

## חלק א: סטטיסטיקה תיאורית

$$\bar{x} = \frac{\sum_{i=1}^n x_i}{n} \quad ; \quad \bar{x} = \frac{\sum x f(x)}{n} \quad ; \quad MR = \frac{x_{\max} + x_{\min}}{2} \quad \text{מדדי מרכז:}$$

מדדי פיזור:

$$s_x^2 = \frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n} = \frac{\sum_{i=1}^n x_i^2}{n} - \bar{x}^2$$

$$s_x^2 = \frac{\sum_{i=1}^n (x_i - \bar{x})^2 f(x)}{n} = \frac{\sum_{i=1}^n x_i^2 f(x)}{n} - \bar{x}^2$$

$$s_x = \sqrt{s_x^2}$$

טרנספורמציות: אם  $x' = b \cdot x + a$  אזי:

$$Mo' = b \cdot Mo + a \quad Md' = b \cdot Md + a \quad MR' = b \cdot MR + a$$

$$\bar{x}' = b \cdot \bar{x} + a$$

$$s_{x'}^2 = b^2 s_x^2 \quad s_{x'} = |b| s_x$$

ממוצע משוקלל ושונות מצורפת:

$$\bar{\bar{x}} = \frac{\sum_{j=1}^k \bar{x}_j n_j}{N} \quad ; \quad N = \sum_{j=1}^k n_j \quad ; \quad s_c^2 = \frac{\sum_{j=1}^k n_j s_j^2}{N} + \frac{\sum_{j=1}^k n_j (\bar{x}_j - \bar{\bar{x}})^2}{N}$$

$$Z_x = \frac{x - \bar{x}}{s_x} \quad \text{מדדי מיקום יחסי:}$$

נוסחאות אחוזונים:

$$C_x = \left[ \frac{(x - L_0)}{(L_1 - L_0)} \cdot f(x_m) + F(x_{m-1}) \right] \cdot \frac{100}{n} \quad ; \quad x_C = L_0 + \frac{\frac{n \cdot C}{100} - F(x_{m-1})}{f(x_m)} \cdot (L_1 - L_0)$$

התפלגות נורמלית:

$$P(Z \leq z) = \phi(z) \quad ; \quad P(Z > z) = 1 - \phi(z)$$

$$P(a < Z < b) = \phi(b) - \phi(a) \quad \text{לכל } a < b$$

מדדי קשר:

$$\lambda_{y/x} = \frac{L_y - L_{y/x}}{L_y} \quad ; \quad \lambda_{x/y} = \frac{L_x - L_{x/y}}{L_x}$$

$$r_c = \sqrt{\frac{1}{n(L-1)} \chi^2} = \sqrt{\frac{1}{n(L-1)} \sum_i \frac{(O_i - E_i)^2}{E_i}} \quad ; \quad \phi = \sqrt{\frac{\chi^2}{n}} = \sqrt{\frac{(a \cdot d - b \cdot c)^2}{e \cdot f \cdot r \cdot k}}$$

$$r_s = 1 - \frac{6 \sum_{i=1}^n d_i^2}{n(n^2 - 1)}$$

$$r = \frac{\text{cov}(x,y)}{S_x \cdot S_y} = \frac{1}{n} \sum_{i=1}^n Z_{x_i} * Z_{y_i} = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{n * S_x * S_y} = \frac{\sum_{i=1}^n x_i y_i - n \bar{x} \bar{y}}{n * S_x * S_y}$$

$$= \frac{\sum_{i=1}^n x_i y_i - n \bar{x} \cdot \bar{y}}{\sqrt{\left( \sum_{i=1}^n x_i^2 - n \bar{x}^2 \right) \left( \sum_{i=1}^n y_i^2 - n \bar{y}^2 \right)}} = \frac{n \sum_{i=1}^n x_i y_i - \left( \sum_{i=1}^n x_i \right) \left( \sum_{i=1}^n y_i \right)}{\sqrt{\left[ n \sum_{i=1}^n x_i^2 - \left( \sum_{i=1}^n x_i \right)^2 \right] \left[ n \sum_{i=1}^n y_i^2 - \left( \sum_{i=1}^n y_i \right)^2 \right]}}$$

$$\frac{\sum_{i=1}^n x_i y_i}{n} - \bar{x} \bar{y} = \text{cov}(x, y) = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{n}$$

קו הרגרסיה

$$\tilde{y} = bx + a \quad ; \quad b = \frac{rs_y}{s_x} \quad ; \quad a = \bar{y} - b\bar{x} \quad ; \quad r^2 = \frac{s_{\tilde{y}}^2}{s_y^2}$$

$$\tilde{x} = b' y + a' \quad ; \quad b' = \frac{rs_x}{s_y} \quad ; \quad a' = \bar{x} - b' \bar{y} \quad ; \quad r^2 = \frac{s_{\tilde{x}}^2}{s_x^2}$$

חלק ב: הסתברות

$(N)_k = N * (N - 1) * (N - 2) * \dots * (N - K + 1)$  קומבינטוריקה:

$P(A^c) = 1 - P(A)$  פעולות בקבוצות:  
 $P(A \cup B) = (P(A) + P(B) - P(A \cap B))$

הסתברות מותנית:

$P(B / A) = \frac{P(A \cap B)}{P(A)} \quad (P(A) > 0)$

$P(A \cap B) = P(A) * P(B / A)$

$P(A \cap B) = P(A) * P(B)$  אם ו-B הם מאורעות בלתי תלויים  $(P(B/A) = P(B))$  אם ורק אם

אם  $X \sim B(n, p)$  אזי:

$P(X = k) = \binom{n}{k} p^k (1 - p)^{n-k} \quad ; \quad k = 0, 1, 2, \dots, n$  לכל

$\binom{n}{k} = \frac{n!}{k!(n-k)!} \quad ; \quad n! = n \cdot (n-1) \cdot (n-2) \cdot \dots \cdot 1 \quad ; \quad 0! = 1$

$E(X) = \sum_i x_i P(x_i) = \mu$

$V(X) = \sum_i (x_i - \mu)^2 P(x_i) = \sum_i x_i^2 P(x_i) - \mu^2 = \sigma^2$

$E(X) = np \quad ; \quad V(X) = npq$  אם  $X \sim B(n, p)$  אזי:

$E(Y) = bE(X) + a$  אם  $Y = bX + a$  אזי:

$V(Y) = b^2 V(X) \quad ; \quad \sigma_Y = |b| \sigma_X$

אם  $X_1, X_2, \dots, X_n$  משתנים מקרים אזי:

$E(X_1 + X_2 + \dots + X_n) = E(X_1) + E(X_2) + \dots + E(X_n)$

אם  $X_1, X_2, \dots, X_n$  משתנים מקריים בלתי תלויים בזוגות, אזי:

$V(X_1 + X_2 + \dots + X_n) = V(X_1) + V(X_2) + \dots + V(X_n)$

נספח ב – טבלאות התפלגות

פונקציית ההתפלגות המצטברת של משתנה נורמלי סטנדרטי,  $\Phi(z)$

$z$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998

טבלת עזר:  $z$  כפונקציה של  $\Phi(z)$

$\Phi(z)$	$z$	$\Phi(z)$	$z$	$\Phi(z)$	$z$
.50	0	.91	1.341	.995	2.576
.55	.126	.92	1.405	.999	3.090
.60	.253	.93	1.476	.9995	3.291
.65	.385	.94	1.555	.9999	3.719
.70	.524	.95	1.645	.99995	3.891
.75	.674	.96	1.751	.99999	4.265
.80	.842	.97	1.881	.999995	4.417
.85	1.036	.98	2.054	.999999	4.753
.90	1.282	.99	2.326	.9999999	5.199