STA 3180 Statistical Modelling: Structural Equation Modeling

Structural Equation Modeling (SEM)

Structural equation modeling (SEM) is a powerful statistical technique used to analyze relationships between observed and latent variables. It is a multivariate analysis technique that combines elements of factor analysis, path analysis, and regression analysis. SEM can be used to test hypotheses about the relationships between variables, and to estimate the strength of those relationships.

Key Concepts

* **Latent Variables** - Latent variables are variables that cannot be directly observed, but can be inferred from observed variables.

* **Observed Variables** - Observed variables are variables that can be directly measured or observed.

* **Path Analysis** - Path analysis is a type of SEM that is used to examine the relationships between observed and latent variables.

* **Factor Analysis** - Factor analysis is a type of SEM that is used to identify underlying factors that explain the relationships between observed variables.

* **Regression Analysis** - Regression analysis is a type of SEM that is used to predict the values of one variable based on the values of other variables.

Definitions

* **Structural Equation Modeling** - Structural equation modeling (SEM) is a multivariate analysis technique that combines elements of factor analysis, path analysis, and regression analysis. It is used to analyze relationships between observed and latent variables, and to test hypotheses about the relationships between variables.

* **Latent Variable** - A latent variable is a variable that cannot be directly observed, but can be inferred from observed variables.

* **Observed Variable** - An observed variable is a variable that can be directly measured or observed.

* **Path Analysis** - Path analysis is a type of SEM that is used to examine the relationships between observed and latent variables.

* **Factor Analysis** - Factor analysis is a type of SEM that is used to identify underlying factors that explain the relationships between observed variables.

* **Regression Analysis** - Regression analysis is a type of SEM that is used to predict the values of one variable based on the values of other variables.

Coding Examples

Example 1: Path Analysis

```
Start of Code
library(sem)
# Create a path model
model <- sem(
    # Define observed variables
    Y1 ~ X1 + X2,
    Y2 ~ X3 + X4,
    # Define latent variables
    Y1 ~~ L1 + L2,
    Y2 ~~ L1 + L3
)
# Fit the model
fit <- sem(model, data = data)
# Summarize the results
summary(fit)
End of Code
```

Example 2: Factor Analysis

```
Start of Code
library(sem)
# Create a factor model
model <- sem(
    # Define observed variables
    Y1 ~ X1 + X2,
    Y2 ~ X3 + X4,
    # Define latent variables
    L1 ~~ X1 + X2,
    L2 ~~ X3 + X4
)
# Fit the model
fit <- sem(model, data = data)
# Summarize the results
summary(fit)
End of Code
```

Example 3: Regression Analysis

```
Start of Code
library(sem)
# Create a regression model
model <- sem(
    # Define observed variables
    Y ~ X1 + X2,
    # Define latent variables
    Y ~~ L1 + L2
)
# Fit the model
fit <- sem(model, data = data)
# Summarize the results
summary(fit)
End of Code
```

Practice Multiple Choice Questions

Q1. Which of the following is NOT a type of Structural Equation Modeling?

A. Cluster Analysis

B. Path Analysis

C. Factor Analysis

D. Regression Analysis

Answer: A. Cluster Analysis