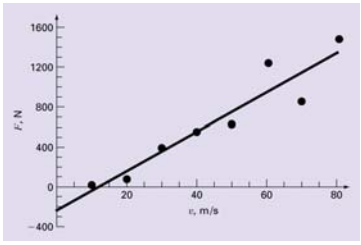
Chap. 14 Curve Fitting: 선형 회귀분석

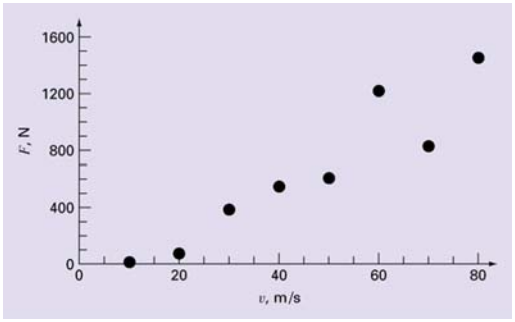
- 곡선 맞춤 개요
- 통계학 기초
- 선형 회귀분석
- 비선형 방정식의 선형화

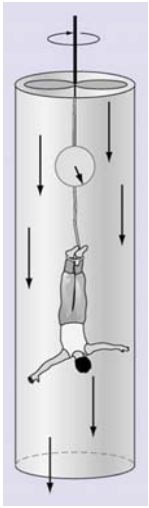


곡선맞춤의 필요성

❑ 사례: 실험에 의한 항력계수 결정

- 번지점프하는 사람에 작용하는 항력: $F = cv^2$
- 풍동실험에 의한 항력계수(c) 결정





곡선맞춤 (Curve Fitting)

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❑ 곡선맞춤

- 불연속적인 데이터 사이에 있는 점에서의 값 추정시 필요
- 주어진 데이터를 가장 적절히 표현할 수 있는 함수식 계산
- 곡선맞춤 종류: 최소제곱 회귀분석 vs. 보간법

❑ 최소제곱 회귀분석 (Least-Square Regression)

❑ 보간법 (Interpolation)

곡선맞춤 (Curve Fitting)

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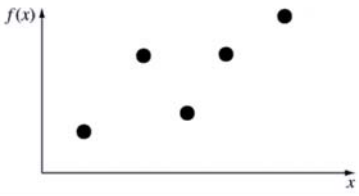
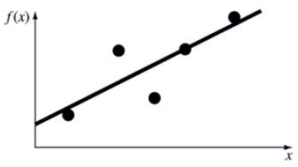
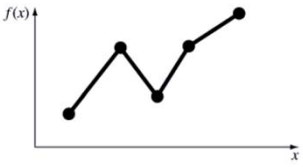
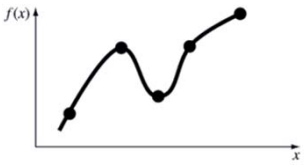


최소제곱법 (선형) 선형보간법 곡선보간법







[Review] Statistics

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For n data points $y_1, y_2, \ldots, y_n$

P. 354 예제 14.1

평균 (mean)

표준편차 (standard deviation)

분산 (variance)

분산계수 (coefficient of variation)

: 평균값에 대한 표준편차의 비

정규분포 (Normal Distribution)

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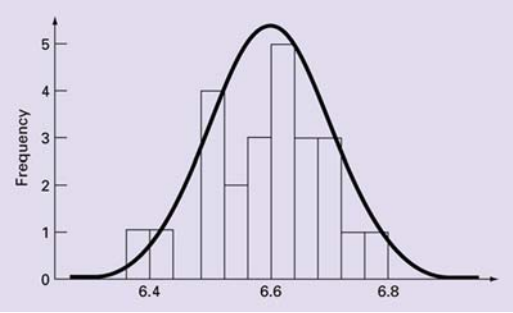
❑ **히스토그램 (histogram)**

- 데이터가 평균값 주변에 어떻게 분포되어있는지를 시각적으로 표현
- 데이터가 충분할 경우 히스토그램은 완만한 종 형태로 근사화됨



68% of total measurements in

95% of total measurements in

MATLAB 내장함수
mean(x), median(x), hist(x)

Linear Least Squares Regression

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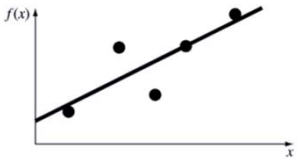
f(x) is in a linear form : $f(x) = ax + b$

the error :

Is minimized when :

→

→



선형 회귀분석 사례

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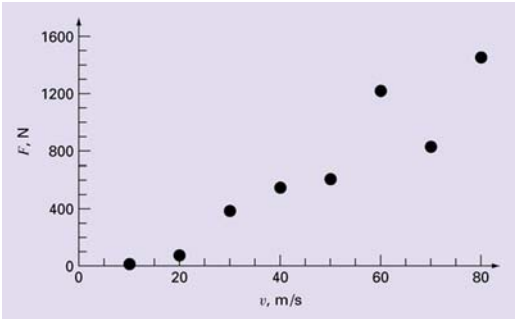
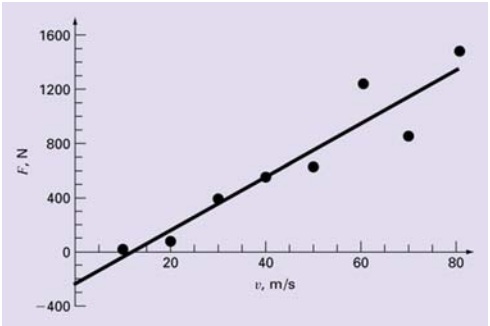
P. 366 예제 14.4





선형회귀분석의 오차

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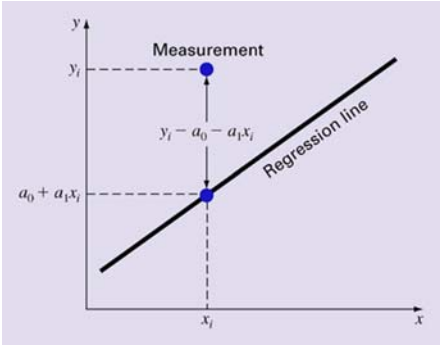
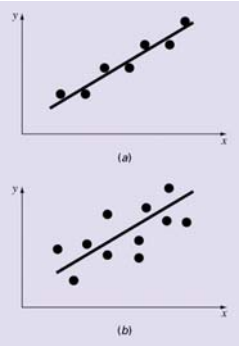
잔차 (Residual)





선형회귀분석의 표준편차

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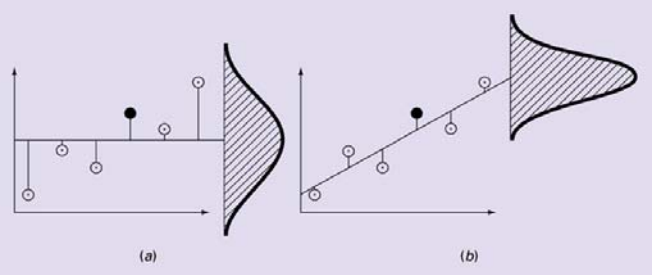
데이터 평균값 기준 표준편차

선형 회귀곡선 기준 표준편차



회귀곡선의 적합성

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❑ **결정계수 (Coefficient of determination)**

❑ **상관계수 (Correlation coefficient)**

P. 369 예제 14.5

- r = 1 : 회귀분석 직선은 데이터의 변화도를 100% 표현 (완전 적합)
- r = 0 : 회귀분석 직선은 데이터의 변화도와 아무런 상관관계가 없음
- 가능하면 r(or r^2) 값이 1에 가깝도록 회귀곡선 설정

비선형 방정식의 선형화

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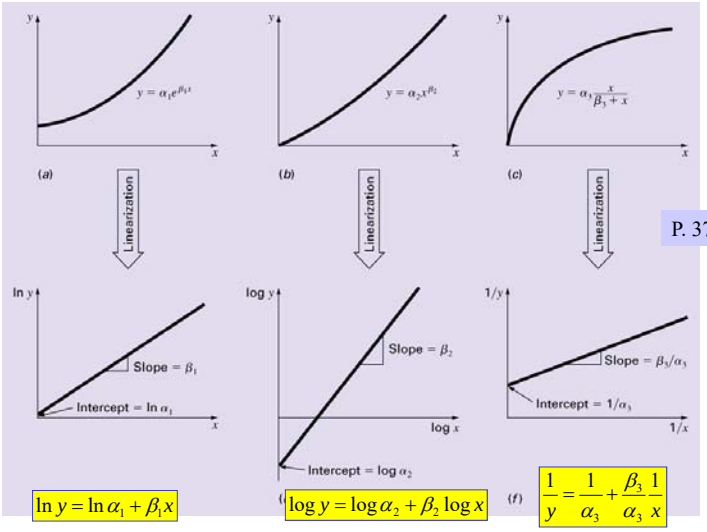

P. 373 예제 14.6

선형회귀분석 – M File

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```
function [a, r2] = linregr(x,y)
% [a, r2] = linregr(x,y):
%   Least squares fit of a straight line to data
%   by solving the normal equations.
% input:
%   x = independent variable
%   y = dependent variable
% output:
%   a = vector of slope, a(1), and intercept, a(2)
%   r2 = coefficient of determination

n = length(x);
if length(y)~=n, error('x and y must be same length'); end
x = x(:); y = y(:);    % convert to column vectors
sx = sum(x); sy = sum(y);
sx2 = sum(x.*x); sxy = sum(x.*y); sy2 = sum(y.*y);
a(1) = (n*sxy-sx*sy)/(n*sx2-sx^2);
a(2) = sy/n-a(1)*sx/n;
r2 = ((n*sxy-sx*sy)/sqrt(n*sx2-sx^2)/sqrt(n*sy2-sy^2))^2;
```

```
% create plot of data and best fit line

xp = linspace(min(x),max(x),2);
yp = a(1)*xp+a(2);
plot(x,y,'o',xp,yp)
grid on
```


[사례연구] 효소반응 모델의 선정 (p. 378 ~ 382)

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Michaelis-Menten 모델 : 기질의 농도에 따른 효소의 반응속도 관계식

v :초기반응속도, v_m : 최대초기반응속도
$[S]$: 기질의 농도, k_s : 반포화 상수

상호작용을 고려한 2차 모델

Matlab Command

```
S = [1.3   1.8   3   4.5   6   8   9];
v = [0.07   0.13   0.22   0.275   0.335   0.35   0.36];
```