لجان الدفعات

STATISTICS

MORPHINE ACADEMY

Probability Distribution

Discrete

Binomial Distribution

هي من توزيعات الاحتمالات المنفصلة التي تُستخدم
لوصف التجارب العشوائية التي تتكون من عدد معين من التجارب
ولكل تجربة نتيجتان ← نجاح / ← فشل.

Continuous

Normal Distribution

Example: Binomial Experiment

Testing the effectiveness of a drug

- Suppose that 10 patients with identical infirmities take a drug, for each patient, it s observed whether the drug is effective or not effective. Thus a success is a cure and failure is a non-cure.

$n = 10$
علاج $p = 70\%$
$q = 30\%$
independent (لأنه شفاء المريض لا يؤثر ع مريض آخر)

- The probability of success, p, is the effectiveness of the drug cures a patient, the probability of failure, q=1-p, is the probability that the drug does not cure a patient.

- Finally, we can assume that the results of administering the drug are independent from one patient to another. Hence the conditions of Binomial experiment are met.

ليش التوزيع الي ذكرناه هوه ثنائي؟

* التجربة تتكون من 10 تجارب متشابهة.
* كل تجربة الها نجاح او فشل فقط.
* احتمالية النجاح ثابتة.
* النتائج مستقلة.

اخذناه بالتوجيهي.

وكان معنا قانون لحسابه ع سرعة التوجيهي

$$P(X=k) = \binom{n}{k} p^{k} q^{n-k}$$

$\binom{n}{k}$: عدد الطرق لاختيار k نجاح من n تجربة.

ع سبيل المثال الي اخذناه : $P(X=7)$ لـ $p=0.7 , n=10$

Binomial Distribution Thinking Challenge

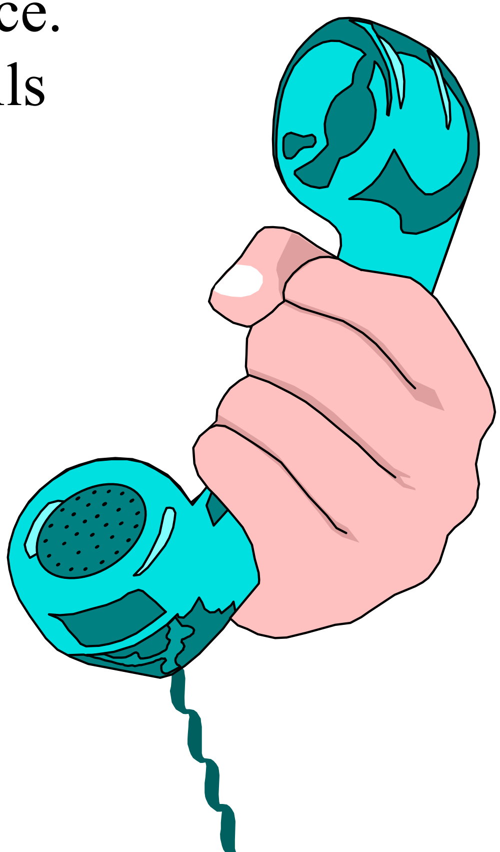
You're a telemarketer selling service. You've sold 20 in your last 100 calls (***p* = .20**). If you call **12** people tonight, what's the probability of

A. No sales?

B. Exactly 2 sales?

C. At most 2 sales?

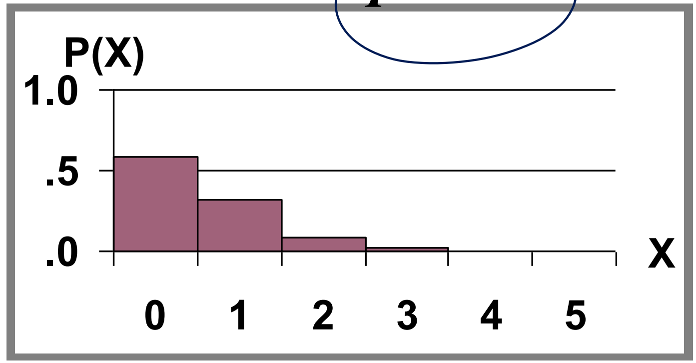
D. At least 2 sales?



Binomial Distribution Characteristics

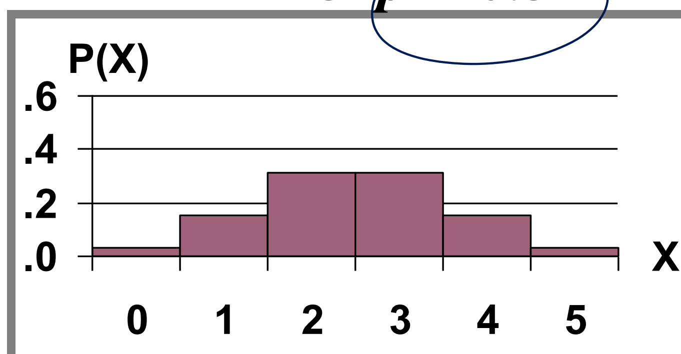
Positive

$n = 5 \quad p = 0.1$



symmetric.

$n = 5 \quad p = 0.5$



Mean

$$\mu = E(x) = np$$

Standard Deviation

$$\sigma = \sqrt{npq}$$

$$\sigma = \sqrt{5 * 0.2 * 0.8} = \sqrt{0.8} \approx 0.89$$

Recall that q = 1 - p

Example

- Suppose it is known a new drug is successful in curing a muscular pain in 22% of the cases. If it is tried on a random sample of 5 patients, then answer the following:

المعطيات:

$n = 5$

$p = 0.22$

$q = 1 - p = 0.78$

$x \sim Bin(5, 0.22)$

a) Find the probability that:

1) No one of patient will be cured?
2) Exactly 3 patients will be cured?
3) At least 2 patients will be cured?
4) At most 4 patients will be cured?
5) From 1 to 4 patients will be cured?

b) Find the mean and standard deviation for the distribution of the number of patients who are cured?

c) What is the approximate shape for the distribution of the number of patients who are cured?

Solution

- n=5, p=0.22, X~Bin(5,0.22)

$$P(X=0)=\binom{5}{0}(0.22)^0(0.78)^{5-0}=\frac{5!}{0!5!}(1)(0.289)=(1)(1)(0.289)=0.289$$

$$P(X=1)=\binom{5}{1}(0.22)^1(0.78)^{5-1}=\frac{5!}{1!4!}(0.22)(0.370)=(5)(0.22)((0.370)=0.407$$

$$P(X=2)=\binom{5}{2}(0.22)^2(0.78)^{5-2}=\frac{5!}{2!3!}(0.0484)(0.475)=(10)(0.0484)((0.475)=0.229$$

$$P(X=3)=\binom{5}{3}(0.22)^3(0.78)^{5-3}=\frac{5!}{3!2!}(0.010648)(0.6084)=(10)(0.010648)(0.6084)=0.065$$

$$P(X=4)=\binom{5}{4}(0.22)^4(0.78)^{5-4}=\frac{5!}{4!1!}(0.00234256)(0.78)=(5)(0.00234256)(0.78)=0.009$$

$$P(X=4)=\binom{5}{5}(0.22)^5(0.78)^{5-5}=\frac{5!}{5!0!}(0.0005153632)(1)=(1)(0.0005153632)(1)=0.001$$

Continued

x	0	1	2	3	4	5	sum
P(X=x)	0.289	0.407	0.229	0.065	0.009	0.001	1

a) The probability:

1) Probability that no one of patients will be cured = $P(X=0)=0.289$.
2) Probability that exactly 3 patients will be cured $=P(X=3)=0.065$.
3) Probability that at least 2 patients will be cured = $P(X \geq 2)$

$= P(X=2)+P(X=3)+P(X=4)+P(X=5)$

$= 0.229+0.065+0.009+0.001$

$= 0.304$ **OR**

The probability that at least 2 patients will be cured

$= P(X \geq 2) = 1- P(X<2)$

$= 1-(P(X=0)+P(X=1))$

$= 1-(0.289+0.407) = 1- 0.696 = 0.304$

Continued

4) Probability that at most 4 patients will be cured

$= P(X \leq 4)$

$= P(X=0)+P(X=1)+P(X=2)+P(X=3)+P(X=4)$

$= 0.289+0.407+0.229+0.065+0.009 = 0.999$

OR

Probability that at most 4 patients will be cured

$= P(X \leq 4) = 1 - (P > 4) = 1 - (P(X=5) = 1 - 0.001 = 0.999$

5) Probability that from 1 to 4 patients will be cured

$= P(1 \leq X \leq 4)$

$= P(X=1)+P(X=2)+P(X=3)+P(X=4)$

$= 0.407+0.229+0.065+0.009$

$= 0.71$

Continued

b) The mean and the standard deviation for the number of patients who are cured can be calculated as follows:

- The mean $\mu = E(x) = np$

$$= (5)(0.22) = 1.1 \text{ patients}$$

- The standard deviation $\boxed{\sigma = \sqrt{npq}}$

$$\sigma = \sqrt{np(1-q)} = \sqrt{(5)(0.22)(0.78)} = 0.926 \text{ patient.}$$

c) The approximate shape of the distribution of the number of patients who are cured is right-skewed (positive) because p = 0.22 which is less than 0.5.

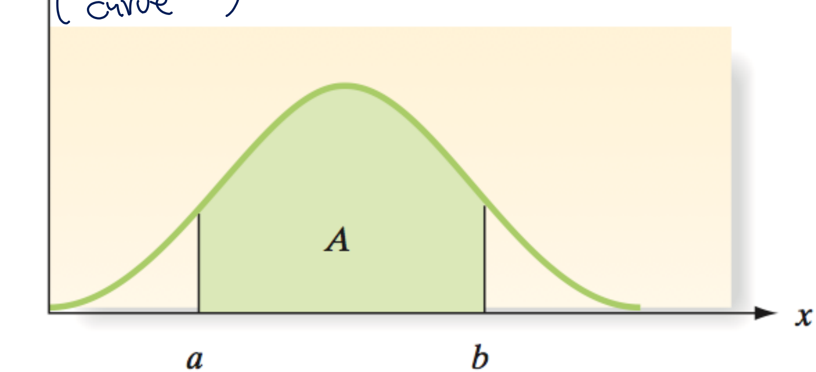
p = 0.22 < 0.5

(Right-skewed) posivie

Continuous Probability Density Function

The graphical form of the probability distribution for a continuous random variable x is a smooth curve

لما يكون المتغير العشوائي x (مستمر) {زي الطول/الوزن/الوقت}، فإن توزيع الاحتمال الخاص فيه لا يُعبّر عنه بنقاط منفصلة، وإنما بمنحنى سلس (smooth curve)



Probability Distributions for Continuous Random Variables

The Normal Distribution

Probability Density Function
(pdf)

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}}\, e^{-\left(\frac{1}{2}\right)\left(\frac{x-\mu}{\sigma}\right)^2}$$

where

μ = Mean of the normal random variable x

σ = Standard deviation

$\pi = 3.1415\ldots$

$e = 2.71828\ldots$

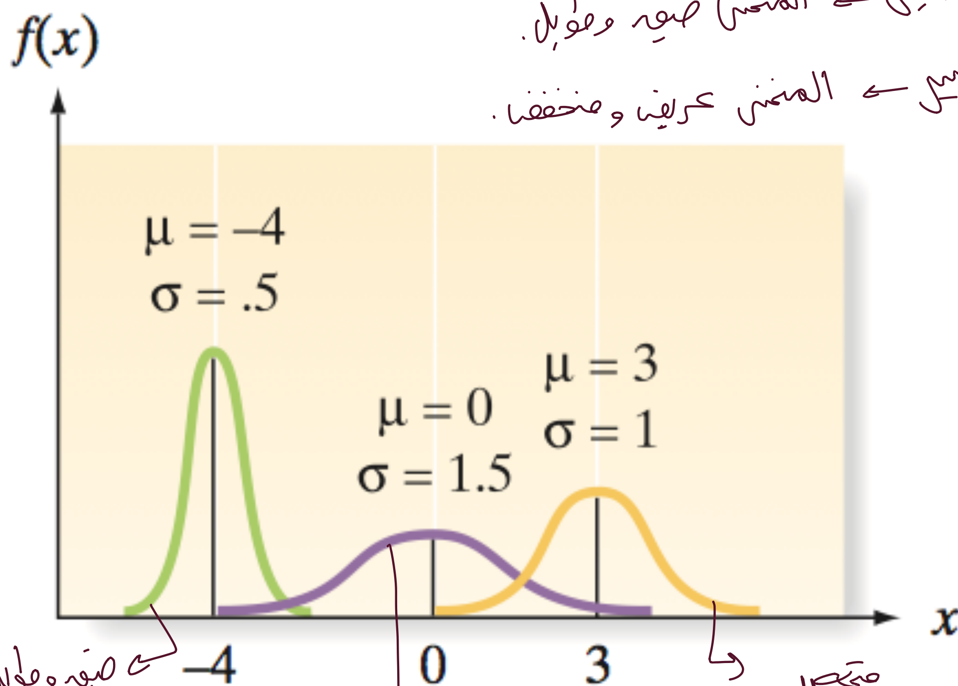
$P(x < a)$ is obtained from a table of normal probabilities μ ← يحدد موقع المنحنى على المحور الأفقي .

σ ← يحدد عرض المنحنى .

Effect of Varying Parameters (μ & σ)

اذا كان σ صغير ← المنحنى ضيق وطويل .

" " σ كبير ← المنحنى عريض ومنخفض .



← ضيق وطويل (اليسار)

اوسع واوسط

متجه لليمين .

The Beauty of the Normal Curve

- Note that, when X is normally distributed with the mean μ and standard deviation σ, then we refer to that as follows: $\boldsymbol{X \sim N(\mu, \sigma^2)}$.
- Example: 68-95-99 Rule

The Hashemite University students intelligence scores (X) are normally distributed with μ = 100 and σ =15; that is $\boldsymbol{X \sim N(100, 255)}$.

- **68% of scores within μ ± σ =100 ± 15=85 to 115**
- **95% of scores within μ ± 2σ =100 ± (2)(15) = 70 to 130**
- **99.7% of scores within μ ± 3σ =100 ± (3)(15) = 55 to 145**

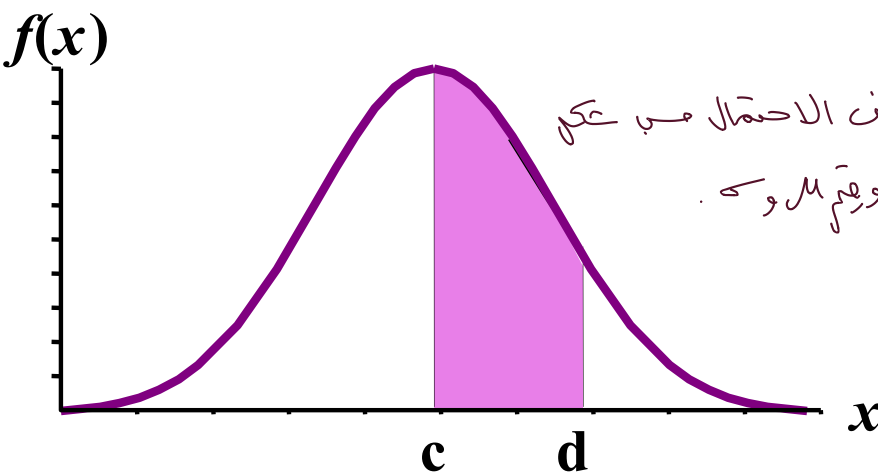
Normal Distribution Probability

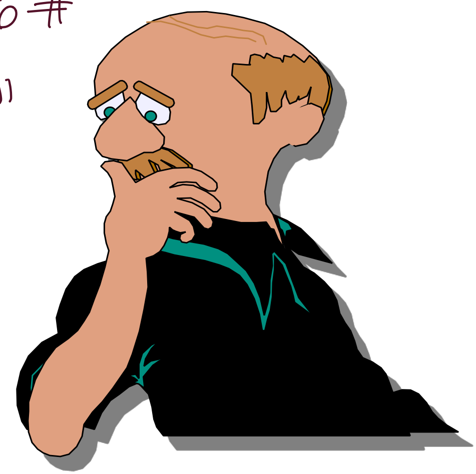
الاحتمال = المساحة تحت المنحنى
بين الفترتين a و b .

Probability is area under curve!

$$P(c \le x \le d) = \int_c^d f(x)dx\,?$$

طبعًا يختلف الاحتمال حسب شكل
المنحنى وقيم a و b .



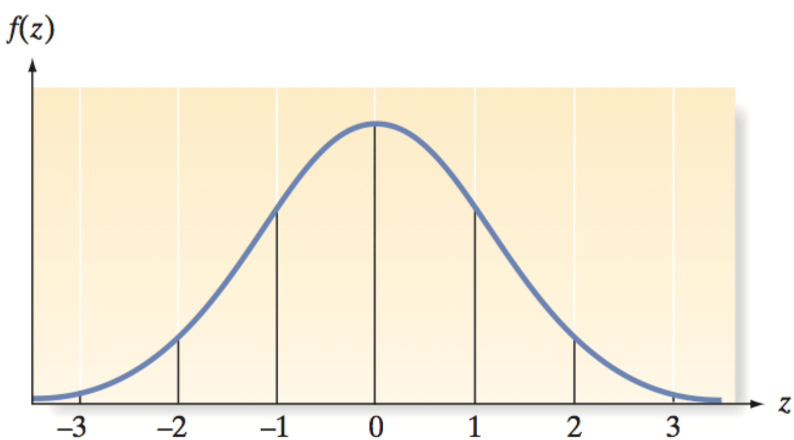


Standard Normal Distribution

The **standard normal distribution** is a normal distribution with $\mu = 0$ and $\sigma = 1$. A random variable with a standard normal distribution, denoted by the symbol z, is called a standard normal random variable.

Z~N(0, 1).

كل التوزيعات الطبيعية
ممكن نحولها لتوزيع
معياري للتسهيل.



وهاد بسمح
باستخدام جداول
z بدل حسابات
معقدة.

Property of Normal Distribution

If x is a normal random variable with mean μ and standard deviation σ, then the random variable z, defined by the formula

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

has a standard normal distribution. The value z describes the number of standard deviations between x and μ.

انه اذا كان عندي متغير x يتبع توزيع طبيعي بمتوسط μ وانحراف معياري σ ،

فبقدر احوله لمتغير عياري Z .

انه يمكن تحويل اي توزيع طبيعي الى توزيع طبيعي معياري باستخدام الصيغة :

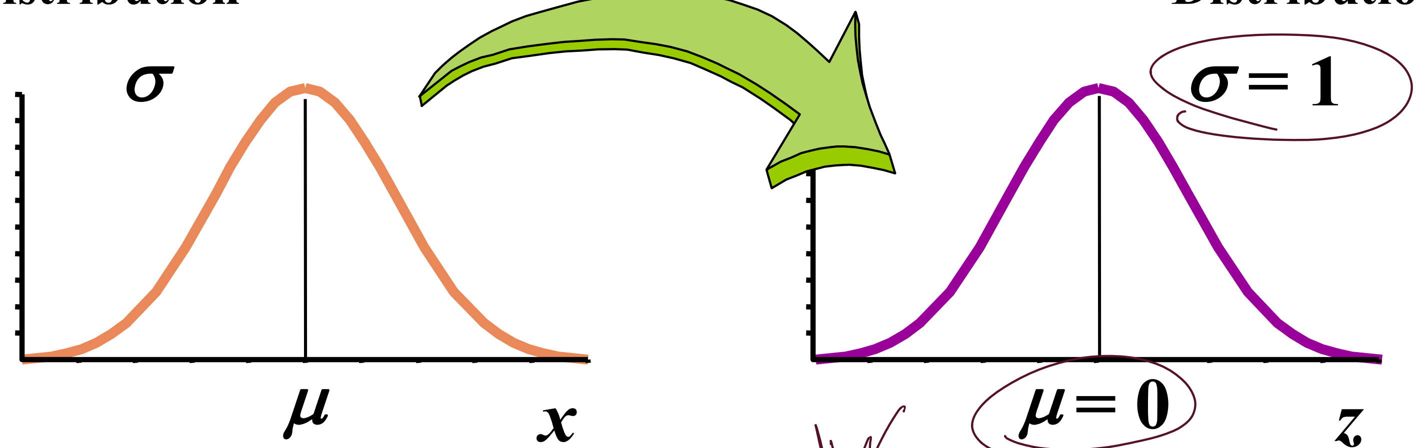
$z = \frac{x-\mu}{\sigma}$

Standardize the Normal Distribution

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

Normal Distribution

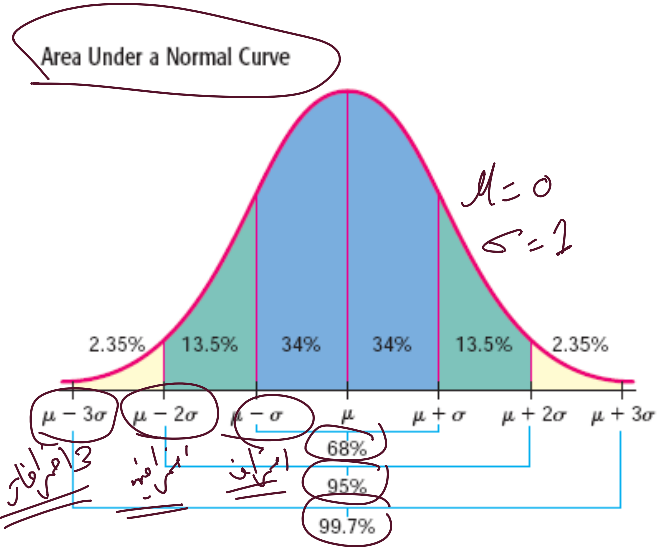
Standardized Normal Distribution

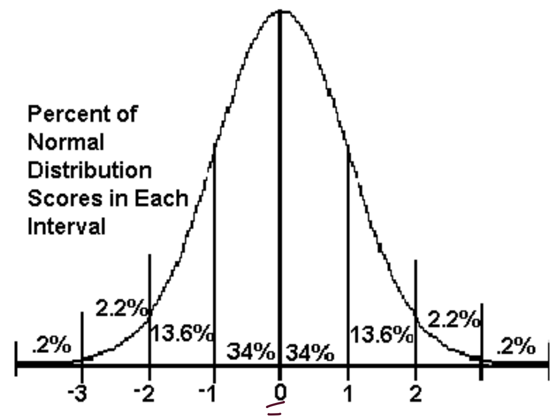


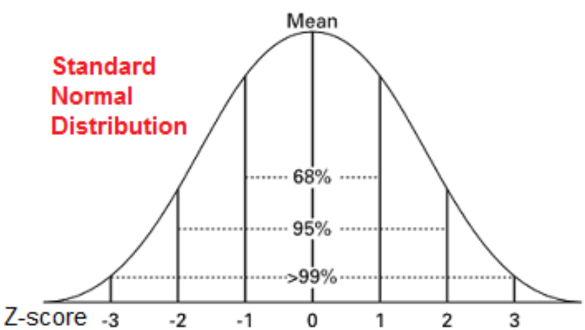
الناتج

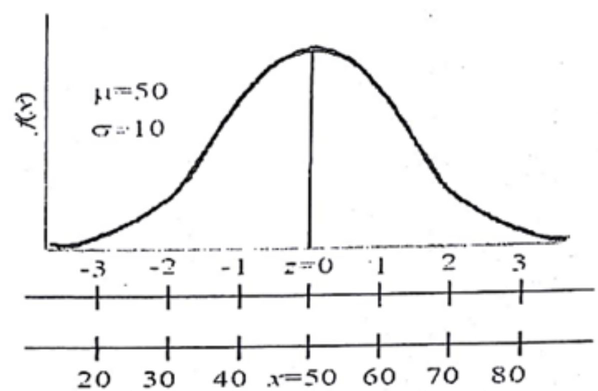
One table!

Standard Normal Distribution

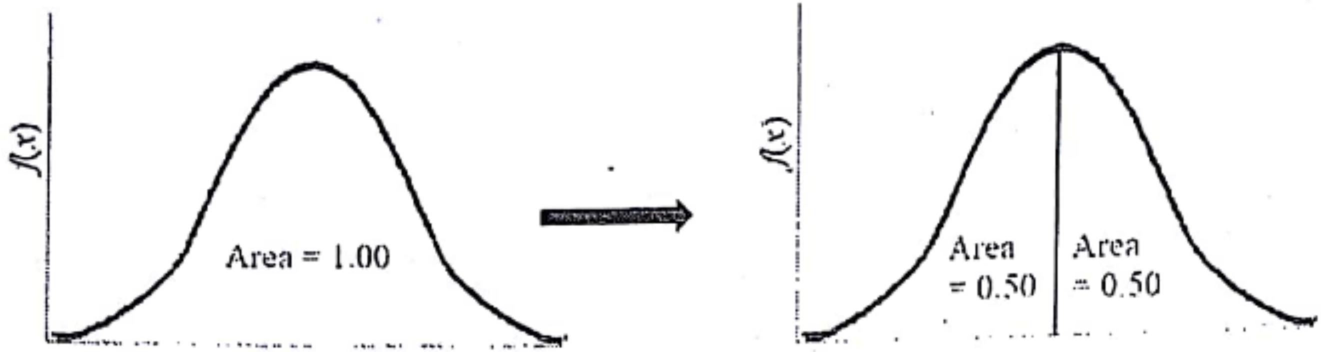






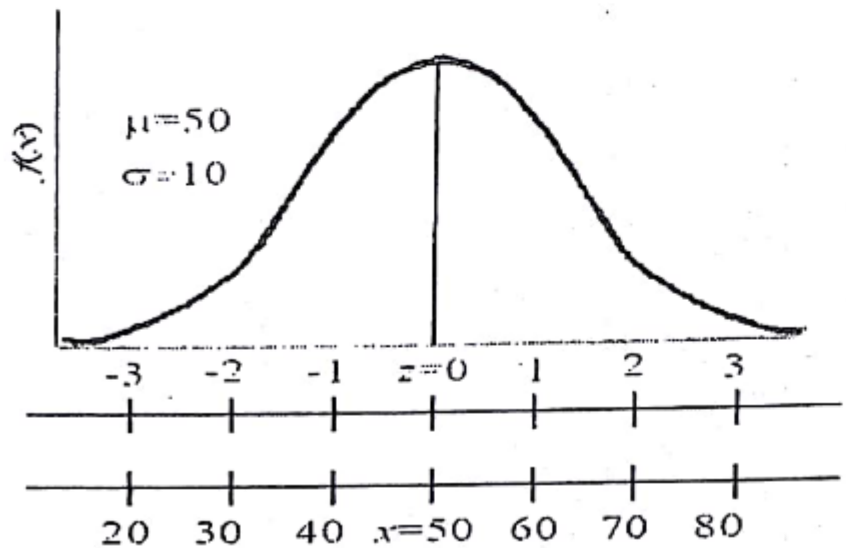


STANDARD NORMAL DISTRIBUTION



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

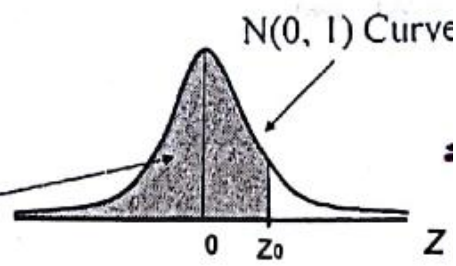
or, $X = \mu + z\sigma$



Finding Areas Under the Standard Normal Curve

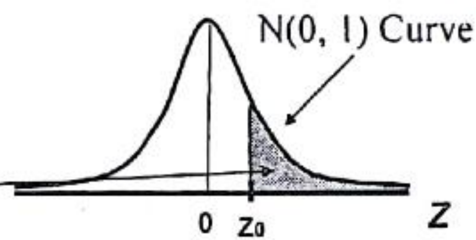
(a) To find the area to the *left* of z_0, find the area that corresponds to z_0 in the Standard Normal Table by using the following rule:

$$P(Z \leq z_0) = N(z_0)$$



(b) To find the area to the *right* of z_0, use the Standard Normal Table to find the area that corresponds to *left* of z_0. Then subtract the area from 1 by using the following formula:

$$P(Z > z_0) = 1 - P(Z \leq z_0) = 1 - N(z_0)$$



Or

$$P(Z > z_0) = P(Z \leq -z_0) = N(-z_0)$$

Non-standard Normal $\mu = 5$, $\sigma = 10$: $P(5 < x < 6.2)$

0= 0.5 0.12 = 0.5478

P(0 < z < 0.12)= **0.5478 – 0.5 =0.0478**

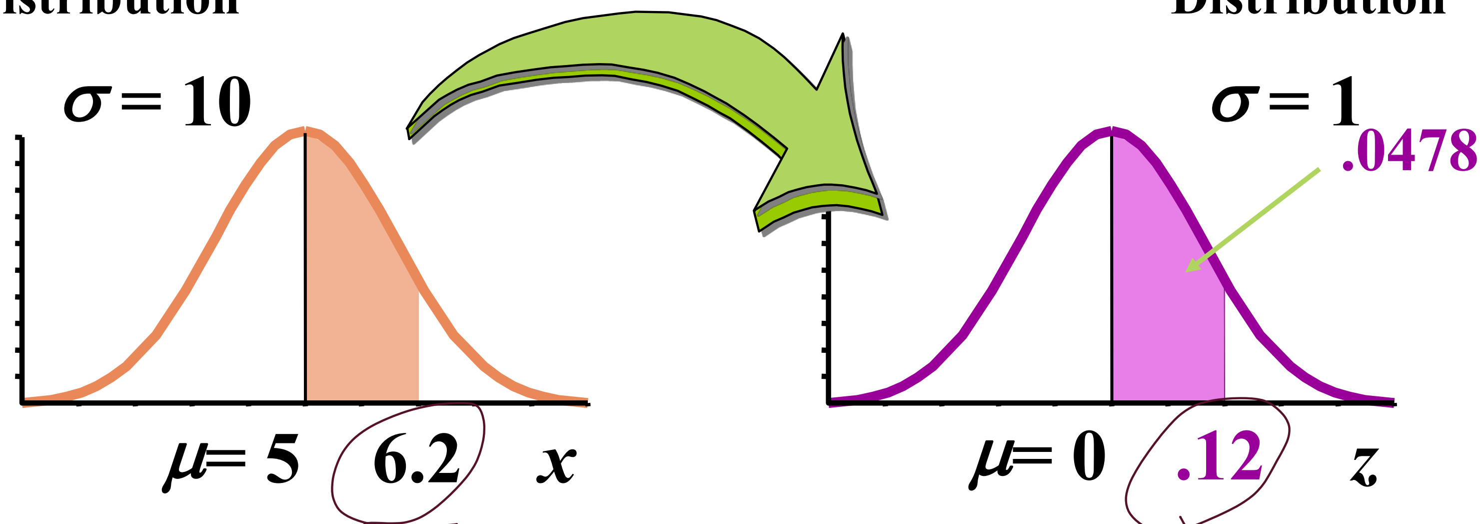
$\boxed{0 < z < 0.12}$

$$z = \frac{x - \mu}{\sigma} = \frac{6.2 - 5}{10} = .12$$

Z=(5-5)/10=0

Normal Distribution

Standardized Normal Distribution



Shaded area exaggerated

The Standard Normal Table:
$P(0 < z < 1.96)$

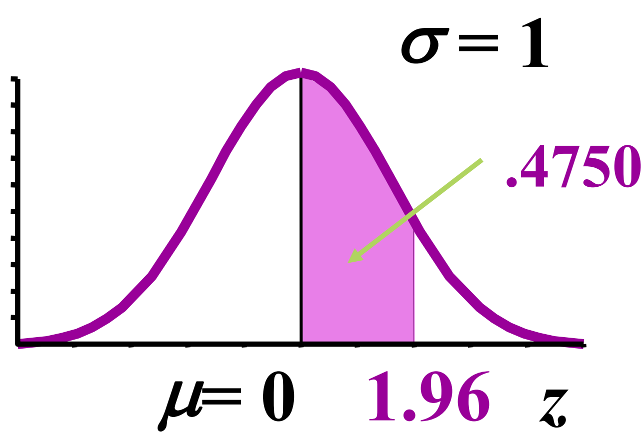
Standardized Normal Probability Table

Z	.04	.05	.06
1.8	.96512	.96784	.96856
1.9	.97381	.97441	.97500
2.0	.97932	.9798	.98030
2.1	.98382	.98422	.984616

Probabilities

0= 0.5 1.96 = 0.9750

P(0 < z < 0.12)= 0.9750 – 0.5 = 0.4750



Shaded area exaggerated

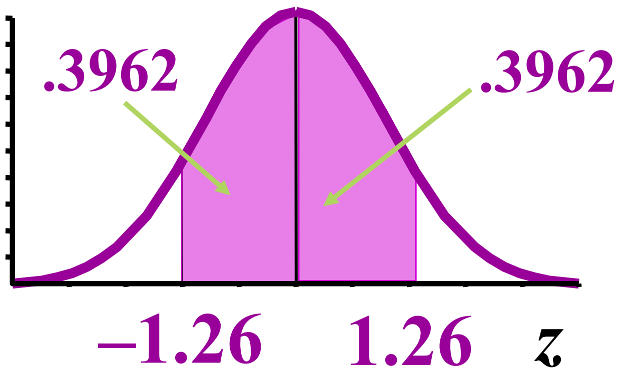
The Standard Normal Table:
$P(-1.26 \le z \le 1.26)$

Standardized Normal Distribution

$\sigma = 1$

-1.26 = 0.1038 1.26 = 0.8962

P(-1.26 ≤ z ≤ 1.26)= **0.8962 – 0.1038 = 0.7924**



$\mu = 0$

Shaded area exaggerated

$P(-1.26 \le z \le 1.26)$

$= 0.8962 - 0.1038$

$= 0.7924$

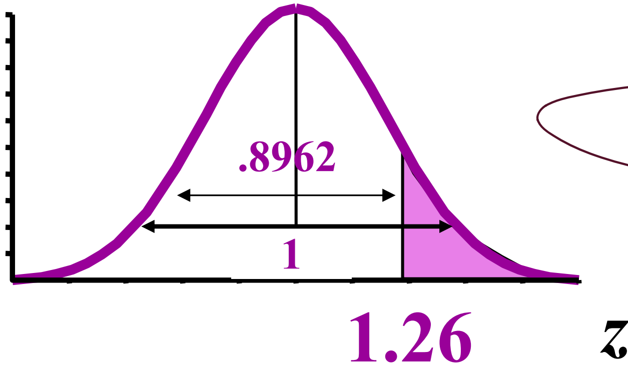
لنفس الاحتمالية بين $Z=-1.26$ و $Z=1.26$

$P(Z \le 1.26) \approx 0.8962$ من الجدول

The Standard Normal Table: $P(z > 1.26)$

Standardized Normal Distribution

$\sigma = 1$



$\mu = 0$

$P(z > 1.26) = 1 - P(z \leq 1.26$

$= 1 – .8962$

$= .1038$

Or

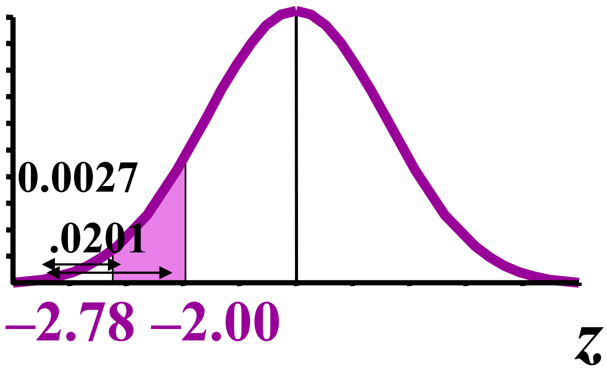
$P(z > 1.26) = P(z \leq -1.26)$

$= .1038$

The Standard Normal Table: $P(-2.78 \leq z \leq -2.00)$

Standardized Normal Distribution

$\sigma = 1$



$\mu = 0$

Shaded area exaggerated

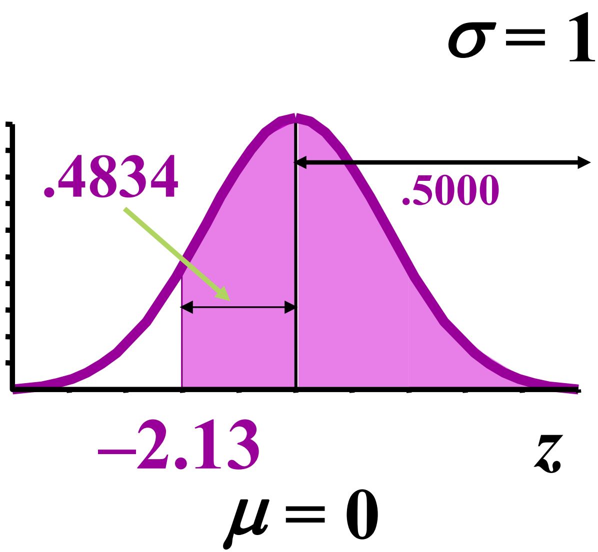
$P(-2.78 \leq z \leq -2.00)$

$= .0228 - .0027$

$= .0201$

The Standard Normal Table: $P(z > -2.13)$

Standardized Normal Distribution



Shaded area exaggerated

$P(z > -2.13) = P(z \leq 2.13)$

$= 0.9834$

OR

$P(z > -2.13) = 1 - P(z \leq -2.13)$

$= 1 - 0.0166$

$= .9834$

يعني أول اشي :

① تحديد الاحتمالية المطلوبة :

• حدد النطاق اللي بدك تحسب اله الاحتمالية

مثل $P(a < Z < b)$ او $P(Z > c)$.

② تحويل الى قيمة Z :

• اذا كان التوزيع غير قياسي، استخدم الصيغة : $Z = \frac{x-\mu}{\sigma}$

• احسب قيمة Z لكل حد بالنطاق (مثل Z_1 و Z_2).

③ استخدام جدول Z :

• ارجع لجدول التوزيع الطبيعي القياسي لإيجاد الاحتمالية المتراكمة

$P(Z \le z)$ لكل قيمة Z.

• الجدول يعطيك المنطقة من اليسار $(-\infty)$ الى Z المحدد

④ حساب الاحتمالية:

• لنطاق بين قيمتين $P(z_1 < Z < z_2)$:

$$P(z_1 < z < z_2) = P(Z \le z_2) - P(Z \le z_1)$$

• للقيم الأكبر من Z $P(Z > z)$:

$$P(Z > z) = 1 - P(Z \le z)$$

• استخدم التناظر (لأنه المنحنى متماثل) إذا لزم الأمر:

$$P(Z > z) = P(Z < -z)$$

وهي خلاصة طريقة الحل إن شاء الله.

Non-standard Normal μ = 5, σ = 10:

$$P(3.8 \le x \le 5)$$

$$z = \frac{x-\mu}{\sigma} = \frac{3.8-5}{10} = -.12$$

Z score for -.12= 0.4522

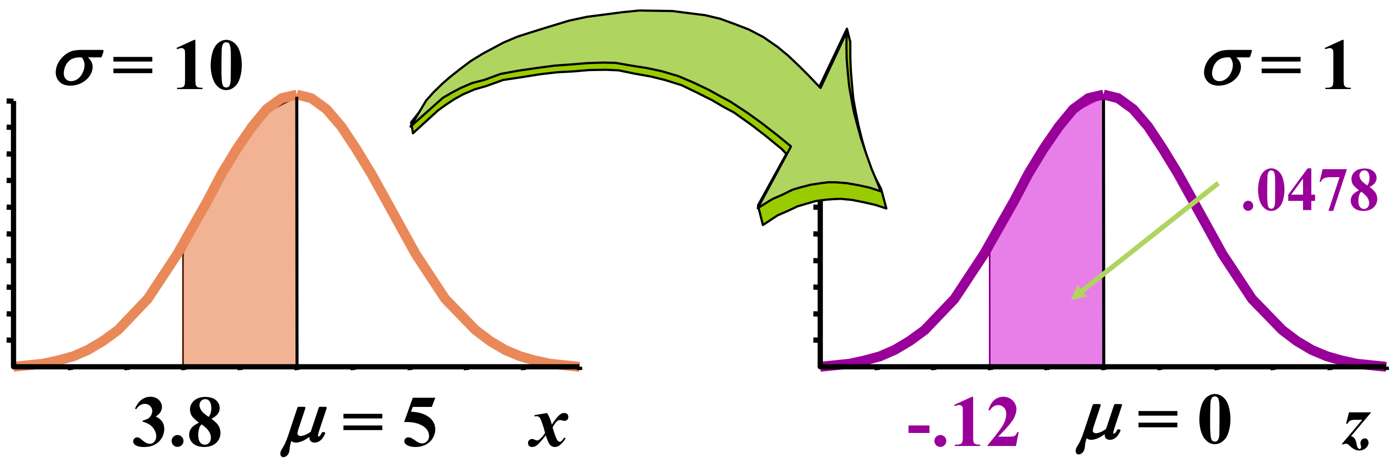
P(-.12 ≤ z ≤ **0)**

=**0.5-**0.4522

=0.0478

Normal Distribution

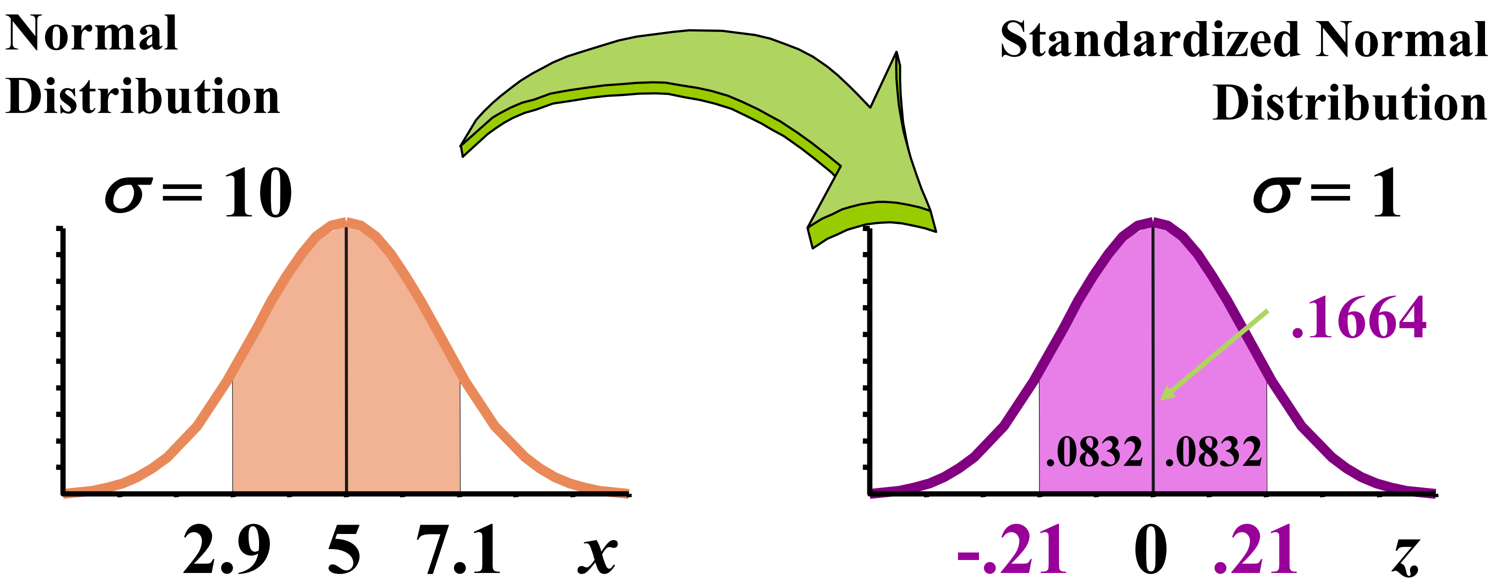
Standardized Normal Distribution



Shaded area exaggerated

Non-standard Normal $\mu = 5$, $\sigma = 10$: $P(2.9 \le x \le 7.1)$

$$z = \frac{x - \mu}{\sigma} = \frac{2.9 - 5}{10} = -.21 \qquad z = \frac{x - \mu}{\sigma} = \frac{7.1 - 5}{10} = .21$$



Shaded area exaggerated

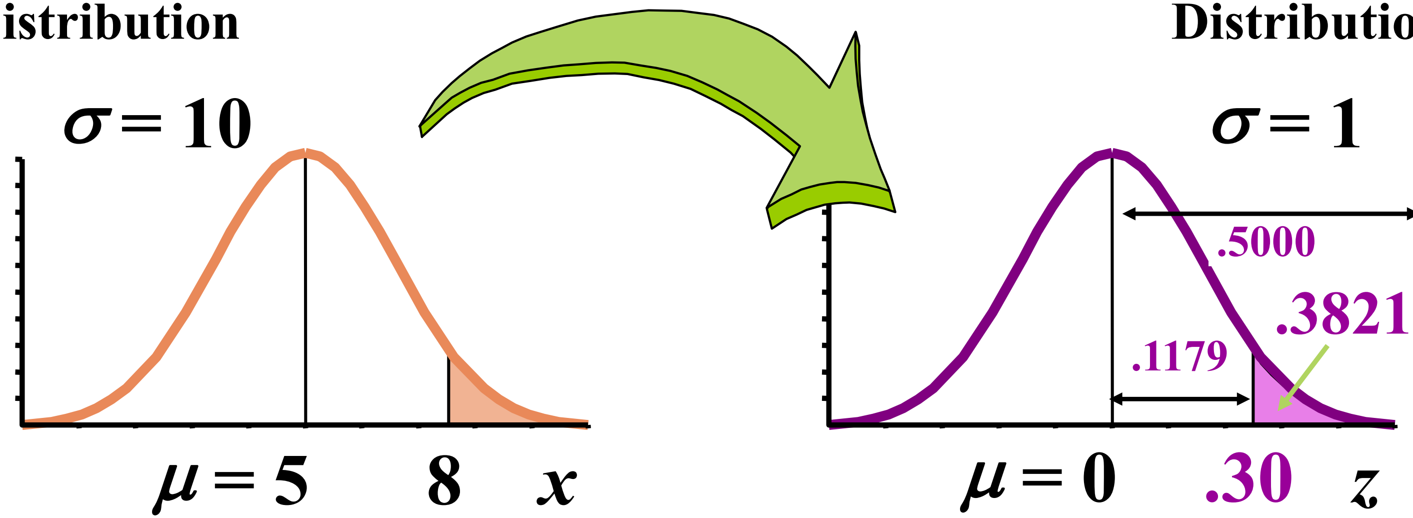
$P(-.21 \le z \le 0.21)$
$=0.5832-0.4522$
$=0.1664$

Non-standard Normal $\mu = 5$, $\sigma = 10$: $P(x \geq 8)$

$$z = \frac{x - \mu}{\sigma} = \frac{8 - 5}{10} = .30$$

Normal Distribution

Standardized Normal Distribution



Shaded area exaggerated

$P(z \geq 0.3) = 1 - P(z \leq 0.3)$

$= 1 - 0.6179$

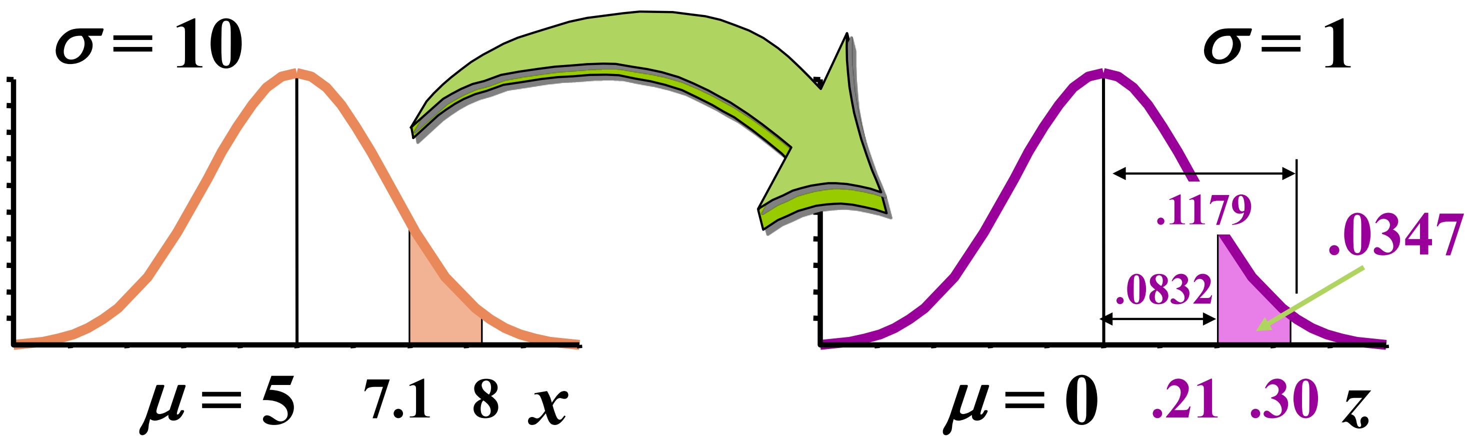
$= 0.3821$

Non-standard Normal μ = 5, σ = 10: P(7.1 ≤ *X* ≤ 8)

$$z = \frac{x-\mu}{\sigma} = \frac{7.1-5}{10} = .21 \qquad z = \frac{x-\mu}{\sigma} = \frac{8-5}{10} = .30$$

Normal Distribution

Standardized Normal Distribution



Shaded area exaggerated

P(0.21 ≤ z ≤ 0.3)
=0.6179 - 0.5832
=0.0347

اما ملخص طريقة الحل هو:

① الخطوة الأساسية هي تحويل القيم x الى z باستخدام

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

② استخدام جدول z لإيجاد الاحتمالات المتراكمة، ثم حساب

الفرق او الطرح من النهاية.

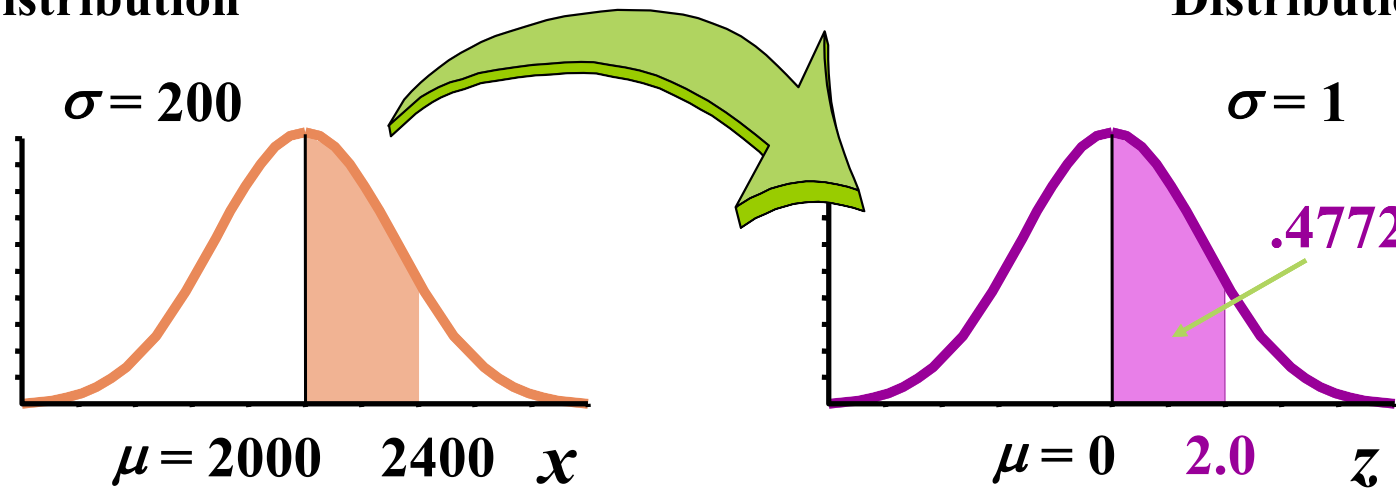
المعيار	التوزيع الطبيعي القياسي (Standard)	التوزيع الطبيعي غير القياسي (Non-standard)
تعريف	توزيع طبيعي بمتوسط $\mu = 0$ وانحراف معياري $\sigma = 1$.	توزيع طبيعي بمتوسط μ وانحراف معياري σ يختلفان عن 0 و1.
رمز	$Z \sim N(0, 1).$	$X \sim N(\mu, \sigma).$
حاجة للتحويل	لا حاجة، القيم جاهزة كـ Z مباشرة.	يجب تحويل القيم X إلى Z باستخدام $Z = \frac{X - \mu}{\sigma}$.
استخدام جدول Z	يُستخدم مباشرة لإيجاد $P(Z \leq z)$.	يُستخدم بعد التحويل إلى Z لإيجاد الاحتمالية.
أمثلة على الحساب	لحساب $P(0 < Z < 1.96)$: استخدم الجدول مباشرة (0.4750).	لحساب $P(3.8 \leq X \leq 5)$ مع $\mu = 5$، $\sigma = 10$: احسب $Z = -0.12$ و $Z = 0$، ثم $0.5 - 0.4522 = 0.0478$.
تعقيد الحساب	أقل تعقيدًا لأن القيم جاهزة.	أكثر تعقيدًا بسبب الحاجة للتحويل أولاً.
الرسم البياني	منحنى مركز حول 0 مع انحراف معياري 1.	منحنى قد يكون مركزًا حول أي قيمة μ مع انحراف σ مختلف.

Solution* $P(2000 \le x \le 2400)$

$$z = \frac{x - \mu}{\sigma} = \frac{2400 - 2000}{200} = 2.0$$

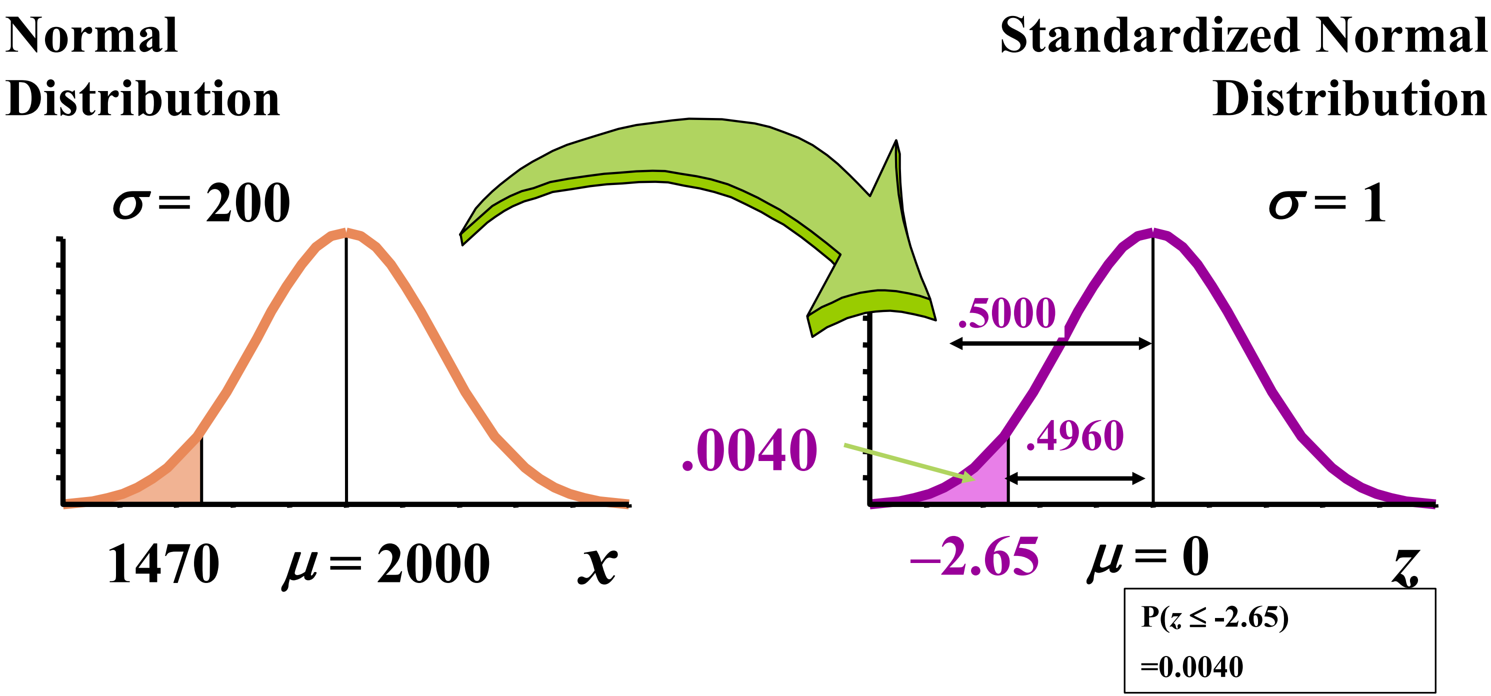
Normal Distribution

Standardized Normal Distribution



Solution* $P(x \leq 1470)$

$$z = \frac{x - \mu}{\sigma} = \frac{1470 - 2000}{200} = -2.65$$



Example

A survey in Jordan indicates that pharmacies use their computers in an average of 2.4 years before upgrading to a new machine. The standard deviation is 0.5 year. A pharmacy is selected at random. Find the probability that the pharmacy will use it for less than or equal 2 years before upgrading. Assume that the variable X is normally distributed?

Continued

Solution

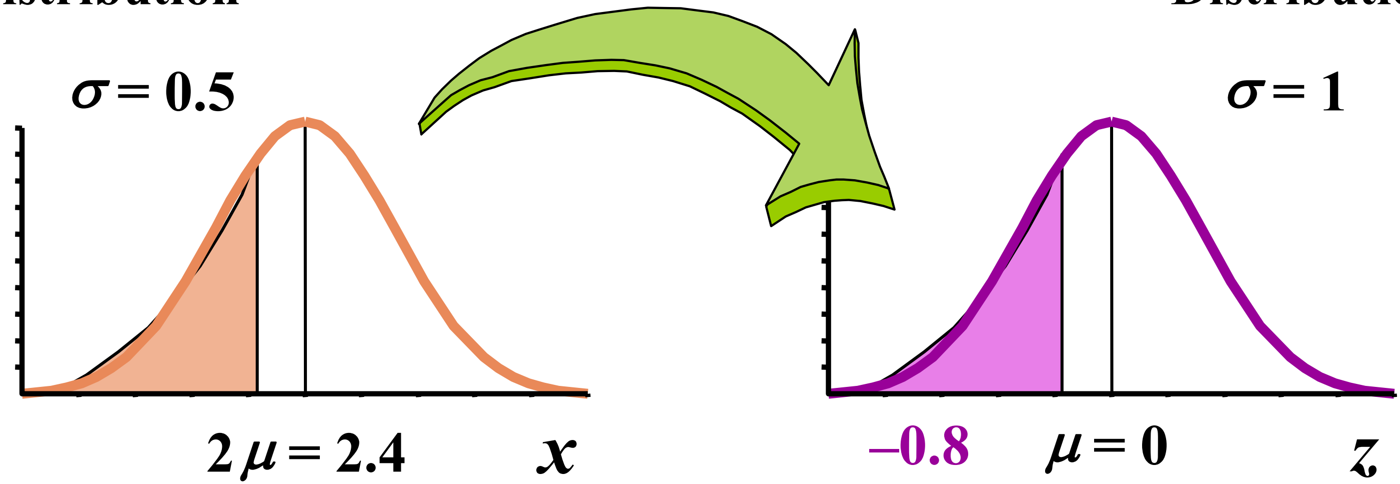
We need to find P(X ≤ 2) as follows: (x-μ)/σ = (2-2.4)/0.5 = -0.8

So P(z ≤ -0.8) = 0.2119

$$z = \frac{X-\mu}{\sigma} = \frac{2-2.4}{0.5} = -0.8$$

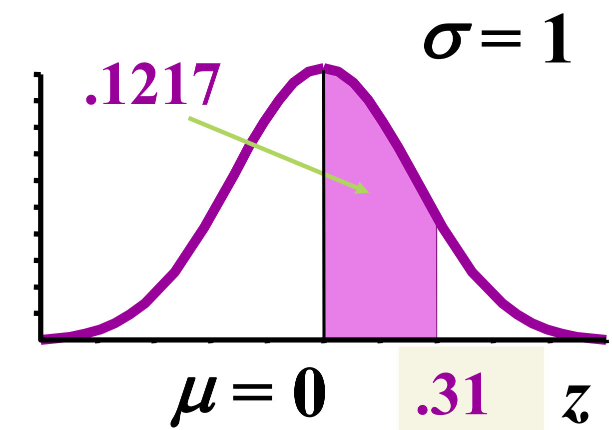
Normal Distribution

Standardized Normal Distribution



Finding z-Values for Known Probabilities

What is Z, given $P(z) = .1217$?



Shaded area exaggerated

z	0	0.01	0.02
+0	.50000	.50399	.50798
+0.1	.53983	.54380	.54776
+0.2	.57926	.58317	.58706
+0.3	.61791	.62172	.62552

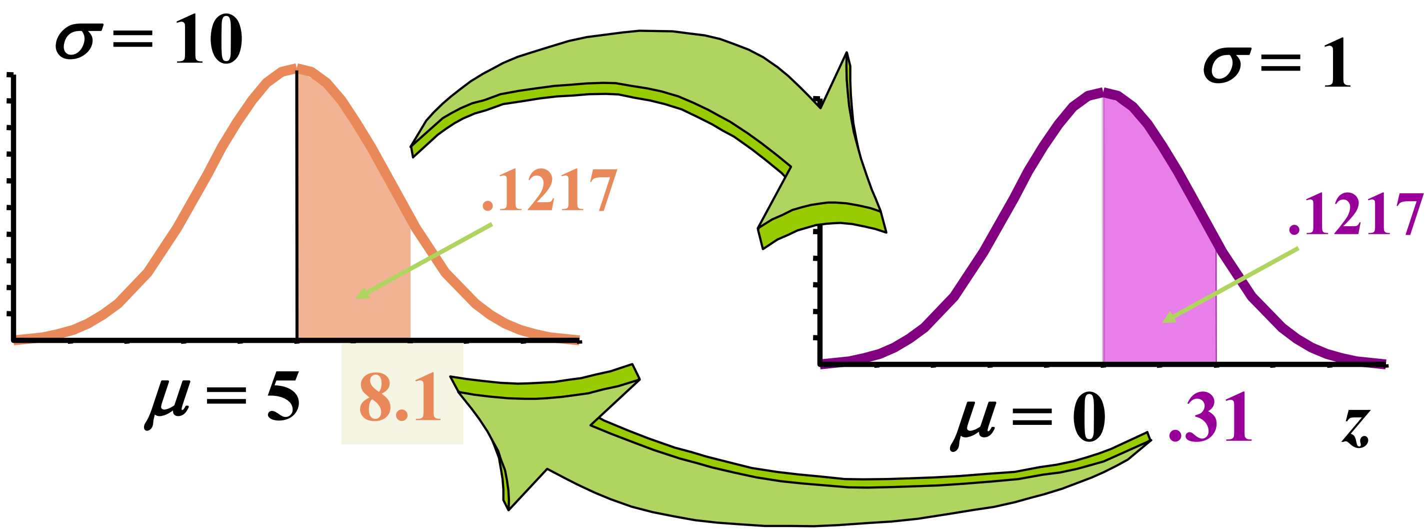
The probability between the z and the mean =0.1217

0.1217 + 0.500 = 0.6217

So it is corresponding to 0.31

Finding x Values for Known Probabilities

Normal Distribution **Standardized Normal Distribution**



$$x = \mu + z \cdot \sigma = 5 + (.31)(10) =$$

Shaded areas exaggerated

$\mu = 2.4$ / $\sigma = 0.5$

$$Z = \frac{X - \mu}{\sigma} = \frac{2 - 2.4}{0.5} = -0.8$$

← استخدام جدول Z :

$P(Z \leq -0.8) \approx 0.2119$

∴ فالاحتمالية : $P(X \leq 2) = P(Z \leq -0.8) \approx 0.2119$

يعني ← في حوالي 21.19% احتمال ان البطارية تخدم الجهاز لمدة

2 سنة أو أقل.

Example

The daily sales volume in JD for a given pharmacy in Jordan is normally distributed with a mean of 67 JD per day and a standard deviation of 4 JD per day. Find the daily sales volume x corresponding to z-score 1.96, -2.33, and 0?

- $z = 1.96$, $x = 67+1.96(4) = 74.84$ JD per day
- $z = -2.33$, $x = 67+(-2.33)(4) = 57.68$ JD per day.
- $z= 0$, $x = 67+0(4) = 67$ JD per day.
- Notice that 74.84 JD is above the mean, 57.68 JD is below the mean, and 67 JD is equal to the mean.

$\sigma = 4 \;/\; \mu = 67$

74.84 د $= x : 1.96 = \dfrac{7.84}{4} = \dfrac{74.84 - 67}{4} = z = \dfrac{x - \mu}{\sigma}$

57.68 د $= x : -2.33 = \dfrac{-9.32}{4} = \dfrac{57.68 - 67}{4} = z = \dfrac{x - \mu}{\sigma}$

67 د $= x : 0 = \dfrac{67 - 67}{4} = z = \dfrac{x - \mu}{\sigma}$

يعني : * 74.84 دينار فوق المتوسط بمقدار 1.96 انحراف معياري.

* 57.68 دينار تحت المتوسط بمقدار 2.33 انحراف معياري.

* 67 دينار يساوي المتوسط (فش انحراف)

Other Discrete Distributions: Poisson

Characteristics of a Poisson Random Variable

يتكون من عدد المرات التي تحدث فيها حدث معين في وحدة زمن او مساحة.

1. Consists of counting number of times an event occurs during a given unit of time or in a given area or volume (any unit of measurement).
2. The probability that an event occurs in a given unit of time, area, or volume is the same for all units.
3. The number of events that occur in one unit of time, area, or volume is independent of the number that occur in any other mutually exclusive unit.
4. The mean number of events in each unit is denoted by λ.

المتوسط العددي للاحداث

Poisson Random Variable خصائص ال

① يتكون من عدد المرات التي تحدث فيها حدث معين في وحدة زمن او مساحة .

② احتمال حدوث حدث في وحدة زمن/مساحة/حجم هو نفسه لجميع الوحدات .

③ عدد الاحداث في وحدة واحدة مستقلة عن عدد الاحداث في وحدات متباعدة .

④ المتوسط اليومي للاحداث $\Leftarrow \lambda$

Poisson Probability Distribution Function

$$\boxed{p(x) = \frac{\lambda^x e^{-\lambda}}{x!}} \qquad (x = 0, 1, 2, 3, \ldots)$$

$$\mu = \lambda$$

$$\sigma^2 = \lambda$$

$p(x)$ = Probability of x given λ

λ = Mean (expected) number of events in unit

e = 2.71828 . . . (base of natural logarithm)

x = Number of events **per unit**

Poisson Probability Distribution Function

يمثل معدل حدوث الاحداث في وحدة زمن او مساحة ،
ومحونته E(x)

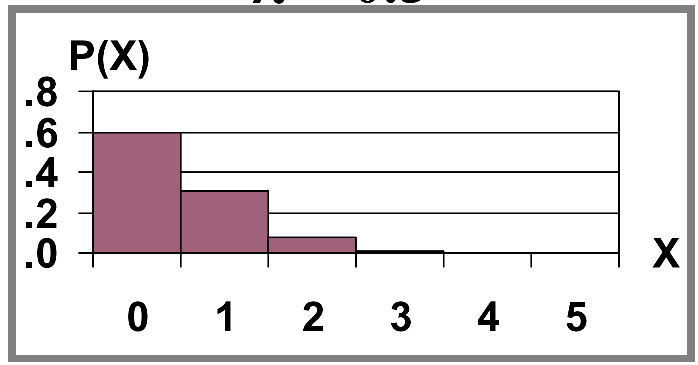
Mean

$$\mu = E(x) = \lambda$$

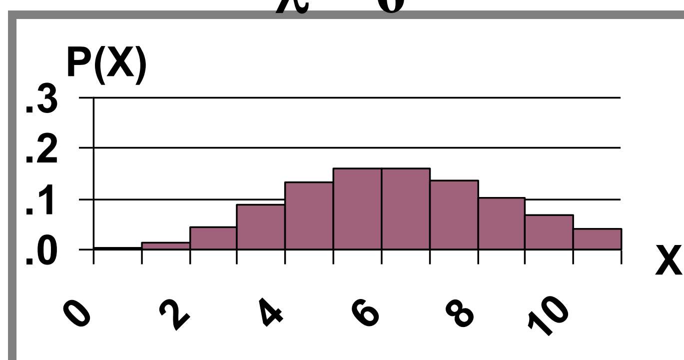
Standard Deviation

$$\sigma = \sqrt{\lambda}$$

$\lambda = 0.5$



$\lambda = 6$



Poisson Distribution Example

Customers arrive at a rate of 72 per hour. What is the probability of 4 customers arriving in 3 minutes?

Poisson Distribution Solution

72 Per Hr. = 1.2 Per Min. = 3.6 Per 3 Min. Interval

$$p(x) = \frac{\lambda^{x} e^{-\lambda}}{x!}$$

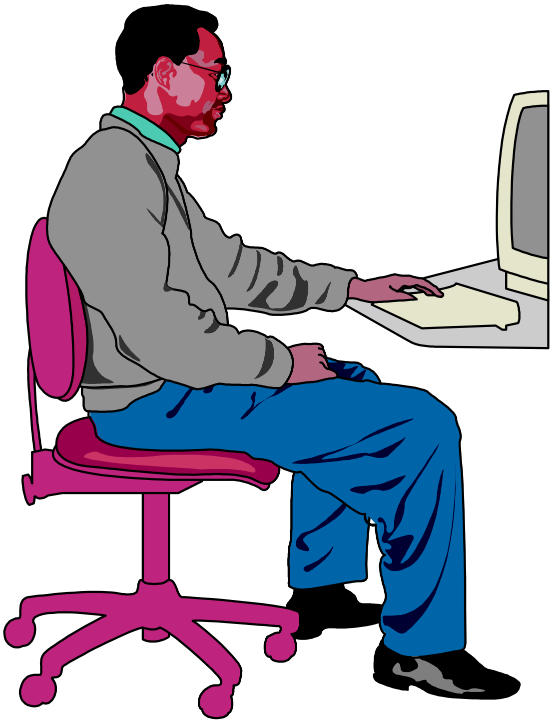
$$p(4) = \frac{(3.6)^{4} e^{-3.6}}{4!} = .1912$$

يعني الاحتمالية ان يصل 4 عملاء في 3 دقائق

هي حوالي ١٩.١٢ ٪

Thinking Challenge

You work in Quality Assurance for an investment firm. A clerk enters **75** words per minute with **6** errors per hour. What is the probability of **0 errors** in a **255-word** bond transaction?



Poisson Distribution Solution: Finding λ*

- 75 words/min = (75 words/min)(60 min/hr)
  = 4500 words/hr
- 6 errors/hr = 6 errors/4500 words
  = **.00133** errors/word
- In a **255**-word transaction (interval):
  λ = (**.00133** errors/word)(**255** words)
  = .34 errors/255-word transaction

Poisson Distribution Solution: Finding p(0)*

يعني الاحتمالية انه لا يرتكب
اي خطأ في معالجة 255 كلمة
هو حوالي 71.18 %

$$p(x) = \frac{\lambda^{x} e^{-\lambda}}{x!}$$

$$p(0) = \frac{(.34)^{0} e^{-.34}}{0!} = .7118$$