

CREOG Exam Scores – What do they really mean?



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Precis

- CREOG scores are under appreciated. Converting scores to percentiles allow for comparison of a resident's/training program's standing with their peers in areas of knowledge depth, progress of learning & risk of **failing** written Board exams. Interpretation basis explained, tools provided.

Learning Objectives

- Advise residents of their test results in comparison with their peer residents nationally
- Monitor resident's progress & national standing in learning over time
- Easily convert scores to percentiles
- Assess failing risk on written Board exam

I have no conflicts of interest

Administer the exam as instructed

It's the only meaningful opportunity to assess your residents knowledge foundation

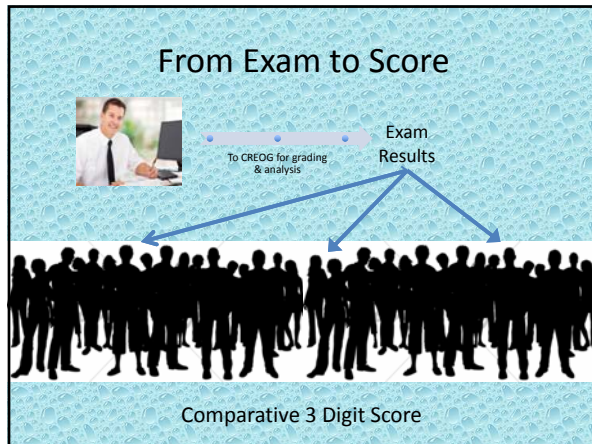
Major Test Categories & Breakdown

CREOG QUESTION CATEGORY	2012 ITEMS	2013 ITEMS
General Considerations	29 (9%)	24 (8%)
Primary and Preventive Ambulatory Health Care	50 (15%)	50 (16%)
Obstetrics	75 (23%)	75 (24%)
Gynecology	76 (23%)	74 (23%)
Reproductive Endocrinology	42 (13%)	40 (13%)
Oncology	37 (11%)	42 (13%)
Genomics	14 (4%)	13 (4%)
TOTAL EXAMINATION	323	318

Common Beliefs & Misconceptions

- Test Scores are linearly related to # questions answered correctly
- Similar scores in subsequent years will happen if I don't read
- Occasional reading will significantly increase my CREOG score
- Test scores provide little or unknown value in risk assessment towards failing ABOG written exam

Each of the above points are fallacies



Where to focus on the Report?

2013 CREOG In-Training Examination Score Report

Name: Resident A
ID Number: 111-22-3333

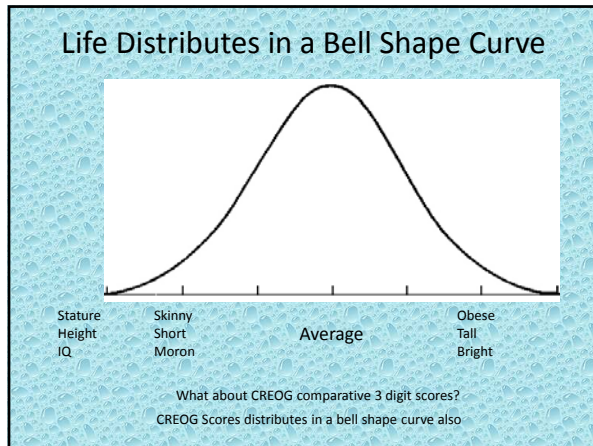
Program:
Year:

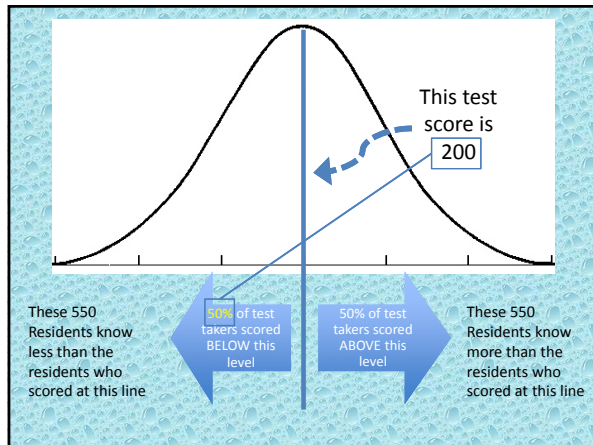
	Score	SEM by year*
1. Your overall standardized score compared to all years**	223	216 - 230
2. Your standardized score compared to year	243	235 - 251
3. Total percent correct	73	70 - 75

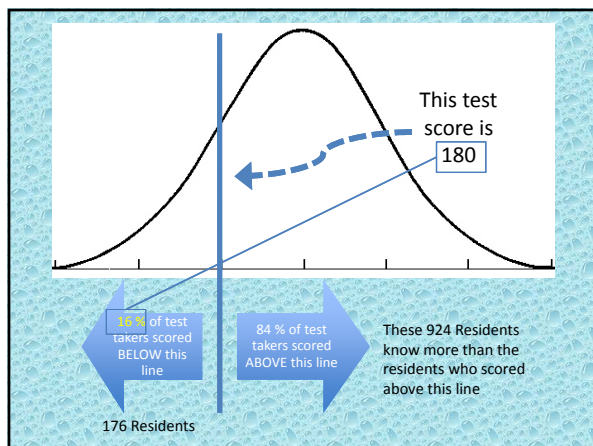
There are about 1100 residents in training in each level Nationally

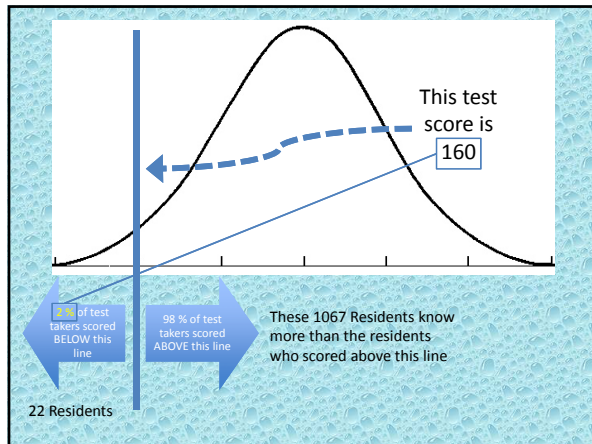
Life Distributes in a Bell Shape Curve

- Stature – there are skinny people, there are obese people
- Height – there are short people, there are tall people
- IQ – there are morons, there are bright
- In each of the above, there are also average people which account for the majority



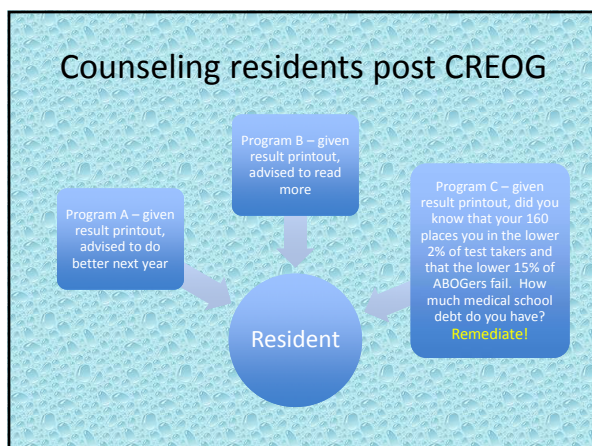




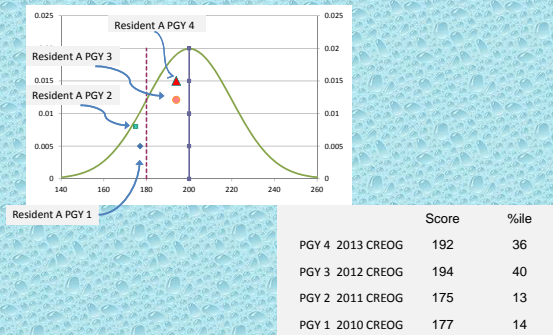


Facts to Consider

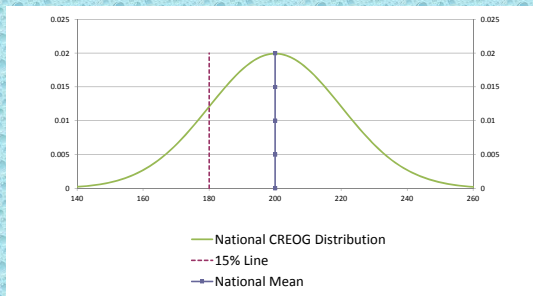
- CREOG is the only standardize national exam administered to residents
- CREOG assesses resident education
- ABOG assesses ability to practice
- Both CREOG & ABOG ultimately tests knowledge
- Test are designed to be discriminators, (i.e. there are passers & failures (e.g. ABOG, USMLE, COMLEX))
- About 15% of ABOG test takers fail every year



Charting Resident CREOG Performance



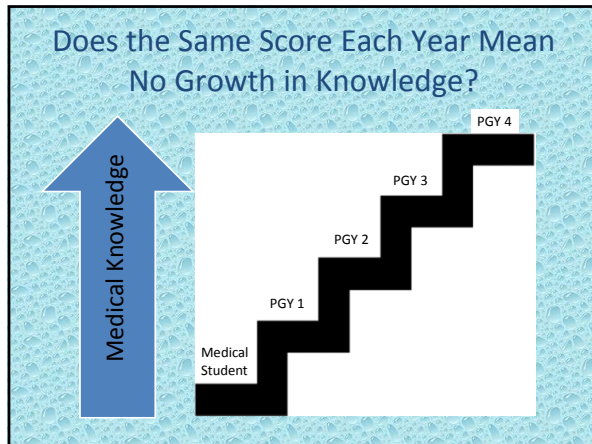
Normal Curve with 3 Digit Comparative Scores



Conversion of Comparison Score to Percentile

Score	Percentile	Score	Percentile	Score	Percentile
140	0.1%	180	15.9%	220	84.1%
141	0.2%	181	17.6%	221	84.8%
142	0.3%	182	19.3%	222	85.5%
143	0.4%	183	21.0%	223	86.1%
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148	1.0%	188	29.5%	228	89.5%
149	1.1%	189	31.2%	229	90.2%
150	1.2%	190	32.9%	230	91%
151	1.3%	191	34.6%	231	91.6%
152	1.4%	192	36.3%	232	92.3%
153	1.5%	193	38%	233	92.9%
154	1.6%	194	39.7%	234	93.6%
155	1.8%	195	41.4%	235	94.3%
156	1.9%	196	43.1%	236	95%
157	2.0%	197	44.8%	237	95.7%
158	2.1%	198	46.5%	238	96.3%
159	2.3%	199	48.2%	239	97%
160	2.5%	200	50%	240	97.7%

*Partial List



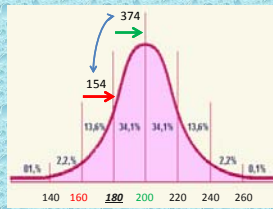
Does the Same Score Each Year Mean No Growth in Knowledge?

	CREOG Score	Percent Correct
Resident B		
PGY 1 2009 CREOG	195	55
PGY 2 2010 CREOG	195	59
PGY 3 2011 CREOG	193	65

• To maintain the same 3 digit score each successive year – resident needs to answer 4-6% more questions right than previous year (i.e. 12-19 new facts). Assuming 320 CREOG questions and 5% is about 3-4 questions.

- ### How Much Work is Involved in Improving CREOG Scores?
- Each year the average resident increases knowledge by 12-19 new facts.
 - To improve a comparative 3 digit score, the resident must do better than previously better scoring residents from previous years.
 - The number of residents that they must outperform is dependent where their CREOG score is.

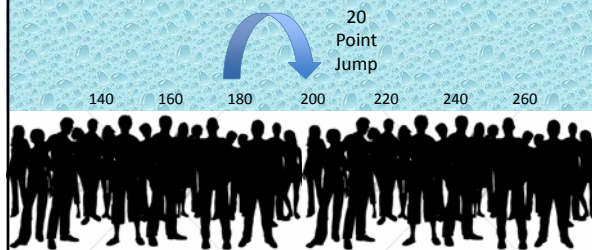
How Many Residents Need to be Outperformed to Improve CREOG Scores



To go from **160** to **180**, Resident C has to do better than 154 residents the next time.

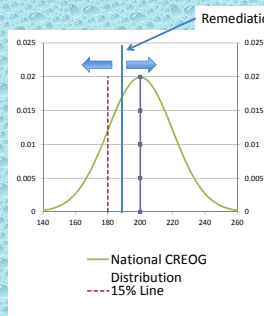
To go from **180** to **200**, Resident A has to do better than 374 residents the next time.

Additional Knowledge Needed to Improve CREOG Scores



Requires 32-50 more correct answers than the previous year.

Who to Remediate?



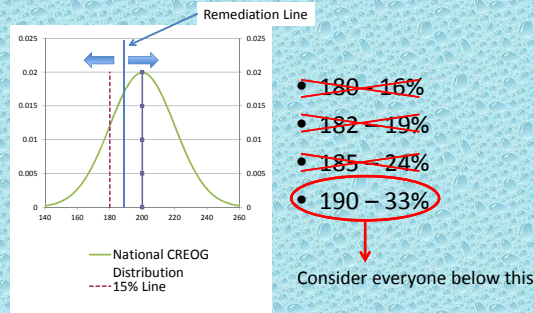
- Where do you draw the line at which everyone below is placed on remediation?
 - Draw it high, then you work harder to remediate more residents
 - Draw it low then you may jeopardize the weak resident passing ABOG
- | | |
|--|------------------------------|
| <ul style="list-style-type: none"> 180 - 16% 182 - 19% 185 - 24% 190 - 33% | <p>Scores are not linear</p> |
|--|------------------------------|

Who to Remediate?

2012 CREOG In-Training Examination Score Report		
Name: Resident C ID Number: 999-88-7777	Score 176	Program: Year:
1. Your overall standardized score compared to all years**	190	SEM by year 168 - 183
2. Your standardized score compared to year 1	52	182 - 198
3. Total percent correct		50 - 54

- SEM – This is an index of the examination's precision in measuring your overall ability as represented by the score reported. If you were to repeat the CREOG In-Training Examination 100 times, your score would fall in the range of +/- 1 SEM on 68 out of 100 times.

Who to Remediate?





Operations and Technology Consulting
Management Education Web Simulations

TM Calendar
An easy-to-use
calendar with
reminder capability
for MS Excel

Amazon.com

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available

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Best \$9.64

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available

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You are on the [Home/Excel/Charts/Normal curve](#) page

Drawing a Normal curve

A graph representing the density function of the Normal probability distribution is also known as a Normal Curve or a Bell Curve (see Figure 1 below). To draw such a curve, one needs to specify two parameters, the mean and the standard deviation. The graph below has a mean of zero and a standard deviation of 1, i.e., ($\mu=0$, $\sigma=1$). A Normal distribution with a mean of zero and a standard deviation of 1 is also known as the *Standard Normal Distribution*.

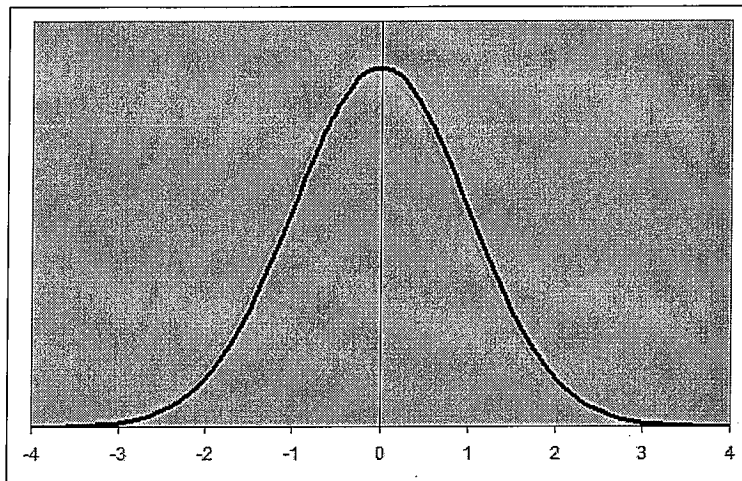


Figure 1 -- Standard Normal Distribution

In Excel, there are multiple ways to draw this function.

[Enumerating a set of points in a worksheet](#)

[Using named formulas to create the graph](#)

[Using the free add-in, Plot Manager](#)

[Understanding the Standard Normal distribution and how it connects all other Normal distribution functions.](#)

Enumerating a set of points in a worksheet

The goal is to create a normal distribution graph with a specified mean and standard deviation. Start by entering those values in some cells in a worksheet.

The example used to illustrate the process plots a graph with a mean of 10 and a standard deviation of 2. Enter those values in cells F1 and H1.

	D	E	F	G	H
1		Mean:	10	Std.Dev.	2
2					

Start by setting up the x-values for a standard normal curve.

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Tutors, Try Now
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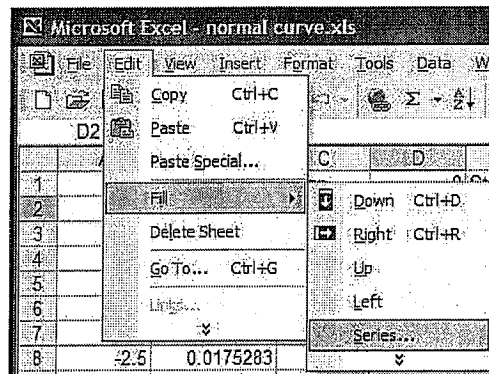
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regression curve
fitting software. Try
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	A
1	
2	-4

In A2, enter the number -4.

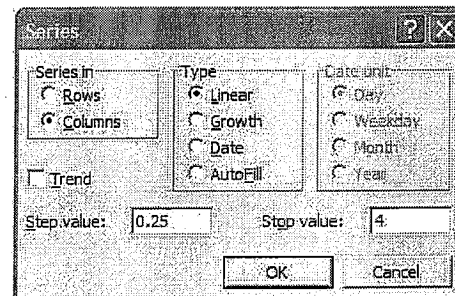
Select cell A2, then select Edit | Fill ► Series...



Set up the resulting dialog box as on the right.

Using a step value of 0.25 is typically adequate.

However, if you want more data points, use a smaller number, such as 0.1.



Next, in B2, enter the formula =A2*\$H\$1+\$F\$1.

This converts the standard normal distribution to the distribution of interest.

In C2, enter the formula =NORMDIST(B2,\$F\$1,\$H\$1,FALSE).

This provides y-values for the distribution of interest.

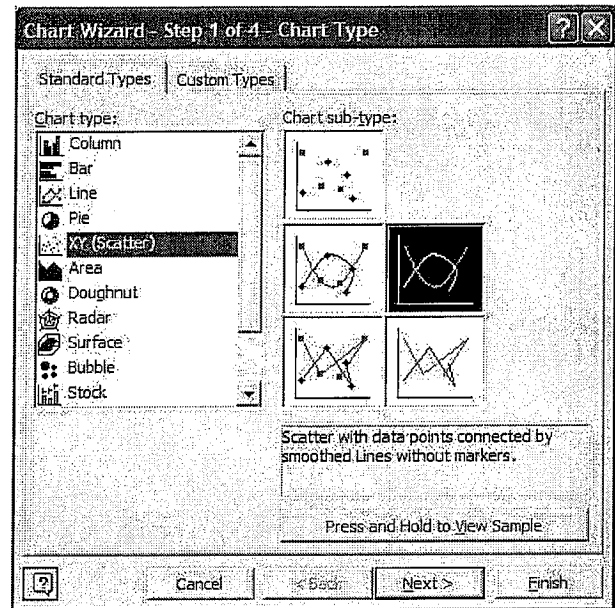
Copy B2:C2 down to cover all the rows that contain data in column A.

The result should look like Figure 2 (on the right).

	A	B	C
1			
2	-4	2	6.69151E-05
3	-3.75	2.5	0.000176298
4	-3.5	3	0.000436341
5	-3.25	3.5	0.001014524
6	-3	4	0.002215924
7	-2.75	4.5	0.004546781
8	-2.5	5	0.00876415
9	-2.25	5.5	0.015869826
10	-2	6	0.026995483
11	-1.75	6.5	0.043138659
12	-1.5	7	0.064758798
13	-1.25	7.5	0.091324543
14	-1	8	0.120985362
15	-0.75	8.5	0.150568716
16	-0.5	9	0.176032663
17	-0.25	9.5	0.193334058
18	0	10	0.19947114
19	0.25	10.5	0.193334058
20	0.5	11	0.176032663
21	0.75	11.5	0.150568716
22	1	12	0.120985362
23	1.25	12.5	0.091324543
24	1.5	13	0.064758798
25	1.75	13.5	0.043138659
26	2	14	0.026995483
27	2.25	14.5	0.015869826
28	2.5	15	0.00876415
29	2.75	15.5	0.004546781
30	3	16	0.002215924
31	3.25	16.5	0.001014524
32	3.5	17	0.000436341
33	3.75	17.5	0.000176298
34	4	18	6.69151E-05

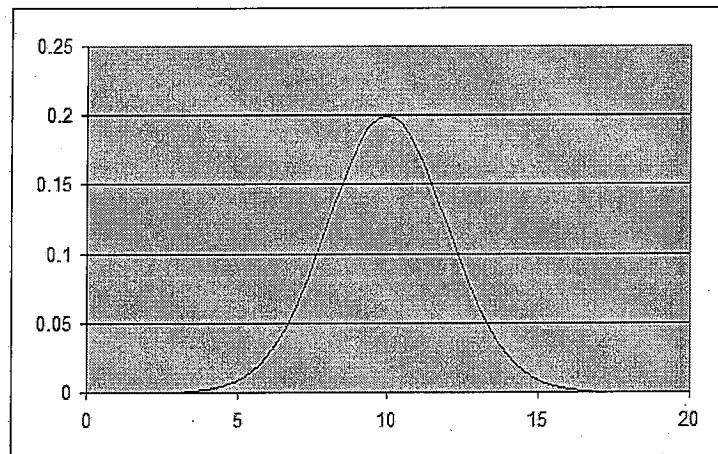
Figure 2

Plot columns B and C in a XY Scatter chart (smoothed lines without markers):



The result should be as on the left.

Finally, format the chart to get a result similar to Figure 1 or as desired.



Using named formulas to create the graph

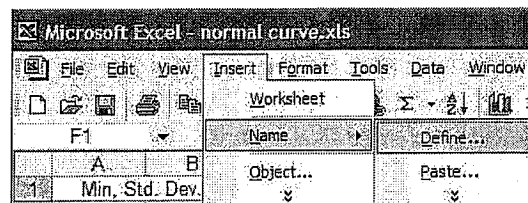
One can use named formulas to create the chart. The advantage of this method is that it doesn't use temporary cells in a worksheet to create the chart. However, it might be a little more difficult to understand.

Put the information required to create the chart in cells in a worksheet:

The first three cells contain information similar to that provided in the '[Enumerating a set of points in a worksheet](#)' section above. The last item is analogous to the step value used in the Fill dialog box. However, this time, the number of points used in the chart is specified directly.

	A	B	C	D
1	Min, Std. Dev. from the mean			-4
2			Mean	10
3			Std. Dev	2
4		Number of Points		30

Next, create the required names using Insert | Name ► Define...



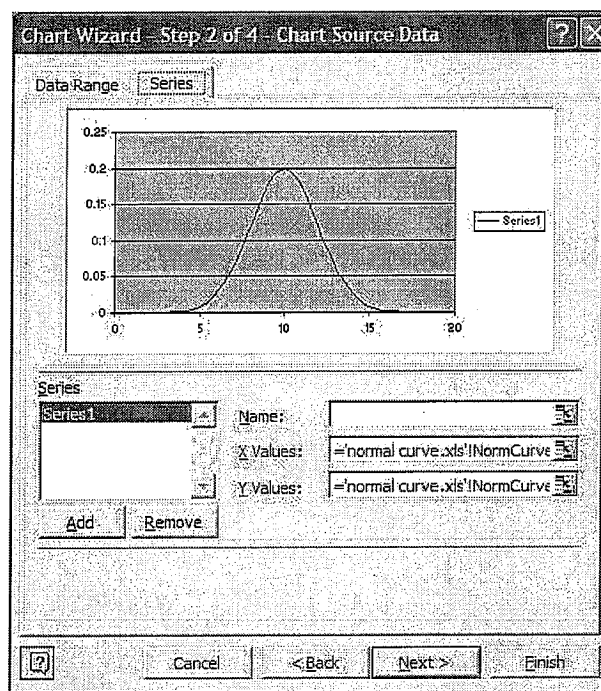
The result should look like..

NormCurveMean	=Sheet1!\$D\$2
NormCurveMinVal	=Sheet1!\$D\$1
NormCurveNbrPoints	=Sheet1!\$D\$4
NormCurveStdDev	=Sheet1!\$D\$3
NormCurveXVals	=NormCurveMean+NormCurveStdDev*(NormCurveMinVal+ABS(2*NormCurveMinVal))/(NormCurveNbrPoints-1)*(ROW(OFFSET(Sheet1!\$A\$1,0,0,NormCurveNbrPoints,1))-1))
NormCurveYVals	=NORMDIST(NormCurveXVals, NormCurveMean, NormCurveStdDev, FALSE)

Next, plot the normal curve. Click any cell that does *not* contain data and has no adjacent cell with data. Click the Chart Wizard and select the XY Scatter chart (sub type Smoothed line with no markers) as in the 'Enumerating a set of points in a worksheet' section. In the 2nd step of the wizard, select the Series tab, then the Add button. Specify the names as the x- and y-values.

Finally, format the chart as desired.

For more on how to use named formulas in a chart, see the Dynamic Charts page of the author's web site at www.tushar-mehta.com



Using the free add-in, Plot Manager

This add-in makes it easy to plot a complete graph by entering the formula for the graph in a single Excel worksheet cell.

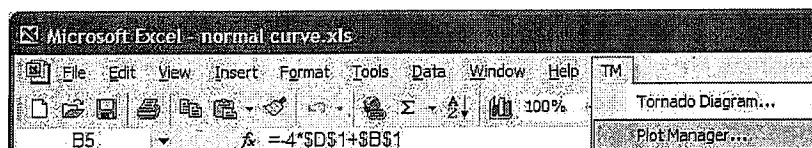
Suppose, the mean and standard deviation for the normal chart are in B1 and D1:

	A	B	C	D
1	Mean	10	Std.Dev	2

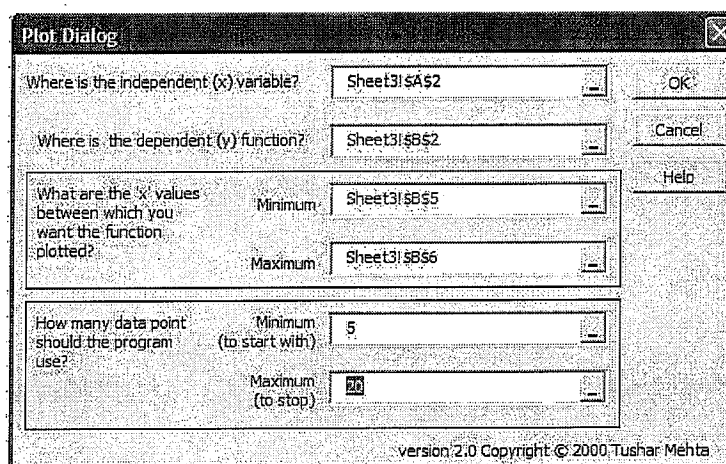
In B2, enter the formula for a normal distribution function. =NORMDIST(A2,\$B\$1,\$D\$1,FALSE).

In B5 and B6, enter the minimum and maximum x-values to plot. ± 4 standard deviations translate to $=-4*\$D\$1+\$B\1 and $=4*\$D\$1+\$B\1 , respectively.

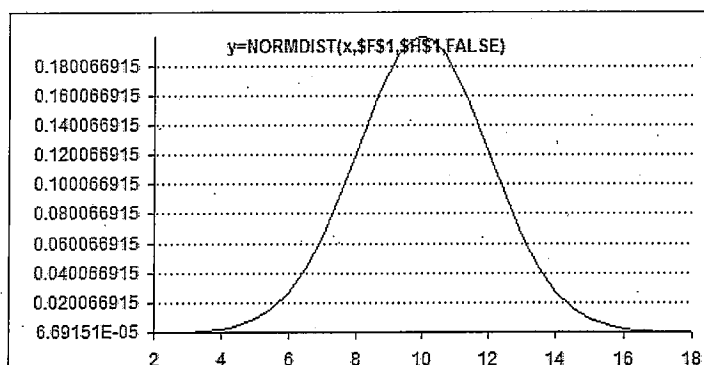
Now, use the Plot Manager add-in.



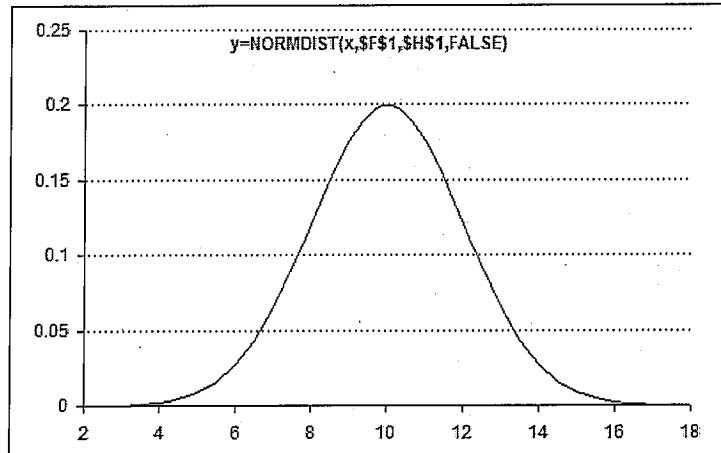
Specify the parameters as shown on the right



The add-in will add a new worksheet to the workbook. On that sheet, in addition to working data will be a normal chart.

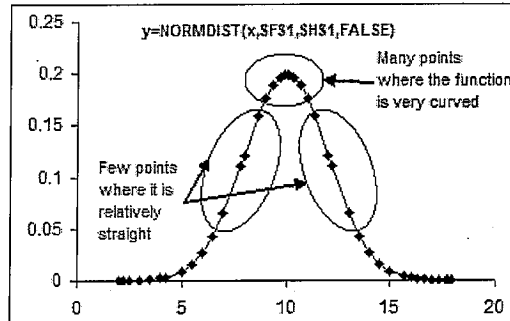
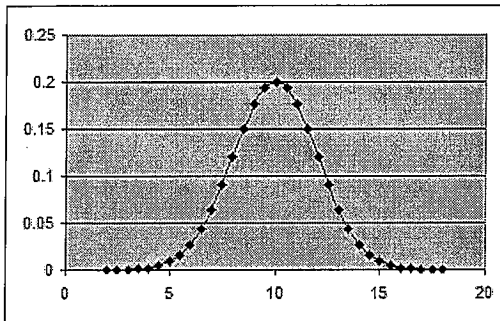


Format the chart as desired; move it to another sheet if that is more appropriate.



What is the advantage of Plot Manager?

It creates (x,y) data pairs after taking into account the local curvature of the function. Then, it assigns more data points where the function is curved and fewer points where the function is relatively straight. Comparing two normal curves, where the one on the right is done by the Plot Manager software, the uneven allocation of the data points becomes quite evident.

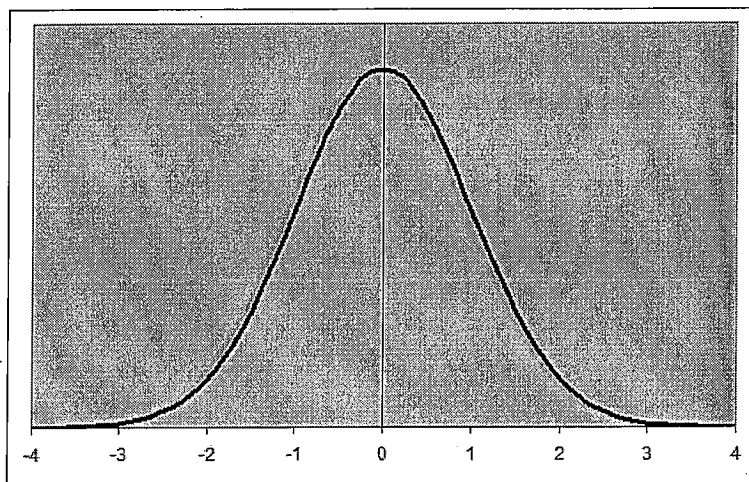


Understanding the Standard Normal distribution and how it connects all other Normal distribution functions.

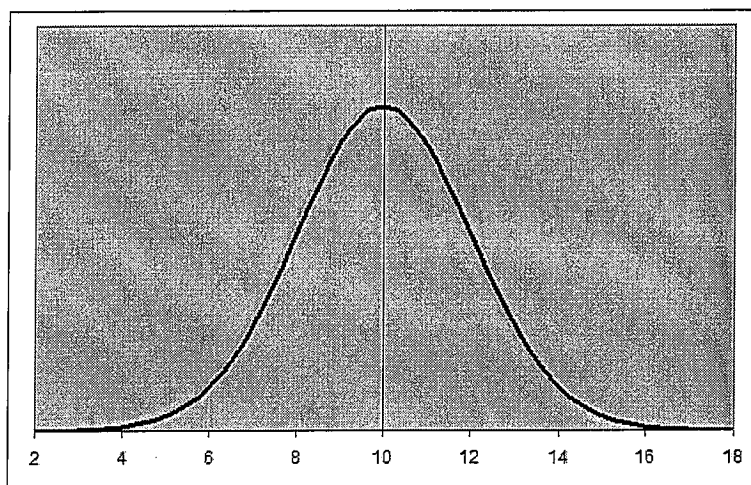
A value, x , from a normal distribution specified by a mean of μ and a standard deviation of σ can be converted to a corresponding value, z , in a standard normal distribution with the transformation $z=(x-\mu)/\sigma$. And, of course, in reverse, any value from a standard normal graph, say z , can be converted to a corresponding value on a normal distribution with a mean of μ and a standard deviation of σ by the formula $x=\mu+z*\sigma$. Remember that the standard normal distribution has a mean of 0 and a standard deviation of 1 -- i.e., ($\mu=0, \sigma=1$).

The ability to carry out this transformation is very important since we can do all our analysis with the standard normal distribution and then apply the results to *every* other normal distribution, including the one that is actually of interest. For example, to draw a normal curve with a mean of 10 and a standard deviation of 2 ($\mu=10, \sigma=2$), we would draw the standard normal distribution and just re-label the axis. The first figure below is the standard normal curve and the next figure is the curve with ($\mu=10, \sigma=2$).

Each value along the x-axis represents that many standard deviations from the mean, which, for the standard normal distribution, is zero. The 1 (or -1) is one standard deviation from the mean. Similarly, the 3 (or -3) is three standard deviations from the mean.



Exactly as in the case of the standard normal distribution, the numbers on the x-axis represent the standard deviations from the mean. Since the mean is 10 and the standard deviation is 2, one standard deviation from the mean ($\pm 1\sigma$) yields the values 12 and 8 ($10 \pm 1 \cdot 2$). Similarly, $\pm 3\sigma$ yields the values 4 and 16.



Keywords: standard normal distribution bell curve population grade statistics sample sampling mean cumulative probability density function



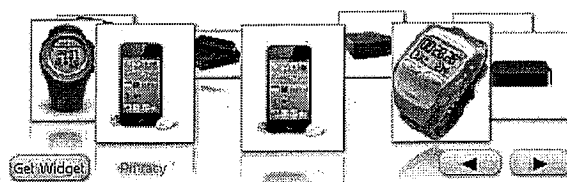
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Scores & Percentiles

2Score	Percentile	2Score	Percentile	2Score	Percentile
140	0.1%	180	15.9%	220	84.1%
141	0.2%	181	17.6%	221	84.8%
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151	1.3%	191	34.6%	231	91.6%
152	1.4%	192	36.3%	232	92.3%
153	1.5%	193	38%	233	92.9%
154	1.6%	194	39.7%	234	93.6%
155	1.8%	195	41.4%	235	94.3%
156	1.9%	196	43.1%	236	95%
157	2.0%	197	44.8%	237	95.7%
158	2.1%	198	46.5%	238	96.3%
159	2.2%	199	48.2%	239	97%
160	2.3%	200	50%	240	97.7%
161	3.0%	201	51.7%	241	97.8%
162	3.7%	202	53.4%	242	97.9%
163	4.3%	203	55.1%	243	98%
164	5.0%	204	56.8%	244	98.1%
165	5.7%	205	58.5%	245	98.2%
166	6.4%	206	60.2%	246	98.4%
167	7.1%	207	61.9%	247	98.5%
168	7.7%	208	63.6%	248	98.6%
169	8.4%	209	65.3%	249	98.7%
170	9.1%	210	67%	250	98.8%
171	9.8%	211	68.7%	251	98.9%
172	10.5%	212	70.4%	252	99%
173	11.1%	213	72.1%	253	99.1%
174	11.8 %	214	73.8%	254	99.2%
175	12.5%	215	75.5%	255	99.3%
176	13.2%	216	77.2%	256	99.5%
177	13.9%	217	78.9%	257	99.6%
178	14.5%	218	80.6%	258	99.7%
179	15.2%	219	82.3%	259	99.8%
				260	99.9%

CREOG Comparative 3 Digit Score Graph

