All distributions
2, 17

Bernoulli:
*1 1 trial
*2 2 Possible Outcome

P.M.F. : $P(X=x) = p^{x}(1-p)^{1-x}$
Expectation: $E(x) = p$
Variance: $V(x) = p(1-p)$

$x = 0, 1$

$^{20}C_7 = \binom{20}{7}$

single coin toss.
ছক্কার 6 আসার সম্ভাবনা
dice trow করলে even আসার সম্ভাবনা। (counts number of success) (for both)

BiNomial:
*1 n trial
*2 two (2) possible outcome
*3 every trials are independent.
toss a coin for 5 times.
* highest value = trial সংখ্যার সমান।
*4 x indicates number of success

P.M.F. : $P(X=x) = \binom{n}{x} p^{x}(1-p)^{n-x}$
Expectation: $E(x) = np$
Variance: $V(x) = np(1-p)$

$x = 0, 1, 2, \dots, n$

Binomial: number of trials are fixed. Variance ≤ Mean

difference

Poisson: (1) Number of trials are infinite. variance = Mean

Poisson:
*1 counts number of events that occur within in a time interval.
*2 নির্দিষ্ট সময়ে কতবার আসলো/ উঠলো।
*3 যখন x কোনো number of events, অর্থাৎ Random variable-এর trial সংখ্যা fixed থাকবে না। তখন Poisson Dis-- follow করবে।
*4 x indicates number of events/counts number of events.

P.M.F: $P(X=x) = \frac{e^{-\lambda}\lambda^{x}}{x!}$
Expectation: /Average Value $E(x) = \lambda$
Variance: $V(x) = \lambda$

$x = 0, 1, 2, 3, \dots \infty$

λ হচ্ছে parameter. unknown value/ quantity.

Geometric:
*1 number of trial is not fixed.
*2 The experiment will continue until the first success occurs.
*3 so success fixed = 1. trial সংখ্যা unknown.
*4 x indicates number of trial.
$x \neq 0$. P indecates the probablity.
1বার H না পাওয়া পর্যন্ত toss করে যাচ্ছি।

P.M.F: $P(X=x) = (1-p)^{(x-1)} p$
Expectation: $E(x) = 1/p$
Variance: $V(x) = \frac{1-p}{p^2}$

$x = 1, 2, 3, \dots \infty$

Negative binomial:
*1 Extention of geomatric distribution.
*2 The experiment will continue until the r^{th} success occur.
*3 $r > 1$. & r indicates number of success
*4 No. of trial is not fixed
*5 P indecates the probablity.

P.M.F: $P(X=x) = \binom{x-1}{r-1} \times (1-p)^{(x-r)} \times p^{r}$
Expectation: $E(x) = r/p$
Variance: $V(x) = \frac{r(1-p)}{p^2}$

$x = r, r+1, r+2, \dots \infty$
$r > 1$

Normal :

*1 a func of continuous random var.

Exam-এর জন্য থাকবে N.Dist...

*2 range of random var $-\infty < x < \infty$

*3 " " μ (mu) $-\infty < \mu < \infty$

*4 " " variance (σ^2) $0 \le \sigma^2 < \infty$

P.D.F.: $f(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$ $-\infty < x < \infty$, $-\infty < \mu < \infty$, $0 \le \sigma^2 < \infty$

Expectation: $E(x) = \mu$

Variance: $V(x) = \sigma^2$

Standard Normal Distribution:

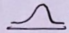
*1 $\mu = 0$
$\sigma^2 = 0$

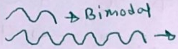
P.D.F: $f(z) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}z^2}$

Property of Normal distribution

1) symmetric func. (দেখতে হবে তাহলে আর কিছু check দিয়ে। যেকোনো Pvalue > 0.5 হলে Normal
Pvalue < 0.5 " Not "

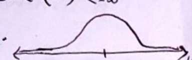
2) Mean (Average Value) = Mode (Maximam Value) = Median (middle point).

3) Unimodal (only one peak point. )



4) The total Area ($\int_{-\infty}^{\infty} f(x)\,dx$) under the curve is equal (=) to one (1) ($\int_{-\infty}^{\infty} f(x)\,dx = 1$)

5) The normal curve approaches, but not touches the x-axis.



Transformation:

$$f(x) = \int_{-\infty}^{\infty} \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} dx$$ Normal dist...

$$= \int_{-\infty}^{\infty} \frac{1}{\sqrt{2\pi}\,\sigma} e^{-\frac{1}{2}z^2} \sigma\,dz = \int_{-\infty}^{\infty} \frac{1}{\sqrt{2\pi}} e^{-\frac{z^2}{2}} dz$$ Standard N. dis

$z = \frac{x-\mu}{\sigma} = \frac{x}{\sigma} - \frac{\mu}{\sigma}$

$\frac{dz}{dx} = \frac{1}{\sigma}$

$\therefore dx = \sigma\,dz$.

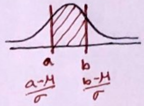
Probablity Calculation for Normal Distribution.

(i) $P(a < x < b)$

$= P\left(\frac{a-\mu}{\sigma} < \frac{x-\mu}{\sigma} < \frac{b-\mu}{\sigma}\right)$

$= P\left(\frac{a-\mu}{\sigma} < z < \frac{b-\mu}{\sigma}\right)$

$= F\left(\frac{b-\mu}{\sigma}\right) - F\left(\frac{a-\mu}{\sigma}\right)$



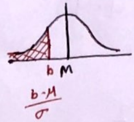
(ii) $P(x < b)$

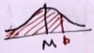
$= P(-\infty < x < b)$

$= P\left(\frac{-\infty-\mu}{\sigma} < \frac{x-\mu}{\sigma} < \frac{b-\mu}{\sigma}\right)$

$= P\left(-\infty < z < \frac{b-\mu}{\sigma}\right)$

$= F\left(\frac{b-\mu}{\sigma}\right)$





(iii) $P(x > a)$

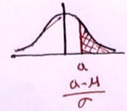
$= P(a < x < \infty)$

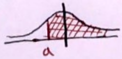
$= P\left(\frac{a-\mu}{\sigma} < \frac{x-\mu}{\sigma} < \frac{\infty-\mu}{\sigma}\right)$

$= P\left(\frac{a-\mu}{\sigma} < z < \infty\right)$

$= F(\infty) - F\left(\frac{a-\mu}{\sigma}\right)$

$= 1 - F\left(\frac{a-\mu}{\sigma}\right)$





F(sth)-এর মান আমরা
page 787-795 -এর মধ্যে পাবো
আর না পাইলে lik $F(-4) = 0$
$F(4) = 1$

follows

$x \sim$ any distribution & the sample size is large ($n \geq 30$), population mean or expected value of $x = \mu$ & population variance $= V(x)$

∴ Average value of the random variable,

$$\bar{X} \sim N\left(E(x), \frac{V(x)}{n}\right) \equiv \bar{x} \sim N\left(E(\bar{x}), V(\bar{x})\right)$$

যার ও distribution-ই হোক x, কিন্তু $\bar{x}$ normal distribution follow করে।

Exp

if, $\bar{X} \sim N\left(\mu, \frac{\sigma^2}{n}\right)$ * $[E(cx) = cE(x)]$ * $V(cx) = c^2 V(x)$

∴ Expectation, $E(\bar{x}) = \mu$

$\therefore E\left(\sum_{i=1}^{n} x_i\right) = n\mu$

Variance, $V(x) = \frac{\sigma^2}{n}$

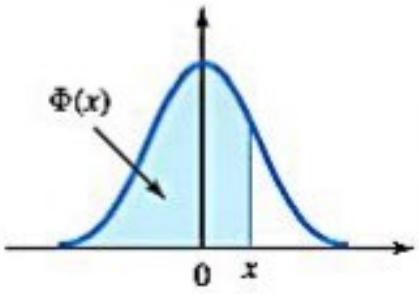
$\therefore V\left(\sum_{i=1}^{n} x_i\right) = \frac{n^2\sigma^2}{n}$

$= n\sigma^2$

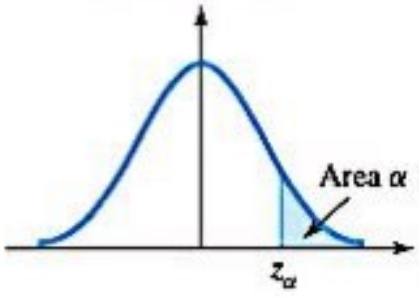
$$\bar{X} \sim N\left(\mu, \frac{\sigma^2}{n}\right)$$

$$\sum_{i=1}^{n} \bar{x}_i \sim N(n\mu, n\sigma^2)$$

Table I: Cumulative Distribution Function of the Standard Normal Distribution



Critical Points



α	z_α
0.10	1.282
0.05	1.645
0.025	1.960
0.01	2.326
0.005	2.576

x	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
−3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
−3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
−3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
−3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
−3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
−2.9	0.0019	0.0018	0.0017	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
−2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
−2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
−2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
−2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
−2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0061
−2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
−2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
−2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
−2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
−1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
−1.8	0.0359	0.0352	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
−1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
−1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
−1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
−1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0722	0.0708	0.0694	0.0681
−1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
−1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
−1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
−1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
−0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
−0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
−0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
−0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
−0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
−0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
−0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
−0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
−0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
−0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641

(Continued on next page)

x	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5339
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9019	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9278	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9610	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998