CHAPTER FIVE

MIX AND YIELD VARIANCES

4.1 Overview of Mix and Yield Variance

- There are a variety of possible extensions to the basic variance analysis presented in previous chapter. Although it is not practical to include all possible variations of variance analysis, one or two additional types of analysis will provide you with a feel for the variations of variance analysis found in practice. Material mix and yield variances provide a variance analysis extension that some firms have found useful.
- Most products are a combination of different materials and several types of labor substituted in a product. For example, orange juice manufacturers can mix Jimma and Harar oranges in slightly different proportions. A fried chicken franchise may mix experienced higher paid cooks with low paid helpers in their breading operation.
- A **mix variance** is the cost that results from the difference between an actual mix and a standard mix. Often mix changes can also impact the total output that is produced from a given amount of input. For example, substituting cooks for helpers may result in higher quantity of breaded chicken pieces because the cooks are faster and more experienced. Generally speaking, when materials or labor varies from their predetermined proportion the result will be a mix variance.
- **A yield variance** is the extra cost from the loss in quantity that results when there is a change in the mix material or labor.

4.2 Material Mix and Yield Variance

- When different types of materials used as substitutes for each other, a standard mix is usually determined to insure a quality product at the lowest possible cost. If the actual material mix varies from the standard mix, both quality and cost may be affected. The effect on cost can be determined by separating the material quantity variance into two variances referred to as material mix and material yield variances.
- In addition to the substitutability requirement, the unit of measure for the various materials needs to be the same. Materials may be measured in gallons or pounds or board feet, or some other measure, but the unit of measure must be the same for each ingredient. If these two prerequisites are satisfied, material mix and yield variances can be calculated.

- As said earlier, mix and yield variances for materials may be used when the materials are substitutable for each other. When inputs are substitutable, direct materials efficiency improvement relative to budgeted costs can come from two sources:
  (1) Using less input to achieve a given output, and
  (2) Using a cheaper mix to produce a given output.
- The total material variance is the sum of material price variance and material quantity variance. The material quantity variance is the difference between a flexible budget based on the actual quantity used and a flexible budget based on the standard quantity allowed. The material quantity variance is further separated into mix and yield variances.
- **Material mix variance is computed as follows.**

Direct Material Mix Variance	**=**	**Actual DM Mix Percentage**	**-**	**Budgeted DM mix Percentage**	**x**	**Actual Qty of All DM used**	**x**	**Budgeted Price of DM input**

- **Material yield variance is computed as follows.**

Direct Material Yield Variance	**=**	**Actual Qty of All DM Used**	**-**	**Budgeted Qty of All DM Allowed for Actual Output**	**x**	**Budgeted DM mix Percentage**	**x**	**Budgeted Price of DM input**

Illustration: Assume Bole Burger combines three ingredients in the production of the firm's popular hamburger. The standard quantities and input prices of these materials are provided below for a normal production batch of 2,000 pounds of hamburger.

Material	Standard Mix	Standard Inputs	Standard Price per pound
A	10%	200	Br1.00
C	50%	1,000	2.00
B	40%	800	3.00
		2,000	

The following data are provided for a recent production period in which 20,500 pounds of materials were used to produce 20,000 pounds of hamburger.

Material	Actual Quantities Used
A	2,460
C	9,225
B	8,815
	20,500

Required

a) Calculate the material quantity variance for this situation.

b) Calculate the material mix variance for this situation.

c) Calculate the material yield variances for this situation.

The standard quantities of inputs allowed for actual output are:

A = (200/2,000) x 20,000 = **2,000**
B = (1,000/2,000) x 20,000 = **10,000**
C = (800/2,000) x 20,000 = **8,000**

The variances are calculated in the following manner:

a) Material Quantity Variance = (AQ - SQ)(SP)	
A = (2,460 - 2,000) (1.00) = **B = (10,000 – 9,225) (2.00) =** **C = (8,000 - 8,815) (3.00) =**	**Br 460 U** **1,550 F** **2,445 U** **Br 1,355U**
b) Material Mix Variance = (AM- SM) (ATM)(SP)	
A (0.12-0.10) x 20,500x 1.00 = **B (0.45– 0.50) x20,500 x 2.00 =** **C (0.43 -0.40) x 20,500 x 3.00 =**	**Br 410 U** **2,050 F** **1,845U** **Br 205U**
c) Material Yield Variance = (ATM - STM) (SM)(SP)	
A (20,500-20,000)x 0.10x 1.00 = **B (20,500-20,000)x 0.50x 2.00 =** **C (20,500-20,000)x 0.40x 3.00 =**	**Br 50 U** **500 U** **600 U** **Br 1150 U**

- The sum of the mix and yield variances must be equal to the material quantity variance. The status of the material quantity variance is determined in the usual way, i.e., it is unfavorable if the actual quantity used exceeds the standard quantity allowed. The mix variance is unfavorable if Actual Mix > Standard Mix, i.e., the actual quantity exceeds the quantity called for by the standard mix. This is unfavorable because it increases the cost of the product. The material yield variances represent a measure of what the material quantity variances would have been if the actual mix proportions were equal to the standard mix proportions. The yield variances are unfavorable when Actual Total Material Used >Standard Total Materials allowed for Actual Output.

4.3 Labor Mix and Yield Variances

- The idea of labor mix and yield variance is the same as material mix and yield variance.

Illustration: consider Birhanu Electric Works – an electrical contractor who performs new construction wiring. The typical crew consists of one experienced electrician and two apprentice electricians. An experienced electrician can wire 10 fixtures per hour while an apprentice can wire only 5 fixtures per hour. The standard and actual data is summarized as follows.

Birhanu Electric: Standard Cost Sheet for Ginbot

	Standard	**Standa**	**Standa**	**Standard**	**Standard**

Labor	Rate per Hour	rd Crew Mix	rd Hours	Labor Cost	Output in Fixtures
Apprentice Electricians	Br 15	2 (67%)	320	Br 4,800	1,600
Master Electricians	Br 40	1 (33%)	160	6,400	1,600
Total			**480**	**Br 11,200**	**3,200**

During Ginbot, Birhanu Electric wired 3,600 fixtures at a total labor cost of Br 15,000. The detailed breakdown of the actual hours is shown as follows:

Labor	Standard Rate per Hour	Actual Hours	Actual Output in Fixtures
Apprentice Electricians	Br 15	240	1,440
Master Electricians	Br 40	240	2,160
Total		**480**	**3,600**

Required

d) Calculate the labor quantity variance for this situation.

e) Calculate the labor mix variance for this situation.

f) Calculate the labor yield variances for this situation.

a) Labor Quantity Variance

To understand labor mix and yield variances, we will begin by computing the quantity variance for the two types of labor, apprentice and master. The first table shows the standard wage rates and the budgeted hours (480) for a budgeted output of 3,200 fixtures. Since the actual output is 3,600 fixtures (see the second table), the standard total hours for the actual output is 540 hours [(3,600/3,200) x 480)]. Ignoring the mix, we can compute a quantity variance as simply the difference between actual hours and the flexible budget for the standard hours earned on the basis of the output of 3,600 fixtures. The labor quantity variance for Ginbot is:

LQV (Apprentices) = (AQ – SQ) x SP
= (240 – 360) x Br 15
= **Br 1,800 F**

LQV (Master) = (AQ – SQ) x SP
= (240 – 180) x Br 40
= **Br 2,400 U**

LQV (Combined) = Br 1,800 F + Br 2,400 U
= **Br 600 U**

b) Labor Mix Variance

Let us now consider the impact of a crew mix. For Ginbot, there is a mix variance because the actual labor mix used differed from the standard labor mix. The third

column of the second table above shows that the actual apprentice labor was 50 percent rather than the expected 67 percent and that the master electrician was 50 percent rather than 33 percent. The mix variance measures the monetary effect of using a different mix. In our example, it is the higher than expected percentage of master electrician hours. The mix variance uses the actual hours, but assumes that they are distributed in the budgeted mix. This is because we want to isolate the effect of a change in mix without adding the effect of a change in output as well. The formula for computing the mix variance is as follows:

Direct Labor Mix Variance	=	**Actual DL Mix Percentage**	-	Budgeted DL Mix Percentage	x	Actual Qty of All DL Hours Used	x	Standard Rate per Hour

The electrician crew mix variance for Ginbot is computed as follows:

DLMV (Apprentice) = (.50 – .67) x 480 x Br15 = Br 1,200 F

DLMV (Master) = (.50 – .33) x 480x Br 40 = Br 3,200 U

Total Labor Mix Variance **Br 2,000 U**

The decrease in the percentage of apprentice labor used results in a favorable variance while the increase in the use of master labor results in an unfavorable mix variance. The net effect of the mix change is an unfavorable crew mix variance of Br 2,000. Because the total mix must equal 100 percent, there is always at least one favorable and one unfavorable mix variance if there is any change in mix.

c) Labor Yield Variance

The change in mix required more of the expensive master electricians. While this increased the total wages paid, master electricians work faster and the yield from the same 480 labor hours has gone up. Instead of the budgeted 3,200 fixtures we have 3,600 fixtures. In effect, the 480 hours at the new mix has yielded 540 labor hours worth of output. This impact can be captured in the yield variance, which shows us the productivity impact of the new mix. Again, to isolate the effect of a change in the yield, we will hold the mix constant and assume that the earned hours and the actual hours were both at the standard mix. The formula for computing the mix variance is as follows:

Direct Labor Yield Variance	**=**	**Actual Total Labor Hours Used**	**-**	**Budgeted Total Labor Hours Allowed for Actual Output**	**x**	**Budgeted DL mix Percentage**	**x**	**Standard Rate per Hour**

The crew yield variance for Ginbot is computed as follows:

DLYV (Apprentice) = (480 – 540) x 0.67 x Br 15 = Br 600 F

DLYV (Master) = (480 – 540) x 0.33 x Br 40 = Br 800 F

Total Labor Yield Variance = **Br 1,400 F**

- ❖ Note that the mix and yield variances together give additional information about the causes of a quantity variance. When mix and yield variances are combined, they equal the quantity variance. In our example, the mix and yield equal the combined quantity variance of Br 600 Unfavorable.

  Total mix variance = Br 2,000 U
  Total yield variance = Br1,400 F
  Total Quantity variance = Br 600 U

We can see that despite the increased productivity of the master electricians, the decision to substitute the higher paid labor has resulted in an overall unfavorable variance of Br 600. This was because unfavorable mix variance was larger than the favorable yield variance. Birhanu is better off sticking to its standard crew mix and avoiding the type of tradeoff between using cheaper labor it did in Ginbot.

4.4 SALES VARIANCES

- The idea of variance analysis can be extended to areas other than production. For example, an analysis can be made on why actual revenue differed from budgeted revenue. If, for example, a company budgeted to sell 10,000 units at Br 50 each but because of market forces had to reduce the price to Br 48 and even so they were only able to sell 9,000 at this price, a variance occurs. Then:

  Actual Sales Revenue = 9,000 x Br 48 = Br 432,000
  Budgeted Sales Revenue = 10,000 x Br 50 = Br 500,000
  Sales Variance = Br 432,000 – Br 500,000 = -Br 68,000 = Br 68,000 U

- This variance is negative which means that less revenue was obtained than expected and is therefore unfavorable and marked with U. This variance is made up of two elements: the reduction in volume of 1,000 units and the reduction in selling price of Br 2 per unit. From the above example it can be seen that two items will contribute to sales variance: the **sales-price variance (SPV)** and the **sales-volume variance (SVV).**
- The sales-price variance arises because a company increased or decreased its sales price when compared with the budgeted sales price. The sales-volume variance arises from an increase or decrease in units sold. Generally speaking, sales variances can be analyzed by splitting the total variance into six variances as shown below.

Example

Agere ltd sales three products in the Dembel City centre. The Company Budgeted to sell 10,000 units. The budgeted 10,000 units represent 50% market share. The details for the budgeted and actual data for the year 1996 fiscal year are as follows:

	Budgeted Data				**Actual Data**			
Product	**Selling Price per Unit**	**Quantity**	**Sales Mix**	**Total Revenue**	**Selling Price per Unit**	**Unit Volume**	**Sales Mix**	**Total Revenue**
A	12	1,000	10%	12,000	10	1,800	15%	18,000
B	20	3,000	30	60,000	25	4,800	40	120,000
C	15	6,000	60	90,000	15	5,400	45	81,000
		10,000		**162,000**		**12,000**		**219,000**

Required

1. Calculate Static-budget variance.
2. Compute Flexible-budget variance.
3. Compute Sales-volume variance.
4. Compute Sales-mix variance.
5. Compute Sales-quantity variance.
6. Compute Market share and market size variance.

1. The Static-budget variance for Agere Ltd is computed as follows:

Static-Budget Variance= Actual Result- budgeted Amount

A= 18,000-12,000 = 6,000F

B= 120,000-60,000 =60,000F

C= 81,000-90,000 = 9,000U

Total SBV =57,000F

- Static-Budget variance can be further split into Flexible-Budget and Sales-Volume variance.

2. The Flexible-budget variance for Agere Ltd is computed as follows:

Flexible-budget variance =Actual Result- Flexible-budget Amount

FBV A=18,000- (12x 1,800) = 3,600U

B=120,000-(20x 4,800) =24,000F

C=81,000-(15 x 5,400) = 0

Total.....20,400F

3. The Sales-volume variance for Agere Ltd is computed as follows:

SVV = (Actual Sales Quantity - Budgeted Sales Quantity) x Budgeted Selling Price per Unit

SVV-A= (1,800-1,000) x 12= $9,600F

B= (4,800-3,000) x 20=$36,000F

C= (5,400-6,000) x 15= $9,000U

Total SVV=$36,600F

4. Sales-mix variance: difference between (1) budgeted amount for the actual sales mix, and (2) the budgeted amount if the budgeted sales mix had been changed. The formula for computing the sales-mix variance in terms of revenue and the amount for Agere Ltd is:-

SMV	**=**	**Actual Sales Mix Percentage**	**-**	**Budgeted Sales Mix percentage**	**X**	**Actual Units Of All Products Sold**	**x**	**Budgeted Selling Price Per Unit**

SMV-A= (0.15-0.10) x 12,000 x 12= $7,200F

B= (0.40-0.30) x 12,000 x 20=$24,000F

C= (0.45-0.60) x 12,000 x 15=$27,000U

TSMV= $4,200F

5. Sales-quantity variance: is the difference between two amounts: (1) the budgeted amount based on actual quantities sold of all products and the budgeted mix, and (2) the amount in the static budget (which is based on the budgeted quantities to be sold of all products and the budgeted mix). The formula for computing the sales-quantity variance in terms of revenue and the amount for Agere Ltd is:-

SQV	**=**	**Actual Units Of All Products Sold**	**-**	**Budgeted Units Of All Products Sold**	**x**	**Budgeted Sales Mix percentag**	**x**	**Budgeted Selling Price Per**

	e	**Unit**

SQV-A = (12,000 -10,000) x 0.10x 12= $2,400F
B = (12,000 -10,000) x 0.30x 20= $12,000F
C = (12,000 -10,000) x 0.60x 15= $18,000F
SQV= $32,400F

6. **Market Share and Market Size Variance: s**ales depend on overall market demand as well as the firm's ability to maintain its share of the market. The following table summarizes the budgeted and actual sales units for the industry.

	Budgeted Industry Quantity	**Actual Industry Quantity**
Product A	1,800	2,200
Product B	6,200	8,000
Product C	12,000	14,800
Total	**20,000**	**25,000**

- Agere Ltd can use the industry information to get further insight into the sales quantity variance by dividing this variance into a market-size and market-share variance.
- Market- size variance is the difference between two amounts (1) the budgeted amount based on the actual market size in units and the budgeted market share, and (2) the static budget amount based on the budgeted market-size in units and the budgeted market share. The formula and the amount for Agere Ltd are: -

MSV= (Actual MSZ - Budgeted MSZ) x Budgeted MSR x Budgeted ASP

Where, MSV= Market Share Variance MSR= Market Share in Units
MSZ= Market Size in Units ASP= Average Selling Price per Unit

MSV for Agere Ltd is computed as follows:-
MSV= (25,000-20,000) x 0.50x 16.20
= **Br 40,500F**

- Market –share variance is the difference between two amounts: (1) the budgeted amount at budgeted mix based on actual market size in units and the actual market share, and (2) the budgeted amount at budgeted mix based on actual market size in units and the budgeted market share. The formula and the amount for Agere Ltd are: -

Mkt-share Variance= (Actual MSR- Budgeted MSR)x Actual MSZ x Budgeted ASP

MSV for Agere Ltd is computed as follows:-
Mkt-share Variance= (0.48- 0.50) x 25,000x 16.20
=**Br 8,100 U**