CHAPTER 9
BENEFIT-COST PROGRAM: RESULTS

Introduction

This chapter summarizes all of the results which are calculated from the data inputs. There are four main types of results:

1. **Summary of Damages Before Mitigation,**
2. **Summary of Damages After Mitigation,**
3. **Benefit-Cost Results, and**
4. **Summary.**

ALL of the results depend directly on the input data for either a LEVEL ONE (Minimum Data) or a LEVEL TWO (Detailed) analysis.

Results should always be reviewed for reasonableness. If any of the results appear unreasonable, then check the corresponding input parameters which lead to the results.

The computer software truism

"GARBAGE IN, GARBAGE OUT"

applies to benefit-cost analysis of hazard mitigation projects.

Each analyst conducting benefit-cost analysis has the responsibility to ensure that all data inputs are reasonable, defensible, and well-documented. The program processes all of the data inputs in a mathematically correct manner, but **the program cannot produce correct results when incorrect data are entered**. The analyst has control over the data inputs and thus responsibility for the results.

SUMMARY OF DAMAGES BEFORE MITIGATION

This section of results characterizes the vulnerability of the **EXISTING** building to flood damages and losses **BEFORE** undertaking any mitigation measures. The estimated scenario damages and losses for the existing building at each flood depth depend directly on the depth-damage functions for building and contents, displacement, and functional downtimes, and all of the other data input parameters. The expected annual damages and losses also depend very strongly on the degree of flood risk at the site under evaluation.

SCENARIO DAMAGES BEFORE MITIGATION ($ per event)

Scenario Damages Before Mitigation ($ per event)

Scenario Damages are defined as damages and losses per flood event (occurrence). Scenario damages indicate the estimated damages which would result from a single flood of a particular depth at the building under evaluation. For example, the scenario damages for a 3-foot flood are the expected damages and losses **each time** a 3-foot flood occurs at a particular site. Scenario damages do **NOT** depend on the probability of floods at that location.

Scenario Damages Table

Flood Depth	Building Damages	Contents Damages	Displacement Costs	Business Losses	Rental Losses	Public/ Nonprofit	Total
-2	$0	$0	$0	$0	$0	$0	$0
-1	$0	$0	$0	$0	$0	$0	$0
0	$3,750	$1,688	$0	$250	$0	$5,171	$10,859
1	$6,750	$3,038	$0	$450	$0	$9,308	$19,546
2	$9,750	$4,388	$3,600	$650	$900	$13,445	$32,733
3	$13,500	$6,075	$6,267	$900	$1,567	$18,616	$46,925
4	$15,000	$6,750	$7,333	$1,000	$1,833	$20,685	$52,602
5	$16,500	$7,425	$8,400	$1,100	$2,100	$22,753	$58,278

The **Scenario Damages Table** contains scenario damages for each flood depth from -2 to 18 feet for six categories of damages and losses: building damages, contents damages, displacement costs, business income losses, rental income losses, and lost public/nonprofit services. In addition, the total damages and losses are shown for each flood depth.

The information in this **Scenario Damages Before Mitigation Table** shows the total vulnerability of the existing building to flood damage, how these damages are distributed among different categories of damages, and how these damages vary with flood depth.

EXPECTED ANNUAL DAMAGES BEFORE MITIGATION ($)

The **Scenario Damages** discussed above do NOT depend on flood hazard risk. Two identical buildings located at different elevations in a flood plain will have identical scenario damages at each flood depth. However, the probability of flood damage varies markedly with elevation in a flood plain.

Expected Annual Damages take into account the annual probabilities of floods of each depth. **Expected Annual Damages** are the **AVERAGE** damages per year expected over a long time period. "Expected annual" does NOT mean that these damages will occur every year.

For each flood depth, **Expected Annual Damages** are calculated by multiplying the **Scenario Damages** times the **Expected Annual Number of Floods** of each depth.

Expected Annual Damages Table

Flood Depth	Building Damages	Contents Damages	Displacement Costs	Business Losses	Rental Losses	Public/ Nonprofit	Total
-2	$0	$0	$0	$0	$0	$0	$0
-1	$0	$0	$0	$0	$0	$0	$0
0	$387	$174	$0	$26	$0	$534	$1,121
1	$235	$106	$0	$16	$0	$324	$680
2	$114	$51	$42	$8	$11	$158	$384
3	$53	$24	$25	$4	$6	$74	$186
4	$20	$9	$10	$1	$2	$28	$70
5	$7	$3	$4	$0	$1	$10	$26

The **Expected Annual Damage Table** contains expected annual damages for each flood depth from -2 to 18 feet for six categories of damages and losses: building damages, contents damages, displacement costs, business income losses, rental income losses, and lost public/nonprofit services. In addition, the total damages and losses are shown for each flood depth.

Expected Annual Damages will generally be much smaller than **Scenario Damages** because the expected annual number or annual probability of a flood of a given depth is usually much less than one.

Interpreting Damages Before Mitigation

Scenario Damages and **Expected Annual Damages** provide different information. **Scenario Damages** describe how much flood damage there will be each time a given flood occurs. However, because **Scenario Damages** DO NOT consider flood probabilities, they do not provide sufficient information for decisionmaking. **Scenario Damages** for a given flood depth may be high, but if the flood probability is very

low, no mitigation action may be warranted. For example, if a 5-foot flood causes $50,000 damages but such a flood is expected to occur only once in 1,000 years, then simply repairing the very infrequent flood damage may be the most sensible and cost-effective strategy.

The **Scenario Damages Before Mitigation** and the **Expected Annual Damages Before Mitigation** provide, **in combination**, a complete picture of the vulnerability of the building to flood damage before undertaking a mitigation project.

Expected Annual Damages DO consider flood probabilities. A building with high **Expected Annual Damages** means that not only are **Scenario Damages** high, but also that flood probabilities at the depths that cause considerable damages are relatively high. High **Expected Annual Damages** means that there are high **potential benefits** in avoiding such damages through mitigation projects.

Even for buildings with high **Expected Annual Damages**, all mitigation projects are not necessarily cost-effective. Cost-effectiveness depends on the cost of the mitigation project and on the effectiveness of the mitigation project in avoiding damages, as well as on the **Expected Annual Damages**.

SUMMARY OF DAMAGES AFTER MITIGATION

This section of results characterizes the vulnerability of the building to flood damages and losses **AFTER** undertaking a particular mitigation measure. Scenario damages after mitigation depend on the damages before mitigation and on the effectiveness of the mitigation measure in avoiding damages. The **Expected Annual Damages and Losses** after mitigation also depend very strongly on the degree of flood and flood-related risks at the site under evaluation.

SCENARIO DAMAGES AFTER MITIGATION ($ per event)

Scenario Damages After Mitigation are the damages and losses expected to occur per flood event after the mitigation project is implemented. For some mitigation projects such as relocation or buyout, the **Scenario Damages After Mitigation** will be zero. For other projects, such as elevation or flood barriers, **Scenario Damages After Mitigation** will be lower than before mitigation but not zero at those flood depths where the mitigation measure is partially effective.