NIOSH Lifting Equation

ISYE 348 Fall 2024 Lab 11

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This lab assignment is due by 23:59 on 2024-11-26. If you have any questions or need clarification, please reach out to me via email or during office hours. The report will be graded on **20 points** based on the following criteria:

Criteria	Points
Introduction (your own words; 50-100 words)	1
Methods (your own words; 100-200 words)	1
Results	9
Discussion	6
Conclusion	3

Submission: Please submit your report as a PDF file on Canvas. Make sure to include your name and your partner's name at the beginning of the report. Include any code, plots, or tables as needed to support your answers. Make sure to answer all questions thoroughly and provide detailed explanations where necessary. Cite any external sources used. Submit one single pdf file with all the answers.

Collaboration with your classmates is encouraged, and you will work in pairs for this lab to complete the report. Please list your partner's name at the beginning of the report. Only one submission per group is required. Must include data from both partners in the report.

Late submissions will be penalized by a 1 point deduction every hour past the deadline.

$$\text{score} = \max(20 - \lfloor \text{hours\_late} \rfloor, 0)$$

Please read the course policy on academic integrity and collaboration on the course syllabus. If you have any questions about what is permissible, please ask before submitting your work.

Introduction

This laboratory exercise will help you understand the NIOSH Lifting Equation through hands-on measurements and calculations. You will analyze six different lifting configurations to determine their safety and recommend improvements.

Learning Objectives

By the end of this lab, you will be able to:

- Use measurement tools (goniometer, tape measure) to collect lifting task parameters
- Apply the NIOSH Lifting Equation to real-world lifting scenarios
- Evaluate the safety of lifting tasks
- Recommend ergonomic improvements based on quantitative analysis

Required Equipment

- Goniometer
- Tape measure
- Calculator
- Data collection sheets
- Boxes or containers for lifting (weight should be clearly marked)
- Scale (to verify weights)
- [optional] Marking tape (for floor distances)

NIOSH Lifting Equation Review

The Revised NIOSH Lifting Equation calculates the Recommended Weight Limit (RWL) using the following formula:

$$\text{RWL} = \text{LC} \times \text{HM} \times \text{VM} \times \text{DM} \times \text{AM} \times \text{CM} \times \text{FM}$$

Where:

- LC (Load Constant) = 23 kg or 51 lbs
- HM (Horizontal Multiplier) = 25/H
- VM (Vertical Multiplier) = 1 - (0.003|V-75|)
- DM (Distance Multiplier) = 0.82 + (4.5/D)
- AM (Asymmetric Multiplier) = 1 - (0.0032|A|), where |A| is the absolute value of the angle in degrees
- CM (Coupling Multiplier)=
    - 1.0 (good), 0.95 (fair), or 0.90 (poor) if V<75 cm
    - 1.0 (good), 1 (fair), or 0.90 (poor) if V ≥ 75 cm
- FM (Frequency Multiplier) = Table value based on frequency and duration

Procedure

1. **Preparation**
   - Review the NIOSH Lifting Equation components
   - Familiarize yourself with measurement tools
2. **For Each Lifting Configuration**
   - Measure and record:
     - Horizontal distance (H) at origin and destination
     - Vertical height (V) at origin and destination
     - Vertical travel distance (D)
     - Asymmetric angle (A) at origin and destination
     - Coupling classification
     - Frequency of lifts (if applicable)
   - Document the values in your data sheet
   - Sketch/photograph the lifting posture
   - Note any observational data
3. **Calculations**
   - Calculate each multiplier using the measured values
   - Determine the RWL for each configuration
   - Calculate the Lifting Index (LI) using the actual load weight
   - Show all calculations in your lab report
4. **Analysis**
   - Identify the most limiting factor(s) for each lift
   - Compare the different configurations
   - Recommend improvements for hazardous lifts (LI > 1.0)

Results

- Completed data sheets for all configurations
- Calculated RWL and LI values
- Summary table comparing all configurations
- Graphical representation of lifting postures
- Observational notes for each configuration

Create a table for each lift with the following columns:

Parameter	Origin	Destination	Multiplier	Value
H (cm)			HM	
V (cm)			VM	
D (cm)			DM	
A (deg)			AM	
Coupling			CM	
Frequency			FM	

Discussion questions

1. What were the most limiting factors for each lifting configuration?
2. Which lifting tasks were the most hazardous based on the Lifting Index (LI)?
3. What ergonomic improvements would you recommend for the hazardous lifts?
4. How do the results of this lab exercise align with the principles of ergonomics and safe lifting practices?
5. Suggest two improvements to the lifting setup to reduce the risk of injury.
6. What are the limitations of the NIOSH Lifting Equation, and how could it be improved?

Conclusions

- Summary of key findings
- Recommendations for improvement
- Lessons learned from the lab exercise