establishes a flexible budget based on interest rates for each department.
- ▶ The Boat and Car Loan Department offers five-year loans.
- ▶ It matches certificates of deposit (CDs) against car and boat loans.

## Sandy Cove Bank

- ▶ Given all the uncertainty about interest rates, management believes that five-year savings interest rates could vary between 2 percent and 16 percent for the coming year. (*Note: 'Given' in this sentence embeds a critical management accounting activity: forecasting.*)
- ▶ The savings rate is the rate paid on CD savings accounts.
- ▶ The loan rate is the rate charged on auto and boat loans.

## Sandy Cove Bank

- ▶ Expected new demand for fixed-rate, five-year loans and the new supply of fixed-rate, five-year savings accounts at various interest rates.

Loan Rate	Loan Demand	Savings Rate	Savings Supply
6%	\$12,100,000	2	\$ 4,700,000%
7%	10,000,000	3	5,420,000
8%	8,070,000	4	8,630,000
9%	6,030,000	5	9,830,000
10%	4,420,000	6	11,800,000

- ▶ There are no loans from previous years. Note that the department maintains a 4 percent spread between loan and savings rates to cover processing, loan default, and overhead.



## Sandy Cove Bank

- ▶ The amount of new loans granted is always the lesser of the loan demand and loan supply.
- ▶ For simplicity, this bank may lend 100 percent of deposits.
- ▶ In practice, this rate is set by policy makers and regulators not the bank itself.

## Sandy Cove Bank

- ▶ Although rates are set nationally, the bank may pay or charge slightly different rates to limit demand or boost supply as needed in its local market.
- ▶ The Boat and Car Loan Department incurs processing, loan default, and overhead expenses related to these accounts.

## Sandy Cove Bank

- ▶ The first two expenses vary, depending on the dollar amount of the accounts.
- ▶ The annual processing expense is budgeted to be 1.5 percent of the loan accounts.
- ▶ Default expense is budgeted at 1 percent of the amount loaned per year.

## Sandy Cove Bank

- ▶ Again, loans and savings would ideally be the same.
- ▶ Overhead expenses are estimated to be \$30,000 for the year, regardless of the amount loaned.

## SCB Question 1

1. Calculate the processing, loan default, and overhead expenses for each possible interest rate.

Loan Rate	Loan Demand	Savings Rate	Savings Supply	New Loans
6%	\$12.1 M	2%	\$ 4.7 M	\$ 4.7 M
7%	10	3%	5.42	5.42
8%	8.07	4%	8.63	8.07
9%	6.03	5%	9.83	6.03
10%	4.42	6%	11.8	4.42

## SCB Solution 1

Loan Rate	Loan Demand	Savings Rate	Savings Supply	New Loans	Processing Expenses
6%	\$12.1 M	2%	\$ 4.7 M	\$ 4.7 M	\$70,500
7%	10	3%	5.42	5.42	81,300
8%	8.07	4%	8.63	8.07	121,050
9%	6.03	5%	9.83	6.03	90,450
10%	4.42	6%	11.8	4.42	66,300

- Processing is 1.5% of loan accounts

## SCB Solution 1

Loan Rate	Loan Demand	Savings Rate	Savings Supply	New Loans	Processing Expenses	Default Exp
6%	\$12.1 M	2%	\$ 4.7 M	\$ 4.7 M	\$70,500	\$47,000
7%	10	3%	5.42	5.42	81,300	54,200
8%	8.07	4%	8.63	8.07	121,050	80,700
9%	6.03	5%	9.83	6.03	90,450	60,300
10%	4.42	6%	11.8	4.42	66,300	44,200

- Default expense is budgeted at 1 percent of the amount loaned per year.

## SCB Solution 1

Loan Rate	Loan De-mand	Savings Rate	Savings Supply	New Loans	Processing Expenses	Default Exp	Overhead Expenses
6%	\$12.1M	2%	\$ 4.7M	\$4.7M	\$70,500	\$47,000	\$30,000
7%	10	3%	5.42	5.42	81,300	54,200	30,000
8%	8.07	4%	8.63	8.07	121,050	80,700	30,000
9%	6.03	5%	9.83	6.03	90,450	60,300	30,000
10%	4.42	6%	11.8	4.42	66,300	44,200	30,000

- ▶ These are the budgeted expenses, this is the foundation of financing plans to make sure that these resources are in place when they are needed.
- ▶ In this case it is the deposits that need to be in place for the lending to happen.



## SCB Question 2

2. Create an annual budgeted income statement for five-year loans and deposits for the Boat and Car Loan Department given a savings interest rate of 4 percent. Remember to match supply and demand.

Interest income	$\$8,070,000 \times 8\% =$	\$645,600
Interest expense	$\$8,070,000 \times 4\% =$	322,800
Net interest income		\$322,800
Fixed overhead		30,000
Processing expense		121,050
Default expense		80,700
Net income		\$ 91,050

## SCB Question 3

3. Table 2 shows the actual income statement for the Boat and Car Loan Department. Included are the actual loans and savings for the same period. Calculate the variances and provide a possible explanation.

	Budget	Actual
Interest income	\$645,600	\$ 645,766
Interest expense	322,800	314,360
Net interest income	\$322,800	\$ 331,406
Fixed overhead	30,000	30,200
Processing expense	121,050	130,522
Default expense	80,700	77,800
Net income	\$ 91,050	\$ 92,884
Loans	8,070,000	\$8,062,000
Deposits	8,070,000	\$8,123,000

## SCB Solution 3

	Budget	Actual	Fav. (Unfav.) Variance
Interest income	\$645,600	\$ 645,766	\$ 166
Interest expense	322,800	314,360	8,440
Net interest income	\$322,800	\$ 331,406	\$ 8,606
Fixed overhead	30,000	30,200	(200)
Processing expense	121,050	130,522	(9,472)
Default expense	80,700	77,800	2,900
Net income	\$ 91,050	\$ 92,884	1,834
Loans	8,070,000	\$8,062,000	\$ (8,000)
Deposits	8,070,000	\$8,123,000	\$(53,000)

## SCB Solution 3

- ▶ Even though loans were lower and deposits were higher than expected, interest income was higher and interest expense was lower than expected.
- ▶ The answer can be obtained by calculating the average interest rates earned and paid.

## SCB Solution 3

- ▶ On \$8,062,000 worth of loans, Sandy Cove earned \$645,766 interest, or 8.01 percent (0.01 percent more than expected).
- ▶ Similarly, it paid only 3.87 percent (0.13 percent less) on deposits.

## SCB Solution 3

- ▶ Therefore, the net interest income variance of \$8,606 is a combination of two effects: the variance in the actual loans and deposits (quantity) and the variance in the interest rates (price).
- ▶ The combined effects are a favorable interest income variance, a favorable interest expense variance, and an overall favorable net interest income variance.

## SCB Solution 3

- ▶ At a savings interest rate of 4 percent, there is an excess supply of deposits over demand for loans.
- ▶ The Boat and Car Loan Department lowered the interest rate on deposits to stem additional deposits.

## SCB Solution 3

- ▶ The increase in the interest rate on loans can be attributed only to an increase in the demand for loans, which resulted in the department charging a slightly higher average interest rate.
- ▶ The higher processing expense could be related to the higher number of accounts processed and improvements in the default rate.
- ▶ That is, the favorable default expense could be attributed to an improved screening process-related to spending more on processing.



## Terminology

# Terminology

Before we dig into understanding variances, we need to define a couple of terms.

## Standards vs. Budgets

- ▶ Budgeted costs and standard costs are the same thing.
- ▶ You can think of a 'budget' as the entire financial and operational plan.
- ▶ You can think of the 'standards' as all of the individual forecasts that go into the budget.
- ▶ Though the words are used interchangeably.

## Standards vs. Actuals

- ▶ Standards are our predictions (generated from our model of costs)
- ▶ Actuals are what we observe (generated by reality)

Note that this definition is related to the data selection issue on the mid-term.

Variance:

$$\text{Total Variance} = \text{Actual Cost} - \text{Standard Cost}$$

## Decomposing Variances

## Total Var. into Price & Quantity Vars

- ▶ Start with this:

*Total variance is equal to actual cost minus standard cost.*

## Total Var. into Price & Quantity Vars

- ▶ Define a few variables:

	Symbol		Subscript
Total Variance	$TV$	Actual	$a$
Quantity	$Q$	Standard	$s$
Price	$P$		

- ▶ *This is all we need to decompose any variance into it's price and volume components.*



## Total Var. into Price & Quantity Vars

- ▶ Now we can rewrite this:
  - ▶ Total Variance = Actual Cost - Standard Cost
- ▶ In terms of prices and quantities as this:
  - ▶  $TV = (Q_a \times P_a) - (Q_s \times P_s)$
- ▶ and do a little bit of algebra to do the decomposition.

*Note: I'll give you the relationship above, and you can either memorize or derive the other forms.*

Decomposition:

## The algebra:

- ▶ Goal: Write the rhs. so that one term includes the change error in  $P$  and the other includes the error in  $Q$ .
  - ▶  $TV = (Q_a \times P_a) - (Q_s \times P_s)$
- ▶ Start by adding and subtracting  $(P_s \times Q_a)$ 
  - ▶  $TV = (Q_a \times P_a) + [(P_s \times Q_a) - (P_s \times Q_a)] + (Q_s \times P_s)$

Does  $(P_s \times Q_a)$  have real world meaning?

- ▶  $P_s$  is the standard or budgeted price.
- ▶  $Q_a$  is the actual quantity.
- ▶ So  $P_s \times Q_a$  is a flexible budget!
  - ▶ (Or at least it's one line from a flexible budget.)

The algebra:

- ▶  $TV = [(Q_a \times P_a) - (P_s \times Q_a)] + [(P_s \times Q_a) - (Q_s \times P_s)]$
- ▶  $TV = [Q_a(P_a - P_s)] + [P_s(Q_a - Q_s)]$

## The Price and Quantity Variances

## The Price and Quantity Variances

$$TV = [Q_a(P_a - P_s)] + [P_s(Q_a - Q_s)]$$

- ▶ Now we have TV as a function of the error in  $P$  ( $P_a - P_s$ ) and the error in  $Q$  ( $Q_a - Q_s$ ).
- ▶ Multiplying the error in  $P$  by the actual quantity gives us the portion of TV that is due to the error in  $P$ .

## The Price and Quantity Variances

- ▶ Multiplying the error in  $Q$  by the forecasted (budgeted, or standard) quantity gives us the portion of TV that is due to the error in  $Q$ .

*The intuition behind this decomposition is critical.*



## The Price and Quantity Variances

$$TV = Q_a(P_a - P_s) + P_s(Q_a - Q_s)$$

Total Variance	Price Variance	Volume Variance
$TV$	$[Q_a(P_a - P_s)]$	$[P_s(Q_a - Q_s)]$

## Three variance decompositions

## Three variance decompositions

This is the general form:  $TV = [Q_a(P_a - P_s)] + [P_s(Q_a - Q_s)]$  now we'll consider specific versions.

## Direct Labor Variance

	Actual DL Cost	Flexible Budget	Standard DL Cost
General Form	$P_a \times Q_a$	$P_s \times Q_a$	$P_s \times Q_s$

**We have other terms for the price and quantity of labor!:**

- ▶ Price (\$P) → Wage ( $W$ )
- ▶ Quantity → Hours

## Direct Labor Variance

Total Variance	Actual DL Cost	Flexible Budget	Standard DL Cost
$(H_a \times W_a) - (W_s \times H_s)$	$W_a \times H_a$	$W_s \times H_a$	$W_s \times H_s$

## Direct Labor Variance

Total Variance	Wage Variance	Efficiency Variance
$(H_a \times W_a) - (W_s \times H_s)$ $[H_a(W_a - W_s)] +$ $[W_s(H_a - H_s)]$	$W_a \times H_a - W_s \times H_a$ $H_a(W_a - W_s)$	$W_s \times H_a - W_s \times H_s$ $W_s(H_a - H_s)$

Why is the “Volume Variance” called the “Efficiency Variance” when we are talking about labor?

## What might DLVs mean?

*Large variances in either direction indicate performance is not as planned, due to either poor planning, poor management, or random fluctuation.*

## What might DLVs mean?

- ▶ Unfavorable wage variance
  - ▶ Workers were not available at lower rates
- ▶ Unfavorable wage variance with favorable efficiency variance
  - ▶ Higher-paid workers performed work more efficiently
- ▶ Favorable wage variance with unfavorable efficiency variance
  - ▶ Lower-paid workers performed work less efficiently



## Direct Materials Variance

	Actual DM Cost	Flexible Budget	Standard DM Cost
General Form	$P_a \times Q_a$	$P_s \times Q_a$	$P_s \times Q_s$

**For materials we stick with the term “Price” and “Quantity”**

## Direct Materials Variance

	Actual DM Cost	Flexible Budget	Standard DM Cost
Total Variance			
$(Q_a \times P_a) - (P_s \times Q_s)$	$P_a \times Q_a$	$P_s \times Q_a$	$P_s \times Q_s$

Total Variance	Price Variance	Quantity Variance
$(Q_a \times P_a) - (P_s \times Q_s)$	$P_a \times Q_a - P_s \times Q_a$	$P_s \times Q_a - P_s \times Q_s$
$[Q_a(P_a - P_s)] + [P_s(Q_a - Q_s)]$	$Q_a(P_a - P_s)$	$P_s(Q_a - Q_s)$

## Incentive Effects of Variances:

- ▶ Rewarding purchasing managers for favorable direct materials price variances creates an incentive for them to buy large quantities when price discounts are offered for high-volume purchases.
- ▶ Penalizing production managers for unfavorable labor efficiency variances encourages keeping labor busy producing more.

## Incentive Effects of Variances:

- ▶ Mitigation of inventory building incentive
  - ▶ Charge purchasing department for cost of holding inventory.
  - ▶ Just-in-time (JIT) purchasing and production policies

## A note on JIT:

- ▶ Managerial accountants and consultants love JIT
- ▶ Toyota (and the whole Japanese Auto industry) is an often cited example.
- ▶ The 2011 Tohoku and Miyagi Earthquakes disrupted supply chains which lead to careful restructuring, and decreased reliance on pure just-in-time production.

## A note on JIT:

- ▶ Nonetheless, JIT was still widely used and COVID 2019 disrupted these supply chains.
- ▶ The Invasion of Ukraine by the Russian military also disrupted supply chains.
- ▶ In all of these cases excess inventory proved immensely valuable.

## Overhead Variance

## Overhead Variance: Terms

- ▶ Overhead variances are slightly more complex, because in addition to predicting price and quantity we also have to predict overhead consumption (the overhead rate).
- ▶ This is a 'meta' prediction in the sense that it depends on several other predictions:
  - ▶ Consumption of the overhead
  - ▶ Use of the underlying driver
- ▶ So when we observe an overhead variance, there are more things to explore.



## Overhead Variance: Volume

- ▶ BV: Budgeted volume
  - ▶ (also known as denominator volume)
  - ▶ Estimated at the beginning of the year and used for calculating the overhead rate
- ▶ SV: Standard volume
  - ▶ (also known as earned or allowed volume)
  - ▶  $(\text{Output units completed}) \times (\text{Standard input hours per output unit})$
  - ▶ Volume used to apply overhead to work-in-process inventory
- ▶ AV: Actual volume
- ▶ Actual hours or other input resource used during period

## Overhead Variance: Volume Estimates

- ▶ Estimated budget volume influences overhead rate.
  - ▶ Increasing budgeted volume (denominator) while holding total budgeted dollars constant (numerator) decreases the overhead rate.
- ▶ Expected volume to set budget
  - ▶ Adjust expectation based on number of units forecast for next year.
  - ▶ Rises and falls with business cycle
- ▶ Normal volume to set budget
  - ▶ Forecast of long-run average annual production
  - ▶ Does not change over business cycle

## Flexible and Static Overhead Budgets:

For the sake of a simple example assume that the Toronto Engine Plant exists and has the following attributes:

	Forecast
Fixed Overhead (FOH)	\$1,350,000
Variable Overhead (VOH)	\$14
Budgeted Volume (BV) <i>(the driver is DLH)</i>	67,500 hours

*Remember that this “budgeted volume” is different than the “standard volume” though this distinction isn’t particularly clear given the way that we named things in the direct variances.*

## Flexible Overhead Budget ( $BOH_{Flex}$ )

- ▶ **Flexible overhead budget is the formula for budget forecast.**
- ▶  $BOH_{Flex} = FOH + (VOH \times BV)$
- ▶  $BOH_{Flex} = \$1,350,000 + (\$14 \times BV)$

*Remember that Flexible Budgets are always formulas.*

## (Static) Overhead Budget

- ▶ Estimate budgeted overhead (BOH) dollars using a specific forecasted volume number (BV) and the flexible overhead budget formula.
- ▶  $BOH = FOH + (VOH \times BV)$
- ▶  $BOH = \$1,350,000 + (\$14 \times 67,500 \text{ hours})$
- ▶  $BOH = \$2,295,000$

## Overhead Rate:

- ▶ This is the same sort of overhead rate that we've been thinking about with all of our allocations.
- ▶ Overhead rate is the total budgeted overhead dollars for the year divided by the budgeted volume for the year.

$$OHR = (BOH/BV) = (FOH/BV) + VOH$$

$$OHR = (\$2,295,000/67,000hours) = \$1,350,000/67,000hours + \$14$$

$$OHR = 34$$

## The Overhead Rate Consists of Estimated:

- ▶ Fixed overhead \$ per input hour ( $\text{FOH} / \text{BV}$ ), and
- ▶ Variable overhead \$ per input hour (VOH)

We need volume information!



## Budgeted Volume

### **Budgeted Volume (Using Expected Volume)-Toronto Engine Plant's Cylinder Boring Department**

Product	Expected Production	Standard Hours per Block	Budgeted Volume
4-cylinder blocks	25,000 blocks	0.50	12,500
6-cylinder blocks	40,000 blocks	0.70	28,000
8-cylinder blocks	30,000 blocks	0.90	27,000
Total	95,000 blocks		
Budgeted volume			67,500

## Actual and standard volumes:

Product	Actual Production	Standard Hours per Block	Standard Volume	Actual Volume
4-cylinder blocks	27,000 blocks	0.50	13,500	14,200
6-cylinder blocks	41,000 blocks	0.70	28,700	29,000
8-cylinder blocks	28,000 blocks	0.90	25,200	25,000
Total	96,000 blocks			
Standard volume (SV)			67,400	
Actual volume (AV)				68,200

## Volumes:

Budgeted	Standard	Actual
67,500	67,400	68,200

## Overhead Allocated or Absorbed

- ▶ To allocate overhead we use the overhead rate and the standard volume.
- ▶ Standard Volume = Units of output  $\times$  Standard input per output
  - ▶  $SV = 67,400$  machine hours for 96,000 blocks
- ▶ Overhead absorbed = Overhead rate  $\times$  Standard volume =  $OHR \times SV$ 
  - ▶ Overhead absorbed =  $\$34 \times 67,400$  machine hours =  $\$2,291,600$

**Actual Overhead Cost Incurred: \$2,300,000**

Total Overhead Variance

## Total Overhead Variance

- ▶ Overhead variances occur when the actual overhead incurred does not equal the overhead absorbed or allocated.

## Total Overhead Variance

**Total Overhead Variance = Actual Overhead Costs - Overhead Absorbed**

$$AOH - (OHR \times SV) = AOH - (OHR \times SV)$$

$$\$2,300,000 - \$2,291,600 = \$8,400$$

**Interpretation:**

- ▶ Overhead is 'Underabsorbed', if actual > absorbed
- ▶ Overhead is 'Overabsorbed', if actual < absorbed

## Decompose Overhead Variance



## Decompose Overhead Variance

**Total Overhead Variance = Actual Overhead - Overhead Absorbed**

- ▶ Overhead spending variance = Actual overhead - Flexible budget at actual volume
- ▶  $OSV = AOH - FB@AV$
- ▶ Overhead efficiency variance = Flexible budget at actual volume - Flexible budget at standard volume
- ▶  $OEV = FB@AV - FB@SV$
- ▶ Overhead volume variance = Flexible budget at standard volume - Overhead Absorbed
- ▶  $OVV = FB@SV - OA$

## Decompose Overhead Variance

TOV	=	AOH		-		OA
OSV	=	AOH	-	FB@AV		
OEV	=			FB@AV	-	FB@SV
OVV	=				FB@SV	- OA

## More detailed definitions:

TOV	=	AOH	-	$OHR \times SV$
OSV	=	AOH - FOH+(VOH×AV)		
OEV	=	FOH+(VOH×AV) - FOH+(VOH×SV)		
OVV	=	FOH+(VOH×SV) -	$OHR \times SV$	