E-411-PRMA

Lecture 2

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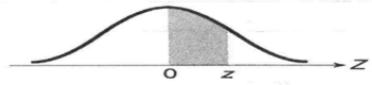
TABLE A.4 **Areas of the standard normal distribution. The entries in this table are the probabilities that a standard normal random variable is between 0 and z (the shaded area).**



	Second Decimal Place in z									
z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998
3.5	0.4998									
4.0	0.49997									
4.5	0.499997									
5.0	0.4999997									

SAT

The SAT is an aptitude test that high school students take. It is one of the criteria that is used in a college's decision to admit a student. It is composed of a math and a verbal section. Each has a mean of 500 and a standard devation of 110 and is normally distributed.

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  - How many people got scores between 390 and 610?
  - If Sigga got a 350 on the math section, how many people scored below her?
  - If Einar was in the 98% percentile in math, what was Einar's score?

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- Various linear and non-linear transformations are done to create scores and scores may be normalized.

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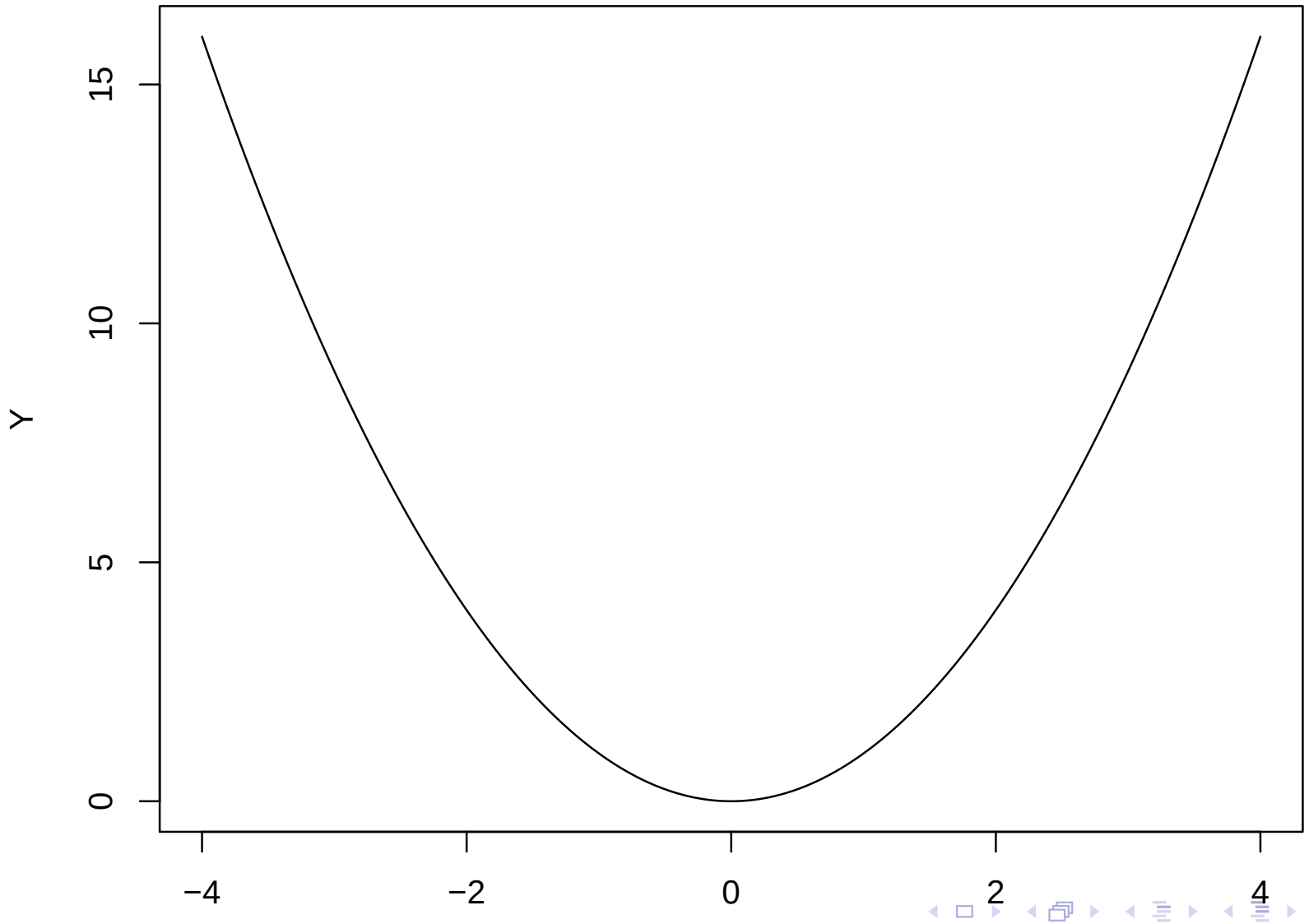
- Are we talking about the population or the sample?
- How does this relate to a hypothesis test?

What is a correlation?

- Is it an association?
- Does it imply causation?
- Is a correlation necessary for causation?
- Does it need linearity?
- Is it affected by variability?
- Is it affected by outliers?
- Is it related to the simple linear regression?

What is the Pearson correlation coefficient?



Pearson correlation coefficient

$$\frac{\sum(X-\bar{X})(Y-\bar{Y})}{\sqrt{\sum(X-\bar{X})^2\sum((Y-\bar{Y})^2}}$$

Calculating Pearson correlation coefficient

	X	Y
	5	6
	3	0
	1	0
Mean	3	2

```
x <- c(5, 3, 1)
y <- c(6, 0, 0)
cor(x, y)
```

R correlation applet

1. Open RStudio
2. Open correlation_applet.R
3. Click the "Source" button

Spearman's rho

- Non-parametric measure of association
- Appropriate when at least one of your variables is ordinal variables
- Don't use Pearson's correlation with ordinal variables!

Simple Linear Regression

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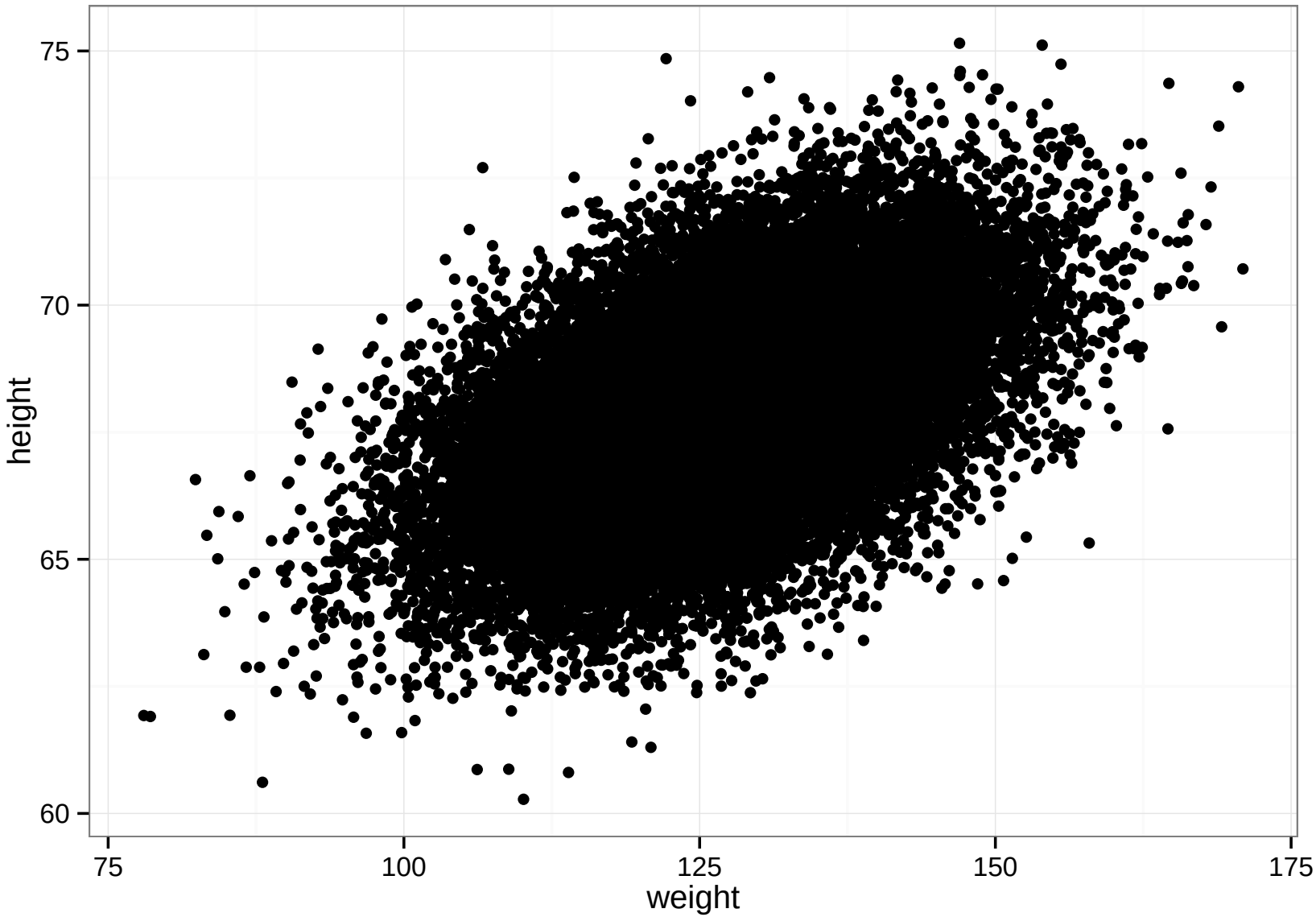
- How could we assess if this is appropriate?

1993 Growth Survey of 25,000 Hong Kongese children

source: http://wiki.stat.ucla.edu/socr/index.php/SOCR_Data_Dinov_020108_HeightsWeights



Model Summary

Parameter	Estimate	SE	t-value	p-value
β_0	57.57	0.11	506.01	¡ .001
β_1	0.08	0.001	91.98	¡ .001

How does this relate to correlation?

Slope and the correlation

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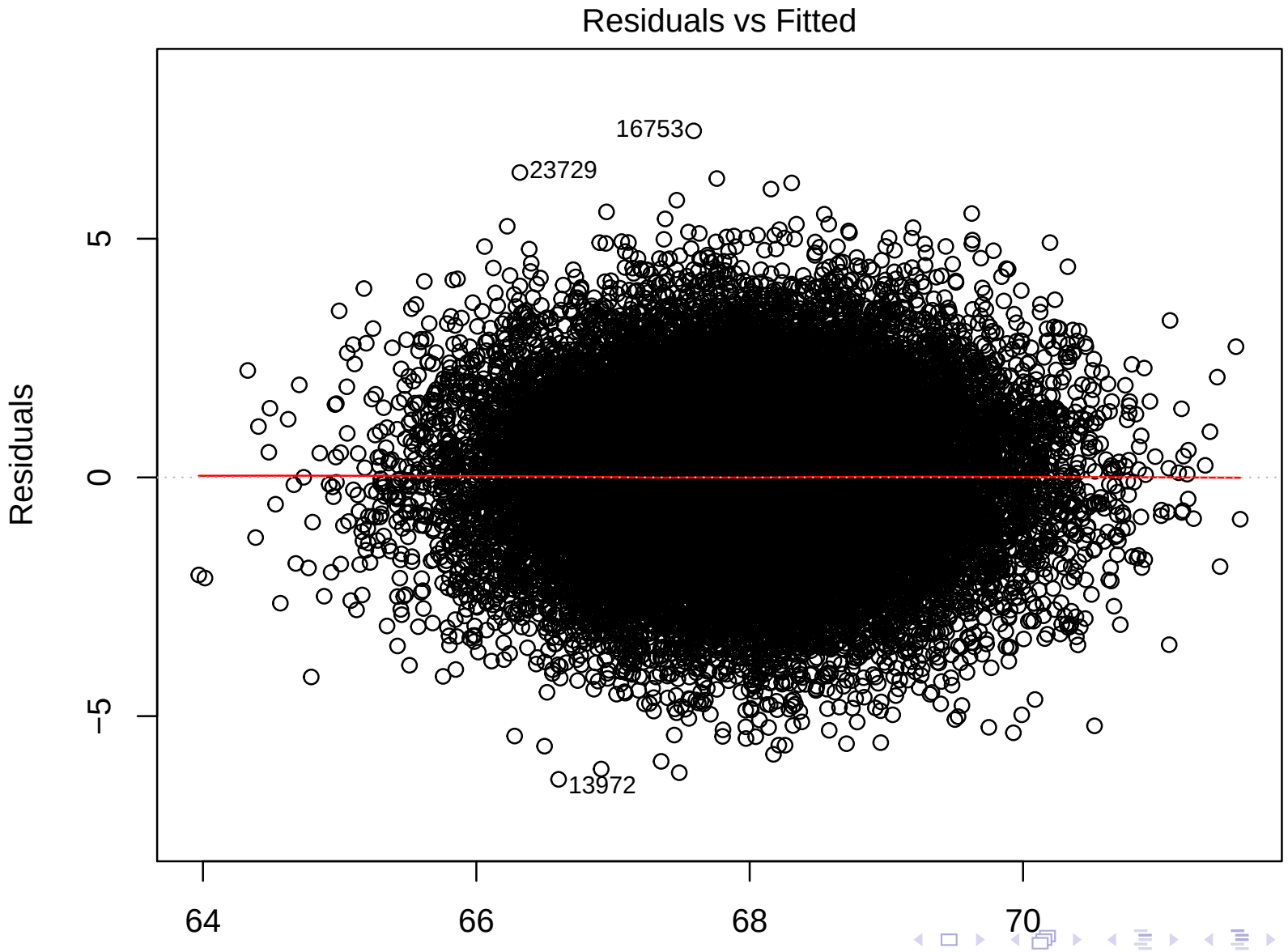
- 0.5028585

Always look at the residuals



Brief history of testing

- 2200 BCE, Chinese believed to use testing for determining who would get governmental jobs
- Greek and Romans categorized individuals based on personality type ("blood" or "phlegm")
- Francis Galton's classification based on "natural gift" (i.e. eugenics)
  - Contributed to development of questionnaries, rating scales, and self-report inventories
- Wilhelm Wundt's laboratory and his focus on "standardization"
  - James Cattell's mental tests
  - Charles Spearman - reliability and factor analysis

Testing in the 20th century

- 1905, Binet and Simon publish a test measuring intelligence in mental retarded school children in Paris
- 1939, Wechsler publishes a test to measure intelligence in adults (would become WAIS)
- Group intelligence test administered by the US military during WWI and WWII
- WWI personality tests used to screen recruits

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- Test can benefit society

What makes a good test?

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- Understanding the normative sample is very important, why?

Sampling

- Simple random sample
- Stratified random sample
- Cluster random sample
- Purposive sample
- Convenience sample

Different Norms

- Percentiles
- Developmental Norms
  - Age Norms
    - A 6 year old performs at the level of a 10 year old
    - This is on this material only though!
  - Grade Norms
    - School year typically 10 months in the US
    - A 4th grader is performing at the level of a 5th grader in third month
    - This is on this material only though!
- National Norms, nationally representative
  - Anchor norms enable two tests to be compared
  - In USA, students could take SAT or ACT for admission to college

Fixed Reference and Criterion-Related

- Fixed reference group scores are used as the basis for calculation of future administrations of the test
- Raw scores are scaled relative to the performance of the fixed reference group
  - Answering 50 items correctly one year and 50 on the following year doesn't mean you'll have the same score
- SAT does this through using anchor items and equating
- Criterion-referenced, evaluate a score with reference to a set criteria or standard NOT other test takers
- What is the fairest way to score grades in a class room?