

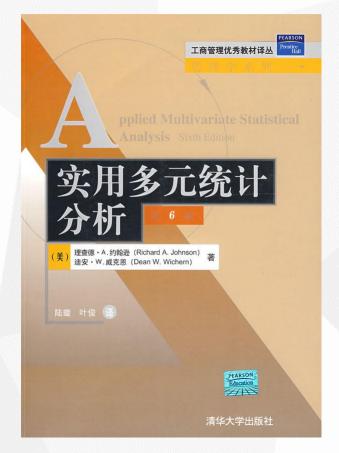
多元统计分析

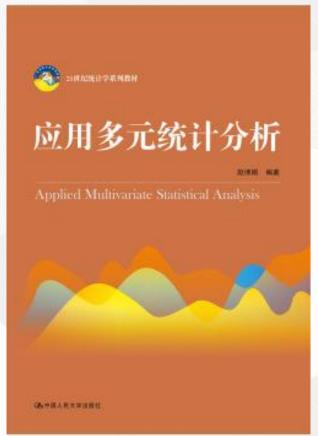
MULTIVARIATE STATISTICAL ANALYSIS

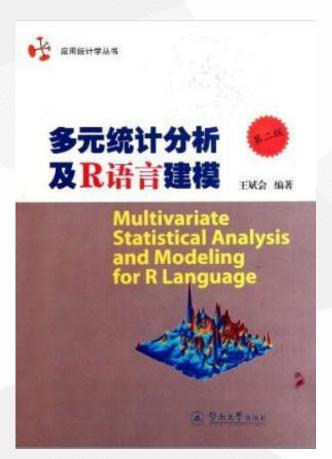
数学与统计学院 杨炜明



参考书目











Aspects Of Multivariate Analysis

输入简短的关键句



Univariate case:

 x_i = measurement of the *i*-th item

Multivariate case:

 x_{ij} = measurement of the j-th variable on the i-th item



$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1p} \\ x_{21} & x_{22} & \cdots & x_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{np} \end{bmatrix}$$

· p表示变量数, n表示项目或实验单元数



判别分析问题

为了研究中小企业的破产模型,选定4个经济指标:

 X_1 总负债率(现金收益/总负债)

 X_2 收益性指标(纯收入/总财产)

 X_3 短期支付能力(流动资产/流动负债)

 X_4 生产效率性指标(流动资产/纯销售额)

对17个破产企业(1类)和21个正常运行企业(2类)进行了调查,得如下资料:



总负债率	收益性指标	短期支付能力	生产效率指标	类别
45	41	1.09	.45	1
56	31	1.51	.16	1
.06	.02	1.01	.40	1
07	09	1.45	.26	1
10	09	1.56	.67	1
14	07	.71	.28	1
23	30	.22	.18	1
.07	.02	1.31	.25	1
.01	.00	2.15	.70	1
28	23	1.19	.66	1
.15	.05	1.88	.27	1
.37	.11	1.99	.38	1
08	08	1.51	.42	1
.05	.03	1.68	.95	1
.01	.00	1.26	.60	1
.12	.11	1.14	.17	1
28	27	1.27	.51	1
.51	.10	2.49	.54	2
.08	.02	2.01	.53	2



	(i			
. 38	.11	3. 27	. 55	2
. 19	. 05	2. 25	. 33	2
. 32	. 07	4. 24	. 63	2
. 31	. 05	4. 45	. 69	2
. 12	. 05	2. 52	. 69	2
02	. 02	2.05	. 35	2
. 22	. 08	2. 35	. 40	2
. 17	. 07	1.80	. 52	2
. 15	. 05	2. 17	. 55	2
 10	-1.01	2. 50	. 58	2
. 14	03	. 46	. 26	2
. 14	. 07	2.61	. 52	2
 33	09	3.01	. 47	2
. 48	. 09	1. 24	. 18	2
. 56	. 11	4. 29	. 45	2
. 20	. 08	1. 99	. 30	2
. 47	. 14	2. 92	. 45	2
. 17	. 04	2. 45	. 14	2
. 58	. 04	5.06	. 13	2
. 04	. 01	1. 50	. 71	待判
 06	06	1. 37	. 40	待判



奥运会十项全能运动项目得分数据

百米跑成绩 X_1 跳远成绩 X, 铅球成绩 X_3 跳高成绩 X_4 400米跑成绩 X_5 百米跨栏 X_6 铁饼成绩 X_7 撑杆跳远成绩 X_8 标枪成绩 X_9 1500米跑成绩 X₁₀



Descriptive Statistics

• Sample mean:

$$\overline{x}_j = \frac{1}{n} \sum_{i=1}^n x_{ij}$$
 $j = 1, 2, \dots, p$

• Sample variance:

$$s_j^2 = s_{jj} = \frac{1}{n} \sum_{i=1}^n (x_{ij} - \overline{x}_j)^2$$
 $j = 1, 2, \dots, p$



Sample covariance

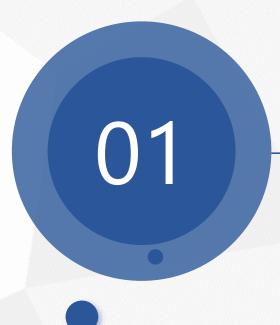
$$s_{jk} = \frac{1}{n} \sum_{i=1}^{n} (x_{ij} - \overline{x}_j)(x_{ik} - \overline{x}_k) \quad j, k = 1, 2, \dots, p$$

Sample correlation

$$r_{jk} = \frac{S_{jk}}{\sqrt{S_{jj}} \sqrt{S_{kk}}} = \frac{\sum_{i=1}^{n} (x_{ij} - \overline{x}_{j})(x_{ik} - \overline{x}_{k})}{\sqrt{\sum_{i=1}^{n} (x_{ij} - \overline{x}_{j})^{2}} \sqrt{\sum_{i=1}^{n} (x_{ik} - \overline{x}_{k})^{2}}}$$

$$= \frac{\sum_{i=1}^{n} (x_{ij} - \overline{x}_{j})(x_{ik} - \overline{x}_{k})}{\sqrt{\sum_{i=1}^{n} (x_{ij} - \overline{x}_{j})^{2}} \sqrt{\sum_{i=1}^{n} (x_{ik} - \overline{x}_{k})^{2}}}$$
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Matrix Algebra and Random Vectors



1.4 Some Basics of Matrix and Vector Algebra

Vector

$$\mathbf{A}_{(n \times p)} = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1p} \\ a_{21} & a_{22} & \cdots & a_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{np} \end{bmatrix}$$



1.4 Some Basics of Matrix and Vector Algebra

矩阵运算

Addition

Scalar multiplication

Matrix multiplication A*B

Transpose A'

Inverse $(n \times n)$ inv(A)

Rank rank(A)

Determinant $(n \times n)$ det(A)

Eigen value and eigenvector [V, D]=eig(A)



Scalar multiplication kA
Matrix multiplication
$$A*B$$

$$A = \begin{pmatrix} 1 & 2 & 3 \\ 2 & 3 & -5 \\ 4 & 7 & 1 \end{pmatrix}$$

$$B = \begin{pmatrix} 1 & 3 & -2 & 2 \\ 0 & 2 & -1 & 3 \\ -2 & 0 & 1 & 5 \end{pmatrix}$$